AKKERMAN®

TRENCHLESS EQUIPMENT SPECIALISTS

OPERATOR'S MANUAL

Guided Boring Machine

GBM S/N: A40019 & A40020

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SERVICE • RELIABILITY • INNOVATION

Introduction

This operator's manual contains important safety, operation, and maintenance information for your Akkerman Guided Boring Machine (GBM). You must read and understand this manual before you operate and maintain this equipment. Keep this manual with your Guided Boring Machine at all times. Additional copies of this manual may be purchased from the Akkerman Product Support Department, or downloaded from the Akkerman web site at www.akkerman.com.

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

The use of second rate parts could affect the efficient performance of the GBM. 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.

Guided Boring Machine

The Guided Boring Machine (GBM) installs small diameter pipes with the grade and alignment precision the gravity sewer and water industry demand. The GBM works in conjunction with a specially designed theodolite guidance system to provide extremely accurate pipe installation. Accurate pipeline installation is achieved through video monitor surveillance of an illuminated target via theodolite. Pilot head steering is accomplished by aligning an angled pilot head, or steering head, to the desired course with forward thrust. Pilot tubes are installed behind the steering head and rotated while simultaneously thrusting forward. After the steering head has reached the reception shaft, a reaming head and auger tubes with flighting are installed behind the pilot tubes. With the addition of each section of auger tube in the launch shaft, a section of pilot tube is removed in the reception shaft. The process is repeated until all pilot sections have been removed. A pipe adapter is then installed on the last section of auger casing and subsequent pipes thrust into place while the auger tubes are removed from the reception shaft.

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

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

NOTES

Contents

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 hard hat, 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.

LOCKOUT POWER BEFORE SERVICING

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

LOCKOUT main power supply before servicing. Electrical repairs must be performed only by a certified electrician.

MAINTAIN BATTERY SAFELY

⚠WARNING Batteries produce explosive gases.

Wear eye protection and protective clothing during battery service.

Keep sparks, flames, and cigarettes away from batteries.

Contact with battery acid can cause severe burns. Flush immediately and thoroughly with clean water. Get medical attention immediately.

Charge a battery only in a well-ventilated area.

Never charge a frozen battery.

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.

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.

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 instantly.

Do not enter area under or around a load.

KEEP PERSONNEL AWAY FROM MOVING PARTS

⚠WARNING Crushing hazard.
Keep personnel away from inside of GBM when jacking or moving GBM. Failure to do so could result in serious personal injury or death.

USING PLUMB BOB

⚠WARNING Falling plumb bob can cause serious personal injury or death, and/or equipment damage.

NEVER hang or secure the plumb bob overhead when not in use.

ALWAYS remove the plumb bob from the string lines and place in storage container after use.

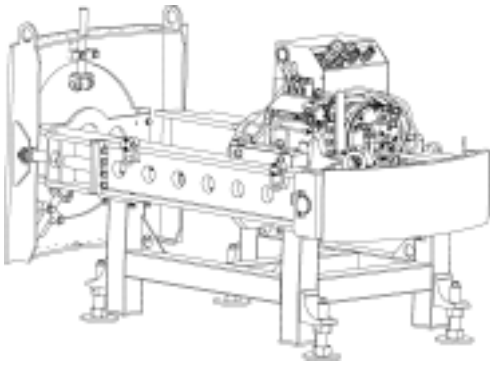
HANDLING AUGER CASINGS

⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits an obstruction.

Properly install safety chain assembly to augers and casings before lowering into or lifting out of shaft.

Do not stand or walk under a load.

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 GBM before making repairs, adjustments, or removing obstructions.

Only trained and qualified personnel should perform 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.

AVOID PINCH POINTS

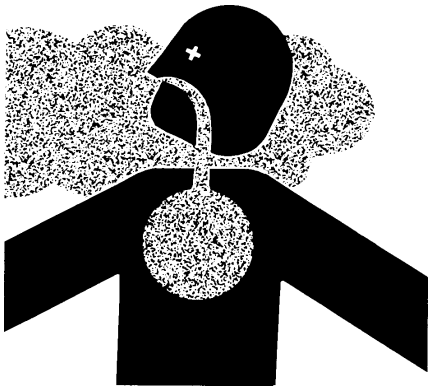
⚠WARNING Moving parts or the mishandling of parts can cause severe personal injury.

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.

TEST TUNNEL & SHAFT VENTILATION



⚠WARNING Keep tunnel and shafts well ventilated at all times.

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

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

If the levels exceed OSHA prescribed levels, leave tunnel and shaft 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/shaft, cut power from power source.

Gases must be removed before reentering tunnel/shaft.

REFUELING

⚠WARNING Fires and explosions can cause serious injury or death.

Handle fuel with care. It is highly flammable.

DO NOT refuel power pack while smoking or when near open flame or sparks.

Always stop engine before refueling power pack.

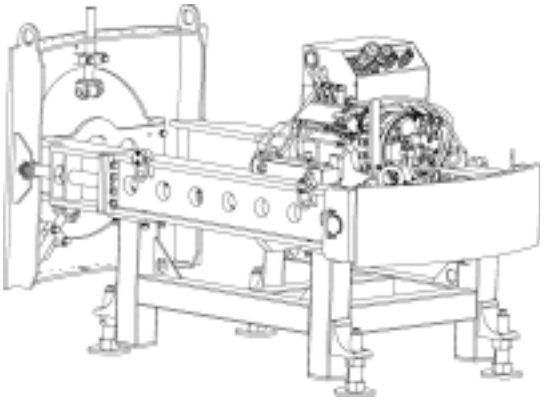
FIRE PREVENTION

⚠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.

HIGH PRESSURE HYDRAULICS



⚠WARNING The GBM contains high pressure hydraulics.

Keep all guards in place.

KEEP JOB SITE CLEAN AND ORGANIZED

⚠WARNING Tripping can cause serious personal injury.

Be sure to keep job site clean and organized.

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 AWAY FROM AUGER

⚠DANGER Contact with rotating auger will cause severe injury or death.

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

Do not operate without covers and guards in place.

Lockout power before servicing.

COOLING SYSTEM

⚠WARNING Cooling system under pressure. Explosive release of HOT engine coolant can cause severe burns. SLOWLY remove the radiator cap ONLY if the engine is cool.

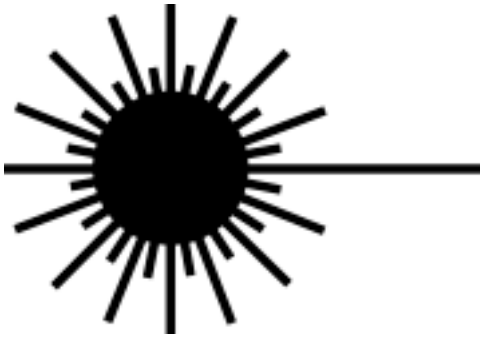
NO SMOKING IN TUNNEL

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

Do not smoke in tunnel.

AVOID LASER LIGHT EXPOSURE

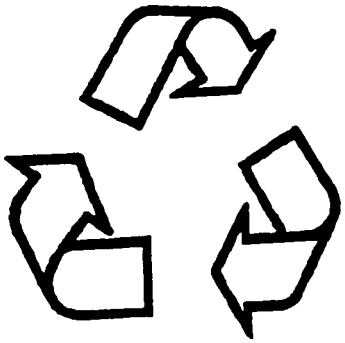
⚠ DANGER Staring into laser light will cause severe injury.



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.

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.

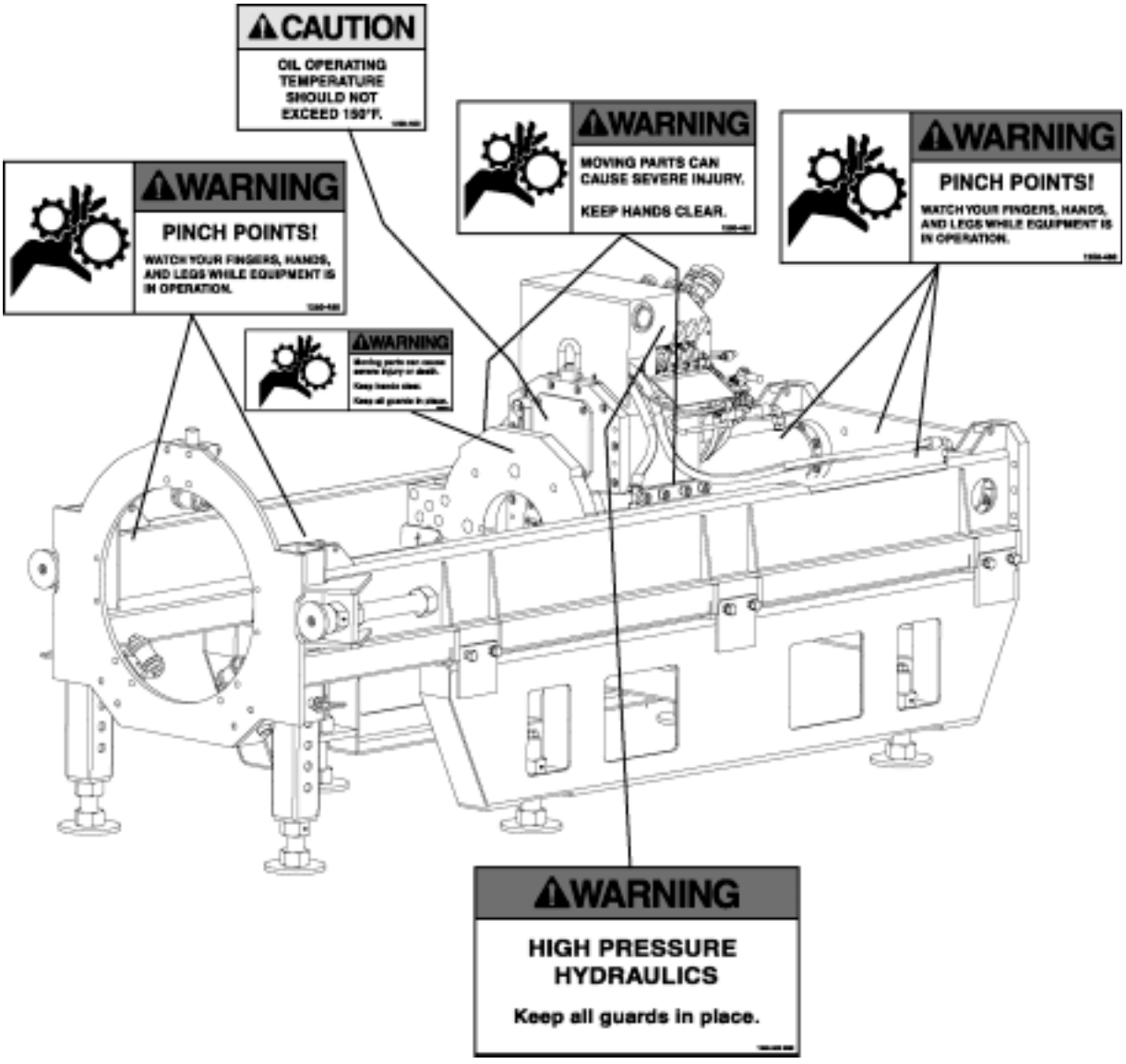
Safety Decals

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

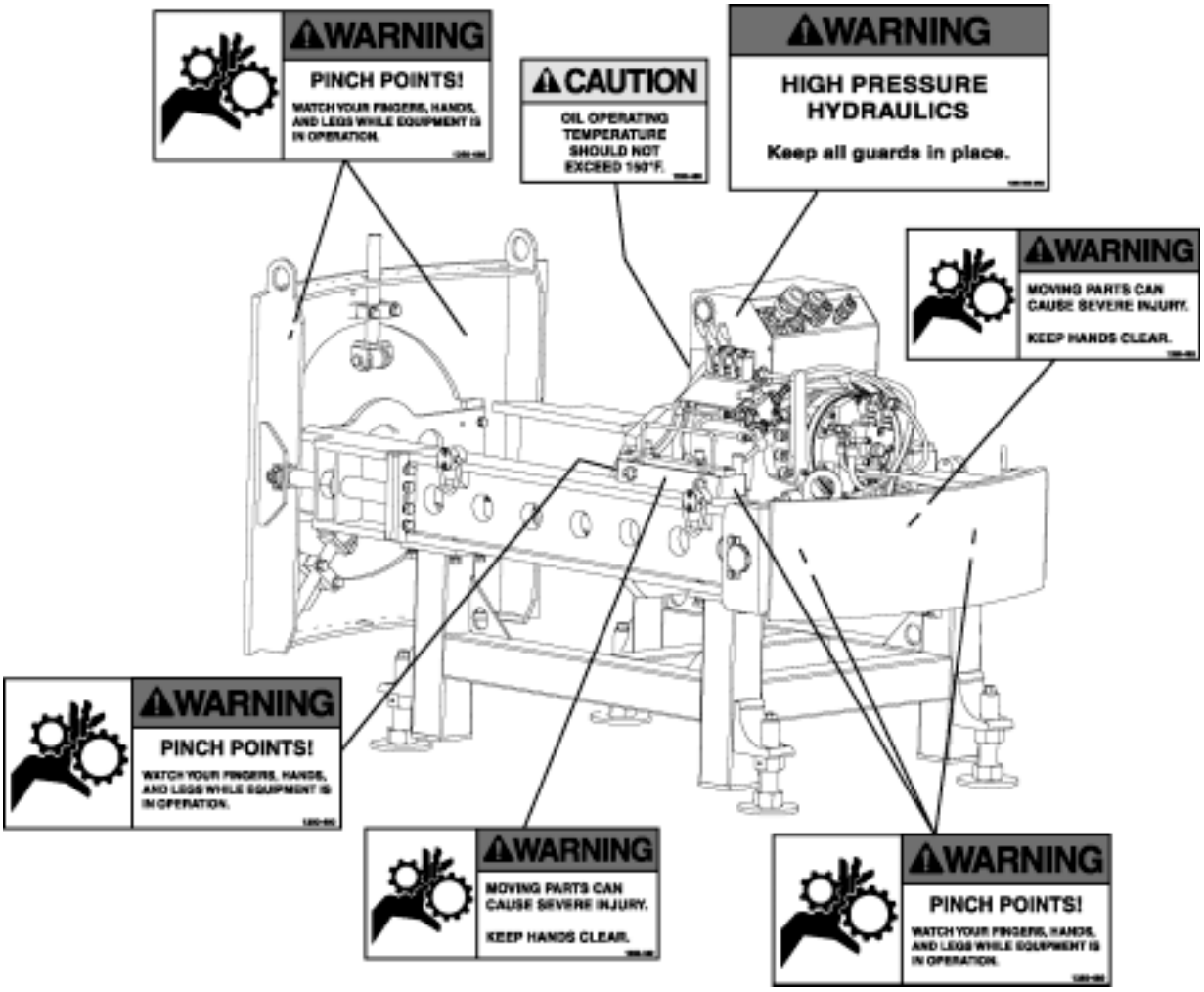
Serious injury or property damage can occur if safety instructions are not followed. Contact your Akkerman Product Support representative for free replacement safety decals.

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

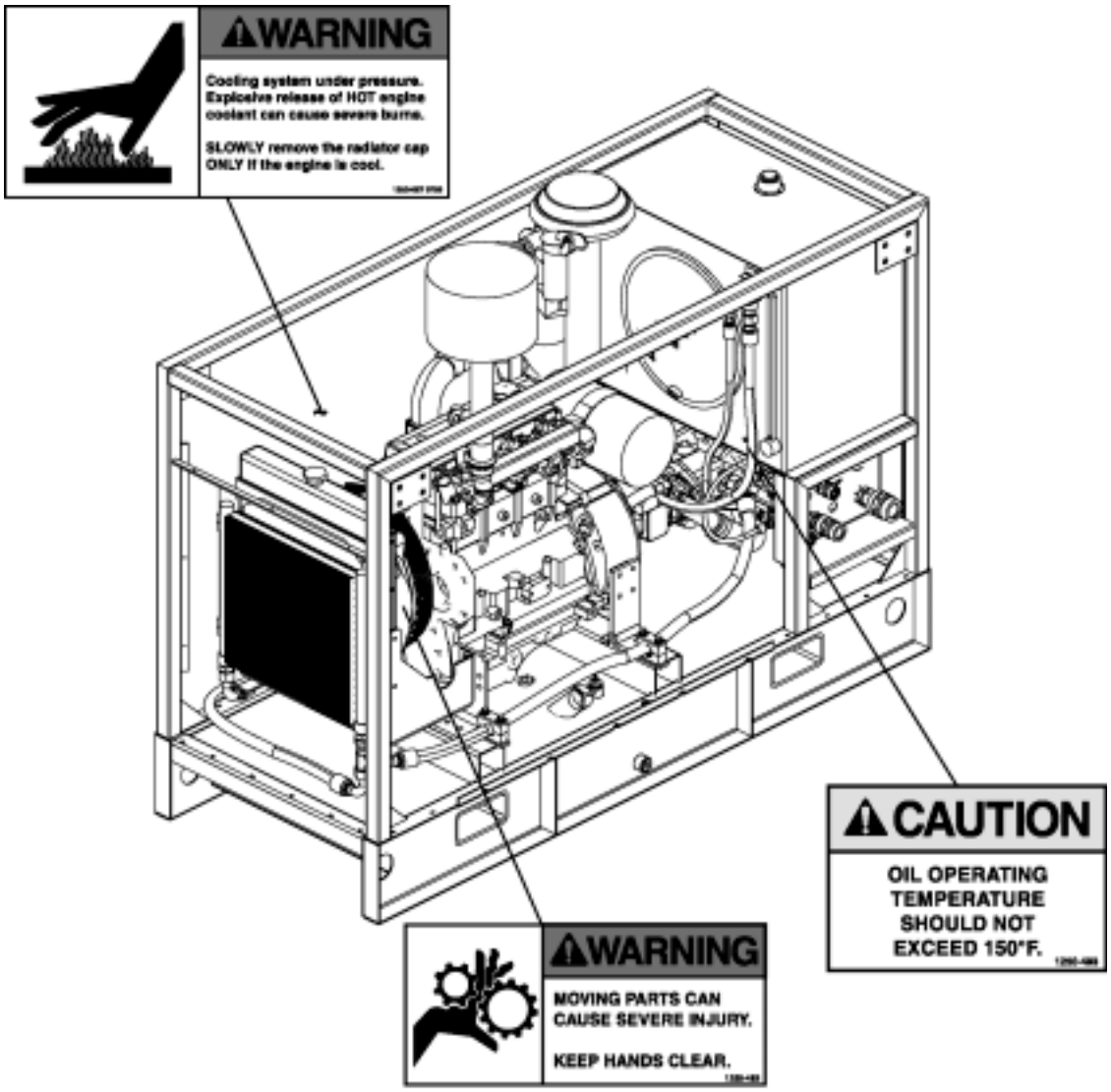
GBM - SINGLE STAGE FRAME



GBM - LATCHING FRAME



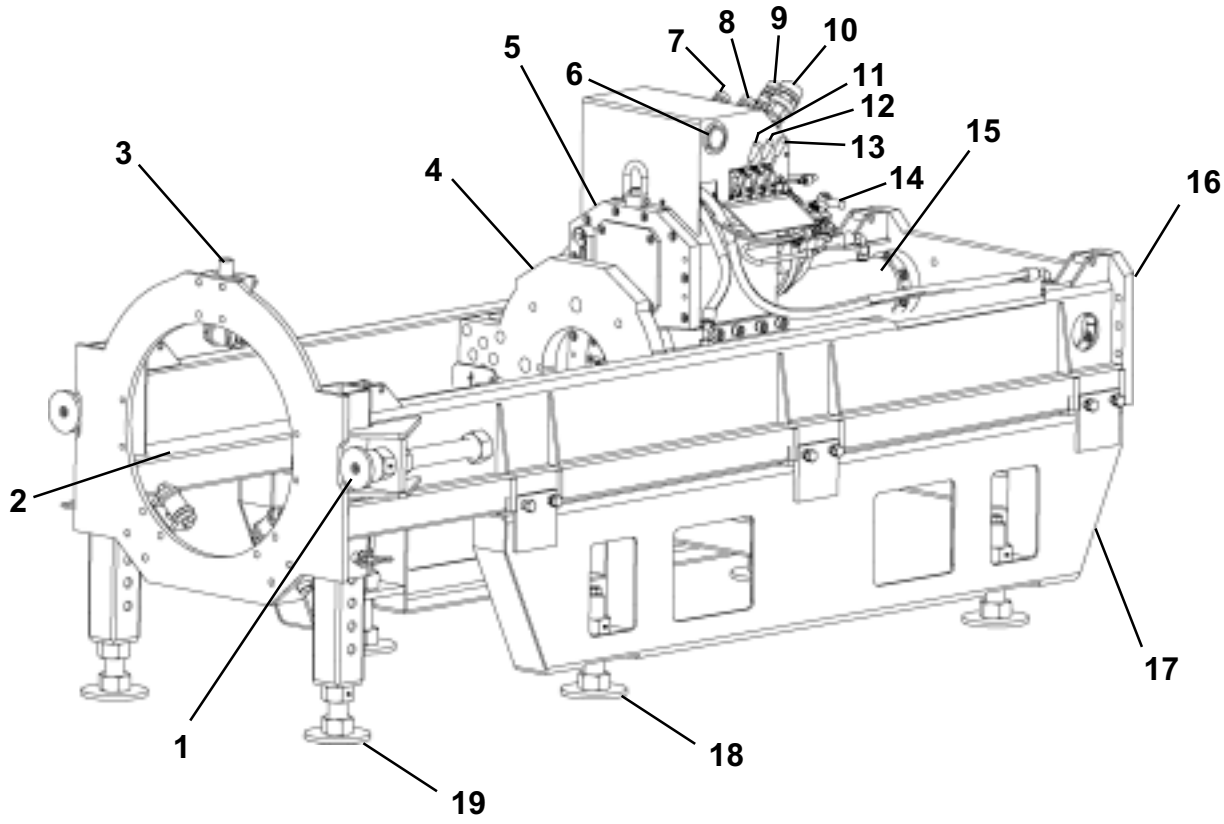
GBM - POWER PACK



2 Required

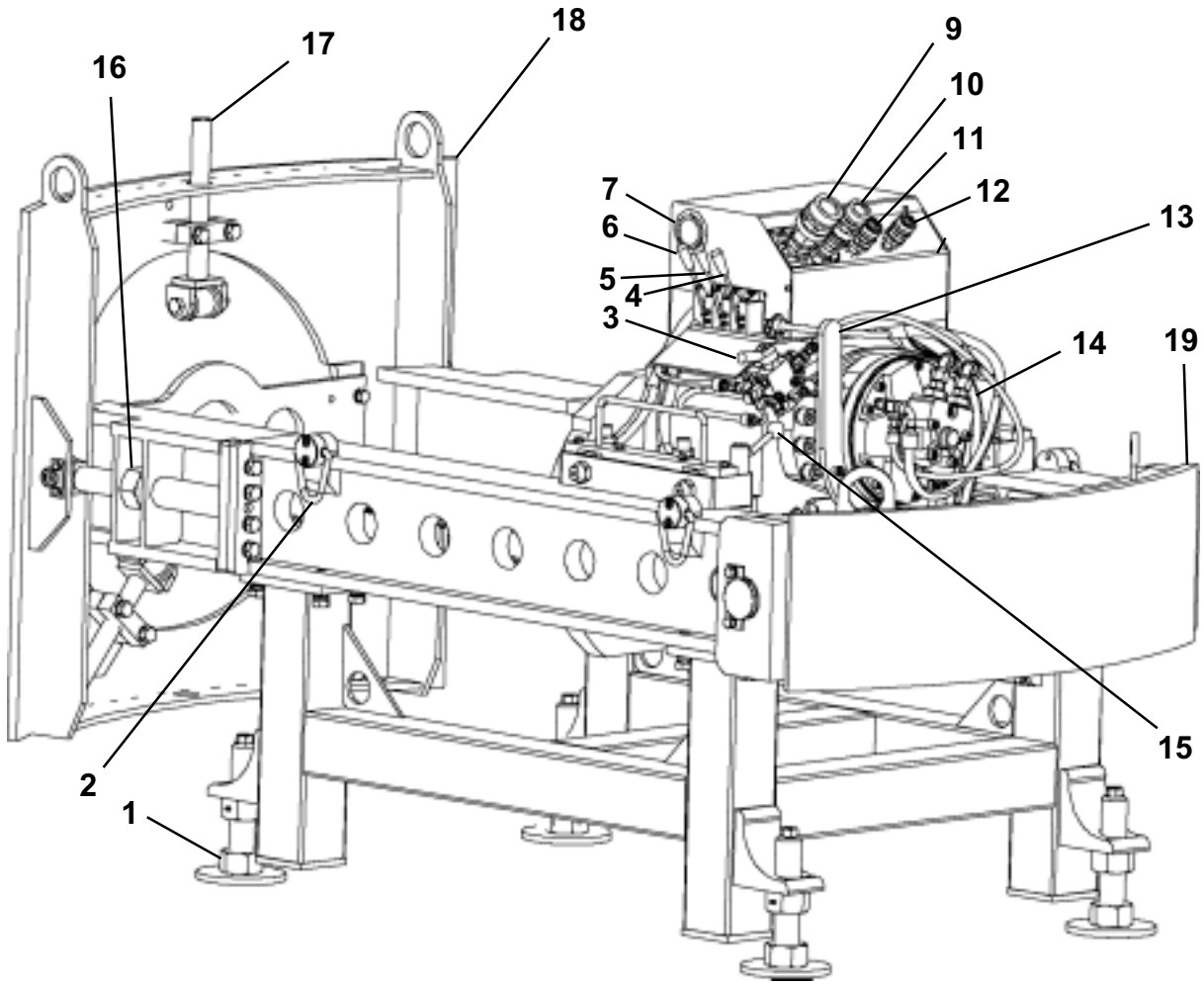
Terminology

GBM SINGLE STAGE FRAME



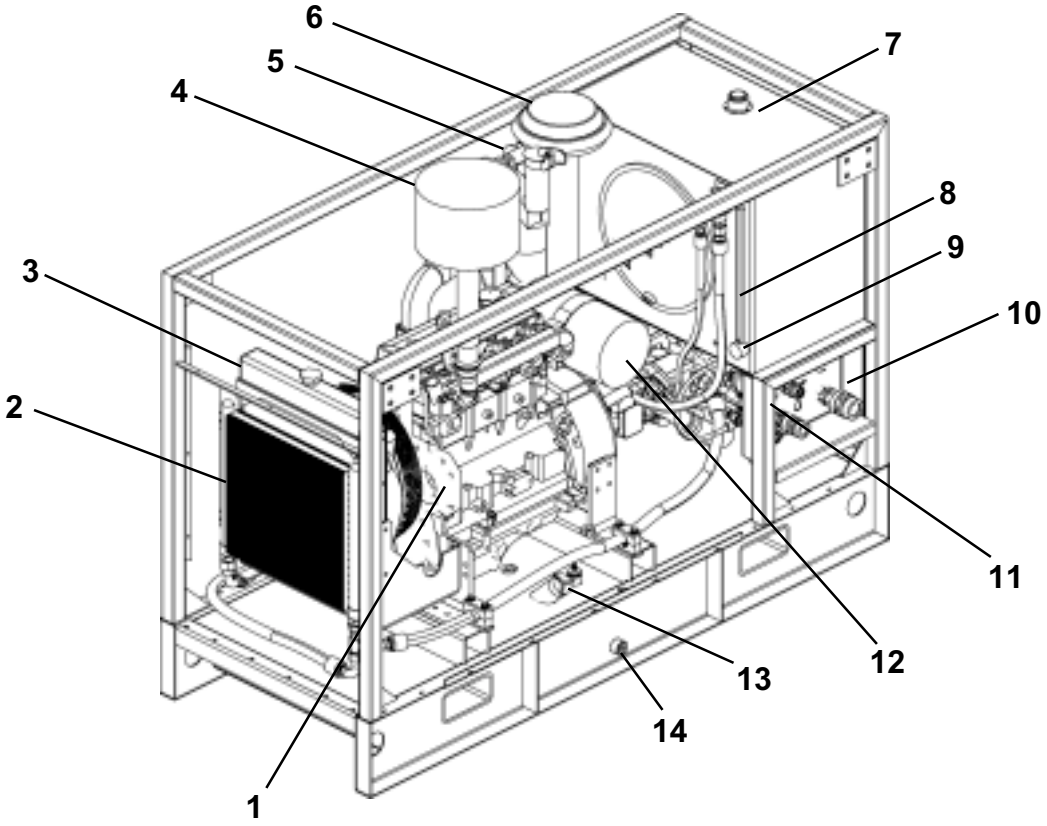
1. Shaft Tensioner
2. Drilling Guide
3. Roller Bracket Assembly
4. Thrust Plate
5. Thrust Frame Assembly (includes Gear Box)
6. Pressure Gauge
7. Load Sense Connector
8. Case Drain Connector
9. Pressure Connector
10. Return Line Connector
11. Drilling Frame Travel Cylinder Control
12. Drilling Drive Rotation Control
13. Auxiliary
14. Drilling Drive Speed Selector
15. Thrust Cylinders
16. Drilling Frame
17. Lower Base Frame Assembly
18. Leveling Assembly
19. Stabilizer Leg

GBM LATCHING FRAME



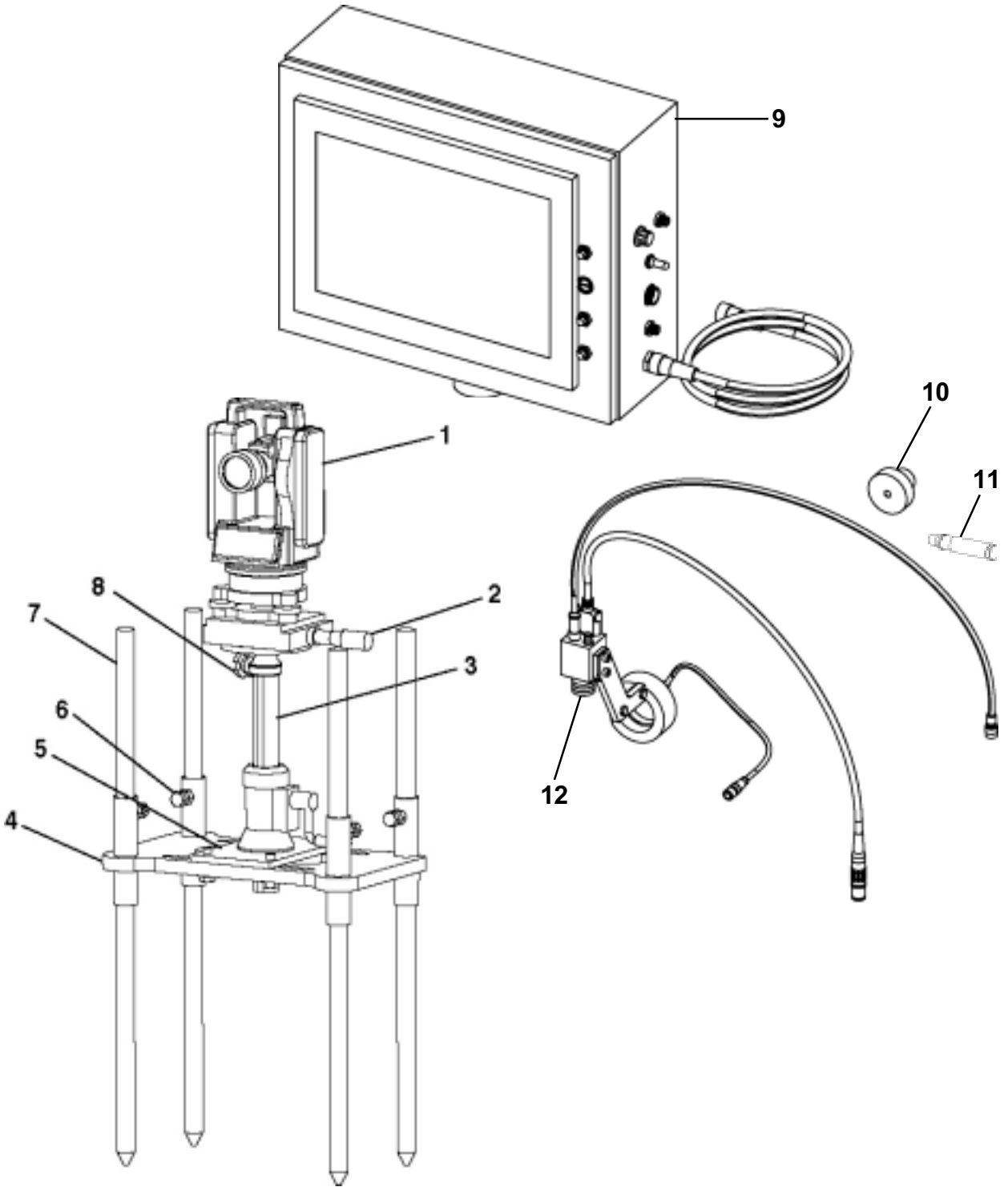
1. Leveling Assembly
2. Lifting Hook
3. Drilling Drive Speed Selector
4. Drilling Frame Travel Motor Control
5. Drilling Drive Rotation Control
6. Drilling Frame Travel Cylinder Control
7. Pressure Gauge
8. Target Monitor (not shown)
9. Return Line Connector
10. Pressure Connector
11. Case Drain Connector
12. Load Sense Connector
13. Latch Pin Manual Release Control
14. Thrust Frame Assembly
15. Gear Box Assembly Cam Lock
16. Shaft Tensioner
17. Casing Roller Bracket
18. Front Plate
19. Back Plate

POWER PACK



1. Engine
2. Oil Cooler
3. Radiator
4. Muffler
5. Hydraulic Return Filter
6. Air Cleaner Hood
7. Hydraulic Reservoir
8. Oil Level Gauge
9. Oil Temperature Gauge
10. Hydraulic Connections
11. Maint. Light Switch, Pendant Connection
12. Air Cleaner
13. Fuel Fill
14. Fuel Drain

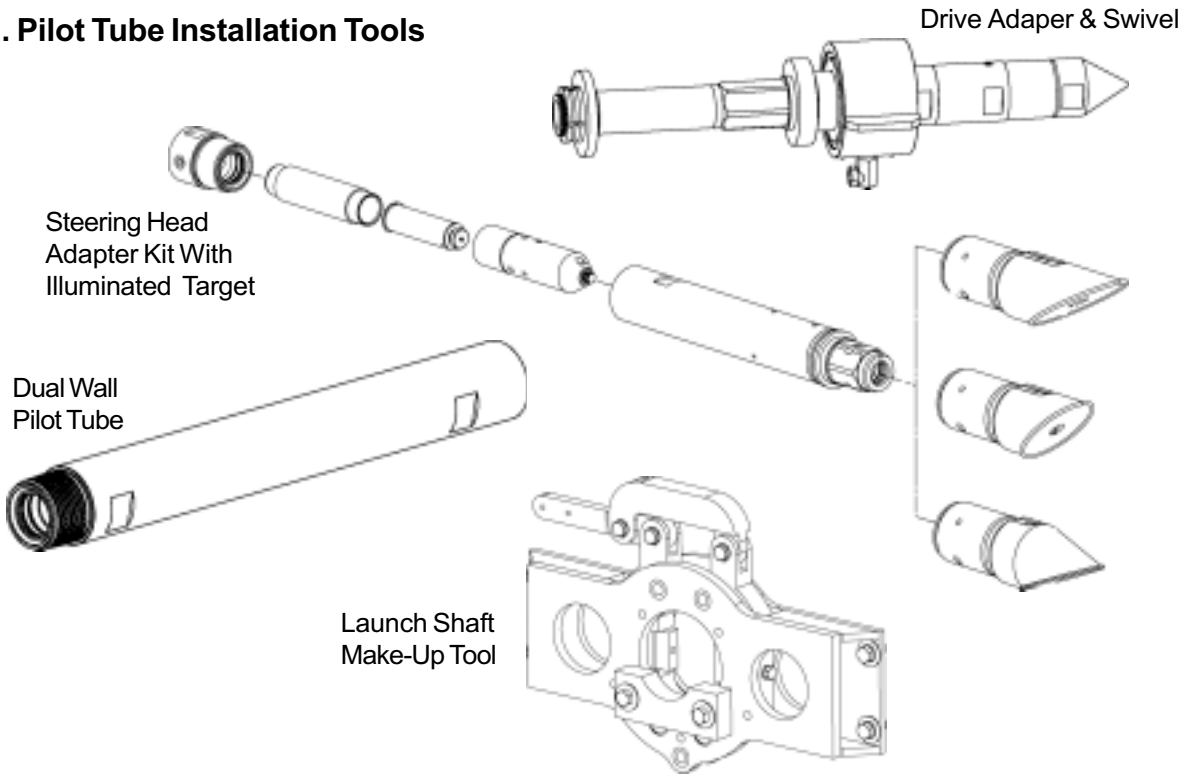
GUIDANCE SYSTEM



1. Theodolite
2. Lateral Slide
3. Elevator Column
4. Mounting Base
5. Vertical Lift Mounting Plate
6. Bolt & Washer
7. Stake Stand
8. Column Lock
9. Target Monitor
10. Laser Sight Alignment Tool
11. Laser Sight
12. Camera & Optics

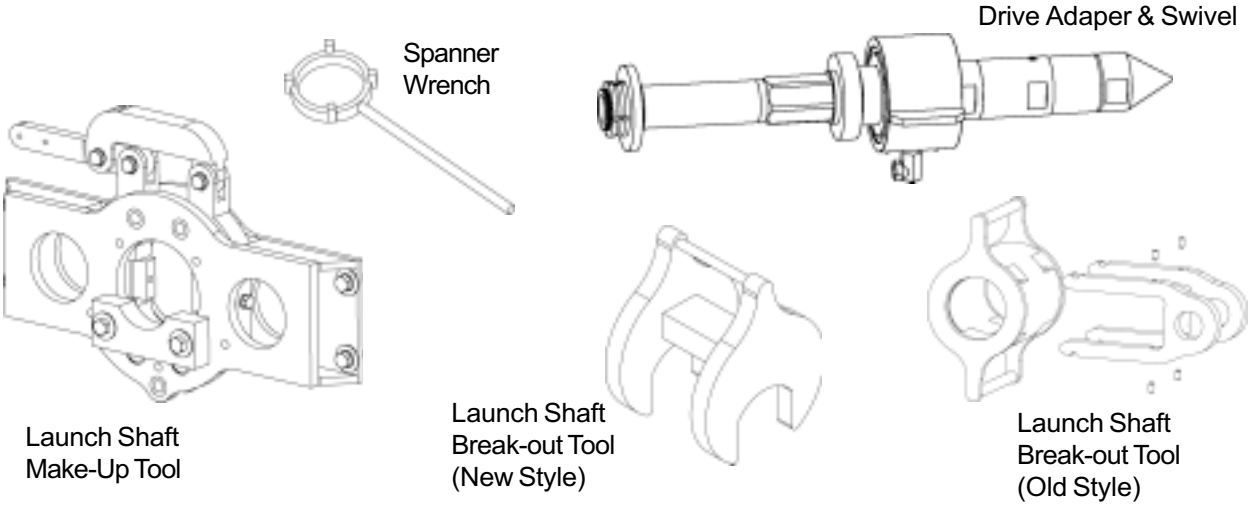
GBM TOOLING - THREE STEP METHOD

1. Pilot Tube Installation Tools

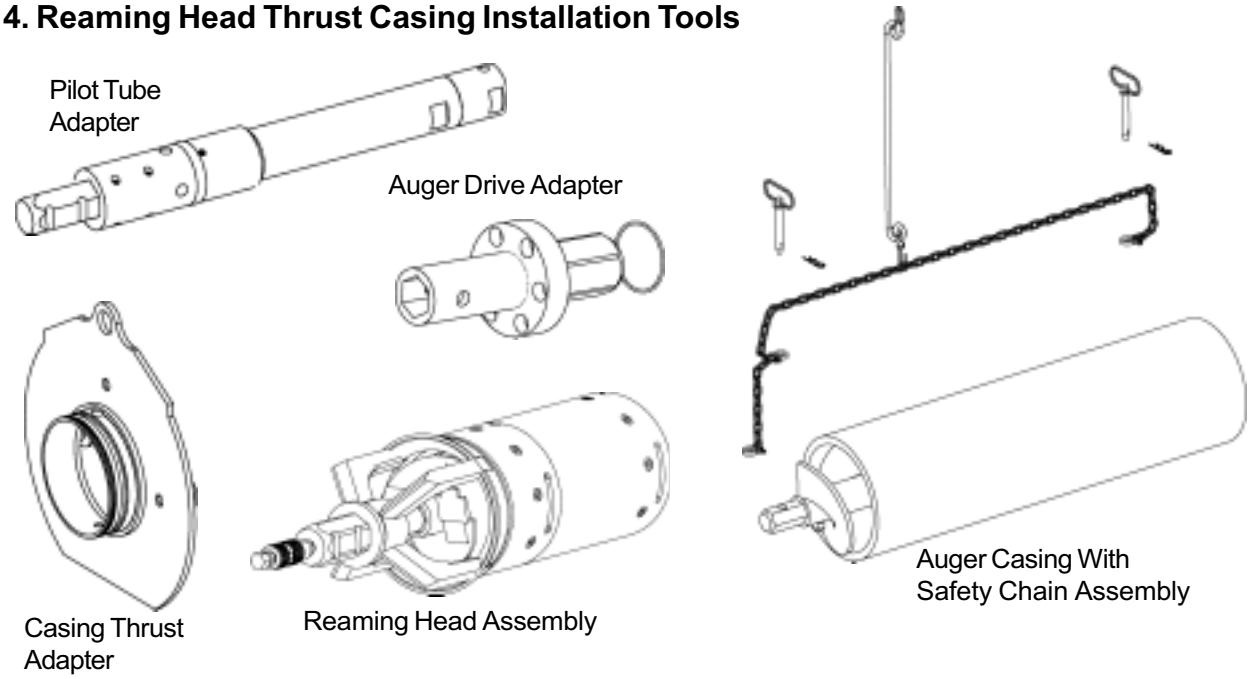


2. Pilot Tube Reception Shaft Removal Tools

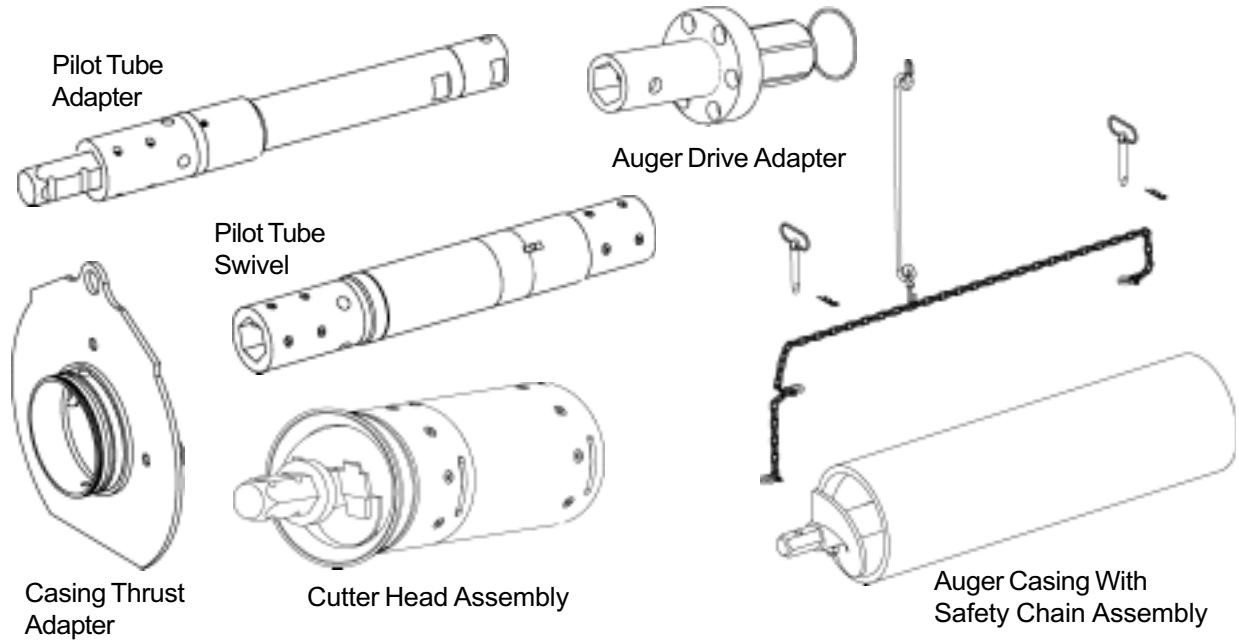
3. Pilot Tube Launch Shaft Pull Back Tools



4. Reaming Head Thrust Casing Installation Tools



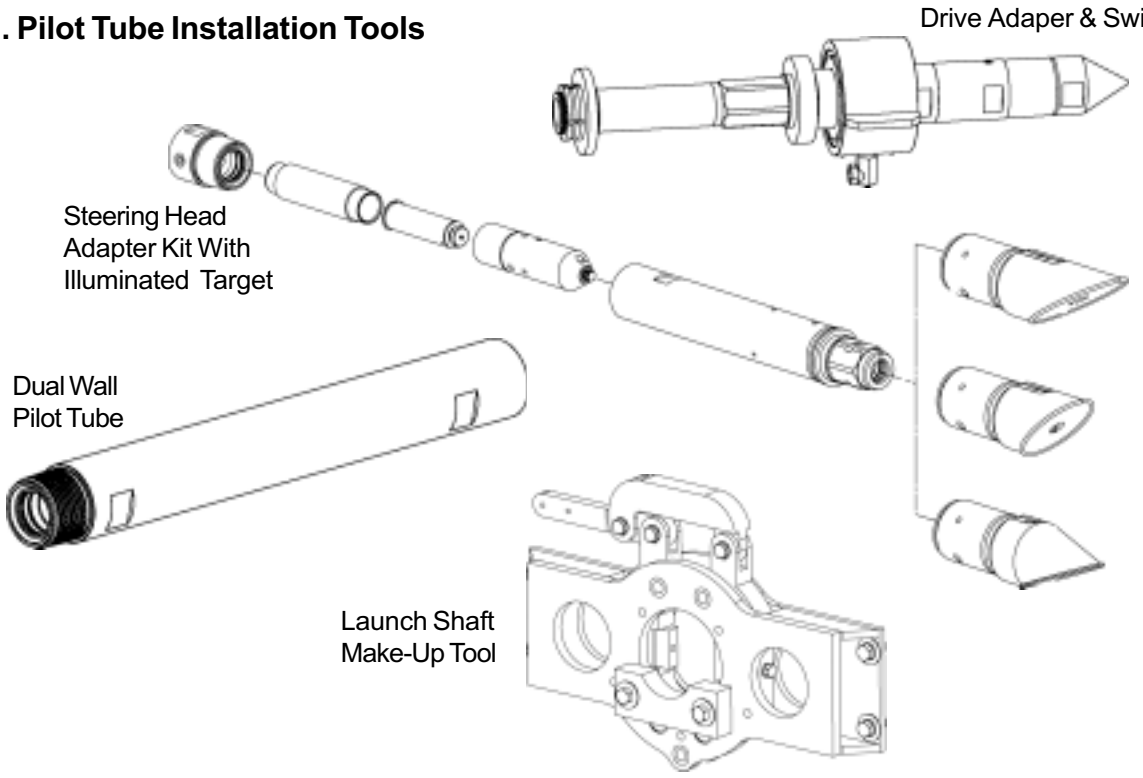
5. Cutter Head Thrust Casing Installation Tools



6. Pipe Installation Tools

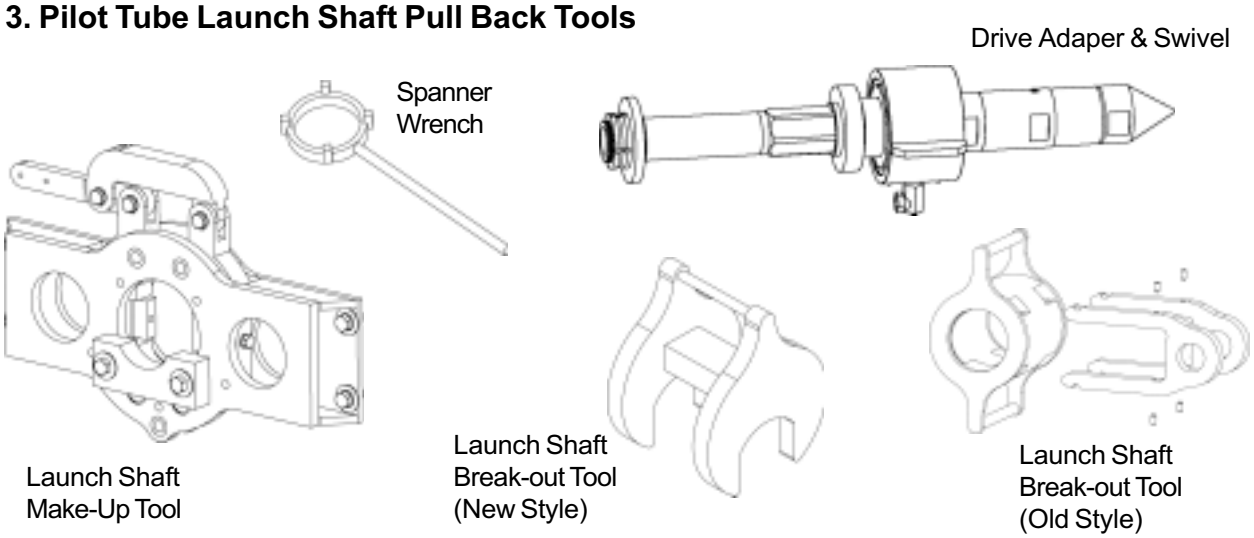
GBM TOOLING - TWO PASS METHOD

1. Pilot Tube Installation Tools



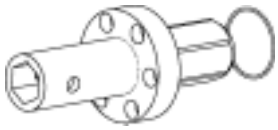
2. Pilot Tube Reception Shaft Removal Tools

3. Pilot Tube Launch Shaft Pull Back Tools

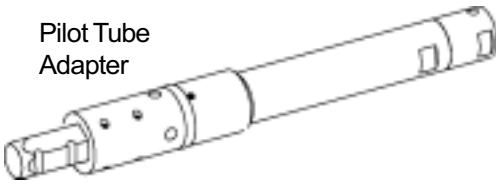


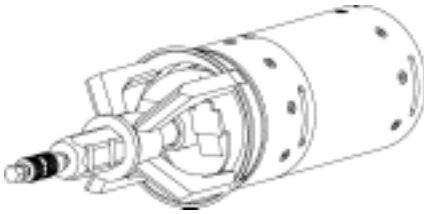
4. Reaming Head Installation Tools

Auger Drive Adapter



Pilot Tube Adapter





Reaming Head Assembly

Two Pass Transition Thrust Adapter

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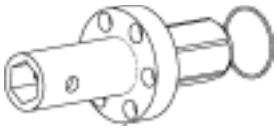
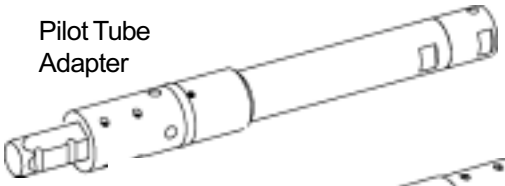
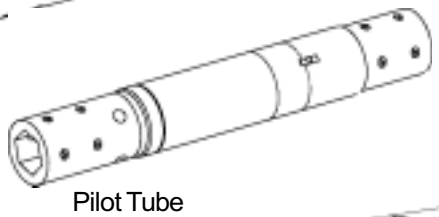
5. Cutter Head Installation Tools

Auger Drive Adapter

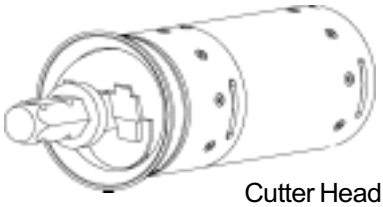


Pilot Tube Adapter

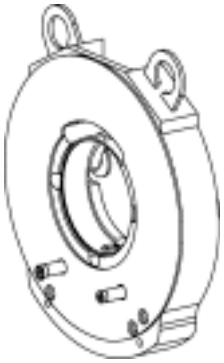




Pilot Tube Swivel



Cutter Head Assembly



Two Pass Transition Thrust Adapter

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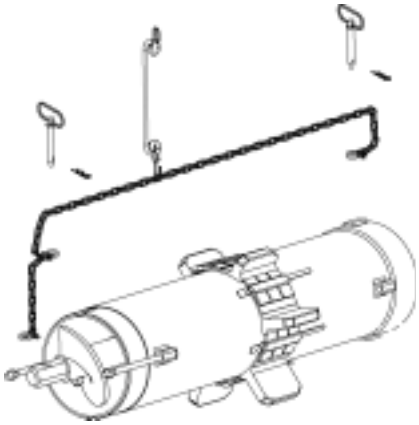
6. Auger Casing With Product Pipe Tools

Two Pass Transition Thrust Adapter

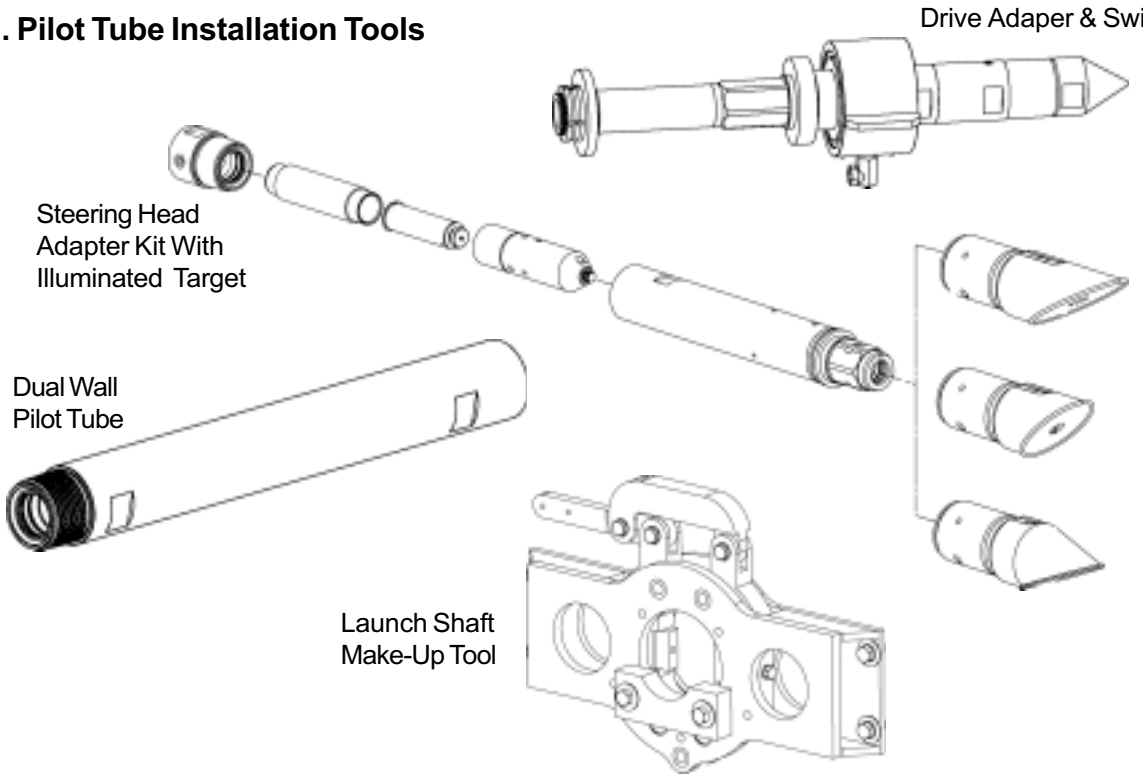
Casing To Pipe Adapter



Auger Casing With Casing Spacer & Safety Chain Assembly

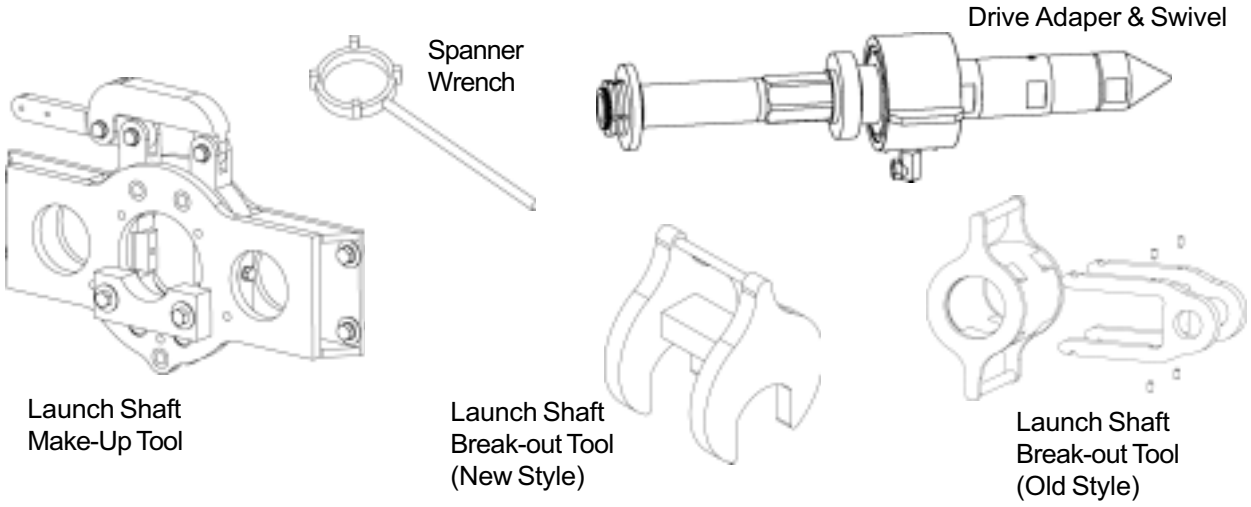
GBM TOOLING - AUGER BORING METHOD

1. Pilot Tube Installation Tools

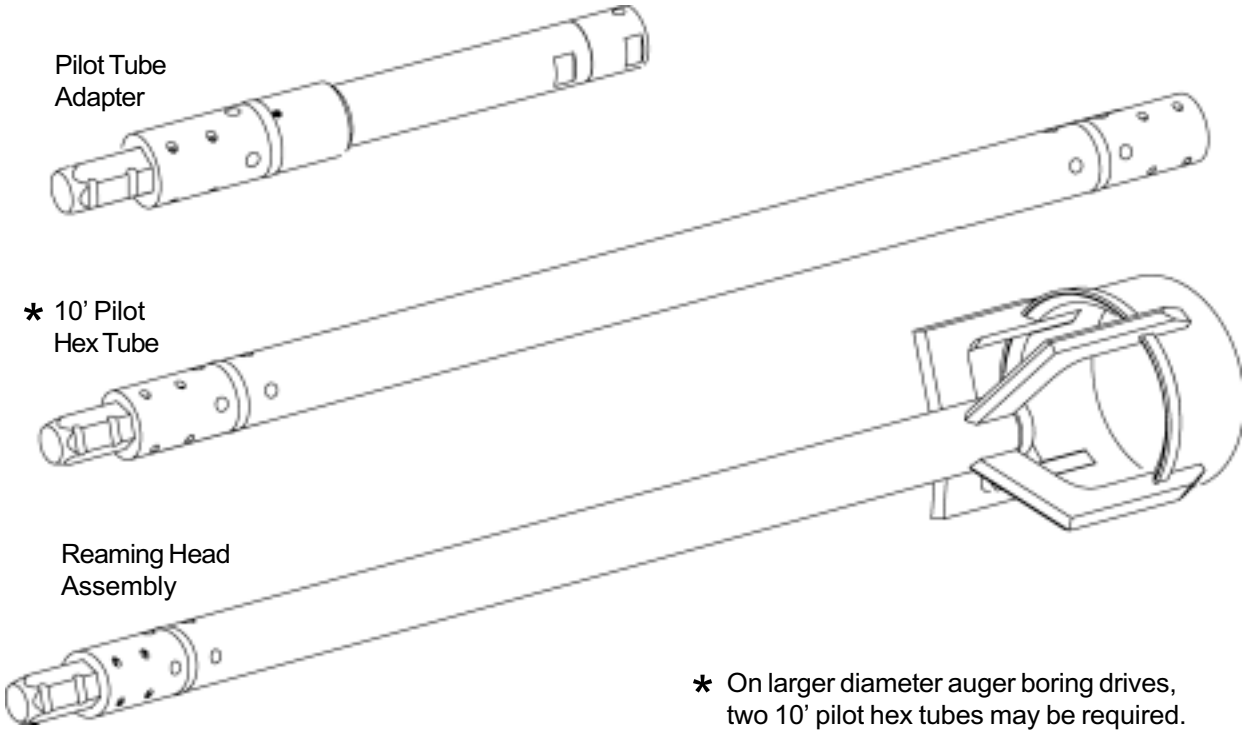


2. Pilot Tube Reception Shaft Removal Tools

3. Pilot Tube Launch Shaft Pull Back Tools

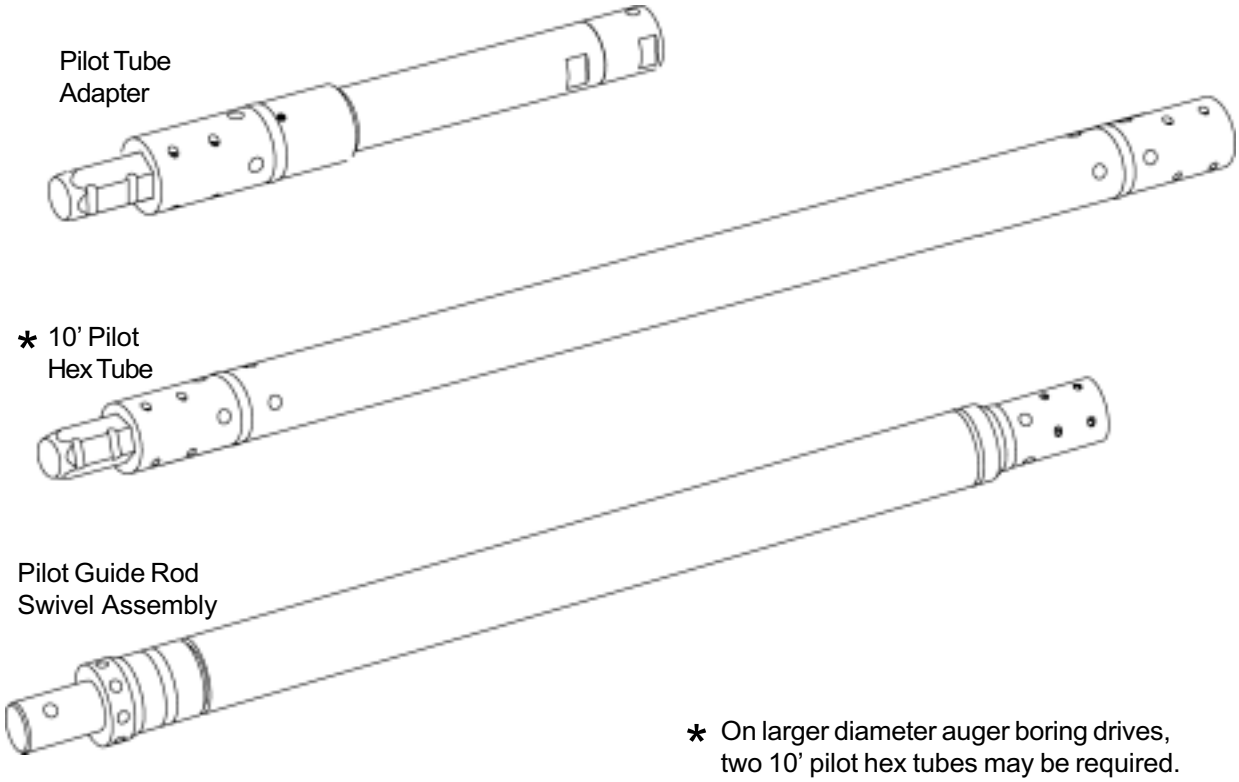


4. Reaming Head Installation Tools



* On larger diameter auger boring drives, two 10' pilot hex tubes may be required.

5. Open Face Cutter Head Installation Tools

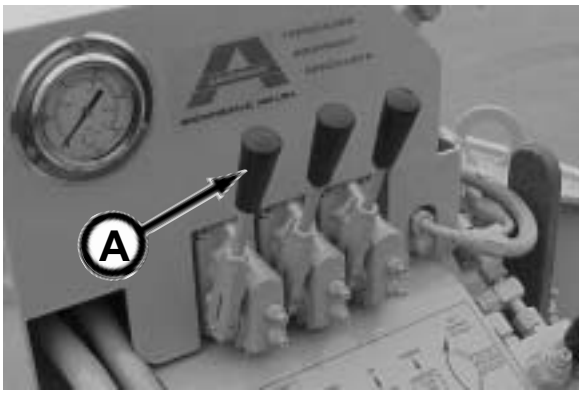


* On larger diameter auger boring drives, two 10' pilot hex tubes may be required.

Controls & Instruments

DRILLING FRAME TRAVEL CYLINDER CONTROL

Use the drilling frame travel cylinder control (A) to extend and retract the frame travel cylinders.

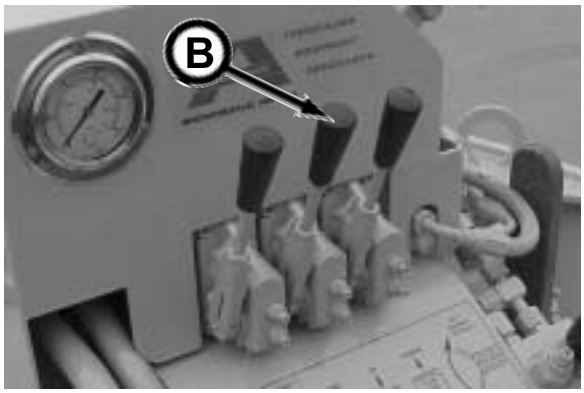


DRILLING DRIVE ROTATION CONTROL

The drilling drive rotation control (B) is used to rotate the steering head, pilot tube, and augers in the clockwise direction.

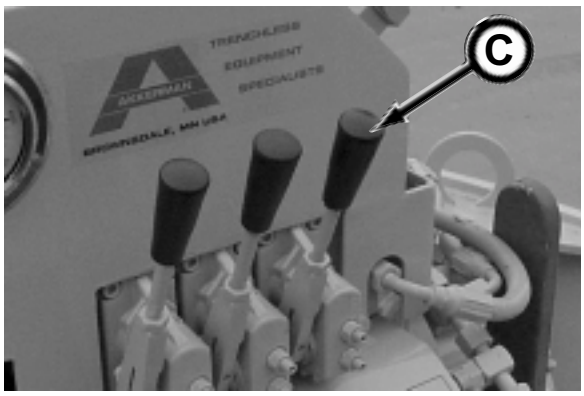
NOTICE Always rotate the pilot tube CW (clockwise). Rotating the pilot tubes CCW (counterclockwise) will unthread the pilot tubes in the pipeline resulting in unrecoverable pilot tubes.

Use CCW rotation when the steering head adapter or pilot tube is locked into the make up tool for removal from the gear box drive adapter or when cleaning the auger casings.



DRILLING FRAME TRAVEL MOTOR (LATCHING FRAME ONLY)

The frame travel motor control (C) is used for ease of moving the gear box assembly forward or back.



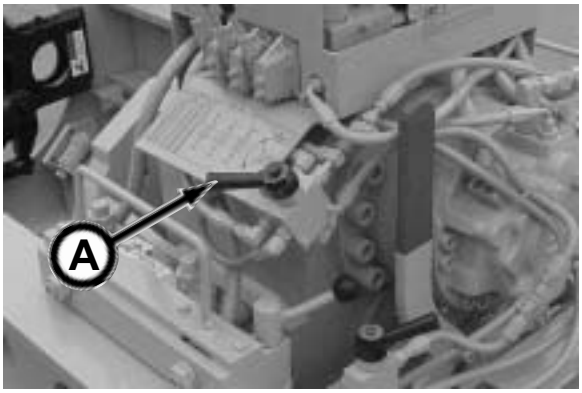
DRILLING DRIVE SPEED SELECTOR

The drive speed selector (A) controls the rotational drive motor speed.

When pushing pilot tubes, use the LSHT or Low Speed High Torque position.

When using auger casings, use the HSLT or High Speed Low Torque position.

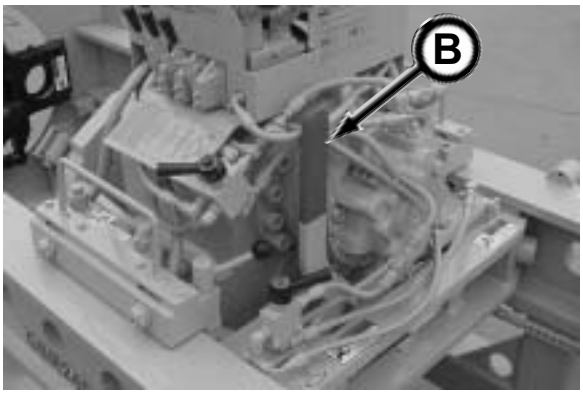
NOTICE Depending on soil conditions and length of drive, for better augering performance you may want to change the speed selector from HSLT position to the LSHT position .



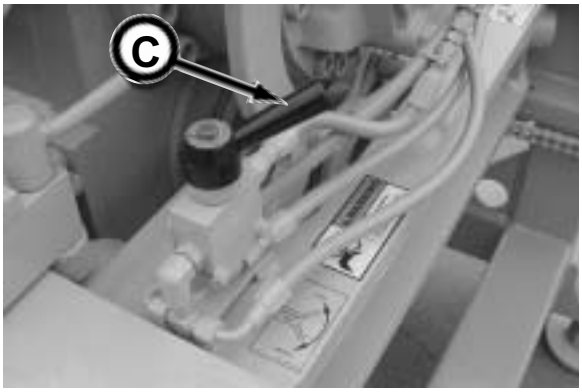
LATCHING PIN CONTROLS (LATCHING FRAME ONLY)

NOTICE Latching pins must be completely engaged into frame holes before jacking. Failure to do so, could cause machine damage.

Manual Control
Pull the handle (B) to unlock the latching pins.
Release the handle to lock the latching pins.



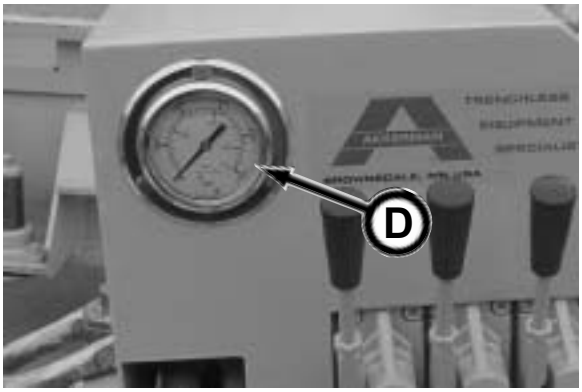
Cylinder Control (if equipped)
The latching pin cylinder control C) hydraulically locks and unlocks the latching pins.



DRILLING DRIVE PRESSURE GAUGE

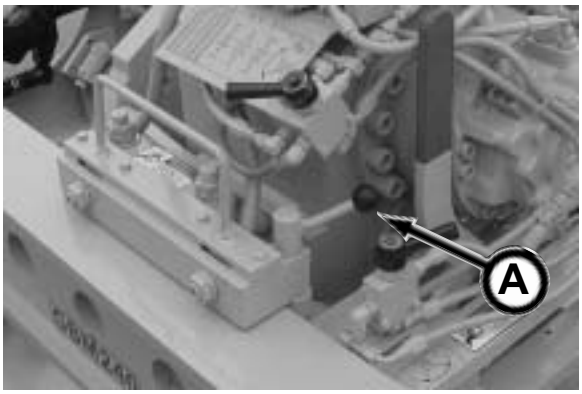
Use the pressure gauge (D) to monitor the GBM rotation and jacking thrust pressure.

Operating range is up to 4000 psi.
Maximum pressure is 5000 psi.



GEAR BOX ASSEMBLY CAM LOCK (LATCHING FRAME ONLY)

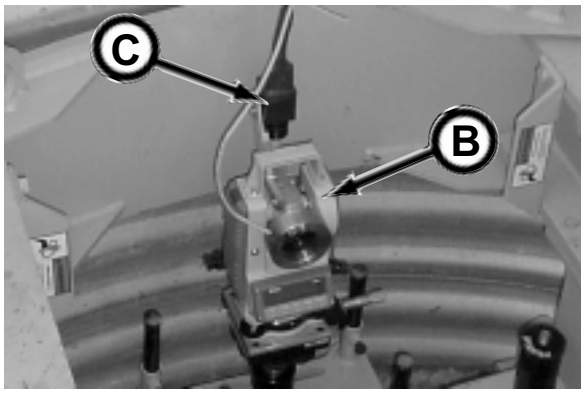
Engage the cam lock (A) when you do not want the gear box assembly to move when the GBM is positioned on a steep slope.



THEODOLITE & CAMERA

The theodolite (B) is used to align and maintain line and grade with a designed accuracy of .25 inch up to 300 feet.

The camera (C) mounted on the theodolite, transfers the digital image of the illuminated target (in the steering head) to the monitor.



TARGET MONITOR

The target monitor allows the operator to observe the location of the target in the pipeline in relation to the cross hairs on the monitor.

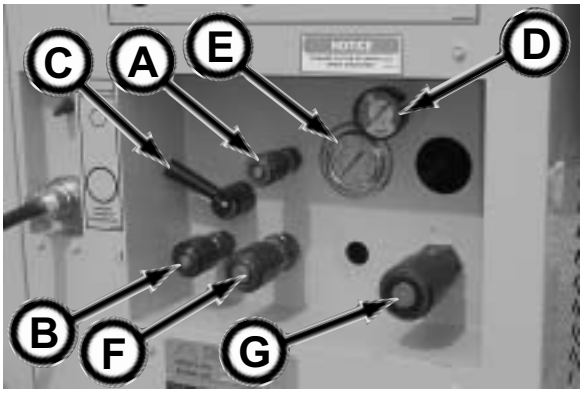
Any corrections made to line and/or grade will be visible on the monitor.

Adjust the Gain, Exposure, Zoom, Left/Right, and LED brightness controls by pressing the Select button to the desired adjustment and pressing the Increase and Decrease buttons for precise adjustment control.

- Gain control adjusts the camera sensitivity.
- Exposure control adjusts the amount of light available to the camera.
- Zoom control adjusts the camea zoom lens in and out.
- Left/Right control moves the image left or right on the screen.
- Up/Down control moves the image up or down.
- LED brightness control adjusts the brightness of the monitor.

POWER PACK

The power pack provides hydraulic power for the jacking frame. The 4.5 liter diesel engine drives a load sensing, variable volume, and torque limiting piston pump.



A – Load Sense Hydraulic Hose Connection
B – Case Drain Hydraulic Hose Connection
C – Drilling System Pressure Selector (see below)
D – Hydraulic Return Filter Indicator (see below)
E – Drilling System Pressure Gauge
F – Pressure Hydraulic Hose Connection
G – Return Hydraulic Hose Connection

Drilling System Pressure Selector (C)
High Pressure (5000 psi)
When installing pilot tubes or auger casings, move selector to the HP or high pressure setting.

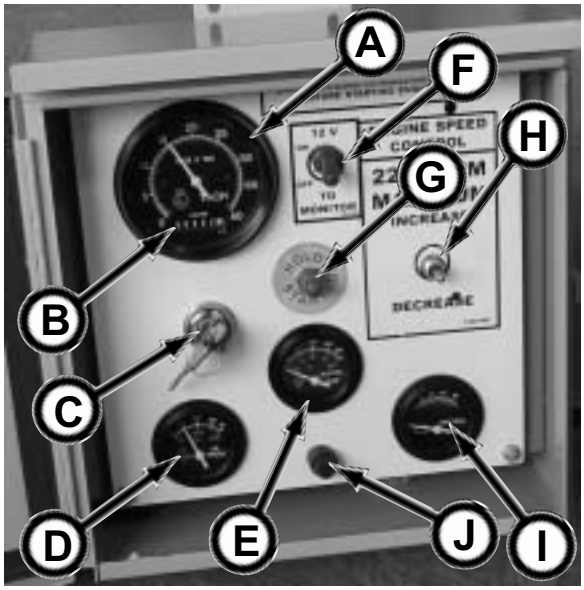
Low Pressure (adjustable up to 5000 psi)
When installing small diameter product pipe such as 8 in. to 10 in. or other pipe that has a lower thrust load pressure rating, use the LP or low pressure setting to protect the product pipe. Adjust the pressure according to your pipe's pressure rating. To adjust the pressure, refer to Adjusting Drilling System Pressure in Operation section.

Hydraulic Return Filter Indicator (D)
To prevent under or over servicing of the hydraulic filter element, a filter indicator has been installed on your GBM Power Pack.

The green OK zone indicates that the filter is functioning properly.
The yellow zone indicates that the filter will soon require replacement.

Replace return filter when the needle on the gauge is in the red CHANGE zone (see 10. Check Hydraulic Return Filter Indicator in Periodic Maintenance section).

CONTROL PENDANT



NOTICE Refer to the Deere engine manual for more information.

The control pendant allows the operator in the launch shaft to control the power pack and monitor vital engine functions.

Tachometer (A)
The tachometer indicates engine speed in hundreds of revolutions per minute (rpm).

Hourmeter (B)
The hourmeter registers time in full hours and tenths (1/10) of hours.

Ignition Switch (C)
Turning switch to ON position, applies power to the starter. Turning switch to OFF position, shuts down the engine.

Oil Pressure (D)
The oil pressure gauge indicates oil pressure as follows:
Full load rated speed is 50 ± 15 psi (345 ± 103 kPa).
Minimum rated speed is 40 psi (275 kPa).
Minimum at 850 rpm is 15 psi (105 kPa).
This unit is equipped with a low engine oil pressure safety switch. If the oil pressure is too low, the engine will automatically shut down to prevent engine damage.

Water Temperature (E)
Normal engine coolant operating temperature range is 180° to 202°F (82° to 94°C). If coolant temperature rises above 234°F (112°C), reduce load on engine. Unless temperature drops quickly, stop engine and determine causes before resuming operation.

This unit is equipped with a engine high temperature safety switch. If the engine coolant temperature exceeds a set point, the engine will automatically shut down to prevent engine damage.

Monitor Switch (F)
Flip switch UP to turn guidance system monitor ON or DOWN to turn monitor OFF.

Start Button (G)
To start the power pack engine, depress and hold start button, turn the ignition switch clockwise to crank the engine. When engine starts, release the key so it turns to the ON position. After engine starts, continue to hold the start button until the oil pressure gauge reads at least 15 psi (105 kPa).

Engine Speed Control (H)
Flip switch UP to increase engine speed to a maximum 2200 rpm.
Flip switch DOWN to decrease engine speed.

Battery (Voltmeter) Gauge (I)
When the ignition switch is ON and engine OFF, the indicator will read battery voltage (12 to 12.5 volts). When the key switch is ON and engine running the indicator should move to the 12 to 15 volt zone.

If voltage remains in the 12 volt and below zone or the 15 to 16 voltage range, check the electrical system for improper charging. Operating with high voltage can damage the electrical system.

Fuse Holder (J)
Contains 14 amp fuse.

Pre-Start Inspection

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

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

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

	1. Use "ONE-CALL" notification to check for buried utility lines prior to tunneling.
	2. Check the excavated launch and reception pits or shafts for proper shoring or bracing to prevent slides or cave-ins.
	3. A qualified electrician must check that all electrical connections are properly secured and grounded prior to operation.
	4. Thoroughly clean equipment of mud and dirt.
	5. Check condition of personal protective equipment. Replace equipment if defective.
	6. Contractor is responsible for all personnel to wear proper protective equipment on the job site.
	7. Remove combustible or flammable materials from equipment. Store materials properly.
	8. Test air monitoring and ventilation detectors for proper operation.
	9. Inspect GBM equipment for damage. Repair or replace as needed.
	10. Be sure all covers and guards are in place before operation.
	11. (Latching Frame) Be sure to lock latching pins to frame before boring.
	12. Check for loose or missing hardware. Replace damaged or missing hardware.
	13. Check for worn, loose, or damaged wire. Repair or replace wiring.
	14. Tighten loose clamps or fittings.
	15. Check wire harnesses for frayed or worn insulation or wires. Replace damaged or worn harnesses.
	16. No riders are allowed on the GBM.
	17. Check for fluid leaks. Repair leak or replace components.
	18. Keep job site clean and organized.
	19. Check equipment for proper lubrication.
	20. Remove all personnel from inside the GBM.
	21. Check for leaks in hydraulic hoses and/or lines (replace defective hoses and/or lines).
	22. Check hydraulic hoses and lines for wear and/or damage. Replace any defective hoses and/or lines.
	23. Remove all tools from inside of power pack and on GBM.

Operation

HOW TO USE THIS SECTION

There are several components that are used with the Guided Boring Machine (GBM). Components vary depending upon your desired upsizing installation process; three step pipe installation, two pass pipe installation, and auger boring pipe installation. Refer to “GBM Installation Options” in this section.

This section is divided into nine subsections to help you identify the contents of this section. The subsections will also make it easier for you to go back to specific areas for reference.

Operation - Operation Guidelines & Installation Options

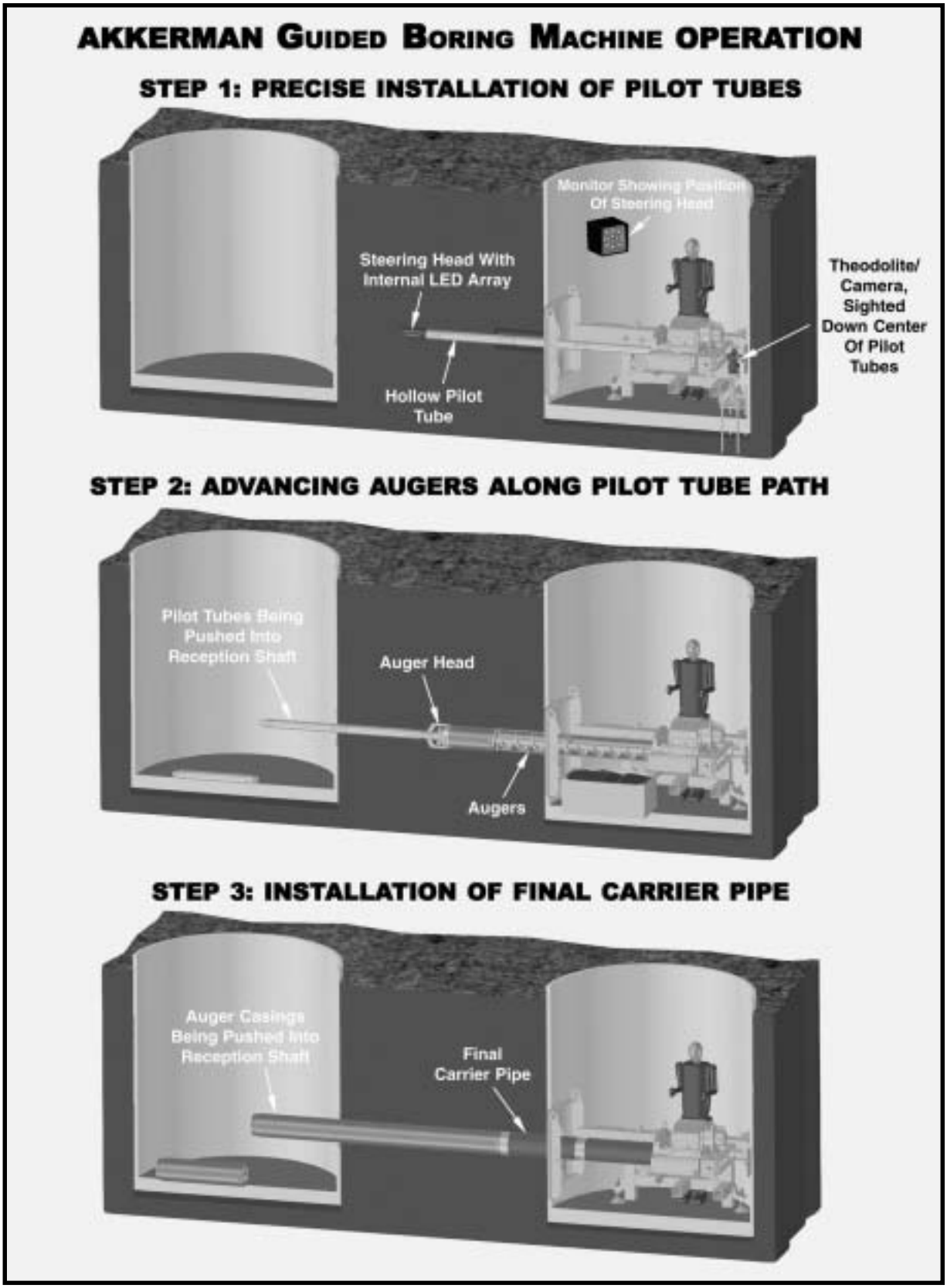
OPERATING GUIDELINES

⚠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.

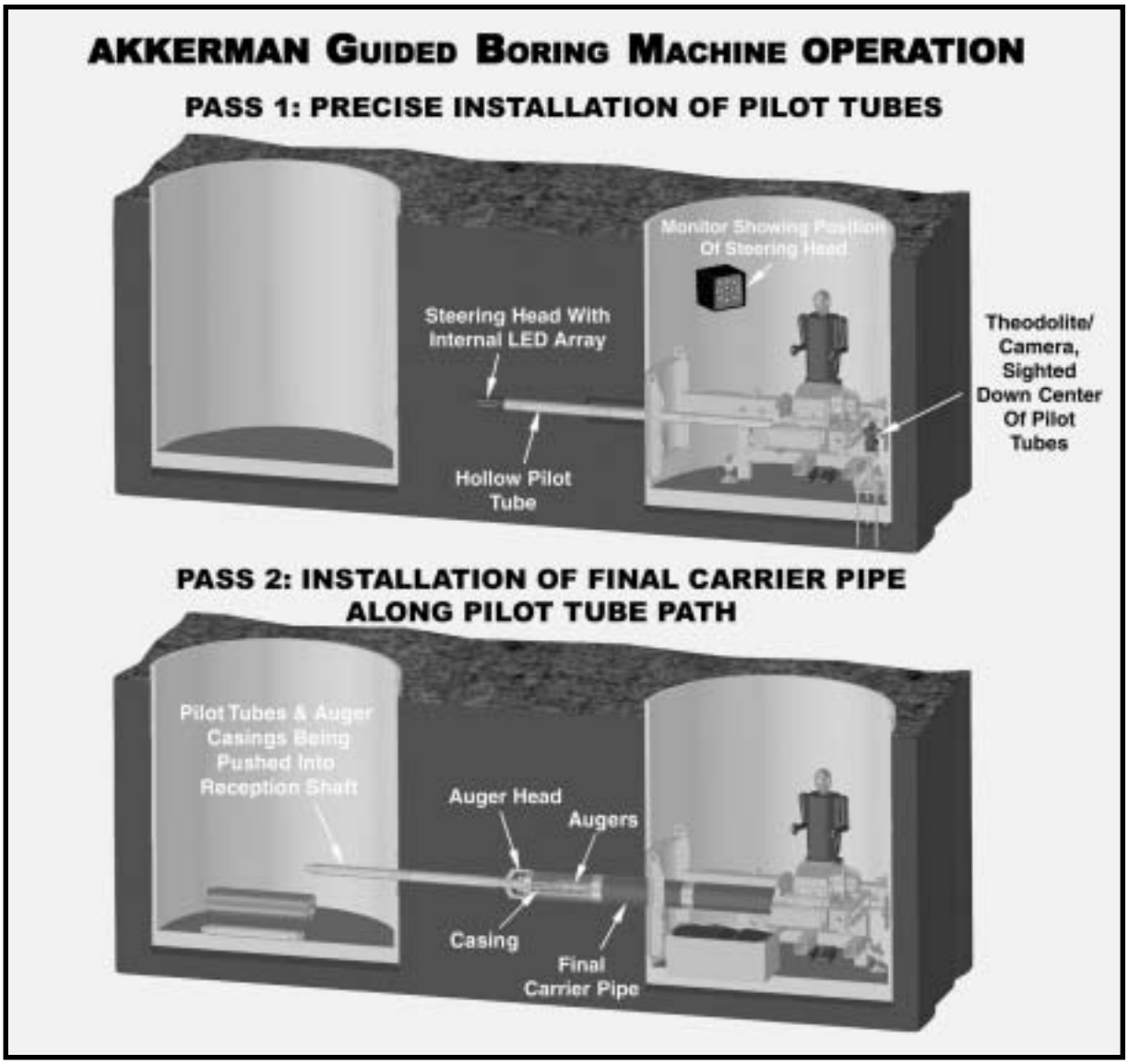
1. Before operating, read and understand the Safety, Pre-Start Inspection, and Operation sections.
2. Do not operate this equipment while under the influence of alcohol, drugs, or medication.
3. Follow all Federal, State, and Local safety regulations and procedures.
4. Be sure OSHA prescribed safety protective equipment is being worn by all personnel.
5. Be sure the area is safe for operation. Keep work site clean and organized.
6. NEVER operate equipment if it has been engulfed with water. Contact your Akkerman Product Support representative for proper procedures on how to restore equipment for operation.
7. Have a fully charged fire extinguisher on the job site at all times.
8. Before operating, repair all equipment problems.
9. Be sure the excavated launch and reception pits or shafts are properly shored or braced to prevent slides or cave-ins.
10. Test air monitoring and ventilation detectors for proper operation. Never enter a tunnel without gas detectors.
11. A fully trained and qualified signal person must direct the excavator or crane operator when lifting and lowering equipment into the launch or reception pits.
12. Never walk or work under any part of the excavator or crane and suspended loads.
13. Remove plumb bobs from string lines and place in storage container after use. Never hang or secure plumb bobs over shaft. Doing so may cause severe injury or death from a falling plumb bob.
14. Operate jacking system at lowest pressure possible to prevent excessive heat build up.
15. Operate all controls to make sure they work properly.
16. Pressure peaks cause hoses to jump without notice. Keep all personnel away from hoses during operation of equipment.
17. Lock out electrical power at the source (generator) before servicing electrical components.
18. Beware of pinch points.
19. If this manual is lost, contact your Akkerman Product Support Representative for a new manual or download this manual from the Akkerman web site at www.akkerman.com.
20. High pressure hydraulics are used on the GBM. Be sure all covers and guards are in place before operating.
21. Check theodolite level often.
22. Check line and grade alignment on target monitor often to avoid misalignment. Keep pilot tube ventilated to prevent condensation buildup in tube which will result in poor target visibility.
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 power pack is locked out, tagged out.

GBM INSTALLATION OPTIONS

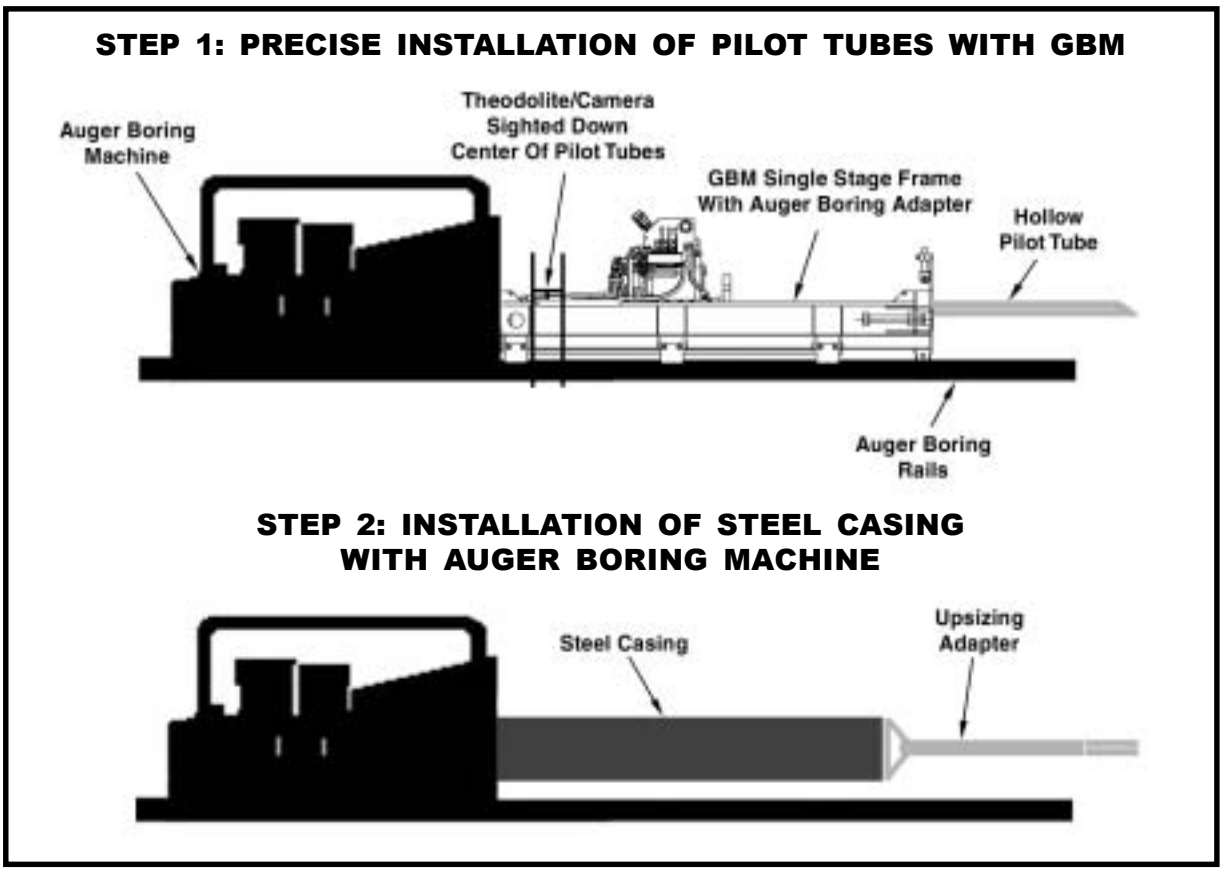
I. Three Step Method (Typical)



II. Two Pass Method



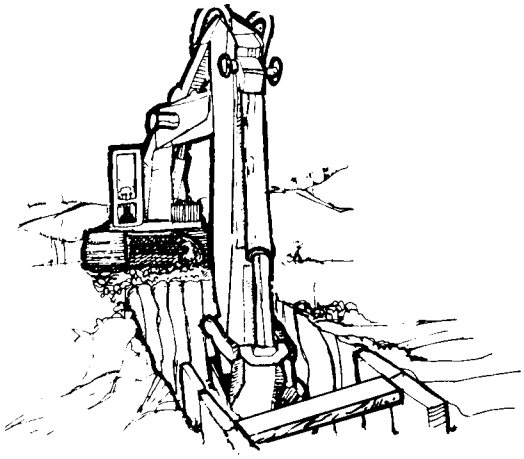
III. GBM / Auger Boring Machine Method



Operation - Shaft Set Up

SETTING UP THE LAUNCH AND RECEPTION SHAFTS

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



AEM is the original author and publisher of the above illustration

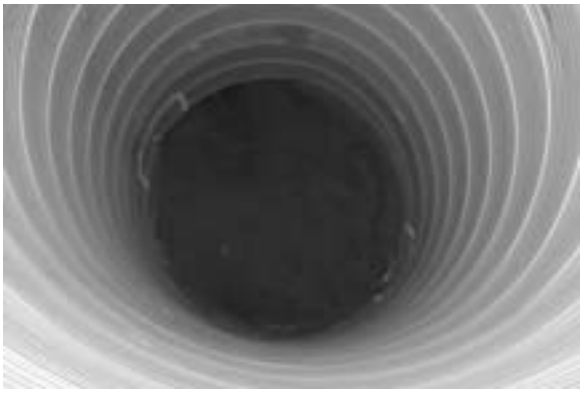
⚠WARNING Gases may be present during excavation and could cause severe personal injury or death. Use an approved air analyzer to detect hazardous gases on the job site and in the tunnel at all times.

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.

3. Construct a shaft floor with a solid base suitable for the weight of the jacking system and pipe. Typically a shaft uses 12 inches of stone for a dry shaft or a 6 inch or more concrete base for a moist shaft. Consult your civil and structural engineers for your pit floor requirements.

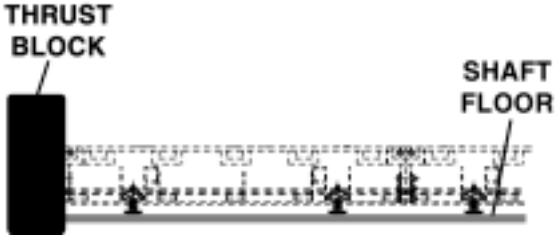
Auger Boring Shaft

4. If using stone for the shaft floor base, place road plates (1 inch plate of steel) or other solid material where the leveling assemblies or the rail assembly leveling hardware for auger boring, will be located to prevent jacking assembly or auger boring machine from shifting during operation.



Round Shaft

5. Construct concrete reaction block designed to withstand maximum capacity of thrust unit. A structural engineer must be consulted on the design of this block. This block must be square with the line of the pipeline and rail assembly (if using GBM with auger boring machine).



Operation - GBM Frame Set Up In Shaft

SETTING UP THE GBM IN LAUNCH SHAFT

NOTICE If using the GBM with an Auger Boring Machine, refer to Setting Up GBM With Auger Boring Machine in this section.

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

⚠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 instantly. Do not walk or stand under a load.

1. Carefully lower GBM frame into position in launch shaft.

2. Start leveling and setting line, elevation, and grade of the GBM frame to the centerline of the pipeline/flowline based on surveying marks. Be sure to compensate for the steering head overcut (1/2") and the reaming head or other upsizing tool overcut.

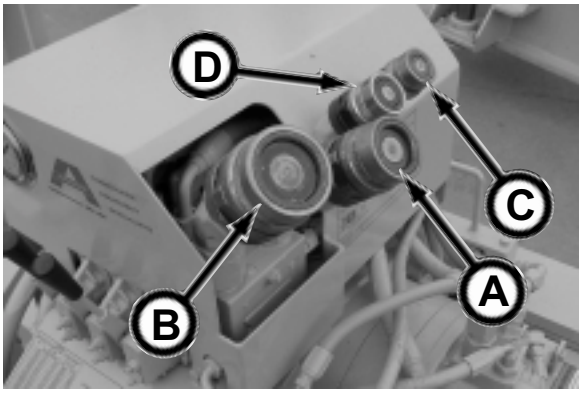
NOTICE Use a transit or string line to transfer the surveyor's marks to the shaft for setting the GBM frame on line.

3. Secure GBM frame to shaft wall and/or floor as needed to prevent the frame from moving while jacking. Be sure to tighten the shaft tensioners against shaft wall or other braces. Periodically retighten the shaft tensioners during operation.

4. Position the Power Pack on firm, level ground at the top of the launch shaft.

⚠WARNING Do not position the GBM Power Pack near the edge of the shaft where the ground may be unstable and cause a slide or cave-in. Doing so could cause severe injury or death.

5. With the power pack engine shut down, connect the pressure (A), return (B), load sense (C), and case drain (D) hydraulic hoses from the GBM Power Pack to the GBM jacking frame.



6. Start the engine (refer to Start The Engine in this section, subsection Power Pack Operation).

7. Check the hydraulic system for proper operation and that there are no leaks at the quick couplers.

8. Once the GBM and Power Pack are properly set up, proceed to Setting Up the Guidance System in this section.

SETTING UP GBM WITH AUGER BORING MACHINE

⚠WARNING Suspended loads may fall and cause severe injury or death. Do not walk or stand under a 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, excavator or other lifting equipment may decrease.

1. Lower the auger frame rails into launch shaft and set to the survey's line and grade.

2. On the GBM jacking frame, position and secure the gearbox assembly in the middle of the frame. This will balance the frame during the installation process.

3. Lower the GBM jacking frame into position on the auger frame rails using a properly rated four leg sling (5,000 lb. [2,268 kg] minimum).

4. With the GBM jacking frame positioned on the auger frame rails, tighten the hardware to secure the position of the jacking frame to the frame rails.

5. After frame is secured, check the GBM jacking frame center to be sure it is on the same center as the auger drive used on your project.

   If centerline is in question, refer to the Auger Boring Data Sheet, in this section, to determine that the GBM mounting brackets match your auger boring machine rails.

6. The auger boring power unit can be installed before or after the GBM jacking frame is secured to frame rails.

7. After the GBM jacking frame is secured to the auger frame rails, the auger boring power unit is advanced forward to the back of the GBM jacking frame, which is used as a backstop.

8. Position the GBM Power Pack on firm, level ground at the top of the launch shaft.

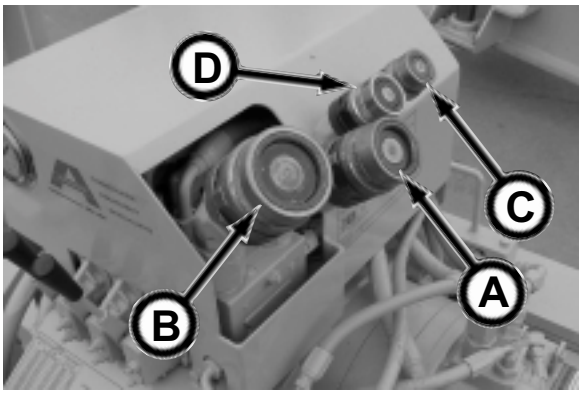
⚠WARNING Do not position the GBM Power Pack near the edge of the shaft where the ground may be unstable and cause a slide or cave-in. Doing so could cause severe injury or death.

9. With the power pack engine shut down, connect the pressure (A), return (B), load sense (C), and case drain (D) hydraulic hoses from the GBM Power Pack to the GBM jacking frame.

10. Start the engine (refer to Start The Engine in this section, subsection Power Pack Operation).

11. Check the hydraulic system for proper operation and that there are no leaks at the quick couplers.

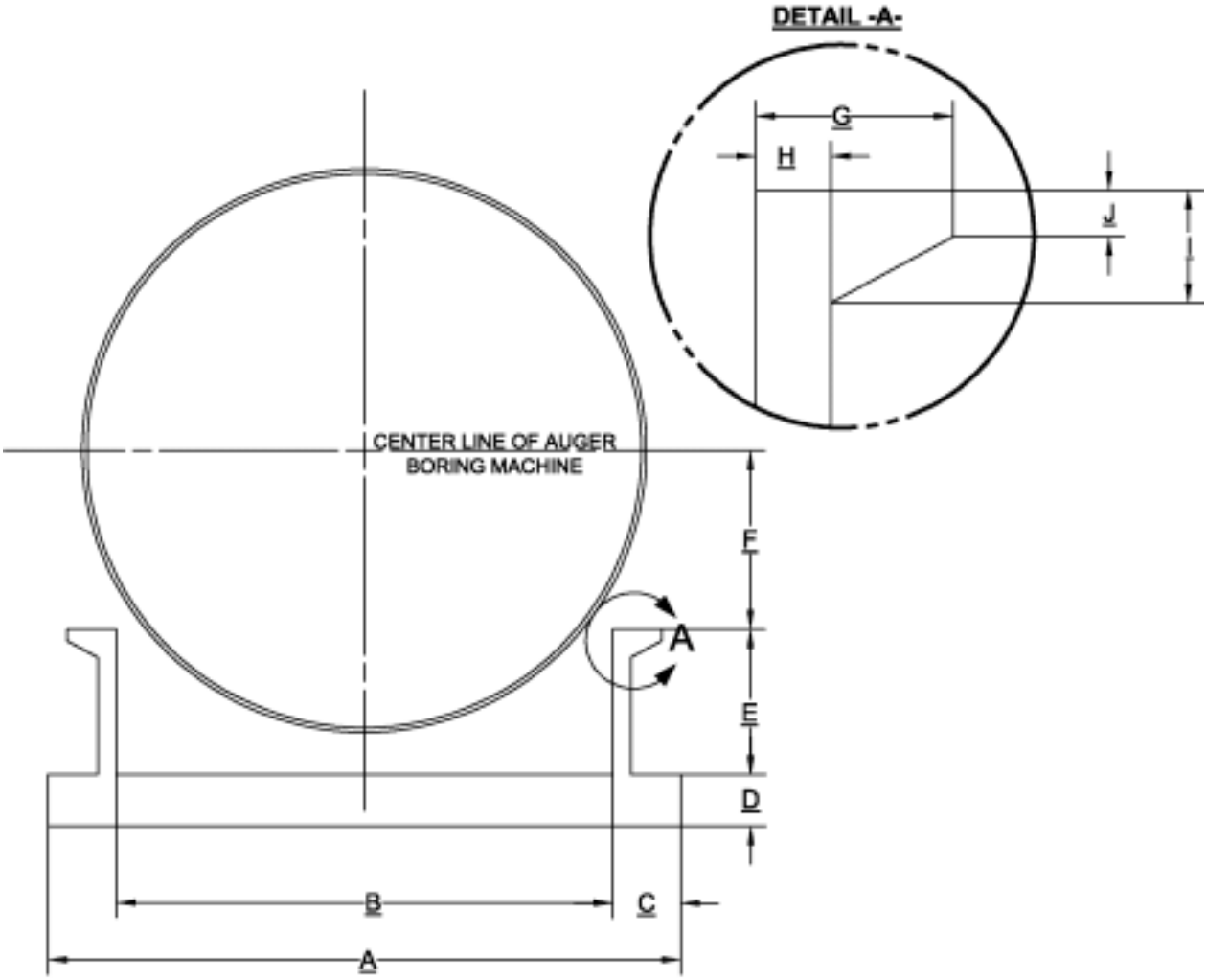
12. Proceed to Setting Up the Guidance System in this section.



AUGER BORING DATA SHEET

Due to the varying designs of auger boring track between manufacturers and model sizes, the GBM is secured to the auger boring machine's track through a set of adapter brackets, designed specifically to match your auger boring machine.

This data sheet is provided for recording the dimensions of your auger boring machine to assure the GBM frame is in the same center line as the center line of the auger boring machine.



AUGER BORING BASE DIMENSIONS:	
ITEM	DIMENSION
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	

Operation - Power Pack Operation

STARTING THE ENGINE

1. Perform the daily maintenance items listed in section 9, Periodic Maintenance.

2. Clean hose connections prior to connecting hoses.

3. Connect hydraulic hoses to the power pack connections and the GBM connections BEFORE starting engine.

Power Pack Hydraulic Connections

NOTICE All hoses must be securely connected. If not equipment will be damaged.

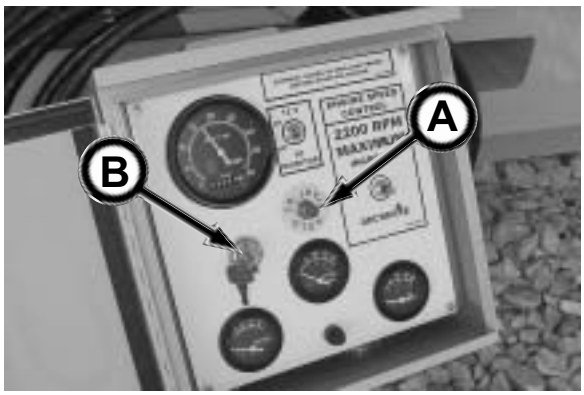
GBM Hydraulic Connections

4. Depress and hold start button (A) while starting.

5. Turn the ignition switch (B) clockwise to crank the engine. When the engine starts, release the key so it returns to the ON position.

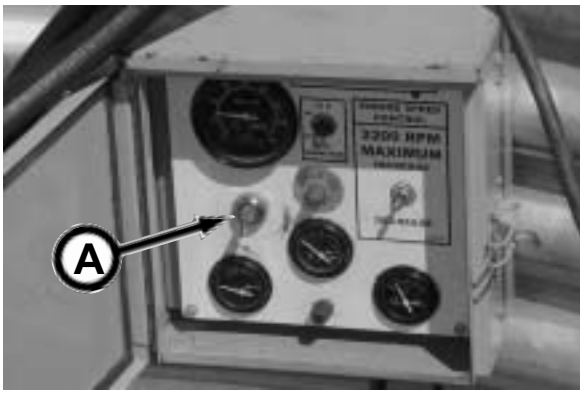
6. After the engine starts, continue to hold the start button until the oil pressure gauge reads at least 15 psi (105 kPa).

7. Check all gauges for normal engine operation. If operation is not normal (refer to Control Pendant in the Control & Instruments section), stop the engine and determine the cause.



STOPPING THE ENGINE

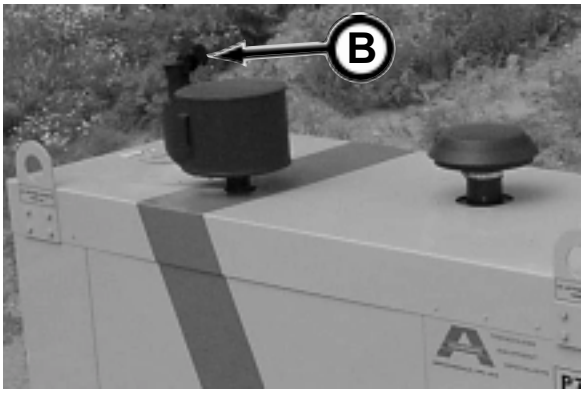
1. Flip the engine speed control down until engine speed is at idle.



NOTICE Before stopping an engine that has been operating at high engine speed, idle engine at least 2 minutes to cool hot engine parts.

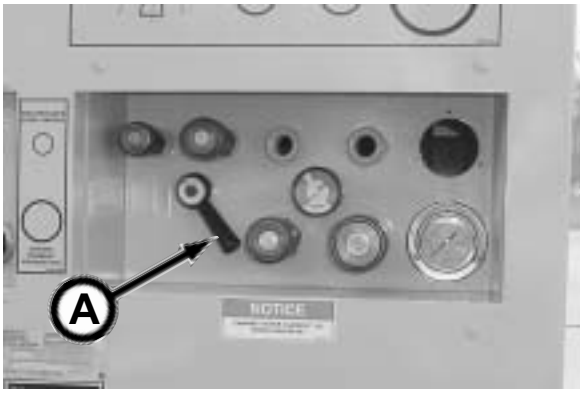
2. Turn ignition switch (A) counterclockwise to the OFF position to stop the engine.

3. Remove ignition key.



NOTICE Be sure that the exhaust rain cap (B) is installed when the engine is not running. This will prevent water and dirt from entering engine.

ADJUSTING DRILLING SYSTEM PRESSURE

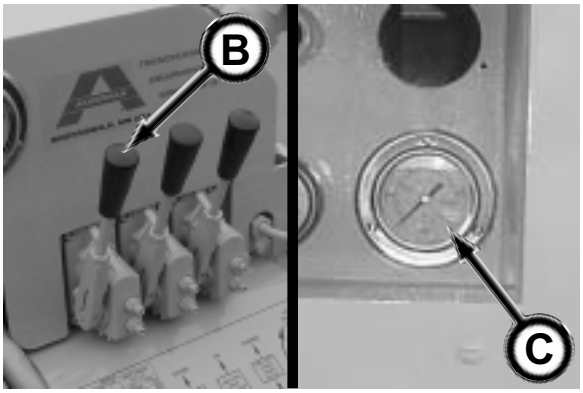


1. With the GBM hydraulic hoses connected to the power pack and the power pack engine running, select LP (low pressure) on the Drilling System Pressure Selector (A). Check the selector decal for the LP position.

GBM240				
PRESSURE PSI	CYLINDER LOAD IN TONS		DRIVE TORQUE IN Ft / lbs	
	EXTEND	RETRACT	LSHT	HSLT
250	4.9	2.5	499	197
500	9.8	5.0	998	393
750	14.8	7.5	1497	590
1000	19.7	10.0	1996	786
1250	24.6	12.5	2495	983
1500	29.5	15.0	2994	1179
1750	34.4	17.5	3493	1376
2000	39.4	20.0	3992	1573
2250	44.3	22.5	4491	1769
2500	49.2	25.0	4990	1966
2750	54.1	27.5	5489	2162
3000	59.1	30.0	5988	2359
3250	64.0	32.5	6487	2555
3500	68.9	35.1	6986	2752
3750	73.8	37.6	7485	2949
4000	78.7	40.1	7984	3145
4250	83.7	42.6	8483	3342
4500	88.6	45.1	8982	3538
4750	93.5	47.6	9481	3735
5000	98.4	50.1	9980	3932

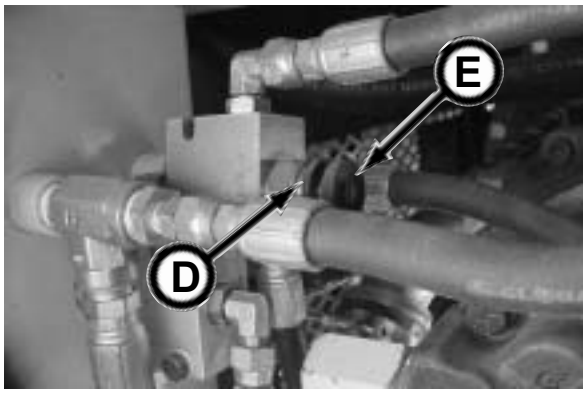
2. Check the thrust pressure rating for your product pipe.

3. Calculate the pressure limit for your product pipe based on every 1000 psi is equal to 20 tons of thrust pressure. Or refer to the thrust pressure chart (to the right or on the GBM).



4. Fully retract jacking cylinders by using the drilling frame travel cylinder control (B).

5. Check the pressure on the drilling system pressure gauge (C) on the power pack.



NOTICE Only a qualified service technician is allowed to perform pressure adjustments to the power pack.

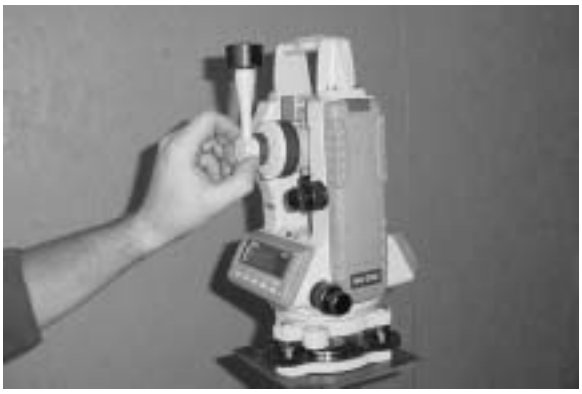
If the pressure needs to be increased, loosen lock collar (D) and turn adjustment dial (E) IN. Once the pressure is properly adjusted, tighten lock collar.

If the pressure needs to be decreased, loosen lock collar (D) and turn adjustment dial (E) OUT. Once the pressure is properly adjusted, tighten lock collar.

CHECKING THEODOLITE ZERO POINT CALIBRATION

IMPORTANT: It is critical to check the zero point calibration of the theodolite before use. If the theodolite gets bumped, jarred, or dropped, the calibration must be checked. Failure to check this calibration could cause misalignment in your line and grade. Keep in mind, if the theodolite is misaligned one degree, you will be off nearly two feet per 100 feet in the drive.

1. Remove prism.



2. Install the 40X eyepiece (from the prism) or 30X eyepiece (included) to telescope.

3. Move telescope to the horizontal position and lock position with vertical lock knob.

4. Level the theodolite with the circular level (A) using the leveling screws.

5. Using the plate level (B), level the theodolite using the leveling screws.

6. Once theodolite is level, rotate theodolite 90° and level the theodolite with the plate level (A) using the leveling screws.

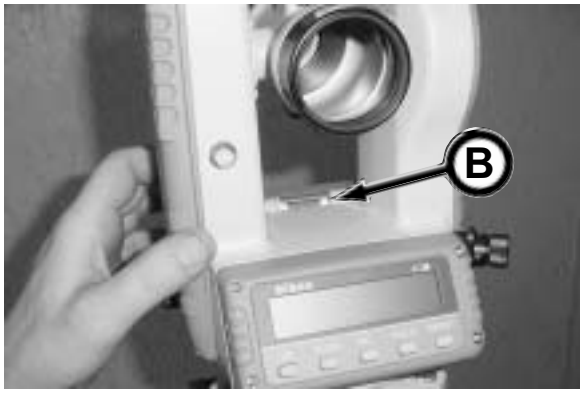
NOTICE It is easier to level theodolite in step 6 if you use the same two leveling screws that you used in step 5.

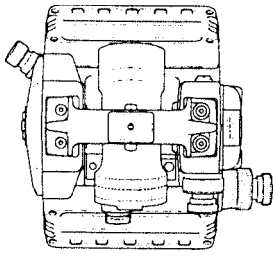
7. Repeat steps 5 and 6 until theodolite is level in both directions.

8. Once theodolite is level, rotate theodolite 180° and check plate level (B) to ensure the theodolite is completely level.

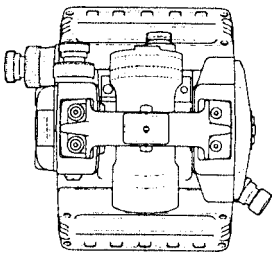
   If theodolite is not level, proceed to step 9.

   If theodolite is level, proceed to step 11.





Theodolite Leveled In Step 7



Theodolite Rotated 180° To Check Level In Step 8

9. If level is off, insert adjustment tool (included with theodolite) into adjustment nut, and move the bubble half the distance that the bubble was off.

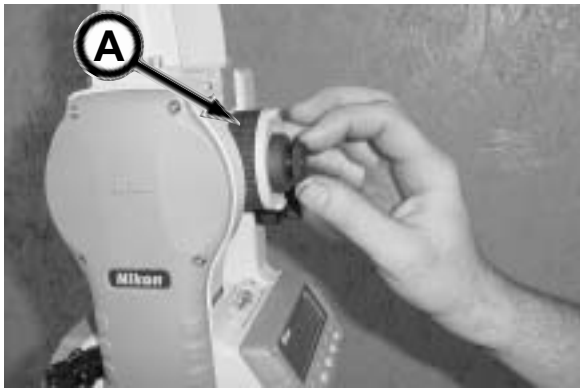
10. Relevel theodolite (repeat steps 5 through 8).

11. Turn ON theodolite.

12. “TILT TELESCOPE” is shown on the theodolite LED display. While holding telescope, loosen vertical adjustment/lock, then use the vertical fine adjust until the vertical alignment on the display reads, VA: 90° 00’ 00”.

13. Looking through the telescope, locate a stationary object approximately as long as your drive.

NOTICE You will need to use the telescope focusing ring (A), to focus on the object. You may also need to adjust the lens so the cross hairs are well defined while viewing (as shown).



IMPORTANT! DO NOT USE THE HOLD BUTTON WITH THE GBM SYSTEM! Doing so will freeze the displayed horizontal angle readout which will remain unchanged regardless of theodolite directional movement.

14. Once the stationary object is positioned in the cross hairs, press the RESET button. The LED display will read HA: 00° 00’ 00”.

    This will zero only your horizontal alignment. This does not affect the vertical alignment.

15. Loosen the vertical adjust/lock and rotate the telescope 180°, and loosen the horizontal adjust/ lock and rotate the theodolite base 180°.

NOTICE Take note of the vertical alignment reading on the LED display before rotating theodolite. After rotating 180°, these two readings should equal 360°. The horizontal reading should also equal 360°.

16. Using the horizontal fine adjust, turn knob until the horizontal alignment reads HA: 180° 00’ 00”.

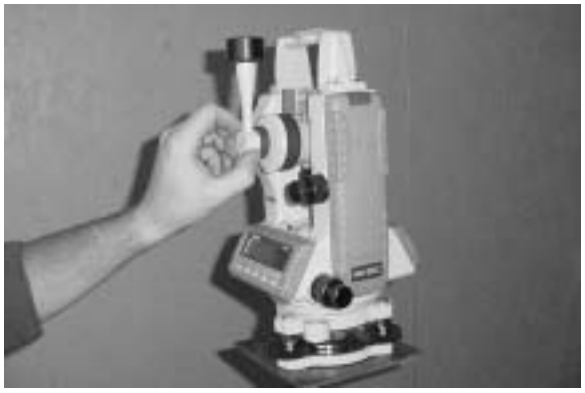
17. Look into the telescope. The stationary object should be within the cross hairs.

18. If the stationary object is not within the cross hairs, the theodolite is out of adjustment and must be recalibrated. Refer to the Nikon NE-202 Instruction Manual.

19. Remove the 40X or 30X eyepiece from telescope.

20. Replace the 40X eyepiece into prism.

21. Replace prism.



22. Carefully place theodolite in storage case. Secure case.

ASSEMBLING THE GUIDANCE SYSTEM FOR THE LATCHING FRAME

1. Install the guidance system mounting base at rear of launch shaft. The base should be centered between the frame rails and 2.5 in. to 2-3/4 in. from frame cross member to front of mounting rods.

2. Using the mounting base as a guide, drive the four rods through the base and into the ground until they are in solid material. The base must have at least a 3” clearance on the bottom side of the plate so the theodolite stand can be mounted.

NOTICE The rods must be positioned so the rods or the mounting plate do not contact any moving parts.

3. Level the base from front to back and side to side.

4. With the base level, secure the base to the rods with four set screws.

5. Center mounting plate on mounting base and secure with four 1/2 x 1-1/2 in. bolts (included).

6. Attach elevator column to mounting plate. Hand tighten only.

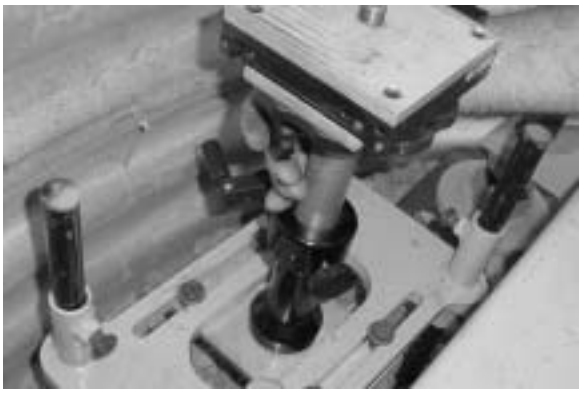
NOTICE If shaft floor is below the base of the jacking frame, an extension may be required. Six and twelve inch extensions are provided.

• Attach extension to mounting plate. Hand tighten only.

• Attach elevator column to extension. Hand tighten only.

9. Hand tighten elevator column adapter to lateral slide.

10. Insert adapter/slide assembly into column and secure with locking knob on column.



IMPORTANT: It is critical to check the zero point calibration of the theodolite before use. If the theodolite gets bumped, jarred, or dropped, the calibration must be checked. Failure to check this calibration could cause misalignment in your line and grade. Keep in mind, if the theodolite is misaligned one degree, you will be off nearly two feet per 100 feet in the drive. See Checking Theodolite Zero Point Calibration in this section.

11. Attach theodolite to lateral slide by rotating theodolite base clockwise (CW) on lateral slide until snug. Do not overtighten.

12. Remove battery cover.

13. Separate cover from battery holder.

14. Install six new AA batteries into battery holder.

15. Secure battery holder into cover and replace cover.

16. Level theodolite with the adjustment knobs located on the theodolite base.

17. Rotate theodolite 90 degrees and adjust until level.

18. Repeat steps 16 and 17 until theodolite is level in both directions.

19. Remove bolts from mounting on telescope with lens in vertical position.

20. Remove protective cover from camera. Retain cover for protection during storage.

21. Install camera to theodolite with bolts removed in step 19. Tighten with 7/16 in. wrench.

NOTICE Place bolts on camera bracket before positioning bracket against theodolite.

NOTICE Be sure vertical lock is not set on theodolite.

22. Remove telescope lens cap.

23. Attach counterweight to telescope and secure with one 1/4 x 2 in. screw.

24. Secure retical (cross hair) light to counterweight.

The tip of the light must be directed into the telescope lens for the theodolite cross hairs to display on the monitor.

25. Secure camera cables in two places so as not to affect the calibration of the theodolite.

26. Attach the LED plug, camera link, power pendant and the retical light power supply cables to monitor case.

27. Attach power supply cable from monitor to base of control pendant.

NOTICE Monitor must be OFF before starting engine.

ASSEMBLING THE GUIDANCE SYSTEM FOR SINGLE STAGE FRAME

1. Install the guidance system mounting stand. The theodolite pad (A) should be centered between the frame rails.

2. Using the stand frame (B) as a guide, drive the four rods (C) into the ground until they are in solid material.

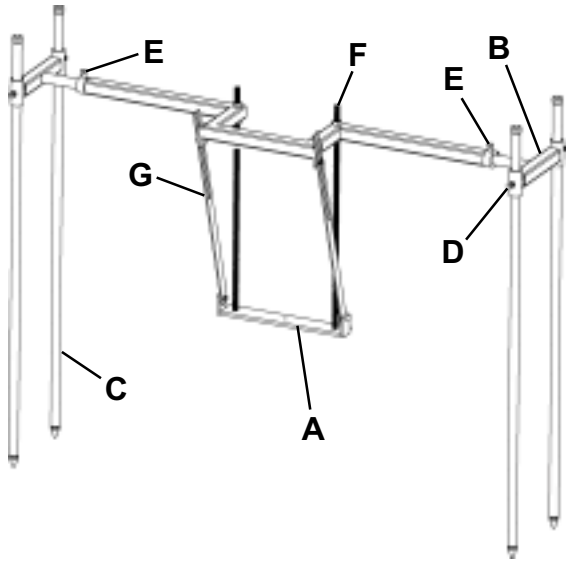
NOTICE The rods must be positioned so the rods or the mounting stand do not contact any moving parts and if auger boring, outside the ground disturbance of auger boring machine.

3. Lower the frame over the rods so the frame does not touch the GBM frame or any moving parts (such as the fittings on the thrust cylinders) and secure to frame with set screws.

4. Level frame side to side with set screws (D) on rods.

5. Center theodolite pad assembly with center line of jacking frame and level frame front to back with frame set screws (E) using plumb bob, if possible.

6. Attach lateral slide to theodolite pad (A) with one 5/8 in. brass bolt.



A - Theodolite Pad
B - Stand Frame
C - Rod
D - Frame Set Screw
E - Center Stand Set Screw
F - Elevation Adjustment
G - Theodolite Pad Stiffener

IMPORTANT: It is critical to check the zero point calibration of the theodolite before using in launch shaft. If the theodolite gets bumped, jarred, or dropped, the calibration must be checked. Failure to check this calibration could cause misalignment in your line and grade. Keep in mind, if the theodolite is misaligned one degree, you will be off nearly two feet per 100 feet in the drive. See Checking Theodolite Zero Point Calibration in this section.

7. Attach theodolite to lateral slide by rotating theodolite base clockwise (CW) on lateral slide until snug. Do not overtighten.

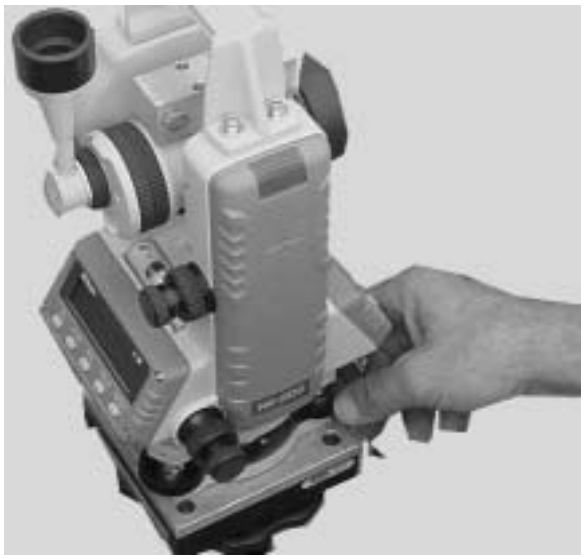
8. Remove battery cover.

9. Separate cover from battery holder.

10. Install six new AA batteries into battery holder.

11. Secure battery holder into cover and replace cover.

12. Level theodolite with adjustment knobs located on the theodolite base.



13. Rotate theodolite 90 degrees and adjust until level.

14. Repeat steps 8 and 9 until theodolite is level in both directions.

15. Remove bolts from mounting on telescope.

16. Remove protective cover from camera. Retain cover for protection during storage.

17. Install camera to theodolite with bolts removed in step 15. Tighten with 7/16 in. wrench.

18. Remove telescope lens cap.

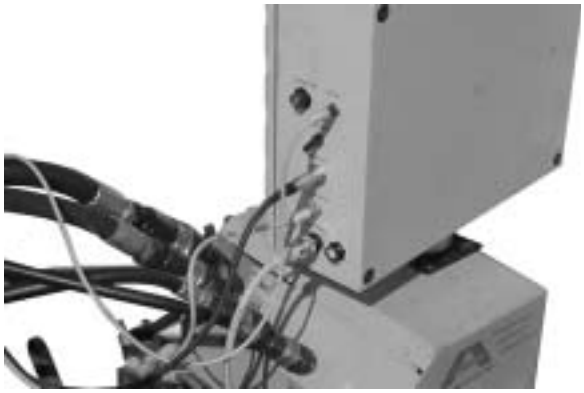
19. Attach counterweight to telescope and secure with one 1/4 x 2 in. screw.

20. Secure retical (cross hair) light to counterweight.

The tip of the light must be directed into the telescope lens for the theodolite cross hairs to display on the monitor.

21. Secure camera cables in two places so as not to affect the calibration of the theodolite.

22. Attach the LED plug, camera link, power pendant and the retical light power supply cables to monitor case.



23. Attach power supply cable from monitor to base of control pendant.

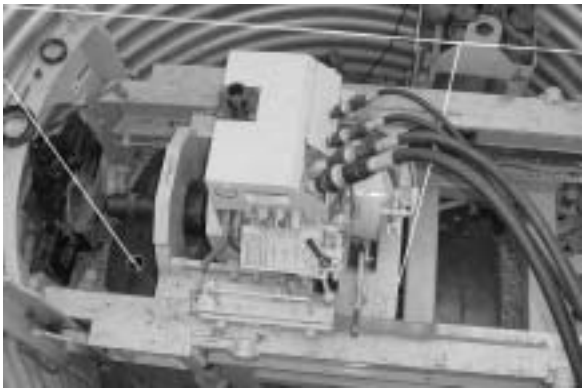
NOTICE Monitor must be OFF before starting engine.

PRELIMINARY THEODOLITE SETUP FOR LINE & GRADE

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. Using the surveying marks on edge of shaft, run a string line between these two marks to set the line of the theodolite. Then use two lines and plumb bobs to transfer the surveying marks to the shaft floor.

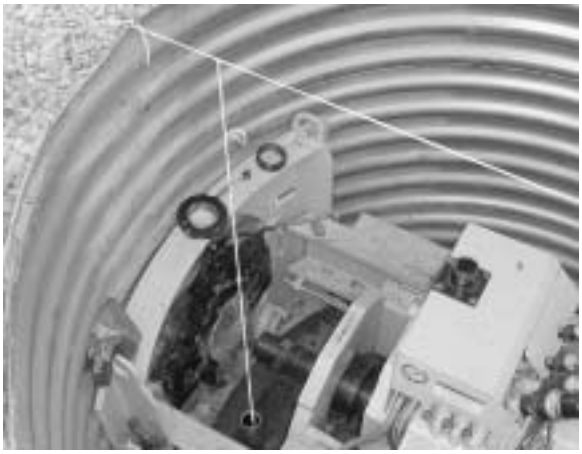
NOTICE For best monitor viewing, use white string to transfer the surveying marks.



Position one line and plumb bob a minimum of 28 inches (711 mm) in front of the theodolite.

Suspend the plumb bob into a cup of oil to restrict the effects of air movement along the string lines. This will ensure a more accurate reading.

NOTICE Be sure plumb bob is free to move in oil. Do not allow the plumb bob to touch the bottom or sides of cup.

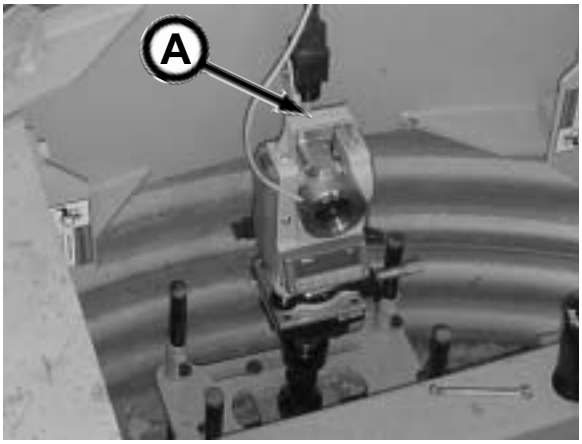


Position a second line and plumb bob at the front end of the jacking frame as far forward as possible. Suspend plumb bob into cup of oil.

NOTICE Be sure plumb bob is free to move in oil. Do not allow the plumb bob to touch the bottom or sides of cup.

ROUGH CENTER ALIGNMENT

2. Once the guidance system is fully assembled and the string line is positioned to the surveying marks, suspend a plumb bob from the string line slightly above the theodolite. Move the theodolite base as needed until the theodolite center station point (A) is centered with plumb bob to establish the rough center alignment. You will have to use the lateral slide adjustment for fine tuning the center point, later in the preliminary theodolite setup.



LEVELING THEODOLITE

3. Adjust theodolite until level with the adjustment knobs.

4. Once theodolite is level, rotate the theodolite 90° and adjust until level.

5. Repeat steps 3 and 4 until the theodolite is level in all directions.

6. Turn ON theodolite.

7. “TILT TELESCOPE” is shown on the theodolite LED display. Loosen vertical coarse adjust/lock knob (large knob) and rotate the telescope until “VA” and “VH” are displayed.

8. Tilt the telescope until VA is close to 90°.

9. Lock the telescope position with the vertical lock knob.

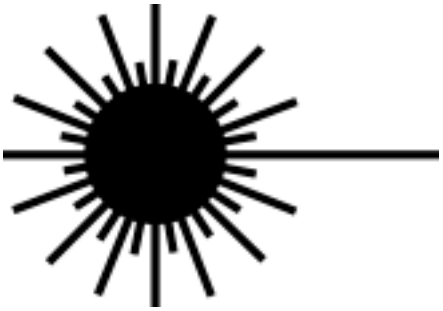
10. With the vertical fine adjust knob (small knob), adjust the VA reading until 90° 00’ 00” is displayed.

11. Press %/VA button. Using vertical adjust knob (A), adjust the % of grade per the project requirement.

IMPORTANT! DO NOT USE THE HOLD BUTTON WITH THE GBM SYSTEM! Doing so will freeze the displayed horizontal angle readout which will remain unchanged regardless of theodolite directional movement.

⚠ DANGER Staring into laser light will cause severe injury.

Do not stare into the laser sight light beam or the laser guidance system laser light beam. Avoid direct eye exposure. Do not aim laser at anyone’s eyes.



12. Turn the laser bore sight ON by turning the end cap clockwise until the laser light turns ON.

NOTICE The battery life (fully charged) with the laser continuously ON is approximately one hour. The battery life will be shorter in colder climates.

13. Slide the laser bore sight completely into the laser alignment holder.

14. Thread the alignment holder/laser bore sight into the theodolite counterweight until it is snug against telescope.

SET/CHECK ELEVATION

15. Elevation is set by using a transit and surveying marks.

    To check the elevation:

    a. Move the gear box assembly as far forward as possible.

    b. Insert the target completely into the drive swivel. Do not turn on target.

    c. The laser bore light should be centered on the middle dot of the target.

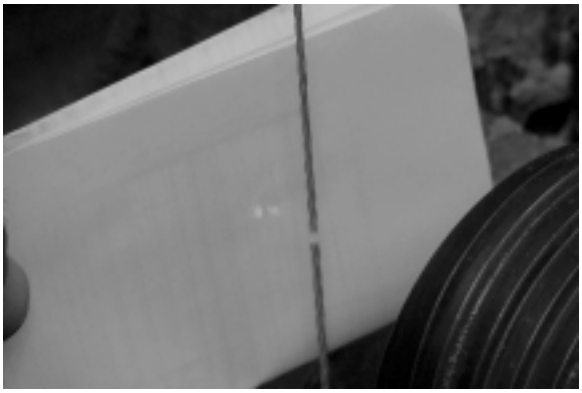
    d. If the laser beam is not centered on the middle dot of the target, move the elevation of the theodolite until the laser beam is centered on the target's middle dot by: loosening column lock, raise or lower column with handle and relock column.

    e. Relevel theodolite.

PRELIMINARY STRING LINE CALIBRATION

16. Using the horizontal fine tuning knob, adjust as needed to center the laser light with the front string line.

NOTICE Use a piece of paper or cardboard to help determine when the front line is centered in the laser light.



17. Using the lateral slide, adjust as needed to line up the laser light with the front string line.

NOTICE Use a piece of paper or cardboard to help determine when the back line is centered in the laser light.

18. Repeat steps 16 and 17 until both string lines are centered within the laser light.

19. Press RESET on theodolite until the LED displays HA: 00° 00’ 00”

20. Recheck level.

21. Unthread alignment holder/bore sight laser from counterweight.

22. Remove laser bore sight from the laser alignment holder by inserting rod (included) through hole in holder and gently push the laser bore sight out of holder.

⚠ DANGER Staring into laser light will cause severe injury.

23. Turn the laser OFF by turning the end cap counterclockwise until laser light is OFF.

24. Replace laser bore sight and rod into storage case.

25. Replace the retical (cross hair) light to counterweight. The tip of the light must be directed into the telescope lens for the theodolite cross hairs to display on monitor.

26. Remove the target from the drive swivel.

FINAL THEODOLITE SETUP

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. With engine running, turn monitor power ON at pendant.

NOTICE The monitor power at the pendant must be turned OFF before starting engine.

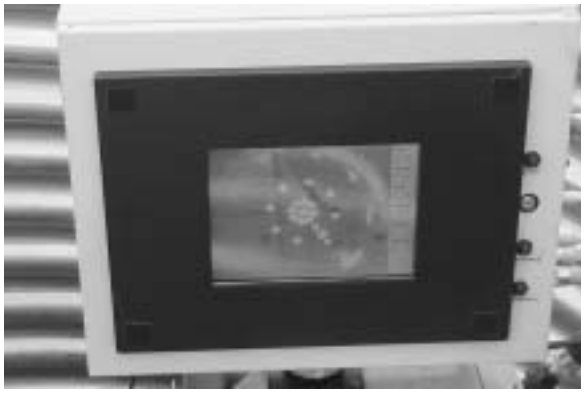
NOTICE Engine RPM must be at least 1500 RPM to power monitor.

2. Turn ON monitor with switch.

3. Turn ON target.

4. Insert the lighted target completely into the drive swivel.

5. Adjust the elevation as needed to center the middle dot of the target with the crosshairs on the monitor.



NOTICE To improve the target image and crosshairs on the monitor, use the Gain, Exposure, Zoom, Left/Right, Up/Down, and LED brightness controls on the monitor and the focusing ring on the theodolite telescope.

MONITOR STARTING POINT ADJUSTMENTS:

	Gain	*Exposure*
Target Set Up	40s or less	125 or less
Normal Oper.*	125	225-250

* after 3 to 5 pilot tubes installed

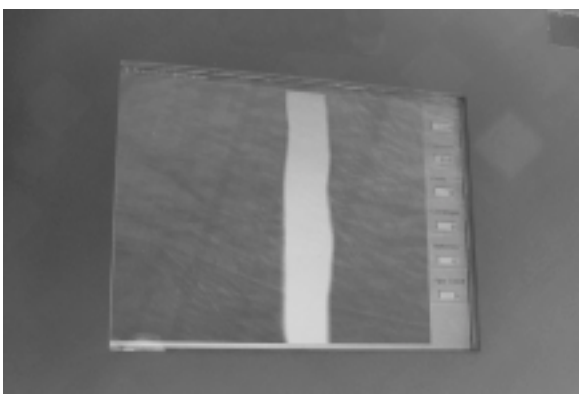
6. Once elevation is adjusted, remove the target and turn OFF.

7. Recheck your grade by pressing the %VA button. If necessary, adjust the % of grade by using the vertical fine adjust.

IMPORTANT! DO NOT USE THE HOLD BUTTON WITH THE GBM SYSTEM! Doing so will freeze the displayed horizontal angle readout which will remain unchanged regardless of theodolite directional movement.

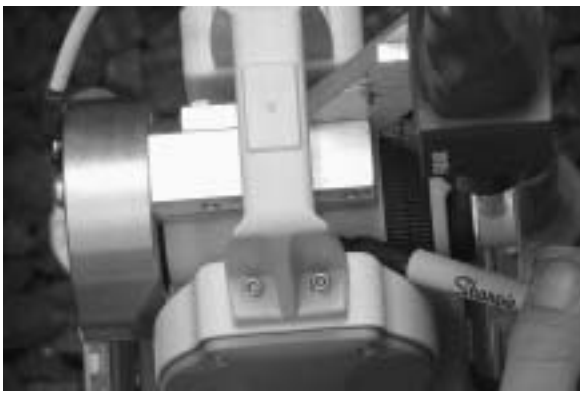
8. Relevel the theodolite, if necessary.

9. Center both the front and back string lines to the crosshairs on the monitor as follows:



NOTICE By adjusting the focus on the theodolite, the line image will change from the forward line to the rear line and vise versa. You may have to tap the string to determine which string you have focused.

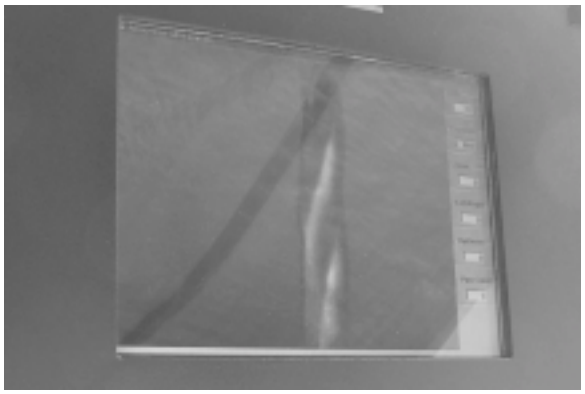
a. Using the focusing ring on the telescope, focus on the string lines. When you are able to focus on a string line, mark the focus location so you can easily go back to this location.



b. Use the lateral slide to line up the back string line on the monitor crosshairs.

NOTICE The back string line will be wider and brighter than the front string.

c. Use the horizontal fine adjust to line up the front string line on the monitor crosshairs.



d. Continue to line up the front and back string lines until they are both centered with the vertical crosshair on the monitor.

e. Once the two strings are centered with the monitor crosshairs, the theodolite is now in line with the surveyor's marks.

NOTICE Due to ground shifting during jacking, you must periodically check the level of the theodolite to assure that the theodolite is aligned side to side and front to back. Also check to be sure the % of grade is correct.

10. Once string lines are set, press RESET and recheck level, elevation, and grade.

11. Proceed to Installing Pilot Tubes section.

Operation - Installing Pilot Tubes

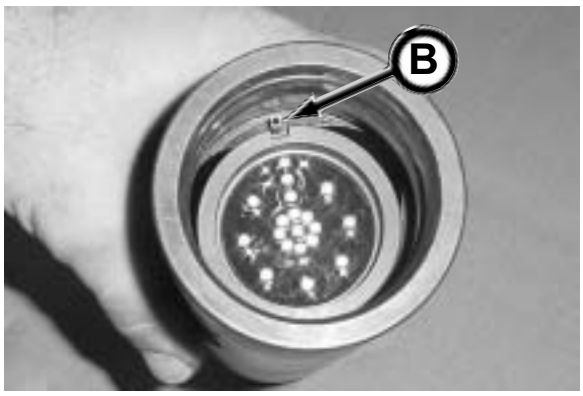
INSTALLING STEERING HEAD ADAPTER TO STEERING HEAD

1. Check o-rings (A) for damage. If damaged, replace with new.

   Check to be sure that both o-rings are properly seated into target holder.

2. Remove cap on target. Turn the target LED lights ON and replace cap on target.

3. Slide target into target holder. Be sure the notch on the target aligns with pin (B) on holder.



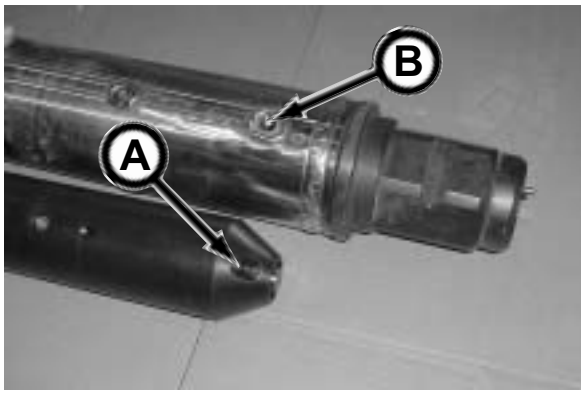
4. Secure target to target holder by tightening three set screws with a 1/8” allen wrench.

5. Fully insert inner tube into target holder.

6. Loosen three set screws on steering head adapter with a 3/16” allen wrench, so the target assembly can be slid into adapter.

7. Remove the front 1/2 x 1-1/4 set screw for alignment purposes.

8. Before installing the target assembly, note that the target holder cavity (A) must align with the adapter set screw hole (B).



9. Slide target assembly into adapter. Be sure the target holder cavity aligns with the adapter set screw hole.

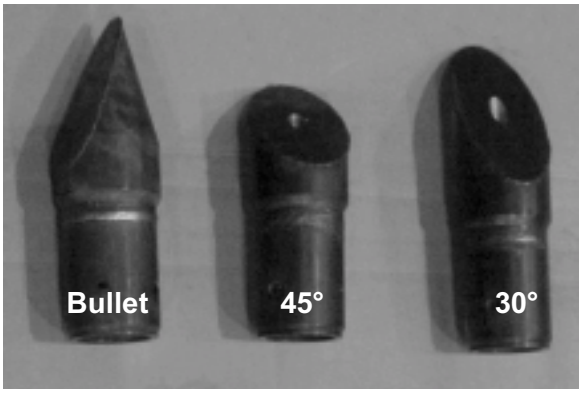
10. Reinstall the 1/2 x 1-1/4 in. set screw (removed in step 7) with a 1/4” allen wrench.

11. Tighten the other three set screws with a 3/16” allen wrench.

12. Check to be sure that the inner tube end of the target assembly is 1 in. (25.4 mm) from the end of the steering head adapter. If not, the target must be remounted until the 1 in. clearance is achieved.

13. Choose the steering head. Since ground conditions can change drastically, use the best steering head for your particular conditions based on the soil analysis. As a general rule:

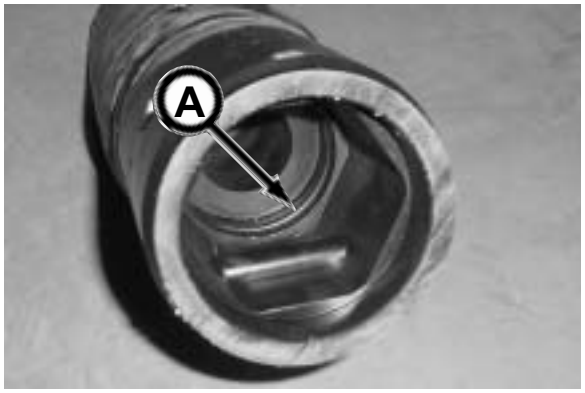
Ground	*Steering Head*
Soft	30° Head
Medium	45° Head
Hard	Bullet Head



NOTICE The bullet steering head has a lubrication port on its side, but NOT on the angled face. The 30° and 45° steering heads have two lubrication ports; one on its side and one on its angled face.

14. Check o-ring (A) for damage. If o-ring is damaged, replace with new.

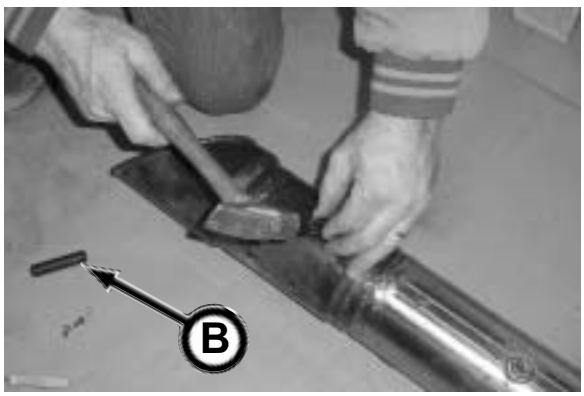
    Check that the o-ring is properly seated into steering head.



15. Install steering head to steering head adapter by aligning the adapter pin with the countersunk hole in the steering head. Be sure there is no gap between the adapter and steering head surfaces.

16. Check connection pin (B) o-rings for damage. If damaged, replace with new.

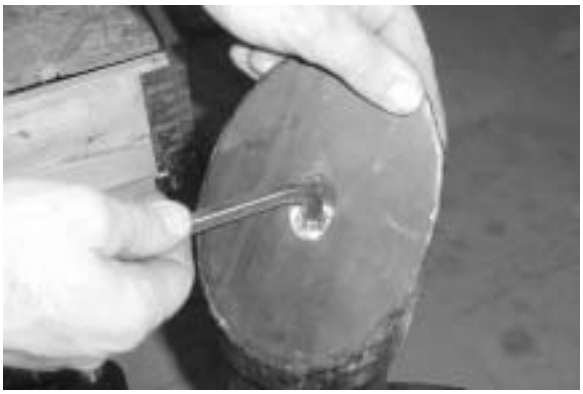
    Lubricate o-rings on connection pins. Secure steering head to adapter with connection pins (2 places).



17. Place anti-seize lubricant on the 10-24 socket head cap screws (2). Install socket head cap screws to secure connection pins to steering head with a 5/32” allen wrench.

18. Put a small amount of pipe sealant on pipe plug and the lubrication plug threads. Install plugs with a 1/4” allen wrench.

NOTICE The solid pipe plug is initially located on the angled face. The pipe plug with the .25 in. (6.4 mm) diameter lubrication port, is located on the side of the steering head. The plugs can be switched as needed per operating conditions. If more flow is desired, upsize the hole in the lubrication plug.

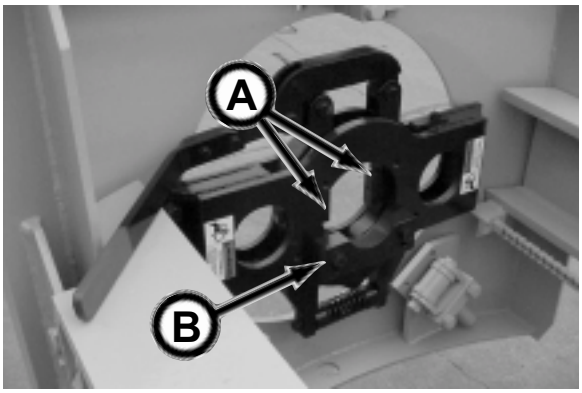


INSTALLING PILOT TUBES

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. Slip the fluid swivel adapter into the internal hex adapter of gear box.

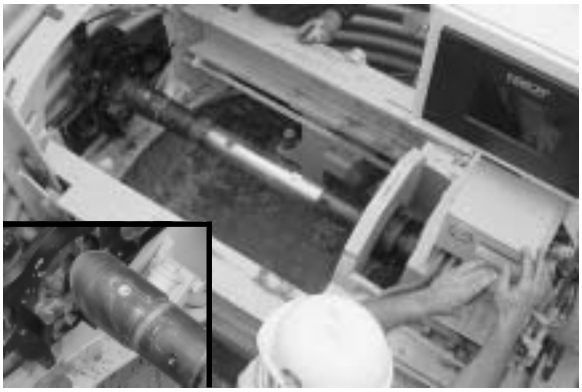
   Secure the flange and locknuts (see inset) on the swivel adapter on the back of the gear box only if you plan to pull back pipe.



2. Remove both jaw insert blocks, bolts, and lockwashers (A) on make-up tool so they will not interfere with steering head adapter in step 5. It may be necessary to lower the guide block (B).

3. Install steering head to steering head adapter. See Installing Steering Head Adapter To Steering Head in this section. Depending on ground conditions, you may want to relocate the lubrication port on the steering head.

4. Install steering head/steering head adapter to swivel drive assembly adapter on gear box using the drive rotation control to CW position, to thread the adapter to the swivel on gear box.



5. Advance steering head into the ground with the tip UP (see inset), by extending travel cylinder control lever to forward position.

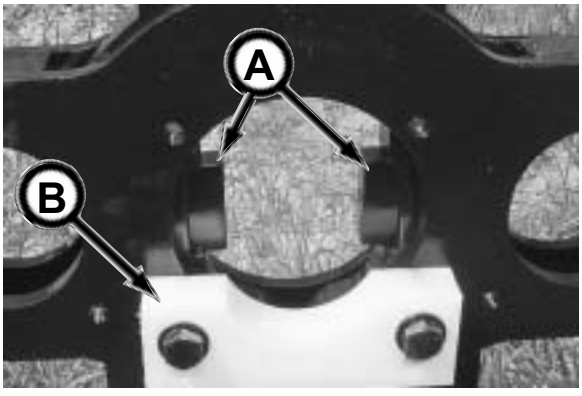
6. (Latching Frame Only) Relatch the latching pins when needed:

NOTICE Latching pins must be completely engaged into frame holes before jacking. Failure to do so, could cause latching mechanism, jacking cylinders, guidance system, and/or pilot tube damage.

- (Manual Lever) Unlock latching pins from frame with lever.

Retract jacking cylinders until the pins lock into the next set of holes in frame. Since the locking pins are torsionally spring loaded, the pins will automatically reset into locking position. Check to make sure the latching pin lever is back to the full vertical position for complete pin engagement.

NOTICE (Hydraulic, if equipped) Unlock latching pins with latching pin control lever. Retract jacking cylinders until the pins line up with the next set of holes in frame. Then relock latching pins into frame holes with lever.



7. Once the steering head has passed the make-up tool, install the jaw insert blocks (A), bolts, and lockwashers that were removed in step 2.

8. Slide the guide block (B) up against pilot tube and secure with two 5/8 x 2-1/4 in. bolts and flat washers.

(continued on next page)

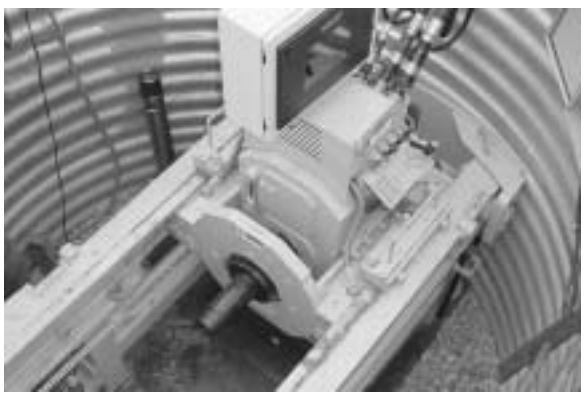
9. Push adapter the full travel of frame until the notches in the steering head adapter line up with the blocks in the make-up tool.

10. Engage the make-up tool to the notches on adapter.

11. (Latching Frame Only) Unlock latching pins.

12. Disengage the drive adapter from the steering head adapter by rotating the drive CCW and retracting the jacking cylinders.

13. Move the gear box assembly to the back of the GBM frame using the frame travel motor until the latching mechanism is locked. Be sure both latching pins are engaged.



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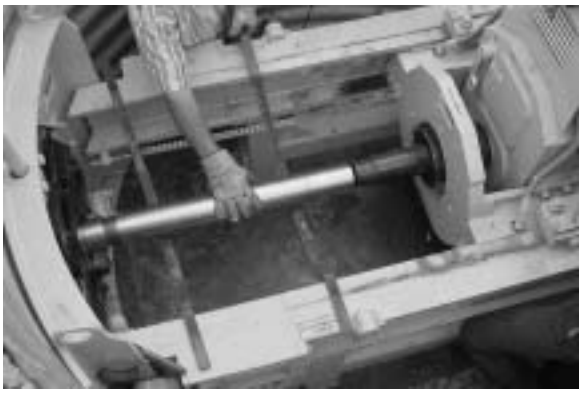
14. Place support bars on frame rails.

15. Remove cap and plug from a pilot tube and secure them together for storage.

16. Place the pilot tube on the pilot tube support bars.



NOTICE BEFORE you install each pilot tube, inspect o-rings for damage. Replace if damaged. Also, wipe o-rings with a lubricant. DO NOT spray a lubricant on the o-rings. Doing so will make it difficult to identify the target on the monitor due to the reflection of the lubricant in the pilot tube.

(continued on next page)

17. Advance gear box assembly with frame travel motor control while using the drive rotation control, CW position, to thread the pilot tube to the drive assembly and steering head adapter.

18. Torque the connection to 1000 psi (2000 ft-lb) on pressure gauge mounted on gear box.

18. Release make-up tool to disengage jaw insert blocks from steering head adapter.

20. Secure the make-up tool in the open position.

NOTICE Do not allow make-up tool jaw insert blocks to ride on pilot tube during the pushing of pipe. Doing so can will cause premature wear to the jaw inserts and the jaw insert bolts will be sheared when the inserts are caught in the pilot tube notches while pushing the pipe.

21. Advance the pilot tube in ground by extending the frame travel cylinders.

    (Latching Frame Only) Relatch the locking pins as needed.

While the pilot tube is advancing, check the target position often. Use the drive rotation lever to align the target on line and grade. Always rotate the pilot tube CW. Rotating the pilot tubes CCW will unthread the pilot tubes in the pipeline resulting in unrecoverable pilot tubes.

(continued on next page)

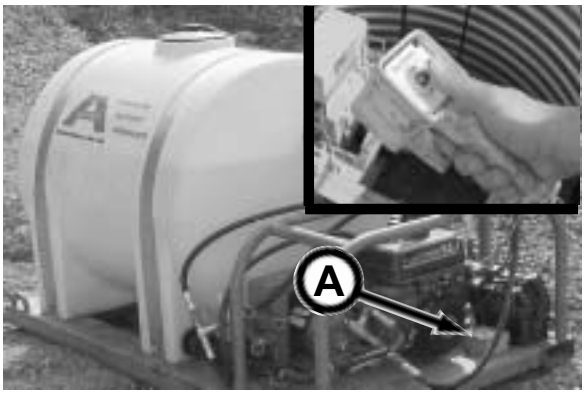
Also, check your jacking pressure with pressure gauge. Working range is up to 4000 psi. Maximum pressure is 5000 psi.

22. Depending on the soil conditions, you may have to add lubrication (do not use bentonite) to lower the jacking pressure. Generally, if the pressure is running at 2500 psi and the pressure consistently increases, add lubrication as follows:

a. connect pump supply hose to fluid connector adapter on drive swivel adapter.

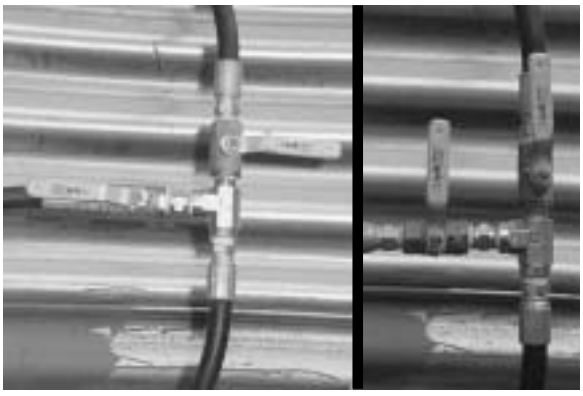
NOTICE To use pendant, switch to remote setting on control box (A).

b. turn on pump using pump pendant to control the lubrication flow, or use a ball valve to control the lubrication flow.



c. Control the lubrication flow so there is no lubrication flowing out of the pilot tubes in the launch shaft.

d. Before loosening pilot tube joints, vent the fluid into a catch pan to relieve pressure and prevent the fluid from entering the inner tube of the pilot tube.



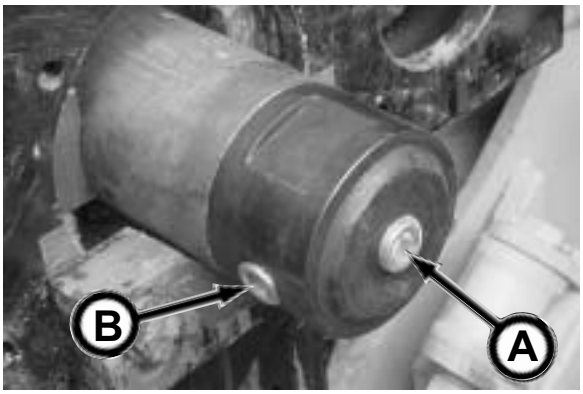
Venting Fluid *Pumping Fluid*

Shutoff Arrangement

(continued on next page)

23. On long down hill drives or certain soil conditions, moisture or condensation may build up in the pilot tube resulting in poor target visibility. If this occurs, install the air/fluid connector to the end of the pilot tube and add air through port (A) to purge the moisture or condensation and increase visibility to the target.

    Fluid can be added through port (B) into the pilot tube fluid passage for lubrication at the steering head.



NOTICE If adding fluid through the air/fluid connector, BEFORE loosening connector to add additional pilot tubes, vent the fluid into a catch pan to relieve pressure and prevent the fluid from entering the inner tube of the pilot tube.

24. Log the pilot tube progress with the Log of Progress work sheets. This log will detail the progress of each pilot tube's jacking pressure, rotational pressure, steering changes, and deviations. This log will be beneficial if there is an abrupt change in jacking pressure or rotational torque.

Akkerman Inc. - GBM Log Of Progress				
Project				
Location				
Length of Drive				
Steering Head Part Number				
Pilot tube No.	**Jacking Pressure**	**Rotational Pressure**	**Steering Changes**	**Deviation**

25. Continue adding pilot tubes by using the make up tool and frame travel control to thread the pilot tube connections, and relatch the locking pins as needed (latching frame only) until the steering head reaches the reception shaft.

NOTICE Regularly secure frame to the shaft while pushing the pilot tubes using the shaft tensioners on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.

(continued on next page)

26. Once the steering head reaches the reception shaft, push the last pilot tube until the notches in the tube line up with the jaw insert blocks on the make-up tool.

27. Engage the make-up tool to the notches on the pilot tube.

28. Disengage the drive adapter from the pilot tube by rotating the drive CCW while retracting the jacking cylinders.

29. Remove the drive adapter swivel from gear box.

30. Proceed as follows using the desired method of pipe installation:

Three Step Method (Typical)
- If using a reaming head, proceed to “Three Step Method: Installing Auger Casings With Reaming Head” in this section, subsection Installing Upsizing Tool.

- If using a cutter head, proceed to “Three Step Method: Installing Auger Casings With Open Face Cutter Head” in this section, subsection Installing Upsizing Tool.

Auger Boring Machine Method
- If using a reaming head with the Auger Boring Machine, proceed to “Auger Boring Method: Reaming Head Installation” in this section, subsection Installing Upsizing Tool.

- If using a cutter head with the Auger Boring Machine, proceed to “Auger Boring Method: Open Face Cutter Head Installation” in this section, subsection Installing Upsizing Tool.

Two Pass Method
- If using a reaming head with the two pass method, proceed to “Two Pass Method: Installing Reaming Head” in this section, subsection Installing Upsizing Tool.

LOG OF PROGRESS

Log the pilot tube progress. This log will detail the progress of each pilot tube's jacking pressure, rotational pressure, steering changes, and deviations. The log will be beneficial if there is an abrupt change in jacking pressure or rotational torque.

Akkerman Inc. - GBM Log Of Progress				
Project				
Location				
Length of Drive				
Steering Head Part Number				
Pilot tube No.	**Jacking Pressure**	**Rotational Pressure**	**Steering Changes**	**Deviation**
Pilot tube No.	**Jacking Pressure**	**Rotational Pressure**	**Steering Changes**	**Deviation**

Operation - Installing Upsizing Tool

AUGER BORING METHOD: REAMING HEAD INSTALLATION

1. Remove guidance system from shaft and store in protective case.

2. If not already removed, remove the drive adapter swivel from gear box.

3. Insert the pilot tube adapter hex into the gear box.

4. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the frame travel motor control.

5. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.

6. Release make-up tool.

7. Advance adapter into ground until the larger diameter tube of the adapter is close to the make-up tool.

8. Remove jaw inserts from the make-up tool. You may also have to lower or remove guide block (A).

9. Advance adapter until there is enough room to pin the 10’ pilot tube to the pilot tube adapter.

10. Move gear box assembly to the back of the GBM frame using the frame travel motor.

11. In the reception shaft, remove steering head.

a. Remove set screw.

b. Drive out pins.

c. Remove pins.

d. Remove steering head.

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

12. Remove GBM frame.

13. Install the 10’ pilot hex tube to the pilot tube adapter with four roll pins. If needed, advance the tubes forward so there is enough room to add the reaming head assembly.

14. Install reaming head assembly to the 10’ pilot hex tube with four roll pins.

15. If necessary, advance the reaming head assembly forward so there is enough room to add a casing section (customer supplied).

16. Weld casing to the reaming head assembly.

17. If needed, cut hole in shaft wall large enough for the reaming head and casings to pass through.

18. Proceed with the auger boring process to add casings and augers. Refer to your auger boring machine's operation manual.

NOTICE Lubricant can be pumped from the reception shaft to lubricate the spoils and casings to reduce jacking forces. Install fluid connector on end of pilot tube in the reception shaft. Refer to "Upsizing Tool Lubrication From Reception Shaft" in this section for configuration details.

19. Once the steering head adapter and the pilot tubes reach the reception shaft, each joint must be loosened with the breakout tool.

Hook up the breakout tool as follows:

Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

Selector Position:
Port A - Extend
Port B - Retract

Plug the breakout tool into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

20. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.

21. Install cap on steering head adapter and pilot tube threads.

22. Place jaw insert on notches of back pilot tube.

23. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 23.

24. Slide other jaw insert on notches of the steering head adapter or the front pilot tube.

25. Slide breakout tool over jaw inserts.

NOTICE You may have to extend or retract the cylinder to line up the jaw insert teeth with the breakout tool gear teeth.

26. Move the control lever to port A to extend the cylinder.

27. Extend cylinder by depressing the switch on the remote controller.

NOTICE The rocker switch on the pump unit can also be used to control the cylinder.

28. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

29. Release switch on controller.

30. Once the joint is loosened, move the control lever to port B.

31. Slightly retract the cylinder until the breakout tool can be slid towards the launch shaft.

32. Remove the front jaw insert.

33. Slide the breakout tool towards the end of the tube and remove the back jaw insert.

34. Slide the breakout tool towards the launch shaft for the next joint removal.

35. Remove the pilot tube and immediately install a plug on the end of the pilot tube to prevent dirt from entering pilot tube.

36. Place pilot tube into pilot tube rack.

37. Install a cap on the end of next pilot tube to be removed. Place the pilot tubes in the pilot tube racks.

38. Continue to remove pilot tubes as they reach the reception shaft.

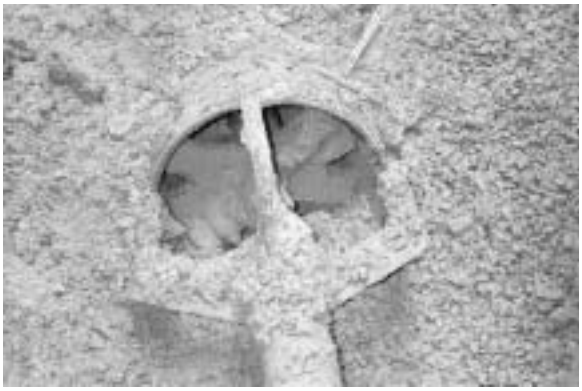
39. Once the pilot tube adapter reaches the reception shaft, remove the last pilot tube with the breakout tool from the pilot tube adapter, cap and plug the pilot tube, and place into pilot tube rack.

40. Remove the pilot tube adapter by removing four roll pins from the pilot tube adapter and the 10' pilot tube. Be sure to cap the threaded end of the adapter.

41. Remove the 10’ pilot tube by removing four roll pins from the 10’ pilot tube and the reaming head assembly.

42. Once the reaming head assembly and casings reach the reception shaft, remove the reaming head from the casing.

The casing installation is now complete. The casings are on line and grade. The next step is to add the product pipe per the project requirements.



AUGER BORING METHOD:
OPEN FACE CUTTER HEAD INSTALLATION

1. Remove guidance system from shaft and store in protective case.

2. If not already removed, remove the drive adapter swivel from gear box.

3. Insert the pilot tube adapter hex into the gear box.

4. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the frame travel motor control.

5. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.

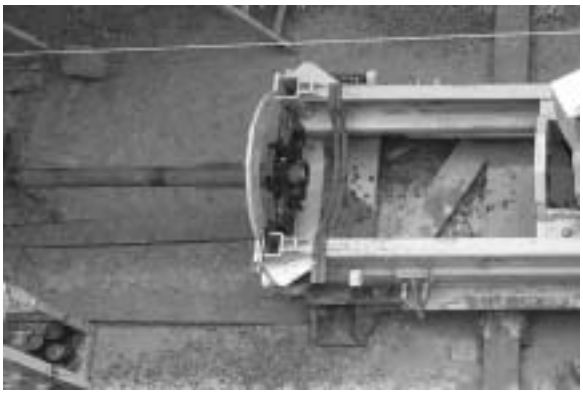
6. Release make-up tool.

7. Advance adapter into ground until the larger diameter tube of the adapter is close to the make-up tool.

8. Remove jaw inserts from the make-up tool. You may also have to lower or remove guide block (A).

9. Advance adapter until there is enough room to pin the 10’ pilot tube to the pilot tube adapter.

10. Move gear box assembly to the back of the GBM frame using the frame travel motor.



11. In the reception shaft, remove steering head.

a. Remove set screw.

b. Drive out pins.

c. Remove pins.

d. Remove steering head.

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

12. Remove GBM frame.

13. Install the 10’ pilot hex tube (5” OD) to the pilot tube adapter with four roll pins. If needed, advance the tubes forward so there is enough room to add the lead guide rod.

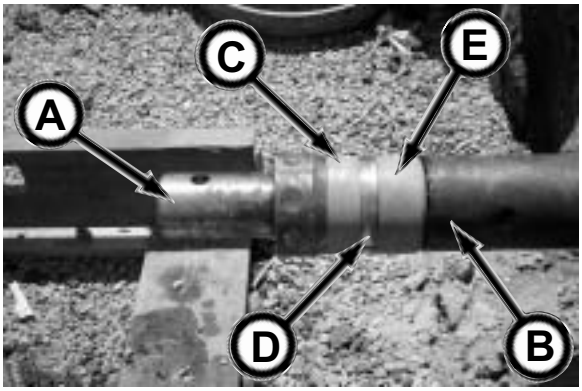
14. Install 10’ lead guide rod (5” to 6” OD) to the 10’ pilot hex tube (5” OD) with four roll pins.

15. With the auger boring machine, advance the guide rod extension tube into the ground.

16. Install 10' guide rod extension tube (6" OD) to the 10' lead guide rod with one 3/4 x 6" socket head cap screw.

17. Before installing guide rod (A) into guide rod extension tube (B), slide the swivel components onto the guide rod as follows: narrow nylon wear ring (C), then the steel thrust washer (D), and finally the wide nylon wear ring (E) with the taper facing the reception shaft.

18. Slide the guide rod with swivel components into guide rod extension tube.



19. Install the guide rod to the auger boring machine hex shaft with a 3/4" bolt.

20. With the auger boring machine, advance the guide rod/guide rod extension tube into the ground until there is enough room to lower casings.

21. Disconnect the guide rod/pilot tube swivel from the auger boring machine hex shaft.

22. Move auger boring machine to the back of the launch shaft so there is enough room to install the steel casing with auger.

23. Lower steel casing/auger into launch shaft.

24. Connect the auger to the guide rod/pilot tube swivel and the auger boring machine hex shaft.

25. Proceed with the auger boring process. Continue to add casings and augers using the auger boring machine to advance the casings until the casings reach the reception shaft.

NOTICE Lubricant can be pumped from the reception shaft to lubricate the spoils. Install fluid connector on end of pilot tube in the reception shaft. Refer to “Upsizing Tool Lubrication From Reception Shaft” in this section for configuration details.

26. Once the steering head adapter and the pilot tubes reach the reception shaft, each joint must be loosened with the breakout tool.

    Hook up the breakout tool as follows:

    Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

    Selector Position:
    Port A - Extend
    Port B - Retract

    Plug the breakout tool into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

27. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.

28. Install cap on steering head adapter and pilot tube threads.

29. Place jaw insert on notches of back pilot tube.

30. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 29 as shown.

NOTICE The cylinder side of the breakout tool is deeper than the other side. This allows the breakout tool to slide over both jaw inserts when loosening the pilot tube joints.

31. Slide other jaw insert on notches of the steering head adapter or the front pilot tube.

32. Slide breakout tool over jaw inserts.

NOTICE You may have to extend or retract the cylinder to line up the jaw insert teeth with the breakout tool gear teeth.

33. Move the control lever to port A to extend the cylinder.

34. Extend cylinder by depressing the switch on the remote controller.

NOTICE The rocker switch on the pump unit can also be used to control the cylinder.

35. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

36. Once the joint is loosened, move the control lever to port B.

37. Slightly retract the cylinder until the breakout tool can be slid towards the launch shaft.

38. Remove the front jaw insert.

39. Slide the breakout tool towards the end of the tube and remove the back jaw insert.

40. Slide the breakout tool towards the launch shaft for the next joint removal.

41. Remove the pilot tube and immediately install a plug on the end of the pilot tube to prevent dirt from entering pilot tube.

42. Place pilot tube into pilot tube rack.

43. Install a cap on the end of next pilot tube to be removed.

44. Continue to remove pilot tubes as they reach the reception shaft. Place the pilot tubes in the pilot tube racks.

45. Once the pilot tube adapter reaches the reception shaft, remove the last pilot tube with the breakout tool from the pilot tube adapter, cap and plug the pilot tube, and place into pilot tube rack.

46. Remove the pilot tube adapter by removing four roll pins from the pilot tube adapter and the 10' pilot tube. Be sure to cap the threaded end of the adapter.

47. Remove the 10' pilot tube (5" OD) by removing four roll pins from the 10' pilot tube (5" OD) and the 10' lead guide rod (5" OD to 6" OD).

48. Remove the 10' lead guide rod (5" OD to 6" OD) by removing the 3/4 socket head cap screw from the 10' lead guide rod and the 10' guide rod extension tube.

49. Once the casings reach the reception shaft, remove the guide rod extension tube and guide rod from the auger shaft.

    The casing installation is now complete. The casings are on line and grade. The next step is to add the product pipe per the project requirements.

THREE STEP METHOD: INSTALLING AUGER CASING WITH REAMING HEAD

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. Remove guidance system from shaft and store in protective case.

2. (Latching Frame Only) Remove two brackets in rear of frame.

3. If not already removed, remove the drive adapter swivel from gear box.

NOTICE If lubrication may be required to lower jacking pressures during the drive, refer to Upsizing Tool Lubrication From Reception Shaft in this section, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

4. Lower the pilot tube adapter and Insert the pilot tube adapter hex into the gear box.

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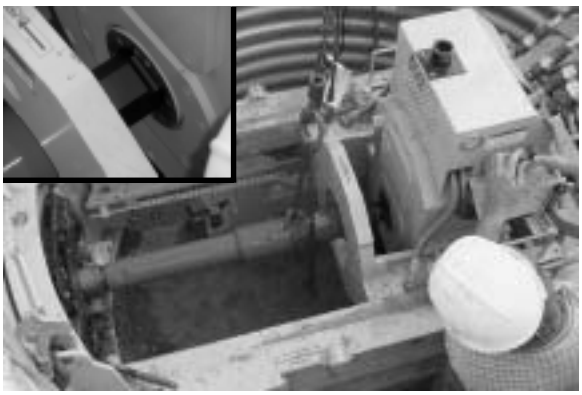


5. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the frame travel motor control.

6. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.

7. Release make-up tool.

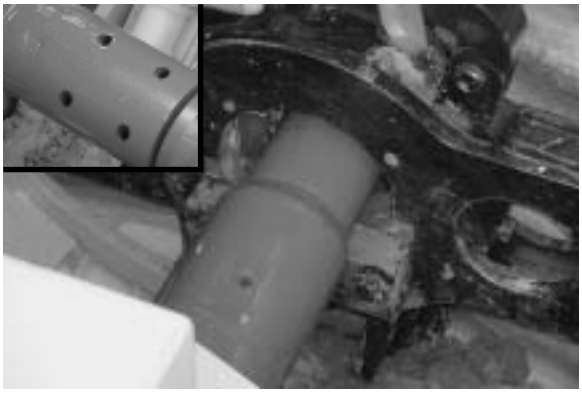
8. Advance adapter into ground until the larger diameter tube of the adapter is close to the make-up tool.

9. Remove jaw inserts from the make-up tool. You may also have to lower or remove guide block (A).

(continued on next page)

10. Advance adapter until there is enough room to pin the pilot tube adapter to the reaming head assembly.

NOTICE For ease of installing reaming head, you may need to rotate the adapter to be sure the four pin holes are in the vertical (up and down) position (see inset).



11. Move the gear box assembly to the back of the GBM frame using the frame travel motor to allow enough room for the dirt bucket and reaming head assembly.

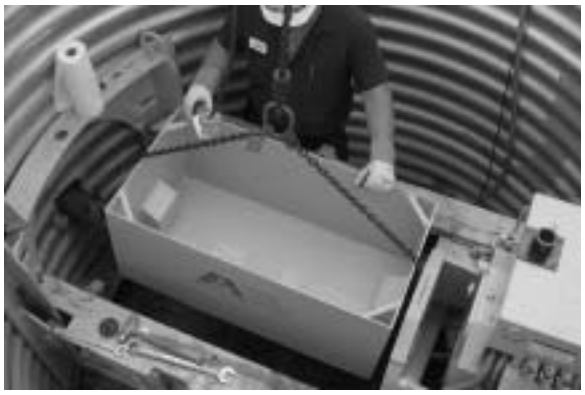
(continued on next page)

12. Remove make-up tool.

NOTICE If lubrication may be required to lower jacking pressures during the drive, refer to Upsizing Tool Lubrication From Reception Shaft in this section, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

13. Remove hex coupler from pilot tube adapter.

14. Lower dirt bucket into shaft.



(continued on next page)

15. In the reception shaft, remove steering head.

a. Remove set screw.

b. Drive out pins.

c. Remove pins.

d. Remove steering head.

(continued on next page)

16. Install casing thrust adapter to thrust plate with three 3/4 x 2 in. bolts and washers.

⚠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 and load can fall instantly.

Do not stand or walk under a load.

NOTICE If lubrication may be required to lower jacking pressures during the drive, refer to Upsizing Tool Lubrication From Reception Shaft in this section, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

17. Lower reaming head assembly into shaft and install fluid connector to reaming head.

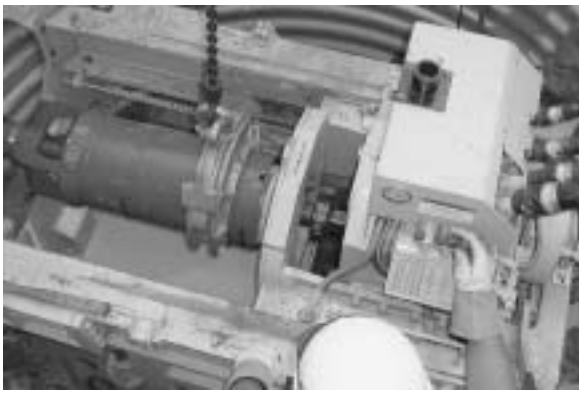
NOTICE Use a properly rated pipe tong or nylon strap to handle the reaming head assembly and casings.

(continued on next page)

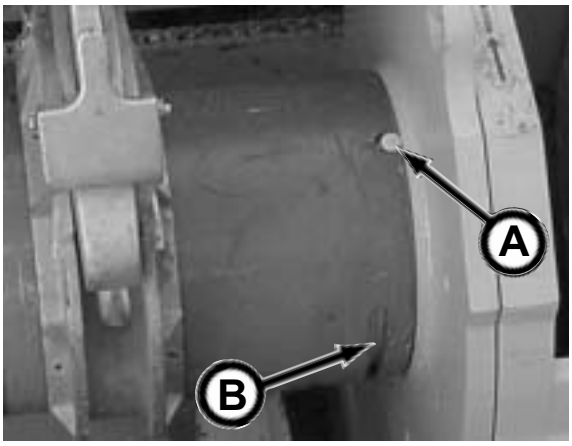
18. Insert reaming head hex shaft into pilot tube adapter and secure with four roll pins.

19. Install auger drive adapter onto auger shaft.

(continued on next page)

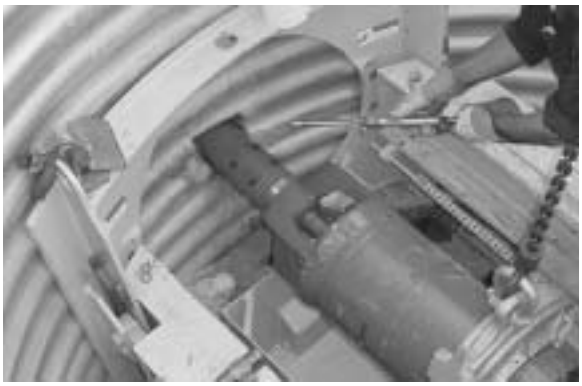


20. Align and engage auger drive adapter with the hex opening in gear box using the drive rotation control and frame travel motor control.



21. Using hoist, align notches in reaming head casing with top alignment guide (A) and bottom alignment guide (not shown) on thrust plate.

NOTICE If pulling back of pipe will be required, install keepers into reaming head assembly lead casing and casing thrust adapter (B).



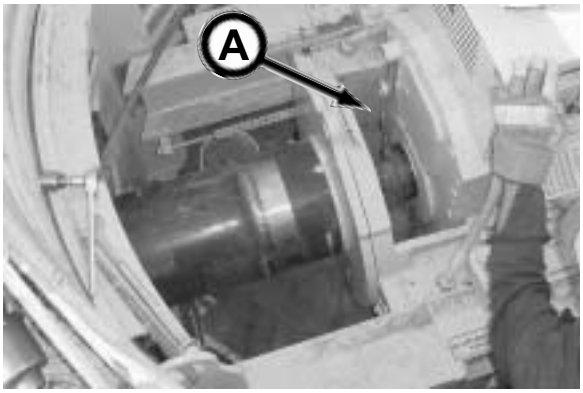
22. Cut an opening in the shaft large enough for the reaming head, thrust casings, and product pipe to pass through.

23. Move drilling drive speed selector to the HSLT or High Speed Low Torque position.

NOTICE Depending on soil conditions and length of drive, it may be necessary to change the selector to the LSHT position.

(continued on next page)

24. Advance the reaming head assembly by extending the frame cylinders with the frame travel cylinder control and the clockwise drive rotation control.



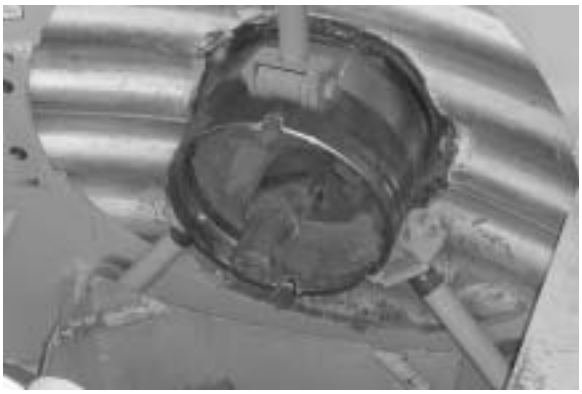
NOTICE Rotate the augers and advance the casings so small clumps of spoil are going into the dirt bucket. Over advancing the casings will restrict the flow of material out of the auger resulting in the spoil plugging in the spoil chamber (A).

(Latching Frame Only) Relatch latching pins as needed.

NOTICE Be sure latching pins are completely engaged into frame holes before jacking.

25. Continue to advance the reaming head assembly the full length of the frame.

NOTICE Lubricant can be pumped from the reception shaft to lubricate the spoils and casings to reduce jacking forces. Install fluid connector on end of pilot tube in the reception shaft. Refer to “Upsizing Tool Lubrication From Reception Shaft” in this section for configuration details.



26. Before retracting gear box, adjust the three roller brackets to casing by loosening clamp, slide roller into position, and retighten clamp. The rollers will support the casing while the gear box is retracted.

27. Move the gear box assembly to the back of the GBM frame using the frame travel motor until the latching mechanism is locked (latching frame only).

28. Lower thrust casing/auger into launch shaft.

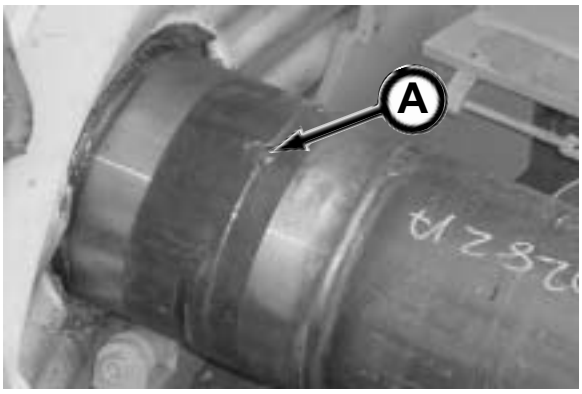
(continued on next page)

⚠WARNING Safety glasses must be worn while using power equipment (air tools). Failure to do so could cause severe injury from flying debris.

29. Slide the thrust casing auger onto the end of the reaming head assembly auger shaft.

30. With the auger flighting lined up, attach the auger ends with one 3/4 x 4 in. bolt and nylock lock nut. Tighten the nut so the end of the nut is flush with the end of the bolt. Do not overtighten.

31. Advance the casing to the reaming head assembly casing and align with alignment guides in the 12 o'clock (A) and 6 o'clock positions.

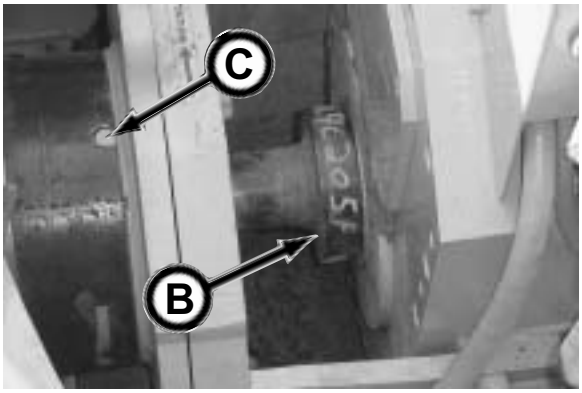


32. Install four casing joint keepers at the 2 o'clock, 4 o'clock, 8 o'clock, and 10 o'clock positions to lock the casings together.

33. Remove auger drive adapter from gear box and insert onto casing auger shaft.

(continued on next page)

34. Align the auger drive adapter (B) into the gear box while aligning the notches in the casings with the alignment guides (C) on thrust plate using the drive rotation control and frame travel motor control.



NOTICE If pulling back of pipe will be required, place keepers into casing and casing thrust adapter.

NOTICE BEFORE rotating augers, the casings must be fully engaged with alignment guides on thrust plate. This prevents the casings from rotating with the augers.

35. Advance the casing/auger with the drilling frame cylinder control and the rotation (CW) control.

NOTICE With the addition of each section of casing/auger, a section of pilot tube will be removed in the reception shaft. Refer to procedure starting with step 39.

36. Periodically empty the dirt bucket.

37. Replace dirt bucket.

(continued on next page)

38. Continue to add casings and augers until all pilot tubes and the reaming head assembly are removed from reception shaft.

NOTICE Regularly secure frame to the shaft while pushing the casings using the shaft tensioners on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.

NOTICE Lubricant can be pumped from the reception shaft to lubricate the spoils and casings to reduce jacking forces. Install fluid connector on end of pilot tube in the reception shaft. Refer to “Upsizing Tool Lubrication From Reception Shaft” in this section for configuration details.

39. Once the steering head adapter and the pilot tubes reach the reception shaft, each joint must be loosened with the breakout tool.

Hook up the breakout tool as follows:

Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

Selector Position:
- Port A - Extend
- Port B - Retract

Plug the breakout tool into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

(continued on next page)

40. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.

41. Install cap on steering head adapter and pilot tube threads.

42. Place jaw insert on notches of back pilot tube.

43. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 42 as shown.

NOTICE The cylinder side of the breakout tool is deeper than the other side. This allows the breakout tool to slide over both jaw inserts when loosening the pilot tube joints.

(continued on next page)

44. Slide other jaw insert on notches of the steering head adapter or the front pilot tube.

45. Slide breakout tool over both jaw inserts.

NOTICE You may have to extend or retract the cylinder to line up the jaw insert teeth with the breakout tool gear teeth.

46. Move the control lever to port A to extend the cylinder.

47. Extend cylinder by depressing the switch on the remote controller.

(continued on next page)

NOTICE The rocker switch on the pump unit can also be used to control the cylinder.

48. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

49. Release switch on controller.

50. Once the joint is loosened, move the control lever to port B.

51. Slightly retract the cylinder until the breakout tool can be slid towards the launch shaft.

52. Remove the front jaw insert.

(continued on next page)

53. Slide the breakout tool towards the end of the tube and remove the back jaw insert.

54. Slide the breakout tool towards the launch shaft for the next joint removal.

55. Remove the pilot tube and immediately install a plug on the end of the pilot tube to prevent dirt from entering pilot tube.

56. Place pilot tube into pilot tube rack.

57. Install a cap on the end of next pilot tube to be removed.

58. Continue to remove pilot tubes as they reach the reception shaft. Place the pilot tubes in the pilot tube racks.

(continued on next page)

59. Once the pilot tube adapter reaches the reception shaft, remove the last pilot tube with the breakout tool from the pilot tube adapter, cap and plug the pilot tube, and place into pilot tube rack.

60. Remove the pilot tube adapter by removing four roll pins from the pilot tube adapter and reaming head assembly connection. Be sure to cap the threaded end of the adapter.

61. Once the reaming head assembly can be removed from the reception shaft, remove the keepers from the reaming head assembly and lead casing.

NOTICE Using a hoist to keep the reaming head in line with the pipe line, remove bottom keepers first, otherwise the weight of the casing and auger will make it difficult to remove the bottom keepers once the top keepers are removed.

62. Slide the reaming head assembly casing to gain access to the auger connection.

(continued on next page)

63. Remove the casing thrust plate from the GBM frame in the launch shaft.

64. Place spacer between thrust plate and auger. Push the auger forward with the drilling cylinder control to gain access to the auger connections in the reception shaft for removal.

(continued on next page)

65. In the reception shaft, remove the reaming head auger by removing the auger bolt and nut that was installed in the launch shaft (back bolt as shown). Replace auger into the reaming head assembly casing.

⚠WARNING Auger may fall out of casing and cause severe injury or death if reaming head assembly tips or hits an obstruction.

66. Install safety chain assembly to auger to secure auger into reaming head assembly.

67. Remove the reaming head assembly from reception shaft.

Proceed to “Three Step Method: Installing Product Pipe” in this section, subsection Installing Product Pipe.

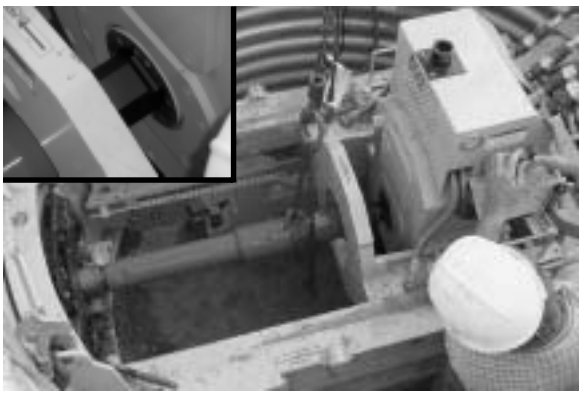
THREE STEP METHOD: INSTALLING AUGER CASINGS WITH OPEN FACE CUTTER HEAD

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. Remove guidance system from shaft and store in protective case.

2. (Latching Frame Only) Remove two brackets in rear of frame.

3. If not already removed, remove the drive adapter swivel from gear box.



4. Insert the pilot tube adapter into the gear box.

(continued on next page)

5. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the frame travel motor control.

6. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.

7. Release make-up tool.

NOTICE If lubrication may be required to lower jacking pressures during the drive, refer to Upsizing Tool Lubrication From Reception Shaft in this section, to determine how to prepare the pilot tube adapter for lubrication requirements.

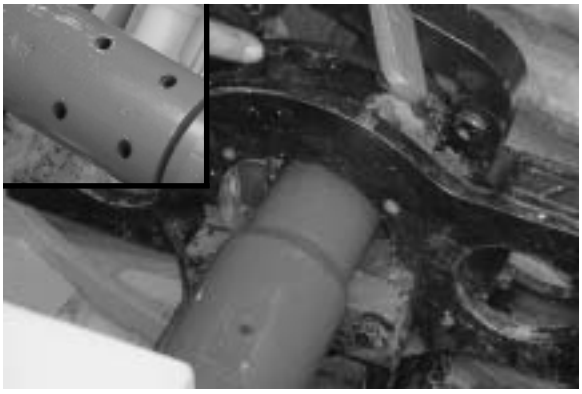
8. Advance adapter into ground until the larger diameter tube of the adapter is close to the make-up tool.

9. Remove jaw inserts from the make-up tool. You may also have to lower or remove guide block (A).

(continued on next page)

10. Advance adapter until there is enough room to pin the pilot tube adapter to the pilot tube swivel.

NOTICE For ease of installing pilot tube swivel, you may need to rotate the adapter to be sure the four pin holes are in the vertical (up and down) position (see inset).



11. Move the gear box assembly to the back of the GBM frame using the frame travel motor to allow enough room for the pilot tube swivel.

(continued on next page)

12. Remove make-up tool.

13. Lower pilot tube swivel into launch shaft.

14. Insert the pilot tube swivel (grease fitting end in first) into the hex of the pilot tube adapter and secure with four pins.

NOTICE The end of the pilot tube swivel with the grease fitting MUST be installed into the pipeline first, directly behind the pilot tube adapter. Installing the swivel backwards will cause increased rotational torque, a breakdown of the bearing lubrication due to ground friction generating heat on the swivel assembly, and continued use will cause bearing failure.

(continued on next page)

15. Advance swivel until there is enough room to pin the cutter head assembly to the pilot tube swivel.

16. Move the gear box assembly to the back of the GBM frame using the frame travel motor to allow enough room for the dirt bucket and cutter head assembly.

17. Install casing thrust adapter to thrust plate with three 3/4 x 2 in. bolts and washers.

18. Lower dirt bucket into shaft.

(continued on next page)

19. In the reception shaft, remove steering head.

a. Remove set screw.

b. Drive out pins.

c. Remove pins.

d. Remove steering head.

(continued on next page)

⚠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 and load can fall instantly.

Do not stand or walk under a load.

20. Lower cutter head assembly into launch shaft.

NOTICE Use a pipe tong or nylon strap to handle the cutter head and casings.

21. Install cutter head hex shaft into pilot tube swivel and secure with four roll pins.

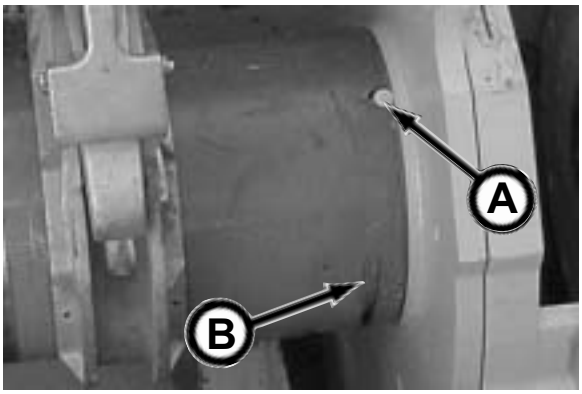
(continued on next page)

22. Install auger drive adapter onto auger shaft.

23. Align and engage auger drive adapter with the hex opening in gear box using the drive rotation control and frame travel motor control.

(continued on next page)

24. Using hoist, align notches in cutter head casing with top alignment guide (A) and bottom alignment guide (not shown) on thrust plate.



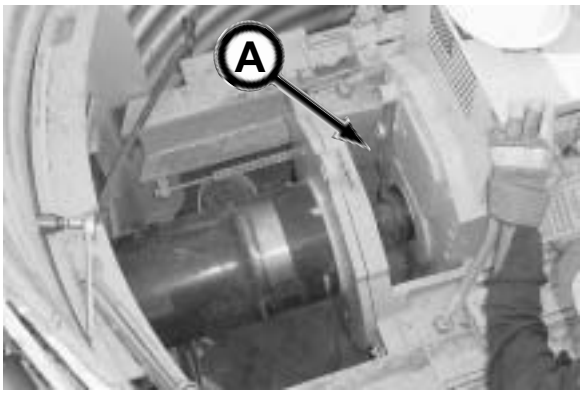
NOTICE If pulling back of pipe will be required, install keepers into cutter head assembly lead casing and casing thrust adapter (B), and bolt the auger drive adapter to the gear box and the auger shaft.

25. Cut an opening in the shaft large enough for the cutter head, thrust casings, and product pipe to pass through.

26. Move drilling drive speed selector to the HSLT or High Speed Low Torque position.

NOTICE Depending on soil conditions and length of drive, it may be necessary to change the selector to the LSHT position.

27. Advance the cutter head assembly by extending the frame cylinders with the frame travel cylinder control and the clockwise drive rotation control.



NOTICE Rotate the augers and advance the casings so small clumps of spoil are going into the dirt bucket. Over advancing the casings will restrict the flow of material out of the auger resulting in the spoil plugging in the spoil chamber (A).

(Latching Frame Only) Relatch latching pins as needed.

28. Continue to advance the cutter head assembly the full length of the frame.

(continued on next page)

29. Before retracting gear box, adjust the three roller brackets to casing by loosening clamp, slide roller into position, and retighten clamp. The rollers will support the casing while the gear box is retracted.

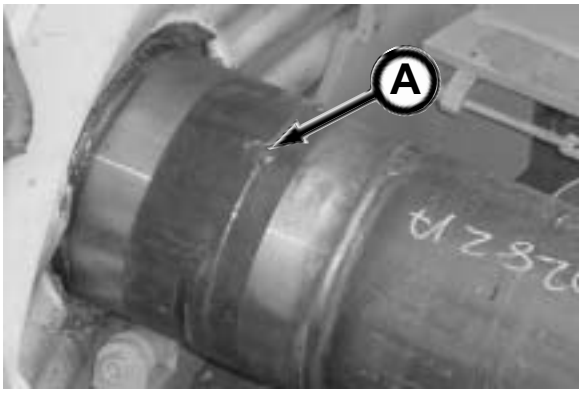
30. Move the gear box assembly to the back of the GBM frame using the frame travel motor until the latching mechanism is locked (latching frame only).

31. Lower thrust casing/auger into launch shaft.

32. Slide the thrust casing auger onto the end of the cutter head assembly auger shaft.

33. With the auger flighting lined up, attach the auger ends with one 3/4 x 4 in. bolt and nylock nut. Tighten the nut so the end of the nut is flush with the end of the bolt. Do not overtighten.

34. Advance the casing to the cutter head assembly casing and align with alignment guides in the 12 o'clock (A) and 6 o'clock positions.



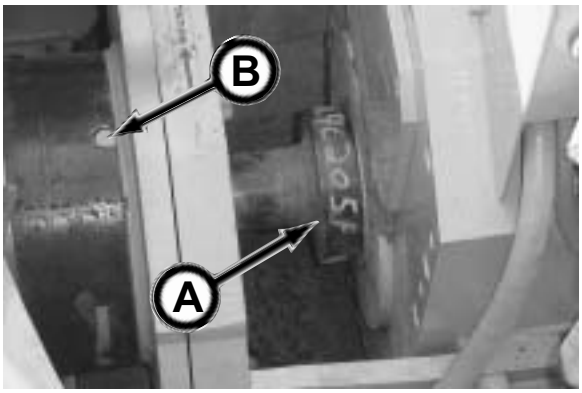
(continued on next page)

35. Install four casing joint keepers at the 2 o'clock, 4 o'clock, 8 o'clock, and 10 o'clock positions to lock the casings together.

36. Remove auger drive adapter from gear box and insert onto casing auger shaft.

37. Align the auger drive adapter (A) into the gear box while aligning the notches in the casings with the alignment guides (B) on thrust plate using the drive rotation control and frame travel motor control.

NOTICE If pulling back of pipe will be required, place keepers into casing and casing thrust adapter.



38. Advance the casing/auger with the drilling frame cylinder control and the rotation (CW) control.

NOTICE With the addition of each section of casing/auger, a section of pilot tube will be removed in the reception shaft. Refer to procedure starting with step 42.

(continued on next page)

39. Periodically empty the dirt bucket.

40. Replace dirt bucket.

41. Continue to add casings and augers until all pilot tubes and the cutter head assembly are removed from reception shaft.

NOTICE Regularly secure frame to the shaft while pushing the casings using the shaft tensioners on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.

(continued on next page)

NOTICE Lubricant can be pumped from the reception shaft to lubricate the spoils. Install fluid connector on end of pilot tube in the reception shaft. Refer to “Upsizing Tool Lubrication From Reception Shaft” in this section for configuration details.

42. Once the steering head adapter and the pilot tubes reach the reception shaft, each joint must be loosened with the breakout tool.

    Hook up the breakout tool as follows:

    Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

    Selector Position:
    Port A - Extend
    Port B - Retract

    Plug the breakout tool into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

43. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.

44. Install cap on steering head adapter and pilot tube threads.

(continued on next page)

45. Place jaw insert on notches on back pilot tube.

46. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 45 as shown.

NOTICE The cylinder side of the breakout tool is deeper than the other side. This allows the breakout tool to slide over both jaw inserts when loosening the pilot tube joints.

47. Slide other jaw insert on notches of the steering head adapter or the front pilot tube.

48. Slide breakout tool over both jaw inserts.

NOTICE You may have to extend or retract the cylinder to line up the jaw insert teeth with the breakout tool gear teeth.

(continued on next page)

49. Move the control lever to port A to extend the cylinder.

50. Extend cylinder by depressing the switch on the remote controller.

NOTICE The rocker switch on the pump unit can also be used to control the cylinder.

51. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

52. Release switch on controller.

(continued on next page)

53. Once the joint is loosened, move the control lever to port B.

54. Slightly retract the cylinder until the breakout tool can be slide towards the launch shaft.

55. Remove the front jaw insert.

56. Slide the breakout tool towards the end of the tube and remove the back jaw insert.

57. Slide the breakout tool towards the launch shaft for the next joint removal.

(continued on next page)

58. Remove the pilot tube and immediately install a plug on the end of the pilot tube to prevent dirt from entering pilot tube.

59. Place pilot tube into pilot tube rack.

60. Install a cap on the end of next pilot tube to be removed.

61. Continue to remove pilot tubes as they reach the reception shaft. Place the pilot tubes in the pilot tube racks.

(continued on next page)

62. Once the pilot tube adapter reaches the reception shaft, remove the last pilot tube with the breakout tool from the pilot tube adapter, cap and plug the pilot tube, and place into pilot tube rack.

63. Remove the pilot tube adapter by removing four roll pins from the pilot tube adapter and pilot tube swivel. Be sure to cap the threaded end of the adapter.

(continued on next page)

64. Remove the pilot tube swivel by removing four roll pins from the pilot tube swivel and cutter head assembly connection.

65. Once the cutter head assembly can be removed from the reception shaft, remove the keepers from the cutter head assembly and lead casing.

NOTICE Using a hoist to keep the cutter head in line with the pipe line, remove bottom keepers first, otherwise the weight of the casing and auger will make it difficult to remove the bottom keepers once the top keepers are removed.

66. Slide the cutter head assembly casing to gain access to the auger connection.

(continued on next page)

68. Place spacer between thrust plate and auger. Push the auger forward with the drilling cylinder control to gain access to the auger connections in the reception shaft for removal.

(continued on next page)

69. In the reception shaft, remove the cutter head auger by removing the auger bolt and nut that was installed in the launch shaft (back bolt as shown). Replace auger into the cutter head assembly casing.

⚠WARNING Auger may fall out of casing and cause severe injury or death if cutter head assembly tips or hits an obstruction.

70. Install safety chain assembly to auger to secure auger into cutter head assembly.

71. Remove the cutter head assembly with auger from reception shaft.

Proceed to “Three Step Method: Installing Product Pipe” in this section, subsection Installing Product Pipe.

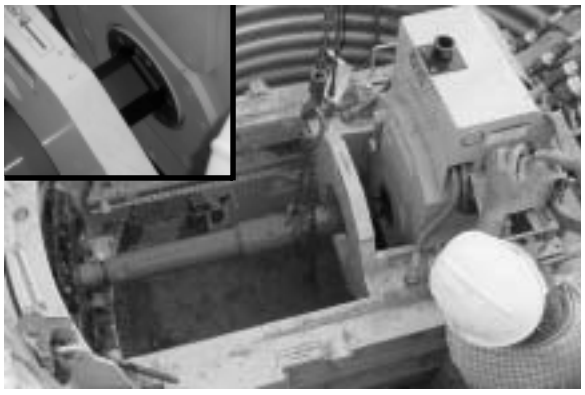
TWO PASS METHOD: INSTALLING REAMING HEAD

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. Remove guidance system from shaft and store in protective case.

2. (Latching Frame Only) Remove two brackets in rear of frame.

3. If not already removed, remove the drive adapter swivel from gear box.



4. Insert the pilot tube adapter hex into the gear box.

(continued on next page)

5. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the frame travel motor control.

6. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.

7. Release make-up tool.

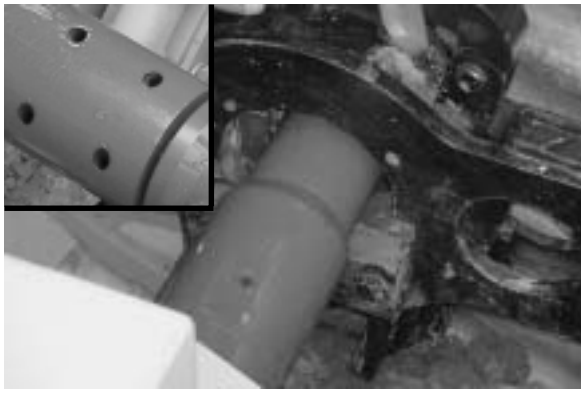
8. Advance adapter into ground until the larger diameter tube of the adapter is close to the make-up tool.

9. Remove jaw inserts from the make-up tool. You may also have to lower or remove guide block (A).

(continued on next page)

10. Advance adapter until there is enough room to pin the pilot tube adapter to the reaming head assembly.

NOTICE For ease of installing reaming head, you may need to rotate the adapter to be sure the four pin holes are in the vertical (up and down) position (see inset).



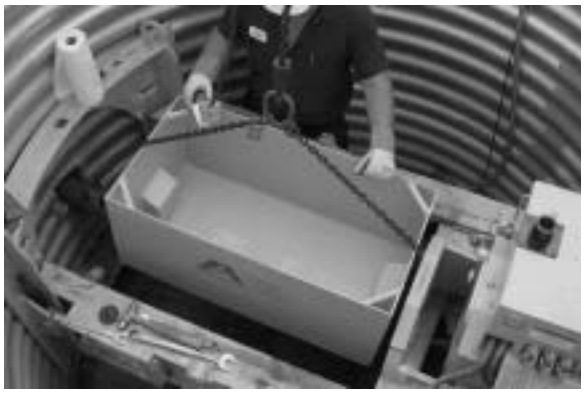
11. Move the gear box assembly to the back of the GBM frame using the frame travel motor to allow enough room for the dirt bucket and reaming head assembly.

(continued on next page)

12. Remove make-up tool.

13. Remove hex coupler from pilot tube adapter.

14. Lower dirt bucket into shaft.



15. In the reception shaft, remove steering head.

a. Remove set screw.

b. Drive out pins.

c. Remove pins.

d. Remove steering head.

(continued on next page)

16. Install casing thrust adapter to thrust plate with three 3/4 x 2 in. bolts and washers.

⚠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 and load can fall instantly.

Do not stand or walk under a load.

NOTICE If lubrication may be required to lower jacking pressures during the drive, refer to Upsizing Tool Lubrication From Reception Shaft in this section, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

17. Lower reaming head assembly into shaft and install fluid connector to reaming head.

NOTICE Use a pipe tong or nylon strap to handle the reaming head assembly and casings.

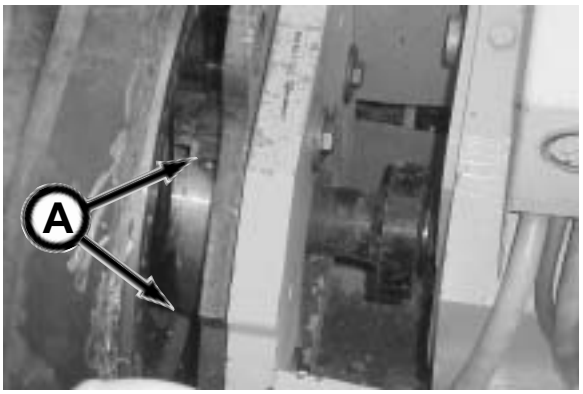
(continued on next page)

18. Insert reaming head hex shaft into pilot tube adapter and secure with four roll pins.

19. Align reaming head auger casing notches with alignment guides (A) on thrust plate.

20. Install auger drive adapter onto auger shaft.

21. Align and engage auger drive adapter with the hex opening in the gear box using the drive rotation control and frame travel motor control.



22. Cut an opening in the shaft large enough for the reaming head assembly and product pipe to pass through.

23. Move drilling drive speed selector to the HSLT or High Speed Low Torque position.

NOTICE Depending on soil conditions and length of drive, it may be necessary to change the selector to the LSHT position.

24. Advance the reaming head assembly by extending the frame cylinders with the frame travel cylinder and the clockwise drive rotation control.

NOTICE Rotate the augers and advance the reaming head assembly and product pipe so small clumps of spoil are going into the dirt bucket. Over advancing the casings will restrict the flow of material out of the auger resulting in the spoil plugging in the spoil chamber.

(Latching Frame Only) Relatch latching pins as needed.

NOTICE Be sure latching pins are completely engaged into frame holes before jacking.

25. Continue to advance the reaming head assembly the full length of the frame.

NOTICE Lubricant can be pumped from the reception shaft to the reaming head lubrication ports to reduce jacking forces on the casings. Install fluid connector on end of pilot tube in the reception shaft. Connect lubricant supply hose to fitting on fluid connector to pump lubricant to the four lubrication ports on the reaming head arms.

26. Before retracting gear box, adjust the three roller brackets to casing by loosening clamp, slide roller into position against reaming head casing, and retighten clamp. The rolls will support the reaming head assembly while the gear box is retracted.

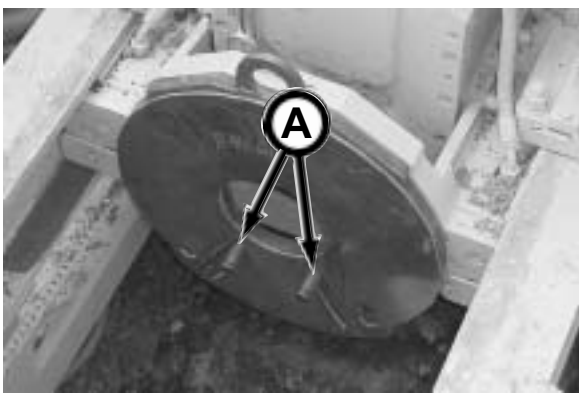
27. Move the gear box assembly to the back of the GBM frame using the frame travel motor.

    (Latching Frame only) Use the frame travel motor until the latching mechanism is locked.

⚠WARNING Suspended loads may fall and cause severe personal injury or death. Do not stand or walk under a load.

28. Install pipe thrust adapter on front of thrust plate and secure with three 3/4 x 1-1/4 in bolts and flat washers.

29. Adjust two pins (A) on front of thrust adapter as needed to align the centerline of product pipe with pipeline.



Proceed to “Two Pass Method: Installing Auger Casings With Product Pipe” in this section, subsection Installing Product Pipe.

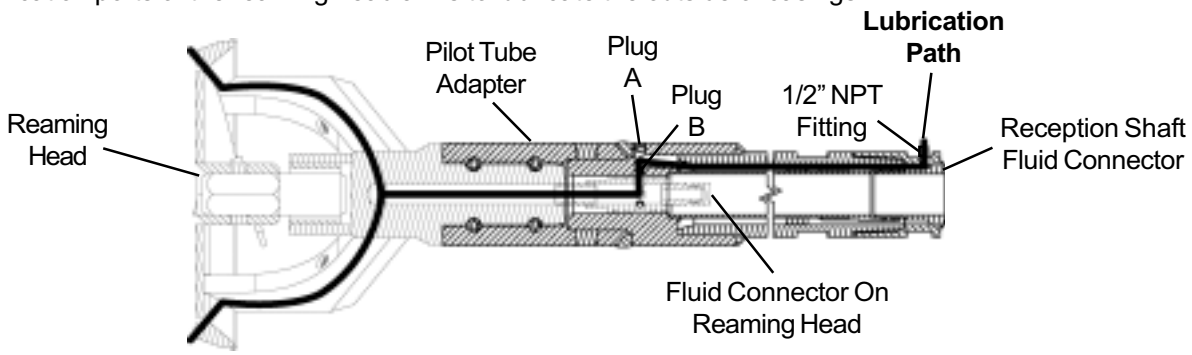
UPSIZING TOOL LUBRICATION FROM RECEPTION SHAFT

The upsizing tool can be lubricated from the reception shaft to lower jacking pressures using the reception shaft fluid connector, pilot tube adapter and upsizing tool fluid connector.

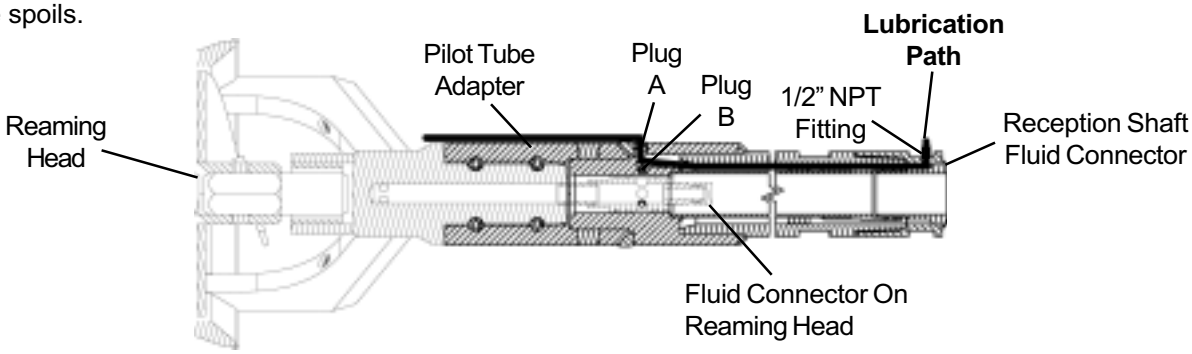
The pilot tube adapter contains three external lubrication ports for lubricating the spoils by connecting a lubrication hose to the reception shaft fluid connector. The casing can be lubricated by the pilot tube adapter's three internal lubrication ports connected to the upsizing tool fluid connector or by connecting a lubrication hose through the reception shaft fluid connector to the upsizing tool fluid connector.

I. Pilot Tube Adapter With Reaming Head Assembly

1. To Lubricate Outside Of Casing
Remove plug A, remove plug B, reinstall plug A, and connect a supply hose to the fitting on the fluid connector. The lubricant will flow through the dual walled pilot tubes, pilot tube adapter, and out the lubrication ports of the reaming head arms to lubricate the outside of casings.

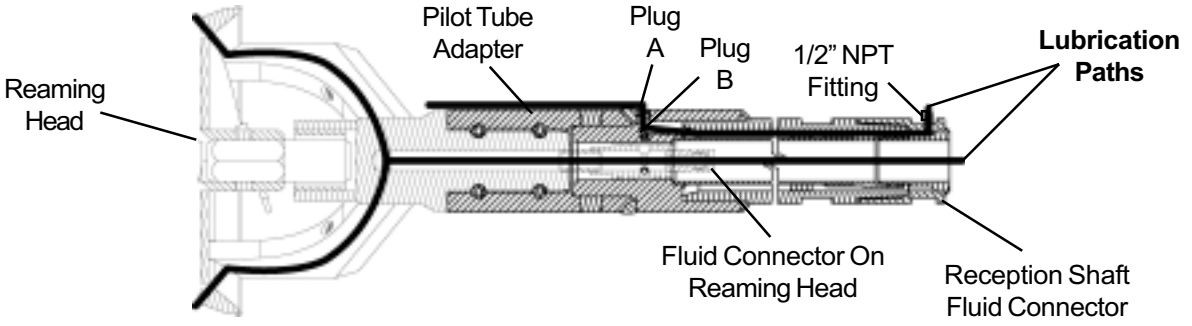


2. To Lubricate Spoils Only
Remove plug A, install plug B, and connect a supply hose to the fitting on the fluid connector. The lubricant will flow through the dual walled pilot tubes and out port A on pilot tube adapter to lubricate the spoils.



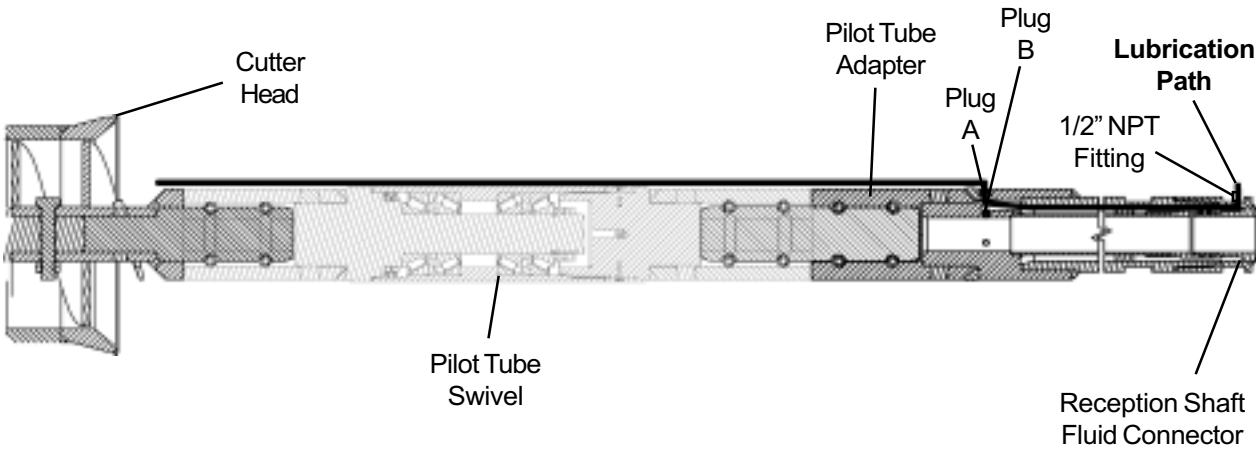
3. To Lubricate Outside Of Casings And Spoils
Remove plug A, install plug B, then connect a supply hose to the fitting on the fluid connector. The lubricant will flow through the dual walled pilot tubes and out port A on pilot tube adapter to lubricate the spoils.

Route supply hose through center of reception shaft fluid connector to fluid connector on reaming head. The lubricant will flow through the supply hose into the reaming head fluid connector and out the lubrication ports of the reaming head arms to lubricate the outside of casings.



II. Pilot Tube Adapter With Cutter Head Assembly

To Lubricate Spoils
Remove plug A, install plug B, and connect a supply hose to the fitting on the reception shaft fluid connector. The lubricant will flow through the dual walled pilot tubes and out port A on pilot tube adapter to lubricate the spoils.

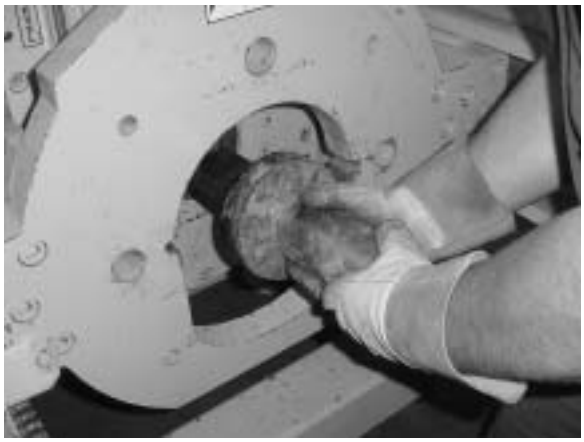


Operation - Installing Product Pipe

THREE STEP METHOD: INSTALLING PRODUCT PIPE

NOTICE Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. With the reaming head or cutter head assembly removed from the reception shaft and the last section of casing/auger advanced as far forward as possible, remove auger drive adapter.

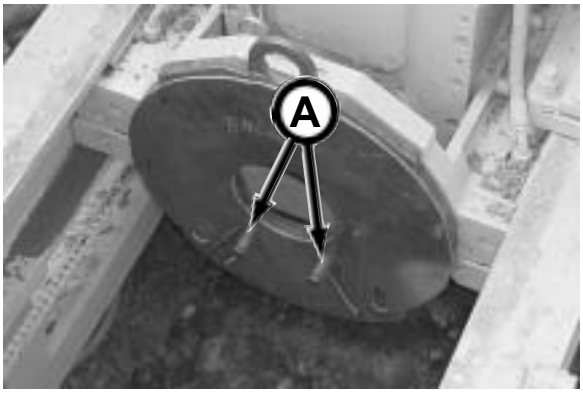


⚠WARNING Suspended loads may fall and cause severe personal injury or death. Do not stand or walk under a load.

2. Install pipe thrust adapter on front of thrust plate and secure with three 3/4 x 1-1/4 bolts and flat washers.

(continued on next page)

3. Adjust two pins (A) on front of thrust adapter as needed to align the centerline of product pipe with pipeline.



4. Install the casing to pipe adapter to the end of the last casing by aligning the alignment guides.

NOTICE The casing to pipe adapter with wood ring, protect the leading product pipe surface. On long runs or collapsing soil, fluid can be connected to this adapter to lower jacking pressures by lubricating the outside diameter of the product pipe.

5. Secure pipe adapter to casing with four keepers.

NOTICE Add wood ring or other means of cushioning to pipe adapter to protect the product pipe while pushing.

⚠WARNING Suspended loads may fall and cause severe personal injury or death. Do not stand or walk under a load.

6. Lower product pipe into launch shaft with the bell end of the product pipe towards the reception shaft.

(continued on next page)

7. Carefully align product pipe into the pipe adapter.

8. Align product pipe onto pipe thrust adapter.

9. Push product pipe into pipeline with the drilling frame travel cylinder control.

NOTICE To properly support the product pipe:
Clay or Hobas: snugly tighten the two lower roller brackets against pipe, and raise up or remove the top roller bracket. Point loading could damage pipe.
Steel Casing: readjust the three roller brackets and tighten snugly against product pipe.

10. Continue to add product pipe until the product pipe reaches the reception shaft.

(continued on next page)

11. With the addition of each section of product pipe, a section of casing/auger is removed from the reception shaft.

12. Using a hoist to keep the casing/auger in line with the pipeline, remove keepers from the casings.

NOTICE Remove bottom keepers first, otherwise the weight of the casing and auger will make it difficult to remove the bottom keepers once the top keepers are removed.

13. Slide the lead casing out to gain access to the auger joint.

14. Disconnect the augers by removing the auger bolt and nut that was installed in the launch shaft (back bolt as shown).

⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits an obstruction. Properly install safety chain assembly to augers and casings before lowering into or lifting out of shaft. Do not stand or walk under a load.

15. Slide the front auger into the lead casing. Secure auger to casing with safety chain assembly.

16. Remove auger casing from reception shaft.

16. Continue removing auger casings until the product pipe reaches the reception shaft. Remove the casing to pipe adapter from the product pipe.

TWO PASS METHOD: INSTALLING AUGER CASINGS WITH PRODUCT PIPE

PREPARING AUGER CASING FOR PRODUCT PIPE

NOTICE In cold climates, keep the segments and slide-locks in a warm area until you are ready for assembly. In hot climates, allow the segments and slide-locks time to adjust to the ambient temperature.

1. Size the casing spacers to make sure you have all the segments and slide-locks.

2. Take the segments and align the buckles. Insert the buckles 1/4 of the way into the slots.

3. Locate the directional arrows on the segment and insert slide lock until the tip exits the end of the segment.

4. Continue the process until only one segment needs to be assembled together.

NOTICE If the casing spacer runner height varies around the casing, be sure the casing spacer is properly located on the auger casing prior to securing casing spacer assembly to auger casing.

5. Wrap the segments around the pipe and align the buckles and lock into place. Take the final slide-lock and slide completely into place. The casing spacer should be located in the middle of the auger casing.

6. Insert all slide-locks as far as possible by hand. Complete tightening by lightly tapping each slide-lock with a rubber headed hammer while holding the slide-lock against the pipe.

NOTICE To tighten casing spacers securely to auger casing, back the slide-lock completely out of the slot. Reinsert slide locks completely into segment by lightly tapping slide-lock back into position, while holding the slide-lock against pipe. Continue this process until the casing spacers are securely against the auger casing and unable to move.

7. Insert auger casing with casing spacer assembly into product pipe.

8. Insert auger into auger casing.

⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits and obstruction.

Properly install safety chain assembly to augers and casings before lowering into or lifting out of shaft.

Do not stand or walk under a load.

Secure auger casing to product pipe with safety chain assembly in steps 9 through 12.

9. Insert pin through shackle and auger shaft. Secure with cotter pin.

10. Adjust position of second shackle on chain link so the pin can be inserted through shackle and auger shaft. Secure with cotter pin.

11. Secure the end of the chain back onto chain with third shackle to keep the chain from hanging loose.

12. Hook the flexible cord to the chain and hoist to take up any chain slack and for ease of reusing the safety chain assembly on the next auger and casing.

13. Lower product pipe with properly secured auger casings into launch shaft. Remove safety chain assembly.

14. Slide the thrust casing auger onto the end of the reaming head assembly auger shaft.

15. With the auger flighting line up, attach the auger ends with one 3/4 x 4 in. bolt and nylock lock nut. Tighten the nut so the end of the nut is flush with the end of the bolt. Do not overtighten.

16. Secure the thrust casing to the reaming head with two 1/2 UNC x 10 in. bolts and nuts.

17. Add wood ring or other means of cushioning to the reaming head assembly casing to protect the product pipe while pushing.

18. Align auger casing notches with alignment guides on thrust plate.

19. Remove auger drive adapter from gear box and insert onto auger shaft.

20. Align and engage auger drive adapter with the hex opening in the gear box using the drive rotation control and frame travel motor control.

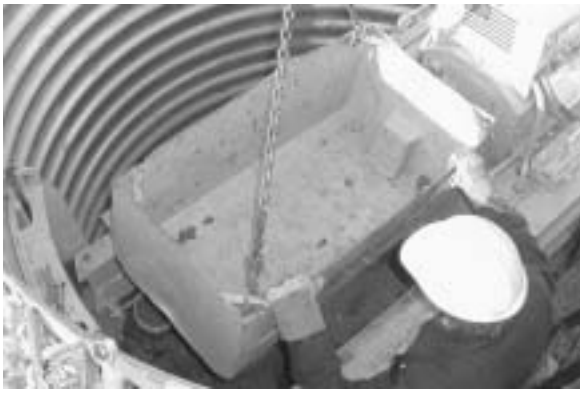
NOTICE To properly support the product pipe:
Clay or Hobas: snugly tighten the two lower roller brackets against pipe, and raise up or remove the top roller bracket. Point loading could damage pipe.
Steel Casing: readjust the three roller brackets and tighten snugly against product pipe.

21. Advance the product pipe with the drilling frame cylinder control and the rotation (CW) control.

NOTICE With the addition of each section of product pipe/auger casings, a section of pilot tube will be removed in the reception shaft. Refer to procedure starting with step 25.

22. Periodically empty the dirt bucket.

23. Replace dirt bucket.



24. Continue to add product pipe with auger casings until all pilot tubes and the reaming head assembly are removed from reception shaft.

NOTICE Regularly secure frame to the shaft while pushing the casings using the shaft tensioners on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.

25. Once the steering head adapter and the pilot tubes reach the reception shaft, each joint must be loosened with the breakout tool.

    Hook up the breakout tool as follows:

    Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

    Selector Position:
    Port A - Extend
    Port B - Retract

    Plug the breakout tool into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

26. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.

27. Install cap on steering head adapter and pilot tube threads.

28. Place jaw insert on notches of back pilot tube.

29. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 55.

30. Slide other jaw insert on notches of the steering head adapter or the front pilot tube.

(continued on next page)

31. Slide breakout tool over both jaw inserts.

NOTICE You may have to extend or retract the cylinder to line up the jaw insert teeth with the breakout tool gear teeth.

32. Move the control lever to port A to extend the cylinder.

33. Extend cylinder by depressing the switch on the remote controller.

NOTICE The rocker switch on the pump unit can also be used to control the cylinder.

(continued on next page)

34. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

35. Release switch on controller.

36. Once the joint is loosened, move the control lever to port B.

37. Slightly retract the cylinder until the breakout tool can be slid towards the launch shaft.

38. Remove the front jaw insert.

39. Slide the breakout tool towards the end of the tube and remove the back jaw insert.

40. Slide the breakout tool towards the launch shaft for the next joint removal.

(continued on next page)

41. Remove the pilot tube and immediately install a plug on the end of the pilot tube to prevent dirt from entering pilot tube.

42. Place pilot tube into pilot tube rack.

43. Install a cap on the end of next pilot tube to be removed.

44. Continue to remove pilot tubes as they reach the reception shaft. Place the pilot tubes in the pilot tube racks.

45. Once the pilot tube adapter reaches the reception shaft, remove the last pilot tube with the breakout tool from the pilot tube adapter, cap and plug the pilot tube, and place into pilot tube rack.

(continued on next page)

46. Remove the pilot tube adapter by removing four roll pins from the pilot tube adapter and reaming head assembly connection. Be sure to cap the threaded end of the adapter.

47. Once the product pipe reaches the reception shaft, remove the reaming head assembly and pipe adapter as follows:

IMPORTANT: Before removing auger casings from product pipe, secure product pipe in the reception shaft to prevent it from being shifted or moved while removing the auger casings. Failure to do so can cause product pipe separation.

48. Remove auger casings from product pipe by using a pull back cylinder, winch or other mechanical pulling device. Pull at center or above center (preferred) of auger casings using a lifting motion. The lifting or upward motion will help reduce friction or pulling force on the pipeline of auger casings. Pulling at below center will cause casing spacer to get caught in product pipe joint resulting in breakage.

49. Disconnect casings by removing two 1/2 in. bolts and nuts.

50. Disconnect augers by removing the auger bolt and nut that was installed in the launch shaft (back bolt as shown).

⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits an obstruction.

Properly install safety chain assembly to augers and casings before lowering into or lifting out of shaft.

Do not stand or walk under a load.

51. Slide auger into casing. Secure auger to casing with safety chain assembly.

52. Remove auger casing from reception shaft.

PILOT TUBE PULL BACK THROUGH LAUNCH SHAFT

1. Secure flange and locknuts on the swivel adapter on the back of the gear box.

2. Install pull back breakout tool onto drive swivel.

NOTICE A new style pull back breakout tool is available for inserting over the notches of the pilot tube and drive swivel.

3. Slide pilot tube wiper onto pilot tube.

4. Advance forward to make-up tool.

5. With the pilot tube locked into the make-up tool, thread the drive swivel into the pilot tube with the clockwise drive rotation control.

6. Disengage the make-up tool.

7. Using the drive frame cylinder control, pull back pilot tube until the notches in the next pilot tube line up with the blocks in the make-up tool.

   (Latching Frame Only) Relatch the latching pins when needed.

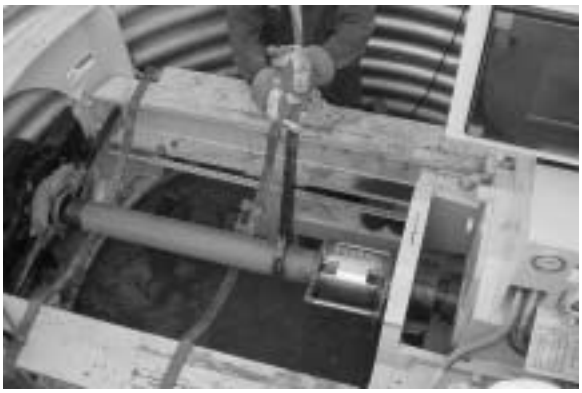
NOTICE Latching pins must be completely engaged into frame holes before jacking. Failure to do so could cause latching mechanism, jacking cylinders, and/or pilot tube damage.

8. Engage make-up tool. It may be necessary to rotate the pipe to align the notches in the pilot tube with the make-up tool blocks.

9. Install locking forks.

10. Place pilot tube support bars on frame rails.

11. Rotate drive rotational control counterclockwise until joint is loosened.



NOTICE It may be necessary to use a wrench to loosen the pilot tube from the breakout tool joint.

12. Remove pilot tube. Install caps and plugs on pilot tube.

13. Continue to pull back pilot tubes as needed.

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 machine.

5. Load and unload on level ground.

6. Use chains to fasten the guided boring machine and tooling to trailer floor.

Fuels & Lubricants

NOTICE Use of inferior fuels or lubricants can affect the efficient performance of your Akkerman Guided Boring Machine. Always use high quality fuel and lubricants as specified in this section.

FUEL SPECIFICATIONS

NOTICE For more information on maintaining your fuel and additional fuel specifications, refer to your Deere engine manual.

Diesel fuels specified to EN 590 or ASTM D975 are recommended.

The fuel must meet the following properties:
- Cetane number of 40 minimum
- Cold Filter Plugging Point below the expected low temperature OR Cloud Point at least 9° F (5° C) below the expected low temperature.
- Fuel lubricity should pass a minimum of 3100 gram load level as measured by the BOCLE scuffing test.
- Sulfur content should not exceed 0.5%. Sulfur content less than 0.05% is preferred.
- Bio-diesel fuels may be used ONLY if the fuel properties meet DIN 51606 or equivalent specification.
- DO NOT mix used engine oil or any other type of lubricant with diesel fuel.

ENGINE OIL

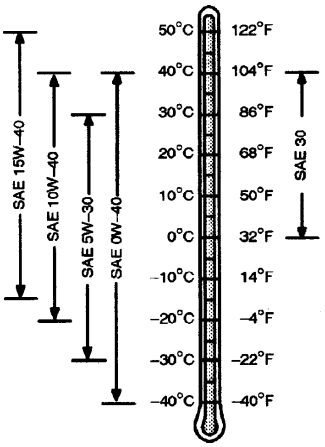
The power pack engine is filled with SAE 10W30 break-in oil.

Drain oil and replace filters after first 100 hours (maximum) operation.

After the first 100 hours of operation, use oil viscosity based on the expected air temperature range during the period between oil changes as shown in chart.

Multi-Viscosity diesel engine oils are preferred.

Other oils may be used if they meet one or more of the following:
- API Service Classification CH-4
- API Service Classification CG-4
- API Service Classification CF-4
- ACEA Specification E3
- ACEA Specification E2



POWER PACK OIL RESERVOIR LUBRICANT

The power pack oil reservoir is filled with ISO-VG-46 20W Premium Hydraulic/Turbine Oil.

Use an API GL-1/GL-2 or equivalent when adding or changing lubricant.

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

GEAR BOX LUBRICANT

The gear box is filled with Mobil SHC 630 Synthetic Bearing and Gear Oil.

Use Mobil SHC 630 or equivalent when adding or changing lubricant.

NOTICE The Mobil SHC 630 Synthetic Bearing and Gear oil is a synthetic oil specifically designed for this application. If you change to a different oil, use a reputable oil supplier to meet or exceed the Mobil SHC 630 oil specification. Do not mix oil manufacturers or grades.

GREASE

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

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

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

BREAKOUT TOOL POWER UNIT LUBRICANT

The breakout tool power unit oil reservoir is filled with ISO-VG-46 20W Premium Hydraulic/Turbine Oil.

Use an API GL-1/GL-2 or equivalent when adding or changing lubricant.

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

ENGINE COOLANT

The engine radiator coolant is a 50% mixture of ethylene glycol engine coolant and distilled, deionized, or demineralized water.

NOTICE Refer to your engine manual for information on using a Supplemental Coolant Additive (SCA) in your cooling system.

This mixture provides protection against corrosion and cylinder liner pitting, and winter freeze protection to -34°F (-37°C). If protection at lower temperatures is required, contact your engine dealer for recommendations.

NOTICE Do not use cooling system sealing additives or antifreeze that contain sealing additives.

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 contaminates.

Periodic Maintenance

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

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

LOCKOUT POWER BEFORE SERVICING

⚠WARNING Severe personal injury or death can result from unexpected pump unit start-up 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.

AVOID PINCH POINTS

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

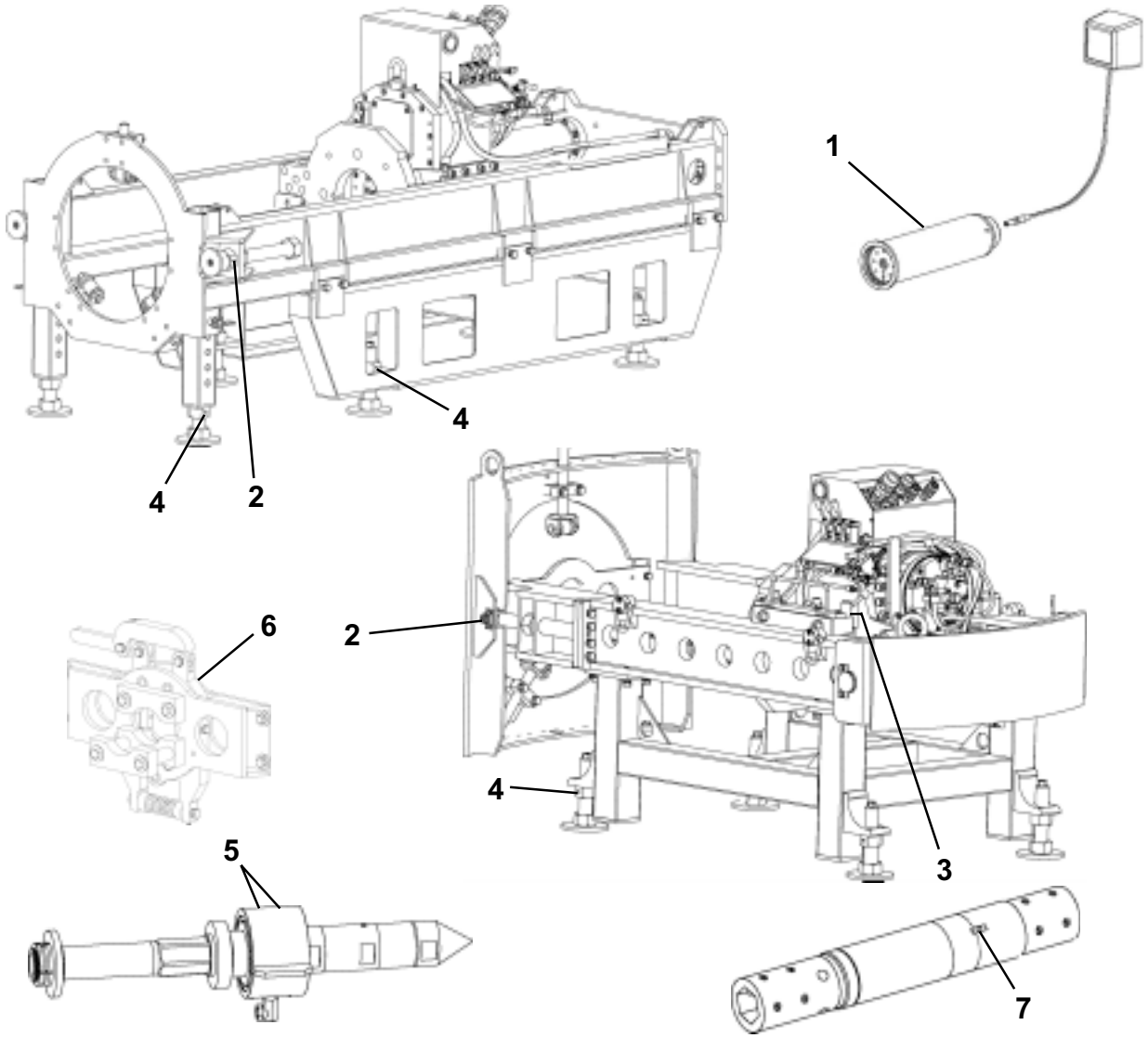
Keep hands away from moving parts.

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

Handle parts carefully to avoid crushing and pinch point hazards.

MAINTENANCE CHARTS

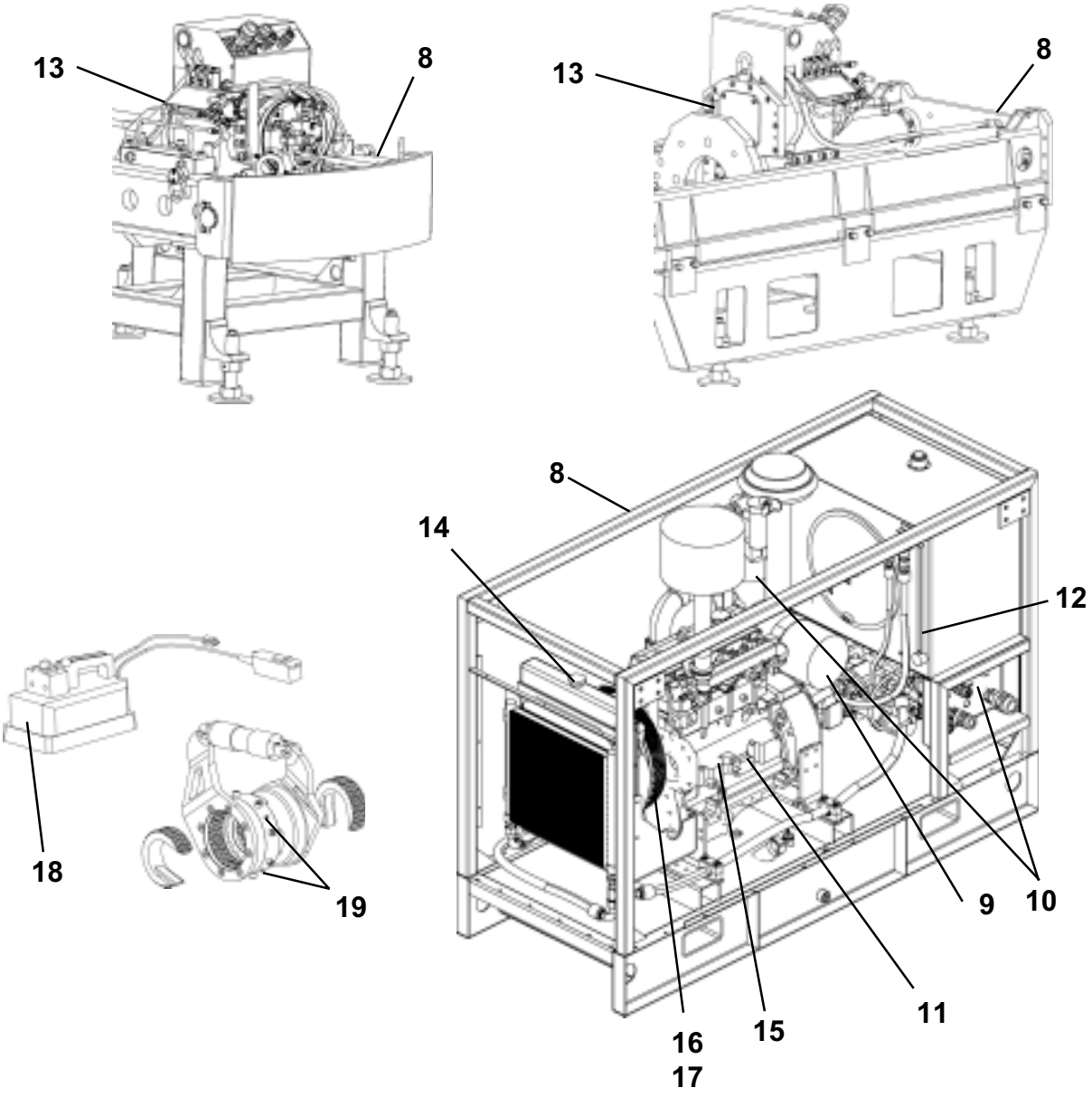
Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



PRIOR TO EACH JOB LAUNCH

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Target	Charge	Charge 24 hours prior to operation.	
2.	Shaft Tensioner	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
3.*	Gear Box Assembly Cam Lock	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
4.	Leveling Assembly	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
5.	Drive Adapter/Swivel	Lubricate	Lubricate with 3 to 5 shots.	Mobil XHP222
6.	Makeup Tool	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
7.**	Pilot Tube Swivel	Lubricate	Lubricate until grease is forced out.	Mobil XHP222

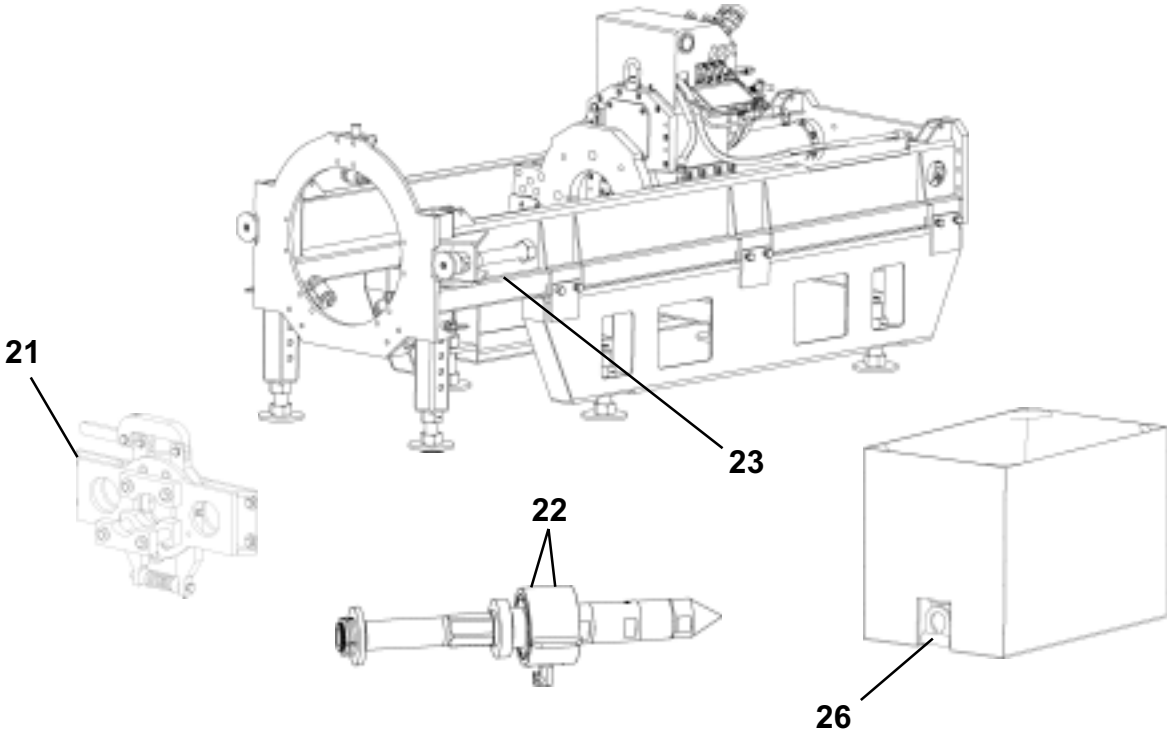
* Latching Frame Only
** Used With Open Face Cutter Only

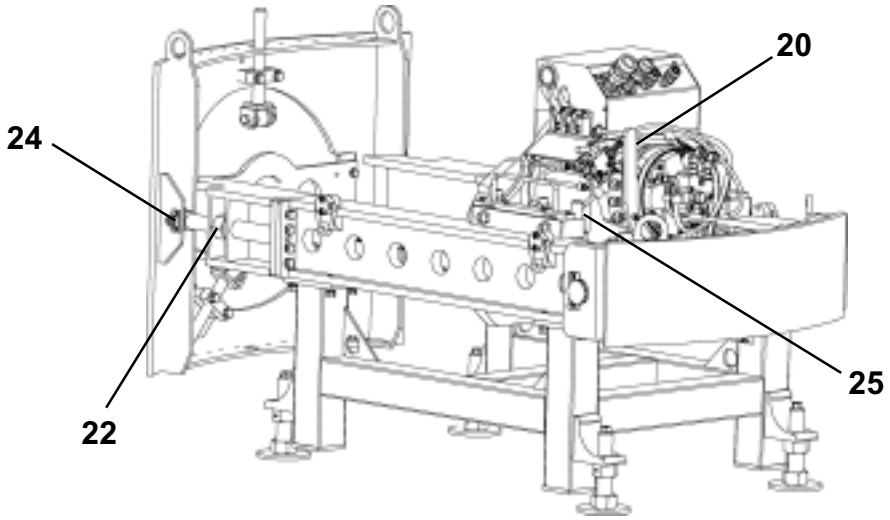


*DAILY OR EVERY 10 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
8.	GBM & Power Pack	Visual Inspection	If parts are damaged or missing, replace.	
9.	Air Cleaner Dust Unloader	Clean Out		
10.	Hydraulic Return Filter	Check Indicator	Replace filter as needed per indicator.	Return Filter
11.	Engine Crankcase	Check Oil Level	Add oil as needed.	See Section 8
12.	Hydraulic Reservoir	Check Fluid Level	Add hydraulic fluid as needed.	ISO-VG-46 20W
13.	Gear Box	Check Oil Level	Add oil as needed.	Mobil SHC 630
14.	Radiator	Check Coolant Level	Add coolant as needed.	
15.	Fuel/Water Separator	Drain Water	Drain until fuel is visible.	
16.	Fan	Inspect Fan & Guard	If damaged, replace with new.	
17.	Belt	Inspect	If damaged, replace with new.	
18.	Breakout Tool	Check Oil Level	Add oil as needed.	ISO-VG-46 20W
19.	Breakout Tool	Lubricate (4 Places)	Lubricate 2 shots per fitting.	Mobil XHP222

* Refer to your engine manual for additional engine maintenance information.

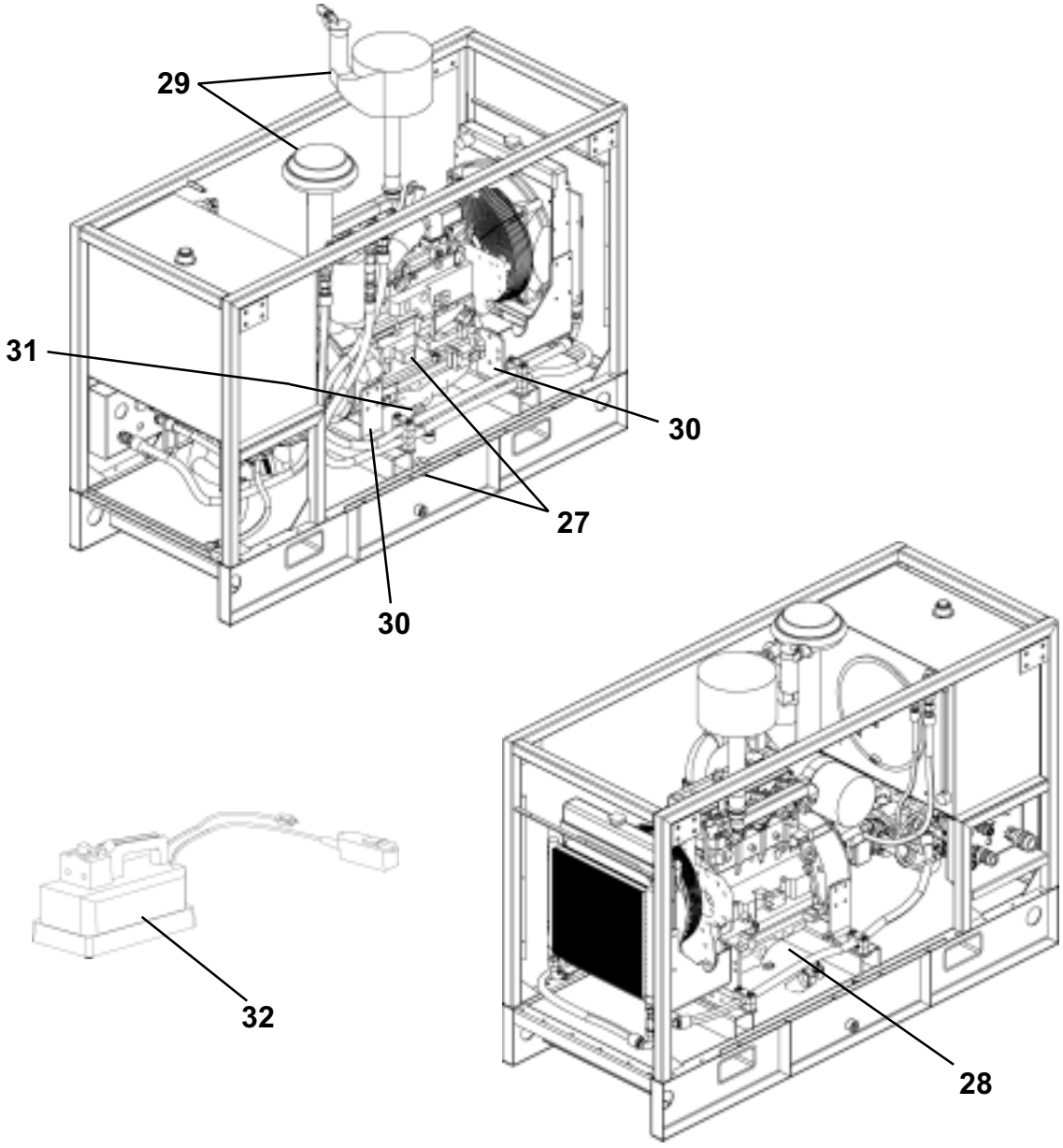




*WEEKLY OR EVERY 50 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
20.**	Latching Mechanism	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
21.	Makeup Tool	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
22.	Drive Adapter/Swivel	Lubricate	Lubricate with 3 to 5 shots.	Mobil XHP222
23.	Shaft Tensioner	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
24.**	Front Plate Pin	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
25.**	Gear Box Assembly Cam Lock	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
26.	Dirt Bucket Lifting Eye	Lubricate	Lubricate until grease is forced out.	Mobil XHP222

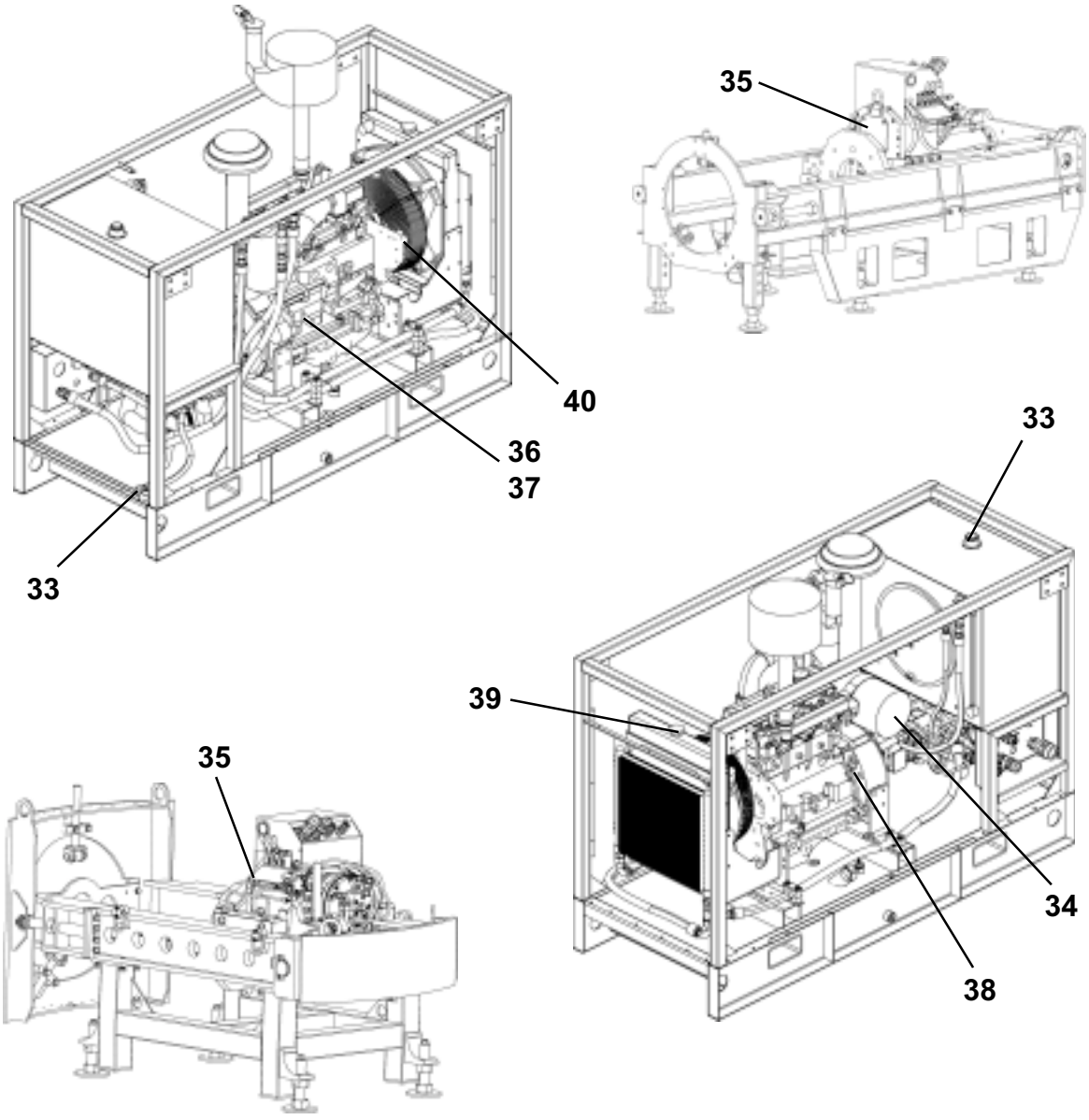
* Refer to your engine manual for additional engine maintenance information.
** Latching Frame Only



*MONTHLY OR EVERY 250 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
27.	Engine Oil/Filter	Drain & Replace	Replace with new oil and filter.	See Section 8
28.	Battery	Inspect	Check for damage or frayed cables.	Battery/Cable
29.	Air Intake & Exhaust System	Inspect All Connections	Repair or replace as needed.	
30.	Engine Mounts	Inspect	Replace as needed.	
31.	Fuel Tank Breather	Clean or Replace		
32.	Breakout Tool Power Unit	Drain, Flush & Refill Reservoir	Refill to top of filler hole.	

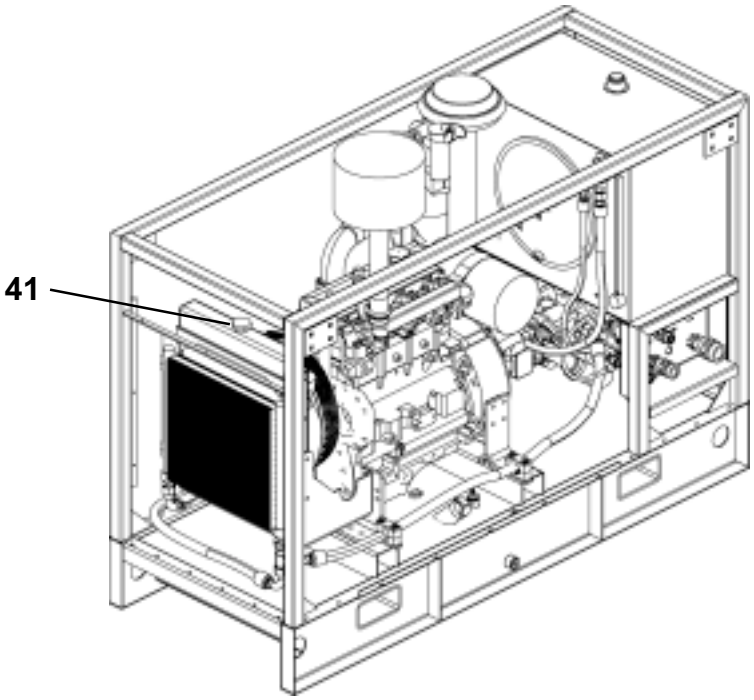
* Refer to your engine manual for additional engine maintenance information.



*EVERY 500 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
33.	Hydraulic Reservoir	Drain & Fill	Drain and fill with new oil.	ISO-VG-46 20W
34.	Air Cleaner	Install New		Element(s)
35.	Gear Box	Drain & Fill	Drain and fill with new oil.	Mobil SHC 630
36.	Fuel System	Replace Fuel Filter		Fuel Filters
37.	Fuel System	Bleed Fuel System	See engine manual.	
38.	Crankcase Vent Tube	Clean		
39.	Cooling System	Check	Coolant touches bottom of filler neck.	Water/Anti-Freeze
40.	Belt & Belt Tensioner	Check		

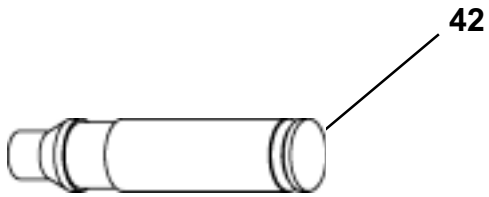
* Refer to your engine manual for additional engine maintenance information.



*EVERY 2000 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
41.	Cooling System	Flush & Fill	Refer to engine manual.	Water/Anti-Freeze

* Refer to your engine manual for additional engine maintenance information.



AS REQUIRED

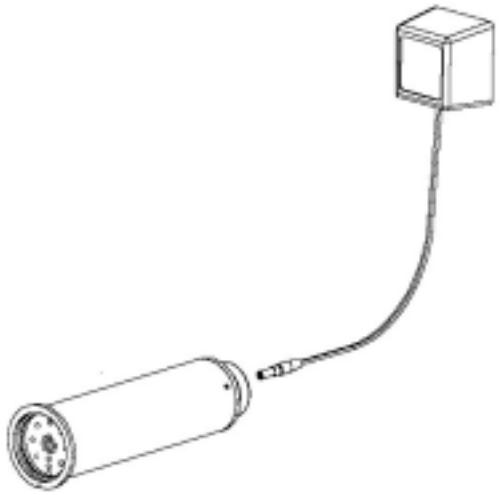
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
42.	Laser Bore Sight	Replace batteries	Three Lr41 Button Batteries	Button Batteries

PRIOR TO EACH JOB LAUNCH

1. CHARGE TARGET LED BATTERY

⚠ CAUTION Use charger only in a dry location to prevent the risk of electric shock.

Recharge target NiCd batteries by connecting the AC adapter to the target and plugging the AC adapter into a 120V outlet. Charge for 24 hours before operation. The battery should last for 10 days on a full charge.

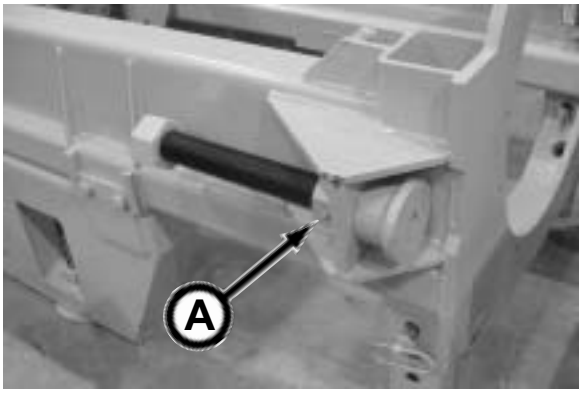


NOTICE It is best to discharge the batteries fully before recharging due to the “memory” effect of NiCd batteries. If battery charge life appears to be shortened, repeat the fully discharge, fully charge cycle a few times to update the memory in the battery. If battery life continues to be short, dispose of battery properly.

2. LUBRICATE SHAFT TENSIONER

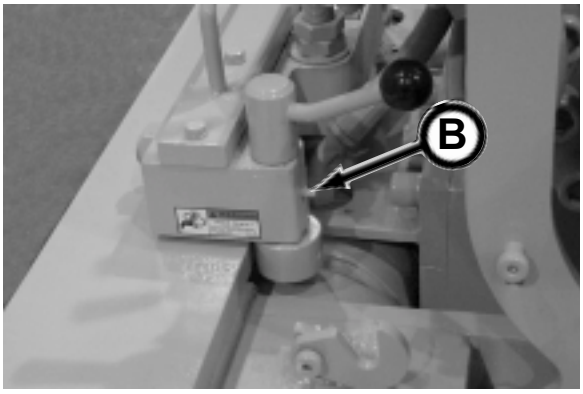
Lubricate shaft tensioner (A) with Mobilgrease® XHP222 or equivalent until grease is forced out.

Lubricate daily if subjected to water and mud.



3. LUBRICATE GEAR BOX ASSEMBLY CAM LOCK (LATCHING FRAME ONLY)

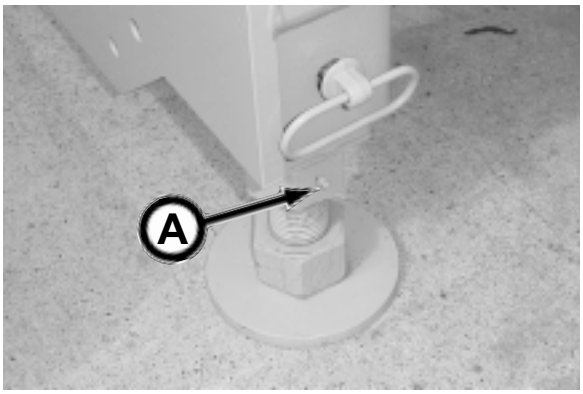
Lubricate cam lock (B) with Mobilgrease® XHP222 or equivalent until grease is forced out.



4. LUBRICATE LEVELING ASSEMBLY

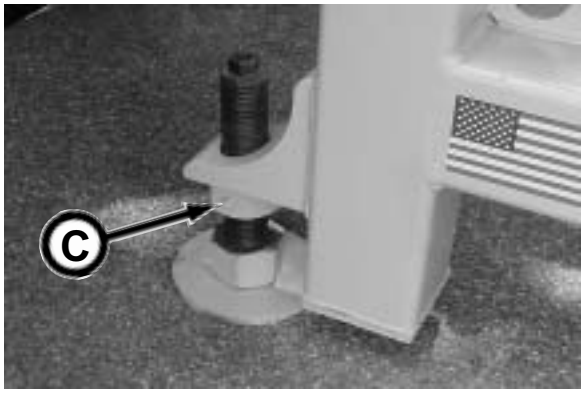
Lubricate leveling assemblies with Mobilgrease® XHP222 or equivalent until grease is forced out.

A - Single Stage Front Leveling Assembly
B - Single Stage Rear Leveling Assembly
C - Latching Frame Leveling Assembly



Single Stage Front Leveling Assembly

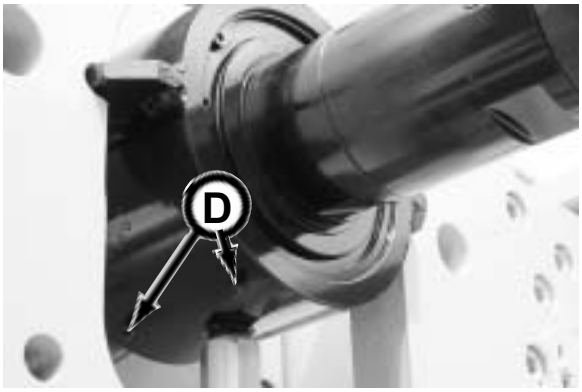
Single Stage Rear Leveling Assembly



Latching Frame Leveling Assembly

5. LUBRICATE DRIVE ADAPTER/SWIVEL

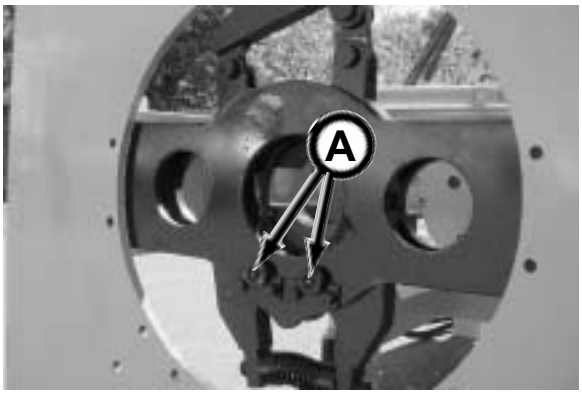
Lubricate drive adapter/swivel (D) (2 places) with 3 to 5 shots of Mobilgrease® XHP222 or equivalent.



6. LUBRICATE MAKEUP TOOL

Lubricate makeup tool (A) with Mobilgrease® XHP222 or equivalent until grease is forced out (2 places).

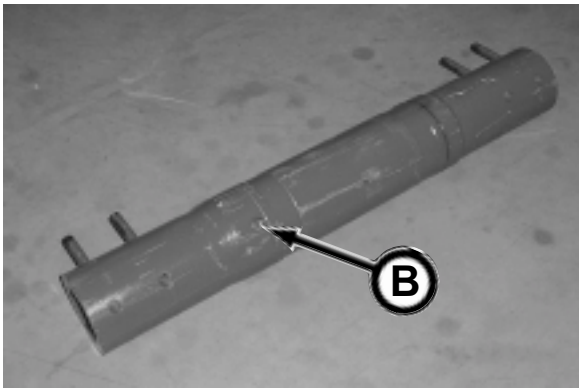
Lubricate daily if subjected to water and mud.



7. LUBRICATE PILOT TUBE SWIVEL

While rotating swivel, lubricate pilot tube swivel (B) with Mobilgrease® XHP222 or equivalent until grease is forced out.

NOTICE The end of the pilot tube swivel with the grease fitting MUST be installed into the pipeline first, directly behind the pilot tube adapter. Installing the swivel backwards will cause increased rotational torque, a breakdown of the bearing lubrication due to ground friction generating heat on the swivel assembly, and continued use will cause bearing failure.



DAILY OR EVERY 10 HOURS OF OPERATION

8. VISUALLY INSPECT EQUIPMENT

Perform a visual inspection of the GBM and power pack. Inspect structures, cylinders, mountings and lubricant levels.

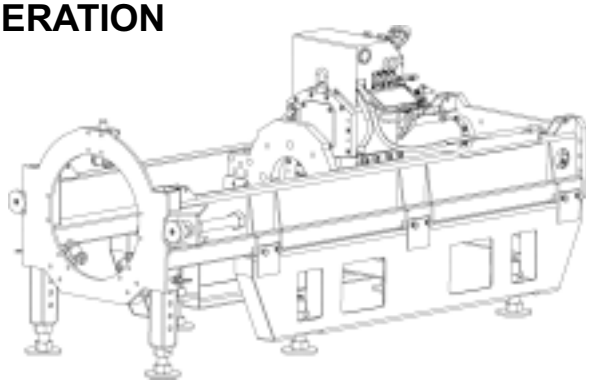
Immediately report any structural problems to your Akkerman product support representative.

Check for oil or coolant leaks, and debris buildup. Make repairs as needed and remove debris.

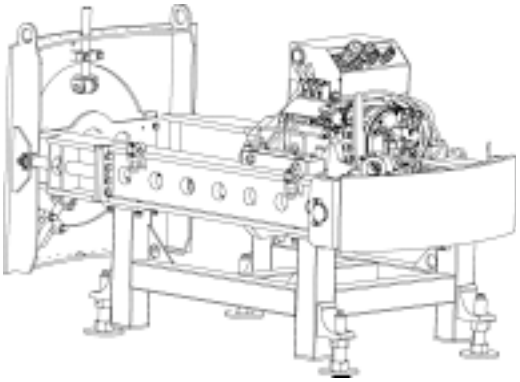
Check air intake and exhaust system hoses and connections. Replace any defective parts.

Check for loose, damaged, or missing parts. Repair or replace as necessary.

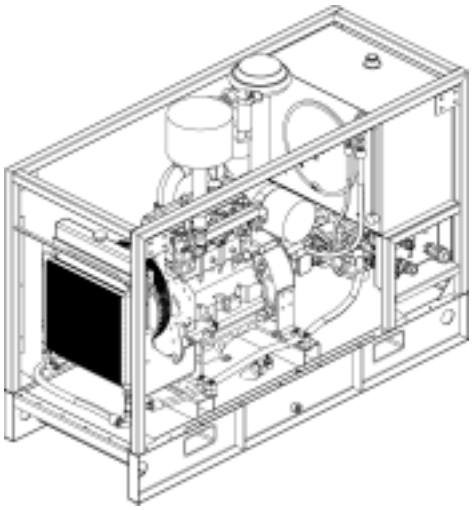
Tighten hardware as needed.



GBM Single Stage Frame



GBM Latching Frame



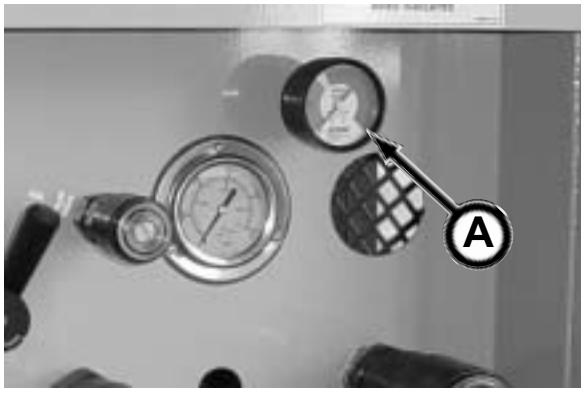
Power Pack (shown without top & side panels)

9. CLEAN OUT DUST UNLOADER VALVE

Squeeze air cleaner dust unloader valve on air cleaner assembly to release any trapped dirt particles. If the sealing tip of the valve is damaged, life of the air filter elements will be greatly reduced.

10. CHECK HYDRAULIC RETURN FILTER INDICATOR

To prevent over or under servicing of the hydraulic return filter, a filter indicator (A) has been installed on your machine.



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

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

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

1. Clean and dry area around return filter.

2. Remove filter. Dispose of oil and 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. With the GBM hydraulic hoses disconnected from the power pack, start engine and run at low idle until the hydraulic system is warm. Then check for leaks.

7. Shut down engine.

8. Check hydraulic reservoir oil level. Add hydraulic oil, if necessary.

11. CHECK ENGINE CRANKCASE OIL LEVEL

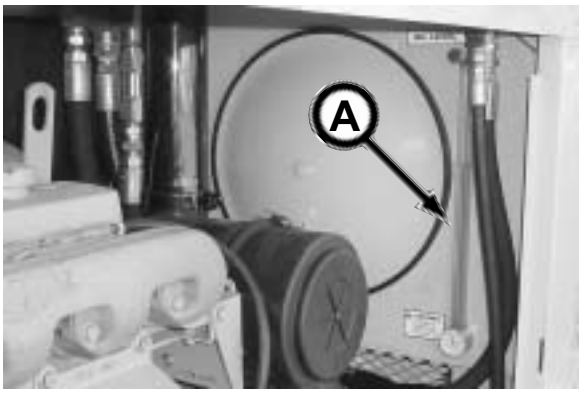
Check engine oil level on dipstick. Do not fill above the top mark on the dipstick.

Oil levels anywhere within the crosshatches on the dipstick are considered in the acceptable operating range.

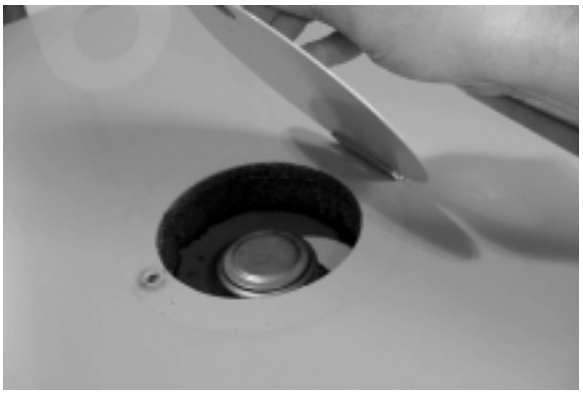
If necessary, add engine oil. See Engine Oil in the Fuels & Lubricants section for the proper oil specification.

12. CHECK HYDRAULIC TANK OIL LEVEL

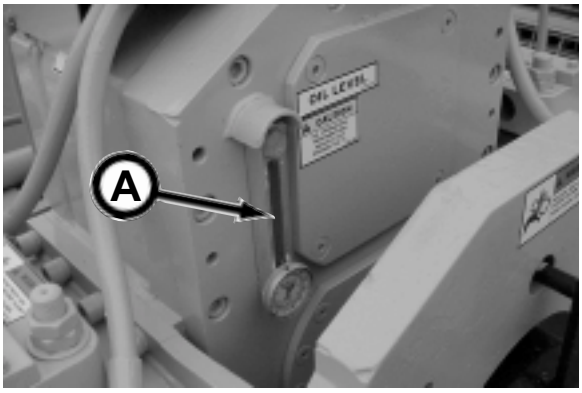
Check hydraulic tank oil level gauge (A).



If the fluid level in the reservoir is less than 3/4 full, fill the reservoir with ISO-VG-46 20W Premium Hydraulic Turbine Oil.



13. CHECK GEAR BOX OIL LEVEL



Check gear box oil level gauge (A).

If necessary, add lubricant. Remove valve cover to gain access to gear box oil fill.

See Gear Box Lubricant in the Fuels & Lubricants section for proper oil specification.

14. CHECK ENGINE COOLANT LEVEL

⚠WARNING Cooling system under pressure. Explosive release of HOT engine coolant can cause severe burns.
SLOWLY remove the radiator cap ONLY if the engine is cool. DO NOT remove the radiator cap when the engine is hot.

Check coolant level when engine is cold. Coolant level should be at bottom of filler neck. If coolant level is low, fill radiator with proper coolant solution.

See Engine Coolant in the Fuels & Lubricants section for proper coolant specification.

15. DRAIN FUEL/WATER SEPARATOR

1. Loosen drain plug (B) at bottom of fuel filter, two or three turns.

2. Loosen air bleed plug (C) two full turns on fuel filter base and drain water from bottom until fuel starts to drain out.

3. When fuel starts to drain out, tighten drain plug securely.

After draining water from the fuel filter, the filter must be primed by bleeding all air from the fuel system.

4. Operate primer lever (D) of the fuel supply pump until fuel flow is free from air bubbles.

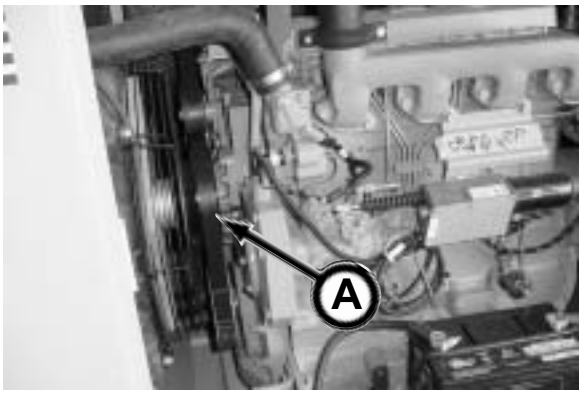
5. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.

If the fuel system needs further bleeding of air, see Bleeding Fuel System in your engine manual.

16. INSPECT FAN & FAN GUARD

⚠WARNING NEVER operate engine without fan guard in place. Serious personal injury could result if contact is made with rotating fan.

With engine shut off and key removed from control pendant to prevent accidental starting, check fan for cracks, and bent or loose blades. Check fan to make sure it is properly mounted. Replace damaged fan and fan guard.



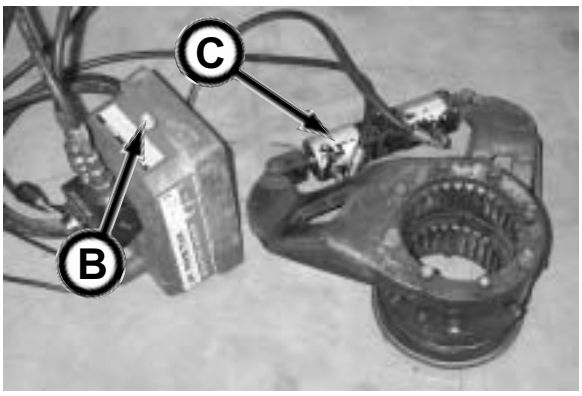
17. INSPECT BELT

Visually inspect the drive belt (A) for cracking, fraying or pieces of material missing. Replace belts as needed. See your Engine Operator's Manual for belt replacement.

18. CHECK BREAKOUT TOOL POWER UNIT OIL LEVEL

1. Clean area around filler cap (B).

2. Retract cylinder (C).

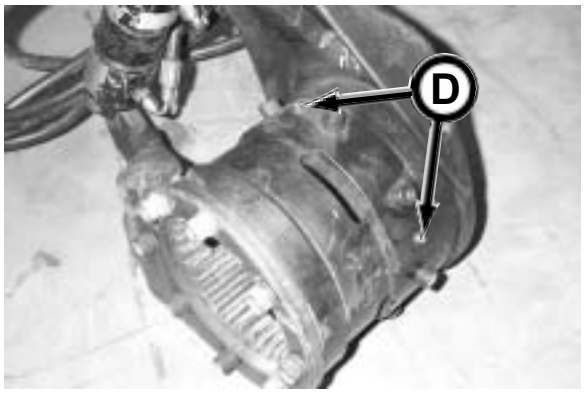


3. Tip the end of the power unit with the filler cap up. Remove filler cap and check that oil is filled to the top of filler collar.

4. If needed, fill reservoir with ISO-VG-46 20W Premium Hydraulic/Turbine Oil or equivalent. Replace filler cap.

5. Bleed air from system as follows: Position cylinder on its side with the fittings up, place the power unit flat on ground, cycle the cylinder several times (fully extend and retract), tip the power unit with the filler cap up, and open filler cap to recheck oil level in reservoir. Add additional oil as needed.

6. Replace filler cap. Tighten cap a half to one full turn after o-ring contacts sealing surface.



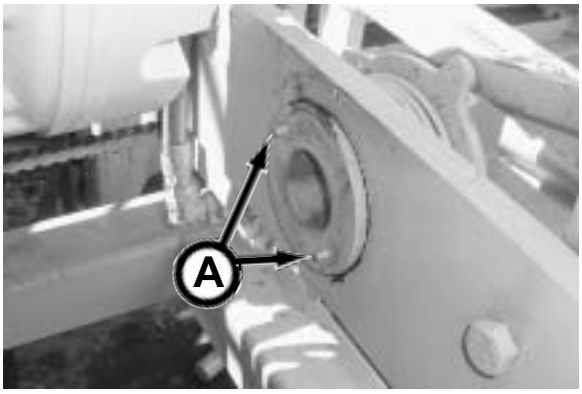
19. LUBRICATE BREAKOUT TOOL

Lubricate breakout tool (D) with 2 shots of Mobilgrease® XHP222 or equivalent at each grease fitting (4 places).

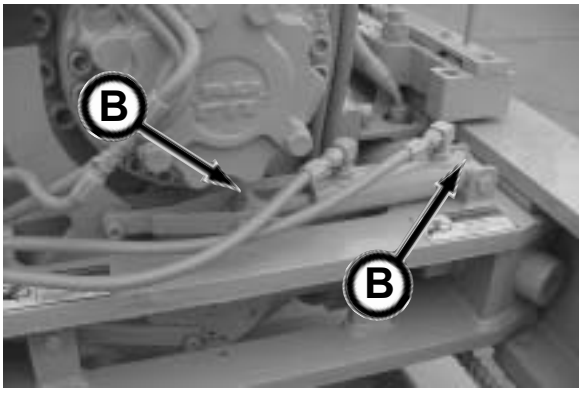
WEEKLY OR EVERY 50 HOURS OF OPERATION

20. LUBRICATE LATCHING MECHANISM (LATCHING FRAME ONLY)

Manual Latching
Extend drive cylinders to gain access to grease fittings (A). Lubricate latching mechanism (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.

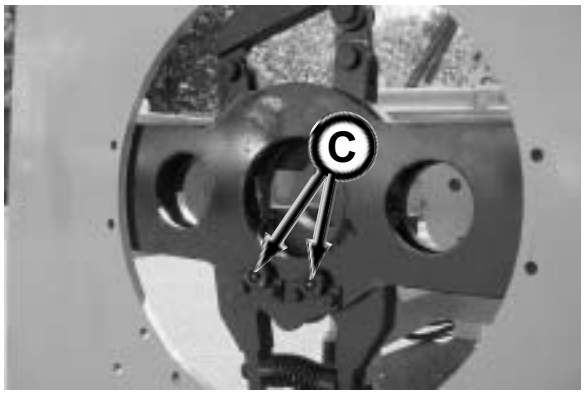


Hydraulic Latching (if equipped)
Lubricate latching mechanism cylinder pins (B) (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.



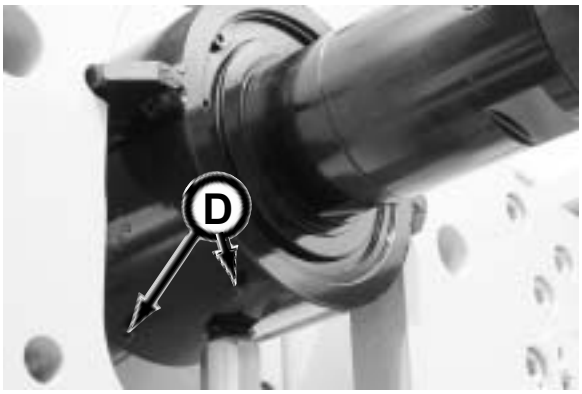
21. LUBRICATE MAKEUP TOOL

Lubricate makeup tool (C) with Mobilgrease® XHP222 or equivalent until grease is forced out (2 places).



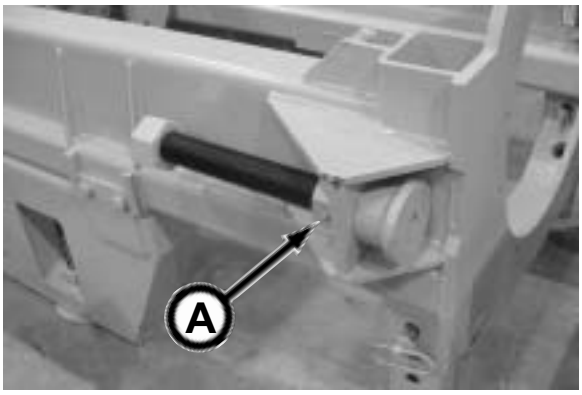
22. LUBRICATE DRIVE ADAPTER/SWIVEL

Lubricate drive adapter/swivel (D) (2 places) with 3 to 5 shots of Mobilgrease® XHP222 or equivalent.



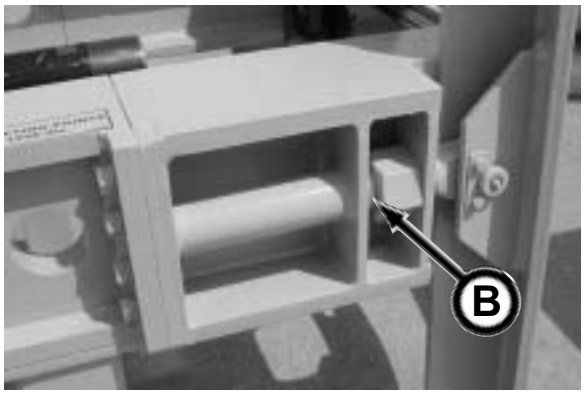
23. LUBRICATE SHAFT TENSIONER

Single Stage Frame
Lubricate shaft tensioner (A) with Mobilgrease® XHP222 or equivalent until grease is forced out.



GBM Single Stage Frame

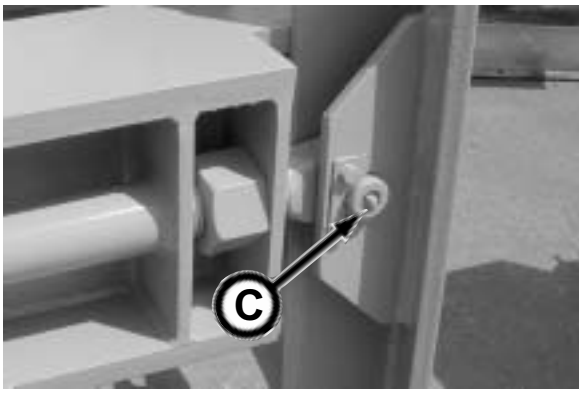
Latching Frame
Lubricate shaft tensioner (B) threads with Mobilgrease® XHP222 or equivalent.



GBM Latching Frame

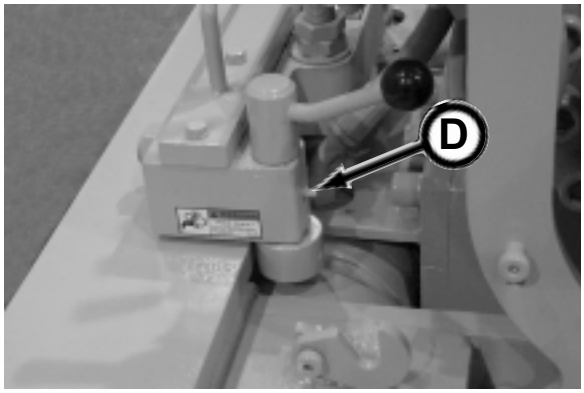
24. LUBRICATE FRONT PLATE PINS (LATCHING FRAME ONLY)

Lubricate front plate pins (C) (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.



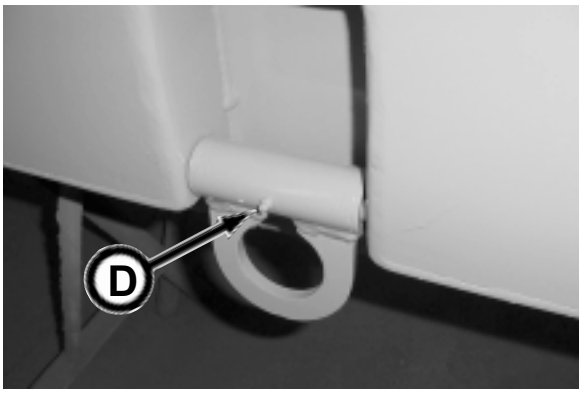
25. LUBRICATE GEAR BOX ASSEMBLY CAM LOCK (LATCHING FRAME ONLY)

Lubricate cam lock (D) with Mobilgrease® XHP222 or equivalent until grease is forced out.



26. LUBRICATE DIRT BUCKET LIFTING EYE

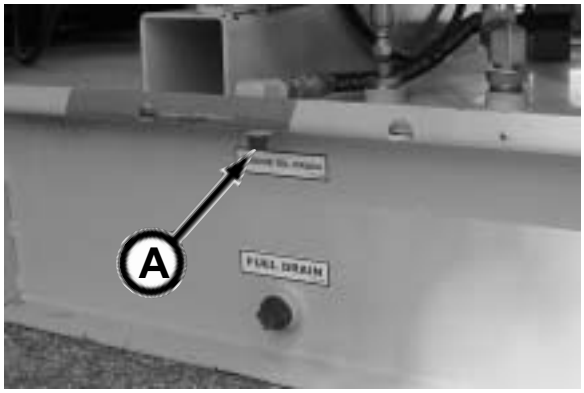
Lubricate lifting eyes (A) (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.



MONTHLY OR EVERY 250 HOURS OF OPERATION

27. CHANGE ENGINE OIL & FILTER

1. Remove engine oil drain plug (A).



2. Open oil drain shut off by moving handle in-line with hose.
3. Drain oil into a catch pan of proper size.
4. Install drain plug.

5. Close oil drain shut off by moving handle 90 degrees to hose.

6. Clean and dry area around the oil filter.

7. Remove oil filter and clean filter mounting pad. Dispose of filter properly.

8. Lubricate gasket on new filter with clean oil.

9. Fill filter with new, clean engine oil.

10. Install new filter and hand tighten according to values printed on the filter. Do not overtighten the filter element.

11. Remove fill cap.

12. Fill engine with engine oil specified in the Fuels & Lubricants section. The following fluid capacity is an approximate value. Be sure to check levels after filling. DO NOT OVERFILL.

    Oil Capacity .....14.3 qt (13.5 L)

13. Install fill cap. Hold and screw cap handle clockwise to tighten. Clean up spills.

14. Start engine and run until warm and check for leaks.

15. Shutdown engine. Wait approximately 5 minutes to let the oil drain from the upper portion of the engine. Check oil level. Oil level should be on upper mark of dipstick.

28. CHECK BATTERY

Visually check the battery for damage. If damaged replace with new.

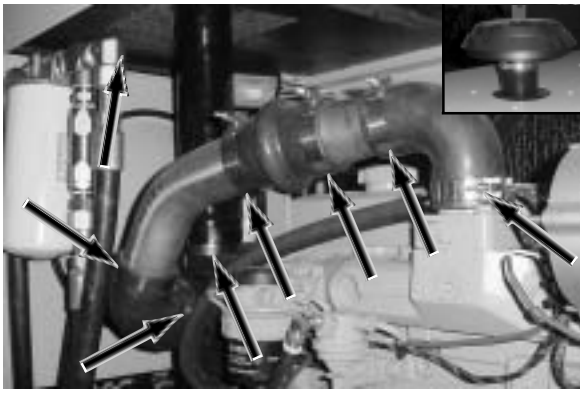
Check battery cables for damage or fraying. If damaged, replace with new.

Be sure cables are secured properly to the battery posts and engine mounts.

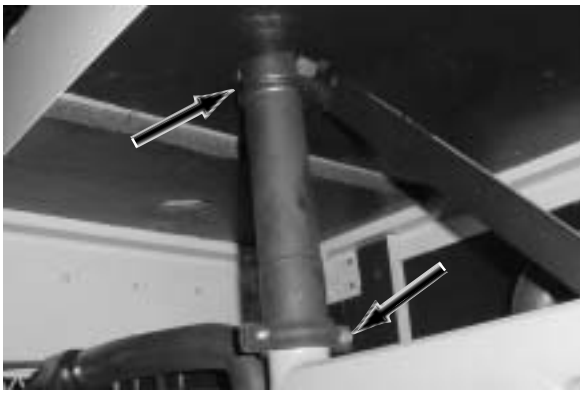
Inspect battery mount and strap for damage.

29. INSPECT AIR INTAKE & EXHAUST CONNECTIONS

Inspect all air intake (8 places) and exhaust (2 places) connections. Tighten clamps as needed and replace defective parts.



Air Intake System

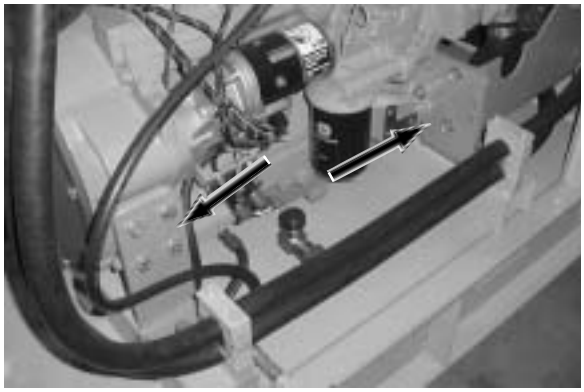


Exhaust System

30. INSPECT ENGINE MOUNTS

Visually inspect engine mounts for loose hardware or damaged parts.

Tighten all loose hardware and replace defective parts.



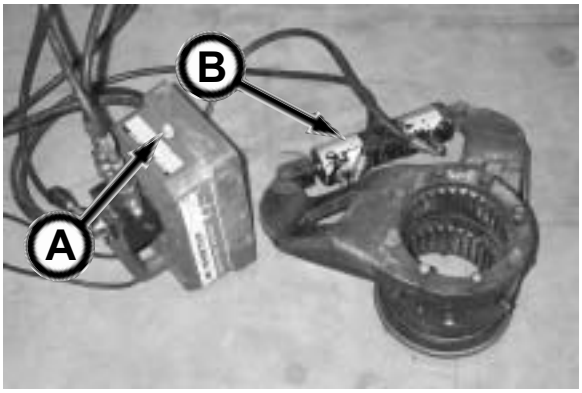
31. CLEAN FUEL TANK BREATHER

Remove breather and clean any debris or dirt from breather body or screen.

If breather is damaged, replace with new.

Replace breather.

32. REPLACE BREAKOUT TOOL POWER UNIT OIL



1. Clean area around filler cap (A).

2. Retract cylinder (B).

3. Open filler cap and drain oil from reservoir.

4. Flush reservoir.

5. Refill the reservoir by tipping the end of the power unit with the filler cap up (vertical position). Remove filler cap and fill oil to the top of filler collar with ISO-VG-46 20W Premium Hydraulic/ Turbine Oil or equivalent. Replace filler cap.

6. Bleed air from system as follows:

   a. Position cylinder on its side with the fittings facing up.

   b. With the power unit flat on ground (horizontal position, cycle the cylinder several times (fully extend and retract).

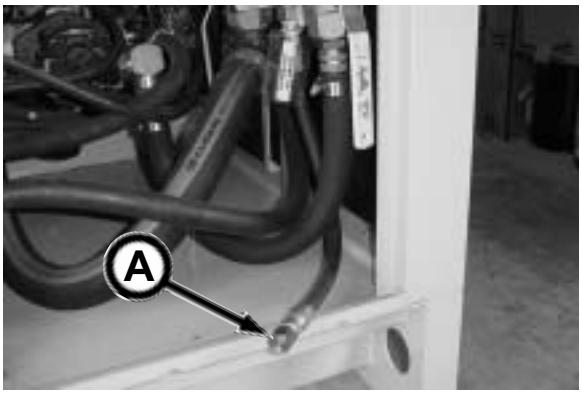
   c. Tip the power unit with the filler cap up, and open filler cap to recheck oil level in reservoir. Add additional oil as needed.

6. Replace filler cap. Tighten cap a half to one full turn after o-ring contacts sealing surface.

EVERY 500 HOURS OF OPERATION

33. DRAIN & FILL HYDRAULIC RESERVOIR

1. Remove end panel.



2. Remove drain plug (A) from hose.

3. Open oil drain shut off by moving handle in-line with fitting.

4. Drain oil into a 40 gal (151 L) catch pan..

5. Install drain plug.

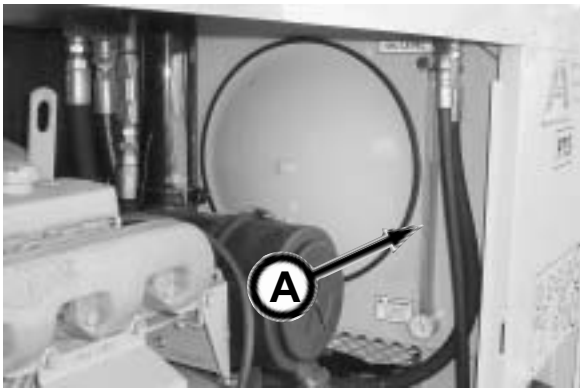
6. Close oil drain shut off by moving handle 90 degrees to fitting.

7. Open oil fill cover. Clean area around fill cap. Remove fill cap, strainer, and gaskets. Retain machine screws.

   Clean strainer with new hydraulic oil as specified in the Lubricants section. Dispose of oil properly. Replace strainer with new gaskets and secure with machine screws.

NOTICE Refer to Fuels & Lubricants section for recommended hydraulic oil.

8. Fill until oil reaches high mark on gauge (A).



9. Replace fill cap and secure fill cover.

10. Replace end cover.

34. REPLACE AIR CLEANER FILTERS

Replace air cleaner elements at 500 hours or 12 months, whichever occurs first.

1. Clean area around the air cleaner assembly.

2. Unlatch and remove cover.

3. Gently remove primary element. Bumping the element against air cleaner housing may contaminate the clean side of the filter housing with dirt and dust.

4. Properly dispose of primary element.

5. Thoroughly clean out the inside of filter housing with a clean, damp cloth. Dirt left in the filter housing will shorten the life of the filter elements.

6. Gently remove secondary (safety) element. Immediately install a new secondary element to prevent any dirt or dust from entering the air intake system.

NOTICE NEVER run the engine without the secondary element in place. Doing so will cause engine damage.

Replacement of the secondary element is usually necessary only when the primary element has a hole in it.

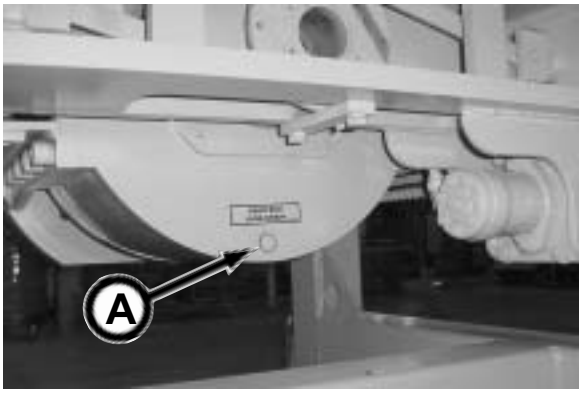
7. Carefully install a new primary filter element by applying pressure by hand at outer rim of filter.

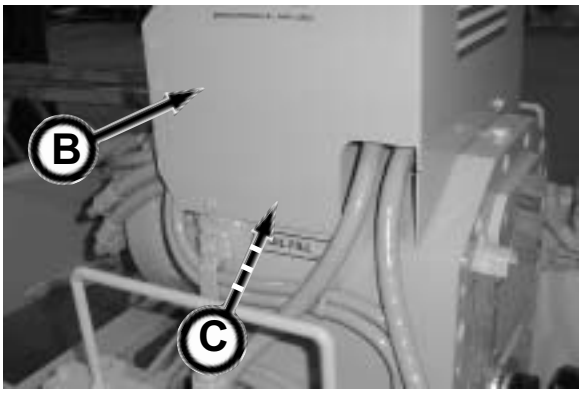
NOTICE Do not use latches on cover to force filter into air cleaner. Using cover to force filter into housing will damage cleaner housing.

8. Replace cover with dust unloader valve facing down (6 o'clock position). Secure the latches.

35. DRAIN & FILL GEAR BOX OIL

1. Clean and dry area around the gear box drain plug.
2. Remove drain plug (A).
3. Drain gear box oil into a proper sized catch pan.
4. Dispose of oil properly.
5. Remove gear box cover (B) to gain access to fill plug (C).
6. Clean and dry area around the fill plug.
7. Remove fill plug.
8. Fill gear box with Mobil SHC 630 Synthetic Bearing and Gear Oil or equivalent until the oil reaches the high mark on gauge. Do not mix oil manufacturers or grades.
9. Replace fill plug and gear box cover.

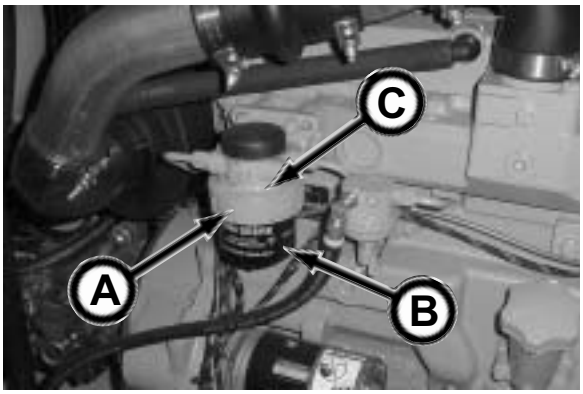




36. REPLACE FUEL FILTER

1. Clean area around fuel filter assembly.

2. Loosen drain plug and drain fuel into a proper container.



3. Hold the retaining ring (A) and rotate it counterclockwise 1/4 turn. Remove ring with filter element (B).

   Lifting up on retaining ring as it is rotated helps to get it past the raised locators on the fuel filter.

4. Inspect filter mounting base (C) for damage. Clean if needed.

5. Install new filter element onto mounting base. Be sure element is properly indexed and firmly seated on base. The filter may need to be rotated for correct alignment.

   Raised locators on fuel filter must be indexed properly with slots in mounting base for correct installation.

6. Align keys on filter element with slots in filter base.

7. Install retaining ring onto mounting base making sure the dust seal is in place on filter base. Hand tighten ring, about 1/3 turn, until it “snaps” into the detent. Do not overtighten retaining ring.

   The proper installation is indicated when a “click” is heard and a release of the retaining ring is felt.

   A plug is provided with the new element for plugging the used element.

(continued on next page)

8. Bleed the fuel system (refer to 37. Bleeding The Fuel System in this section).

9. Tighten bleed plug.

37. BLEEDING THE FUEL SYSTEM

Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the fuel system.

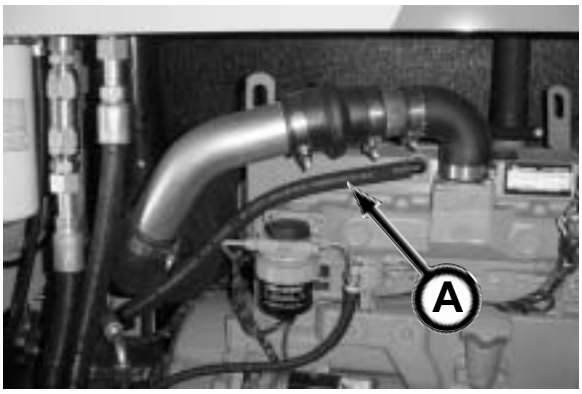
1. Loosen the bleed screw two full turns by hand on fuel filter base.

2. Operate pump primer lever until fuel flow is free from air bubbles.

3. Tighten bleed plug (A) securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.

4. Start engine and check for leaks.

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles. Refer to your John Deere engine manual for service information.



38. CLEAN CRANKCASE VENT TUBE

1. Remove and clean crankcase tube (A).

2. After cleaning, install tube and tighten hose clamps securely.

39. CHECK COOLING SYSTEM

⚠WARNING Cooling system under pressure. Explosive release of HOT engine coolant can cause severe burns. SLOWLY remove the radiator cap ONLY if the engine is cool.

1. Visually check the cooling system for leaks. Tighten all clamps securely.

2. Check to be sure the coolant level is at the bottom of the filler neck. Add coolant mixture if needed. Refer to Engine Coolant in the Fuels & Lubricants section of this manual.

3. Inspect all cooling system hoses. If the hoses are found to be in a hard, weak, or cracked condition, replace the hose(s).

4. Check the radiator for bent fins. Carefully straighten fins.

5. Check the inlet and outlet tubes for cracks, kinks, dents, or fractured seams. Repairs must be made by a qualified radiator technician.

6. Check the effectiveness of the coolant solution. Refer to your Deere engine manual for service information.

7. Pressure test the cooling system. Refer to your Deere engine manual for service information.

40. CHECK BELT & BELT TENSIONER

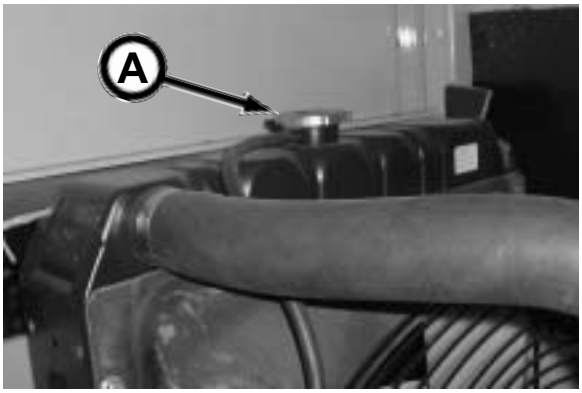
1. Inspect the drive belt for excessive wear or damage. If damaged, replace with new.

2. Check the drive belt tensioner for proper operation. If tensioner is not working properly, replace with new. See your Deere engine manual for service information.

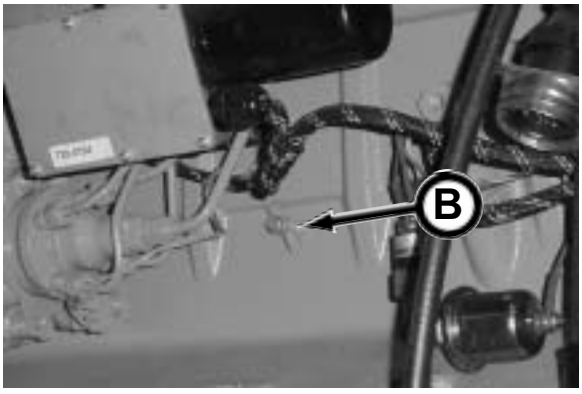
EVERY 2000 HOURS OF OPERATION

41. FLUSH & FILL COOLING SYSTEM

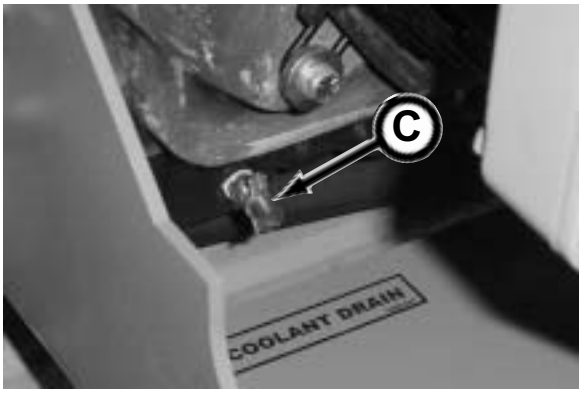
⚠WARNING Cooling system under pressure. Explosive release of HOT engine coolant can cause severe burns. SLOWLY remove the radiator cap ONLY if the engine is cool.



1. With gloves and eye protection, slowly remove the radiator cap (A).



2. Open engine block drain valve (B) on left side of engine. Drain all coolant from engine block into catch pan. Dispose of coolant properly.



3. Open radiator drain valve (C). Drain all coolant from radiator into catch pan. Dispose of coolant properly.

4. Remove thermostats (refer to your engine manual for service information) and install cover using old gasket and tighten cap screws to 35 ft.lb. (47 N·m).

5. After coolant has drained, close engine block drain valve and radiator drain valve.

NOTICE Never add water or coolant to a hot engine. Doing so will result in engine damage.

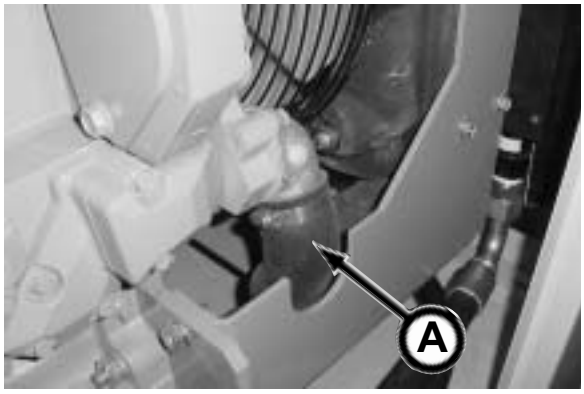
6. Refill the cooling system with soft, clean water.

(continued on next page)

⚠CAUTION Do not run engine longer than 10 minutes. Doing so may cause burns when radiator is draining from an overheated engine.

7. Start the engine and run it for about 10 minutes to thoroughly circulate the water and to stir up possible rust or sediment.

8. Stop engine and immediately drain the water from the system before rust and sediment settle.



NOTICE It may be necessary to remove the lower radiator hose (A) to fully drain the system. Be sure to replace radiator hose and tighten clamp after draining.

9. After draining water, close the engine and radiator drain valves.

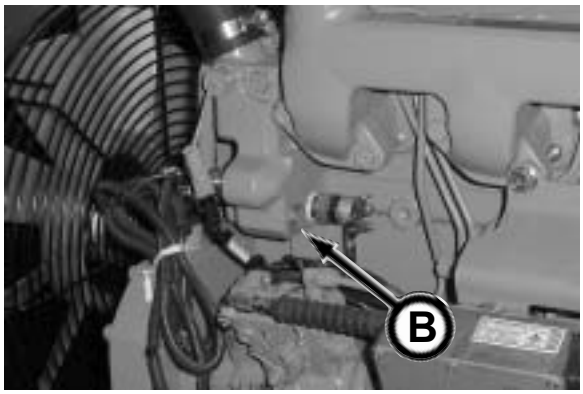
10. Reinstall radiator cap, and if removed, reinstall the lower radiator hose and clamp.

11. Continue flushing system until scale deposits, rust, sediment and cooling cleaner (if used) are completely removed.

NOTICE Cooling system cleaners may need to be used to remove scale formation. See your engine manual for more information.

12. Close engine drain plug and radiator plug.

13. (If removed) Reinstall radiator hose and tighten clamp securely.



14. Install thermostats using a new gasket (see your engine manual for more information).

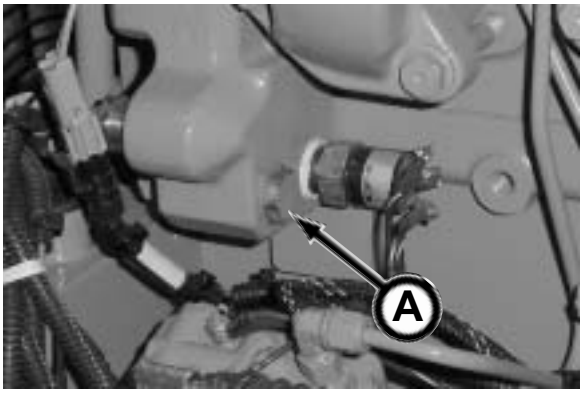
15. Loosen plug (B) in side of thermostat housing to allow air to escape when filling system.

NOTICE DO NOT overfill cooling system. A pressurized system needs space for heat expansion without overflowing at top of radiator.

16. Fill coolant into radiator with a 50% mixture of ethylene glycol engine coolant and distilled, deionized, or demineralized water, and a supplemental coolant additive until the coolant level reaches the bottom of the radiator filler neck.

NOTICE Refer to your engine manual for information on using a Supplemental Coolant Additive (SCA) in your coolant system.

(continued on next page)

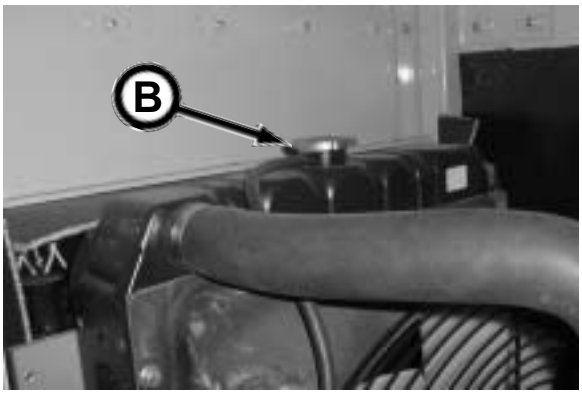


17. Tighten thermostat housing plug (A) when air has been expelled from system.

18. Replace radiator cap.

19. Start engine and operate it for 5 minutes to circulate the water/coolant/SCA (if used) mixture.

20. Shut off engine.



21. SLOWLY remove radiator cap.

22. Check radiator coolant level and fill as needed for coolant to reach the bottom of the filler neck.

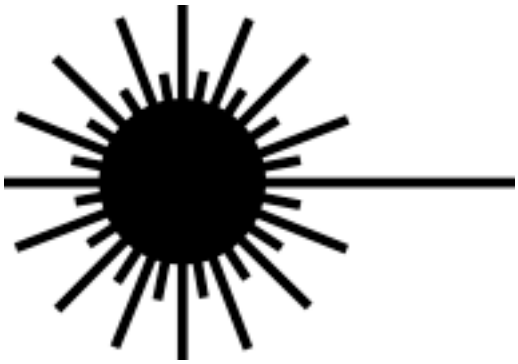
23. Replace radiator cap (B).

24. Start engine and run it until it reaches operating temperature. This will mix the coolant uniformly and circulate it throughout the system. The normal engine coolant temperature range is 180° to 202°F (82° to 94°C).

25. Shut off engine. Check coolant level and add if necessary. Check entire coolant system for leaks.

AS REQUIRED

42. REPLACING LASER BORE SIGHT BATTERIES



⚠ DANGER Staring into laser light will cause severe injury.
Do not stare into the laser sight light beam or the laser guidance system laser light beam. Avoid direct eye exposure. Do not aim laser at anyone's eyes.

1. Remove the end cap by holding the laser chamber and turning end cap completely counterclockwise.

2. Remove the three Lr41 button batteries from the chamber. Examine the orientation of the batteries. The positive or + side of the batteries face towards the end cap.

3. Insert three new Lr41 button batteries into the laser sight with the negative side of the battery into the chamber first.

4. Replace end cap.

Storage

PREPARING FOR STORAGE

1. Repair worn or damaged parts.
2. Wash all equipment thoroughly.
3. Lubricate all grease points on the Guided Boring Machine. Grease threads on bolts used for adjustments.
4. Drain gear box. Add Mobil SHC 630 or equivalent until oil level is at high mark on oil level gauge.
5. Retract all hydraulic cylinders if possible. If not, coat exposed cylinder rods with a corrosion preventive.
6. Drain engine oil, replace filter(s) and refill engine with oil specified in Fuels & Lubricants section.
7. Drain water and sediment from fuel system. Dispose of water and sediment properly.
8. Add proper fuel stabilizer for a full tank. Fill fuel tank completely.
9. Store diesel fuel in plastic, aluminum, or steel containers specially coated for diesel fuel storage.
10. Loosen all belts.
11. Clean air cleaner.
12. Restart engine and operate machine long enough to warm the oil. Check for leaks after machine warms up.
13. Remove battery (negative cable first) and store it in a cool, dry place. Remove corrosion from cables and battery case. Use baking soda to neutralize acid. Place battery on wood (not concrete) and connect a small trickle charger to it to maintain charge; OR charge battery every 30 days it is in storage, if necessary.
14. Repaint equipment where necessary.
15. Drain hydraulic oil, flush oil reservoir, change hydraulic filters, and refill hydraulic reservoir. Check for leaks.
16. Change hydraulic filters and refill hydraulic reservoir. Check for leaks.
17. Wipe up lube spills. Dispose of rags and trash properly.
18. Seal all engine openings with moisture-resistant tape to prevent animals and insects from building nests inside machine.
19. If possible, store equipment under cover and out of the weather in a ventilated area.
20. If the engine will be stored over 6 months, refer to your engine manual for preparing the engine for long term storage.

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 sealing tape from engine openings.
5. Charge battery (if necessary) and install it.
6. Check coolant level. If coolant level is low, check for leaks and add coolant as required.
7. Adjust belt tension.
8. Check gear box oil level. Add oil as needed. See Gear Box Lubricant in Lubricants section.
9. Remove the cylinder corrosion preventive from the cylinder rods if it is not compatible with hydraulic oil or seal materials.
10. Check for leaks. Repair or replace as necessary.
11. Check hydraulic oil level. If fluid is low, check for leaks and add oil as required. See Power Pack Oil Reservoir Lubricant in Lubricants section.
12. Check condition of all hoses and connections. Tighten, repair or replace with new as needed.
13. Before operating, cycle hydraulic functions several times to purge air from the hydraulic system.
14. See your engine manual on how to restore engine to service.
15. If diesel fuel is stored for more than a month prior to use, or there is a slow turnover in fuel tank or supply tank, add a fuel conditioner or equivalent to stabilize the fuel and prevent water condensation.
16. Review this Operator's Manual.

Troubleshooting

Guided Boring Machine

Problem	Cause	Solution
No power to guidance system.	Switch on control pendant is OFF.	Turn switch ON.
	Connections are loose or disconnected.	Secure all connections.
	Blown monitor fuse.	Replace fuse.
	Voltage is less than 10 VDC.	Check voltage.
Valve functions (jacking, rotation, travel) do not operate.	Power pack engine is not running.	Start up engine.
	Insufficient oil in hydraulic reservoir.	Check oil level and fill as needed.
	Quick couplers are not properly connected.	Connect quick couplers on gear box properly.
	No oil flow.	Open inlet valve on power pack.
Latches on latching frame do not engage.	Thrust block shifting causing frame rails to misalign.	Reposition frame and modify thrust block to maintain parallel frame rails.
Make-up tool mounting block bolts break.	Jacking when make-up tool locked or partially engaged into pilot tube notch.	Unlock or fully open make-up tool before jacking.
Break-out tool does not operate.	Defective switch on controller.	Replace switch.
Low jacking pressure.	Power pack high/low selector is in low pressure position.	Move selector to high pressure.
High rotational pressure.	Jacking frame motor speed is at high speed position.	Move selector to low speed position.

Power Pack Engine

Problem	Cause	Solution
Engine cranks but will not start.	No fuel.	Check fuel in tank. Open fuel shut-off valve.
	Fuel filter plugged or full of water.	Replace fuel filter and/or drain water from filter.
	Injection pump not getting fuel or air in fuel system.	Bleed fuel system.
	Wire harness or wires disconnected on injector pump.	Repair loose connections or replug harness.
Engine hard to start or will not start.	No fuel.	Check fuel in tank. Open fuel shut-off valve.
	Air in fuel line.	Bleed fuel system.
	Cold weather.	Use cold weather starting procedure.
	Crankcase oil too heavy.	Use proper oil viscosity.
	Clogged fuel filter.	Replace filter element.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed fuel system.
Engine shuts down during operation.	Defective high water temperature sensor.	Replace water temp. sensor.
	Defective low oil pressure switch.	Replace low pressure switch.
Engine knocks.	Low engine oil level.	Add oil to engine crankcase.
	Low coolant temperature.	Remove and check thermostat.
Engine runs irregularly or stalls frequently.	Low coolant temperature.	Remove and check thermostat.
	Clogged fuel filter.	Replace filter element.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed fuel system.
Below normal engine temperature.	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check gauge, sender, and connections.
Lack of power.	Engine overloaded.	Reduce load on engine.
	Intake air restriction.	Service air cleaner.
	Clogged fuel filter.	Replace fuel filter.
	Improper type of fuel.	Use proper fuel.
	Below normal engine temperature.	Remove and check thermostat.
	Restricted fuel hose.	Clean or replace fuel hose.
	Torque limiter out of adjustment.	Readjust torque limiter. Contact your Akkerman product support rep.

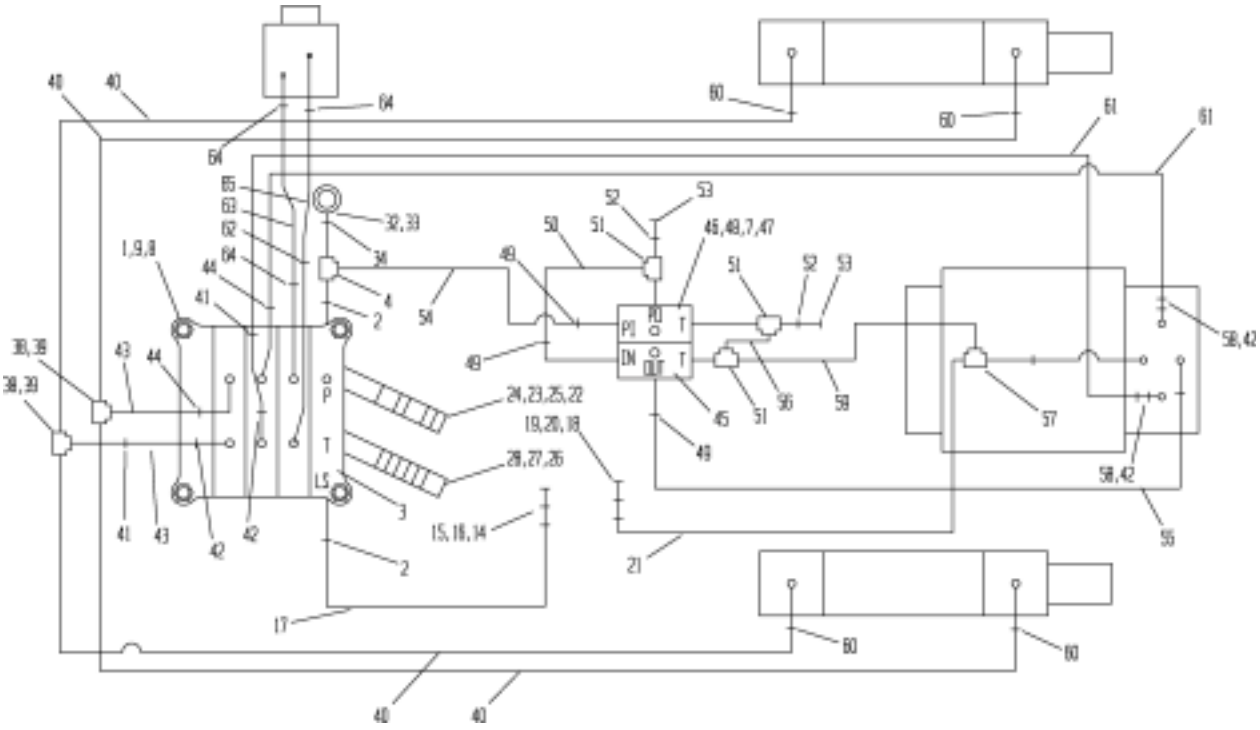
Power Pack Engine (continued)

Problem	Cause	Solution
Low oil pressure.	Low oil level.	Add oil.
	Improper oil type.	Drain, fill crankcase with proper oil and quantity.
High oil consumption.	Crankcase oil too light.	Use proper oil.
	Oil leaks.	Check for leaks in lines, gaskets, and drain plug.
	Restricted crankcase vent tube.	Clean vent tube.
Engine emits white smoke.	Improper type of fuel.	Use proper fuel.
	Low engine temperature.	Warm up engine to normal operating temperature.
	Defective thermostat.	Remove and check thermostat.
Engine emits black or gray exhaust smoke.	Improper type of fuel.	Use proper fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load on engine.
Engine overheats.	Engine overloaded.	Reduce load on engine.
	Low coolant level.	Fill radiator to proper level and check for leaks.
	Faulty radiator cap.	Have a technician check.
	Drive belt loose or defective.	Replace belt.
	Defective belt tensioner.	Replace tensioner.
	Low engine oil level.	Add oil as needed.
	Plugged radiator.	Clean.
	Cooling system requires flushing.	Flush cooling system.
	Defective thermostat.	Remove and check thermostat.
	Incorrect grade of fuel.	Use correct grade of fuel.
High fuel consumption.	Incorrect grade of fuel.	Use correct grade of fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load on engine.
Undercharged system.	Excessive engine idling.	Increase engine rpm when heavy electrical load is used.
	Poor electrical connectors on battery, ground strap, starter, or alternator.	Inspect and clean or replace as necessary.
	Defective battery.	Test battery.
	Defective alternator.	Test charging system. Replace alternator.

Power Pack Engine (continued)

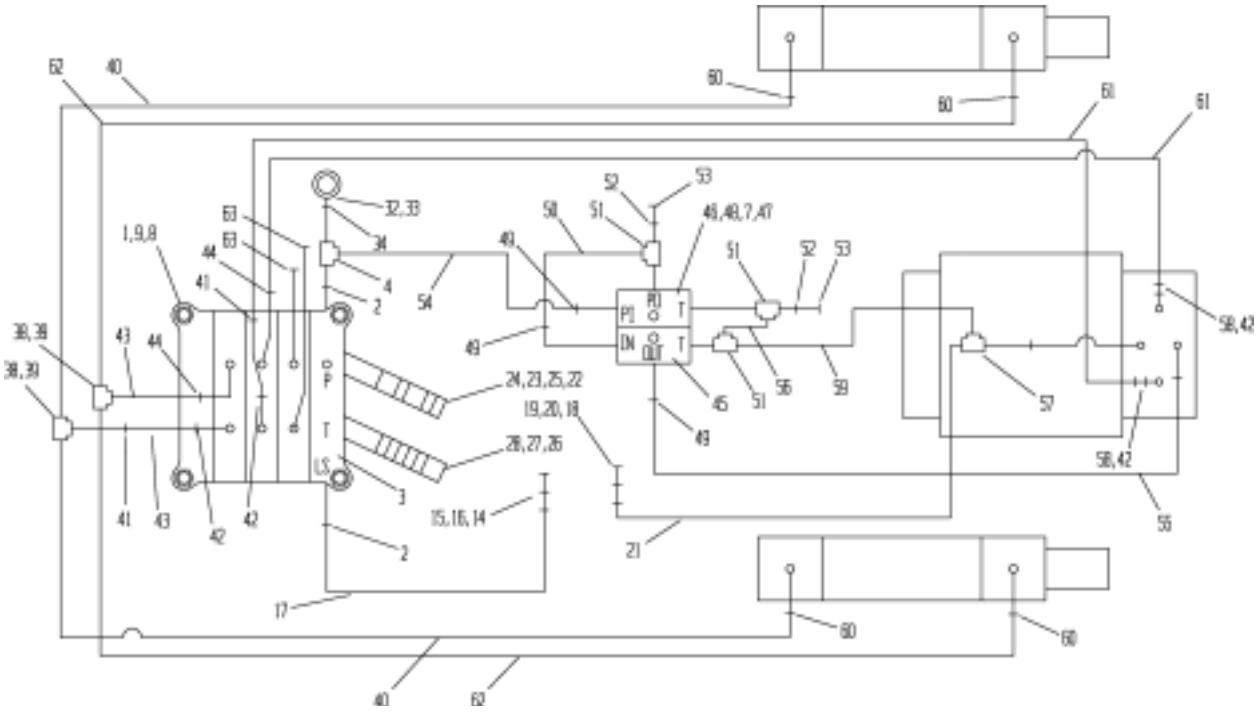
Problem	Cause	Solution
Battery uses too much water.	Cracked battery case.	Replace battery.
	Defective battery.	Test battery. Replace if needed.
Battery will not charge.	Loose or corroded connections.	Clean and tighten connections.
	Worn out battery.	Replace battery.
	Drive belt loose or defective.	Replace belt.
	Defective belt tensioner.	Replace tensioner.
Starter will not crank.	Loose or corroded connections.	Clean and tighten connections.
Starter cranks slowly.	Crankcase oil too heavy.	Use proper oil.
	Loose or corroded connections.	Clean and tighten connections.
Entire electrical system does not function.	Loose or faulty battery connection.	Clean and tighten connections.
	Worn out battery.	Replace battery.

HYDRAULIC ASSEMBLY - LATCHING FRAME



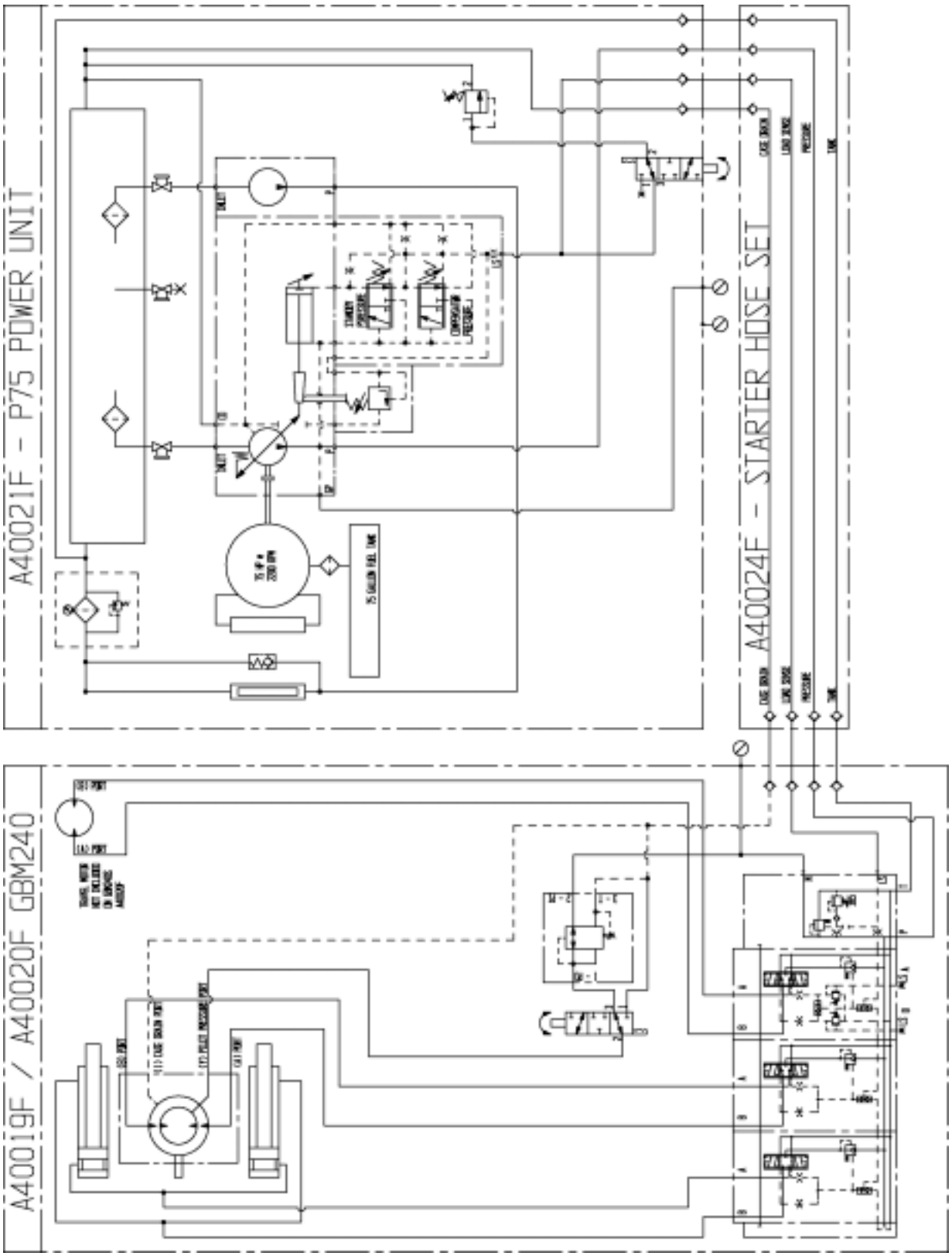
1 VALVE MOUNTING PLATE ASSEMBLY
2 FITTING
3 3 SECTION CONTROL VALVE
4 TEE
5 COVER MOUNTING TAB
6 BOLT 1/4-20 UNC X 1/2"
7 LOCK WASHER 1/4
8 LOCK WASHER 3/8
9 BOLT 3/8-16 UNC X 3/4"
10 PLATE MOUNT - SMALL
11 PLATE MOUNT - LARGE
12 HI -COLLAR LOCK WASHER 5/16
13 SOCKET HEAD CAP SCREW 5/16-18 UNC X 3/4"
14 COUPLER
15 FITTING
16 O-RING
17 1/4 HOSE ASSEMBLY
18 COUPLER 1/2
19 FITTING
20 O-RING
21 1/2 HOSE ASSEMBLY
22 3/4 QUICK COUPLER
23 FITTING
24 FITTING
25 O-RING
26 QUICK COUPLER
27 FITTING
28 STRAIGHT
29 VALVE COVER
30 FRONT PANEL-COVER 1
31 SOCKET HEAD CAP SCREW 1/4" -20 UNC X 1/2
32 GAUGE 5000 PSI
33 CONNECTOR
34 1/4 HOSE ASSEMBLY
35 BOTTOM MOUNT, MONITOR ASSEMBLY
36 HEX NUT 1/4-20 HEX NUT
37 BOLT 1/4-20 UNC HEX BOLT X 3/4
38 TEE
39 #10 NUT
40 1/2 HOSE ASSEMBLY
41 FITTING
42 FITTING
43 1/2 HOSE ASSEMBLY
44 FITTING
45 SELECTOR
46 PRESSURE REDUCING VALVE
47 FLAT WASHER 1/4
48 SOCKET HEAD CAP SCREW 1/4" - 20 UNC X 3.00
49 FITTING, 90 DEGREE
50 1/4 HOSE ASSEMBLY
51 TEE
52 #6 INSERT
53 #6 NUT
54 1/4 HOSE ASSEMBLY
55 1/4 HOSE ASSEMBLY
56 1/4 HOSE ASSEMBLY
57 TEE
58 FITTING
59 1/4 HOSE ASSEMBLY
60 FITTING
61 1/2 HOSE ASSEMBLY
62 FITTING
63 3/8 HOSE ASSEMBLY
64 FITTING, 90 DEGREE
65 3/8 HOSE ASSEMBLY
66 CLAMP
67 CLAMP

HYDRAULIC ASSEMBLY - SINGLE STAGE FRAME

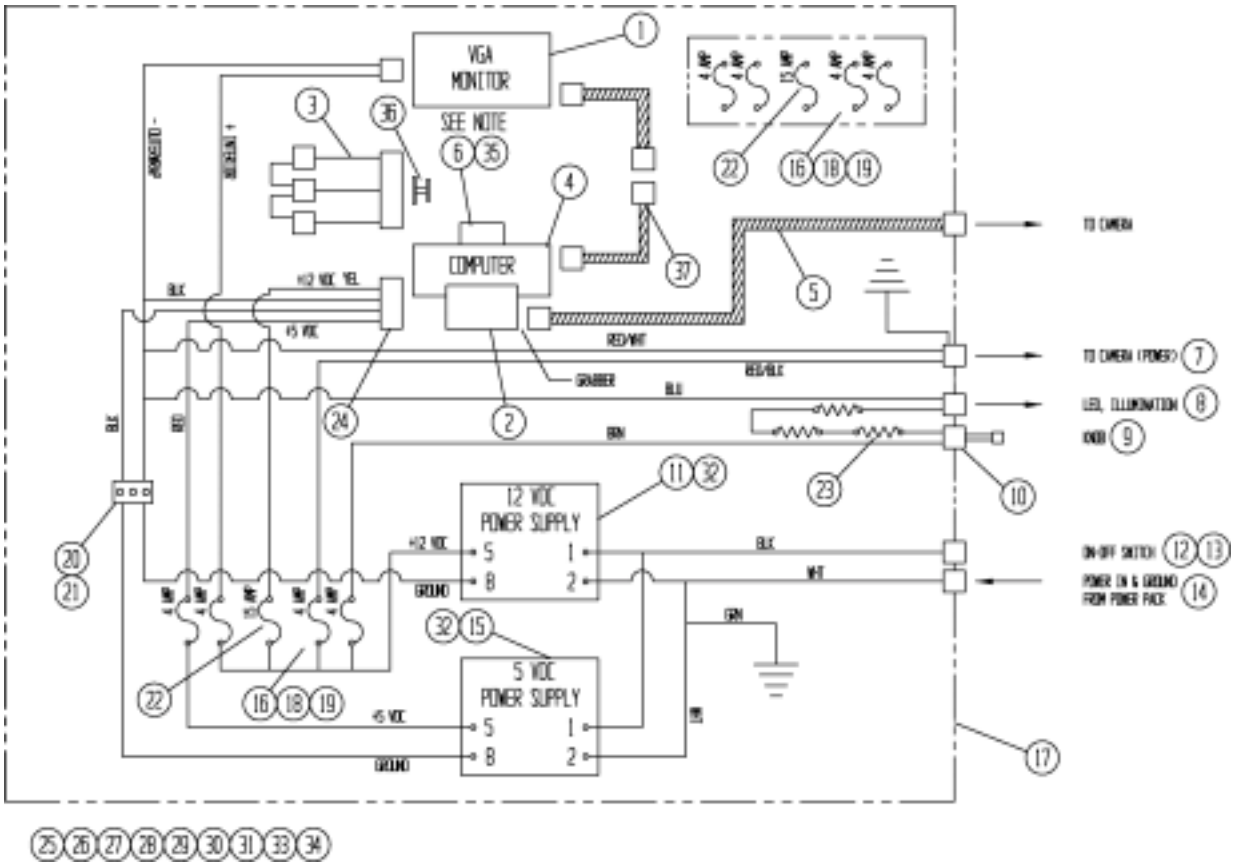


1 VALVE MOUNTING PLATE ASSEMBLY
2 FITTING
3 3 SECTION CONTROL VALVE
4 TEE
5 COVER MOUNTING TAB
6 BOLT, 1/4-20 UNC X 1/2
7 LOCK WASHER 1/4
8 LOCK WASHER 3/8
9 BOLT, 3/8-16 UNC X 3/4
10 PLATE MOUNT - SMALL
11 PLATE MOUNT - LARGE
12 HI -COLLAR LOCK WASHER 5/16
13 SOCKET HEAD CAP SCREW 5/16-18 UNC X 3/4
14 COUPLER
15 FITTING
16 O-RING
17 1/4 HOSE ASSEMBLY
18 COUPLER
19 FITTING
20 O-RING
21 1/2 HOSE ASSEMBLY
22 QUICK COUPLER
23 FITTING
24 FITTING
25 O-RING
26 QUICK COUPLER
27 FITTING
28 REDUCER
29 VALVE COVER
30 FRONT PANEL-COVER
31 SOCKET HEAD CAP SCREW 1/4" -20 UNC X 1/2
32 GAUGE 5000 PSI
33 CONNECTOR
34 1/4 HOSE ASSEMBLY
35 BOTTOM MOUNT, MONITOR ASSEMBLY
36 NUT 1/4
37 BOLT, 1/4-20 UNC X 3/4
38 TEE
39 #10 NUT
40 1/2 HOSE ASSEMBLY
41 FITTING-90
42 FITTING
43 1/2 HOSE ASSEMBLY
44 FITTING
45 SELECTOR
46 PRESSURE REDUCING VALVE
47 FLAT WASHER 1/4
48 SOCKET HEAD CAP SCREW 1/4" - 20 UNC X 3.00
49 FITTING-90
50 1/4 HOSE ASSEMBLY
51 FITTING
52 INSERT
53 NUT
54 1/4 HOSE ASSEMBLY
55 1/4 HOSE ASSEMBLY
56 1/4 HOSE ASSEMBLY
57 TEE
58 FITTING
59 1/4 HOSE ASSEMBLY
60 FITTING
61 1/2 HOSE ASSEMBLY
62 1/2 HOSE ASSEMBLY
63 O-RING HEX HEAD PLUG
64 CLAMP

HYDRAULIC SCHEMATIC



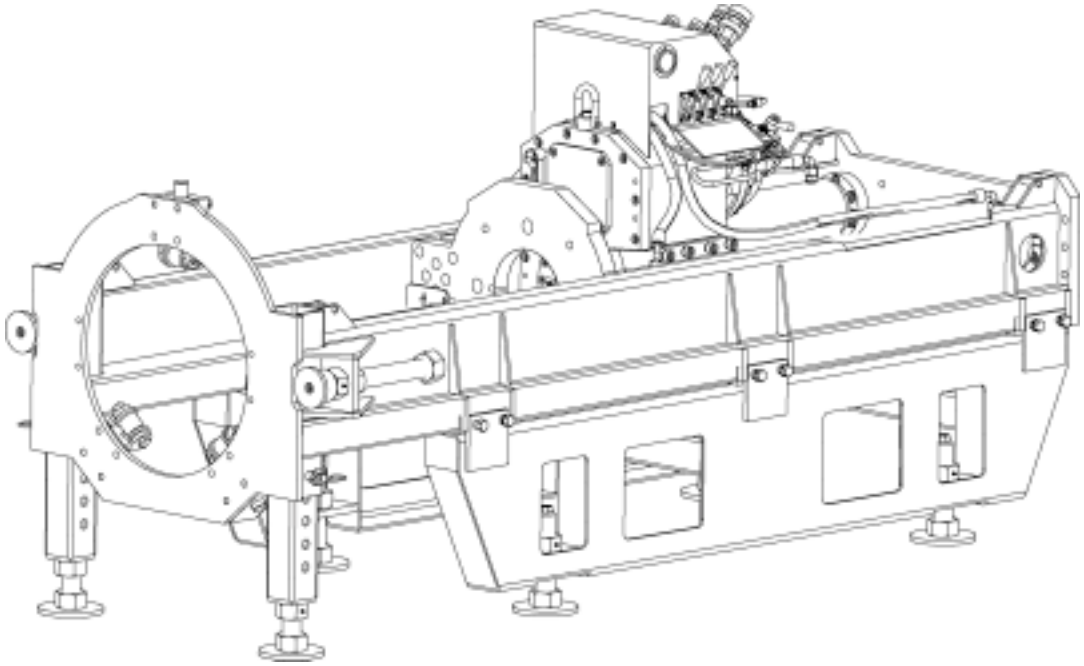
MONITOR BOX ASSEMBLY



1 MONITOR, FLAT PANEL
2 CAMERA LINK INTERFACE
3 BUTTON HARNESS
4 PROCESSOR
5 CAMERA CABLE
6 COMPACT FLASH
7 RECEPTACLE
8 CONNECTOR
9 KNOB
10 POT
11 POWER SUPPLY
12 SWITCH - TOGGLE
13 SWITCH - TOGGLE BOOT
14 RECEPTACLE
15 POWER SUPPLY
16 FUSE
17 BOX,
18 FUSE HOLDER
19 BLOCK, FUSE
20 BARRIER STRIP
21 JUMPER STRIP
22 FUSE
23 RESISTOR
24 POWER CABLE
25 DECAL SET
26 BOLT, 1/4-20 X 3/4
27 1/4 LOCK WASHER
28 1/4-20 HEX NUT
29 LEXAN MONITOR COVER ASSEMBLY
30 BRACKET, MOUNTING CARD
31 TOP MOUNT, MONITOR ASSEMBLY
32 VELCRO TAPE
33 MOUNTING BASE
34 STAND-OFF
35 SOFTWARE
36 CABLE
37 CABLE

Specifications

GBM - SINGLE STAGE FRAME



Dimensions
- Width ..... 48 in. (1,219 mm)
- Length ..... 118 in. (2,997 mm)
- Height ..... 55 in. (1,397 mm)

Assembly Weight ..... 5,150 lbs. (2,336 kg)

Cylinder Stroke ..... 48 in. (1,219 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34,475 kPa)

Elevation (from shaft floor to drive center) ..... 27 to 33 in. (686 to 838 mm)

Operating Grade (Maximum) 10%

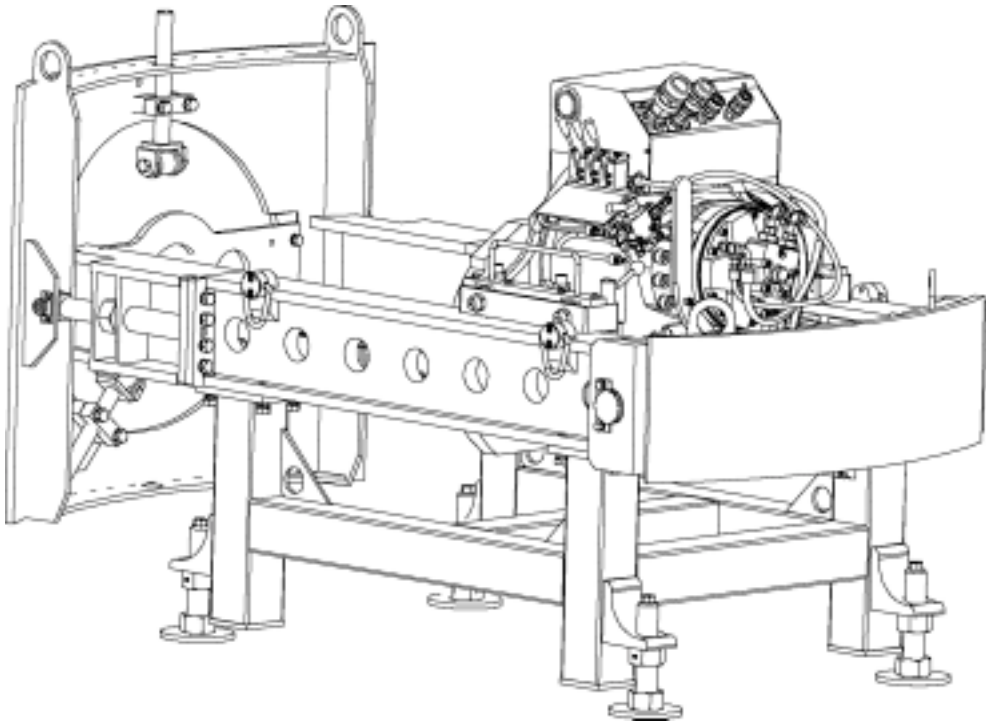
Gear Box
- Rotational Torque* ..... 10,500 ft-lbs. (14,238 N•m)
- Jacking Force ..... 100 Ton (91 mt)
- Pull Back Force ..... 50 Ton (45 mt)

Hydraulic Motor ..... Two Speed
- High Speed ..... 70 rpm
- Low Speed ..... 25 rpm

* Output torque in low speed @ 5,000 psi

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

GBM - LATCHING FRAME



Dimensions
- Width ..... 48 in. (1,219 mm)
- Length ..... 92 in. (2,337 mm)
- Height ..... 60 in. (1,524 mm)

Assembly Weight ..... 5,545 lbs. (2,515 kg)

Latching Positions On Center ..... 8 in. (203 mm)

Cylinder Stroke ..... 10.5 in. (267 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34,475 kPa)

Elevation (from shaft floor to drive center) ..... 27 to 33 in. (686 to 838 mm)

Operating Grade (Maximum) 10%

Gear Box
- Rotational Torque* ..... 10,500 ft-lbs. (14,238 N•m)
- Jacking Force ..... 100 Ton (91 mt)
- Pull Back Force ..... 50 Ton (45 mt)

Hydraulic Motor ..... Two Speed
- High Speed ..... 70 rpm
- Low Speed ..... 25 rpm

* Output torque in low speed @ 5,000 psi

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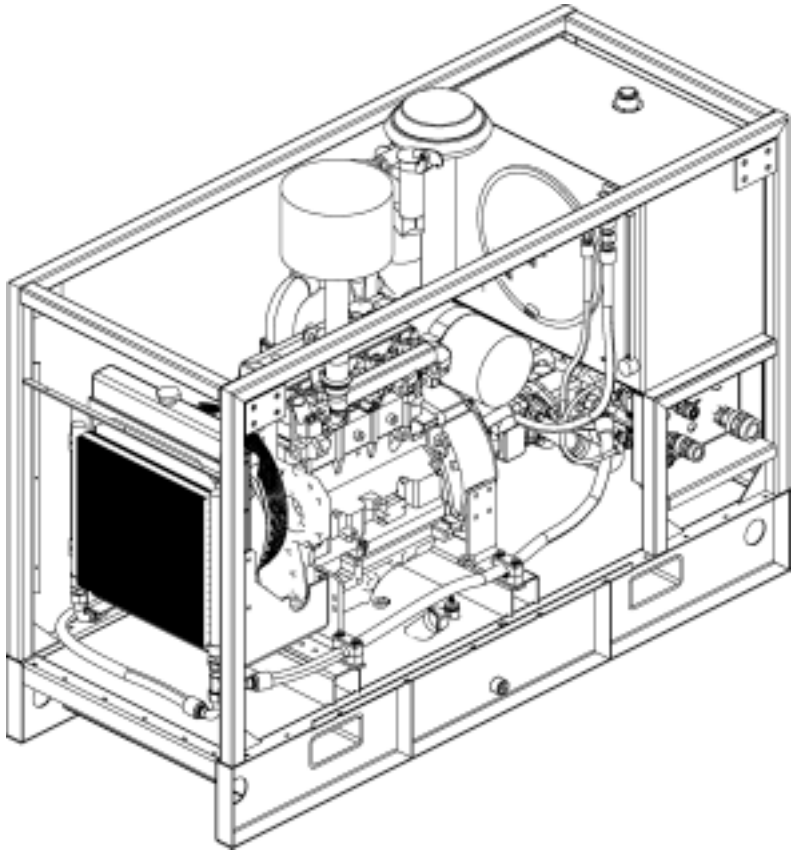
GBM - POWER PACK



Dimensions
- Height ..... 60 in. (1,524 mm)
- Width ..... 36 in. (914 mm)
- Length ..... 90 in. (2,286 mm)
- Weight ..... 3,600 lbs. (1,633 kg)

Fluid Capacities
- Fuel Tank ..... 75 gal (284 L)
- Hydraulic Reservoir ..... 40 gal (151 L)
- Engine Oil ..... 14.3 qt (13.5 L)

Power Unit
- JD 4.5 L 4045 Engine ..... 75 HP (56 kW)

Pumps
- Variable Piston ..... 0 to 34 gpm (0 to 129 L/min
  - Operating Pressure (Maximum) ..... 5,000 psi (34,475 kPa)
- Gear Pump (Cooling) ..... 25 gpm (95 L/min)Hydraulic Motor

Two Speed
- High Speed ..... 70 rpm
- Low Speed ..... 25 rpm

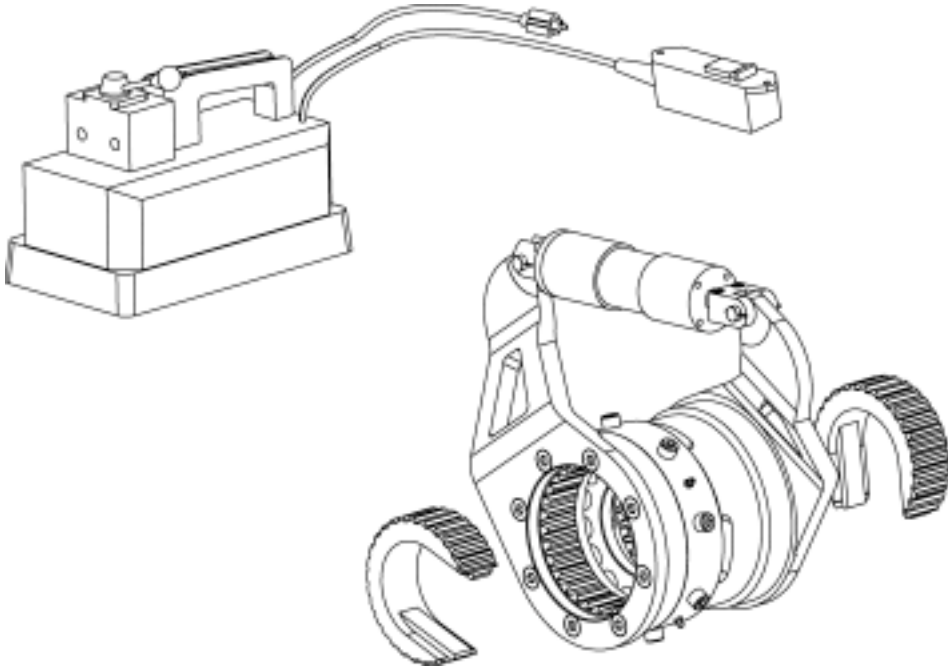
* Output torque in low speed @ 5,000 psi

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

LASER SIGHT ALIGNMENT TOOL

Minimum Range for Sighting String Lines ..... 30 in. (762 mm)
Operation ..... on/off end cap
Battery Life (Continuously On) ..... 1 hour
Laser Type ..... visible red diode laser
Power Supply ..... (3) LR41 batteries for .223
Construction ..... brass

BREAKOUT TOOL POWER UNIT



Power Unit
..... 110 VAC, 1/4 HP, 60 Hz,
..... 120 Cu-In/Min. To 400 PSI
..... 10 Cu-In/Min. To 5,000 PSI

Breakout Torque
..... 2,439 ft-lbs @ 1,000 PSI
..... 12,193 ft-lbs. @ 5,000PSI

Make Up Torque
..... 1,965 ft-lbs. @1,000 PSI
..... 9,825 ft-lbs. @ 5,000 PSI

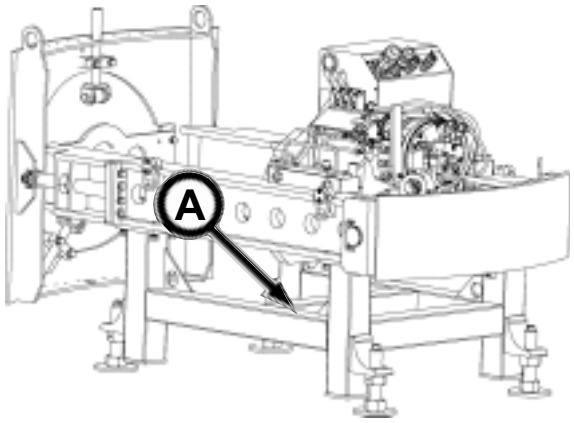
TORQUE CHART

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

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

Identification Numbers

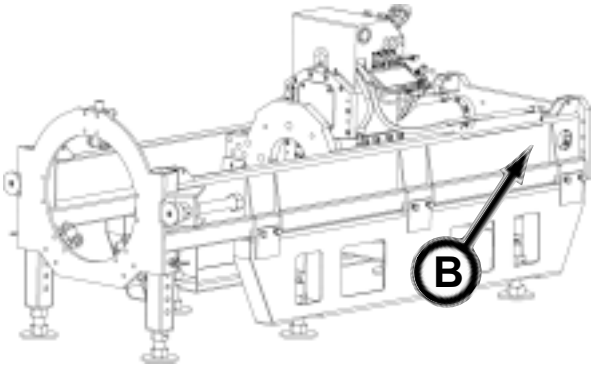
Model and serial numbers are required when ordering parts or requesting service information. Record your model and serial numbers below.



GBM - LATCHING FRAME (A)

Model Number _____

Serial Number _____



GBM - SINGLE STAGE FRAME (B)

Model Number _____

Serial Number _____

POWER PACK

Model Number _____

Serial Number _____

ENGINE (C)

Model Number _____

Serial Number _____

Material Safety Data Sheets

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

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

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

Warranty

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

Index

NOTES

CALIFORNIA
Proposition 65 Warning
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.