



OPERATOR'S MANUAL

5000 Series II Jacking System

Pump Unit S/N: F20400F

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SERVICE • RELIABILITY • INNOVATION

Introduction

This operator's manual contains important safety, operation, and maintenance information for your Akkerman 5000 Series II Jacking System. This system includes the 5000 Series II 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 system at all times. Directions in this manual are referenced from the launch shaft going forward to the reception shaft, unless otherwise noted. Additional copies of this manual may be purchased from the Akkerman Aftermarket 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 Series II Pump Unit with Yoke and Skid

The 5000 Series II 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 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 ATTN: Technical Publications, 58256 266th Street, Brownsdale, MN 55918.

Akkerman reserves the right to improve its products 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.



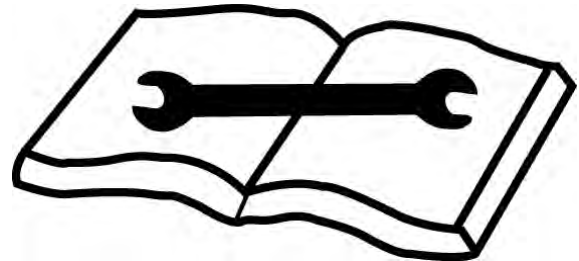
**ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!**

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 or death.

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 and Auxiliary supply and return lines, all control levers must be in the OFF or neutral position. If using a TBM Series II with the 5000 Series II, the tunnel power MUST be shut off.

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.

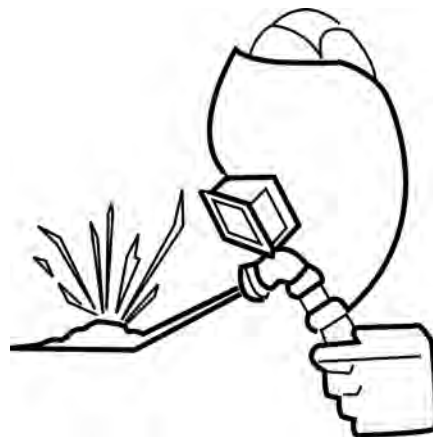


UNAUTHORIZED WELDING

⚠ 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.

Before performing authorized welding on TBM, remove gas detector to prevent damage.



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.

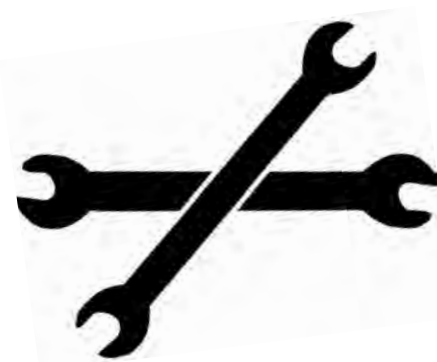
Shut down Pump Unit before making repairs, adjustments, or removing obstructions.

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.

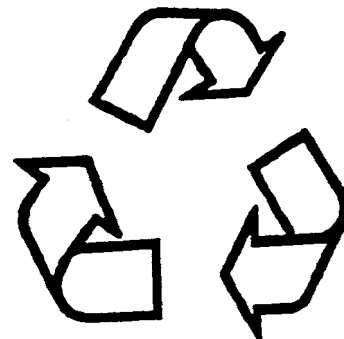
Replace worn or damaged parts. Remove grease, oil, or debris buildup.



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.

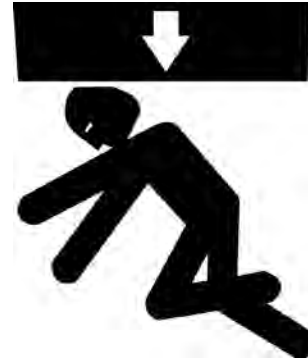


BEWARE OF SUSPENDED LOADS

⚠ 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.

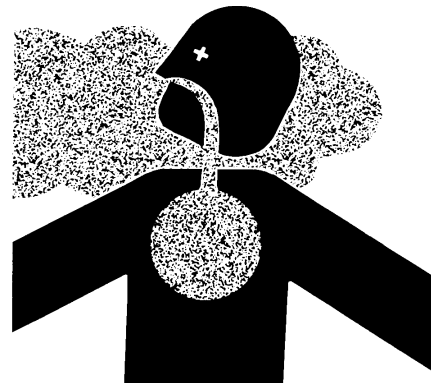
Before and during the tunnel operation, test for combustible and toxic gases and oxygen deficiency.

If the levels exceed MSHA/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 an explosion.



LOCKOUT/TAGOUT 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/TAGOUT 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.



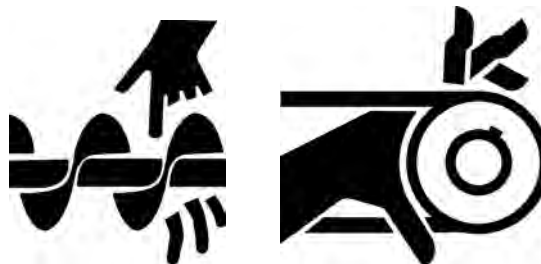
KEEP AWAY FROM CONVEYORS

⚠ 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.

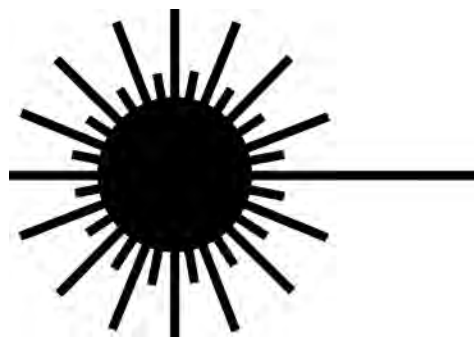


AVOID LASER LIGHT EXPOSURE

⚠ 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.



USING TUNNEL POWER CABLE

⚠ DANGER NEVER disconnect tunnel power cables when tunnel power is ON. Doing so WILL cause severe injury or death from electrical shock.



INSPECT ELECTRICAL CONNECTIONS

⚠ WARNING Regularly inspect electrical connections to be sure they are secure. Failure to do so could cause an explosion if moisture enters a unsecured electrical connection.



AVOID PINCH POINTS

⚠ WARNING Moving parts or the mishandling of parts can cause severe personal injury.

Keep hands away from moving parts.

Watch your fingers, hands, and legs while equipment is in operation.

Handle parts carefully to avoid crushing and pinch point hazards.



STAY AWAY FROM CRANE

⚠ DANGER Stay away from operating crane. If close to power lines, the crane, load, and ground may become electrified resulting in serious injury or death.



NOTES

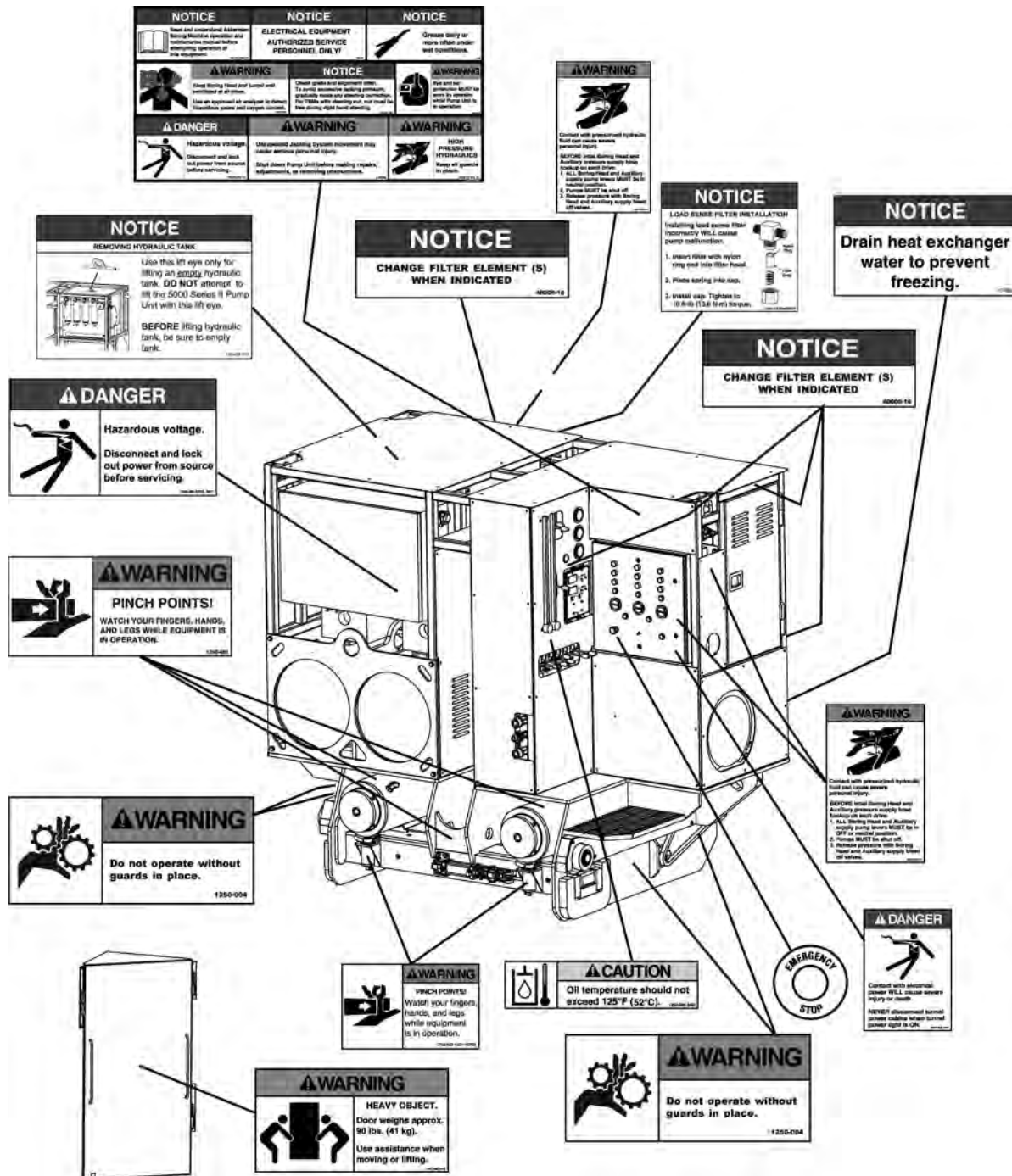
Safety Decals

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.

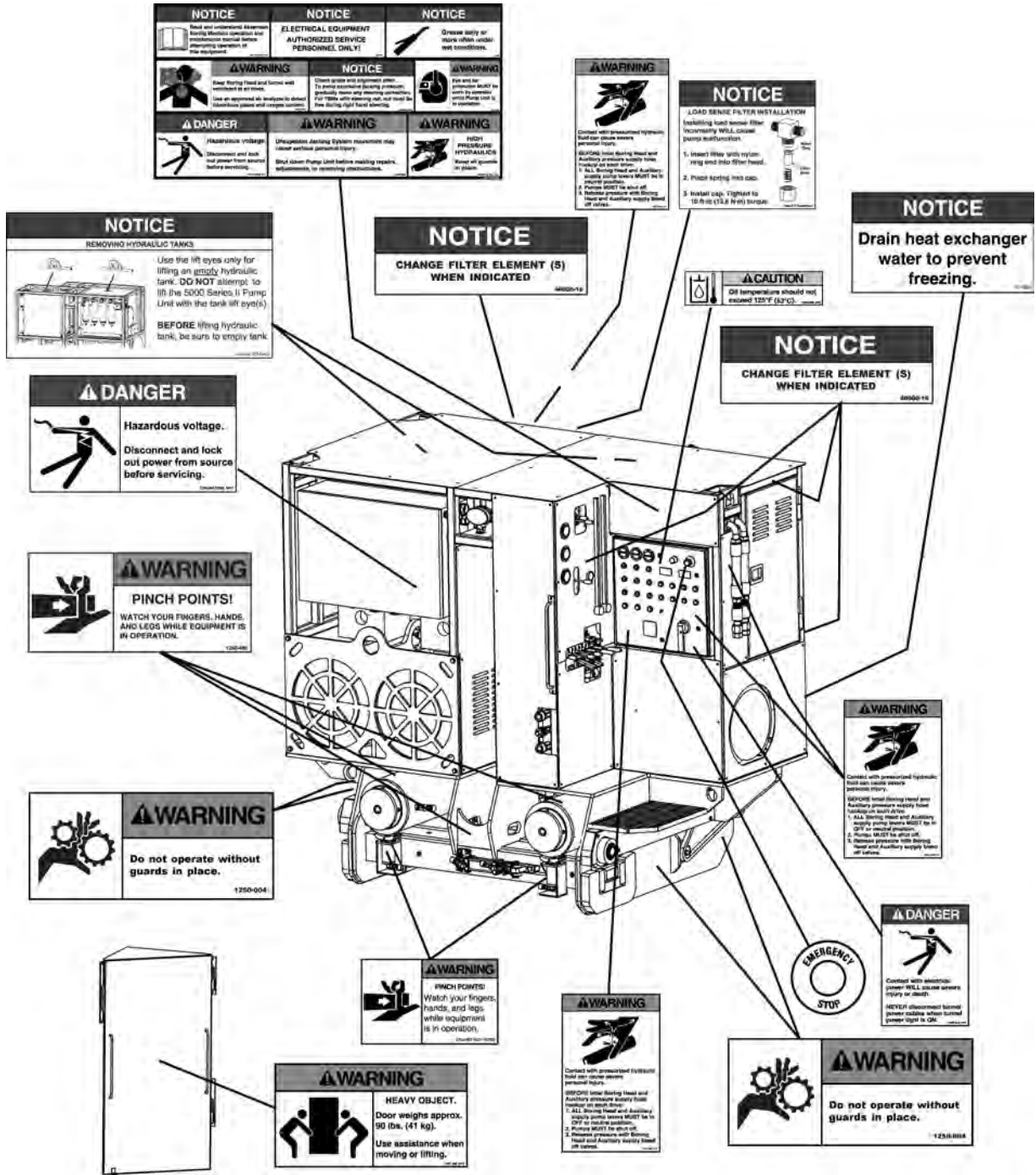
Serious injury or property damage can occur if safety instructions are not followed. Contact your Akkerman Aftermarket Support representative for free replacement safety decals.

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.

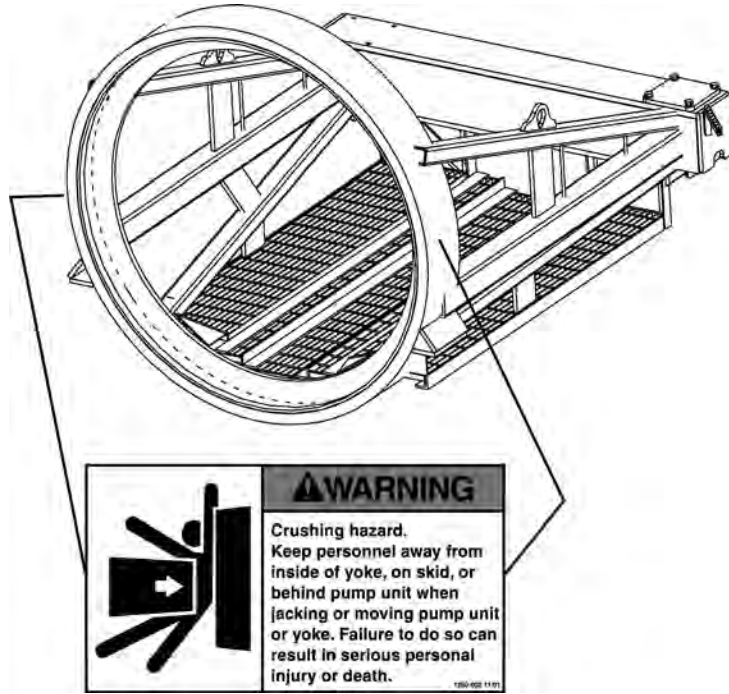
5000 SERIES II PUMP UNIT (SN F20400F-01)



5000 SERIES II PUMP UNIT (SN F20400F-02 & AFTER)



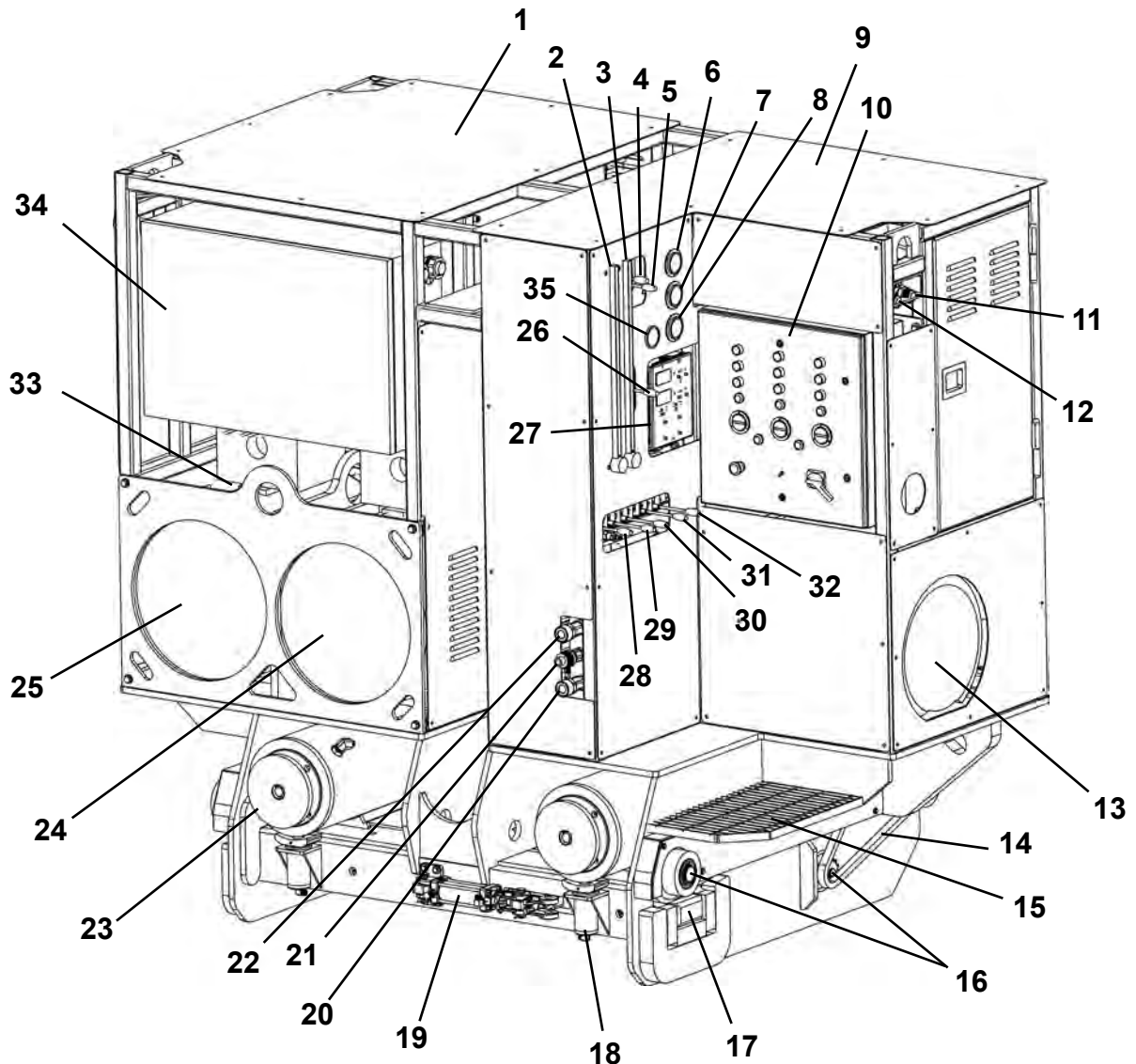
YOKE



NOTES

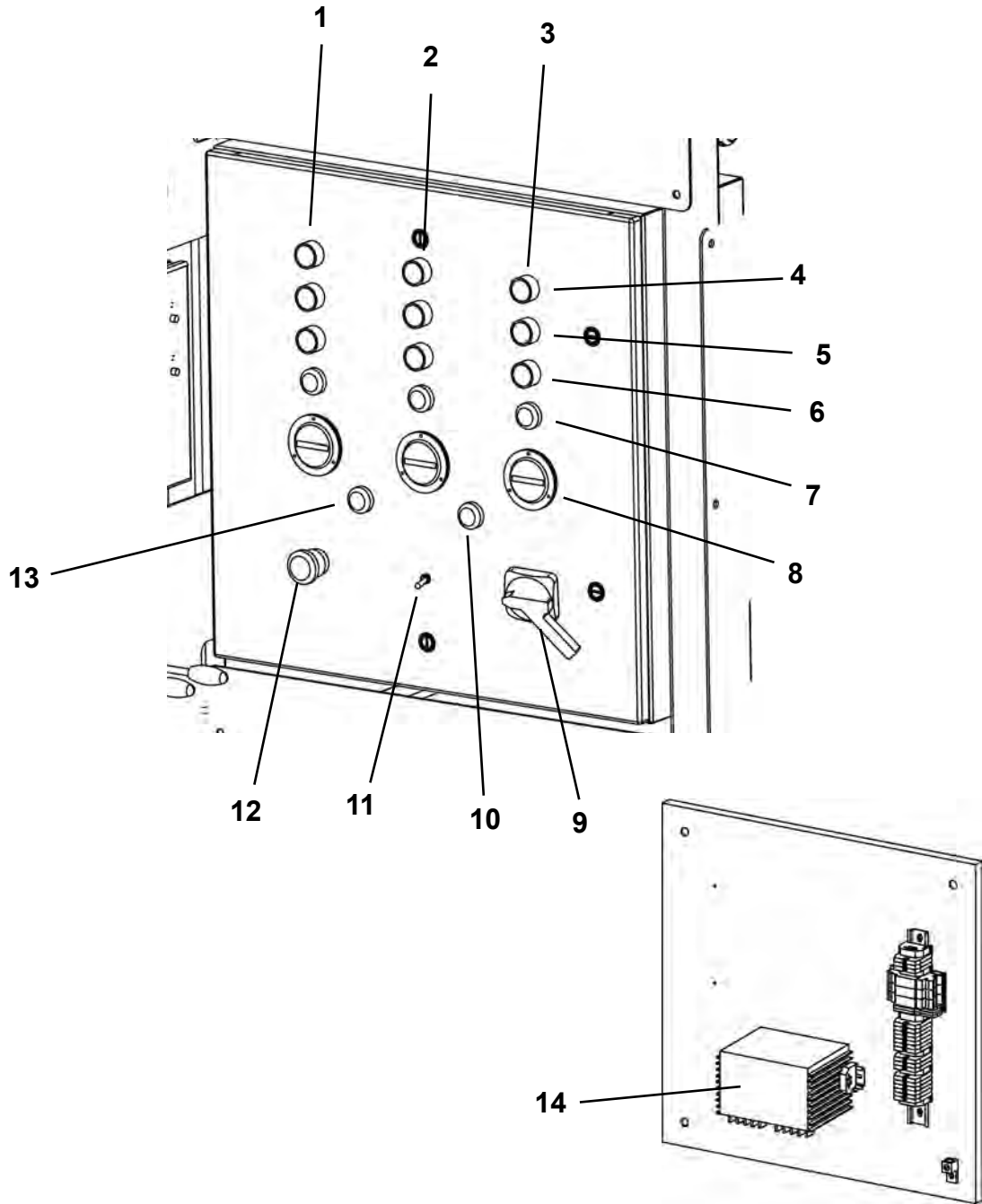
Terminology

5000 SERIES II PUMP UNIT (SN F20400F-01)



- | | |
|---|--|
| 1. Boring Head & Auxiliary System Reservoir | 19. Skid Lock Cylinder |
| 2. Boring Head Hyd Level/Temperature Gauge | 20. IJS Return Hose Connection |
| 3. Jacking Hyd Level/Temperature Gauge | 21. IJS Supply Hose Connection |
| 4. Auxiliary Supply Control 30 & 60 Gal. | 22. Boring Head Tank Fill |
| 5. Boring Head Supply Control 30 Gal. & Boring Head Cooling Control 60 Gal. | 23. Cylinder, 200 Ton Ram |
| 6. Auxiliary Pressure Gauge | 24. Auxiliary 100 HP Motor |
| 7. Boring Head Pressure Gauge | 25. Boring Head 100 HP Motor |
| 8. Jacking Pressure Gauge | 26. Boring Head Supply Control 30/60 Gal. |
| 9. Jacking System Reservoir | 27. Tank Temperature/Level & Skid Lock Indicator Panel |
| 10. Motor Control Panel | 28. Ram Lift Cylinder/ Jacking Cooling Pump Control |
| 11. Boring Head Supply Pressure OUT - Main | 29. Travel (Pump Unit Drive) Control |
| 12. Boring Head Supply Pressure OUT - Auxiliary | 30. Skid Lock Cylinder Control |
| 13. Jacking Circuit 50 HP Motor | 31. IJS Cylinder Control |
| 14. Drive Chain | 32. Main Ram Jacking Cylinder Control |
| 15. Operator Platform | 33. Tunnel Power Connection |
| 16. Drive Assembly | 34. Main Power Panel |
| 17. Skid Lock | 35. Primary Boring Head Return Filter Indicator |
| 18. Ram Lift Cylinder | |

5000 SERIES II - MOTOR CONTROL PANEL (SN F20400F-01)

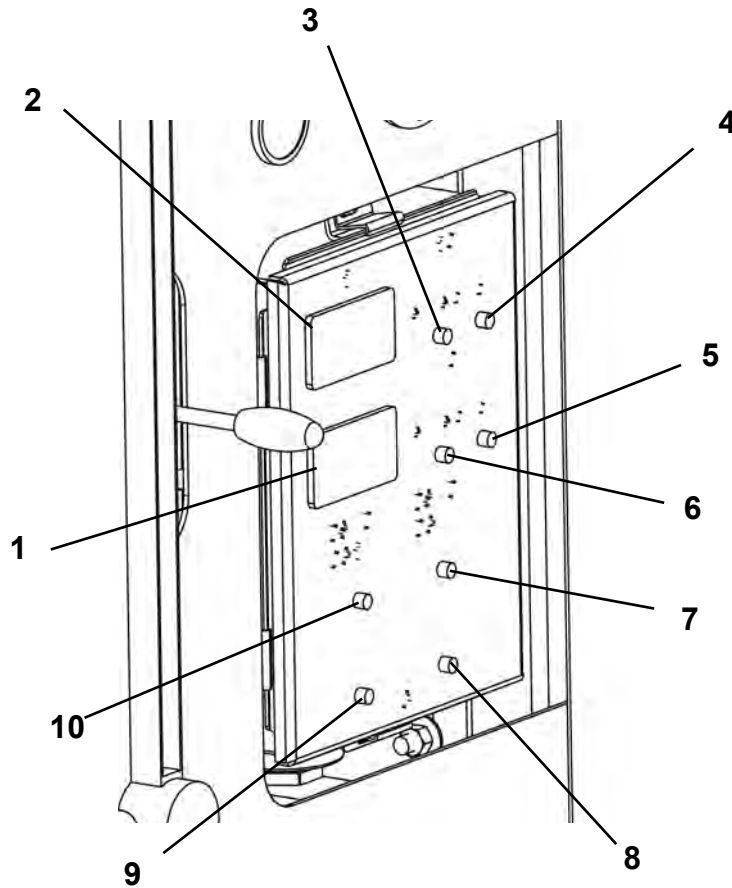


- 1. Jacking Motor Controls
- 2. Boring Head Motor Controls
- 3. Auxiliary Motor Controls
- 4. Start Button (Green)
- 5. Stop Button (Red)
- 6. Motor Overload Reset Button *
- 7. Breaker Tripped Light

- 8. Hourmeter
- 9. Tunnel Power Switch
- 10. Tunnel Power On Light
- 11. Light Switch
- 12. Emergency Stop
- 13. Phase Error Light
- 14. 24V Power Supply

* Used only if equipped with soft start accessory.

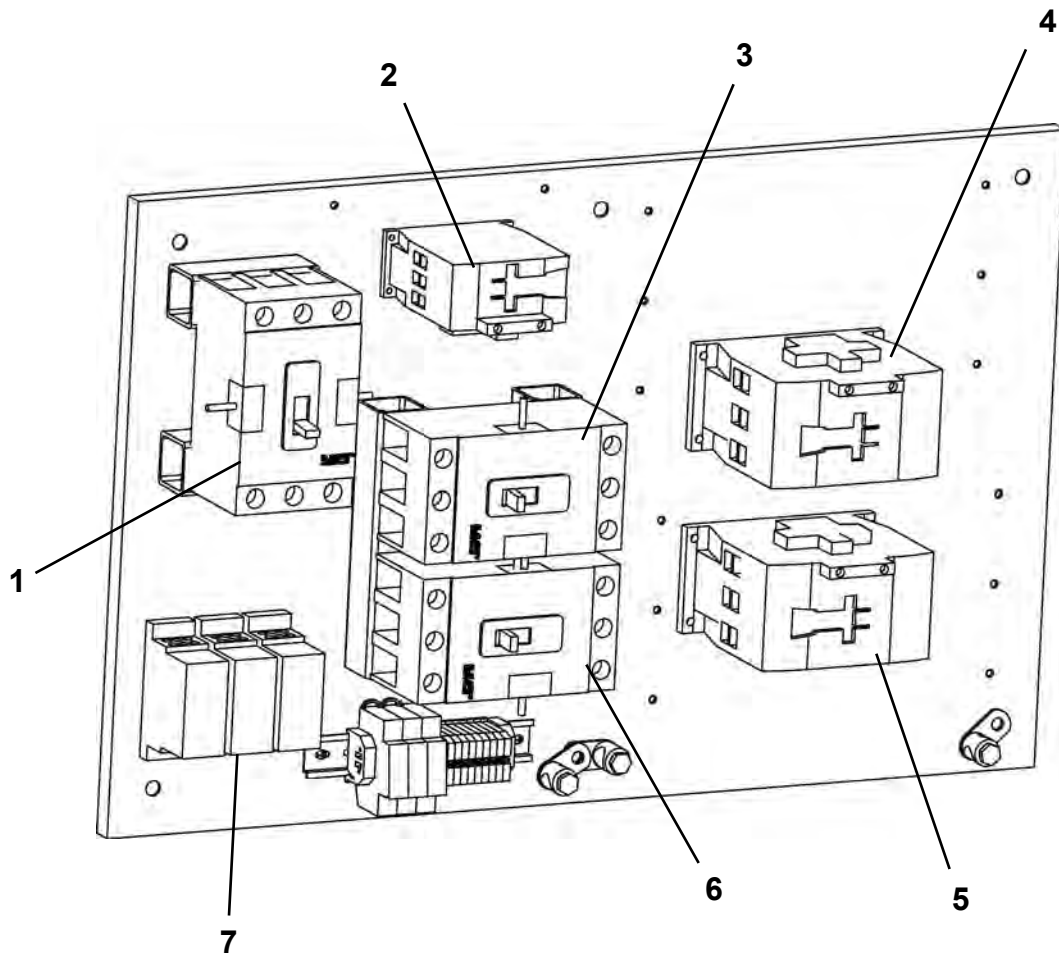
5000 SERIES II - TANK TEMP & SKID LOCK INDICATOR PANEL (SN F20400F-01)



- 1. Boring Head Hydraulic Reservoir Temperature
- 2. Jacking Hydraulic Reservoir Temperature
- 3. Jacking Reservoir Low Oil Level Light
- 4. Jacking Reservoir Empty Oil Level Light
- 5. Boring Head Reservoir Empty Oil Level Light

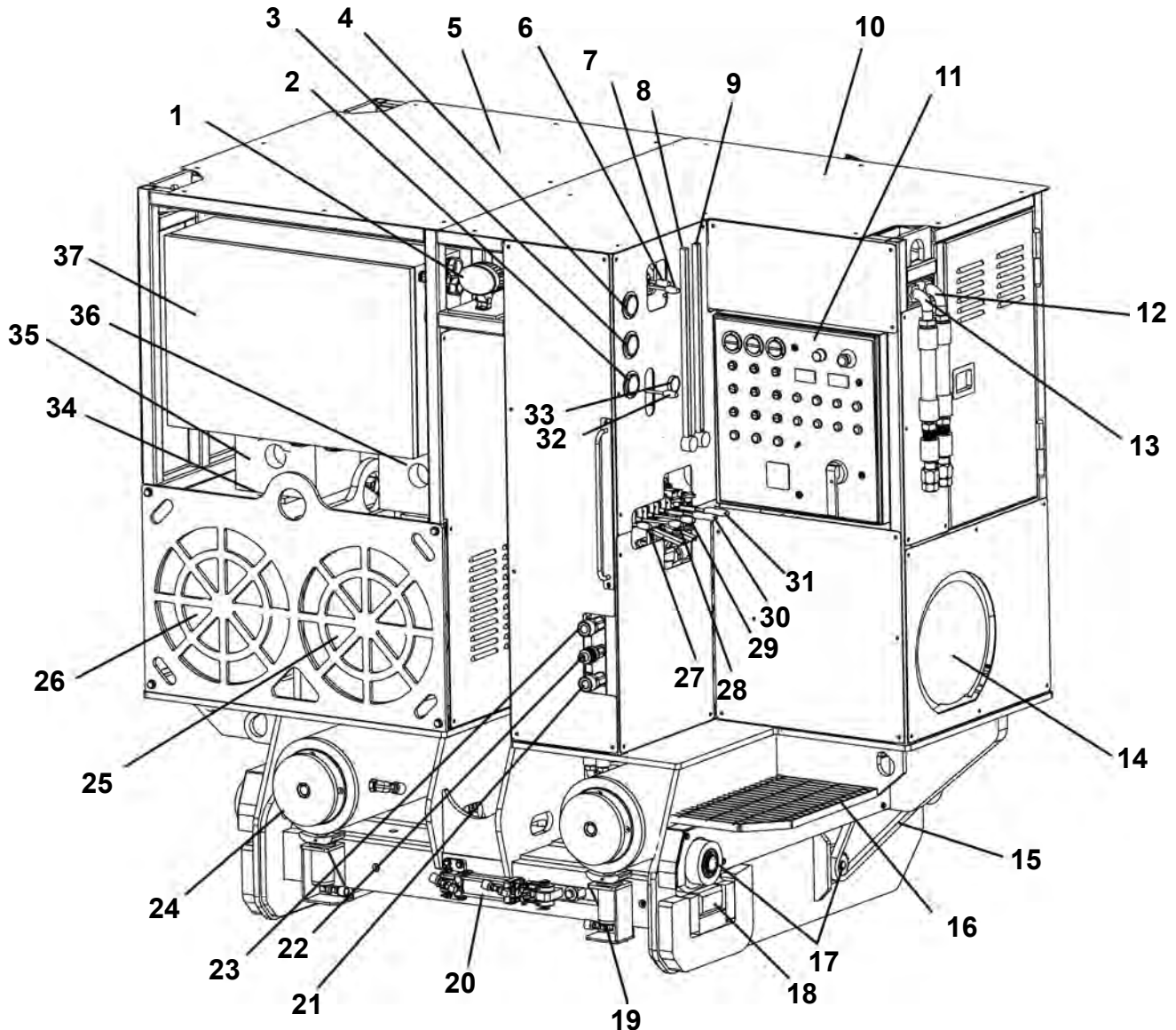
- 6. Boring Head Reservoir Low Oil Level Light
- 7. Skid Lock Cylinder Extend (Locked) - Right
- 8. Skid Lock Cylinder Retract (Unlocked) - Right
- 9. Skid Lock Cylinder Retract - (Unlocked) - Left
- 10. Skid Lock Cylinder Extend (Locked) - Left

5000 SERIES II - MAIN POWER PANEL (SN F20400F-01)



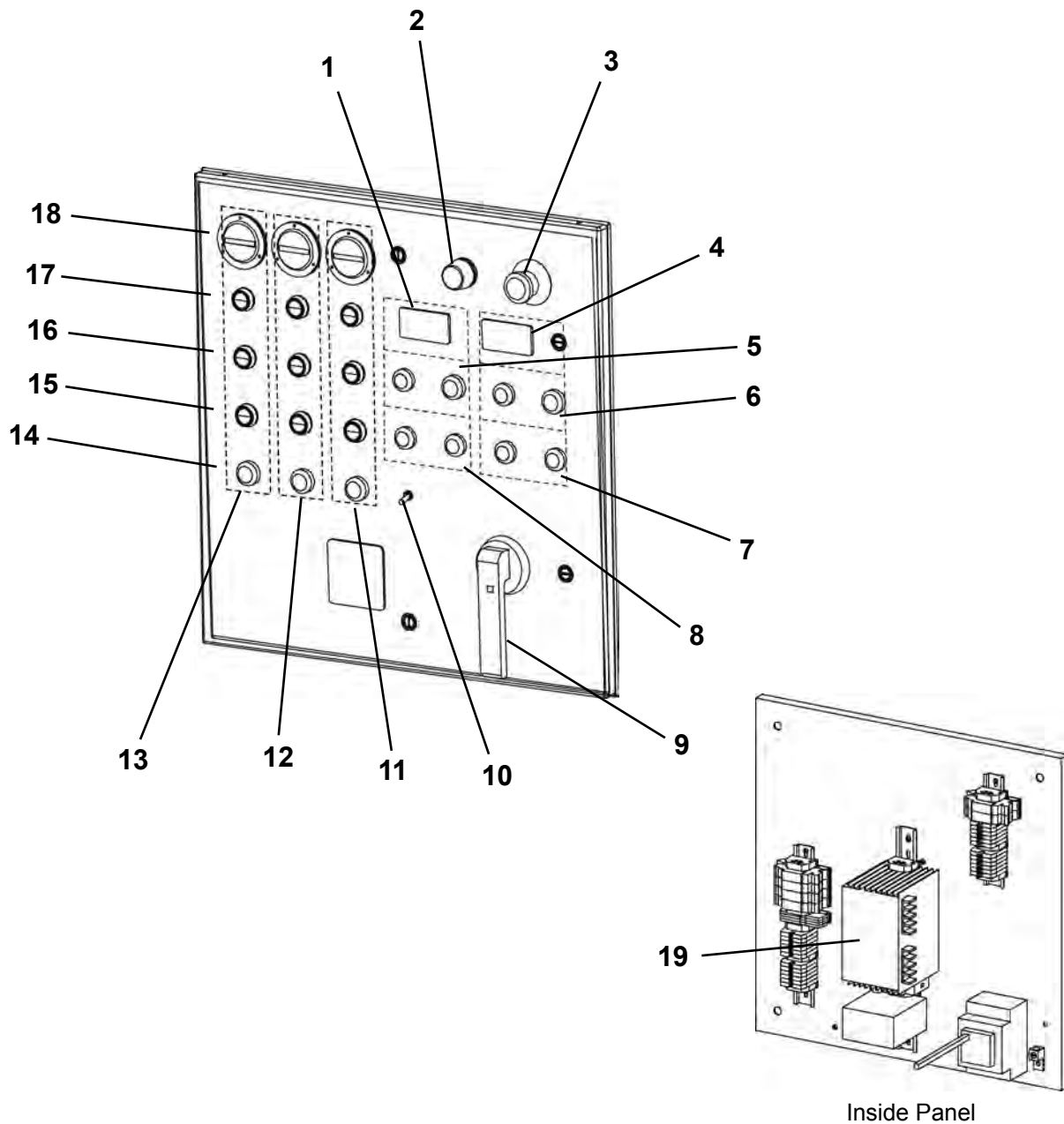
1. Jacking Motor Breaker With Overload Relay
2. Jacking Motor Contactor
3. Auxiliary Motor Breaker With Overload Relay
4. Auxiliary Motor Contactor
5. Boring Head Motor Contactor
6. Boring Head Motor Breaker With Overload Relay
7. Power Distribution Block

5000 SERIES II PUMP UNIT (SN F20400F-02 & AFTER)



- | | |
|---|--|
| 1. Light | 19. Ram Lift Cylinder |
| 2. Jacking Pressure Gauge | 20. Skid Lock Cylinder |
| 3. Boring Head Pressure Gauge | 21. IJS Return Hose Connection |
| 4. Auxiliary Pressure Gauge | 22. IJS Supply Hose Connection |
| 5. Boring Head & Auxiliary System Reservoir | 23. Boring Head Tank Fill |
| 6. Auxiliary Supply Control 30 & 60 Gal. | 24. Cylinder, 200 Ton Ram |
| 7. Boring Head Supply Control 30 Gal. & Boring Head Cooling Control 60 Gal. | 25. Auxiliary 100 HP Motor |
| 8. Boring Head Hyd Level/Temperature Gauge | 26. Boring Head 100 HP Motor |
| 9. Jacking Hyd Level/Temperature Gauge | 27. Ram Lift Cylinder / Jacking Cooling Pump Control |
| 10. Jacking System Reservoir | 28. Skid Lock Cylinder Control |
| 11. Control Panel | 29. Travel (Pump Unit Drive) Control |
| 12. Boring Head Supply Pressure OUT - Main | 30. IJS Cylinder Control |
| 13. Boring Head Supply Pressure OUT - Auxiliary | 31. Main Ram Jacking Cylinder Control |
| 14. Jacking Circuit 50 HP Motor | 32. Boring Head Supply Control 30/60 Gal. |
| 15. Drive Chain | 33. Primary Boring Head Return Filter Indicator |
| 16. Operator Platform | 34. Tunnel Power Connection |
| 17. Drive Assembly | 35. Boring Head Supply (Pump 1) |
| 18. Skid Lock | 36. Auxiliary Supply (Pump 2) |
| | 37. Main Power Panel |

5000 SERIES II - CONTROL PANEL (SN F20400F-02 & AFTER)



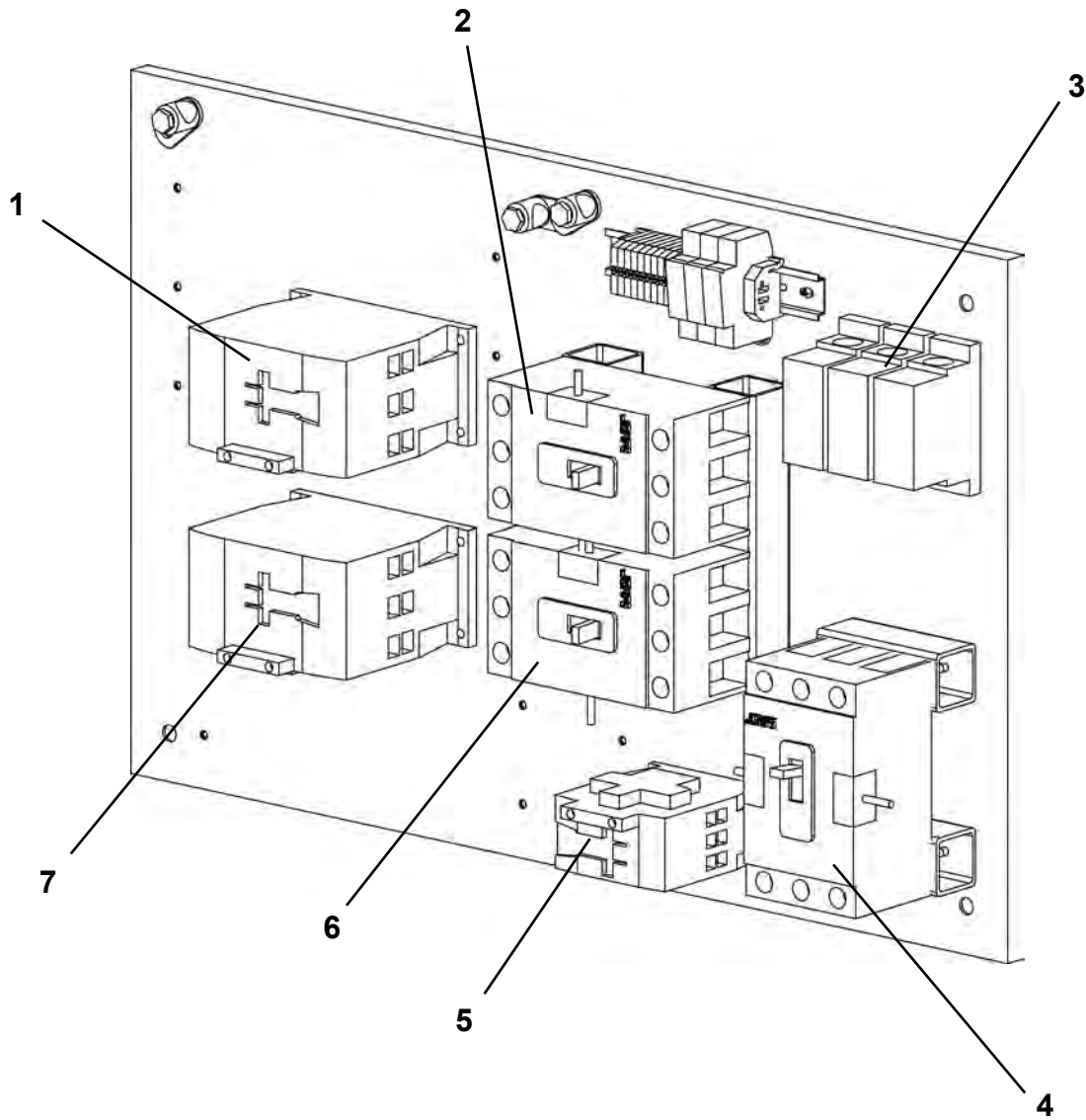
- | | |
|---|------------------------------------|
| 1. Boring Head Hydraulic Tank Temp | 10. Light Switch |
| 2. Tunnel Power On Light | 11. Jacking Motor Controls* |
| 3. Emergency Stop | 12. Auxiliary Motor Controls* |
| 4. Jacking Hydraulic Tank Temp | 13. Boring Head Motor Controls* |
| 5. Boring Head Tank Low/Empty Oil Level Indicator | 14. Breaker Tripped Light |
| 6. Jacking Tank Low/Empty Oil Level Indicator | 15. Motor Overload Reset Button ** |
| 7. Skid Lock Left Unlocked/Locked Indicator* | 16. Stop Button (Red) |
| 8. Skid Lock Right Unlocked/Locked Indicator* | 17. Start Button (Green) |
| 9. Tunnel Power Switch | 18. Hourmeter |
| | 19. 24V Power Supply |

* The skid lock indicators and motor control locations represent SN F20400F-03 & After.

The specific indicators and motor controls for SN F20400F02 are reoriented on the control panel.

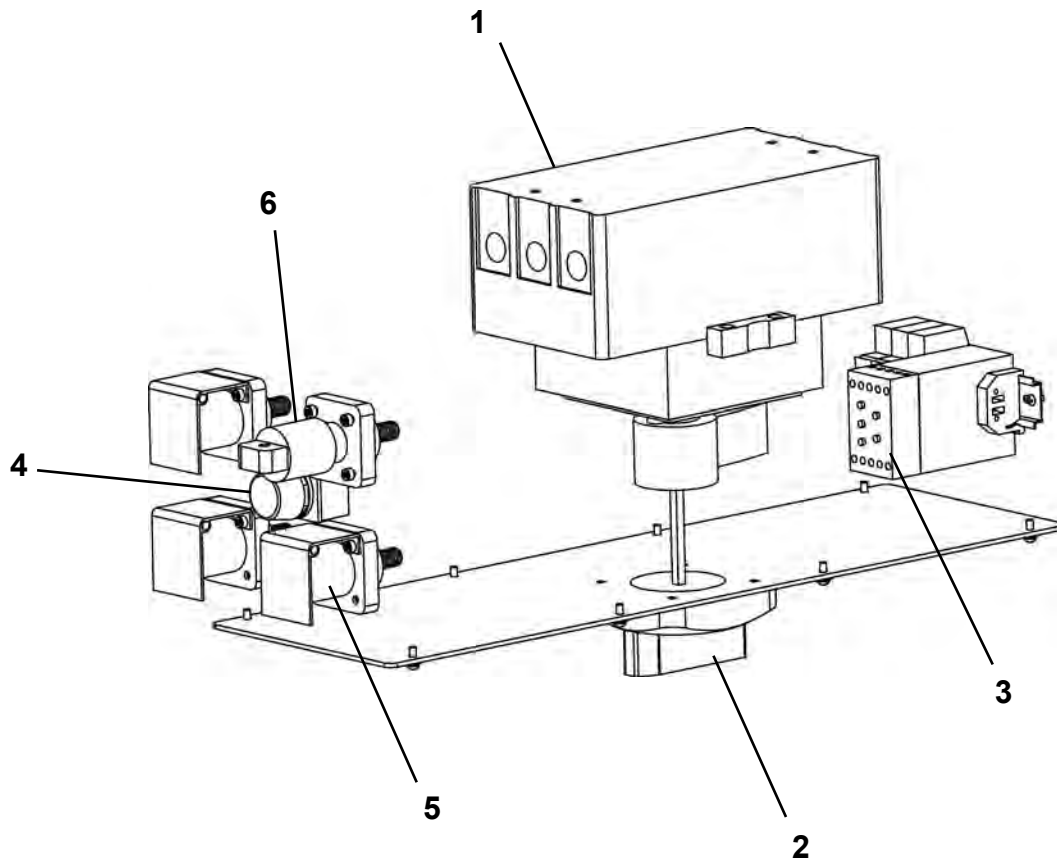
** Used only if equipped with soft start accessory.

5000 SERIES II - MAIN POWER PANEL (SN F20400F-02 & AFTER)



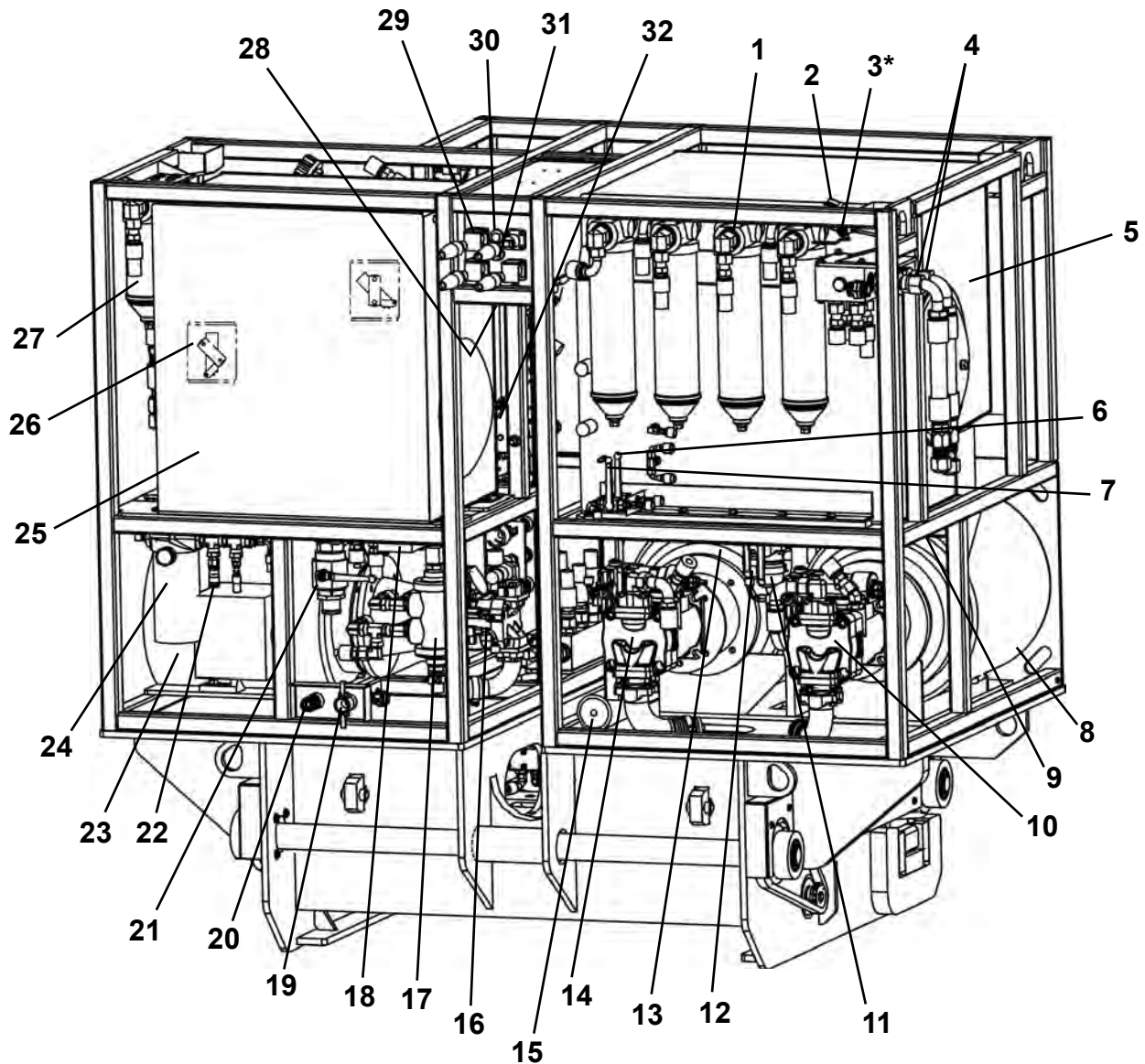
1. Boring Head Motor Contactor
2. Boring Head Motor Breaker With Overload Relay
3. Power Distribution Block
4. Jacking Motor Breaker With Overload Relay
5. Jacking Motor Contactor
6. Auxiliary Motor Breaker With Overload Relay
7. Auxiliary Motor Contactor

5000 SERIES II - MAIN DISCONNECT ELECTRICAL BOX



1. Main Breaker 400A
2. Main Power Disconnect Switch
3. Phase Detector 480V
4. Phase Error Light
5. Electrical Power Cable Cam Lock Connections
6. Ground Cable Cam Lock Connection

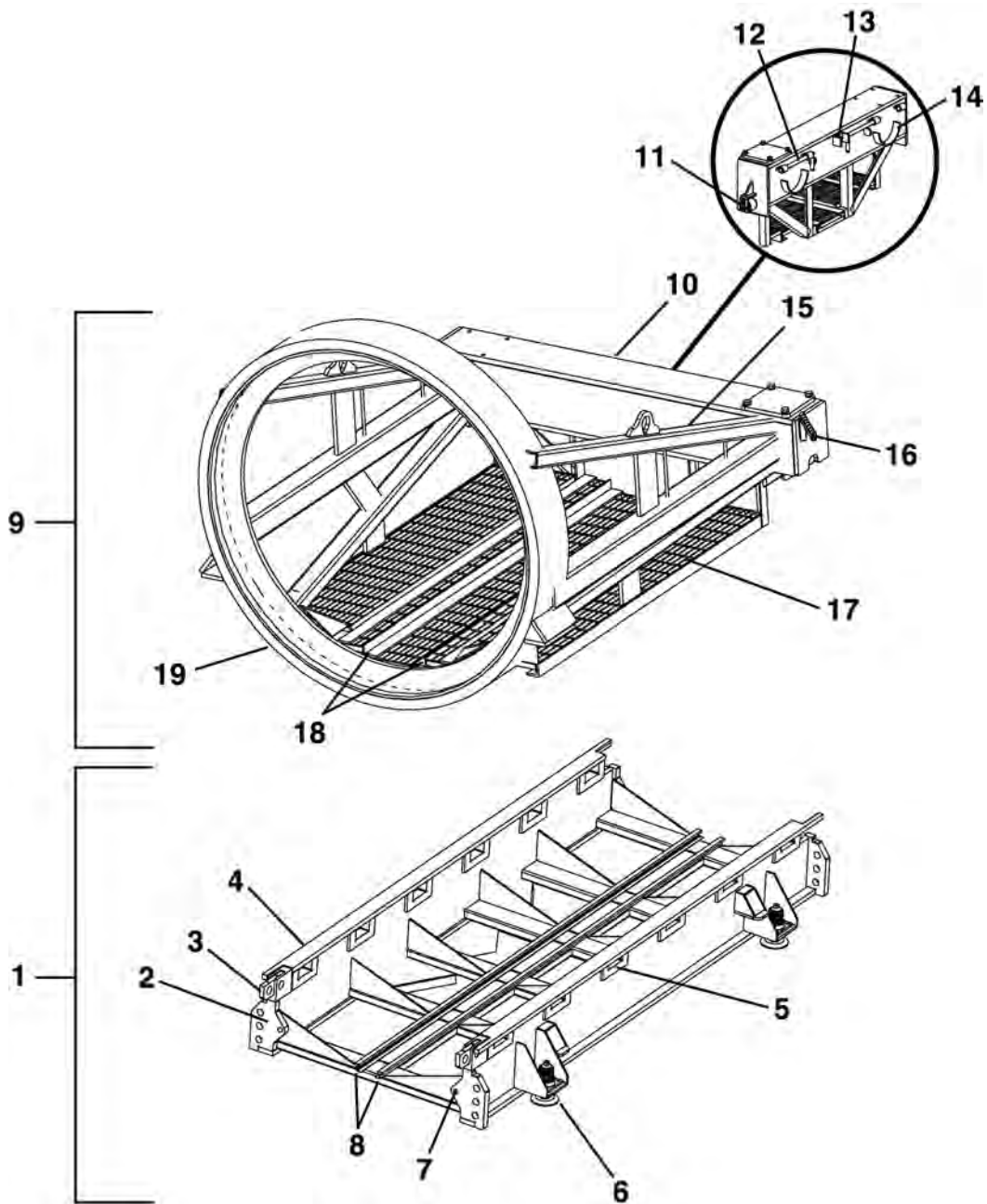
5000 SERIES II - REAR COMPONENTS



- | | |
|---|---|
| 1. Boring Head Return/BH Case Drain Filters (4) | 17. Jacking System Heat Exchanger |
| 2. Tank Breather | 18. Jacking System Tank Drain Valve |
| 3. Tank Vent Valve* | 19. Heat Exchanger Water Supply Fitting |
| 4. Boring Head Supply Return | 20. Heat Exchanger Water Discharge Fitting |
| 5. Boring Head Supply Reservoir | 21. Jacking System Shutoff Valve |
| 6. Auxiliary Supply Bleed Off Valve | 22. Jacking Tank Fill Connection |
| 7. Boring Head Supply Bleed Off Valve | 23. Jacking System 50 HP Motor |
| 8. Boring Head 100 HP Motor | 24. Jacking Fill Tank Filter |
| 9. Boring Head Tank Drain Valve | 25. Jacking System Reservoir |
| 10. Boring Head Supply Pump | 26. Cable Clamp Holders |
| 11. Boring Head Supply Shutoff Valve | 27. Jacking/IJS Return Filters |
| 12. Auxiliary Supply Shutoff Valve | 28. Main Power Switch |
| 13. Auxiliary Supply Motor | 29. Electrical Power Cable Cam Lock Connections |
| 14. Auxiliary Supply Pump | 30. Phase Error Light - Green (SN F20400F-02 & After) |
| 15. Transfer Pump | 31. Phase Error Light - Red |
| 16. Jacking System Pump | 32. Boring Head Heat Exchanger |

* SN F20400F-01 through 3 only.

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

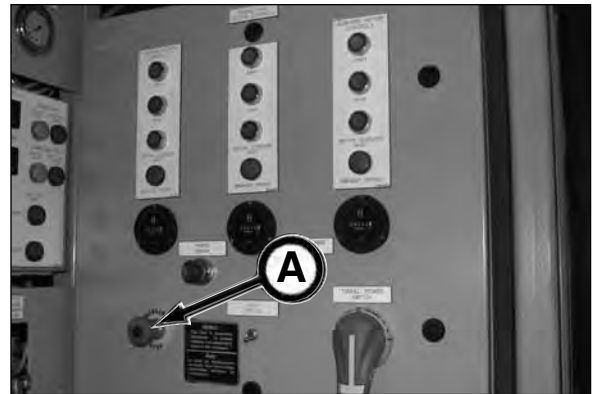
EMERGENCY STOP

⚠ WARNING ALL Emergency Stop buttons MUST be operating properly BEFORE operating Pump Unit and TBM. Failure to do so may cause severe injury or death.

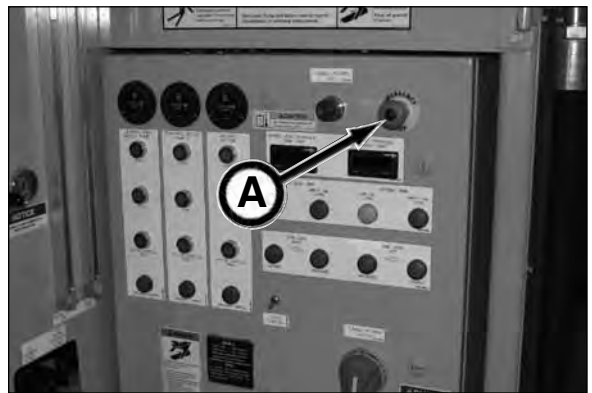
Push Emergency Stop button (A) IN to stop all electrical and hydraulic functions on the 5000 Series II Pump Unit and the tunnel boring machine.

The E-Stop button will illuminate when it is pulled OUT.

The E-Stop button must be pulled out to restart operation.



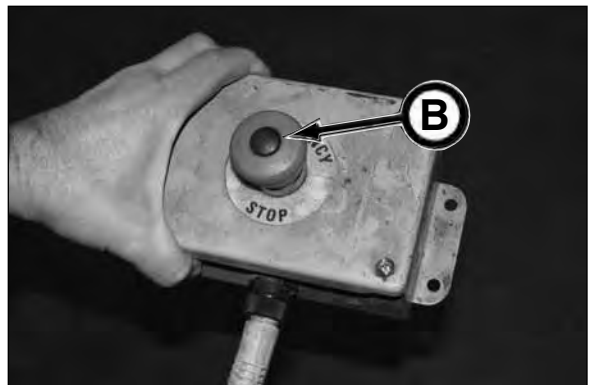
E-Stop on 5000 Series II Pump Unit SN F20400F-01



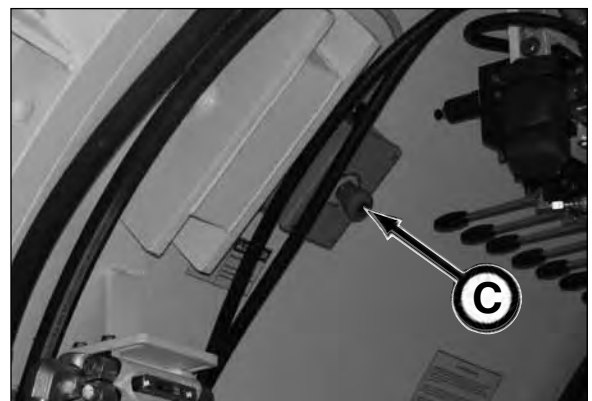
E-Stop on 5000 Series II Pump Unit SN F20400F-02 & After

NOTICE All E-Stop buttons (Pump Unit E-Stop (A), Remote Pump Unit E-Stop (B) and TBM E-Stop (C) [if equipped]) MUST be pulled out to restart operation.

The operating lights will not be functional.



Remote E-Stop on 5000 Series II Pump Unit



E-Stop on 720 Series II TBM

PHASE ERROR LIGHT

WARNING Any electrical work completed on the pump unit must be performed by a certified electrician.

The input power is monitored for proper three phase electrical power.

If the red Phase Error Light (A) is ON, this indicates that the external power source phase power is installed incorrectly. Disconnect and lock out ALL power before attempting to reverse the two generator power leads.

The Phase Error light will also illuminate in the following conditions:

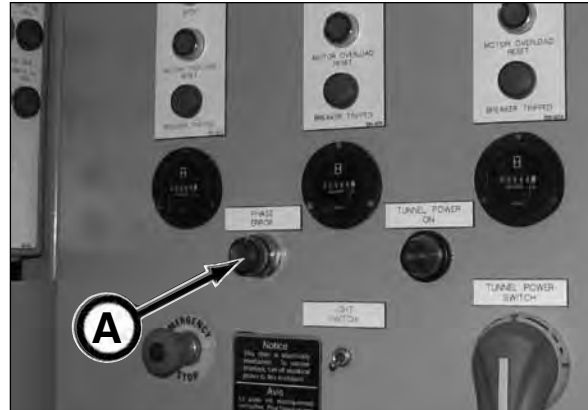
- Undervoltage (Less than 95%)
- Overvoltage (greater than 110%)
- Phase imbalance
- Phase loss

If it becomes necessary to troubleshoot the electrical fault, the 5000 Series II Pump Unit is equipped with a Phase Detector (includes fault indicators). Gain access to the Phase Detector ONLY if it is required to help diagnose electrical issues. Lock out power, then remove the main disconnect electrical box cover (B) to gain access to the Phase Detector.

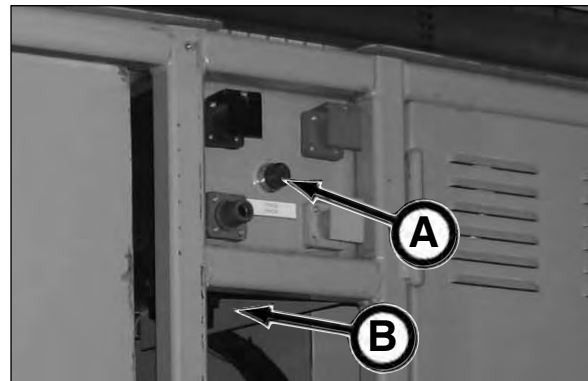
NOTICE On SN F20400F-02 & after, the pump unit is equipped with a green phase light (C), indicating that the power is in proper phase.

Refer to the table to the right for the Phase Error LED status indicator codes. The LED status light is located on the inside of the main disconnect electrical box.

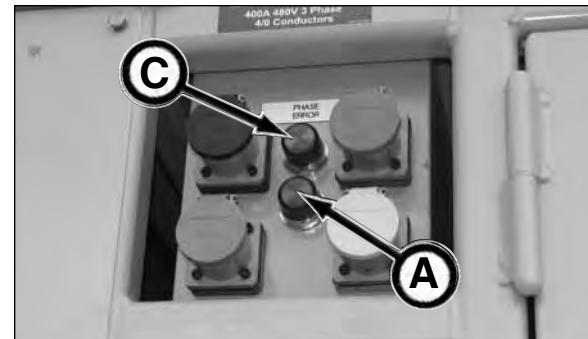
IMPORTANT: DO NOT start up electric motors if the red Phase Error light (A) is illuminated. Doing so will run motors backwards causing component damage.



Phase Error Light on 5000 Series II Pump Unit
SN F20400F-01 Control Panel



Phase Error Light on 5000 Series II Pump Unit
SN F20400F-01
Cam Lock Power Connection Panel



Phase Error Light on 5000 Series II Pump Unit
SN F20400F-02 & After
Cam Lock Power Connection Panel

FAULT INDICATION CODE TABLE	
Led Status	Indicator
Green Steady	Normal / Relay ON
Green Flashing	Power Up / Restart Delay
Red Steady	Unbalance
Red Flashing	Under Voltage / Overvoltage
Amber Steady	Reversal
Amber Flashing	Loss
Green/Red Alternating	Under / Overvoltage Trip Pending
Red/Amber Alternating	Nominal Voltage Set Error

MAIN POWER SWITCH

⚠ DANGER Hazardous voltage. Disconnect and lock out/tag out power from source before servicing.

⚠ DANGER If high voltage cables or cable connections are damaged, contact with cables/connections may result in electrical shock causing severe injury or death. Disconnect and lock out/tag out power from source before servicing.

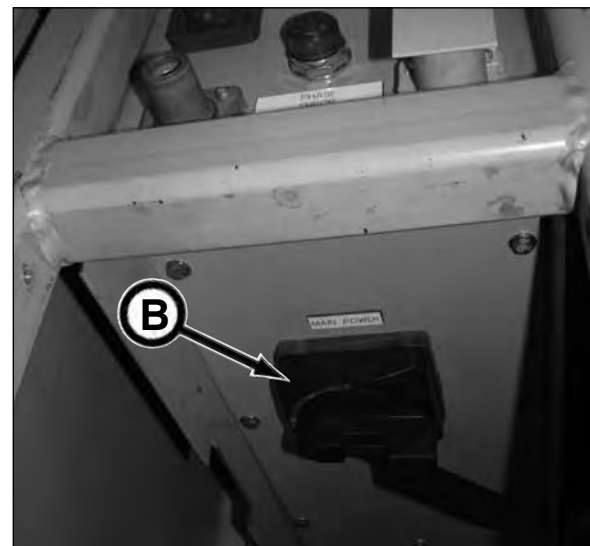
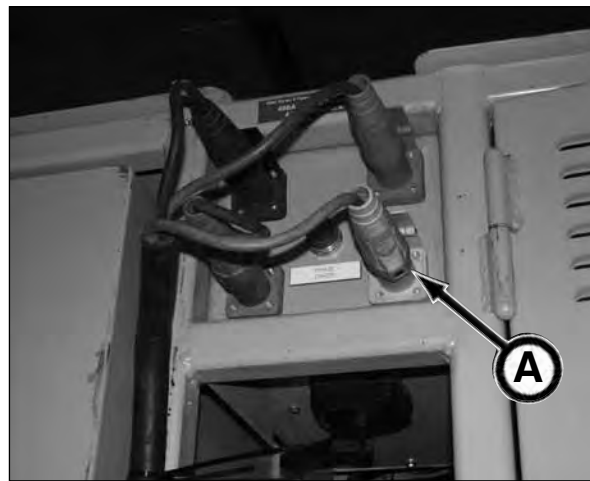
NOTICE Power supply requirements: 400A 480V 3 Phase with lugs capable of 4/0 conductors.

⚠ WARNING Any electrical work performed on the pump unit must be completed by a certified electrician.

NOTICE All Emergency Stop buttons must be pulled out to restart operation.

Use the main power switch (B) to allow power from an external power source to the pump unit and TBM electrical components as follows:

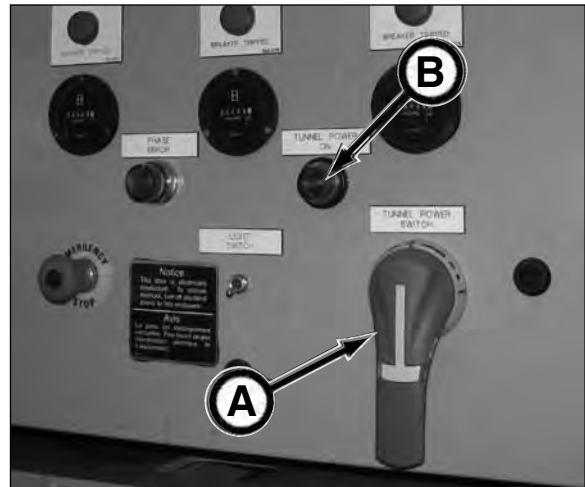
1. Hook up power cables to the electrical power cable cam lock connections (A) from external power source.
2. Turn on external power source and check for proper phase (refer to Phase Error Light in this section).
3. With proper phase, turn on main power switch (B).



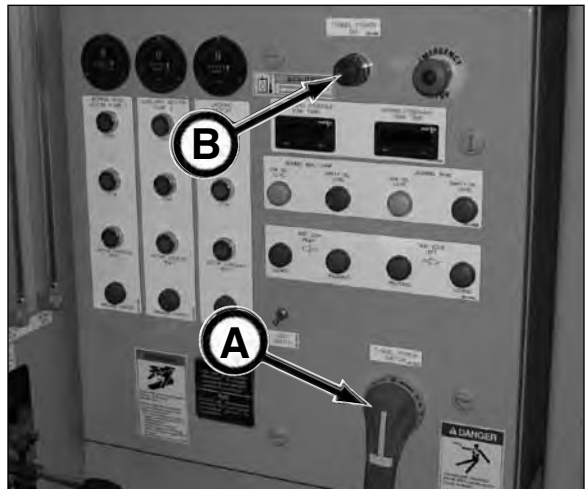
TUNNEL POWER

The Akkerman 5000 Series II Pump Unit is equipped with a Tunnel Power switch (A) and a Tunnel Power ON light (B) for the Akkerman Series II TBMs with 480V power.

Once the pump unit main power switch is on and all Emergency Stop buttons are pulled out, the Tunnel Power switch can be turned on which will illuminate the Tunnel Power On light. The tunnel power light provides the operator a quick visual indicator that power is ON in the tunnel and to take all necessary precautions with high voltage electricity.



5000 Series II Pump Unit SN F20400F-01



5000 Series II Pump Unit SN F20400F-02 & After

⚠ DANGER NEVER disconnect tunnel power cables when tunnel power light is ON. Doing so will cause severe injury or death from electrical shock.



Connect a 10GA tunnel cable (Akkerman PN FA20511F0) to the 5000 Series II Pump Unit tunnel power cable connection (C) and the other end to the incoming power connection in the 720 Series II TBM.



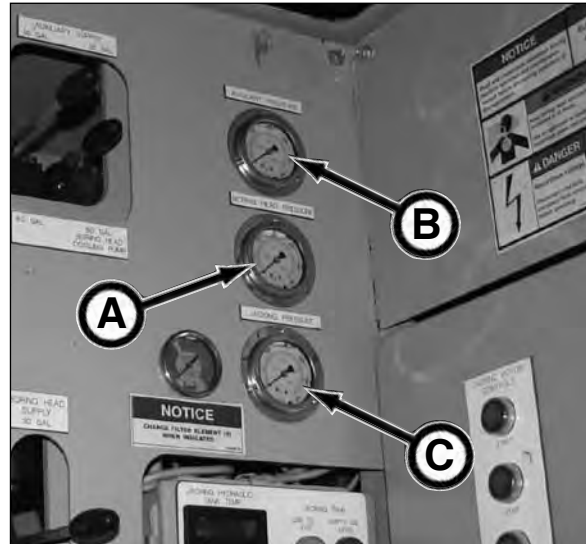
SYSTEM PRESSURE GAUGES

The 5000 Series II Pump Unit is equipped with pressure gauges to monitor the pressures of the three hydraulic systems; boring head, auxiliary and jacking systems.

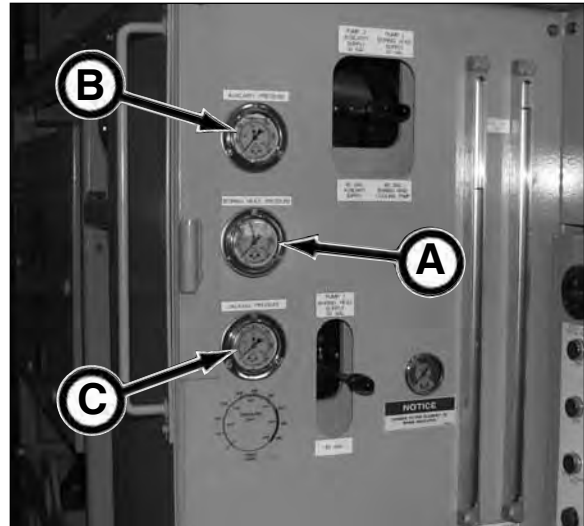
The boring head (A) and auxiliary (B) systems are low pressure systems used for the boring head components and the conveyor. These systems are capable of 3,000 psi.

The jacking system (C) system is a high pressure system used to control the dual ram jacking cylinders and the intermediate jacking station cylinders.

The jacking system is capable of 5,100 psi.
If using IJS, the system is capable of 6,000 psi.



5000 Series II Pump Unit SN F20400F-01



5000 Series II Pump Unit SN F20400F-02 & After

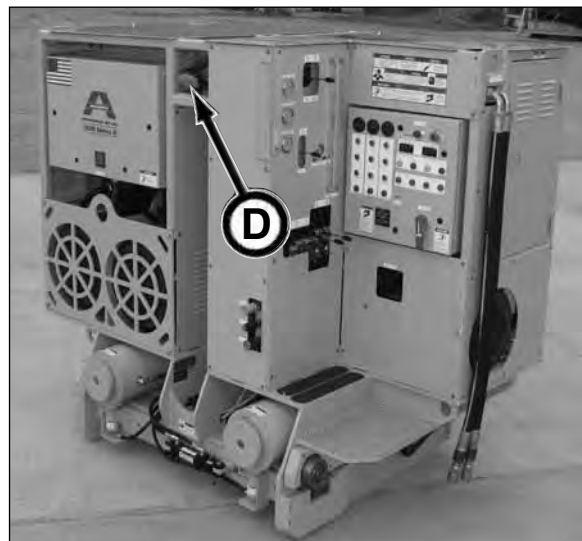
LIGHT

The pump unit is equipped with an operating light.

Flip light switch (D) as follows:

Light ON - UP

Light OFF - DOWN



MOTOR CONTROLS (SN F20400F-01)

The motor controls regulate the 100 HP boring head motor, 100 HP auxiliary motor and the 50 HP jacking system motor as follows:

NOTICE All E-Stop buttons must be pulled out for the motor controls to be operational.

IMPORTANT: DO NOT start up electric motors if Phase Error light (J) is illuminated. Doing so will run motors backwards causing component damage.

To power ON the electrical and hydraulic systems, depress start button:

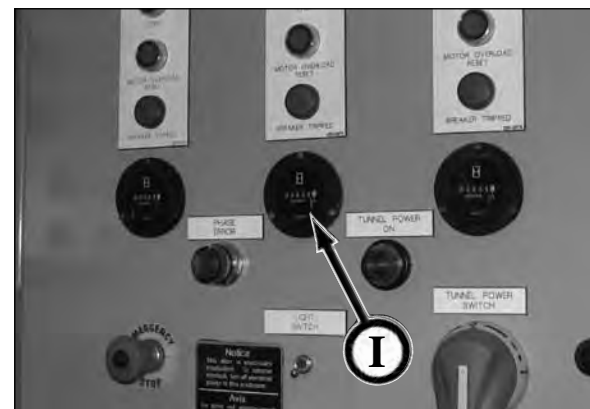
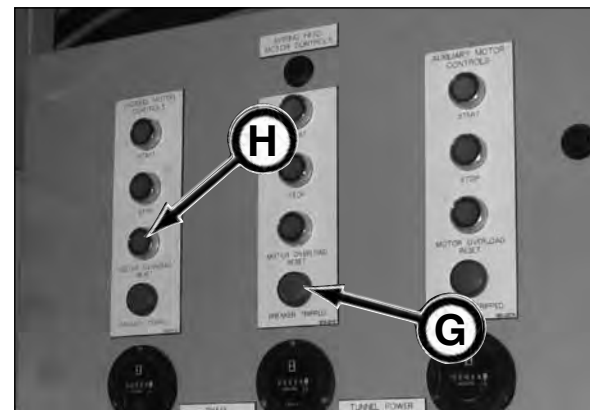
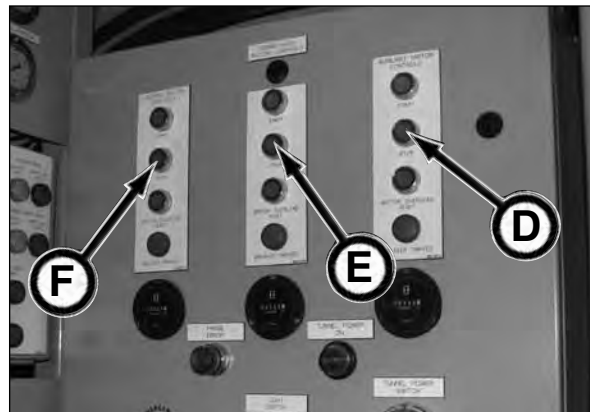
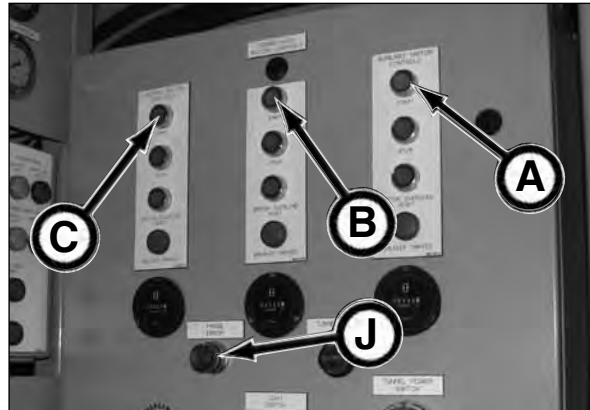
Auxiliary System	A
Boring Head System	B
Jacking System	C

To power OFF the electrical and hydraulic systems, depress stop button:

Auxiliary System	D
Boring Head System	E
Jacking System	F

When the pump unit is equipped with the optional soft start system, the system breaker tripped light (G) may illuminate indicating a system motor overload. If this occurs, depress the system motor overload reset button (H) to reset the starter breaker.

The pump unit is also equipped with an individual hourmeter (I) for each motor system. The hourmeter registers in full hours and 1/10th hours.



MOTOR CONTROLS (SN F20400F-02 & AFTER)

The motor controls regulate the 100 HP boring head motor, 100 HP auxiliary motor and the 50 HP jacking system motor as follows:

NOTICE All E-Stop buttons must be pulled out for the motor controls to be operational.

To power ON the electrical and hydraulic systems, depress start button:

Boring Head System	A
Auxiliary System	B
Jacking System	C

To power OFF the electrical and hydraulic systems, depress stop button:

Boring Head System	D
Auxiliary System	E
Jacking System	F

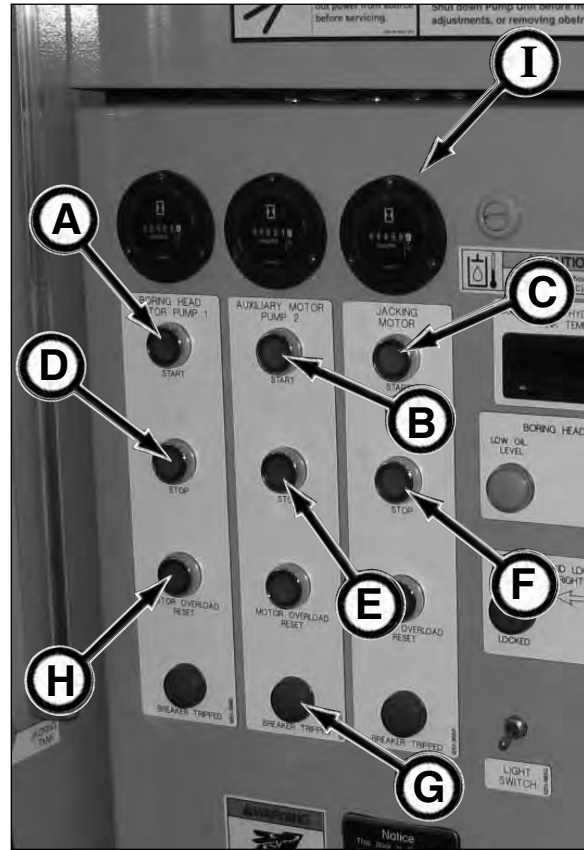
When the pump unit is equipped with the optional soft start system, the system breaker tripped light (G) may illuminate indicating a system motor overload. If this occurs, depress the system motor overload reset button (H) to reset the starter breaker.

The pump unit is also equipped with an individual hourmeter (I) for each motor system. The hourmeter registers in full hours and 1/10th hours.

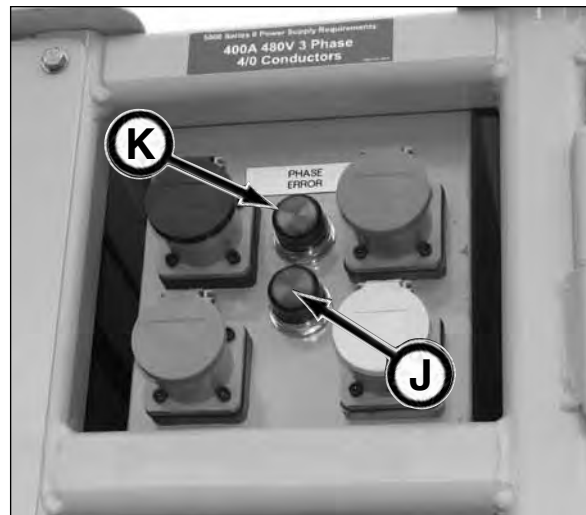
IMPORTANT: DO NOT start up electric motors if the red Phase Error light (J) is illuminated. Doing so will run motors backwards causing component damage.

NOTICE The green Phase light (K) indicates the power is in proper phase.

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



SN F20400F-03 & After Shown*



BORING HEAD & AUXILIARY SUPPLY CONTROLS

The boring head and auxiliary supply controls regulate the hydraulic oil flow to the boring head components and conveyor.

The 5000 Series II Pump Unit maximum flow is 120 GPM. The maximum pressure is 3,000 psi.

Move the controls as follows:

Single Feed (60 gal) for all TBMs:

Move lever A down to position D.

Dual Feed (90 gal) for TBM 360, 48SC, 420, 480:

Move lever A down to position D and lever C up to position G.

Dual Feed (120 gal) for TBM 540 (SN 4 & After), 600, 660, 720, 780:

Move lever A down to position D and lever C down to position H.

Dual Feed (120 gal) for Series II TBMs:

Move lever A down to position D and lever C down to position H.

Boring Head Cooling Pump (60 gal):

For hydraulic oil cooling during pipe setting, move lever B down to position I (refer to Boring Head Cooling Pump Control in this section).

NOTICE

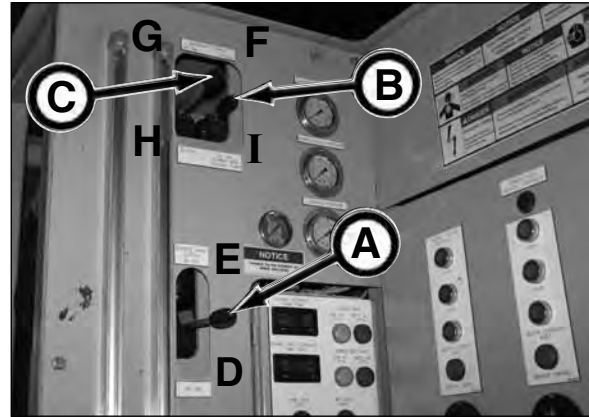
Selecting control levers A and B will cause hydraulic oil to flow out the main boring head supply pressure hose (J) to the TBM components. Selecting control lever C will cause hydraulic oil to flow out the auxiliary boring head supply pressure hose (K) to the TBM components.

NOTICE

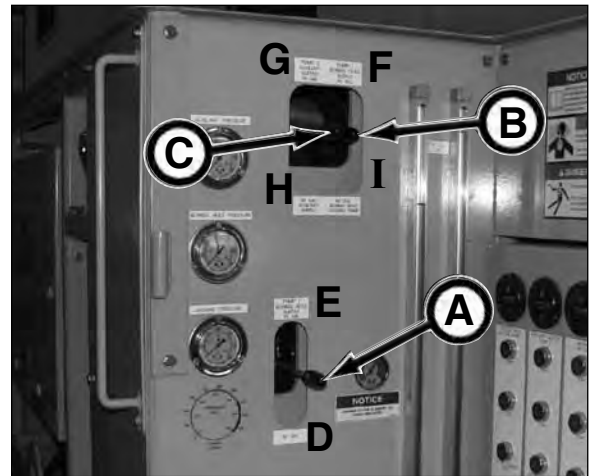
Though it is possible for a 90 GPM flow through the main supply line, it is highly NOT recommended to do so since it will cause additional heat and pressure loss due to back pressure in the system. It is recommended to use a maximum of 60 GPM flow through each of the boring head and auxiliary supply lines for a maximum flow of 120 GPM.

NOTICE

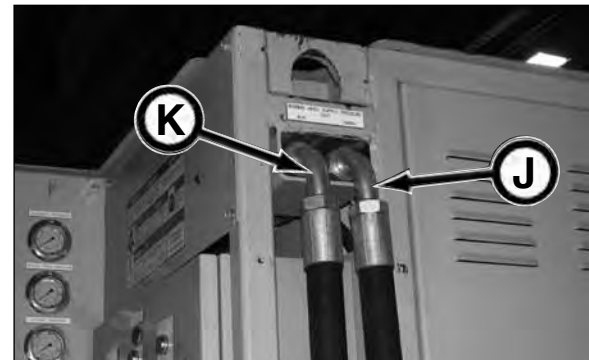
When pressure exceeds 2,800 psi, the boring head component performance will start to diminish until it reaches the relief setting of 3,000 psi. This will suspend operation, while retaining 3,000 psi within the pressure lines.



5000 Series II Pump Unit SN F20400F-01



5000 Series II Pump Unit SN F20400F-02 & After



- A - Boring Head 30 - 60 Gal Supply Control Lever
- B - Boring Head 30 Gal / BH Cooling Pump Lever
- C - BH Auxiliary 30 - 60 Gal Supply Control Lever
- D - Boring Head 60 Gal Supply Position
- E - Boring Head 30 Gal Supply Position
- F - Boring Head 30 Gal Supply Position
- G - BH Auxiliary 30 Gal Supply Position
- H - BH Auxiliary 60 Gal Supply Position
- I - Boring Head Cooling Pump Position
- J - Main Boring Head Supply Pressure Hose
- K - Auxiliary Boring Head Supply Pressure Hose

BH - Boring Head

SUPPLY BLEED OFF VALVES

⚠ WARNING Contact with pressurized hydraulic fluid can cause severe personal injury.

BEFORE initial Boring Head and Auxiliary pressure supply hose hookup on each drive:

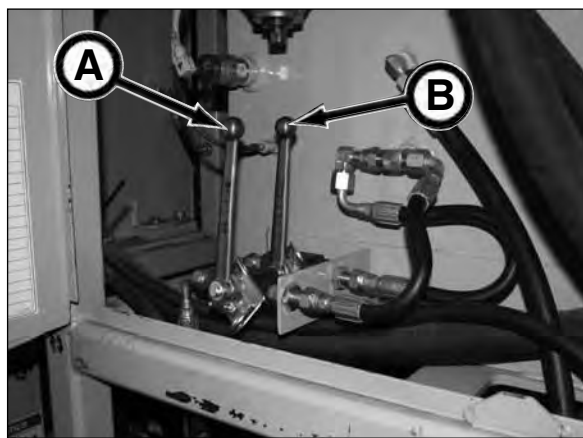
1. ALL Boring Head and Auxiliary supply pump levers MUST be in OFF or neutral position.
2. Pumps MUST be shut off.
3. Release pressure with Boring Head and Auxiliary supply bleed off valves.



The bleed off valves are used to release hydraulic pressure that may be in the boring head and auxiliary hydraulic systems to prevent injury from escaping hydraulic oil when connecting supply hoses to the pump unit for the first time on each drive.

Boring Head Supply Bleed Off Valve (A)

Auxiliary Supply Bleed Off Valve (B)



BORING HEAD COOLING PUMP CONTROL

When boring head functions are used, the oil flows through the heat exchanger to cool the oil.

When the boring head functions are not being utilized, the boring head oil is not flowing through the heat exchanger causing the oil to heat. Therefore, during periods such as setting a new pipe or other down time, it is recommended to operate the boring head pump to run the oil through the cooling circuit to keep the oil cool.

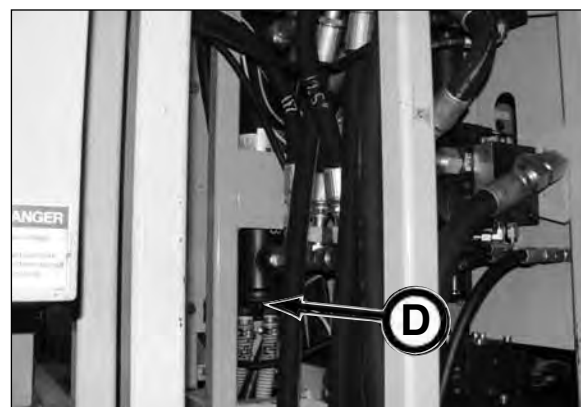
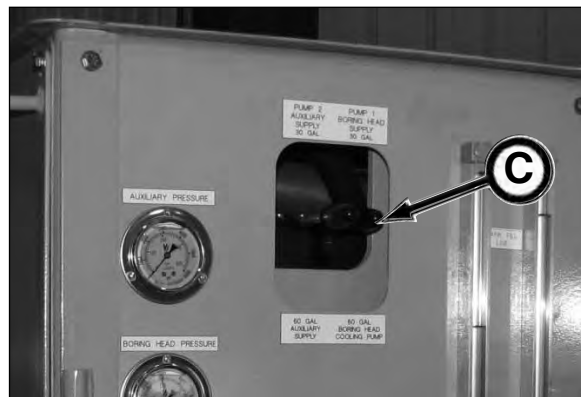
Move the boring head cooling pump lever (C) DOWN to operate the boring head pump to run the boring head oil through the boring head heat exchanger (D). Move the lever to the off or neutral position to stop the manual operation of the pump. The boring head motor must be ON for the pump to function.

⚠ WARNING If supply lines are opened while pressurized, oil can penetrate your skin causing serious injury.

ALL boring head and auxiliary controls (except the boring head cooling pump control) MUST be in the OFF or neutral position during a new pipe set or other non-mining operations.

The hydraulic oil temperature should not exceed 125°F (52°C).

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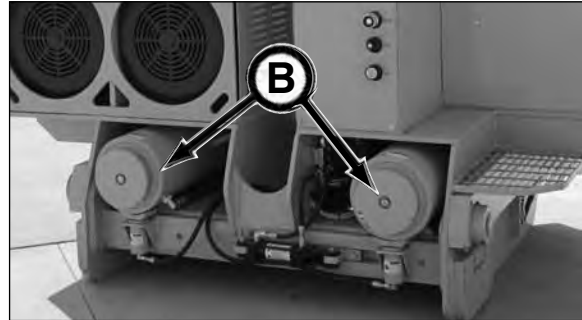
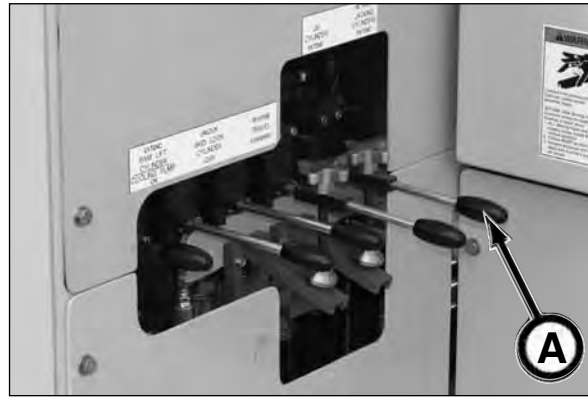


JACKING CYLINDER CONTROL

Use the Jacking Cylinder control (A) to regulate the main dual ram cylinders (B).

Move the jacking cylinder control lever to extend and retract the main ram cylinders as follows:

- UP - retract main ram cylinders
- DOWN - extend main ram cylinders



An adjustable speed control is equipped for ease of maintaining jacking speed at a desired rate.

To set control:

1. Pull out outer brace so inner brace moves onto mount.



2. Use hand wheel to adjust stop for the desired jacking cylinder speed rate when control lever is fully depressed.



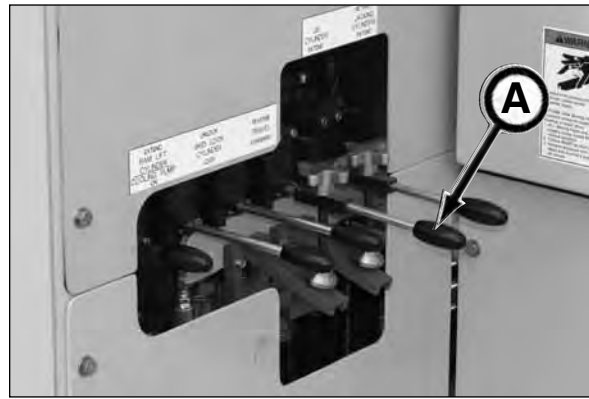
3. You will now be able to depress the control lever to the control mount and achieve the same cylinder extension rate. Readjust as necessary.



IJS CYLINDER CONTROL

Use the IJS Cylinder control (A) to regulate the intermediate jacking station cylinders (B).

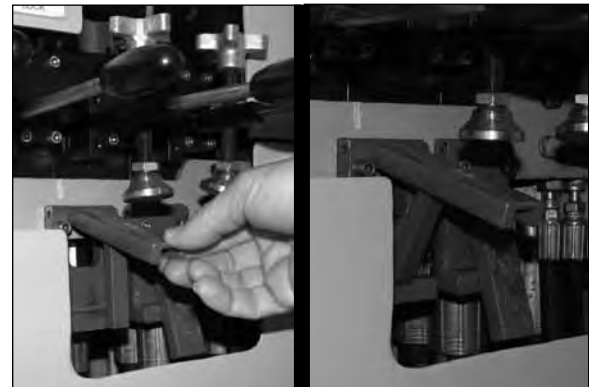
Move the jacking cylinder control lever DOWN to extend the main ram cylinders.



An adjustable speed control is equipped for ease of maintaining jacking speed at a desired rate.

To set control:

1. Pull out outer brace so inner brace moves onto mount.



2. Use hand wheel to adjust stop for the desired jacking cylinder speed rate when control lever is fully depressed.



3. You will now be able to depress the control lever to the control mount and achieve the same cylinder extension rate. Readjust as necessary.



RAM LIFT CYLINDER CONTROL

⚠ WARNING PINCH POINTS! Watch your fingers, hands and legs while equipment is in operation.



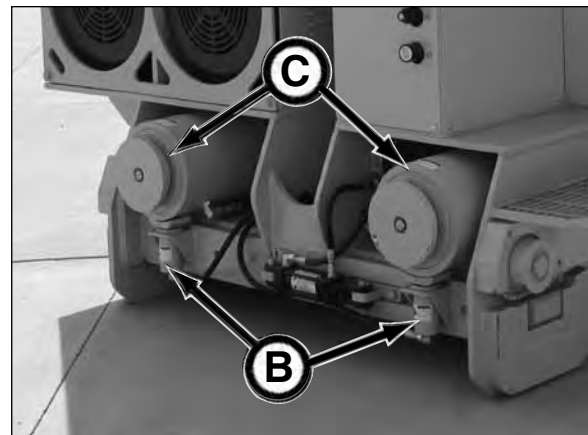
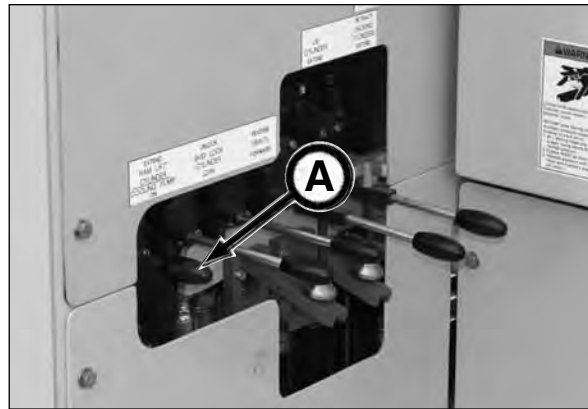
The ram lift cylinder control (A) regulates the two ram lift cylinders (B) to align the pump unit main ram cylinders (C) to the yoke ram cradles (D).

Move control as follows:

UP - Raises main ram cylinders

NOTICE To hold the cylinders in the raised position, move the control to the UP detent position.

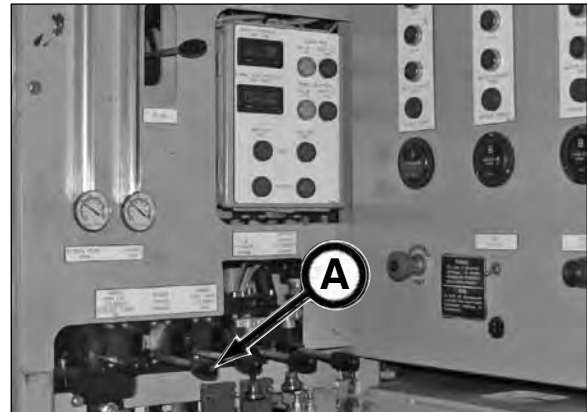
To lower cylinders, SLOWLY move control from detent to neutral position. Releasing control lever will lower cylinders.



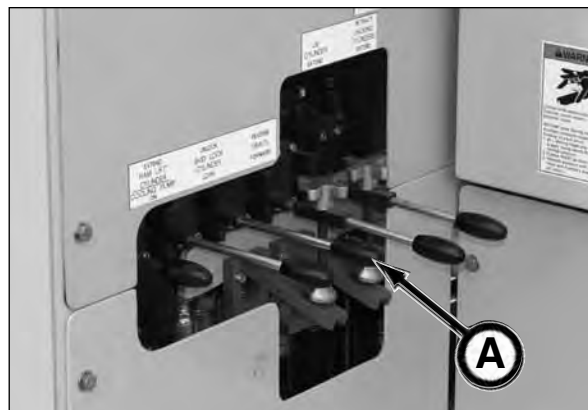
TRAVEL CONTROL

The travel control (A) regulates the pump unit drive movement on the skid assembly. Move travel control as follows:

- UP - Reverse movement
- DOWN - Forward movement



5000 Series II Pump Unit SN F20400F-01



5000 Series II Pump Unit SN F20400F-02 & After



SKID LOCK CONTROL (SN F20400F-01)

The skid lock control (A) extends and retracts the cylinder to lock or unlock the pump unit skid lock blocks (B) with the skid pockets (C).

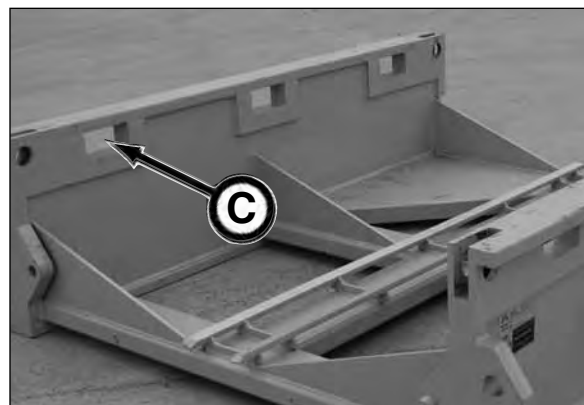
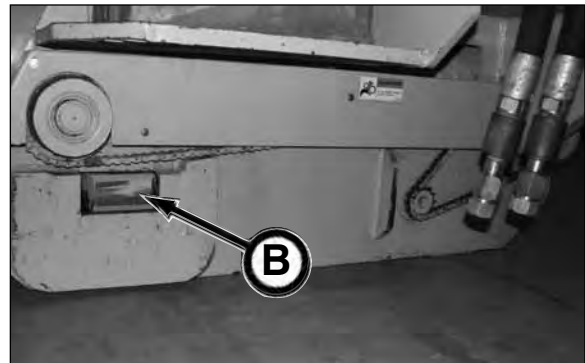
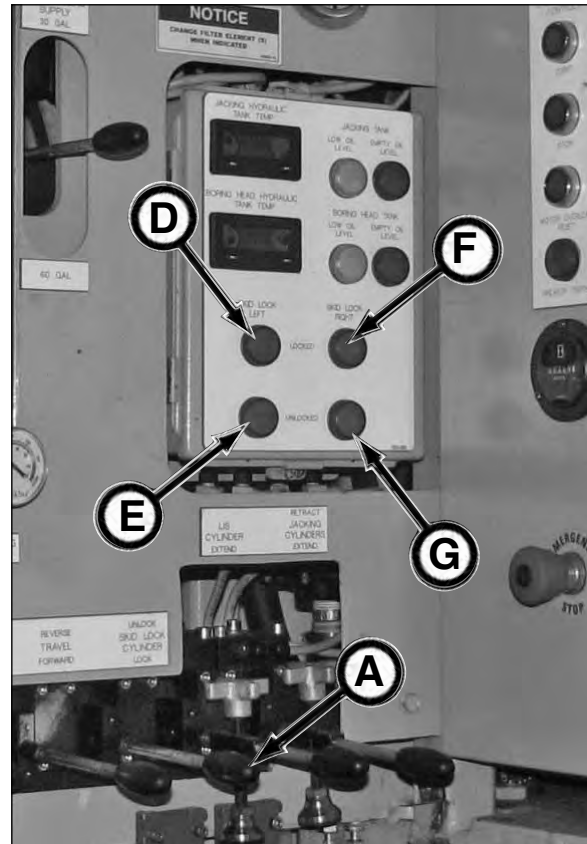
Move skid lock control lever to extend or retract the skid lock blocks to lock or unlock with the skid pockets as follows:

- UP - retract (unlock) blocks
- DOWN - extend (lock) blocks

The lock indicators illuminate once the lock blocks are completely in place:

- Left Skid Lock Cylinder
 - Lock (Extend) Light (D)
 - Unlock (Retract) Light (E)

- Right Skid Lock Cylinder
 - Lock (Extend) Light (F)
 - Unlock (Retract) Light (G)

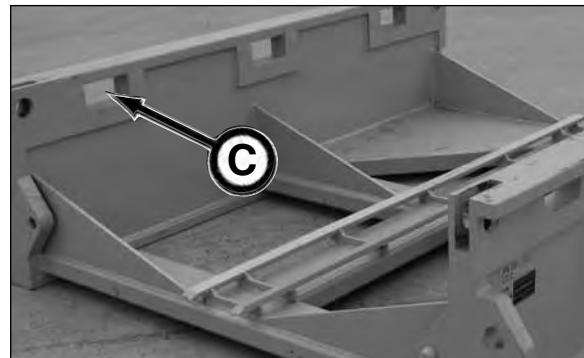
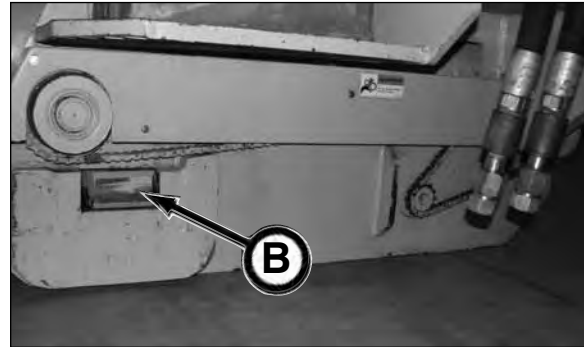
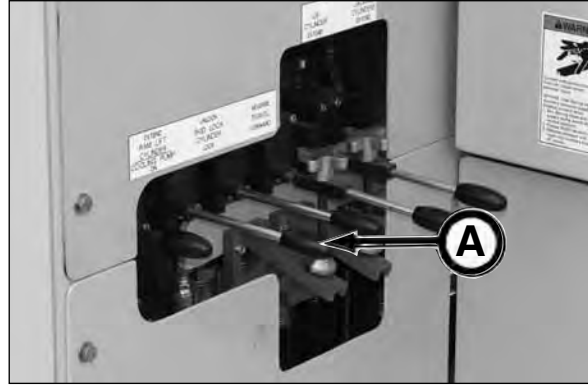


SKID LOCK CONTROL (SN F20400F-02 & AFTER)

The skid lock control (A) extends and retracts the cylinder to lock or unlock the pump unit skid lock blocks (B) with the skid pockets (C).

Move skid lock control lever to extend or retract the skid lock blocks to lock or unlock with the skid pockets as follows:

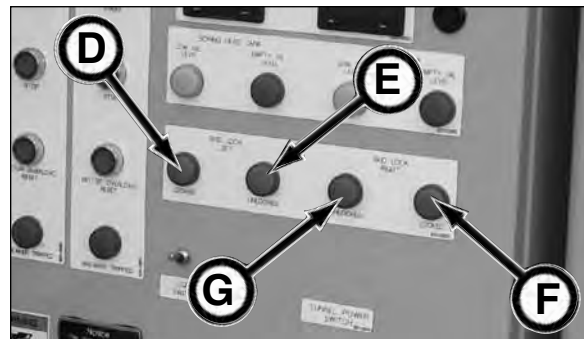
- UP - retract (unlock) blocks
- DOWN - extend (lock) blocks



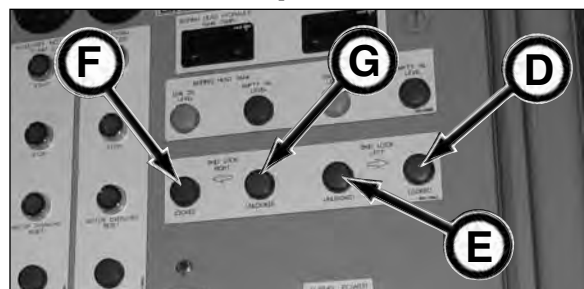
The lock indicators illuminate once the lock blocks are completely in place:

- Left Skid Lock Cylinder
 - Lock (Extend) Light (D)
 - Unlock (Retract) Light (E)

- Right Skid Lock Cylinder
 - Lock (Extend) Light (F)
 - Unlock (Retract) Light (G)



5000 Series II Pump Unit SN F20400F-02



5000 Series II Pump Unit SN F20400F-03 & After

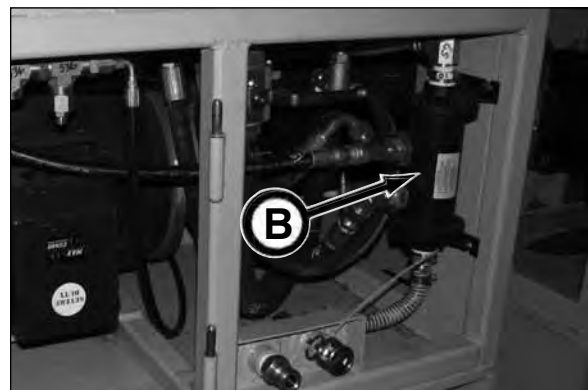
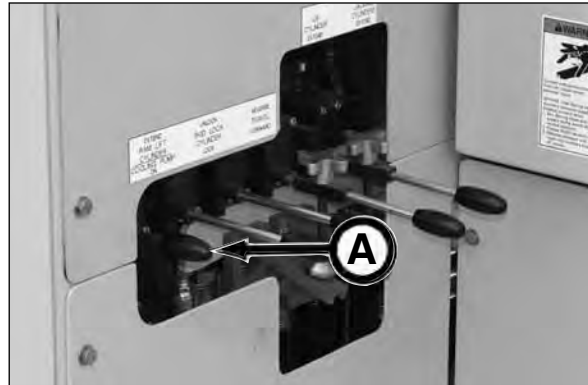
JACKING SYSTEM COOLING PUMP CONTROL

When jacking functions (main ram cylinders, IJS, pump unit travel, ram lift cylinder, skid locks) are used, the oil flows through the heat exchanger to cool the oil.

When the jacking functions are not being utilized, the jacking system oil is not flowing through the heat exchanger causing the oil to heat. Therefore, during periods such as setting a new pipe or other down time, it is recommended to operate the jacking system pump to run the oil through the cooling circuit to keep the oil cool.

Move the jacking system cooling pump lever (A) DOWN to operate the jacking system pump to run the jacking oil through the jacking heat exchanger (B). Release the lever to stop the manual operation of the pump. The jacking motor must be ON for the pump to function.

The hydraulic oil temperature should not exceed 125°F (52°C).



FILTER INDICATOR GAUGES

To prevent under or over servicing of the hydraulic filter elements, filter gauges and indicators are installed on the 5000 Series II Pump Unit. Always check gauges when the oil is at normal operating temperature and the system is at normal operating flow.

BORING HEAD PRIMARY RETURN FILTER GAUGE (A) for primary return filter (B).

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

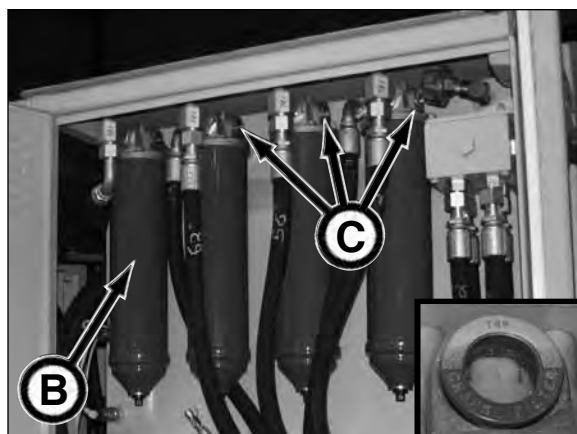
The yellow zone indicates that the filters will require replacement shortly.

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



BORING HEAD SECONDARY RETURN FILTER GAUGES (C)

As the pressure drop increases across the filter element, the white bar in the visual window will start to lower. When the bar is at the red CHANGE FILTER marking (see inset), the oil will start to bypass indicating the filter must be replaced.



JACKING TANK FILL FILTER GAUGE (D)

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

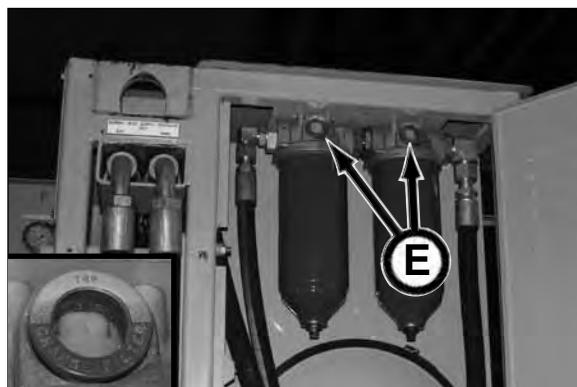
The yellow zone indicates that the filters will require replacement shortly.

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



JACKING SYSTEM RETURN FILTER GAUGES (E)

As the pressure drop increases across the filter element, the white bar in the visual window will start to lower. When the bar is at the red CHANGE FILTER marking (see inset), the oil will start to bypass indicating the filter must be replaced.



BORING HEAD HYDRAULIC RESERVOIR (SN F20400F-01)

The boring head hydraulic reservoir (A) includes a remote oil level sight gauge (B). The reservoir capacity is 160 gal. (606 L).

The pump unit is also equipped with a digital temperature display (C) along with low oil level (D) and empty oil level (E) indicators.

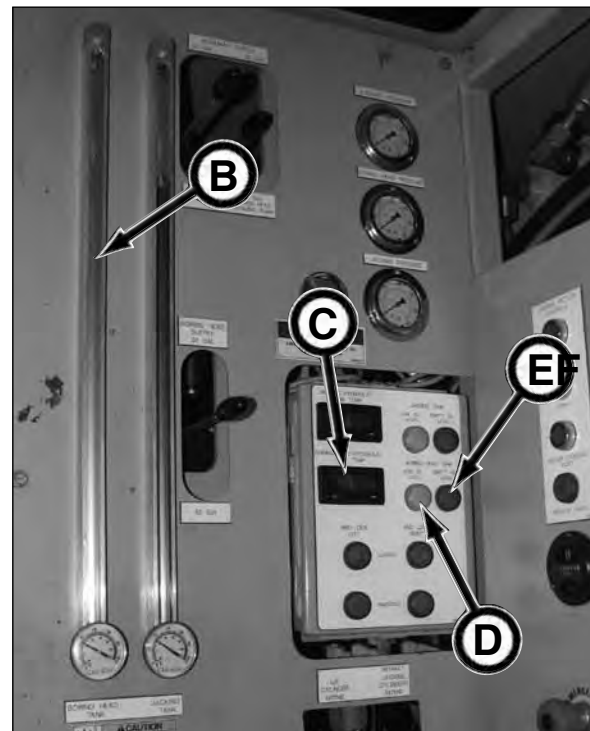
If the oil level in the reservoir reaches the low oil level sensor, the low oil level indicator (D) will illuminate providing the operator a visual warning that the reservoir must be refilled. The light will continue to illuminate until the oil level in the reservoir is above the low oil level sensor.

If the oil level in the reservoir reaches the empty oil level sensor, both the low level indicator (D) and the empty oil level indicator (E) will illuminate providing the operator a visual warning that the reservoir must be refilled.

IMPORTANT: When oil reaches the empty oil level sensor, the electrical and hydraulic systems MUST BE SHUTDOWN to prevent damage to components. Refill reservoir immediately.

The hydraulic oil temperature should not exceed 125°F (52°C).

NOTICE If needed, activate the boring head cooling pump (heat exchanger) to cool reservoir oil during non-mining operation (refer to Boring Head & Auxiliary Supply Controls in this section).



To fill boring head system reservoir, refer to Filling Hydraulic Reservoirs in Section 6, Operation.

BORING HEAD HYDRAULIC RESERVOIR - SN F20400F-02 & AFTER

The boring head hydraulic reservoir (A) includes a remote oil level sight gauge (B). The reservoir capacity is 160 gal. (606 L).

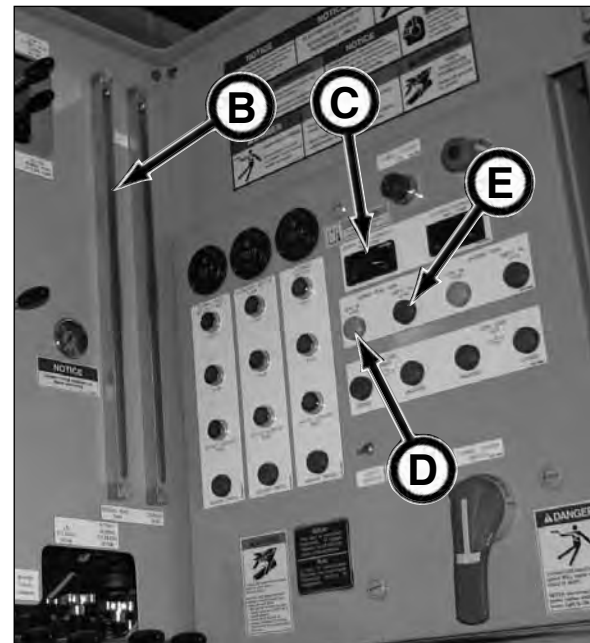
The pump unit is also equipped with a digital temperature display (C) along with low oil level (D) and empty oil level (E) indicators.

If the oil level in the reservoir reaches the low oil level sensor, the low oil level indicator (D) will illuminate providing the operator a visual warning that the reservoir must be refilled. The light will continue to illuminate until the oil level in the reservoir is above the low oil level sensor.

If the oil level in the reservoir reaches the empty oil level sensor, both the low level indicator (D) and the empty oil level indicator (E) will illuminate providing the operator a visual warning that the reservoir must be refilled. Also, when the oil reaches the empty oil level sensor, the electrical and hydraulic systems automatically shutdown to prevent damage to components. Refill reservoir immediately.

The hydraulic oil temperature should not exceed 125°F (52°C).

NOTICE If needed, activate the boring head cooling pump (heat exchanger) to cool reservoir oil during non-mining operation (refer to Boring Head & Auxiliary Supply Controls in this section).



To fill boring head system reservoir, refer to Filling Hydraulic Reservoirs in Section 6, Operation.

JACKING SYSTEM HYDRAULIC RESERVOIR (SN F20400F-01)

The jacking system hydraulic reservoir (A) includes a remote oil level sight gauge (B). The reservoir capacity is 100 gal. (379 L).

The pump unit is also equipped with a digital temperature display (C) along with low oil level (D) and empty oil level (E) indicators.

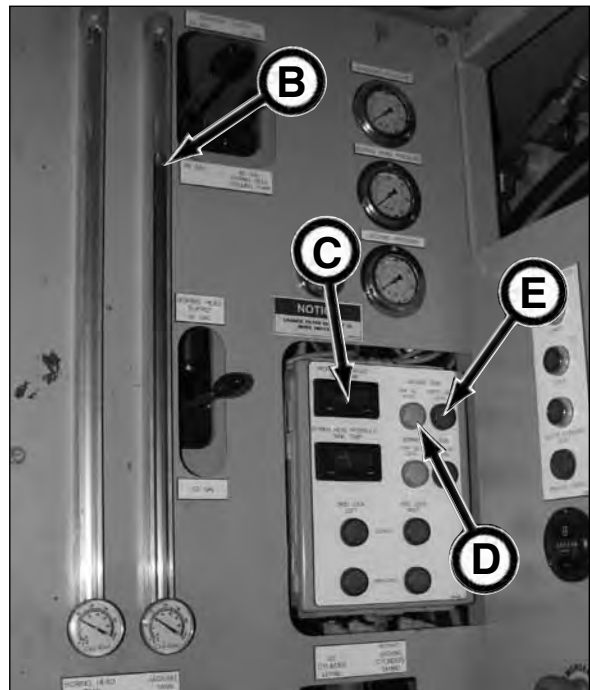
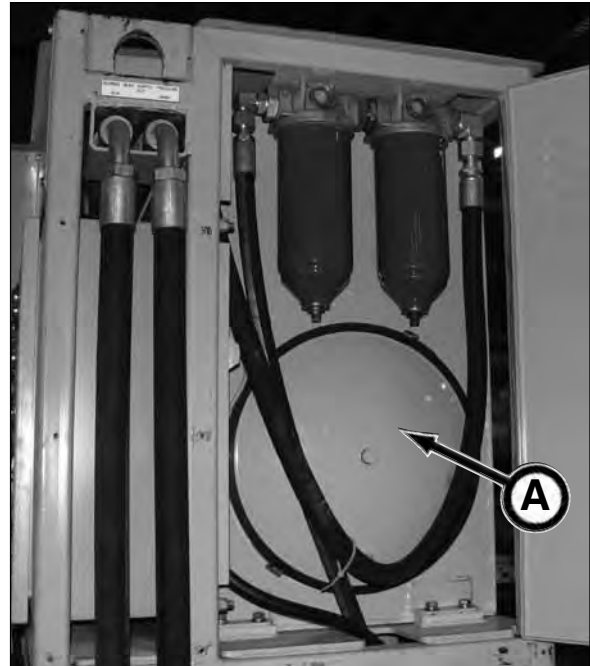
If the oil level in the reservoir reaches the low oil level sensor, the low oil level indicator (D) will illuminate providing the operator a visual warning that the reservoir must be refilled. The light will continue to illuminate until the oil level in the reservoir is above the low oil level sensor.

If the oil level in the reservoir reaches the empty oil level sensor, both the low level indicator (D) and the empty oil level indicator (E) will illuminate providing the operator a visual warning that the reservoir must be refilled.

IMPORTANT: When the oil reaches the empty oil level sensor, the electrical and hydraulic systems MUST BE SHUTDOWN to prevent damage to components. Refill reservoir immediately.

The hydraulic oil temperature should not exceed 125°F (52°C).

To fill jacking system reservoir, refer to Filling Hydraulic Reservoirs in Section 6, Operation.



JACKING SYSTEM HYDRAULIC RESERVOIR - SN F20400F-02 & AFTER

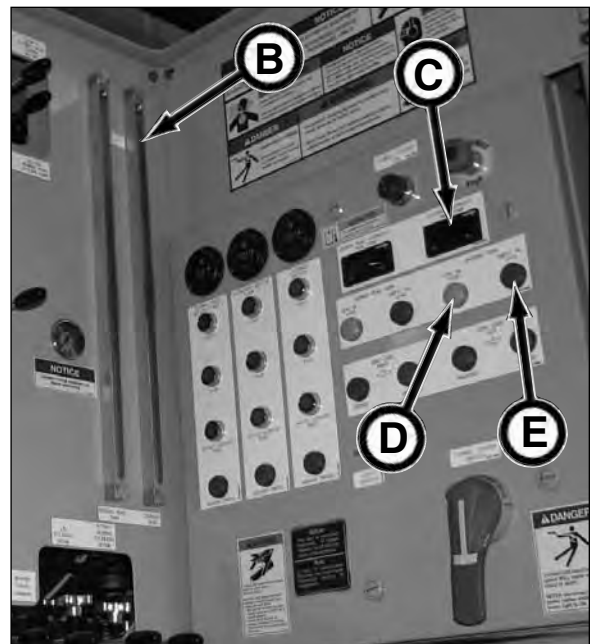
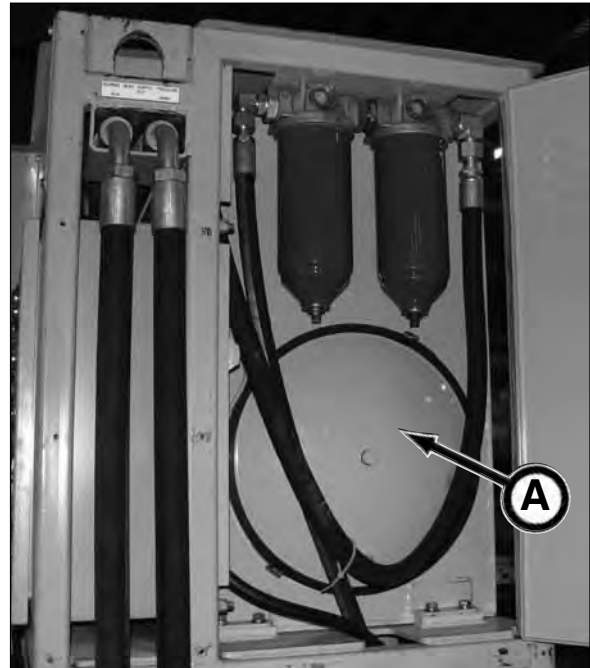
The jacking system hydraulic reservoir (A) includes a remote oil level sight gauge (B). The reservoir capacity is 100 gal. (379 L).

The pump unit is also equipped with a digital temperature display (C) along with low oil level (D) and empty oil level (E) indicators.

If the oil level in the reservoir reaches the low oil level sensor, the low oil level indicator (D) will illuminate providing the operator a visual warning that the reservoir must be refilled. The light will continue to illuminate until the oil level in the reservoir is above the low oil level sensor.

If the oil level in the reservoir reaches the empty oil level sensor, both the low level indicator (D) and the empty oil level indicator (E) will illuminate providing the operator a visual warning that the reservoir must be refilled. Also, when the oil reaches the empty oil level sensor, the electrical and hydraulic systems automatically shutdown to prevent damage to components. Refill reservoir immediately.

The hydraulic oil temperature should not exceed 125°F (52°C).



To fill jacking system reservoir, refer to Filling Hydraulic Reservoirs in Section 6, Operation.

NOTES

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. Make a copy this pre-start inspection checklist. Once it is complete, check off, initial and date each item and file the copy as a record of maintenance.

	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 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 air monitoring and ventilation detectors for proper operation.
	10. Test E-Stop (Emergency Stop) buttons for proper operation at the start of each shift.
	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 skid lock blocks are locked into skid.
	14. Check for proper motor rotation on all three electric motors.
	15. Check for loose or missing hardware. Replace damaged or missing hardware.
	16. Check for worn, loose, or damaged wire and 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 during 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.
	26. Be sure all suction valves are open and secured to prevent accidental closure.
	27. BEFORE removing pump unit supply hose caps, release pressure in supply hoses with bleed off valves.
	28. BEFORE starting, ALL controls must be in the OFF or neutral position.

NOTES

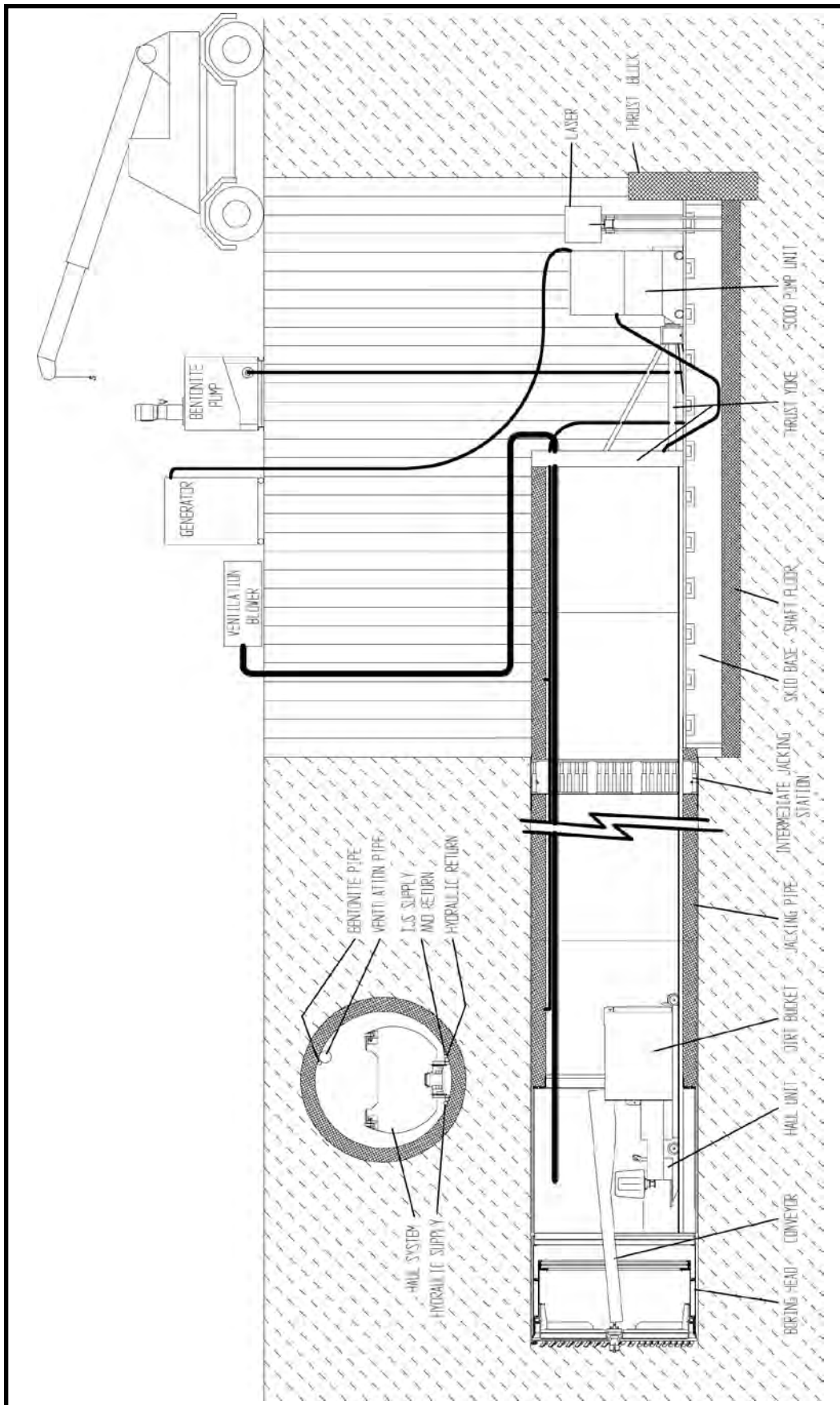
Operation

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 Aftermarket 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 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 shafts.
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. Be sure to check all Emergency Stop buttons for proper operation.
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 becomes lost, contact your Akkerman Aftermarket Support Representative for a new manual or download this manual from 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. They must be in place and undamaged.
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 in lock out/tag out.
25. Before startup, be sure controls are in the OFF or neutral position.
26. Prior to each drive, using bleed off valves, release hydraulic pressure from the Boring Head and Auxiliary hydraulic systems before connecting supply hoses to pump unit.
27. NEVER disconnect tunnel power cables when tunnel power light is ON.

TYPICAL 5000 PIPE JACKING SYSTEM LAYOUT

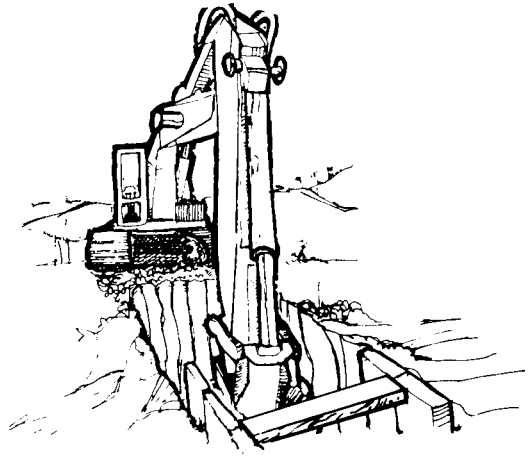


SETTING UP THE JACKING SYSTEM

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, shaft layout design, and survey are complete, excavate the launch and reception shafts. Be sure the shafts will be well drained and use proper shoring or bracing in accordance with your local, state, and federal regulations.

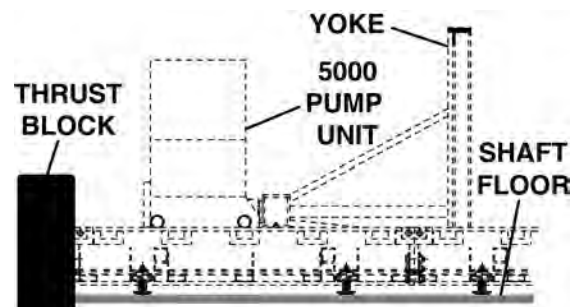


AEM is the original author and publisher of the above illustration

3. Construct a shaft floor with a solid base suitable for the weight of the jacking system and pipe. Typically a shaft uses 6 to 8 inches of stone for a dry pit or a 6 inch or more concrete base for a moist shaft. Consult your civil and structural engineers for your shaft floor requirements.
4. If using stone for the shaft 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 thrust 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.

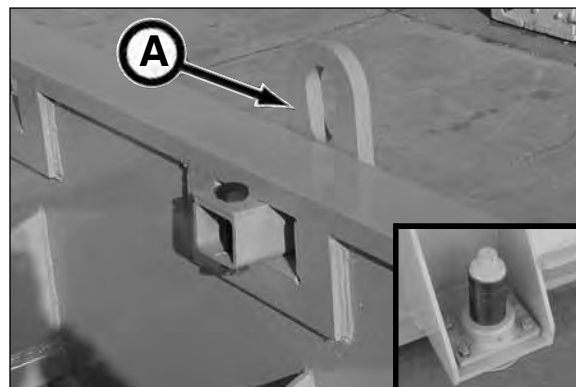


⚠ WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

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.

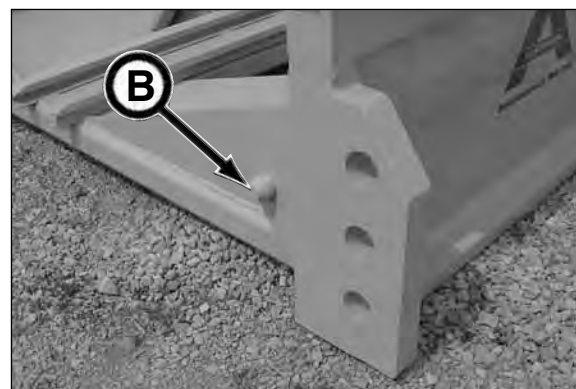


6. Lower skid assembly into launch shaft using lift eye assemblies (A) and place against the thrust block. Correct the skid assembly line and grade with leveling screws (see inset). Be sure there is at least 6 inches between the front of skid rails and where the launch seal will be located.



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

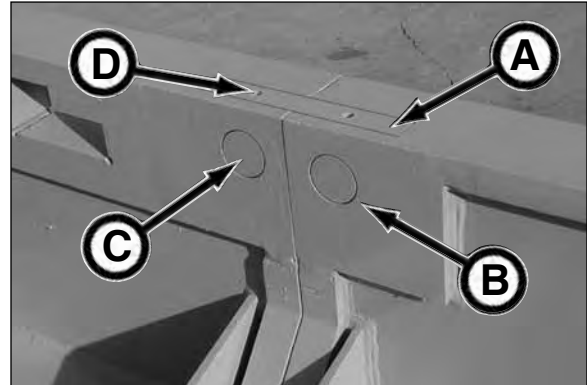
A. Align the skid sections using the locator pin (B).



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.

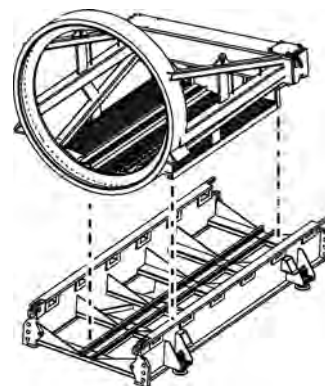
NOTICE Both the left and right ends of the skid frame **MUST** be against thrust block, otherwise damage will occur to the skid frame during jacking operation.



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.

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



- 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.



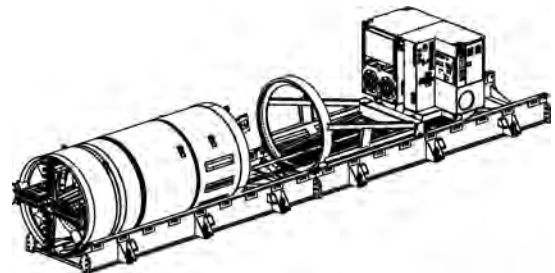
- Lower the stand for the laser guidance system as close to the rear of the jacking shaft as possible without contacting skid assembly or pump unit. Be sure the guidance system will not be affected by thrust applied to jacking system.



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



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



PREPARING PUMP UNIT FOR OPERATION

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

NOTICE Any time the power cables are removed from either the generator or pump unit, this start-up check must be performed to assure proper operation of pump unit.

1. Turn OFF your external power source and perform the Lockout/Tagout procedure.
2. Test to ensure no voltage is present.
3. Hook up power cables to external power source.

NOTICE Power Supply Requirements: 400A 480V 3 Phase with lugs capable of 4/0 conductors.

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

5. Hook up power cables from external power source to cam lock connections on pump unit.

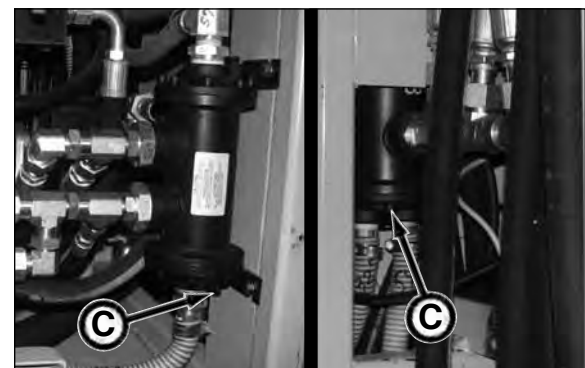
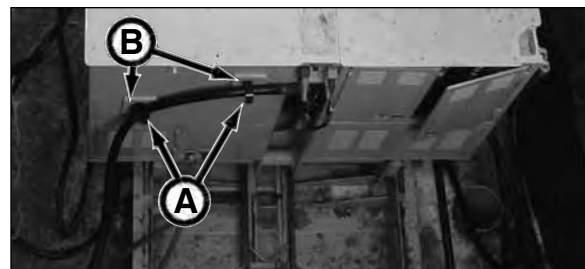
6. Fasten power cord (using cable clamps (A) secured to clamp holders (B) on pump unit) so it does not come in contact with any moving parts.

7. Be sure heat exchanger drain plug (C) is installed in both boring head and jacking system heat exchangers.



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Jacking System
Heat Exchanger Drain

Boring Head System
Heat Exchanger Drain

- Connect a clean water supply hose (1" cam lock) with 20 GPM minimum to heat exchanger supply fitting (A). Be sure hose does not come in contact with moving parts.

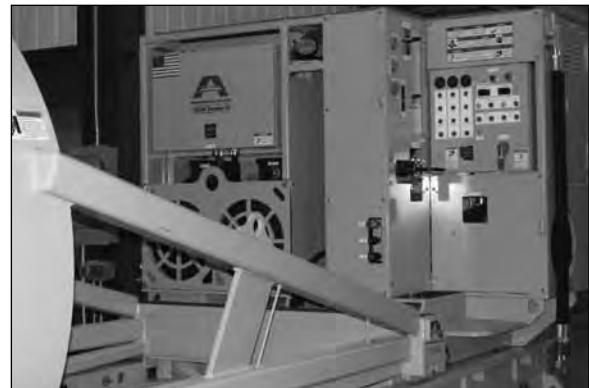
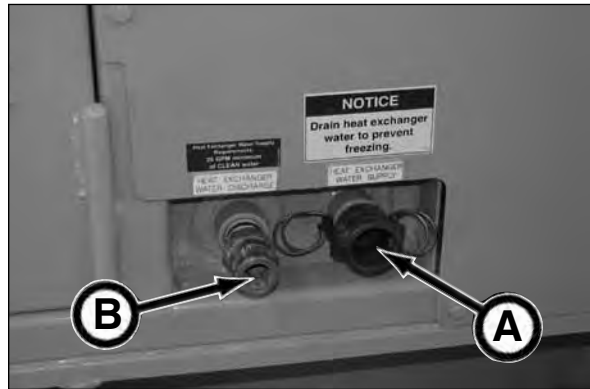
NOTICE If pumping 80+°F water, flow should be around 25 GPM.

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

- Connect a discharge hose (1" cam lock) to heat exchanger discharge fitting (B). Be sure hose does not come in contact with moving parts.

NOTICE Be sure to drain heat exchangers (boring head and jacking heat exchangers) 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.

- Move all pump unit controls to OFF or neutral position. Be sure E-Stop button is pushed in to prevent any accidental start up.
- Turn on external power source.



SN F20400F-02 & After Shown

- Check red Phase Error light (C). If light is illuminated, this indicates that the external power source phase power is installed incorrectly. Shut down external power source and lock out/tag out ALL power before attempting to reverse the two generator power leads. If power leads require adjustment, ONLY a certified electrician can perform this electrical service.



SN F20400F-01 Shown

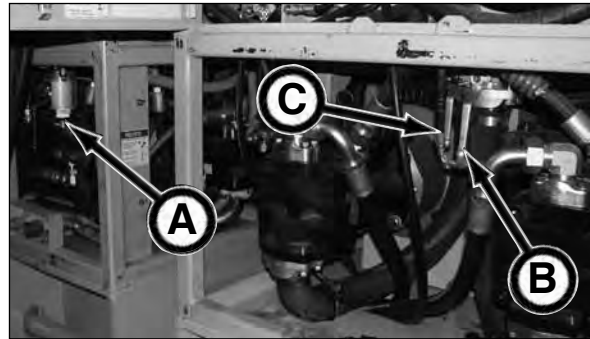
- (If needed) Once power leads are reversed, recheck phase by turning on external power source. Once phase is correct proceed to step 14.

IMPORTANT: DO NOT start up electric motors if red Phase Error light (C) is illuminated. Doing so will run motors backwards causing component damage.



SN F20400F-02 & After Shown

14. Check to be sure ALL hydraulic pump supply shut off valves (jacking [A], boring head [B] and auxiliary [C]) are open. Also with the valves open, be sure the jacking shut off valve is tie strapped to valve and the boring head and auxiliary shut off valve pins are locked open to prevent accidental closure during operation.



15. Pull out E-Stop button.

NOTICE All E-Stop buttons must be pulled out for pump unit to operate.



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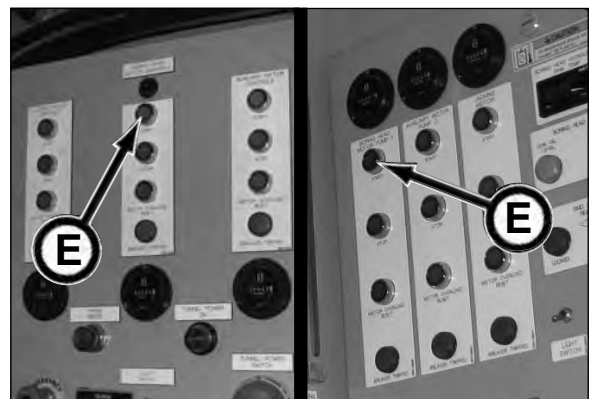
SN F20400F-02 & After

16. Turn pump unit main power switch (D) to ON position.



TESTING BORING HEAD ELECTRIC MOTOR ROTATION

17. Depress Boring Head Motor START button (E).

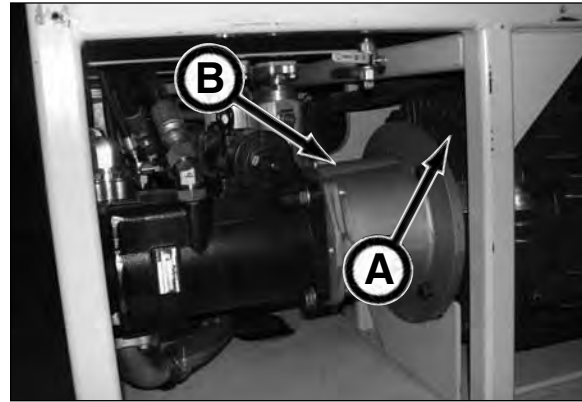


SN F20400F-01

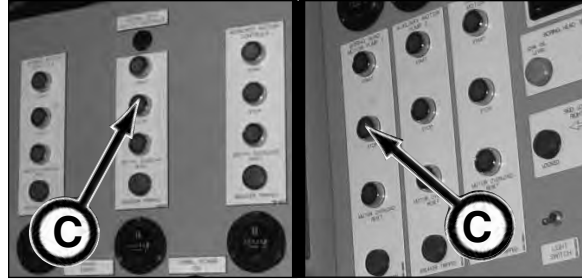
SN F20400F-02 & After*

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).

18. Check the 100 HP boring head motor (A) for proper rotation. A rotation arrow is located on the motor base. Loosen inspection cover (B) and move cover to check motor rotation. Once checked, replace and retighten cover. Then depress Boring Head Motor STOP button (C) to stop motor rotation.



If rotation is incorrect, have your certified electrician perform the following procedure. Push E-Stop button IN and turn main power switch to OFF, and lock out/tag out the main power source. Test to ensure no voltage is present, then rewire for proper motor rotation. Then turn on main power source, pull E-Stop button OUT and turn main power switch to ON position. Repeat steps 17 and 18 to recheck for proper motor rotation.

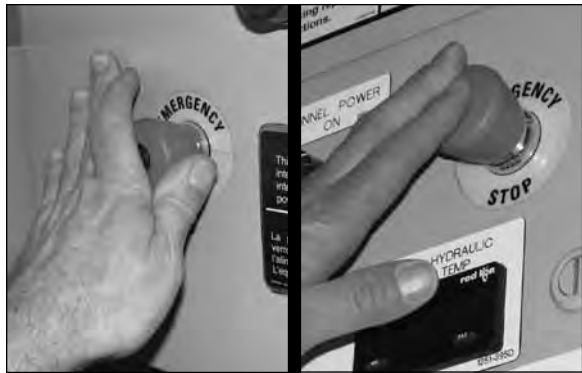


SN F20400F-01

SN F20400F-02 & After*

NOTICE Improper motor rotation WILL damage hydraulic components.

19. With the 100 HP boring head motor running, push E-Stop IN to stop the motor. This will check to be sure the E-Stop button is functioning properly. If the motor does not stop, lockout/tagout the main power source and have an electrician repair the E-Stop **IMMEDIATELY!** Check the remote E-Stop for proper operation.

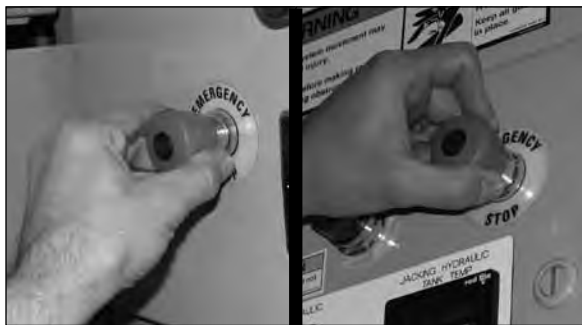


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20. If E-Stop is functioning properly, pull E-Stop button OUT.

NOTICE All E-Stop buttons must be pulled out for pump unit to operate.



SN F20400F-01

SN F20400F-02 & After

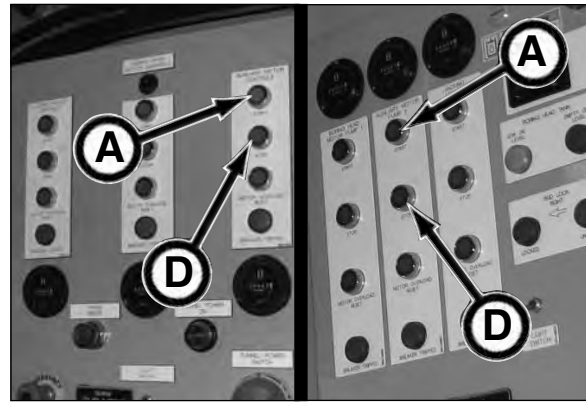
21. Turn pump unit main power switch (D) to ON position.

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



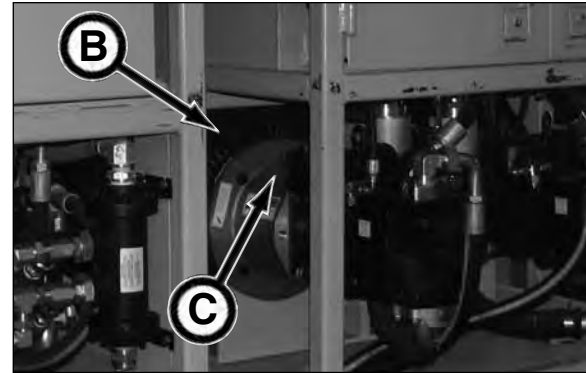
TESTING AUXILIARY ELECTRIC MOTOR ROTATION

22. Depress Auxiliary Motor START button (A).



SN F20400F-01 SN F20400F-02 & After*

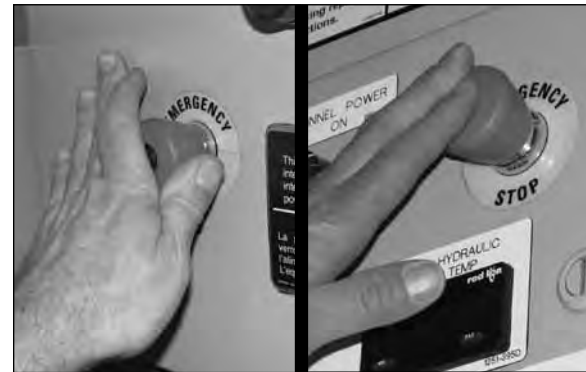
23. Check the 100 HP auxiliary motor (B) for proper rotation. A rotation arrow is located on the motor base. Loosen inspection cover (C) and move cover to check motor rotation. Once checked, replace and retighten cover. Then depress Auxiliary Motor STOP button (D) to stop motor rotation.



If rotation is incorrect, have your certified electrician perform the following procedure. Push E-Stop button IN and turn main power switch to OFF, and lock out/tag out the main power source. Test to ensure no voltage is present, then rewire for proper motor rotation. Then turn on main power source, pull E-Stop button OUT and turn main power switch to ON position. Repeat steps 22 and 23 to recheck for proper motor rotation.

NOTICE Improper motor rotation WILL damage hydraulic components.

24. With the 100 HP auxiliary motor running, push E-Stop button IN to stop the motor. This will check to be sure the E-Stop button is functioning properly. If the motor does not stop, lockout/tagout the main power source and have an electrician repair the E-Stop **IMMEDIATELY!** Check the remote E-Stop for proper operation.



SN F20400F-01 SN F20400F-02 & After

25. If E-Stop is functioning properly, pull E-Stop button OUT.

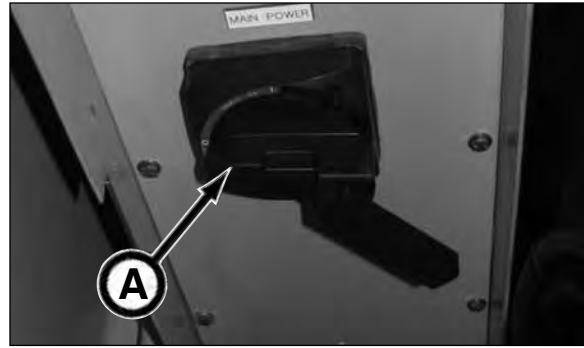
NOTICE All E-Stop buttons must be pulled out for pump unit to operate.



SN F20400F-01 SN F20400F-02 & After

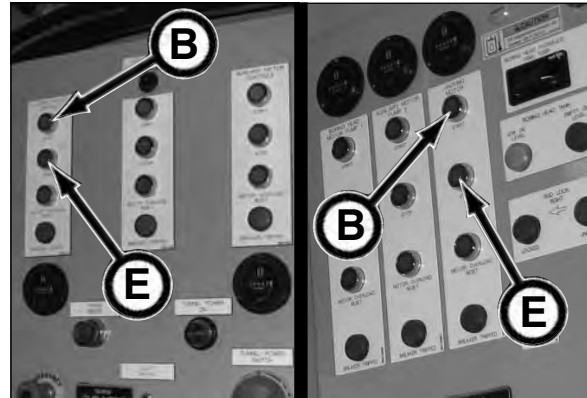
* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).

26. Turn pump unit main power switch (A) to ON position.



TESTING JACKING ELECTRIC MOTOR ROTATION

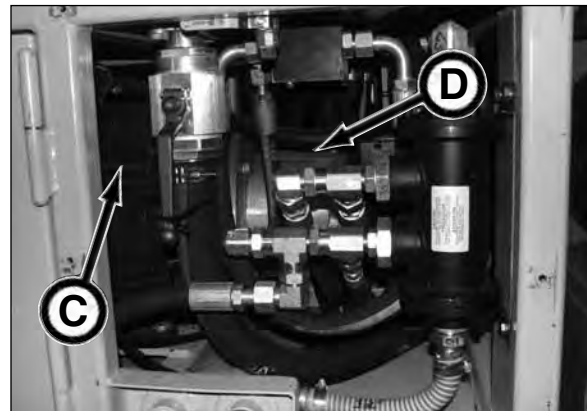
27. Depress Jacking Motor START button (B).
28. Check the 50 HP jacking motor (C) for proper rotation. A rotation arrow is located on the motor base. Loosen inspection cover (D) and move cover to check motor rotation. Once checked, replace and retighten cover. Then depress Jacking Motor STOP button (E) to stop motor rotation.



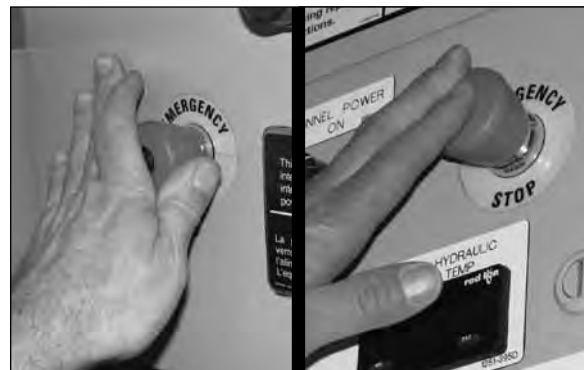
SN F20400F-01

SN F20400F-02 & After*

If rotation is incorrect, have your certified electrician perform the following procedure. Push E-Stop button IN and turn main power switch to OFF, and lock out/tag out the main power source. Test to ensure no voltage is present, then rewire for proper motor rotation. Then turn on main power source, pull out E-Stop button and turn main power switch to ON position. Repeat steps 27 and 28 to recheck for proper motor rotation.



29. With the 50 HP jacking motor running, push in E-Stop to stop the motor. This will check to be sure the E-Stop button is functioning properly. If the motor does not stop, lockout/tagout the main power source and have an electrician repair the E-Stop **IMMEDIATELY!** Check the remote E-Stop for proper operation.



SN F20400F-01

SN F20400F-02 & After

30. After Start-Up Check procedure is complete, proceed to Setting Up The Pump Unit & TBM Supply/Return Hydraulics in this section.

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).

SETTING UP THE PUMP UNIT & TBM SUPPLY/RETURN HYDRAULICS

There are two hydraulic supply/return options available for setting up the 5000 Series II 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 supply motor. 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.

⚠ 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. Before hooking up the supply hoses to the pump unit for the first time on each drive, refer to “BEFORE INITIAL SUPPLY HOSE HOOKUP ON EACH DRIVE” below:

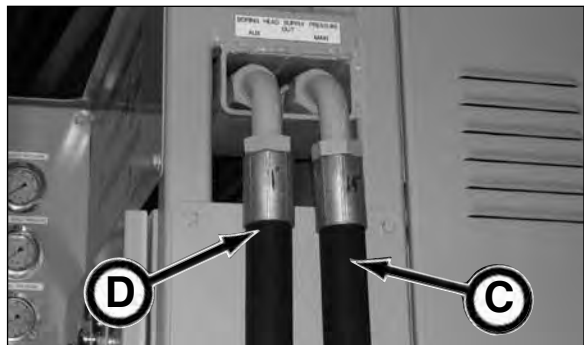
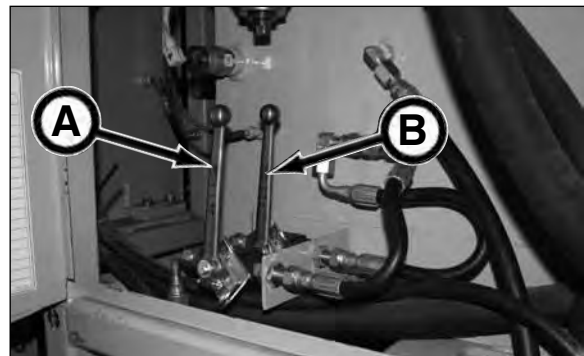
BEFORE INITIAL SUPPLY HOSE HOOKUP ON EACH DRIVE:

Move controls to the OFF or neutral position, release boring head and auxiliary supply hose pressure with boring head supply bleed off valve (A) and auxiliary supply bleed off valve (B), AND use gloves before connecting or disconnecting hydraulic oil hoses/lines.

IMPORTANT: If switching from single feed to dual feed during drive, the hydraulic pressure MUST be released BEFORE connecting/disconnecting hoses using the supply bleed off valves.

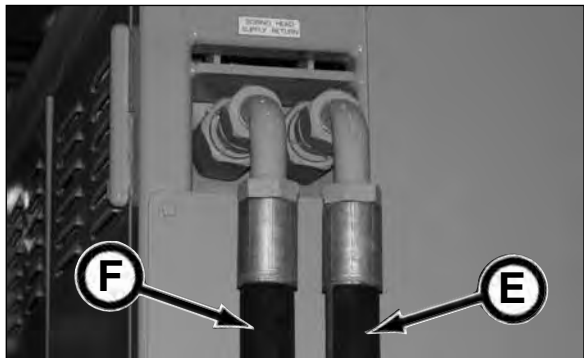
Single Feed (60 GPM Maximum)

1. Connect main supply quick coupler hose (C) to the TBM supply quick coupler hose. Cap auxiliary supply quick coupler hose (D) for single feed option.
2. Connect return line quick coupler hose (E) to the TBM return line quick coupler. Cap return line quick coupler hose (F).



Dual Feed (120 GPM Maximum)

1. Connect main supply quick coupler hose (C) to the TBM supply quick coupler hose.
2. Connect auxiliary supply quick coupler hose (D) to the TBM auxiliary supply quick coupler hose.
3. Connect return line quick coupler hoses (E and F) to the TBM return line quick coupler hoses.



OPERATING THE PUMP UNIT

There are several steps to safely operate the 5000 Series II 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 6-14 - 6-15
- B. Positioning Pump Unit/Yoke With TBM, pg 6-16
- C. Installing Conveyor & Dirt Bucket, pg 6-17
- D. Positioning TBM For Jacking Operation, pg 6-18
- E. Jacking Operation, pg 6-19 - 6-28

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 Aftermarket 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 properly connected to the Pump Unit with proper phase, move all controls to OFF or neutral position. Pull the E-Stop button OUT and turn the main power switch to ON position.

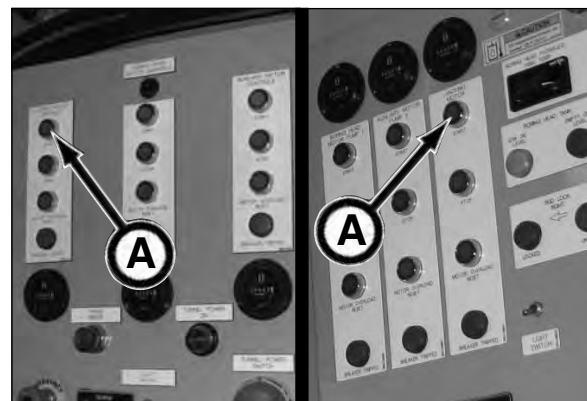


SN F20400F-01

SN F20400F-02 & After

2. Start Jacking Motor by depressing START button (A).

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



SN F20400F-01

SN F20400F-02 & After*

WARNING PINCH POINTS! Watch your fingers, hands, and legs while equipment is in operation.

3. Pull main ram jacking cylinder control DOWN to extend the main ram jacking cylinders until the rams move to the yoke ram cradles (A). Release lever.



Extending Main Ram Jacking Cylinders



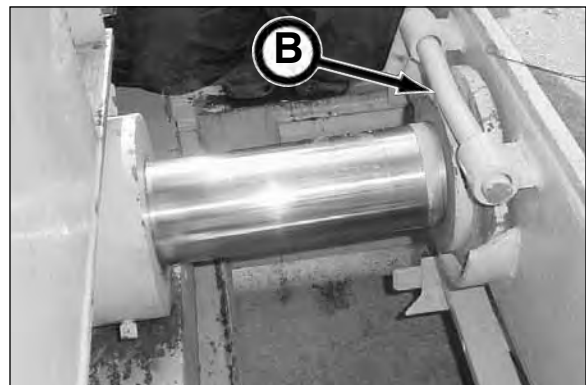
4. Use ram lift cylinder lever to position lift rams onto the yoke ram cradles. Move the main rams into position as needed for locking.



*Extending Ram Lift Cylinders
SN F20400F-01 Shown*

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

6. Release ram lift cylinder lever.



B. POSITIONING PUMP UNIT/YOKE WITH TBM

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

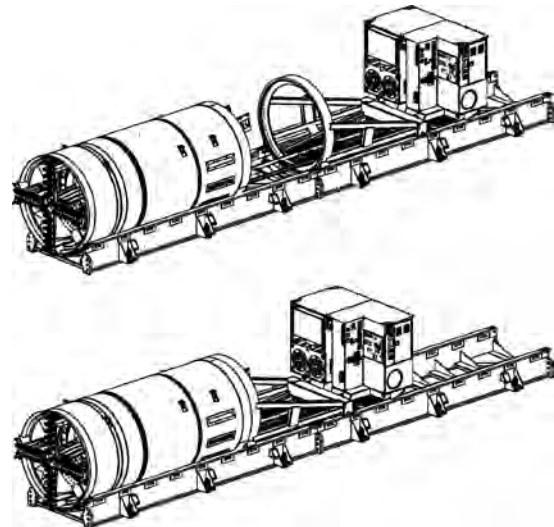
Do not allow riders on the Pump Unit or the Yoke when they are moving.



7. Move travel lever DOWN to propel the pump unit and yoke forward into position behind tunnel boring machine (TBM).

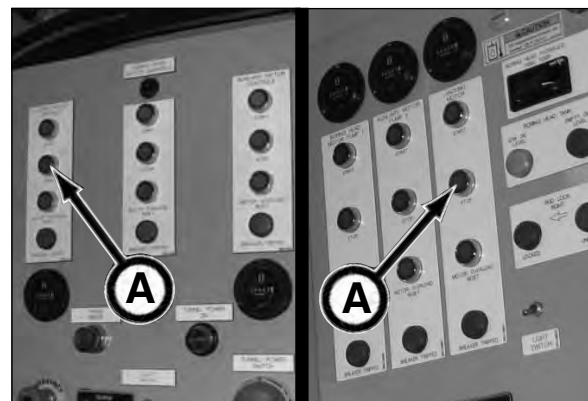


*Pump Unit Forward Travel Control
SN F20400F-02 & After Shown*



8. Stop Jacking Motor by depressing STOP button (A).

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



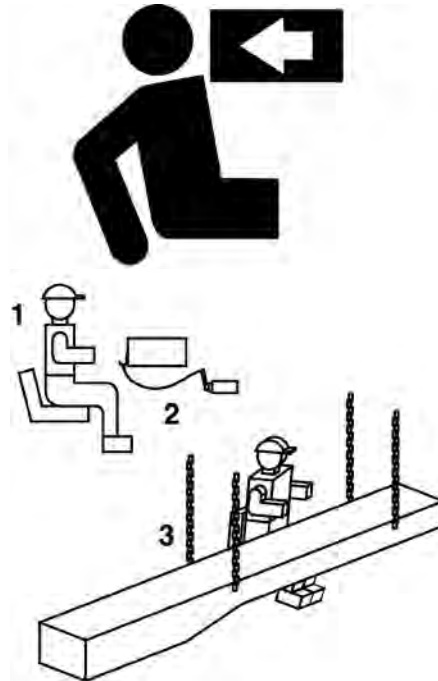
SN F20400F-01

*SN F20400F-02 & After**

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.



9. 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.



10. 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.

IMPORTANT: Prior to each drive, using bleed off valves, release hydraulic pressure from the Boring Head and Auxiliary hydraulic systems before connecting supply hoses to pump unit.

IMPORTANT: If switching from single feed to dual feed during drive, the hydraulic pressure **MUST** be released **BEFORE** connecting/disconnecting hoses using the supply bleed off valves.

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

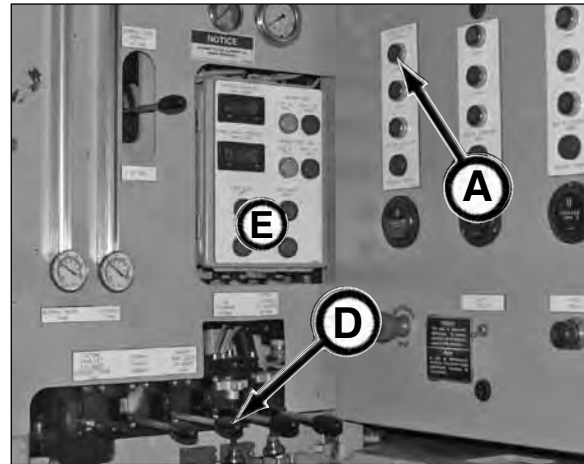
11. Lower dirt bucket into yoke behind conveyor.



D. POSITIONING TBM FOR JACKING OPERATION

12. Start the jacking motor by depressing the Jacking Motor START button (A).

SN F20400F-01



SN F20400F-02 & After*

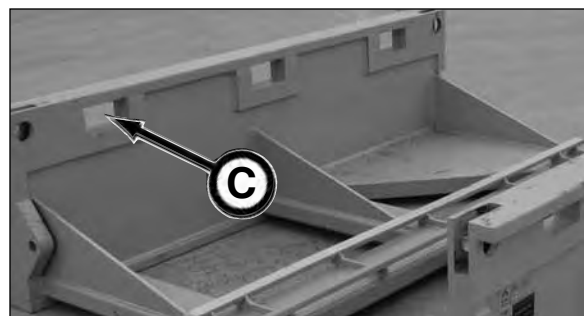
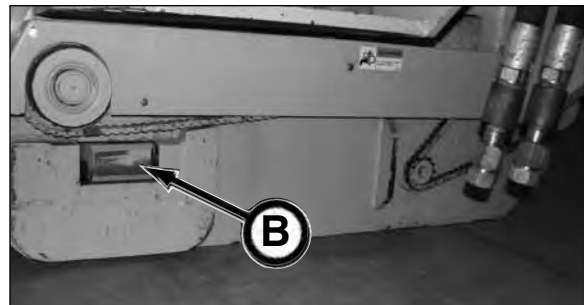
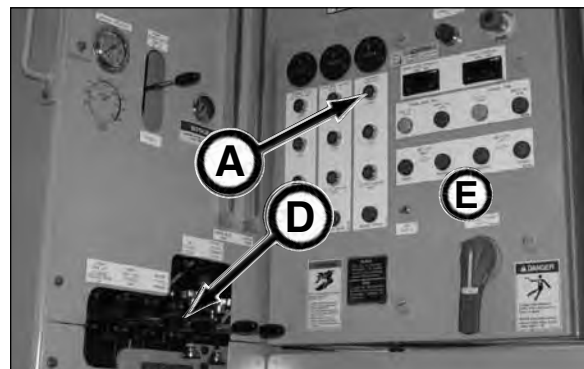
* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).

13. Lock skid lock blocks (B) into skid pockets (C) by operating the skid lock control (D). The skid lock blocks must be fully engaged into skid pockets before jacking.

NOTICE

It will be necessary to periodically reposition the skid lock blocks; at end of jacking ram cylinder stroke, or when unloading dirt bucket.

The lock position indicators (E) will illuminate once the lock blocks are completely in the lock or unlock position.



14. Pull Main Ram Jacking cylinder control DOWN 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

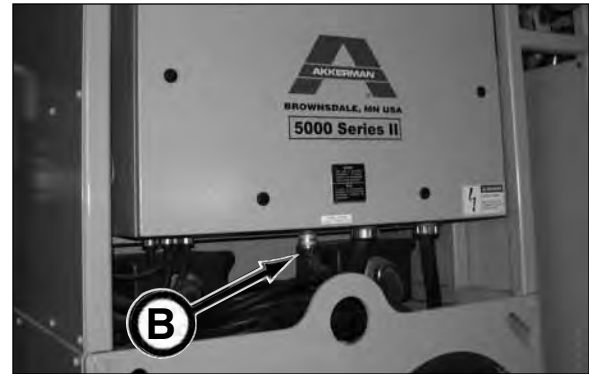
NOTICE

The TBM operator controls the boring head and conveyor. The Pump Unit operator controls the oil flow to the TBM components and the pump unit high pressure jacking cylinders. **The TBM and Pump Unit operators MUST be in constant communication to insure proper tunnel installation.** Before rotating the cutter head, make sure the cutter teeth will not interfere with skid frame.

15. Attach electrical connections to TBM. The non-Series II TBM connection (A) requires 110 VAC. The Series II TBM connection (B) requires a 400 Amp 480 VAC 3 Phase power supply.

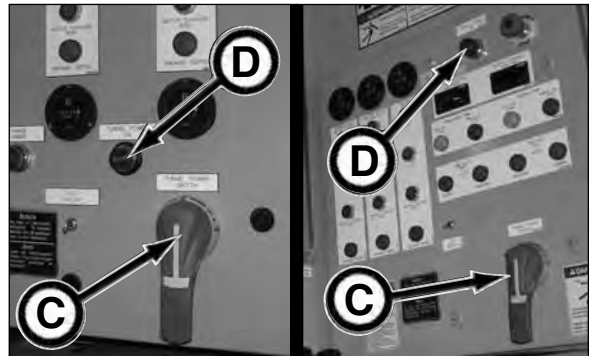


Non-Series II TBM Power Connection



Series II TBM Power Connection

16. (Series II TBMs Only) With the pump unit main power switch ON and all E-Stop buttons pulled out, flip Tunnel Power Switch (C) to the ON position. This will illuminate the Tunnel Power ON light (D) which provides the operator a quick visual indicator that power is ON in the tunnel and to take all necessary precautions with high voltage electricity.

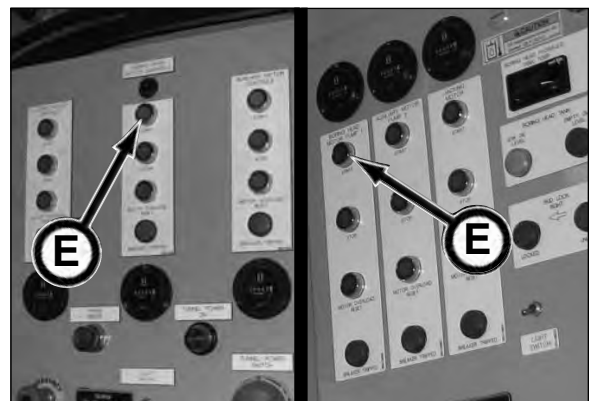


SN F20400F-01

SN F20400F-02 & After

17. Start the boring head motor by depressing the Boring Head Motor START button (E).

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).

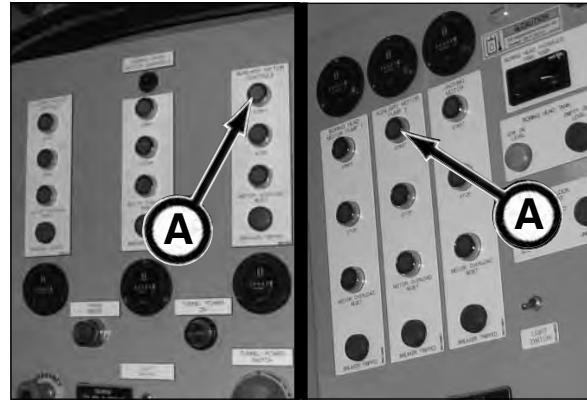


SN F20400F-01

SN F20400F-02 & After*

18. With the Jacking and Boring Head motors running, start the auxiliary motor (if needed for dual feed) by depressing the Auxiliary Motor START button (A).

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



SN F20400F-01

SN F20400F-02 & After*

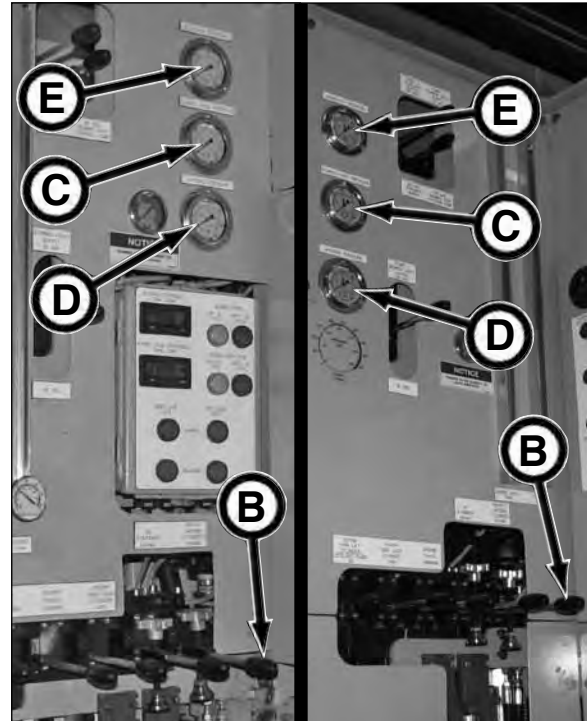
19. Start jacking by using the jacking cylinder control (B) to regulate the main jacking cylinders while the boring head operator is controlling the TBM cutter head and conveyor functions. Monitor the boring head pressure gauge (C), jacking pressure gauge (D), and auxiliary pressure gauge (E) (if auxiliary power is used) and make adjustments as needed.

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 2,800 psi and will be completely over relief at 3,000 psi suspending operation, while retaining 3,000 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 (boring head/auxiliary system) may also be a result of hard ground.

The high pressure (jacking) maximum system pressure is 5,100 psi for jacking and 6,000 psi for IJS.

The chart below shows the jacking cylinder pressure with equivalent jacking force in tons.

PSI	TONS
1000	78.5
2000	157
3000	235.5
4000	314
5000	392.5



SN F20400F-01

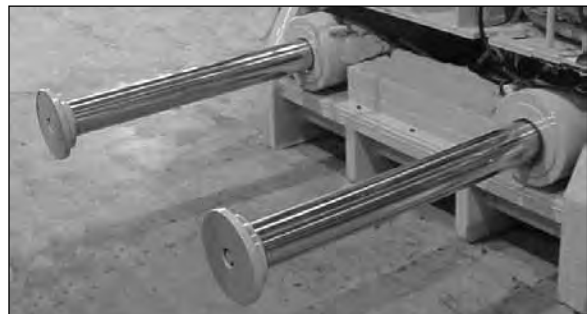
SN F20400F-02 & After

20. 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.

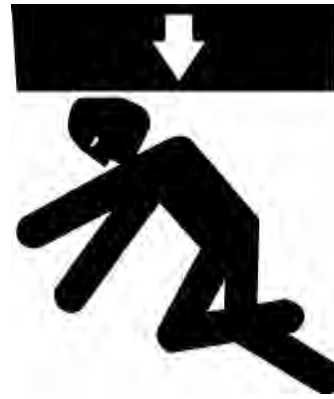
NOTICE

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 reposition the pump unit on the skid. Refer to steps 21 through 24.



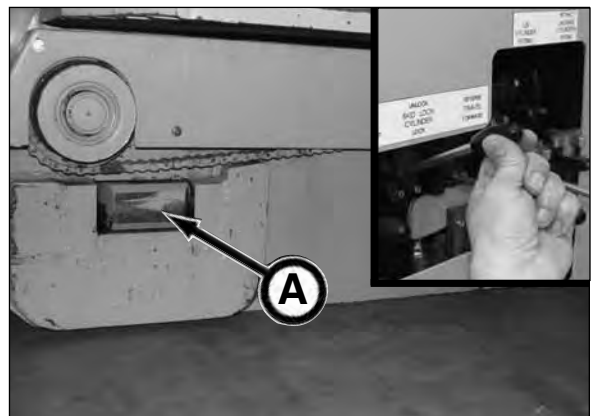
⚠ WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.



21. Unload dirt bucket.



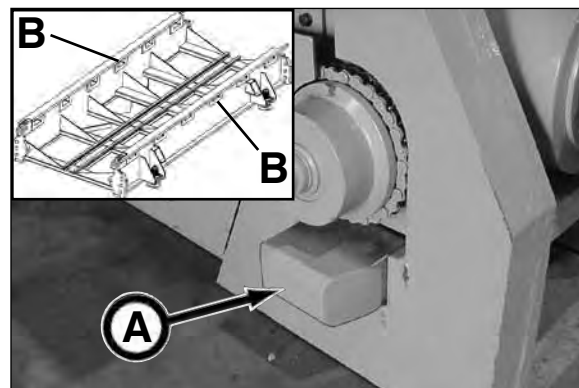
22. Unlock skid lock blocks (A) from skid using skid lock control (inset).



23. Simultaneously retract main ram cylinders (using the jacking cylinder control) and move pump unit forward (with travel control) to keep the yoke in contact with the pipe.



24. Lock pump unit skid lock blocks (A) into skid pockets (B) with the skid lock control. The skid lock blocks must be fully engaged (refer to lock indicators on control panel) into skid pockets before jacking.

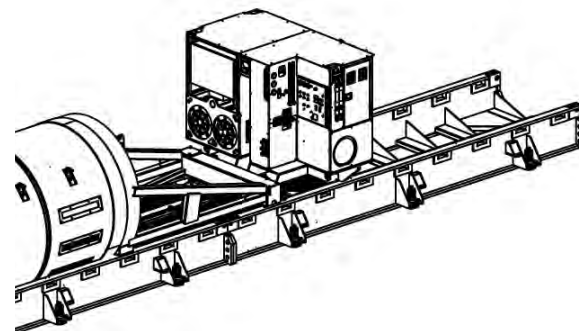


Locking Skid Lock Blocks
SN F20400F-02 & After Shown

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

DANGER Contact with electrical power WILL cause severe injury or death. NEVER disconnect tunnel power cables when tunnel power light is ON.

25. Continue jacking until the TBM has been jacked far enough into the ground to allow enough space to add one section of pipe.



26. Return all controls to the neutral or OFF position.

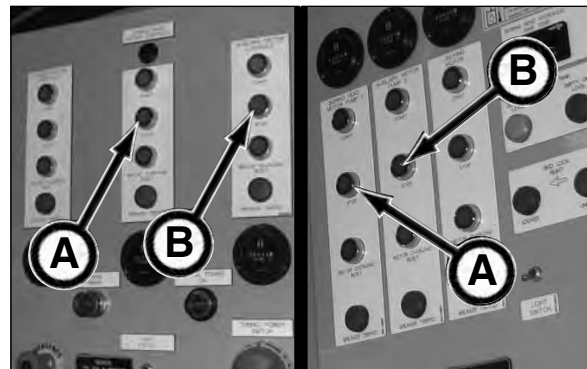


SN F20400F-01

SN F20400F-02 & After

27. Stop the boring head and auxiliary motors by depressing the Boring Head Motor STOP button (A) and the Auxiliary Motor STOP button (B).

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



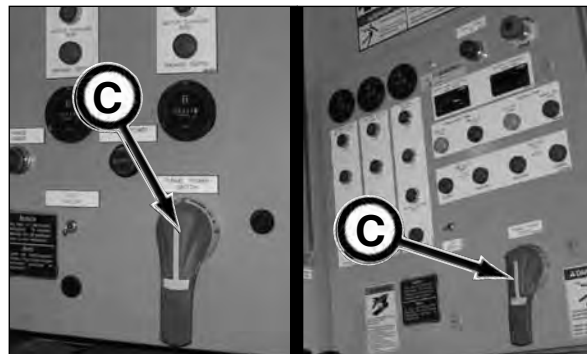
SN F20400F-01

SN F20400F-02 & After*

⚠ DANGER Contact with electrical power WILL cause severe injury or death. NEVER disconnect tunnel power cables when tunnel power light is ON.



28. (For Series II TBMs only) Move Tunnel Power switch (C) to the OFF position.



SN F20400F-01

SN F20400F-02 & After

⚠ 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.

BEFORE connecting or disconnecting hydraulic oil hoses/lines, ALWAYS move controls to the OFF or neutral position, STOP the boring head and auxiliary motors AND use gloves.



29. With gloves, disconnect pump unit supply and return line hoses from boring head supply and return line hoses. Cap hoses.



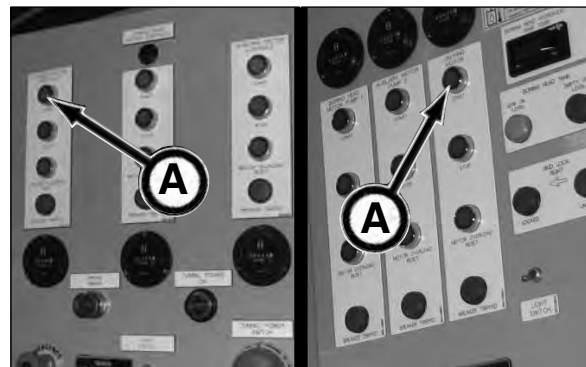
⚠ DANGER NEVER disconnect tunnel power cables when tunnel power light is ON. Doing so will cause severe injury or death from electrical shock.

30. Disconnect the ventilation, electrical and communication lines and position them to quickly route through next pipe.



31. If not already running, start the jacking motor by depressing Jacking Motor START button (A).

* The motor control switch locations for SN F20400F-02 are different than SN F20400F-03 & After (shown).



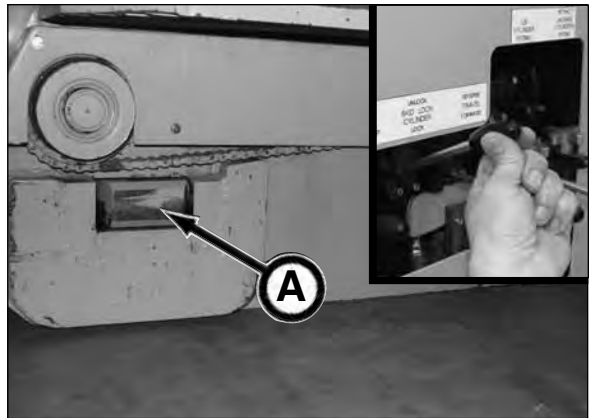
SN F20400F-01

SN F20400F-02 & After*

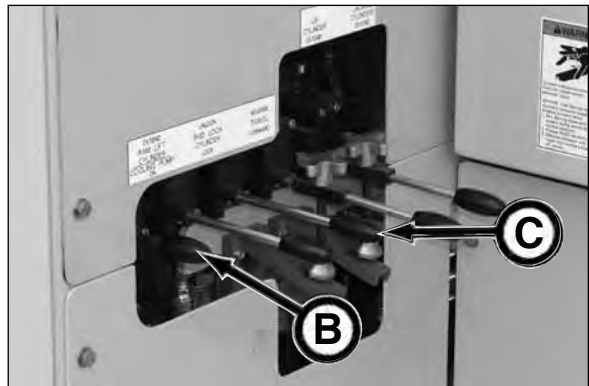
32. Retract main ram cylinders using jacking cylinder control.



33. Unlock skid lock blocks (A) from skid using skid lock control (inset).



34. Move pump unit and yoke back far enough to lower the first section of pipe by moving the ram lift cylinder control (B) UP and holding the travel control (C) UP to reverse position.



SN F20400F-02 & After Shown

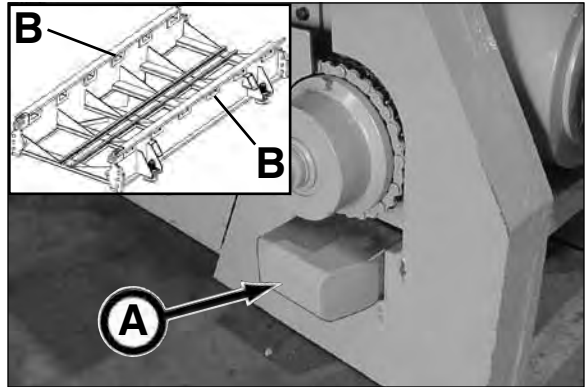


35. Lower the first section of pipe into position on skid between the TBM and yoke. Then travel up to back of pipe to mate the yoke with the pipe.

NOTICE Though the pipeline layout is determined during the pipeline project design phase, generally the bell end of the pipe will be towards the TBM.



36. Lock pump unit skid lock blocks (A) into skid pockets (B) with the skid lock control. The skid lock blocks must be fully engaged (refer to lock indicators on control panel) into skid pockets before jacking.



*Locking Skid Lock Blocks
SN F20400F-02 & After Shown*

37. With jacking cylinder control, extend cylinders until trailing section mates with the TBM.

NOTICE Relock the skid lock blocks as needed.

38. 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.



⚠ 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.

BEFORE connecting or disconnecting hydraulic oil hoses/lines, ALWAYS move controls to the OFF or neutral position, STOP the boring head and auxiliary motors AND use gloves.

39. Reconnect boring head and auxiliary supply and return line hoses, adding additional hoses as necessary.



⚠ DANGER Contact with electrical power WILL cause severe injury or death. NEVER connect or disconnect tunnel power cables when tunnel power light is ON.

40. Reconnect the ventilation, electrical and communication lines, adding additional lines 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.

41. Lower haul unit into place with battery box end toward the TBM. Refer to your Haul Unit Operator's Manual for haul unit installation.
42. 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.

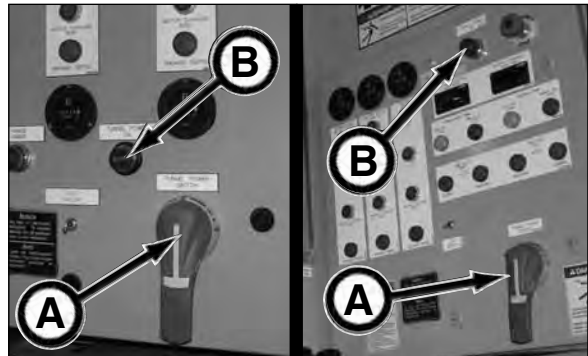
43. Recheck laser guidance system accuracy often, with and without forward thrust applied, to avoid making improper steering corrections. Typically, the conveyor must be raised to check line and grade target.



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.



44. (Series II TBMs Only) With the pump unit main power switch ON and all E-Stop buttons pulled out, flip Tunnel Power Switch (A) to the ON position. This will illuminate the Tunnel Power ON light (B) which provides the operator a quick visual indicator that power is ON in the tunnel and to take all necessary precautions with high voltage electricity.



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45. 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, whichever occurs first. Contact the Akkerman Aftermarket Sales Department for more information on the proper setup and usage of IJS.

INSTALLING IJS

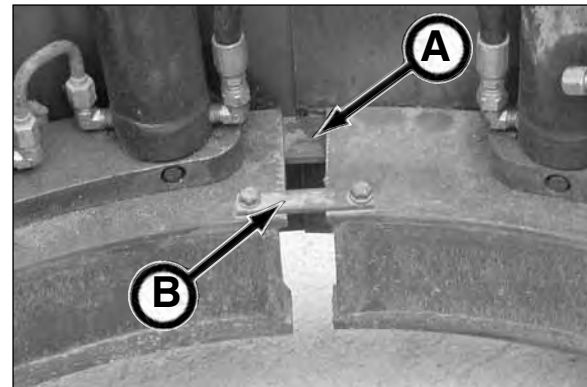
⚠ WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

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



NOTICE IJS configurations may vary depending upon project requirements.

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



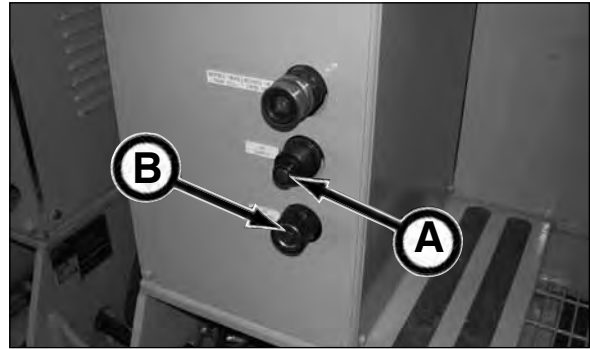
⚠ WARNING Pinch Points! Watch your fingers, hands, and legs while installing IJS sleeve.

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.



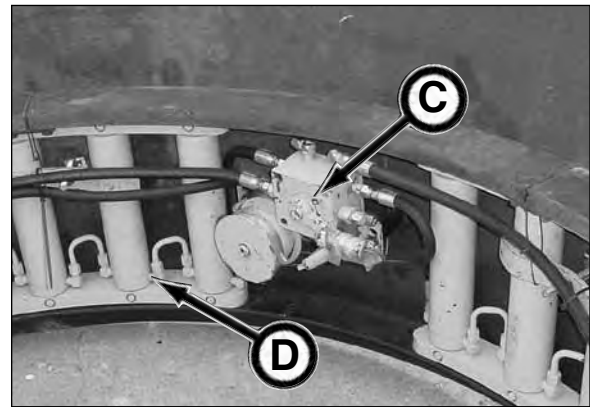
9. Connect hydraulic hoses to Pump Unit.

- a. Connect quick coupler (A) to intermediate jacking station valve pressure port. Use hose rated for at least 6,000 psi working pressure ONLY.
- b. Connect coupler (B) to the IJS tunnel return line.

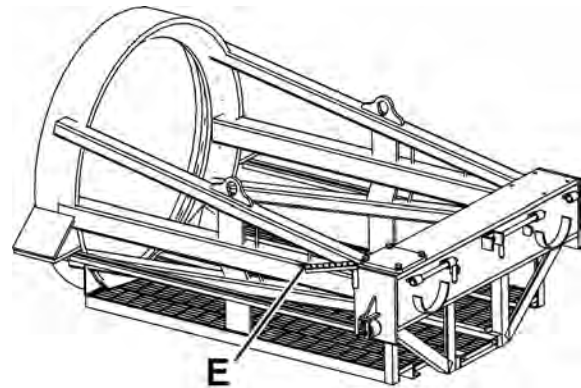


10. Mount the IJS valve (C) between cylinder segments (D).

11. Connect hydraulic hoses to IJS valve:
- a. Pressure to port P
 - b. Return to port T
 - c. Connect cylinders to C ports

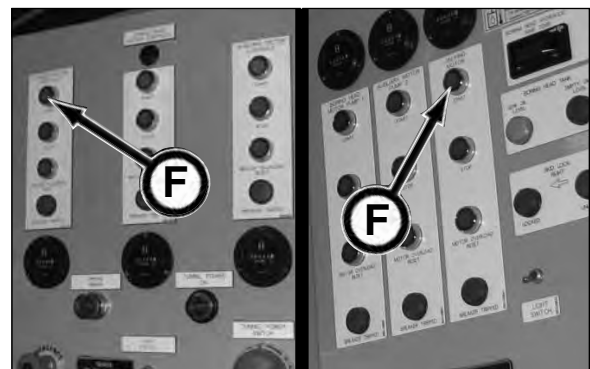


12. Secure cable weight to IJS line holder (E) on yoke.



OPERATING IJS

13. Start jacking motor by depressing jacking START button (F).

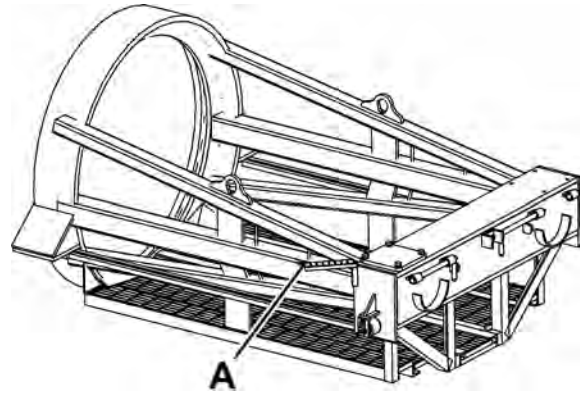


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Operation - Using Intermediate Jacking Stations: Operating IJS

14. Pull cable for IJS #1 on IJS line holder (A) to open valve and extend IJS cylinders by moving the IJS cylinder control DOWN. Operate the boring head the same as if the TBM is being jacked with the main ram cylinders for IJS #1.
15. When the IJS cylinders (for IJS #1) are at full extension, the pressure on the jacking pressure gauge should start to climb rapidly.
16. Release cable and IJS cylinder control.
17. Pull cable for IJS #2 to open and operate IJS cylinder control to close IJS #1 by extending cylinders. When the IJS cylinders are at full extension, the pressure on the jacking pressure gauge should start to climb rapidly.



NOTICE DO NOT operate TBM cutterhead when extending cylinders for IJS #2, IJS #3, etc. or when closing final IJS.

18. Release cable and IJS cylinder control.
19. Pull cable for IJS #3 to open and operate IJS cylinder control (extend IJS cylinders) to close IJS #2. When the IJS cylinders are at full extension, the pressure should start to climb rapidly.
20. Release cable and IJS cylinder control.
21. Repeat this opening and closing process for any additional IJS.
22. Continue jacking by extending the main rams cylinders using the jacking cylinder control to close the last IJS.



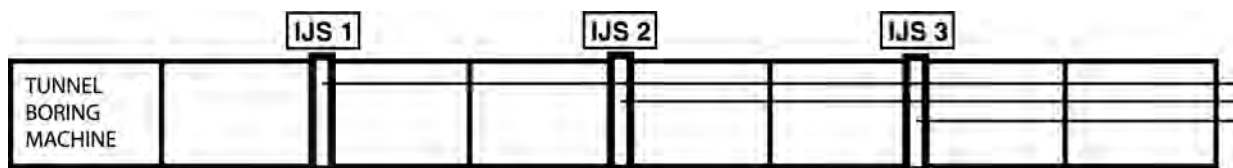
Extending IJS Cylinders

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.



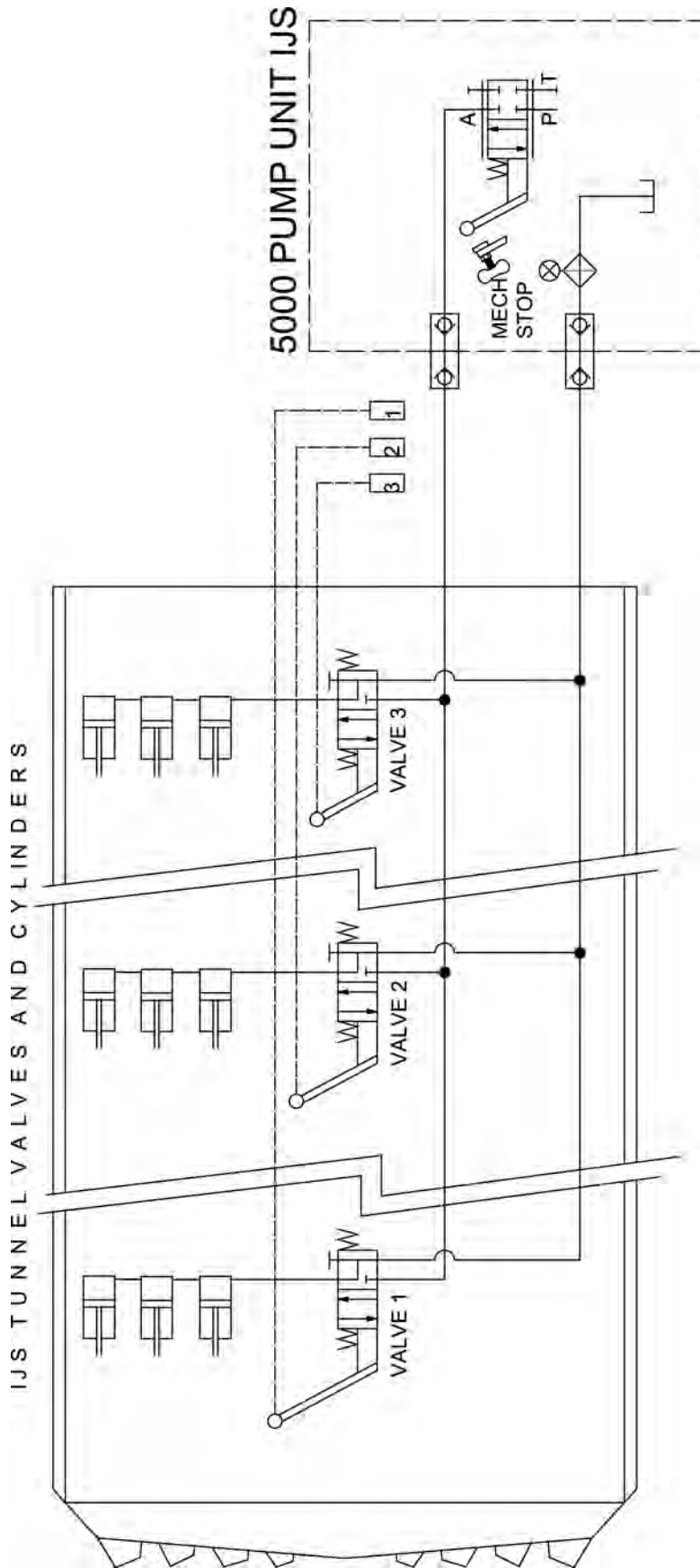
Extending Main Ram Jacking Cylinders

Refer to the IJS Schematic on the next page.



Intermediate Jacking Station Sequence

IJS SCHEMATIC



FILLING HYDRAULIC RESERVOIRS

A transfer pump (8 gal/min) is equipped on the 5000 Series II pump unit to provide an easy on-board means of filling the boring head hydraulic reservoir and the jacking hydraulic reservoir.

FILLING BORING HEAD RESERVOIR

NOTICE

If reclaiming hydraulic oil from tunnel lines, refer to Purging Fluid From Tunnel Lines in Section 6, Operation.

1. (SN F20400F-01 through 3 only) Clean area around tank vent valve (A). Open valve.

NOTICE

BEFORE FILLING BORING HEAD RESERVOIR, open tank vent valve (A) to release excessive air while filling reservoir. Failure to do so will result in a ruptured tank seal causing oil to flow out of the inspection tank seal. This valve must be closed immediately after filling tank to prevent contaminants from entering the reservoir.

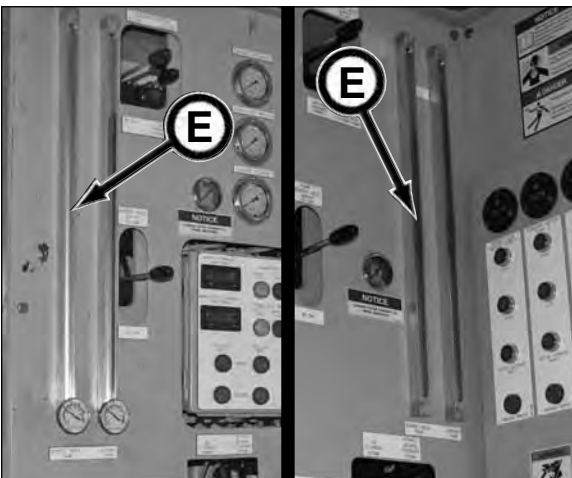
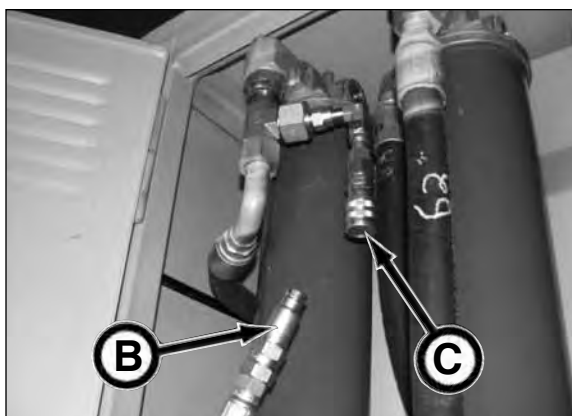
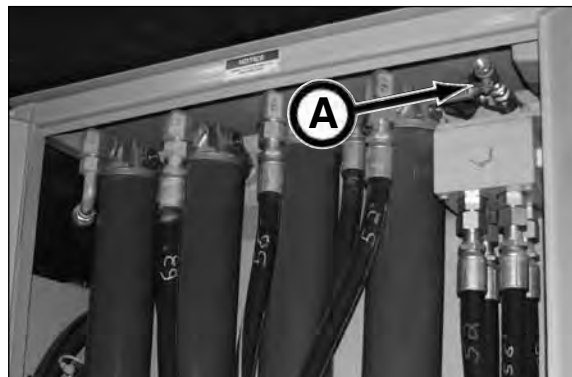
2. Gain access to transfer pump quick coupler (B) (located in the boring head tank filter panel) and connect to boring head tank quick coupler (C).

3. Connect transfer pump plug (D) to 110V power source outlet. The pump will start immediately.

4. Carefully watch the tank volume on the level gauge (E) so the oil in the tank will not overflow. If the volume pumped into the reservoir exceeds the tank capacity, the oil will start to spray out of the tank vent valve.

5. Unplug transfer pump plug (D) from power source.

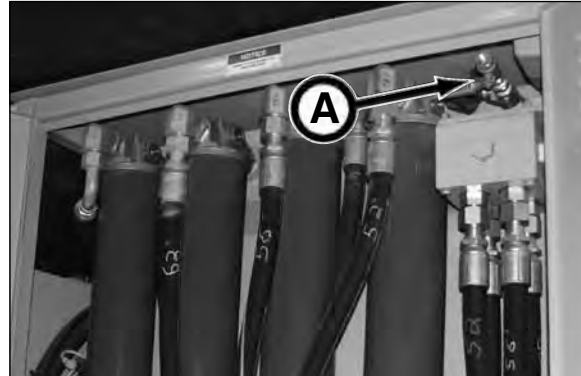
6. (SN F20400F-01 through 3 only) Close tank vent valve (A). This valve must be closed immediately after filling tank to prevent contaminants from entering the reservoir.



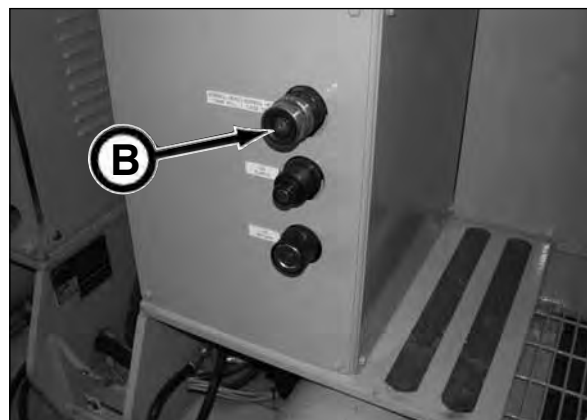
FILLING BORING HEAD RESERVOIR WITH CUSTOMER SUPPLIED PUMP

1. (SN F20400F-01 through 3 only) Open tank vent valve (A).

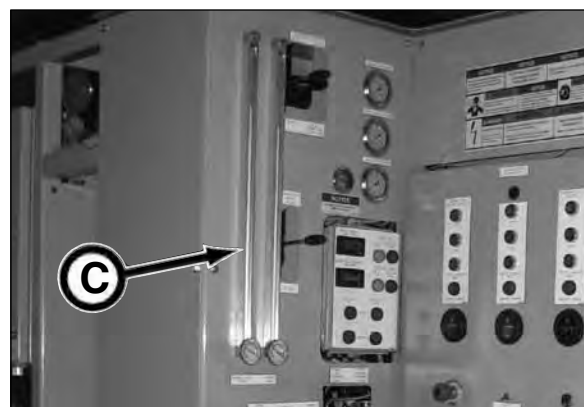
NOTICE BEFORE FILLING BORING HEAD RESERVOIR, open tank vent valve (A) to release excessive air while filling reservoir. Failure to do so will result in a ruptured tank seal causing oil to flow out of the inspection tank seal. This valve must be closed immediately after filling tank to prevent contaminants from entering the reservoir.



2. Connect fill pump hose (customer supplied) to Boring Head Tank Fill connection (B).

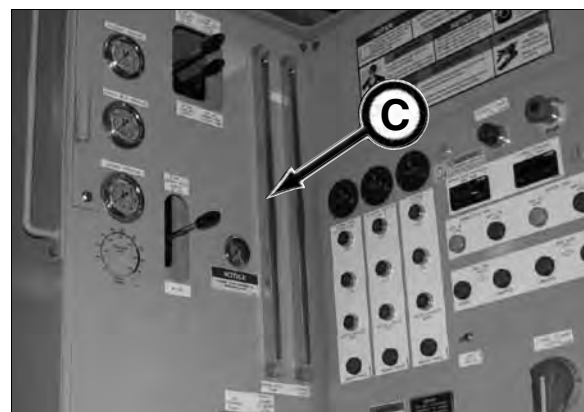


3. Start pump (customer supplied) to fill reservoir.
4. Carefully watch the tank volume on the level gauge (C) so the oil in the tank will not overflow. If the volume pumped into the reservoir exceeds the tank capacity, the oil will start to spray out of the tank vent valve.



SN F20400F-01

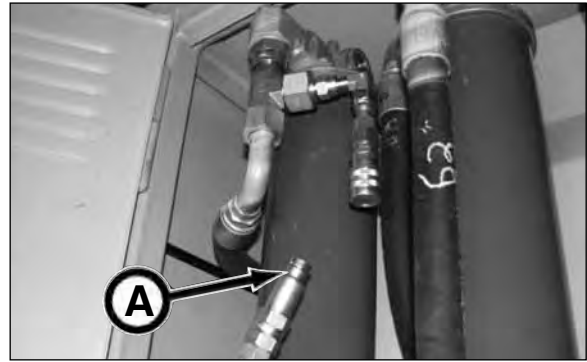
5. Once reservoir is filled, remove fill pump hose from boring head tank fill connection (B).
6. (SN F20400F-01 through 3 only) Close tank vent valve (A). This valve must be closed immediately after filling tank to prevent contaminants from entering the reservoir.



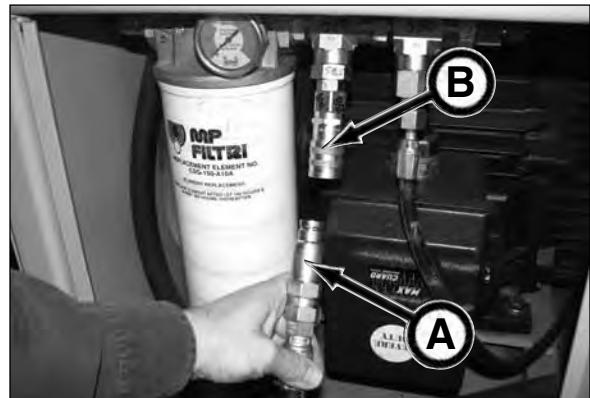
SN F20400F-02 & After

FILLING JACKING RESERVOIR

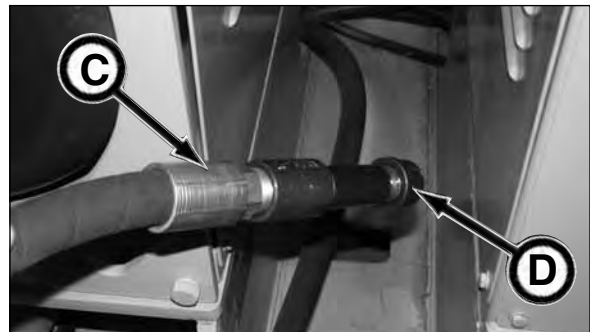
1. Gain access to transfer pump quick coupler (A) (located in the boring head tank filter panel).



2. Route the pump quick coupler to the Jacking Tank Fill quick coupler (B). Connect the couplers.



3. Gain access to the fill hose (C), located in the bottom of the laser line chamber of the pump unit frame. Remove cap (D) on hose. Route hose and connect to clean oil supply container (barrel).



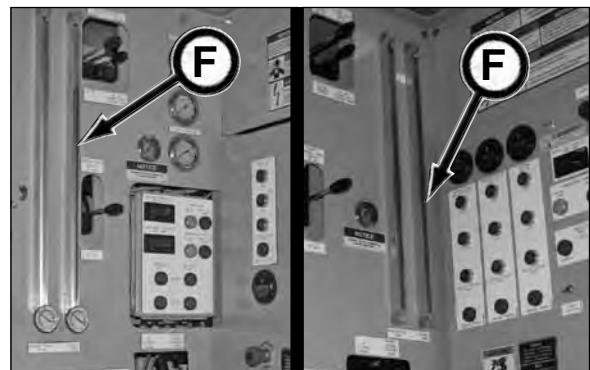
4. Connect transfer pump plug (E) to 110V power source outlet. The pump will start immediately.



5. Carefully watch the tank volume on the level gauge (F) so the oil in the tank will not overflow.

6. Unplug transfer pump plug (D) from power source.

7. Remove fill hose (C) from oil supply container, replace cap (D) and route fill hose back into pump unit belly



SN F20400F-01

SN F20400F-02 & After

PURGING FLUID FROM TUNNEL LINES WITH NON SERIES II TBM

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

Release all pressure before performing maintenance or repairs.

Never weld near pressurized fluid lines.

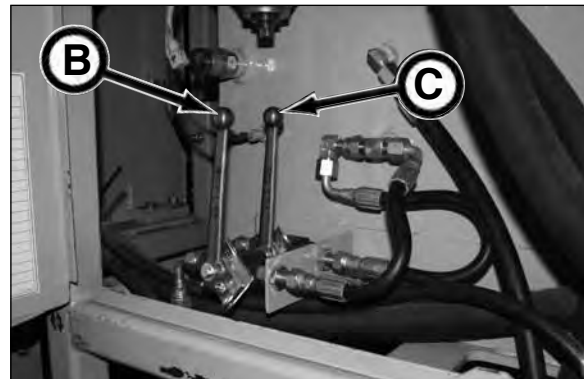
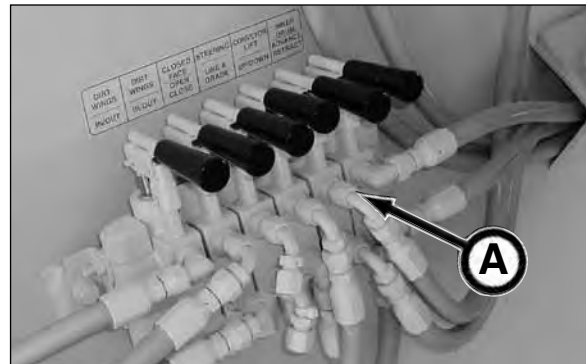
DO NOT use your hands to check for leaks. When searching for leaks, use a piece of wood or cardboard.

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.

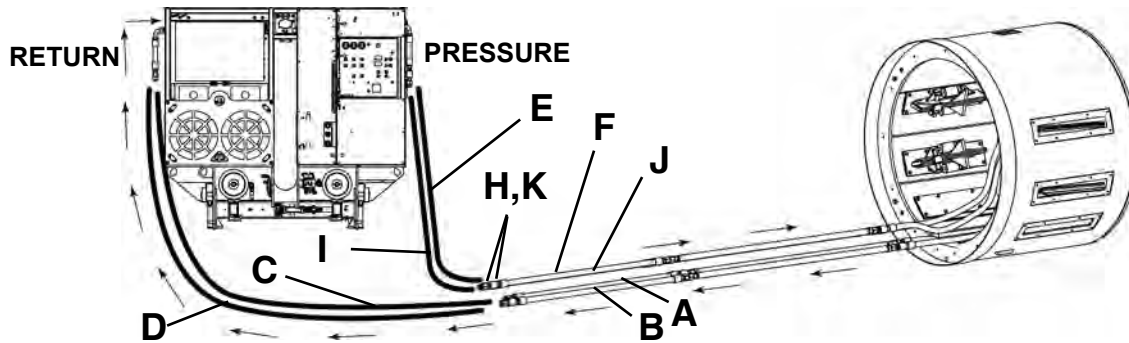


Once the tunnel pipeline is complete, the tunnel lines may be purged (reclaim oil in lines) of the hydraulic fluid. Using compressed air, the oil will flow through the pressure lines, TBM, out of the return lines and into a separate hydraulic tank reservoir.

1. Relieve pressure from pressure lines by cycling controls on the TBM 6 way control valve (A) and release pressure with the pump unit boring head supply bleed off valve (B) and the auxiliary supply bleed off valve (C).



(continued on next page)



2. To prevent tank rupture when purging tunnel lines, disconnect both tunnel return lines (A and B) from 5000 Series II Pump Unit hoses (C and D). Securely attach tunnel lines (A, B) to a separate CLEAN hydraulic tank reservoir (vented barrel). Cap pump unit hoses (C,D).

NOTICE

Be sure tank is large enough to accommodate oil being purged.

3. Disconnect 5000 Series II pump unit boring head pressure hose (E) from tunnel line (F). Cap pressure hose (E) to pump unit.
4. Install air/hydraulic adapter (G), or similar adapter, to boring head pressure tunnel line connection (H) and connect hose from compressor to adapter.
5. Turn on compressor, open valve on air/hydraulic adapter and purge tunnel lines of hydraulic fluid to separate hydraulic tank reservoir.
6. Once line is purged, remove adapter, cap line (F).
7. Disconnect 5000 Series II pump unit auxiliary pressure hose (I) from tunnel line (J). Cap pressure hose (I) to pump unit.
8. Install air/hydraulic adapter (G), or similar adapter, to auxiliary pressure tunnel line connection (K) and connect hose from compressor to adapter.
9. Turn on compressor, open valve on air/hydraulic adapter and purge tunnel lines of hydraulic fluid to pump unit boring head hydraulic tank.
10. Once line is purged, remove adapter, cap line (J).



NOTICE

When the pump unit is hooked up for dual feed supply hydraulics, both return lines are common, therefore when purging fluid from tunnel lines, one return line may hold some fluid after the purging process. Be sure both return lines are free of fluid.

11. Remove tunnel lines (A,B) from collection tank. Cap tunnel lines.

PURGING FLUID FROM TUNNEL LINES WITH SERIES II TBM

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

Release all pressure before performing maintenance or repairs.

Never weld near pressurized fluid lines.

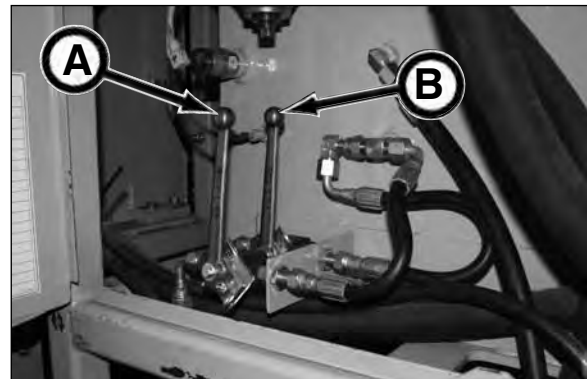
DO NOT use your hands to check for leaks. When searching for leaks, use a piece of wood or cardboard.

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.



Once the tunnel pipeline is complete, the tunnel lines may be purged (reclaim oil in lines) of the hydraulic fluid. Using compressed air, the oil will flow through the pressure lines, TBM, out of the return lines and into a separate hydraulic tank reservoir.

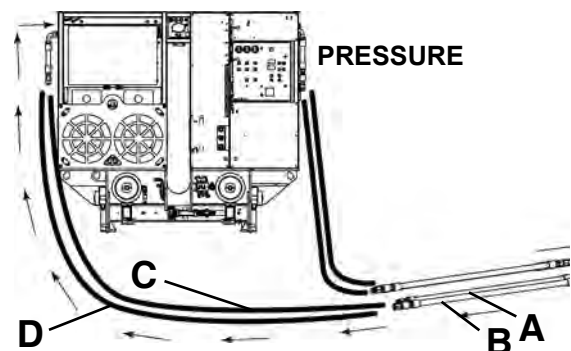
1. Relieve pressure from pressure lines with pump unit boring head supply bleed off valve (A) and the auxiliary supply bleed off valve (B).



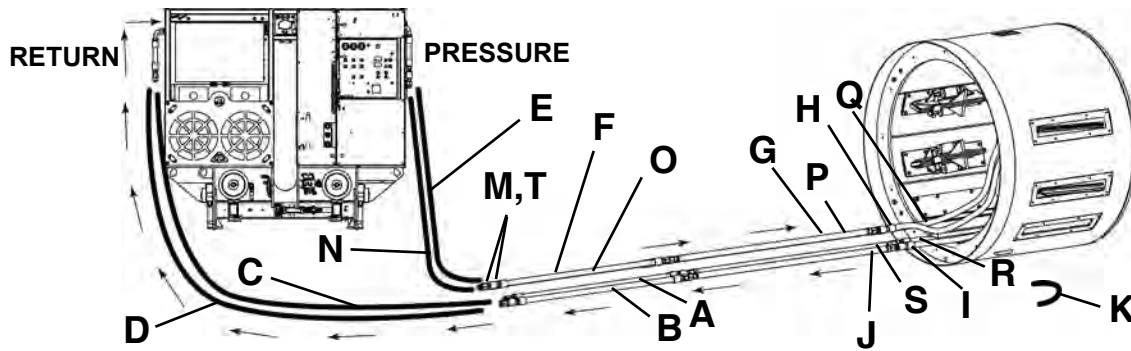
2. To prevent tank rupture when purging tunnel lines, disconnect both tunnel return lines (A and B) from 5000 Series II Pump Unit return hoses (C and D). Securely attach tunnel lines (A, B) to a separate CLEAN hydraulic tank reservoir (vented barrel). Cap pump unit hoses (C,D).

NOTICE Be sure collection tank is large enough to accommodate oil being purged.

RETURN



(continued on next page)

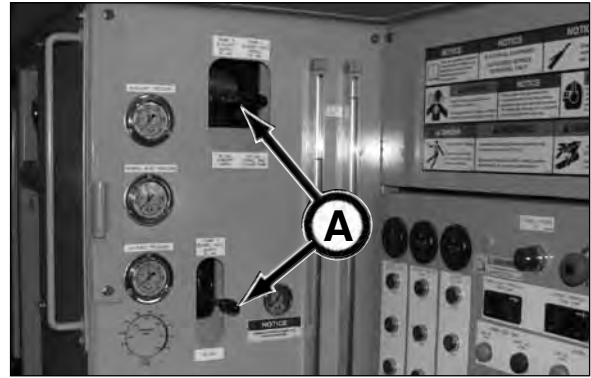


3. Disconnect 5000 Series II pump unit boring head pressure hose (E) from tunnel line (F). Cap pressure hose (E) to pump unit.
4. Disconnect tunnel line (G) from TBM pressure hose (H). Disconnect TBM return hose (I) from tunnel line (J).
5. Cap TBM pressure hose (H) and TBM return hose (I).
6. Install jumper hose (K) to tunnel lines (G) and (J).
7. Install air/hydraulic adapter (L), or similar adapter, to boring head pressure tunnel line connection (M) and connect hose from compressor to adapter.
8. Turn on compressor, open valve on air/hydraulic adapter and purge tunnel lines of hydraulic fluid to separate hydraulic tank reservoir.
9. Once line is purged, remove adapter, cap line (F).
10. Remove jumper hose (K) from tunnel lines (G) and (J). Cap tunnel lines.
11. Disconnect 5000 Series II pump unit auxiliary pressure hose (N) from tunnel line (O). Cap pressure hose (N) to pump unit.
12. Disconnect tunnel line (P) from TBM pressure hose (Q). Disconnect TBM return hose (R) from tunnel line (S).
13. Cap TBM pressure hose (Q) and TBM return hose (R).
14. Install jumper hose (K) to tunnel lines (P) and (S).
15. Install air/hydraulic adapter (L), or similar adapter, to auxiliary pressure tunnel line connection (T) and connect hose from compressor to adapter.
16. Turn on compressor, open valve on air/hydraulic adapter and purge tunnel lines of hydraulic fluid to pump unit boring head hydraulic tank.
17. Once line is purged, remove adapter, cap line (O).
18. Remove jumper hose (K) from tunnel lines (P) and (S). Cap tunnel lines.
19. Remove tunnel lines (A,B) from collection tank. Cap tunnel lines.

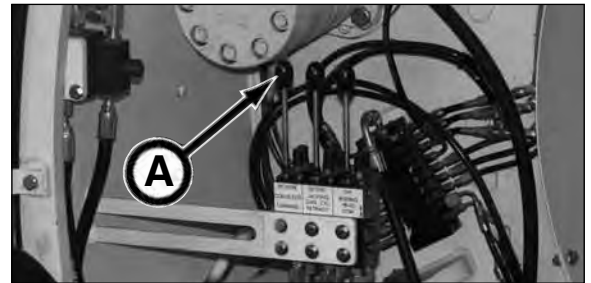


DAILY SHUT DOWN

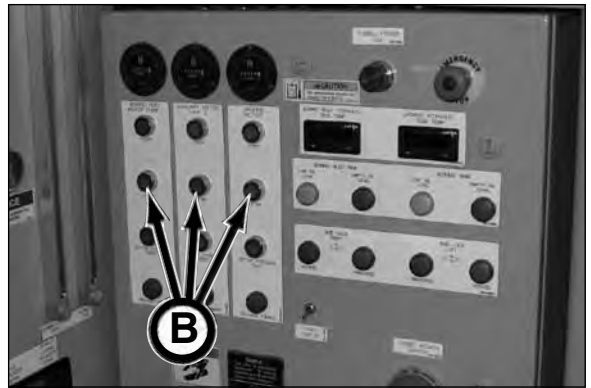
1. Return all hydraulic controls (A) on the pump unit and TBM to the OFF or neutral position.



SN F20400F-02 & After Shown



2. Stop the boring head, auxiliary and jacking motors (B).



SN F20400F-02 & After Shown

3. (TBM Series II) Move the TBM main power switch to the OFF position.



4. (TBM Series II) Push TBM E-Stop button IN.



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5000sljacksysom_050071

5. Move Tunnel Power switch to the OFF position. Place switch in lockout/tagout.



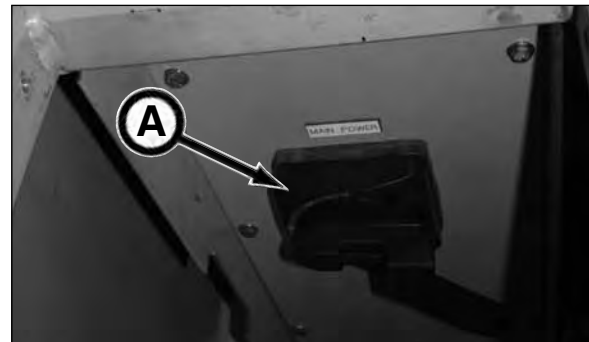
SN F20400F-01 Shown

6. Press pump unit E-Stop button IN.

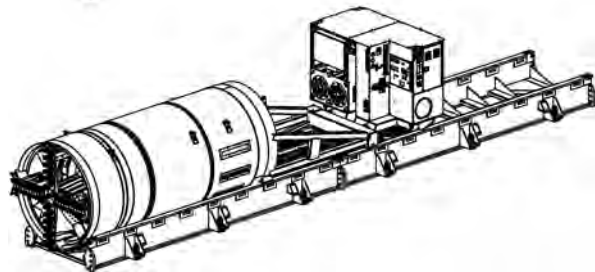


SN F20400F-02 & After Shown

7. Move pump unit Main Power switch (A) to the OFF position and perform lockout/tagout.
8. Shut off water supply to pump unit heat exchanger. Drain water if freezing temperatures are possible.
9. Shut off main power source and perform lockout/tagout.
10. Perform a visual system inspection by checking the following items: all fluid levels, leaks, and machine damage. Make repairs before operating. Also check to be sure all electrical and hydraulic connections are properly connected and secured.



NOTICE The pump unit and TBM should not be engulfed with water. Damage will result. If equipment becomes engulfed with water, contact your Akkerman Aftermarket Support representative for proper procedures on how to restore equipment for operation.



REMOVING JACKING SYSTEM

When pipe line is complete:

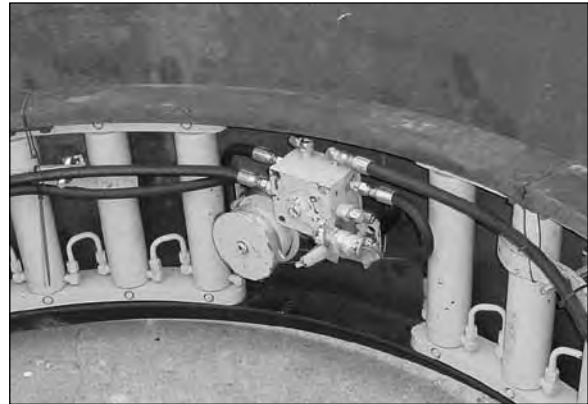
⚠ WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury. Contact medical help immediately if any oil or fluid is injected into your skin.

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.



1. 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).
2. Reclaim hydraulic oil from tunnel lines (refer to Purging Fluid From Tunnel Lines in this section).
3. Disconnect hydraulic hoses from inside of TBM and cap hoses.



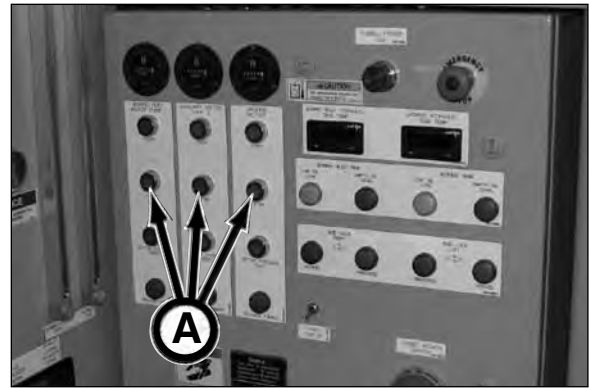
⚠ WARNING Any electrical work completed on the jacking system **MUST** be performed by a certified electrician.

4. Turn Tunnel Power switch to OFF position and perform lockout/tagout.



SN F20400F-01 Shown

5. Depress STOP button (A) on all motors; boring head, auxiliary and jacking motors.



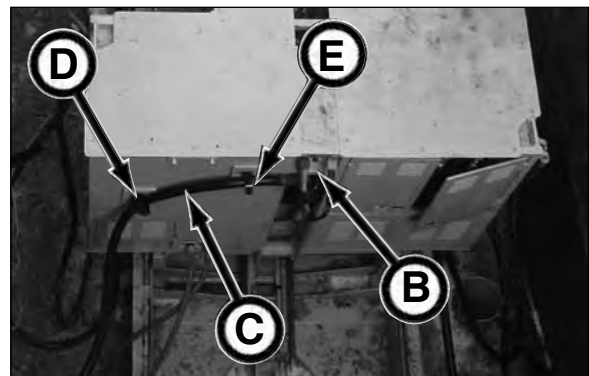
SN F20400F-02 & After Shown

6. Push E-Stop button IN and LOCKOUT power source(s).



SN F20400F-02 & After Shown

7. Disconnect tunnel power cables leads from camlock connections (B).
8. Disconnect tunnel power cable (C) from pump unit by rotating left cable clamp (D) clockwise and right cable clamp (E) counterclockwise. Rotating cable clamps can easily be achieved by moving power cable as needed until clamps are released from cable clamp holders.



⚠ 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.

9. Remove TBM, haul unit and track.
10. Remove Pump Unit, yoke, and skid(s).



NOTES

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. Lift pump unit using a three part sling. Prior to lifting, the three lifting points must be inspected (if damaged, lifting points must be repaired before lifting pump unit), and the pump unit must lift freely. If it is stuck to the ground, it must be broken loose before lifting.

NOTICE

NEVER attempt to lift the pump unit with the hydraulic tank lift eyes. The hydraulic tank lift eyes are only designed to lift an empty hydraulic tank.

6. Load and unload on level ground.
7. Securely fasten pump unit doors prior to shipping to prevent damage to pump unit components.
8. Use chains to fasten the pump unit (see 10 below), yoke, skid, and intermediate jacking stations to trailer floor.
9. Use straps around pump unit assembly for added protection during shipment.
10. Use tie down eyes (2 places) to secure Pump Unit to trailer floor.



Transporting

NOTES

Lubricants

NOTICE

Use of inferior lubricants can affect the efficient performance of your 5000 Series II 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.

HYDRAULIC RESERVOIR LUBRICANT

The 5000 Series II Pump Unit hydraulic reservoirs are filled with ISO-VG-46 20W Premium Hydraulic Oil.

Capacities:

Boring Head Reservoir	160 gal (606 L)
Jacking Reservoir	100 gal (379 L)

NOTICE

If using a too heavy of viscosity oil in cold temperatures, hydraulic oil pump damage could result due to pump cavitation. On the contrary, using ISO 32 oils above 150°F operating temperatures (oil temp. in reservoir) will result in reduced hydraulic power to functions.

Recommended hydraulic oil:

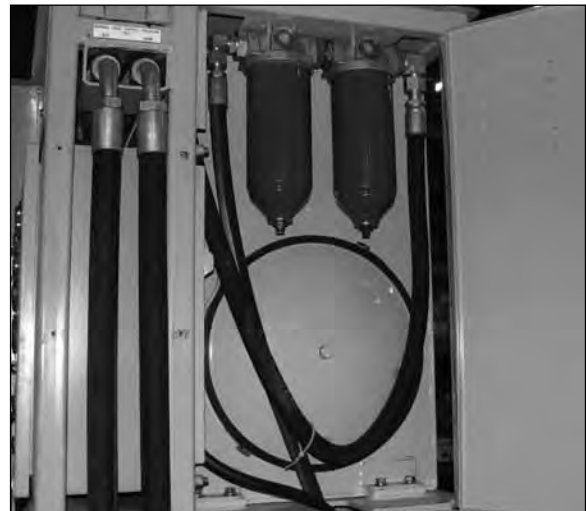
Ambient Temp.	Hydraulic Oil
-25°F to 60°F (-32°C to 16°C)	ISO 32
0°F to 95°F (-18°C to 35°C)	ISO 46
32°F to 105°F (-0°C to 41°C)	ISO 68

NOTICE

If you change to a different oil, use a reputable oil supplier to meet or exceed the ISO-VG-68 or API GL-1/GL-2 oil specification. Do not mix oil manufacturers or grades.



Boring Head Hydraulic Reservoir



Jacking Hydraulic Reservoir

ELECTRIC MOTOR BEARING GREASE

The electric motor lubrication grease fittings are lubricated with Mobil Polyrex® EM grease.

The Polyrex EM grease is a specially formulated grease for electric-motor bearings.

Use Mobil Polyrex® EM grease or equivalent when lubricating the lubrication fittings.



SKID LOCK BLOCK GREASE

The eight skid lock block lubrication fittings are greased with Mobilgrease® XHP220 Premium Lubricating Grease. Use Mobilgrease® XHP005 in lower temperatures as shown in the chart below.

The XHP220 and XHP005 greases are a high performance, lithium grease featuring high temperature, water contamination, shock loading and extended re-lubrication operations, and where extreme cold temperature pumpability is important.

Use Mobilgrease® XHP220 or XHP005 Lubricating Grease or equivalent when greasing the lubrication fittings.

Recommended grease:

Ambient Temp.	Grease
-25°F to 32°F (-32°C to 0°C)	XHP005
0°F to 105°F (-18°C to 41°C)	XHP220

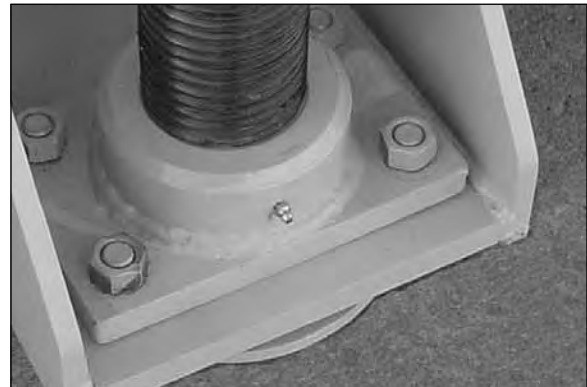


GREASE

The lubrication fittings on the skid and yoke 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 greasing the lubrication fittings.



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.

LUBRICATION & MAINTENANCE INTERVALS

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.

Use the hourmeters on the 5000 Series II to help determine proper maintenance intervals.

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



SN F20400F-02 & After Shown

BEFORE PERFORMING MAINTENANCE

1. Push IN all E-Stop buttons.
2. Relieve hydraulic pressure.
3. Do not work on hydraulic system if oil temperature exceeds 125°F (52°C)
4. Lockout all power. Perform lock out/tag out procedure.



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.

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.



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. Turn Tunnel power switch to the OFF position.



2. Push E-STOP button in.

3. Lockout power source.



AVOID PINCH POINTS

⚠ WARNING Moving parts or the mishandling of parts can cause severe personal injury.

Keep hands away from moving parts.

Watch your fingers, hands, and legs while equipment is in operation.

Handle parts carefully to avoid crushing and pinch point hazards.

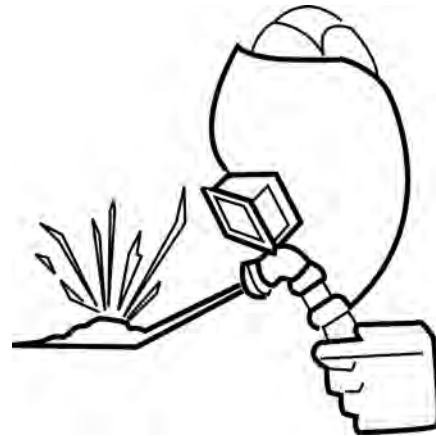


UNAUTHORIZED WELDING

⚠ 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.

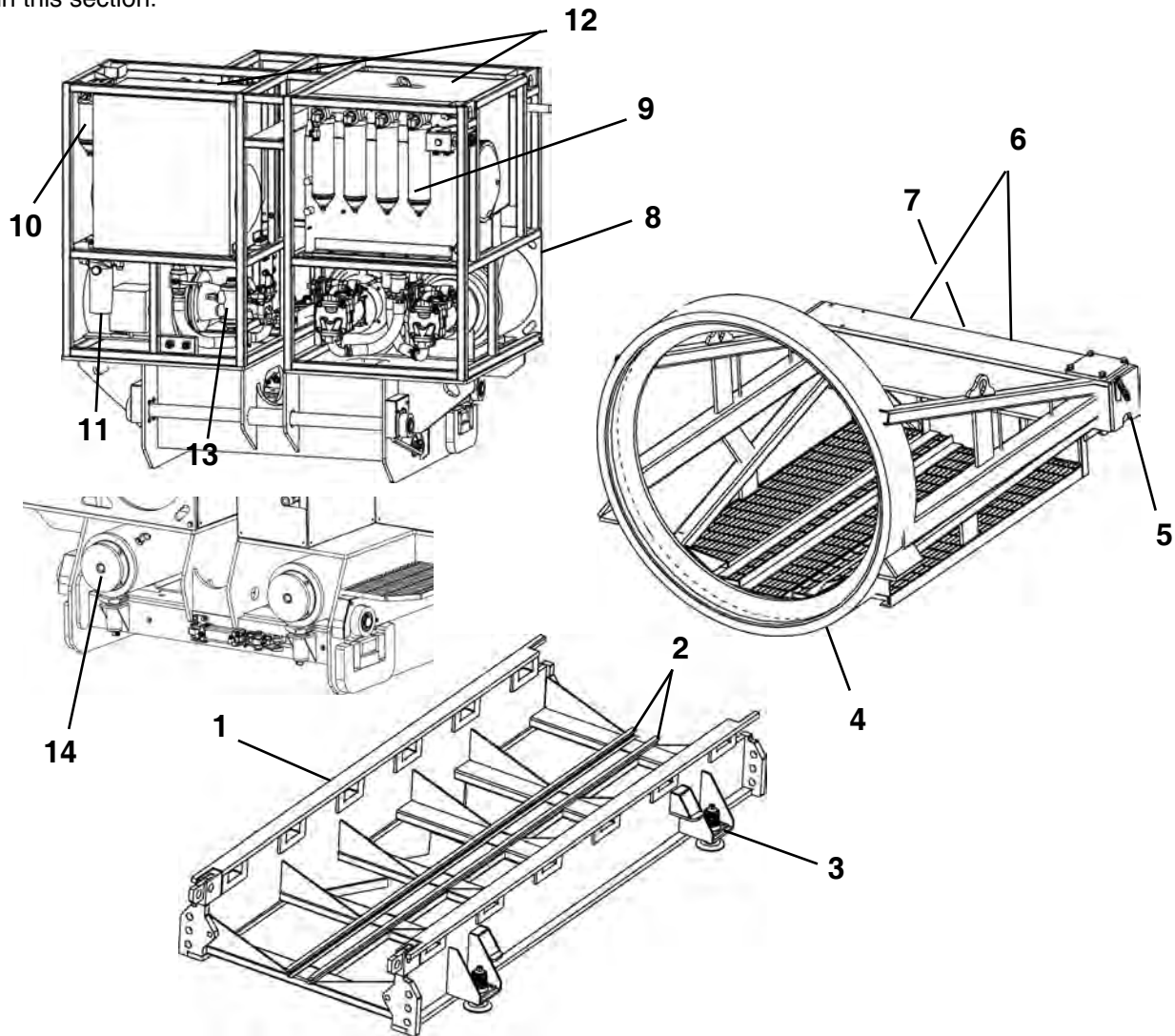
Before performing authorized welding on TBM, remove gas detector to prevent damage.



MAINTENANCE CHARTS

NOTICE

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

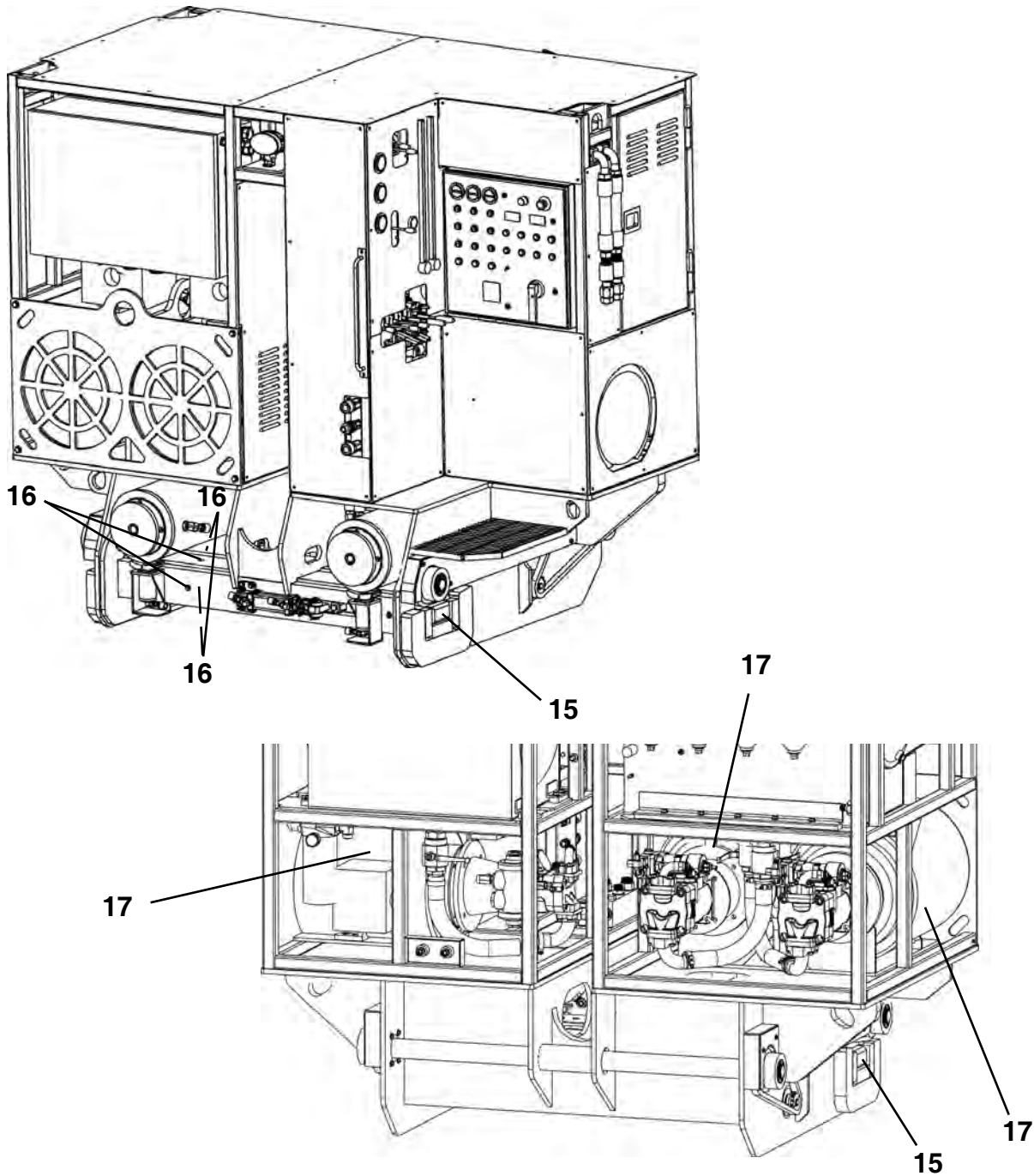


DAILY OR EVERY 10 HOURS OF OPERATION OR SHIFT CHANGE

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 Frame	Inspect	If damaged, repair or replace.	
9.	Boring Head Return Filters	Check	Replace filters per indicator.	Return Filters
10.	Jacking Return Filter	Check	Replace filters per indicator.	Return Filters
11.	Jacking Fill Filter	Check	Replace filter per indicator.	Filter
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.



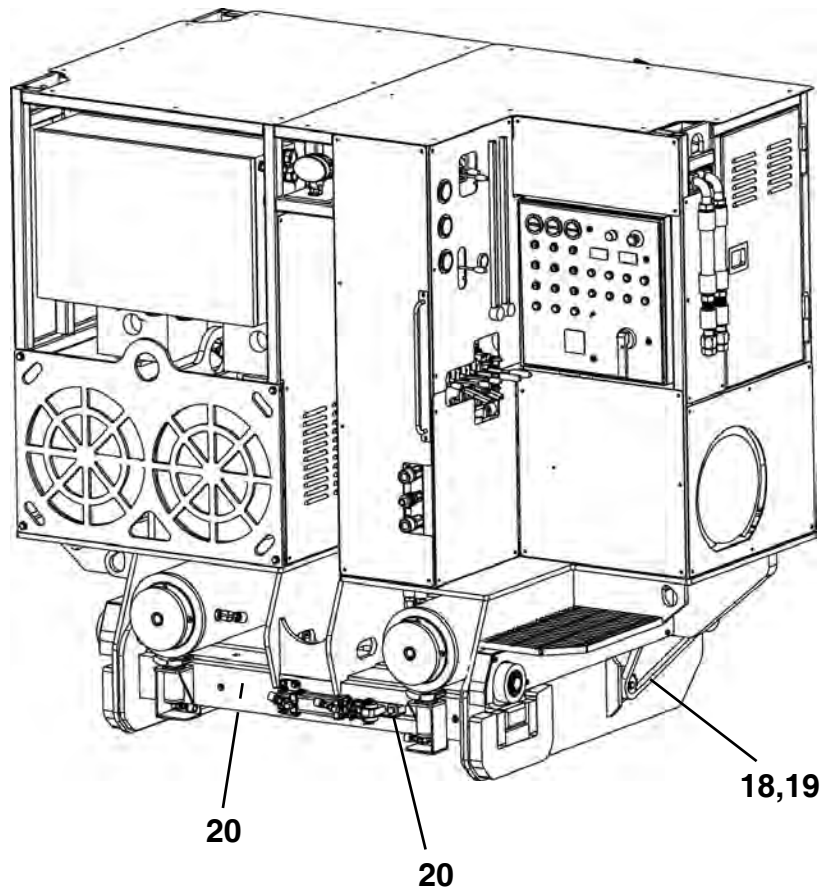
WEEKLY OR EVERY 50 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
15.	Skid Lock Blocks	Inspect (2 Places)	Repair or replace.	Mobil XHP222*
16.	Skid Lock Blocks	Lubricate (8 Places)	2 to 4 shots.	
17.	Motors	Check	Ventilation openings clean and drain holes open.	

* Refer to Section 8, Lubricants for the proper grease per ambient temperature: Mobilgrease® XHP222 or XHP005.

NOTICE

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

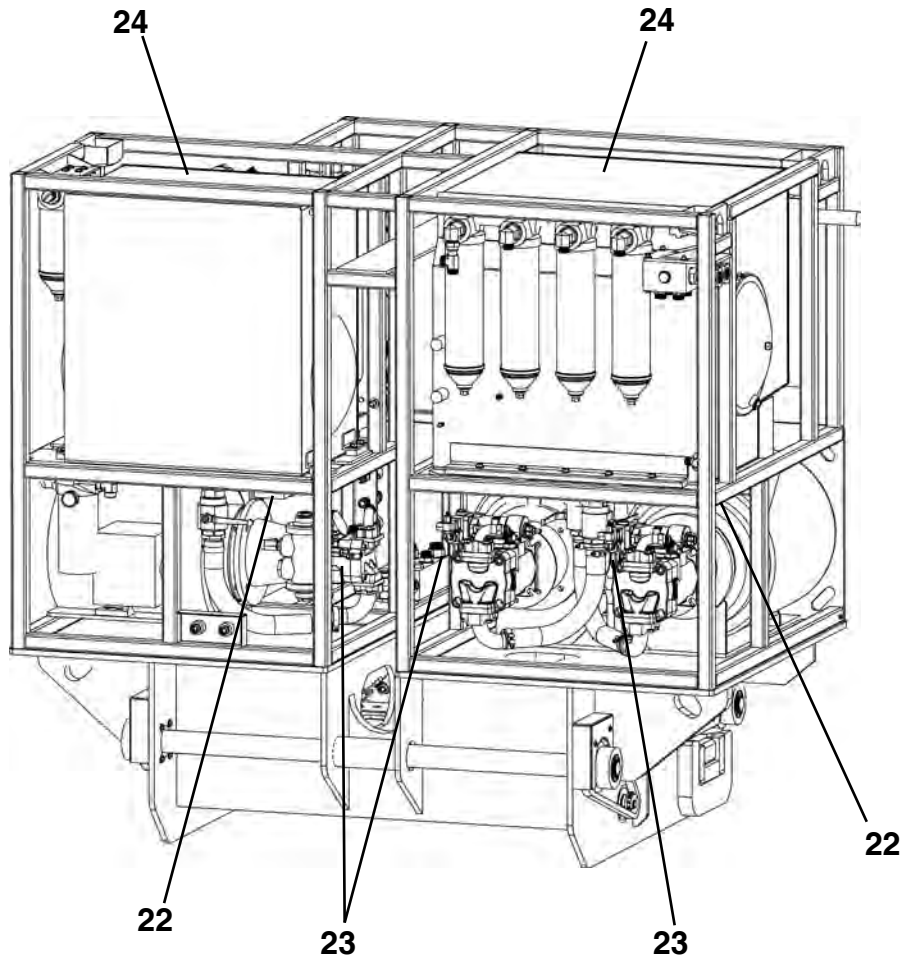


MONTHLY OR EVERY 250 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
18.	Drive Chain	Adjustment (2 Places)	1/4-1/2" deflection.	Lt. Wt. Motor Oil
19.	Chain	Lubricate (2 Places)		
20.	Skid Lock Linkage	Check (2 Places)	Hdwr tightness and dirt buildup.	
21.*	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.



COMPLETION OF EACH DRIVE

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
22.	Hydraulic Reservoirs	Drain water (2 Places)	Drain until water is removed.	

EVERY 500 HOURS OF OPERATION

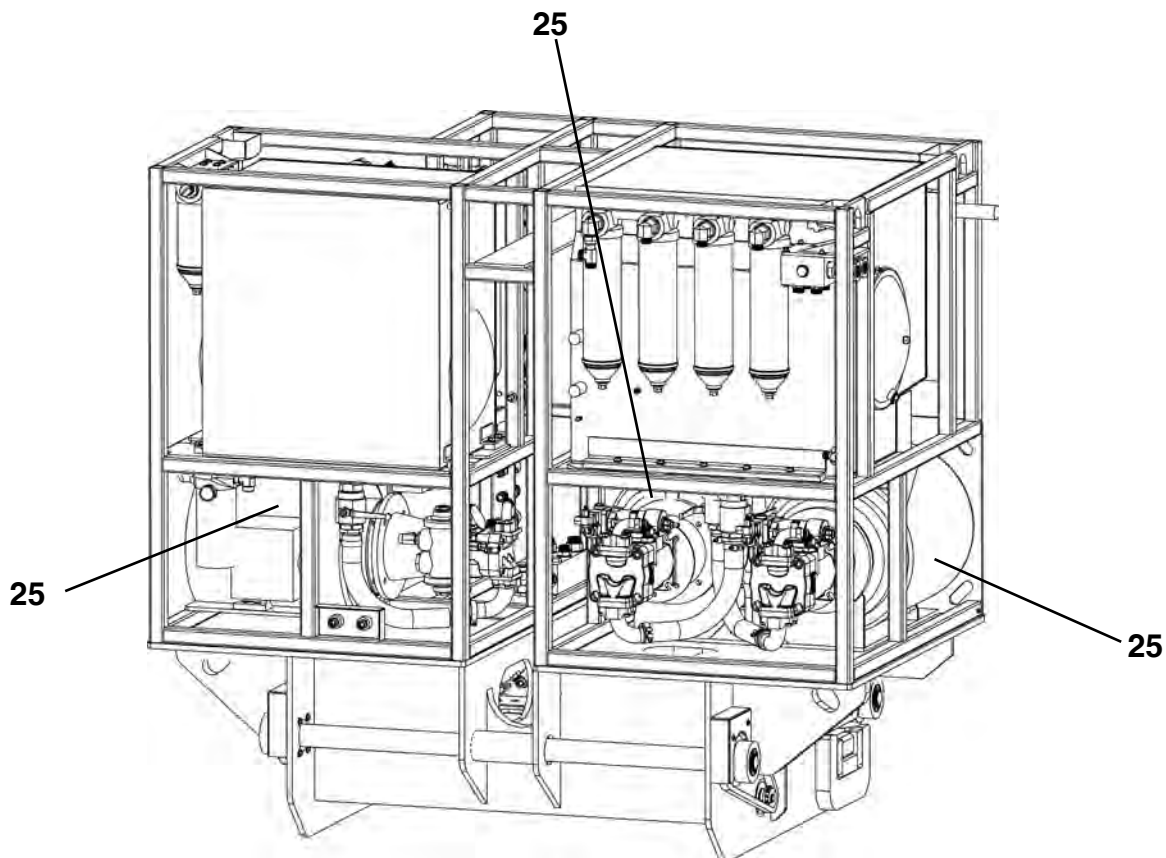
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
23.	Load Sense Filters	Replace (3 Places)	Replace with new.	LS Filters

EVERY 1000 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
24.	Hydraulic Reservoirs	Drain and replace	Drain and fill with new oil.	ISO-VG-46-20W

NOTICE

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



ANNUALLY

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
25.	Electric Motor Brgs.	Lubricate (*6 Places)	2 Shots	Mobil Polyrex EM

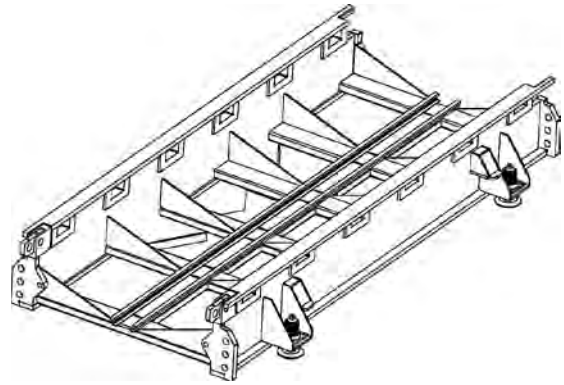
* 2 places per motor.

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.

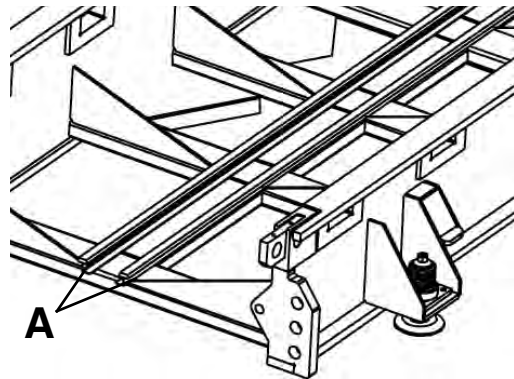
If cracks or damage are present, contact your Akkerman Product Support representative for authorized repair or replacement procedures.



2. INSPECT RAILS

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

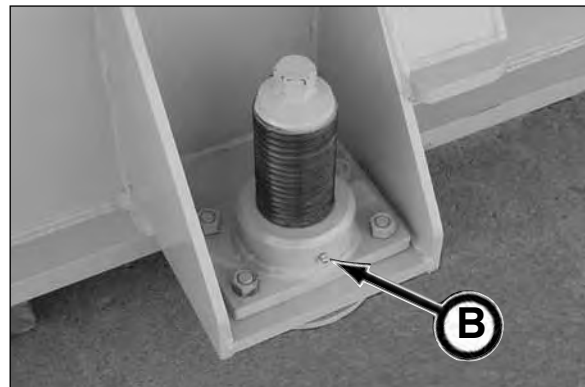
If cracks or damage are present, contact your Akkerman Product Support representative for authorized repair or replacement procedures.



3. LUBRICATE LEVELING SCREWS

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

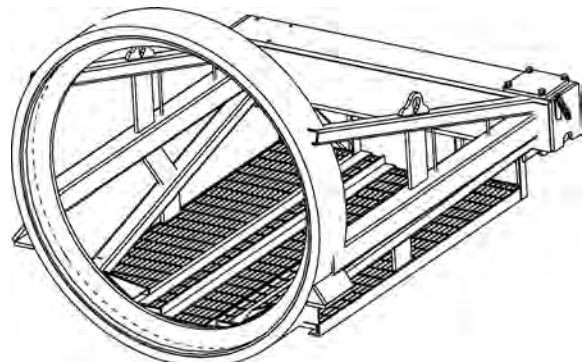
Lubricate threads thoroughly.



4. INSPECT YOKE FRAME

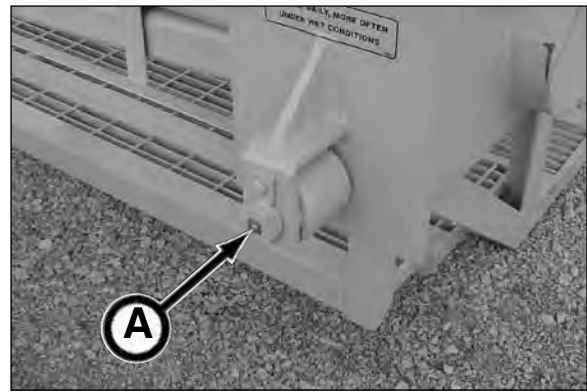
Visually inspect yoke for cracks or other damage. Also check for damaged, loose, or missing hardware. Replace with new.

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



5. LUBRICATE YOKE WHEELS

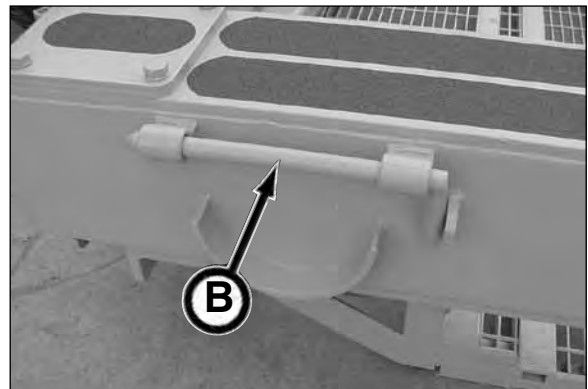
Lubricate yoke wheels (A) (2 places) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent until greased is forced out.



6. INSPECT RAM RETAINING PINS

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

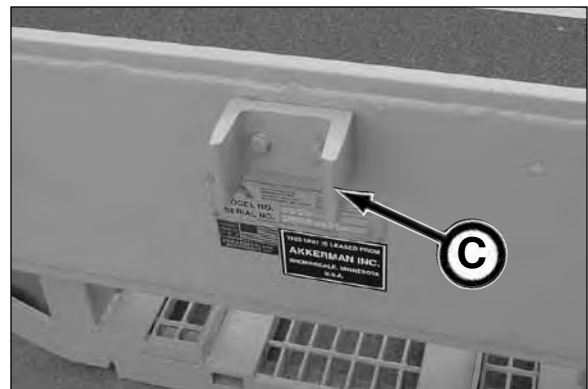
If damage is present, replace with new.



7. INSPECT RAM RETAINING PIN STOP

Visually inspect stop (C) or hardware for damage.

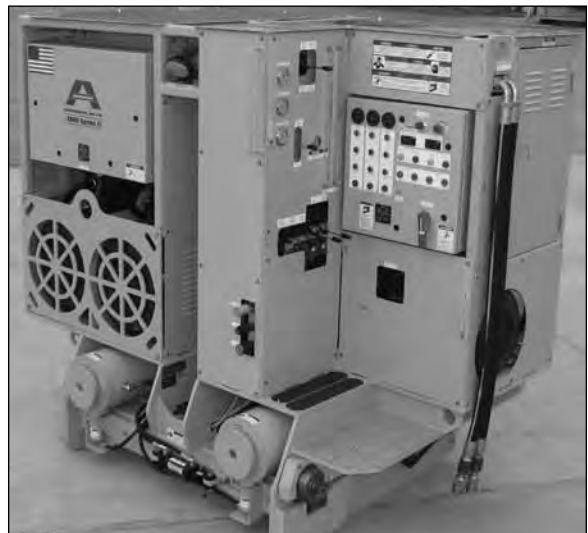
If damaged or missing, replace with new.



8. INSPECT PUMP UNIT

Visually inspect 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 Aftermarket Support representative for authorized repair or replacement procedures.



9. CHECK BORING HEAD FILTER INDICATORS

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

Always check gauges when the oil is at normal operating temperature and the system is at normal operating flow. Otherwise, the gauges may indicate a false reading.

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.

BORING HEAD PRIMARY RETURN FILTER

GAUGE (A) for primary return filter (B) only.

It is not necessary to replace any of the other return filters unless the a filter's indicator displays that it is necessary to replace filter.

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

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

When the needle on the gauge is in the red CHANGE zone, replace filter as soon as possible to prevent hydraulic component damage (see Replacing Filter below)

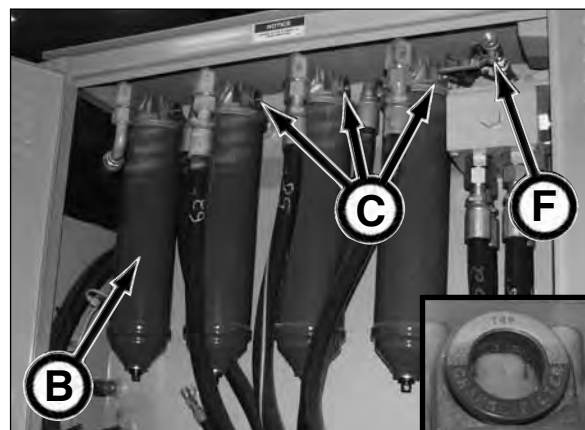
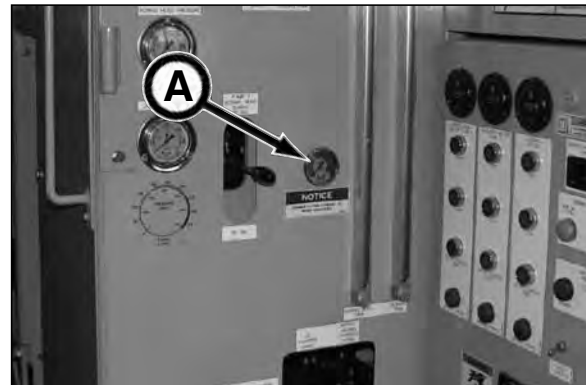
BORING HEAD SECONDARY RETURN FILTER INDICATORS (C)

As the pressure drop increases across the filter element, the white bar in the visual window will start to lower. When the bar is at the red CHANGE FILTER marking (see inset), the oil will start to bypass indicating the filter must be replaced.

REPLACING FILTER (S)

1. With pump unit power shutdown, clean and dry area around the filter head (D), filter housing (E) and tank vent valve (F).
2. Open tank vent valve (F) to release tank pressure.
3. Loosen housing bolt fastener (G) until filter housing releases from filter head.
4. Check filter gasket in filter head. If worn or damaged replace with new. Install new gasket (if needed) with a light coat of clean hydraulic oil into filter head. Be sure the gasket is not twisted and is correctly in place.

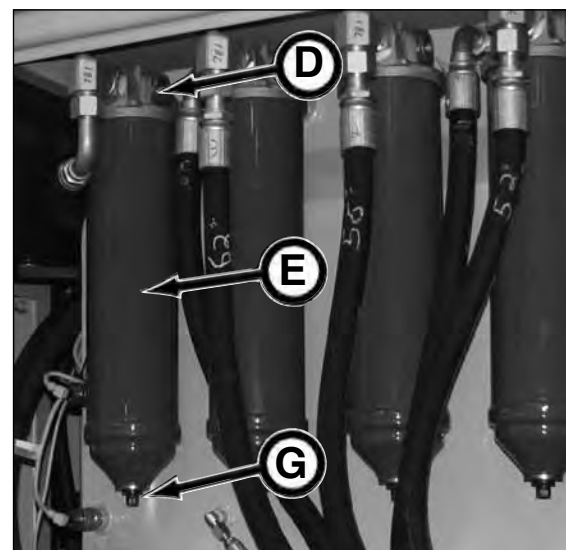
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Filter OK



Filter Needs Service

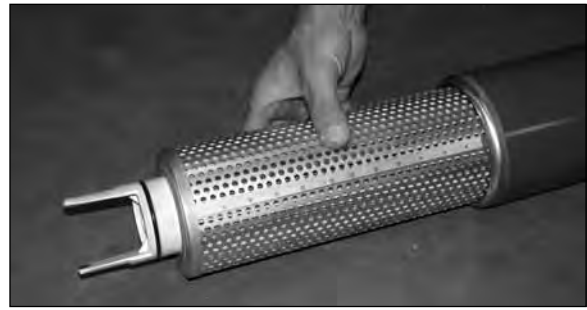


9. CHECK BORING HEAD FILTER INDICATORS (continued)

NOTICE

Filter assembly removed from pump unit for photographic purposes only.

5. Remove filter with alignment/indicator adapter from housing.
6. Since the oil flow through the filter is inside to outside the filter element, clean the housing in the event particles remain in the bottom of the housing.
7. Carefully remove alignment/indicator adapter from filter. Retain adapter. Dispose of filter properly.
8. Check for metal flakes on magnet of white indicator or in sight gauge. If metal flakes are visible, replace all filters and reservoir oil.
9. Check gasket on adapter. If worn or damaged, replace with new. Install new gasket (if needed) with a light coat of clean hydraulic oil onto adapter gasket. Be sure the gasket is not twisted and is correctly in place.
10. Install alignment/indicator adapter (removed in step 7) into new filter.
11. Carefully install filter - alignment/indicator adapter into clean housing by aligning housing bolt fastener through alignment/indicator adapter.
12. Carefully align alignment/indicator adapter tabs into filter head. Secure housing to head with housing bolt fastener.
13. Close tank vent valve.
14. With tank vent valve closed, start up pump unit, run until hydraulic system is warm, start boring head motor and check for leaks.
15. Stop boring head motor and shutdown pump unit. Replace other filter(s) as needed.



10. CHECK JACKING HYDRAULIC RETURN FILTER INDICATORS

To prevent under or over servicing of the jacking hydraulic return filter elements, filter indicators have been installed on your 5000 Series II Pump Unit.

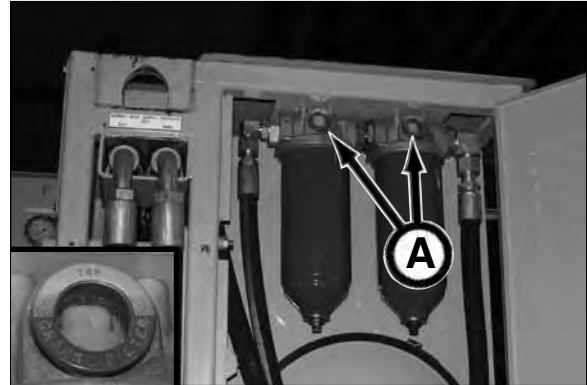
Always check indicators when the oil is at normal operating temperature and the system is at normal operating flow. Otherwise, the indicators may show a false reading.

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.

JACKING RETURN FILTER INDICATORS (A)

As the pressure drop increases across the filter element, the white bar in the visual window will start to lower. When the bar is at the red CHANGE FILTER marking (see inset), the oil will start to bypass indicating the filter must be replaced.



Filter OK



Filter Needs Service

REPLACING FILTER

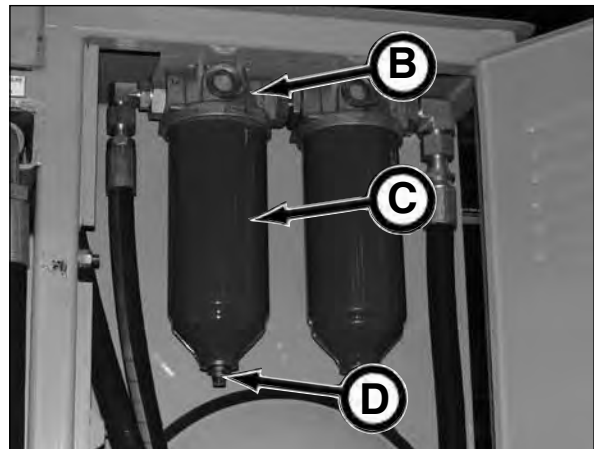
1. With pump unit power shutdown, clean and dry area around the filter head (B) and filter housing (C).
2. Loosen housing bolt fastener (D) until filter housing releases from filter head.
3. Check filter gasket in filter head. If worn or damaged replace with new. Install new gasket (if needed) with a light coat of clean hydraulic oil into filter head. Be sure the gasket is not twisted and is correctly in place.

NOTICE

Filter assembly removed from pump unit for photographic purposes only.

4. Remove filter with alignment/indicator adapter from housing.
5. Since the oil flow through the filter is inside to outside the filter element, clean the housing in the event particles remain in the bottom of the housing.

(continued on next page)



10. CHECK JACKING HYDRAULIC RETURN FILTER INDICATORS *(continued)*

6. Carefully remove alignment/indicator adapter from filter. Retain adapter. Dispose of filter properly.
7. Check gasket on adapter. If worn or damaged, replace with new. Install new gasket (if needed) with a light coat of clean hydraulic oil onto adapter gasket. Be sure the gasket is not twisted and is correctly in place.



8. Install alignment/indicator adapter (removed in step 6) into new filter.



9. Carefully install filter - alignment/indicator adapter into housing by aligning housing bolt fastener through alignment/indicator adapter.



10. Carefully align alignment/indicator adapter tabs into filter head. Secure housing to head with housing bolt fastener.
11. Start up pump unit, run until hydraulic system is warm, start jacking motor and check for leaks.
12. Stop jacking motor and shutdown pump unit. Replace other filter, if needed.



11. CHECK JACKING FILL FILTER INDICATOR

To prevent under or over servicing of the jacking hydraulic fill filter element, a filter indicator gauge has been installed on your 5000 Series II Pump Unit.

Always check gauge when the oil is at normal operating temperature and the system is at normal operating flow. Otherwise, the gauge may indicate a false reading.

The filter requires 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.

JACKING FILL FILTER GAUGE (A)

The green OK zone indicates that the filter is functioning properly.

The yellow zone indicates that the filter will require replacement shortly.

When the needle on the gauge is in the red CHANGE zone, replace filter as soon as possible to prevent hydraulic component damage using the following procedure.

REPLACING FILTER

1. With pump unit power shutdown, clean and dry area around the filter (B).
2. Remove filter. Dispose of filter properly.

NOTICE Remove filter gasket if stuck in filter housing.

3. Fill new filter with clean hydraulic oil.
4. Lubricate new filter gasket with a light coating of clean hydraulic oil.
5. Install new filter. Hand tighten only.
6. Start up pump unit, run until hydraulic system is warm, start jacking motor and check for leaks.
7. Stop jacking motor and shut down pump unit.
8. Check hydraulic reservoir oil level on gauge. Add hydraulic oil, if necessary.

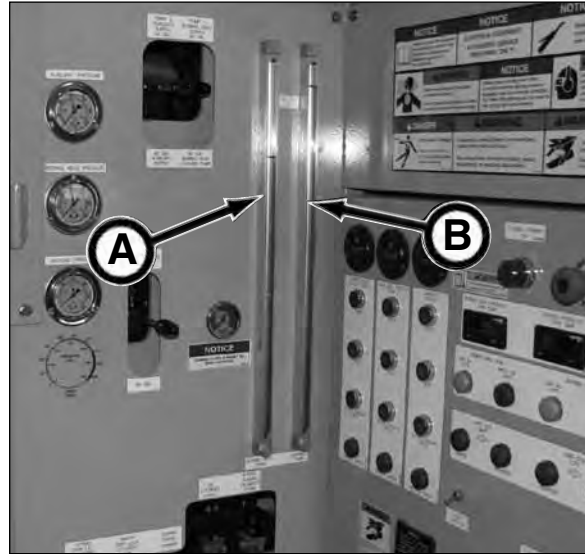


12. CHECK HYDRAULIC OIL RESERVOIR LEVEL & CONDITION OF OIL

1. Check reservoir hydraulic oil 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.
 - c. Large particle contamination from oil sample.

If any of these conditions are found, the reservoir must be drained, cleaned, and refilled with new hydraulic oil. Refer to Every 1000 Hours of Operation, "24. Drain & Replace Hydraulic Oil" in this section.

2. Check the hydraulic boring head reservoir gauge (A) and the jacking reservoir gauge (B) for the proper oil level. Keep oil maintained between the low and high marks on the gauge. If needed, add oil to the reservoir (refer to Filling Hydraulic Reservoirs in Section 6, Operation).



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Boring Head Tank Fill Quick Coupler Connection (C)



Jacking Tank Fill Quick Coupler Connection (D)

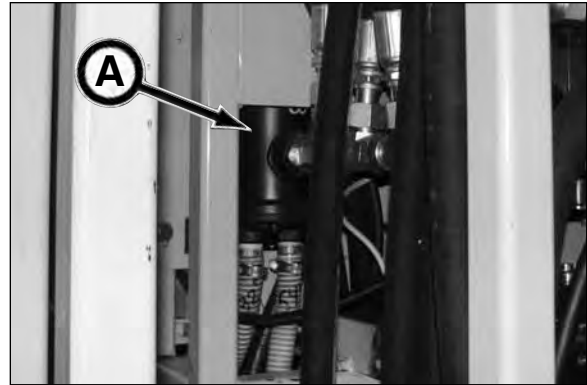


13. DRAIN HEAT EXCHANGERS

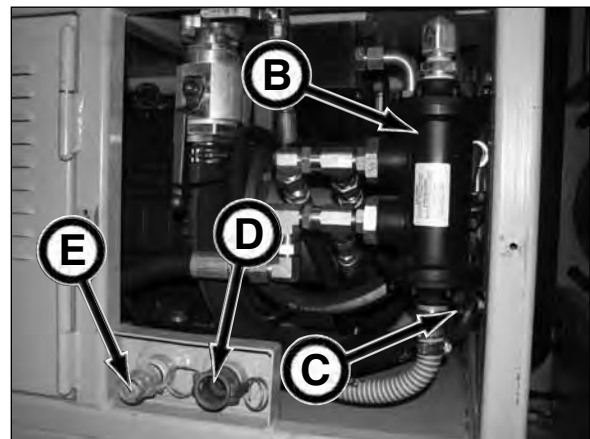
If the ambient temperature is expected to be near freezing 32°F (0°C) or below, drain the water from **BOTH** the boring head heat exchanger (A) and the jacking system heat exchanger (B). **Failure to drain water from heat exchangers will cause component damage.**

Drain heat exchangers as follows:

1. On the jacking system heat exchanger, remove drain plug (C).
2. Attach an air line to the heat exchanger water supply fitting (D).
3. Turn on air compressor (maximum 25 psi) and run until water no longer runs out of the heat exchanger water discharge outlet (E).
4. Remove air line from supply fitting and replace water supply hose.
5. Replace jacking system heat exchanger drain plug (removed in step 1).



Boring Head System Heat Exchanger

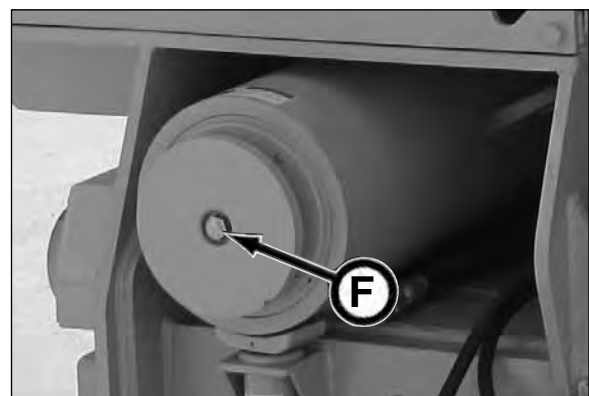


Jacking System Heat Exchanger

14. CHECK CYLINDER RAM PLATE HARDWARE

Check cylinder ram plate bolts (F) for damage. Be sure they are securely fastened against plate.

If damaged, replace with new 3/4 UNC x 2.5 bolt.

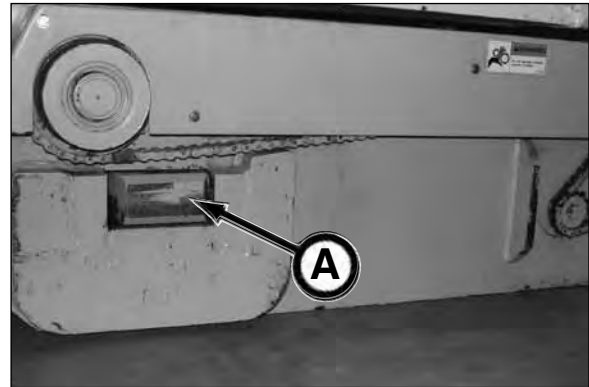


WEEKLY OR EVERY 50 HOURS OF OPERATION

15. INSPECT SKID LOCK BLOCKS

Inspect the skid lock blocks (A) (2 places) for burrs or damage from jacking.

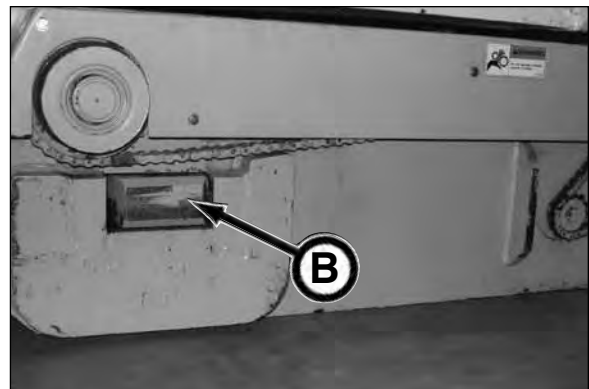
If burrs or damage are present, repair or replace dogs.



16. LUBRICATE SKID LOCK BLOCKS

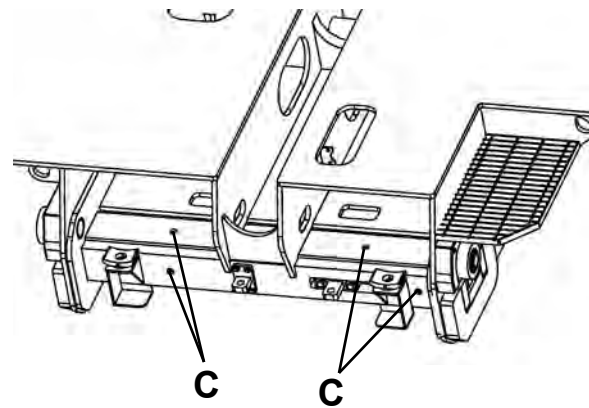
Grease the skid lock blocks (B) with 2 to 4 shots of Mobilgrease® XHP220 Premium Lubricating Grease at each of the eight skid lock block lubrication fittings (C) on the pump unit. Use Mobilgrease® XHP005 in lower temperatures as shown in the chart below.

Use Mobilgrease® XHP220 or XHP005 Lubricating Grease or equivalent when greasing the lubrication fittings.

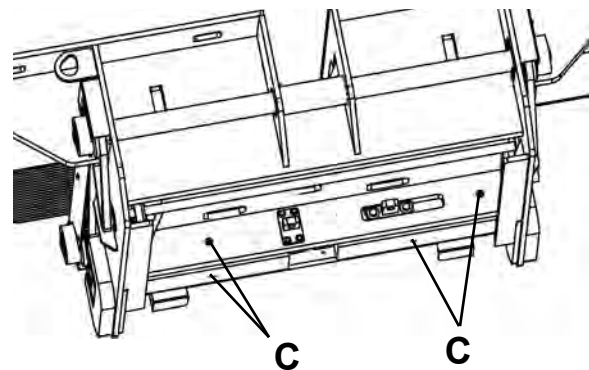


Recommended grease:

Ambient Temp.	Grease
-25°F to 32°F (-32°C to 0°C)	XHP005
0°F to 105°F (-18°C to 41°C)	XHP220



Front View Of Skid Lock Block Lubrication Fittings



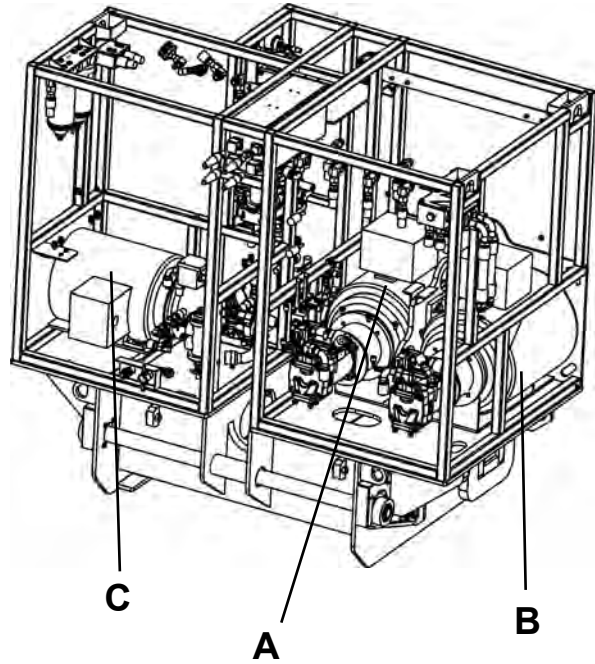
Rear View Of Skid Lock Block Lubrication Fittings

17. CHECK MOTORS

Inspect each motor (the 100 HP Boring Head motor (A), the 100 HP Auxiliary motor (B), and the 50HP jacking motor (C)) 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.

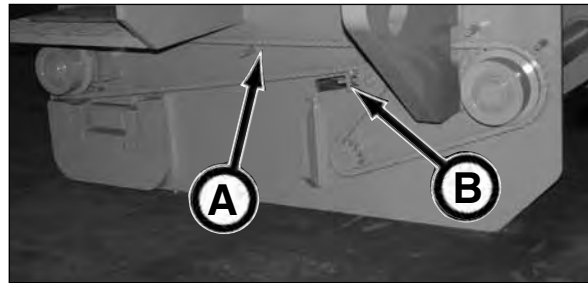
Grease and oil can be removed from the motors with a petroleum solvent.



MONTHLY OR EVERY 250 HOURS OF OPERATION

18. CHECK DRIVE CHAIN TENSION

1. Remove covers.
2. Check chain deflection at (A) on both right and left sides. 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 "19. Lubricate Drive Chain" in this section.
4. Replace covers.



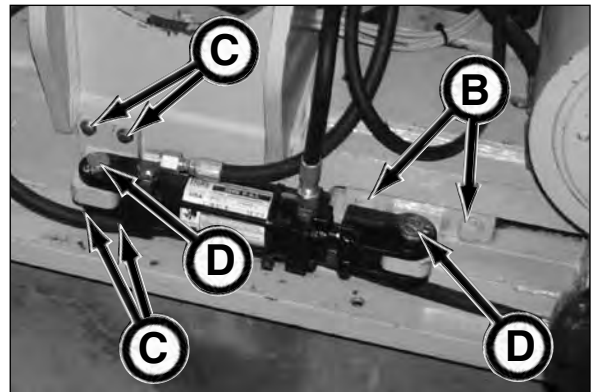
19. LUBRICATE DRIVE CHAIN

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



20. CHECK SKID LOCK LINKAGE

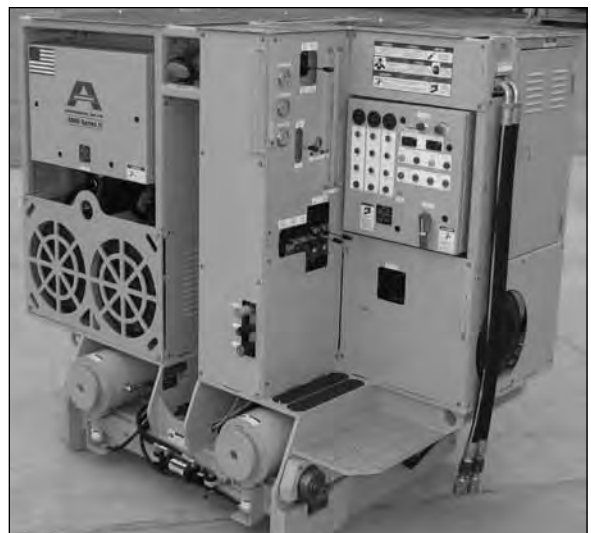
1. Check front skid lock linkage hardware (B), cylinder mount hardware (C) and cylinder pins (D) for tightness and damage. Replace loose or damaged hardware or pins as necessary.
2. Remove any dirt buildup.
3. Check rear skid lock linkage repeating steps 1 and 2.



21. PERFORM HYDRAULIC OIL ANALYSIS

Test the quality of your boring head and jacking 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.

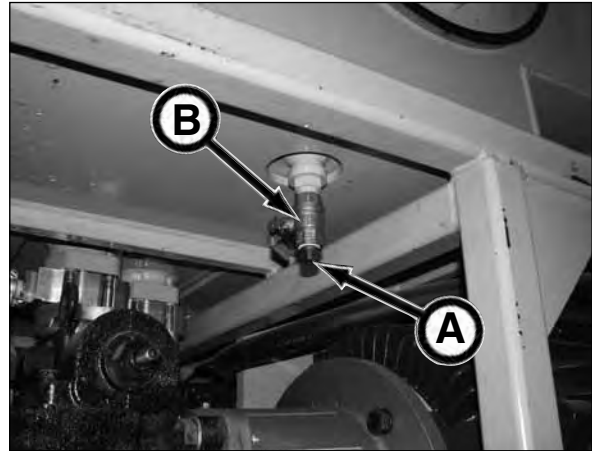


COMPLETION OF EACH DRIVE

22. DRAIN WATER FROM HYDRAULIC RESERVOIRS

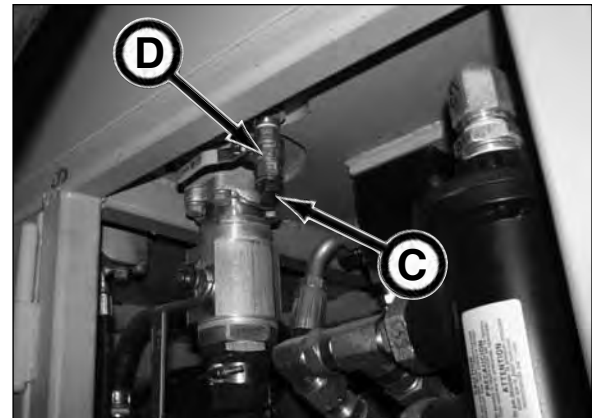
Remove water contamination from the hydraulic reservoirs by draining water from the boring head hydraulic reservoir and the jacking hydraulic reservoir at the completion of each drive.

1. With pump unit on level ground, allow oil in hydraulic reservoirs to settle overnight.
2. On the boring head reservoir, remove plug (A) and slightly open tank drain ball valve (B) and drain (into a properly sized catch pan) until there is no water in oil.
If desired to prevent drained fluids on pump unit components, install a 1/2" NPT hose to tank valve fitting and route hose to catch pan.
3. Once water is removed from tank, close tank drain ball valve, remove hose (if used) and reinstall plug.



Boring Head Reservoir

4. On the jacking reservoir, remove plug (C) and slightly open tank drain ball valve (D) and drain (into a properly sized catch pan) until there is no water in oil.
If desired to prevent drained fluids on pump unit components, install a 1/2" NPT hose to tank valve fitting and route hose to catch pan.
5. Once water is removed from tank, close tank drain ball valve, remove hose (if used) and reinstall plug.



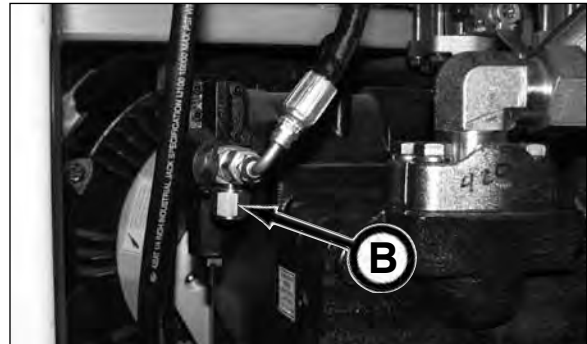
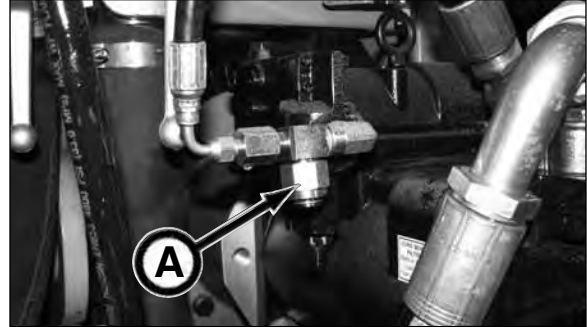
Jacking Reservoir

EVERY 500 HOURS OF OPERATION

23. REPLACE LOAD SENSE FILTERS

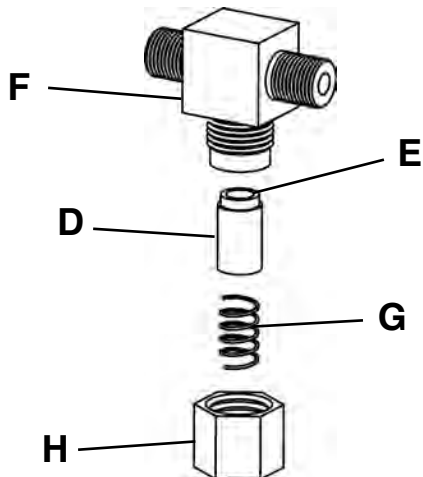
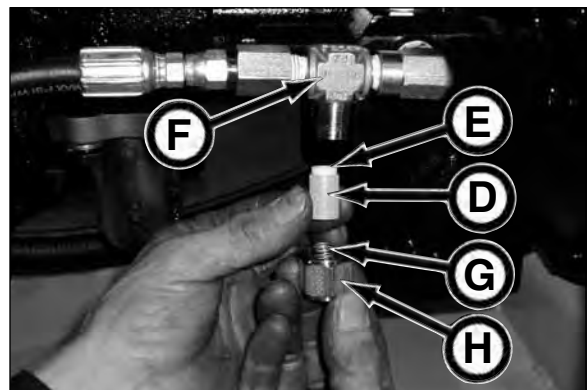
The load sense filters (boring head (A), auxiliary (B), jacking (C)) must be replaced at:

- 500 hours or yearly, whichever occurs first
- a major component fails
- any sign of water contamination
- a hydraulic oil sample indicates large particle contamination
- controls are sluggish



NOTICE Installing a load sense filter incorrectly, WILL cause pump malfunction.

1. Remove cap, spring and filter from filter head.
2. Insert new filter (C) with nylon ring end (D) into filter head (E).
3. Place spring (F) into cap (G).
4. Install cap onto filter head. Tighten to 10 ft-lb (13.6 N·m) torque.



Load Sense Filter Installation



EVERY 1000 HOURS OF OPERATION

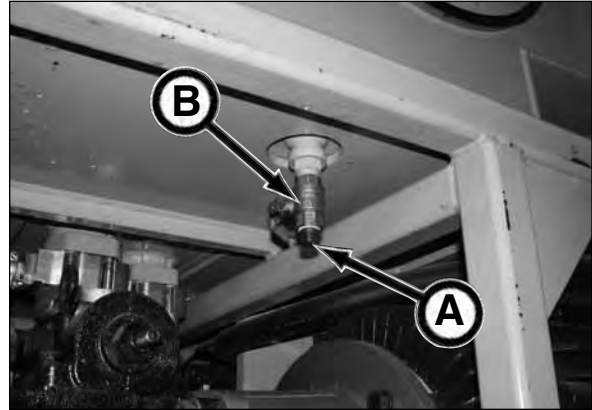
24. DRAIN & REPLACE HYDRAULIC OIL

Drain and replace the boring head and jacking hydraulic oil reservoirs every 1000 hours or if any of the following situations occur:

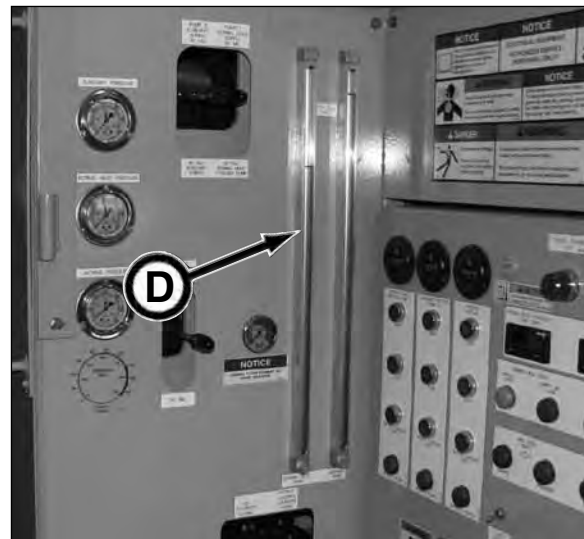
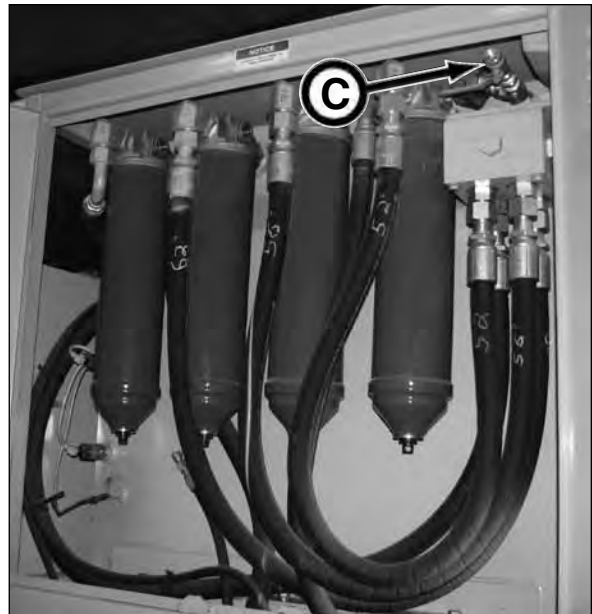
- A major component fails.
- Any sign of water contamination from an oil analysis or if oil is milky or foaming.
- A hydraulic oil sample indicates large particle contamination.
- Pump unit becomes engulfed in water.

To Drain/Fill Boring Head Oil Reservoir:

1. Remove plug (A) from tank drain valve (B).
2. Install a 1/2" NPT drain hose to tank drain valve fitting. Route/connect hose to a properly sized container.
3. Clean area around tank vent valve (C).
4. Open tank vent valve. This will help to speed up the draining time.
5. Open tank drain valve (B) to drain reservoir oil.
6. Once oil is drained, close drain valve (B), remove drain hose (if used) and reinstall drain plug (A).
7. Dispose of oil properly.
8. Check to be sure tank vent valve (C) is open to release excessive air while filling. Failure to open this valve while filling may cause tank seal to rupture.
9. Fill boring head reservoir (refer to Filling Hydraulic Reservoirs in Section 6, Operation).
10. Fill tank to proper level on gauge (D) with hydraulic oil specified in Section 8, Lubricants. Do not mix manufacturers or grades. Boring head hydraulic oil reservoir capacity is 160 gal (606 L).
11. Close tank vent valve (C). Failure to close this valve will result in reservoir contamination.
12. Check for leaks.



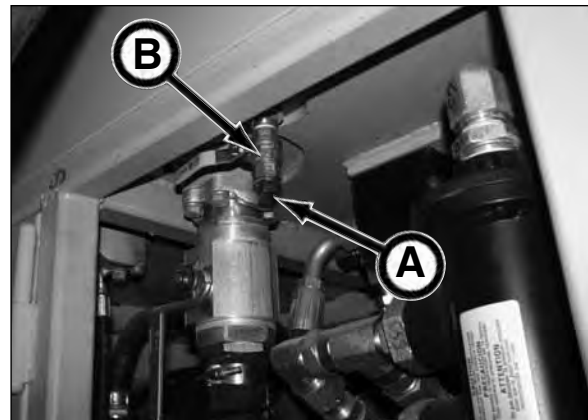
Boring Head Reservoir



SN F20400F-02 & After Shown

To Drain/Fill Jacking Oil Reservoir:

1. Remove plug (A) from tank drain valve (B).
2. Install a 1/2" NPT drain hose to tank drain valve fitting. Route/connect hose to a properly sized container.
3. Open tank drain valve (B) to drain reservoir oil.
4. Once oil is drained, close drain valve (B), remove drain hose (if used) and reinstall drain plug (A).
5. Dispose of oil properly.

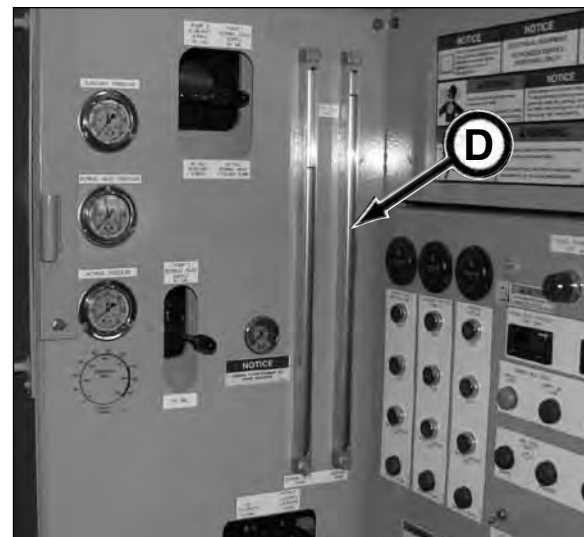


Jacking Reservoir

6. Clean area around Jacking Tank Fill connection (C).
7. Fill jacking reservoir (refer to Filling Hydraulic Reservoirs in Section 6, Operation).



8. Fill tank to proper level on gauge (D) with hydraulic oil specified in Section 8, Lubricants. Do not mix manufacturers or grades. Jacking hydraulic oil reservoir capacity is 100 gal (379 L).
9. Remove fill pump/hose from fill connection (C).
10. Check for leaks.



SN F20400F-02 & After Shown

ANNUALLY

25. LUBRICATE MOTOR BEARINGS

NOTICE For additional electric motor maintenance information, contact your Akkerman Aftermarket Support representative.

Lubricate the electric motor bearings (A) with two shots of Mobil Polyrex® EM grease or equivalent (refer to Grease Type below). There are two lubrication fittings on each of the three (boring head, auxiliary and jacking) electric motors.

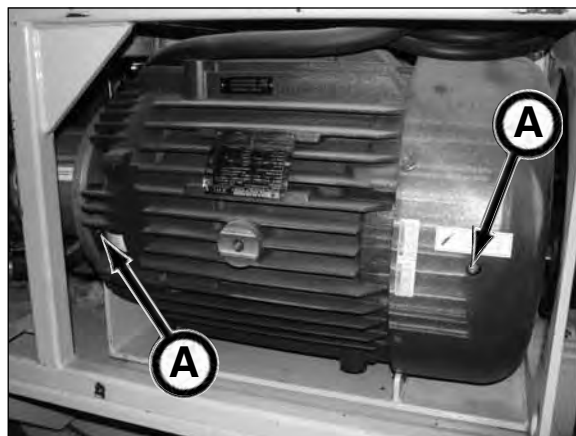
When adding lubricant, keep dirt out of the lubrication area. Wipe the fitting completely clean and use clean greasing equipment.

GREASE TYPE (unless nameplate states otherwise:

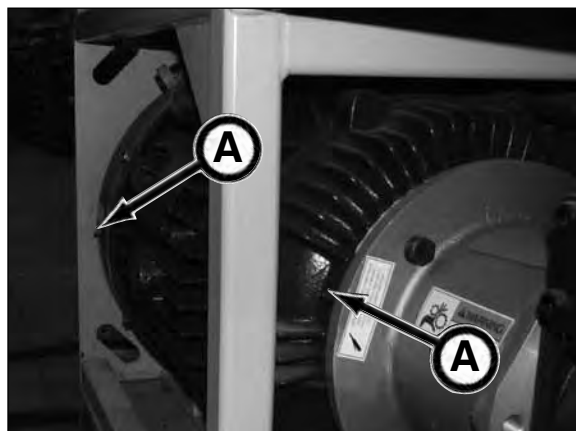
Nameplate Ambient Temperature between -22°F (-30°C) to 150°F (65°C) inclusive:

Recommended grease for standard service conditions is Mobil Polyrex® EM. Equivalent and compatible greases include: Texaco Polystar RB, Rykon Premium #2, Pennzoil Pen 2 Lube, Chevron SRI & Mobil SHC 100.

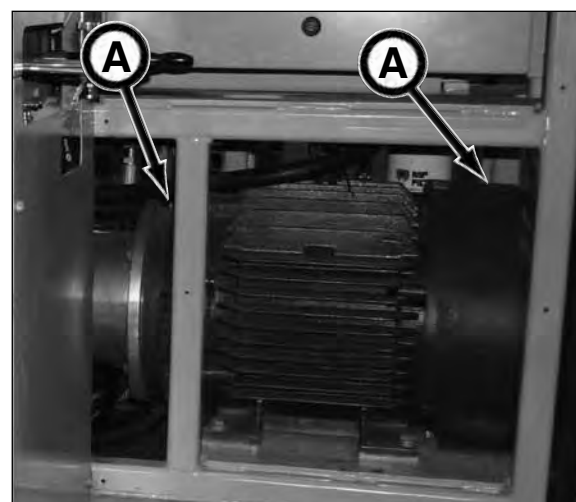
Nameplate Ambient Temperature below -22°F (-30°C): Special low temperature grease is recommended such as Aeroshell 7 or Beacon 325 for ball bearings and Mobil SHC 100 for roller bearings.



Boring Head Motor



Auxiliary Motor



Jacking Motor

NOTES

Storage

PREPARING FOR STORAGE

1. Repair worn or damaged parts.
2. Wash all equipment thoroughly.
3. Lubricate all grease fittings on the skid, yoke, and 5000 Series II 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 exchangers.
8. Drain hydraulic oil, replace with new hydraulic filters and refill hydraulic reservoirs. Check for leaks.
9. Wipe up lube spills. Dispose of rags and trash properly.
10. If possible, store equipment under cover and out of the weather in a ventilated area.
11. Review this Operator's Manual.

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.

NOTES

Troubleshooting

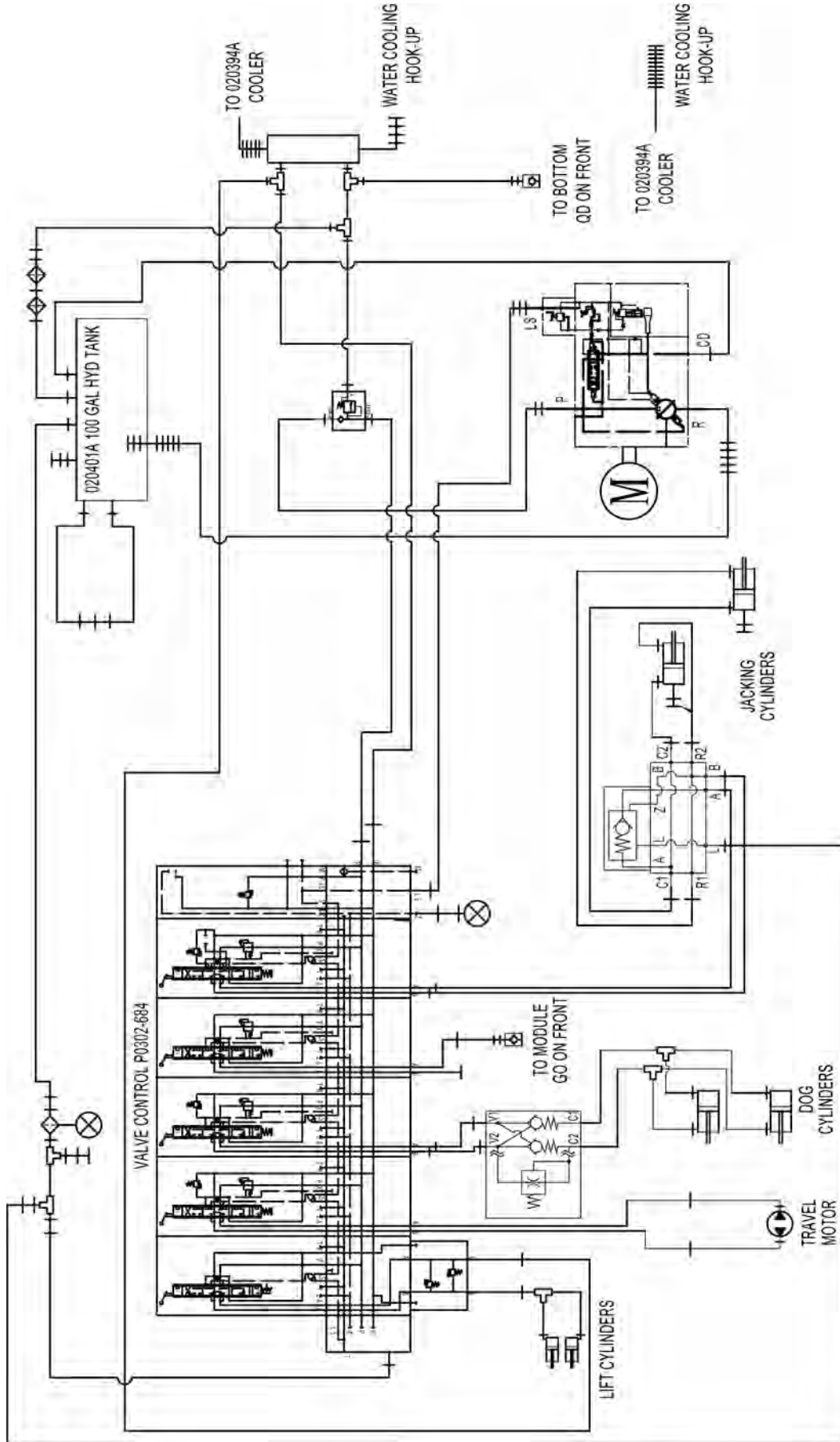
Problem	Cause	Solution
Pump Unit push cylinders stall before reaching max. operating pressure (5,100 psi).	Pump compensator set below maximum setting.	Adjust.
	Main relief set below max. setting.	Adjust.
	Worn or damaged cylinder seals.	Replace seals.
	Worn or damaged control valve seals.	Replace seals.
	If cylinders continue to stall, contact your Akkerman Aftermarket 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.
	If cylinders continue to collapse, contact your Akkerman Aftermarket Support Representative.	
The 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.
	Low oil level reaches empty sensor.	Fill reservoir with oil.
	Motor overload.	Reset overload.
	Generator or power supply faulty.	Repair or replace.
	Faulty Start/Stop switch.	Replace switch.
	Faulty low oil level switch or relay.	Replace switch.
	If motors will still not start, contact your Akkerman Aftermarket Support Representative.	
Hydraulic oil temperature gauge exceeds 150°F (66°C).	Heat exchanger water supply not adequate.	Water supply must be a minimum of 20 gpm. If 80°F+, use 25 gpm.
	Operating with a 90/30 GPM supply.	Reset to 60/60 GPM supply.
	Excessive water 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.
	If oil temperature continues to exceed 150°F (66°C), contact your Akkerman Aftermarket Support Representative.	

Troubleshooting

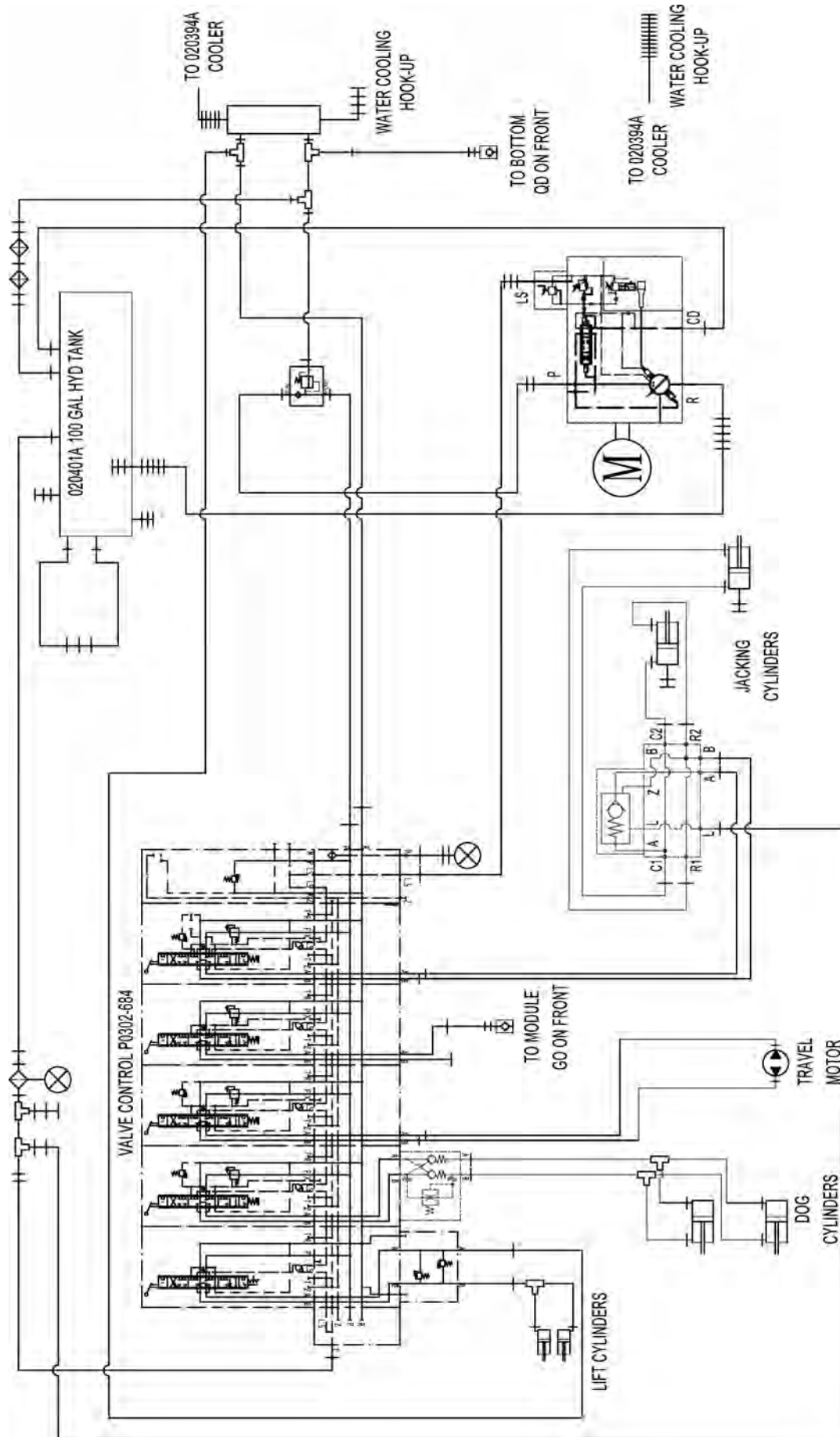
Problem	Cause	Solution
Boring head supply gauge frequently reaches 2,800 psi.	Tank ball valve closed.	Open ball valve.
	Pipe advancement rate too fast.	Slow main ram thrust.
	Too few cutter bar drive motors.	Reduce advancement rate or install additional motors, if possible.
	Single feed supply to boring head	Change to dual feed supply.
	Incorrect cutter bar selected for ground condition.	Change cutter head.
	(Pre Series II TBMs Only) Worn or damaged TBM inner drum thrust roller bearings.	Replace bearings.
	(Pre Series II TBMs Only) Worn or damaged TBM inner drum rollers.	Replace rollers.
	If boring head supply gauge continues to frequently reach 2,800 psi, contact your Akkerman Aftermarket Support Representative.	
Pump Unit motors start but no oil pressure is available.	Tank ball valve closed.	Open supply shutoff valve.
	Incorrect motor rotation.	Rewire motor for proper rotation.
	Electrical phase error.	Reverse power leads.
	Faulty relief valve.	Replace valve.
	Low standby pressure.	Adjust to 220 psi.
	Worn or damaged hydraulic pump.	Repair or replace pump.
		If there continues to be no oil pressure, contact your Akkerman Aftermarket Support Representative.
Valve functions (jacking, travel, IJS, cylinder lift and skid lock controls) do not operate.	Tank ball valve closed.	Open jacking supply shutoff valve.
	Valve pump is not running.	Start up jacking motor.
	Low oil level reaches empty sensor.	Fill reservoir with oil.
	Load sense filter clogged.	Replace load sense filter.
	Low or no standby pressure.	Adjust to 220 psi.
		If the jacking valve functions continue to not operate, contact your Akkerman Aftermarket Support Representative.

NOTES

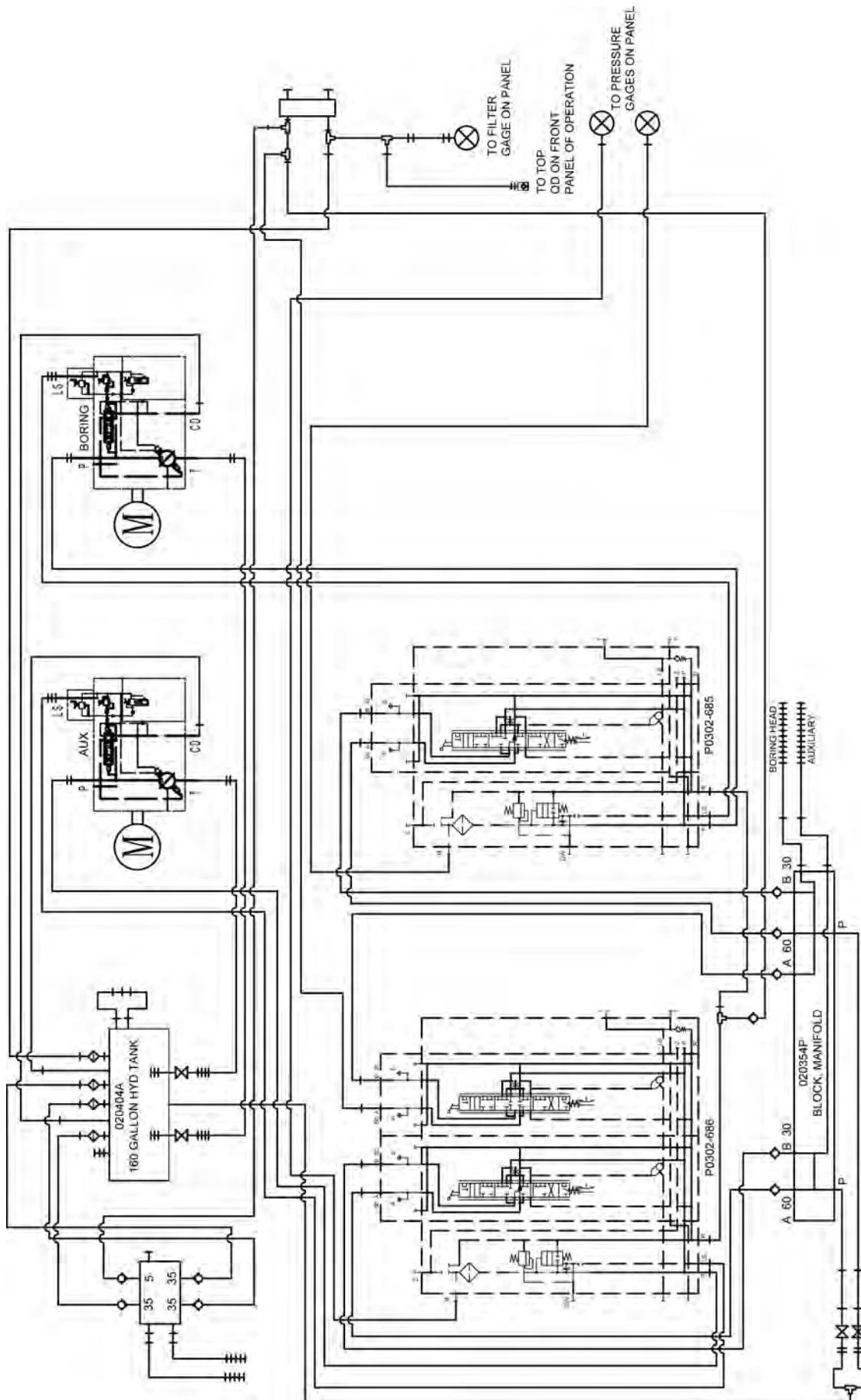
5000 SERIES II (SN F20400F-01) HYDRAULIC SCHEMATIC - 100 GALLON



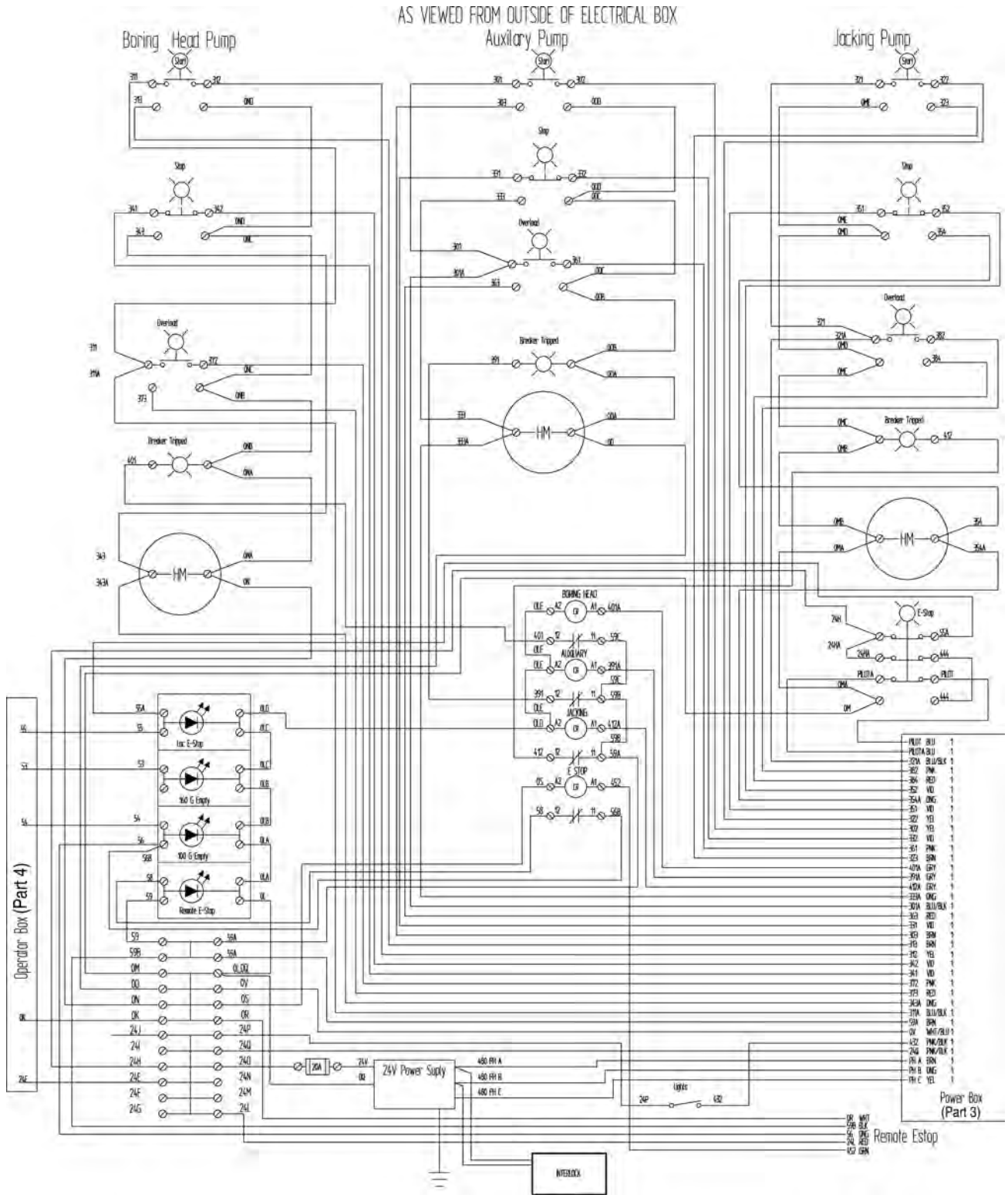
5000 S II (SN F20400F-02 & AFTER) HYDRAULIC SCHEMATIC - 100 GALLON



5000 SERIES II PUMP UNIT HYDRAULIC SCHEMATIC - 160 GALLON



5000 SERIES II PUMP UNIT ELECTRICAL SCHEMATIC - PART 1 OF 4



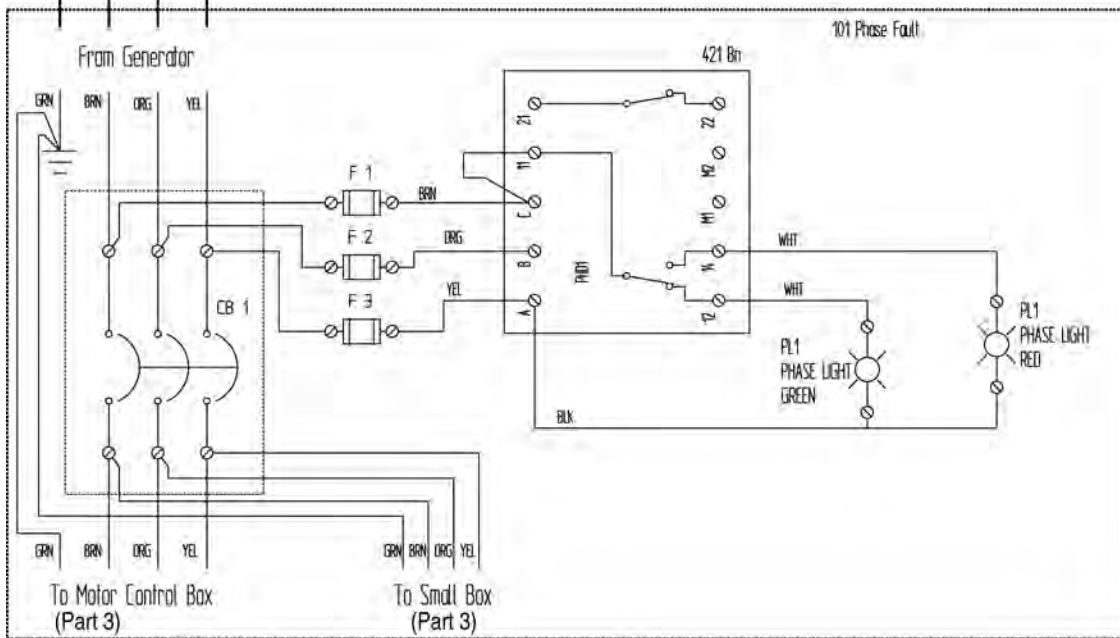
5000 SERIES II PUMP UNIT ELECTRICAL SCHEMATIC - PART 2 OF 4

- CB1 P0251-429 400A Main Breaker
- F1 - F3 P0310-473B Fuse holder
- P0310-954 1A Fuse
- PHD1 P0251-443 Phase Detector
- PH1 P0251-463 Pilot Light
- P0251-464 Pilot Light Lens

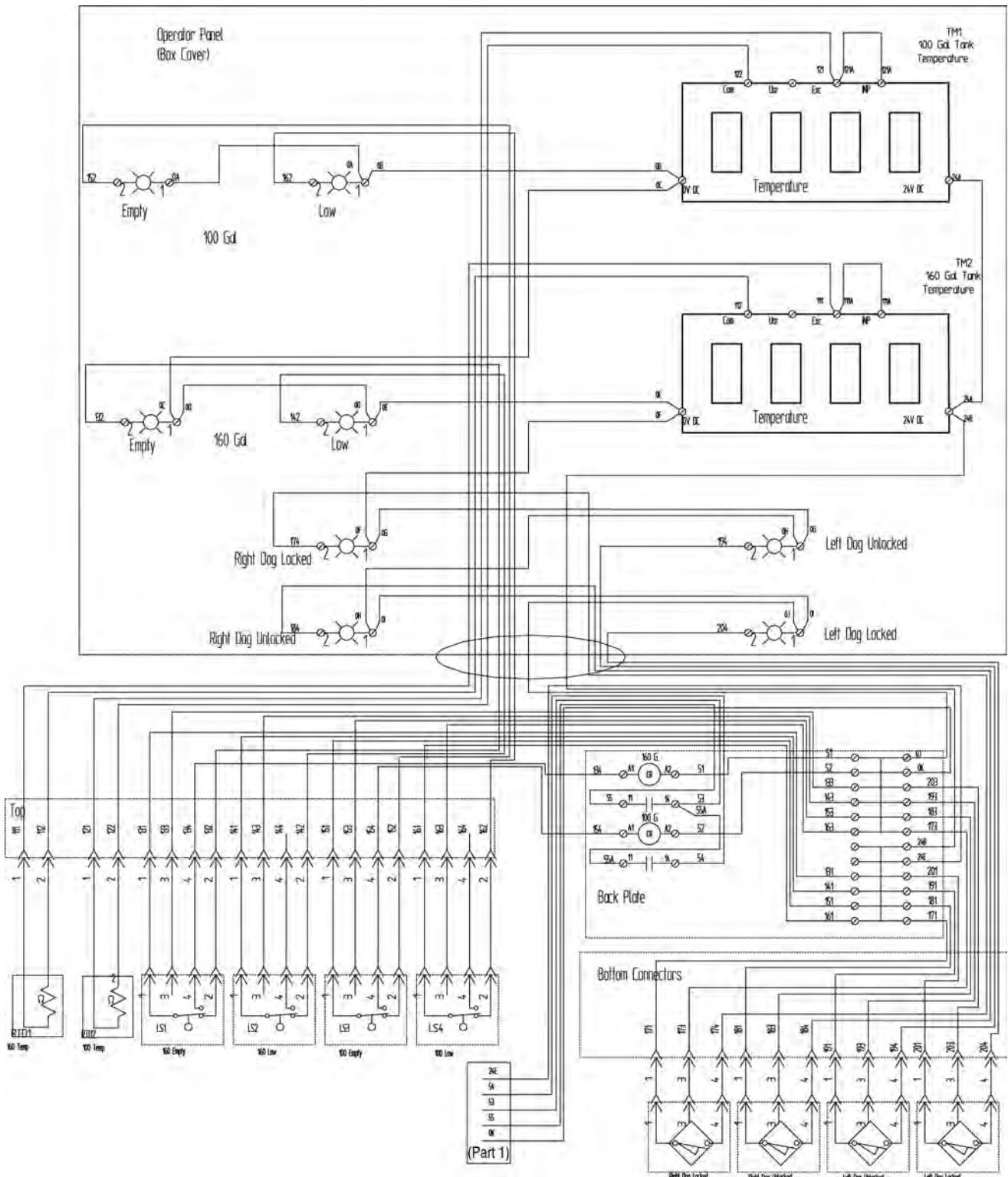
- REFERENCE -

F20623F

STARTER CABLE

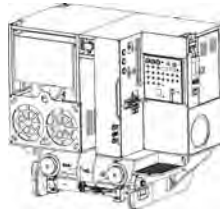


5000 SERIES II PUMP UNIT ELECTRICAL SCHEMATIC - PART 4 OF 4



Specifications

5000 SERIES II PUMP UNIT



Dimensions
 Height 90" (2,286 mm)
 Width 102" (2,591 mm)
 Depth 62" (1,575 mm)

Weight
 With Oil 17,200 lbs. (7,802 kg)

Thrust
 Total 400 Ton (363 t)
 (Two 200 ton, 36" stroke cylinders)

Hydraulic Supply
 - Three independent hydraulic systems for jacking and TBM supply functions.
 - Individual hydraulic oil coolers for the jacking and TBM hydraulic systems. Cooling water must be supplied for heat exchangers.

Low Pressure (TBM & Conveyor)

- A 100 HP (74 kW) electric motor provides power for 30 or 60 GPM load sense, variable volume pump @2,800 psi. Maximum pressure is 3,000 psi.
 - A second 100 HP auxiliary electric motor provides power for an additional 30 or 60 GPM load sense, variable volume pump @ 2,800 psi. Maximum pressure is 3,000 psi.

High Pressure (Jacking & IJS Cylinders)

- A 50 HP electric motor provides power for 0 to 26 GPM load sense, horsepower limiting, variable volume pump.

Maximum pressure

Jacking 5,100 psi
 IJS 6,000 psi

Hydraulic Reservoir Capacity

Boring Head /Auxiliary 160 gal. (606 L)
 Jacking 100 gal. (379 L)

Heat Exchanger Cooling Water Supply

Minimum below 80°F water temp 20 GPM
 Minimum above 80°F water temp 25 GPM

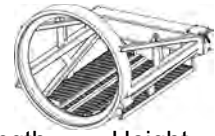
Electrical

Supply 400A, 480 V, 60 Hz, 3 Phase
 Cable 4/0 x 100'

Pit Height (Minimum)

With Pump Unit and Skid 110" (2,794 mm)

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



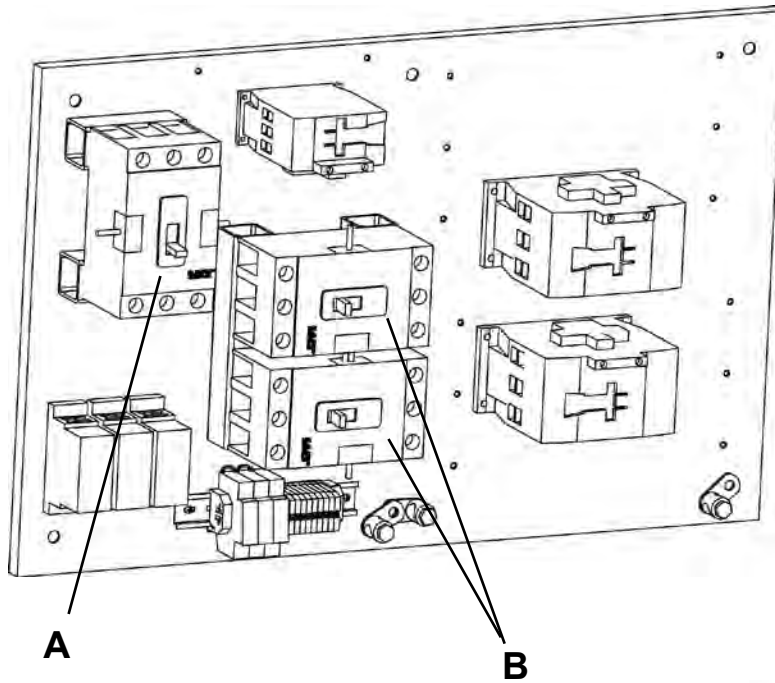
Model	Width	Length	Height
Skid 2.5 Foot	80" (2,032mm)	30" (762mm)	25.5" (648mm)
Skid 7.5 Foot	91" (2,311mm)	90" (2,286mm)	25.5" (648mm)
Skid 15 Foot	91" (2,311mm)	180" (4,572mm)	25.5" (648mm)
Skid 22.5 Foot	91" (2,311mm)	270" (6,858mm)	25.5" (648mm)

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)

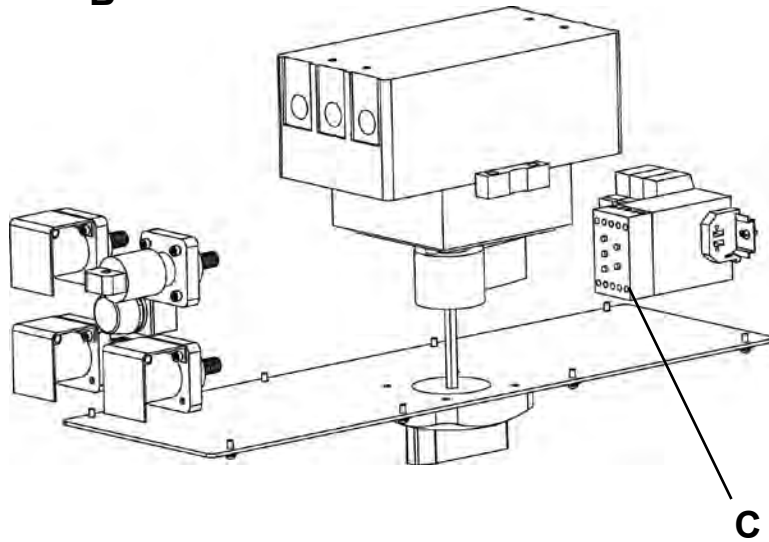
Akkerman reserves the right to improve its product without notice or obligation.

RELAY SETTINGS



Located In
Main Power Panel

Located In
Main Disconnect
Electrical Box



50 HP Overload Relay (A)

FLA D
Class N

100 HP Overload Relay (B)

FLA F
Class N

Phase Check Relay (C)

Undervoltage 80%
Nominal Voltage 480
Unbalance 10%
Time Delay Undervoltage (Seconds) 0.1
Time Delay Restart (Seconds) 1

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)

NOTES

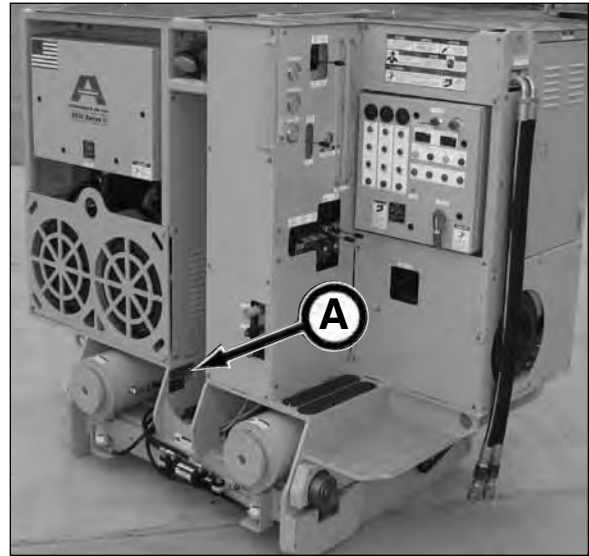
Identification Numbers

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 _____

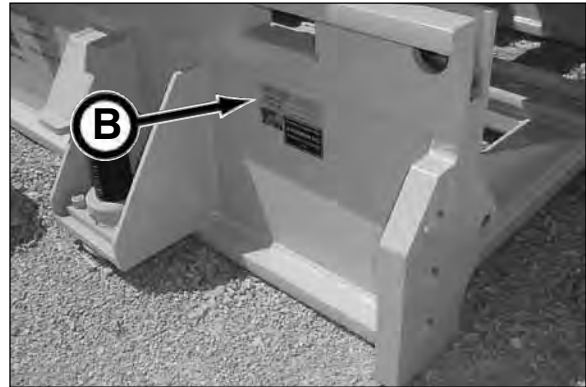
Serial Number _____



SKID (B)

Model Number _____

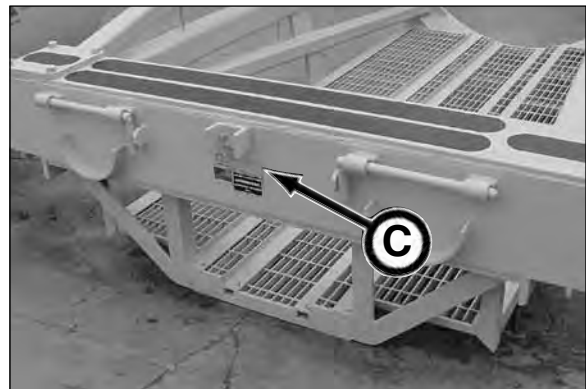
Serial Number _____



YOKE (C)

Model Number _____

Serial Number _____



NOTES

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 will provide, at no cost, MSDS which apply to its product line. Simply contact your Akkerman Aftermarket 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.

NOTES

Warranty

Akkerman 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 does not warrant the fitness of its equipment for a particular purpose or application.

Warranty

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