OPERATOR'S MANUAL

Guided Boring Machine

GBM S/N: 240A/ABM
(FA40027F162 & After and FA62563F)
Power Pack SN: P4075D (FA40040F38 & After)

Publication No. 050187A

Rev. No. 260829

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Akkerman Inc. 58256 266th Street Brownsdale, MN 55918
Phone: 507-567-2261 Fax: 507-567-2605 email: akk@akkerman.com

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Introduction

This operator's manual contains important safety, operation, and maintenance information for your Akkerman 240A & 240ABM Guided Boring Machine (GBM) system and P4075D Power Pack. You must read and understand this manual and other equipment manuals before you operate and maintain this equipment. Keep all manuals with your GBM equipment at all times. Additional copies of this Operator's Manual may be purchased from the Akkerman Aftermarket Support Department, or downloaded for free from the Akkerman website 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 system. ALWAYS use genuine Akkerman parts.

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

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

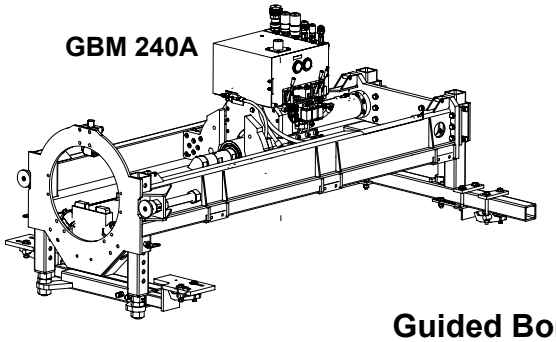
⚠WARNING Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

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

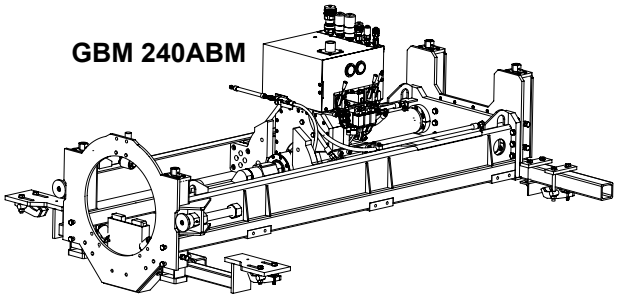
SAFETY INSTRUCTIONS Usually consists of individual messages stating procedures or actions that must be followed for the safe operation of a product.

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

GBM 240A



GBM 240ABM



Guided Boring Machine

The Guided Boring Machine (GBM) installs small diameter pipes with grade and alignment precision. The GBM works in conjunction with a specially designed theodolite guidance system. Accurate pipeline installation is achieved through live 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 followed by pilot tubes. 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 casing with auger in the launch shaft, a section of pilot tube is removed in the reception shaft. The process is repeated until all pilot tubes are removed. A pipe adapter is then installed on the last section of casing with auger, and subsequent pipes are thrust into place while the casing and augers are removed from the reception shaft. The GBM system is often used for guided auger boring, and combined with an auger boring rig. When guided auger boring, pilot tubes are installed with the GBM system with the GBM frame mounted to the auger boring rig track. When pilot tubes are accurately installed the GBM system is removed, and the auger boring rig increases the bore diameter.

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

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

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NOTES

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.



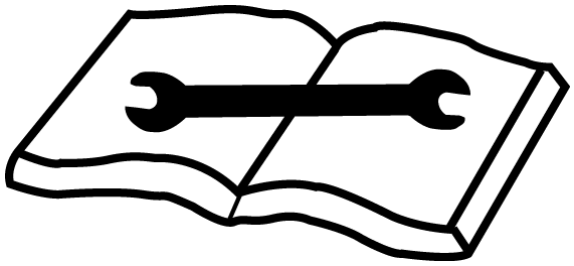
ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

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

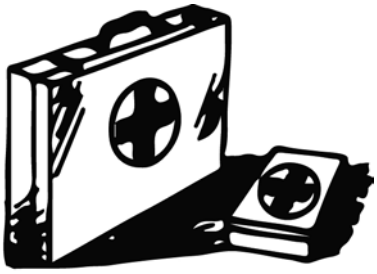
Wear OSHA approved protective clothing, such as hard hat, gloves, safety goggles, earmuffs or ear plugs, face shield, and steel-toed boots, when operating and servicing this equipment.

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.

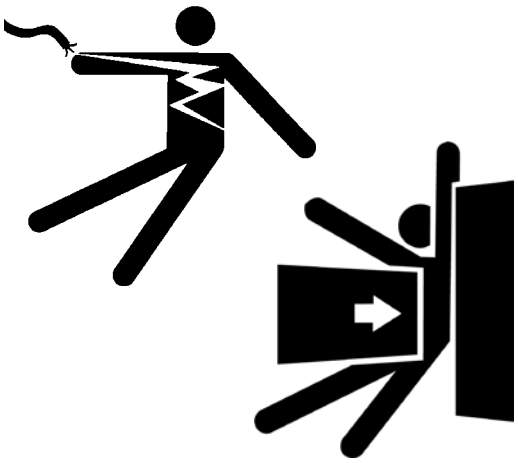


KEEP FIRST-AID KIT ACCESSIBLE

Keep a first-aid kit handy and properly maintained. Call 9-1-1 for emergencies.



LOCKOUT TAGOUT POWER



⚠DANGER Failure to lockout tagout (LOTO) power before repair, service or adjustment WILL cause severe personal injury or death.

LOTO power before repairs, service or adjustments unless otherwise noted. Any electrical repairs must be performed only by a certified electrician.

Refer to *Lockout Tagout Procedure Guideline* in this section.

HYDRAULIC OIL/FLUIDS UNDER PRESSURE



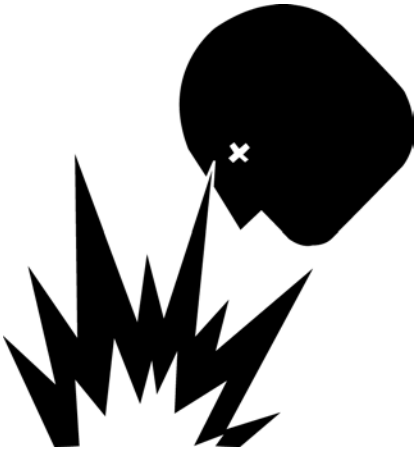
⚠WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury.

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.

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.

BEWARE OF SUSPENDED LOADS



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

If a hydraulic hose breaks from the boom of a crane/excavator, or the lifting support fails, the boom and/or load can fall instantly.

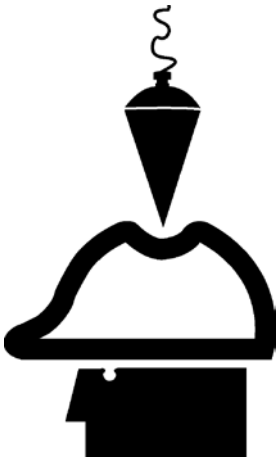
Do not enter area under or around a suspended load.

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 can result in serious personal injury or death.

USING PLUMB BOB

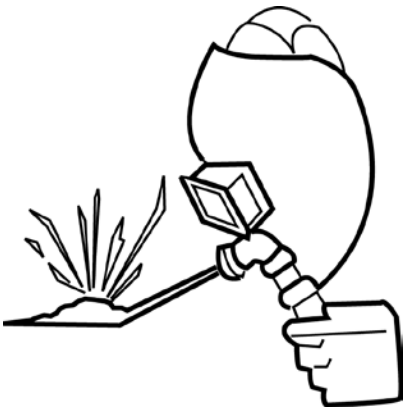


⚠WARNING Falling plumb bob can cause serious personal injury or death, and/or equipment damage.

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.

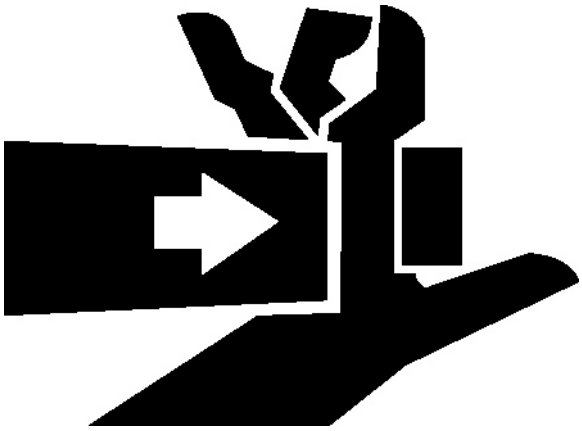
UNAUTHORIZED WELDING



⚠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.

AVOID PINCH POINTS



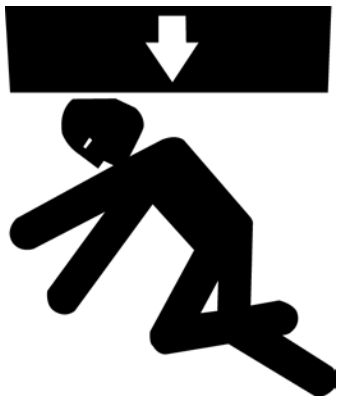
⚠WARNING Moving parts or the mishandling of parts can cause severe personal injury.

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.

HANDLING AUGER CASINGS

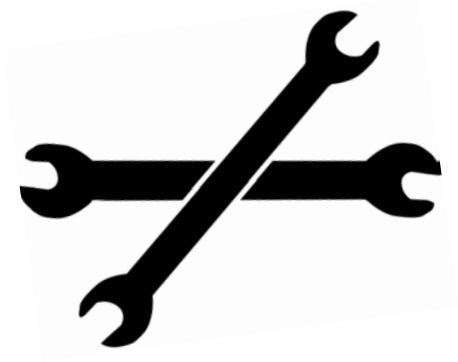


⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits an obstruction.

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

Do not stand or walk under a load.

PRACTICE SAFE MAINTENANCE



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

LOCKOUT TAGOUT power before performing any maintenance. Refer to Lockout Tagout Procedure Guideline in this section.

LOCKOUT TAGOUT before making repairs, adjustments, or removing obstructions unless otherwise noted.

Only trained and qualified personnel should perform maintenance or repairs.

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

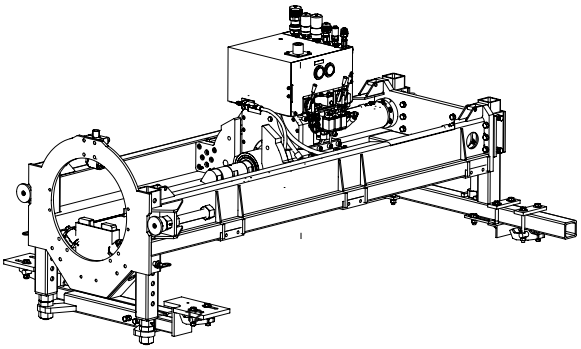
Do not service the machine while it is in motion.

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

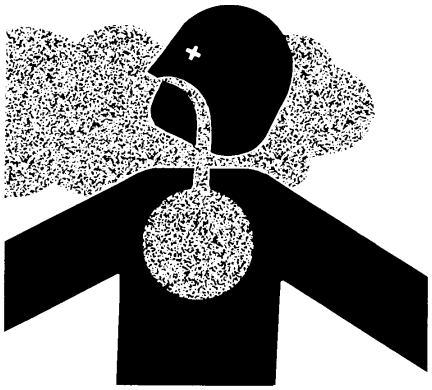
REGULARLY CLEAN AND INSPECT EQUIPMENT

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

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



TEST SHAFT & TUNNEL VENTILATION



⚠WARNING Keep shafts and tunnel 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.

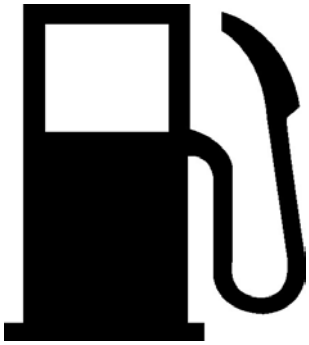


Once ALL personnel are out of tunnel/shaft, cut power from power source.

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

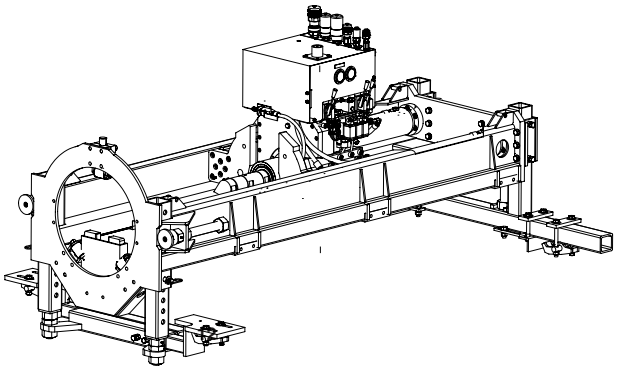


⚠CAUTION Fires can cause injury or property damage.

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 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 Tagout power before servicing. Refer to Lockout Tagout Procedure Guideline in this section.

BE CAREFUL OF 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.

SLIPPERY WHEN WET



⚠WARNING Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

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

Remove any buildup of grease, oil, or debris.

KEEP JOB SITE CLEAN AND ORGANIZED



⚠WARNING Tripping can cause serious personal injury.

Be sure to keep job site clean and organized.

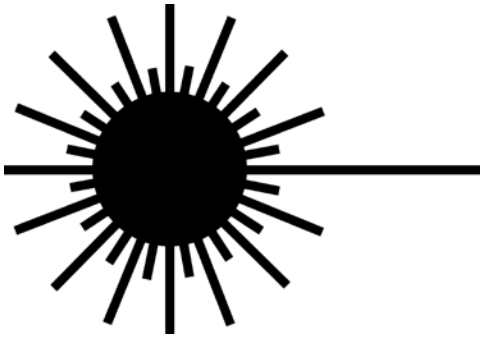
NO SMOKING IN TUNNEL



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

Do not smoke in tunnel.

AVOID LASER LIGHT EXPOSURE

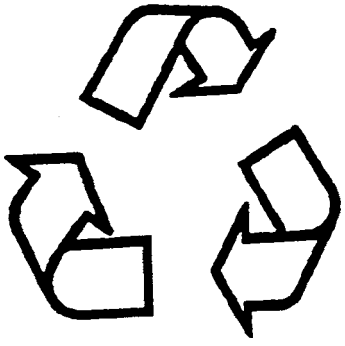


⚠DANGER Staring into laser light will cause severe injury.

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

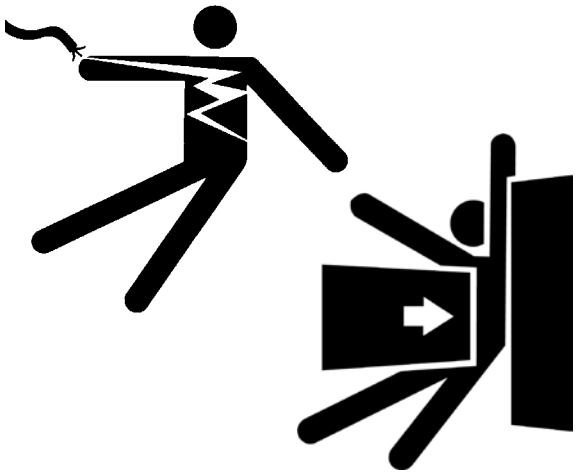


Follow all applicable environmental and safety regulations when recycling or disposing of waste materials, including fluids/oil, fuel, filters, coolant, and batteries.

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

LOCKOUT TAGOUT PROCEDURE GUIDELINE

Lock out and tag out all power sources before performing repairs, service, adjustments, or daily shutdown. Proper isolation and Lockout Tagout (LOTO) procedures prevent accidents and save lives. Equipment must be locked out and tagged out whenever unexpected start-up or the release of stored energy could injure personnel during cleaning, adjustment, repair, or servicing.



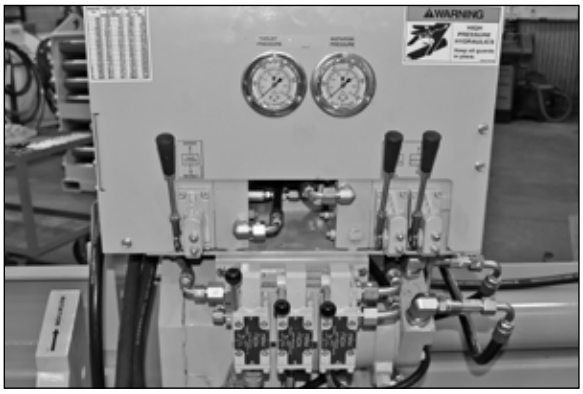
⚠DANGER Failure to lock out tag out power before repairs, service or adjustments WILL cause severe personal injury or death.

Lock out tag out power before repairs, service or adjustments. Electrical repairs must be performed only by a certified electrician.

The contractor is fully responsible for the safety of all personnel on the job site. Use the following as a guideline for a LOTO procedure. The contractor must determine the best LOTO practices for personnel on the job site.

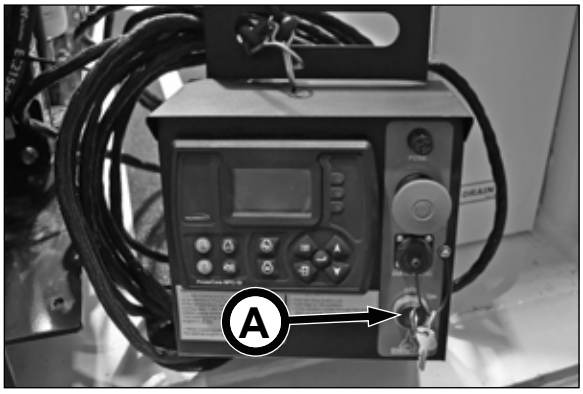
1. Follow all Federal, State and Local safety regulations and procedures.
2. Be sure OSHA or compliant safety personal protective equipment is being worn by all personnel.
3. Be sure the area is safe for operation. Keep work site clean and organized.

4. Place all controls on jacking frame and power pack in OFF or neutral position.



(continued on next page)

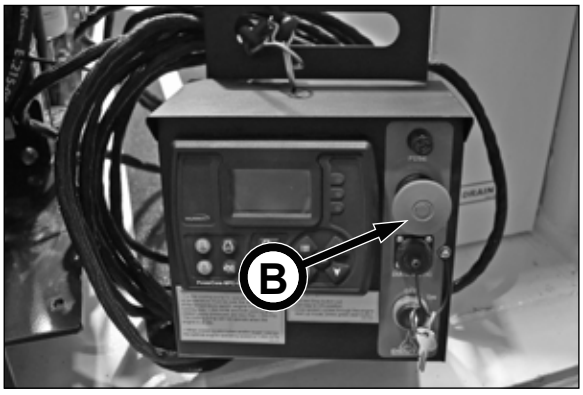
5. Turn ignition key (A) to the OFF position and remove key from ignition switch to avoid accidental startup.



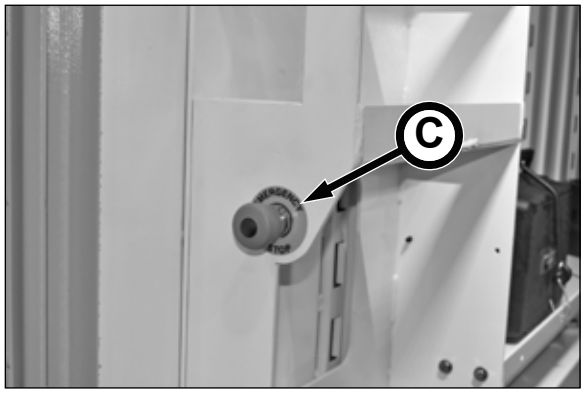
P4075D Power Pack Control Console

6. Press IN all Emergency Stop (E-Stop) buttons.

P4075D Power Pack Control Console E-Stop (B)

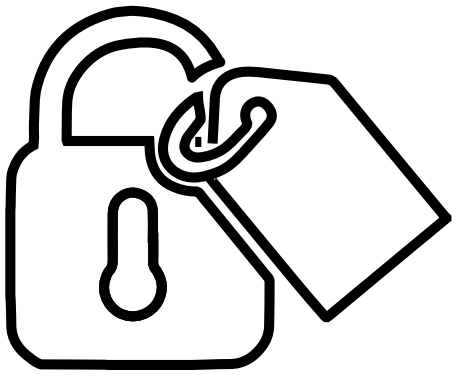


P4075D Power Pack E-Stop (C), located on tooling rack inside container



7. There are two options for lockout tagout, depending upon if the equipment will be serviced or shutdown for the day.

IMPORTANT: The contractor must determine the best lockout tagout practices for their employees on the job site.



- Lockout Tagout the Battery Disconnect Switch by following step 8 for details.
- Lockout Tagout the Power Pack Container by following step 9 for details.

8. ***Lockout Tagout the Battery Disconnect Switch Option - P4075D***

   Turn the battery disconnect switch (A) to the OFF position.

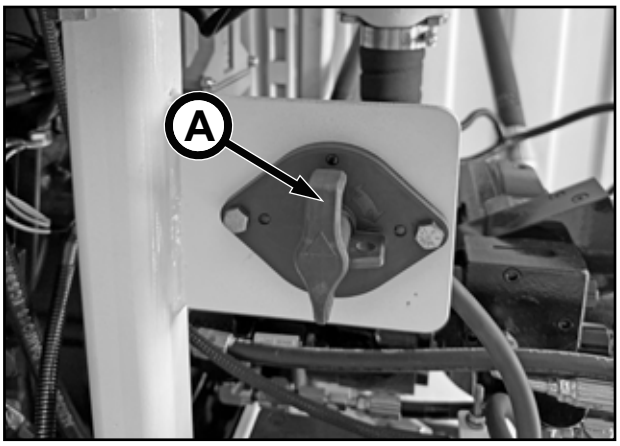
   Install shackle of OSHA approved lock (B) with tag (C) through latch.

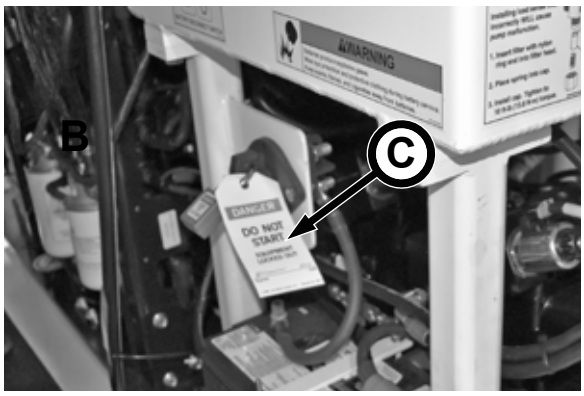
   Secure lock by pushing shackle into body of the lock until the shackle is locked into the locking mechanism. Turn key to lock shackle in place.

   Remove key from lock.

   Test to be sure shackle is fully secured into lock.

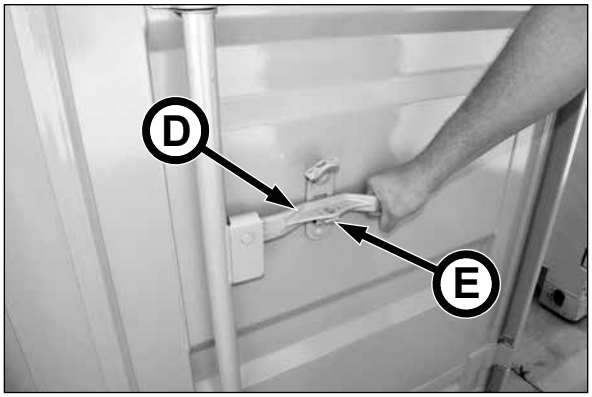
   Sign “Equipment Locked Out” tag or equivalent.

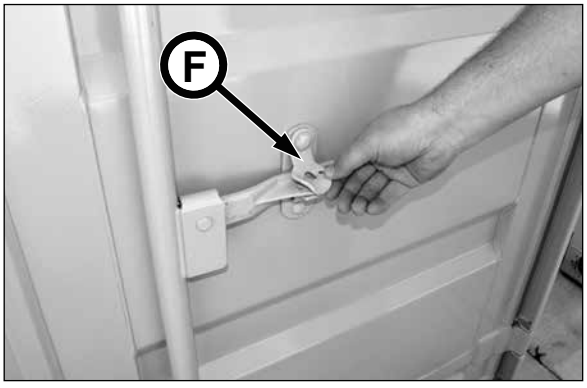




9. ***Lockout Tagout the Power Pack Container***

   Close power pack container doors. Secure door handle (D) into locking keeper (E) with handle retainer (F).





(continued on next page)

9. ***Lockout Tagout the Power Pack Container (continued)***

Install shackle of OSHA approved lock with tag through container, locking keeper and handle retainer.



Secure lock by pushing shackle into body of the lock until the shackle is locked into the locking mechanism.

Test to be sure shackle is fully secured into lock.



Remove key from lock.



Sign “Equipment Locked Out” tag or equivalent. Repeat all step 9 procedures for doors on opposite end of the power pack container.



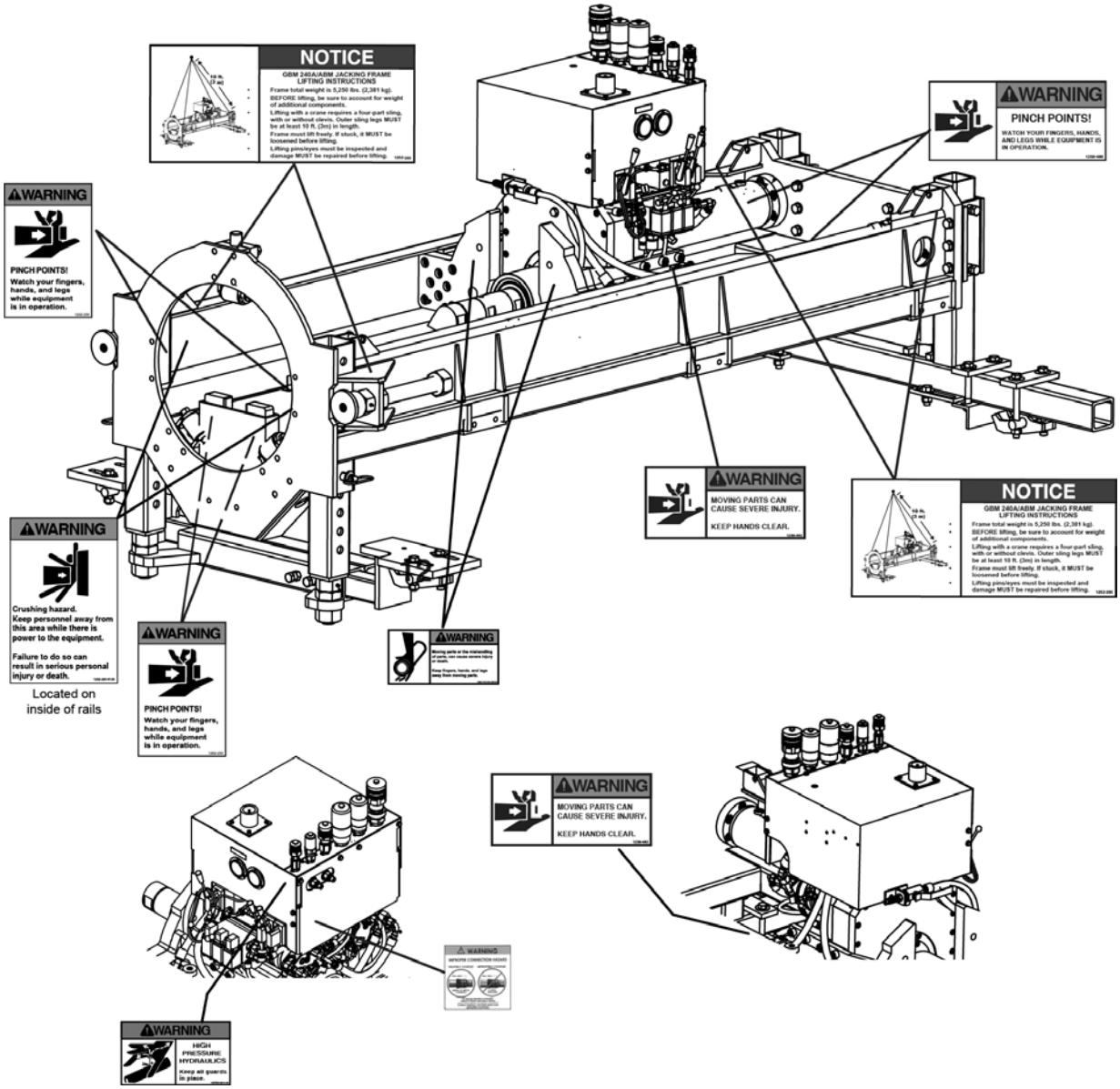
Safety Decals

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

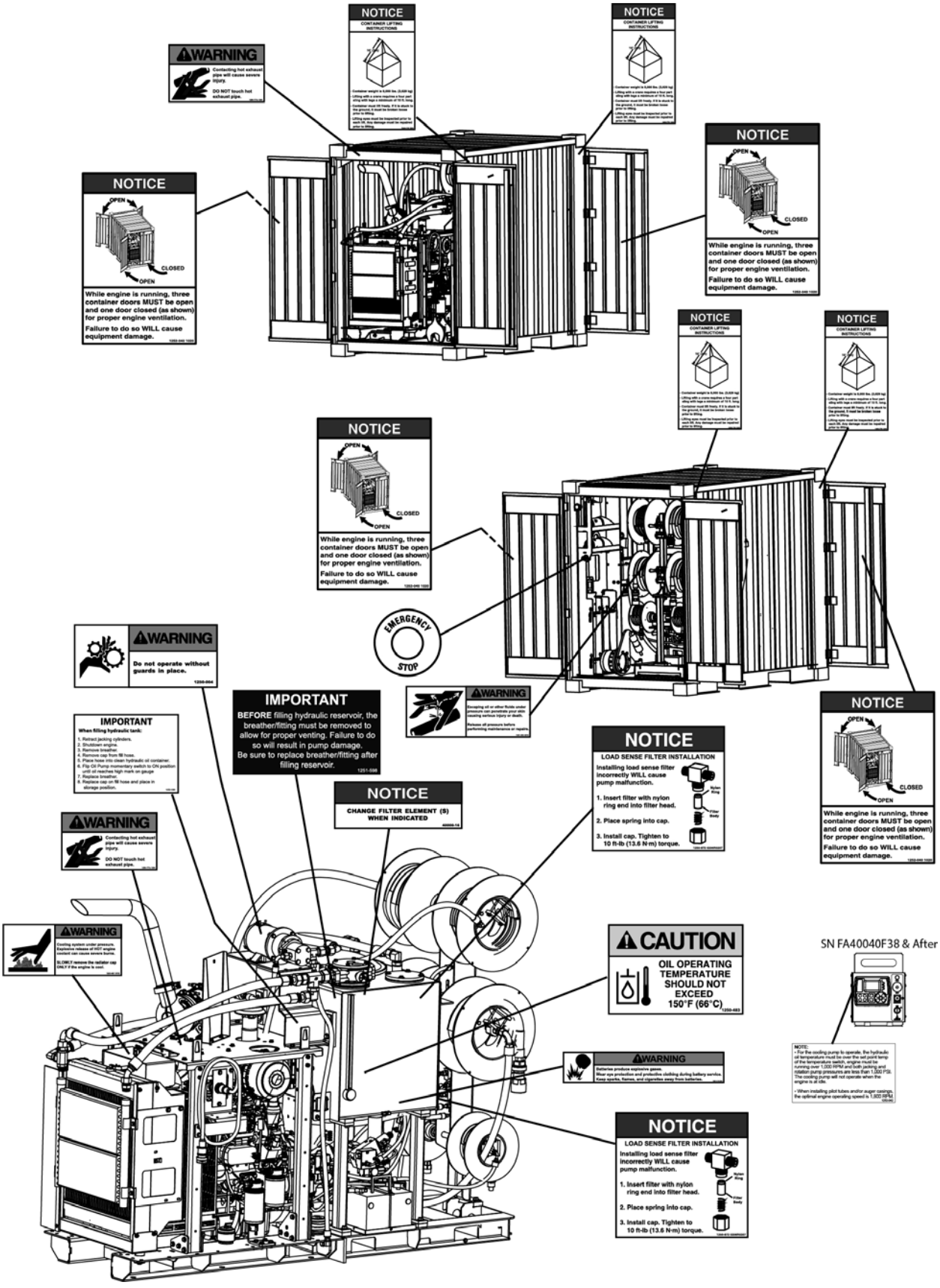
Serious injury or property damage can occur if safety instructions are not followed. Contact your Akkerman Aftermarket Support representative for free replacement safety decals.

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

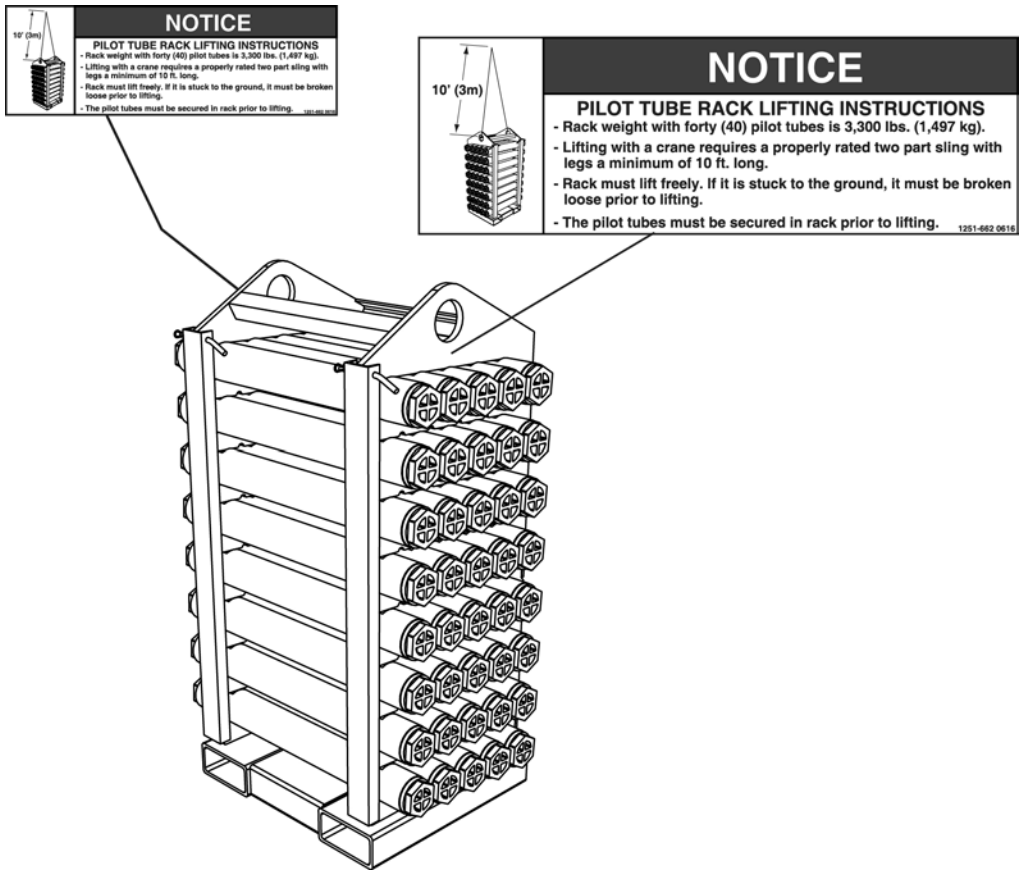
GBM - SINGLE STAGE FRAME 240A/240ABM



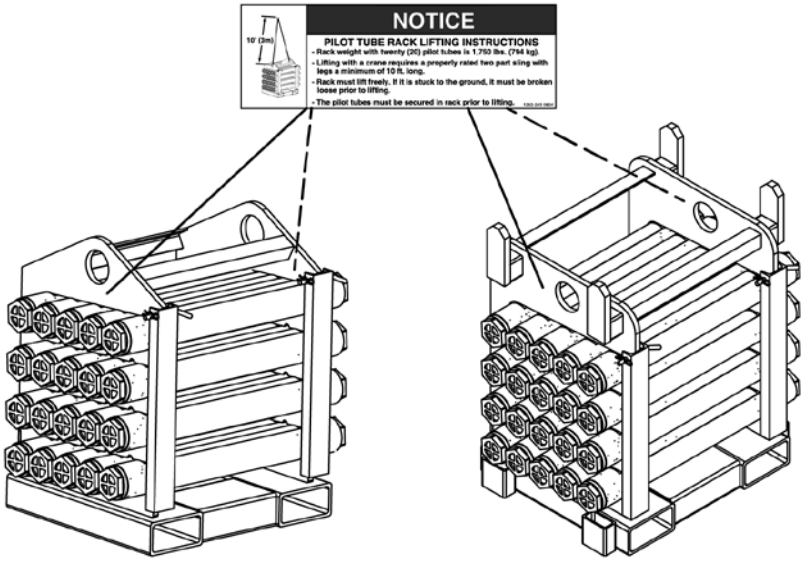
POWER PACK P4075D



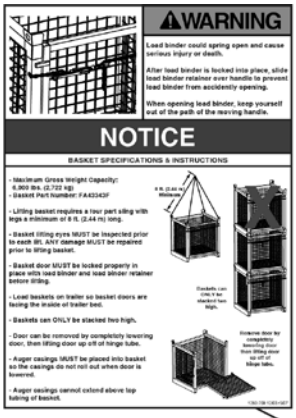
PILOT TUBE HORIZONTAL RACK - 100 FT



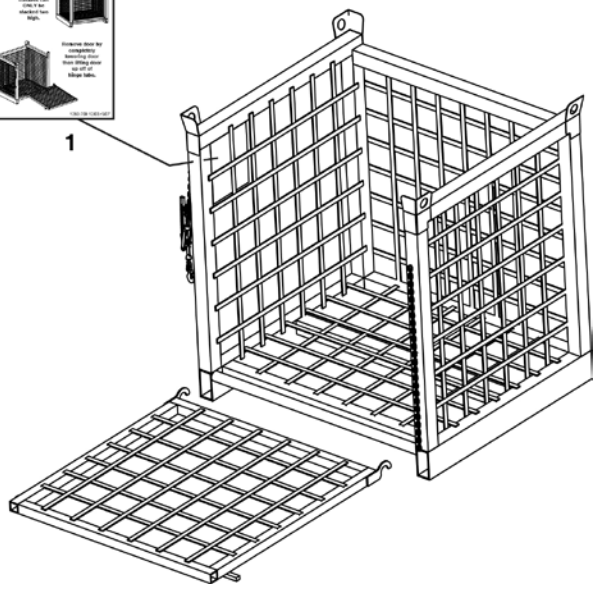
PILOT TUBE HORIZONTAL RACK - 50 FT

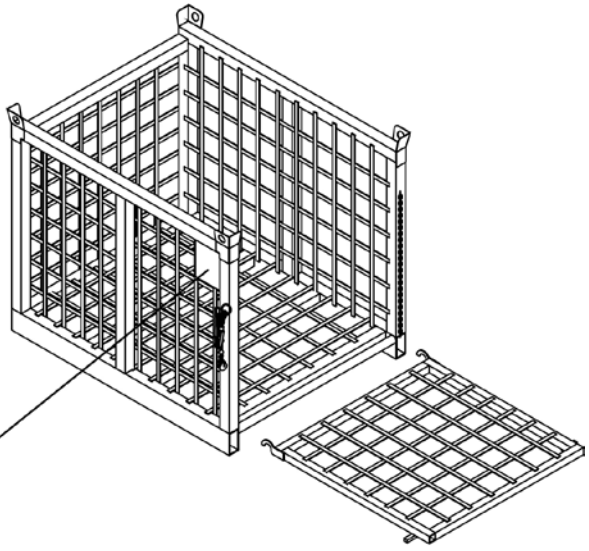


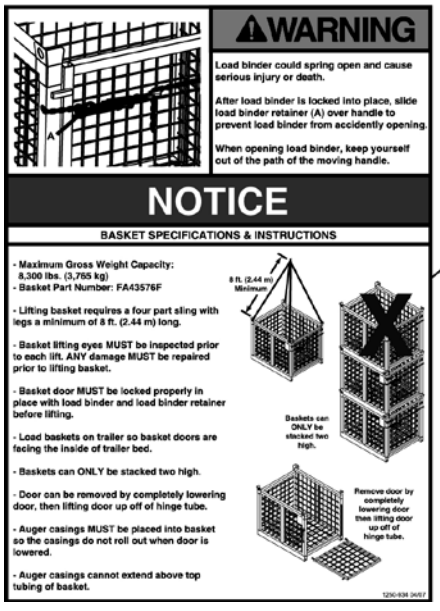
THRUST CASING WIRE BASKETS



1

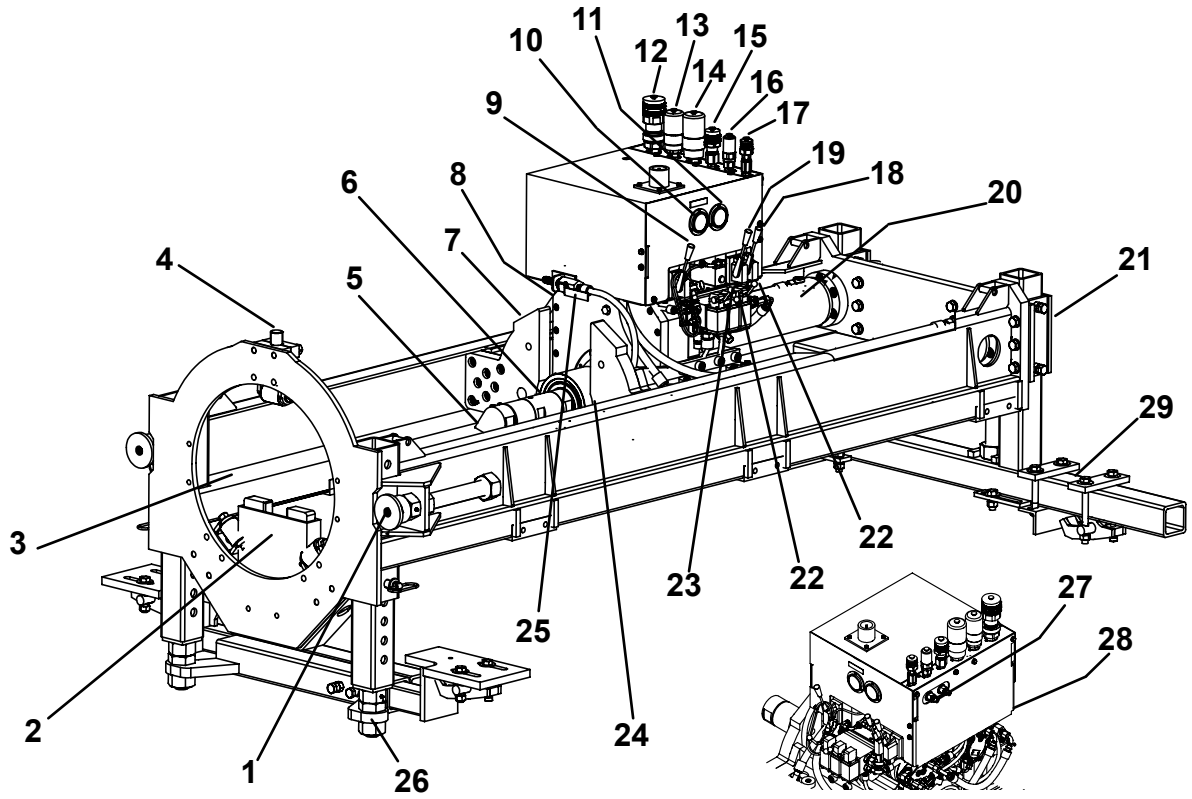






Terminology

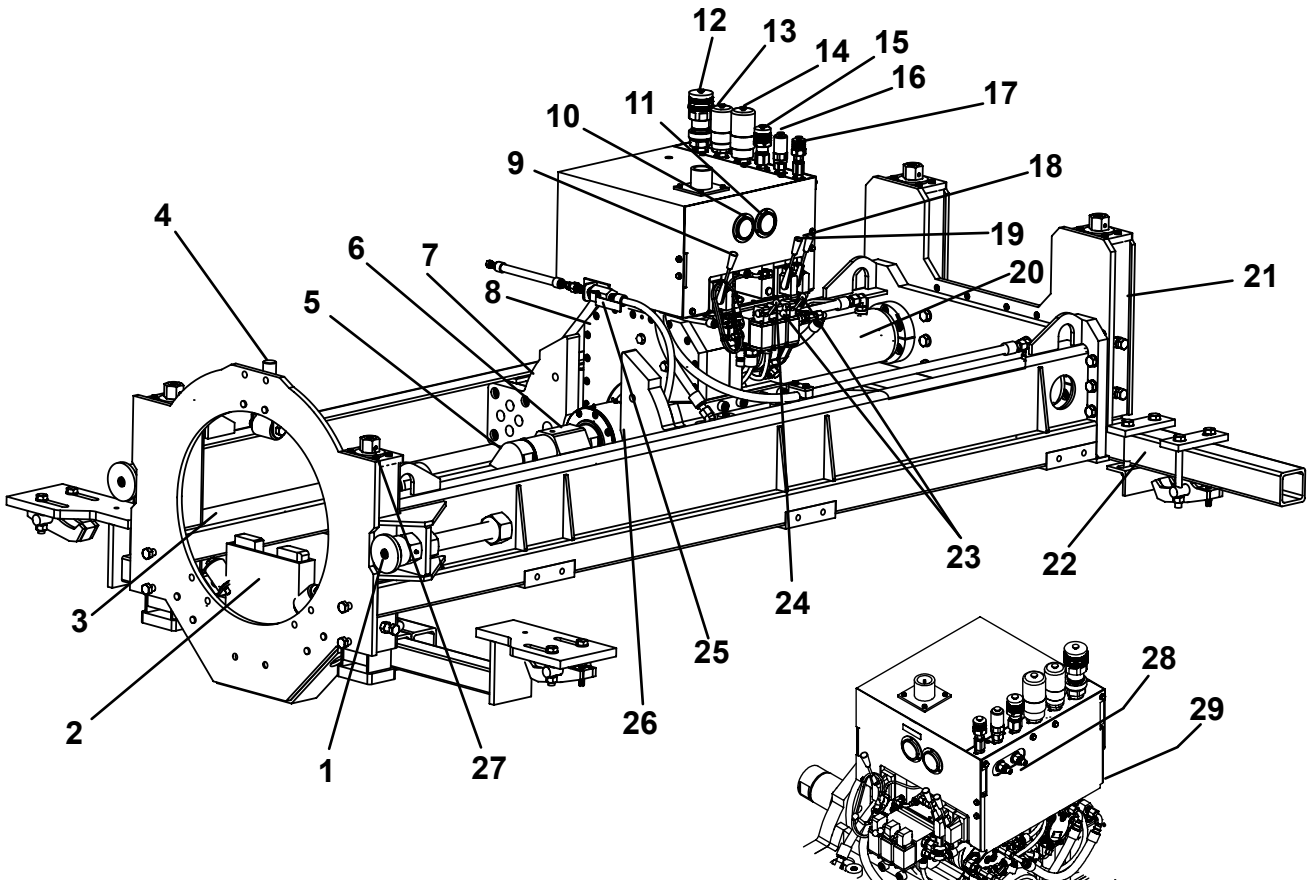
GBM SINGLE STAGE FRAME 240A - SN FA40027F162 & AFTER



1. Shaft Tensioner
2. Hydraulic Make Up Tool
3. Drilling Guide
4. Roller Bracket Assembly
5. Alignment Guide Adapter
6. Drive Swivel
7. Thrust Plate
8. Thrust Frame Assembly (includes Gearbox)
9. Thrust Cylinder Control
10. Thrust Pressure Gauge
11. Rotation Pressure Gauge
12. Return Line Connector
13. Thrust Pressure Connector
14. Rotation Pressure Connector
15. Case Drain Connector
16. Thrust Load Sense Connector
17. Rotation Load Sense Connector
18. Auxiliary Control
19. Drive Rotation Control
20. Thrust Cylinders
21. Drilling Frame
22. Drive Speed Selectors
23. Make Up Tool Control
24. Lube Dump Control
25. Fluid/Lube Control
26. Stabilizer Leg
27. GBM Pressure Controls
28. Data Logging Cable
29. Universal Auger Adapter

240A Jacking Frame with Universal Auger Boring Rig Adapter is standard. An optional lower base frame assembly for standalone GBM jacking frame applications is available.

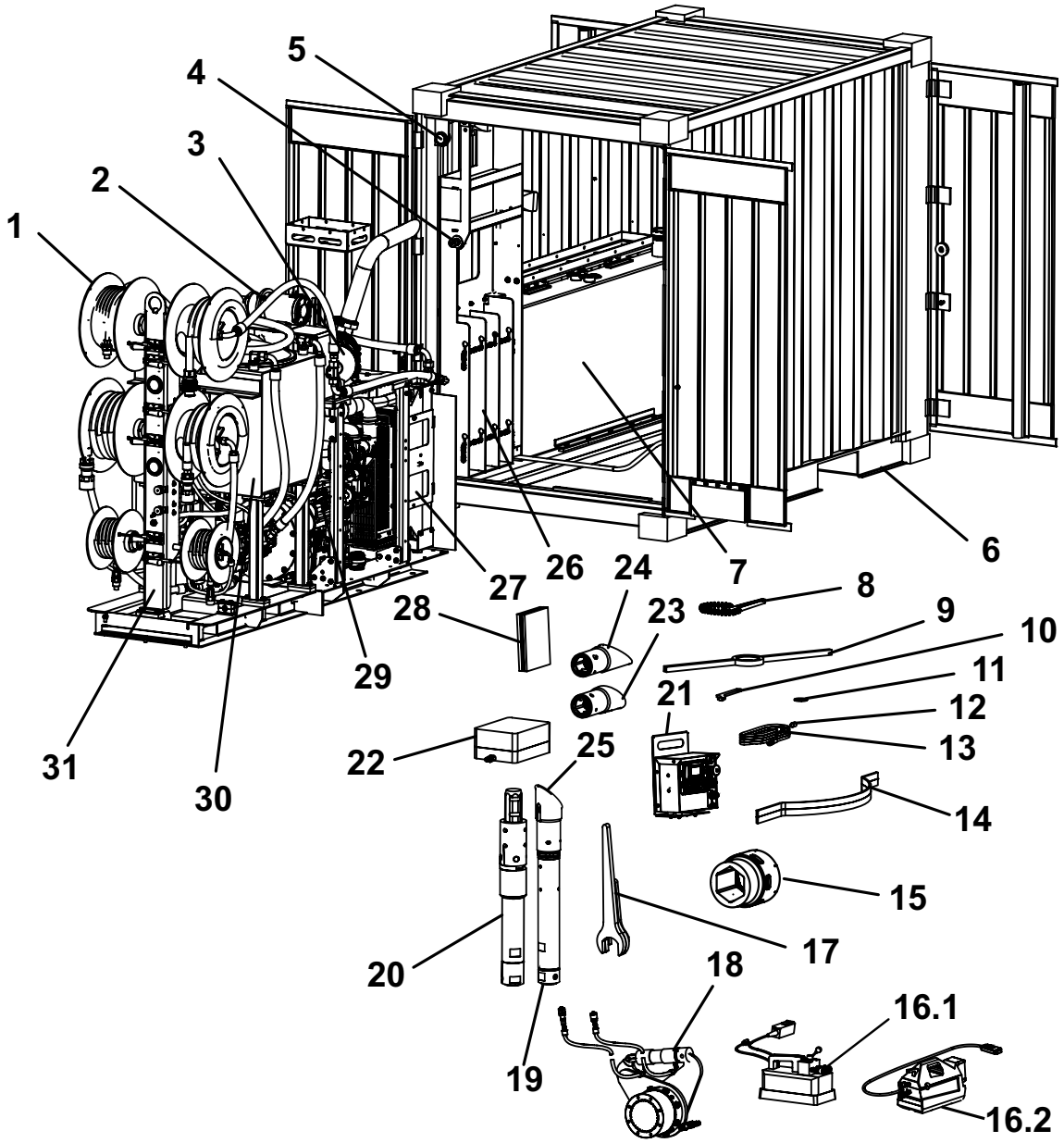
GBM SINGLE STAGE FRAME 240ABM - SN FA62563F



1. Shaft Tensioner
2. Hydraulic Make Up Tool
3. Drilling Guide
4. Roller Bracket Assembly
5. Alignment Guide Adapter
6. Drive Swivel
7. Thrust Plate
8. Thrust Frame Assembly (includes Gearbox)
9. Thrust Cylinder Control
10. Thrust Pressure Gauge
11. Rotation Pressure Gauge
12. Return Line Connector
13. Thrust Pressure Connector
14. Rotation Pressure Connector
15. Case Drain Connector
16. Thrust Load Sense Connector
17. Rotation Load Sense Connector
18. Auxiliary Control
19. Drive Rotation Control
20. Thrust Cylinders
21. Drilling Frame
22. Universal Auger Adapter
23. Drive Speed Selectors
24. Make Up Tool
25. Fluid/Lube Control
26. Lube Dump Control
27. Leveling Assembly
28. GBM Pressure Controls
29. Data Logging Cable

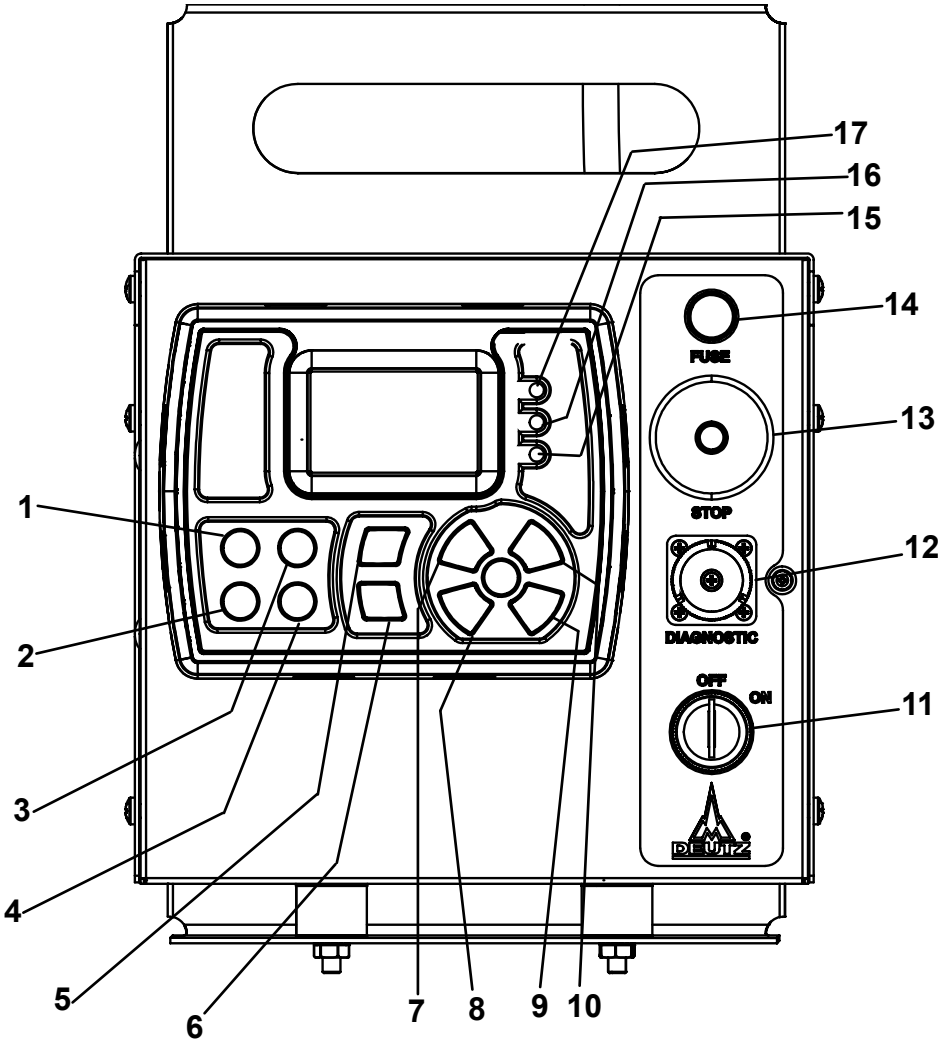
* 240ABM Jacking Frame with Universal Auger Boring Rig Adapter is standard. An optional lower base frame assembly for standalone GBM jacking frame applications is available.

P4075D POWER PACK - SN FA40040F38 & AFTER



1. Hydraulic Hose Reels
2. Cooling Pump
3. Exhaust Catalytic Converter
4. Emergency Stop
5. Fuel Level Gauge
6. Container
7. Fuel Tank 50 Gal.
8. Chain Wrench
9. Pilot Tube Scraper
10. Spanner Wrench
11. Pilot Tube O-rings
12. Cable Extension Adapter
13. Cable, Guidance System
14. Pilot Tube Support Bars
15. Launch Shaft Breakout Tool
16.1 Breakout Tool Power Pack
16.2 Cordless, Rechargeable Breakout Tool Power Pack
17. Wrench Set
18. Dual Tube Breakout Tool
19. Steering Head Adapter
20. Pilot Tube Adapter
21. Control Pendant With Hanger
22. Nitrogen Purging Kit
23. Steering Head - 30 Degree
24. Steering Head - 45 Degree
25. Steering Head - 5.5 Degree
26. Tooling Storage
27. Radiator & Oil Cooler
28. Manual
29. Diesel Engine, 74 HP Tier IV
30. Hydraulic Reservoir 50 Gal.
31. Hose Reel Tower

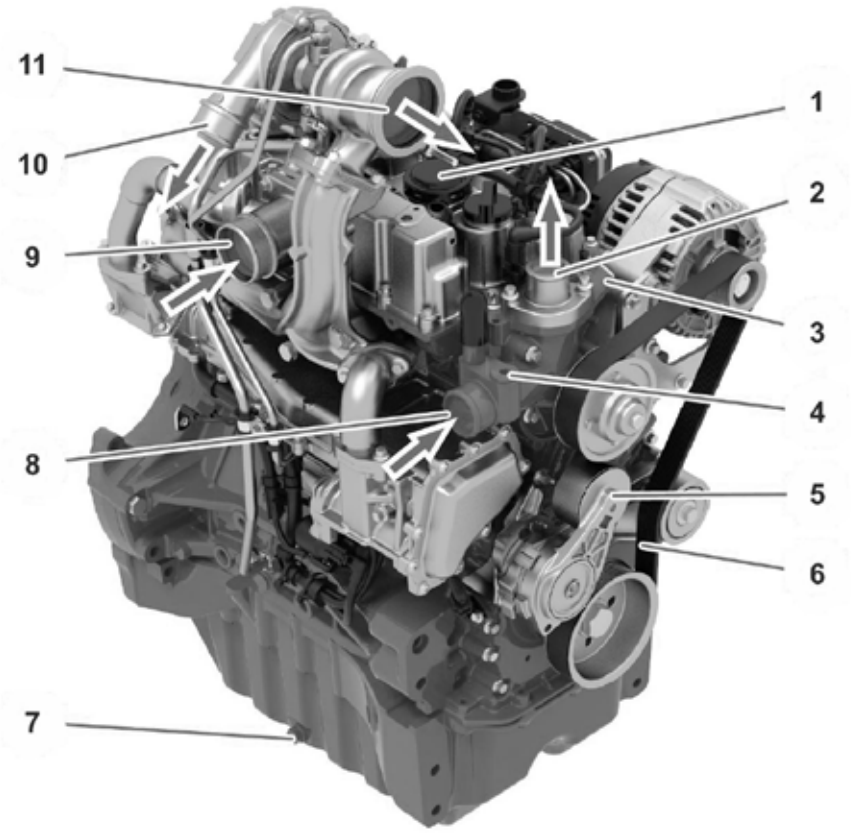
P4075D CONTROL PENDANT - SN FA40040F38 & AFTER



1. Start Key
2. Stop Key
3. Auto/Manual Key
4. Alarm Silence Key
5. Manual Throttle Increase Key
6. Manual Throttle Decrease Key
7. Menu Key
8. Up Key
9. Down Key
10. Back Key
11. Key Ignition, On/Off Switch
12. Diagnostic Port
13. Emergency Stop (E-Stop)
14. Fuse Button
15. Auto Mode/Running Loaded (Green) LED Light
16. Warning State (Yellow) LED Light
17. Shutdown State (Red) LED Light

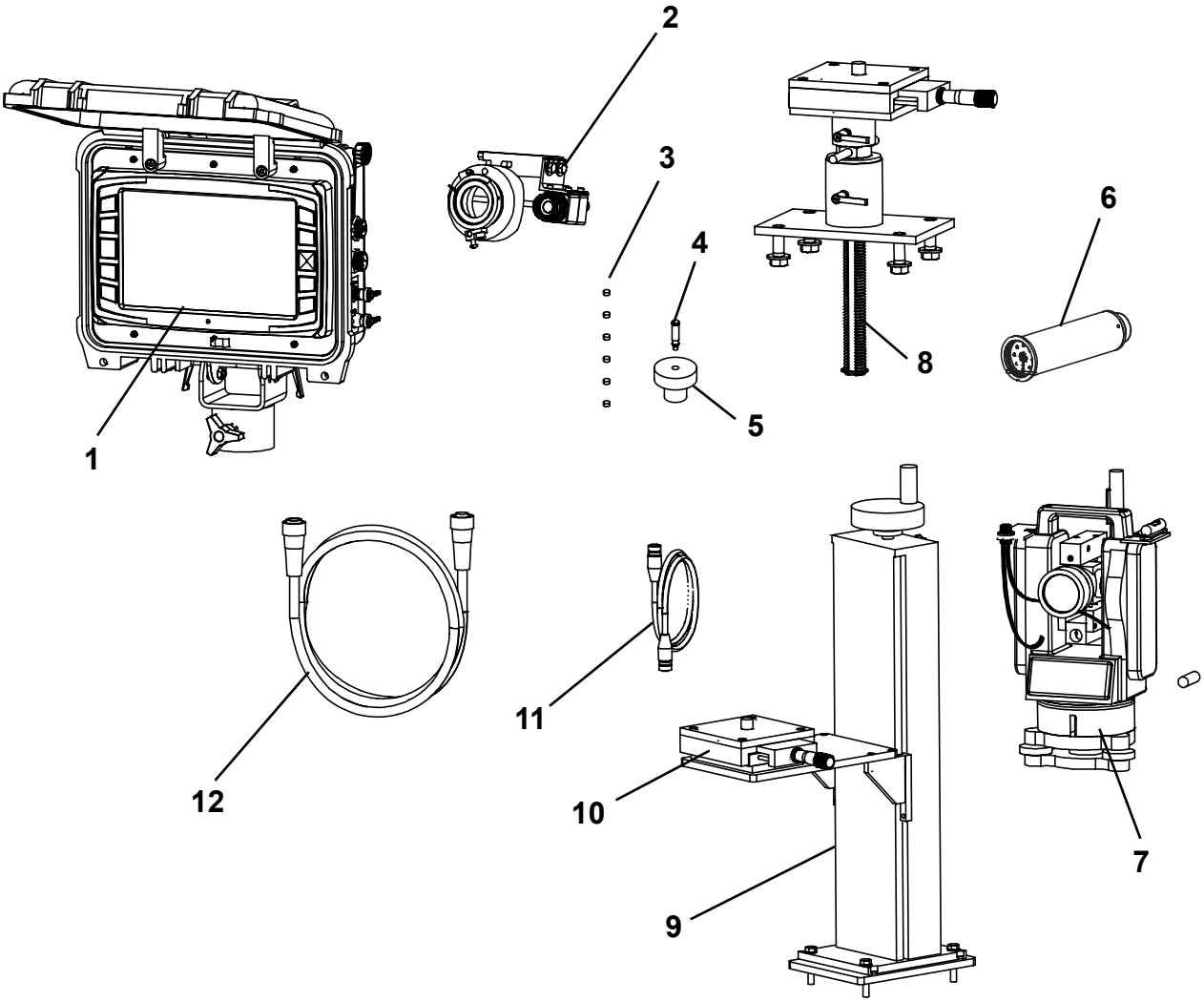
P4075D POWER PACK ENGINE

NOTICE Refer to your Deutz engine operating manual for more information.



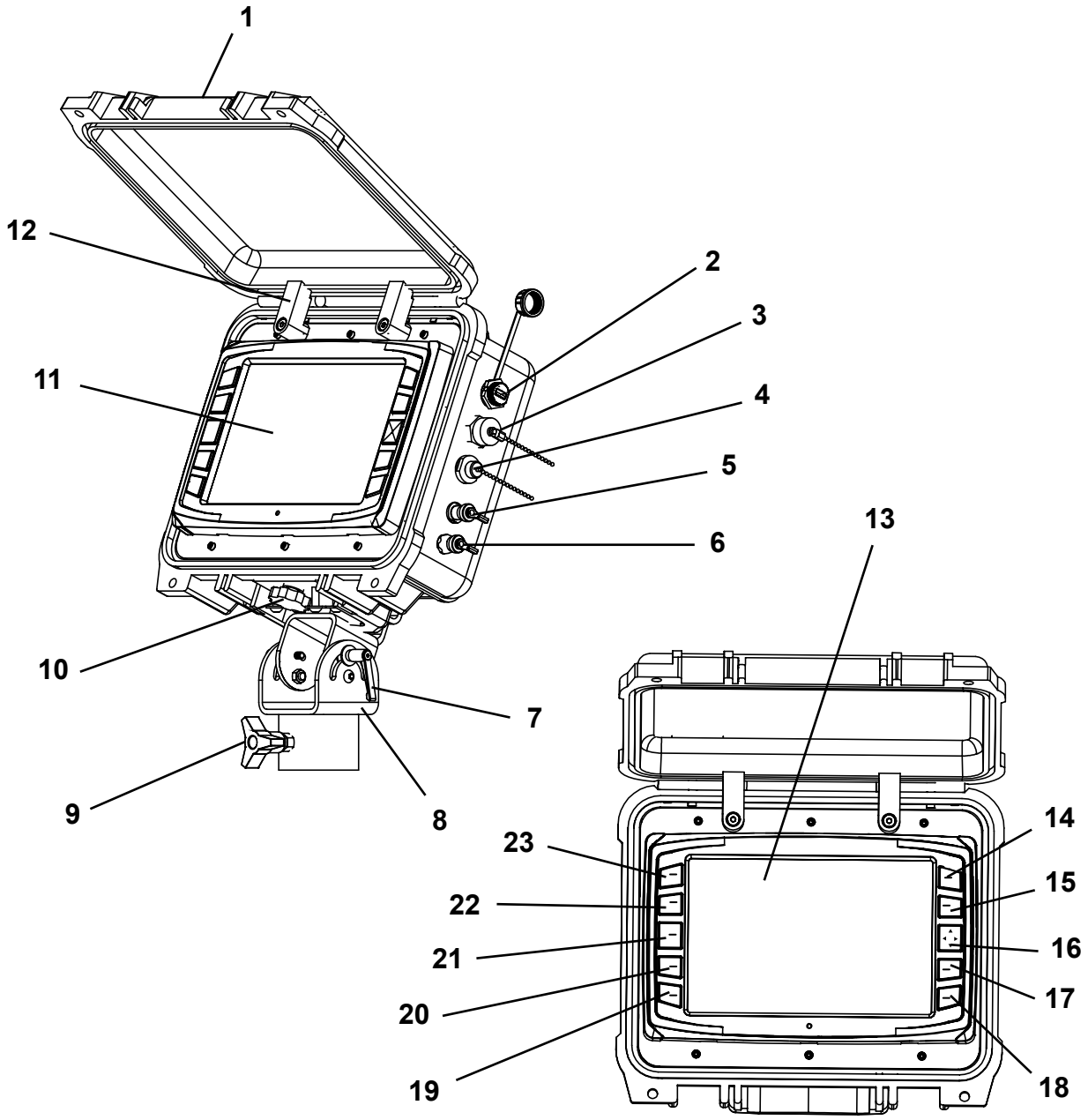
1. Crankcase
2. Coolant Outlet
3. Coolant Suppy Flow to Cab Heating
4. Coolant Return Flow From Cab Heating
5. Tension Pulley
6. V-Rib Belt
7. Lubricating Oil Drain Plug
8. Coolant Inlet
9. Charge Air Inlet
10. Charge Air Outlet
11. Exhaust Outlet

GUIDANCE SYSTEM (GEN V)



1. Monitor Assembly With Docking Station
2. Camera Optics
3. Laser Bore Sight Batteries
4. Laser Bore Sight
5. Alignment Holder
6. Target
7. Theodolite
8. Elevator Column (Earlier Version)
9. Elevator Column (Later Version)
10. Lateral slide
11. LED/Focus Cable
12. Guidance Power Cable

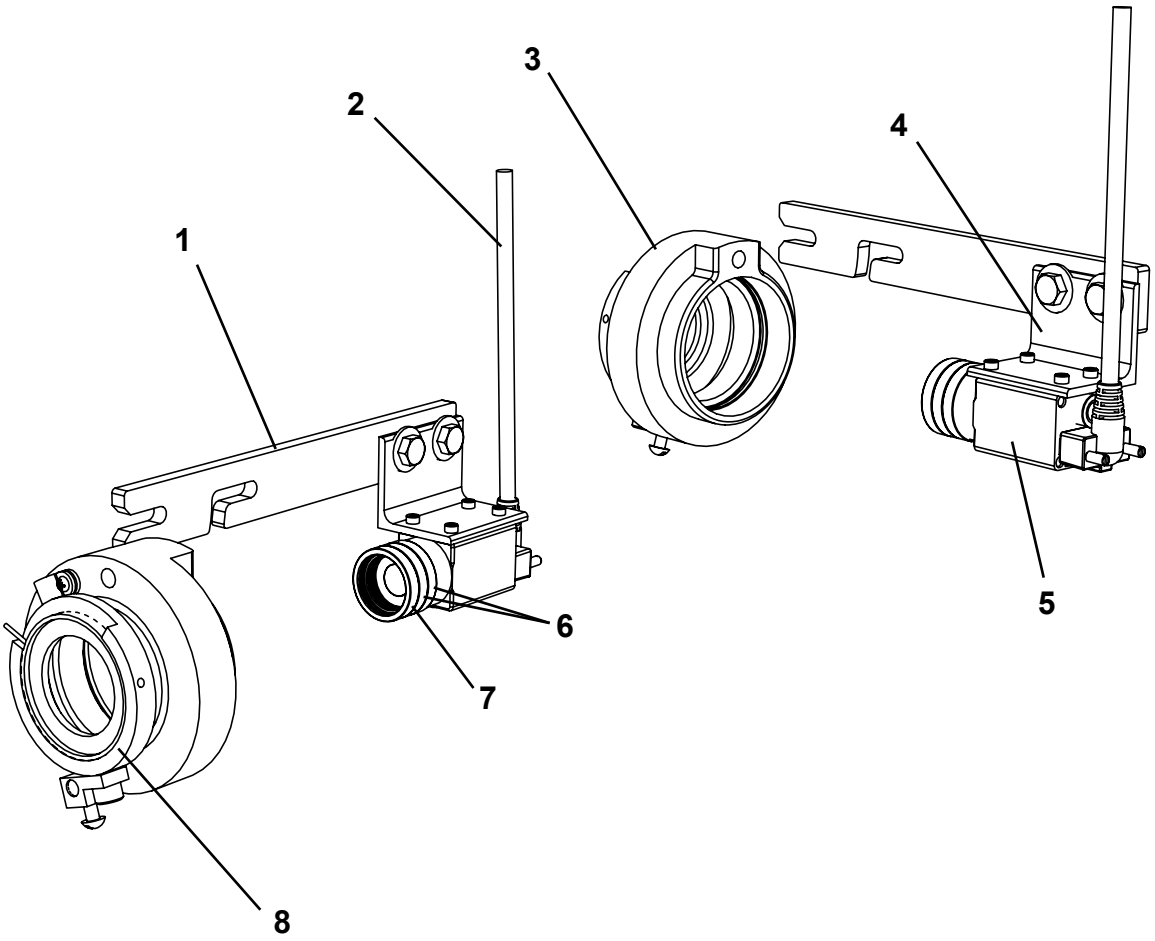
GUIDANCE SYSTEM MONITOR ASSEMBLY (GEN V)



1. Case/Sun Visor
2. USB Port/Data Log Flash Drive
3. Power IN Cable Connection
4. Data Log Connection*
5. LED/Focus Cable Connection
6. Camera Cable Connection
7. Monitor Tilt Adjustment
8. Monitor Mount
9. Monitor Mount Knob
10. Case Mount Knob
11. Monitor Display
12. Lid Support
13. GBM System Window
14. Gain Button
15. Exposure Button
16. Focus Button/4-Way Directional Selector/ Power ON Button (Up Arrow)
17. Pan Button
18. Zoom Button
19. Pilot Tube Counter
20. LED Brightness Button
21. Wide Mode Button
22. Reset Zoom Button
23. Shut Down Button

* Equipped with monitors SN 49400A-28 & After.

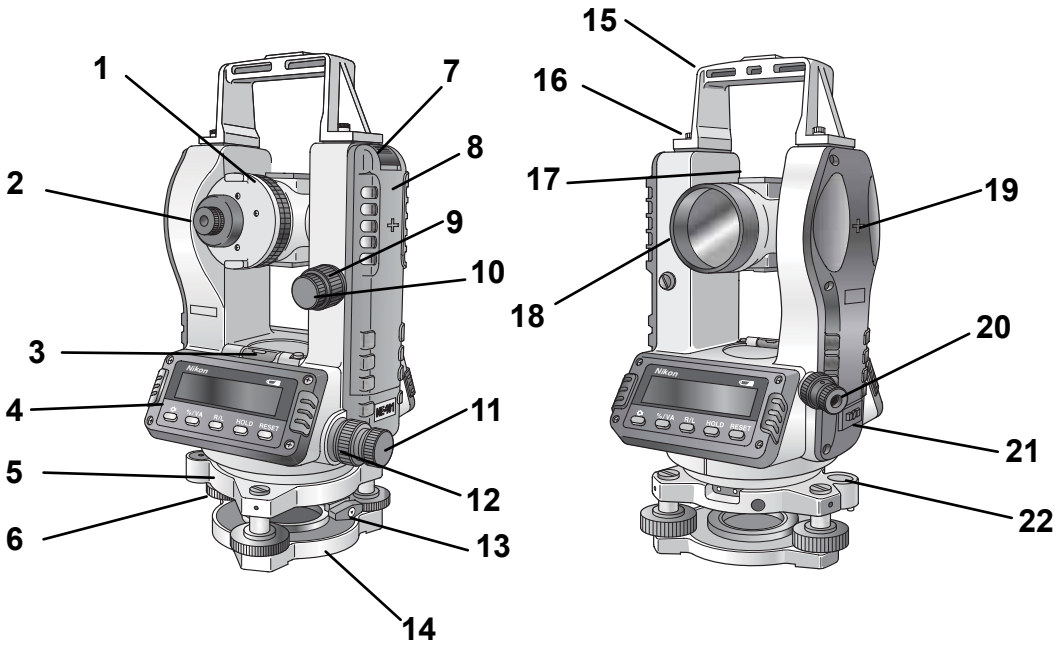
CAMERA OPTICS



1. Camera Arm Mount
2. LED Focus Cable
3. Counterweight
4. Camera Angle Bracket
5. Camera
6. Lens Mount/Lens
7. Tube Extension
8. Iris Mount

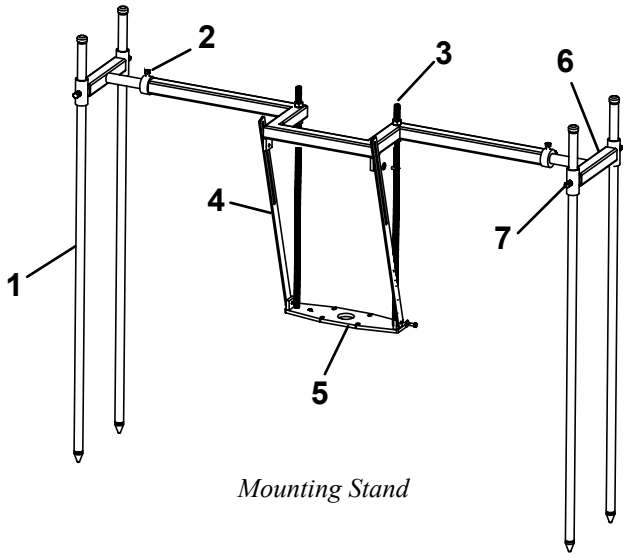
THEODOLITE

NOTICE For more information, refer to your theodolite manual. Earlier units may be a different configuration than the one shown below.

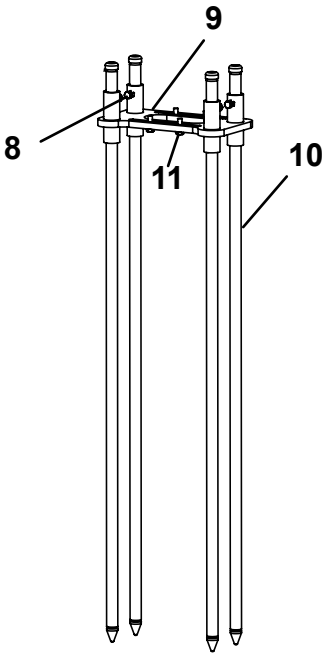


1. Focusing Ring
2. Eyepieces
3. Plate Level
4. Display
5. Leveling Base
6. Leveling Knobs
7. Battery Button
8. Battery Pack
9. Vertical Coarse Adjust Lock Knob
10. Vertical Fine Adjust Knob
11. Horizontal Fine Adjust Knob
12. Horizontal Coarse Adjust Lock Knob
13. Leveling Base Clamp
14. Base Plate
15. Carrying Handle
16. Carrying Handle Clamp Screw
17. Optical Sight
18. Objective
19. Horizontal Axis Indication Mark
20. Optical Plummet
21. Power Button
22. Circular Level

THEODOLITE STANDS



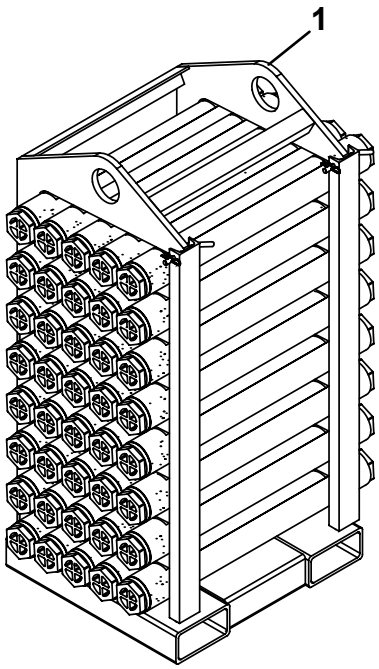
Mounting Stand



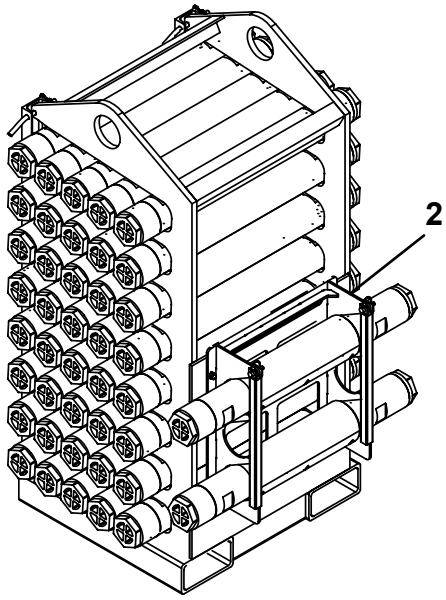
Mounting Base

1. Rods
2. Center Stand Set Screw
3. Elevation Adjustment Rod
4. Theodolite Pad Stiffener
5. Theodolite Pad
6. Stand Frame
7. Frame Set Screw
8. Mounting Plate Bolts
9. Mounting Base
10. Rods
11. Base Set Screws

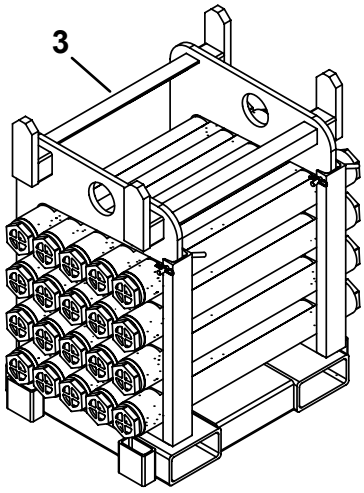
PILOT TUBES & RACKS

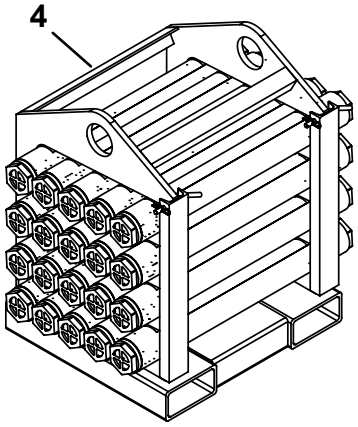


Front View



Back View with
Spinner Tubes/Pilot Tube Expansion Sleeves and Rack

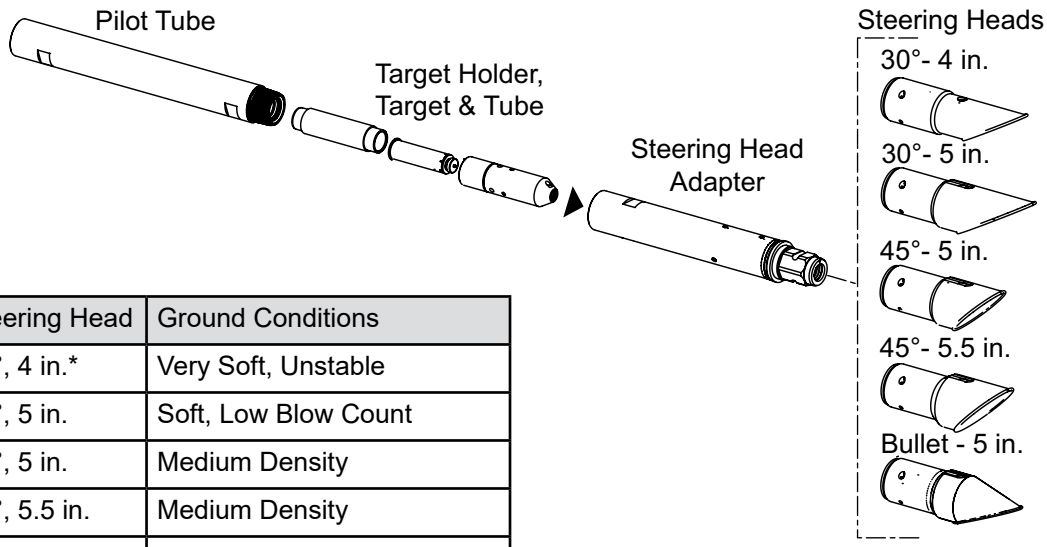




1. 100 ft. Pilot Tube Rack
2. Spinner Tube/Pilot Tube Expansion Sleeve Rack
3. 50 ft. Stackable Pilot Tube Rack
4. 50 ft. Pilot Tube Rack

GBM TOOLING - PILOT TUBE INSTALLATION TOOLS

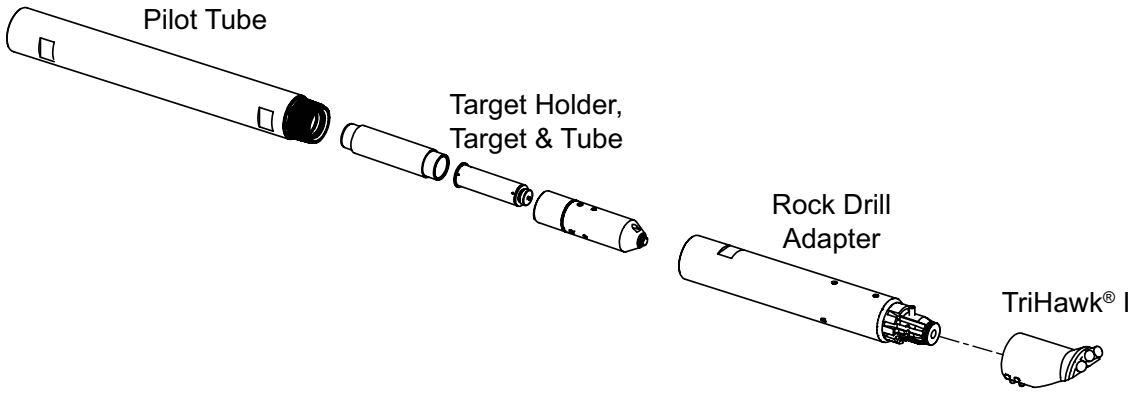
1a. Standard Pilot Tube Installation



Steering Head	Ground Conditions
30°, 4 in.*	Very Soft, Unstable
30°, 5 in.	Soft, Low Blow Count
45°, 5 in.	Medium Density
45°, 5.5 in.	Medium Density
Bullet, 5 in.*	Very Hard, High Blow Count

*Optional

1b. Pilot Tube Installation with TriHawk® and Rock Drill Adapter



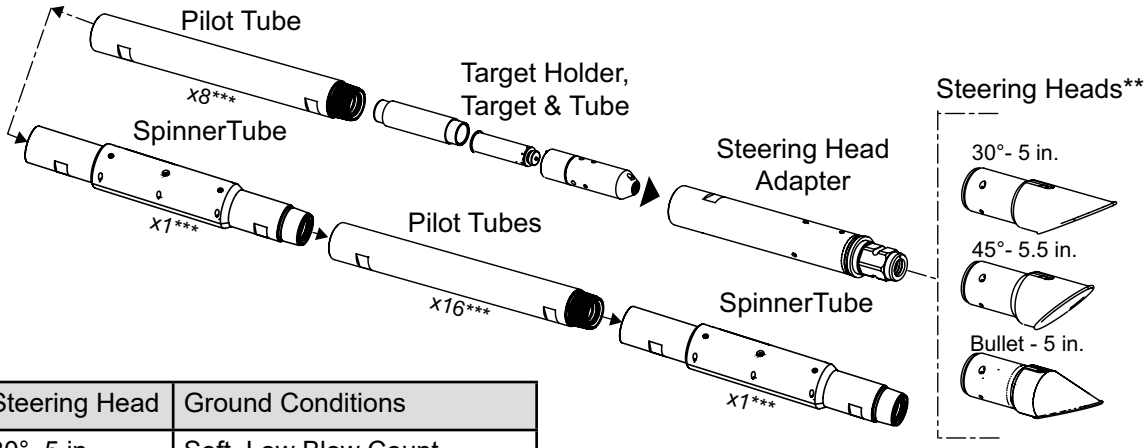
Drill Bit*	Ground Conditions
TriHawk® I	Compacted Soils, Cobble, Soft Rock up to 8,000 psi
TriHawk® III	Hard Soils, Soft to Medium Rock, up to 12,000 psi
TriHawk® IV	Glacial Till, Cobble, Fractured Rock
TriHawk® V	Cobble, Flat River Stone, Loose Fill, Hardpan

* Refer to Operator's Manual TriHawk® Tooling Installation manual, 050168A.

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

GBM Tooling - Pilot Tube Installation Tools (continued)

1c. Pilot Tube Installation Using Spinner Tubes/Pilot Tube Expansion Sleeves for Swelling Clay



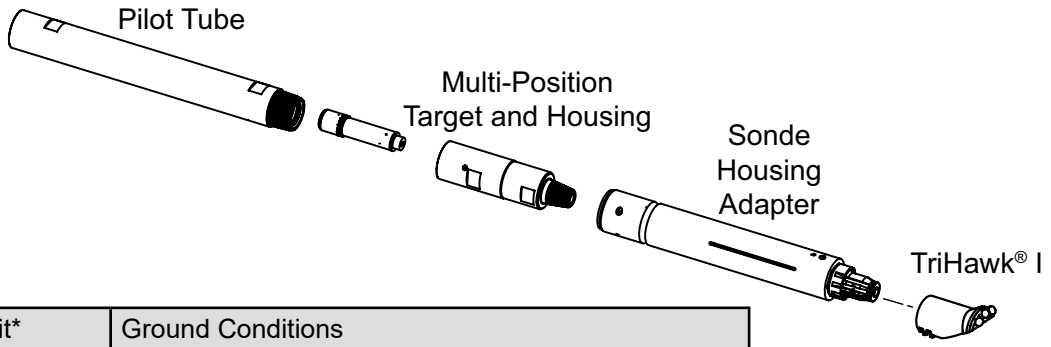
Steering Head	Ground Conditions
30°, 5 in.	Soft, Low Blow Count
45°, 5.5 in.	Medium Density
Bullet, 5 in.*	Very Hard, High Blow Count

*Optional

** Pilot Tube Expansion Sleeve must be used with 5 in. minimum steering head for maximum effectiveness.

*** Installation intervals of pilot tubes and expansion sleeves may vary based on ground conditions. Refer to Spinner Tubes/Pilot Tube Expansion Sleeves Instruction, 050179A.

1d. Pilot Tube Installation with TriHawk® to Sonde, Multi-Position Target & Housing



Drill Bit*	Ground Conditions
TriHawk® I	Compacted Soils, Cobble, Soft Rock up to 8,000 psi
TriHawk® III	Hard Soils, Soft to Medium Rock, up to 12,000 psi
TriHawk® IV	Glacial Till, Cobble, Fractured Rock
TriHawk® V	Cobble, Flat River Stone, Loose Fill, Hardpan

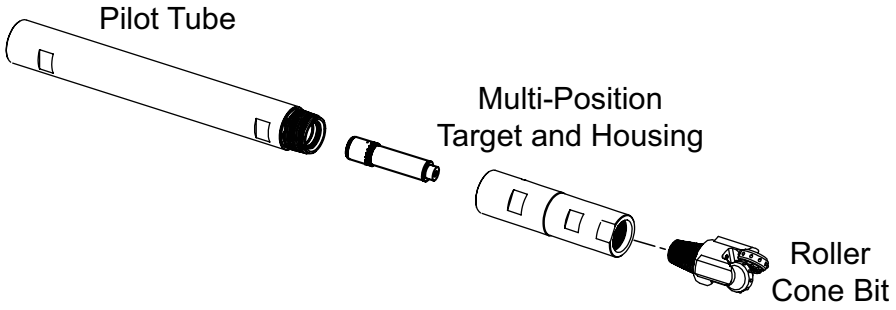
* For use with customer supplied Sonde/Beacon, max. length 15 in. Refer to Operator's Manual TriHawk® Tooling Installation manual, 050168A.

(continued on next page)

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

GBM Tooling - Pilot Tube Installation Tools (continued)

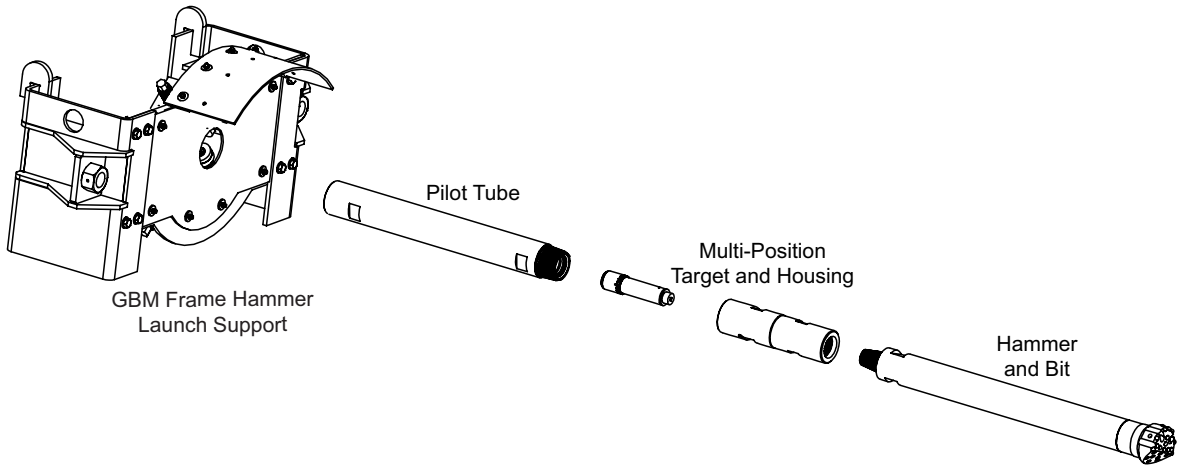
1e. Pilot Tube Installation with Roller Cone Bit, Multi-Position Target & Housing



Dual Roller Cone Bit*	Ground Conditions
Infinity®	Cobble, loose rock and gravel up to 30,000 psi

* Refer to roller cone bit manufacturer's manual for operation reference. Both 2 3/8 in. and 2 7/8 in. API roller cone and target housings are available. Contact Akkerman Aftermarket Support for more information.

1f. HD Pilot Tube Installation with Pneumatic Hammer, Multi-Position Target & Housing



Hammer*	Ground Conditions
Numa®	Rock up to 35,000 psi

* Refer to Operator's Manual Pneumatic Hammer Installation manual, 050159A and pneumatic hammer manufacturer's manual.

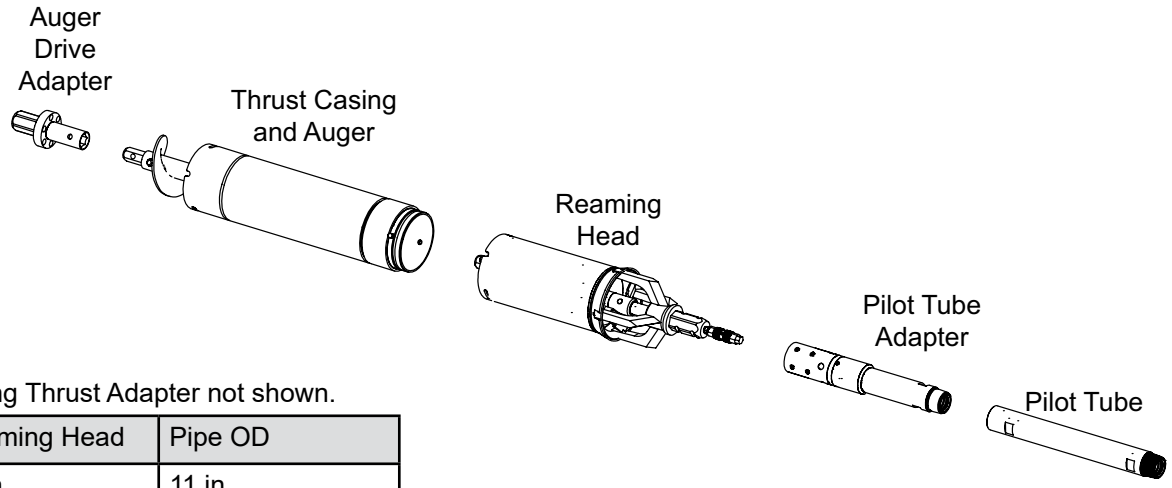
Akkerman Inc. reserves the right to improve its product without notice or obligation.

NOTES

GBM TOOLING - UPSIZING TOOLS

GBM Tooling - Temporary Casing and Augers

1a. Reaming Head Thrust Casing Installation

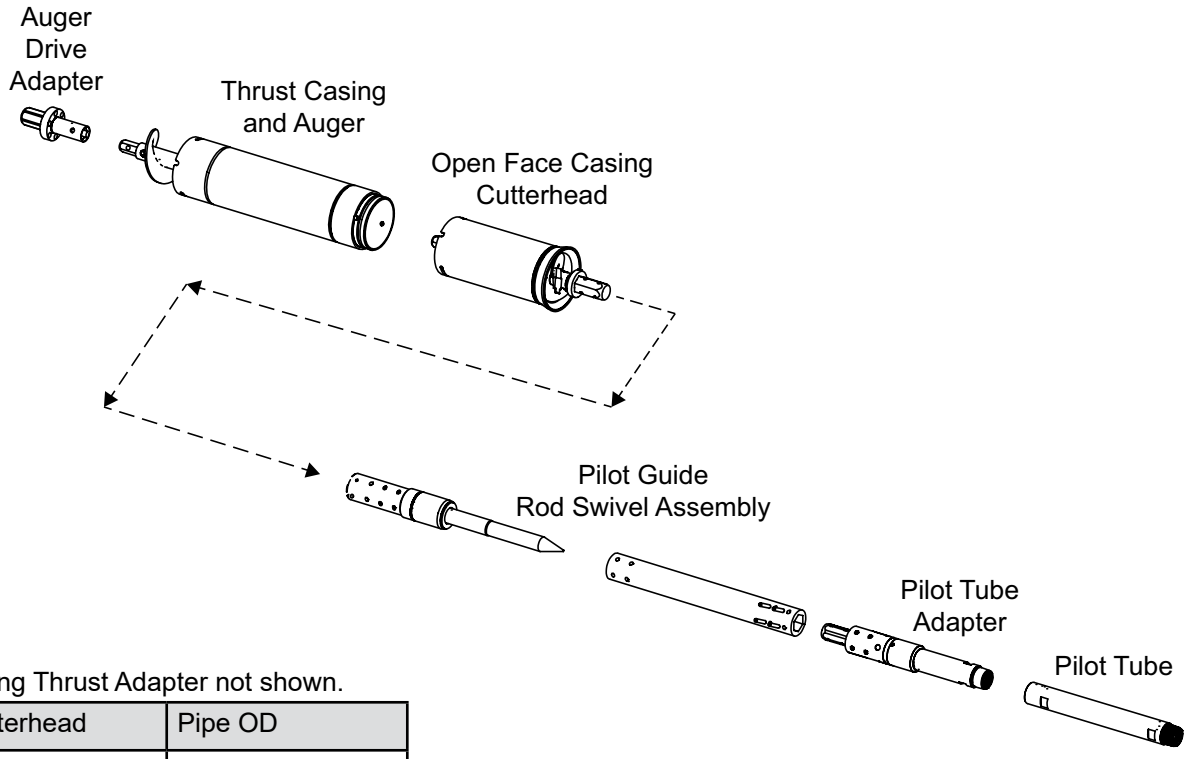


Casing Thrust Adapter not shown.

Reaming Head	Pipe OD
11 in.	11 in.

The 240A/240ABM jacking frame gearbox is limited to 100 ton jacking capacity. Akkerman recommends use of the GBM 4800C jacking frame with a P250D or P200E power pack for Powered Reaming Head (PRH) and Powered Cutter Head (PCH) installations.

1b. Cutter Head Thrust Casing Installation



Casing Thrust Adapter not shown.

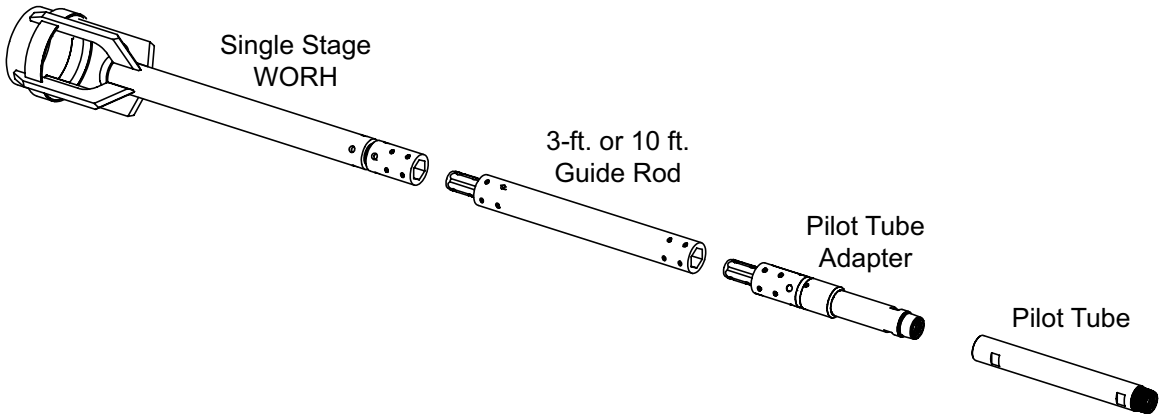
Cutterhead	Pipe OD
11 in.	11 in.

The 240A/240ABM jacking frame gearbox is limited to 100 ton jacking capacity. Akkerman recommends use of the GBM 4800C jacking frame with a P250D or P200E power pack for Powered Reaming Head (PRH) and Powered Cutter Head (PCH) installations.

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

GBM Tooling - Auger Boring Methods Upsizing Tools

1c. Weld-On Reaming Head (WORH) Installation



WORH	Pipe OD	Guide Rod*
Single-Stage WORH	8-20 in. OD	No Guide Rod
	20-24 in. OD	3 ft. Guide Rod
	24-30 in. OD	10 ft. Guide Rod**
	30-36 in. OD	(2) 10 ft. Guide Rods
Two-Stage WORH	36-72 in. OD	Follows Single-Stage WORH with Spacer Section of Steel Casing

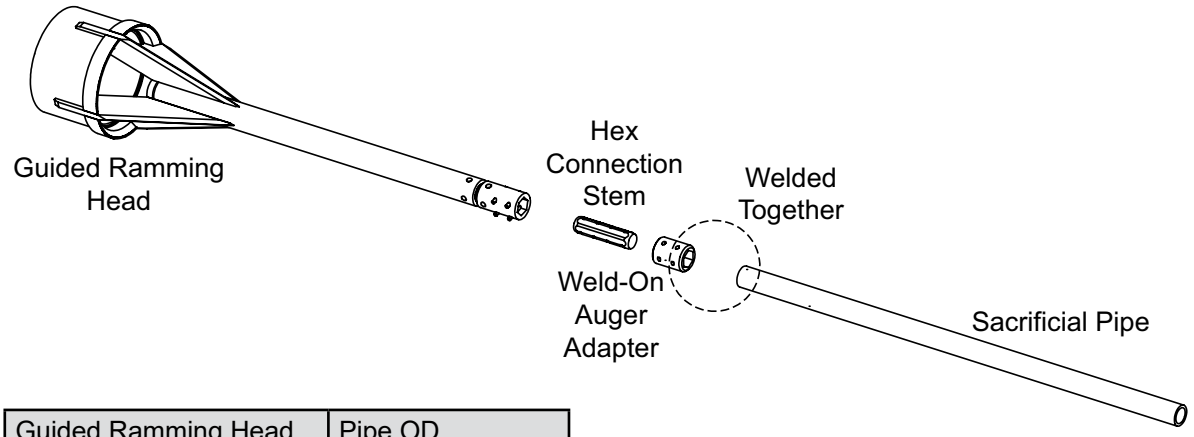
WORHs are available for low blow count (N<15) ground conditions, for harder ground (N<20), and an HD version for hard ground and high jacking forces (N<20+). Contact Akkerman Aftermarket Support for more information.

* Some projects and ground conditions may require a different WORH, custom overcut, and/or guide rod(s) configuration.

** Use 3 ft. Guide Rod in multiples in place of 10-ft. Pilot Hex Tube in small reception shafts. If following with Weld-On Reaming Head, it must be customized for length. Contact Akkerman Aftermarket Support for more information.

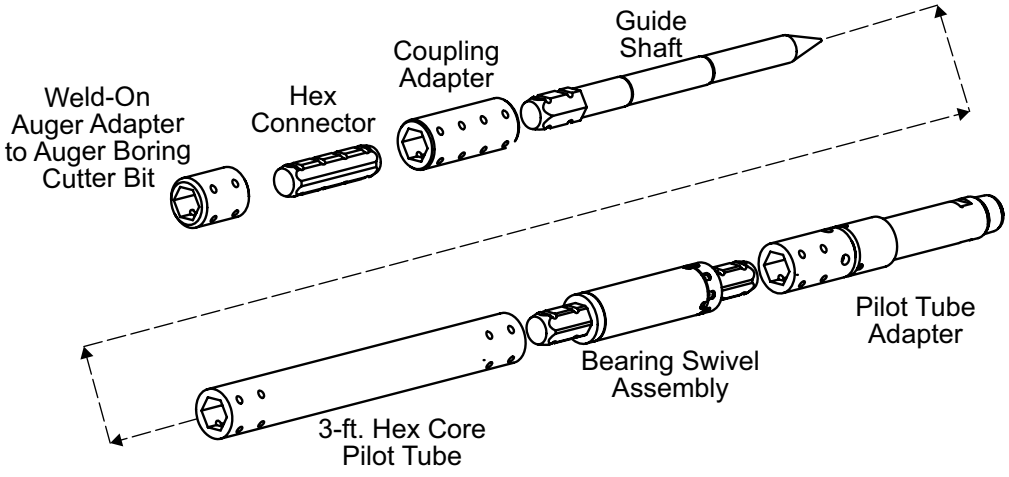
(continued on next page)

1d. Guided Ramming Head (GRH) Installation



Guided Ramming Head	Pipe OD
GRH-20	20 in.
GRH-24	24 in.
GRH-30	30 in.
GRH-36	36 in.

1e. Open Face Cutter Head Installation for up to 24 in. OD Pipe with Auger Pullback Options



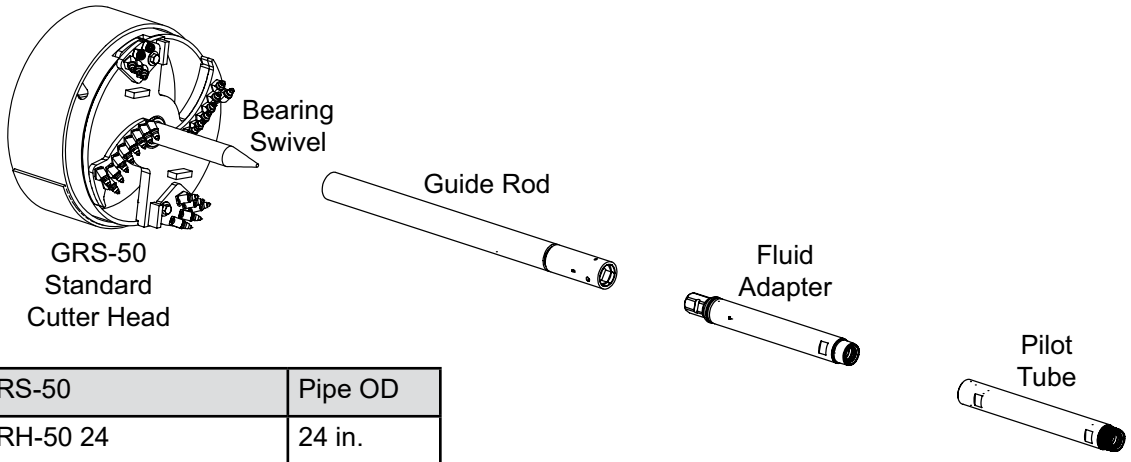
Open Face Cutterhead not shown. Contact Akkerman Aftermarket Support and refer to the Auger Pullback Bearing Assembly, FA49335F.

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

GBM Tooling - Auger Boring Methods Upsizing Tools (continued)

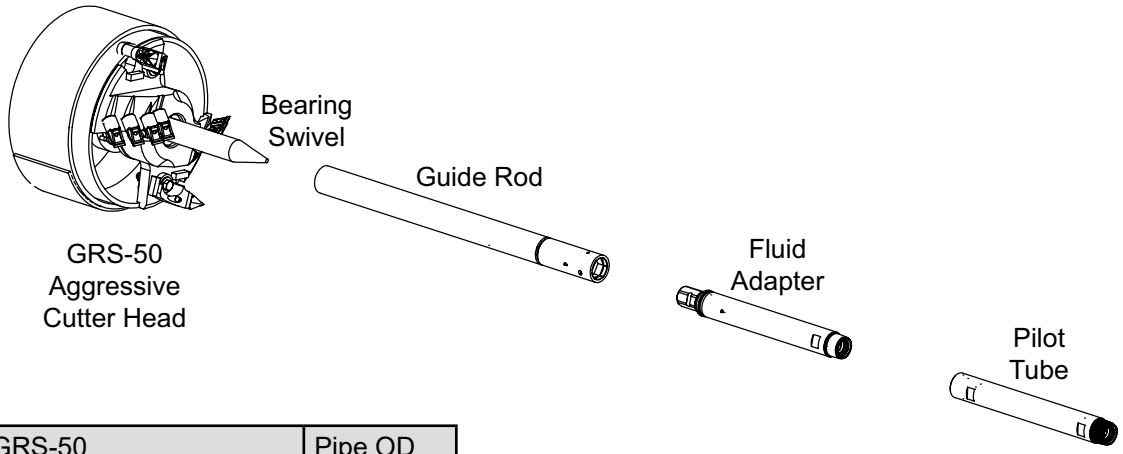
1f. Guide Rock Swivel 50 (GRS-50) and Tooling Installation

Standard GRS-50 Cutter Head



GRS-50	Pipe OD
GRH-50 24	24 in.
GRS-50 26	26 in.
GRS-50 28	28 in.
GRS-50 30	30 in.
GRS-50 32	32 in.
GRS-50 36	36 in.
GRS-50 42	42 in.

Aggressive GRS-50 Cutter Head

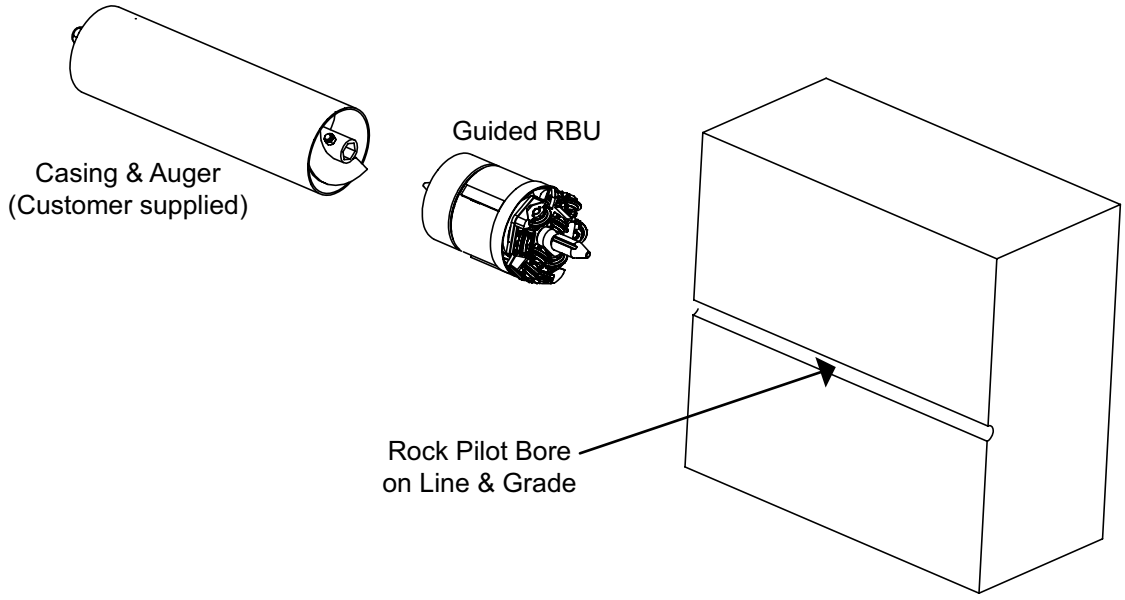


GRS-50	Pipe OD
GRH-50 24A	24 in.
GRS-50 30A	30 in.
GRS-50 36A	36 in.
GRS-50 42A	42 in.

Refer to Operation & Parts Manual Guide Rod Swivel GRS-50, Rock Boring Unit RBU, 050186A.

GBM Tooling - Auger Boring Methods Upsizing Tools (continued)

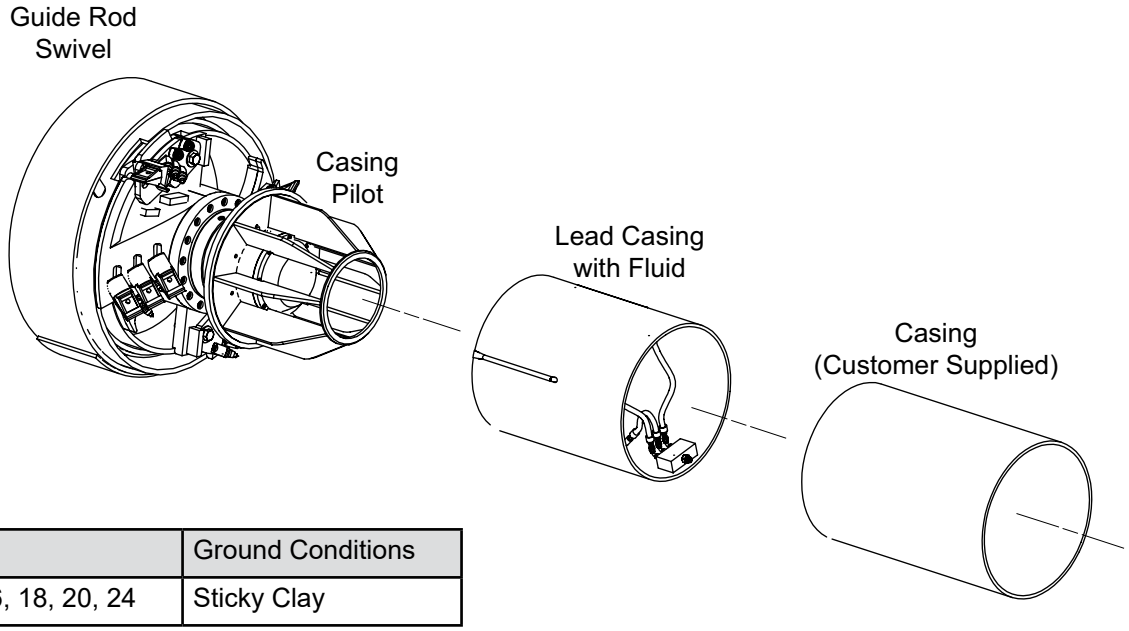
1g. Rock Boring Unit (RBU) - Guided Installation



RBU	Pipe OD	Ground Conditions	Thrust Load Rating (Max.)
RBU 24 RKH	24	Up to 25,000 psi UCS	90,000 lbf.

RKG = Rock Head

1h. Casing Bearing Cutterhead Installation



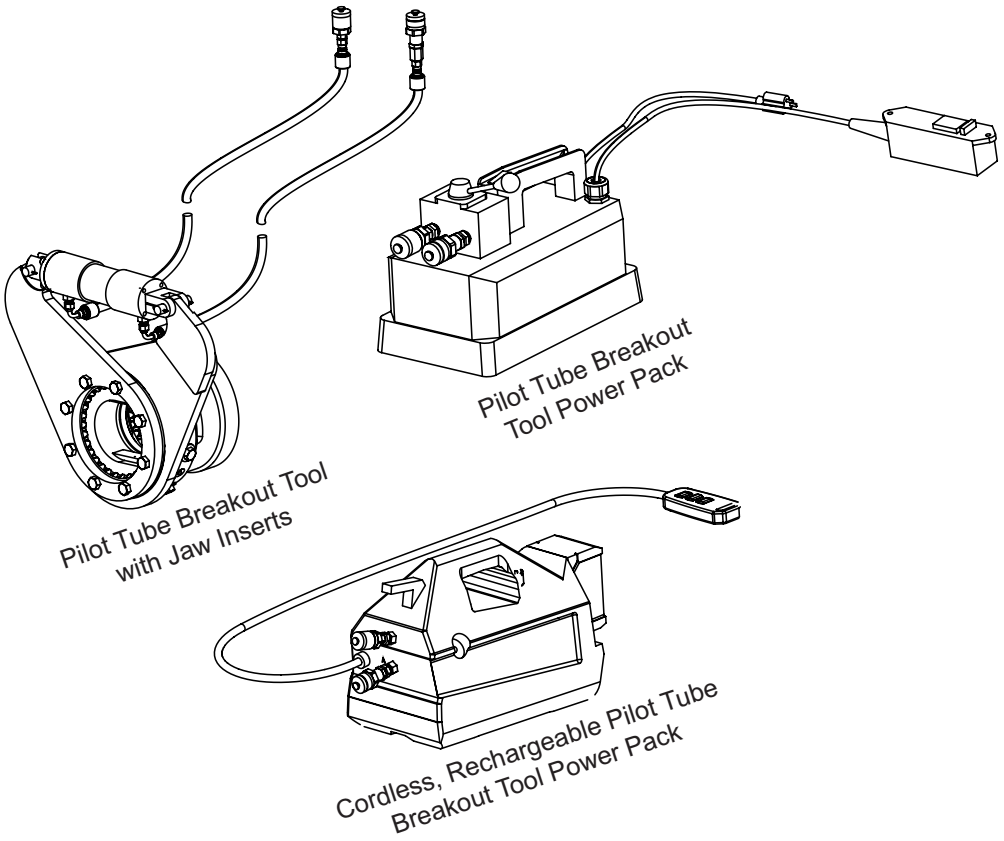
CBCH	Ground Conditions
16 - 16, 18, 20, 24	Sticky Clay

Refer to Operation & Parts Manual Guide Rod Swivel GRS-50, Rock Boring Unit RBU, 050186A.

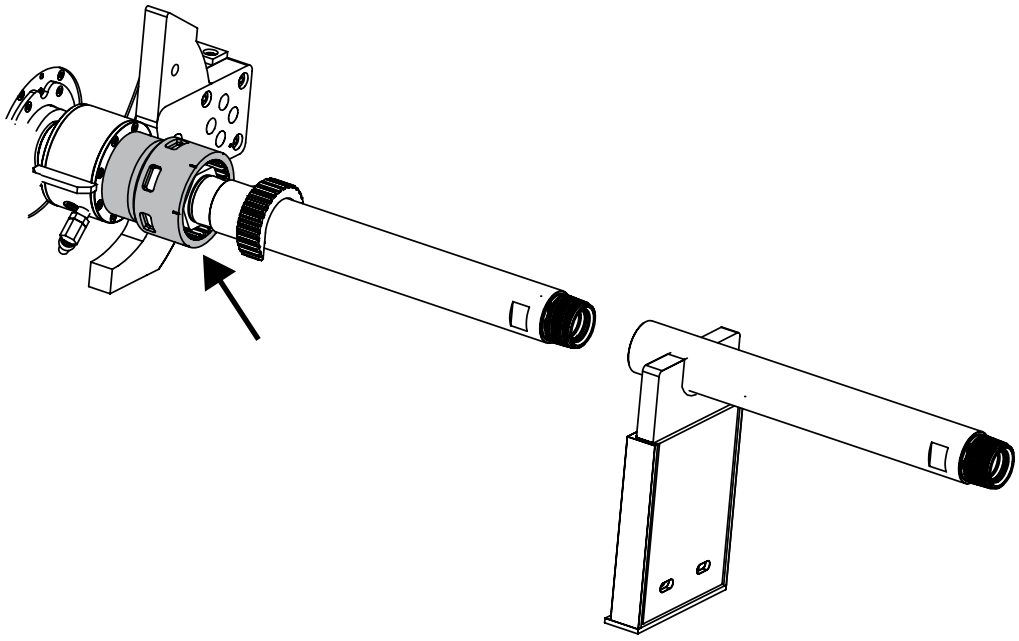
Akkerman Inc. reserves the right to improve its product without notice or obligation.

GBM TOOLING - PILOT TUBE REMOVAL TOOLS

1a. Pilot Tube Removal From Reception Shaft



1b. Pilot Tube Removal by Pullback in Launch Shaft



* Refer to Pilot Tube Pullback Through Launch Shaft Instruction, 050178A.

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

NOTES

Controls & Instruments

EMERGENCY STOPS

IMPORTANT: Emergency Stop (E-Stop) buttons are used for emergency situations only. E-Stop buttons alone are **NOT** intended for lockout tagout purposes. Refer to *Lockout Tagout Procedure Guideline* in Section 1, Safety.

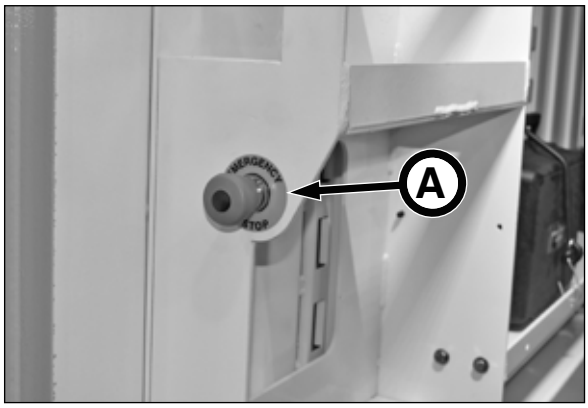
⚠WARNING **ALL** E-Stop buttons MUST be operating properly BEFORE operating the GBM and Power Pack. Failure to do so may cause severe injury or death.

POWER PACK
The E-Stop button (A) is located on the tooling rack.

Push E-Stop button IN to stop all electrical and hydraulic functions.

The button will illuminate when it is pulled OUT.

NOTICE The E-Stop button must be pulled OUT for engine to start.

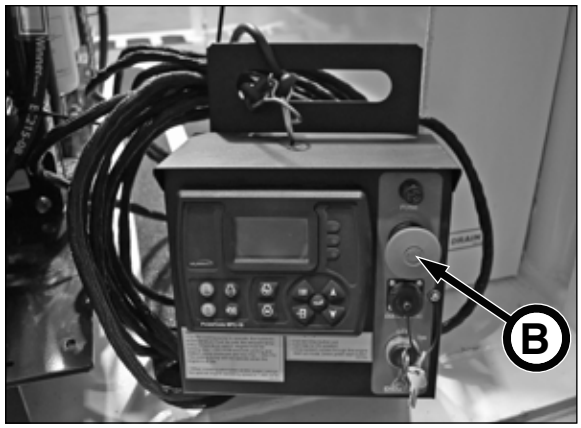


POWER PACK CONTROL PENDANT
The control pendant has an E-Stop button (B).

Push E-Stop button IN to stop all electrical and hydraulic functions.

The button will illuminate when it is pulled OUT.

NOTICE The E-Stop button must be pulled OUT to restart engine.



BATTERY DISCONNECT SWITCH

The power pack Battery Disconnect Switch (A) connects or disconnects power from the batteries to the engine. It will prevent battery drainage when power pack is not in use.

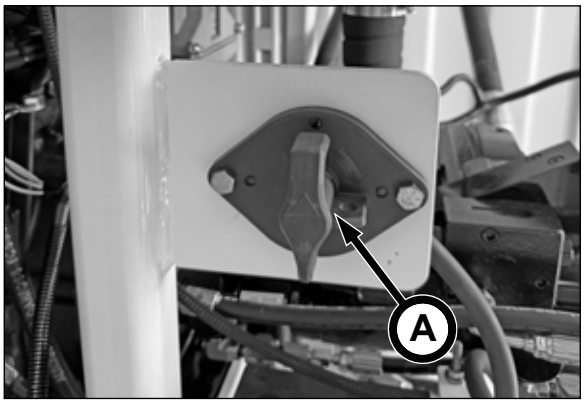
Turning the switch to the OFF position will cut power to the electrical control box and the control pendant.

Turn the switch as follows.

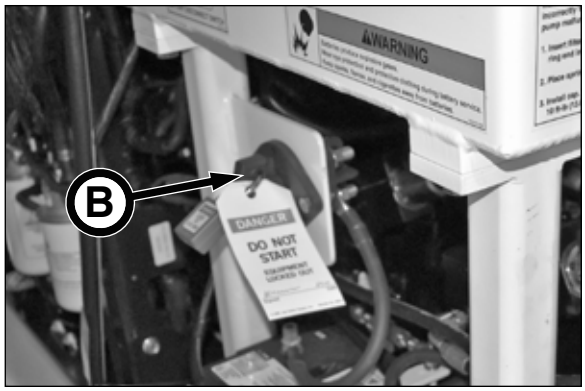
Power ON - CW (clockwise)
(horizontal position)
Power OFF - CCW (counterclockwise)
(vertical position)

The Battery Disconnect Switch also provides a means to lockout tagout (B) the Power Unit when conducting service or maintenance on the unit.

Refer to *Lockout Tagout Procedure Guideline* in section 1, Safety.



Battery Disconnect Switch shown in the OFF position

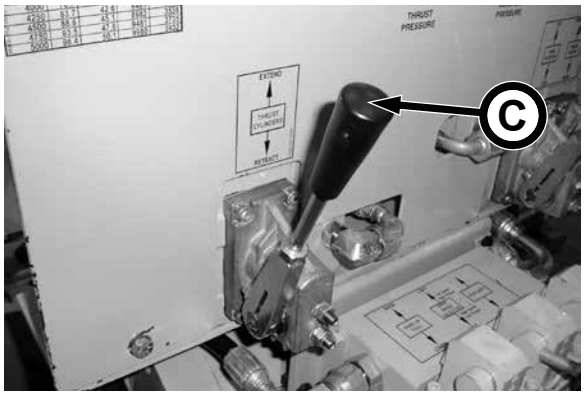


Battery Disconnect Switch in LOTO.

THRUST CYLINDER CONTROL

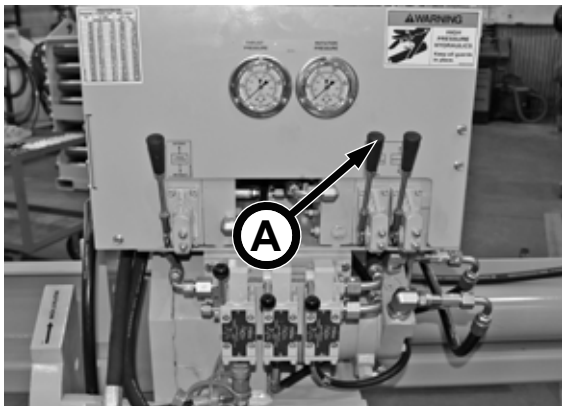
Use the thrust cylinder control (C) to extend and retract the frame travel cylinders.

Extend Cylinders - Push Lever Up
Retract Cylinders - Pull Lever Down



DRIVE ROTATION CONTROL

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



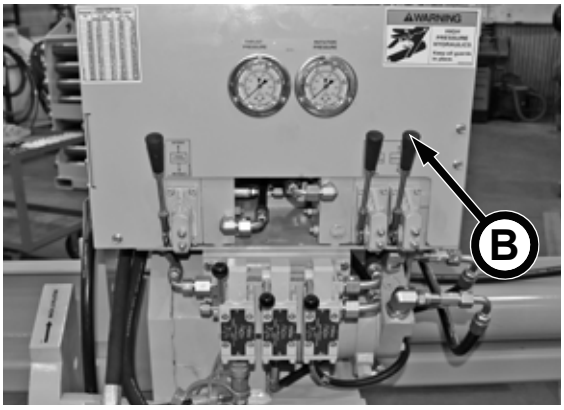
NOTICE Always rotate pilot tubes CW. Rotating pilot tubes CCW (counterclockwise) will unthread the pilot tubes in the pipeline resulting in unrecoverable pilot tubes.

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

Clockwise (CW) Rotation - Push Lever Up
Counterclockwise (CCW) Rotation - Pull Lever Down

AUXILIARY CONTROL

The auxiliary control (B) is an available circuit with lever to control auxiliary functions.

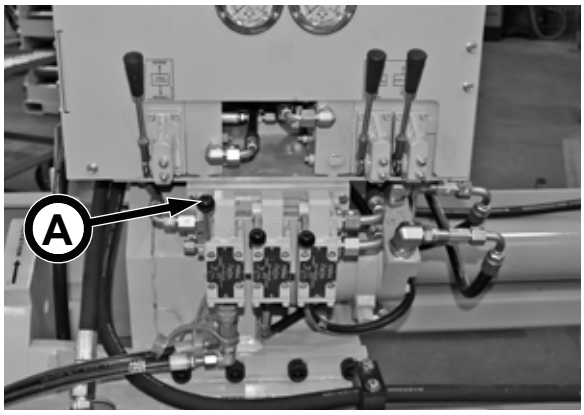


MAKE UP TOOL CONTROL

The hydraulic make up tool control (A) is used to tighten each section of the pilot tubes as they are being installed in the launch shaft.

In pull back operation, the make up tool is used to separate the pilot tubes in the launch shaft.

Lock - Push Lever Up
Unlock - Pull Lever Down



DRIVE SPEED SELECTORS

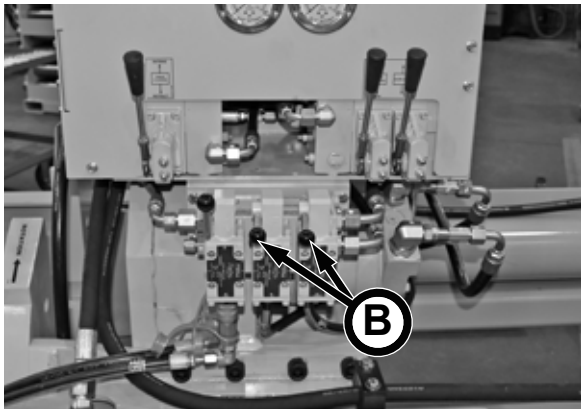
The drive speed selectors (B) control the rotational drive motors speed.

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

When using auger casings, use the HSLT (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.

LSHT - Push Lever Up
HSLT - Pull Lever Down

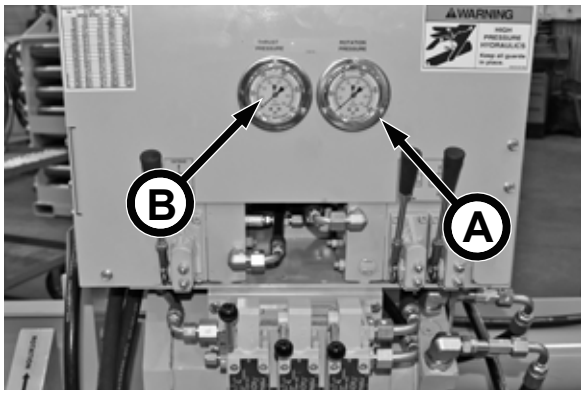


NOTE:
1. For maximum torque, **both** motor selectors must be in LSHT position.
2. Achieve a mid speed (40 rpm) setting by placing one motor selector in HSLT and the other motor selector in LSHT position.

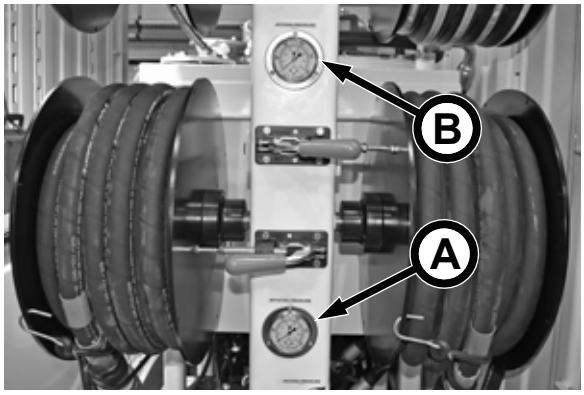
HYDRAULIC PRESSURE GAUGES

Use the pressure gauges to monitor the GBM rotation (A) and thrust (jacking) (B) pressures.

Operating range is up to 4,000 psi (27.579 mPa). Maximum pressure is 5,000 psi (34.474 mPa).



GBM 240A/ABM Frame

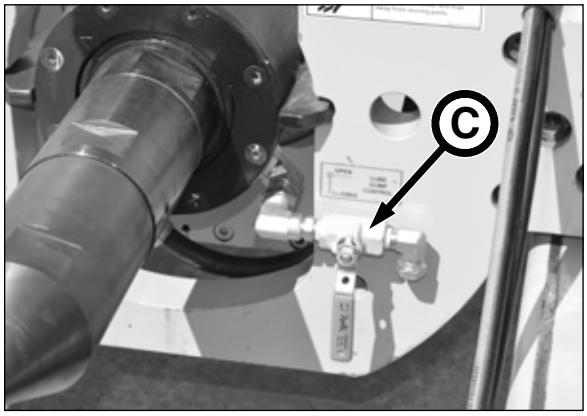


P4075D Power Pack

LUBE DUMP CONTROL

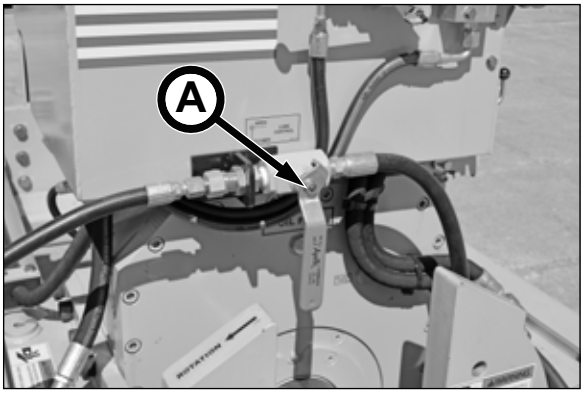
Using the lube dump control (C), bleed the lubricant fluid into a catch pan or other suitable container **BEFORE LOOSENING PILOT TUBE JOINTS**.

This will relieve fluid pressure and prevent the fluid from entering the inner tube of the pilot tube.



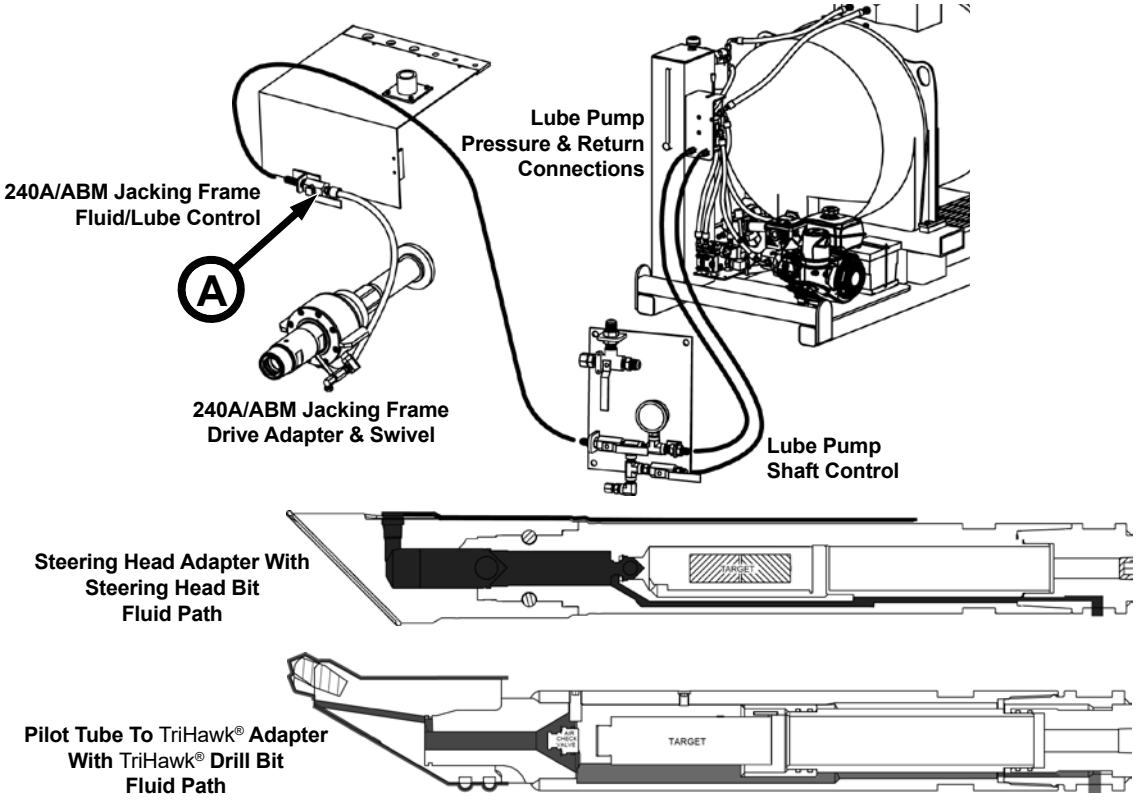
FLUID/LUBE CONTROL

The fluid/lube control (A) regulates the lubricant flow to the drive adapter and swivel which allows the lubricant to flow through the dual-walled pilot tube annular space and then out the lead tooling port.



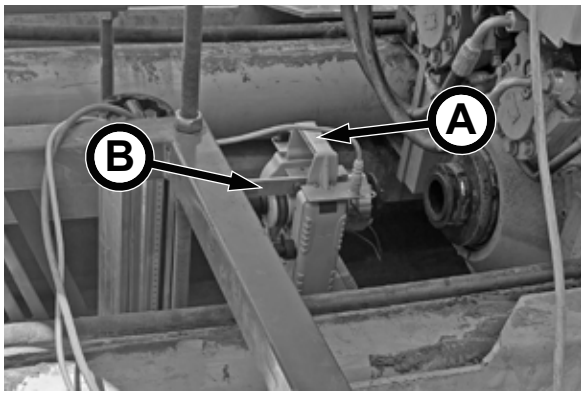
- Lubricant out of the lead tooling will lubricate the outside of the pilot tubes. Control lubrication flow so there is no lubricant flowing out of the pilot tubes into the launch shaft.

- When using TriHawk® drill bit/other hard rock lead tooling, lubricant tooling cools the drill bit and flushes the cuttings to the launch shaft. Control lubrication flow so there is lubricant/cuttings flowing out of the bored hole into the launch shaft.



THEODOLITE & CAMERA

The **theodolite** (A) is used to align and maintain line and grade with a designed accuracy of .25 inch (6.35 mm) up to 300 feet (91 m). Refer to your Nikon® theodolite manual for additional operation information.

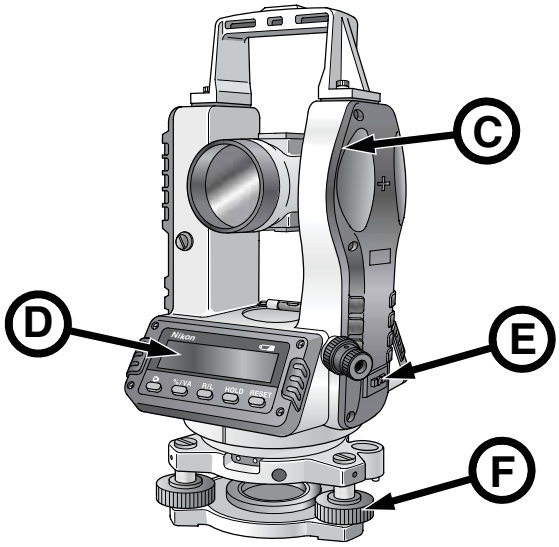


The theodolite mounted **camera** (B) transfers the digital image of the illuminated target (in the steering head) to the monitor assembly.

Use the following controls to set up, operate and adjust the theodolite assembly on the elevator column/theodolite stand:

Battery Button and Pack (C) Opens battery pack and keeps it locked in place.

Display (D) Shows the theodolite's modes, battery level, position, and errors or warnings. Includes buttons for light, %/VA (vertical/horizontal angle) R/L (horizontal angle reading direction), hold (holds horizontal angle reading), and reset (clear horizontal angle).



Power Button (E) Turns the theodolite on.

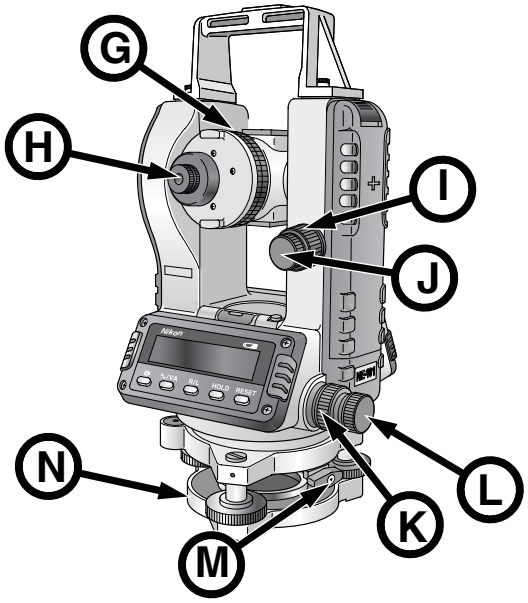
Adjustment Knobs (3) (F) Adjust these knobs to level theodolite assembly on a vertical axis on the elevator column/theodolite stand. Use the plate level and circular level to check level.

Focusing Ring (G) Adjust the focus on the stringline during final theodolite setup. Use remote focus on monitor to adjust.

Eyepieces (H) Adjust to focus crosshairs. Use the 40X magnification eyepiece and barrel for standard operation. Use 30X eyepiece when checking Zero Point Calibration. Thread eyepieces into the barrel using the knurled edge.

Vertical Coarse Adjust/Lock Knob (I) Use to lock the theodolite vertical position.

Vertical Fine Adjust Knob (J) Use to make small, precise vertical adjustments. The Vertical Coarse Adjust/Lock Knob must be unlocked first.



Horizontal Coarse Adjust/Lock Knob (K) Use to lock the theodolite horizontal position.

Horizontal Fine Adjust Knob (L) Use to make small, precise horizontal adjustments. The Horizontal Coarse Adjust/Lock Knob must be unlocked first.

Leveling Base Clamp (M) Locks the theodolite to base plate.

Leveling Base (N) Screw into lateral slide.

MONITOR ASSEMBLY

The target displayed on the monitor assembly allows the operator to observe the location of the target in the pipeline in relation to the crosshairs on the monitor.

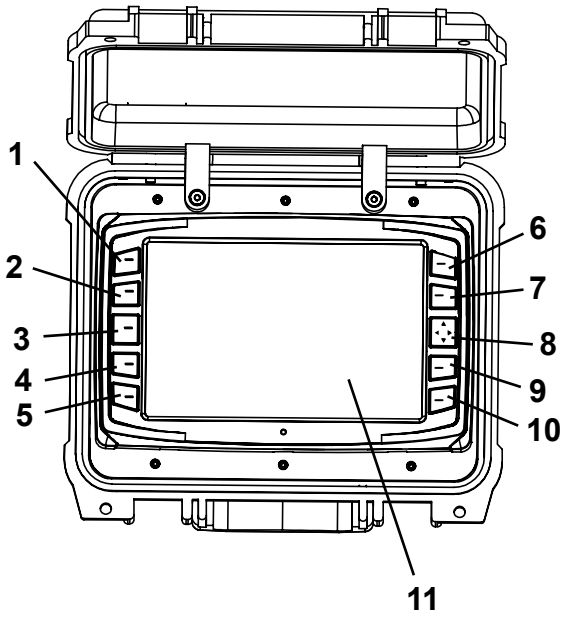
Any corrections made to line and/or grade will be visible on the monitor.

For more information on operating the monitor assembly, refer to *Monitor Assembly Start Up & Operation (Gen V)* in section 6, Operation, subsection *Guidance System Setup*.



Computer Control Buttons

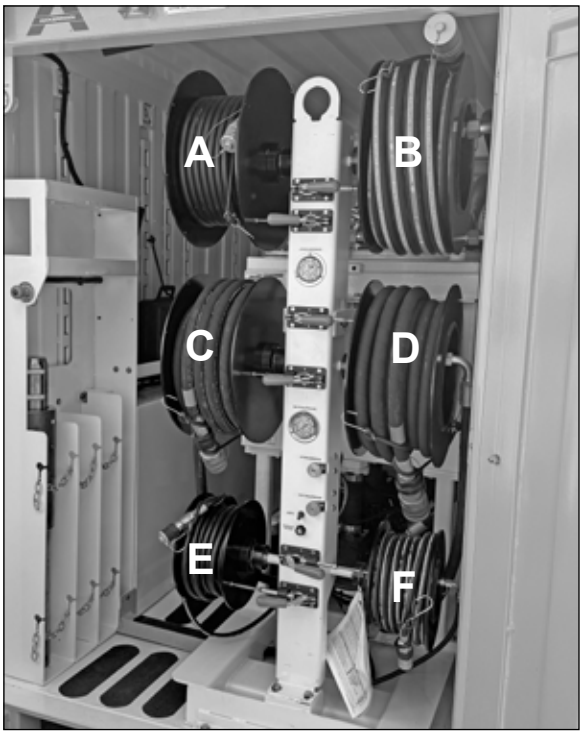
1. Shut Down Button
2. Reset Zoom Button - resets to Level 3
3. Wide Mode Button
4. LED Brightness Button* - adjusts illumination of crosshairs on monitor display (0 - 95%)
5. Pipe Tube Counter - manual pipe counter
6. Gain Button* - controls the camera sensitivity (0 - 255)
7. Exposure Button* - controls amount of light available to the camera (1 - 99%)
8. Multi Function Button:
   - Focus Button
   - 4-Way Selector Button: when selecting LED, Gain, Exposure, Pan and Zoom
   - Power ON Button (Up Arrow)
9. Pan Button* - moves image width/height
10. Zoom Button* - adjusts image in and out (Levels 1 - 15, default Level 3)
11. GBM System Window



**** Use the 4-Way Selector Button (8) to adjust the function as needed.***

POWER PACK CONTROLS

The P4075D power pack provides hydraulic power for the jacking frame and tooling components. The four cylinder, 74 HP diesel engine drives dual load sensing, variable volume, and torque limiting piston pumps.



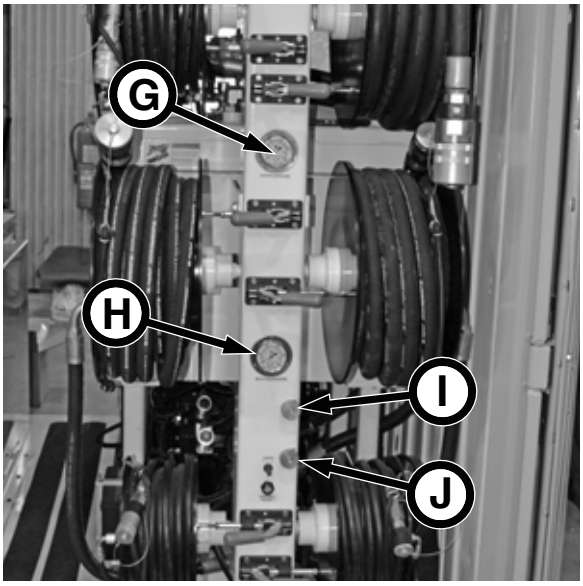
Hydraulic Hose Reels
The hydraulic hoses are stored on hose reels for ease of routing hoses to jacking frame.
The hoses are connected to the GBM hydraulic connections as follows:

A – Case Drain Hydraulic Hose Connection
B – Return Hydraulic Hose Connection
C – Thrust Pressure Hydraulic Hose Connection
D – Rotation Pressure Hydraulic Connection
E – Thrust Load Sense Hydraulic Hose Connection
F – Rotation Load Sense Hydraulic Hose Connection

Hydraulic Pressure Gauges & Adjustment Valves
Use the pressure gauges to monitor the GBM jacking thrust (G) and rotation (H) pressures.

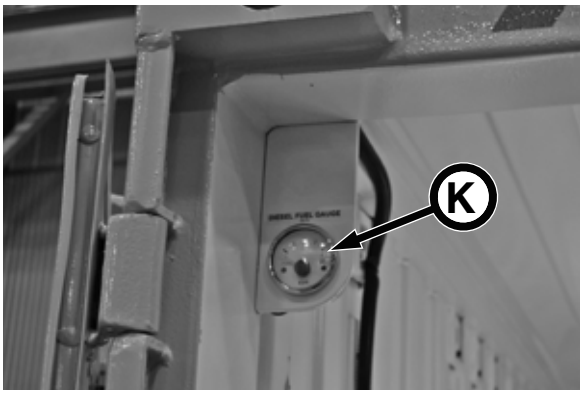
Operating range is up to 4,000 psi (27.579 mPa). Maximum pressure is 5,000 psi (34.474 mPa).

The pressure adjustment valves are factory set at 5,000 psi (34.474 mPa). If your pipe has a lower thrust load pressure rating, use adjustment valve (I) to adjust the pressure to protect the product pipe. To adjust the pressure, refer *Adjusting Thrust Pressure* in section 6, Operation. Do not adjust the rotation adjustment valve (J).



G – Jacking (Thrust) Pressure Gauge
H – Rotation Pressure Gauge
I – Jacking Pressure Adjustment Valve
J – Rotation Pressure Adjustment Valve

Diesel Fuel Gauge
View the Diesel Fuel Gauge (K) to monitor the engine diesel fuel level.

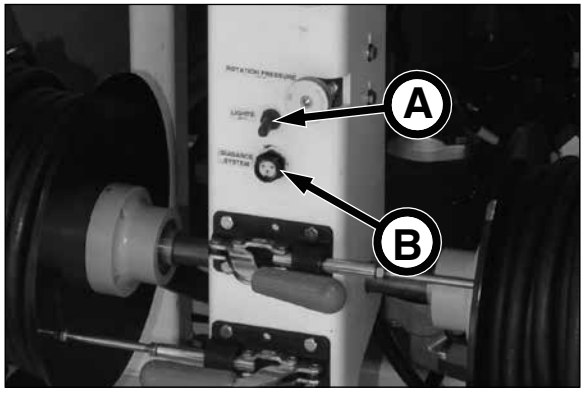


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Power Pack Controls (continued)

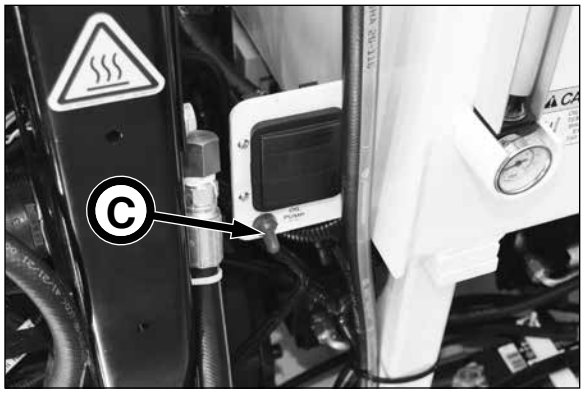
Container Lights Switch
Flip Lights Switch (A) to the UP position to power the two container magnetic repositional LED lights. Flip the switch DOWN to turn the lights off.

Guidance System
The 12V connection (B) is equipped to supply power to the 12V guidance system. The main power must be on for power to this connection. The E-Stop does not affect the power to the guidance system.



Oil Pump Switch
Flip Oil Pump Switch (C) to ON position to pump hydraulic oil into the hydraulic reservoir. Once reservoir is full, be sure to flip oil pump switch to the OFF position.

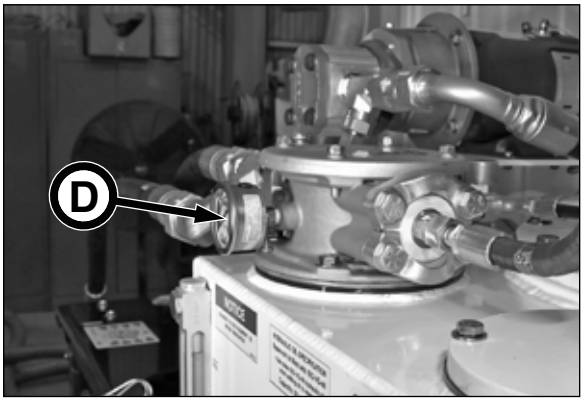
> **IMPORTANT: BEFORE** filling hydraulic reservoir, the breather/fitting must be removed to allow for proper bleeding. Failure to do so may result in pump damage. Be sure to replace breather/fitting after filling reservoir.



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

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

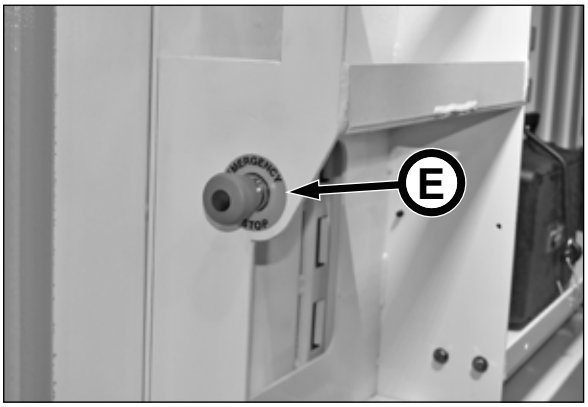
Replace return filter when the needle on the gauge is in the red CHANGE zone (see *Check Hydraulic Return Filter Indicators* in section 9, Periodic Maintenance).



Emergency Stop
Push Emergency Stop (E-Stop) button (E) IN to stop all electrical and hydraulic functions.

The button will illuminate when it is pulled OUT.

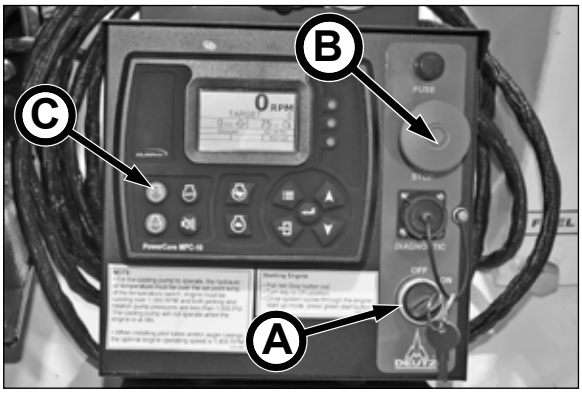
This button must be pulled out to restart engine.



POWER PACK CONTROL PENDANT

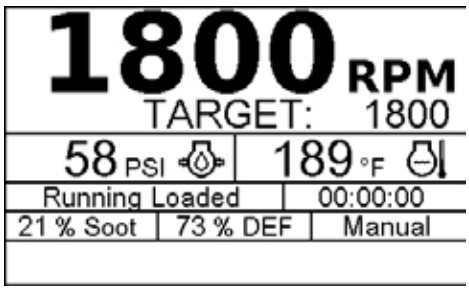
NOTICE Refer to your Deutz engine manual and dealer for more information.

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

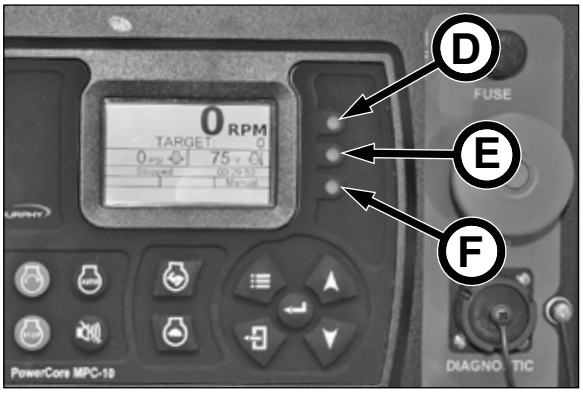


Key Start Switch
The key start switch (A) controls the engine electrical system. To start the engine:
1. Pull red Stop button (B) out.
2. Turn key switch CW to ON position (A).
3. After system cycles through the engine start up mode, press green Start Key (C).
4. When the engine starts, release the start key. DO NOT crank the engine more than 20 seconds. Doing so will damage starter.

Display Screen
The display screen shows the engine functions, oil pressure, coolant temperature, soot percentage, DEF level, throttle mode and wanring icons.



LED Indicators
The LED indicators will illuminate when there is a shutdown state, warning state, auto mode, or running loaded.
- Shutdown State (Red) LED (D)
- Warning State (Yellow) LED (E)
- Auto Mode or Running Loaded (Green) LED (F)



Keypad Functions
Refer to Control Pendant - Keypad Functions in this section.

Diagnostic Port
The diagnostic port (G) will be used by a certified Deutz engine technician in the event troubleshooting of the engine operation is required.



POWER PACK CONTROL PENDANT KEYPAD FUNCTIONS

NOTICE Refer to your Deutz engine manual and dealer for more information.



Start Key (A) Push to start operation.

Stop Key (B) Push to stop manual mode of operation. As a safety feature, the stop key will skip the cool-down state when pressed twice.

Auto Key (C) Auto mode is not enabled on this control pendant.

Alarm Silence Key (D) Push to acknowledge alarms on the controller for warnings and shutdowns and silences the remote alarm.

Manual Throttle Increase (Rabbit) Key (E) Push to manually increase the engine throttle.

Manual Throttle Decrease (Turtle) Key (F) Push to manually decrease the engine throttle.

Menu Key (G) Push to review controller menu options.

Back Key (H) Push to move back one step while in the menu.

Enter Key (I) Push to enter a value in the menu when selected and acknowledge alarms/ shutdowns.

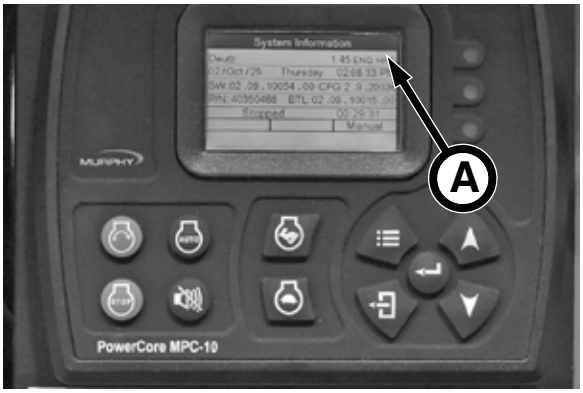
Up Key (J) Push to navigate up through the menu and forward on the main menu pages.

Down Key (K) Push to navigate down through the menu and reverse on the main menu pages.

LEDs (L, M, N) The three LEDs indicate Shutdown (L) (Red), Warning (M) (Yellow), and Auto Mode/ Running Loaded (N) states.

POWER PACK CONTROL PENDANT HOURMETER

Navigate to the system information menu to view current engine hours (A).



POWER PACK CONTROL PENDANT FUSE

⚠WARNING Failure to Lockout Tagout (LOTO) power before servicing can cause severe personal injury or death. Refer to *Lockout Tagout Procedure Guideline* in the Safety section.

The control pendant fuse protects the electrical circut from damage from shorts or overload.

Correct what caused the short or overload then replace the fuse before further operation.



⚠WARNING **Always install the same amperage rated and type fuse as the one you are replacing.** Never use a fuse with a higher amperage rating as damage will result to the circuit it is protecting.

NOTES

Pre-Start Inspection

⚠WARNING Do not operate this equipment until you read, study, and understand this manual and any other equipment manuals. 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 MSHA and 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 (refer to *Lockout Tagout Procedure Guideline* in Section 1, Safety).

Use the following checklist ✓ as a guide for your daily pre-start inspection. Make a copy of this Pre-Start Inspection checklist. Once a task in completed, check, initial and date each item and retain a copy as a record of maintenance.

	1. Use “ONE-CALL” notification to check for buried utility lines prior to tunneling.
	2. Check the excavated launch and reception pits or shafts for proper shoring or bracing to prevent slides or cave-ins.
	3. A qualified electrician must check that all electrical connections are properly secured and grounded prior to operation.
	4. 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. Test E-Stop (Emergency Stop) buttons for proper operation at the start of each shift.
	10. Inspect GBM equipment for damage. Repair or replace as needed.
	11. Check diesel engine fuel level. Add as needed.
	12. Check engine crankcase oil level. Add as needed.
	13. Check engine cooling air intake areas and external surfaces of engine. Be sure they are clean and unobstructed.
	14. Check engine air cleaner components; in place and securely fastened.
	15. Be sure all covers and guards are in place before operation.
	16. Check for loose or missing hardware. Replace damaged or missing hardware.
	17. Check for worn, loose, or damaged wire. Repair or replace wiring.
	18. BEFORE starting equipment, ALL controls must be in the OFF or neutral position.
	19. Check wire harnesses for frayed or worn insulation or wires. Replace damaged or worn harnesses.
	20. No riders are allowed on the GBM.
	21. Check for fluid leaks. Repair leak or replace components.
	22. Keep job site clean and organized.
	23. Perform all lubrication and maintenance procedures. Refer to Section 9, Periodic Maintenance.
	24. Check equipment for proper lubrication.
	25. Remove all personnel from inside the GBM.
	26. Check for leaks in hydraulic hoses and/or lines (replace defective hoses and/or lines).
	27. Check hydraulic hoses and lines for wear and/or damage. Replace any defective hoses and/or lines.
	28. Be sure all suction valves are open and valve handles tie strapped to prevent accidental closure.
	29. Remove all tools on GBM.
	30. Before operating, become aware of all pinch point areas on the GBM by conducting a visual inspection.
	31. Decals must be clean and legible.

NOTES

Operation

HOW TO USE THIS SECTION

There are several components that are used with the Guided Boring Machine (GBM) system. Components vary depending upon your desired upsizing installation process. Refer to *GBM Installation Options* in this section.

This section is divided into 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.

6-5-1 Operation Guidelines

6-5-1 Operation Guidelines
6-5-2 GBM Installation Options
6-5-4 Recommended Tools & Equipment

6-10-1 Shaft Set Up

6-10-1 Setting Up The Launch & Reception Shafts

6-15-1 GBM Frame Set Up

6-15-1 Setting Up GBM With Auger Boring Machine
6-15-5 Setting Up GBM As Standalone System
6-15-7 Auger Boring Data Sheet
6-15-8 Quick Coupler Connections

6-20-1 Power Pack Operation

6-20-1 Using Emergency Stop
6-20-1 Setting Up The Power Pack
6-20-3 Starting The Power Pack
6-20-5 Stopping The Engine
6-20-6 Check Hydraulics After Start-Up
6-20-7 Adjusting Thrust Pressure
6-20-9 Filling The Hydraulic Oil Reservoir
6-20-11 Daily Shutdown

6-25-1 Guidance System Set Up

6-25-1 Checking Theodolite Zero Point Calibration
6-25-6 Install Guidance System Mounting Stand
6-25-8 Install Guidance System Mounting Base
6-25-10 Assembling Guidance System
6-25-16 Preliminary Theodolite Set Up For Line & Grade
6-25-24 Monitor Assembly Start Up & Operation
6-25-29 Using Data Logging
6-25-31 Final Theodolite Set Up

6-30-1 Installing Pilot Tubes

6-30-1 Installing Steering Head Adapter to Steering Head
6-30-6 Using GBM Smart Target
6-30-7 Installing Pilot Tubes
6-30-17 Log Of Progress

6-35-1 Installing Upsizing Tools

6-35-1 Auger Boring Methods
- 6-35-1 Weld-On Reaming Head Installation
- 6-35-13 Open Face Cutter Head Installation

6-35-25 Three Step Methods
- 6-35-25 Auger Casing Installation With Reaming Head
- 6-35-43 Auger Casing Installation With Open Face Cutter Head

6-35-62 Upsizing Tool Lubrication From Reception Shaft
6-35-64 Installing Casing Auger Pin To Auger & Casing

6-40-1 Installing Product Pipe

6-40-1 Three Step Methods: Installing Product Pipe

6-45-1 Miscellaneous

6-45-1 Pilot Tube Pullback Through Launch Shaft
6-45-5 Using Spinner Tubes/Pilot Tube Expansion Sleeve

NOTES

OPERATION - OPERATION 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.

⚠WARNING Keep personnel away from the inside of the GBM jacking frame while there is power to the equipment. Failure to do so can result in serious 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 personal 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 Akkerman Aftermarket Support 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. Test 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. Lockout tagout electrical power at the source (generator) before servicing electrical components.
18. Beware of pinch points.
19. If this manual is lost, contact Akkerman Aftermarket Support for a new manual or download 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.
25. Be sure all suction valves are open and valve handles tie strapped to prevent accidental closure.

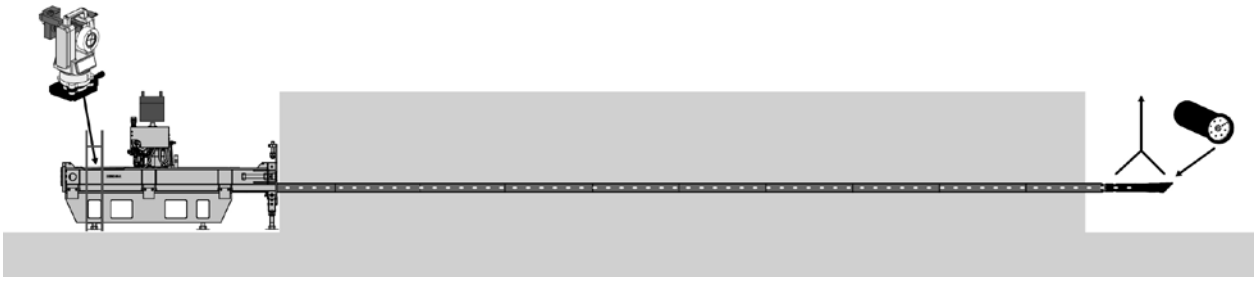
GBM INSTALLATION OPTIONS

Pilot Tube Installation Options

Step 1a: Precise Installation of Pilot Tubes with Steering Head or Hard Ground Tooling with GBM and Auger Boring Machine

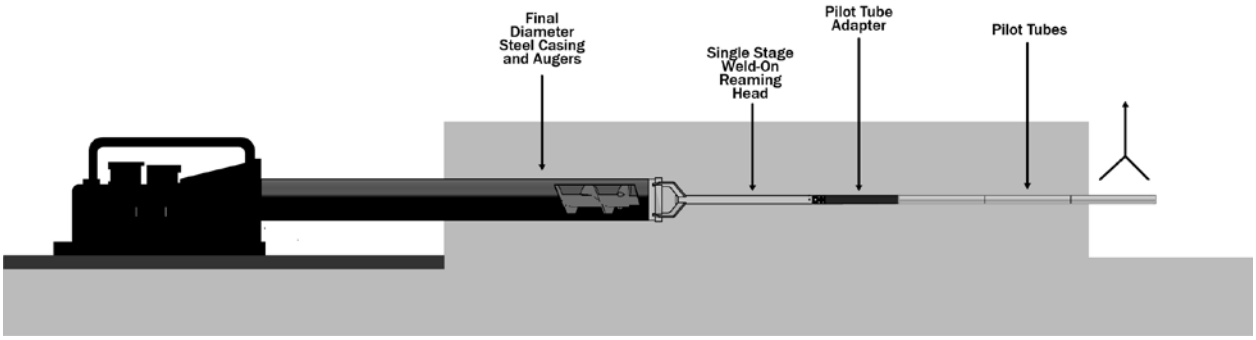


Step 1b: Precise Installation of Pilot Tubes with Steering Head or Hard Ground Tooling with GBM and standalone base

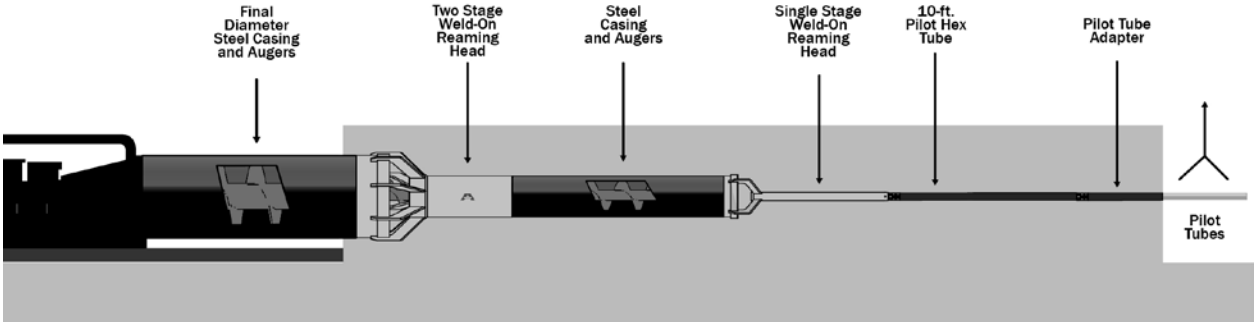


Upsizing Tool Installation Options - Auger Boring Methods

Step 2a: Installation of 12- 36-in. (305 - 914 mm) OD Steel Casing with Single-Stage Weld-On Reaming Head and Auger Boring Machine

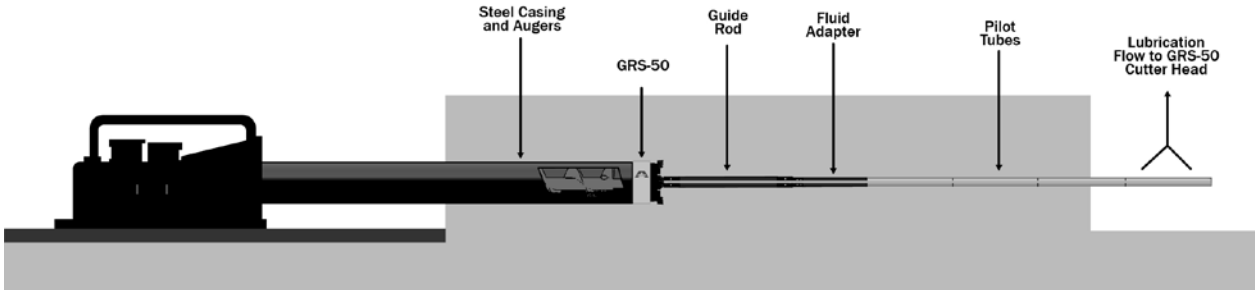


Step 2b: Installation of larger than 36-in. (914 mm) OD Steel Casing with Two-Stage Weld-On Reaming Head and Auger Boring Machine

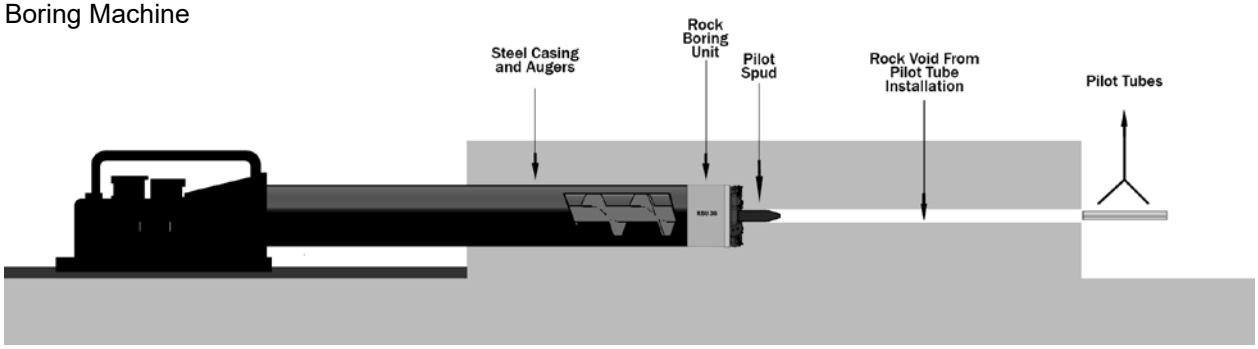


Upsizing Tool Installation Options - Auger Boring Methods (continued)

Step 2c: Installation of larger than 24-in. (610 mm) OD Steel Casing in Hard Ground with GRS-50 Or Open Face Cutterhead and Auger Boring Machine

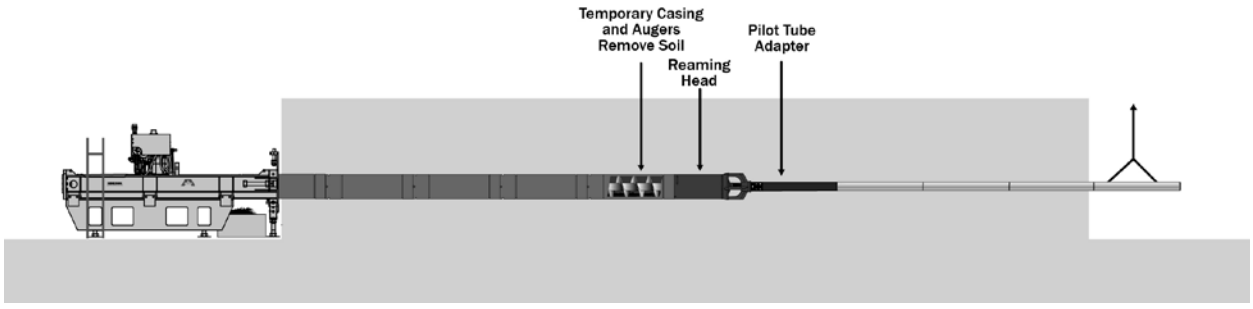


Step 2d: Installation of larger than 24-in. (609 mm) OD Steel Casing in Hard Ground with RBU and Auger Boring Machine

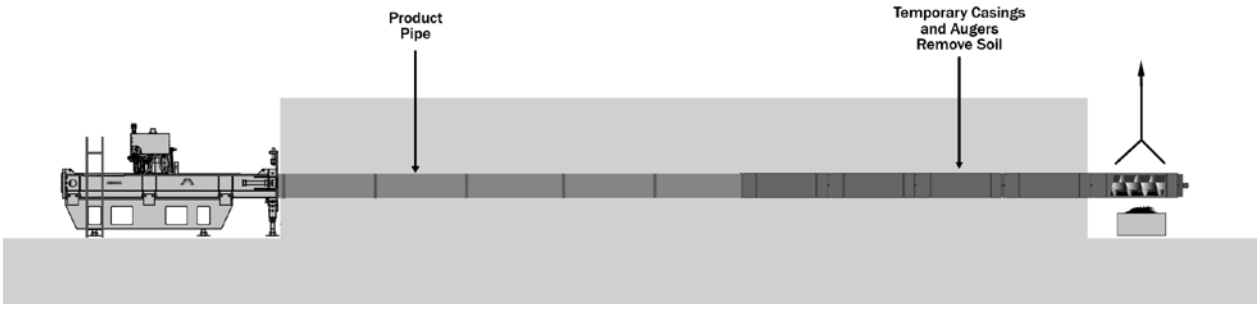


Upsizing Tool and Product Pipe Installation Options - Three Step Methods

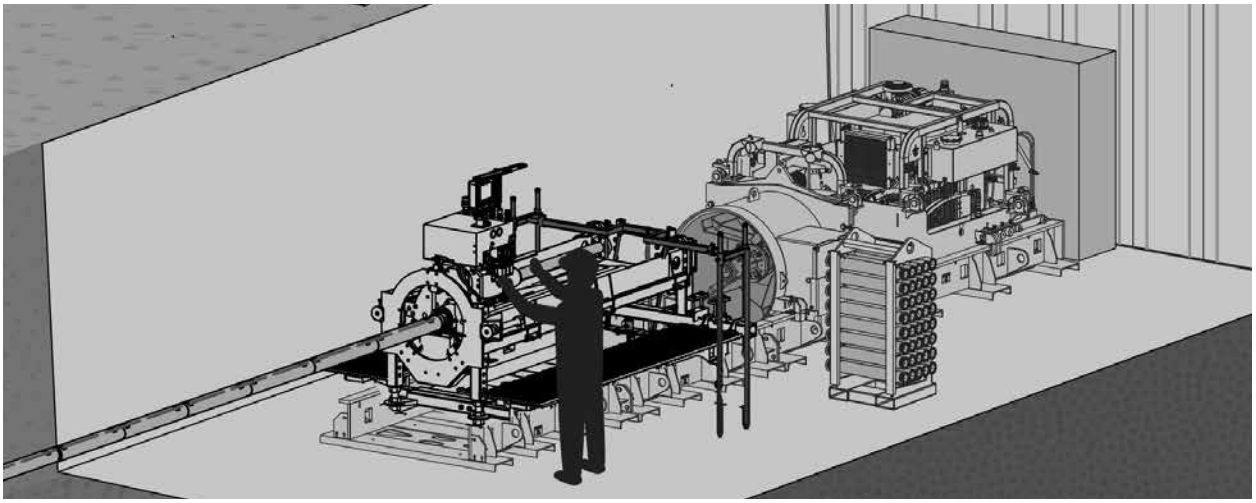
Step 2: Installation of up to 16-in. (406 mm) temporary casing and augers using reaming head



Step 3: Installation of up to 16-in. (406 mm) product pipe



RECOMMENDED TOOLS & EQUIPMENT



Below is a list of tools and equipment commonly used for complex technical construction operations. Actual requirements will vary based on job site conditions, available equipment, and budget considerations. Some items listed are only needed in specific situations, and the list should not be considered exhaustive. For Akkerman-supplied spare parts, contact Akkerman Aftermarket Support.

SAFETY EQUIPMENT

- Safety equipment, first-aid kit, fire extinguishers, and stokes-type stretcher
- Air monitoring system
- Gas detection system
- Personal gas detectors
- Any other required safety PPE or gear

CONSUMABLES

Fuel & Lubricants

- Diesel/gasoline for power pack and bentonite & lubrication pump
- Fuel stabilizer for power pack and bentonite & lubrication pump
- Hydraulic filters for power pack
- 3 to 6-gal. drums of Propylene Glycol (RV Antifreeze) for winterizing equipment
- Mobil SHC 630 for jacking frame gearbox
- Mobilgrease XHP222 and grease gun for lubrication points, jacking frame leveling, and drive adapter Assemblies
- ISO-VG-46G 20W Premium Hydraulic Turbine Oil or Enerpac HP® for breakout tool power unit lubrication
- Anti-seize lubricant for pilot tube threads

Spare Tooling & Parts

- Spare tooling (bullet bits, spade tooling, and disc cutters if applicable)
- Replacement pilot tube o-rings
- Replacement pilot tube caps
- Replacement casing clips
- Pilot tube log

Batteries

- Minimum of two 1.5V D replacement batteries for target, of the same manufacturer
- Minimum of six AA replacement batteries for theodolite
- Minimum of three 392 button replacement batteries for laser bore sight

(continued on next page)

Recommended Tools & Equipment, Tools (continued)

Clean-Up
- Oil absorbent pads
- Rubber gloves
- Shop towels/rags
- Paint rollers for cleaning pilot tube interiors

TOOLS

Basic Mechanical Hand Tools
- Wrenches up to 1 1/8-in.
- Adjustable wrenches - 12, 15, 18-in.
- 1/2-in. up to 1 1/8-in. drive socket/ratchet set
- Allen wench set to 3/8-in.
- 3 lb. hammer
- Pry bar for casings
- Set of punches
- Large maul
- Shovels

Other Tools
- 4-ft. level for setting jacking frame elevation
- Welder and torch set
- Surveying equipment - transit level, grade rod, string line, and plumb-bobs
- Flash light
- Hydraulic bottle jack
- Bullet level
- Pilot tube gauge check tool
- Tarp or pop-up tent to keep guidance system dry

SUPPORT EQUIPMENT

- Bentonite/pipe lubricant (polymer)
- Marsh funnel for density checks
- Hydrant (preferred) or clean water supply
- Appropriately sized crane/excavator and rigging for equipment and pipe segments
- Generator 110VAC (for Pilot Tube Break Out Tool)
- Air compressor
- Air hammer
- Water pump and clean water supply
- Nitrogen tank minimum 80 cu. ft. for purging applications

NOTES

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.

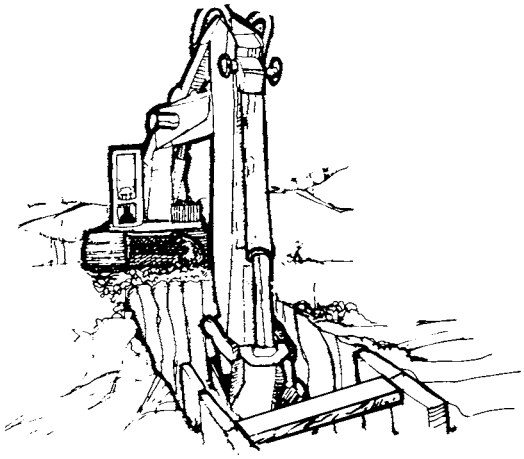
⚠WARNING Gases may be present during excavation and could cause severe personal injury or death. Use an approved air analyzer to detect hazardous gases on the job site and in the tunnel at all times.

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 (305 mm) of stone for a dry shaft or a 6 inch (152 mm) or more concrete base for a moist shaft. Consult your civil and structural engineers for your pit floor requirements.

4. If using stone for the shaft floor base, place road plates (1 inch [25.4 mm] 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.

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).



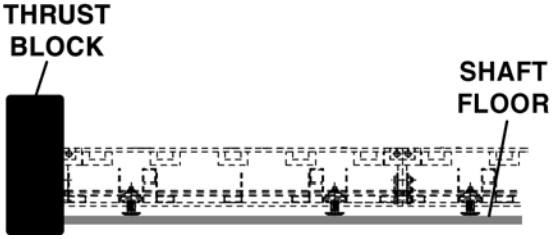
AEM is the original author and publisher of the above illustration



Auger Boring Shaft



Trenchbox Shaft with Steel Plate



NOTES

Operation - GBM Frame Set Up

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. Refer to *Lifting Instructions* in section 7, Transporting.



4. 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.

5. 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.

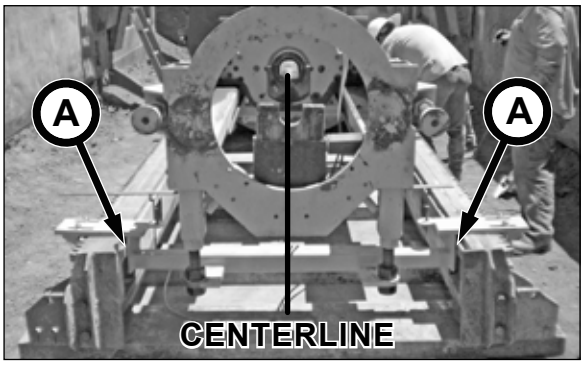
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Setting Up GBM With Auger Boring Machine (continued)

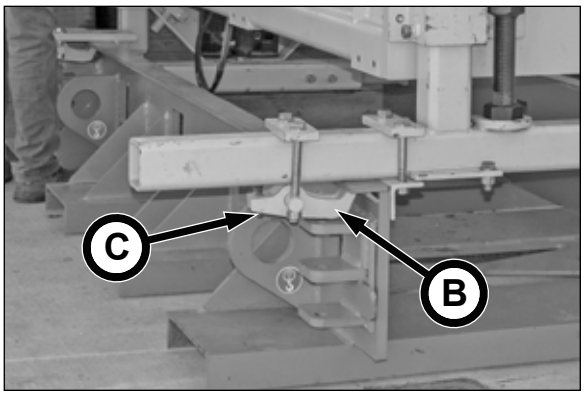
NOTICE The GBM frame centerline MUST be the on the same centerline as the auger boring machine.

6. Align the angle bracket stops inside and against the skid rails (A).

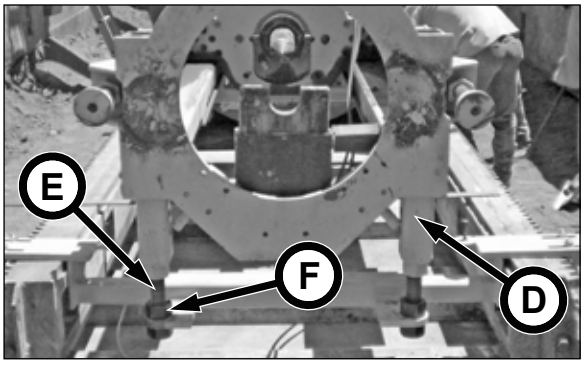
   Divide the rail inside measurement by two and then measure from the centerline of the front mount adapter to the angle bracket stops. The distance from centerline must be equal.



7. Install pivot clamp (B) to front leg extensions with four 3/4 UNC x 4 in. hex bolts and flat washers.
8. Secure front mount adapter or front leg extensions against top of rails by tightening pivot bolt (C) located at rear of clamp.

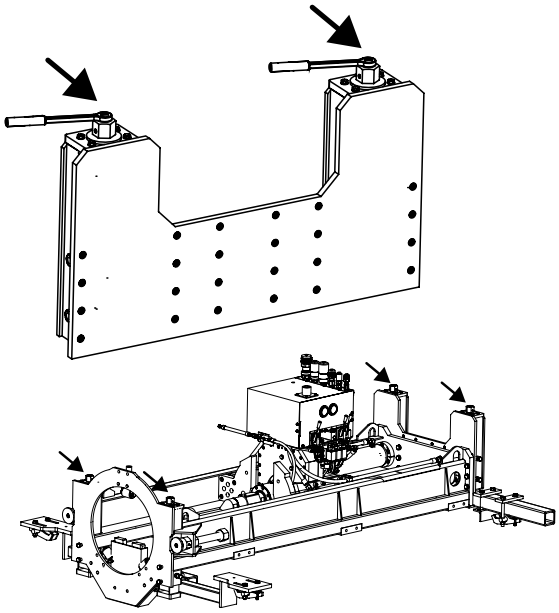


9a. If using the **240A jacking frame**, use the GBM frame's adjustable legs (D), screw rods (E) and nuts (F) to raise or lower the frame to the same centerline as the auger boring frame.



9b. If using the **GBM 240ABM**, adjust both frame height adjustment screws on each end at the same time using a 0.5 in. ratchet wrench.

   To adjust legs down, turn screws counterclockwise (CCW). To adjust legs up, turn screws clockwise (CW).



Setting Up GBM With Auger Boring Machine (continued)

10. After the GBM jacking frame is secured to the frame rails, install the auger boring machine onto the rails.



11. Use the cylinders of the auger boring machine to close the distance between it and the back of the GBM jacking frame, which serves as a backstop for the GBM jacking frame.

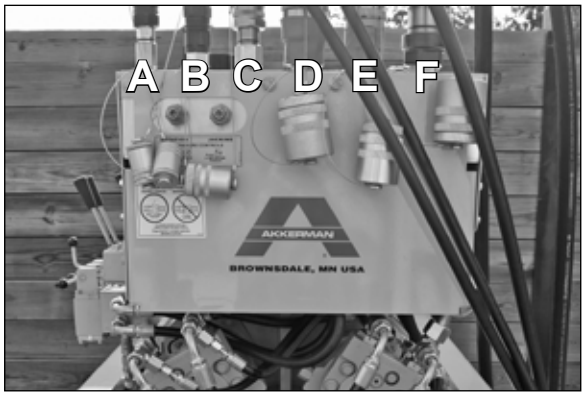
    If the auger boring machine master ring is larger than the 30 in., it is necessary to nest a wood board or steel plate between the master ring and the back of the GBM jacking frame to transfer thrust and maintain alignment.



12. 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.

13. With the power pack engine shut down, roll out the hydraulic hoses and connect the hoses to the GBM jacking frame hydraulic connections as shown: rotation load sense (A), thrust load sense (B), case drain (C), rotation pressure (D), thrust pressure, (E) and return (F). Refer to *Quick Coupler Installation* in this section.



14. Start the engine. Refer to *Starting The Power Pack* in this section, subsection *Power Pack Operation*.

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

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

NOTES

SETTING UP GBM AS STANDALONE SYSTEM

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

⚠WARNING Suspended loads may fall and cause severe personal injury or death. If a hydraulic hose breaks from the boom of a crane/excavator, or load support fails, the boom or load can fall instantly. Do not walk or stand under a load.



NOTICE The lower base assembly operates effectively without the need to remove the universal auger boring adapter.

1. Install base assembly (A) onto the GBM 240A/ ABM frame.

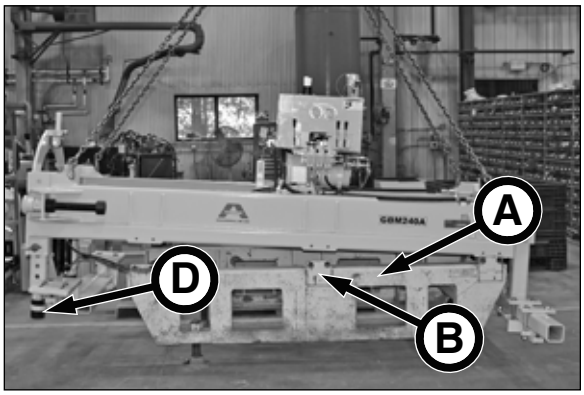
   a. Set the GBM 240A/ABM jacking frame on flat ground, and carefully hoist it about feet off the ground using a properly rated four-leg sling. Refer to *Lifting Instructions* in section 7, Transporting.

   b. Place the lower base assembly on flat ground, taking care to position the two crossbars towards the back of the 240A/ABM frame.

   c. Carefully lower the 240A/ABM onto the lower base, aligning the six mount plates (B) below the jacking frame gusset pockets.

   d. Secure lower base to the 240A/ABM using the twelve (12) 3/4 x 1.5 in. bolts and washers (C) provided with the lower base frame assembly (six on each side).

   e. If front load is expected on the project, remove the GBM jacking frame front two stabilizer legs (D), and replace them with the jack screw legs included in the lower base assembly (not shown).







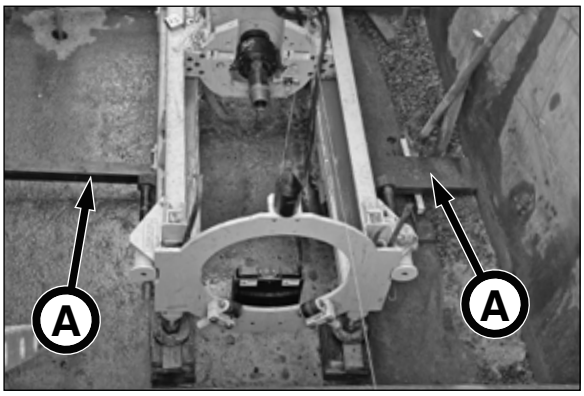
2. Carefully lower GBM frame into position in launch shaft. Use a properly rated four leg sling. Refer to *Lifting Instructions* in section 7, Transporting.

(continued on next page)

Setting Up GBM As Standalone System (continued)

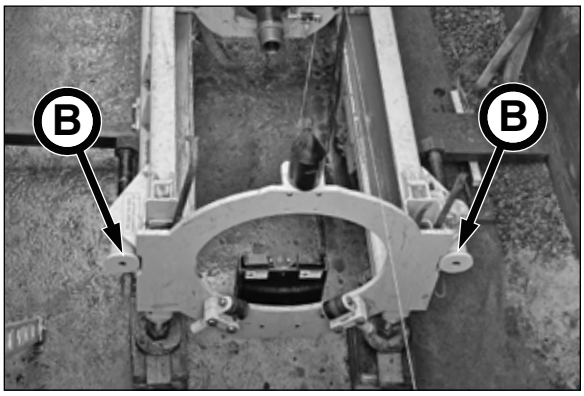
3. Start leveling and setting line, elevation, and grade of the GBM frame to the centerline of the pipeline/flowline based on surveying marks. Be sure to compensate for the steering head overcut (1/2 in. [13 mm]) and the reaming head or other upsizing tool overcut.

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



GBM frame bracing in standalone application

4. Secure GBM frame to shaft wall and/or floor (A) as needed to prevent the frame from moving while jacking. Tighten the shaft tensioners (B) against shaft wall or other braces. Periodically retighten the shaft tensioners during operation.



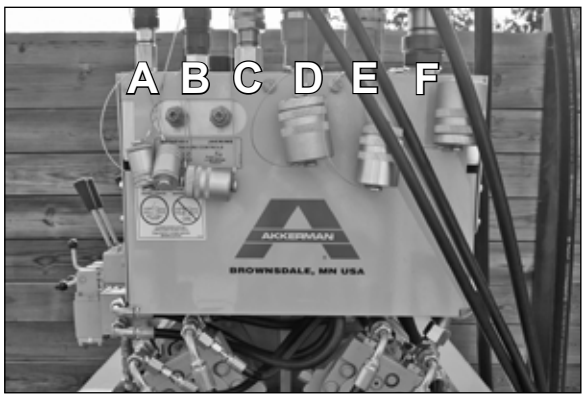
GBM frame shaft tensioners (shown retracted)

5. 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.



6. With the power pack engine shut down, roll out the hydraulic hoses and connect the hoses to the GBM jacking frame hydraulic connections as shown: rotation load sense (A), thrust load sense (B), case drain (C), rotation pressure (D), thrust pressure, (E) and return (F). Refer to *Quick Coupler Installation* in this section.



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

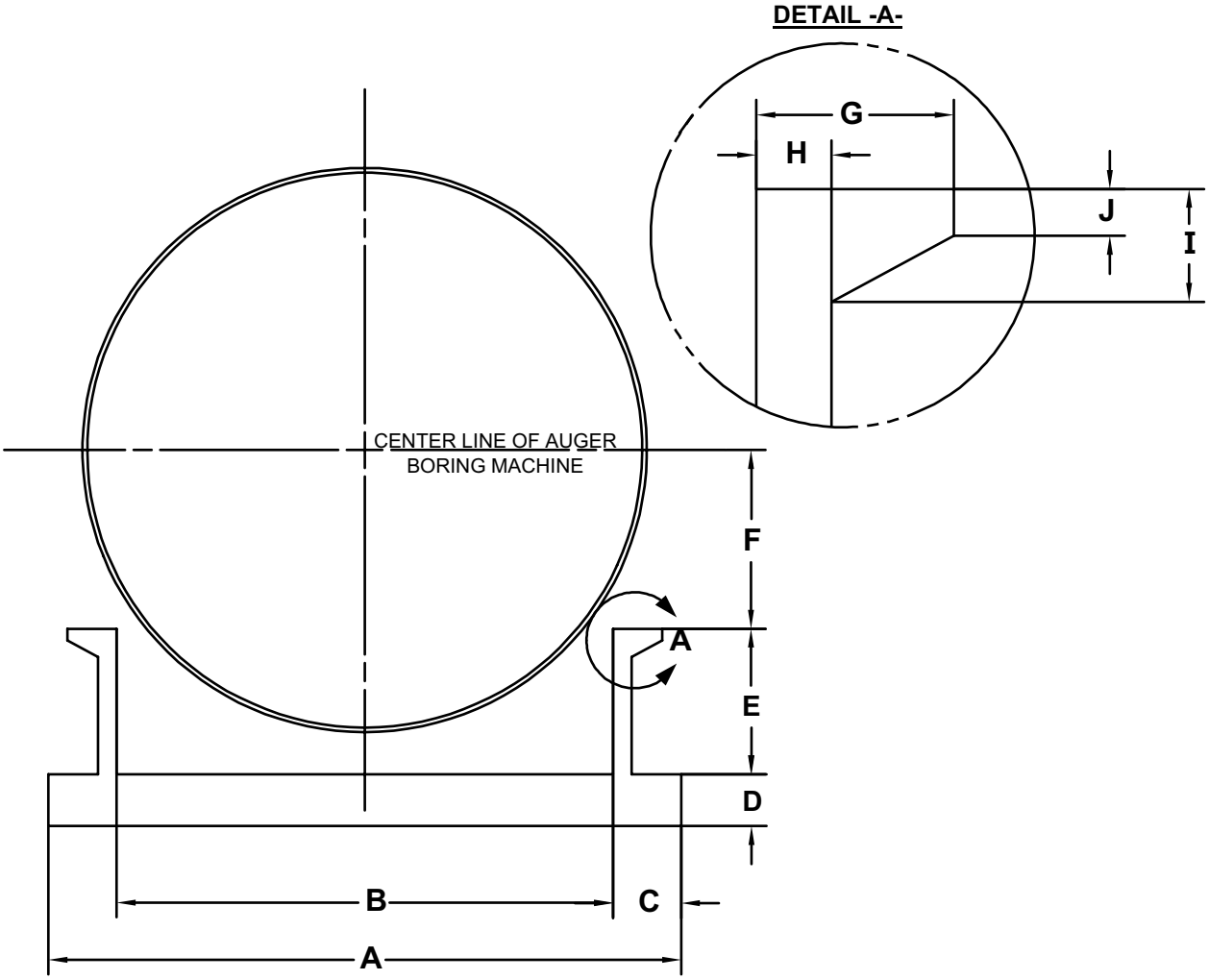
8. Check the hydraulic system for proper operation and that there are no leaks at the quick couplers.

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

AUGER BORING DATA SHEET

Due to the varying designs of auger boring machine track between manufacturers and model sizes, the GBM jacking frame is secured to the auger boring machine's track using the 240A/240ABM frame universal auger boring machine adapter.

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

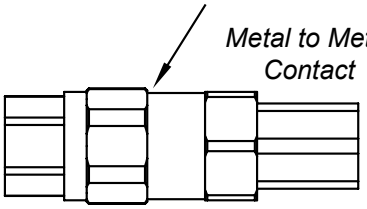


Auger Boring Base Dimensions	
Item	**Dimension**
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	

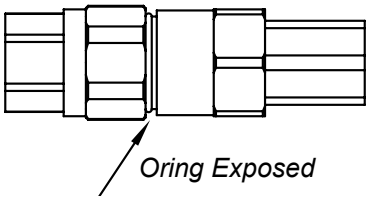
QUICK COUPLER CONNECTIONS

Use the following instructions to properly install the couplers. BEFORE installation, be sure to clean ALL mating surfaces to prevent contamination.

⚠WARNING IMPROPER CONNECTION HAZARD. To ensure proper coupling, female sleeve and male nipple MUST HAVE METAL TO METAL CONTACT. Partially exposed o-ring indicates improper coupling.



PROPERLY COUPLED



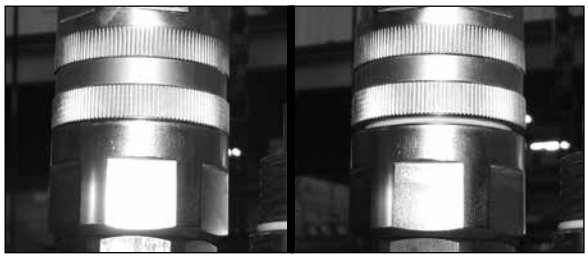
IMPROPERLY COUPLED

NOTICE NEVER clamp on the coupler sleeve. This will cause distortion, resulting in coupler damage.

GBM Quick Couplers
The quick couplers are used to connect and disconnect hydraulic lines quickly and easily without tools.

CONNECT
a. Hand tighten coupler by rotating clockwise (CW) until o-ring is no longer visible. If o-ring is visible, the connection is not locked.

DISCONNECT
b. Rotate hose coupler counterclockwise (CCW) until coupler is removed.



Connection Locked *Connection Unlocked*

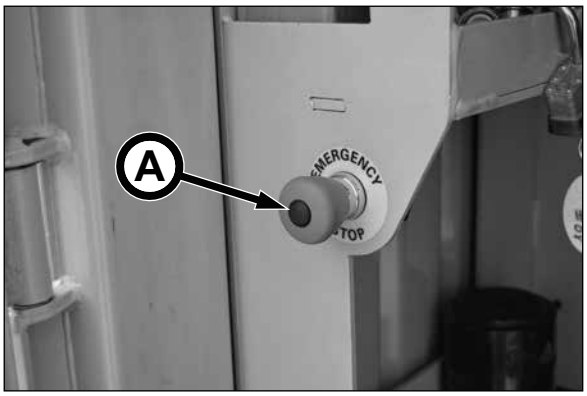
Operation - Power Pack Operation

USING EMERGENCY STOP

Push Emergency Stop (E-Stop) button (A) IN to stop all electrical and hydraulic functions.

The button will illuminate when it is pulled OUT.

This button must be pulled out to start/restart engine.



SETTING UP THE POWER PACK

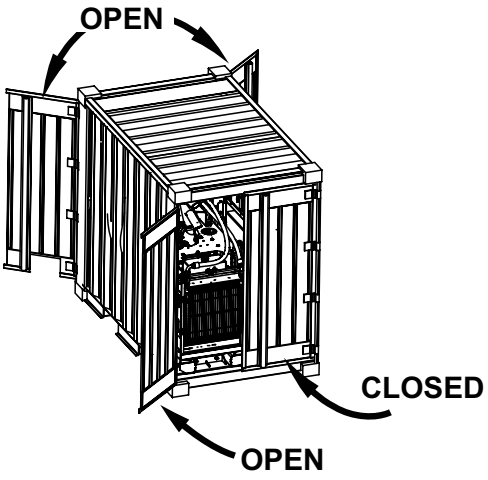
1. Position the Power Pack on firm, level ground at the top of the launch shaft.

⚠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.



2. **IMPORTANT:** Three container doors MUST be open (as shown) while engine is running to allow proper engine ventilation. Running engine with doors closed WILL cause engine damage.

Front, Hose Reel End



Back, Engine & Radiator End

Setting Up The Power Pack (continued)



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

4. Clean hose connections prior to connecting hoses.



5. Connect hydraulic hoses from the power pack to the GBM jacking frame connections BEFORE starting engine.

   Start connecting the hoses from the right quick coupler and work your way to the left, beginning with the return line. Unwind the return hose from the power pack and pull it toward the GBM jacking frame. Remove the cap from the return line quick coupler on the GBM jacking frame, then connect the hose.

   Refer to *GBM Quick Coupler Connection* in this section to properly install hoses to quick couplers.

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

STARTING THE POWER PACK

NOTICE Refer to your engine Operating manual for detailed information on the proper break-in/cold weather starting and operation of your engine.

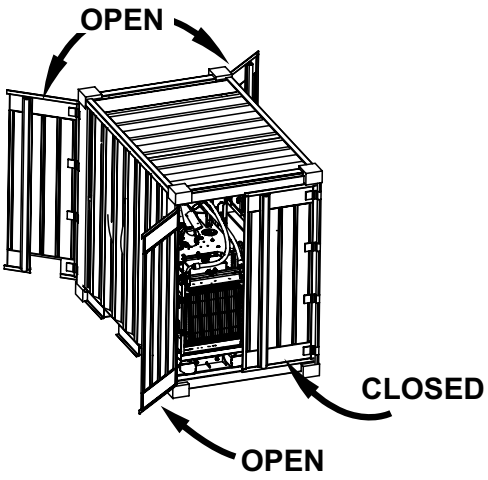
1. Check engine oil level. Add oil as necessary.



2. Open three container doors as shown.

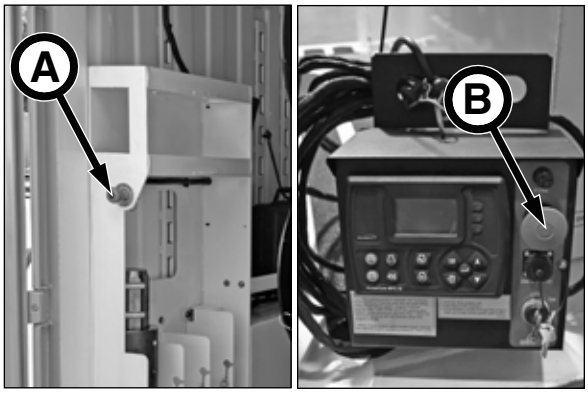
   IMPORTANT: Three container doors MUST be open while engine is running to allow proper engine ventilation. Running engine with doors closed WILL cause engine and component damage.

Front, Hose Reel End



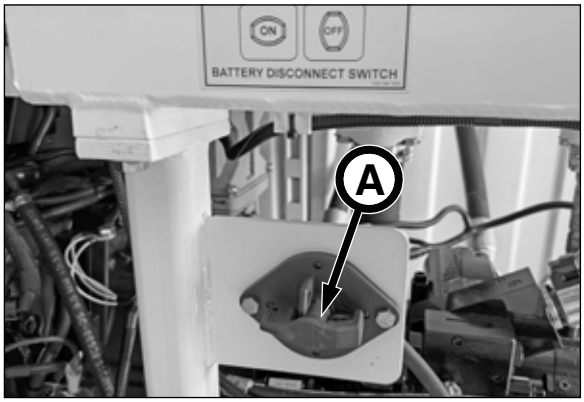
Back, Engine & Radiator End

3. Be sure Emergency Stop (E-Stop) buttons are pulled out on the Power Pack (A) and the control pendant (B).



(continued on next page)

Starting The Power Pack (continued)



4. Turn Battery Disconnect Switch (A) CW to ON position to power electrical control box and control pendant.

NOTICE All E-Stop buttons must be pulled out for engine/motor to start.



NOTICE Do not operate starter for more than 20 seconds at a time. Doing so may cause the starter to overheat.

5. Turn key switch (B) CW to ON position. Push Start Key soft key; the engine will crank. When the engine starts, release the soft key.



6. After engine starts, idle engine at no more than 900 rpm until warm.

7. Watch temperature reading. Do not place engine under full load until it is properly warmed up.

8. Check all readings for normal engine operation while using the GBM. If operation is not normal (refer to your engine Operator's Manual), stop the engine and determine the cause.

NOTICE For the cooling pump to operate, the hydraulic oil temperature must be over the set point temperature of the temperature switch, engine must be running over 1,000 RPM and both jacking and rotation pump pressures are less than 1,000 PSI. The cooling pump will not operate when the engine is at idle.

STOPPING THE ENGINE

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



1. Run engine at 900 rpm for at least two minutes to cool.

2. Push Stop Key soft key; the engine will shutdown.



3. Turn key switch CCW to OFF position.

4. Remove ignition key to prevent any accidental starting.

CHECK HYDRAULICS AFTER ENGINE START-UP

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

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

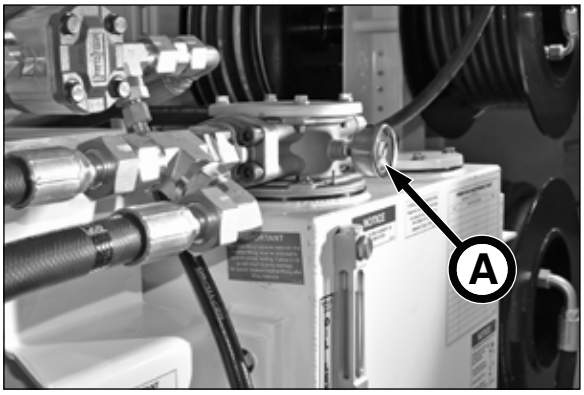
DO NOT use your hands to check for leaks. When searching for leaks, use a piece of wood or cardboard.

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

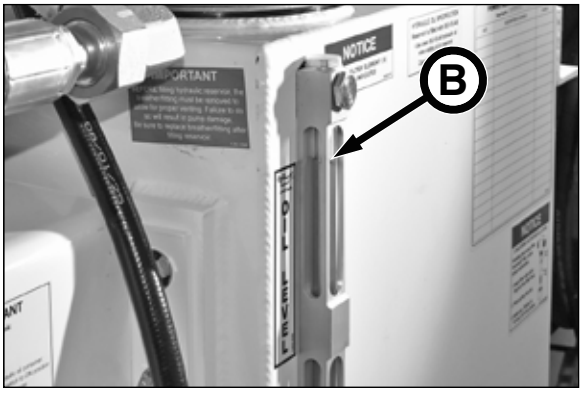


1. Check return filter indicator (A). Once operating temperature reaches at least 100°F (38°C), if the filter indicator needle is in the red CHANGE zone, replace filter. Refer to section 9, Periodic Maintenance for filter replacement instructions.

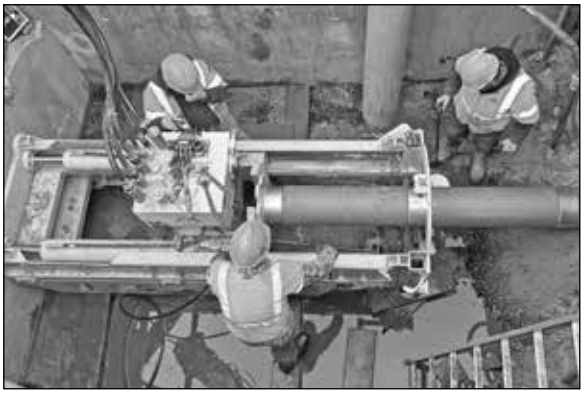
2. Check hydraulic components and hoses for leaks. Repair or replace as needed.



3. Check hydraulic reservoir oil level (B). Add as needed. Refer to *Power Pack Hydraulic Oil Reservoir Lubricant* in section 8, Fuels & Lubricants for the proper oil specification.



ADJUSTING THRUST PRESSURE

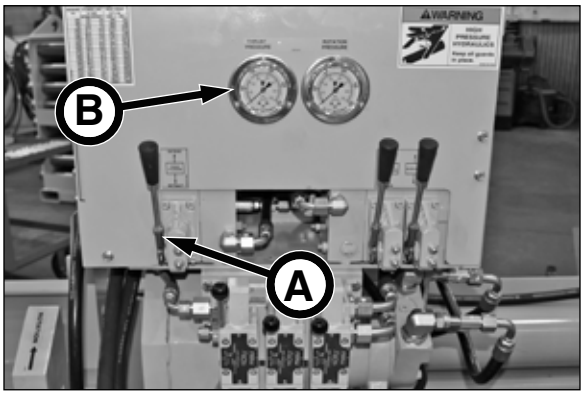


NOTICE To protect your product pipe, you must be sure the product pipe rating can withstand the GBM jacking frame thrust pressure. The factory setting is 5,000 psi (34.474 mPa). If your pipe is rated for less than that, you must lower the GBM jacking frame thrust pressure to match your pipe's limit. Failure to do so will break the pipe.

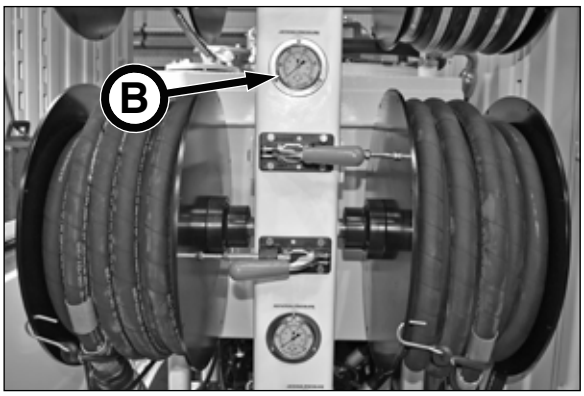
1. Check the thrust pressure rating for your product pipe.

PRESSURE PSI	CYLINDER LOAD IN TONS		DRIVE TORQUE IN Ft / lbs	
	EXTEND	RETRACT	LSHT	HSLT
250	4.9	2.5	530	353
500	9.8	5.0	1060	706
750	14.8	7.5	1590	1059
1000	19.7	10.0	2121	1413
1250	24.6	12.5	2651	1766
1500	29.5	15.0	3181	2119
1750	34.4	17.5	3711	2472
2000	39.4	20.0	4241	2825
2250	44.3	22.5	4771	3178
2500	49.2	25.0	5301	3531
2750	54.1	27.5	5831	3884
3000	59.1	30.0	6361	4239
3250	64.0	32.5	6891	4592
3500	68.9	35.1	7421	4945
3750	73.8	37.6	7951	5298
4000	78.7	40.1	8481	5652
4250	83.7	42.6	9015	6006
4500	88.6	45.1	9545	6359
4750	93.5	47.6	10075	6712
5000	98.4	50.1	10605	7065

2. Calculate the pressure limit for your product pipe and refer to the thrust pressure chart. Every 1,000 psi equals 20 tons of thrust pressure.



3. With the hydraulic hoses connected to the GBM jacking frame and the power pack engine running, fully retract the GBM jacking frame cylinders by using the thrust cylinder control (A).



4. Check the GBM jacking frame thrust pressure gauge (B) or power pack jacking (thrust) pressure gauge.

   Check operating pressure by retracting the jacking cylinders and holding lever after the cylinder base has stopped moving. Observe pressure on gauge.

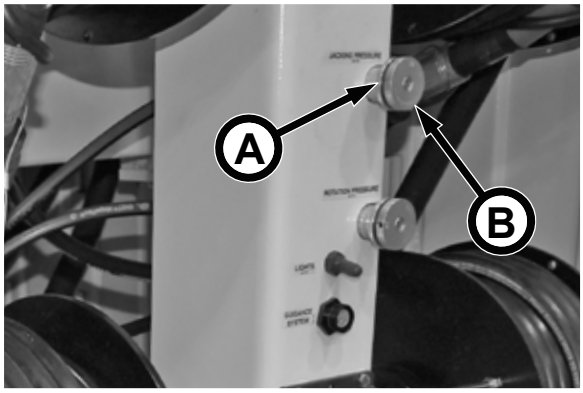
(continued on next page)

Adjusting Thrust Pressure (continued)

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

If the jacking (thrust) pressure must be decreased, loosen lock collar (A) and turn adjustment dial (B) OUT. Once the pressure is properly adjusted, tighten lock collar.

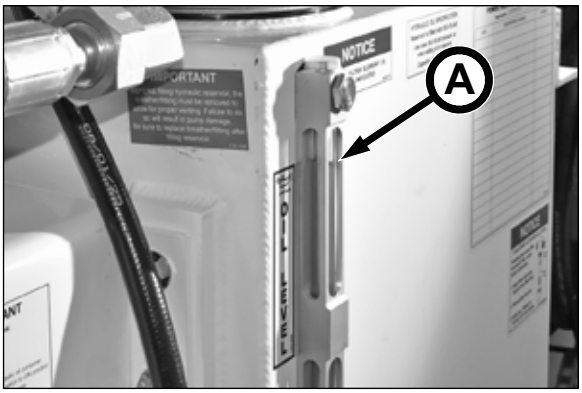
If the pressure needs to be increased, loosen lock collar (A) and turn adjustment dial (B) IN. Once the pressure is properly adjusted, tighten lock collar.



Jacking (Thrust) Pressure Lock Collar and Adjustment Dial

FILLING HYDRAULIC OIL RESERVOIR

Check hydraulic tank oil level gauge (A). The power pack is typically filled with ISO-VG-46 Premium Hydraulic Turbine Oil.



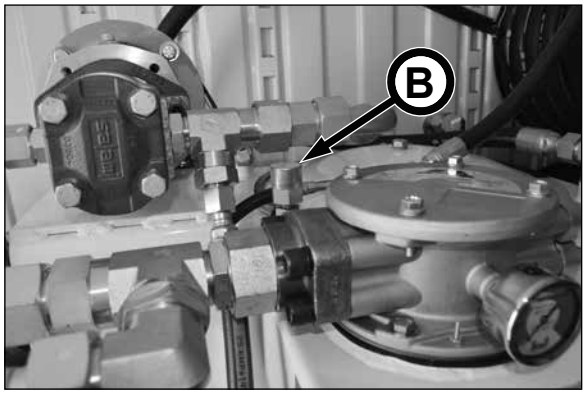
NOTICE Refer to *Fuels & Lubricants* section for recommended hydraulic oil and ambient operating temperatures.

If the fluid level in the reservoir is less than 3/4 full, fill the reservoir with as follows:

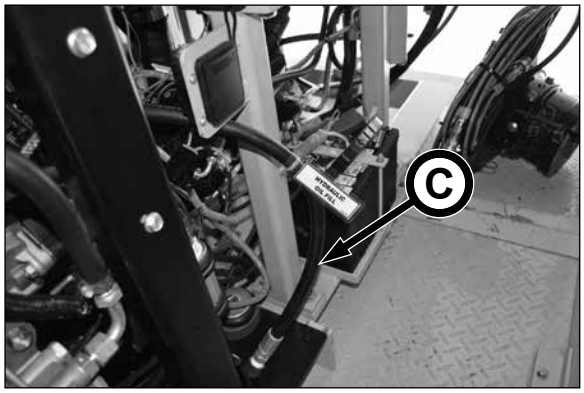
1. Retract thrust cylinders on GBM frame.

2. Shut down engine.

IMPORTANT: BEFORE filling hydraulic reservoir, you must remove the breather/fitting to allow for proper bleeding. Failure to do so will result in pump damage. Be sure to replace breather/fitting after filling reservoir.



3. Remove breather/fitting (B) from reservoir BEFORE filling reservoir to allow for proper bleeding during filling process.



4. Remove hydraulic oil fill hose (C) from storage location. Remove cap from hose.



5. Place hose into clean hydraulic oil container.

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Filling Hydraulic Oil Reservoir (continued)

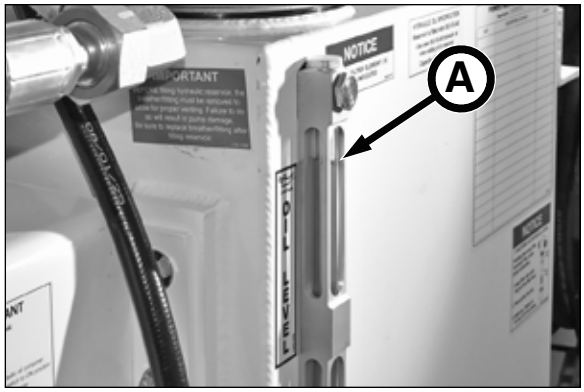
6. Flip Oil Fill Pump switch to the ON position to pump hydraulic oil into the hydraulic reservoir.



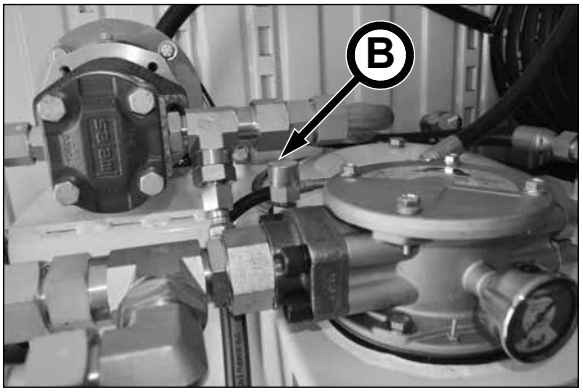
7. Fill until oil reaches the high mark on gauge (A).

NOTICE Be sure the GBM frame thrust cylinders are retracted.

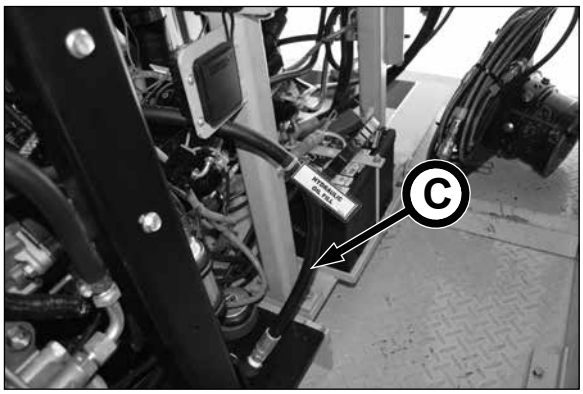
8. Flip the Oil Fill Pump switch to the OFF position.



9. Replace breather/fitting (B) on reservoir.



10. Replace cap on fill hose (C) and place hose in storage location.



DAILY SHUTDOWN

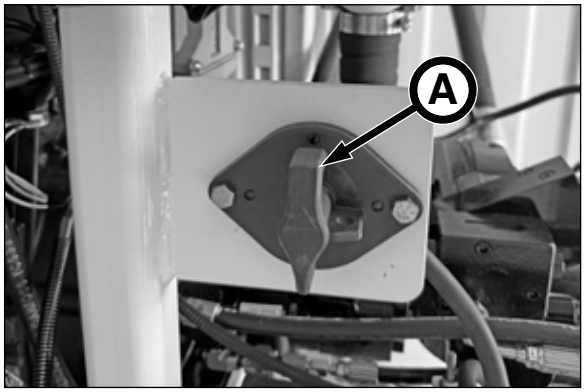


1. Shutdown engine.

   Push Stop Key soft key; the engine will shutdown.



2. Turn key switch counterclockwise (CCW) to OFF position and remove ignition key.



3. Turn Battery Disconnect Switch (A) CCW to OFF position to power down electrical control box and control pendant.



NOTICE If desired or required by the contractor, the battery disconnect switch can be used as an additional lockout tagout for the power unit. Refer to *Lockout Tagout Procedure Guideline* in section 1, Safety.

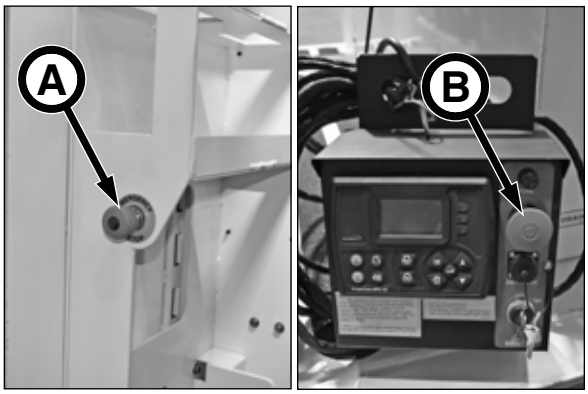
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Daily Shutdown (continued)

4. Check for leaks. Clean up as needed.



5. Push IN E-Stop button on the Power Pack (A) and control pendant (B).



6. Perform lockout tagout on the power pack. Refer to *Lockout Tagout Procedure Guideline* in section 1, Safety.



Operation - Guidance System Setup

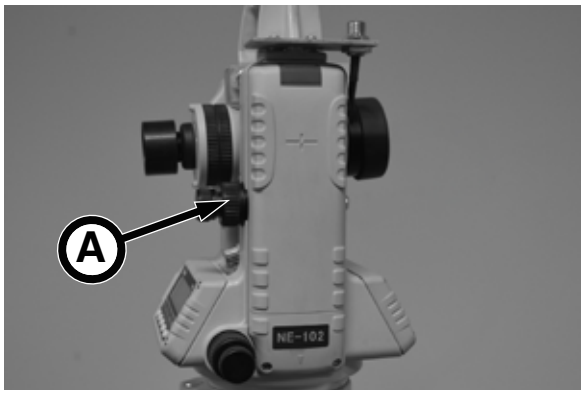
CHECKING THEODOLITE ZERO POINT CALIBRATION

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 ft (0.6 m) per 100 ft (30.5 m) in the drive.

1. Move the telescope 90° vertically and press the drive motor and camera assemblies to compress the spring. Gently remove the remote focus drive belt. Retain for later.



2. Move telescope to the horizontal position and lock position with vertical course adjust lock knob (A).

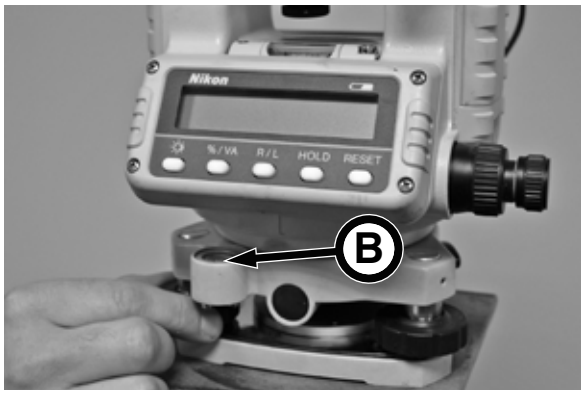


3. Remove the 40X eyepiece with barrel by unscrewing it from theodolite until resistance is felt, then turn an additional 3/4 turn.

4. Install the 30X eyepiece on telescope.

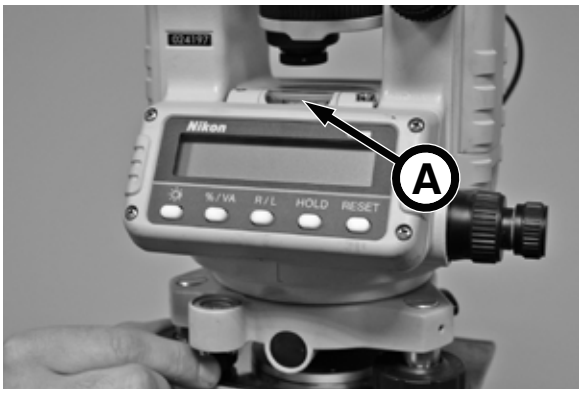


5. Conduct a preliminary theodolite level by watching the bubble in the circular level (B) and adjusting the leveling screws.



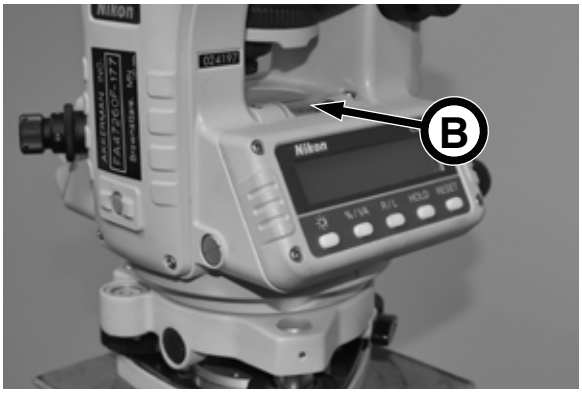
(continued on next page)

6. Perform additional theodolite leveling using the plate level bubble (A) while making adjustments using the leveling screws.



7. Rotate theodolite 90° and level it again, using the plate level bubble (B) while making adjustments using the leveling screws.

NOTICE It is easier to level theodolite in step 7 if you use the same two leveling screws that you used in step 6.

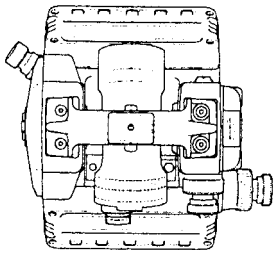


8. Repeat steps 6 and 7 until theodolite is level in both directions.

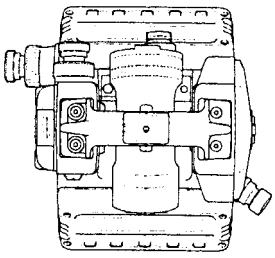
9. Once theodolite is level, rotate theodolite 180° and check plate level (B) to ensure the theodolite is completely level.

   If theodolite is not level, proceed to step 10.

   If theodolite is level, proceed to step 12.

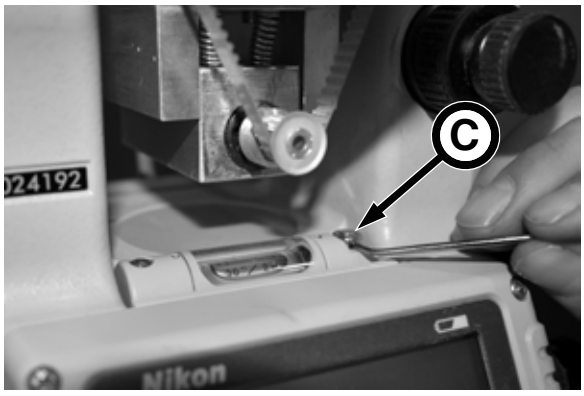


Theodolite Leveled In Step 7



Theodolite Rotated 180° To Check Level In Step 9

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



11. Relevel theodolite (repeat steps 6 through 9).

12. Turn theodolite ON.



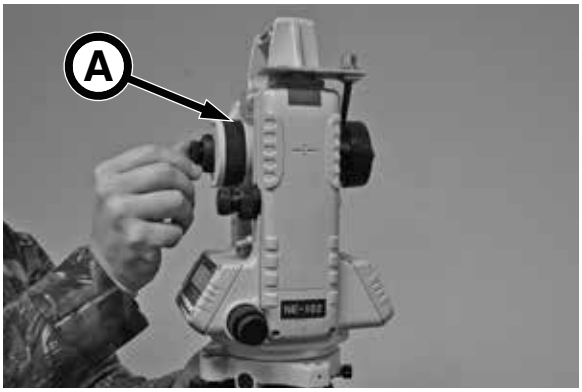
13. “TILT TELESCOPE” is shown on the theodolite LED display. While holding telescope, loosen vertical adjustment/lock, then use the vertical fine adjust until the vertical alignment on the display reads, VA: 90° 00’ 00”.



14. Look through the telescope and 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 crosshairs are well defined while viewing.



(continued on next page)

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.



15. Once the stationary object is positioned in the crosshairs, press the RESET (A) button. The LED display will read HA: 00° 00’ 00”.

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



16. 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 equal 180°.



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



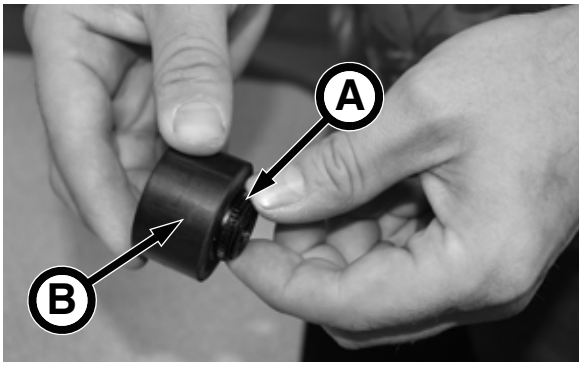
18. Look into the telescope. The stationary object should be within the crosshairs.

19. If the stationary object is not within the crosshairs, the theodolite is out of adjustment and must be recalibrated. Refer to the Nikon Theodolite Instruction Manual, “Vertical Circle Zero Point Error.”

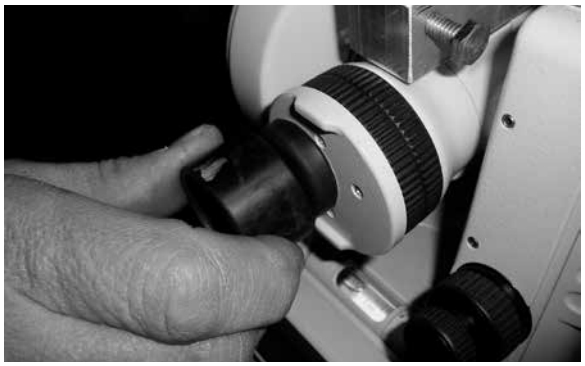
20. Remove the 30X eyepiece from telescope.



21. Replace the 40X eyepiece with barrel as follows:



a. While holding 40X eyepiece (A) by the knurled section, unscrew barrel section (B) counterclockwise (CCW) from eyepiece until finger tight, so focus is fully extended (the knurled section of eyepiece must not be against the barrel section).



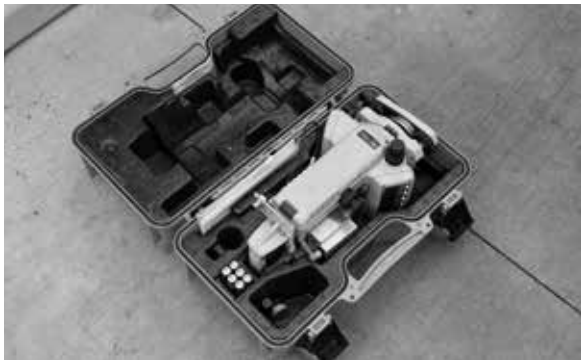
b. Screw eye piece/barrel assembly into theodolite until resistance is felt, then turn an additional 3/4 turn. Do not bottom out barrel to prevent overtightening. If you feel you have overtightened, repeat steps 21a and 21b.

NOTICE DO NOT OVERTIGHTEN. Overtightening will cause eyepiece focus failure.

22. Replace the remote focus drive belt by pinching the drive motor and focusing ring to compress the spring. Ensure the grooves in the belt are positioned properly.



23. Carefully return theodolite to storage case. Secure case.



INSTALL GUIDANCE SYSTEM THEODOLITE STAND

The Guidance System Mounting Stand is designed for use with most auger boring machine skid when the shaft/pit width allows.

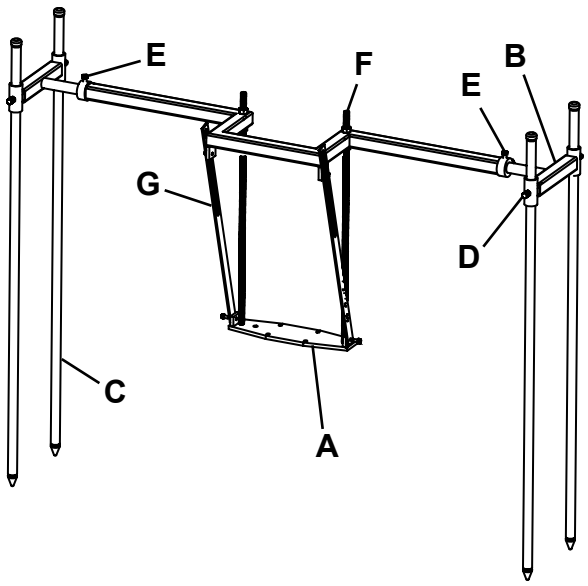
1. Install the guidance system theodolite stand. Center the theodolite pad (A) between the frame rails.

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

NOTICE Position theodolite stand rods at least six inches from skid and as least six inches from the shaft wall so the stand does not contact any moving parts outside the ground disturbance of the auger boring machine (if applicable).

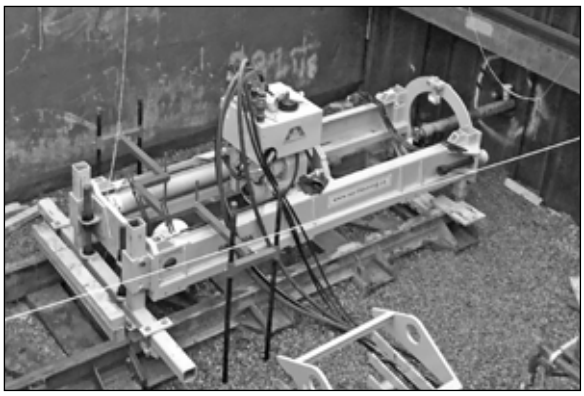
3. Lower the frame over the rods so the frame does not touch the GBM frame or any moving parts and secure to frame with set screws.

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



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

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



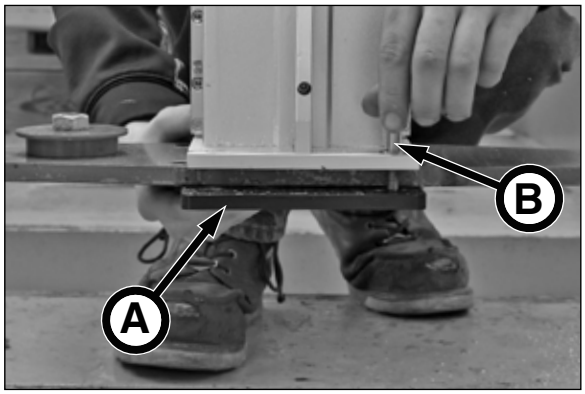
IMPORTANT: It is critical to check the zero point calibration of the theodolite before using in launch shaft. If the theodolite gets bumped, jarred, or dropped, the calibration must be checked. Failure to check this calibration could cause misalignment in your line and grade. Keep in mind, if the theodolite is misaligned one degree, you will be off nearly two ft. (0.6 m) per 100 ft. (30.5 m) in the drive. See *Checking Theodolite Zero Point Calibration* in this section.



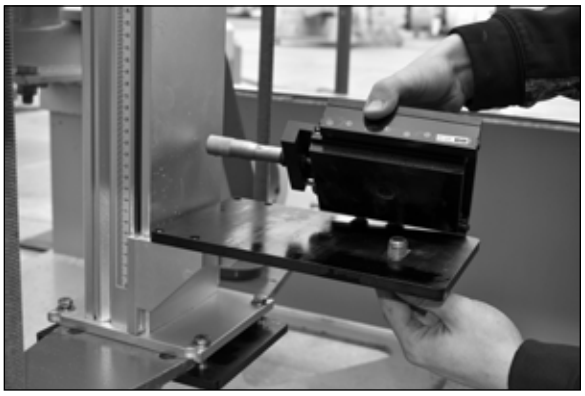
6. Lower and center elevator column and onto theodolite pad.



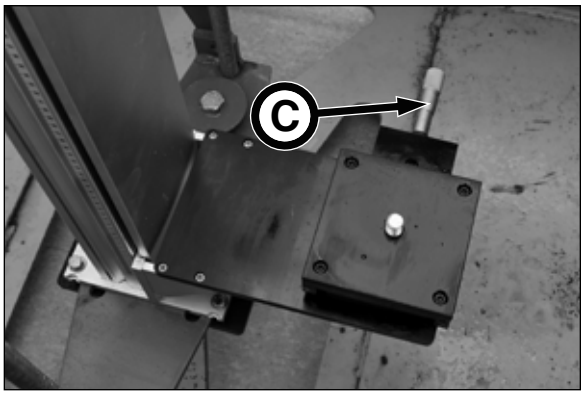
7. Position and center elevator column mounting plate (A) under the mounting stand theodolite pad and secure it to the elevator column base with four 5/16 x 1-3/4 in. bolts (B) using 1/2 in. wrench. DO NOT overtighten.



8. Screw lateral slide to elevator column plate brass stud until snug. Hand tighten only. Do not overtighten.



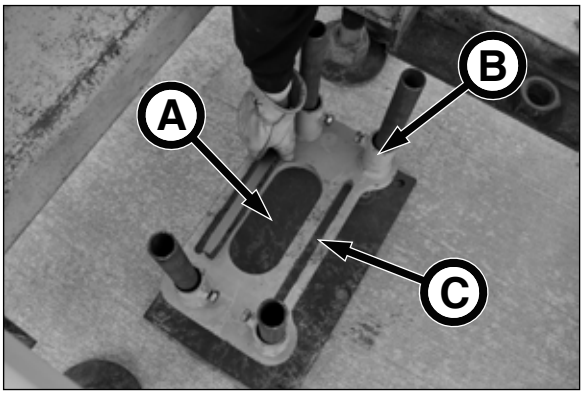
9. Turn lateral slide handle (C) 90° towards operator side of the jacking frame. Tighten elevator column plate brass stud using 15/16 wrench on the underside of the plate. DO NOT overtighten.



10. Proceed to *Assembling the Guidance System*.

INSTALL GUIDANCE SYSTEM MOUNTING BASE

Use the Guidance System Mounting Base with extra wide auger boring machine skid or when the shaft/pit width is limited.



1. Install the guidance system mounting base at the rear of the jacking frame. Position it so the slots and oval opening (A) are horizontal to the frame rails, then center it between the frame rails.

Note: Though the photos in this section depict the mounting base installed on concrete, the mounting base rods must be installed in gravel to properly support the theodolite.

2. Using the mounting base as a guide, drive the four rods through the base (B) and into the ground until they are in solid material. The base must have at least a 3 in. (76 mm) clearance on the bottom side of the plate to mount the theodolite stand/elevator column.

NOTICE Position the mounting base and rods so they do not contact any moving parts.



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

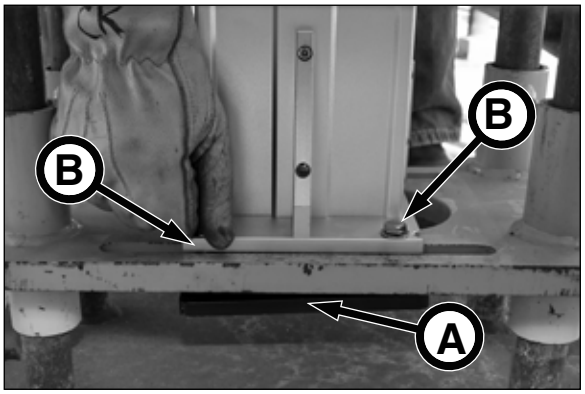


4. With the base level, secure the base to the rods with four set screws.

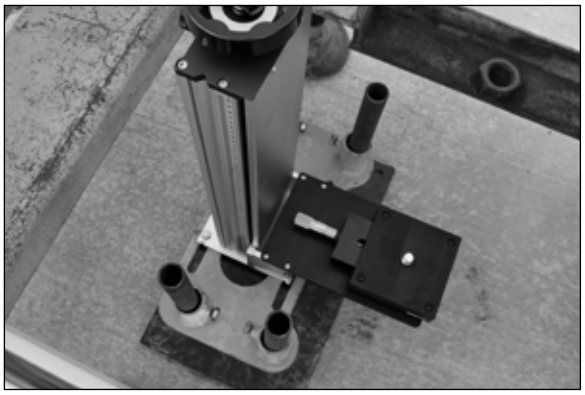
5. Lower and center elevator column onto mounting base with mounting plate.



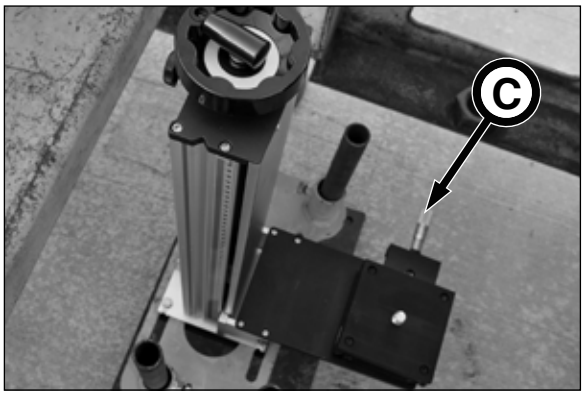
6. Position and center elevator column mounting plate (A) under the mounting stand theodolite pad and secure it to the elevator column base with four 5/16 x 1-3/4 in. bolts (B) using 1/2 in. wrench. DO NOT overtighten.



7. Screw lateral slide to elevator column plate brass stud until snug. Hand tighten only. DO NOT overtighten.



8. Turn lateral slide handle (C) 90° towards operator side of the jacking frame. Tighten elevator column plate brass stud using 15/16 wrench on the underside of the plate. DO NOT overtighten.

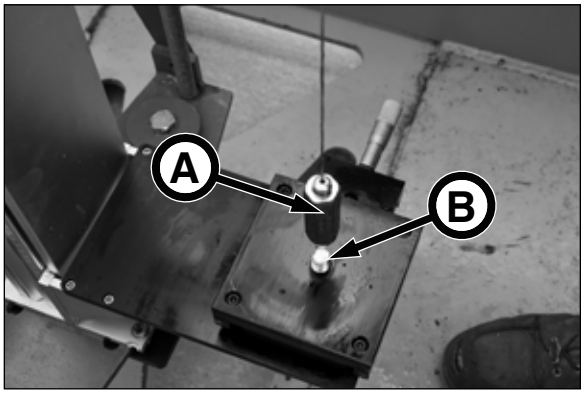


9. Proceed to *Assembling the Guidance System*.

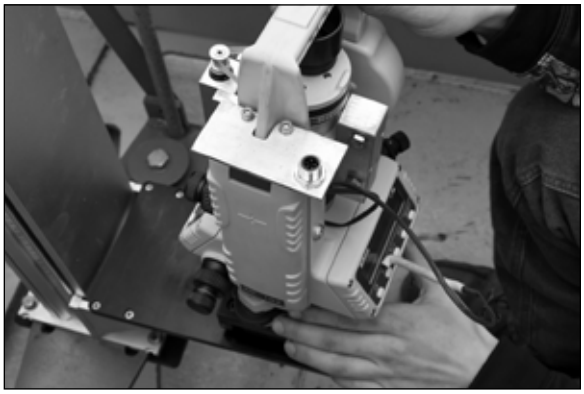
ASSEMBLING GUIDANCE SYSTEM

1. Center back plumb bob (A) over lateral slide brass stud (B).

   Ensure plumb bob and stringline are centered over brass stud. Make theodolite stand adjustments as necessary to achieve alignment with stringline.



2. Attach theodolite to lateral slide by threading theodolite base clockwise (CW) onto the brass stud until snug. DO NOT overtighten.



3. Remove battery cover.

NOTICE Check theodolite battery power before setting up for each drive. The battery power is shown on the theodolite display panel.

4. Separate cover from battery holder.



5. Install six new AA alkaline batteries into battery holder.



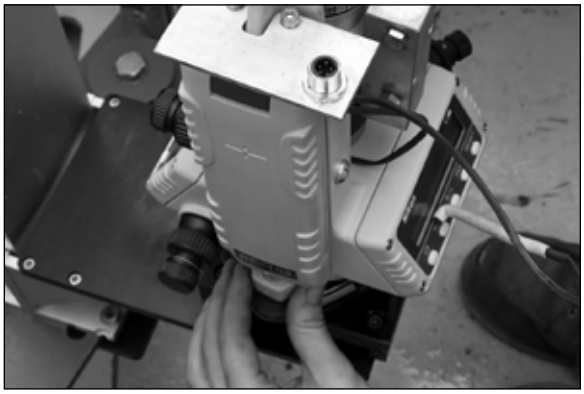
6. Secure battery holder into cover and replace cover.



7. Level theodolite with leveling screws on the theodolite base.

8. Rotate theodolite 90° and adjust until level.

9. Repeat steps 7 and 8 until theodolite is level in both directions.

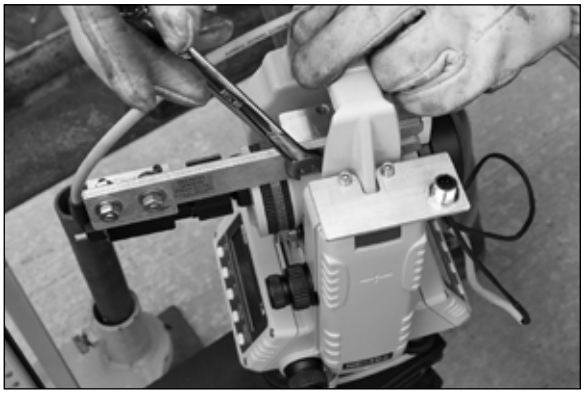


10. Install camera to theodolite. Tighten with 7/16 in. wrench.

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

NOTICE Be sure vertical lock is not set on theodolite.

NOTICE If crosshairs are not centered vertically on monitor, loosen camera mounting bolts to make adjustment, then retighten mounting bolts.



11. Remove telescope lens cap.



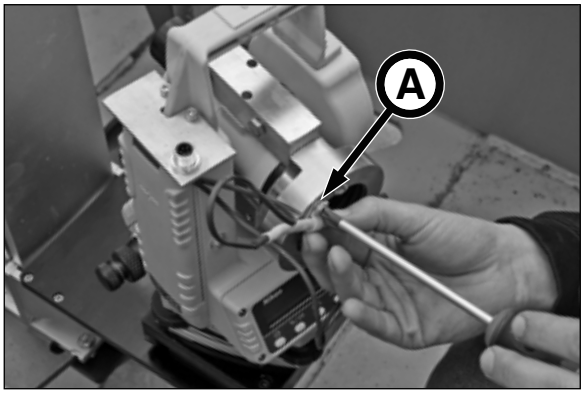
(continued on next page)

Assembling Guidance System (continued)

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



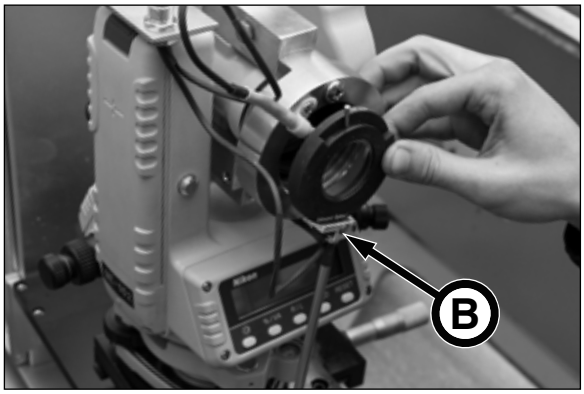
13. Secure LED light cable (A) to counterweight with #6 screw included in camera assembly.



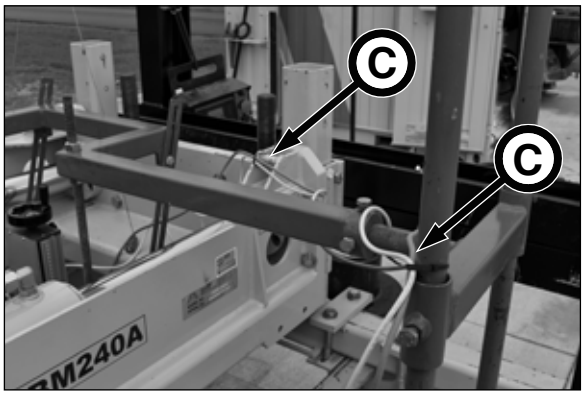
14. Install iris screw (B) and rotate iris into place over theodolite lens. Use the iris to control the amount of light coming through the lens.

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

NOTICE BEFORE powering up guidance system and power pack, refer to *Monitor Assembly Start Up & Operation* in this section.



15. Secure camera cables in two places (C), often on the mounting stand, to prevent interference with the theodolite calibration. Provide sufficient cable slack to accomondate theodolite rotation.

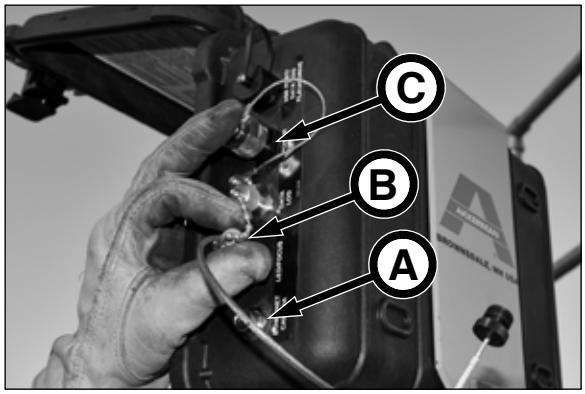


Assembling Guidance System (continued)

16. Install guidance system monitor assembly onto GBM frame mount. Tighten the knob to secure it.



17. Unthread and remove the monitor connection covers for Ethernet Camera (A), LED Focus (B) and Power In (C) connections.



18. Connect other end of the Ethernet Camera cable to Ethernet Camera connection on monitor.

    Be sure connection is free of debris. Align the cable keyway (D) with the slot in the monitor connection.



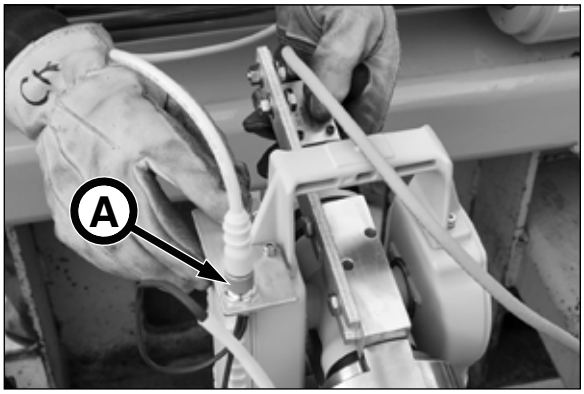


Ethernet Camera cable alignment keyway

(continued on next page)

Assembling Guidance System (continued)

19. Connect LED Focus cable connection (A) to theodolite.



20. Connect the other end of LED Focus cable to the LED Focus connection on monitor.

    Be sure connection is free of debris. Align the cable keyways with the slots in the monitor connection.



21. Connect the Guidance System 3 pin cable to the Guidance System connection on the power pack tower (between the hose reels).

    Align the Guidance System cable keyway with the slots in the power pack tower and monitor connections.



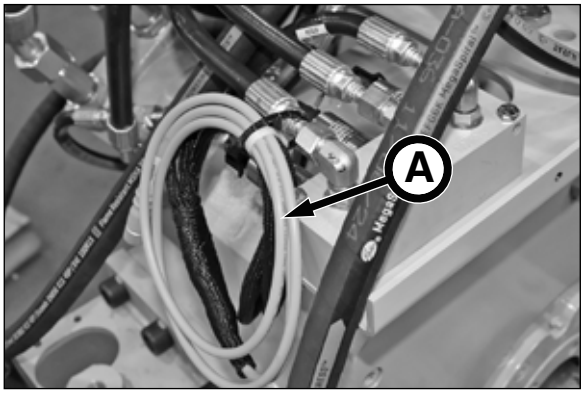
22. Connect the other end of the Guidance System cable to the Power In connection on the monitor.

    Be sure connection is free of debris. Align the cable keyway with the slot in the monitor connection.

IMPORTANT: Always connect the Guidance System cable to the monitor last, but before the data logging cable (if used).



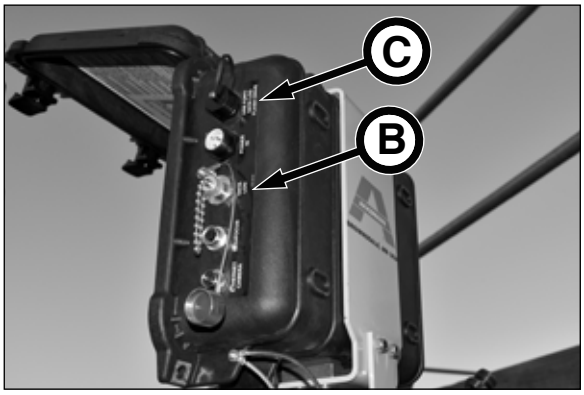
Assembling Guidance System (continued)



23. If pressure data logging is needed, connect pressure transducer cable (A) from jacking frame [shown on frame without manifold cover] to Data Log (B) connection on monitor.

    If using data logging, insert USB flash drive into the USB Port/Data Log Flash Drive (C) connection.

NOTICE Akkerman Guidance System Monitors are equipped with a Data Log connection (B) to record thrust and rotation PSI. To record PSI data, PRIOR to start up, connect pressure transducer cable on GBM frame to Data Log (B) connection. The pressure data will record to the log file.



24. Proceed to *Preliminary Theodolite Set Up For Line & Grade.*

PRELIMINARY THEODOLITE SETUP FOR LINE & GRADE

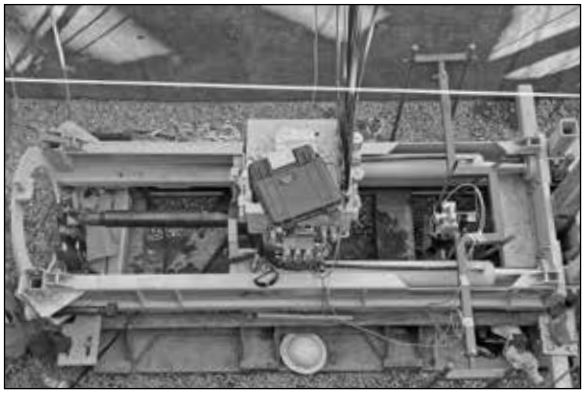


⚠WARNING Falling plumb bob can cause serious personal injury or death, and/or equipment damage.

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.

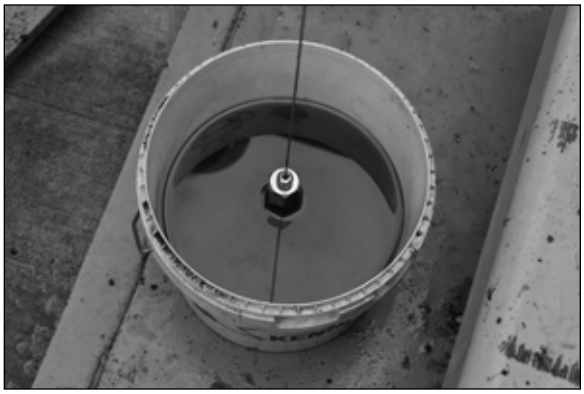
1. Using the surveying marks on edge of shaft, run a string line between these two marks to set the line of the theodolite.



a. Tie two lines with plumb bobs to transfer the surveying marks to the shaft floor.

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

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



c. Suspend the plumb bob into container 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 container.

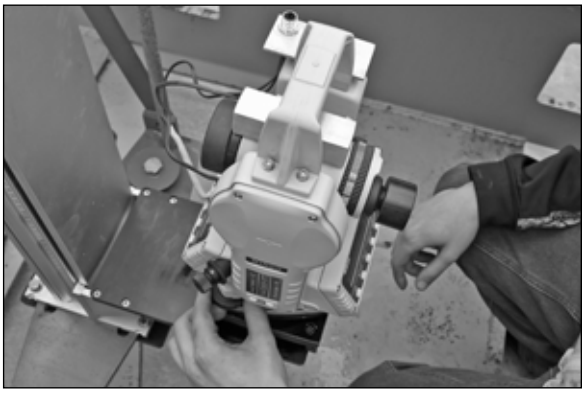
d. Position a second line and plumb bob at the front end of jacking frame as far forward as possible. Suspend plumb bob into container of oil.



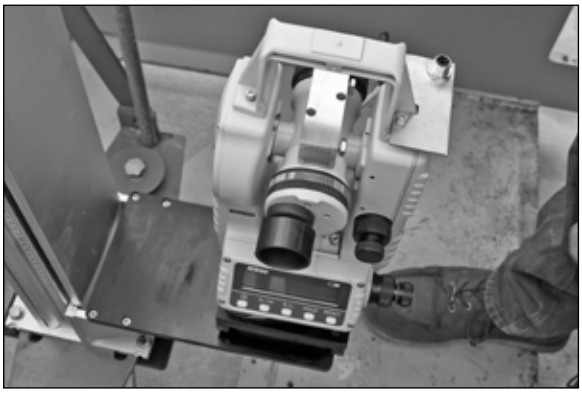
NOTICE Be sure plumb bob is free to move in oil. Do not allow the plumb bob to touch the bottom or sides of container.

LEVELING THEODOLITE

2. Level theodolite using leveling screws.



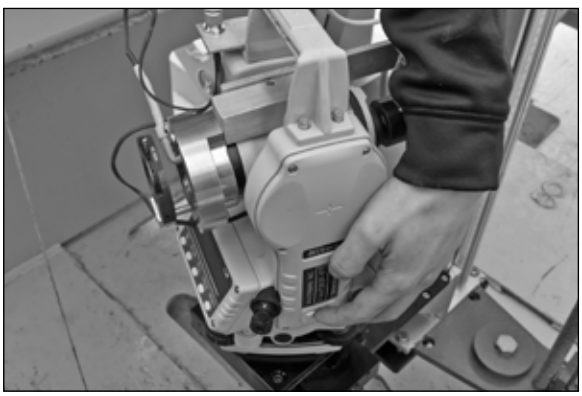
3. Once theodolite is level, rotate the theodolite 90° and adjust until level.



4. Using plate level as a reference, repeat steps 2 and 3 until the theodolite is level (A) in all directions.



5. Press Power button to turn ON theodolite.



(continued on next page)

Preliminary Theodolite Setup For Line & Grade (continued)

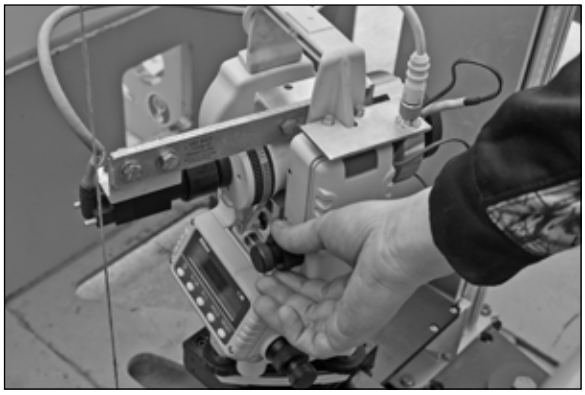


6. “TILT TELESCOPE” is shown on the theodolite LED display.

7. Loosen vertical coarse adjust/lock knob (large knob) and rotate the telescope until “VA” and “HA” 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” or 0.00% is displayed.

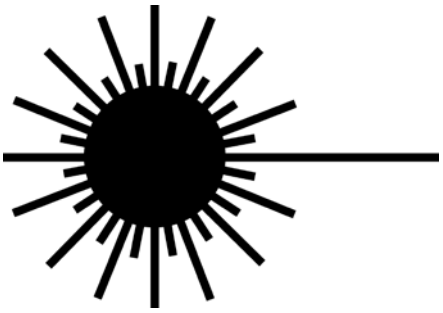
NOTICE For more information, refer to *Understanding Grade Degrees Versus Grade Percent*, in Specifications, section 12.

Preliminary Theodolite Setup For Line & Grade (continued)



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.

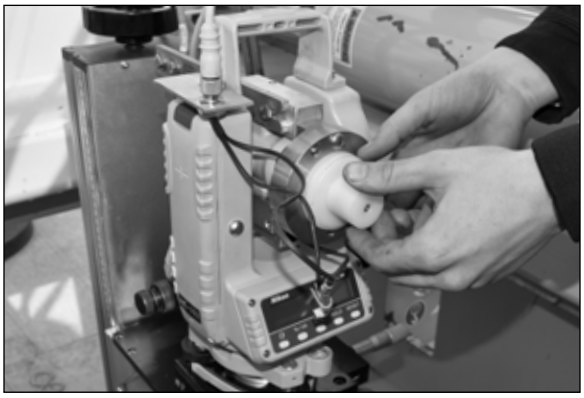
NOTICE The battery life (fully charged) with the laser continuously ON is approximately 15 minutes. The battery life will be shorter in colder climates.



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

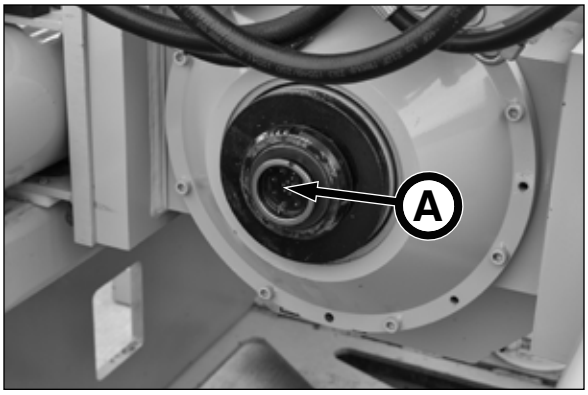
(continued on next page)

Preliminary Theodolite Setup For Line & Grade (continued)



14. Remove LED light cable from counterweight and thread the alignment holder/laser bore sight into the theodolite counterweight until it is snug against telescope.

SET/CHECK ELEVATION



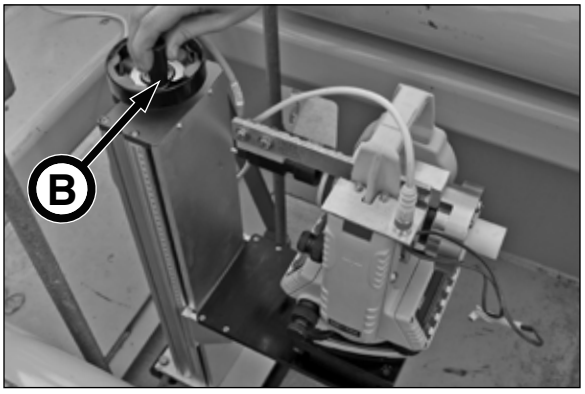
15. Elevation is set by using a transit and surveying marks.

    To check the elevation:

    a. Insert the target (A) completely into the back of the drive motor. Do not turn on target.



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



    c. If the bore sight laser beam is not centered on the middle dot of the target, raise or lower the elevator column until it is centered on the target's middle dot. Turn the elevator column handle (B) to raise or lower the theodolite platform.

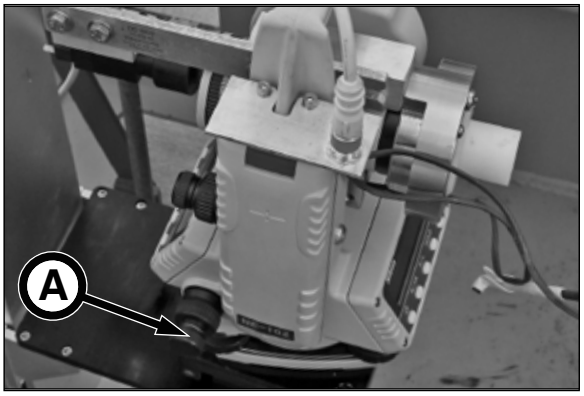
    d. Relevel theodolite.

Preliminary Theodolite Setup For Line & Grade (continued)



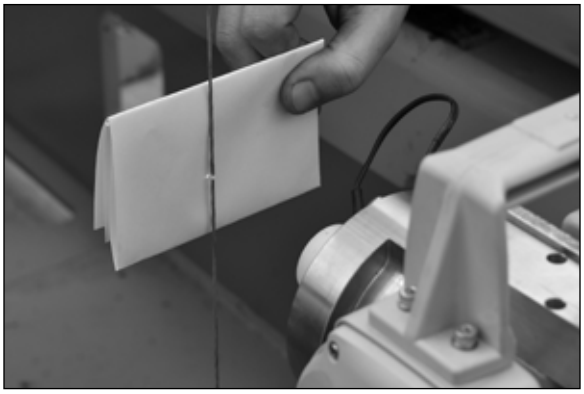
16. Once bore sight laser beam is centered on middle dot of the target, remove the target from the drive swivel.

NOTICE DO NOT store batteries in reverse polarity. Storing batteries backwards WILL cause target damage.



PRELIMINARY STRING LINE CALIBRATION

17. Using the horizontal fine tuning knob (A), adjust the laser light with the front string line as needed.



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



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

(continued on next page)

Preliminary Theodolite Setup For Line & Grade (continued)



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

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

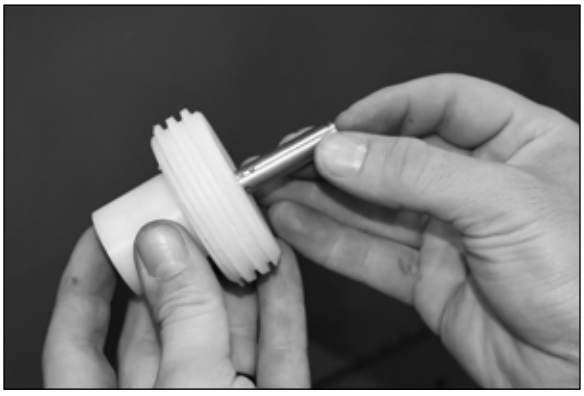


20. Press RESET button and hold for three second, until the LED displays HA: 00° 00’ 00”.

21. Recheck level.

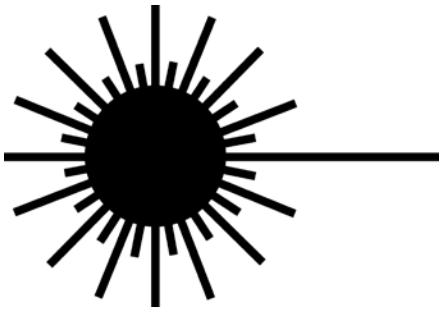


22. Unthread alignment holder/bore sight laser from counterweight.



23. Remove laser bore sight from the laser alignment holder.

Preliminary Theodolite Setup For Line & Grade (continued)



⚠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.



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

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



26. Replace the LED light cable to counterweight. The tip of the light must be directed into the telescope lens for the theodolite crosshairs to display on monitor.

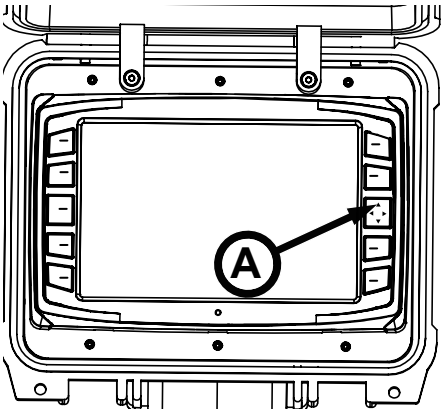
27. Proceed to *Monitor Assembly Start Up & Operation* or to *Final Theodolite Setup* in this section.

MONITOR ASSEMBLY START UP & OPERATION

NOTICE Before starting up guidance system monitor assembly, be sure the theodolite zero point calibration is checked, and the guidance system is properly assembled.

START UP

NOTICE If using data logging, BEFORE power pack startup, insert USB flash drive into USB Port/Data Log Flash Drive port on guidance system monitor and connect pressure transducer cable to data log port. Do not remove flash drive until the monitor is powered down.



1. With the guidance system properly set up, (refer to *Assembling The Guidance System* in this section), startup power pack. The monitor will automatically start up typically within 15 seconds on initial power connection.

   NOTE: If the monitor was shut down using the shutdown button, press the up arrow (A) on the Four-Way Selector button to turn it back on.



2. The monitor will display the Akkerman logo while it is connecting to the camera. Allow for complete computer and camera boot-up.

NOTICE If the Akkerman logo stays on the screen too long, unplug both the camera cable and power cable from the monitor. Plug the camera cable back in first, then plug and the power cable back in. Press the up arrow on the Four-Way Selector button to restart the computer.



3. Perform the preliminary theodolite setup for line and grade and the final theodolite setup. Refer to *Preliminary Theodolite Setup For Line & Grade*, and *Final Theodolite Setup* in this section.

Monitor Assembly Start Up & Operation (continued)

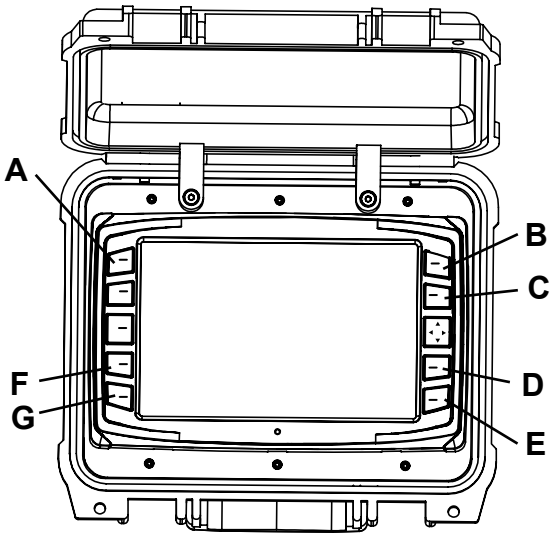
SHUT DOWN
Prior to removing/disconnecting power from monitor, shut down the monitor by pressing the Shutdown button (A).

SUDDEN POWER LOSS
If a sudden or unexpected power loss occurs or power pack is shut down, once power is restored, the Gain (B), Exposure (C), Pan Width/Height (D), Zoom (E), LED brightness (F) and Pilot Tube Counter (G) settings will return to the factory default settings.

DISCONNECTING CAMERA
Shut down the computer properly by pressing the Shutdown button (A) before disconnecting the camera.

Do not disconnect the camera while the computer is on. If you unplug the camera while the computer is still running, the screen may freeze.

If the screen freezes, unplug the monitor's power, reconnect the camera, and repower the monitor to return to operation.



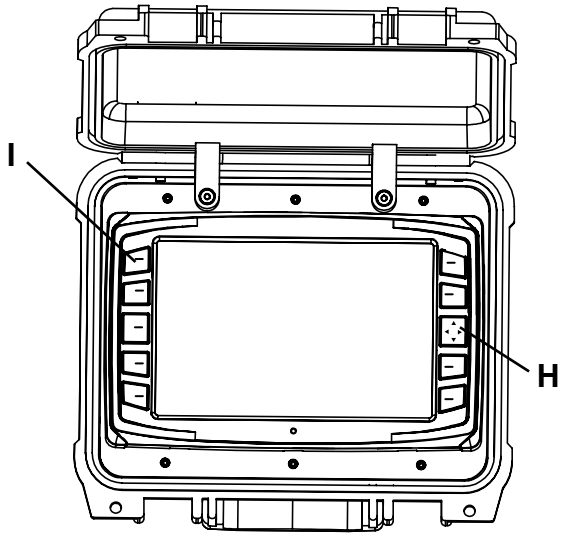
A - Shutdown
B - Gain
C - Exposure
D - Pan Width/Height
E - Zoom
F - LED Brightness
G - Pilot Tube Counter

ON & OFF CONTROL

The monitor computer will automatically start up on initial power connection. Thereafter, press the up arrow on the Four-Way Selector button to start up the monitor.

ON
To power on (boot up) monitor assembly computer, press up arrow on four-way selector button (H).

OFF
To shut down the computer, press Shutdown button (I).



H - Power ON Button (Up Arrow)
I - Shutdown

Monitor Assembly Start Up & Operation (continued)

LED BRIGHTNESS-GAIN-EXPOSURE-PAN-ZOOM-CONTROLS

Adjust the LED Brightness, Gain, Exposure, Pan and Zoom by selecting the desired function and make adjustments as needed with the Four-Way Selector button (A).

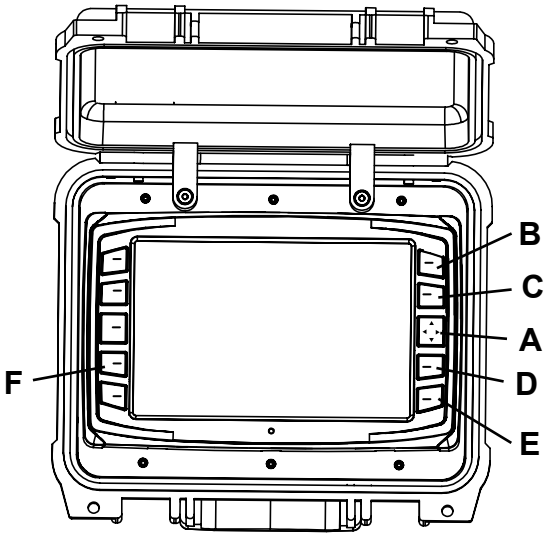
Gain (B)
- Controls the camera sensitivity (0 - 255)

Exposure (C)
- Controls the amount of light available to the camera (1 - 99%)

Pan (D)
- Moves the image left or right or up or down on the screen

Zoom (E)
- Controls the camera zoom lens in and out (Levels 1 - 15, default Level 3)

LED Brightness (F)
- Adjusts illumination of crosshairs on monitor display (0 - 95%)

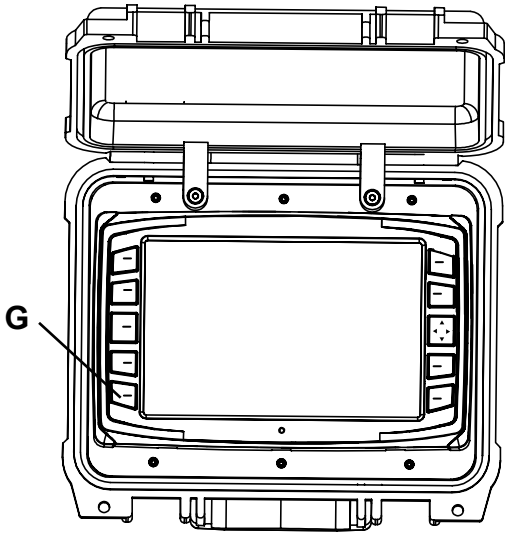


A - Four Way Selector
B - Gain
C - Exposure
D - Pan Width/Height
E - Zoom
F - LED Brightness

PILOT TUBE COUNTER

The manual, operator-controlled Pilot Tube Counter button helps track of the number of pilot tubes installed. The number is also saved in the data log file.

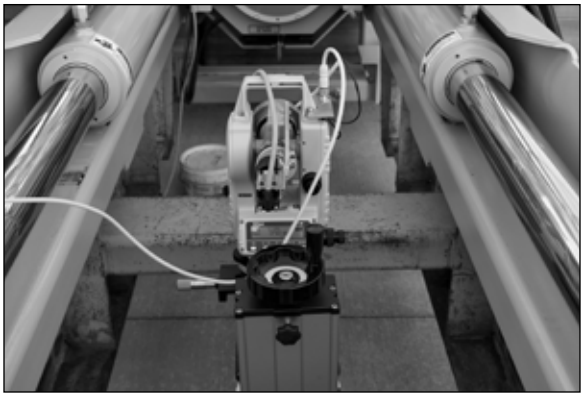
Pilot Tube Counter (G)
- To add a pilot tube to the count, press the pilot tube counter once after each installation
- To reduce the count, hold down the pilot tube counter button. Note, the number will first increase by one before it decreases.



G - Pilot Tube Counter

Monitor Assembly Start Up & Operation (continued)

USING REMOTE FOCUS CONTROLS

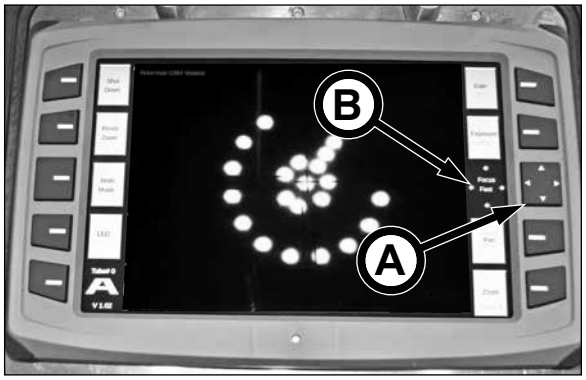


The Remote Focus controls let the operator adjust the theodolite image from the monitor screen instead of turning the focus ring on the theodolite. A motor and belt make the adjustments on the theodolite focus ring.

Press and toggle the Four-Way Focus button (A) to control focus speed and visual focus as follows:

Focus Speed - Left and Right Arrows
- Slow - fine focusing at slow speed
- Medium - medium speed focusing
- Fast - quickly move to the focal point

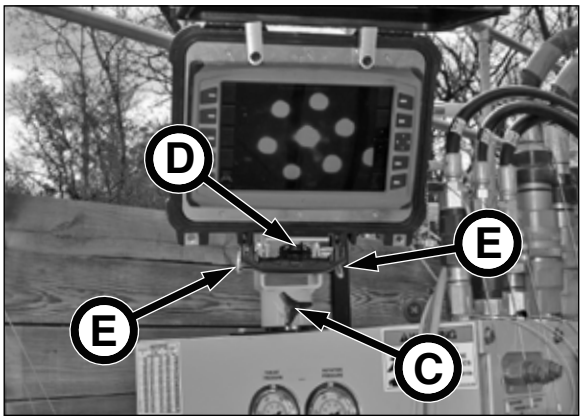
The current speed is displayed to the left of the four-way Focus button (B).



Visual Focus - Up and Down Arrows
- Up Arrow - move focal point toward target
- Down Arrow - move focal point toward theodolite

NOTICE When the focus is at the end of travel, no further adjustment is possible and the belt will slip. Release the arrow buttons to prevent premature wear to motor or belt.

MONITOR REMOVAL/REPLACE/TILT



To remove guidance system monitor case from monitor mount, loosen the monitor mount knob (C) and lift the monitor off the mount.

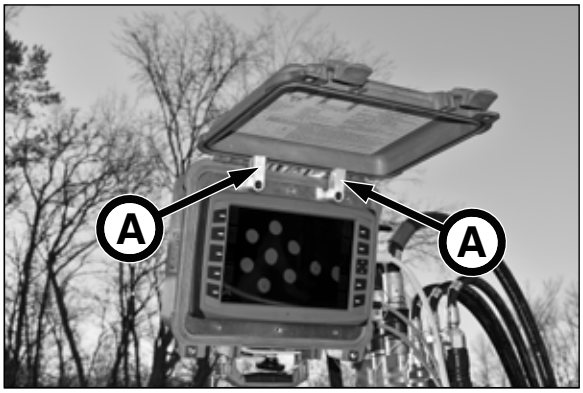
To replace monitor case to monitor mount, place the monitor case on mount and tighten the monitor knob (D) to secure it.

To tilt monitor for improved viewing, loosen tilt adjustment levers (E), tilt monitor to the desired angle, tighten tilt adjustment levers to lock it in place.

Monitor Assembly Start Up & Operation (continued)

USING CASE AS SUN VISOR

Open case and rotate both lid supports (A) up. Lower case cover to supports for use as a sun visor. Be sure to rotate lid supports down before attempting to close case cover.

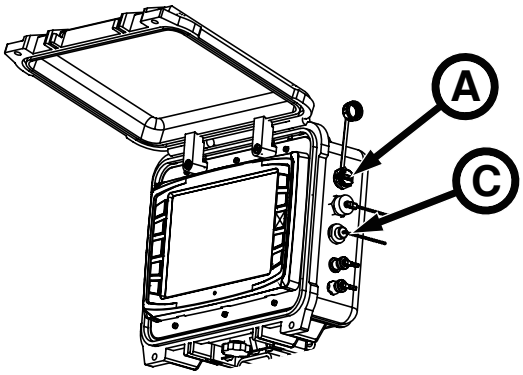


CLEANING MONITOR DISPLAY

The monitor display can be scratched. Use a soft, lint-free cloth to clean dust, fingerprints and smudges. DO NOT use solvents. If cleaning is necessary on the guidance system, use a lightly dampened microfiber cloth or other soft lint-free cloth.

USING DATA LOGGING

Prior to start up, insert USB flash drive into USB Port/Data Log Flash Drive connection (A). DO NOT remove flash drive until the monitor is powered down.

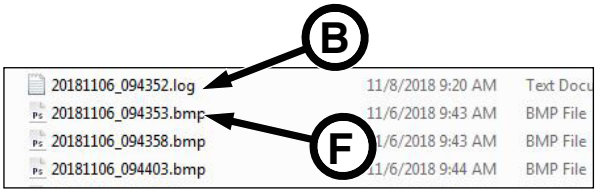


Data logging generates two files every five seconds which are saved to the USB flash drive.

1. A .log file (B) is generated recording the time stamp, pan width, pan height, frame per second, pilot tube # and zoom level.

   A new .log file is generated when the monitor is shutdown and restarted as long as a USB flash drive is in the USB Port/Data Log Flash Drive connection.

   The Datalog connection port (C) records thrust PSI and rotation PSI. To record PSI data, **prior to start up**, connect pressure transducer cable on GBM frame to Data Log connection (B). The pressure data will record to the log file (B/D).

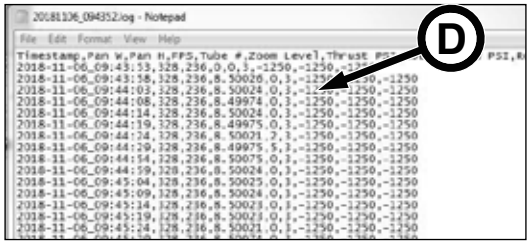


   To access data:

   a. Insert USB flash drive in a computer USB port.

   b. Navigate to *timestamp.log* file.

   c. Double click *timestamp.log* to open file in text form (D).



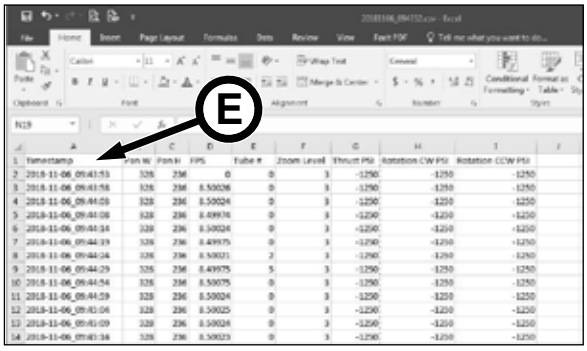
   d. Click File.

   e. Click Save As.

   f. Change the .log file extension to .csv (column separated value) file extension.

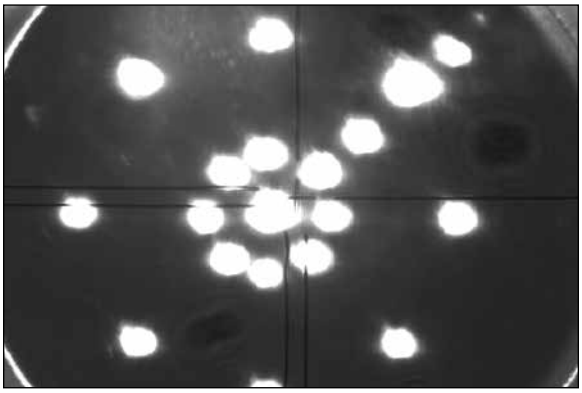
   g. Close file.

   h. Double click the .csv file. The data will open in a spread sheet program and is now in column form (E).



2. As the datalog information is saved, a .bmp image file (F) is created. The .bmp file shows the target screen that corresponds to the time stamp entry in the datalog file.

   To view the .bmp file, double-click the file with the time stamp you want and it will open in your default photo program.

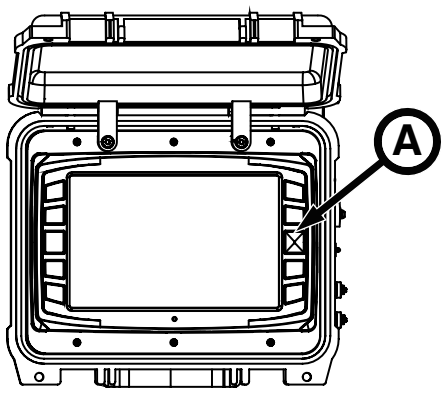


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NOTES

FINAL THEODOLITE SETUP

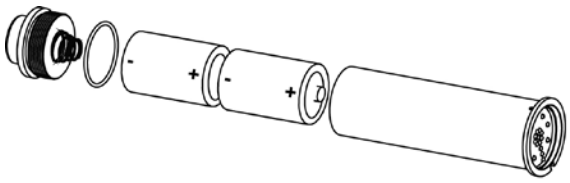
1. Startup power pack.



2. If guidance system monitor is not ON, turn ON monitor assembly by pressing top arrow (A) on 4-way selector button.

3. Turn ON target.

   Remove cap, gently place alkaline batteries into target tube (with positive polarity towards LED lights).

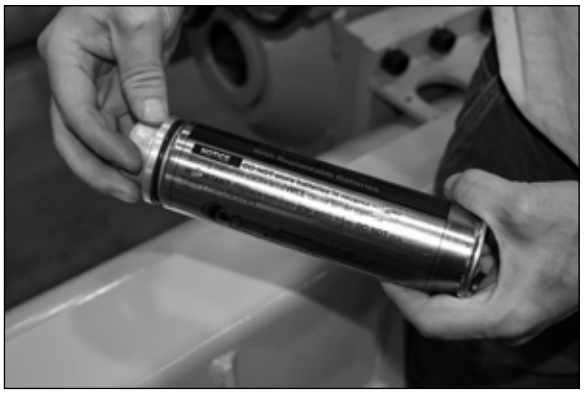


   Standard or Smart Target
   Two (2) new 1.5 volt alkaline D size batteries

   Multi-Position Smart Target
   One (1) new double, 3.6 volt alkaline C size battery, or two (2) new 1.5 volt alkaline C size batteries

   IMPORTANT: DO NOT mix battery manufacturers.

   Screw cap with o-ring completely onto end of target tube to prevent moisture from entering target tube. When the target is properly assembled, the target will be illuminated.



   NOTICE If using smart target, for smart target modes and operation, refer to *Using GBM Smart Target* in this section.



   When the target is properly assembled, the target will be illuminated.

   NOTICE If using smart target, for smart target modes and operation, refer to *Using GBM Smart Target* in this section.

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Final Theodolite Setup (continued)



4. Insert the lighted target completely into the back of the drive motor.

5. Use the elevator column handle to raise or lower theodolite elevation until the target's middle dot is centered with the crosshairs on the monitor.



NOTICE To improve the target image and crosshairs on the monitor, adjust the Gain, Exposure, Zoom, Pan, LED brightness and focusing control buttons on the monitor.



6. Relevel the theodolite, if necessary.



7. Recheck the grade shown on the display. If needed, adjust it using the vertical fine adjust knob.

   Pressing the %VA button will hide the grade reading. Press the %VA button again to show the reading.

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.

Final Theodolite Setup (continued)



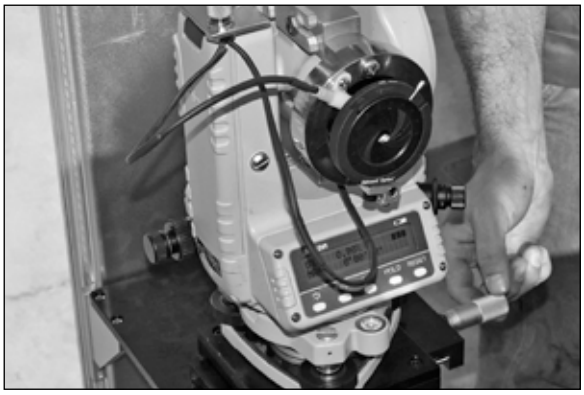
8. Once elevation is adjusted, remove the target from the back of the drive motor and turn OFF.



9. Focus and align both the front and back stringlines to the crosshairs on the monitor as follows:

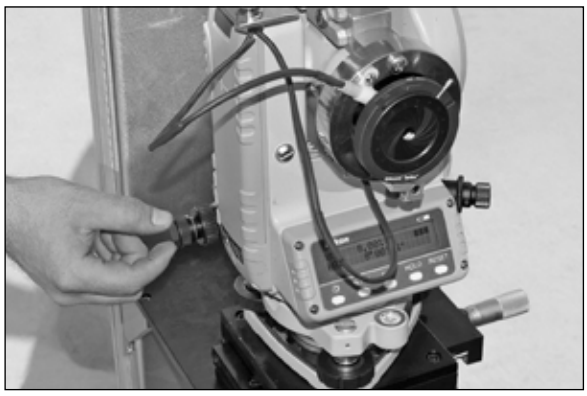
   a. Use the up and down airs on the four-way selector to focus the stringline on the vertical crosshairs.

NOTICE By adjusting the focus on the theodolite, the stringline 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.



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

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



   c. Use the horizontal fine adjust knob to line up the front stringline on the monitor's vertical crosshairs.

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Final Theodolite Setup (continued)

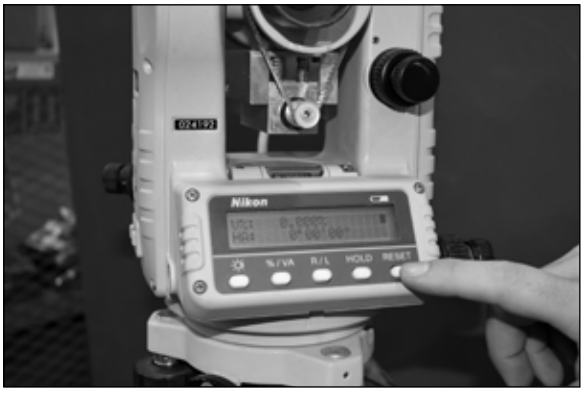
d. Continue to line up the front and back string lines until they are both centered with the vertical crosshairs on the monitor.



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.



NOTICE After reset, the horizontal display must be at 0°00'00" and must remain at 0°00'00" until the end of the drive.

In the event the theodolite is bumped or moved and the display is no longer at 0°00'00", the operator must readjust the horizontal adjust back to 0°00'00". Failure to do so will result in the drive being off line.

11. Proceed to *Installing Steering Head Adapter to Steering Head* in this section.

Operation - Installing Pilot Tubes

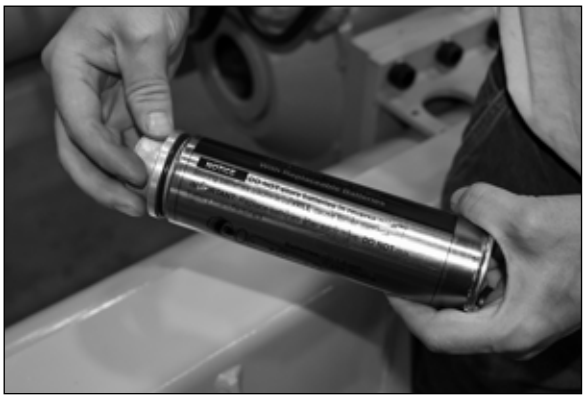
INSTALLING STEERING HEAD ADAPTER TO STEERING HEAD

NOTICE For non-displaceable ground tooling alternatives to the standard steering head, refer to Non-Displaceable Tooling Installation Operator's Manual, 050168A.



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, gently place alkaline batteries into target tube (with positive polarity towards LED lights).

   Standard or Smart Target
   Two (2) new 1.5 volt D size alkaline batteries

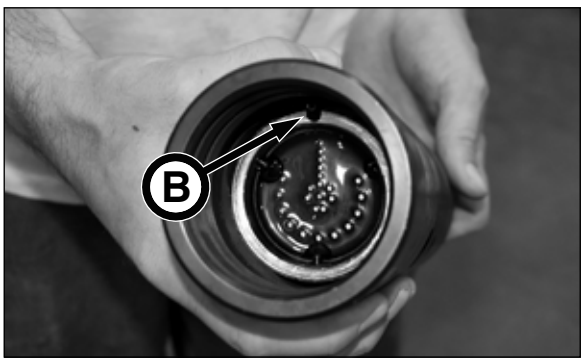
   Multi-Position Smart Target
   One (1) new double, 3.6 volt C size alkaline battery, or two (2) new 1.5 volt C size alkaline batteries

   IMPORTANT: DO NOT mix battery manufacturers.

   Screw cap with o-ring completely onto end of target tube to prevent moisture from entering target tube. When the target is properly assembled, the target will be illuminated.

NOTICE DO NOT store target batteries in reverse polarity. Storing batteries backwards WILL cause target damage. Remove batteries from target for storage.

NOTICE If using smart target, for smart target modes and operation, refer to *Using GBM Smart Target* in this section.

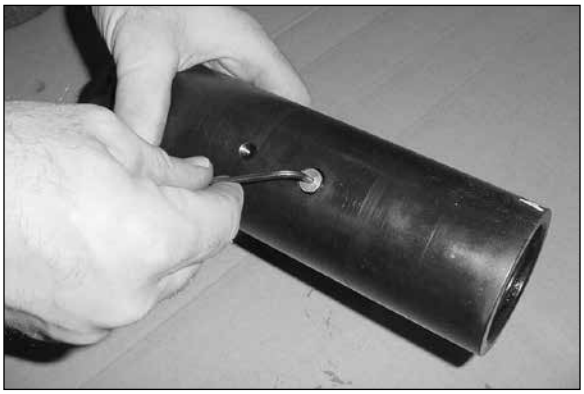


3. Slide target into target holder. Be sure the notch on the target aligns with pin (B) on holder.

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Installing Steering Head Adapter to Steering Head (continued)

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



5. Fully insert inner tube into target holder.

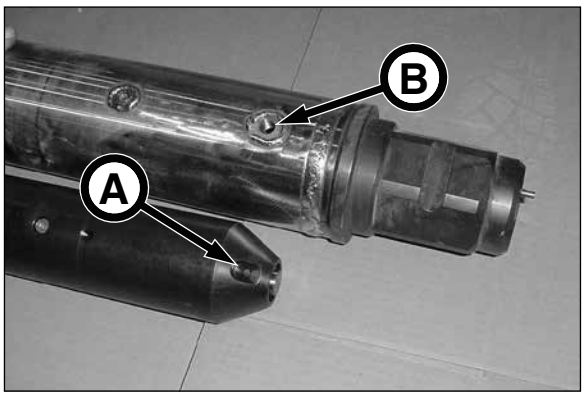


6. Loosen three set screws on steering head adapter with a 3/16 in. allen wrench, so the target assembly can be slid into adapter.

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



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



Installing Steering Head Adapter to Steering Head (continued)

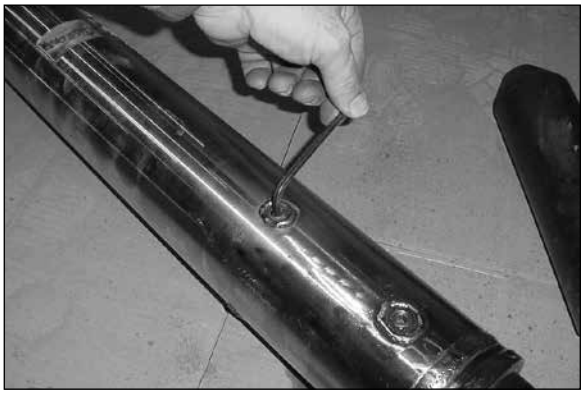
9. Slide target assembly into adapter. Be sure the target holder cavity aligns with the adapter set screw hole.



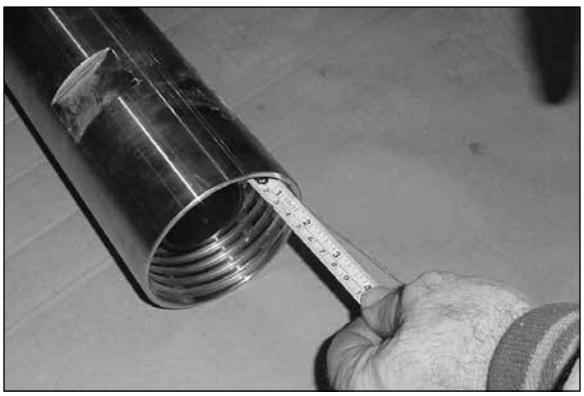
10. Reinstall the 1/2 x 1-1/4 in. set screw (removed in step 7) with a 1/4 in. allen wrench.



11. Tighten the other three set screws with a 3/16 in. 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.



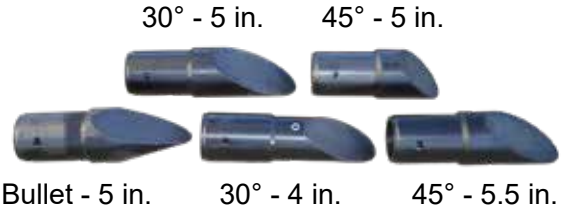
(continued on next page)

Installing Steering Head Adapter to Steering Head (continued)

13. Choose the steering head best suited for the project soil analysis.

Steering Head	Ground Conditions
30°, 4 in.**	Very Soft, Unstable
30°, 5 in. *	Soft, Low Blow Count
45°, 5 in. *	Medium Density
45°, 5.5 in. *	Medium Density
Bullet, 5 in.**	Very Hard, High Blow Count

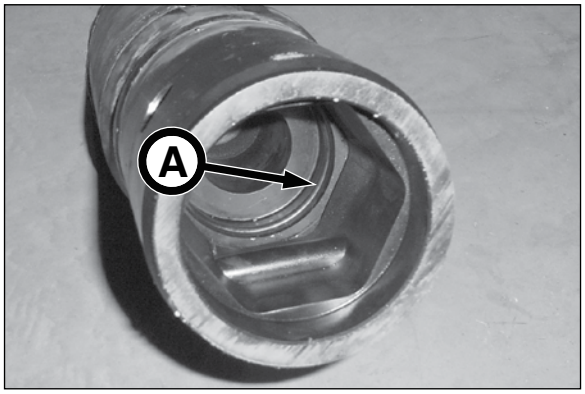
*Included in Power Pack **Optional



NOTICE The steering heads have a lubrication port on its side.

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

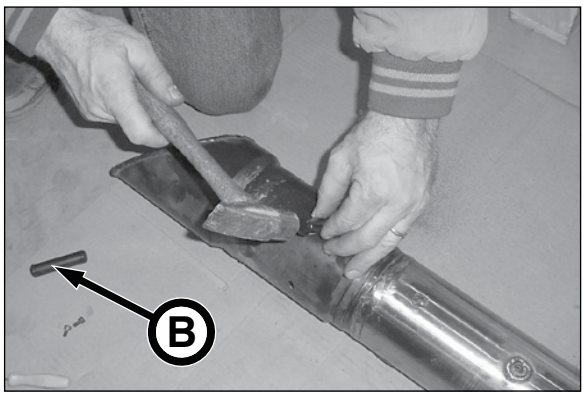
    Check that the o-ring is properly seated into steering head.



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. Secure steering head to adapter with connection pins (B) (2 places).



Installing Steering Head Adapter to Steering Head (continued)



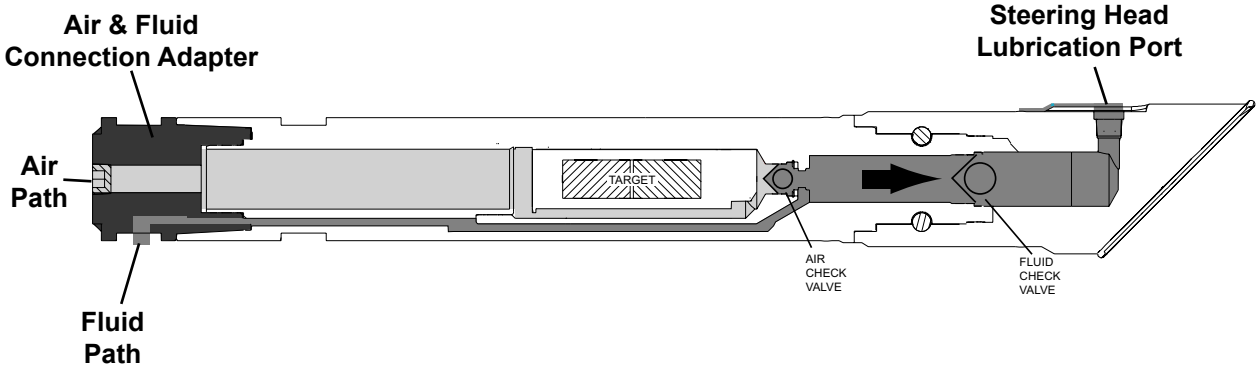
17. Place anti-seize lubricant on the 10-24 socket head cap screws (2). Install socket head cap screws to secure connection pins to steering head with a 5/32 in. allen wrench.



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

NOTICE If more flow is desired, upsize the hole in the lubrication plug.

19. The illustration below shows the fluid and air paths of the pilot tubes and steering head.



The air and fluid connection adapter is installed at the end of a pilot tube to provide an air and fluid path through the pilot tubes to the steering head as follows:

- The **fluid path** lubricates the outside of the pilot tube as it advances and also cools the target and steering head. The fluid path flows through the outer cavity of the dual wall pilot tubes, around the target assembly, and out the lubrication port in the steering head.
- The **air path** is used to purge moisture or condensation in the inner tube to increase visibility of the target. The air path flows through the inner tube of the dual wall pilot tube, around the target and in the fluid cavity.

Inside the steering head is an **air check valve** and a **fluid check valve**. The **air check valve** lets air escape into the fluid cavity while preventing fluid from entering the inner tube of the steering head and pilot tubes. The **fluid check valve** prevents ground water from entering the fluid passage in the steering head and pilot tubes.

NOTICE For non-displaceable ground tooling alternatives to the standard steering head, refer to Non-Displaceable Tooling Installation Operator's Manual, 050168A.

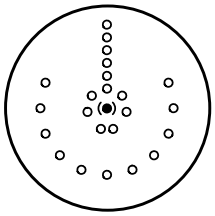
20. Proceed to *Installing Pilot Tubes* in this section.

USING GBM SMART TARGET

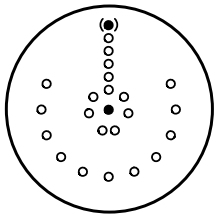
The Akkerman GBM Smart Target is a multi-functional programmable target.

- ***Normal mode:*** all LEDs are on (depending on programming mode) with the steering line LEDs flashing every second.
- ***Battery Voltage Indicator*** is visible at power up for one second. The outer ring LEDs are used as the gauge. One LED is on, then one LED for every 1/10th volt above 2.3 v.
- **Sleep mode*** (only center LED flashes) will conserve battery power when the target has not been rotated more than ± 20° for ten minutes. Wake from sleep mode by simply rotating the target.
- ***Low Battery mode**** (center LED on, outer most LED on steering line flashing) will activate when the battery level reaches <2.1V. Sleep mode will activate in one minute to conserve battery power.
- ***High Temperature mode**** (all LEDs flash except steering line) activates when the target temperature is >131°F (55°C). High temperature mode deactivates when target temperature is <127°F (53°C).

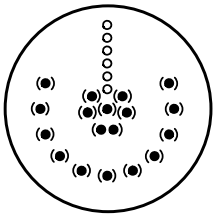
* Refer to illustrations below



Sleep Mode
- only center LED flashes



Low Battery Mode
- center LED on, outer most LED on steering line flashing



High Temperature Mode
- all above LEDs flash except steering line

○ -LED Off ● -LED On (●) -LED Flashing

• Programming mode:

This mode allows the operator to increase/decrease the LED brightness and/or allow the inner LED ring display to be turned on/off. To enter programming mode, a series of target rotations are required within various time constraints.

Enter Programming Mode:

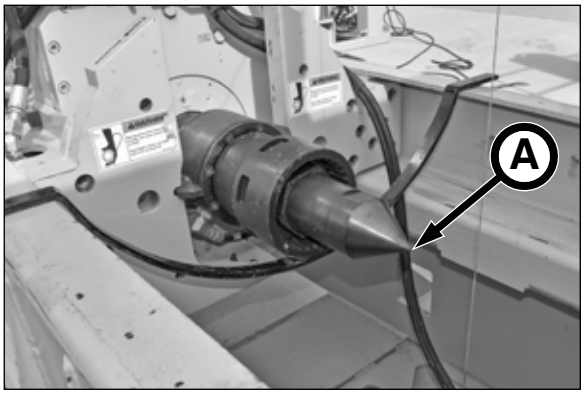
1. Rotate target and stop with the steering line pointing up to 12 o'clock position.
2. Wait 10 seconds for a single flash to appear, and within 10 seconds rotate target CW one complete rotation and stop in the up (12 o'clock) position.
3. Wait 10 seconds for a double flash to appear, and within 10 seconds rotate target two complete CW rotations and stop in the up (12 o'clock) position.
4. Wait 10 seconds for a triple flash to appear, and within 10 seconds rotate target three complete CW rotations and stop in the up (12 o'clock) position.
5. Wait 10 seconds. You are now in programming mode and only the steering line LEDs should be illuminated with outer most LED flashing rapidly.
6. Within 10 seconds rotate the target to desired command (see below):

Programming Command Modes:

- **Increase LED Brightness:** rotate target CW one full rotation with the steering line at the 12 o'clock position. Once brightness level is achieved, rotate target to store the setting.
- **Decrease LED Brightness:** rotate target CW 1/2 rotation with steering line at 6 o'clock position. Once brightness level is achieved, rotate target to store the setting.
- **Inner Ring On/Off:** rotate target CW 1/4 rotation with steering line at 3 o'clock position. The inner ring will toggle On/Off. Wait for inner ring to set the on/off position before rotating.
- **Steering Line Animation On/Off:** rotate target CW 3/4 rotation with steering line at 9 o'clock position. The steering line animation will toggle.

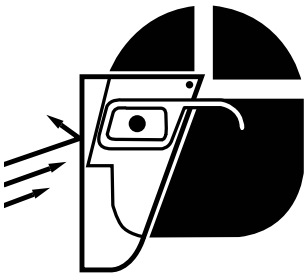
Reset to factory default mode: Using a solid, level surface, place target cap on surface. The outer ring LEDs will go off one by one until the complete target LEDs are off. Then all LEDS will blink twice. The target is now reset to the factory default settings.

INSTALLING PILOT TUBES



NOTICE To verify the centerline of product pipe setup, use the alignment guide adapter (A).

IMPORTANT: DO NOT use this measurement for establishing the project line. The tip of the alignment guide adapter may not be not perfectly centered between the frame rails, which will cause an inaccurate line reading.

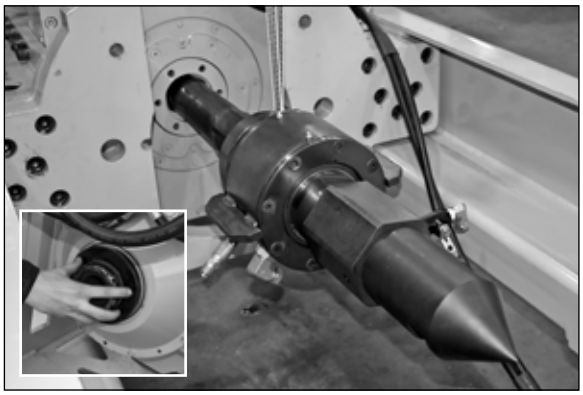


⚠WARNING Flying sparks and debris from torching operation can cause severe injury. Approved personal protection must be worn while torching opening into shaft wall.



1. Cut an opening in the shaft wall large enough for the steering head and pilot tube adapter to pass through.

NOTICE Based on soil conditions, a pit seal may need to be installed. Contact Akkerman Aftermarket Support for more information.



2. If not already installed, install the drive swivel adapter into the gearbox.

⚠CAUTION The drive swivel adapter weighs approximately 101 lbs. (46 kg). Use a properly rated lifting strap to install the drive swivel adapter into the GBM jacking frame.

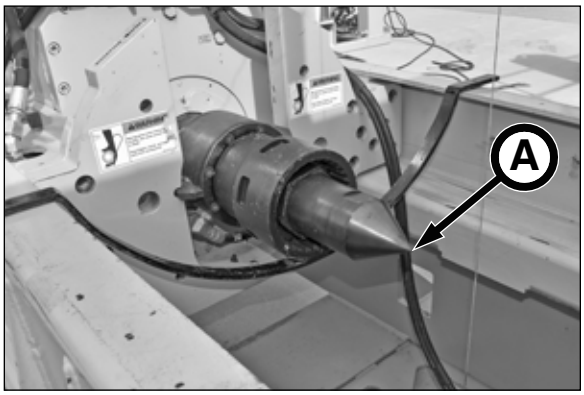
Secure the flange and locknuts (see inset) on the drive swivel adapter on the back of the gearbox if you plan to pull back pipe.

NOTICE Be sure to connect the supply line to the fluid swivel assembly on the drive swivel adapter.

(continued on next page)

Installing Pilot Tubes (continued)

3. Remove the alignment guide adapter (A)



4. Install steering head to steering head adapter. Refer to *Installing Steering Head Adapter To Steering Head* in this section.



NOTICE You must plan for lubrication during the drive, whether or not it is needed for the project. If a “change of conditions” occurs during the drive and lubrication is not setup, the pilot tubes may become unrecoverable or require open trenching. Refer to the adding lubrication steps later in this section. Lubrication will assist in lowering jacking and rotational pressures on the pilot tubes.

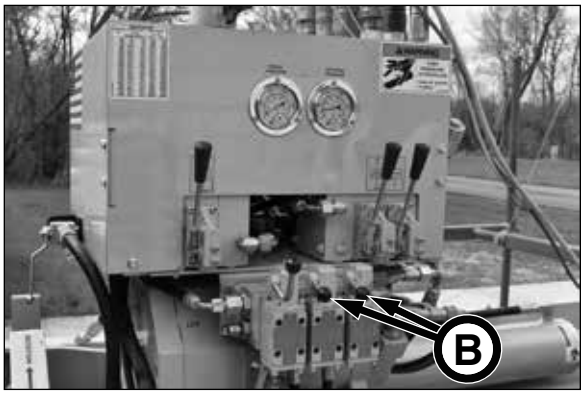
5. Place pilot tube support bars (B) on frame rails.



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

6. Install steering head/steering head adapter to swivel drive assembly adapter on gearbox using the drive rotation control to clockwise (CW) position, to thread the adapter to the swivel on gearbox.

7. Move Motor 1 and Motor 2 Drive Speed Selectors to the Low Speed High Torque (LSHT) position (C).



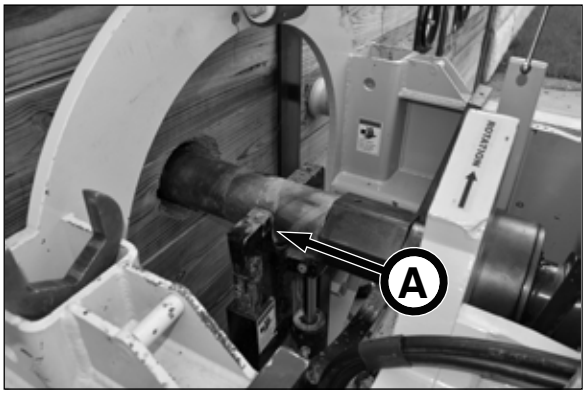
Installing Pilot Tubes (continued)

8. Advance steering head into the ground with the tip UP, by extending thrust cylinder control lever to forward position.



9. Push adapter the full travel of frame until the notches in the steering adapter head line up with the tube support (A) in the make-up tool.

10. Engage the make-up tool tube support to the notches on steering head adapter by extending the Make Up Tool cylinder with control lever.



11. Disengage the drive adapter from the steering head adapter by rotating the drive rotation (B) counterclockwise (CCW) with the auger drive rotation control and using the Thrust Cylinder control (C) to retract the thrust cylinders.



This will cause the drive adapter to unthread from the steering head adapter.



(continued on next page)

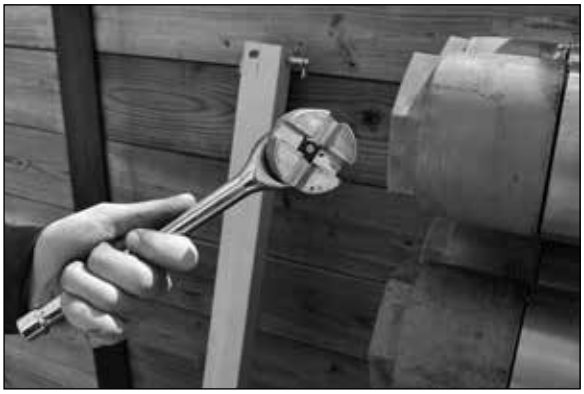
Installing Pilot Tubes (continued)

12. Move the gearbox assembly to the back of the GBM frame using the thrust cylinder control.



13. Reposition the pilot tube support bars on the frame rails.

14. At the pilot tube rack, use the pilot tube cap wrench from the power pack and a 1/2 in. drive ratchet to loosen and remove the pilot tube cap and plug.



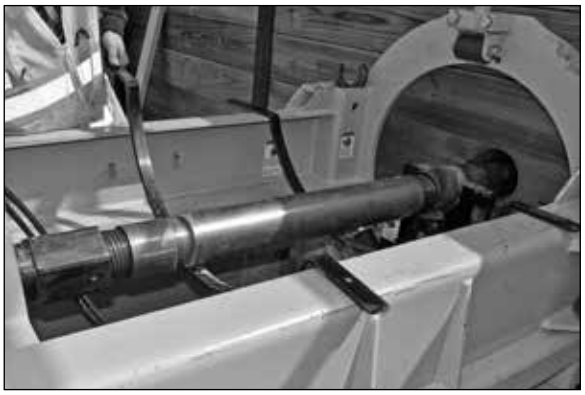


15. Secure the cap and plug together for storage.



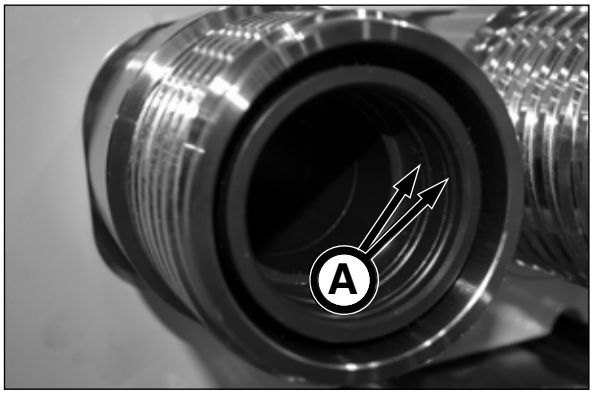
Installing Pilot Tubes (continued)

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

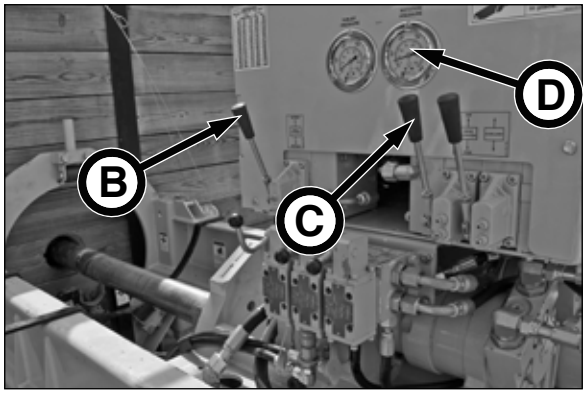


NOTICE If there is dust or dirt in the pilot tube threads, or poor thread lubrication, a high breakout torque and thread damage will occur. This will cause damage to the reception shaft breakout tool and/or other tooling and accessories. Be sure to ALWAYS store pilot tubes with clean caps and plugs attached with threads well lubricated. Use Copper Guard-4 lubricant, (part number P0310-778) or equivalent.

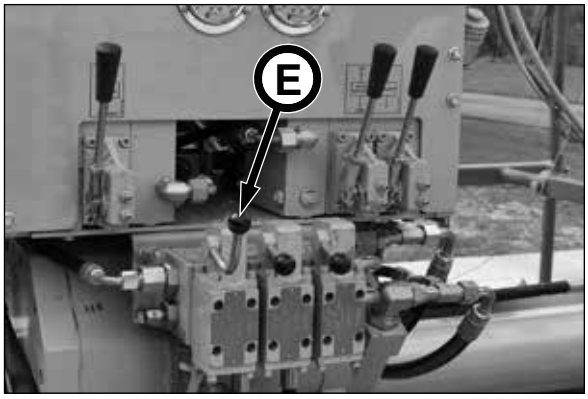
NOTICE BEFORE installing each pilot tube, inspect o-rings for damage. Replace if damaged. Also, wipe o-rings with a lubricant. DO NOT spray a lubricant on the o-rings. Doing so will make it difficult to identify the target on the monitor due to the reflection of the lubricant in the pilot tube.



17. Advance gearbox assembly using extend on the thrust cylinder control (B) while rotating the drive clockwise (CW) using the drive rotation control (C) to thread the pilot tube to the end of the drive assembly and steering head adapter.
18. Torque the connection to 1,000 psi (2,000 ft-lb) on rotation pressure gauge (D) mounted on gearbox.



19. Release make-up tool to disengage tube support from steering head adapter by pulling DOWN (Lower) on Make Up Tool lever (E).



(continued on next page)

Installing Pilot Tubes (continued)



20. Advance the pilot tube in ground by extending the thrust cylinders.



PILOT TUBE INSTALLATION OPERATION GUIDELINES

During advancement of the pilot tube, continuously monitor and verify the target position on the monitor display.

Use the drive rotation control (A) to align the target on line and grade. Always rotate the pilot tube clockwise (CW). Rotating the pilot tubes counterclockwise (CCW) will unthread the pilot tubes in the pipeline resulting in unrecoverable pilot tubes.



NOTICE If you cannot rotate the head in low speed high torque (LSHT) without reversing the thrust, the angled face is too aggressive. If necessary, change to a less aggressive head.

NOTICE The rotational working pressure range is up to 3,600 psi (24.821 mPa) of continuous operation, with a maximum pressure of 5,000 psi (34.474 mPa) intermittent operation. Failure to follow this guideline can cause premature failure of the hydraulic drive motor.

If the steering head is suddenly jarred, an obstruction may be present.

- Slightly retract the thrust cylinders
- Rotate the steering head 180°
- Extend the thrust cylinders and attempt to gauge the size of the obstruction by monitoring reaction forces
- If there is no reaction, saturate the ground with lubrication
- Extend the thrust cylinders again and attempt to push the obstruction out of the pilot tube path
- Continuously verify the target position

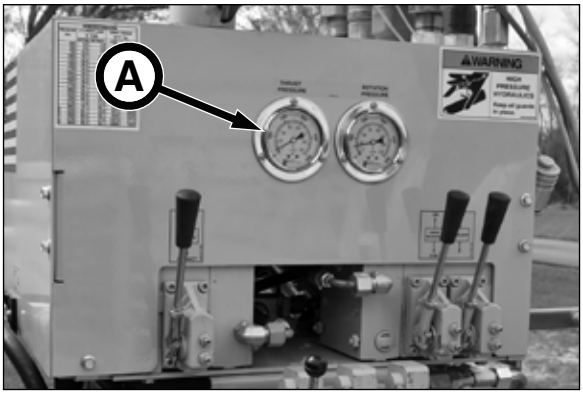
If these attempts are unsuccessful, contact Akkerman Aftermarket support for assistance.

Installing Pilot Tubes (continued)

Pilot Tube Installation
Operational Guidelines (continued)

Also, check your jacking pressure on the thrust pressure gauge (A).

- Working range up to 4,000 psi (27.579 mPa)
- Maximum pressure is 5,000 psi (34.474 mPa)

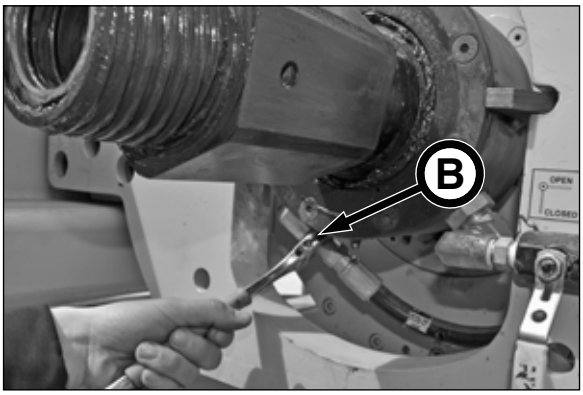


LUBRICATION RECOMMENDATIONS

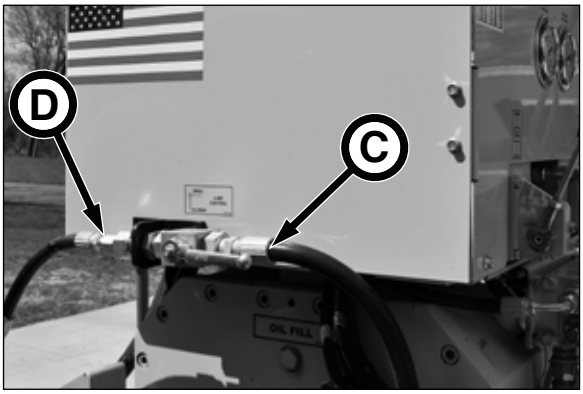
NOTICE You must plan for lubrication during the drive, whether or not it is needed for the project. If a “change of conditions” occurs during the drive and lubrication is not setup, the pilot tubes may become unrecoverable or require open trenching. Akkerman highly recommends to always use lubrication for the specific ground conditions on each job site. Lubrication will assist in lowering jacking and rotational pressures on the pilot tubes.

21. Use lubrication to lower the rotational pressure. Generally, if the pressure is running at 2,500 psi (17.237 mPa) and the pressure consistently increases, add lubrication as follows:

a. Connect pump supply hose to fluid connector adapter (B) on drive swivel adapter.



NOTICE A lube control is mounted on the GBM gearbox cover. Hose (C) is connected to the adapter on the drive swivel. Install the supply hose to connection (D). The valve is shown in the ON or open position.



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

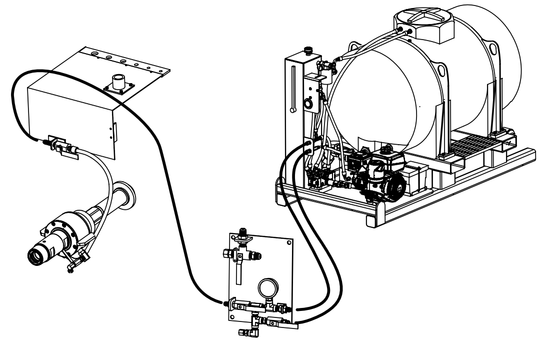
c. Before loosening pilot tube joints, dump the fluid into a catch pan to relieve pressure and prevent the fluid from entering the inner tube of the pilot tube.

(continued on next page)

Installing Pilot Tubes (continued)

Lubrication Recommendations (continued)

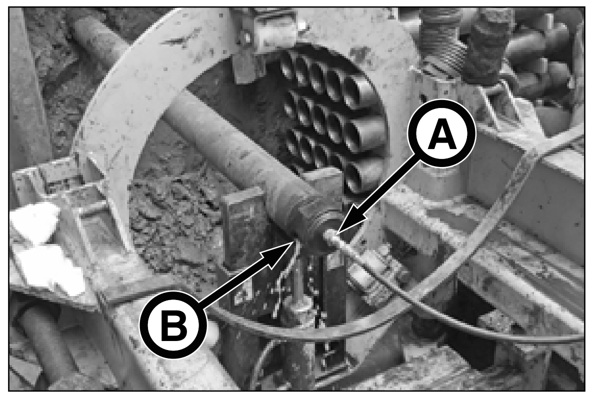
NOTICE If using the Akkerman 1325B, 1525B/D or 1525B/E Bentonite & Lubrication Pump, refer to their Operation & Parts Manual 050112A or 050130A for proper lubrication hookup and operation.



22. 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. Use nitrogen, not oxygen, and as a guideline, maintain 50 psi (345 kPa) for 5 minutes per 100 ft (30.5 m), and adjust accordingly.

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

    The air/fluid connector is part of the pilot tube adapter assembly, and it and the Nitrogen Purge Kit are both located in the power pack.



Nitrogen Purge Using Air/Fluid Connector

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

23. 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

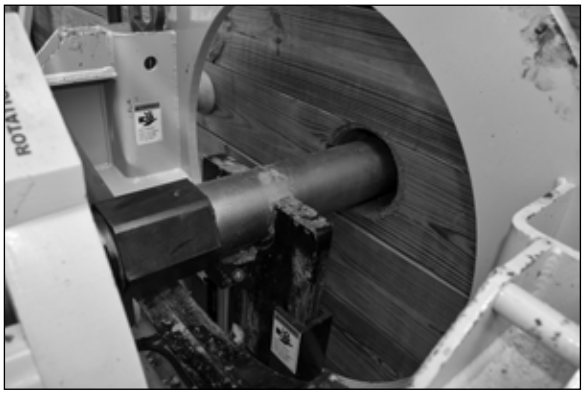
Installing Pilot Tubes (continued)

24. Continue adding pilot tubes by using the make up tool and frame travel control to thread the pilot tube connections until the steering head reaches the reception shaft.

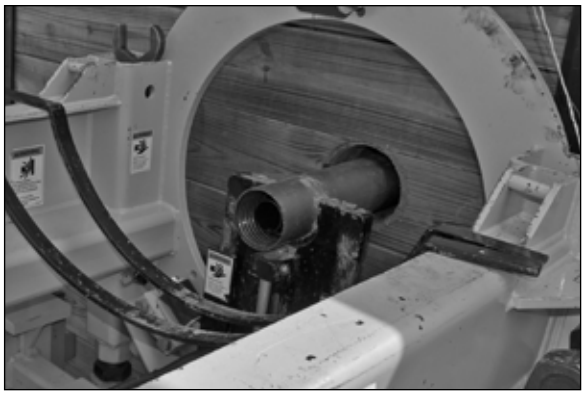


25. Once the steering head reaches the reception shaft, push the last pilot tube until the notches in the tube line up with the tube support on the make-up tool.

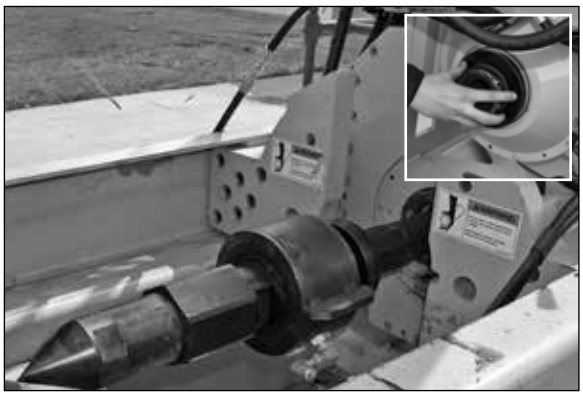
26. Engage the make-up tool tube support to the notches on the pilot tube.



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



28. Remove the drive adapter swivel from gearbox. If installed, remove the locknuts and flange on the back of the gearbox.



(continued on next page)

Installing Pilot Tubes (continued)

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

    Auger Boring Machine Methods (Typical)
    - If using a weld-on reaming head with the Auger Boring Machine, proceed to *Auger Boring Method: Weld-On Reaming Head Installation* in this section, subsection *Installing Upsizing Tools*.

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

    Three Step Methods
    - If using a reaming head, proceed to *Three Step Method: Auger Casings Installation With Reaming Head* in this section, subsection *Installing Upsizing Tools*.

    - If using a cutter head, proceed to *Three Step Method: Installing Auger Casings With Open Face Cutterhead* in this section, subsection *Installing Upsizing Tools*.



Auger Boring Machine Method of Pipe Installation



Three Step Method of Pipe Installation

NOTICE The 240A/240ABM jacking frame gearbox is limited to 100 ton jacking capacity. Akkerman recommends use of the GBM 4800C jacking frame with a P250D or P200E power pack for Powered Reaming Head (PRH) and Powered Cutter Head (PCH) installations.

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.

Pilot Tube Installation Log of Progress				
Project:				
Location:				
Length of Drive:				
Steering Head Part Number:				
Pilot Tube No.	**Jacking Pressure**	**Rotational Pressure**	**Steering Changes**	**Deviation**

NOTES

AUGER BORING METHOD:
WELD-ON REAMING HEAD INSTALLATION

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

⚠WARNING Keep personnel away from the inside of the GBM jacking frame while there is power to the equipment. Failure to do so can result in serious personal injury or death.

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

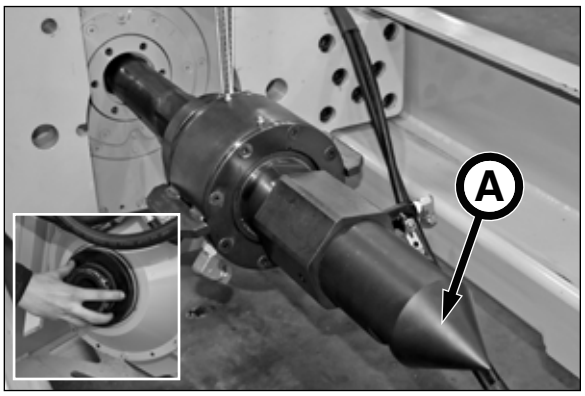


2. If not already removed, remove the drive swivel adapter from the gearbox.

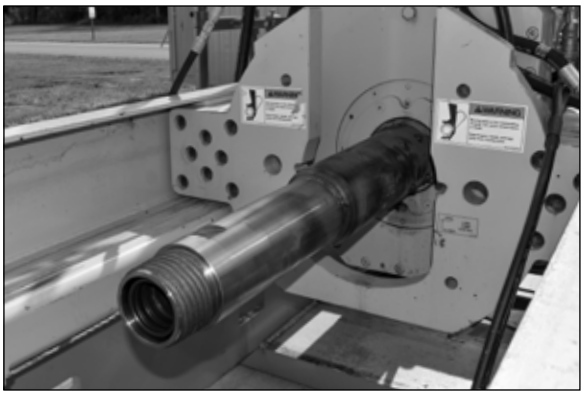
⚠CAUTION The drive swivel adapter weighs approximately 101 lbs. (46 kg). Use a properly rated lifting strap to remove the drive swivel adapter from the GBM jacking frame.

NOTICE Remove the flange and locknuts (see inset) on the drive swivel adapter on the back of the gearbox.

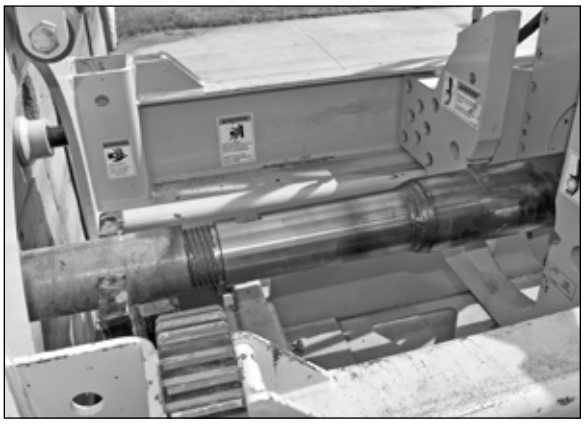
Replace alignment guide adapter (A) to protect threads.



3. Lower the pilot tube adapter and insert the pilot tube adapter into the gearbox. Remove the adapter cap.



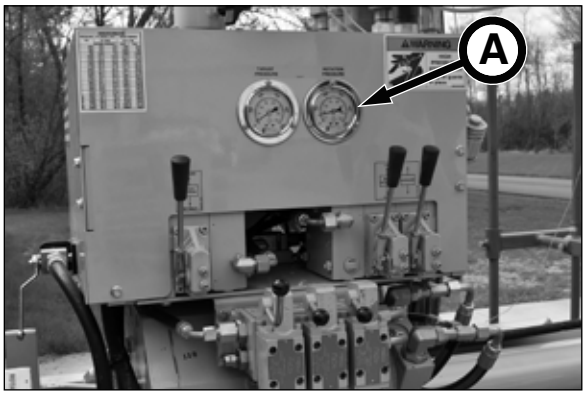
4. With the final pilot tube locked into the make-up tool, advance the pilot tube adapter clockwise (CW) using the drive rotation control. At the same time, use the thrust cylinder control to advance the gearbox assembly to thread the adapter into the pilot tube.



(continued on next page)

Weld-On Reaming Head Installation (continued)

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

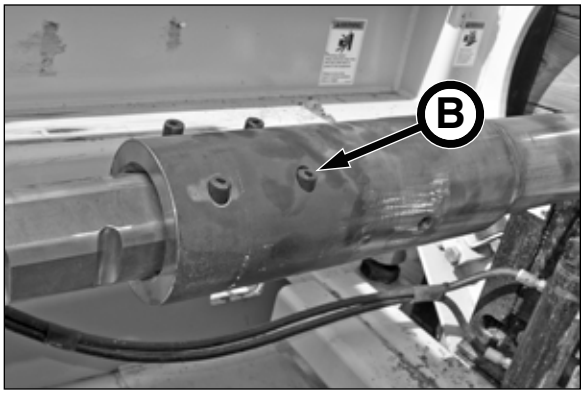


6. Release make-up tool.

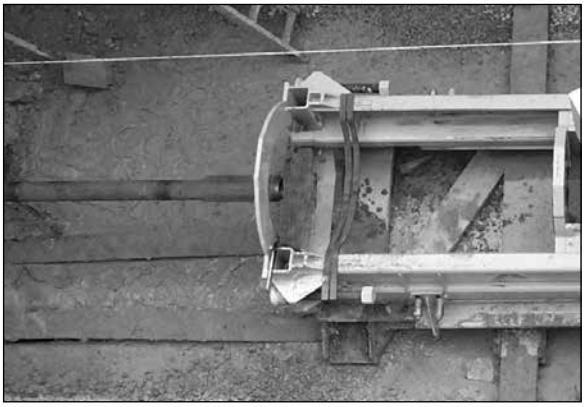
7. Advance pilot tube adapter into ground until there is enough room to clear the GBM frame.

   Ensure the pilot tube adapter hex pins (B) are in the up position to easily connect the Weld-On Reaming Head.





8. Move gearbox assembly to the back of the GBM frame using the thrust cylinder control.



Weld-On Reaming Head Installation (continued)

9. In the reception shaft, remove steering head.

a. Remove set screw.



b. Drive out pins.



c. Remove and retain pins.



d. Remove steering head.



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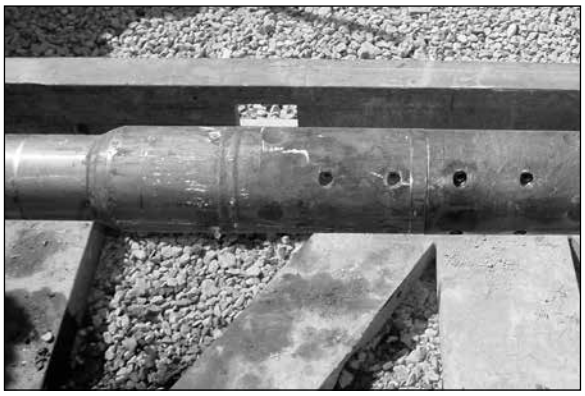
Weld-On Reaming Head Installation (continued)



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

10. Remove GBM frame.

SINGLE-STAGE
WELD-ON REAMING HEAD (WORH)



11. Install guide rod (if applicable) to the pilot tube adapter with four roll pins, referring to the chart below. If needed, advance the tubes forward so there is enough room to add the weld-on reaming head assembly.

Pipe OD	Guide Rod*
8-20 in. OD	No Guide Rod
20-24 in. OD	3 ft. Guide Rod
24-30 in. OD	10 ft. Guide Rod**
30-36 in. OD	(2) 10 ft. Guide Rods



12. Install WORH assembly to the guide rod (if applicable) with four roll pins.

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

14. Weld casing to the WORH assembly.



15. Cut hole in shaft wall large enough for the WORH and casings to pass through.

Weld-On Reaming Head Installation (continued)



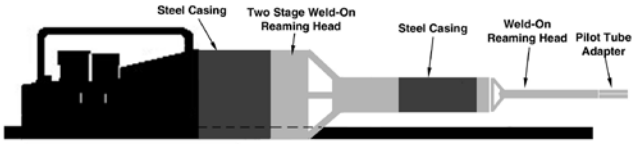
16. Proceed with the auger boring process to add casings and augers. Refer to your auger boring machine's operation manual.

TWO-STAGE
WELD-ON REAMING HEAD (WORH)

17. If you are using the two-stage WORH with the single-stage weld-on reaming head, below are a few operation tips:

    - In soft ground, add at least a 10 ft. (3 m) or 20 ft. (6.1 m) casing or more between the single and two-stage WORHs to hold the line.

    - In hard ground, push single stage WORH completely to the reception shaft before installing the two-stage WORH. This will reduce the jacking forces during advancement of the two-stage WORH.





18. (Two-Stage WORH) Lower two-stage WORH with auger onto auger boring track.

NOTICE Some contractors weld a casing section to the two-stage WORH prior to lowering onto track.



19. (Two-Stage WORH) Connect the augers sections and weld the two-stage WORH to the casing from the single stage WORH.

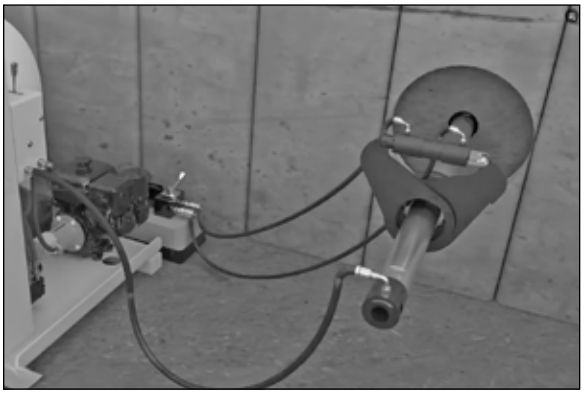
(continued on next page)

Weld-On Reaming Head Installation (continued)



20. Push the WORH/casing with the auger boring machine. Continue with the auger boring process to add casings and augers until the pipeline is complete.

NOTICE Lubricant can be pumped from the reception shaft through the pilot tubes and out the pilot tube adapter to lubricate the spoils and reduce jacking forces. Install the 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.

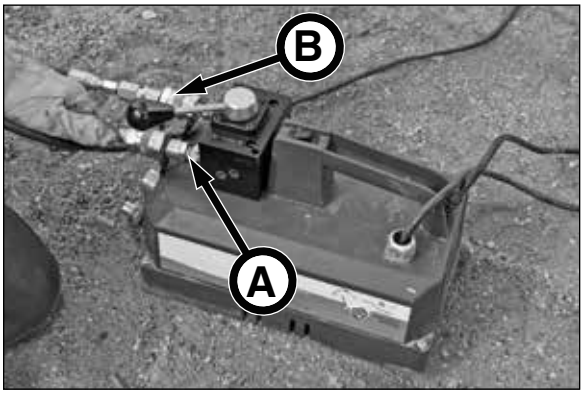


The fluid connector is part of the pilot tube adapter assembly in the power pack.

21. Once the steering head adapter and pilot tubes reach the reception shaft, each joint must be loosened with the dual tube breakout tool and power pack assembly.

    Clean the areas around all the work ports (A, B). Hook up the power pack and breakout tool male and female ends.

    The power pack has a control lever with two selector positions:
    Port A - Extend Breakout Tool Cylinder
    Port B - Retract Breakout Tool Cylinder



Breakout Tool Power Pack Ports A & B

⚠WARNING Electrical shock hazard could cause severe injury or death. Be sure the breakout tool power unit, plug and receptacle (must be three-pronged) are properly grounded and dry before plugging in and during operation.

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

NOTICE A cordless, rechargeable breakout tool power pack is available. Contact Akkerman Aftermarket Support for details.

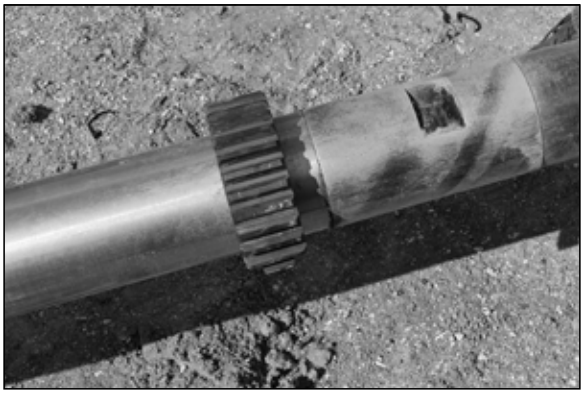
22. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.



Pilot Tube Scraper

Weld-On Reaming Head Installation (continued)

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



24. With the cylinder retracted, slide the breakout tool onto the pilot tube adapter and pilot tube and over the jaw insert from previous step.



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



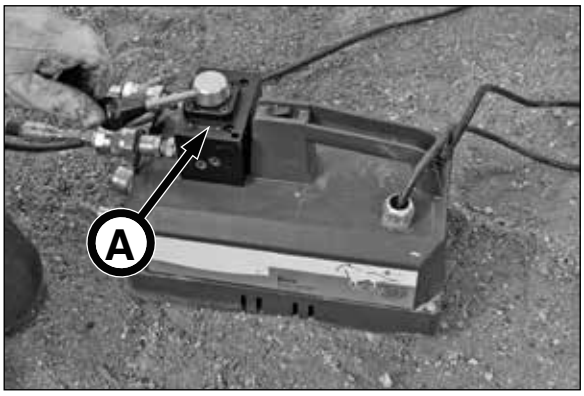
26. Slide breakout tool over jaw inserts.

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



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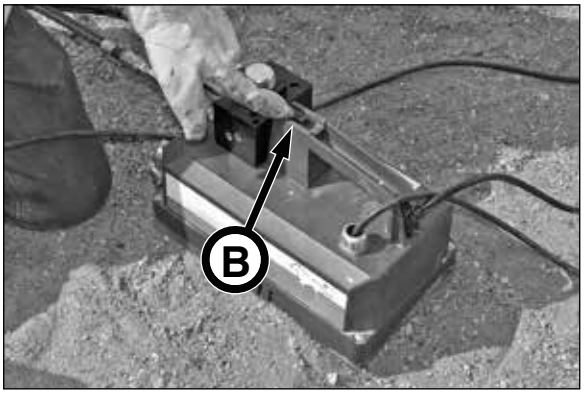
Weld-On Reaming Head Installation (continued)



27. Move the control lever to port A (A) to extend the breakout tool cylinder.



28. Extend breakout tool cylinder by depressing the switch power pack remote controller.



NOTICE The rocker switch (B) on the breakout tool power unit can also be used to control the cylinder.

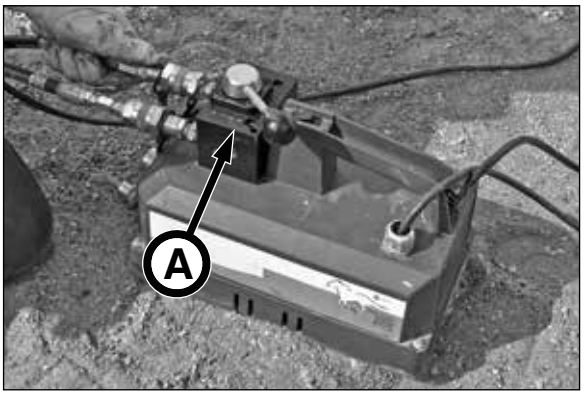


29. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

30. Release rocker switch on controller or power pack.

Weld-On Reaming Head Installation (continued)

31. Once the joint is loosened, move the power pack control lever to port B (A) to retract the breakout tool cylinder.



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

33. Remove the front jaw insert.



34. Slide the breakout tool towards the end of the pilot tube adapter or pilot tube and remove the back jaw insert.

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



36. Remove the steering head adapter or pilot tube and immediately install a cap (steering head adapter) or plug (pilot tube) on the end to prevent dirt from entering pilot tube and protect the threads.



(continued on next page)

Weld-On Reaming Head Installation (continued)

37. After removing the steering head adapter, retrieve the target housing and target. Remove the target batteries and return the target to the guidance system case. Return the steering head adapter assembly, target holder and inner tube to the power pack.



NOTICE DO NOT store target batteries in reverse polarity. Storing batteries backwards WILL cause target damage. Remove batteries from target for storage.

38. After removing each pilot tube, place pilot tube in pilot tube rack.



NOTICE Before using pilot tubes on the next project, be sure pilot tubes are clean and threads are inspected. Refer to Periodic Maintenance, section 9 for proper procedure.

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



40. Continue to remove pilot tubes as they reach the reception shaft. Cap the end of each pilot tube and place it in the rack.



Weld-On Reaming Head Installation (continued)

41. 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.



42. Remove the pilot tube adapter by removing four roll pins and the guide rod (if used). Be sure to cap the threaded end of the adapter.



43. Remove the guide rod (if used) by removing four roll pins and the reaming head assembly.



44. Once the WORH and casings reach the reception shaft, remove the WORH from the casing.

NOTICE If using the two stage weld-on reaming head, continue to rotate the augers and push casings until the two stage weld-on reaming head reaches the reception shaft. Then remove the reaming head from the casing.



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

NOTES

AUGER BORING METHOD: OPEN FACE CUTTER HEAD INSTALLATION

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

⚠WARNING Keep personnel away from the inside of the GBM jacking frame while there is power to the equipment. Failure to do so can result in serious personal injury or death.

NOTICE This upsizing tool method is limited to up to 24 in. OD pipe with pullback options, and up to 50 tons of thrust capacity in stiff or difficult ground without rock. Akkerman recommends use of the GRS-50 or RBU for projects with larger pipe or more difficult ground conditions. Refer to Operation & Parts Manual GRS-50, RBU, 050186A.

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

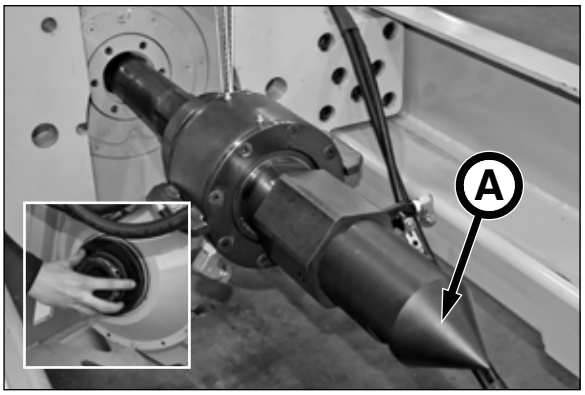


2. If not already removed, remove the drive swivel adapter from the gearbox.

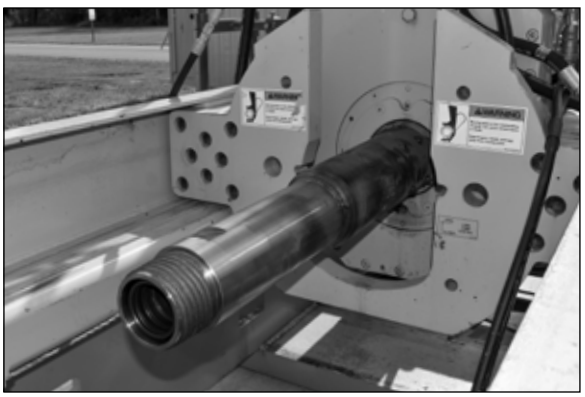
⚠CAUTION The drive swivel adapter weighs approximately 101 lbs. (46 kg). Use a properly rated lifting strap to remove the drive swivel adapter from the GBM jacking frame.

NOTICE Remove the flange and locknuts (see inset) on the drive swivel adapter on the back of the gearbox.

Replace alignment guide adapter (A) to protect threads.

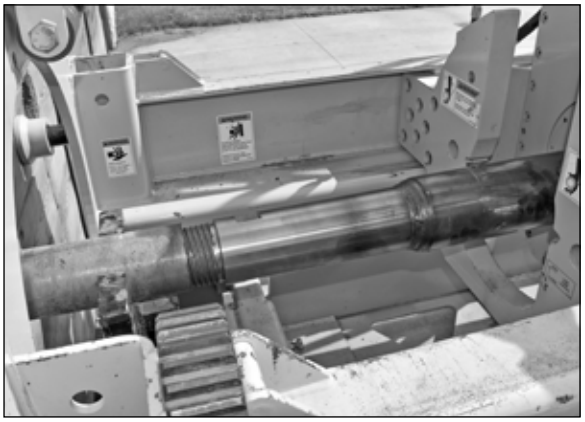


3. Lower the pilot tube adapter and insert the pilot tube adapter hex into the gearbox. Remove the adapter cap.

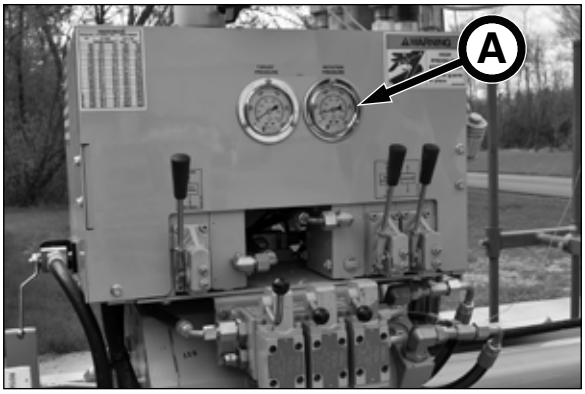


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Auger Boring Cutter Head Installation (continued)



4. With the final pilot tube secured into the make-up tool, thread the pilot tube adapter clockwise (CW) using the drive rotation control, while advancing the gearbox assembly with the thrust cylinder control to thread the adapter into the pilot tube.

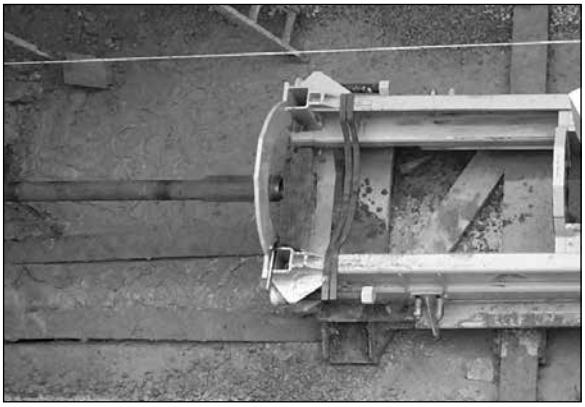


5. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the rotation pressure gauge (A).



6. Release make-up tool.

7. Advance pilot tube adapter into ground until there is enough room to clear the GBM frame. Ensure the pilot tube adapter hex pins are in the up position to easily connect the Weld-On Reaming Head (see inset photo).



8. Move gearbox assembly to the back of the GBM frame using the thrust cylinder control.

Auger Boring Cutter Head Installation (continued)

9. In the reception shaft, remove steering head.

a. Remove set screw.



b. Drive out pins.



c. Remove and retain pins.



d. Remove steering head.



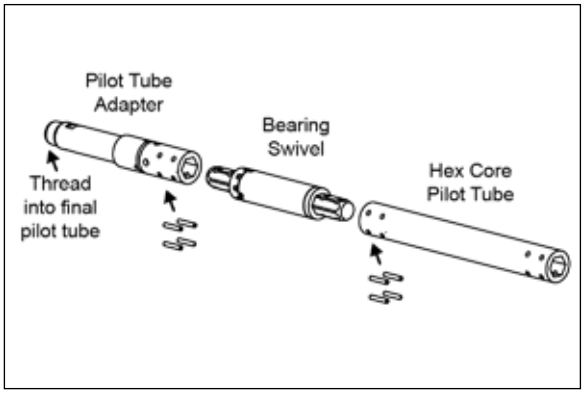
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Auger Boring Cutter Head Installation (continued)



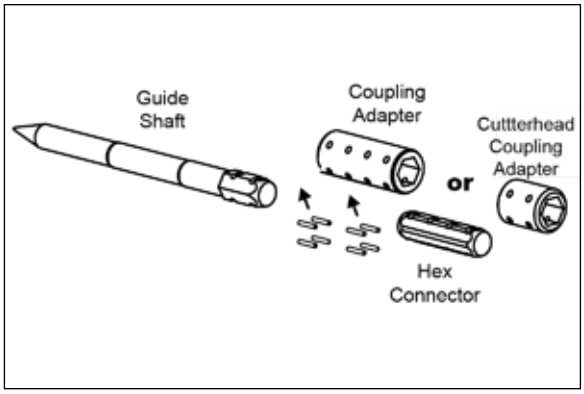
⚠WARNING Suspended loads may fall and cause severe personal injury or death. Do not enter area under or around a load.

10. Remove GBM frame.



11. On the pilot tube side, install the pilot tube adapter to GBM bearing swivel with four roll pins. If needed, advance the tubes forward so there is enough room to add the tooling.

12. Install hex core pilot tube to other end of the GBM bearing swivel with four roll pins.



13. On the auger boring machine side, weld either the cutterhead coupling adapter or the coupling adapter to the auger boring cutter head (whichever is suitable to cutter head configuration) and secure with four roll pins.

14. Insert and connect the hex connector inside the auger or coupling adapter using four roll pins.

15. Insert and connect guide shaft into the coupling adapter using four roll pins.



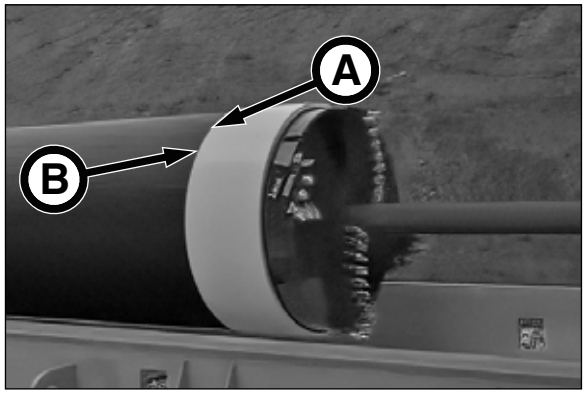
16. With the auger boring machine, advance the guide shaft into the hex core pilot tube, then all tooling and cutterhead into the ground.

Auger Boring Cutter Head Installation (continued)



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

18. Lower steel casing with auger into launch shaft.



19. Connect the first auger to the cutterhead and the hex shaft to the auger boring machine.

20. Weld the outside of the lead casing (A) to the lead edge of the steel casing (B).



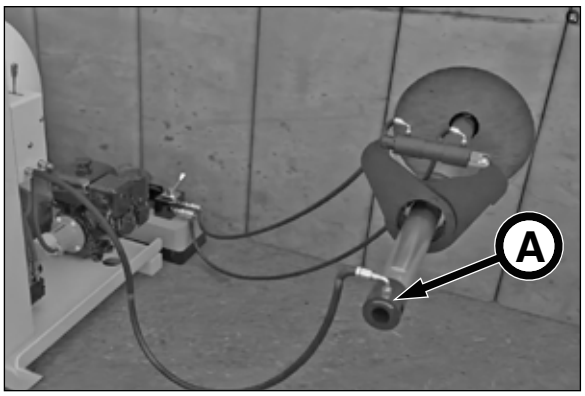
21. Proceed with the auger boring process. Continue to add casings and augers using the auger boring machine to advance the casings until the casings reach the reception shaft.

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Auger Boring Cutter Head Installation (continued)

NOTICE Lubricant can be pumped from the reception shaft through the pilot tubes and out the pilot tube adapter to lubricate the spoils and reduce jacking forces. Install the fluid connector (A) on end of pilot tube in the reception shaft. Refer to *Upsizing Tool Lubrication From Reception Shaft* in this section, for configuration details.

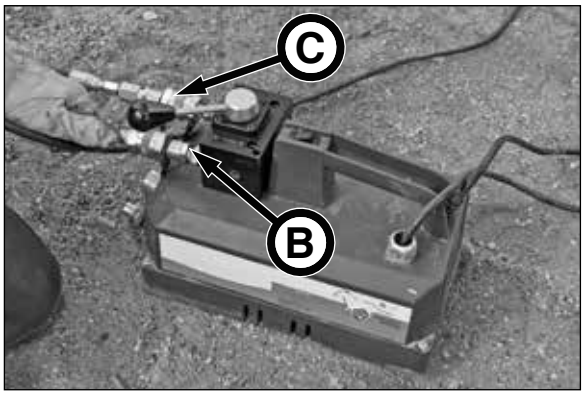
The fluid connector is part of the pilot tube adapter assembly in the power pack.



22. Once the steering head adapter and pilot tubes reach the reception shaft, each joint must be loosened with the dual tube breakout tool and power pack assembly.

    Clean the areas around all the work ports (B, C). Hook up the power pack and breakout tool male and female ends.

    The power pack has a control lever with two selector positions:
    Port A - Extend Breakout Tool Cylinder
    Port B - Retract Breakout Tool Cylinder



Breakout Tool Power Pack Ports A & B

⚠WARNING Electrical shock hazard could cause severe injury or death. Be sure the breakout tool power unit, plug and receptacle (must be three-pronged) are properly grounded and dry before plugging in and during operation.

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

NOTICE A cordless, rechargeable breakout tool power pack is available. Contact Akkerman Aftermarket Support for details.

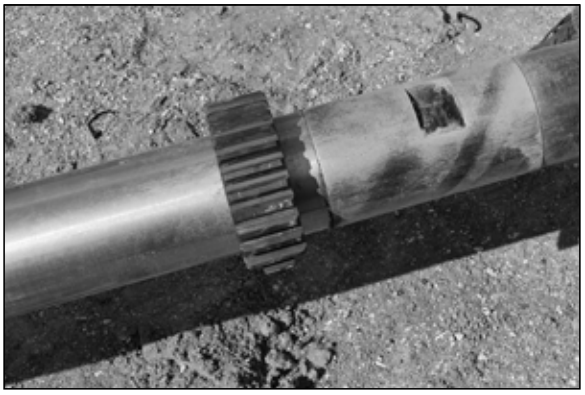
23. Use the pilot tube scraper to remove mud from steering head adapter (shown) and pilot tubes.



Pilot Tube Scraper

Auger Boring Cutter Head Installation (continued)

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



25. With the cylinder retracted, slide the breakout tool onto the pilot tube adapter and pilot tube over the jaw insert from previous step.



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



27. Slide breakout tool over jaw inserts.

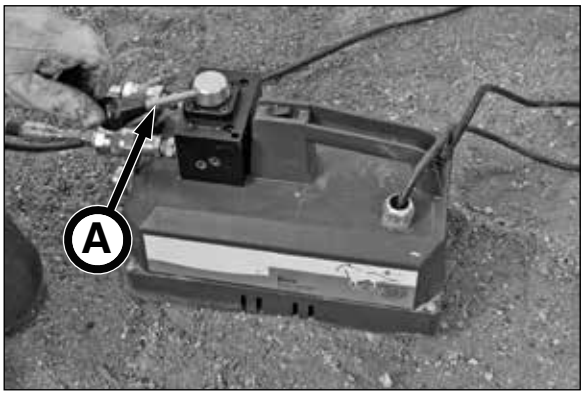
NOTICE You may have to extend or retract the cylinder to line up the jaw insert teeth with the breakout tool gear teeth.



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Auger Boring Cutter Head Installation (continued)

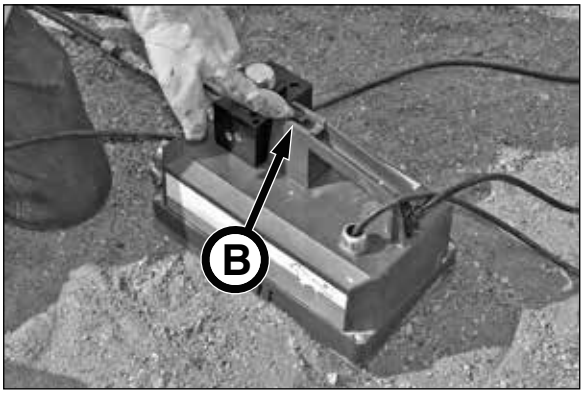
28. Move the control lever to port A (A) to extend the breakout tool cylinder.



29. Extend breakout tool cylinder by depressing the switch power pack remote controller.



NOTICE The rocker switch (B) on the breakout tool power unit can also be used to control the cylinder.



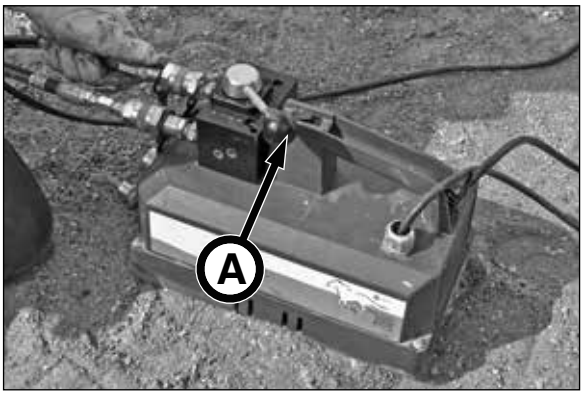
30. Continue to extend the cylinder until the joint is loosened. You should be able to hear and feel a “snap” when the joint is loosened.

31. Release rocker switch on controller or power pack.



Auger Boring Cutter Head Installation (continued)

32. Once the joint is loosened, move the power pack control lever to port B (A) to retract the breakout tool cylinder.



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

34. Remove the front jaw insert.



35. Slide the breakout tool towards the end of the pilot tube adapter or pilot tube and remove the back jaw insert.

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



37. Remove the steering head adapter or pilot tube and immediately install a cap (steering head adapter) or plug (pilot tube) on the end to prevent dirt from entering pilot tube and protect the threads.



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Auger Boring Cutter Head Installation (continued)

38. After removing the steering head adapter, retrieve the target housing and target. Remove the target batteries and return the target to the guidance system case. Return the steering head adapter assembly, target holder and inner tube to the power pack.



NOTICE DO NOT store target batteries in reverse polarity. Storing batteries backwards WILL cause target damage. Remove batteries from target for storage.

39. After removing each pilot tube, place pilot tube into pilot tube rack.



NOTICE Before using pilot tubes on next project, be sure pilot tubes are clean and inspect pilot tube threads. Refer to Periodic Maintenance in section 9 for proper procedure.

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

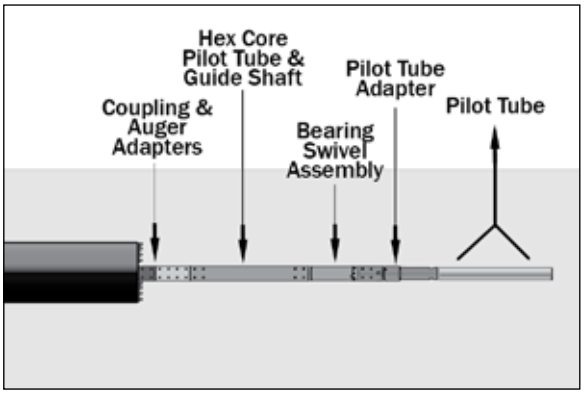


41. Continue to remove pilot tubes as they reach the reception shaft. Cap the end of each pilot tube and place it in the rack.

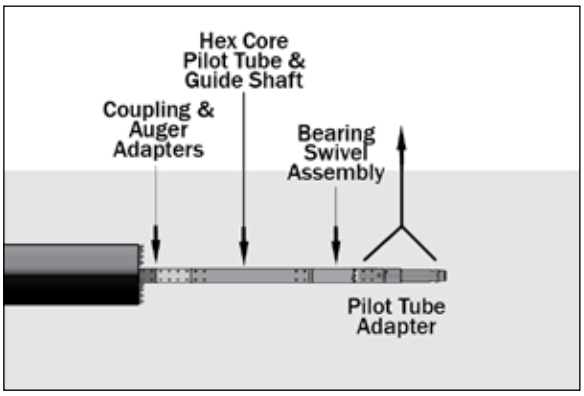


Auger Boring Cutter Head Installation (continued)

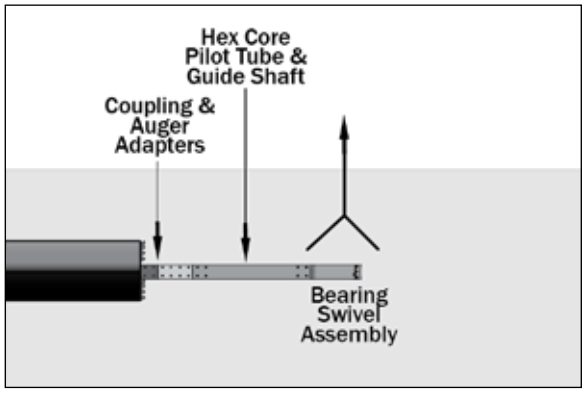
42. Once the pilot tube adapter reaches the reception shaft, remove the last pilot tube with the breakout tool from the pilot tube adapter, cap and plug the pilot tube, and place into pilot tube rack.



43. Remove the pilot tube adapter by removing four roll pins that connect it to the bearing swivel. Be sure to cap the threaded end of the adapter.



44. As they emerge after the pilot tube adapter, remove the bearing swivel, hex core pilot tube, and coupling or auger adapter from the cutter head, and the cutter head from the auger.



45. Once the casing and augers reach the reception shaft, the casing installation is now complete with the casings on line and grade.

    If necessary, the next step is to add the product pipe per the project requirements.



NOTES

THREE STEP METHOD: INSTALLING AUGER CASING WITH REAMING HEAD

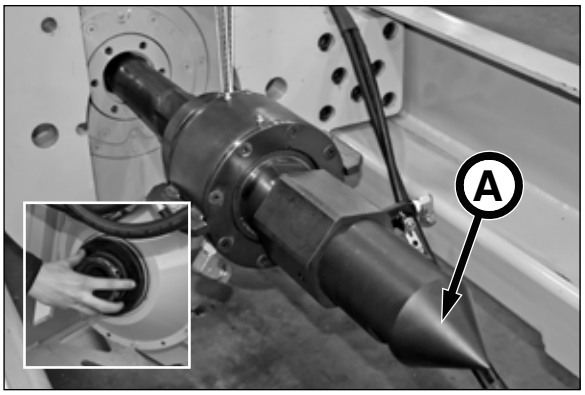
⚠WARNING Keep personnel away from the inside of the GBM jacking frame while there is power to the equipment. Failure to do so can result in serious personal injury or death.

NOTICE Though some photos in this procedure depict an earlier GBM latching frame, this procedure applies to the 240A/ABM frame.



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

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

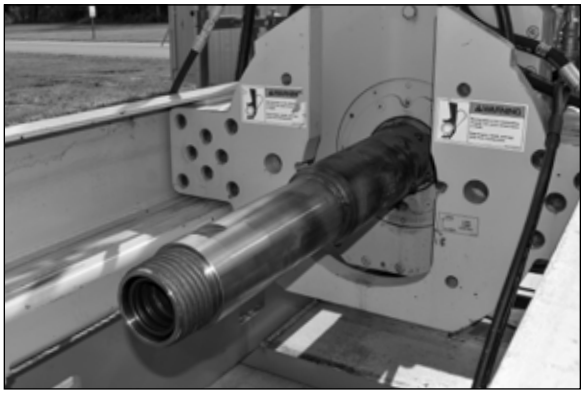


⚠CAUTION The drive swivel adapter weighs approximately 101 lbs. (46 kg). Use a properly rated lifting strap to remove the drive swivel adapter from the GBM jacking frame.

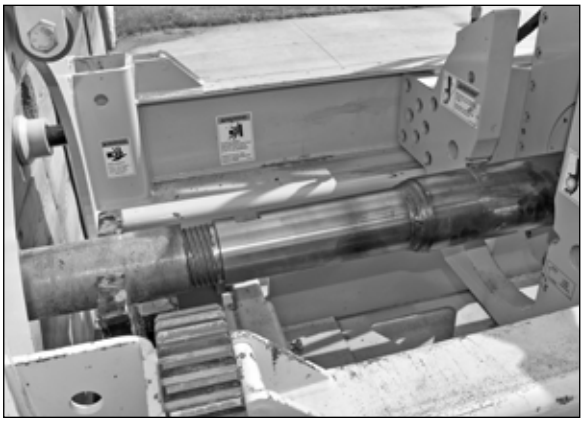
NOTICE Remove the flange and locknuts (see inset) on the drive swivel adapter on the back of the gearbox.

Replace alignment guide adapter (A) to protect threads.

NOTICE Lubrication will 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.



3. Lower the pilot tube adapter and insert the pilot tube adapter hex into the gearbox. Remove the adapter cap.

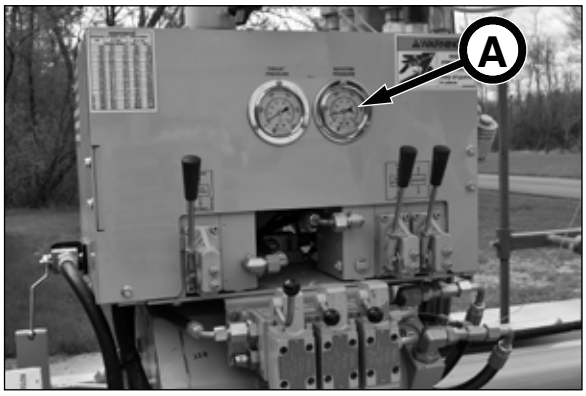


4. With the final pilot tube secured into the make-up tool, thread the pilot tube adapter clockwise (CW) using the drive rotation control, while advancing the gearbox assembly with the thrust cylinder control to thread the adapter into the pilot tube.

(continued on next page)

Installing Auger Casings with Reaming Head (continued)

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



6. Release make-up tool.

7. Advance adapter into ground 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 so the four pin holes are in the vertical (up and down) position.



8. Move gearbox assembly to the back of the GBM frame to allow enough room for the dirt bucket and reaming head assembly using the thrust cylinder control.

9. Remove make-up tool.



NOTICE Lubrication will 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.

10. Remove hex coupler from pilot tube adapter.



Installing Auger Casings with Reaming Head (continued)



11. Lower dirt bucket into shaft.

NOTICE There are various sizes of dirt buckets available depending on jacking frame elevation. The larger the dirt bucket, the less it will need to be emptied, resulting in higher productivity.



12. In the reception shaft, remove steering head.

    a. Remove set screw.



    b. Drive out pins.



    c. Remove and retain pins.

(continued on next page)

Installing Auger Casings with Reaming Head (continued)

d. Remove steering head.



13. Install casing thrust adapter to thrust plate with two 3/4 x 2 in. bolts and washers for 11 in. casings.



NOTICE Lubrication will 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.



(continued on next page)

Installing Auger Casings with Reaming Head (continued)

⚠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.



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



NOTICE Install safety chain assembly or auger pin to auger to secure auger into reaming head assembly. For proper installation of safety chain auger pin, refer to *Installing Safety Chain Assembly/Casing Auger Pin To Auger & Casing* in this section.

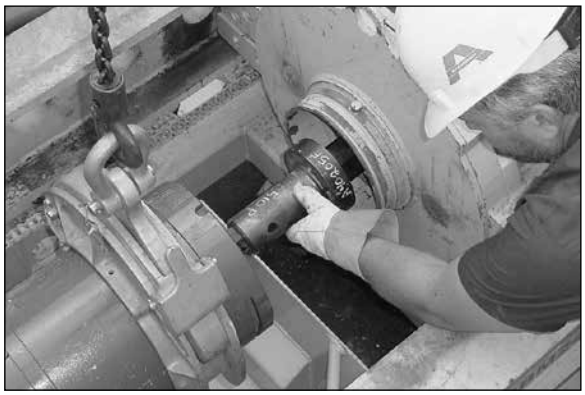
Also, use a properly rated pipe tong or nylon strap to handle the reaming head assembly and casings.

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

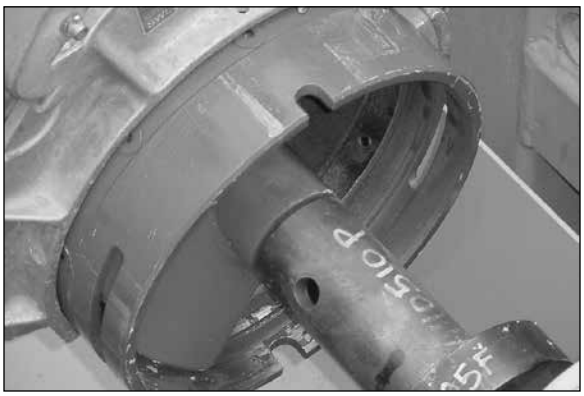


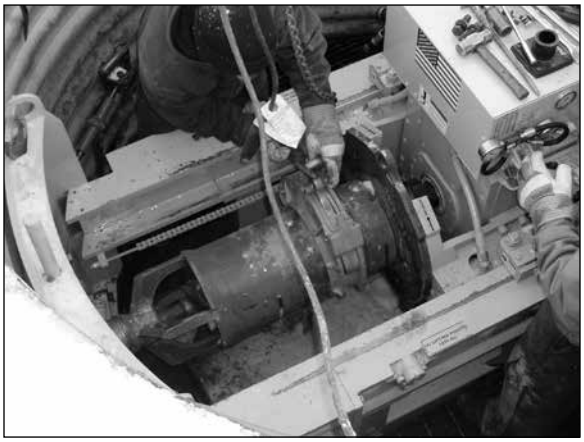
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Installing Auger Casings with Reaming Head (continued)

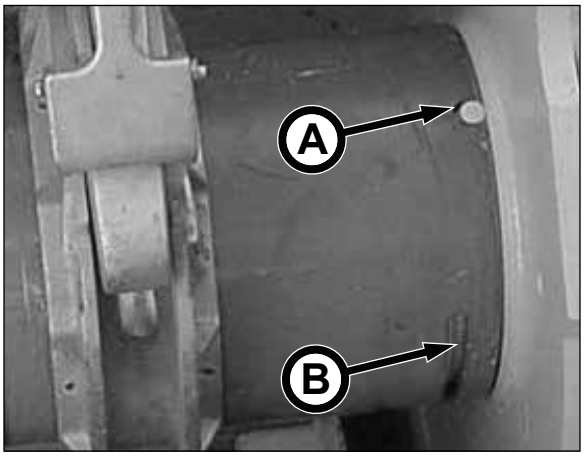


16. Install auger drive adapter onto auger shaft.





17. Align and engage auger drive adapter with the hex opening in gearbox using the drive rotation control and frame travel motor control.



18. 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 casing clips into reaming head assembly lead casing and casing thrust adapter (B).

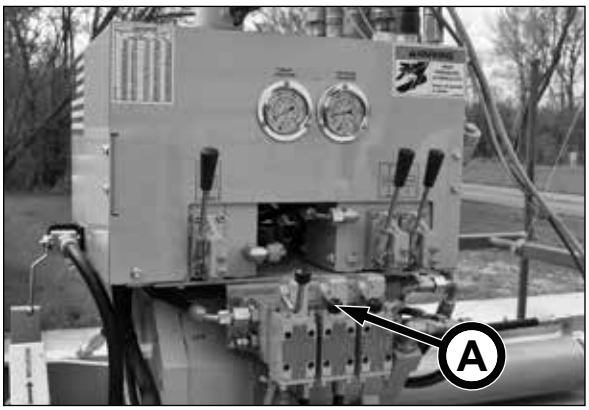
Installing Auger Casings with Reaming Head (continued)

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

⚠WARNING Flying sparks and debris from torching operation can cause severe injury. Approved personal protection must be worn while torching opening into shaft.



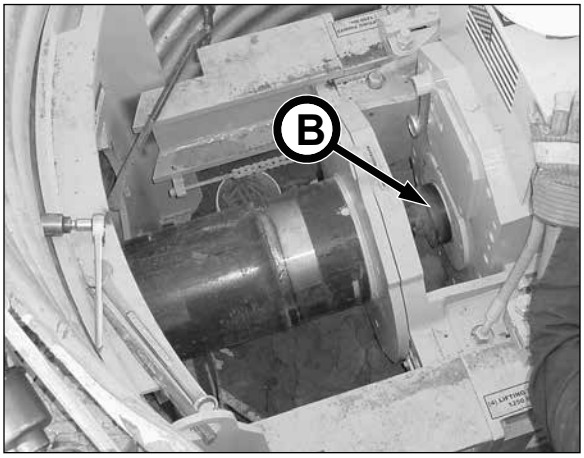
19. Cut an opening in the shaft large enough for the reaming head, thrust casings, powered cutter head (if used) and product pipe to pass through.



20. Move drive speed selector (A) DOWN 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 (Low Speed High Torque) position.

NOTICE The rotational working pressure range is up to 3,600 psi (24.821 mPa) of continuous operation, with a maximum pressure of 5,000 psi (34.474 mPa) intermittent operation. Failure to follow this guideline can cause premature failure of the hydraulic drive motor.



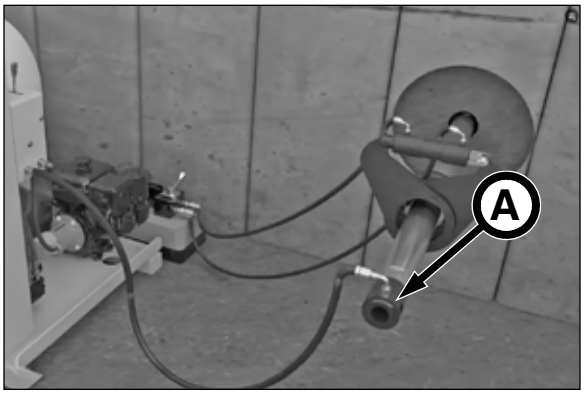
21. Advance the reaming head assembly by extending the thrust cylinders with the thrust cylinder control and rotate the augers in the clockwise direction with drive rotation control.

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 spoils plugging in the spoil chamber (B).

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

(continued on next page)

Installing Auger Casings with Reaming Head (continued)



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

23. Before retracting gearbox, 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 gearbox is retracted.



24. Move the gearbox assembly to the back of the GBM frame using the thrust cylinder control.

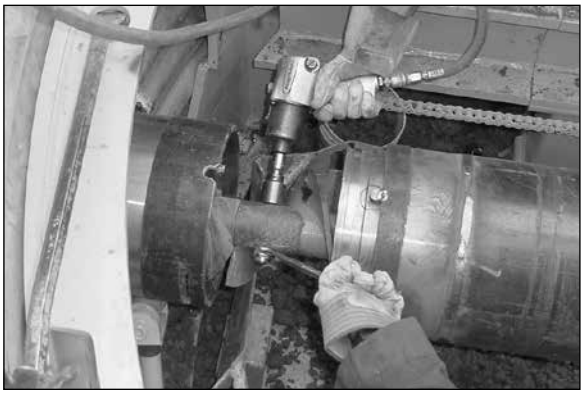
⚠WARNING Moving parts or the mishandling of parts can cause severe personal injury. Handle parts carefully to avoid crushing and pinch point hazards.



25. Lower thrust casing/auger into launch shaft.

NOTICE Install safety chain assembly or auger pin to auger to secure auger into casing. For proper installation of safety chain, refer to *Installing Casing Auger Pin To Auger & Casing* in this section. Also, use a properly rated pipe tong or nylon strap to handle the casings.

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



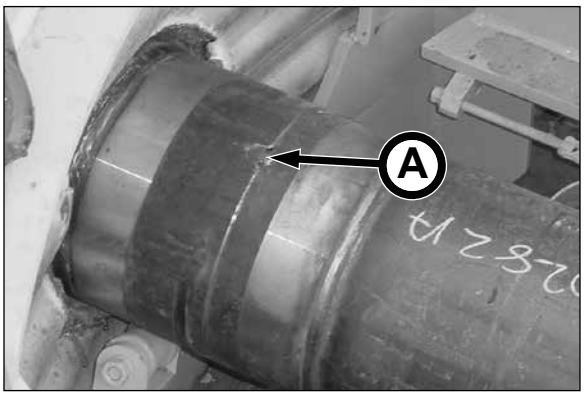
26. Slide the thrust casing auger onto the end of the reaming head assembly auger shaft.

27. 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.

Installing Auger Casings with Reaming Head (continued)

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

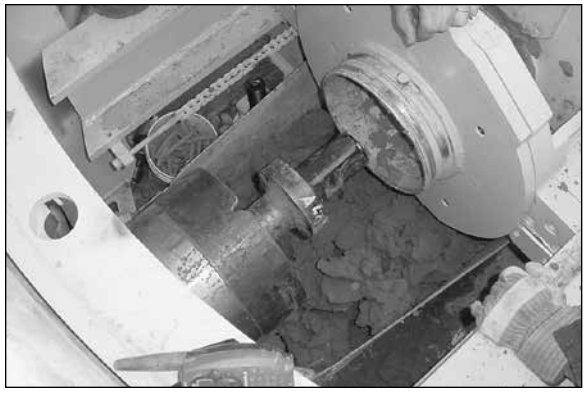
28. Advance the casing to the reaming head assembly casing and align with alignment guides in the 12 o'clock (A) and 6 o'clock positions.



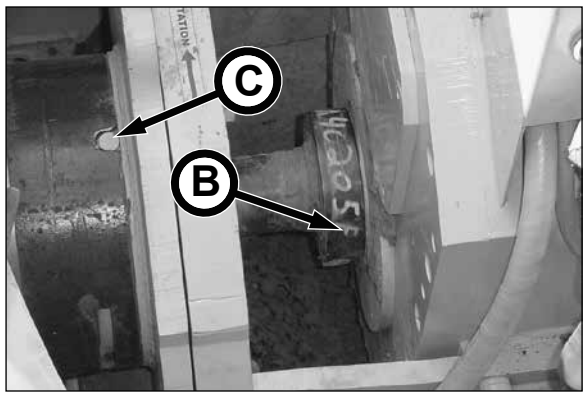
29. Install four casing clips at the 2 o'clock, 4 o'clock, 8 o'clock, and 10 o'clock positions to lock the casings together.



30. Remove auger drive adapter from gearbox and insert onto casing auger shaft.



31. Align the auger drive adapter (B) into the gearbox while aligning the notches in the casings with the alignment guides (C) on thrust plate using the drive rotation control and thrust cylinder control.



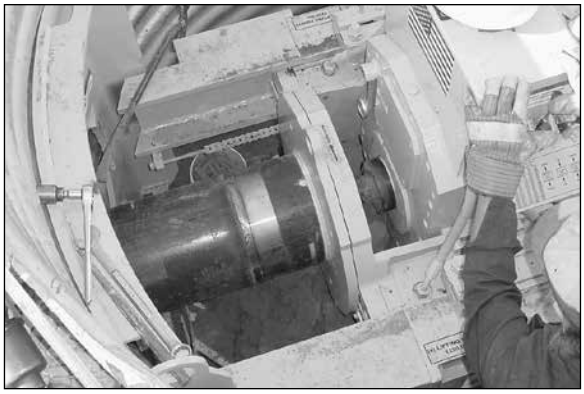
NOTICE If pulling back of pipe will be required, place casing clips into casing and casing thrust adapter.

(continued on next page)

Installing Auger Casings with Reaming Head (continued)

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.

32. Advance the casing/auger with the thrust 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.

33. Periodically empty the dirt bucket.



34. Replace dirt bucket.



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

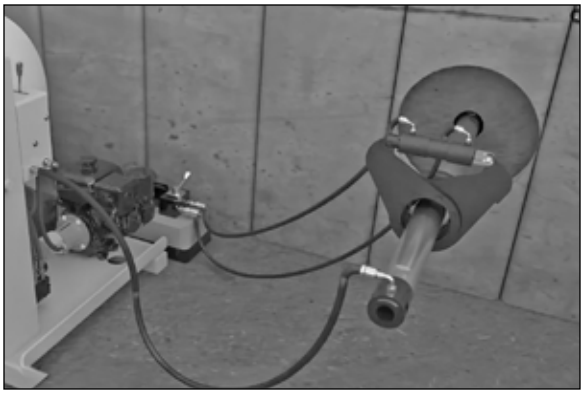


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Installing Auger Casings with Reaming Head (continued)



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

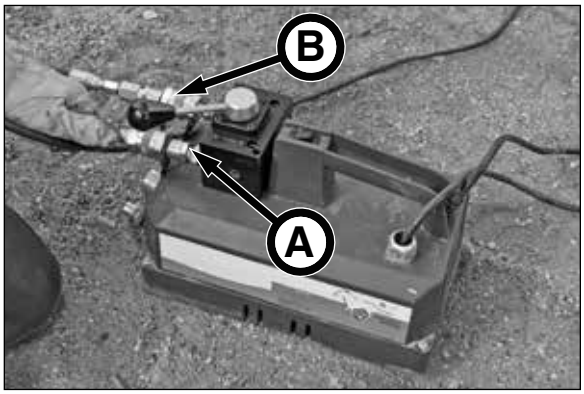


NOTICE Lubricant can be pumped from the reception shaft to lubricate the spoils and casings to reduce jacking forces. Install fluid connector on end of pilot tube in the reception shaft. Refer to *Upsizing Tool Lubrication From Reception Shaft* in this section for configuration details.

36. Once the steering head adapter and pilot tubes reach the reception shaft, each joint must be loosened with the dual tube breakout tool and power pack assembly.

    Clean the areas around all the work ports (A, B). Hook up the power pack and breakout tool male and female ends.

    The power pack has a control lever with two selector positions:
    Port A - Extend Breakout Tool Cylinder
    Port B - Retract Breakout Tool Cylinder



Breakout Tool Power Pack Ports A & B

⚠WARNING Electrical shock hazard could cause severe injury or death. Be sure the breakout tool power unit, plug and receptacle (must be three-pronged) are properly grounded and dry before plugging in and during operation.

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

NOTICE A cordless, rechargeable breakout tool power pack is available. Contact Akkerman Aftermarket Support for details.

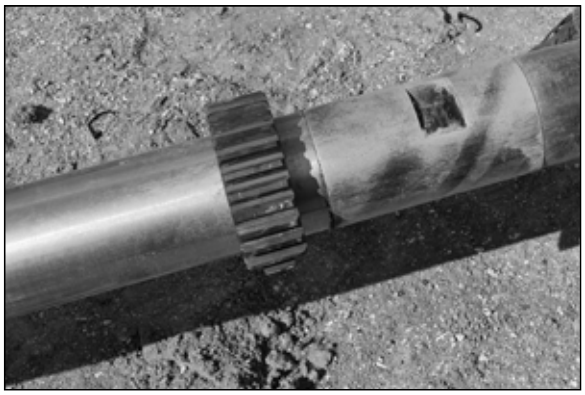
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Installing Auger Casings with Reaming Head (continued)

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



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



39. With the cylinder retracted, slide the breakout tool onto the pilot tube adapter and pilot tube and over the jaw insert from previous step.



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.

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



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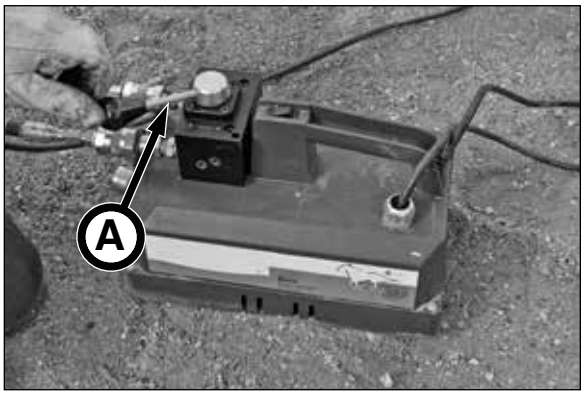
Installing Auger Casings with Reaming Head (continued)

41. 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.

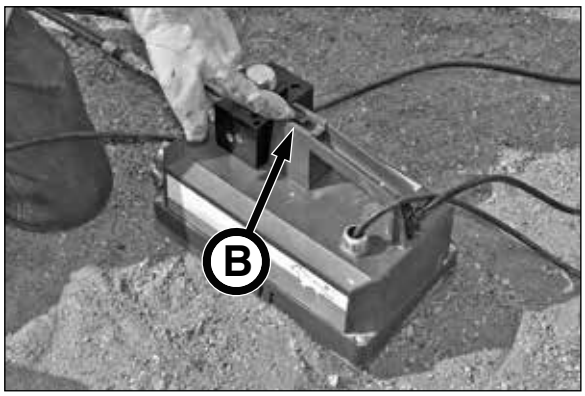
42. Move the control lever to port A (A) to extend the breakout tool cylinder.



43. Extend breakout tool cylinder by depressing the switch power pack remote controller.



NOTICE The rocker switch (B) on the breakout tool power unit can also be used to control the cylinder.



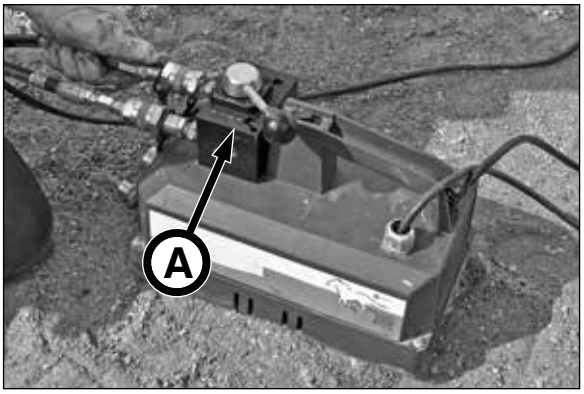
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Installing Auger Casings with Reaming Head (continued)



44. 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.

45. Release switch on controller or power pack.



46. Once the joint is loosened, move the power pack control lever to port B (A) to retract the breakout tool cylinder.



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

48. Remove the front jaw insert.



49. Slide the breakout tool towards the end of the pilot tube adapter or pilot tube and remove the back jaw insert.

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

(continued on next page)

Installing Auger Casings with Reaming Head (continued)

51. Remove the steering head adapter or pilot tube and immediately install a cap (steering head adapter) or plug (pilot tube) on the end to prevent dirt from entering pilot tube and protect the threads.



52. After removing the steering head adapter, retrieve the target housing and target. Remove the target batteries and return the target to the guidance system case. Return the steering head adapter assembly, target holder and inner tube to the power pack.



NOTICE DO NOT store target batteries in reverse polarity. Storing batteries backwards WILL cause target damage. Remove batteries from target for storage.

53. After removing each pilot tube, place pilot tube into pilot tube rack.



NOTICE Before using pilot tubes on next project, be sure pilot tubes are clean and inspect pilot tube threads. Refer to Periodic Maintenance in section 9 for proper procedure.

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



(continued on next page)

Installing Auger Casings with Reaming Head (continued)



55. Continue to remove pilot tubes as they reach the reception shaft. Cap the end of each pilot tube and place it in the rack.



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

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

57. Once the reaming head assembly can be removed from the reception shaft, remove the casing clip 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 casing clip keep first, otherwise the weight of the casing and auger will make it difficult to remove the bottom clip once the top clip is removed.



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

(continued on next page)

Installing Auger Casings with Reaming Head (continued)

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



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







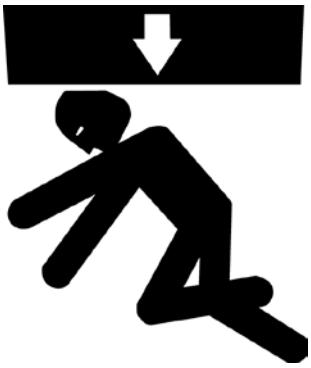
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Installing Auger Casings with Reaming Head (continued)



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

61. 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.

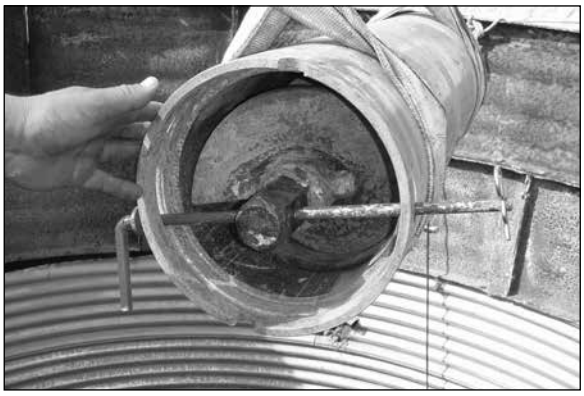


⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits an obstruction. Properly install casing auger pin to augers and casings before lowering into or lifting out of shaft. Do not stand or walk under a load.

62. Install casing auger pin to auger to secure auger into reaming head assembly. For proper installation of safety chain, refer to *Installing Casing Auger Pin To Auger & Casing* in this section.

63. Remove the reaming head assembly from reception shaft.

64. Proceed to *Three Step Method: Installing Product Pipe* in this section.



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

⚠WARNING Keep personnel away from the inside of the GBM jacking frame while there is power to the equipment. Failure to do so can result in serious personal injury or death.

NOTICE Though some photos in this procedure depict an earlier GBM latching frame, this procedure applies to the 240A/ABM frame.

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

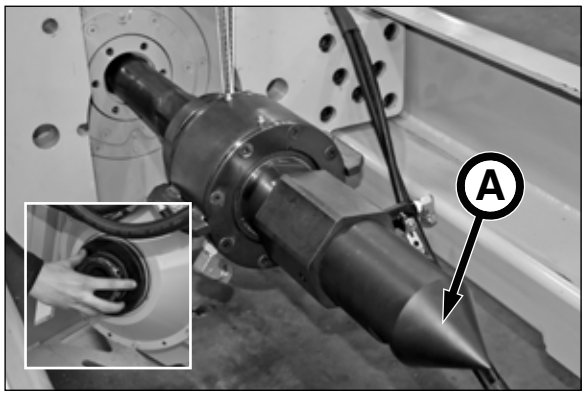


2. If not already removed, remove the drive swivel adapter from the gearbox.

⚠CAUTION The drive swivel adapter weighs approximately 101 lbs. (46 kg). Use a properly rated lifting strap to remove the drive swivel adapter from the GBM jacking frame.

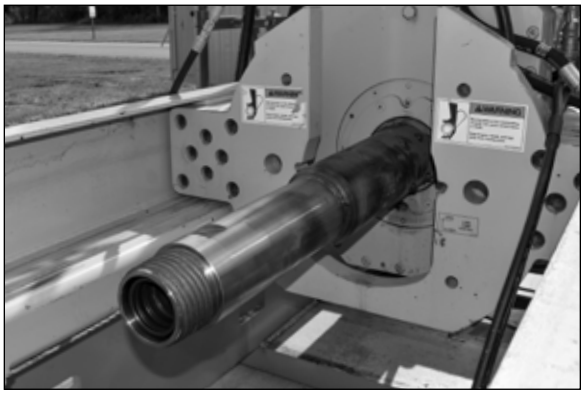
NOTICE Remove the flange and locknuts (see inset) on the drive swivel adapter on the back of the gearbox.

Replace alignment guide adapter (A) to protect threads.

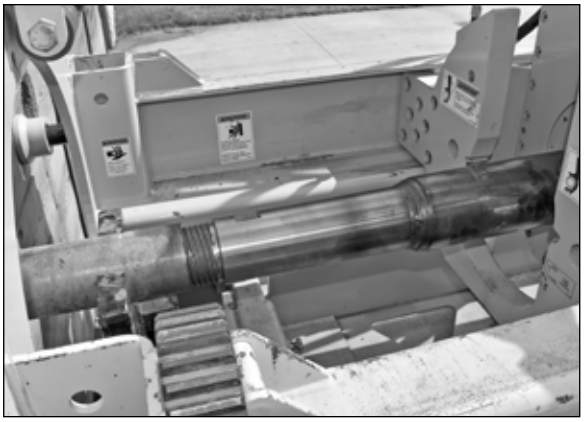


NOTICE Lubrication will lower jacking pressures during the drive. Refer to *Upsizing Tool Lubrication From Reception Shaft* in this section to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

3. Lower the pilot tube adapter and insert the pilot tube adapter hex into the gearbox. Remove the adapter cap.

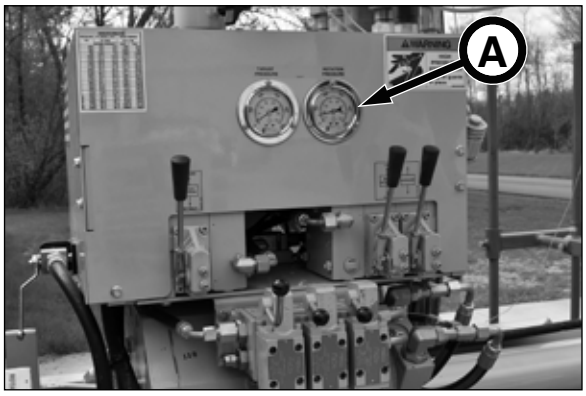


4. With the final pilot tube secured into the make-up tool, thread the pilot tube adapter clockwise (CW) using the drive rotation control, while advancing the gearbox assembly with the thrust cylinder control to thread the adapter into the pilot tube.



(continued on next page)

Installing Auger Casings with Cutter Head (continued)



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

6. Release make-up tool.

NOTICE Lubrication will 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.



7. Advance adapter into ground until there is enough room to pin the pilot tube adapter to the pilot tube swivel.

NOTICE For ease of installing cutter 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).



8. Move gearbox assembly to the back of the GBM frame to allow enough room for the pilot tube swivel using the thrust cylinder control.

9. Remove make-up tool.



10. Lower pilot tube swivel into launch shaft.

Installing Auger Casings with Cutter Head (continued)

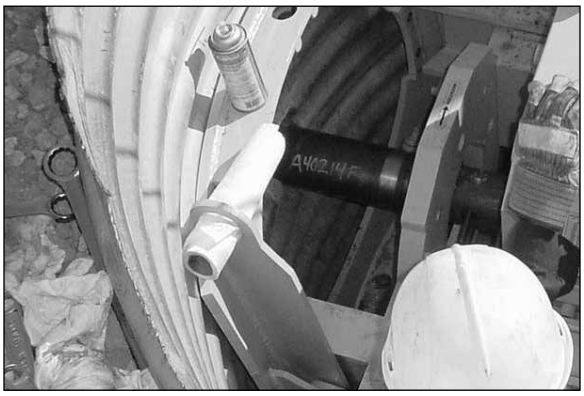
11. Insert the pilot tube swivel (grease fitting end in first) into the hex of the pilot tube adapter and secure with four pins.



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.



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



(continued on next page)

Installing Auger Casings with Cutter Head (continued)

13. Move the gearbox assembly to the back of the GBM frame to allow enough room for the dirt bucket and cutter head assembly.



14. Install casing thrust adapter to thrust plate with two 3/4 x 2 in. bolts and washers for 11-in. casings.



15. Lower dirt bucket into shaft.



(continued on next page)

Installing Auger Casings with Cutter Head (continued)

16. In the reception shaft, remove steering head.

    a. Remove set screw.



    b. Drive out pins.



    c. Remove and retain pins.



    d. Remove steering head.



(continued on next page)

Installing Auger Casings with Cutter Head (continued)

⚠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.





17. Lower cutter head assembly into launch shaft.

NOTICE Install safety chain assembly or auger pin to auger to secure auger into cutter head assembly. For proper installation of safety chain, refer to *Installing Casing Auger Pin To Auger & Casing* in this section.

Also, use a properly rated pipe tong or nylon strap to handle the cutter head assembly and casings.

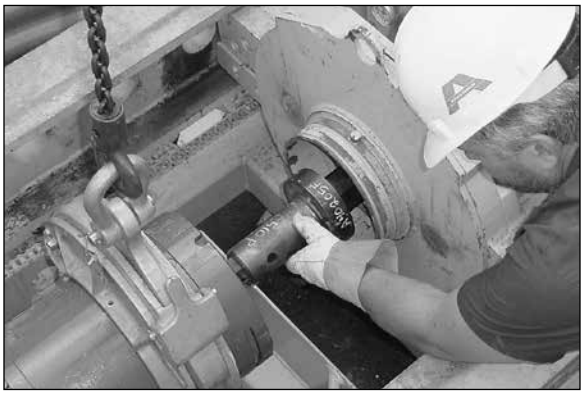


18. Install cutter head hex shaft into pilot tube swivel and secure with four roll pins.



Installing Auger Casings with Cutter Head (continued)

19. Install auger drive adapter onto auger shaft.





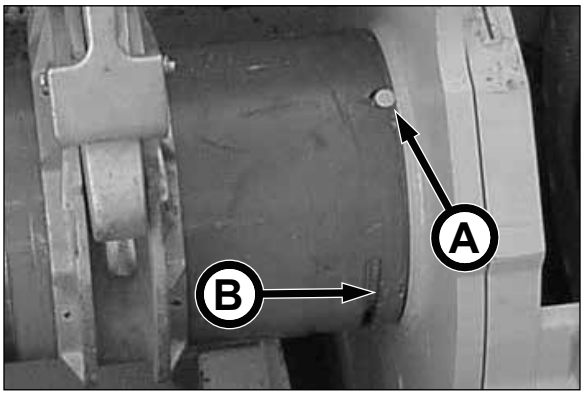
20. Align and engage auger drive adapter with the hex opening in gearbox using the drive rotation control and frame travel motor control.



(continued on next page)

Installing Auger Casings with Cutter Head (continued)

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



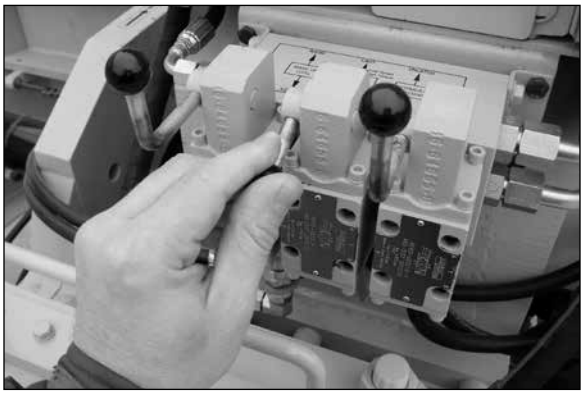
NOTICE If pulling back of pipe will be required, install casing clips into cutter head assembly lead casing and casing thrust adapter (B), and bolt the auger drive adapter to the gearbox and the auger shaft.

⚠WARNING Flying sparks and debris from torching operation can cause severe injury, Approved personal protection must be worn while torching opening into shaft,



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

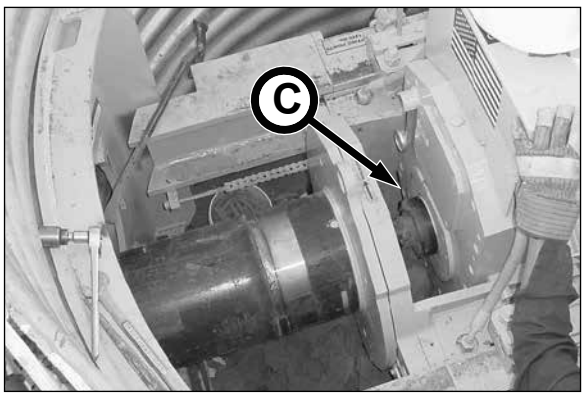
23. Move drilling drive speed selector to the HSLT (High Speed Low Torque) position.



NOTICE Depending on soil conditions and length of drive, it may be necessary to change the selector to the LSHT (Low Speed High Torque) position.

NOTICE The rotational working pressure range is up to 3,600 psi (24.821 mPa) of continuous operation, with a maximum pressure of 5,000 psi (34.474 mPa) intermittent operation. Failure to follow this guideline can cause premature failure of the hydraulic drive motor.

24. Advance the cutter head assembly by extending the thrust cylinders with the thrust cylinder control and rotate the augers in the clockwise direction with drive rotation control.

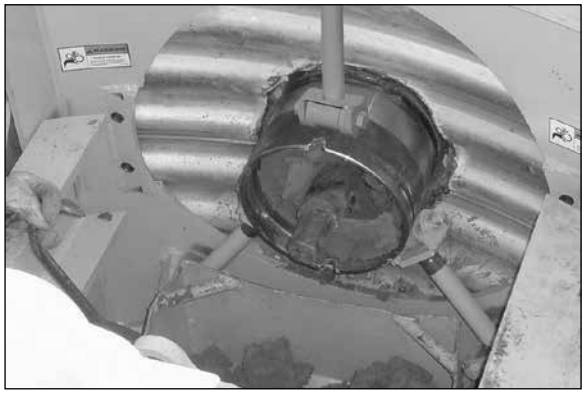


NOTICE Rotate the augers and advance the casings so small clumps of spoil are going into the dirt bucket. Over advancing the casings will restrict the flow of material out of the auger resulting in the spoils plugging in the spoil chamber (C).

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

(continued on next page)

Installing Auger Casings with Cutter Head (continued)



26. Before retracting gearbox, 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 gearbox is retracted.

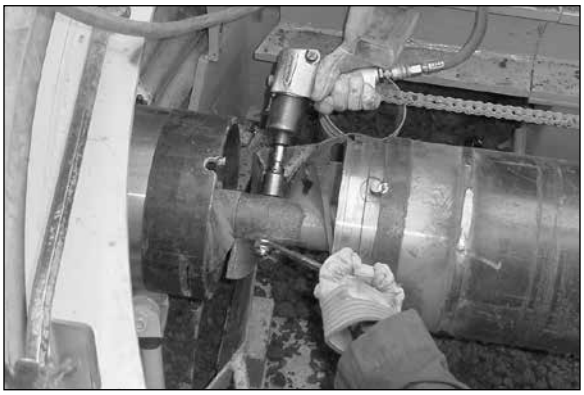
27. Move the gearbox assembly to the back of the GBM frame.



⚠WARNING Moving parts or the mishandling of parts can cause severe personal injury. Handle parts carefully to avoid crushing and pinch point hazards.

28. Lower thrust casing/auger into launch shaft.

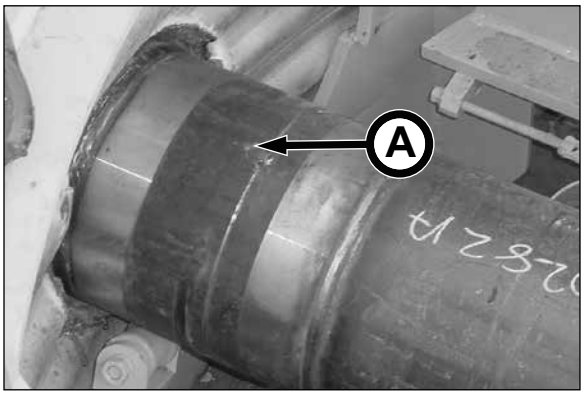
NOTICE Install safety chain assembly or auger pin to auger to secure auger into casing. For proper installation of safety chain, refer to *Installing Safety Chain Assembly/Casing Auger Pin To Auger & Casing* in this section. Also, use a properly rated pipe tong or nylon strap to handle the casings.



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

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

30. 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.



31. 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)

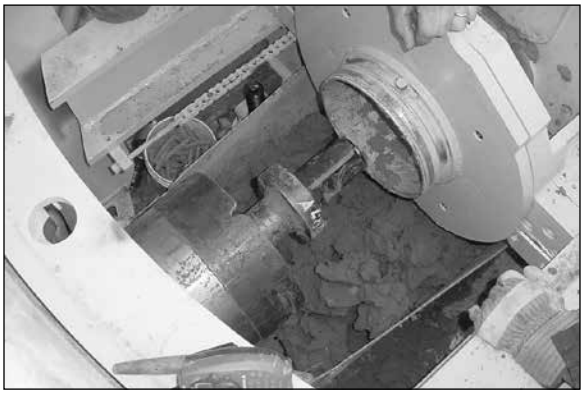
Installing Auger Casings with Cutter Head (continued)

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

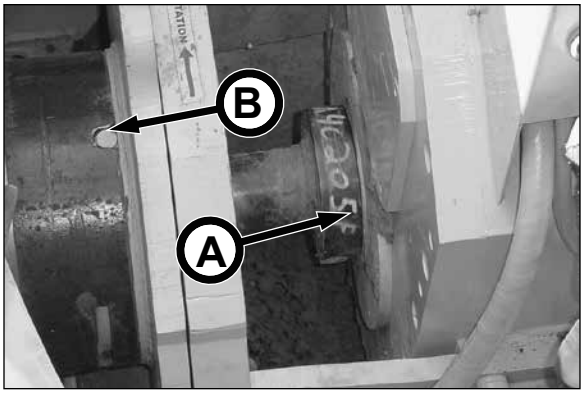


⚠WARNING Safety glasses must be worn while using power equipment (air tools). Failure to do so could cause severe injury from flying debris.

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

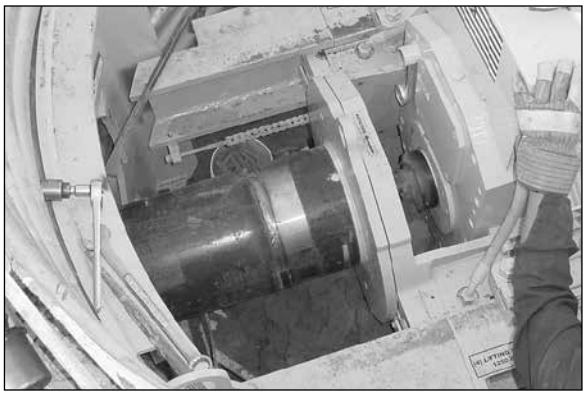


33. Remove auger drive adapter from gearbox and insert onto casing auger shaft.



34. Align the auger drive adapter (A) into the gearbox while aligning the notches in the casings with the alignment guides (B) on thrust plate using the drive rotation control and travel motor control or thrust cylinder control.

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



35. Advance the casing/auger with the thrust cylinder control and the drive 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.

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Installing Auger Casings with Cutter Head (continued)

36. Periodically empty the dirt bucket.



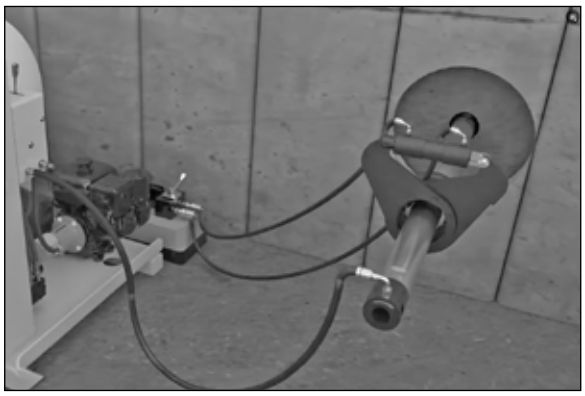
37. Replace dirt bucket.



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



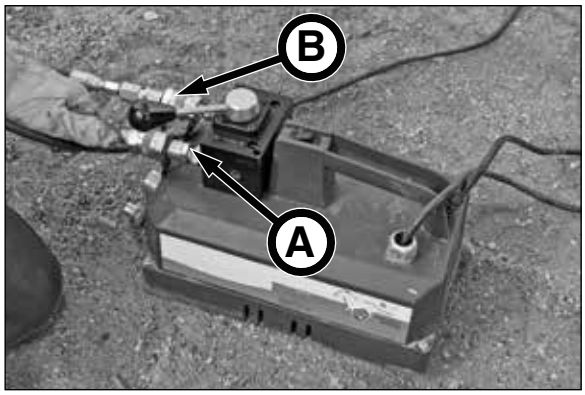
(continued on next page)

Installing Auger Casings with Cutter Head (continued)

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

    Clean the areas around all the work ports (A, B). Hook up the power pack and breakout tool male and female ends.

    The power pack has a control lever with two selector positions:
    Port A - Extend Breakout Tool Cylinder
    Port B - Retract Breakout Tool Cylinder



Breakout Tool Power Pack Ports A & B

⚠WARNING Electrical shock hazard could cause severe injury or death. Be sure the breakout tool power unit, plug and receptacle (must be three-pronged) are properly grounded and dry before plugging in and during operation.

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

NOTICE A cordless, rechargeable breakout tool power pack is available. Contact Akkerman Aftermarket Support for details.

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



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



(continued on next page)

Installing Auger Casings with Cutter Head (continued)



42. With the cylinder retracted, slide the breakout tool onto the pilot tube adapter and pilot tube and over the jaw insert from previous step.

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.

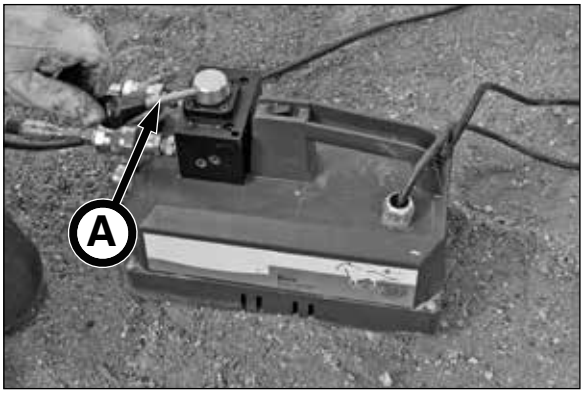


43. Slide other jaw insert on notches of the steering head adapter or the front pilot tube.



44. 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.



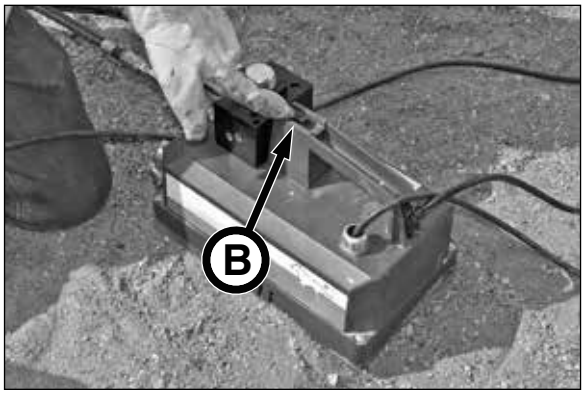
45. Move the control lever to port A (A) to extend the breakout tool cylinder.

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Installing Auger Casings with Cutter Head (continued)



46. Extend breakout tool cylinder by depressing the switch power pack remote controller.

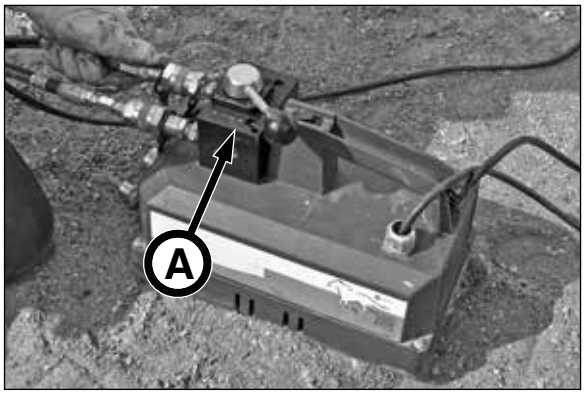


NOTICE The rocker switch (B) on the breakout tool power unit can also be used to control the cylinder.



47. 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.

48. Release switch on controller or power pack.



49. Once the joint is loosened, move the power pack control lever to port B (A) to retract the breakout tool cylinder.

(continued on next page)

Installing Auger Casings with Cutter Head (continued)



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

51. Remove the front jaw insert.



52. Slide the breakout tool towards the end of the pilot tube adapter or pilot tube and remove the back jaw insert.

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



54. Remove the steering head adapter or pilot tube and immediately install a cap (steering head adapter) or plug (pilot tube) on the end to prevent dirt from entering pilot tube and protect the threads.



55. After removing the steering head adapter, retrieve the target housing and target. Remove the target batteries and return the target to the guidance system case. Return the steering head adapter assembly, target holder and inner tube to the power pack.

NOTICE DO NOT store target batteries in reverse polarity. Storing batteries backwards WILL cause target damage. Remove batteries from target for storage.

(continued on next page)

Installing Auger Casings with Cutter Head (continued)



56. After removing each pilot tube, place pilot tube into pilot tube rack.

NOTICE Before using pilot tubes on next project, be sure pilot tubes are clean and inspect pilot tube threads. Refer to Periodic Maintenance in section 9 for proper procedure.



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



58. Continue to remove pilot tubes as they reach the reception shaft. Cap the end of each pilot tube and place it in the rack.



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.

(continued on next page)

Installing Auger Casings with Cutter Head (continued)

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





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





(continued on next page)

Installing Auger Casings with Cutter Head (continued)

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

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

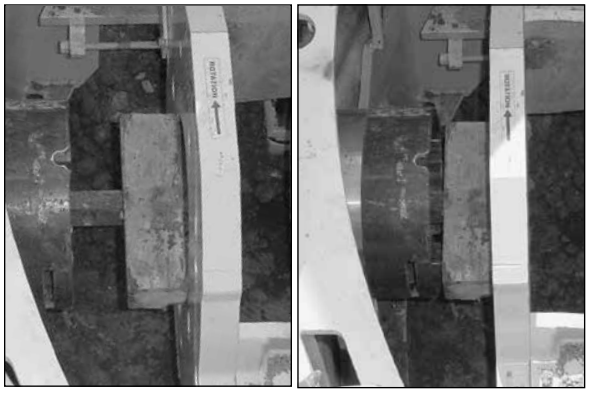


NOTICE Using a hoist to keep the cutter head in line with the pipe line, remove bottom casing clip first, otherwise the weight of the casing and auger will make it difficult to remove the bottom clip once the top clip is removed.

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



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)

Installing Auger Casings with Cutter Head (continued)

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

65. 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.



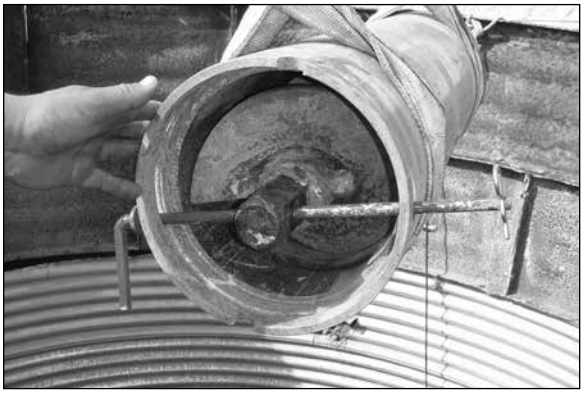
⚠WARNING Auger may fall out of casing and cause severe injury or death if casing tips or hits an obstruction. Properly install casing auger pin to augers and casings before lowering into or lifting out of shaft. Do not stand or walk under a load.



66. Install casing auger pin to auger to secure auger into cutter head assembly. For proper installation of safety chain, refer to *Installing Casing Auger Pin To Auger & Casing* in this section.

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

68. Proceed to *Three Step Method: Installing Product Pipe* in this section.



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 lubrication used when installing pilot tubes varies depending on the soil conditions. Your polymer supplier can help you with the proper lubrication mixture based on your geotechnical report for the project. In most clay type of soils a polymer should be added to the mix to reduce jacking and rotation operating pressures. In unstable soils, add a suspension enhancer to the mixture to prevent the pilot tube from eroding the bore hole.

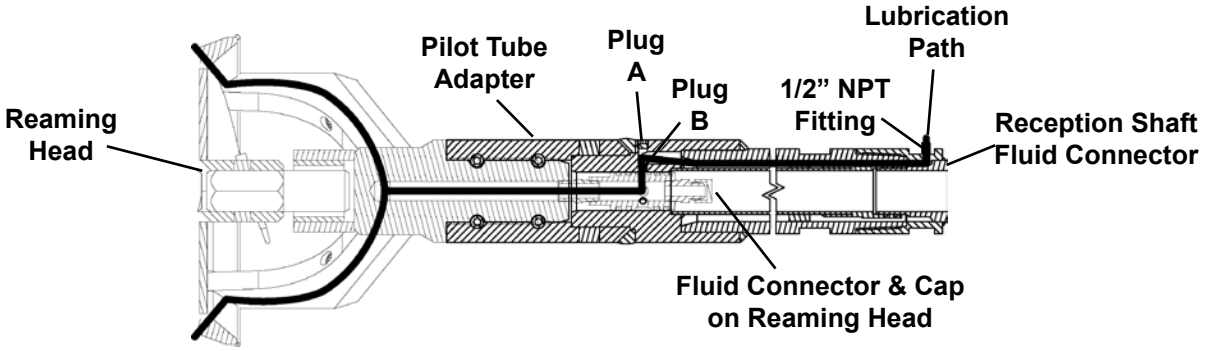
The pilot tube adapter contains three external lubrication ports for lubricating the spoils by connecting a lubrication hose to the reception shaft fluid connector. The casing can be lubricated by the pilot tube adapter's three internal lubrication ports connected to the upsizing tool fluid connector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

NOTICE Plug A (not supplied) is a 1/4" NPT plug. Plug B (supplied) is a 1/8" NPT plug.

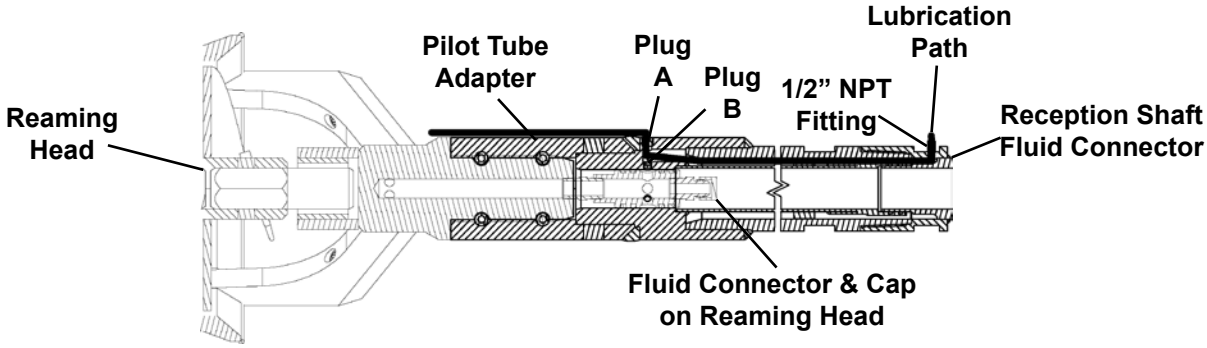
1. To Lubricate Outside Of Casing

Remove plug A (not supplied), remove plug B (supplied), reinstall plug A (not supplied), 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 (not supplied), install plug B (supplied), and connect a supply hose to the fitting on the fluid connector. Ensure that the fluid connector cap is in place. The lubricant will flow through the dual walled pilot tubes and out port A on pilot tube adapter to lubricate the spoils.

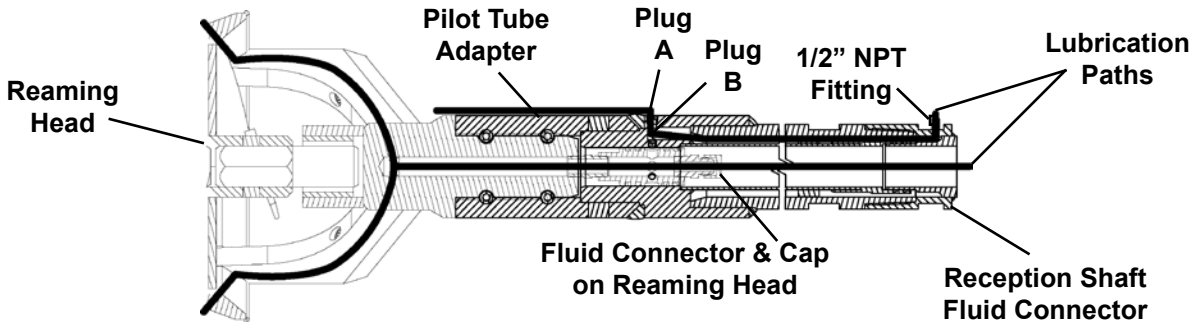


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Upsizing Tool Lubrication From Reception Shaft (continued)

3. To Lubricate Outside Of Casings And Spoils
Remove plug A (not supplied), install plug B (supplied), then connect a supply hose to the fitting on the fluid connector. Remove the fluid connector cap. The lubricant will flow through the dual walled pilot tubes and out port A on pilot tube adapter to lubricate the spoils.

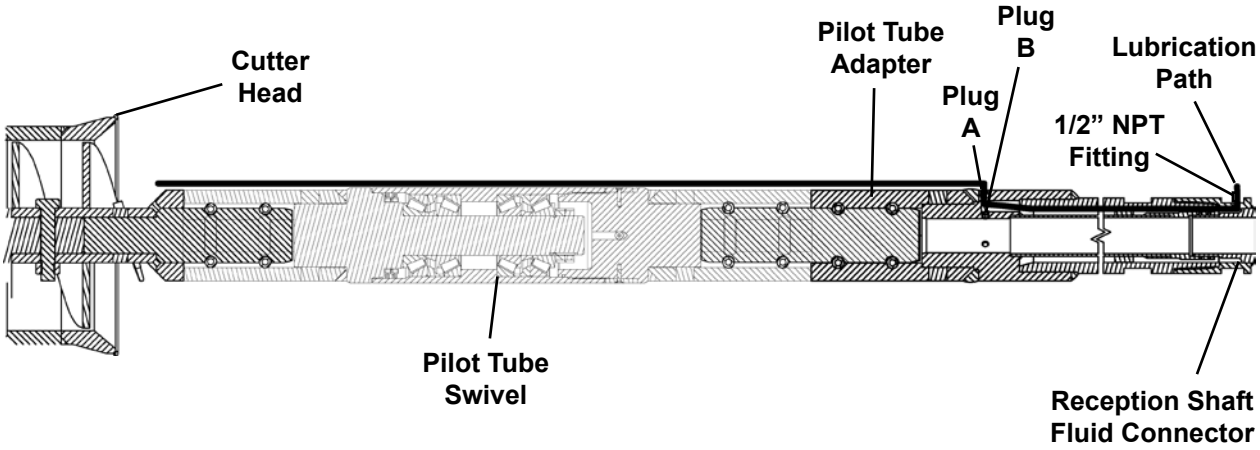
Route supply hose through center of reception shaft fluid connector to fluid connector on reaming head. The lubricant will flow through the supply hose into the reaming head fluid connector and out the lubrication ports of the reaming head arms to lubricate the outside of casings.



II. PILOT TUBE ADAPTER WITH CUTTER HEAD ASSEMBLY

NOTICE Plug A (not supplied) is a 1/4" NPT plug. Plug B (supplied) is a 1/8" NPT plug.

1. To Lubricate Spoils
Remove plug A (not supplied), install plug B (supplied), 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.



INSTALLING CASING AUGER PIN TO AUGER & CASING

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

Properly install casing auger pin to augers and casings before lowering into or lifting out of shaft.

Do not stand or walk under a load.

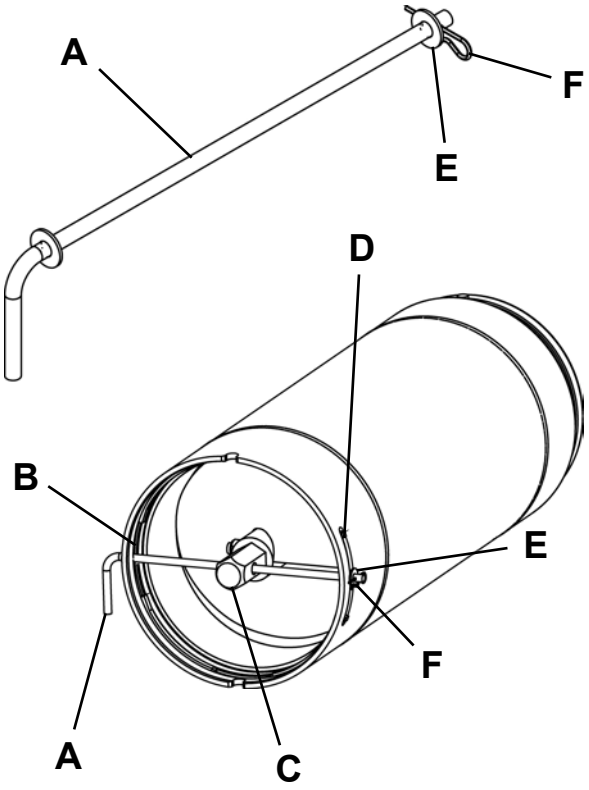


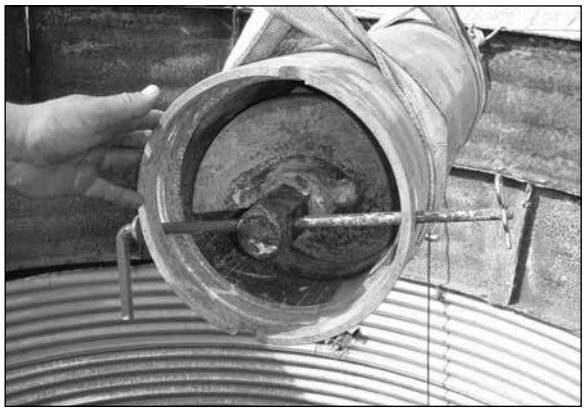
AUGER PIN AND CLIP

Secure auger to casing with an auger pin and clip as follows:

1. Insert casing pin (A) through clip retaining slot (B) in casing, through hole in auger stem (C), through clip retaining slot (D) in other side of casing.

2. Secure auger pin with hardened flat washer (E) and hitch pin clip (F).





(continued on next page)

Operation - Installing Product Pipe

THREE STEP METHOD: INSTALLING PRODUCT PIPE

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

NOTICE If your product pipe is rated lower than 5,000 psi (34.5 MPa) or 100 ton, you MUST readjust the thrust pressure in the P4075D Power Pack. Failure to do so will break the pipe.
Refer to *Power Pack Operation, Adjusting Thrust Pressure* Operation in this section.

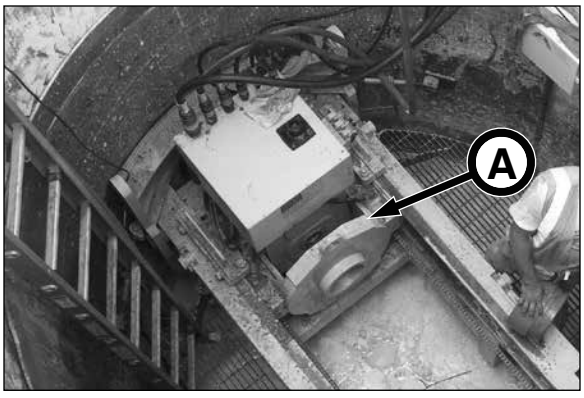
NOTICE This procedure applies to using the single stage jacking frame with the lower base frame assembly for standalone applications. Though the photos in this procedure depict the an earlier jacking frame, this procedure also applies to the single stage frame.



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 (A) on front of thrust plate and secure with two 3/4 x 1-1/4 bolts and flat washers.

(Continued on next page)

Installing Product Pipe (continued)

⚠DANGER Failure to lockout tagout power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

3. 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.

4. Secure pipe adapter to casing with four casing clips.



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.

5. Lower product pipe into launch shaft with the bell end of the product pipe away from the reception shaft.

6. Carefully align product pipe into the pipe adapter.

7. Align product pipe onto pipe thrust adapter.



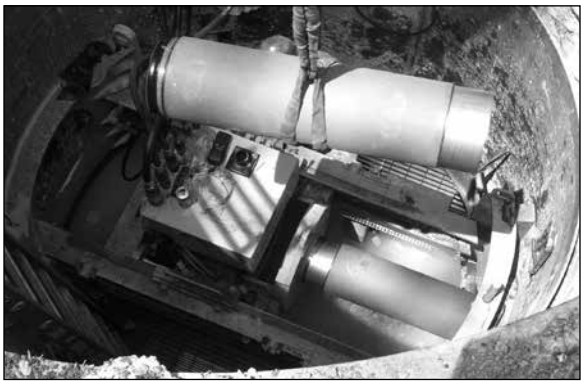
8. Push product pipe into pipeline with the thrust cylinder control.

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



Installing Product Pipe (continued)

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



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

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

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



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



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



(continued on next page)

Installing Product Pipe (continued)



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



14. Slide the front auger into the lead casing. Secure auger to casing with auger pin.

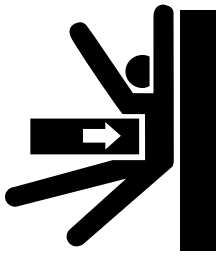
15. Remove auger casing from reception shaft.

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

Operation - Miscellaneous

PILOT TUBE PULLBACK THROUGH LAUNCH SHAFT

⚠WARNING Keep personnel away from the inside of the GBM jacking frame while there is power to the equipment. Failure to do so can result in serious personal injury or death.



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

Keep hand away from moving parts.

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

Handle parts carefully to avoid crushing and pinch point hazards.



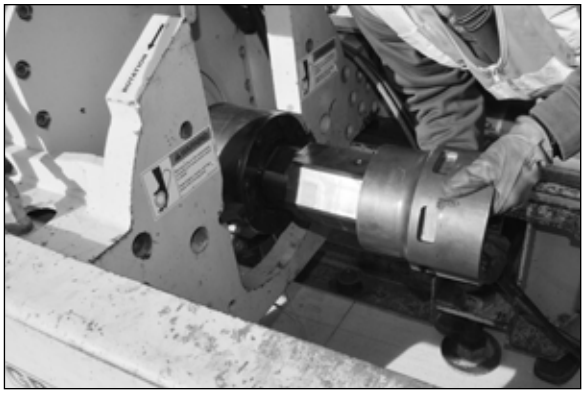
NOTICE Before performing pilot tube pullback, place Drive Speed Selector in LSHT (Low Speed High Torque).

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



Using spanner wrench on flange & locknuts

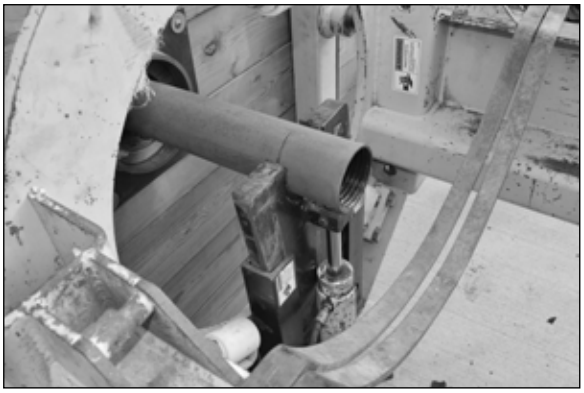
2. Slide the pullback breakout tool over the hex shaft of the drive swivel sub saver.



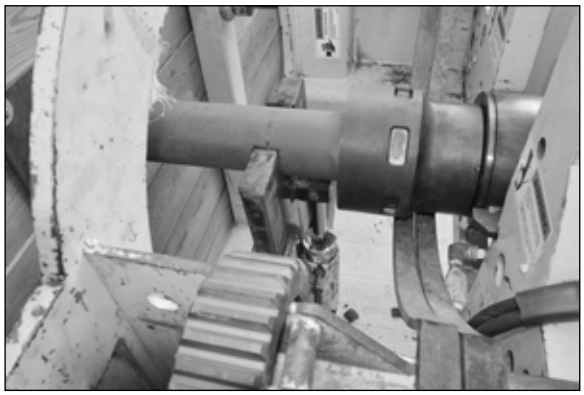
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Pilot Tube Pullback Through the Launch Shaft (continued)

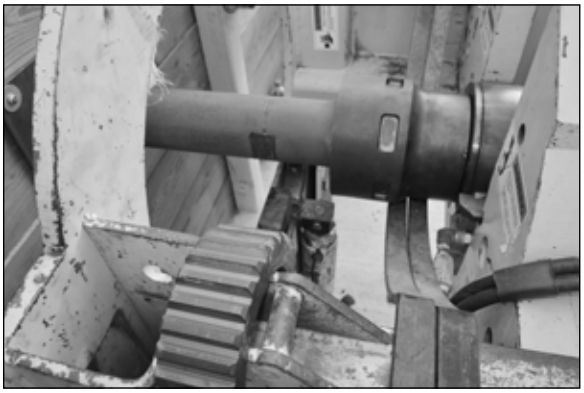
3. With the pilot tube engaged into the make-up tool, thread the drive swivel into the pilot tube by rotating the drive swivel in the clockwise (CW) direction with the drive rotation control until male/female shoulder makes contact. Do not torque this joint.



NOTICE Slide pilot tube scraper onto pilot tube if needed to remove soil accumulated on the outside of pilot tube.



4. Disengage make-up tool and pullback pilot tube until the notches of the next pilot tube align with make-up tool by using the thrust cylinder control.

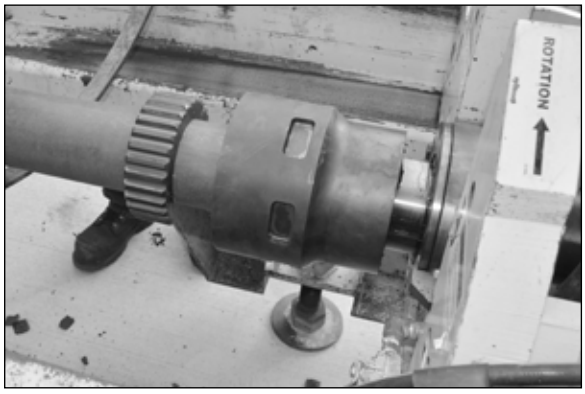


5. Engage make-up tool into pilot tube notches.



Pilot Tube Pullback Through the Launch Shaft (continued)

6. Install insert over notches on the pilot tube.



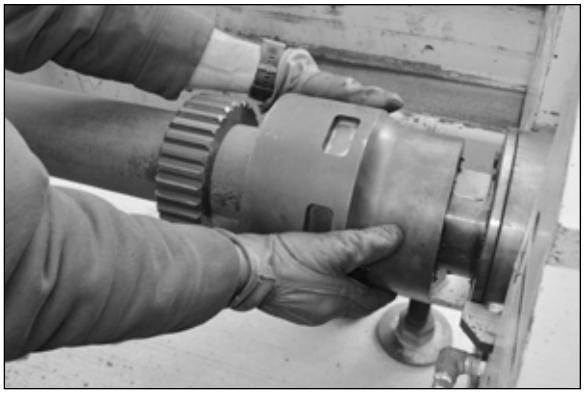
7. Slide pullback breakout tool over insert.



8. With the pilot tube locked into the make-up tool, loosen the pilot tube joints by rotating the drive swivel counterclockwise (CCW) using the drive rotation control.



9. Once the joint has been loosened, slide the pullback breakout tool back to the drive swivel remove insert.

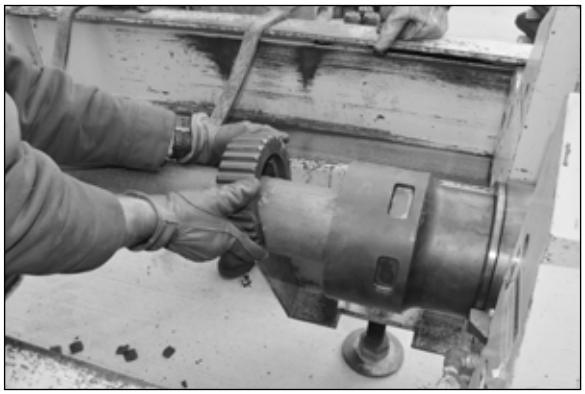


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Pilot Tube Pullback Through the Launch Shaft (continued)

10. Remove pilot tube. Install caps and plugs on pilot tube and place in pilot tube rack.

11. Continue to pullback pilot tubes as needed.





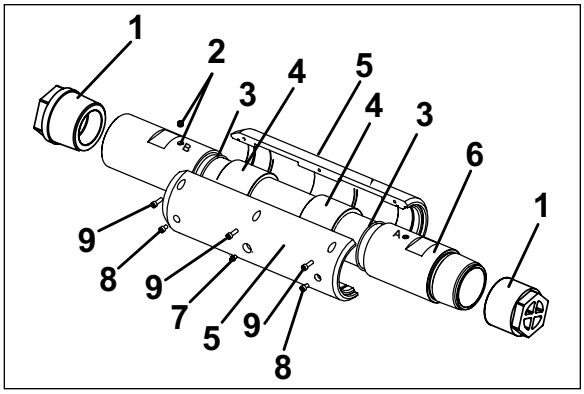
USING SPINNER TUBES/PILOT TUBE EXPANSION SLEEVE

The pilot tube expansion sleeve, A62122A is used to maintain a 5 in. (127 mm) bored hole in ground conditions with swelling or squeezing clay and high plasticity. The expansion sleeve tapered edge deflects swelling clay away from the pilot tubes. The split sleeve design encases the pilot tube, and features interior bushings that allow the pilot tube string to rotate. The design assists to reduce rotational torque and operating pressures and allows additional optional lubrication points along the pilot tube string.

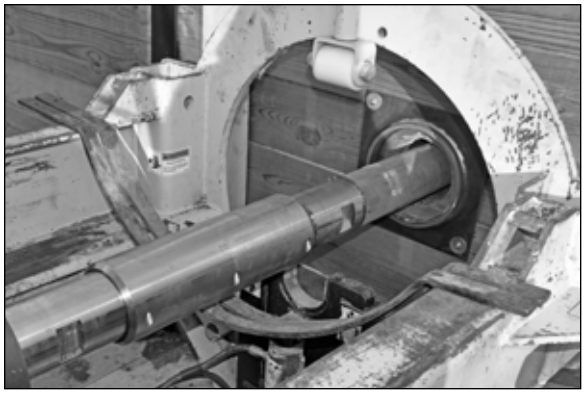
The pilot tube expansion sleeve is typically installed after the first 20 ft (6 m) or approximately eight (8) pilot tubes and then every 40 ft (12 m) or approximately sixteen (16) pilot tubes thereafter.

Spinner Tube / Pilot Tube Expansion Sleeve Terminology

1. Thread Protector Cap and Plug
2. Expansion Sleeve Lubrication Port B with 1/8 in. NPT plug
3. O-Rings
4. Bushings
5. Expansion Sleeve Half with Threads
6. Outer Tube
7. Grease Fitting
8. (2) Screw, Socket Head Cap, 1/4 x 0.375
9. (6) Screw, Socket Head Cap, 1/4 x 0.75



NOTICE The Expansion Sleeve Lubrication Ports allows additional optional lubrication points along the alignment. An unplugged port will result in a loss of lubrication flow at the steering head and other forward tooling. The contractor must gauge when it's necessary to port or plug the B port depending on the project ground conditions. The general recommendation is to plug the first expansion sleeve (approximately 20 ft) and the port the second (approximately 60 ft) and those installed thereafter.



NOTICE Installation may vary based upon ground conditions. The contractor may need to add more Pilot Tube Expansion Sleeves in swelling ground and reduce the distance between them or reduce the number of Pilot Tube Expansion Sleeves in less swelling ground with more distance between them.

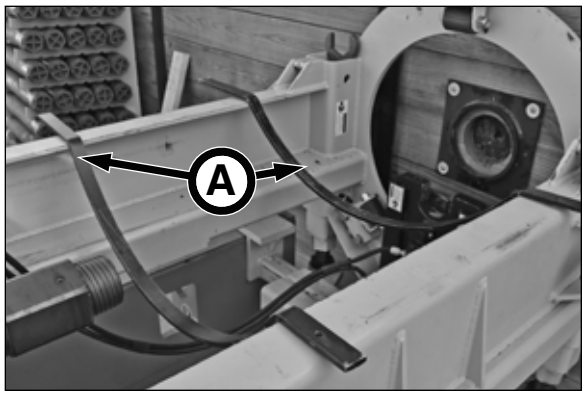
NOTICE The Pilot Tube Expansion Sleeve Assembly include two lubrication ports, labeled A and B. This instruction refers to port B only. Operators should leave the A port plug in place.

NOTICE The Pilot Tube Expansion Sleeves are a larger diameter than the opening on Breakout Tool Assembly. If using an original breakout tool, you must first remove the centering spacer to remove the Pilot Tube Expansion Sleeves from the reception shaft. Refer to *Spinner Tube/Pilot Tube Expansion Sleeve Reception Shaft Removal* in instruction 050179A, or contact Akkerman Aftermarket Support for more information.

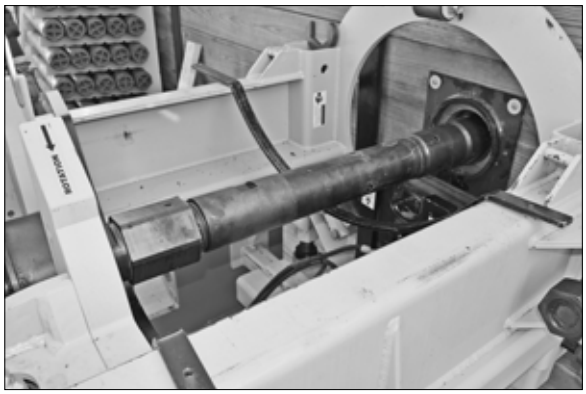
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Using Spinner Tubes/Pilot Tube Expansion Sleeve (continued)

1. Position the pilot tube support bars (A) along the frame rails.

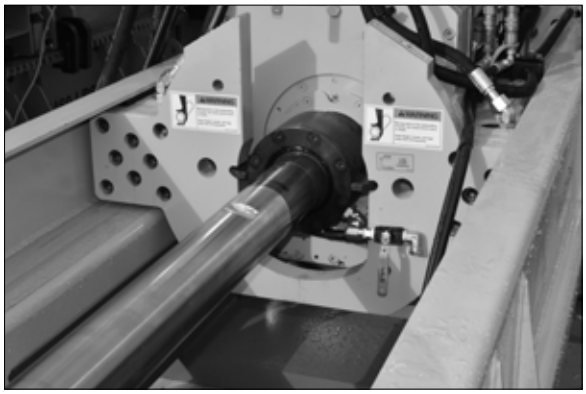


2. Install a minimum 5 in. diameter steering head; one of the 30°, 45°, or bullet steering heads.



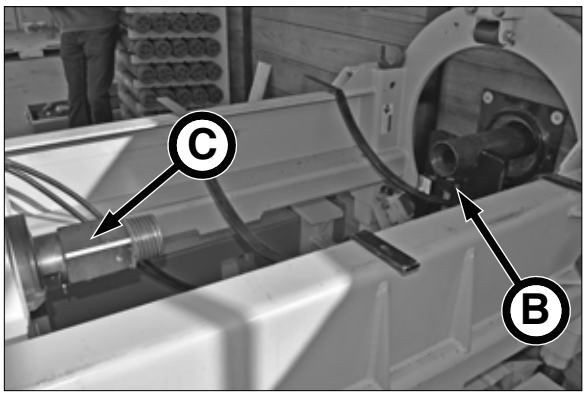
⚠WARNING Suspended loads may fall and cause severe personal injury or death. Do not enter area under or around a suspended load.

3. After the steering head/steering head adapter are launched, install eight (8) pilot tubes for an approximate installation length of 20 ft (6 m).



4. Leave the pilot tube notches engaged in the make-up tool (B), disengage the drive swivel (C), and retract the thrust cylinders by pulling the Thrust Cylinder Control lever down to move the gearbox assembly to the back of the GBM frame.

5. Position the pilot tube support bars along the frame rails.

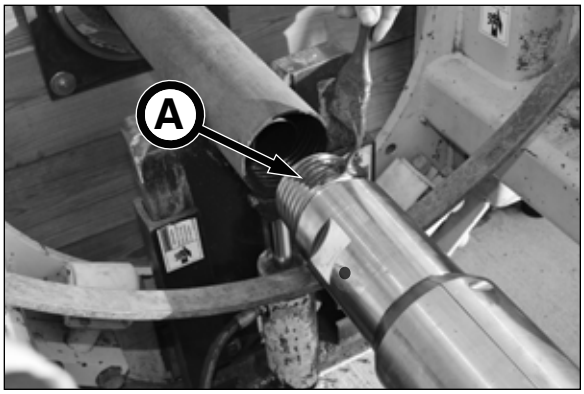


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Using Spinner Tubes/Pilot Tube Expansion Sleeve (continued)

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

6. Lower the Pilot Tube Expansion Sleeve onto the pilot tube support bars. Be sure the 1/8 in. NPT plug is firmly in place.



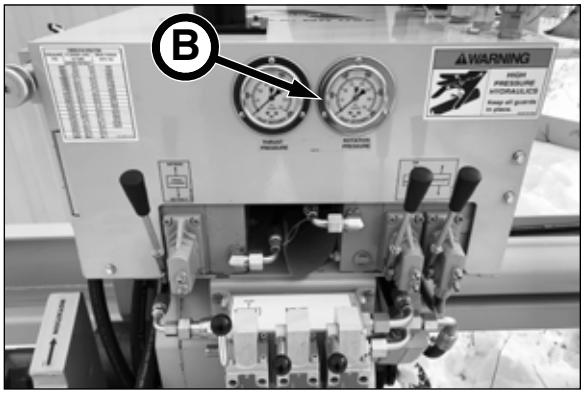
NOTICE The general recommendation is to plug the first expansion sleeve (approximately 20 ft) because of adequate lubrication flow from the steering head port, but the contractor must gauge which to plug or port based on ground conditions.

7. Use Copper Guard 4 lubricant (Akkerman Part No. P0310-778) to lubricate the joint threads (A) that connect the Pilot Tube Expansion Sleeve to the previously installed pilot tube and the drive swivel threads.

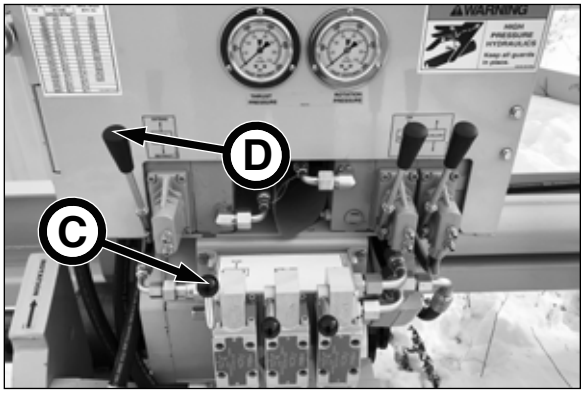


8. Lift up on the pilot tube support bars to position the Pilot Tube Expansion Sleeve in line with the pilot tube string for threading.

9. Advance the gearbox assembly with the thrust cylinder control while rotating the drive CW (using the drive rotation control) to thread the Pilot Tube Expansion Sleeve onto the previously installed pilot tube and the drive swivel.



10. Tighten the connection to 1,000 psi (2,000 ft-lb) torque shown on the rotation pressure gauge (B) on the gearbox.



11. Release the make-up tool to disengage tube support from the previously installed pilot tube by pulling DOWN on the Make-Up Tool lever (C).

12. Advance the Pilot Tube Expansion Sleeve by extending the thrust cylinder control lever (D) to the forward position.

(continued on next page)

Using Spinner Tubes/Pilot Tube Expansion Sleeve (continued)

13. Push the Pilot Tube Expansion Sleeve the full travel of the jacking frame until the notches line up with pilot tube support (A) in the Make-Up Tool.

14. Engage the Make-Up Tool support to the notches (B) on the Pilot Tube Expansion Sleeve by pushing the Make-Up Tool lever UP.

15. Disengage the drive adapter from the Pilot Tube Expansion Sleeve by rotating the drive CCW with the auger drive rotation control and using the Thrust Cylinder control to retract the thrust cylinders.

16. Move the gearbox assembly (C) to the back of the GBM frame using the thrust cylinder control.

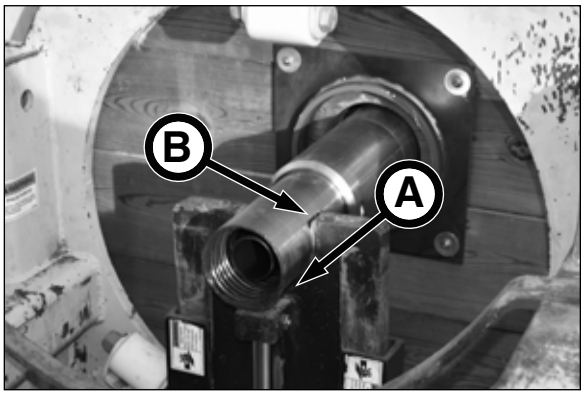
17. Use Copper Guard-4™ lubricant (Akkerman Part No. P0310-778) to lubricate the back Pilot Tube Expansion Sleeve joint thread to the next installed pilot tube.

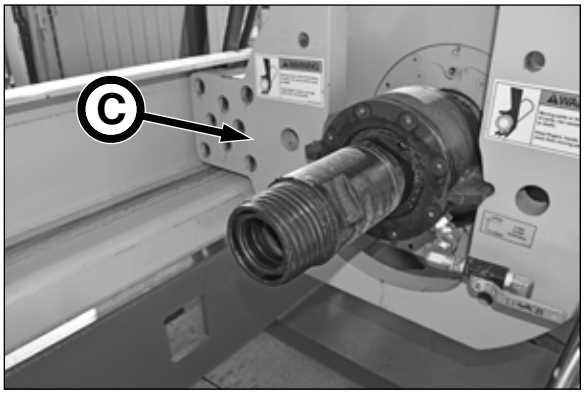
18. Continue to install standard pilot tubes 9 - 24.

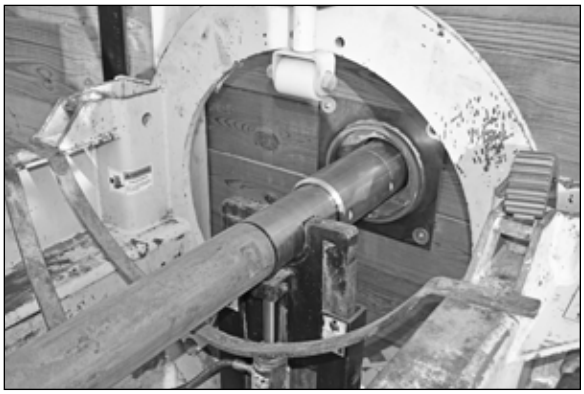
19. Repeat steps 4 through 17 to install the second Pilot Tube Expansion Sleeve. Before installing, use a 3/16 allen wrench to remove the 1/8 in. NPT plug on port B and retain for later use.

NOTICE The general recommendation is to plug the first expansion sleeve (approximately 20 ft) and port the second (approximately 60 ft) and those installed thereafter to alleviate ground swelling. The contractor must gauge which to plug or port based on ground conditions.

20. Continue to insert Pilot Tube Expansion Sleeves every 40 ft (12 m) or 16 pilot tubes thereafter along the alignment until pilot tube installation is complete. Before installing, use a 3/16 allen wrench to remove the 1/8 in. NPT plug on port B and retain for later.







Transporting

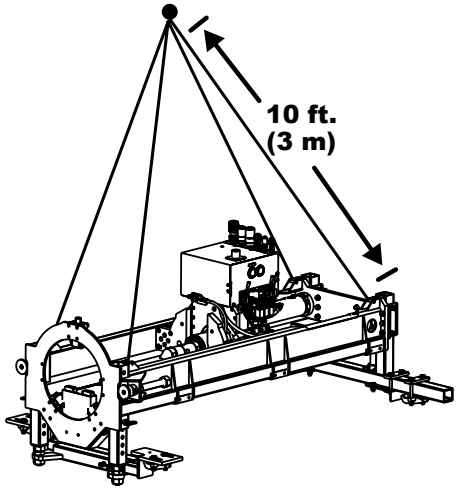
TRANSPORTING GUIDELINES



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 ALL debris from equipment.
5. (P4075D) Turn battery disconnect switch to the OFF position.
6. Load and unload on level ground.
7. If lifting equipment with a hoist or other lifting device, the equipment lifting eyes and sling must be inspected for damage before lifting. If damaged, replace before lifting.
8. Use shipping straps to fasten the guided boring machine and power pack to trailer floor.
9. Secure all loose items.
10. Observe the lifting instructions on the frame and power pack (refer to the lifting instructions below).

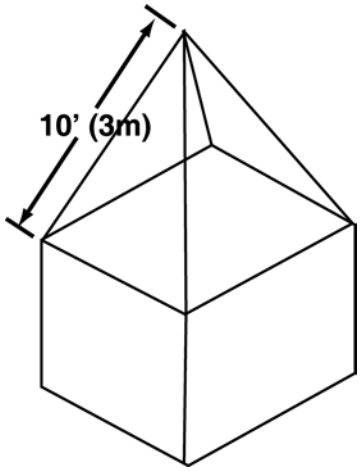
LIFTING INSTRUCTIONS - GBM 240A/ABM JACKING FRAME

- GBM 240A/ABM Jacking Frame total weight is:
  - 5,250 / 5,400 lbs. (2,381 / 2,449 kg) without base
  - 6,000 / 6,150 lbs. (2,721 / 2,789 kg) with base
- BEFORE lifting, be sure to account for weight of additional components.
- Lifting with a crane requires a four-part sling, with or without clevis. Outer sling legs MUST be at least 10 ft. (3m) in length.
- Frame must lift freely. If stuck, loosen before lifting.
- Inspect lifting pins/eyes and repair damage before lifting.



LIFTING INSTRUCTIONS - P4075D POWER PACK

- Container weight is 8,000 lbs. (3,629 kg)
- Lifting with a crane requires a four-part sling with outer sling legs a minimum of 10 ft. (3 m) long.
- Container must lift freely. If it is stuck to the ground, it must be broken loose prior to lifting.
- Lifting eyes must be inspected prior to each lift. Any damage must be repaired prior to lifting.



Fuels & Lubricants

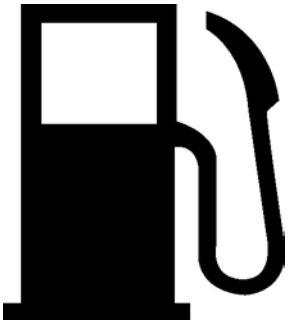
NOTICE Use of inferior fuels or lubricants can affect the efficient performance of your Akkerman Guided Boring Machine and Power Pack. Always use high quality fuel and lubricants as specified in this section. Refer to the Periodic Maintenance section for proper lubrication quantity, maintenance intervals, and procedures.

FUEL SPECIFICATIONS - P4075D

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

Diesel fuels specified to EN 590 or ASTM D975 (No. 1-D, 2-D) are recommended.

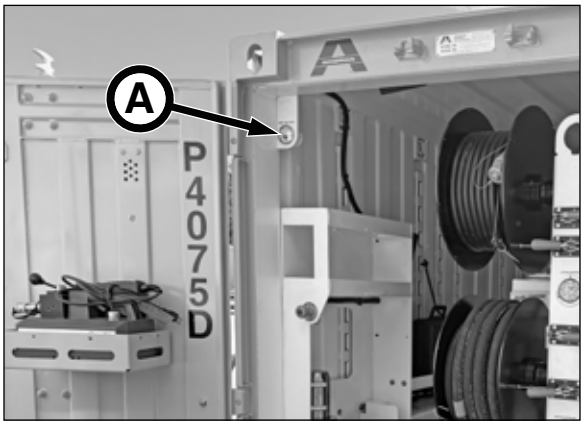
Refer to your engine manual for other fuel requirements.



Fuel tank capacity is 50 gal. (189 L).



A fuel gauge (A) is located at the hydraulic hose reel end of the power pack.



ENGINE OIL - P4075D POWER PACK

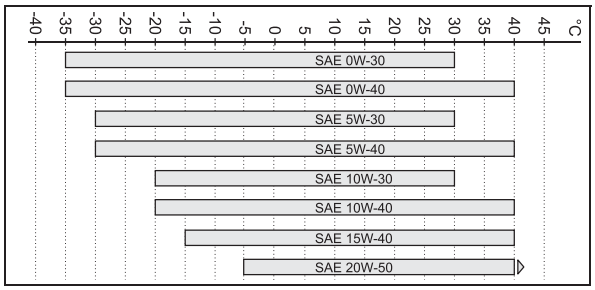
NOTICE For more information on the engine oil specifications, refer to your engine manual.



Change the oil and filters after the first 50 hours of operation, then every 250 hours thereafter with SAE engine oil or other oil viscosity based on the expected air temperature range during the period between oil changes as shown in the charts.

Other oils may be used (refer to engine manual).

Deutz Engine
The engine is filled with SAE 15W-40 engine oil. When changing oil and filters, use SAE 15W-40 engine oil or other oil viscosity as shown in the chart.



Deutz Engine Oil Specification Chart

The engine oil capacity is approximately 8.45 qt. (8 L). Oil level must always be between the MIN and MAX marks. Do not overfill!

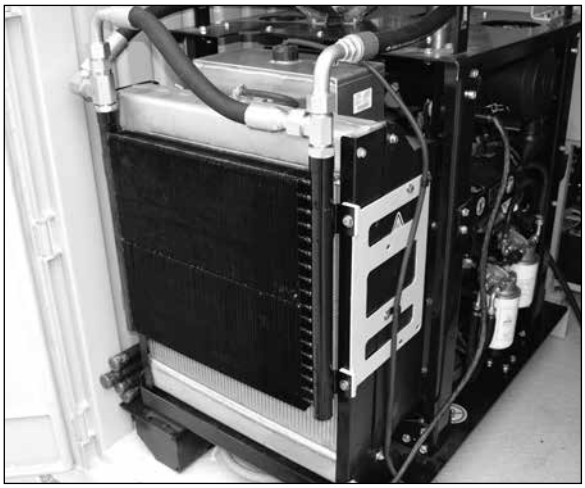
ENGINE COOLANT - P4075D POWER PACK

NOTICE For more information on the engine coolant specifications, refer to your engine manual.

⚠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.



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



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 Refer to your engine manual for information on using a cooling system corrosion protection agent in your cooling system.

HYDRAULIC OIL RESERVOIR LUBRICANT - P4075D POWER PACK



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

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

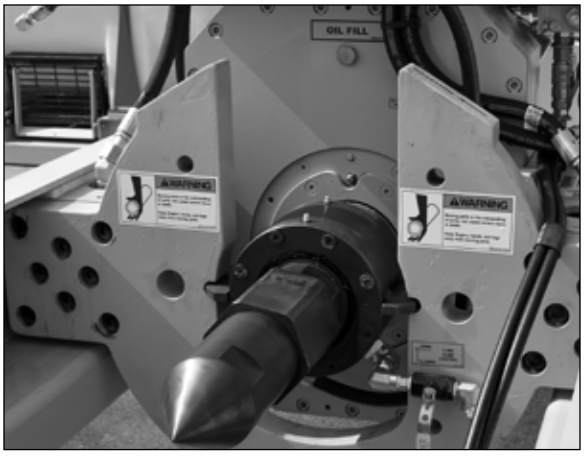
NOTICE If using a too heavy of viscosity oil in cold temperatures, hydraulic oil pump damage could result due to pump cavitation. On the contrary, using ISO 32 or 46 oils above 150°F operating temperatures (oil temp. in reservoir) will result in reduced hydraulic power to functions.

Recommended hydraulic oil:

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

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

GEARBOX LUBRICANT - GBM 240A/ABM FRAME



The GBM 240A/ABM Jacking Frame gearbox is filled with Mobil SHC 630 Synthetic Bearing and Gear Oil.

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

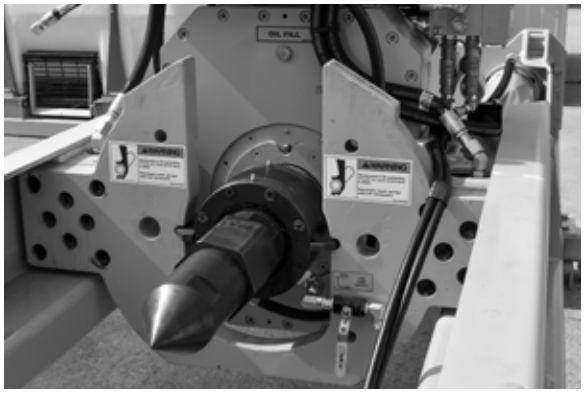
NOTICE The Mobil SHC 630 Synthetic Bearing and Gear oil is a synthetic oil specifically designed for this application. If you change to a different oil, use a reputable oil supplier to meet or exceed the Mobil SHC 630 oil specification. Do not mix oil manufacturers or grades.

GREASE - GBM 240A/ABM JACKING FRAME

The GBM 240A/ABM Jacking Frame 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.

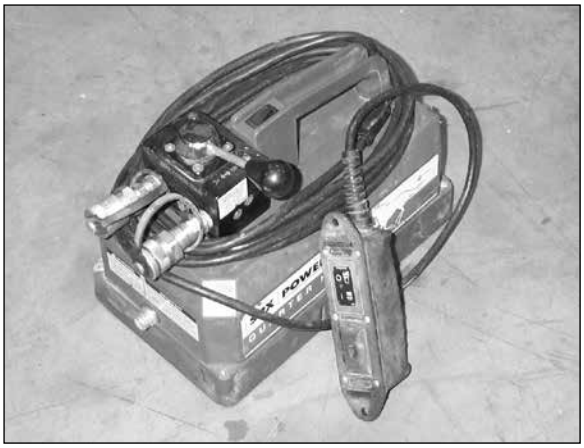


BREAKOUT TOOL POWER UNIT LUBRICANT

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.



Breakout Tool Power Pack

The breakout tool power unit oil reservoir is filled with Enerpac® HF hydraulic oil.

Use Enerpac® HP hydraulic oil when adding or changing lubricant.

Refer to the power unit manufacturer's documentation for more information on the hydraulic oil requirements.



Cordless, Rechargeable Breakout Tool Power Pack

PILOT TUBE JOINT LUBRICANT

The pilot tube and spinner tubes/expansion sleeves joint threads are lubricated with Baker Hughes Copper Guard-4™ (Akkerman part number P0310-778).

Use Baker Hughes Copper Guard-4™ to lubricate pilot tube and spinner tube/expansion sleeve threads.

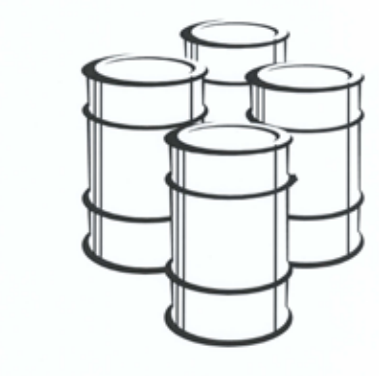
Be sure to ALWAYS store pilot tubes with clean caps and plugs attached with threads well lubricated.



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.



NOTES

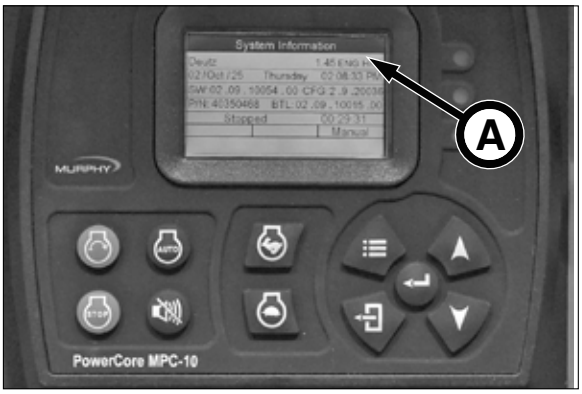
Periodic Maintenance

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

LUBRICATION & MAINTENANCE INTERVALS

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

Use the power pack engine hourmeter (A) to determine the proper lubrication and maintenance intervals.



USING EMERGENCY STOP

IMPORTANT: Emergency Stop (E-Stop) buttons are used for emergency situations only. E-Stop buttons alone are **NOT** intended for lockout/tagout purposes. Refer to *Lockout Tagout Procedure Guideline* in Section 1, Safety.

⚠WARNING **ALL** E-Stop buttons MUST be operating properly BEFORE operating the GBM and Power Pack. Failure to do so may cause severe injury or death.

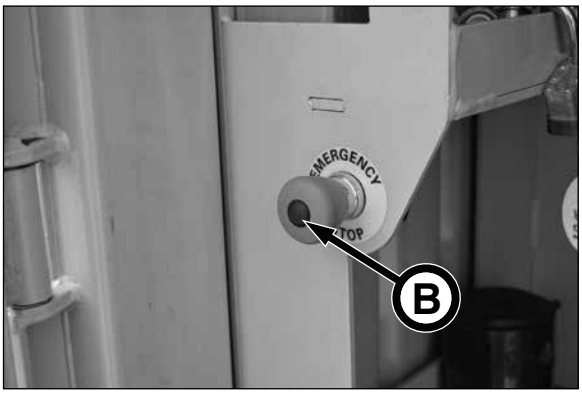
Push E-Stop buttons (B) IN to stop all Electrical and hydraulic functions.

The Power Pack E-Stop button (B) is located on the tooling rack.

The Power Pack Control Pendant is equipped with an E-Stop button (C).

The buttons will illuminate when pulled OUT.

The buttons must be pulled OUT to start/restart engine.



E-Stop Button on Power Pack Tooling Rack



E-Stop Button on Power Pack Remote Pendant

LOCKOUT TAGOUT POWER - P4075D



⚠DANGER Failure to lockout tagout (LOTO) power before repair, service or adjustment WILL cause severe personal injury or death from unexpected start-up or machine movement.

It is the responsibility of the contractor to determine the best method for LOTO on the job site.

LOTO power before repairs, service or adjustments unless otherwise noted. Proper LOTO will prevent accidents and save lives. Performing LOTO will also prevent the equipment from moving or operating unexpectedly. Refer to *Lockout Tagout Procedure Guideline* in Section 1, Safety.



The Battery Disconnect Switch disconnects/connects power from the batteries to the engine. It will prevent battery drainage when power pack is not in use.

The Battery Disconnect Switch also provides a means to LOTO the Power Unit when conducting service or maintenance on the unit. Refer to *Battery Disconnect Switch* in section 4, Controls & Instruments for more information.

HYDRAULIC OIL/FLUIDS UNDER PRESSURE



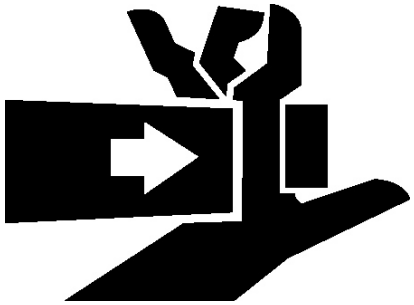
⚠WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury.

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.

AVOID PINCH POINTS



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

Keep hands away from moving parts.

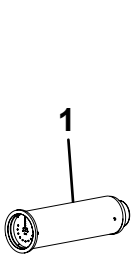
Watch your fingers, hands, and legs while equipment is in operation.

Handle parts carefully to avoid crushing and pinch point hazards.

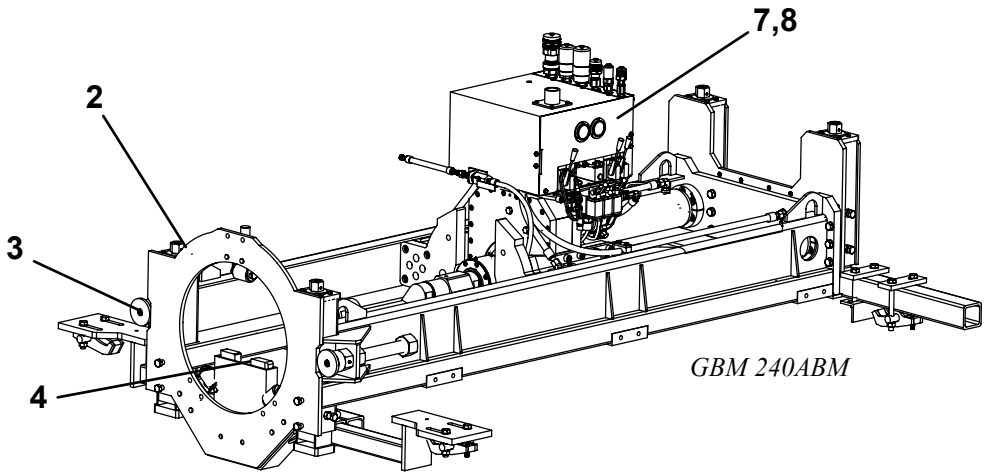
MAINTENANCE CHARTS - 240A/ABM - P4075D

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

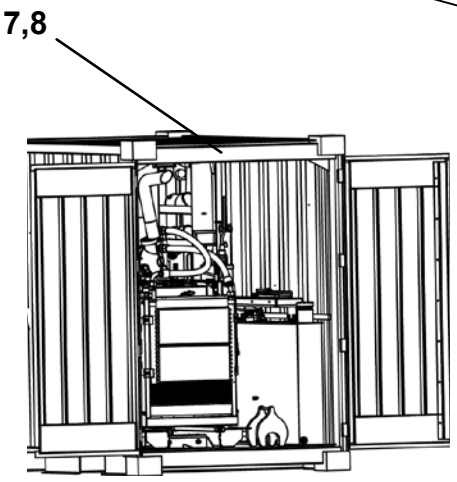
IMPORTANT: The engine maintenance in this section covers only general engine maintenance. You MUST refer to your Engine Operator's Manual for specific maintenance intervals and procedures.



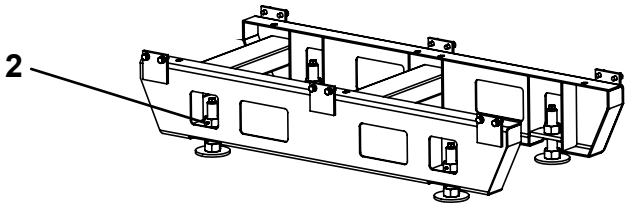
Target

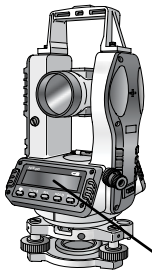


GBM 240ABM

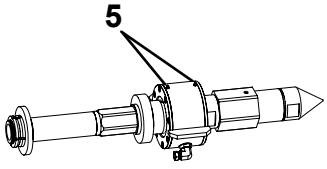


P4075D Power Pack





Theodolite



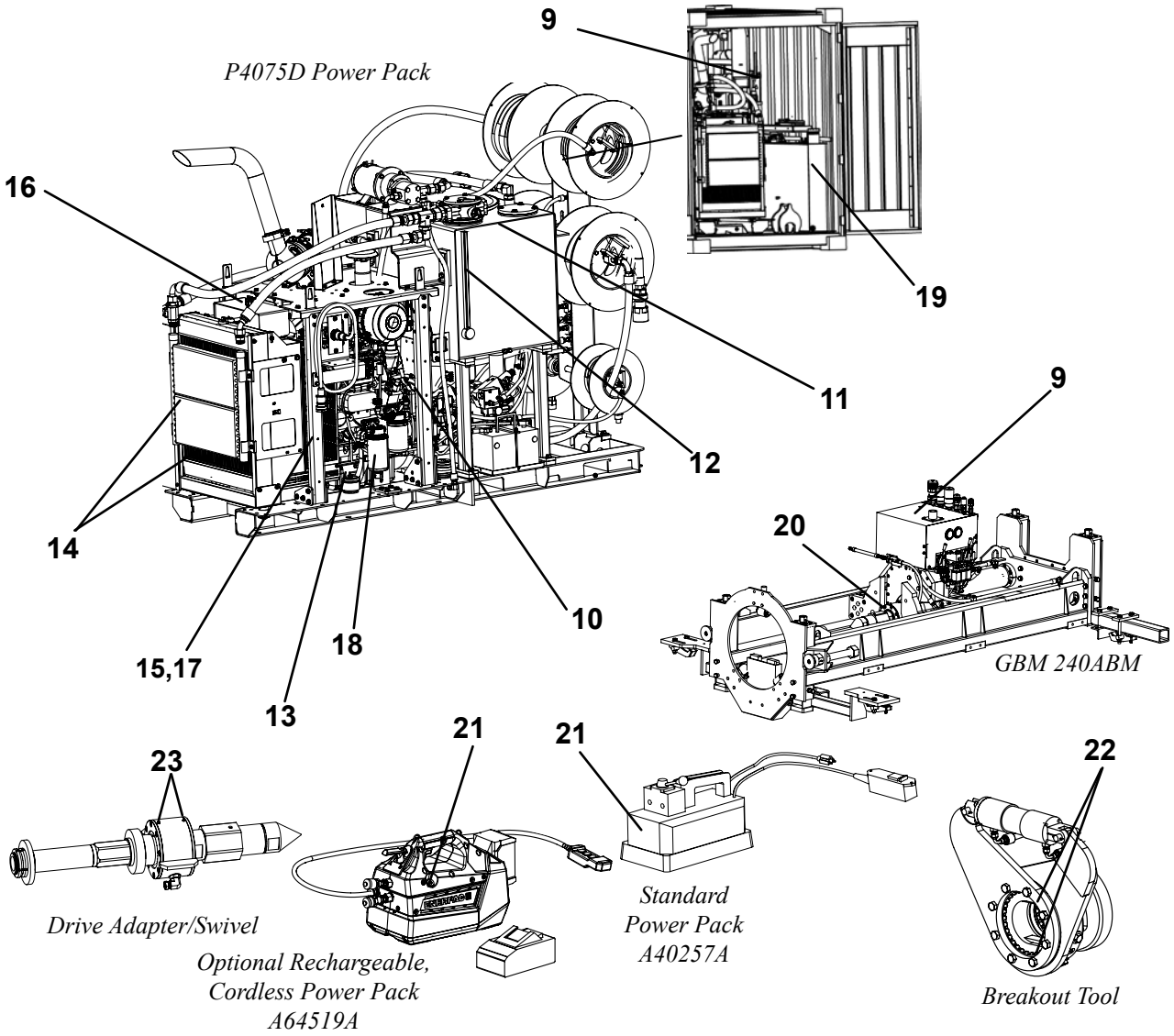
Drive Adapter/Swivel



*PRIOR TO EACH JOB LAUNCH

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Target	Replace Batteries		(2) 1.5V D or C, or Double 3.6V C
2.	Leveling Assemblies	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
3.	Shaft Tensioner	Lubricate (2 places)	Lubricate until grease is forced out.	Mobil XHP222
4.	Hydraulic Make-Up Tool	Clean		
5.	Drive Adapter/Swivel	Lubricate (2 places)	Lubricate with 3-5 shots.	Mobil XHP222
6.	Theodolite	Check	Perform Zero Point Calibration Procedure.	See Section 6-25-1
7.	GBM Frame & Power Pack	Visual Inspection	If parts are damaged or missing, replace.	
^8.	Decals	Inspect	If damaged, replace with new.**	

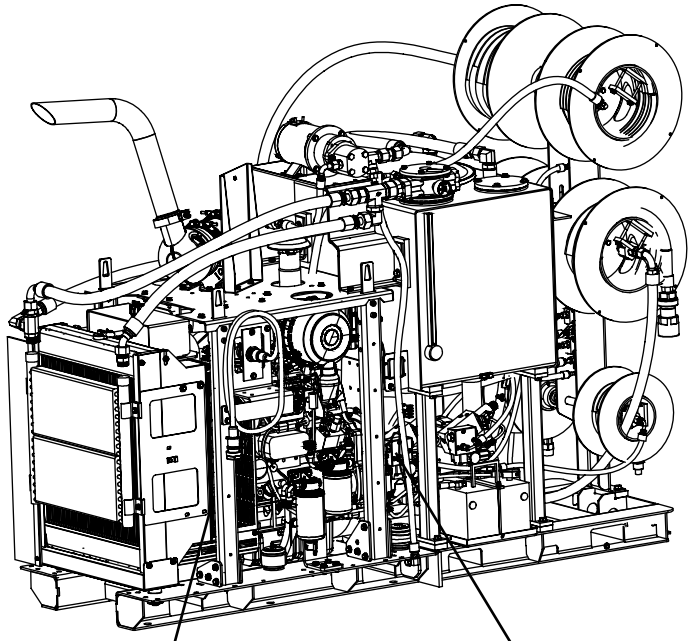
* Refer to your engine manual for additional engine maintenance information.
** Contact Akkerman Aftermarket Support for replacement decals.
^ Not shown.



*DAILY OR EVERY 10 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
9.	GBM Frame & Power Pack	Visual Inspection	If parts are damaged or missing, replace.	
10.	Air Cleaner Dust Unloader	Clean Out		
11.	Hydraulic Return Filter	Check Indicator	Replace filter as needed per indicator.	Return Filter
12.	Hydraulic Reservoir	Check Fluid Level	Add hydraulic fluid as needed.	ISO-VG Fluid
13.	Engine Crankcase*	Check Oil Level	Add oil as needed.	See Section 8
14.	Radiator/Oil Cooler Fins	Clean	As needed.	
15.	Fan	Inspect Fan & Guard	If damaged, replace with new.	
16.	Radiator	Check Coolant Level	Add coolant as needed.	Coolant
17.	Belt	Inspect	If damaged, replace with new.	
18.	Fuel/Water Separator	Drain Water	Drain until fuel is visible.	
19.	Fuel Tank	Check Fuel Level	Add diesel fuel as needed.	Diesel Fuel
20.	Gearbox	Check Oil Level	Add oil as needed,	Mobil SHC 630
**21.	Breakout Tool Power Pack	Check Oil Level	Add oil as needed.	A40257A - ISO-VG-46 20W or A64519A - Enerpac® HF
22.	Breakout Tool	Lubricate (4 places)	Lubricate 2 shots per fitting.	Mobil XHP222
23.	Drive Adapter/Swivel	Lubricate	Lubricate with 3-5 shots.	Mobile XHP222

* Refer to your engine manual for additional engine maintenance information.
** Refer to your Standard or Cordless Hydraulic Pump operation and maintenance manual.

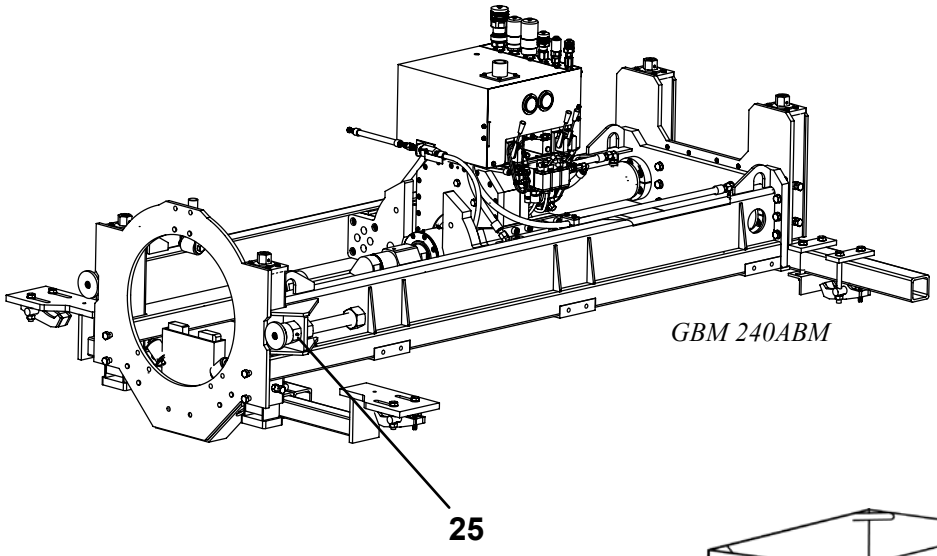


P4075D Power Pack

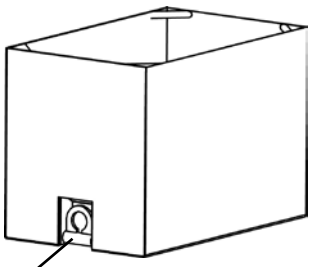
*FIRST 50 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
**24.	Engine Oil & Filter	Drain, Fill & Filter	Replace with new oil & filter.	See Section 8

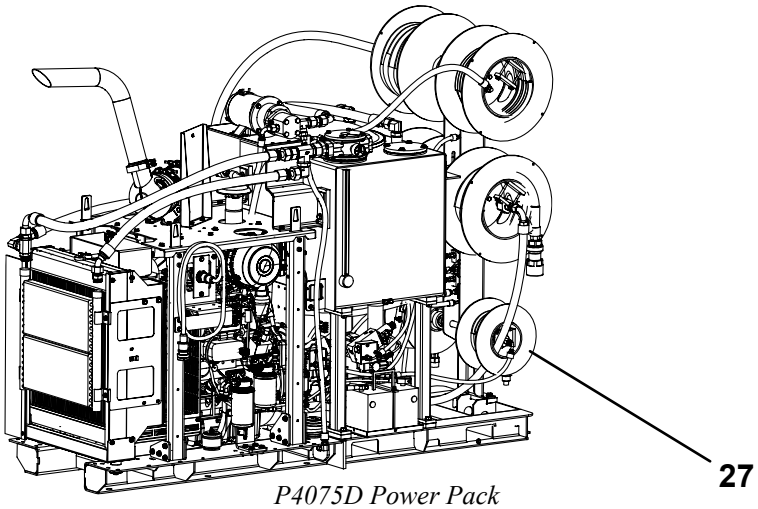
* Refer to your engine operation manual for additional maintenance information.
** During engine break-in period, change the oil and filter for the first time at 50 hours of operation.



GBM 240ABM



GBM Dirt Bucket

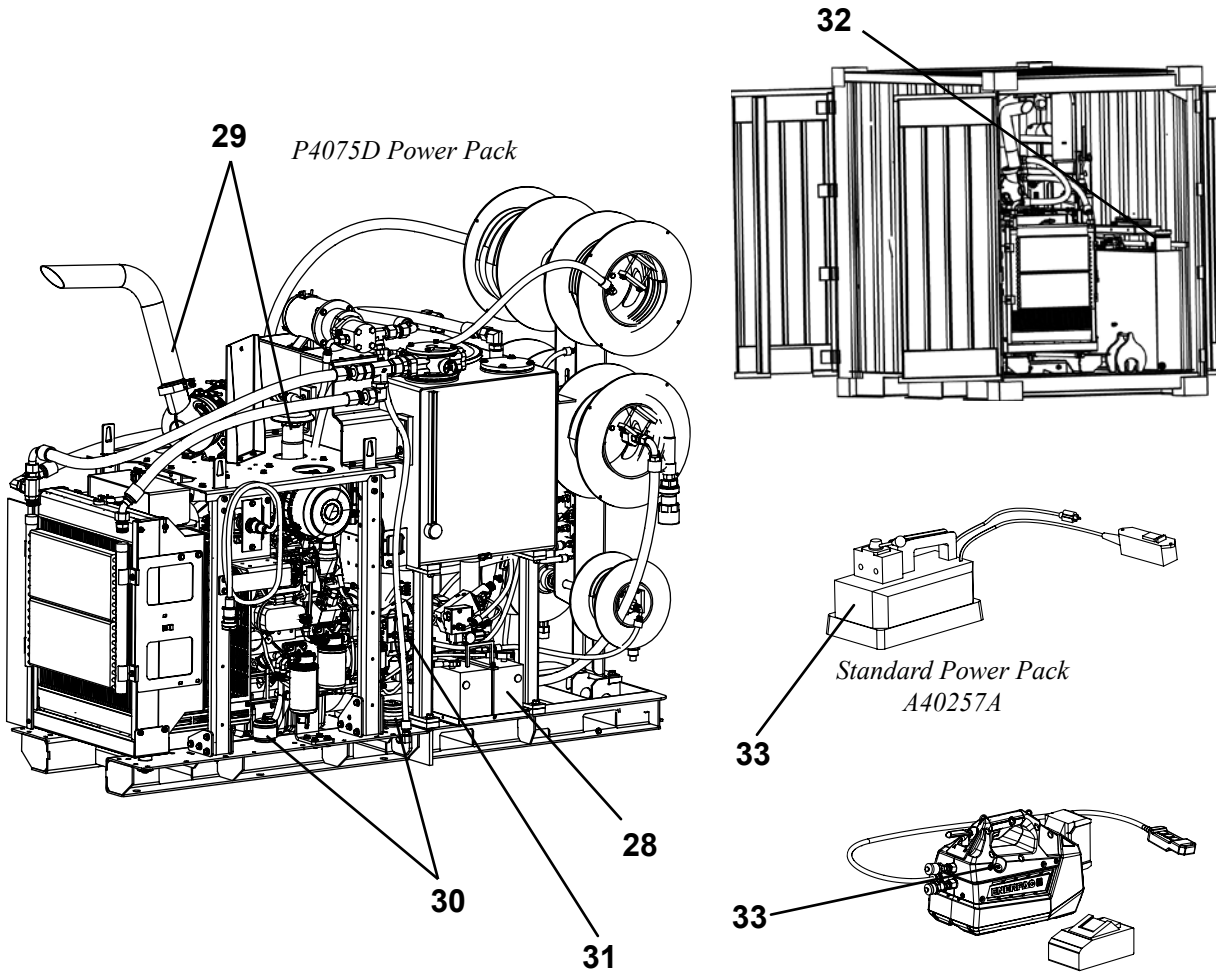


P4075D Power Pack

*WEEKLY OR EVERY 50 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
25.	Shaft Tensioner	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
26.	Dirt Bucket Lifting Eye	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
27.	Hoses & Clamps	Inspect	Replace as needed.	

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

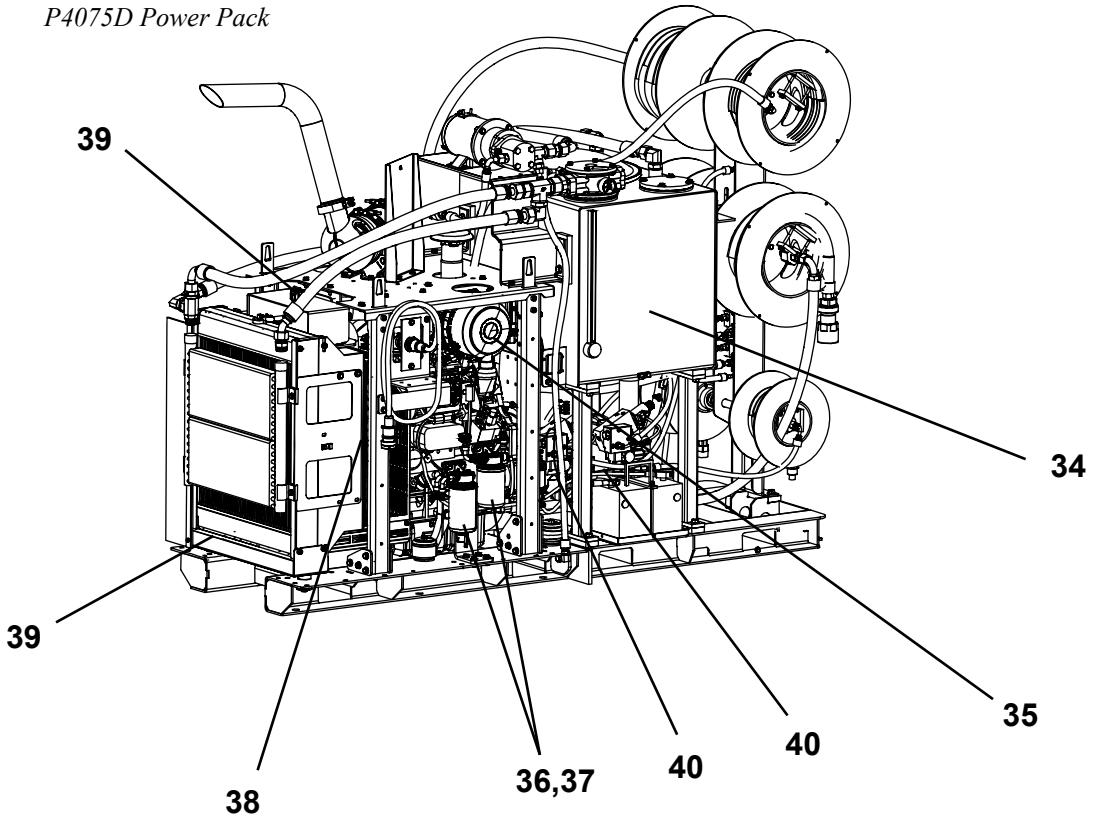


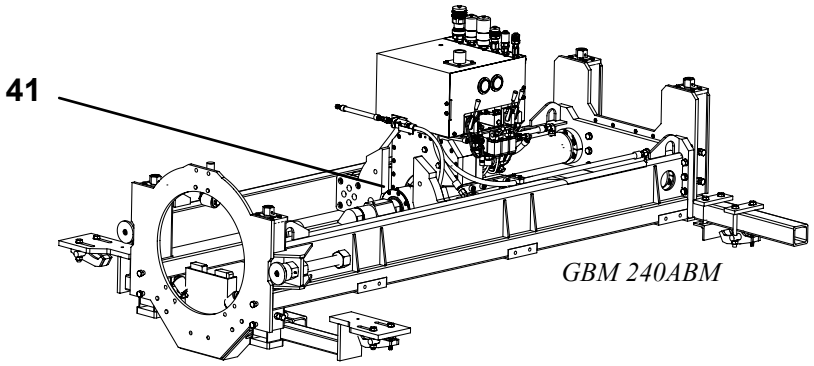
*MONTHLY OR EVERY 250 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
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.	Engine Oil & Filter	Drain, Fill & Filter	Replace with new oil & filter.	See Section 8
32.	Fuel Tank Cap	Inspect & Clean	Replace if damaged.	
**33.	Breakout Tool Power Pack	Drain, Flush & Refill Reservoir	Refill to top of filler hole.	A40257A - ISO-VG-46 20W or A64519A - Enerpac® HF

* Refer to your engine manual for additional engine maintenance information.
** Refer to your Standard or Cordless Power Pack operation and maintenance manual.

P4075D Power Pack



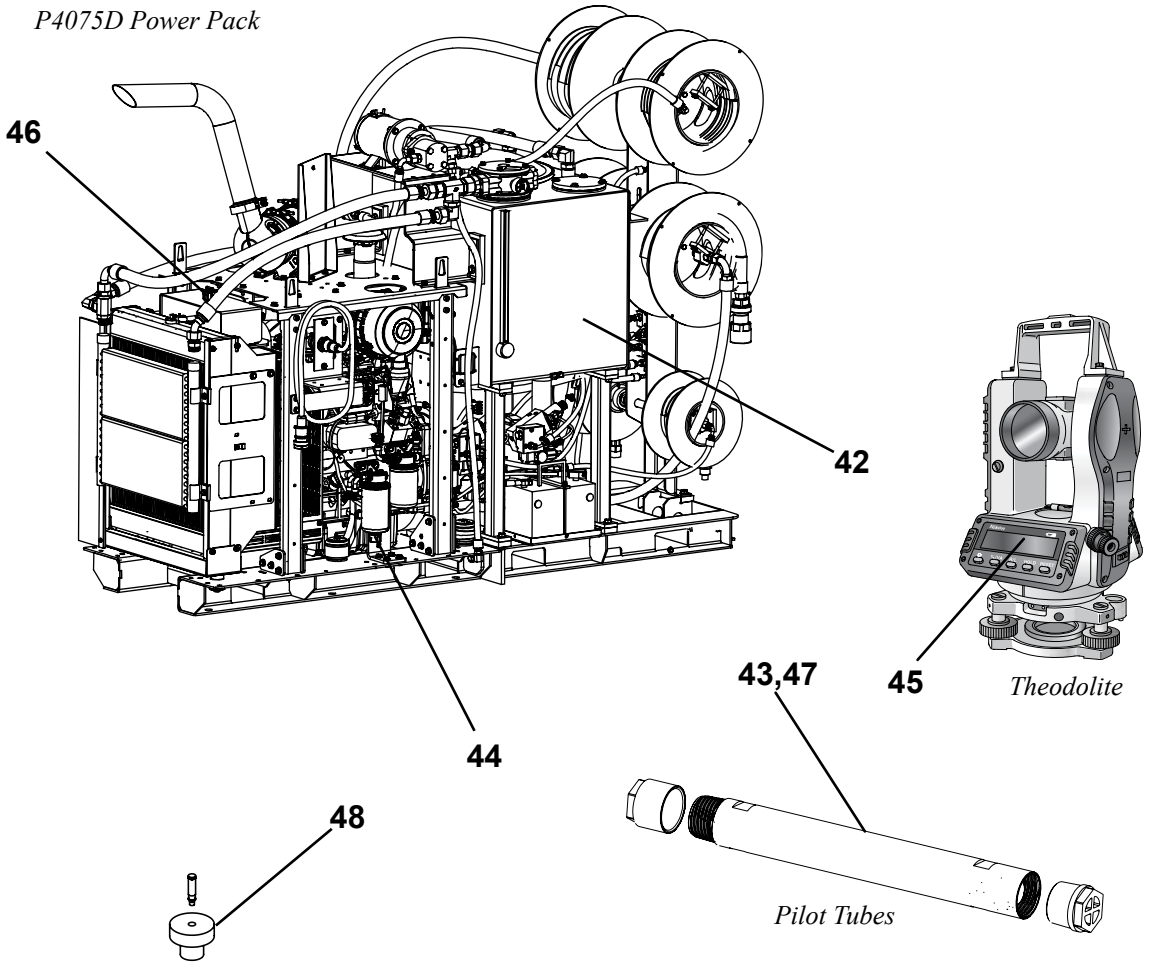


GBM 240ABM

*EVERY 500 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
34.	Hydraulic Reservoir	Drain & Fill	Drain and fill with new oil.	ISO-VG-46 20W
35.	Air Cleaner	Install New		Element(s)
36.	Fuel System	Replace Fuel Filter		Fuel Filters
37.	Fuel System	Bleed Fuel System	See engine manual.	
38.	Belt & Belt Tensioner	Check		
39.	Cooling System	Check Condition	Coolant touches bottom of filter neck.	Water/Anti-Freeze
40.	Load Sense Filters	Replace (2 places)	Replace with new.	Load Sense Filters
41.	Gearbox	Drain & Fill	Drain and fill with new oil	Mobil SHC 630

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



*COMPLETION OF EACH DRIVE

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
42.	Hydraulic Reservoir	Drain water	Drain until water is removed.	
43.	Pilot Tubes	Clean & Lubricate	Clean inner tube & annular space, lubricate to prevent corrosion.	Copper Guard-4™

*EVERY 1000 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
44.	Fuel Pre-Filter	Replace	Refer to engine manual.	Filter Insert
45.	Theodolite	Recalibrate	Send to authorized service center.	

*EVERY 2000 HOURS OF OPERATION

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

AS REQUIRED

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
47.	Pilot Tubes	Inspect & Lubricate	Inspect & relubricate threads.	Copper Guard-4™
48.	Laser Bore Sight	Replace Batteries		392 Button Batteries

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

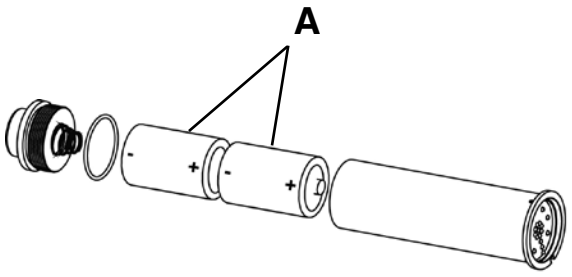
PRIOR TO EACH JOB LAUNCH

1. REPLACE TARGET BATTERIES

The replaceable battery target uses the following alkaline batteries (A):

Standard or Smart Target
Two (2) new 1.5 volt D size alkaline batteries

Multi-Position Smart Target
One (1) new double, 3.6 volt C size battery, or two (2) new 1.5 volt C size alkaline batteries



Remove cap, gently place alkaline batteries into target tube (with positive polarity towards LED lights). Screw cap with o-ring completely onto end of target tube to prevent moisture from entering target tube.

IMPORTANT: DO NOT mix battery manufacturers.

It is recommended to replace batteries before each drive. The batteries should last 14 days.

Target ON/OFF:
OFF - Remove batteries, replace cap.
ON - Place batteries into target tube (as shown)

NOTICE DO NOT store target batteries in reverse polarity. Storing batteries backwards WILL cause target damage. Remove batteries from target for storage.

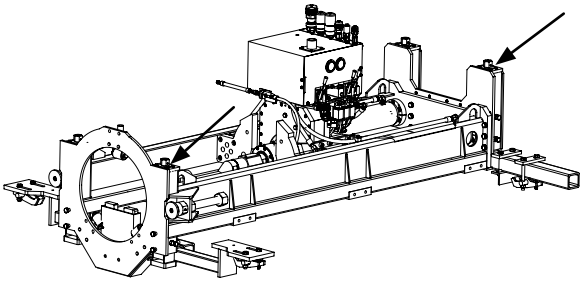
2. LUBRICATE LEVELING ASSEMBLY

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

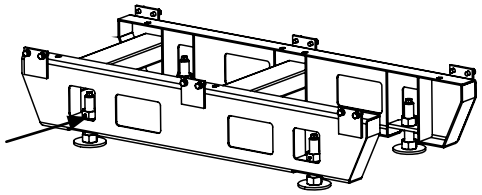
- 240A - Lubricate 2 places (grease fitting on front legs - both sides) as shown
- 240ABM - Lubricate 4 places (grease fittings by height adjustment screw assembly) as shown
- Base assembly - Lubricate 4 places (both sides) as shown



240A Leveling Assembly



240ABM Leveling Assembly



Base Assembly

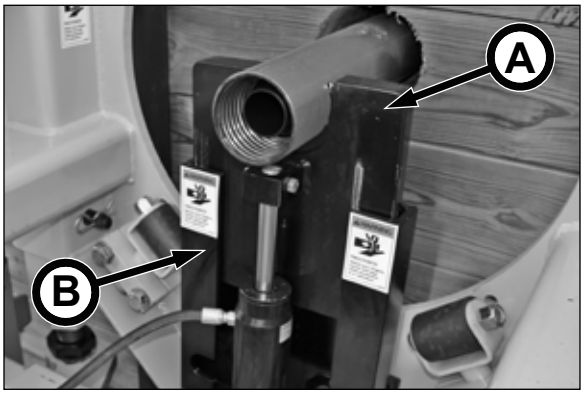
Prior To Each Job Launch (continued)



3. LUBRICATE SHAFT TENSIONER

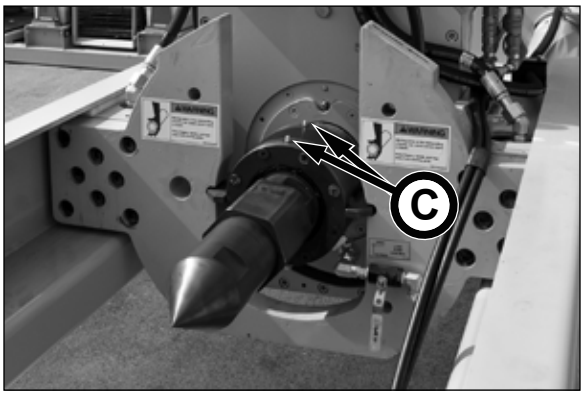
Lubricate shaft tensioner (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.

Lubricate daily if subjected to water and mud.



4. CLEAN HYDRAULIC MAKE-UP TOOL

Clean out dirt or debris from make-up tool tube support (A) and housing (B).



5. LUBRICATE DRIVE ADAPTER/SWIVEL

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



6. CHECK THEODOLITE ZERO POINT CALIBRATION

Perform *Checking Theodolite Zero Point Calibration* procedure in section 6, Operation of this manual.

IMPORTANT! If the stationary object is not within the theodolite crosshairs after completing the horizontal and vertical alignment steps, you must perform the “Vertical Circle Zero Point Error” procedure in accordance with the Nikon Theodolite Instruction Manual.

(continued on next page)

Prior To Each Job Launch (continued)

7. VISUALLY INSPECT EQUIPMENT

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

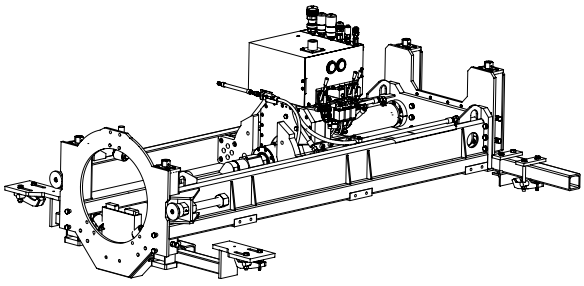
Immediately report any structural problems to Akkerman Aftermarket support.

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

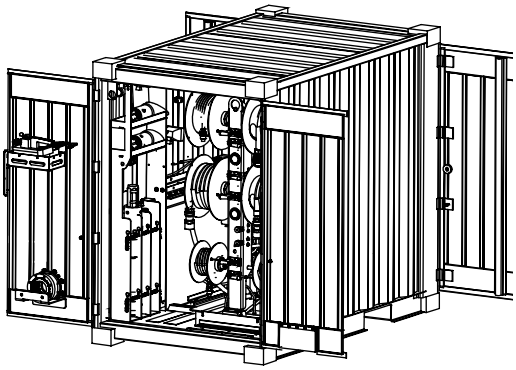
Check air intake and exhaust system hoses and connections. Replace any defective parts.

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

Tighten hardware as needed.



GBM Single Stage Frame



P4075D Power Pack

8. INSPECT DECALS

Inspect ALL decals, operational and safety decals to be sure they are clean and readable.

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

Before apply a new decal, be sure the surface is dry and clean.

Contact Akkerman Aftermarket Support for replacement decals and decal kits.

DAILY OR EVERY 10 HOURS OF OPERATION

9. VISUALLY INSPECT EQUIPMENT

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

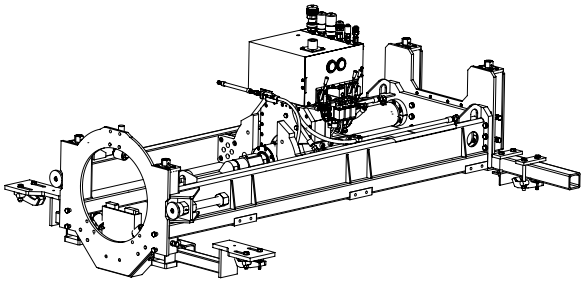
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Check for oil or coolant leaks, and debris buildup. Make repairs as needed and remove debris.

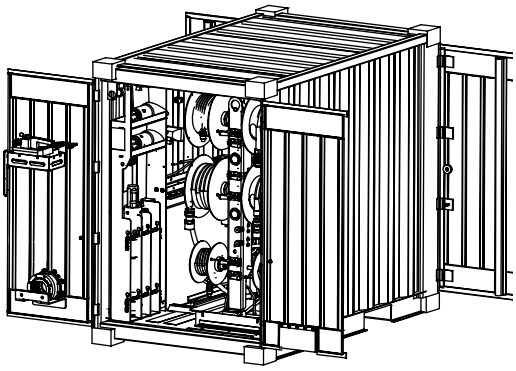
Check air intake and exhaust system hoses and connections. Replace any defective parts.

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

Tighten hardware as needed.



GBM Single Stage Frame



P4075D Power Pack

10. CLEAN OUT DUST UNLOADER VALVE

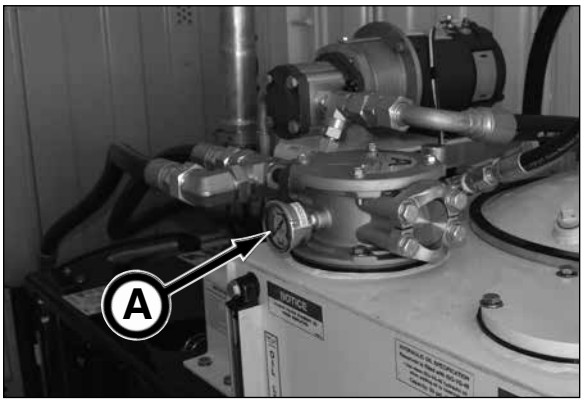
Squeeze air cleaner dust unloader valve on air cleaner assembly to release any trapped dirt particles. If the sealing tip of the valve is damaged, life of the air filter elements will be greatly reduced.



(continued on next page)

Daily Or Every 10 Hours Of Operation (continued)

11. CHECK HYDRAULIC RETURN FILTER INDICATOR



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

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

The filter and oil require replacement if any of the following situations occur:
- A major component fails.
- Any sign of water contamination from an oil analysis or if oil is milky or foaming.
- A hydraulic oil sample indicates large particle contamination.

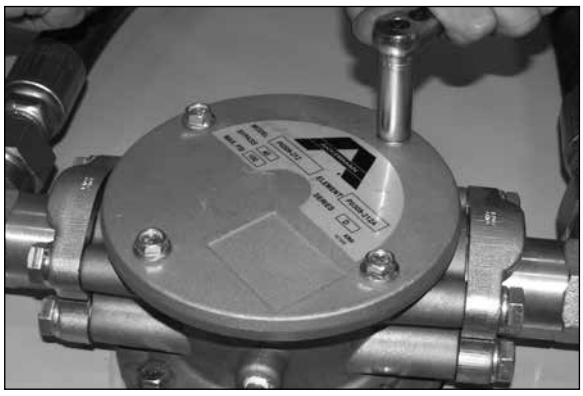
The green OK zone indicates that the filter is functioning properly.

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 hydraulic component damage using the following procedure.



1. With power pack shutdown, clean and dry area around the filter head assembly.



2. Remove filter head fasteners and retain for later use.

(continued on next page)

Daily Or Every 10 Hours Of Operation (continued)

3. Remove head assembly from housing.



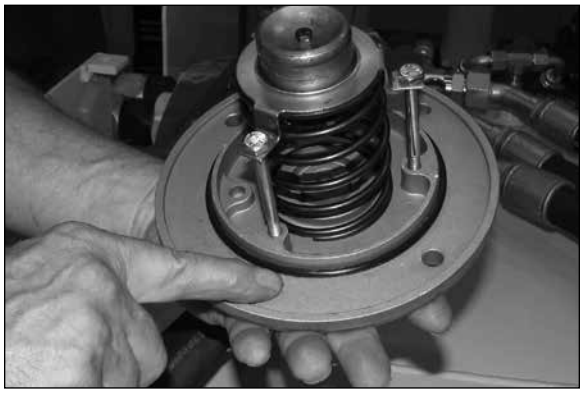
4. Remove filter.

5. Check for metal flakes on filter. If metal flakes are visible, replace all filters and reservoir oil.

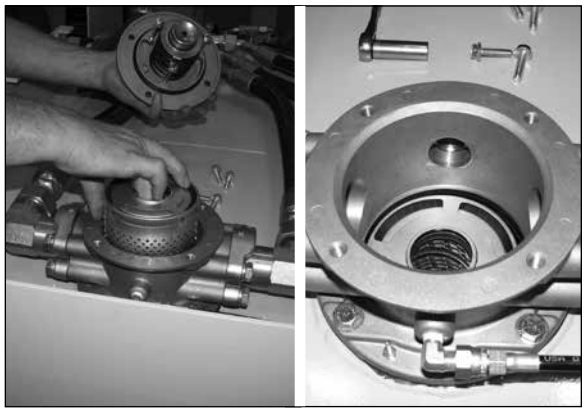
6. Dispose of filter properly.



7. Check filter gasket in filter head. If worn or damaged replace with new. Install new gasket (if needed) with a light coat of clean hydraulic oil into filter head. Be sure the gasket is not twisted and is correctly in place.

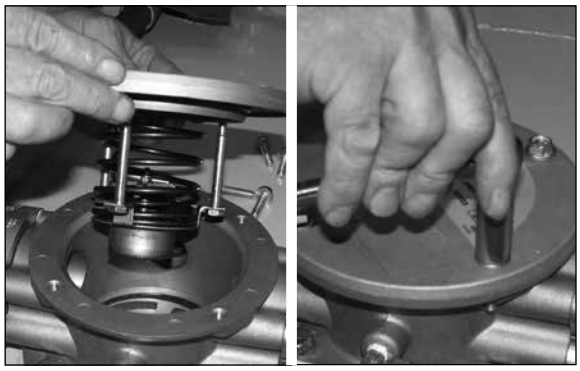


8. Carefully install new filter into filter housing until it is fully seated into housing.



(continued on next page)

Daily Or Every 10 Hours Of Operation (continued)



9. Replace filter head assembly onto housing and secure with fasteners removed in step 2.



10. With the hydraulic hoses disconnected from the GBM, start engine and run at low idle until the hydraulic system is warm. Then check for leaks.

11. Shut down engine. Check for leaks.

12. Check hydraulic reservoir oil level on gauge (A). Add hydraulic oil, if necessary.

12. CHECK HYDRAULIC RESERVOIR OIL LEVEL & CONDITION OF OIL



1. Check reservoir hydraulic oil for the following:

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

If any of these conditions are found, the reservoir must be drained, cleaned, and refilled with new, clean hydraulic oil and the hydraulic filter must be replaced. Refer to *Every 500 Hours of Operation, Drain & Fill Hydraulic Reservoir* in this section.

2. Retract thrust cylinders on GBM frame.

3. Check hydraulic tank oil level gauge (B).

(continued on next page)

Daily Or Every 10 Hours Of Operation (continued)

FILLING RESERVOIR

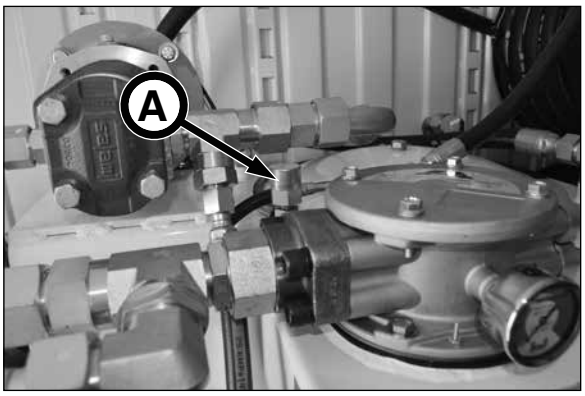
If the fluid level in the reservoir is less than 3/4 full, fill the reservoir with an ISO-VG Premium Hydraulic Turbine Oil (refer to Power Pack Hydraulic Oil Reservoir Lubricant in section 8, Fuels & Lubricants for recommended oil per ambient temperature) as follows:

1. Retract thrust cylinders on GBM frame.

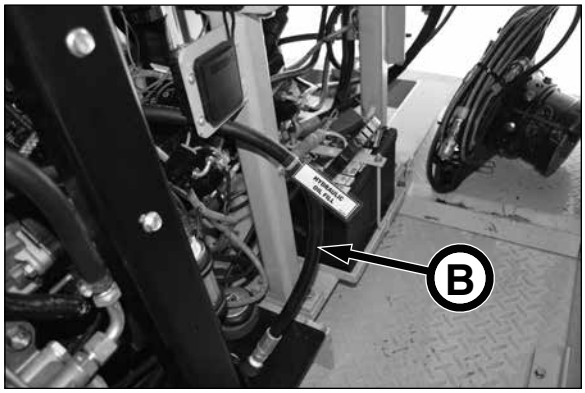
2. Shut down engine.

IMPORTANT: BEFORE filling hydraulic reservoir, the breather/fitting must be removed to allow for proper bleeding. Failure to do so will result in pump damage. Be sure to replace breather/fitting after filling reservoir.

3. Remove breather/fitting (A) from reservoir BEFORE filling reservoir to allow for proper bleeding during filling process.



4. Remove hydraulic oil fill hose (B) from storage location. Remove cap from hose.



5. Place hose into CLEAN hydraulic oil container.



NOTICE Refer to *Fuels & Lubricants* section for recommended hydraulic oil.

(continued on next page)

Daily Or Every 10 Hours Of Operation (continued)

6. Flip Oil Fill Pump switch to the ON position to pump hydraulic oil into the hydraulic reservoir.



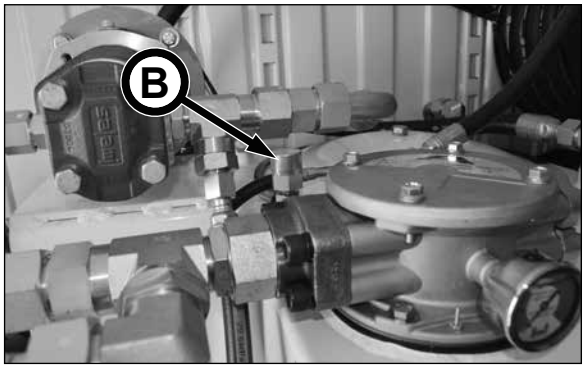
7. Fill until oil reaches the high mark on gauge (A).

NOTICE Be sure the GBM frame thrust cylinders are retracted.

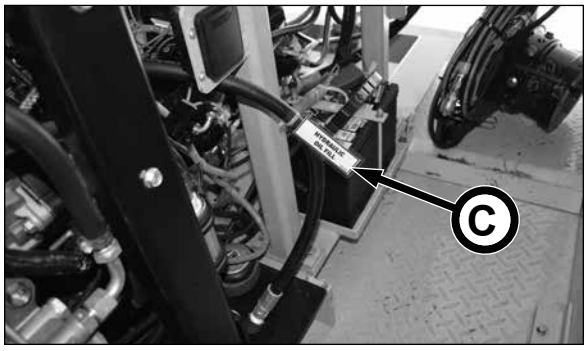
8. Flip Oil Fill Pump switch to the OFF position.



9. Replace breather/fitting (B) on reservoir.



10. Replace cap on fill hose (C) and place hose in storage location.



Daily Or Every 10 Hours Of Operation (continued)

13. CHECK ENGINE CRANKCASE OIL LEVEL

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

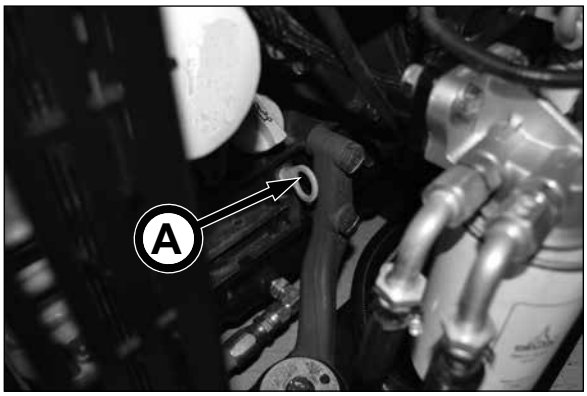
Oil level must always be between the MIN and MAX marks on the dipstick. DO NOT OVERFILL!



If necessary, add engine oil. Remove fill cap (A). Replace cap when complete.

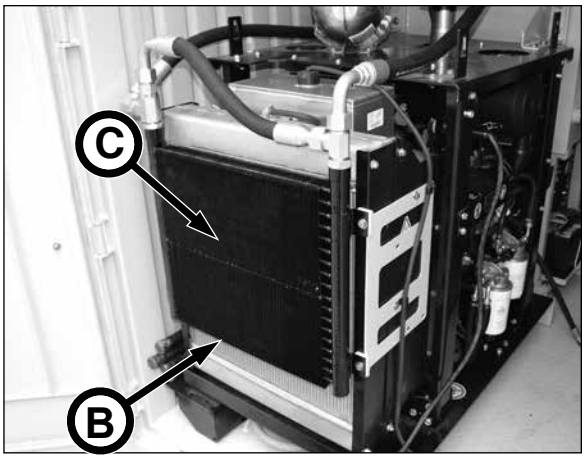
See Engine Oil in Fuels & Lubricants, in section 8 for the proper oil specification.

NOTICE During engine break-in, change the oil and filter for the first time at 50 hours of operation.



14. CLEAN RADIATOR/OIL COOLER FINS

Inspect radiator (B) and oil cooler (C) fins for cleanliness. If necessary, clean radiator and oil cooler fins with compressed air (100 psi maximum).

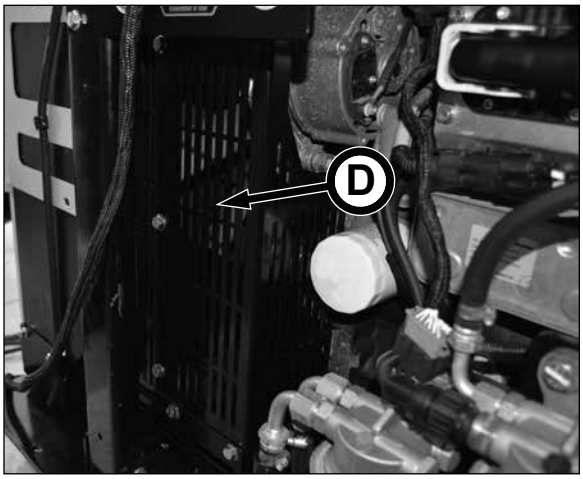


15. INSPECT FAN & FAN GUARD

⚠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 (D) for cracks, and bent or loose blades. Check fan to make sure it is properly mounted. Replace damaged fan and fan guard.

(continued on next page)



Daily Or Every 10 Hours Of Operation (continued)

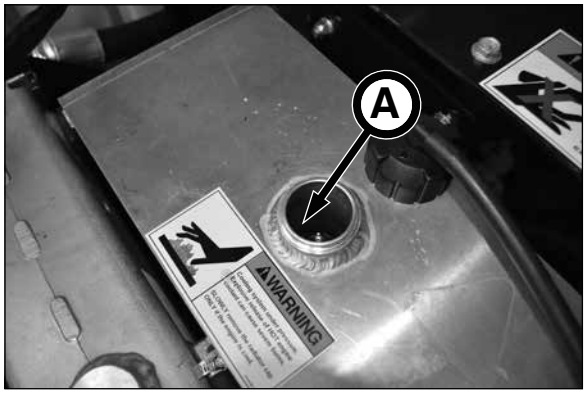
16. CHECK ENGINE COOLANT LEVEL



⚠WARNING Cooling system under pressure. Explosive release of HOT engine coolant can cause severe burns.



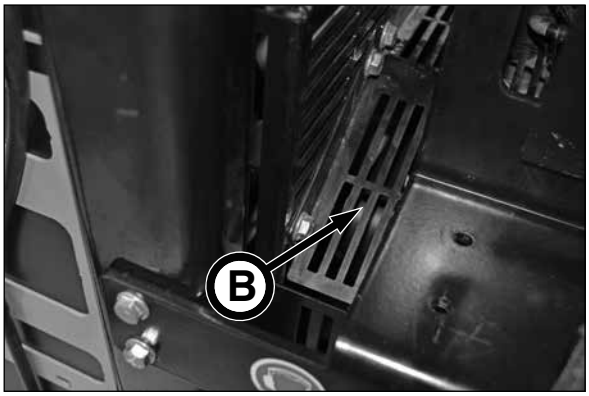
SLOWLY remove the radiator cap ONLY if the engine is cool. DO NOT remove the radiator cap when the engine is hot.



Check coolant level when engine is cold. Coolant level should be at bottom of filler neck (A) on the overflow reservoir. If coolant level is low, fill radiator through the overflow reservoir with proper coolant solution.

See Engine Coolant in section 8, Fuels & Lubricants for proper coolant specification. Be sure to check levels after filling. DO NOT OVERFILL.

17. INSPECT BELT



⚠WARNING NEVER operate engine without belt guard in place. Serious personal injury could result if contact is made with rotating belt.

Visually inspect the drive belt (B) for cracking, fraying or pieces of material missing. Replace belts as needed. Refer to your engine operation manual for belt replacement.

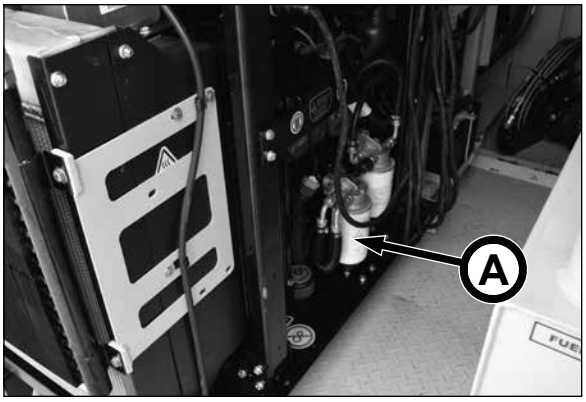
Daily Or Every 10 Hours Of Operation (continued)

18. DRAIN FUEL/WATER SEPARATOR

NOTICE Refer to your engine manual for more information.

1. Shutdown engine.

2. Place an appropriate sized catch pan under the fuel pre-filter assembly (A).



3. Disconnect electrical cable connection (B).

4. Loosen drain plug (C).

5. Drain fluid into catch pan until no water is present and only pure diesel fuel runs out.

6. Tighten drain plug.

7. Reconnect electrical cable connection.

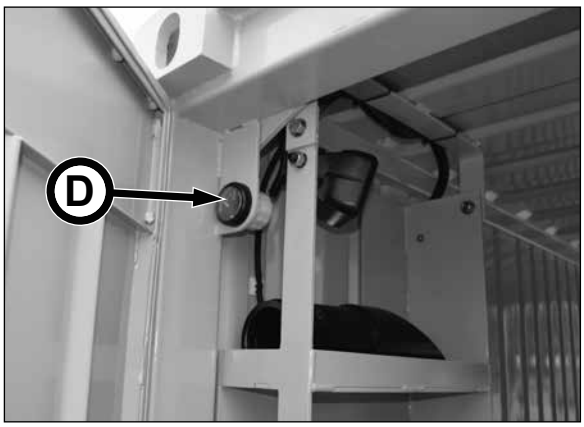


19. CHECK FUEL TANK LEVEL

Check fuel tank diesel fuel level.



A fuel gauge (D) is located at the hydraulic hose reel end of the power pack.



(continued on next page)

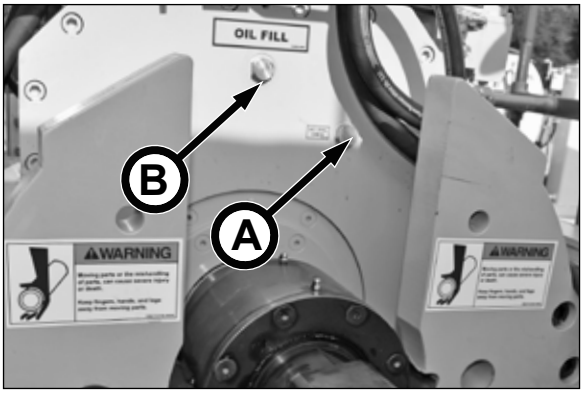
Daily Or Every 10 Hours Of Operation (continued)

20. CHECK GEARBOX OIL LEVEL

Check gearbox oil level by removing check plug (A).

If oil is not level with the check plug hole, add oil into gearbox oil fill port (B).

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



21. CHECK BREAKOUT TOOL POWER UNIT OIL LEVEL

1. Clean area around filler cap (C).

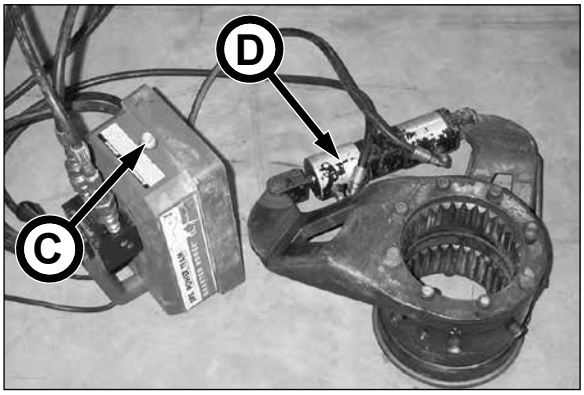
2. Retract cylinder (D).

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 if using standard power pack or Enerpac® HF if using cordless, rechargeable power pack. 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.

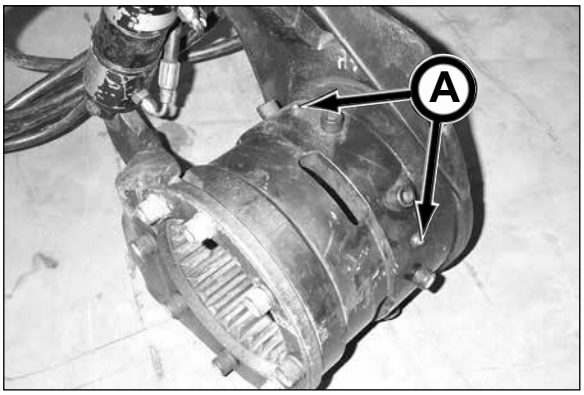


Standard Power Pack & Breakout Tool

Daily Or Every 10 Hours Of Operation (continued)

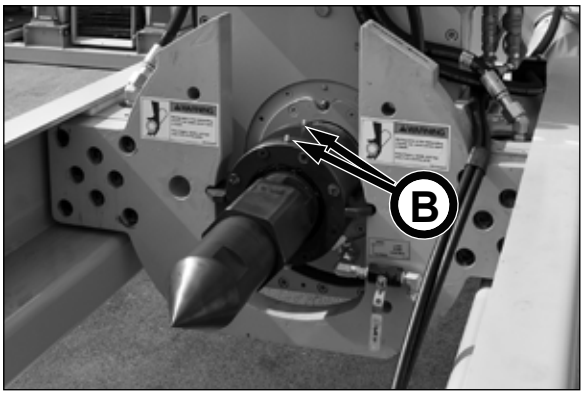
22. LUBRICATE BREAKOUT TOOL

Lubricate breakout tool (A) with 2 shots of Mobilgrease® XHP222 or equivalent at each grease fitting (4 places).



23. LUBRICATE DRIVE ADAPTER/SWIVEL

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

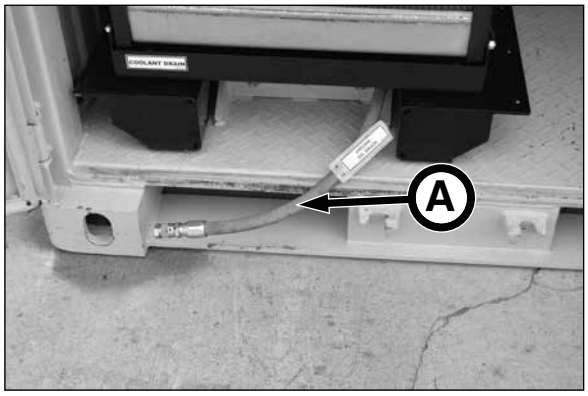


FIRST 50 HOURS OF OPERATION

24. CHANGE ENGINE OIL & FILTER

NOTICE Refer to your engine operation manual for more information.

1. Gain access to the engine oil drain hose (A).



2. Remove cap from hose.

3. Drain oil into a catch pan of proper size.

4. Reinstall cap to hose.

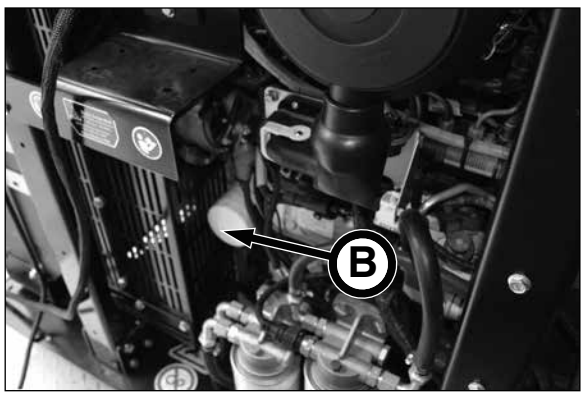


5. Replace drain hose to storage position.



6. Clean and dry area around the oil filter (B).

7. Remove oil filter and clean filter mounting pad. Dispose of filter properly.

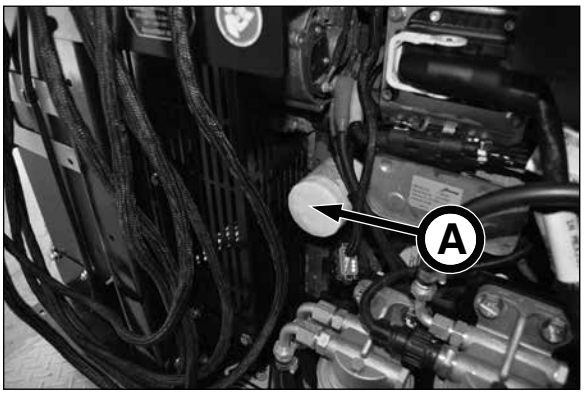


First 50 Hours Of Operation (continued)

8. Lubricate gasket on new filter with clean oil.

   IMPORTANT: The new oil filter should never be prefilled. There is a danger of contamination.

9. Install new filter (A) and hand tighten according to values printed on the filter. Do not overtighten the filter element.

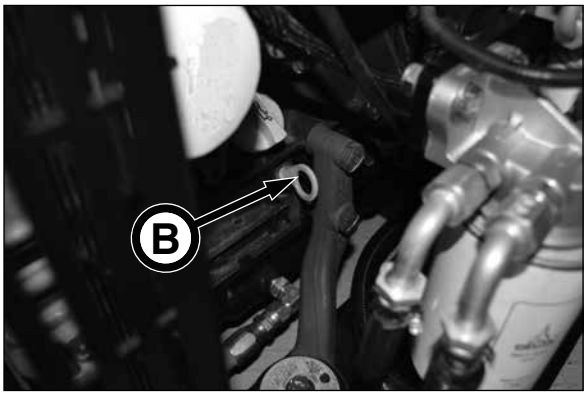


10. Remove fill cap (B).

11. Fill engine with engine oil specified in section 8, Fuels & Lubricants section. The following fluid capacity is an approximate value. Be sure to check level after filling. DO NOT OVERFILL.

    Oil Capacity: 8.45 qt (8 L)

12. Install fill cap. Hold and screw cap handle clockwise to tighten. Clean up spills.



13. Start engine and run until warm and check for leaks.

14. Shutdown engine. Wait approximately 5 minutes to let the oil drain from the upper portion of the engine. Check oil level. Oil level must always be between the MIN and MAX marks on the dipstick. DO NOT OVERFILL!



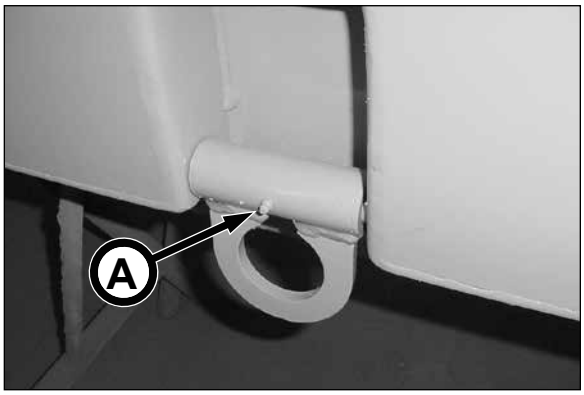
WEEKLY OR EVERY 50 HOURS OF OPERATION



25. LUBRICATE SHAFT TENSIONER

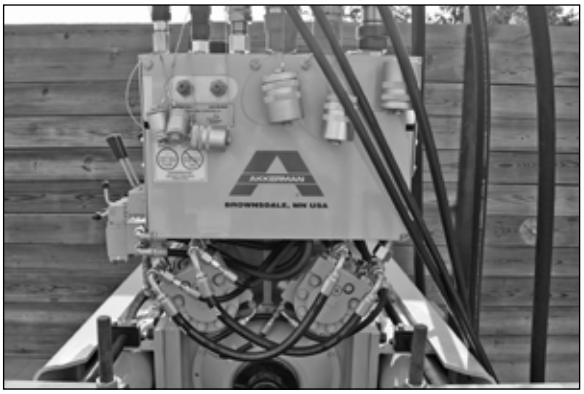
Lubricate shaft tensioner (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.

Lubricate daily if subjected to water and mud.



26. LUBRICATE DIRT BUCKET LIFTING EYE

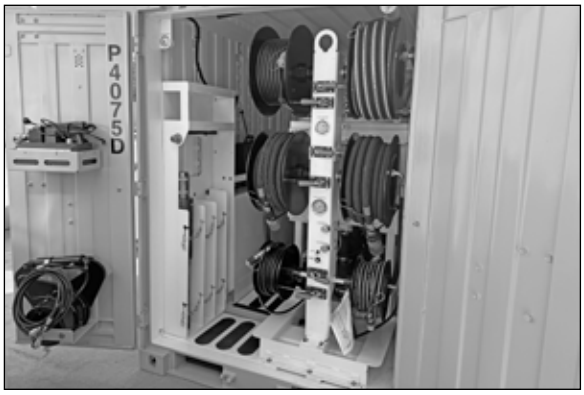
Lubricate lifting eyes (A) (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.



27. INSPECT HOSES & CLAMPS

Inspect ALL hoses for cracking, softness, exposed wire outer covering that is ballooning, kinks, and end fittings that are damaged or leaking. Replace all worn and damaged hoses before operation.

Inspect clamps that may be loose or damaged. Replace any worn or damaged clamps before operation.



MONTHLY OR EVERY 250 HOURS OF OPERATION

28. CHECK BATTERY



⚠WARNING Batteries product explosive gases. Wear eye protection and protective clothing during battery service. Keep sparks, flames, and cigarettes away from batteries.



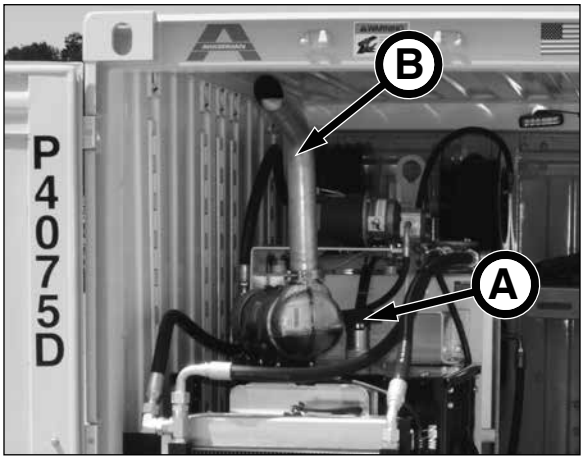
Visually check the battery for damage. If damaged replace with new.

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. Repair or replace as needed.

29. INSPECT AIR INTAKE & EXHAUST CONNECTIONS



Inspect all air intake (A) and exhaust connections (B). Tighten clamps as needed and replace defective parts.

30. INSPECT ENGINE MOUNTS



Visually inspect engine mounts (C) for loose hardware or damaged parts.

Tighten all loose hardware and replace defective parts.

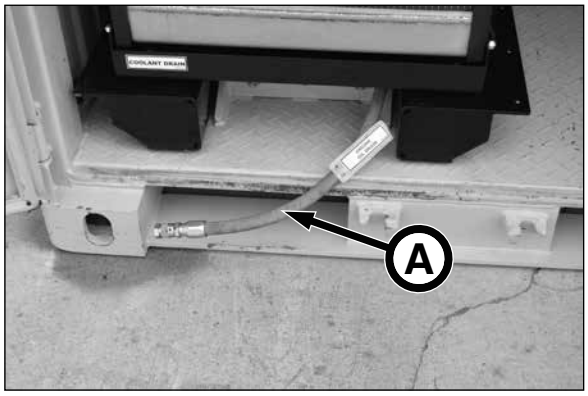
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Monthly Or Every 250 Hours Of Operation (continued)

31. CHANGE ENGINE OIL & FILTER

NOTICE Refer to your engine operation manual for more information.

1. Gain access to the engine oil drain hose (A).



2. Remove cap from hose.

3. Drain oil into a catch pan of proper size.

4. Reinstall cap to hose.

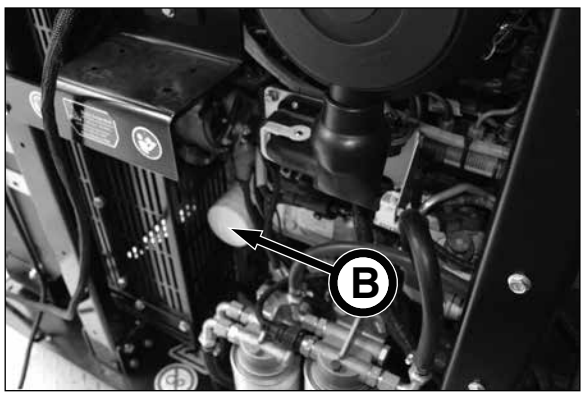


5. Replace drain hose to storage position.



6. Clean and dry area around the oil filter (B).

7. Remove oil filter and clean filter mounting pad. Dispose of filter properly.



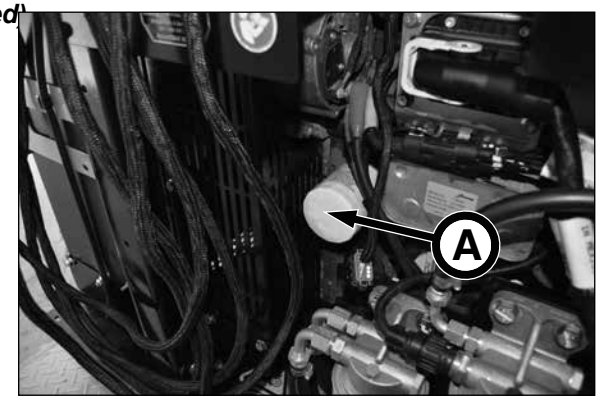
(continued on next page)

Monthly Or Every 250 Hours Of Operation (continued)

8. Lubricate gasket on new filter with clean oil.

   IMPORTANT: The new oil filter should never be prefilled. There is a danger of contamination.

9. Install new filter (A) and hand tighten according to values printed on the filter. Do not overtighten the filter element.

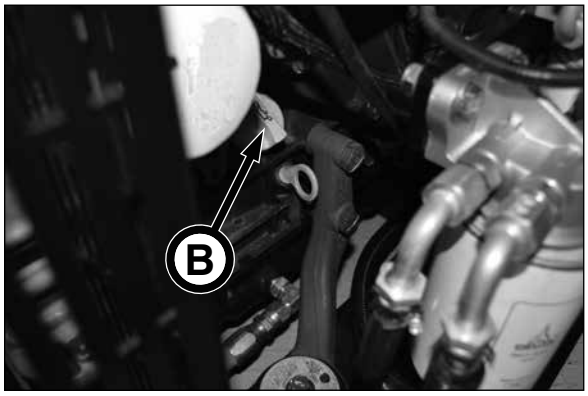


10. Remove fill cap (B).

11. Fill engine with engine oil specified in section 8, Fuels & Lubricants section. The following fluid capacity is an approximate value. Be sure to check level after filling. DO NOT OVERFILL.

    Oil Capacity: 8.45 qt (8 L)

12. Install fill cap. Hold and screw cap handle clockwise to tighten. Clean up spills.



13. Start engine and run until warm and check for leaks.

14. Shutdown engine. Wait approximately 5 minutes to let the oil drain from the upper portion of the engine. Check oil level. Oil level must always be between the MIN and MAX marks on the dipstick. DO NOT OVERFILL!



(continued on next page)

Monthly Or Every 250 Hours Of Operation (continued)

32. INSPECT & CLEAN FUEL TANK CAP

Inspect cap for damage. If cap is damaged, replace with new.

Remove cap and clean any debris or dirt from cap body.

Replace cap.





33. CHECK BREAKOUT TOOL POWER UNIT OIL LEVEL

1. Clean area around filler cap (A).

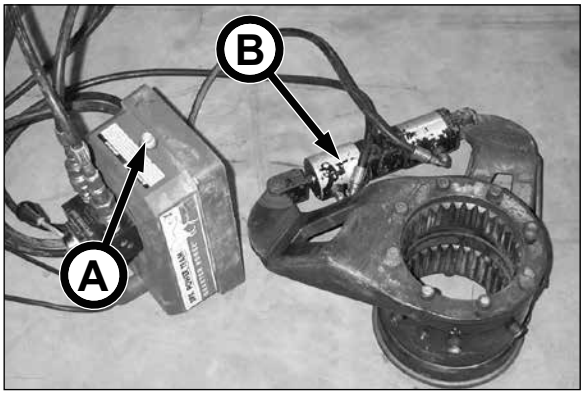
2. Retract cylinder (B).

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 if using standard power pack or Enerpac® HF if using cordless, rechargeable power pack. 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.



Standard Power Pack & Breakout Tool

EVERY 500 HOURS OF OPERATION

34. DRAIN & FILL HYDRAULIC RESERVOIR

1. Retract thrust cylinders on GBM frame.

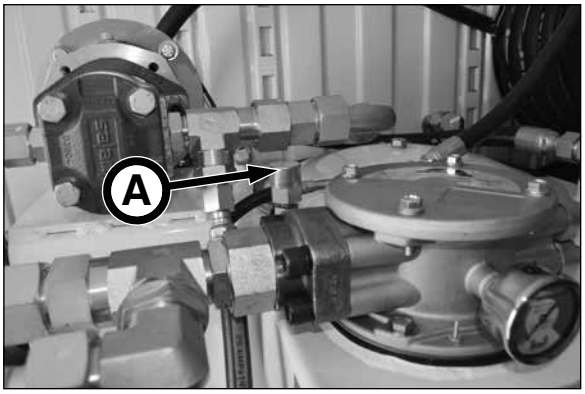
2. Shut down engine.

3. With power pack on level ground, allow oil in hydraulic reservoir to settle overnight.

IMPORTANT: BEFORE filling hydraulic reservoir, the breather/fitting must be removed to allow for proper bleeding. Failure to do so will result in pump damage. Be sure to replace breather/fitting after filling reservoir.

Removing breather/fitting before draining reservoir will drain the oil faster.

4. Remove breather/fitting (A) from reservoir BEFORE filling reservoir to allow for proper bleeding during filling process.

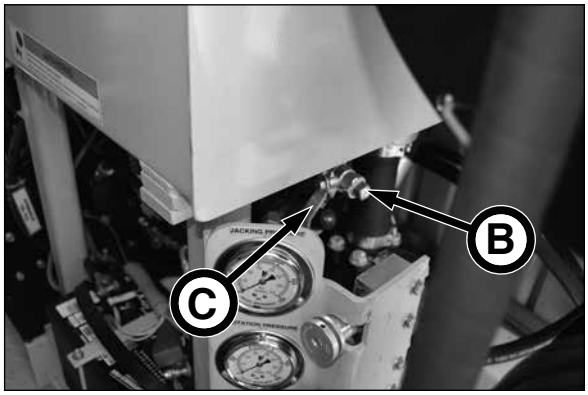


5. Remove plug (B) and install a 1/2” NPT hose to tank valve fitting.

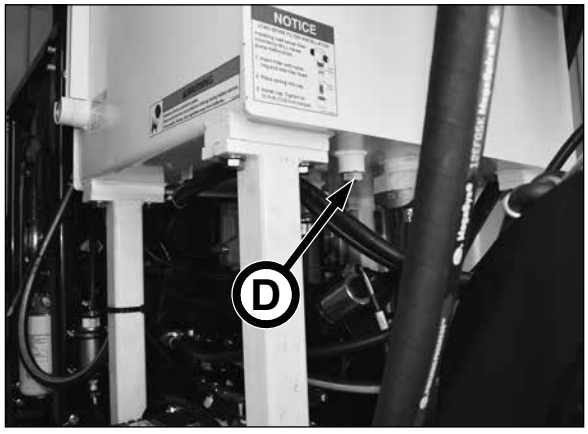
6. Route hose into an appropriate sized catch pan.

7. Slightly open tank drain ball valve (C) and drain until the reservoir has been drained.

8. Close tank drain ball valve, remove hose (if used) and reinstall plug



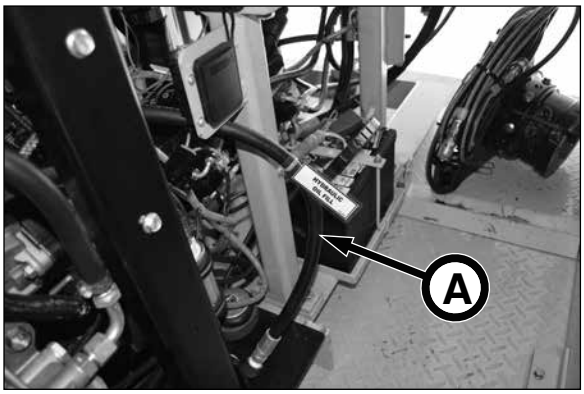
NOTICE Not all units are equipped with a tank drain ball valve. These units include a 1/2” plug (D). Use a funnel to direct the drained oil to a catch pan. Once oil has been drained from reservoir, reinstall plug.



(continued on next page)

Every 500 Hours Of Operation (continued)

9. Remove hydraulic fill hose (A) from storage location. Remove cap from hose.



10. Place hose into clean hydraulic oil container.

NOTICE Refer to Fuels & Lubricants section for recommended hydraulic oil.

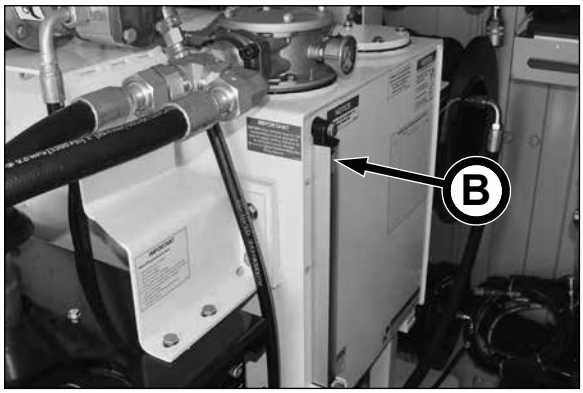


11. Flip Oil Fill Pump switch to the ON position to pump hydraulic oil into the hydraulic reservoir.



12. Fill until oil reaches the high mark on gauge (B).

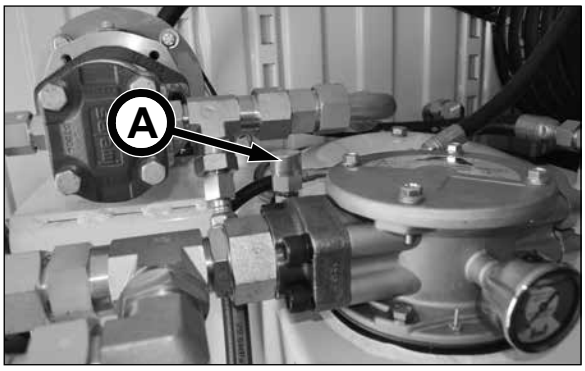
13. Flip Oil Fill Pump switch to the OFF position.



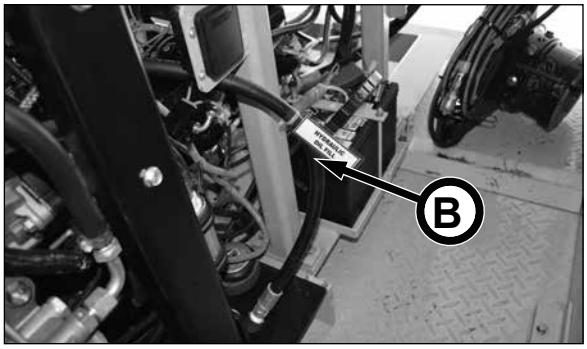
(continued on next page)

Every 500 Hours Of Operation (continued)

14. Replace breather/fitting (A) on reservoir.



15. Replace cap on fill hose (B) and place hose in storage location.



35. REPLACE AIR CLEANER FILTERS

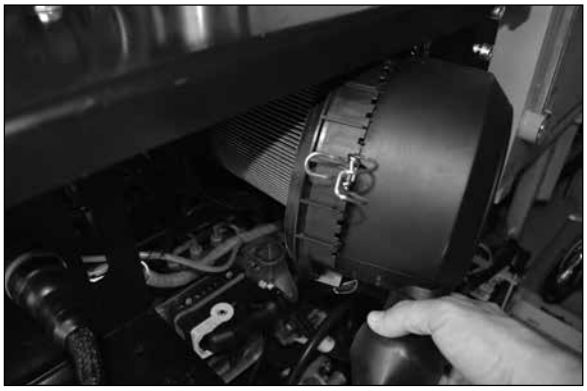
NOTICE Refer to your engine operation manual for more information.

Replace air cleaner elements at 500 hours or 12 months, whichever occurs first.

1. Clean area around the air cleaner assembly.



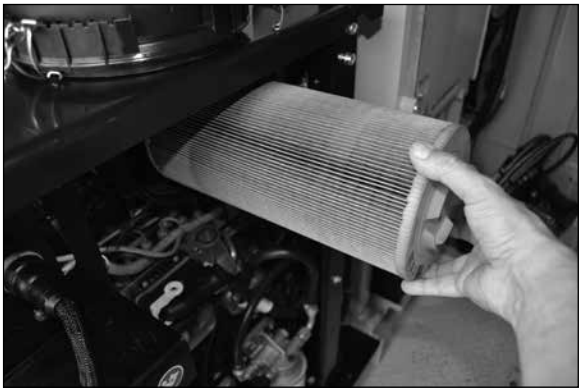
2. Unlatch and remove cover.



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Every 500 Hours Of Operation (continued)

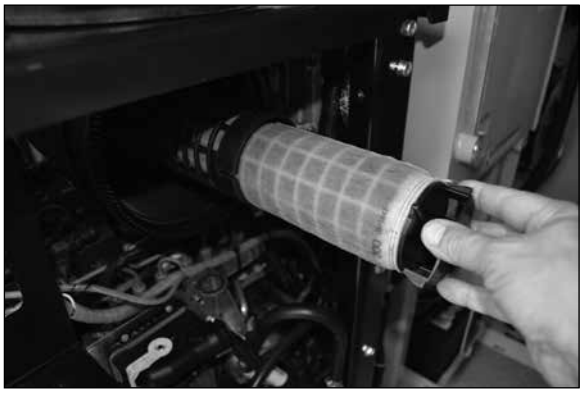
3. Gently remove primary element. Bumping the element against air cleaner housing may contaminate the clean side of the filter housing with dirt and dust.



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.

(continued on next page)

Every 500 Hours Of Operation (continued)

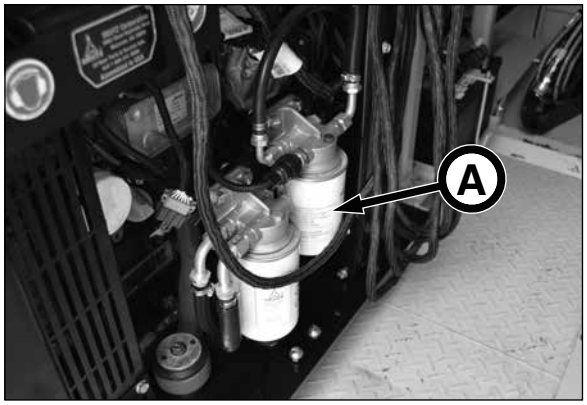
8. Replace cover with dust unloader valve facing down (6 o'clock position). Secure the latches.





36. REPLACE FUEL FILTER

NOTICE Refer to your engine operation manual for more information.



1. Clean area around fuel filter assembly (A).

2. Loosen and remove fuel filter and catch any escaping fuel.

3. Clean the sealing surface of the fuel filter head assembly with a lint-free, clean cloth.

4. Inspect mounting base for damage. Repair or replace as needed.

5. Lubricate gasket on new filter with clean oil.

6. Install new filter and hand tighten according to values printed on the filter. Do not overtighten the filter element.

7. The fuel system must now be bleed. Refer to Bleeding Fuel System. **Do not start the power pack engine until the fuel system has been properly bled.**

(continued on next page)

Every 500 Hours Of Operation (continued)

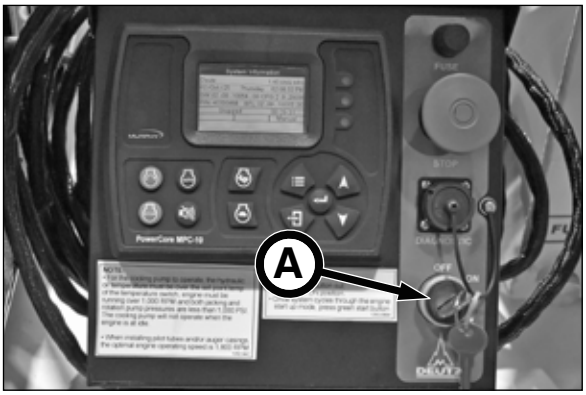
37. BLEED FUEL SYSTEM



NOTICE Refer to your engine operation manual for more information.

Whenever the fuel system has been opened up for service (lines disconnected or filter replaced), it will be necessary to bleed the fuel system.

The fuel system is bleed via the electric fuel supply pump. To ensure that no error messages are generated, do not start the engine while performing the bleeding procedure.

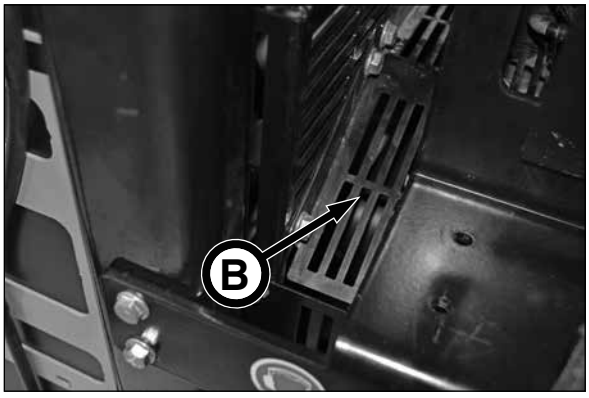


1. Turn key switch (A) clockwise to ON position. The electronic fuel supply pump switches on for 20 seconds in order to bleed the fuel system and buildup the required fuel pressure.

2. Once the fuel pump has stopped, turn the key switch to the OFF position.

3. Repeat steps 1 and 2 at least two more times until the fuel system is properly bled.

38. CHECK BELT & BELT TENSIONER



NOTICE Refer to your engine operation manual for more information.

1. Inspect the drive belt (B) for excessive wear or damage. If damaged, replace with new. Refer to your engine manual for service instructions.

2. Check the drive belt tensioner for proper operation. Refer to your engine manual for service instructions.

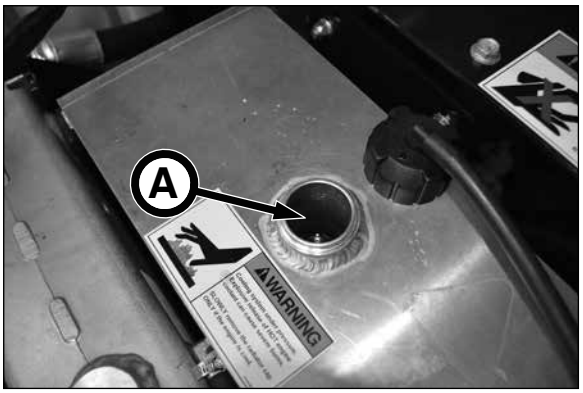
Every 500 Hours Of Operation (continued)

39. CHECK COOLING SYSTEM

NOTICE Refer to your engine operation manual for more information.

⚠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 (A). Add coolant mixture if needed. Refer to Engine Coolant in section 8, Fuels & Lubricants 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.

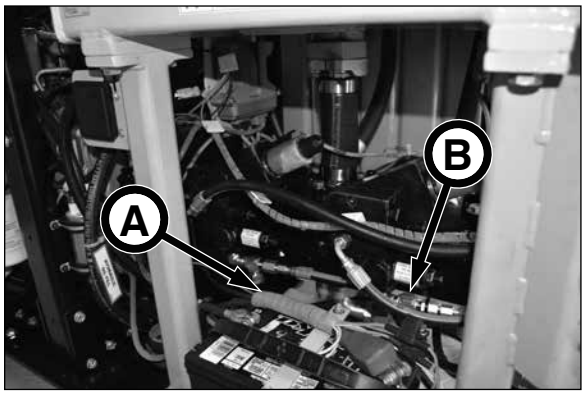
6. Check the effectiveness of the coolant solution with a hydrometer or other measuring device. Refer to your engine manual for service information.

7. Pressure test the cooling system. Refer to your engine manual for service information.

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Every 500 Hours Of Operation (continued)

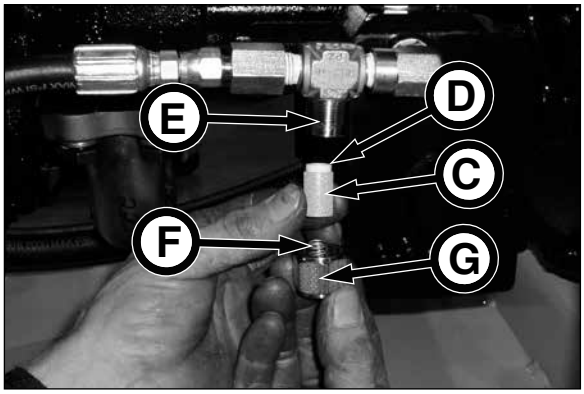
40. REPLACE LOAD SENSE FILTERS



The load sense filters (2 places) for the jacking (A) and rotation (B) pumps must be replaced at:

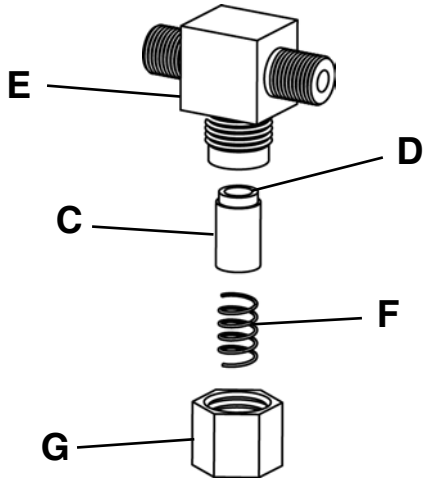
- 500 hours or yearly, which ever occurs first
- A major component fails
- Any signs of water contamination
- Hydraulic fluid sample indicates large particle contamination
- Controls are sluggish

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



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

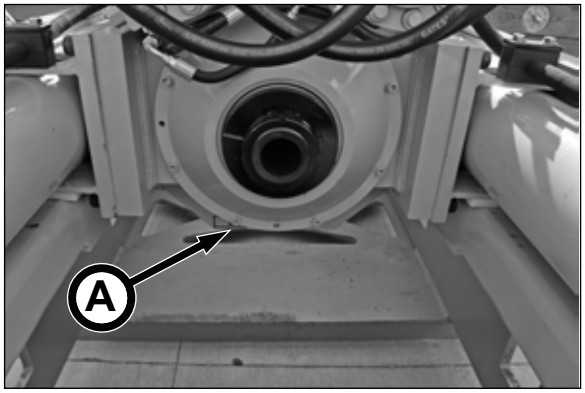




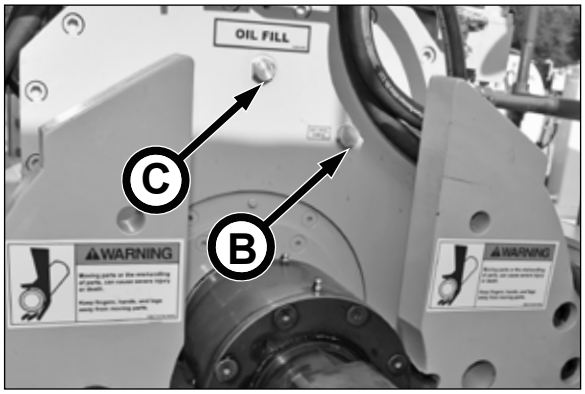
Load Sense Filter Installation

Every 500 Hours Of Operation (continued)

41. DRAIN & FILL GEARBOX OIL



1. Clean and dry area around the gearbox drain plug.
2. Remove drain plug (A).
3. Drain gearbox oil into a proper sized catch pan. Dispose of oil properly.
4. Replace drain plug.



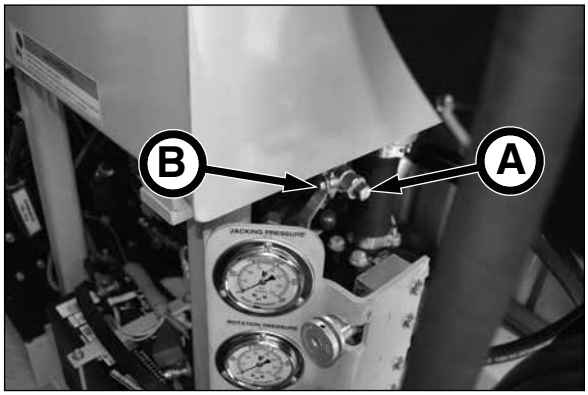
5. Remove check plug (B).
6. Clean and dry area around the fill plug (C).
7. Remove fill plug.
8. Fill gearbox with approximately 13 gal (49 L) of Mobil SHC 630 Synthetic Bearing and Gear Oil or equivalent until oil flows out of check plug hole. Do not mix oil manufacturers or grades. DO NOT OVERFILL!
9. Replace fill plug and gearbox cover.

COMPLETION OF EACH DRIVE

42. DRAIN WATER FROM HYDRAULIC RESERVOIR

Remove water contamination from the hydraulic reservoir by draining water from the reservoir at the completion of each drive.

1. With power pack on level ground, allow oil in hydraulic reservoir to settle overnight.
2. Be sure tank drain ball valve is closed.
3. Remove plug (A) and install a 1/2” NPT hose to tank valve fitting.
4. Route hose into a catch pan.
5. Slightly open tank drain ball valve (B) and drain until there is no water in oil.
6. Once water is removed from reservoir, close tank drain ball valve, remove hose (if used) and reinstall plug.



43. CLEAN & LUBRICATE PILOT TUBES

After each drive, the pilot inner tube (C) and annular space (D) must be cleaned.

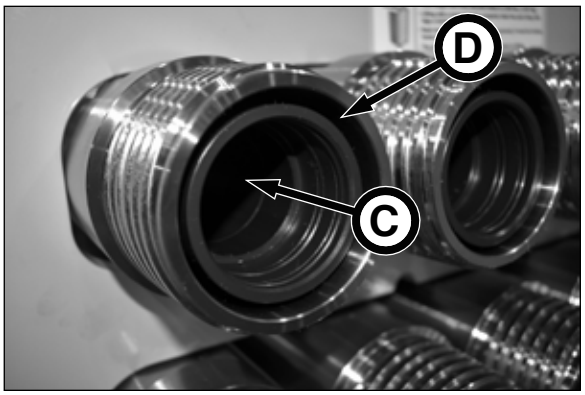
1. Clean the pilot inner tube with pilot tube cleaner (E). Be sure to clean the complete inner tube.

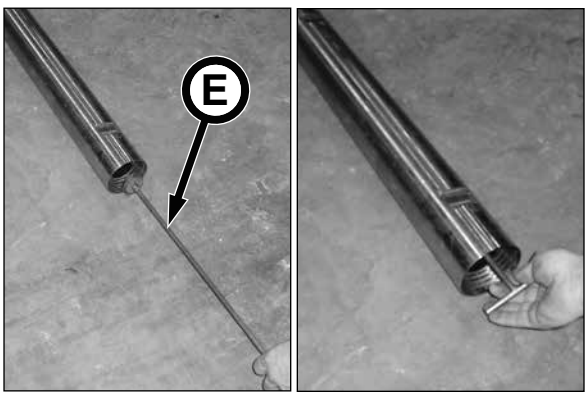
2. Install the fluid connector to the pilot tube.

3. Connect a clean water supply to the fluid connecter. Use a minimum water pressure of 10 gal @ 1,000 psi (37.9 L @ 27.6 mPa).

4. Flush the pilot tube annular space while rotating the pilot tube to prevent any contaminants from settling in the pilot tube.

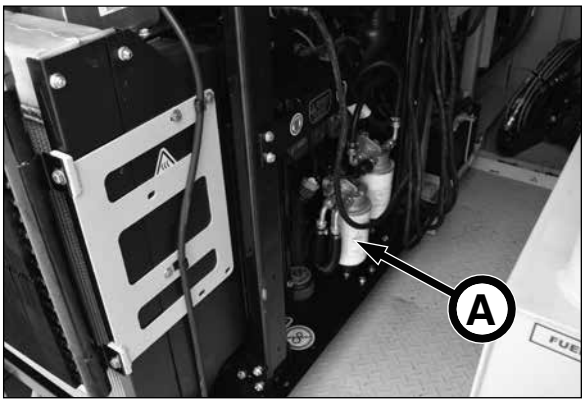
5. When pilot tube interior is completely dry, lubricate the threads with Baker Hughes Copper Guard-4™ and install a cap and plug on each. Return pilot tubes to pilot tube rack.





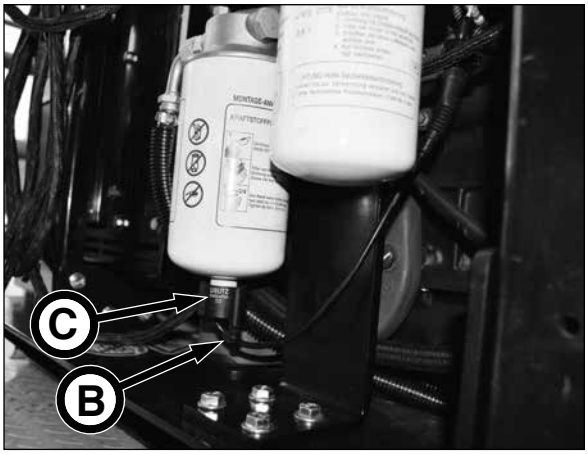
EVERY 1000 HOURS OF OPERATION

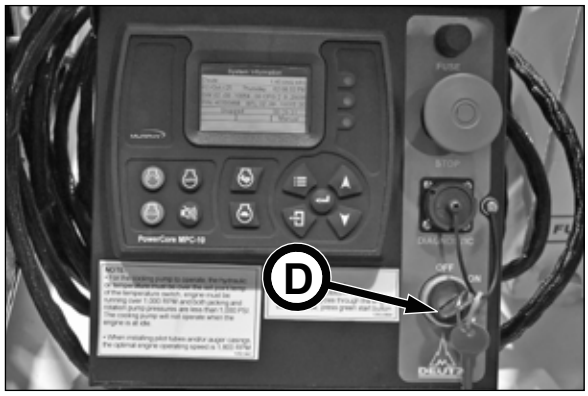
44. REPLACE FUEL/WATER SEPARATOR



NOTICE Refer to your engine manual for more information.

1. Shutdown engine.
2. Shut off the fuel supply to the engine.
3. Place an appropriate sized catch pan under the fuel pre-filter assembly (A).
4. Disconnect electrical cable connection (B).
5. Loosen drain plug (C).
6. Disassemble filter insert.
7. Clean any dirt off the sealing surfaces of the new filter cartridge and opposite side of filter head.
8. Lightly wet the sealing surfaces of the filter cartridge with fuel and install back onto the filter head. Hand tighten according to values printed on the filter.
9. Reinstall and tighten drain plug.
10. Reconnect electrical cable connection.
11. Open fuel supply to the engine.
12. Bleed the fuel system as follows:
13. Turn key switch (D) clockwise to ON position. The electronic fuel supply pump switches on for 20 seconds in order to bleed the fuel system and buildup the required fuel pressure.
14. Once the fuel pump has stopped, turn the key switch to the OFF position.
15. Repeat steps 12 and 13 at least two more times until the fuel system is properly bled.





(continued on next page)

Every 1000 Hours Of Operation (continued)

45. RECALIBRATE THEODOLITE



The theodolite is a sensitive optical instrument that requires special care and maintenance to maintain its accuracy.

Ship your theodolite to an authorized Nikon service center for recalibration every 1000 hours of operation or contact Akkerman Aftermarket Support for assistance. This will maintain the line and grade of the theodolite optics.

If the theodolite is bumped, dropped or if the accuracy is questioned, the theodolite must be recalibrated. Keep in mind if the theodolite is misaligned one degree, you will be off nearly two ft (0.6 m) per 100 ft (30.5 m) in the drive.

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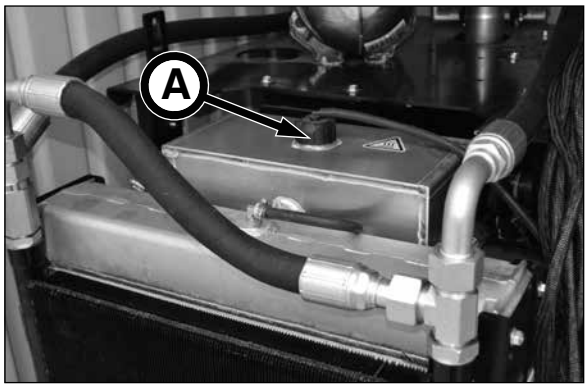
EVERY 2000 HOURS OF OPERATION

46. FLUSH & FILL COOLING SYSTEM

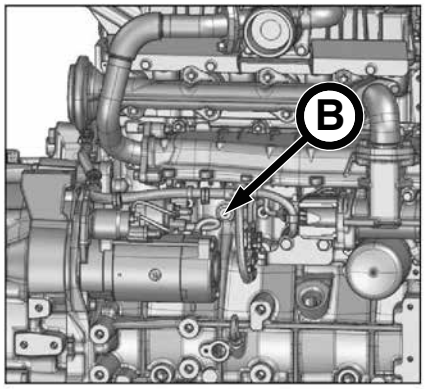


IMPORTANT: Refer to your engine operation manual for more information when flushing and refilling the cooling system.

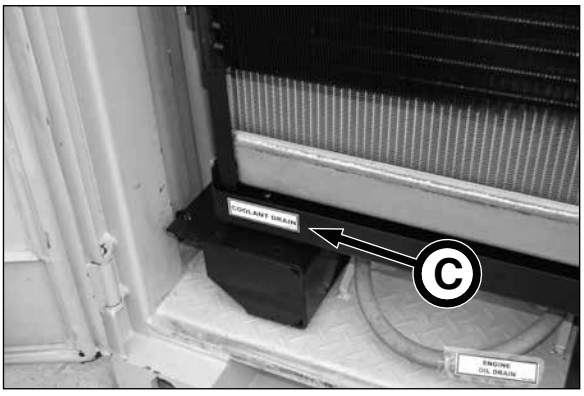
⚠WARNING Cooling system under pressure. Explosive release of HOT engine coolant can cause severe burns. SLOWLY remove the radiator cap ONLY if the engine is cool.



1. With the engine cold, wearing gloves and eye protection, slowly remove the radiator cap (A) on the overflow reservoir.



2. Open engine coolant locking screw (B) on back 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. Replace thermostats, if necessary (contact your engine dealer for service information).

5. After coolant has drained, close engine coolant locking screw and radiator drain valve.

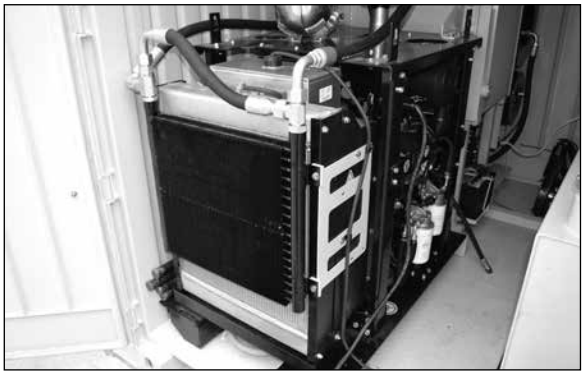
NOTICE Never add water or coolant to a hot engine. Doing so will result in engine damage.

6. Refill the cooling system with soft, clean water.

(continued on next page)

Every 2000 Hours Of Operation (continued)

⚠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 to fully drain the system. Be sure to replace radiator hose and tighten clamp after draining.

9. After draining water, close the engine coolant locking screw and radiator drain valve.

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 locking screw 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).

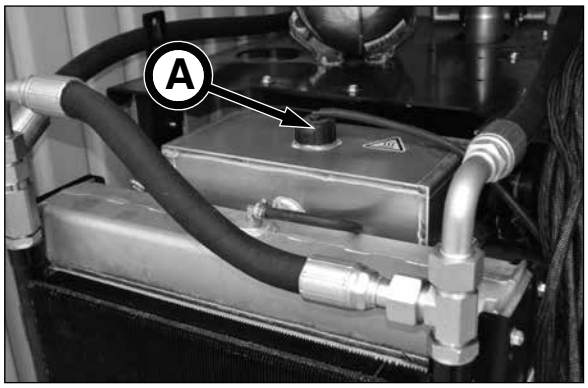
NOTICE DO NOT overfill cooling system. A pressurized system needs space for heat expansion without overflowing at top of radiator.

15. 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 overflow reservoir filler neck.

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

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Every 2000 Hours Of Operation (continued)

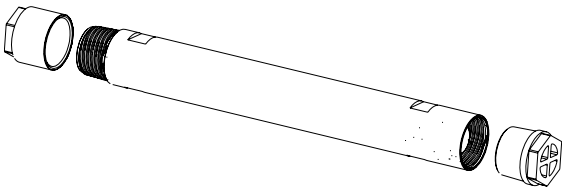


16. Replace radiator cap (A).
17. Start engine and operate it for 5 minutes to circulate the water/coolant/SCA (if used) mixture.
18. Shut off engine.
19. SLOWLY remove radiator cap.
20. Check radiator coolant level and fill as needed for coolant to reach the bottom of the filler neck.
21. Replace radiator cap.
22. Start engine and run it until it reaches operating temperature. This will mix the coolant uniformly and circulate it throughout the system.
23. Shut off engine. Check coolant level and add if necessary. Check entire coolant system for leaks.

AS REQUIRED

47. INSPECT PILOT TUBE THREADS

The pilot tube threads must be cleaned and relubricated with Baker Hughes Copper Guard-4™ or equivalent. This prevents dirt from damaging threads or unlubricated threads from seizing.



Using pilot tubes with unclean threads or improper lubrication will cause premature wear or damage to pilot tubes.

Be sure pilot tube cap and plugs are also cleaned to prevent dirt from adhering to pilot tube threads.

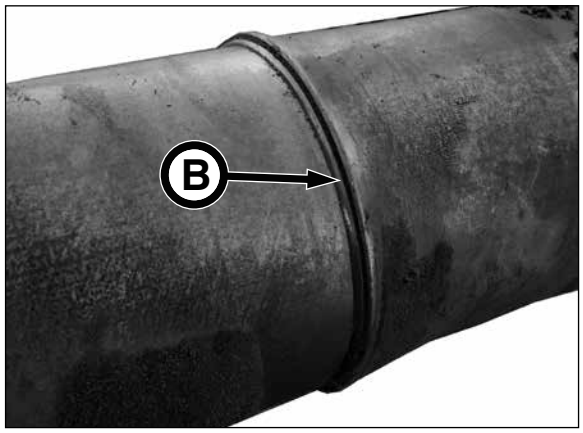
NOTICE If there is dust or dirt in the pilot tube threads, or poor thread lubrication, a high breakout torque and thread damage will occur. This will cause damage to the reception shaft breakout tool and/or other tooling and accessories. Be sure to ALWAYS store pilot tubes with caps and plugs attached.

Thread wear and ballooning occurs over time and is caused by excessive side-loading and high torque.

When pilot tubes are in good condition, the exterior joint region (A) should be smooth, no step or overlap.



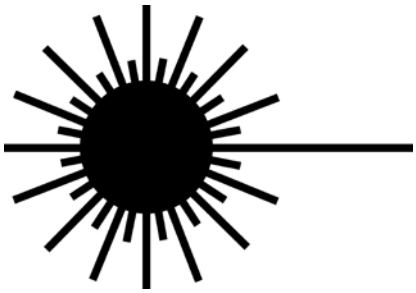
When threads are worn and ballooning has occurred, there will be a noticeable overlap (B) in the joint region.



For more information on identifying and measuring pilot tube wear, contact Akkerman Aftermarket Support.

As Required (continued)

48. 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 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 392 button batteries into the laser sight with the negative side of the battery into the chamber first.

4. Replace end cap.



NOTES

Storage

PREPARING FOR STORAGE

NOTICE For engine storage, refer to your engine operation and maintenance manual.

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 gearbox. Add Mobil SHC 630 or equivalent until oil level flows out of check plug. Replace plugs.
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. Check for leaks. Repair or replace as necessary.
8. Drain water and sediment from fuel system. Dispose of water and sediment properly.
9. Fill fuel tank completely. Refer to engine manual for adding fuel stabilizer into tank.
10. Store diesel fuel in plastic, aluminum, or steel containers specially coated for diesel fuel storage.
11. Loosen all belts.
12. Check condition of wires and cables. Repair or replace as necessary.
13. Clean air cleaner.
14. Restart engine and operate machine long enough to warm the oil. Check for leaks after machine warms up.
15. 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.
16. Repaint equipment where necessary.
17. Drain hydraulic oil, flush oil reservoir, change hydraulic filters, and refill hydraulic reservoir. Check for leaks.
18. Change hydraulic filters and refill hydraulic reservoir. Check for leaks.
19. Wipe up lube spills. Dispose of rags and trash properly.
20. If possible, store equipment under cover and out of the weather in a ventilated area.
21. If the engine will be stored over 6 months, refer to your engine manual for preparing the engine for long term storage.
22. Store hydraulic hoses indoors if possible to minimize UV damage and maintain a consistent ambient temperature. Note, since the hydraulic hoses are filled with hydraulic oil, and are subjected to a drastic temperature increase, the hoses could retain pressure causing them to leak or burst.
23. Clean and drain lubrication and high pressure jetting hoses. Store indoors to minimize UV damaged.
24. Review this Operator's Manual and supporting equipment manuals for additional information on preparing equipment for storage.

REMOVING FROM STORAGE

NOTICE For engine removal from storage, refer to your engine operation and maintenance manual.

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. Charge battery (if necessary) and install it.
5. Check coolant level. If coolant level is low, check for leaks and add coolant as required.
6. Adjust belt tension (refer to your engine manual).
7. Check gearbox oil level. Add oil as needed. See Gearbox Lubricant in Lubricants section.
8. Remove the cylinder corrosion preventive from the cylinder rods if it is not compatible with hydraulic oil or seal materials.
9. Check for leaks. Repair or replace as necessary.
10. 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.
11. Check condition of all hoses and connections. Tighten, repair or replace with new as needed.
12. Before operating, cycle hydraulic functions several times to purge air from the hydraulic system.
13. Refer to your engine manual on how to restore engine to service.
14. 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.
15. Review this Operator’s Manual and supporting equipment manuals for additional information on removing equipment from storage.

Troubleshooting

Guided Boring Machine Jacking Frame		
Problem	**Possible Cause**	**Solution**
No power to guidance system.	Power connections are loose or disconnected.	Secure all connections.
	Voltage is less than 10 VDC.	Check voltage.
Valve function (jacking, rotation, travel) do not operate.	Power pack engine is not running.	Start up engine.
	Quick couplers are not properly connected.	Connect quick couplers on gearbox properly.
	No oil flow.	Open inlet valve on power pack.
	Low oil in hydraulic reservoir.	Check oil and fill reservoir.
	Disconnect disengaged on load sense circuit.	Properly connect load sense hose to jacking frame.
	Load sense filter clogged.	Replace load sense filter.
Valve bank leaking.	Tank disconnect not connected.	Properly connect tank hose to jacking frame.
	Valve cap on opposite end of lever is deformed.	Replace seal/cover.
Hydraulic make-up tool operates incorrectly.	Hoses are installed on wrong port.	Switch hoses.
Breakout tool does not operate.	Break-out tool is unplugged.	Plug in break-out tool.
	Quick disconnect is not fully connected.	Secure quick disconnect.
	Power source defective.	Repair power source.
	Defective switch on controller.	Replace switch.
	Cordless model not charged.	Charge cordless breakout tool.
High rotational pressure.	Jacking frame motor speed is at high speed position.	Move selector to low speed position.
Lack of hydraulic power at tool.	High oil temperature (above 150°F (66°C).	Cool oil to operating temperature.
		Change hydraulic oil to higher viscosity.

Power Pack Engine

NOTICE Before troubleshooting the engine, first retrieve any fault codes on the diagnostic gauge display and perform the corrective actions (refer to your engine operator's manual). If any problems remain, use the following troubleshooting.

Power Pack Engine		
Problem	**Possible 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 temperature sensor.
	Defective 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 vent 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.

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Power Pack Engine (continued)

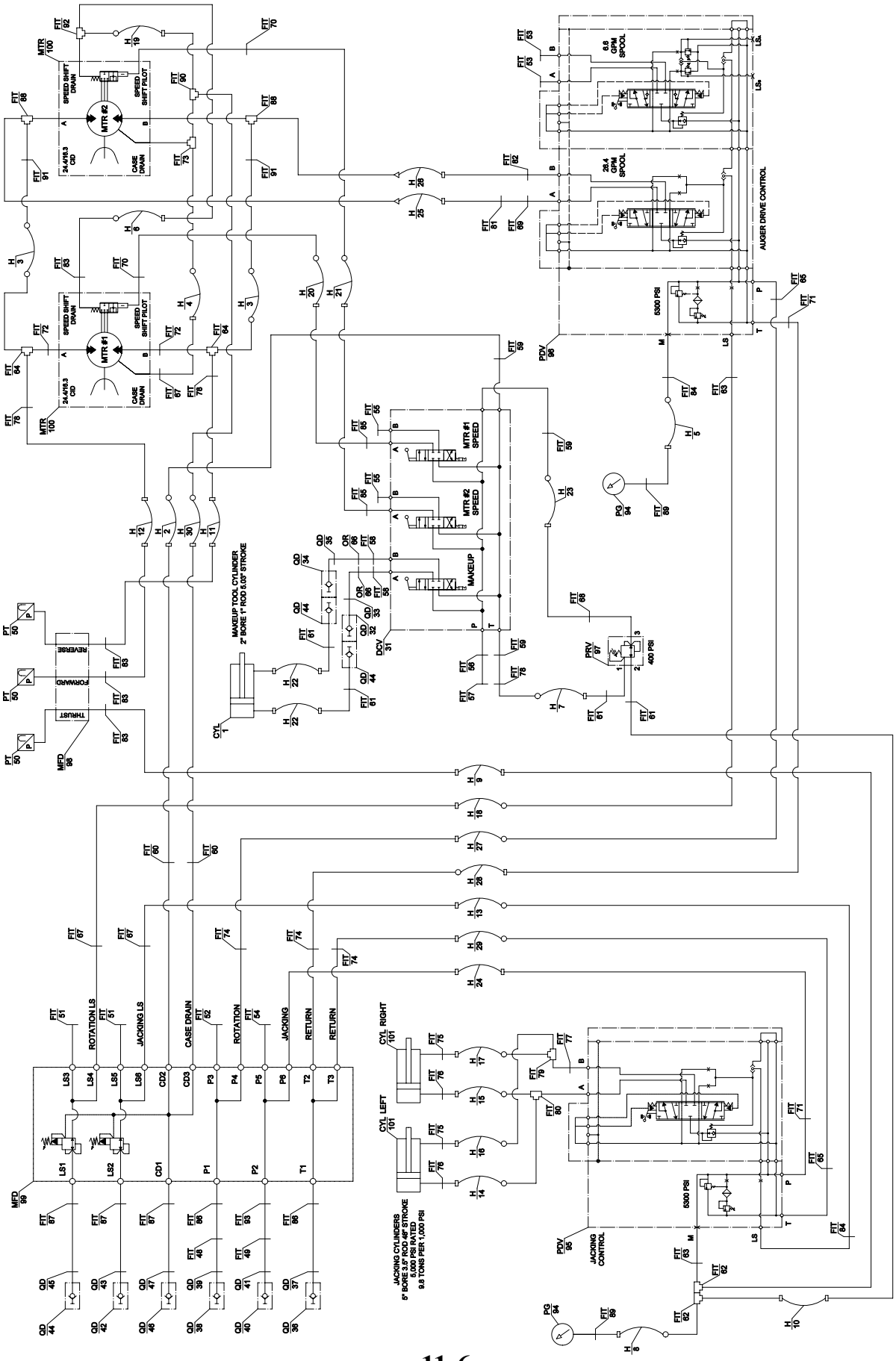
Power Pack Engine (continued)		
Problem	**Possible Cause**	**Solution**
Lack of power (continued).	Below normal engine temperature.	Remove and check thermostat.
	Restricted fuel hose.	Clean or replace fuel hose.
Low oil pressure.	Low oil level.	Add oil.
	Improper oil type.	Drain, fill crankcase with proper oil and quantity.
High oil consumption.	Crankcase oil too light.	Use proper oil.
	Oil leaks, gaskets, and drain plug.	Check for leaks in lines.
	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.	Doors closed on power pack.	Open all power pack doors.
	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.

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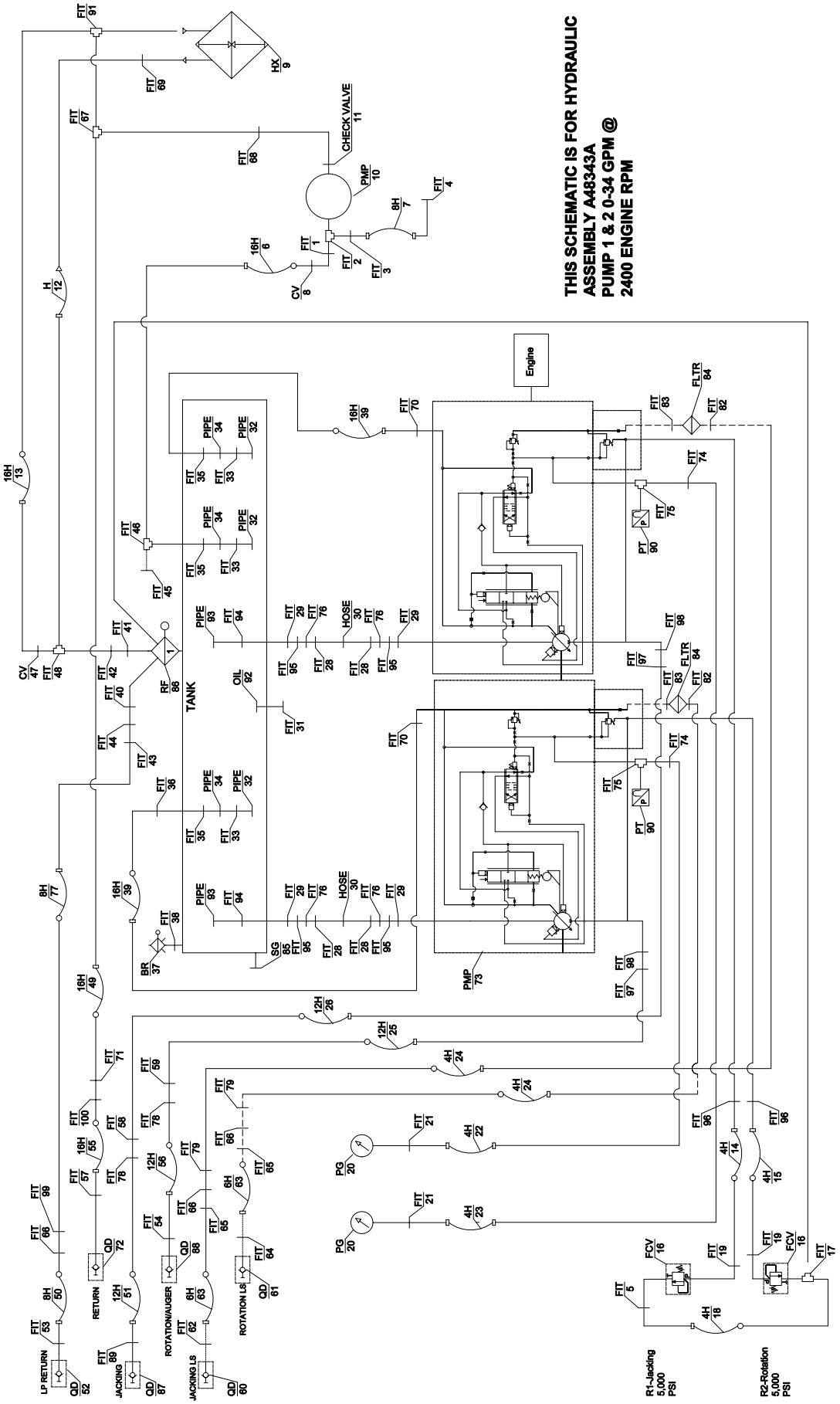
Power Pack Engine (continued)		
Problem	**Possible Cause**	**Solution**
High fuel consumption.	Incorrect grade of fuel.	Use correct grade of fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load on engine.
Undercharged system.	Excessive engine idling.	Increase engine rpm when heavy electrical load is used.
	Poor electrical connectors on battery, ground strap, starter, alternator.	Inspect and clean or replace as necessary.
	Defective battery.	Test battery.
	Defective alternator. Replace alternator.	Test charging system.
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.

GBM Guidance System		
Problem	**Possible Cause**	**Solution**
Monitor display will not advance beyond logo.	Camera cable not connected.	Connect cable.
	Interruption in power.	Restart monitor.
	Damaged cable.	Replace cable.
Monitor won't start.	Power cable not connected.	Connect cable.
	Damaged power cable.	Replace cable.
	Low battery power.	Charge or replace battery.
Crosshairs not visible.	Eyepiece is out of focus.	Adjust eyepiece to focus crosshairs.
	LED cable light not positioned.	Center LED cable light in front of theodolite telescope.
		Press LED Brightness Button on monitor.
Theodolite horizontal readout froze.	Hold button pressed.	Press hold button.
Target will not light.	Batteries not installed correctly.	Correct battery orientation.

HYDRAULIC SCHEMATIC - GBM 240A/240ABM JACKING FRAME

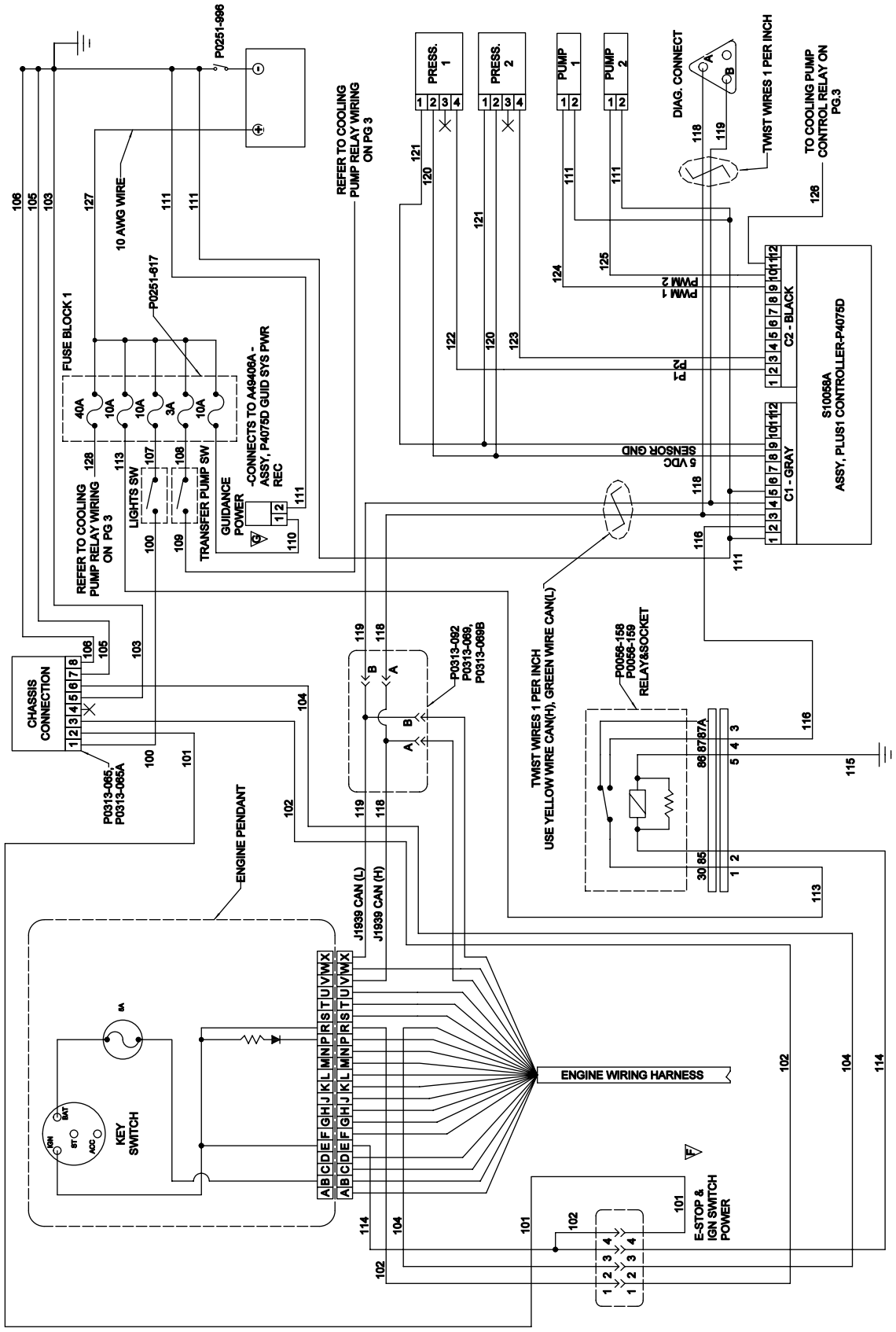


HYDRAULIC SCHEMATIC - P4075D POWER PACK



ELECTRICAL SCHEMATIC - P4075D POWER PACK SN38-57

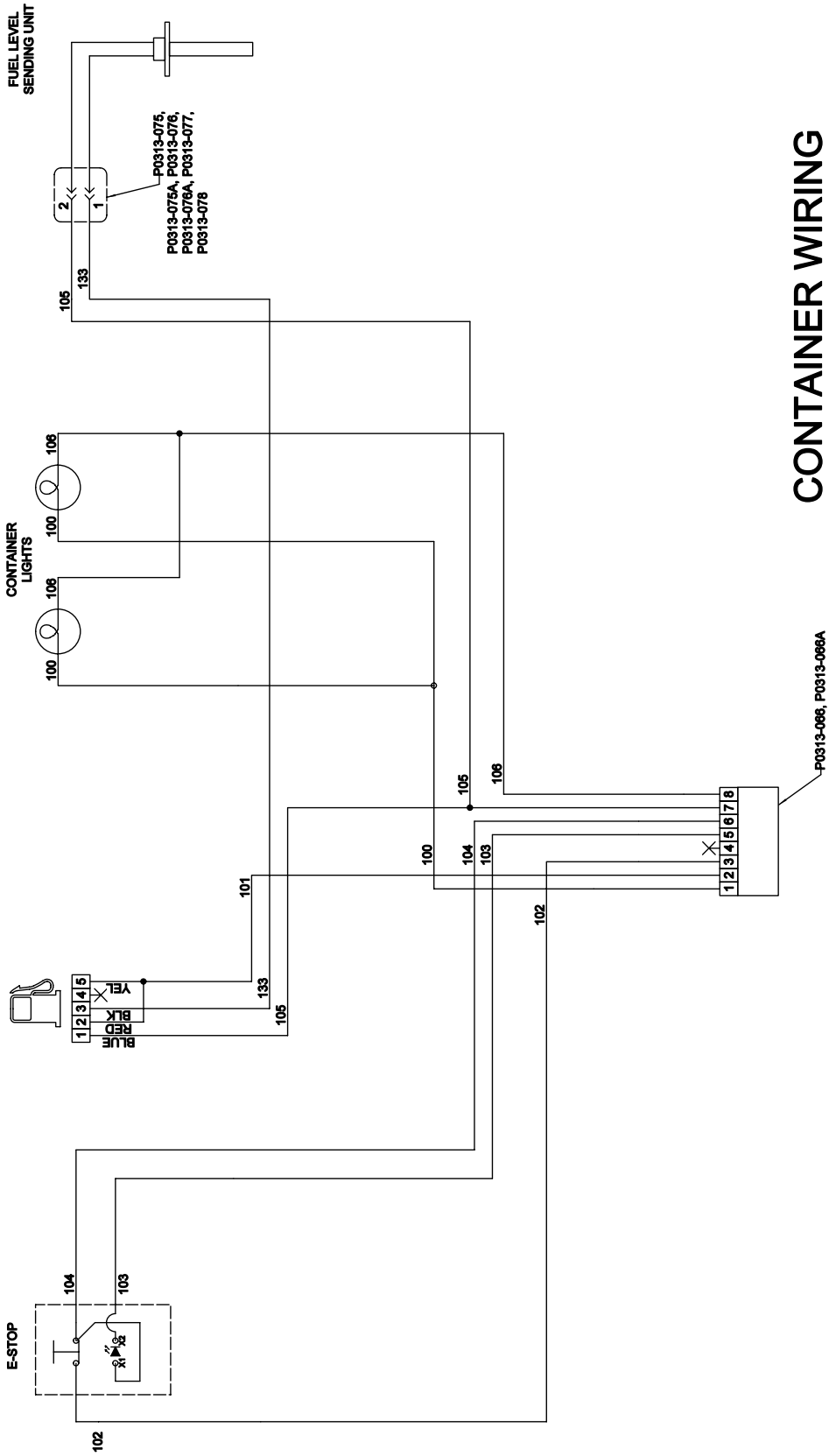
Part 1 of 4



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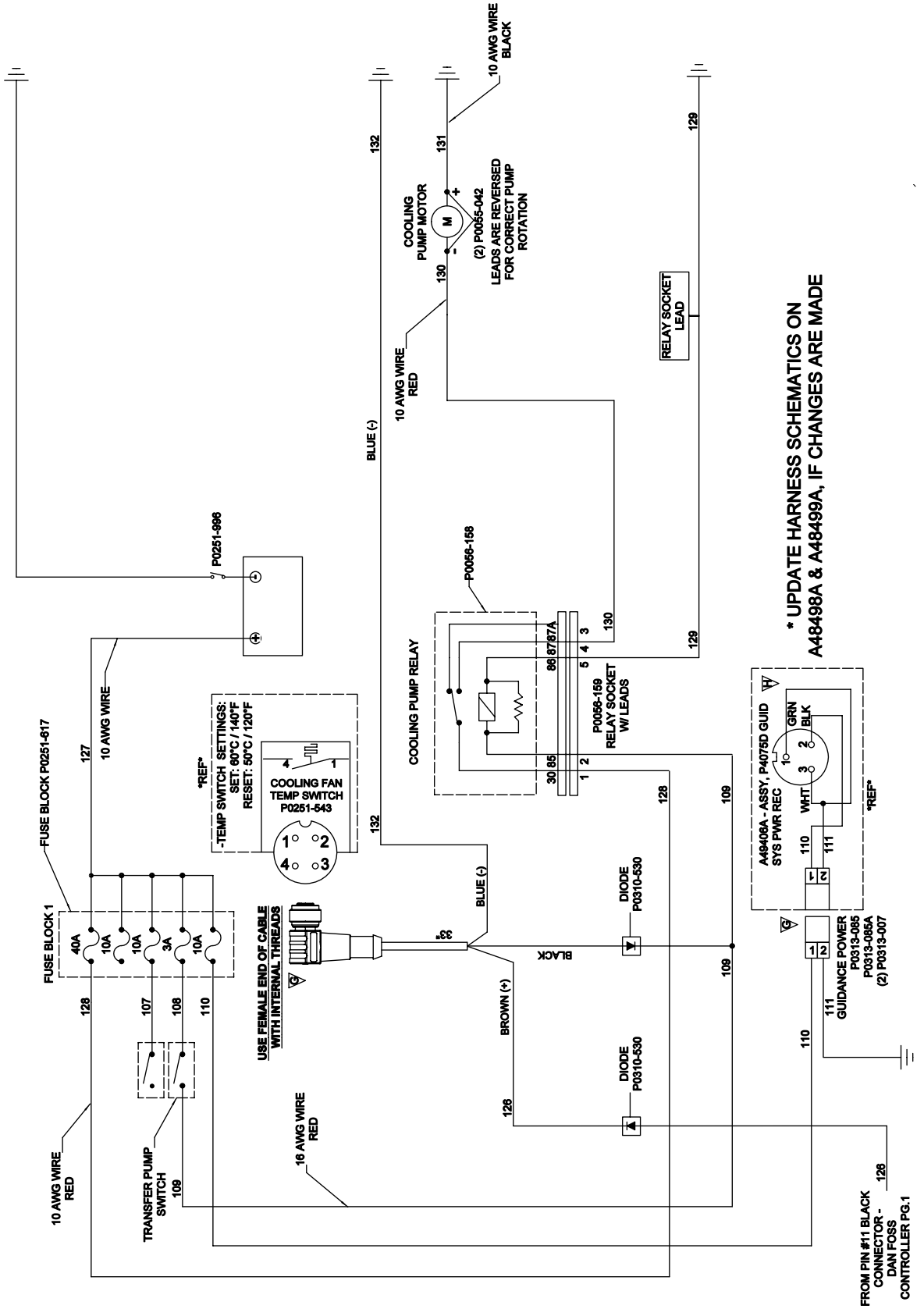
ELECTRICAL SCHEMATIC - CONTAINER WIRING - P4075D SN38-57

Part 2 of 4



Electrical Schematic - Container Wiring - P4075D SN38-57

Part 3 of 4



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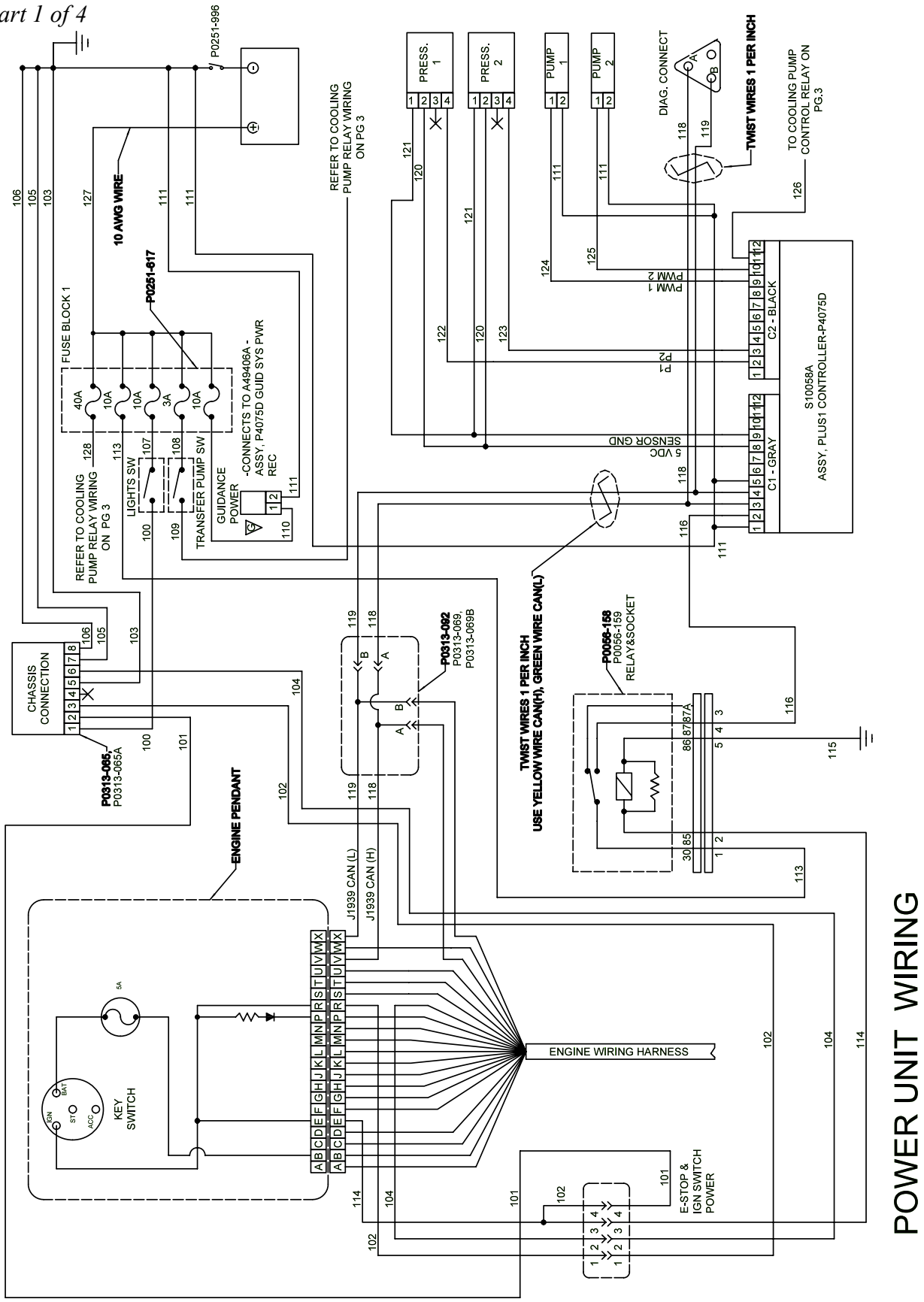
Electrical Schematic - Container Wiring - Wire Number & Circuit Descriptions -
P4075D Power Pack SN38-57
Part 4 of 4

WIRE NUMBER AND CIRCUIT DESCRIPTIONS

Wire Number	Description	From Location # 1	To Location # 2	Wire Color / Gauge
100	POWER TO LIGHTS	TOGGLE SWITCH	LIGHTS	BLUE-BLACK / 16 AWG
101	E-STOP 4 PIN TO FUEL GAUGE	4 PIN E-STOP	FUEL GAUGE	BLUE / 16 AWG
102	POWER TO E-STOP	POWER	E-STOP	BLUE / 16 AWG
103	GROUND TO E-STOP	GROUND	E-STOP	WHITE / 16 AWG
104	E-STOP 4 PIN TO E-STOP BUTTON	E-STOP	ECU POWER	BLUE / 16 AWG
105	FUEL GAUGE GROUND TO SENDER	FUEL GAUGE GROUND	SENDER	BLUE / 16 AWG
106	GROUND TO LIGHTS	GROUND	LIGHTS	WHITE-BLUE / 16 AWG
107	POWER FUSE BOX TO LIGHT SWITCH	FUSE BLOCK 1	LIGHT SWITCH	RED / 16 AWG
108	POWER FUSE BOX TO COOL PUMP RELAY SWITCH	FUSE BLOCK 1	COOLING PUMP RELAY SWITCH	RED / 16 AWG
109	TRANSFER PUMP CONTROL	TRANSFER PUMP SWITCH	COOLING PUMP RELAY	RED / 16 AWG
110	POWER FUSE BOX TO GUIDING SYSTEM PLUG	FUSE BLOCK 1	GUIDANCE PLUG	BLUE / 16 AWG
111	GROUND	BATTERY GROUND	MULTIPLE	WHITE-BLUE / 16 AWG
113	POWER FUSE POWER TO RELAY	FUSE BLOCK 1	LIGHTS	BLUE / 16 AWG
114	ECU POWER RELAY	KEY	RELAY	BLUE / 16 AWG
115	GROUND FOR RELAY	GROUND	RELAY	WHITE-BLUE / 16 AWG
116	RELAY TO DANFOSS GRAY PIN #2	RELAY	DANFOSS GRAY PIN # 2	GREEN / 16 AWG
118	CAN H	CONTROLLER	CAN H	YELLOW / 16 AWG
119	CAN L	CONTROLLER	CAN L	GREEN / 16 AWG
120	5 VDC PRESS # 1 & 2	CONTROLLER	PRESSEURE SENSOR 1 & 2	RED-WHITE / 16 AWG
121	SENSOR GROUND PRESS # 1 & 2	CONTROLLER	PRESSEURE CONTROLLER 1 & 2	WHITE-BLUE / 16 AWG
122	PUMP # 1 PRESSURE	CONTROLLER	PRESSEURE SENSOR 1	VIOLET / 16 AWG
123	PUMP # 2 PRESSURE	CONTROLLER	PRESSEURE SENSOR 2	GREEN / 16 AWG
124	PWM # 1	CONTROLLER	PUMP 1 SOLENOID	ORANGE / 16 AWG
125	PWM # 2	CONTROLLER	PUMP 2 SOLENOID	BLUE / 16 AWG
126	DANFOSS CONTROLLER TO COOLING FAN TEMP SWITCH	CONTROLLER	COOLING FAN TEMP SWITCH	BROWN / 16 AWG
127	FUSE BLOCK TO BATTERY POWER	FUSE BLOCK POWER	BATTERY POWER	BLUE / 10 AWG
128	FUSE BLOCK TO COOLING PUMP RELAY	FUSE BLOCK POWER	COOLING PUMP RELAY	BLUE / 10 AWG
129	TRANSFER PUMP SWITCH TO RELAY	GROUND	COOLING PUMP RELAY	WHITE-BLUE / 16 AWG
130	COOLING PUMP RELAY TO COOLING PUMP MOTOR	COOLING PUMP RELAY	COOLING PUMP MOTOR	BLUE / 10 AWG
131	GROUND COOLING PUMP	COOLING PUMP	GROUND	WHITE-BLUE / 10 AWG
132	GROUND COOLING FAN TEMP SWITCH	GROUND	FAN TEMP SWITCH	BLUE / 16 AWG
133	FUEL LEVEL SIGNAL	FUEL GAUGE	FUEL LEVEL SENDING UNIT	WHITE-BLUE / 16 AWG

ELECTRICAL SCHEMATIC - P4075D POWER PACK SN58 & AFTER

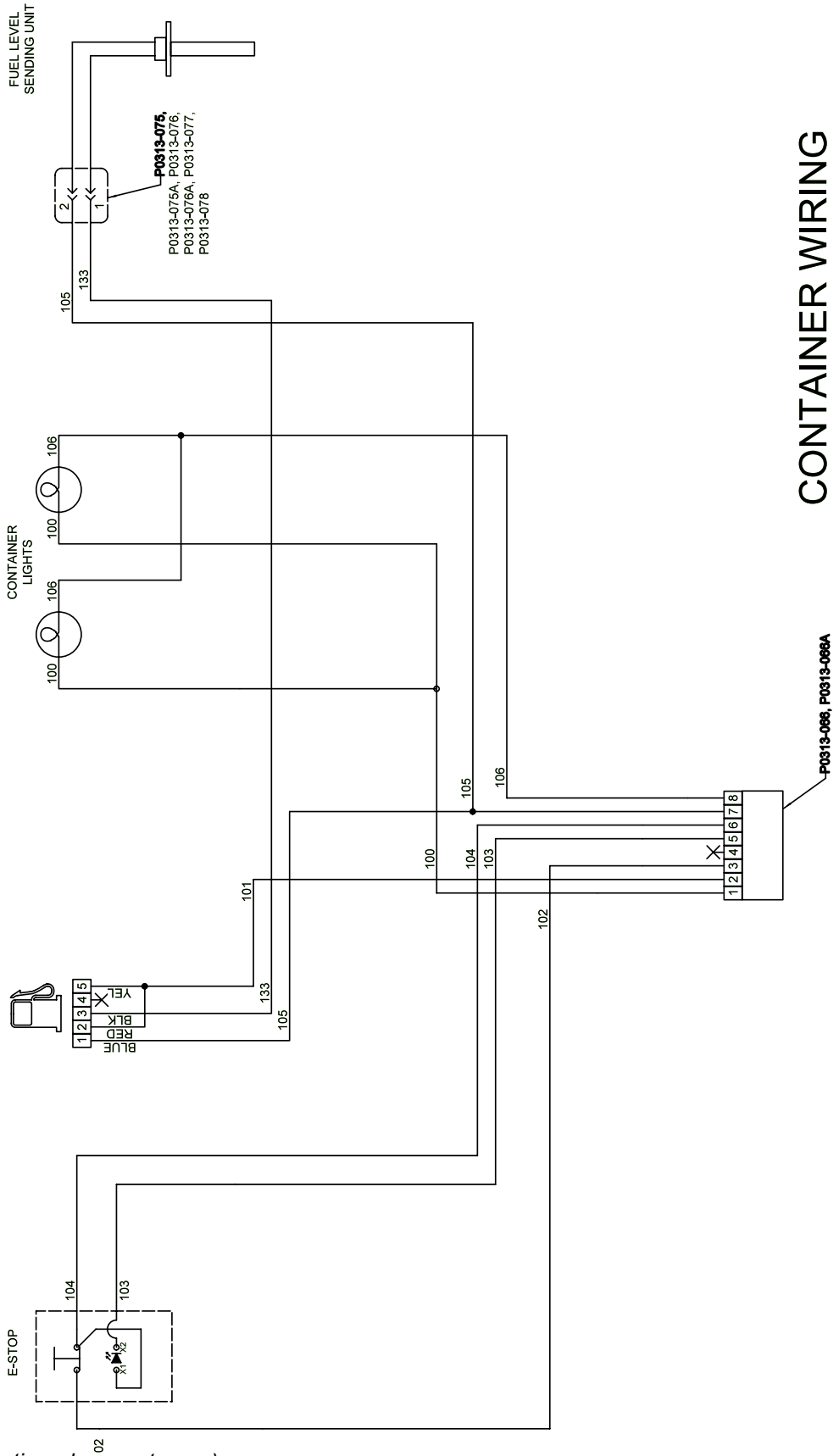
Part 1 of 4



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ELECTRICAL SCHEMATIC - CONTAINER WIRING - P4075D SN58 & AFTER

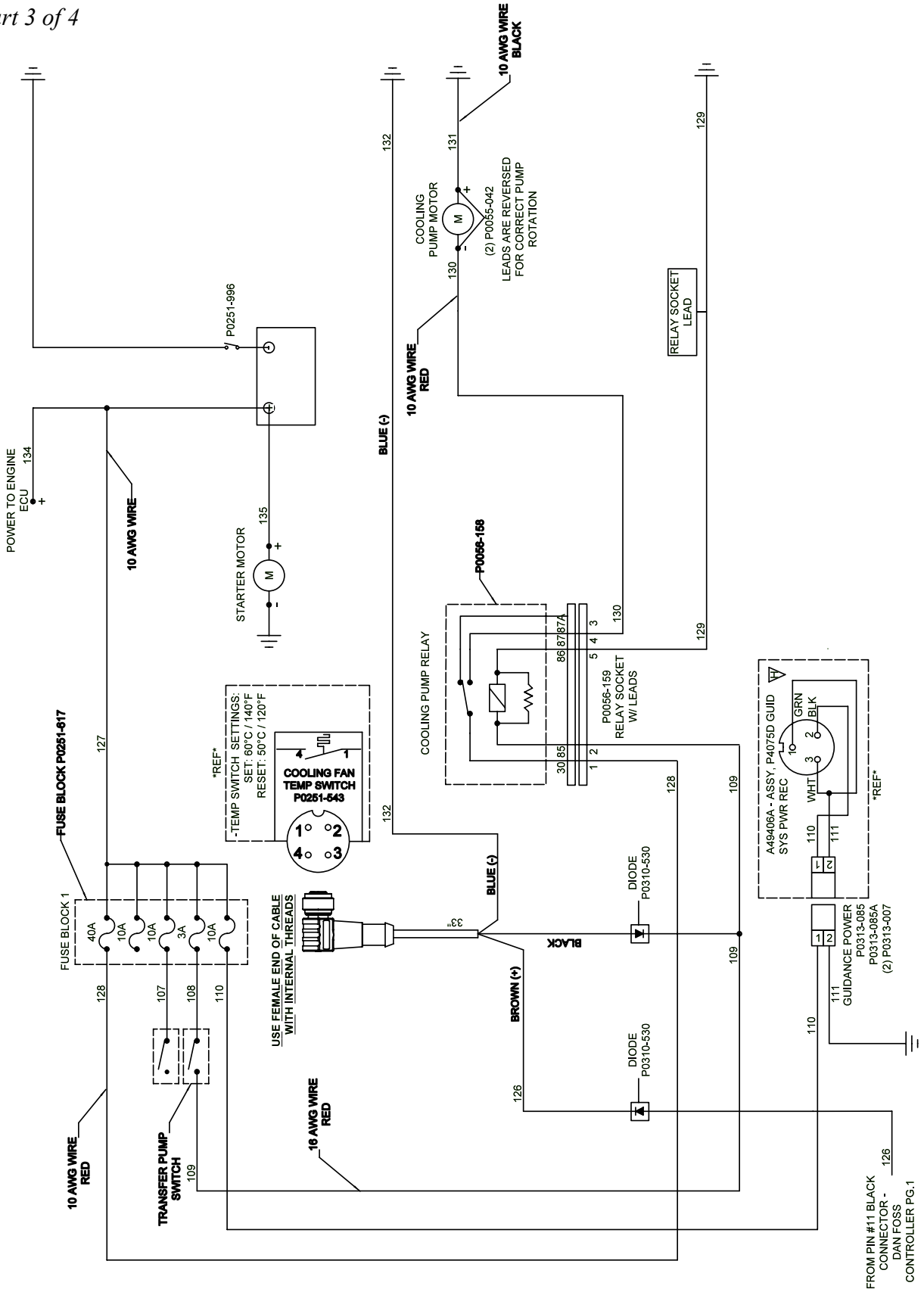
Part 2 of 4



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Electrical Schematic - Container Wiring - P4075D SN58 & After

Part 3 of 4



Electrical Schematic - Container Wiring - Wire Number & Circuit Descriptions - P4075D Power Pack SN58 & After

Part 4 of 4

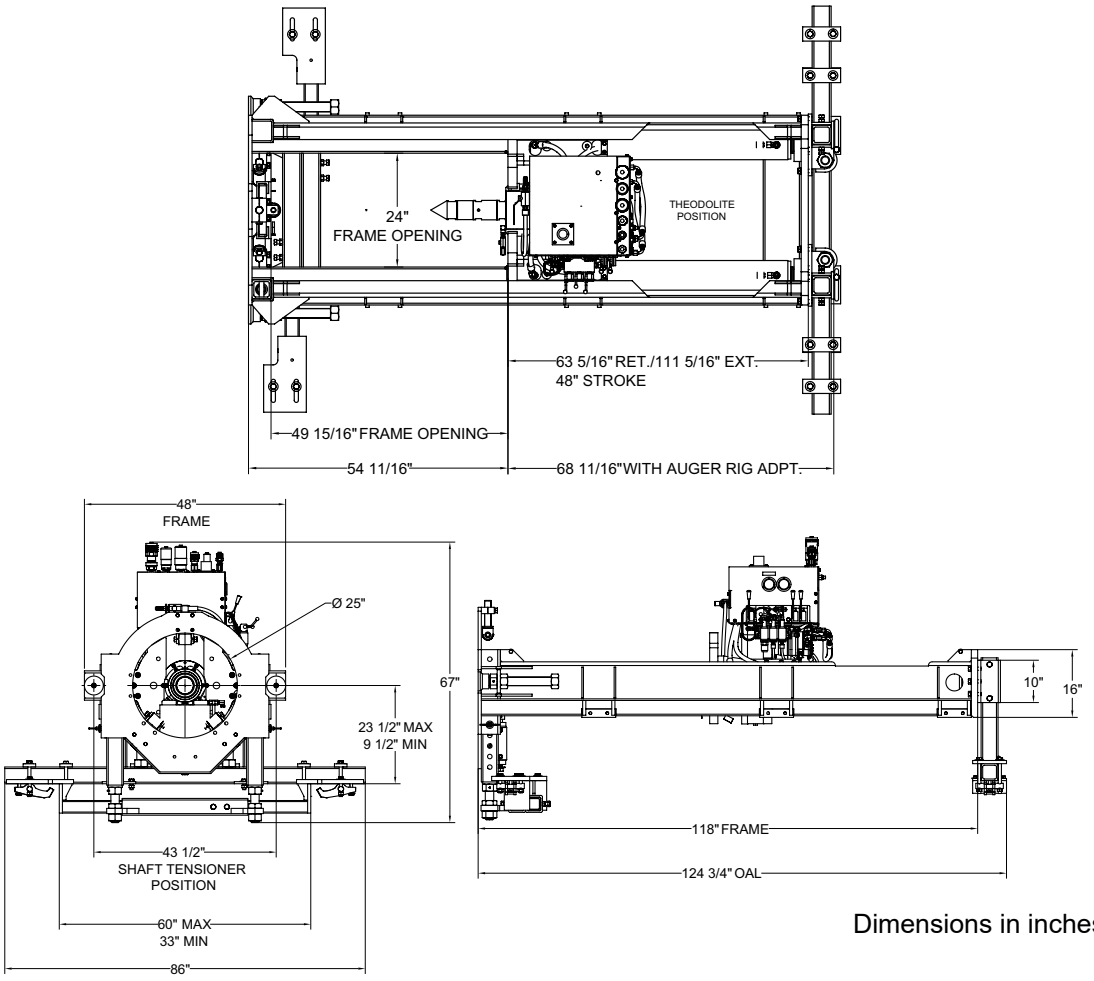
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101	E-STOP 4 PIN TO FUEL GAUGE	4 PIN E-STOP	FUEL GAUGE	BLUE / 16 AWG
102	POWER TO E-STOP	POWER	E-STOP	BLUE / 16 AWG
103	GROUND TO E-STOP	GROUND	E-STOP	WHITE / 16 AWG
104	E-STOP 4 PIN TO E-STOP BUTTON	E-STOP	ECU POWER	BLUE / 16 AWG
105	FUEL GAUGE GROUND TO SENDER	FUEL GAUGE GROUND	SENDER	BLUE / 16 AWG
106	GROUND TO LIGHTS	GROUND	LIGHTS	WHITE-BLUE / 16 AWG
107	POWER FUSE BOX TO LIGHT SWITCH	FUSE BLOCK 1	LIGHT SWITCH	RED / 16 AWG
108	POWER FUSE BOX TO COOL PUMP RELAY SWITCH	FUSE BLOCK 1	COOLING PUMP RELAY SWITCH	RED / 16 AWG
109	TRANSFER PUMP CONTROL	TRANSFER PUMP SWITCH	COOLING PUMP RELAY	RED / 16 AWG
110	POWER FUSE BOX TO GUIDING SYSTEM PLUG	FUSE BLOCK 1	GUIDANCE PLUG	BLUE / 16 AWG
111	GROUND	BATTERY GROUND	MULTIPLE	WHITE-BLUE / 16 AWG
113	POWER FUSE POWER TO RELAY	FUSE BLOCK 1	LIGHTS	BLUE / 16 AWG
114	ECU POWER RELAY	KEY	RELAY	BLUE / 16 AWG
115	GROUND FOR RELAY	GROUND	RELAY	WHITE-BLUE / 16 AWG
116	RELAY TO DANFOSS GRAY PIN #2	RELAY	DANFOSS GRAY PIN # 2	GREEN / 16 AWG
118	CAN H	CONTROLLER	CAN H	YELLOW / 16 AWG
119	CAN L	CONTROLLER	CAN L	GREEN / 16 AWG
120	5 VDC PRESS # 1 & 2	CONTROLLER	PRESSEURE SENSOR 1 & 2	RED-WHITE / 16 AWG
121	SENSOR GROUND PRESS # 1 & 2	CONTROLLER	PRESSEURE CONTROLLER 1 & 2	WHITE-BLUE / 16 AWG
122	PUMP # 1 PRESSURE	CONTROLLER	PRESSEURE SENSOR 1	VIOLET / 16 AWG
123	PUMP # 2 PRESSURE	CONTROLLER	PRESSEURE SENSOR 2	GREEN / 16 AWG
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126	DANFOSS CONTROLLER TO COOLING FAN TEMP SWITCH	CONTROLLER	COOLING FAN TEMP SWITCH	BROWN / 16 AWG
127	FUSE BLOCK TO BATTERY POWER	FUSE BLOCK POWER	BATTERY POWER	BLUE / 10 AWG
128	FUSE BLOCK TO COOLING PUMP RELAY	FUSE BLOCK POWER	COOLING PUMP RELAY	BLUE / 10 AWG
129	TRANSFER PUMP SWITCH TO RELAY	GROUND	COOLING PUMP RELAY	WHITE-BLUE / 16 AWG
130	COOLING PUMP RELAY TO COOLING PUMP MOTOR	COOLING PUMP RELAY	COOLING PUMP MOTOR	BLUE / 10 AWG
131	GROUND COOLING PUMP	COOLING PUMP	GROUND	WHITE-BLUE / 10 AWG
132	GROUND COOLING FAN TEMP SWITCH	GROUND	FAN TEMP SWITCH	BLUE / 16 AWG
133	FUEL LEVEL SIGNAL	FUEL GAUGE	FUEL LEVEL SENDING UNIT	WHITE-BLUE / 16 AWG
134	ENGINE ECU POWER	BATTERY POS	ENGINE ECU LUG	BLACK / 1 AWG
135	STARTER MOTOR POWER	BATTERY POS	STARTER MOTOR POSITIVE LUG	BLACK / 1 AWG

NOTES

Specifications

GBM 240A SINGLE STAGE FRAME



Dimensions in inches

Dimensions
- Width ..... 48 in. (1,219 mm)
- Length ..... 118 in. (2,997 mm)
- Height ..... 55 in. (1,397 mm)

Assembly Weight (without / with optional standalone base)..... 5,250 lbs. (2,381 kg) / 6,000 (2,721 kg)

Cylinder Stroke ..... 48 in. (1,219 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34.474 MPa)

Elevation (from shaft floor to drive center) ..... 24 to 32 in. (609 to 812 mm)

Pipe Diameter (Maximum)..... 24 in. (609 mm)

Operating Grade (Maximum) 10%

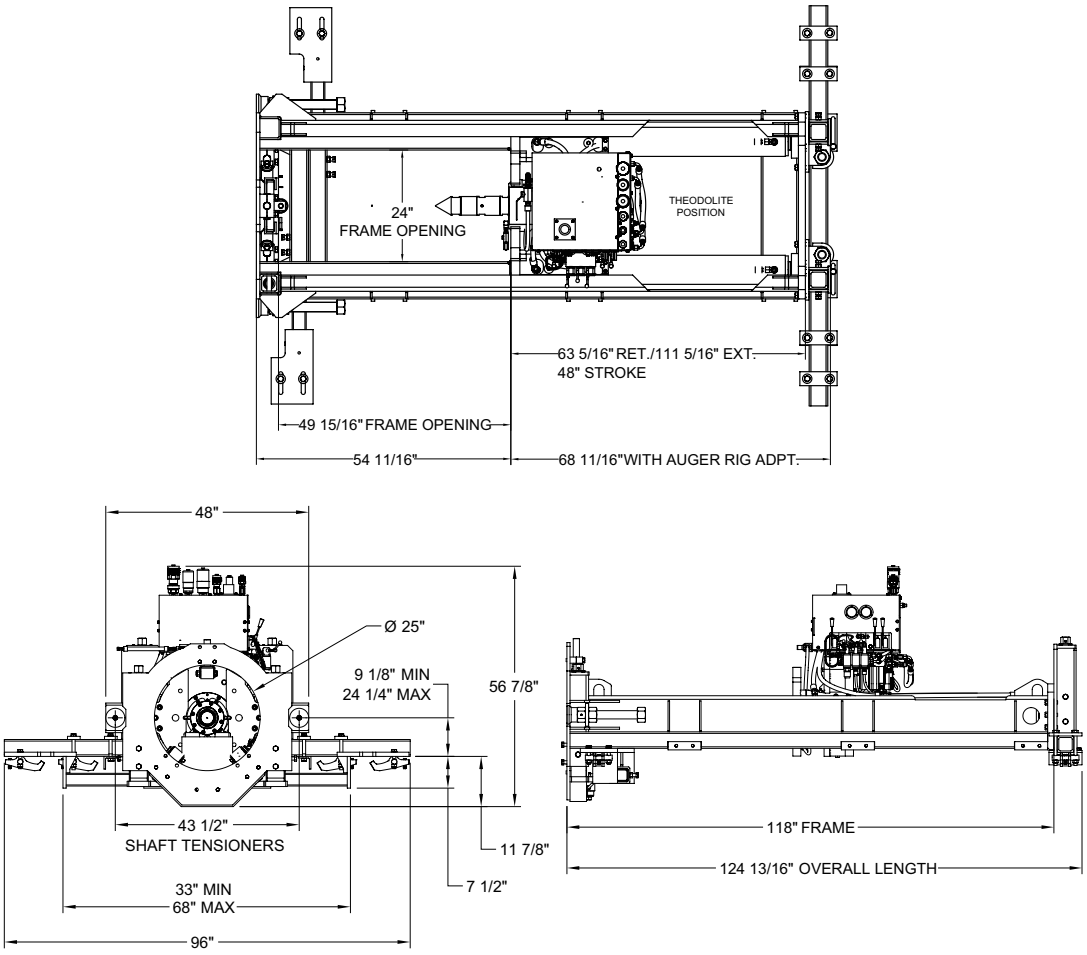
Frame Valve Capacity
- Jacking / Gearbox Rotation ..... 0 - 26 gpm @ 5,000 psi (0-98 L/min @ 34.474 MPa)

Gearbox - 2 Drive Motors
- Oil Capacity ..... 4 gal. (15 L)
- Rotational Torque Low Speed..... 10,500 ft-lbs. @ 5,000 psi (14,236 N·m @ 34.474 MPa)
- Rotation Torque High Speed ..... 7,000 ft-lbs. @ 5,000 psi (9,490 N·m @ 34.474 MPa)
- Jacking Force ..... 100 Ton @ 5,000 psi (90 mt @ 34.474 MPa)
- Pull Back Force ..... 50 Ton @ 5,000 psi (45 mt @ 34.474 MPa)
- Retract Rate ..... 25 ft/min (7.62 m/min)

Hydraulic Motor Speed ..... Two Speed
- High / Mid / Low Speed ..... 50 / 40 / 33 rpm

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

GBM 240ABM SINGLE STAGE FRAME



Dimensions in inches

Dimensions
- Width ..... 48 in. (1,219 mm)
- Length ..... 118 in. (2,997 mm)
- Height ..... 55 in. (1,397 mm)

Assembly Weight (without / with optional standalone base)..... 5,400 lbs. (2,449 kg) / 6,150 (2,789 kg)

Cylinder Stroke ..... 48 in. (1,219 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34.474 MPa)

Elevation (from shaft floor to drive center) ..... 24 to 32 in. (609 to 812 mm)

Pipe Diameter (Maximum)..... 24 in. (609 mm)

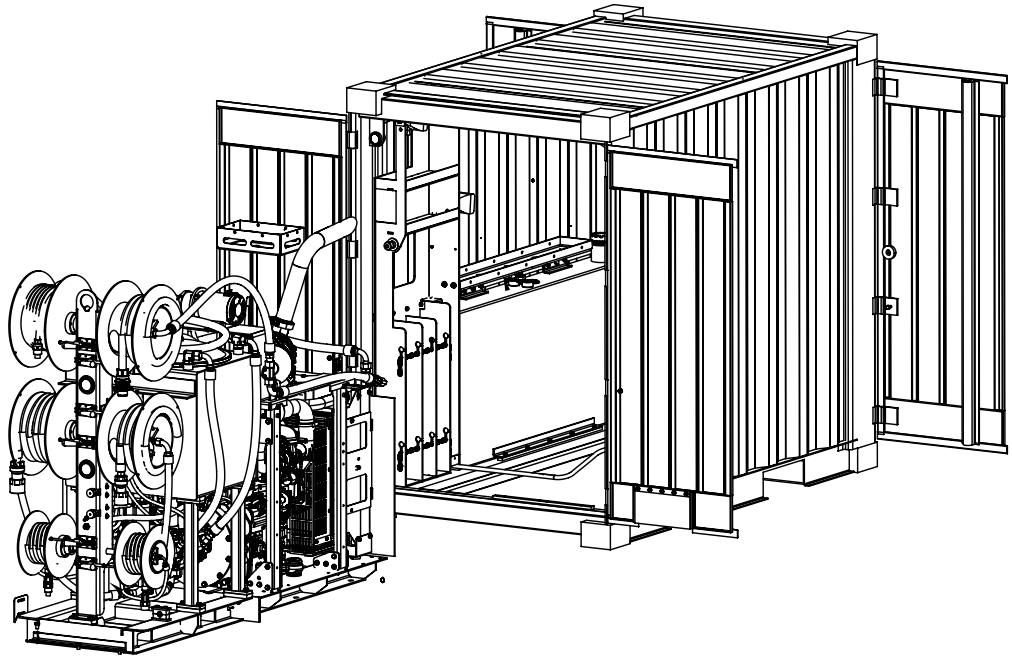
Operating Grade (Maximum) 10%

Gearbox - 2 Drive Motors
- Oil Capacity ..... 4 gal. (15 L)
- Rotational Torque Low Speed..... 10,500 ft-lbs. @ 5,000 psi (14,236 N·m @ 34.474 MPa)
- Rotation Torque High Speed ..... 7,000 ft-lbs. @ 5,000 psi (9,490 N·m @ 34.474 MPa)
- Jacking Force ..... 100 Ton @ 5,000 psi (90 mt @ 34.474 MPa)
- Pull Back Force ..... 50 Ton @ 5,000 psi (45 mt @ 34.474 MPa)
- Retract Rate ..... 25 ft/min (7.62 m/min)

Hydraulic Motor Speed ..... Two Speed
- High / Mid / Low Speed ..... 50 / 40 / 33 rpm

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

P4075D POWER PACK



Dimensions
- Height ..... 82 in. (2,083 mm)
- Width ..... 58 in. (1,473 mm)
- Length ..... 96 in. (2,438 mm)

Assembly Weight ..... 8,000 lbs. (3,629 kg)

Fluid Capacities (approximate)
- Fuel Tank - Diesel ..... 50 gal (189 L)
- Hydraulic Reservoir ..... 55 gal (208 L)
- Engine Oil .....8.5 qt. (8 L)

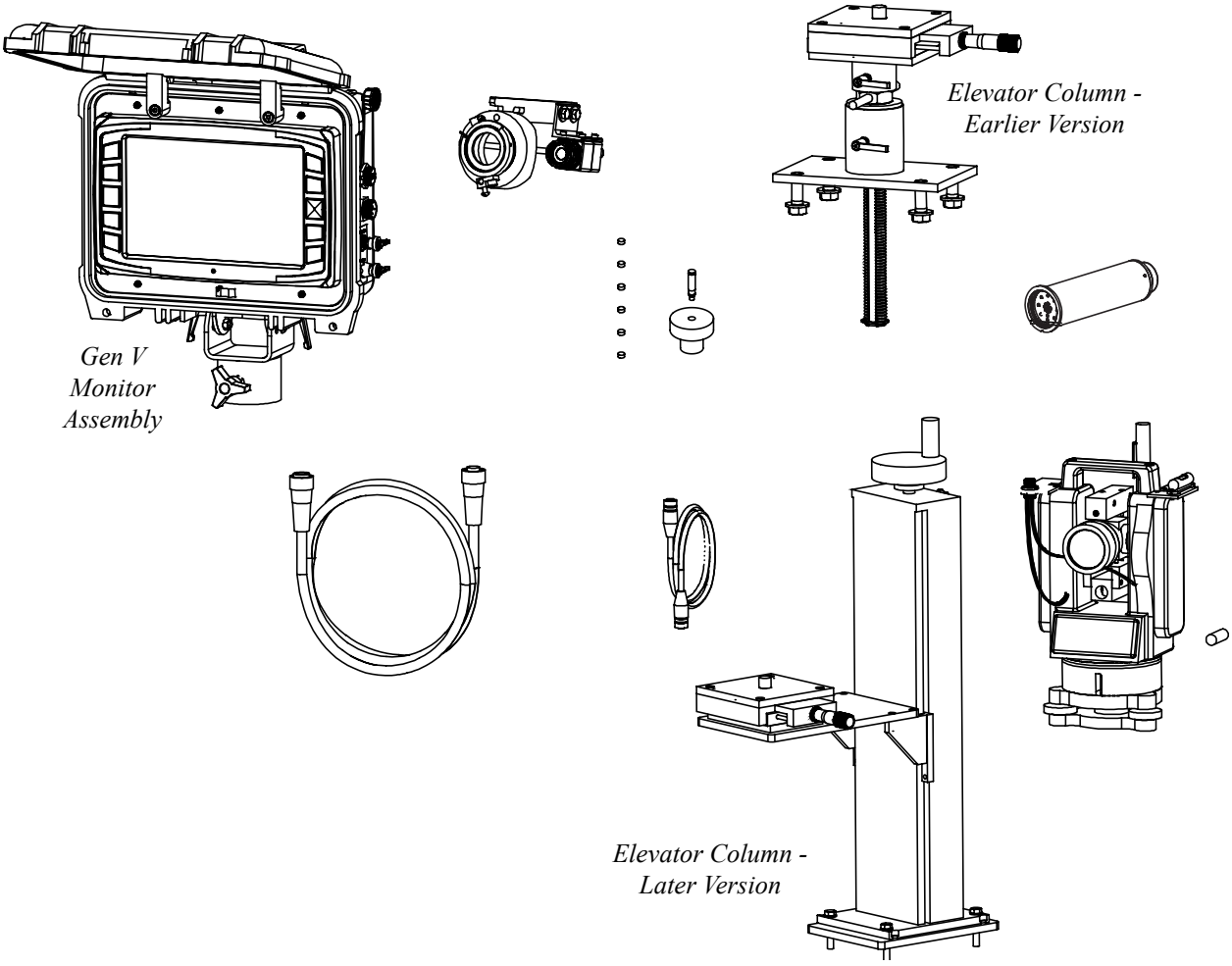
Power Unit ..... 74 HP @ 2,600 rpm
- Deutz® TD 2.9 , Tier IV, 4-Cylinder Diesel Engine ..... 74 HP (55 kW)

Pumps
- Variable Piston
  - Jacking ..... 0 to 34 gpm (0 to 129 L/min)
  - Rotation ..... 0 to 34 gpm (0 to 129 L/min)
  - Operating Pressure Maximum.....5,000 psi (34.474 MPa)

Pilot Tube Adapter ..... 4.15 in. OD x 3 in. ID Hex Core x 5 in. OD

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

GUIDANCE SYSTEM



Dimensions (width x length x height)
- Theodolite Case ..... 12 x 19.5 x 12 in. (305 x 495 x 305 mm)
- Monitor Case ..... 15 x 24 x 10 in. (381 x 610 x 254 mm)

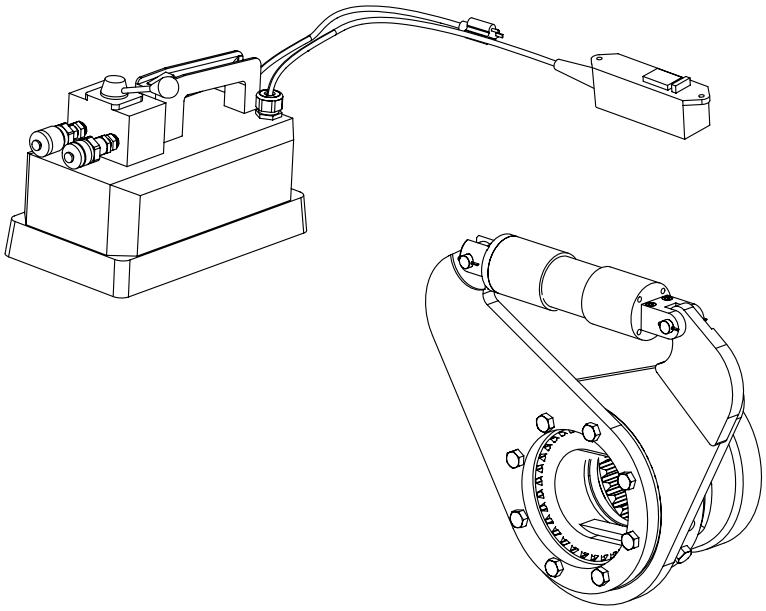
Target ..... Red LED
- Replaceable (Two 1.5 Volt D Size Alkaline Batteries)
  - Battery Life ..... Up to 14 Days

Theodolite Accuracy ..... 5 sec (1.5 mgon) DIN

Bore Sight
- Laser ..... Visible Red Diode
- Minimum Range for Sighting String Lines ..... 30 in. (762 mm)
- Operation ..... On/Off end cap
- Type ..... Visible Red Diode Laser
- Power Supply ..... (3) 392 Button Batteries
- Construction ..... Brass

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

PILOT TUBE BREAKOUT TOOL POWER PACK



Pump
- Length ..... 13 in. (330 mm)
- Width ..... 7.75 in. (197 mm)
- Height ..... 8 in. (203 mm)

- Pump Weight (with oil) ..... 20 lbs. (9 kg)
- Max. Pressure Output ..... 5,000 psi (34.474 MPa)

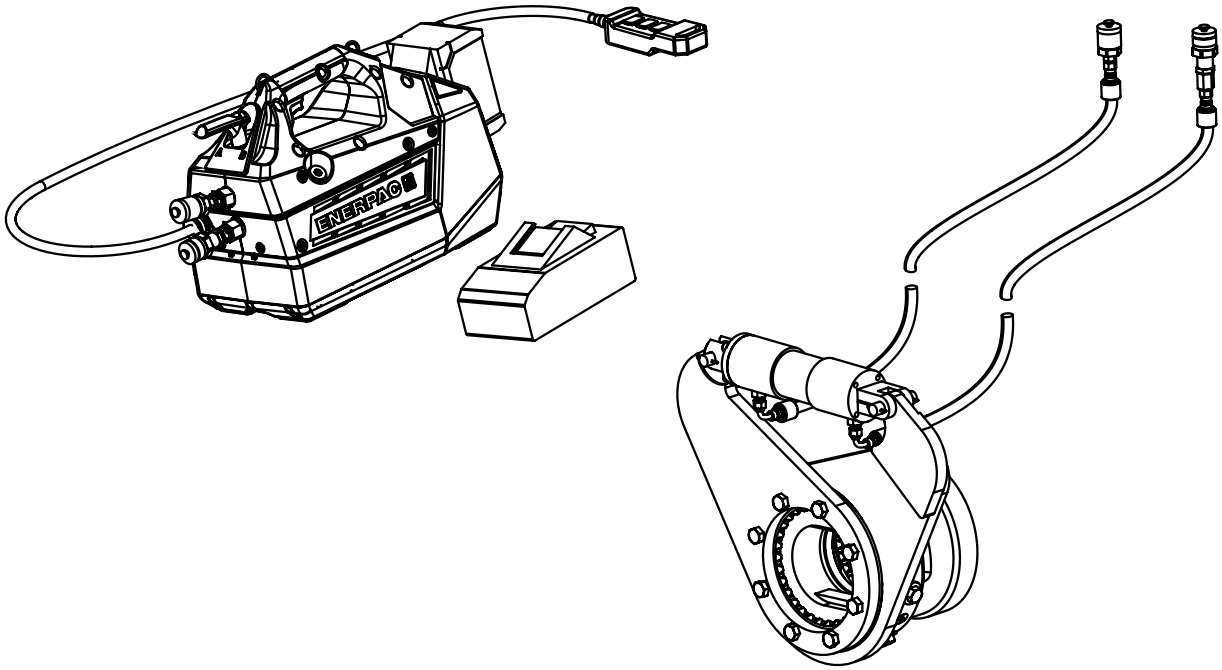
Power Unit
- Power Source
  - 60 Hz ..... 110 VAC, Two Stage, 1/4 HP, 60 Hz
  - 50 Hz ..... 230 VAC, Two Stage, 1/4 HP, 50 Hz

Hydraulic (Two Stage)
- Stage 1 ..... 120 Cu-In/Min. To 400 psi
- Stage 2 ..... 10 Cu-In/Min. To 5,000 psi

Breakout Tool
- Weight ..... 115 lbs. (52 kg)
- Breaking Torque ..... 12,193 ft-lbs. @ 5,000 PSI (16,531 N·m @ 34.474 MPa)
- Make Up Torque ..... 9,825 ft-lbs. @ 5,000 PSI (13,320 N·m @ 34.474 MPa)

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

CORDLESS, RECHARGEABLE PILOT TUBE BREAKOUT TOOL POWER PACK



Pump
- Length ..... 20 in. (508 mm)
- Width ..... 8.25 in. (210 mm)
- Height ..... 12.5 in. (317 mm)

- Pump Weight (with oil) ..... 27.5 lbs. (12.5 kg)
- Max. Pressure Output ..... 5,000 psi (34.474 MPa)

Power Unit
- Power Source
  - Battery ..... 54 VDC, Two Stage, 0.94 HP
  - rpm ..... 14,000 - 18,000
  - dBA 83

Hydraulic (Two Stage)
- Stage 1 ..... 160 Cu-In/Min.
- Stage 2 ..... 22 Cu-In/Min. To 5,000 psi

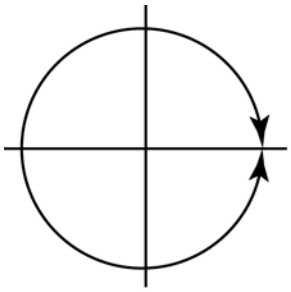
Breakout Tool
- Weight ..... 115 lbs. (52 kg)
- Breaking Torque ..... 12,193 ft-lbs. @ 5,000 PSI (16,531 N·m @ 34.474 MPa)
- Make Up Torque ..... 9,825 ft-lbs. @ 5,000 PSI (13,320 N·m @ 34.474 MPa)

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

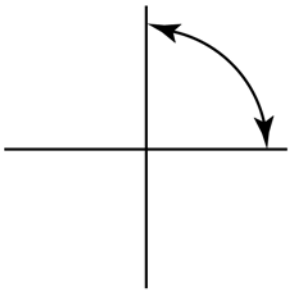
UNDERSTANDING GRADE DEGREES VERSUS GRADE PERCENT

The grade degrees and/or grade percent is provided by the project requirements. Below is a way to convert grade degrees to grade percent or vice versa. When entering grade value in degrees or percent of slope in the theodolite, the grade value can be converted from degrees to percent or percent to degrees by simply pressing the % / VA button on the guidance system theodolite.

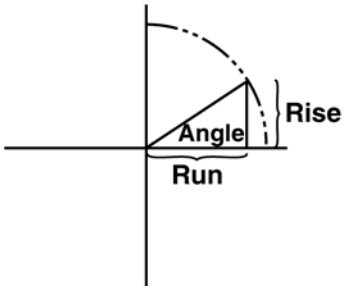
DEGREES GRADE



360 degrees in full circle



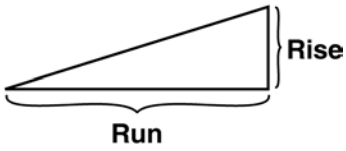
1/4 of a circle is 90 degrees



$$\text{tangent (angle)} = \frac{\text{rise}}{\text{run}}$$

$$\text{angle} = \text{arctangent} \left(\frac{\text{rise}}{\text{run}} \right)$$

PERCENT GRADE



$$\text{percent grade} = \frac{\text{rise}}{\text{run}} \times 100$$

NOTE: Rise and run MUST be in same units, for example, both in feet or both in inches.

Given Percent Grade, Calculate Degrees

Degrees = arctangent (percent grade ÷ 100)

Given Degrees, Calculate Percent Grade

Percent Grade = 100 x tangent (Degrees)

45° = 100% Grade

$$\text{Degrees decimal} = \text{degrees} + \frac{\text{minutes}}{60} + \frac{\text{seconds}}{60 \times 60}$$

TORQUE CHART

Use these torque values as a guideline when tightening hardware unless otherwise specified in this manual. Torque ratings used with permission from Fastenal® fasteners.

⚠ CAUTION All material included in this chart is advisory only, and its use by anyone is voluntary. In developing this information, Fastenal® has made a determined effort to present its contents accurately. Extreme caution should be used when using a formula for torque/tension relationships. Torque is only an indirect indication of tension. Under/over tightening of fasteners can result in costly equipment failure or personal injury.

Imperial/English
Course UNC Thread – Lubricated*
Grade 8 Fasteners**

		Torque	
Bolt Size In. ø	Threads Per Inch	ft-lbs	N·m
1/4	20	9	12
5/16	18	18	24
3/8	16	33	44
7/16	14	52	70
1/2	13	80	108
9/16	12	115	155
5/8	11	159	215
3/4	10	282	382
7/8	9	455	616
1	8	681	923
1 1/8	7	966	1309
1 1/4	7	1363	1847
1 3/8	6	1786	2421
1 1/2	6	2371	3214

*K=0.15 Lubricated condition
** Minimal tensile and proof strength per SAE J429 specifications

Imperial/English
Course UNC Thread – Lubricated*
ASTM A574 Fasteners**

		Torque	
SHCS In. ø	Threads Per Inch	ft-lbs	N·m
1/4	20	10	13
5/16	18	22	29
3/8	16	38	51
7/16	14	61	82
1/2	13	93	126
9/16	12	130	176
5/8	11	179	242
3/4	10	317	429
7/8	9	511	692
1	8	767	1039
1 1/4	7	1533	2078
1 1/2	6	2668	3617

*K=0.15 Lubricated condition
** Minimal tensile and proof strength per ASTM A574 specifications

Metric
Course UNC Thread – Lubricated*
Class 10.9 Fasteners**

		Torque	
Bolt Size mm ø	Threads Per MM	N·m	ft-lbs
4	0.7	3	2
5	0.8	6	4
6	1	11	8
7	1	18	13
8	1.25	27	19
10	1.5	54	39
12	1.75	94	69
14	2	151	111
16	2	234	172
18	2.5	323	238
20	2.5	457	337
22	2.5	623	459
24	3	790	582
27	3	1158	854
30	3.5	1570	1157
33	3.5	2137	1576
36	4	2745	2024

*K=0.15 Lubricated condition
** Minimal tensile and proof strength per ISO 898-1 specifications

Metric
Course UNC Thread – Lubricated*
Class 12.9 Fasteners**

		Torque	
SHCS mm ø	Threads Per MM	N·m	ft-lbs
4	0.7	3	2
5	0.8	7	5
6	1	13	9
7	1	22	16
8	1.25	32	23
10	1.5	63	46
12	1.75	110	81
14	2	176	129
16	2	274	202
18	2.5	378	278
20	2.5	534	393
22	2.5	728	536
24	3	923	680
27	3	1354	998
30	3.5	1835	1353
33	3.5	2498	1842
36	4	3208	2366

*K=0.15 Lubricated condition
** Minimal tensile and proof strength per ISO 898-1 specifications

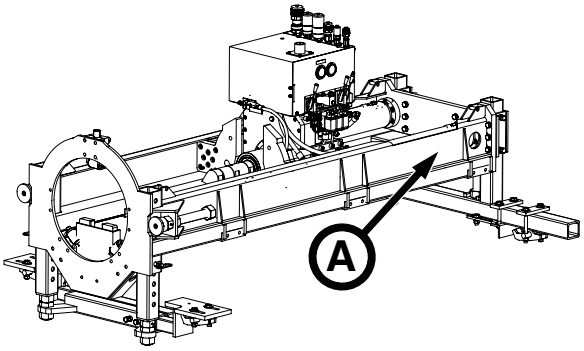
Identification Numbers

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

GBM 240A/ABM SINGLE STAGE FRAME (A)

Model Number _____

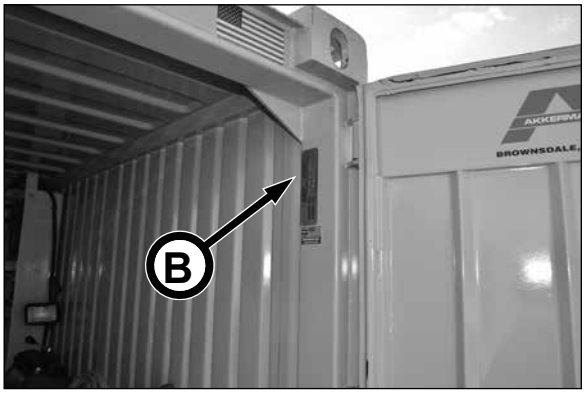
Serial Number _____

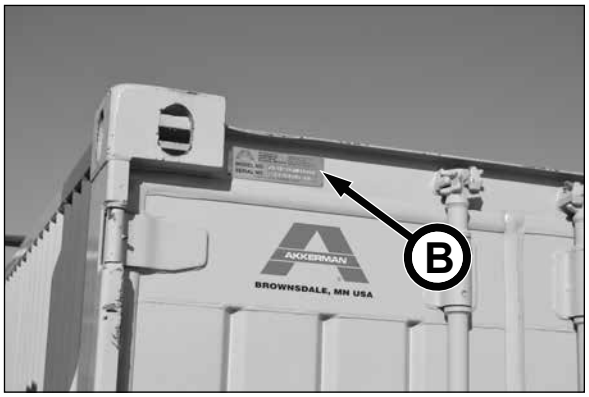


P4075D Power Pack (B)

Model Number _____

Serial Number _____

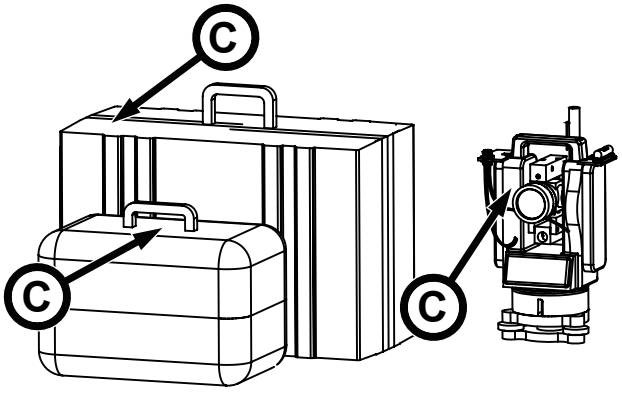




Guidance System (C)

Model Number _____

Serial Number _____



NOTES

Safety Data Sheets

The Federal Occupational, Safety, and Health Administration (OSHA) Standard 29 CFR 1910.1200, require that specific safety data sheets (SDS) 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, SDS which apply to its product line. Simply contact Akkerman Aftermarket Support for a copy.

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

NOTES

Warranty

Akkerman warrants that all equipment manufactured by it be free from defects due to workmanship or material when normally used and serviced for a period of 90 days from the date of shipment by Akkerman. Normal wear and tear to the equipment, including, but not limited to, wear on the cutter face tooling, hydraulic filters, augers, casings, slurry line and seals is not covered by this warranty. Akkerman does not warrant that the equipment meets the requirements of any particular safety code or rule governing equipment classification. If the Customer has questions about local safety codes, rules or ordinances, authorities local to the project should be consulted.

In order to be considered as a potential warranty claim, the component in question must be returned to Akkerman (freight prepaid) for factory inspection and analysis, and determination of warranty applicability. No warranty is provided for electronics or electrical components of any kind. The validity of all warranty claims are subject to the discretion and determination of the Akkerman Aftermarket Support Department. All such determinations are final.

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Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.