



# OPERATOR'S MANUAL

Guided Boring Machine

**GBM S/N: 240A (FA40027F), 308A (FA40032F),  
& 339A (FA43500F),**

**Power Pack SN: P100Q (FA42440F) & P150Q (FA40035F)**

**Powered Cutter Head SN: PCH20 (FA43100F),  
PCH22.5 (FA42850F), & PCH28.5 (FA43000F)**

Publication No. 050043A

Rev. No. 070209 R100122

© Akkerman Inc. 2007, 2010  
All Rights Reserved

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

SERVICE • RELIABILITY • INNOVATION



# Introduction

This operator's manual contains important safety, operation, and maintenance information for your Akkerman Guided Boring Machine (GBM), P100Q or P150Q Power Pack, and Powered Cutter Head. You must read and understand this manual before you operate and maintain this equipment. Keep this manual with your Guided Boring Machine at all times. Additional copies of this manual may be purchased from the Akkerman Product Support Department, or downloaded from the Akkerman web site at [www.akkerman.com](http://www.akkerman.com).

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

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

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

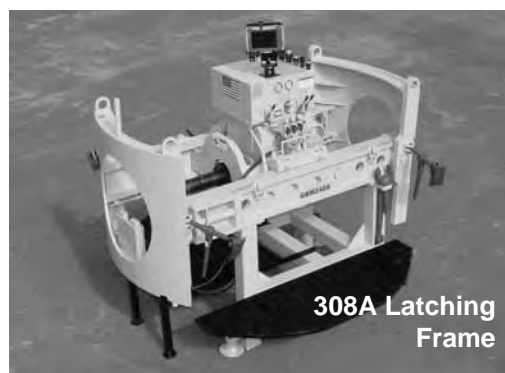
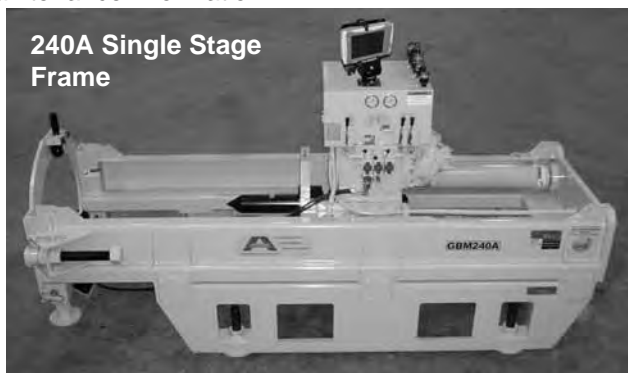
**▲ DANGER** Indicates an extremely hazardous situation which, if not avoided, WILL result in death or serious injury.

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

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

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

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



## Guided Boring Machine

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

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

# Contents

<b>Safety</b> .....	<b>1</b>	<b>Controls &amp; Instruments (continued)</b>	
Be Alert For Safety Information .....	1-1	Hydraulic Pressure Gauges .....	4-3
Read Operator's Manual .....	1-1	Theodolite & Camera .....	4-4
Wear Protective Clothing .....	1-1	Powered Cutter Head	
Lockout Power Before Servicing .....	1-2	Rotation Control .....	4-4
Maintain Battery Safely .....	1-2	Auger Control .....	4-4
Hydraulic Oil/Fluids Under Pressure .....	1-2	Tablet PC Monitor .....	4-5
Unauthorized Welding .....	1-3	On & Off Control .....	4-5
Beware of Suspended Loads .....	1-3	Gain-Exposure-Zoom-Direction-	
Keep Personnel Away From Moving Parts ....	1-3	Pipe Count-Status Control .....	4-5
Using Plumb Bob .....	1-3	Screen Brightness Control .....	4-6
Handling Auger Casings .....	1-4	Using Digitizer Pen .....	4-6
Regularly Clean/Inspect Equipment .....	1-4	Accessing The Task Bar/Start Button .....	4-6
Practice Safe Maintenance .....	1-4	Entering Data .....	4-7
Avoid Pinch Points .....	1-5	Using Theodolite Remote Focus .....	4-7
Test Shaft & Tunnel Ventilation .....	1-5	P100Q Power Pack .....	4-8
Refueling .....	1-5	Control Pendant .....	4-10
Fire Prevention .....	1-6	P150Q Power Pack .....	4-12
High Pressure Hydraulics .....	1-6	Control Pendant .....	4-14
Keep Job Site Clean & Organized .....	1-6		
Slippery When Wet .....	1-6	<b>Pre-Start Inspection</b> .....	<b>5</b>
Keep Away From Auger .....	1-7		
Cooling System .....	1-7	<b>Operation</b> .....	<b>6</b>
No Smoking In Tunnel .....	1-7	<b>How To Use This Section</b> .....	6-0-1
Avoid Laser Light Exposure .....	1-8	<b>Operation Guidelines &amp; Installation Options</b>	6-5-1
Recycle Waste .....	1-8	Operating Guidelines .....	6-5-1
		GBM Installation Options .....	6-5-2
		I. Three Step Method (Typical) .....	6-5-2
		II. Three Step Method (With PCH) .....	6-5-3
		III. Auger Boring Machine Method .....	6-5-4
		<b>Shaft Set Up</b> .....	<b>6-10-1</b>
		Setting Up Launch & Reception Shafts .	6-10-1
		<b>GBM Frame Set Up In Shaft</b> .....	<b>6-15-1</b>
		Setting Up GBM In Launch Shaft .....	6-15-1
		Setting Up GBM With Auger	
		Boring Machine .....	6-15-3
		Auger Boring Data Sheet .....	6-15-5
		Quick Coupler Installation .....	6-15-6
		<b>Power Pack Operation</b> .....	<b>6-20-1</b>
		Starting The Engine	
		P100Q .....	6-20-1
		P150Q .....	6-20-3
		Stopping The Engine .....	6-20-5
		P100Q .....	6-20-5
		P150Q .....	6-20-6
		Emergency Stop (E-Stop) .....	6-20-6
		Adjusting Thrust Pressure .....	6-20-7
		<b>Guidance System Set Up</b> .....	<b>6-25-1</b>
		Theodolite Zero Point Calibration .....	6-25-1
		Assembling Guidance System	
		Latching Frame .....	6-25-6
		Single Stage Frame .....	6-25-13
		Preliminary Theodolite Setup	
		Line/Grade .....	6-25-18
		Tablet PC Start Up & Operation .....	6-25-26
		On & Off Control .....	6-25-27
		Gain-Exposure-Zoom-Direction-	
		Pipe Count-Status Control .....	6-25-27
		Using Digitizer Pen .....	6-25-28
		Accessing The Task Bar/Start Button.	6-25-28
		Entering Data .....	6-25-28
			<i>(continued on next page)</i>

**Operation (continued)**

Tablet PC Start Up & Operation (continued)  
 Using Theodolite Remote Focus ..... 6-25-29  
 Cleaning Tablet PC Screen ..... 6-25-30  
 Docking Station - Removal/Replace 6-25-30  
 Connecting New Camera To  
 Computer ..... 6-25-32  
 Checking Guidance System  
 Camera Connections ..... 6-25-33  
 Final Theodolite Set Up ..... 6-25-34  
**Installing Pilot Tubes ..... 6-30-1**  
 Installing Steering Head Adapter To  
 Steering Head ..... 6-30-1  
 Installing Pilot Tubes ..... 6-30-6  
 Log Of Progress ..... 6-30-15  
**Installing Upsizing Tool ..... 6-35-1**  
 Auger Bore Method: Weld-On Reaming  
 Head Installation. .... 6-35-1  
 Auger Bore Method: Open Face Cutter Head  
 Installation ..... 6-35-13  
 Three Step Method: Installing Auger  
 Casing With Reaming Head ..... 6-35-25  
 Three Step Method: Installing Auger  
 Casing With Open Face Cutter Head 6-35-43  
 Upsizing Tool Lubrication From  
 Reception Shaft ..... 6-35-63  
 Installing Safety Chain Assembly/Casing  
 Auger Pin To Auger & Casing ..... 6-35-65  
 Using The Powered Cutter Head ..... 6-35-67  
 Use Jetting & Pipe Lubrication With  
 Powered Cutter Head ..... 6-35-67  
 Soil Stabilization (Chemical Delivery).. 6-35-69  
 Installing Powered Cutter Head  
 Front Section ..... 6-35-70  
 Rear Section ..... 6-35-81  
 Removing Powered Cutter Head  
 From Reception Shaft ..... 6-35-90  
**Installing Product Pipe ..... 6-40-1**  
 Three Step Method: Installing Product  
 Pipe..... 6-40-1  
**Miscellaneous ..... 6-45-1**  
 Pilot Tube Pull Back Thru Launch Shaft.. 6-45-1

**Transporting ..... 7**  
 Transporting Guidelines ..... 7-1

**Fuels & Lubricants ..... 8**  
 Fuel Specifications ..... 8-1  
 Engine Oil - P100Q ..... 8-1  
 Engine Oil - P150Q ..... 8-2  
 Power Pack Hyd. Oil Reservoir Lubricant .... 8-2  
 Gear Box Lubricant ..... 8-3  
 Grease ..... 8-3  
 Breakout Tool Power Unit Lubricant ..... 8-3  
 Engine Coolant ..... 8-4  
 PCH Bearing Cavity & Gear Box Lubricant ... 8-4  
 Storing Lubricants ..... 8-4

**Periodic Maintenance..... 9**  
 Lubrication & Maintenance Intervals ..... 9-1  
 Lockout Power Before Servicing ..... 9-1  
 Avoid Pinch Points ..... 9-2  
 Hydraulic Oil/Fluids Under Pressure ..... 9-2

**Periodic Maintenance (continued)**

Maintenance Charts - GBM - Power Pack .... 9-3  
 Prior To Each Job Launch ..... 9-3  
 Daily or Every 10 Hours ..... 9-4  
 Weekly or Every 50 Hours ..... 9-5  
 Monthly or Every 250 Hours ..... 9-6  
 Every 500 Hours of Operation ..... 9-7  
 Every 1000 Hours of Operation ..... 9-8  
 Every 2000 Hours of Operation ..... 9-9  
 As Required ..... 9-10  
 After Each Drive ..... 9-11  
 Maintenance Procedures ..... 9-12  
 Prior To Each Job Launch ..... 9-12  
 Daily or Every 10 Hours ..... 9-16  
 Weekly or Every 50 Hours ..... 9-25  
 Monthly or Every 250 Hours ..... 9-27  
 Every 500 Hours of Operation ..... 9-32  
 Every 1000 Hours of Operation ..... 9-41  
 Every 2000 Hours of Operation ..... 9-42  
 As Required ..... 9-45  
 After Each Drive ..... 9-46  
 Maintenance Charts - Powered Cutter Head 9-47  
 Prior To Each Job Launch ..... 9-47  
 After Each Drive ..... 9-48  
 Maintenance Procedures ..... 9-49  
 Prior To Each Job Launch ..... 9-49  
 After Each Drive ..... 9-53

**Storage ..... 10**  
 Preparing For Storage ..... 10-1  
 Removing From Storage ..... 10-2

**Troubleshooting ..... 11**  
 Guided Boring Machine ..... 11-1  
 Power Pack Engine ..... 11-2  
 Powered Cutter Head (PCH) ..... 11-5  
 Tablet PC ..... 11-6  
 Hydraulic Schematic, 240A ..... 11-13  
 Hydraulic Schematic, 308A W/out PCH Cntls... 11-14  
 Hydraulic Schematic, 308A/339A W/PCH... 11-15  
 Hydraulic Schematic, P100Q ..... 11-16  
 Hydraulic Schematic, P150Q ..... 11-17  
 Electrical Schematic, P100Q ..... 11-18  
 Electrical Schematic, P150Q ..... 11-19

**Specifications ..... 12**  
 Single Stage Frame 240A ..... 12-1  
 Latching Frame 308A ..... 12-2  
 Latching Frame 339A ..... 12-3  
 Power Pack P100Q ..... 12-4  
 Power Pack P150Q ..... 12-5  
 Guidance System ..... 12-6  
 Breakout Tool Power Unit ..... 12-7  
 Powered Cutter Head ..... 12-8  
 Torque Chart ..... 12-9  
 Understanding Grade Degrees Versus  
 Grade Percent..... 12-10

**Identification Numbers ..... 13**

**Material Safety Data Sheets ..... 14**

**Warranty ..... 15**

**Index ..... 16**

---

**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!**

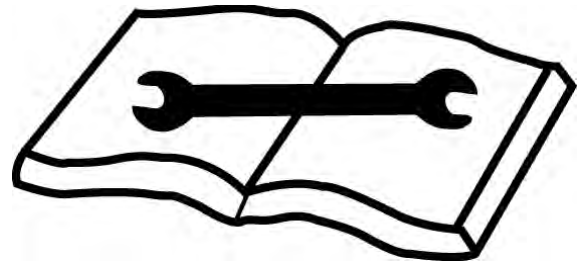
---

## 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.



---

## LOCKOUT POWER BEFORE SERVICING

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

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



---

## MAINTAIN BATTERY SAFELY

**⚠ WARNING** Batteries produce explosive gases.

Wear eye protection and protective clothing during battery service.

Keep sparks, flames, and cigarettes away from batteries.

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

Charge a battery only in a well-ventilated area.

Never charge a frozen battery.



---

## HYDRAULIC OIL/FLUIDS UNDER PRESSURE

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

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

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

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

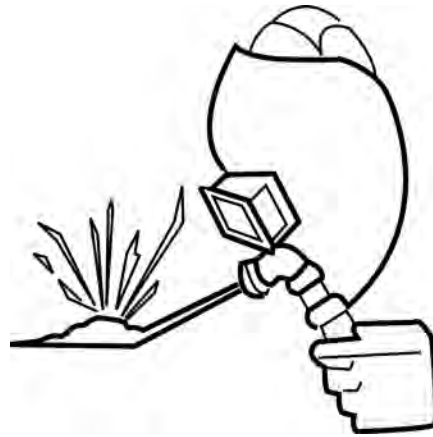


---

## UNAUTHORIZED WELDING

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

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



---

## BEWARE OF SUSPENDED LOADS

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

If a hydraulic hose 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 could result in serious personal injury or death.



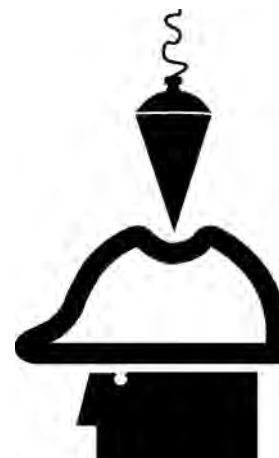
---

## USING PLUMB BOB

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

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

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



---

## HANDLING AUGER CASINGS

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

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

Do not stand or walk under a load.

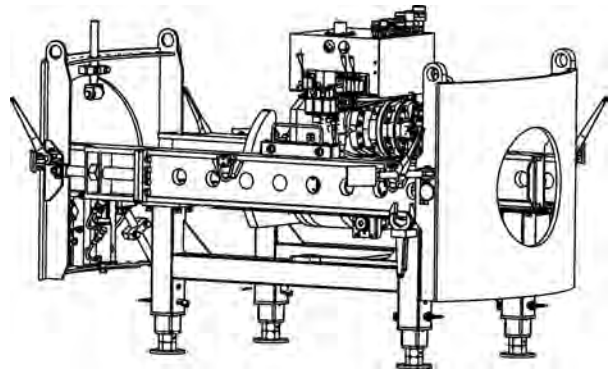


---

## REGULARLY CLEAN AND INSPECT EQUIPMENT

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

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



---

## PRACTICE SAFE MAINTENANCE

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

LOCKOUT power before performing any maintenance.

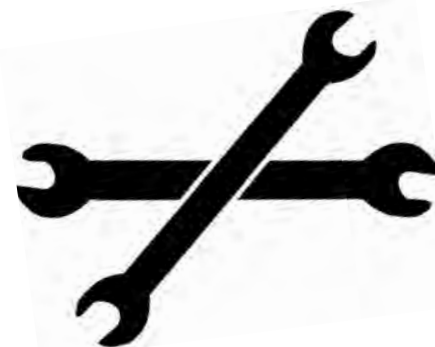
Shut down GBM before making repairs, adjustments, or removing obstructions.

Only trained and qualified personnel should perform maintenance or repairs.

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

Do not service the machine while it is in motion.

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



---

## AVOID PINCH POINTS

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

Keep hands away from moving parts.

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

Handle parts carefully to avoid crushing and pinch point hazards.



---

## TEST SHAFT & TUNNEL VENTILATION

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

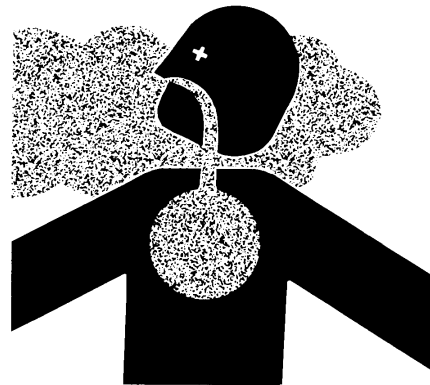
Use an approved air analyzer to detect hazardous gases and oxygen content.

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.

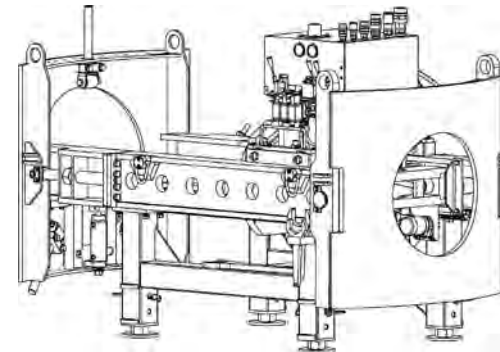


---

## HIGH PRESSURE HYDRAULICS

**⚠ WARNING** The GBM contains high pressure hydraulics.

Keep all guards in place.



---

## KEEP JOB SITE CLEAN AND ORGANIZED

**⚠ WARNING** Tripping can cause serious personal injury.

Be sure to keep job site clean and organized.



---

## SLIPPERY WHEN WET

**⚠ WARNING** Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

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

Remove any buildup of grease, oil, or debris.



---

## KEEP AWAY FROM AUGER

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

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

Do not operate without covers and guards in place.

Lockout power before servicing.



---

## COOLING SYSTEM

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



---

## NO SMOKING IN TUNNEL

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

Do not smoke in tunnel.



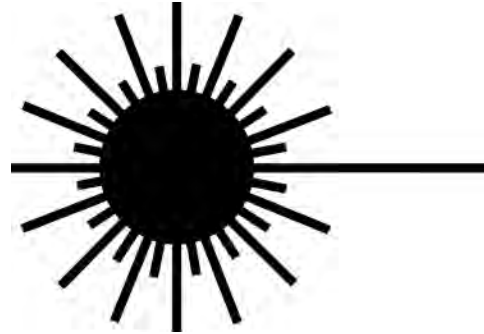
---

## AVOID LASER LIGHT EXPOSURE

**⚠ DANGER** Staring into laser light will cause severe injury.

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

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

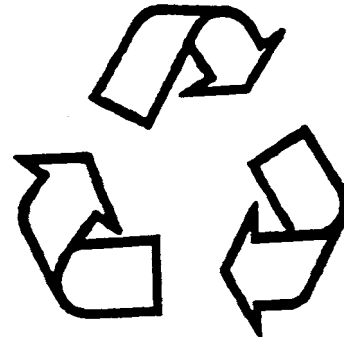


---

## RECYCLE WASTE

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

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



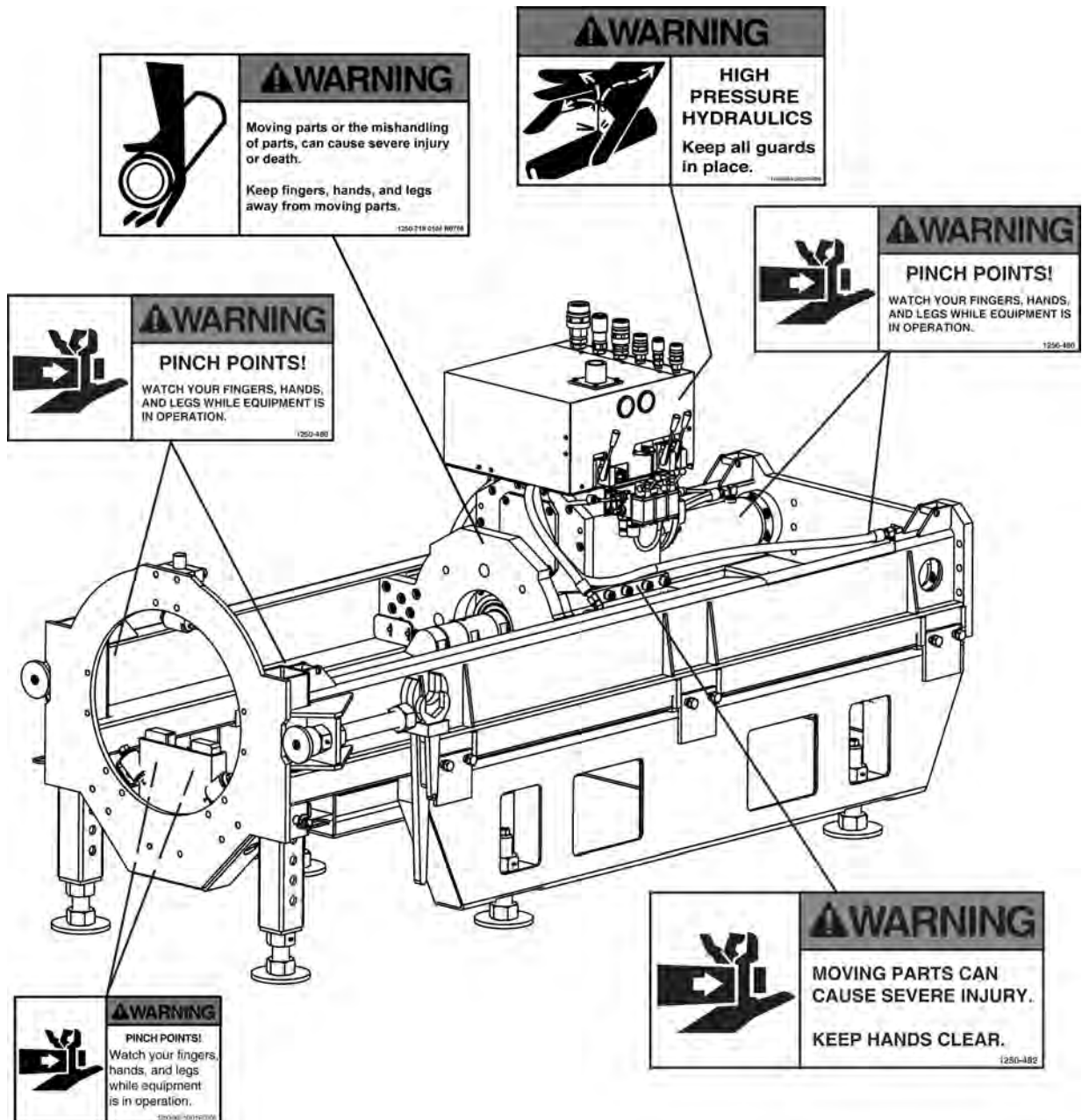
# Safety Decals

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

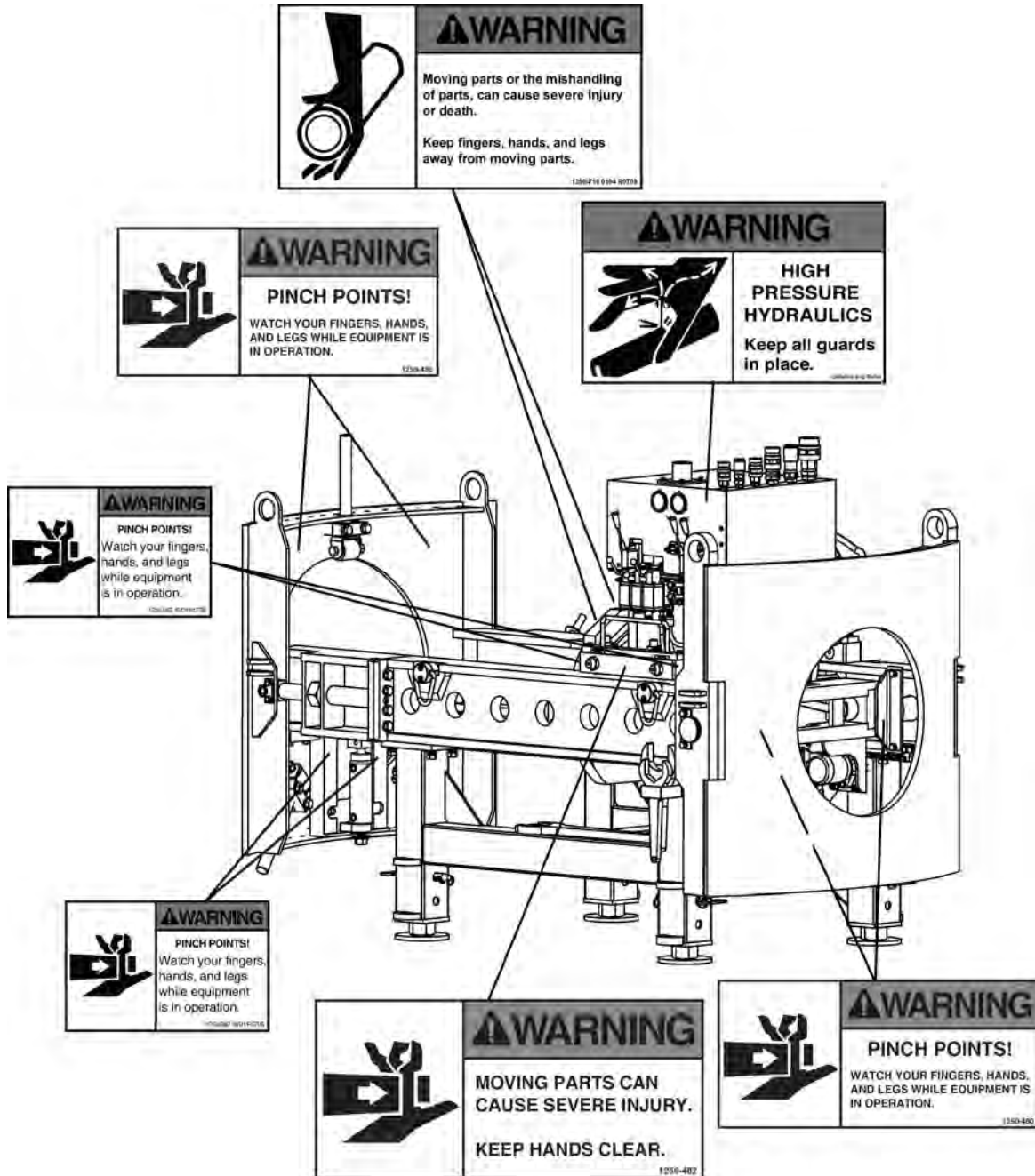
Serious injury or property damage can occur if safety instructions are not followed. Contact your Akkerman Product Support representative for free replacement safety decals.

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

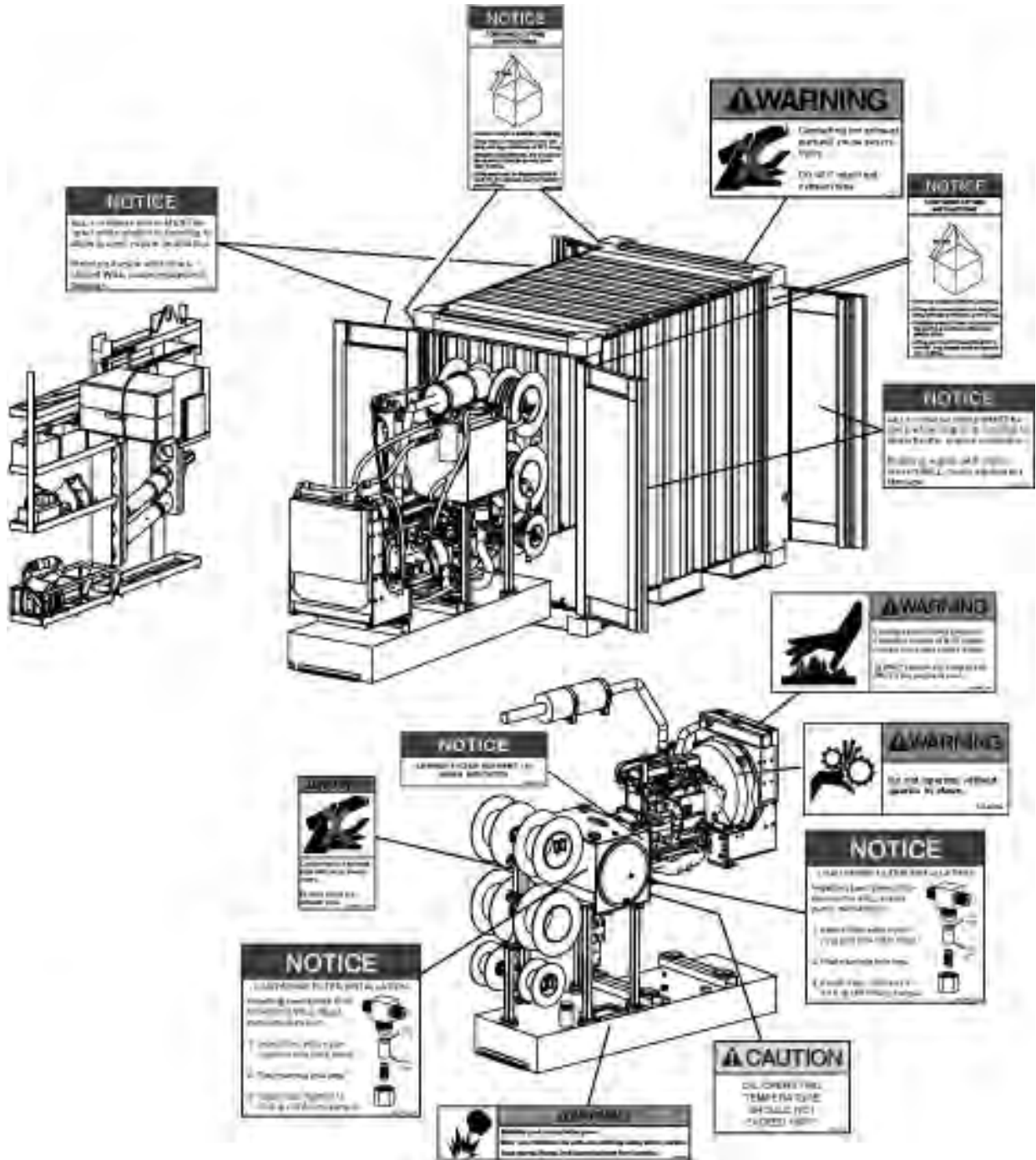
## GBM - SINGLE STAGE FRAME 240A



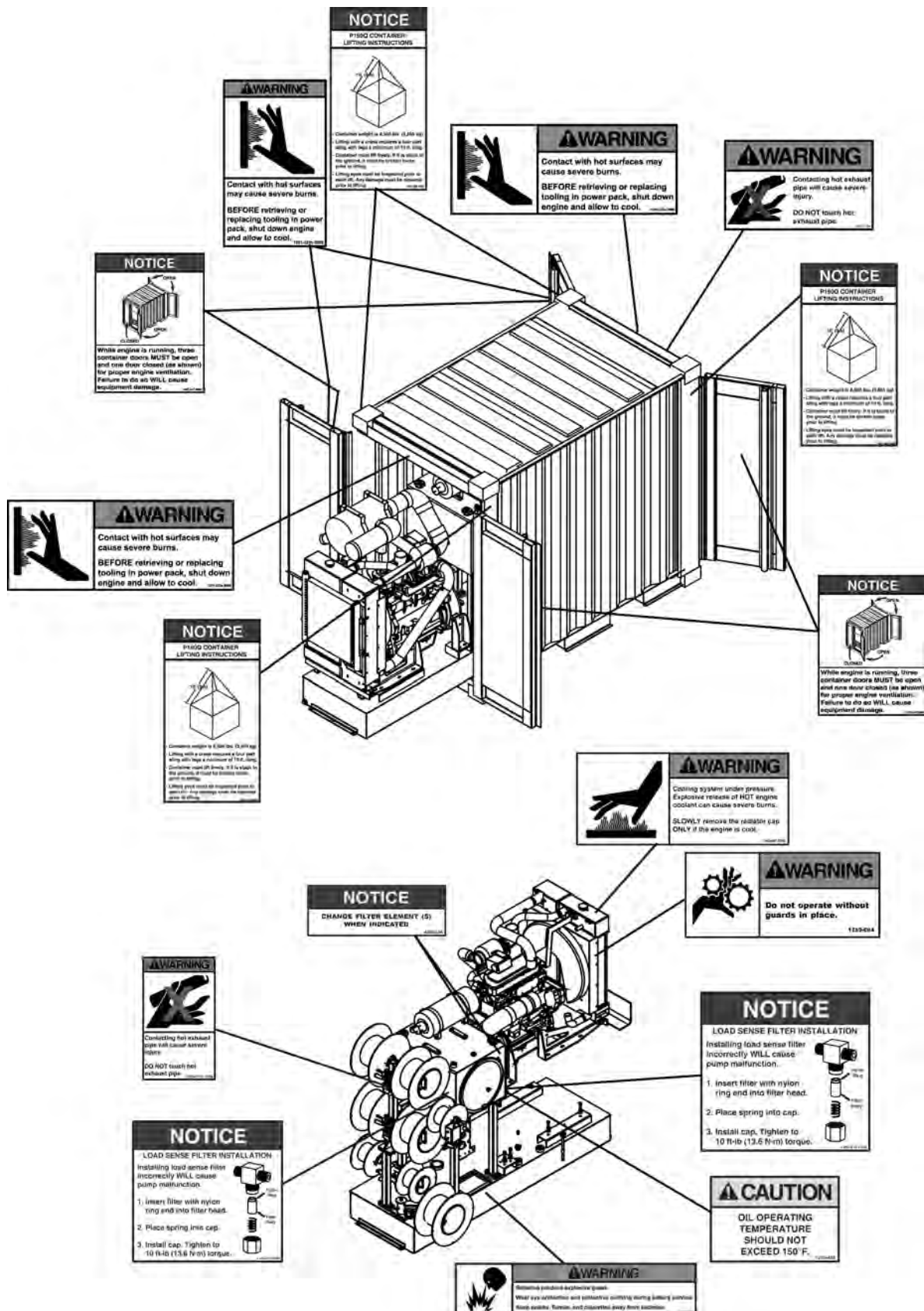
# GBM - LATCHING FRAME 308A / 339A



**GBM - POWER PACK P100Q**

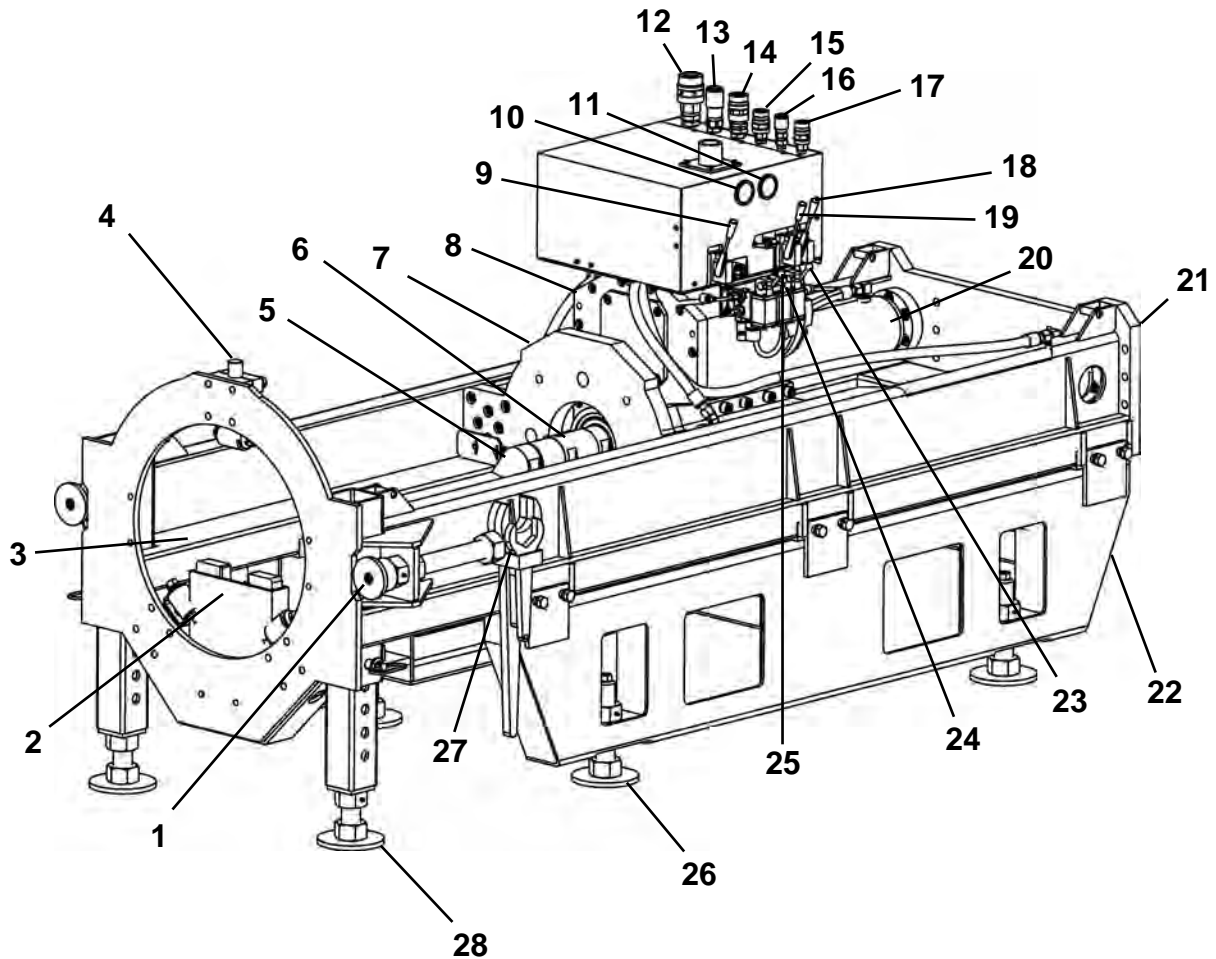


# GBM - POWER PACK P150Q



# Terminology

## GBM SINGLE STAGE FRAME 240A

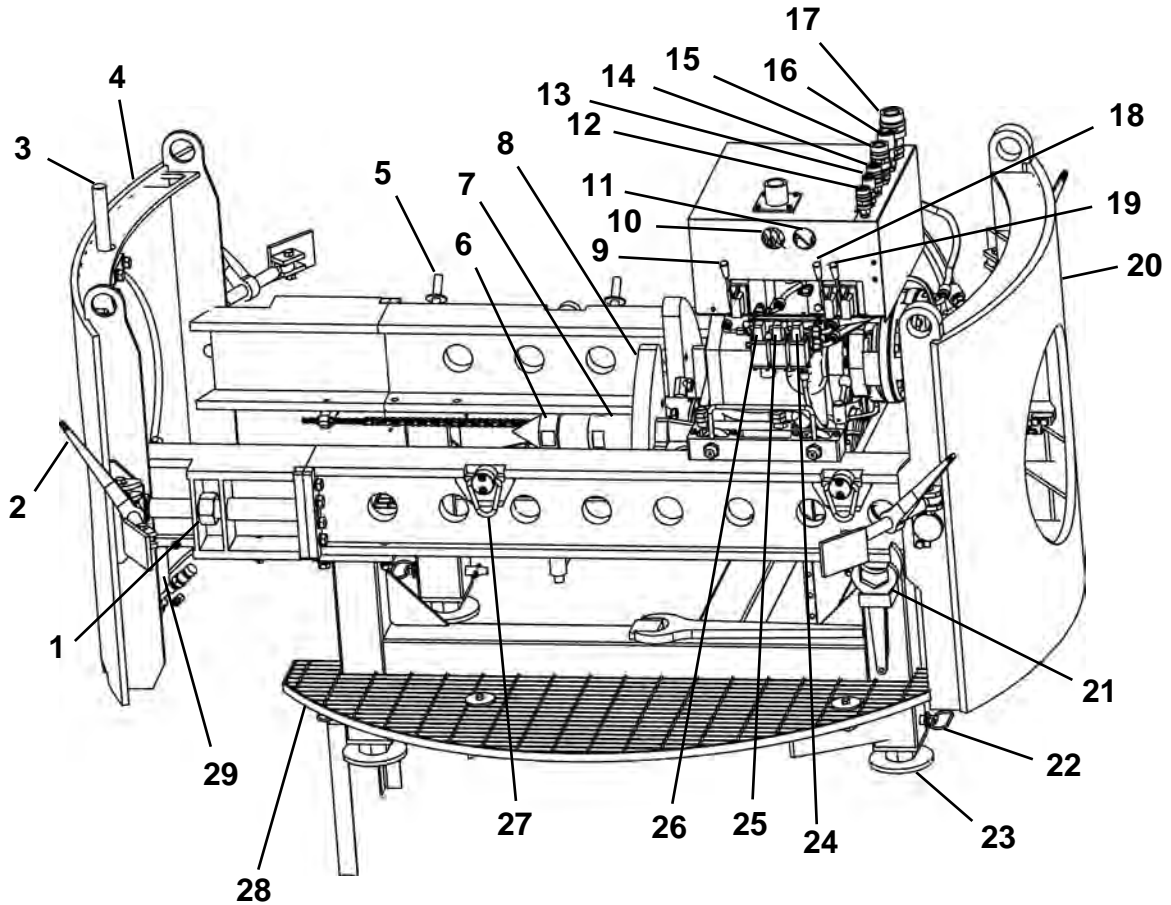


1. Shaft Tensioner
2. Hydraulic Make Up Tool
3. Drilling Guide
4. Roller Bracket Assembly
5. Alignment Guide Adapter
6. Drive Swivel
7. Thrust Plate
8. Thrust Frame Assembly  
(includes Gear Box)
9. Thrust Cylinder Control

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
19. Drive Rotation Control

20. Thrust Cylinders
21. Drilling Frame
22. Lower Base Frame Assembly
23. Auxiliary
24. Drive Speed Selector
25. Make Up Tool
26. Leveling Assembly
27. Wrench Set
28. Stabilizer Leg

## GBM LATCHING FRAME 308A (SN FA40032F-20\* & BEFORE)

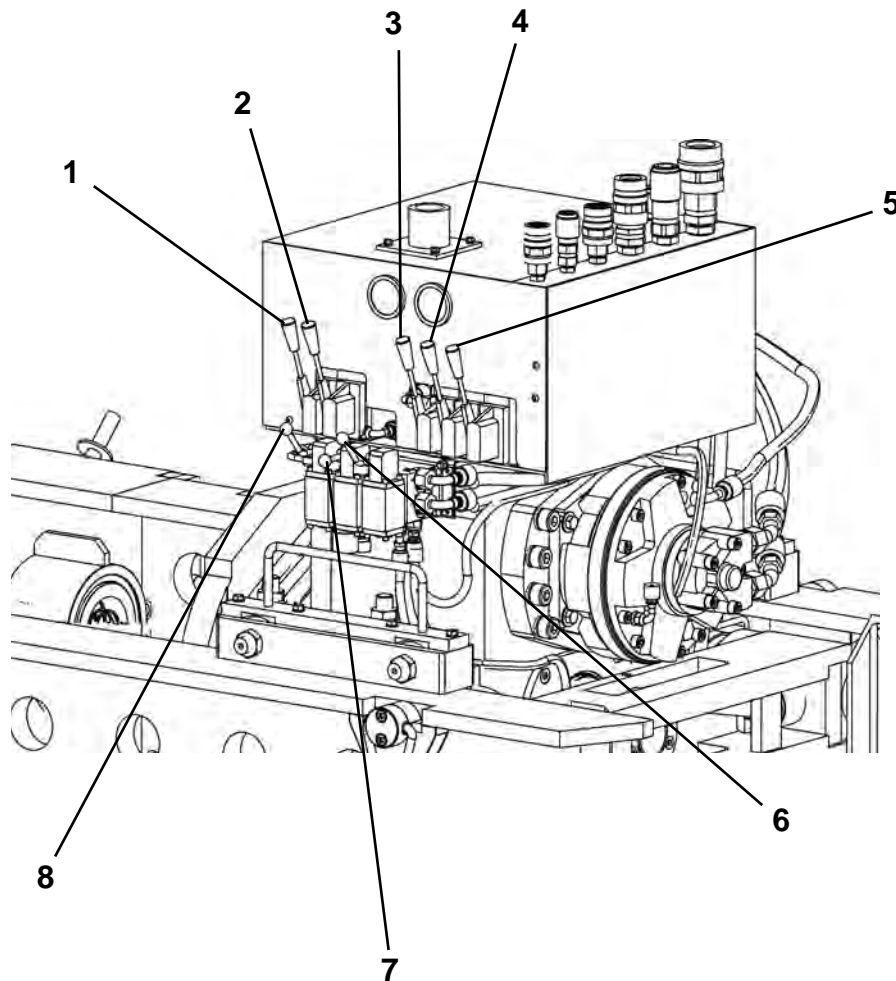


- |                            |                                   |                                  |
|----------------------------|-----------------------------------|----------------------------------|
| 1. Shaft Tensioner         | 10. Thrust Pressure Gauge         | 20. Back Adapter Plate           |
| 2. Shaft Tensioner         | 11. Rotation Pressure Gauge       | 21. Wrench Set                   |
| 3. Casing Roller Bracket   | 12. Rotation Load Sense Connector | 22. Height Adjustment            |
| 4. Front Adapter Plate     | 13. Thrust Load Sense Connector   | 23. Leveling Assembly            |
| 5. Pilot Tube Holder       | 14. Case Drain Connector          | 24. Hydraulic Latching Control   |
| 6. Alignment Guide Adapter | 15. Rotation Pressure Connector   | 25. Drive Speed Rotation Control |
| 7. Drive Swivel            | 16. Thrust Pressure Connector     | 26. Make Up Tool Control         |
| 8. Thrust Plate            | 17. Return Line Connector         | 27. Lifting Hook                 |
| 9. Thrust Cylinder Control | 18. Drive Rotation Control        | 28. Operator Platform            |
|                            | 19. Travel Motor Control          | 29. Hydraulic Make Up Tool       |

\* Some units have been updated with the Powered Cutter Head Valve Package option.

---

## POWERED CUTTER HEAD VALVE PACKAGE OPTION FOR 308A (SN FA40032F-20\* & BEFORE)



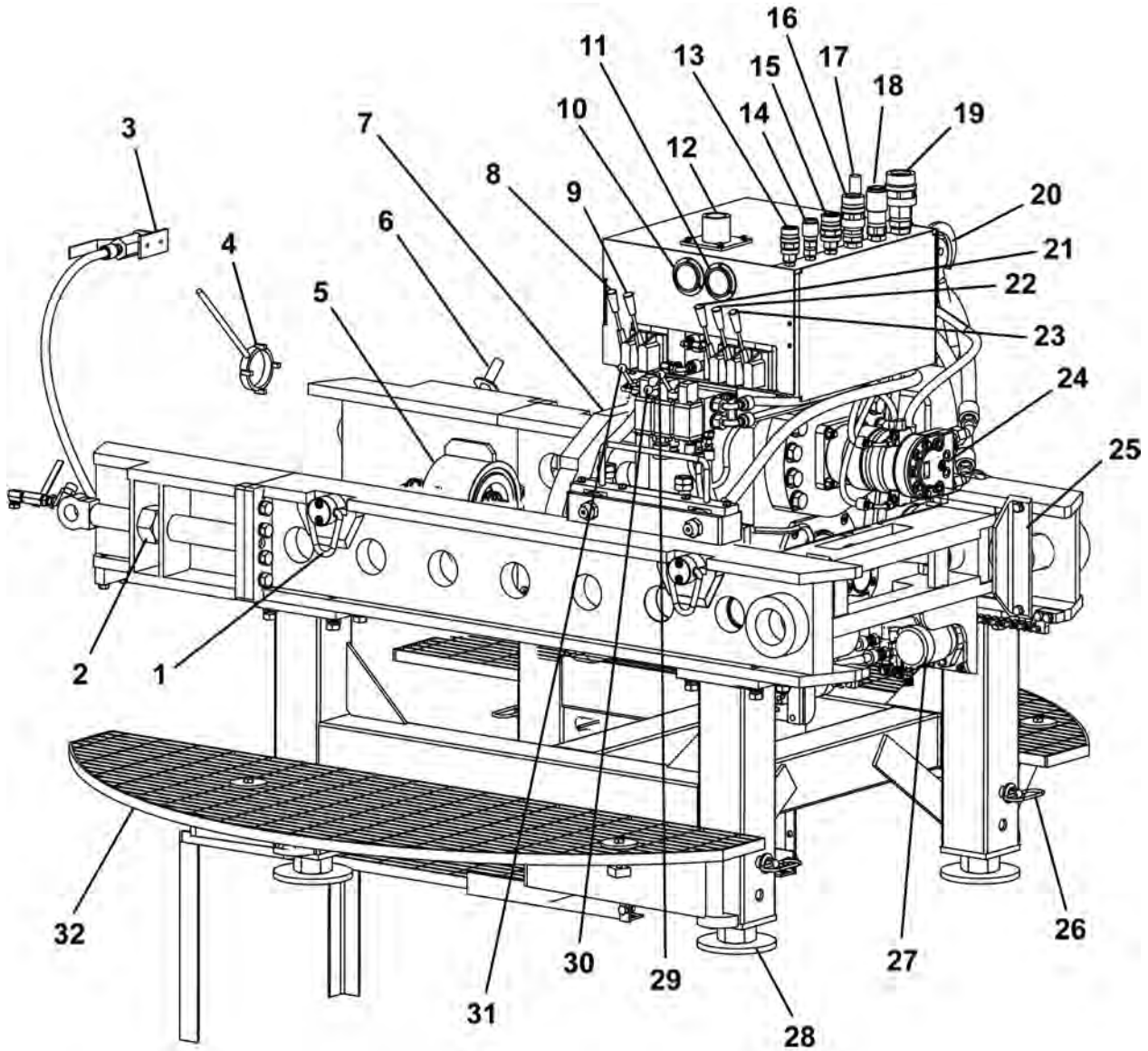
- 1. Thrust Cylinder Control
- 2. Power Cutter Head Rotation Control
- 3. Drive Rotation Control
- 4. Power Cutter Head Auger Control

- 5. Travel Motor (Latching Frame Only)
- 6. Latching Mechanism Control
- 7. Drive Speed Control
- 8. Make Up Tool Control

\* Some units have been updated with the Powered Cutter Head Valve Package option.

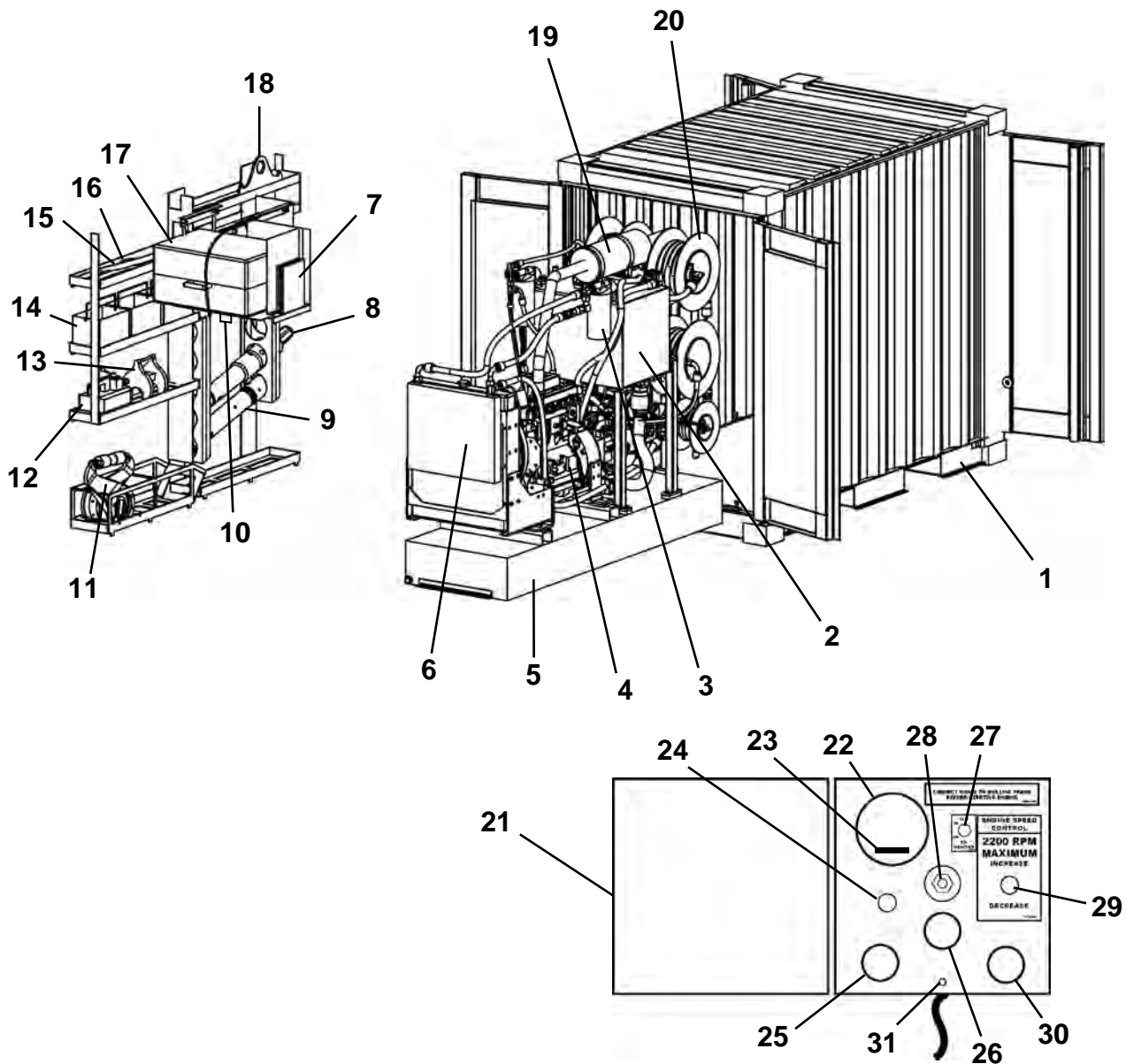
## GBM LATCHING FRAME 308A (SN FA40032F-21 & AFTER) & 339A

Shown without front and rear adapter plates.



- |                                       |                                   |                                                |
|---------------------------------------|-----------------------------------|------------------------------------------------|
| 1. Lifting Hook                       | 12. Guidance System Mount         | 23. Travel Motor Control (Latching Frame Only) |
| 2. Shaft Tensioner                    | 13. Rotation Load Sense Connector | 24. Drive Motor                                |
| 3. Fluid Control                      | 14. Thrust Load Sense Connector   | 25. Travel Stop Bracket                        |
| 4. Spindle Nut Wrench                 | 15. Case Drain Connector          | 26. Height Adjustment                          |
| 5. Drive Swivel                       | 16. Rotation Pressure Connector   | 27. Travel Motor                               |
| 6. Pilot Tube Holder                  | 17. PCH Case Drain Connector      | 28. Leveling Assembly                          |
| 7. Thrust Plate                       | 18. Thrust Pressure Connector     | 29. Hydraulic Latching Control                 |
| 8. Thrust (Jacking) Cylinder Control  | 19. Return Line Connector         | 30. Drive Speed Rotation Control               |
| 9. Powered Cutter Head Rotation Cntrl | 20. PCH Quick Disconnect          | 31. Make Up Tool Control                       |
| 10. Thrust Pressure Gauge             | 21. Drive Rotation Control        | 32. Operator Platform                          |
| 11. Rotation Pressure Gauge           | 22. Power Cutter Head Auger Cntrl |                                                |

# POWER PACK P100Q



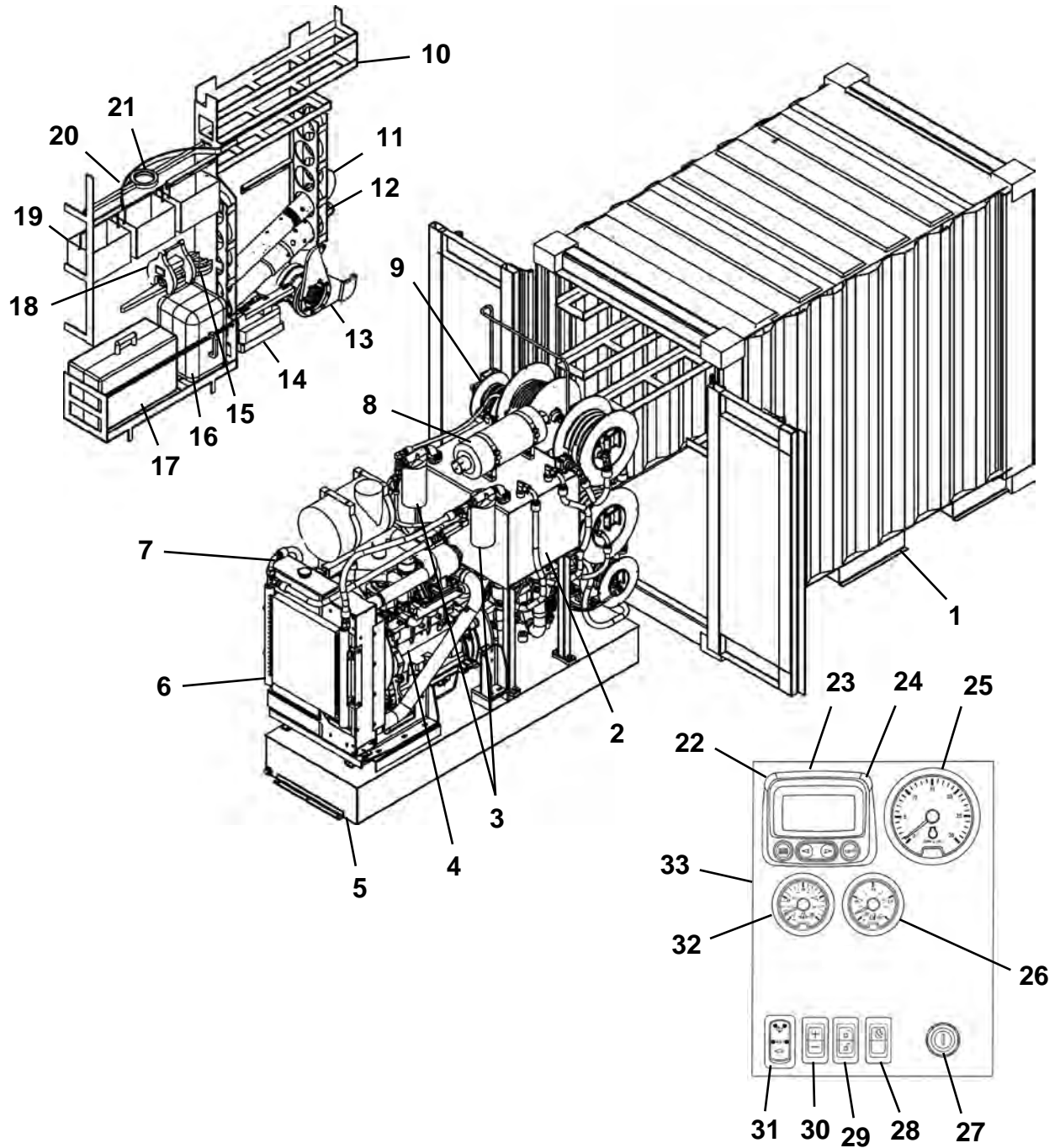
- 1. Container
- 2. Hydraulic Reservoir
- 3. Hydraulic Pressure Filter
- 4. Engine - 4 cyl 99 hp
- 5. Fuel Tank
- 6. Radiator
- 7. Manual
- 8. Reaming Head Adapter
- 9. Steering Head
- 10. Emergency Stop

- 11. Dual Tube Breakout Tool
- 12. Breakout Tool Power Pack
- 13. Launch Shaft Breakout Tool
- 14. Storage Basket
- 15. Pilot Tube Support Bar
- 16. Pilot Tube Scraper
- 17. Guidance System
- 18. Pilot Tube Holder Lifting Bar
- 19. Muffler
- 20. Hydraulic Hose Reel

- 21. Remote Instrument Panel (Control Pendant)
- 22. Tachometer
- 23. Hourmeter
- 24. Ignition Switch - Start Switch
- 25. Oil Pressure Gauge
- 26. Water Temp. Gauge
- 27.\* Monitor Switch
- 28. Start Button - Override Button
- 29. Engine Speed Control
- 30. Battery (Voltmeter) Gauge
- 31. Fuse Holder

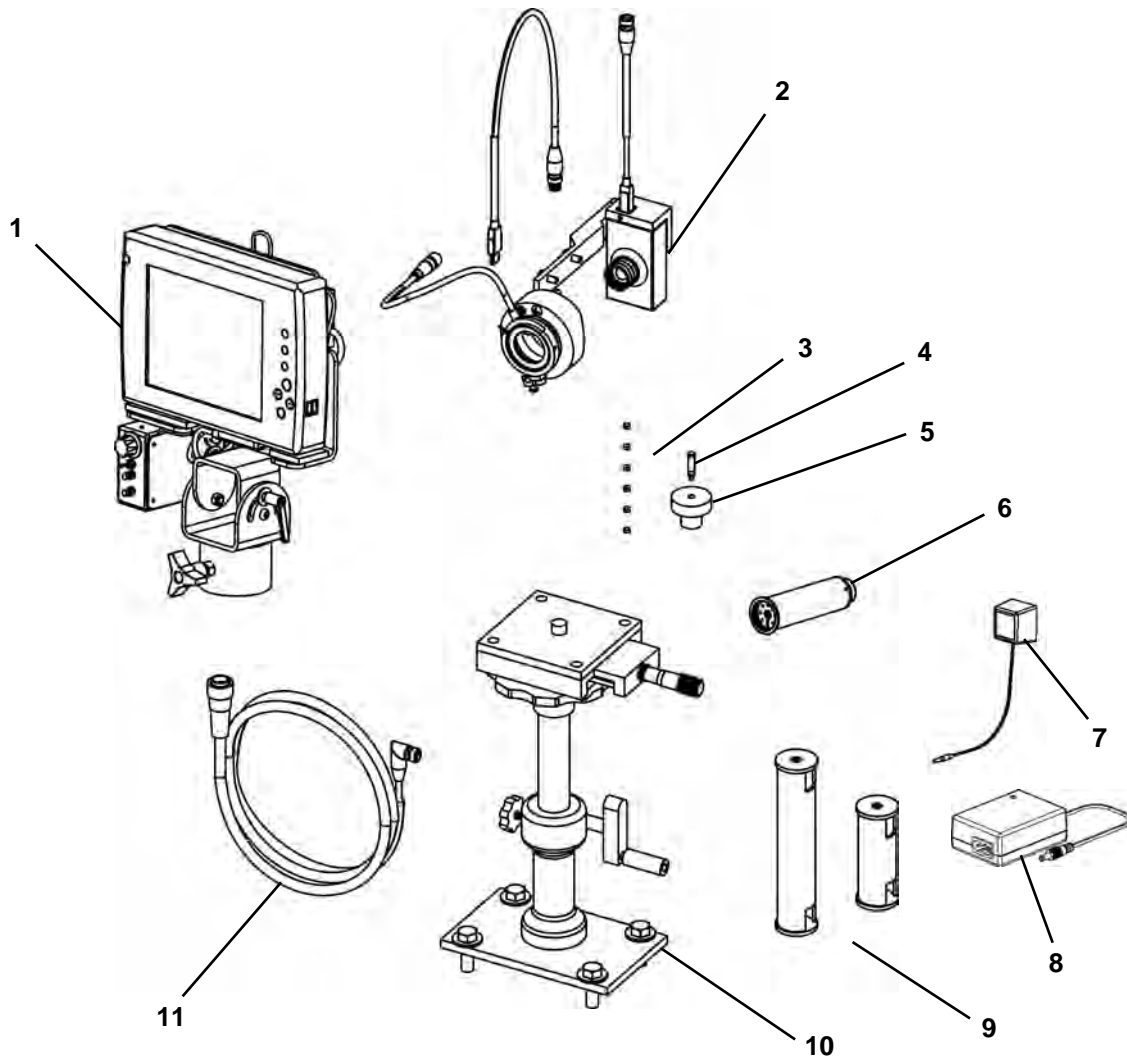
\* SN FA42440F-1 to 68 only. SN FA42440F-69 & after do not have this toggle switch.

**POWER PACK P150Q**



- |                              |                                |                                                  |
|------------------------------|--------------------------------|--------------------------------------------------|
| 1. Container                 | 12. Reaming Head Adapter       | 23. Diagnostic Gauge/Hour Meter                  |
| 2. Hydraulic Reservoir       | 13. Dual Tube Breakout Tool    | 24. Stop Engine Indicator Light                  |
| 3. Hydraulic Pressure Filter | 14. Breakout Tool Power Pack   | 25. Tachometer                                   |
| 4. Engine - 4 Cyl. 154 HP    | 15. Wrench Set                 | 26. Engine Coolant Temp. Gauge                   |
| 5. Fuel Tank                 | 16. Theodolite                 | 27. Key Start Switch                             |
| 6. Oil Cooler                | 17. Guidance System            | 28. Override Shutdown Switch                     |
| 7. Radiator                  | 18. Launch Shaft Breakout Tool | 29. Bump Speed Enable Switch                     |
| 8. Muffler                   | 19. Storage Basket             | 30. Speed Select Switch                          |
| 9. Hydraulic Hose Reel       | 20. Pilot Tube Support Bar     | 31. High-Low Speed Select Switch                 |
| 10. Emergency Stop           | 21. Pilot Tube Scraper         | 32. Engine Oil Pressure Gauge                    |
| 11. Steering Head            | 22. Warning Indicator Light    | 33. Remote Instrument Panel<br>(Control Pendant) |

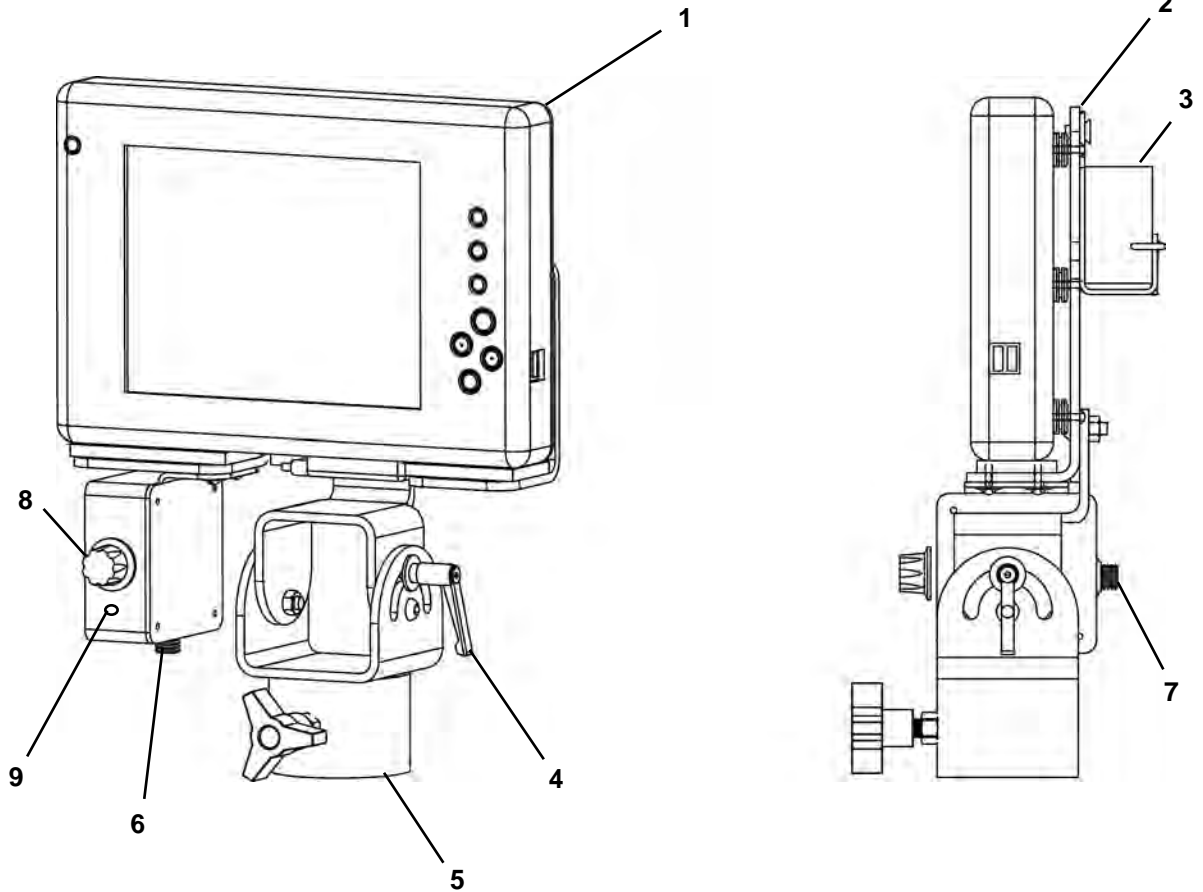
## GUIDANCE SYSTEM



1. Tablet PC With Docking Station
2. Camera Optics
3. Laser Bore Sight Batteries
4. Laser Bore Sight
5. Alignment Holder
6. Target

7. Overnight Charger
8. Smart Charger
9. Column Extensions: 6" & 12"
10. Theodolite Stand
11. Guidance Power Cable

## TABLET PC ASSEMBLY WITHOUT REMOTE FOCUS (SN FA42035F-86 & BEFORE)

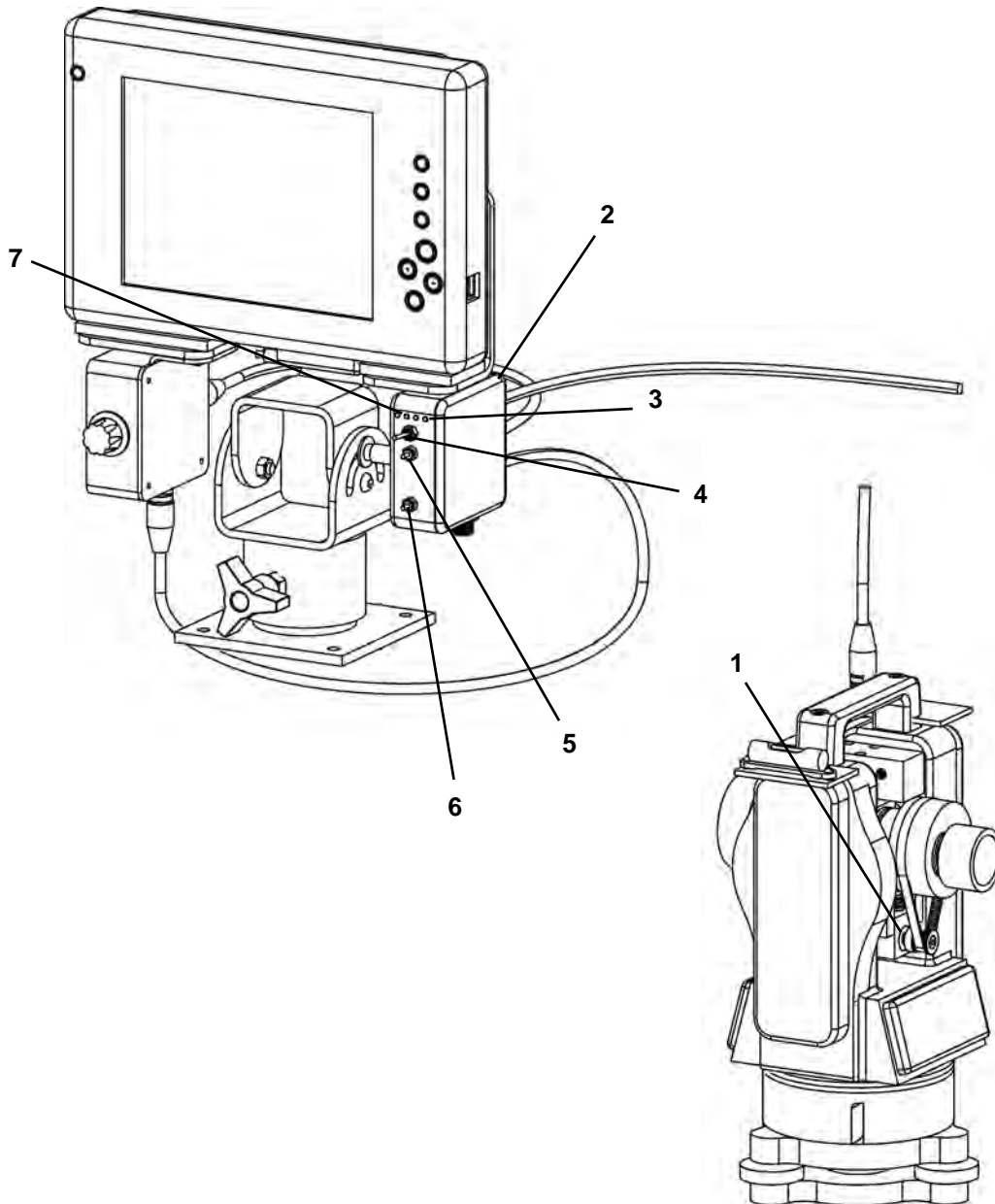


- 1. Tablet PC
- 2. Docking Station
- 3. Power Adapter
- 4. Monitor Tilt Adjustment
- 5. Monitor Top Mount

- 6. Power In Cable Connection
- 7. LED Cable Connection
- 8. LED Brightness Control
- 9. Camera Power Indicator

\* Some units have been updated with the Remote Focus Kit option. See Tablet PC Assembly With Remote Focus Kit (SN FA42035F-86 & Before).

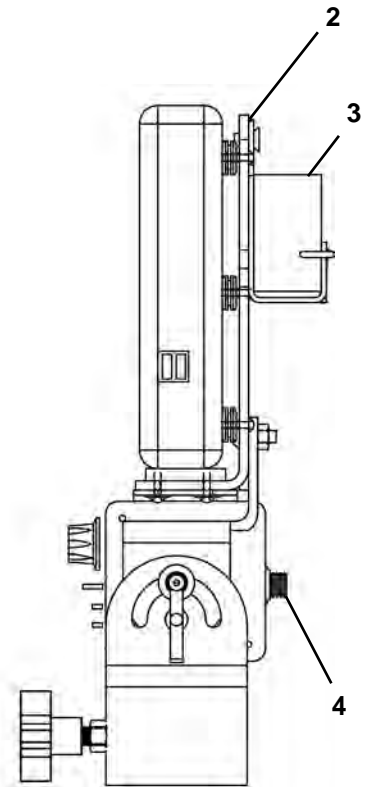
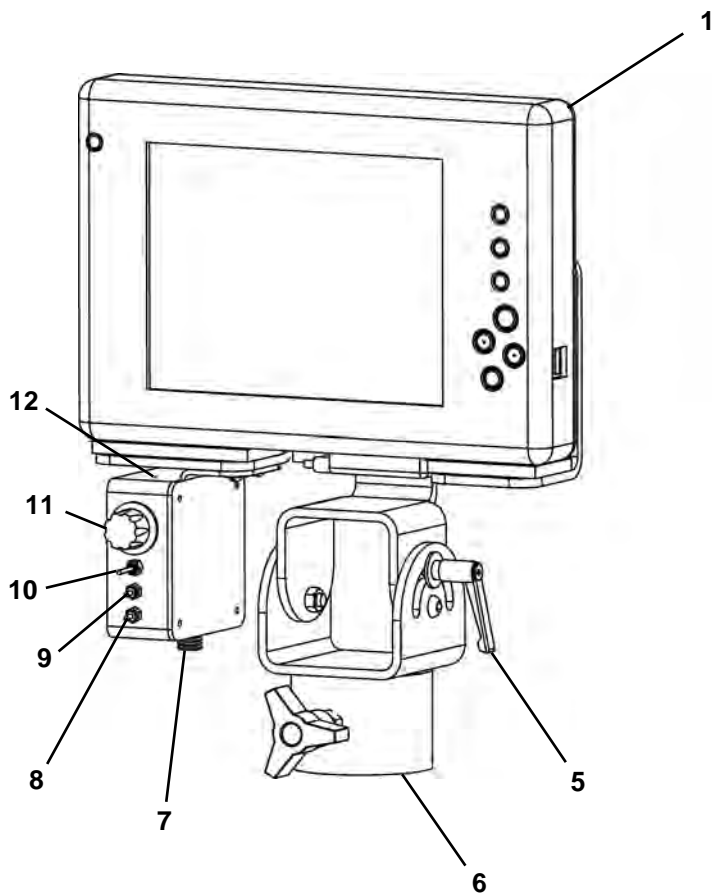
## REMOTE FOCUS KIT (SN FA42035F-86 & BEFORE)



- 1. Drive Motor
- 2. Remote Focus Control Box
- 3. LED Limit Light
- 4. SLOW/FAST Focus Speed Switch

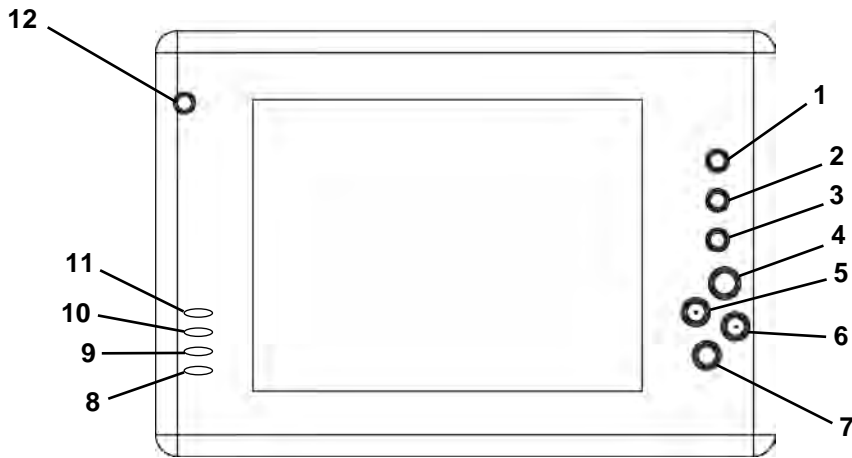
- 5. IN
- 6. OUT
- 7. LED Run

## TABLET PC ASSEMBLY WITH REMOTE FOCUS (SN FA42035F-87 & AFTER)



- |                            |                                  |
|----------------------------|----------------------------------|
| 1. Tablet PC               | 7. Power In Cable Connection     |
| 2. Docking Station         | 8. OUT Focus                     |
| 3. Power Adapter           | 9. IN Focus                      |
| 4. LED Cable Connection    | 10. SLOW/FAST Focus Speed Switch |
| 5. Monitor Tilt Adjustment | 11. LED Brightness Control       |
| 6. Monitor Top Mount       | 12. Camera Power Indicator       |

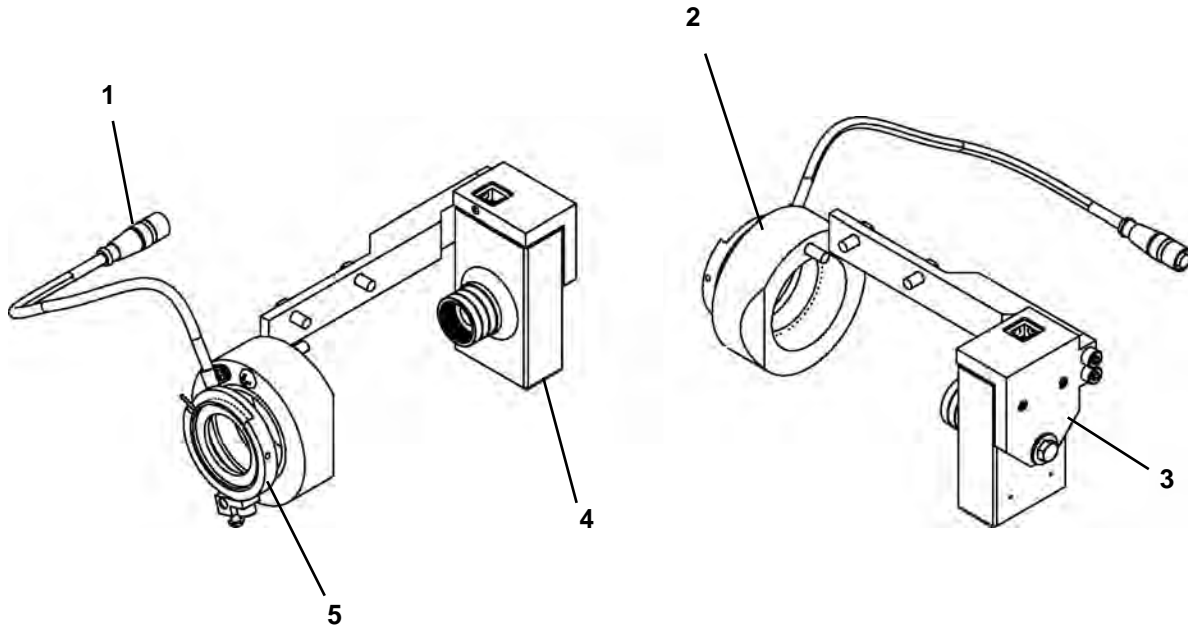
## TABLET PC CONTROLS



- 1. Rotate Screen
- 2. Windows Task Manager
- 3. Select Up
- 4. Select Down (Enter)
- 5. Up
- 6. Down

- 7. Function Key
- 8. Power Light
- 9. Charge Light
- 10. Hard Drive Light
- 11. Wireless Light
- 12. Power

## CAMERA OPTICS



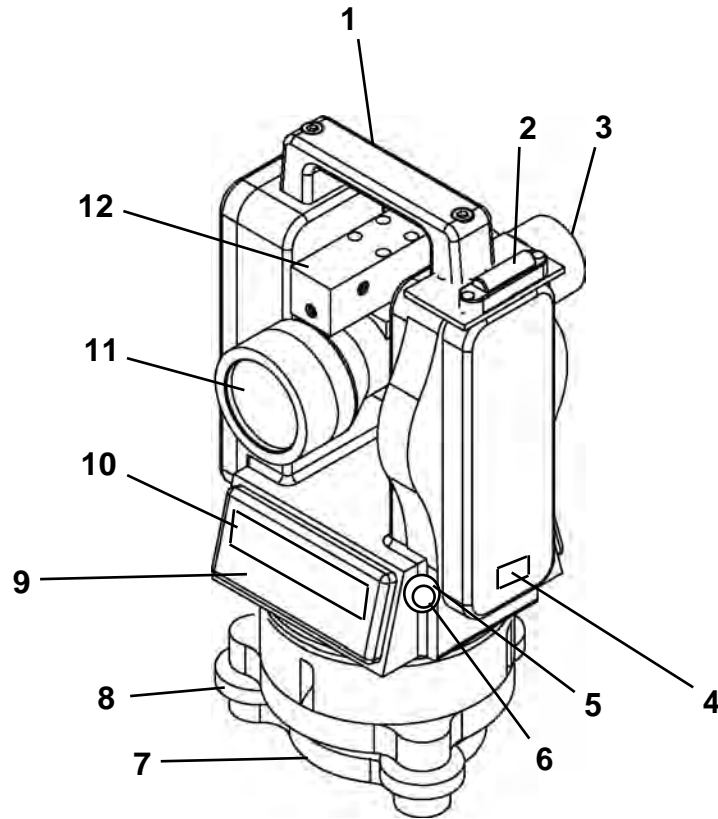
- 1. LED Cable
- 2. Counterweight
- 3. Camera Bracket

- 4. Video Camera
- 5. Iris Mount

## THEODOLITE

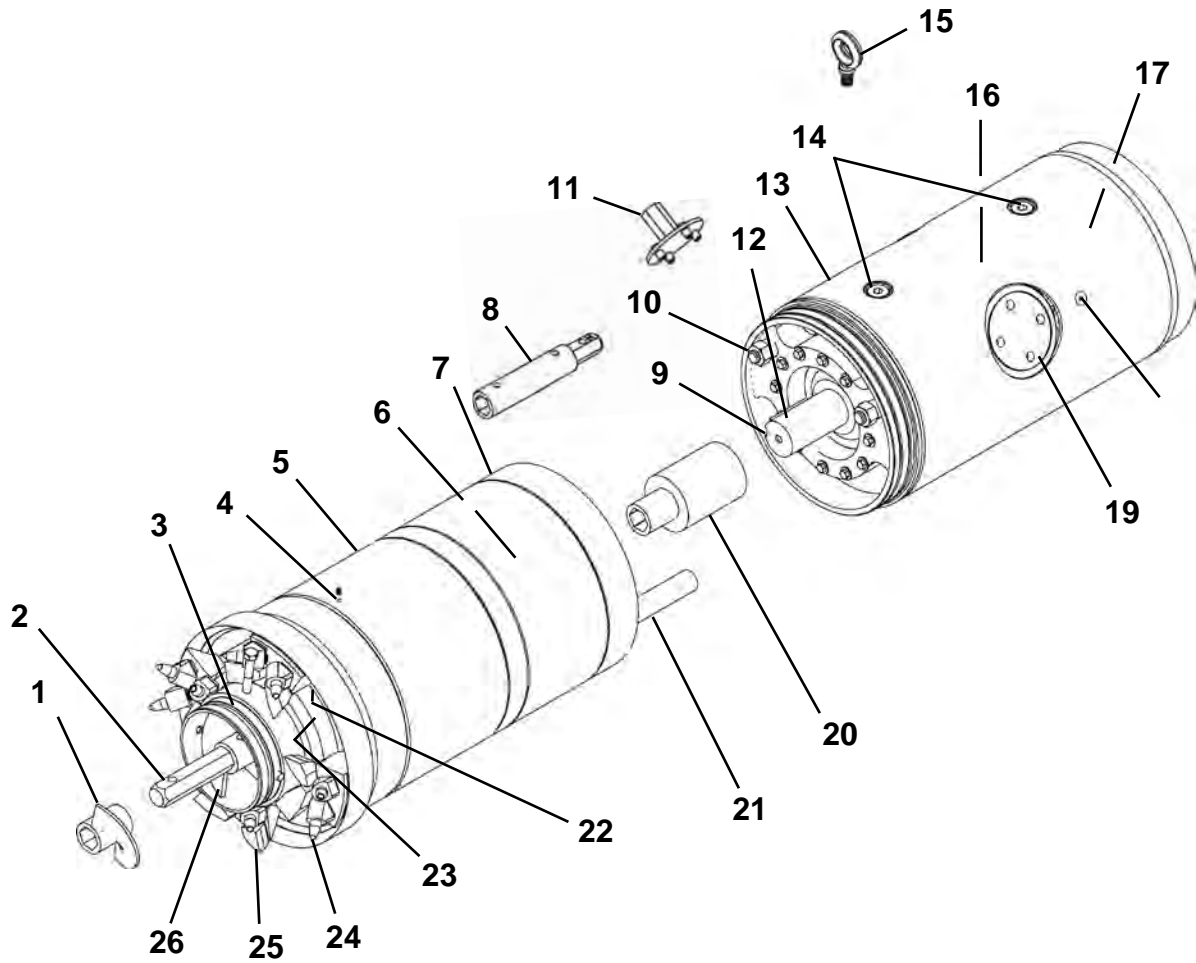
**NOTICE**

For more information, refer to your theodolite manual.



- |                                  |                   |
|----------------------------------|-------------------|
| 1. Carrying Handle               | 7. Base Plate     |
| 2. Level                         | 8. Leveling Screw |
| 3. Telescope Eyepiece            | 9. Keyboard       |
| 4. Power Switch                  | 10. Display       |
| 5. Optical Plummet Focusing Ring | 11. Objective     |
| 6. Optical Plummet               | 12. Camera Mount  |

## POWERED CUTTER HEAD 20 - 22.5 - 28.5



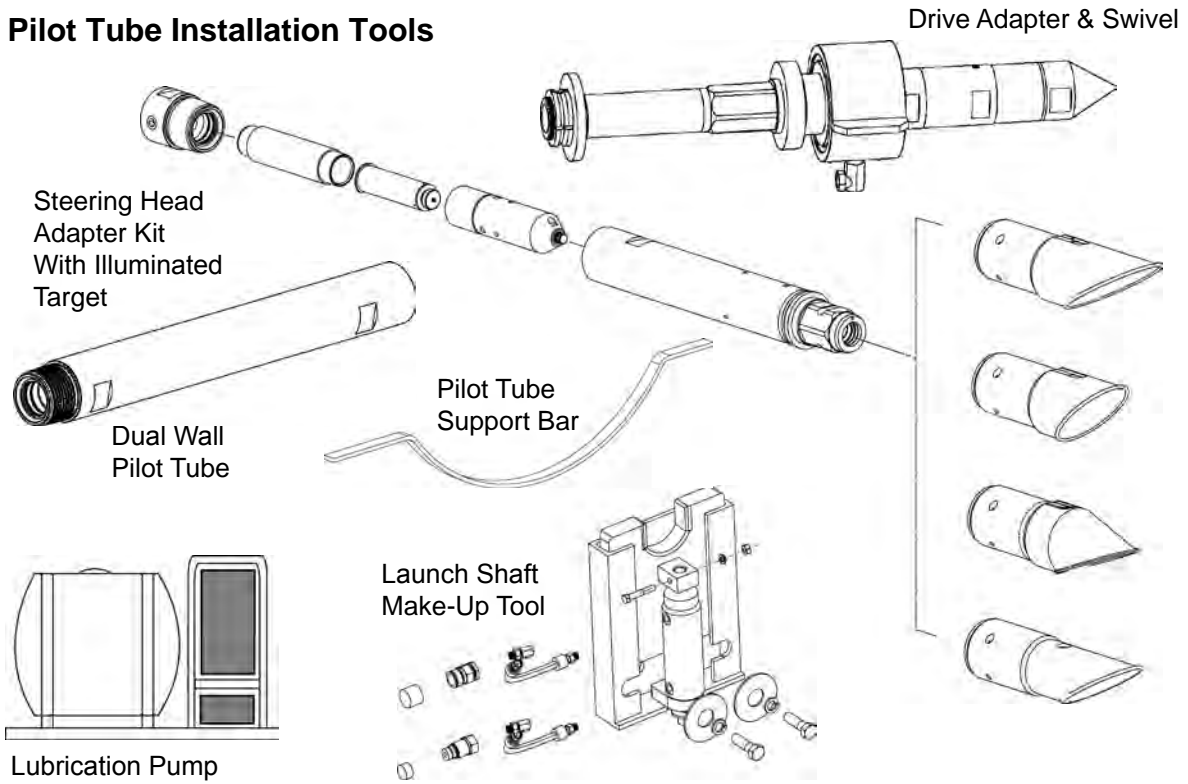
- 1. Lead Auger
- 2. Hex Connector
- 3. PCH Auger Casing
- 4. External Grease Port
- 5. Front Section
- 6. Hydraulic Motor
- 7. Bell End
- 8. GBM Gear Box Connection
- 9. Drive Shaft Keyway
- 10. Alignment Pins
- 11. Port Hole Wrench
- 12. Auger Drive Shaft
- 13. Rear Section

- 14. Lifting Lugs
- 15. Lifting Eye
- 16. Auger Drive Gear Box
- 17. Hydraulic Drive Motor
- 18. Lubrication Port (3)
- 19. Port Hole
- 20. Auger Drive Shaft Coupling
- 21. Hydraulics
- 22. Jetting Ports (3)
- 23. Mixing Chamber
- 24. Cutter Bullet Bit
- 25. Cutter Dirt Bit
- 26. PCH Auger Section

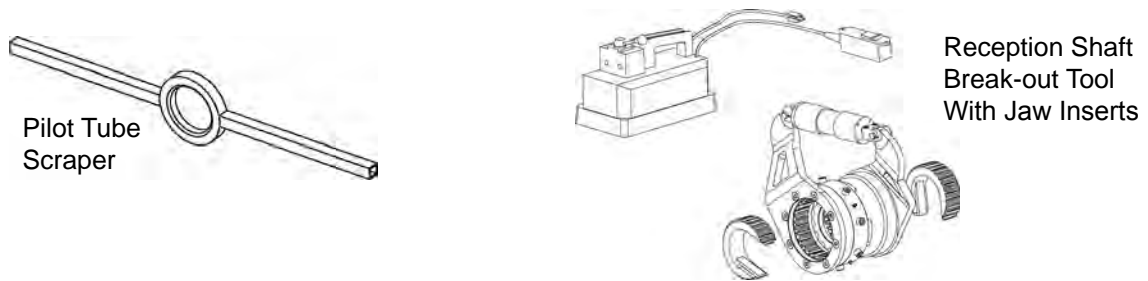
## **NOTES**

# GBM TOOLING - THREE STEP METHOD - FOR 11" THRU 16" OD PIPE

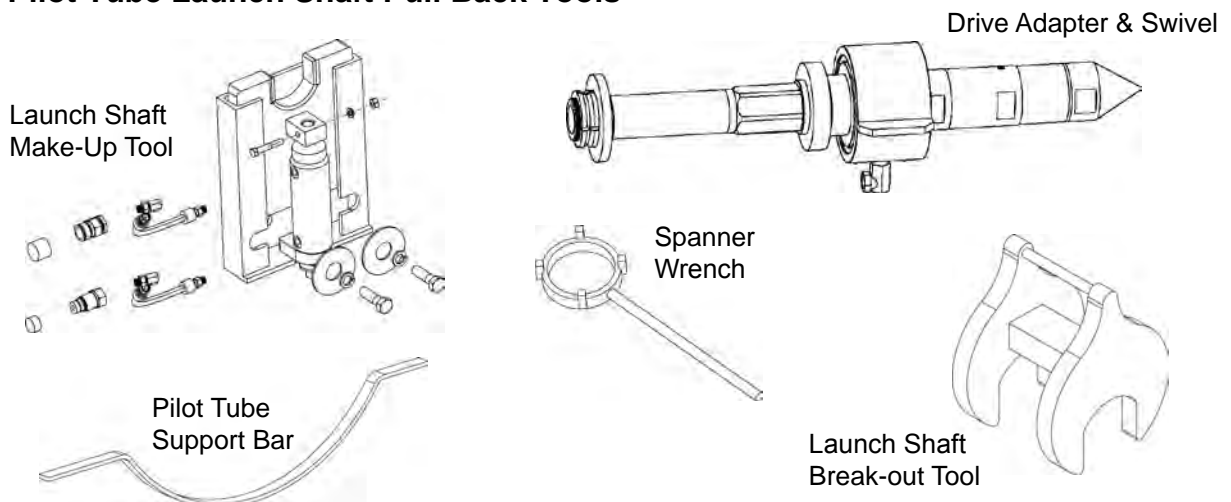
## 1. Pilot Tube Installation Tools



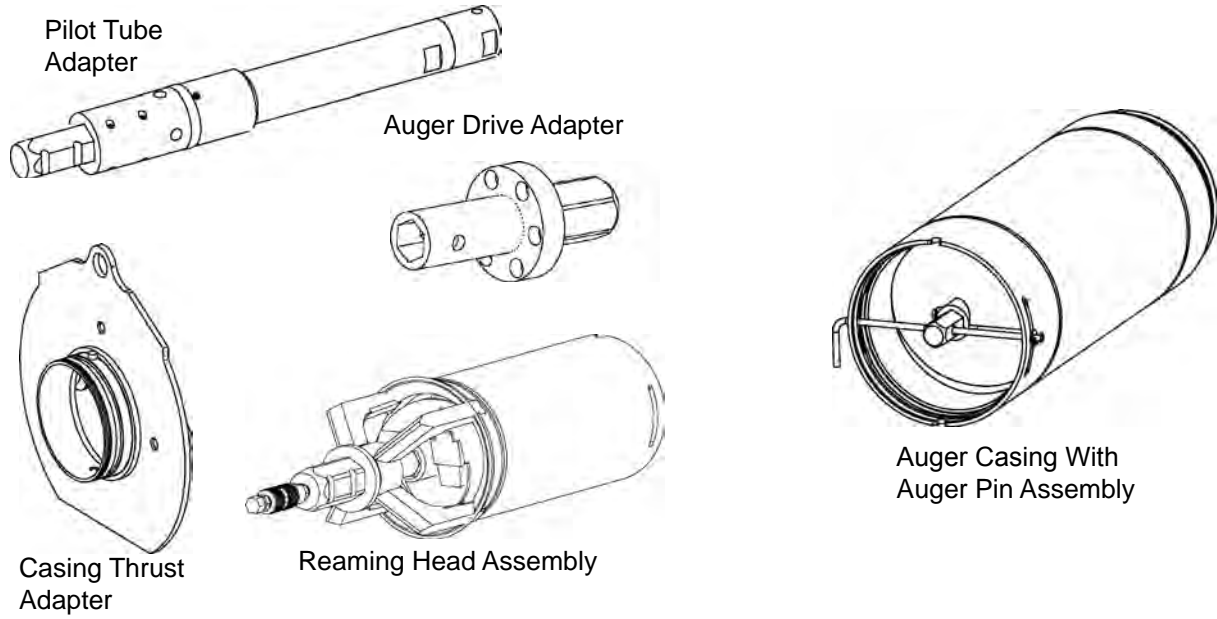
## 2. Pilot Tube Reception Shaft Removal Tools



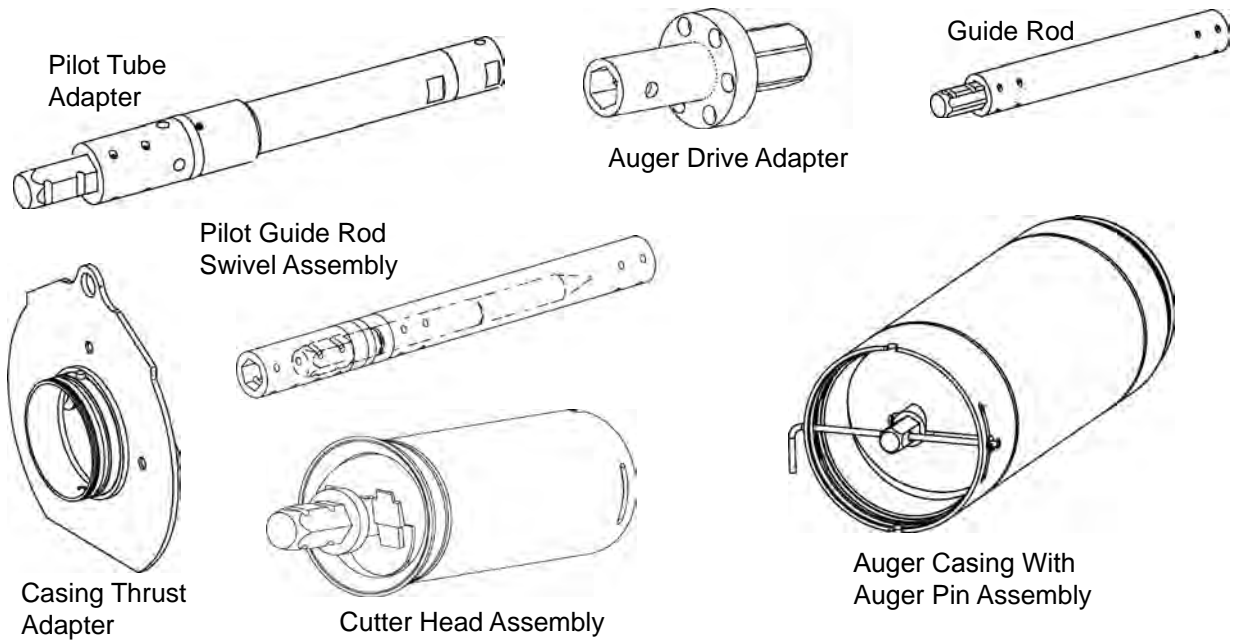
## 3. Pilot Tube Launch Shaft Pull Back Tools



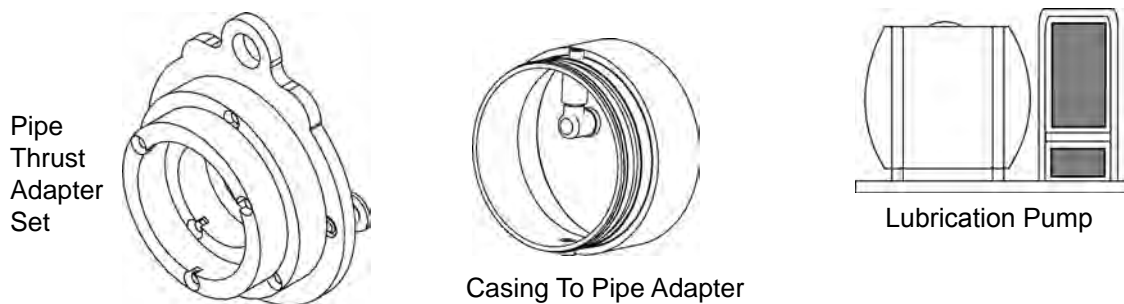
### 4a. Upsizing Tool: Reaming Head Thrust Casing Installation Tools



### 4b. Upsizing Tool: Cutter Head Thrust Casing Installation Tools

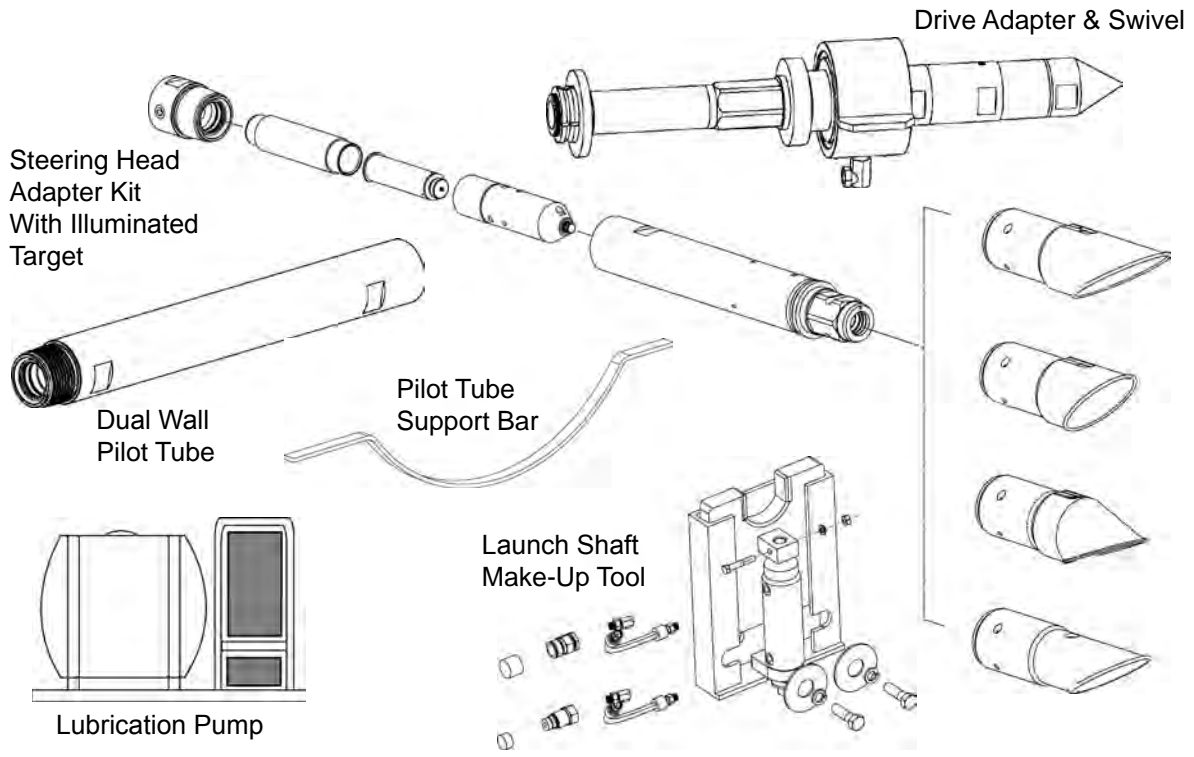


### 5. Pipe Installation Tools

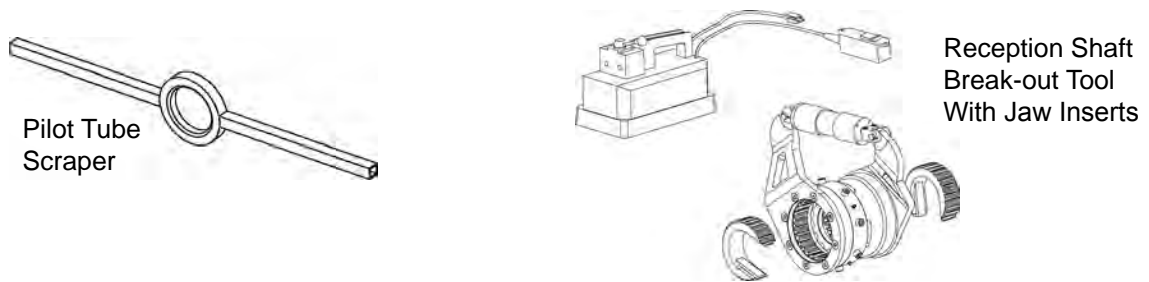


# GBM TOOLING - THREE STEP METHOD WITH POWERED CUTTER HEAD for 20" - 28.5" OD Pipe (308A); for 20" - 31.5" OD Pipe (339A)

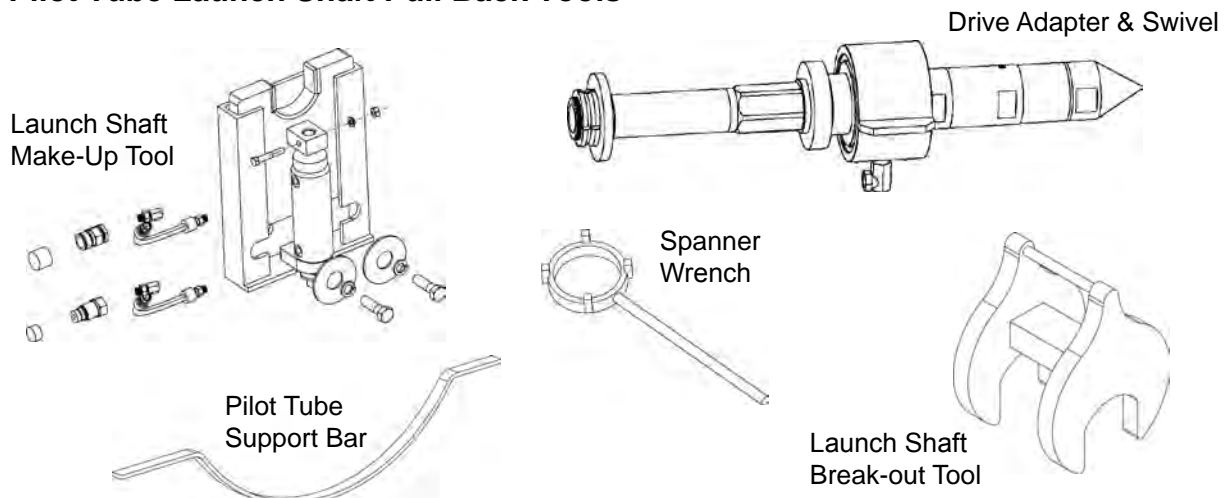
## 1. Pilot Tube Installation Tools



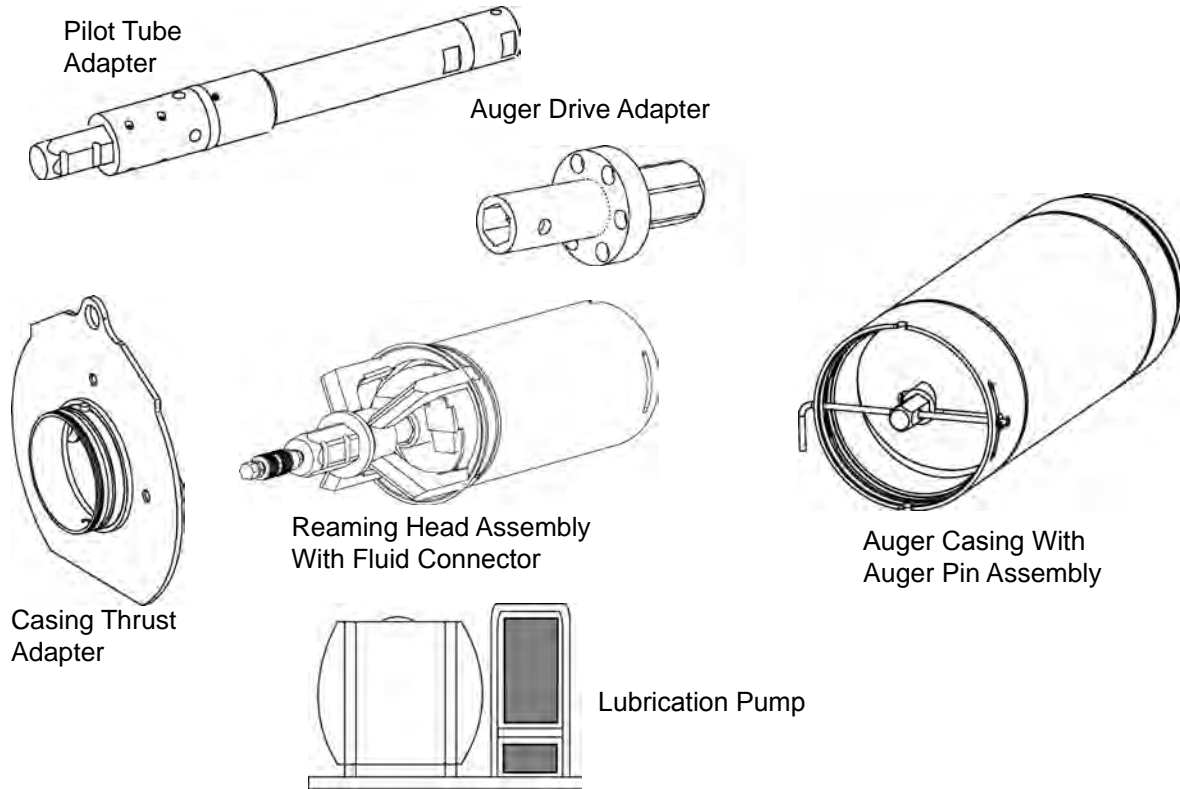
## 2. Pilot Tube Reception Shaft Removal Tools



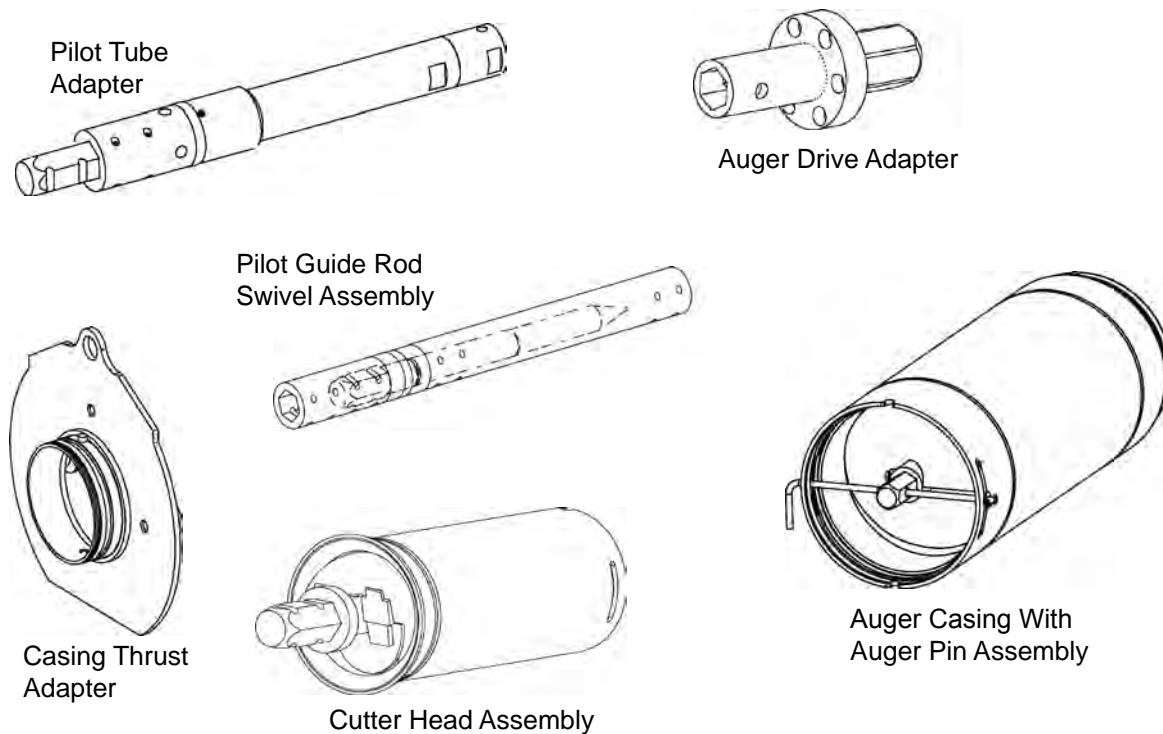
## 3. Pilot Tube Launch Shaft Pull Back Tools



#### 4a. Upsizing Tool: Reaming Head Thrust Casing Installation Tools

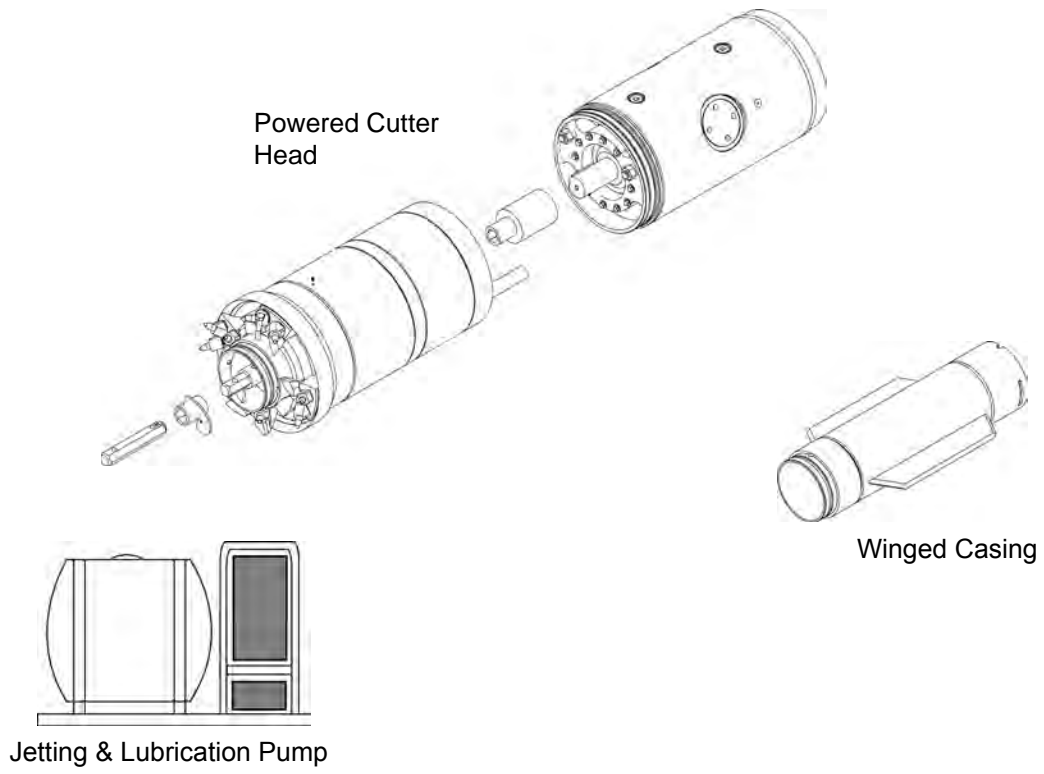


#### 4b. Upsizing Tool: Cutter Head Thrust Casing Installation Tools



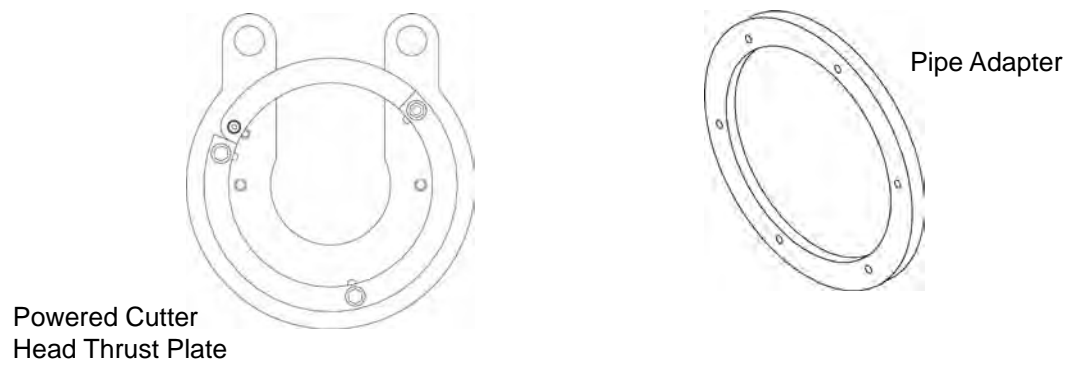
(continued on next page)

## 5. Upsizing Tool: Powered Cutter Head Installation Tools



---

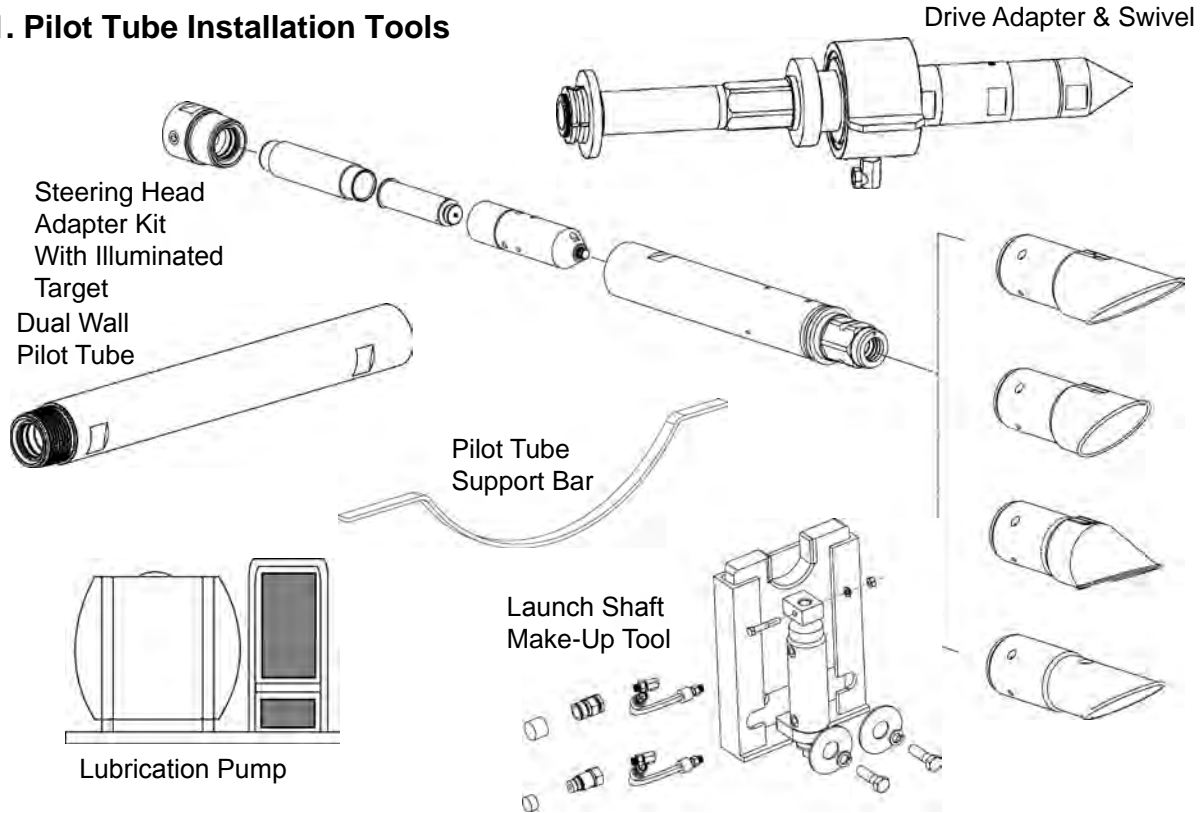
## 6. Pipe Installation Tools



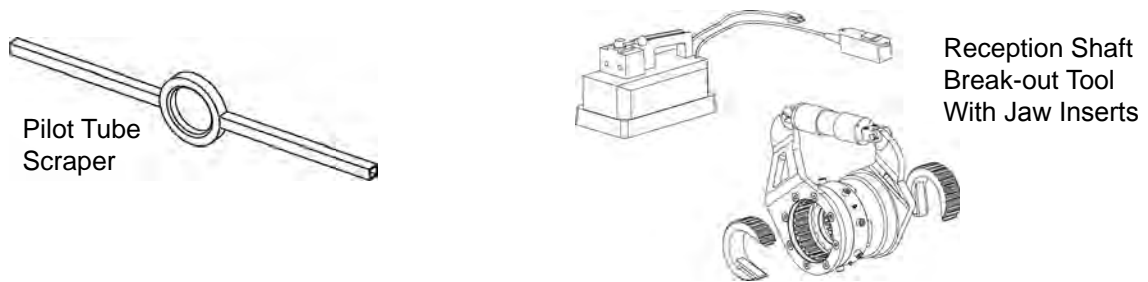
## **NOTES**

# GBM TOOLING - AUGER BORING METHOD

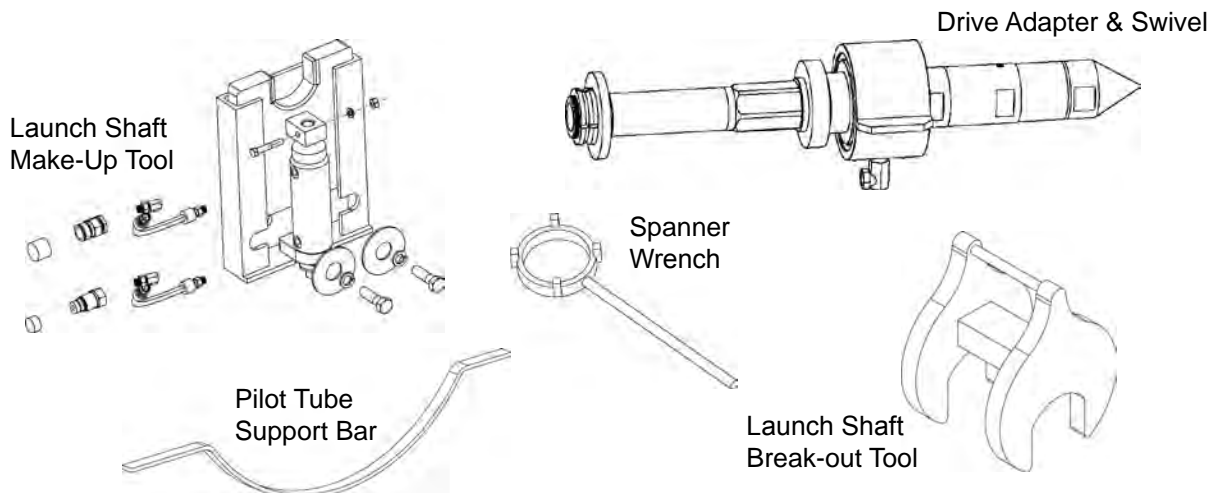
## 1. Pilot Tube Installation Tools



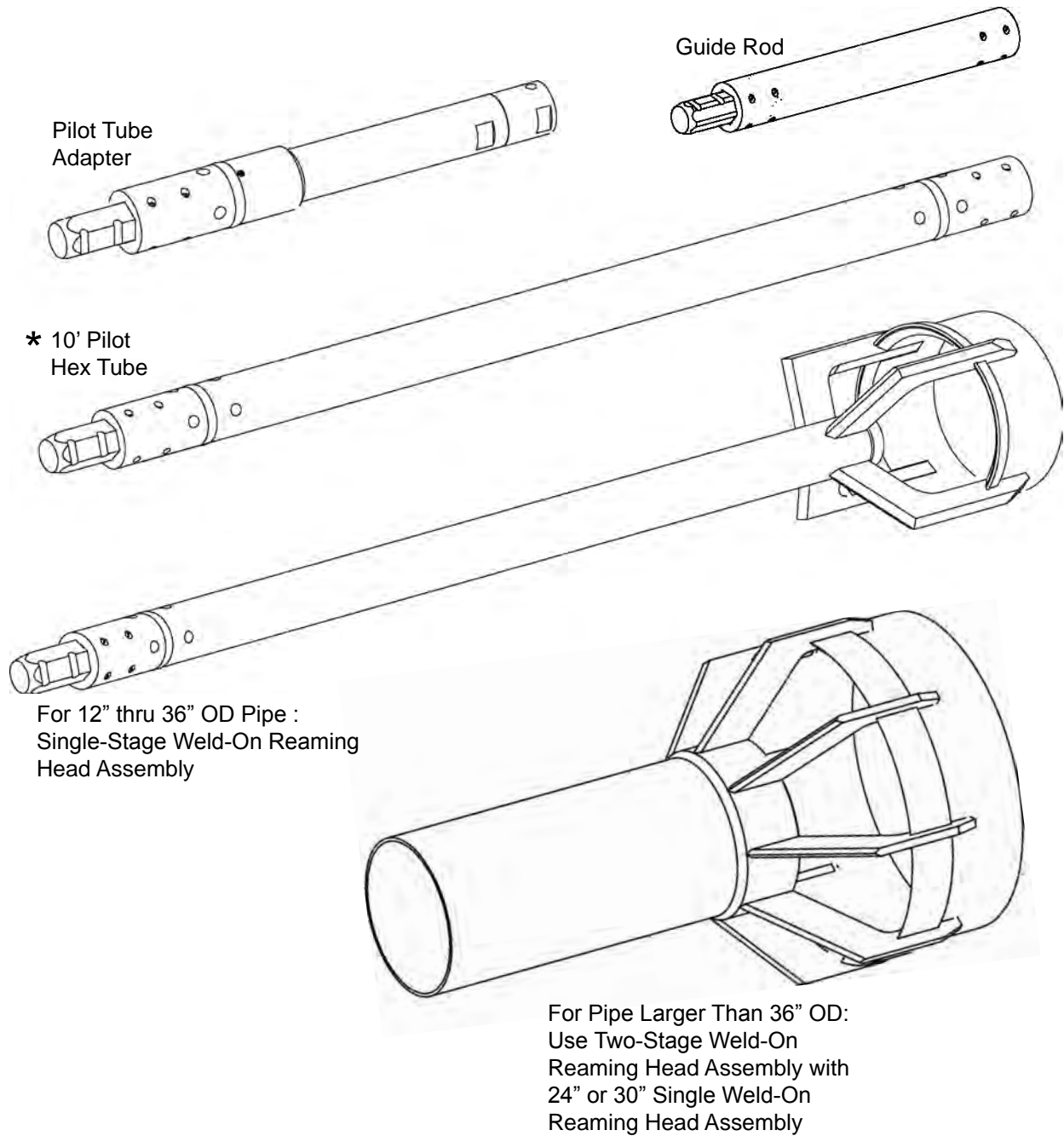
## 2. Pilot Tube Reception Shaft Removal Tools



## 3. Pilot Tube Launch Shaft Pull Back Tools



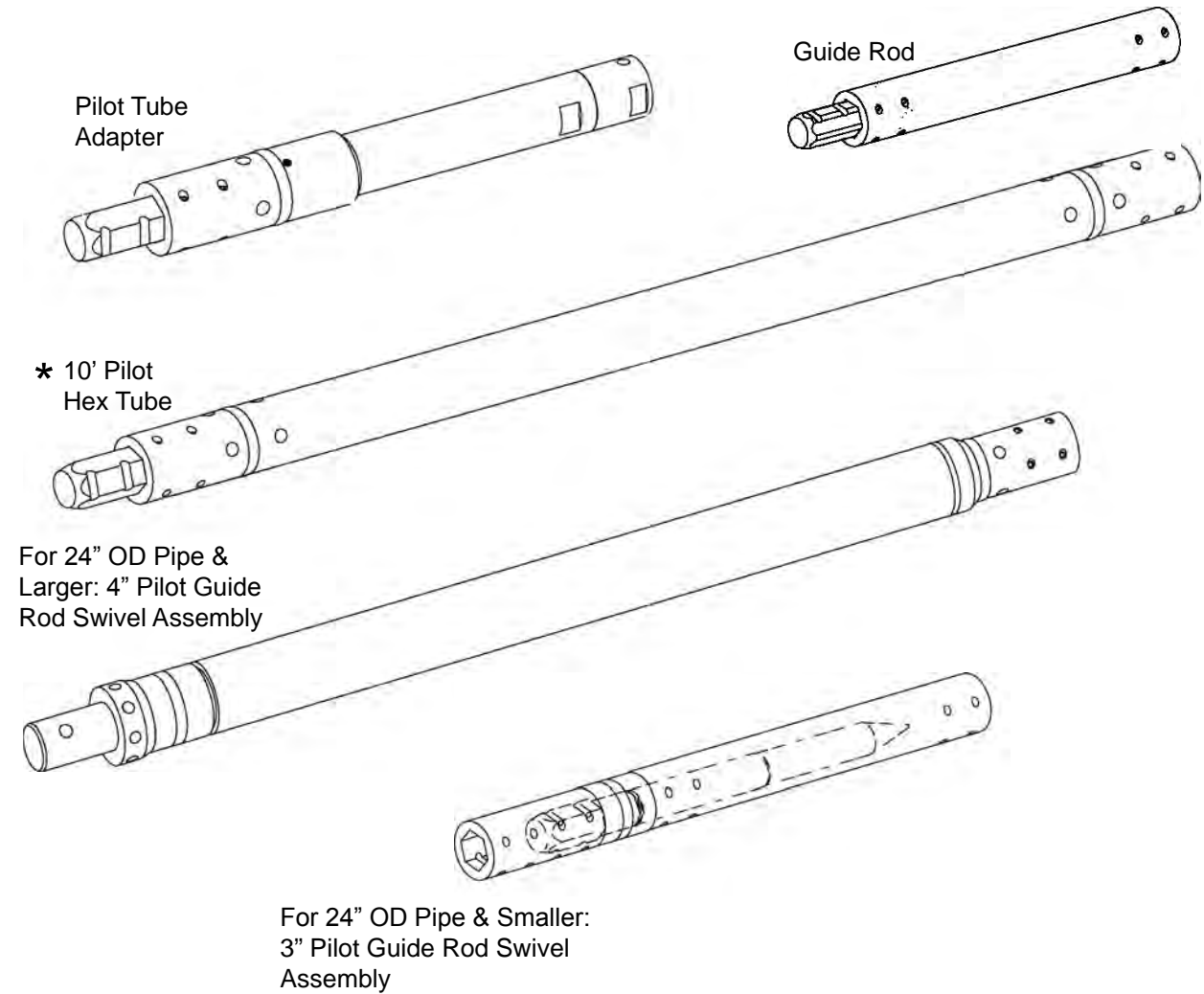
#### 4a. Upsizing Tool: Reaming Head Installation Tools



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

(continued on next page)

#### 4b. Upsizing Tool: Open Face Cutter Head Installation Tools



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

# Controls & Instruments

## THRUST CYLINDER CONTROL

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

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



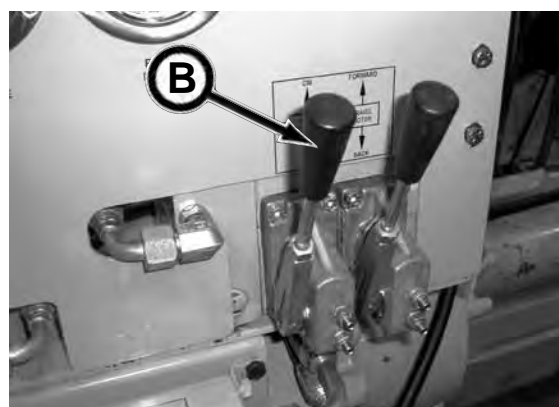
## DRIVE ROTATION CONTROL

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

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

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

- Clockwise (CW) Rotation - Push lever Up
- Counter-Clockwise (CCW) Rotation - Pull lever Down



## TRAVEL MOTOR CONTROL (LATCHING FRAME ONLY)

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

- Forward - Push lever Up
- Back - Pull lever Down



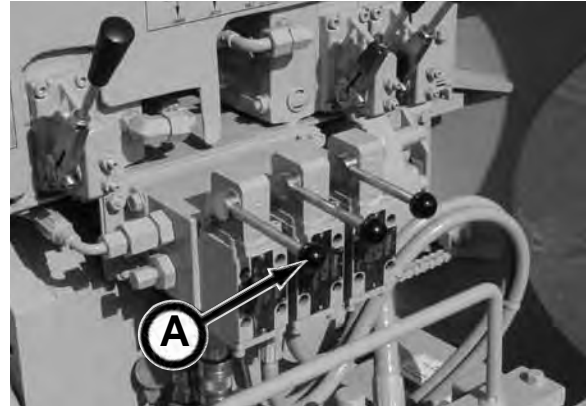
---

## 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 SELECTOR

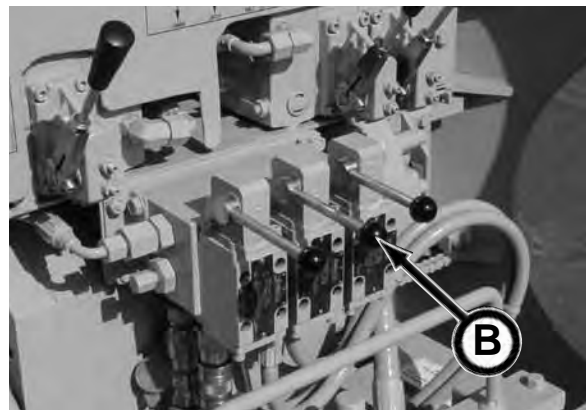
The drive speed selector (B) controls the rotational drive motor speed.

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

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

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

- LSHT - Push lever Up
- HSLT - Pull lever Down

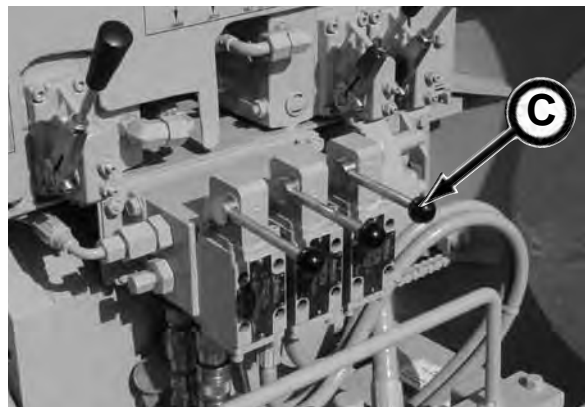


---

## HYDRAULIC LATCHING CONTROL (LATCHING FRAME ONLY)

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

The latching pin cylinder control (C) hydraulically locks and unlocks the latching pins.

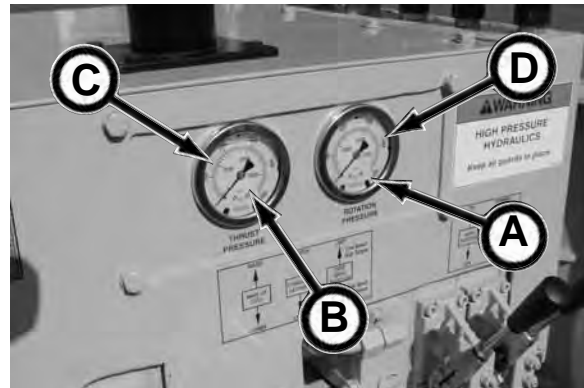


## HYDRAULIC PRESSURE GAUGES

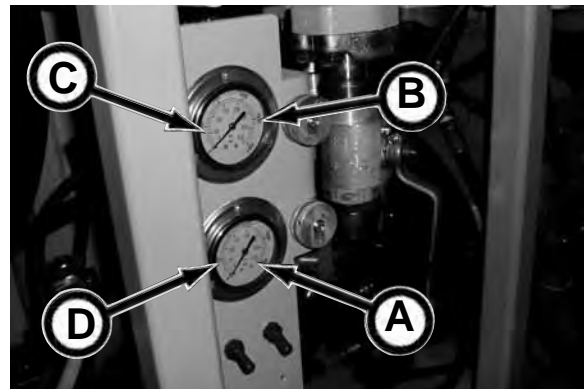
Use the pressure gauges to monitor the GBM rotation (A) and jacking thrust (B) pressure.

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

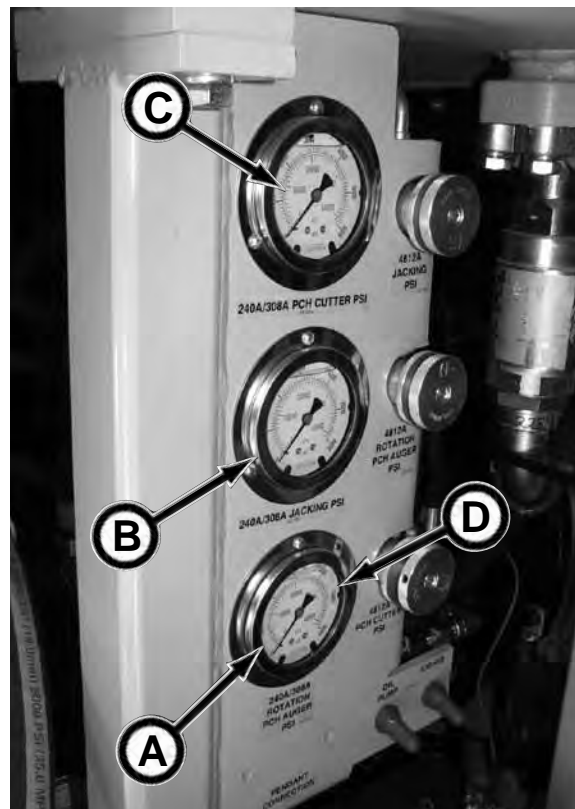
When using the Powered Cutter Head, use the pressure gauges to monitor the PCH cutter head rotation (C) and the PCH auger rotation pressure (D).



*GBM Frame*



*P100Q Power Pack*



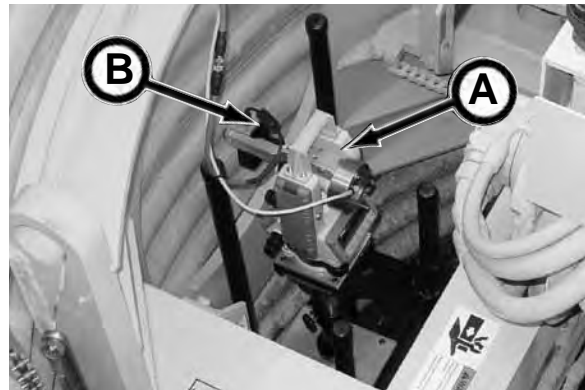
*P150Q Power Pack*

---

## 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).

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



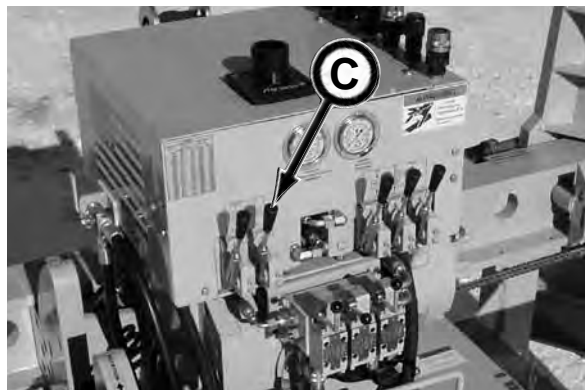
---

## POWERED CUTTER HEAD - ROTATION CONTROL

The rotation control (C) is used to rotate the cutter head of the PCH.

Periodically, change the rotation of the cutter head to maintain the casing guides in the 12 o'clock and 6 o'clock position.

Clockwise (CW) Rotation - Push lever Up  
Counter-Clockwise (CCW) Rotation - Pull lever Down



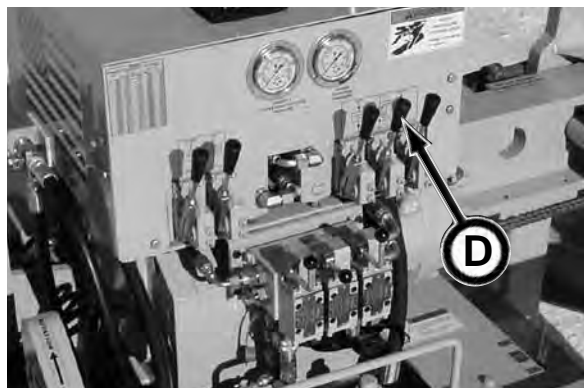
---

## POWERED CUTTER HEAD - AUGER CONTROL

The auger control (D) is used to rotate the powered cutter head auger.

Always rotate the PCH auger in the counter-clockwise (CCW) direction. This will move the spoils to the reception shaft.

Clockwise (CW) Rotation - Push lever Up  
Counter-Clockwise (CCW) Rotation - Pull lever Down



## TABLET PC MONITOR

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

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

### On & Off Control

To turn on (boot up) tablet PC, depress power button (A). The GBM\_System program automatically loads once the Windows® operating system is loaded.

**NOTICE** If a DOS screen appears, the Windows operating system did not load properly. Refer to “Problem: Windows operating system and the Akkerman GBM\_System ... A DOS screen appears” in section 11, Troubleshooting to resolve this issue.

To turn off or shutdown tablet PC power, close the GBM-System program, and depress power button (A) briefly (1 second).

### HARD POWER DOWN

**NOTICE** Use this procedure ONLY as a last resort. This shutdown method will take significantly longer (in excess of 5 minutes) to reboot since the Windows program performs a Disk Check.

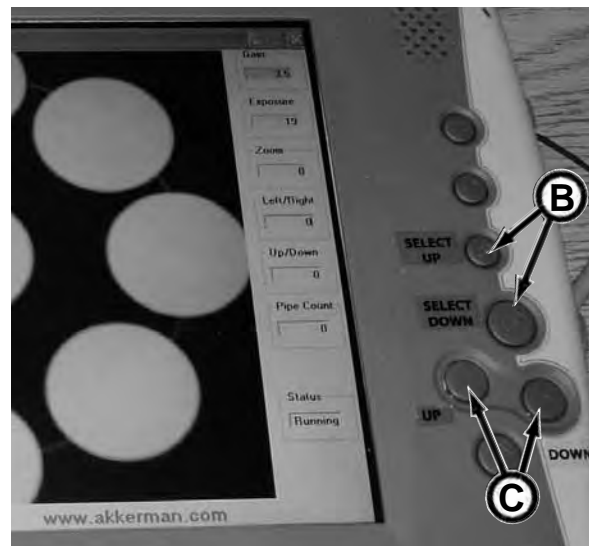
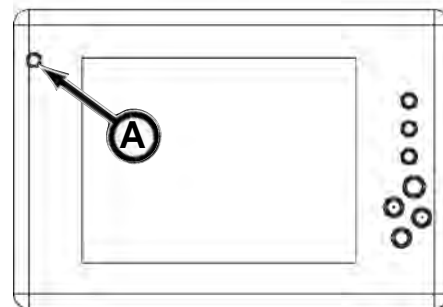
If computer does not respond when: depressing the tablet buttons, using the digitizer pen, computer fails to shutdown or is frozen; depress power button (A) and hold for 7 to 10 seconds. Also, refer to section 11, Troubleshooting.

### Gain- Exposure-Zoom-Direction-Pipe Count-Status Control

Adjust the Gain, Exposure, Zoom, Left/Right, Up/Down, Pipe Count and Status fields using either the Select Up or Select Down buttons (B) until desired field is highlighted.

To increase or decrease the values in the fields, use the Up or Down buttons (C).

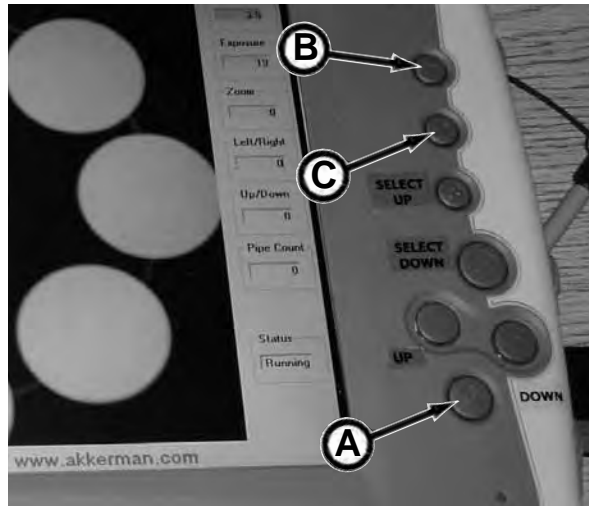
- Gain control adjusts the camera sensitivity.
- Exposure control adjusts the amount of light available to the camera.
- Zoom control adjusts the camera zoom lens in and out.
- Left/Right control moves the image left or right on the screen.
- Up/Down control moves the image up or down.



### Screen Brightness Control

To increase screen brightness, hold down button (A) while depressing button (B) to desired brightness.

To decrease screen brightness, hold down button (A) while depressing button (C) to desired brightness.



### Using Digitizer Pen

When using pen, look on the pointer on the screen, not on the tip of the pen.

Use the pen for many of the same tasks you perform with a mouse:

1. *To select an item on the screen as you would with the left button of an external mouse:*  
Tap the item with the tip of the pen.
2. *To double-click an item on the screen as you would with the left button of an external mouse:*  
Tap the item twice with the tip of the pen. (You need to lift the pen from the tablet briefly and quickly between taps.)
3. *To select an item as you would with the right button of an external mouse:*  
Press and hold down the pen button until a circle of red dots appear with a mouse icon, then lift the pen.

**NOTICE** The pen must be held steady while performing the right click. Otherwise, the computer interprets that you are moving the mouse.

**NOTICE** The button on the side of the pen does not function with the existing software configuration.


### Accessing The Task Bar / Start Button

Access the task bar (D) at the bottom of the tablet screen to select start button, programs, control panel, etc.

With the digitizer pen at a 90 degree angle to the bottom of the tablet screen, hold pen for about one second and lift up pen to unhide the task bar.






### Entering Data

Data will be entered with the digitizer pen through the input panel. There are two ways to gain access to the input panel. Either click the Input Panel icon  on the task bar, or hover the digitizer pen over the character field in which data is to be entered, and click the input panel icon.

**NOTICE** When hovering over a character field, a pause before use will cause the input panel to disappear. Simply hover over the character field to reactivate the input panel.

There are three ways to enter data via the input panel. On the left are three icons which represent the input methods:

-  *writing pad.* Simply write or print desired data and press INSERT.
-  *character pad.* Write or print an individual character in the character slots and press INSERT.
-  *onscreen keyboard.* Click each desired letter on the keyboard using the pen and press INSERT.

### Using the Theodolite Remote Focus

The remote focus feature (standard equipment as of SN FA42035F-87 and after, otherwise a remote focus kit is available for SN FA42035F-86 and before) allows the operator to focus the theodolite image on the Tablet PC screen at the controls of the Tablet PC docking station instead of making the necessary adjustments directly on the theodolite focus ring.

The remote focus assembly is equipped with a dual speed focus adjustment; SLOW or FAST. Flip the toggle switch (A) as follows:

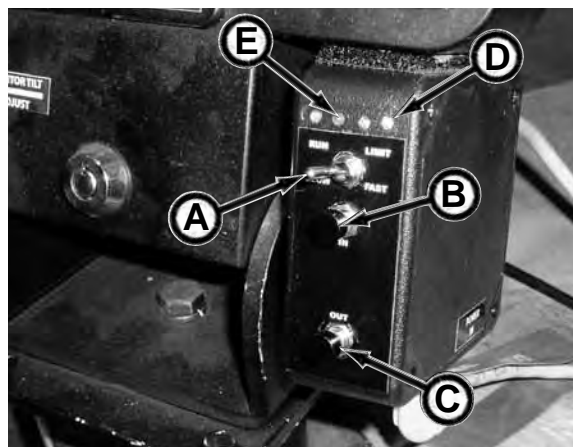
- SLOW - use for fine focusing.
- FAST - use for close or distant focusing.

Other Control Buttons:

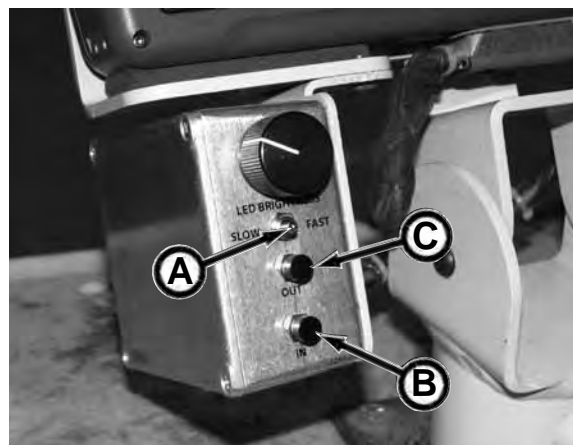
- Depress the IN button (B) for gradual adjustment during close focusing.
- Depress the OUT button (C) for gradual adjustment during distant focusing.
- Buttons can be toggled quickly for fine focus adjustment.

**NOTICE** (If equipped with Remote Focus Kit [SN FA42035F-86 & Before]) When the red LED LIMIT light (D) is illuminated, focus is at the end of travel and you must release button, and then reverse travel direction. Holding button with red LIMIT light illuminated could cause damage to motor and/or belt. The green LED RUN light (E) illuminates when the motor is running.

**NOTICE** (Tablet PC With Remote Focus [SN FA42035F-87 & After]) When the focus is at the end of travel, you will notice that there is no more focus adjustment or the belt will start slipping. Release travel button to prevent premature wear to motor or belt.



Remote Focus Control Kit (SN FA42035F-86 & Before)



Remote Focus Control (SN FA42035F-87 & After)

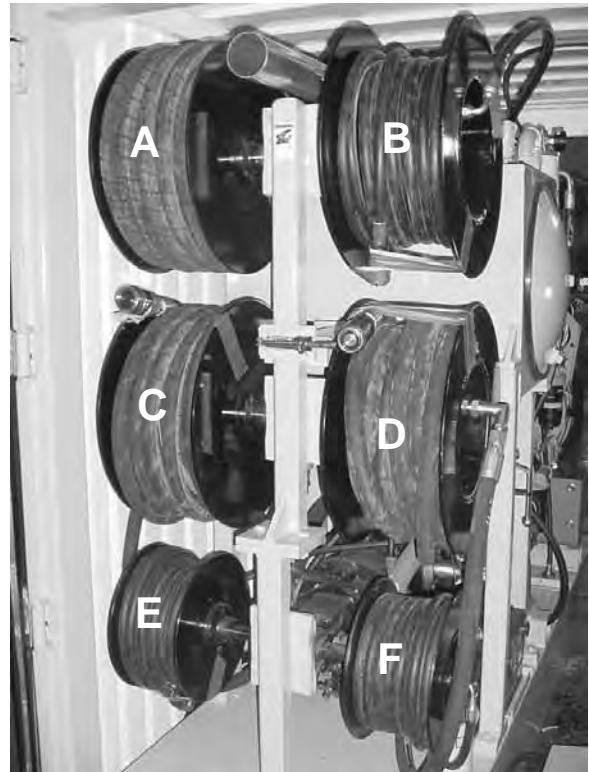
## P100Q POWER PACK

The P100Q power pack provides hydraulic power for the jacking frame and tooling components. The four cylinder, 99 HP diesel engine drives dual load sensing, variable volume, and torque limiting piston pumps.



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

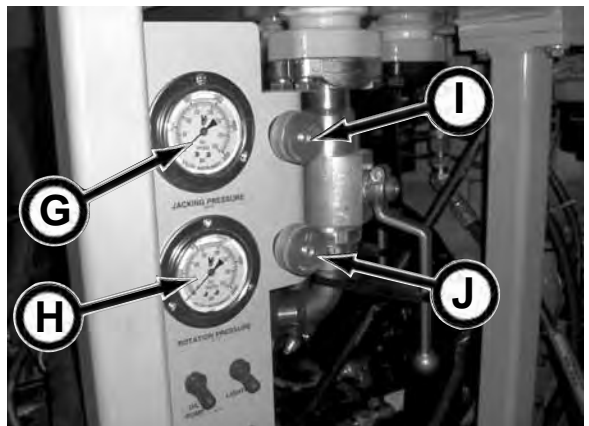


### Hydraulic Pressure Gauges & Adjustment Valves

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 Jacking Pressure in Operation section. The rotation adjustment valve (J) should not be adjusted.

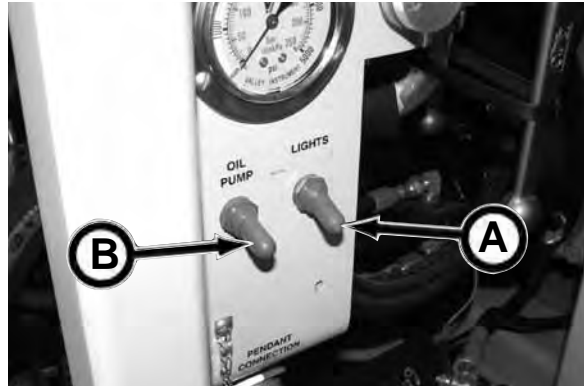


*P100 POWER PACK (continued)*

**Container Light Switch (A)**

**Oil Pump Switch (B)**

Turn switch ON to pump hydraulic oil into the hydraulic reservoir.



**Hydraulic Return Filter Indicators (C)**

To prevent under or over servicing of the hydraulic filter elements, filter indicators have been installed in your GBM Power Pack.

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

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

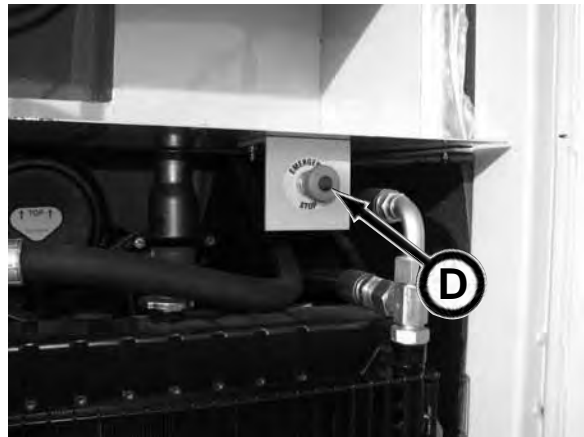


**Emergency Stop**

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

The button will light when it is pushed IN.

This button must be pulled out to restart engine.

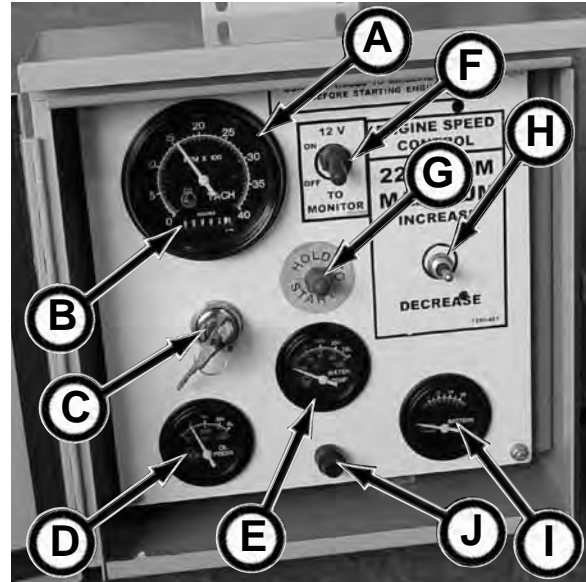


## CONTROL PENDANT - P100Q

### NOTICE

Refer to the Deere engine manual for more information.

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



### Tachometer (A)

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

### Hourmeter (B)

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

### Ignition Switch (C)

Turning switch clockwise to START position, applies power to the starter. Turning switch to OFF position, shuts down the engine.

### Oil Pressure (D)

The oil pressure gauge indicates oil pressure as follows:

Full load rated speed is 50 ± 15 psi (345 ± 103 kPa).

Minimum rated speed is 40 psi (275 kPa).

Minimum at 850 rpm is 15 psi (105 kPa).

This unit is equipped with a low engine oil pressure safety switch. If the oil pressure is too low, the engine will automatically shut down to prevent engine damage.

### Water Temperature (E)

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

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

### Monitor Switch (F)

Flip switch UP to provide power to the guidance system monitor or DOWN to shut down power to monitor. *Later models do not have this switch. As soon as the power engine starts, the 12V Monitor power with power up automatically.*

### Start Button (G)

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

### Engine Speed Control (H)

Flip switch UP to increase engine speed to a maximum 2200 rpm.

Flip switch DOWN to decrease engine speed.

### Battery (Voltmeter) Gauge (I)

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

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

### Fuse Holder (J)

Contains 14 amp fuse.

## **NOTES**

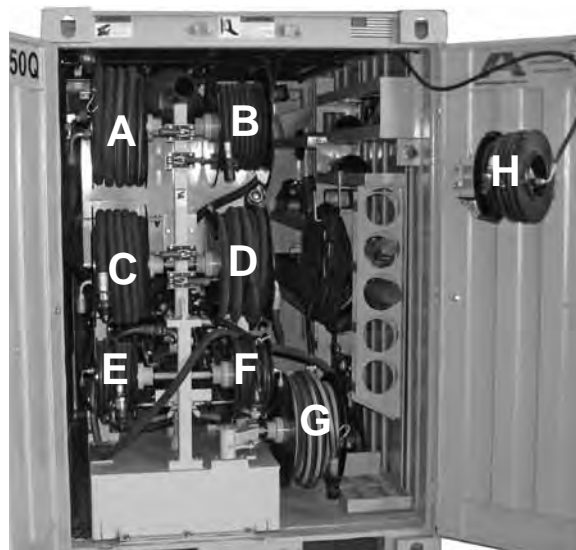
## POWER PACK P150Q CONTROLS

The P150Q power pack provides hydraulic power for the jacking frame and tooling components. The four cylinder, 154 HP diesel engine drives triple load sensing, variable volume, and torque limiting piston pumps.

The hydraulic hoses are stored on hose reels for ease of routing hoses to jacking frame and Powered Cutter Head.

The hoses are connected to the GBM/PCH hydraulic connections as follows:

- A – Return Hose Connection
- B – Case Drain Hose Connection
- C – Powered Cutter Drive Pressure Connection
- D – Thrust (Jacking) Pressure Hose Connection
- E – Powered Cutter Drive Load Sense Connection
- F – Thrust (Jacking) Load Sense Connection
- G – Rotation/PCH Auger Drive Pressure Connection
- H – Rotation/PCH Auger Drive Load Sense Hose Connection



### Hydraulic Pressure Gauges & Adjustment Valves

Use the pressure gauges to monitor the GBM jacking thrust, PCH cutter drive, and drive rotation/PCH auger drive pressures.

#### Jacking

240A/308A/339A - (J), 4812A - (I)  
Operating range in high pressure is up to 5,000 psi (34.474 MPa) with a maximum pressure of 6,000 psi (41.368 MPa).

#### PCH Cutter Drive

240A/308A/339A - (I), 4812A - (K)  
Operating range in high pressure is up to 4,000 psi (27.579 MPa) with a maximum pressure of 5,000 psi (34.474 MPa).

#### Drive Rotation/PCH Auger Rotation Drive

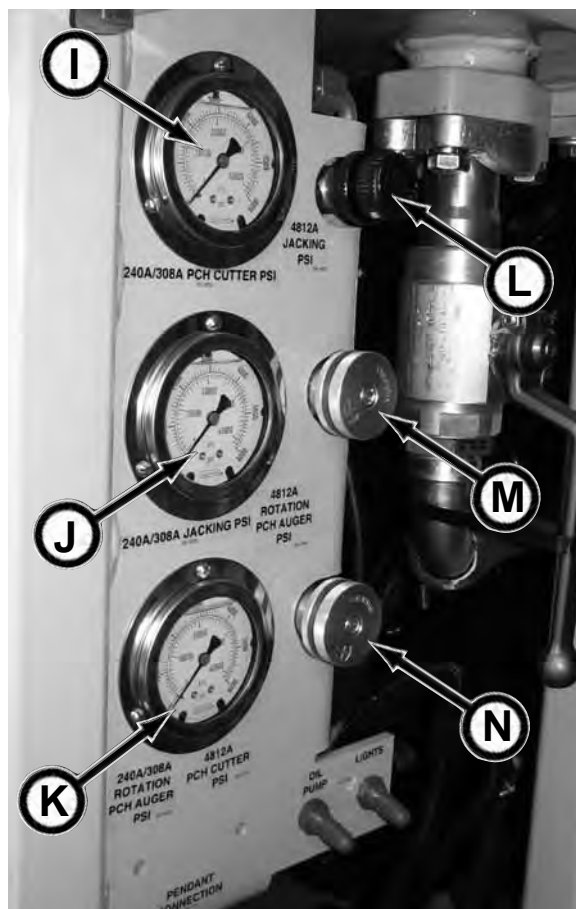
240A/308A/339A - (K), 4812A - (J)  
Operating range in high pressure is up to 4,000 psi (27.579 MPa) with a maximum pressure of 5,000 psi (34.474 MPa).

The pressure adjustment valves are factory set as follows:

**Jacking Valve** - 5,000 psi (34.474 MPa)  
240A/308A/339A - (M), 4812A - (L)  
If your pipe has a lower thrust load pressure rating, use adjustment valve to adjust the pressure to protect the product pipe. To adjust the pressure, refer Adjusting Jacking Pressure in Operation section.

**PCH Cutter Drive Valve** - 5,000 psi (34.474 MPa)  
240A/308A/339A - (L), 4812A - (N)  
The cutter drive adjustment valve should **only** be adjusted per factory instructions.

**Drive Rotation/PCH Auger Rotation Drive Valve**  
- 5,000 psi (34.474 MPa)  
240A/308A/339A - (N), 4812A - (M)  
The rotation adjustment valve should not be adjusted.



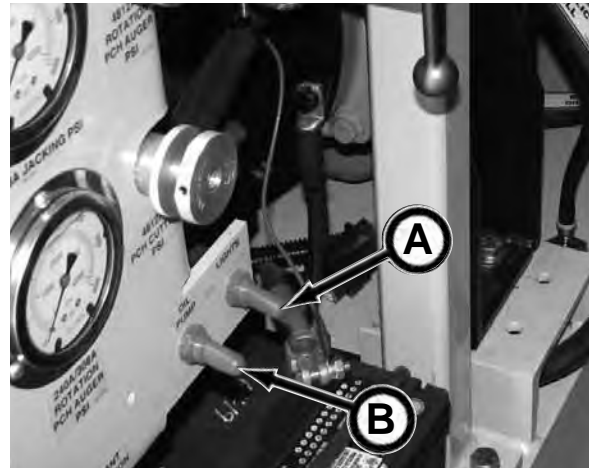
(continued on next page)

*P150 POWER PACK (continued)*

**Container Light Switch (A)**

**Oil Pump Switch (B)**

Turn switch ON to pump hydraulic oil into the hydraulic reservoir.

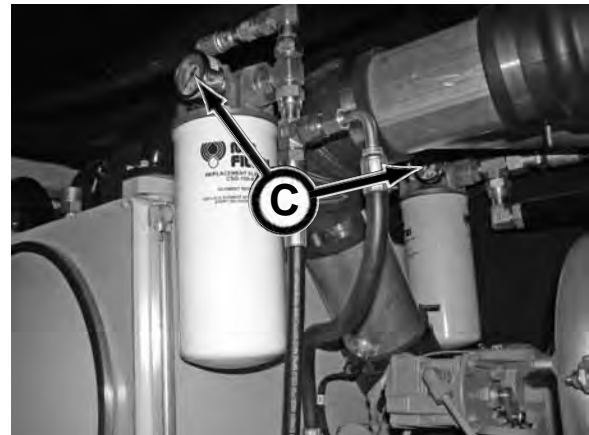


**Hydraulic Return Filter Indicators (C)**

To prevent under or over servicing of the hydraulic filter elements, filter indicators have been installed in your GBM Power Pack.

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

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

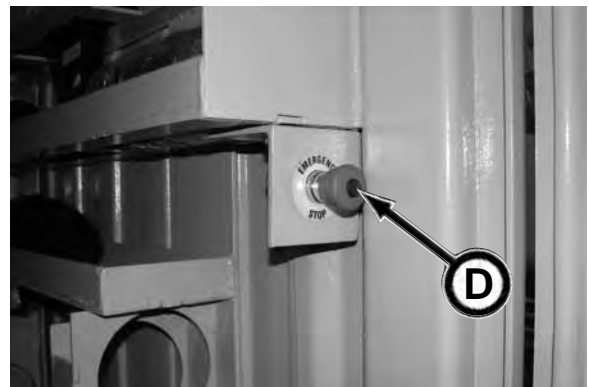


**Emergency Stop**

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

The button will light when it is pushed IN.

This button must be pulled out to restart engine.



**CONTROL PENDANT - P150Q****NOTICE**

Refer to the Deere engine manual for more information.

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

**Diagnostic Gauge/Hour Meter (A)**

The diagnostic gauge (A) displays diagnostic trouble codes (DTCs) as they are accessed. Other information on the engine can be accessed using the touch keys. The hour meter feature displays the operating hours of the engine and should be used as a guide for scheduling periodic maintenance. If the diagnostic gauge receives a trouble code from an engine control unit, the current display will switch to a warning or shutdown screen that will display the trouble code number, the description of the code and the corrective action needed.

**Tachometer (B)**

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

**Engine Oil Pressure Gauge (C)**

The oil pressure gauge indicates engine oil pressure as follows:

Full load rated speed is 50 ± 15 psi (345 ± 103 kPa).

Minimum rated speed is 35 psi (241 kPa).

Minimum at 800 rpm is 15 psi (105 kPa).

This unit is equipped with a low engine oil pressure safety switch. If the oil pressure is too low, the engine will automatically shut down to prevent engine damage.

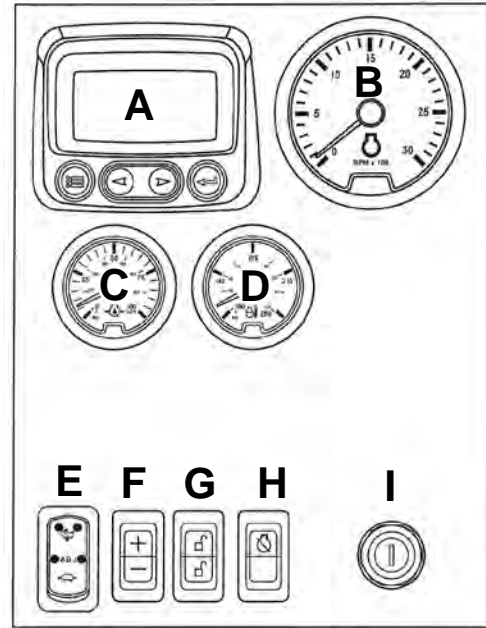
**Engine Coolant Temperature Gauge (D)**

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

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

**High-Low Speed Select Rocker Switch (E)**

The high-low speed select switch (E) is used to set the engine operating speeds at slow (turtle) or fast (rabbit). Factory preset idle speeds can also be adjusted using bump speed enable switch (G) with speed select switch (F).

**Speed Select Switch (F)**

The speed select switch (F) is used to bump engine speed up (+) or down (-) in small increments during operation. This switch must be used with the bump speed enable switch (G) in the unlocked position (top or bottom half of button depressed).

**Bump Speed Enable Switch (G)**

This is a three-position switch (G) with the center position as OFF (locked). With this switch in the OFF position, the speed select switch (F) is also locked, to prevent accidental changes in operating speed. Pressing upper or lower half of switch (G) will unlock or enable the bump speed switch to take effect using speed select switch (F).

**Override Shutdown Switch (H)**

Switch will be present, but may not be active, depending on engine controller (ECU) options originally selected. If switch is active, pressing the upper half of the override shutdown switch (H) will override an engine shutdown signal. The switch must be pressed within 30 seconds to prevent undesired shutdown of engine. Pressing this switch will override the engine shutdown for 30 seconds at a time to move vehicle to a safe location.

**Key Start Switch (I)**

The three-position key start switch (I) controls the engine electrical system. When the key switch is turned clockwise to START, the engine will crank. When the engine starts, the key is released and returns to the ON (RUN) position.

# Pre-Start Inspection

## **▲WARNING**

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

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

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

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

## **NOTES**

# Operation

## HOW TO USE THIS SECTION

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

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

### 6-5-1 Operation Guidelines

- 6-5-1 Operation Guidelines
- 6-5-2 GBM Installation Options

### 6-10-1 Shaft Set Up

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

### 6-15-1 GBM Frame Set Up In Shaft

- 6-15-1 Setting Up The GBM In Launch Shaft
- 6-15-3 Setting Up The GBM With Auger Boring Machine
- 6-15-5 Auger Boring Data Sheet
- 6-15-6 Quick Coupler Installation

### 6-20-1 Power Pack Operation

- 6-20-1 Starting The Engine - P100Q
- 6-20-3 Starting The Engine - P150Q
- 6-20-5 Stopping The Engine - P100Q
- 6-20-6 Stopping The Engine - P150Q
- 6-20-6 Emergency Stop
- 6-20-7 Adjusting Thrust Pressure

### 6-25-1 Guidance System Set Up

- 6-25-1 Checking Theodolite Zero Point Calibration
- 6-25-6 Assembling The Guidance System For The Latching Frame
- 6-25-13 Assembling The Guidance System For The Single Stage Frame
- 6-25-18 Preliminary Theodolite Set Up For Line & Grade
- 6-25-26 Tablet PC Start Up & Operation
- 6-25-34 Final Theodolite Set Up

### 6-30-1 Installing Pilot Tubes

- 6-30-1 Installing Steering Head Adapter To Steering Head
- 6-30-6 Installing Pilot Tubes
- 6-30-15 Log Of Progress

### 6-35-1 Installing Upsizing Tool

- 6-35-1 Auger Boring Method
  - 6-35-1 Weld-On Reaming Head Installation
  - 6-35-13 Open Face Cutter Head Installation
- 6-35-25 Three Step Method
  - 6-35-25 Auger Casing Installation With Reaming Head
  - 6-35-43 Auger Casing Installation With Open Face Cutter Head
- 6-35-63 Upsizing Tool Lubrication From Reception Shaft
- 6-35-65 Installing Safety Chain Assembly/Casing Auger Pin To Auger & Casing
- 6-35-67 Using Powered Cutter Head
  - 6-35-67 Use Jetting & Pipe Lubrication
  - 6-35-69 Soil Stabilization (Chemical Delivery)
  - 6-35-70 Installing Powered Cutter Head - Front Section
  - 6-35-81 Installing Powered Cutter Head - Rear Section
  - 6-35-90 Removing Powered Cutter Head From Reception Shaft

### 6-40-1 Installing Product Pipe

- 6-40-1 Three Step Method
  - 6-40-1 Installing Product Pipe

### 6-45-1 Miscellaneous

- 6-45-1 Pilot Tube Pullback Through Launch Shaft

*Operation*

## **NOTES**

# Operation - Operation Guidelines & Installation Options

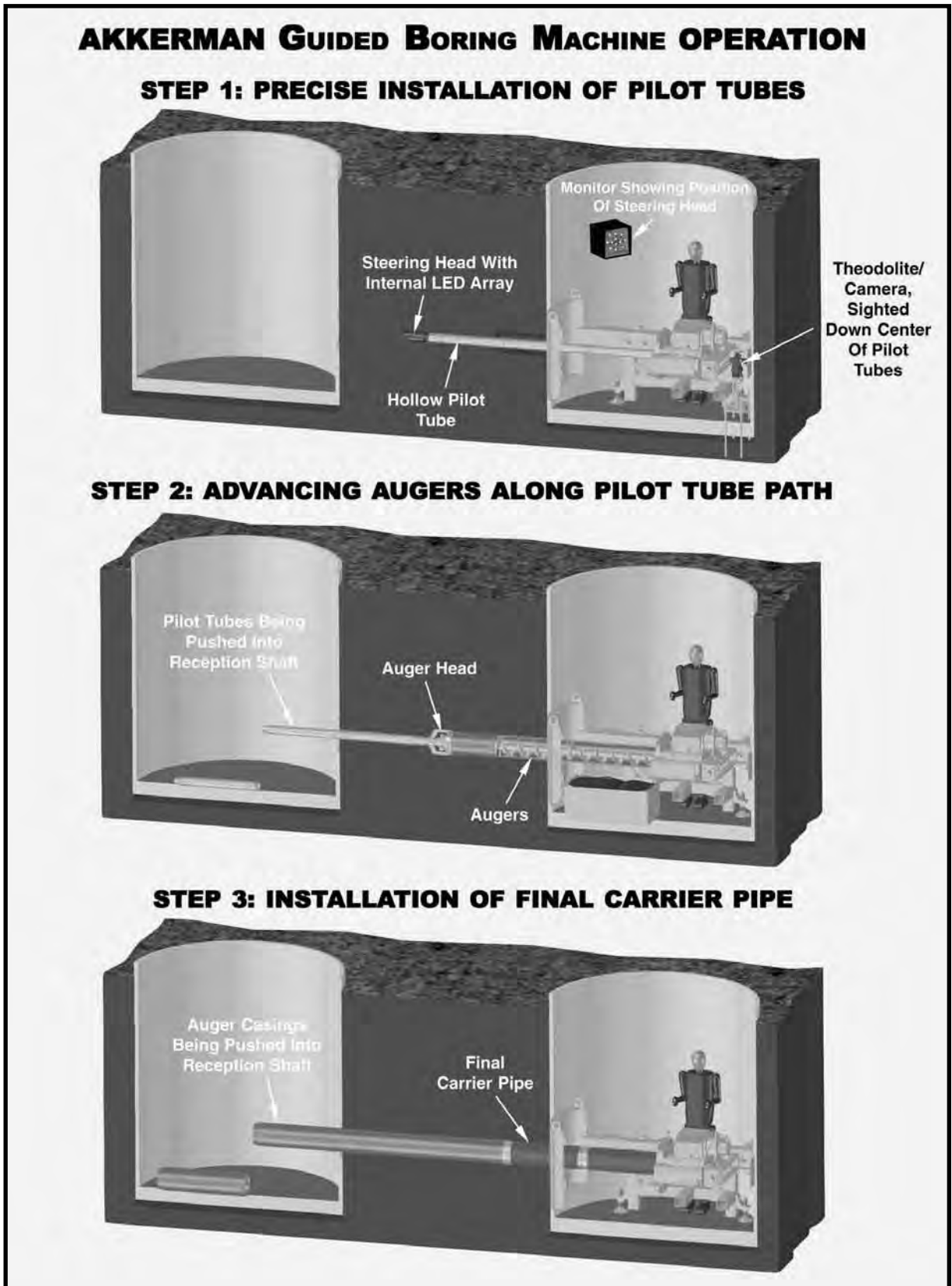
## OPERATING GUIDELINES

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

1. Before operating, read and understand the Safety, Pre-Start Inspection, and Operation sections.
2. Do not operate this equipment while under the influence of alcohol, drugs, or medication.
3. Follow all Federal, State, and Local safety regulations and procedures.
4. Be sure OSHA prescribed safety 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 your Akkerman Product Support representative for proper procedures on how to restore equipment for operation.
7. Have a fully charged fire extinguisher on the job site at all times.
8. Before operating, repair all equipment problems.
9. Be sure the excavated launch and reception pits or shafts are properly shored or braced to prevent slides or cave-ins.
10. Test air monitoring and ventilation detectors for proper operation. Never enter a tunnel without gas detectors.
11. A fully trained and qualified signal person must direct the excavator or crane operator when lifting and lowering equipment into the launch or reception pits.
12. Never walk or work under any part of the excavator or crane and suspended loads.
13. Remove plumb bobs from string lines and place in storage container after use. Never hang or secure plumb bobs over shaft. Doing so may cause severe injury or death from a falling plumb bob.
14. Operate jacking system at lowest pressure possible to prevent excessive heat build up.
15. 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. Lock out electrical power at the source (generator) before servicing electrical components.
18. Beware of pinch points.
19. If this manual is lost, contact your Akkerman Product Support Representative for a new manual or download this manual from the Akkerman web site at [www.akkerman.com](http://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

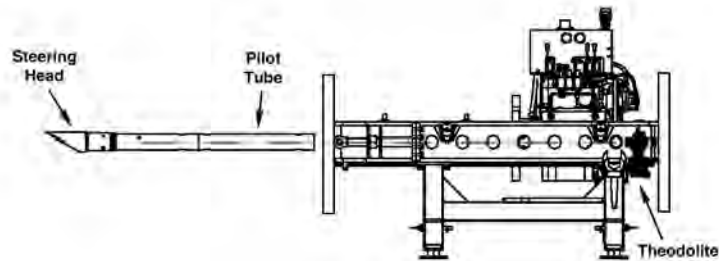
### I. Three Step Method (Typical) (11" - 16" OD [279 - 406 mm] Pipe)



## II. Three Step Method With Powered Cutter Head (20" - 31.5" OD [508 - 800 mm] Pipe)

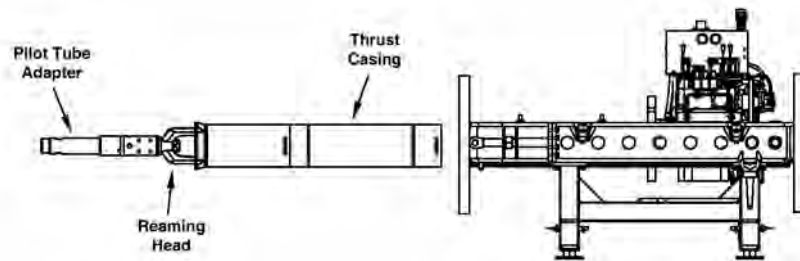
### Step 1: PRECISE INSTALLATION OF PILOT TUBES

The first step is the installation of the pilot tube on line and grade.



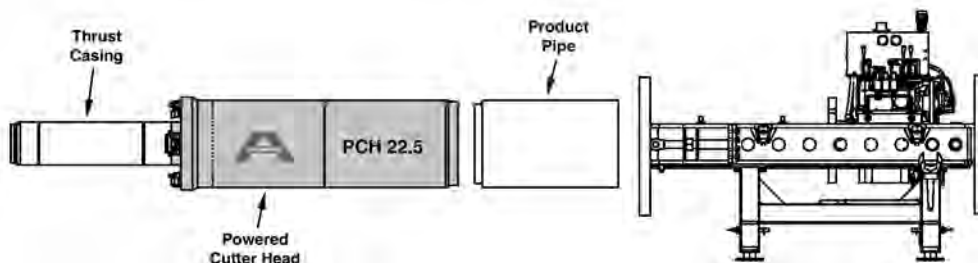
### Step 2: ADVANCING THRUST CASINGS ALONG PILOT TUBE PATH

The second step is to follow the pilot tube with a reaming head, or other upsizing tool, and standard thrust casings.

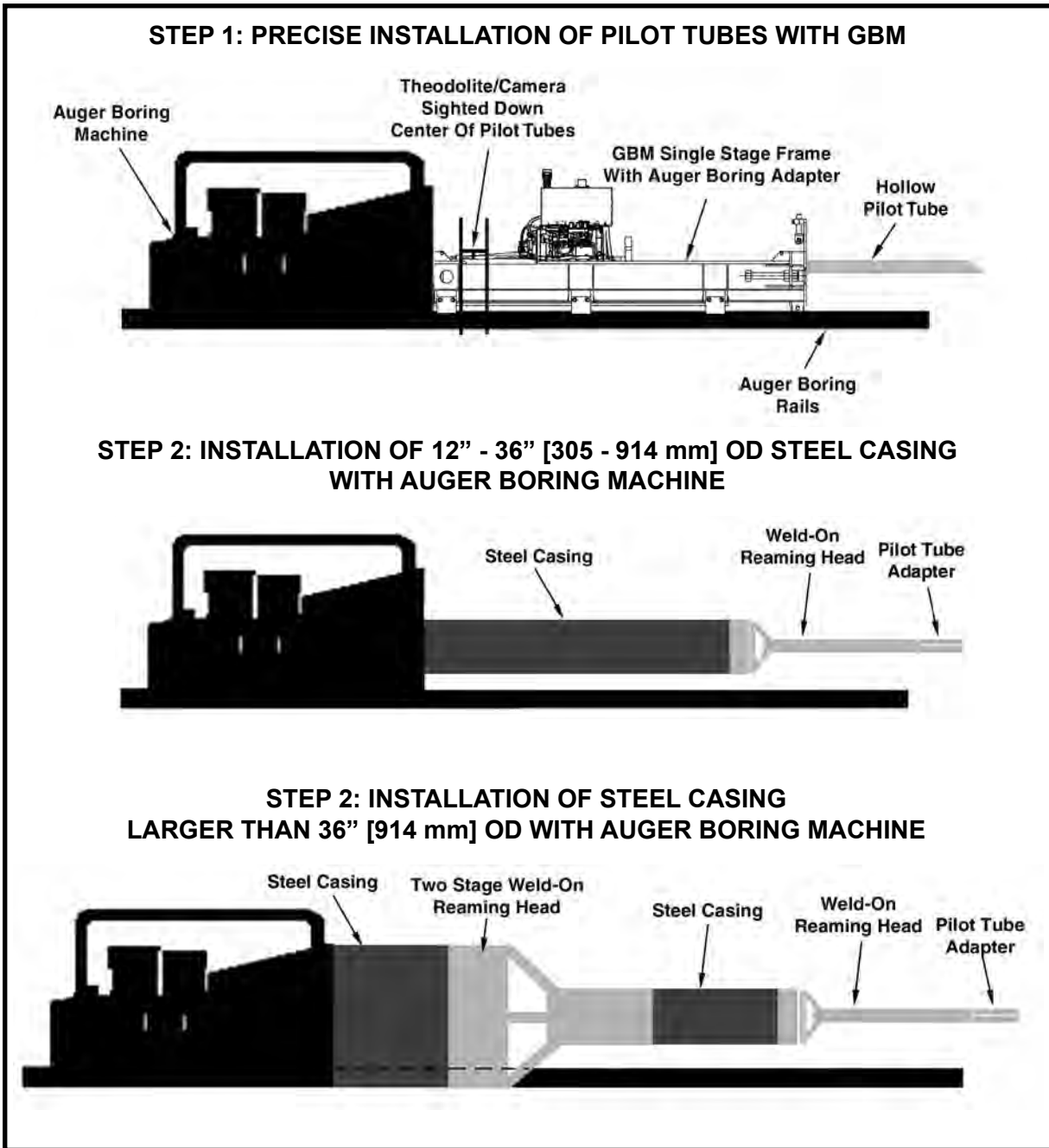


### Step 3: INSTALLATION OF PRODUCT PIPE WITH POWERED CUTTER HEAD

In the third step, the powered cutter head follows the thrust casings to increase the bore to match the product pipe diameter.



III. GBM / Auger Boring Machine Method



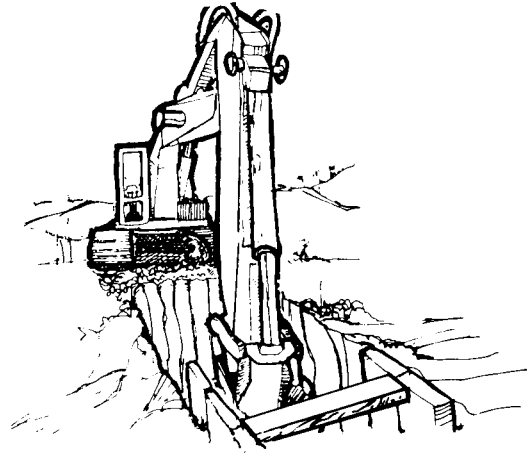
# Operation - Shaft Set Up

## SETTING UP THE LAUNCH AND RECEPTION SHAFTS

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

**⚠ 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.

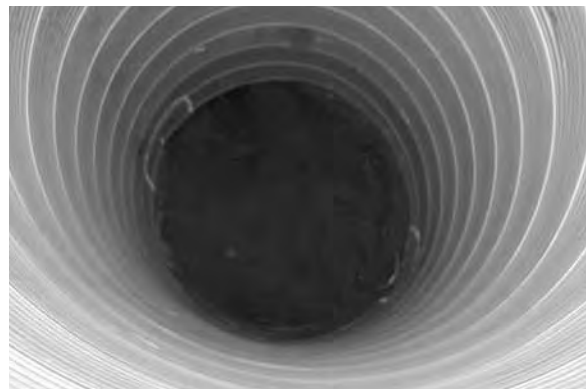
2. After the soil analysis, shaft layout design, and survey are complete, excavate the launch and reception shafts. Be sure the shafts will be well drained and use proper shoring or bracing in accordance with your local, state, and federal regulations.
3. Construct a shaft floor with a solid base suitable 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.



*AEM is the original author and publisher of the above illustration*

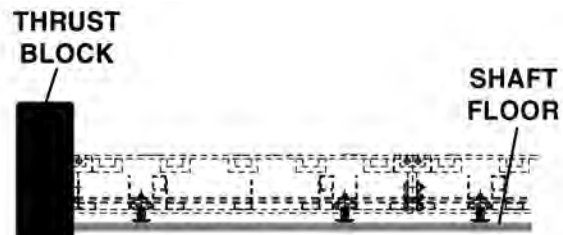


*Auger Boring Shaft*



*Round Shaft*

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



*Operation*

## **NOTES**

# Operation - GBM Frame Set Up In Shaft

## SETTING UP THE GBM IN LAUNCH SHAFT

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

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

**WARNING** Suspended loads may fall and cause severe personal injury or death. If a hydraulic hose 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** (Latching Frame Only) Frame extensions are available for 16", 24", 40", 56" or combinations of these sizes to meet the requirement of the product pipe.

1. Carefully lower GBM frame into position in launch shaft. Use a properly rated four leg sling (6,600 lb. [2,994 kg] minimum).

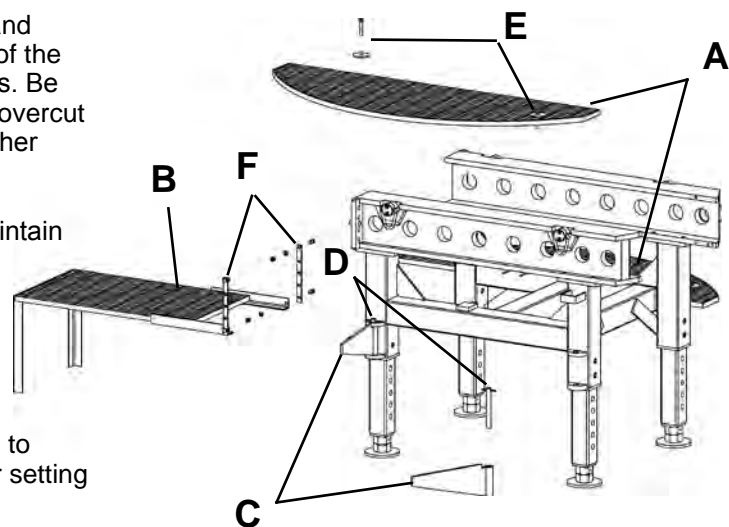
2. (Latching Frame Only) If needed, install operator side (A) and center (B) platforms as shown.

- a. Mount plate support arms (C) on GBM with pins (D).
- b. Lower platforms (A) on support arms (C).
- c. Move support arms to desired location and secure with four 3/4 x 2 in bolts and washers (E).
- d. Install two hanger brackets (F) and center platform. Secure center platform (B) to brackets.

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" [13 mm]) and the reaming head or other upsizing tool overcut.

**NOTICE** When using a PCH to maintain flowline, the machine must be set at an elevation of 1" above centerline. This will compensate for the 1/2" overcut when installing casings and augers and the 3/4" overcut for the PCH installation.

**NOTICE** Use a transit or string line to transfer the surveyor's marks to the shaft for setting the GBM frame on line.  
(continued on next page)



### Setting Up The GBM In Launch Shaft (continued)

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



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

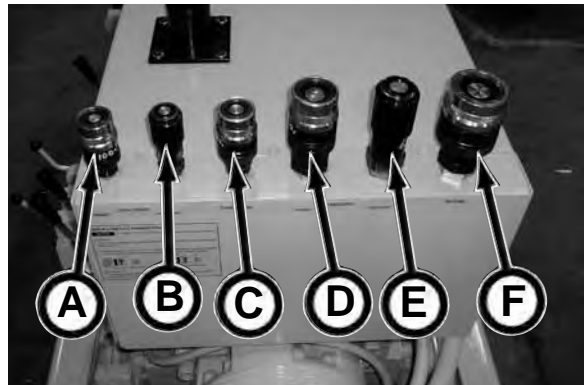
**⚠ WARNING** Do not position the GBM Power Pack near the edge of the shaft where the ground may be unstable and cause a slide or cave-in. Doing so could cause severe injury or death.



6. Slide the vertical exhaust pipe extension onto exhaust pipe and secure with clamp. Be sure the pipe extension is mounted in the vertical position as shown.



7. 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.



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

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

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

## SETTING UP GBM WITH AUGER BORING MACHINE

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

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



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



2. On the GBM jacking frame, position and secure the gearbox assembly in the middle of the frame. This will balance the frame during the installation process.
3. Lower the GBM jacking frame into position on the auger frame rails using a properly rated four leg sling (5,000 lb. [2,268 kg] minimum).



4. With the GBM jacking frame positioned on the auger frame rails, tighten the hardware to secure the position of the jacking frame to the frame rails.
5. After frame is secured, check the GBM jacking frame center to be sure it is on the same center as the auger drive used on your project.

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



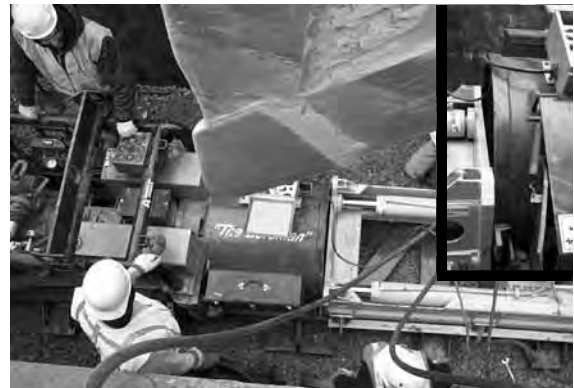
*(continued on next page)*

## Setting Up The GBM With Auger Boring Machine (continued)

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



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



- 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.

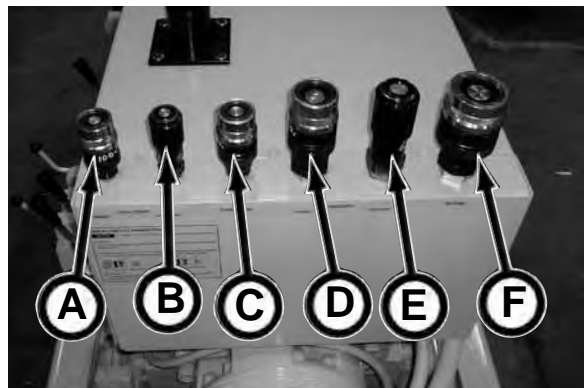


- With the power pack engine shut down, roll out the hydraulic hoses and connect the hoses to the GBM jacking frame hydraulic connections as shown: rotation load sense (A), thrust load sense (B), case drain (C), rotation pressure (D), thrust pressure, (E) and return (F). Refer to Quick Coupler Installation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

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

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

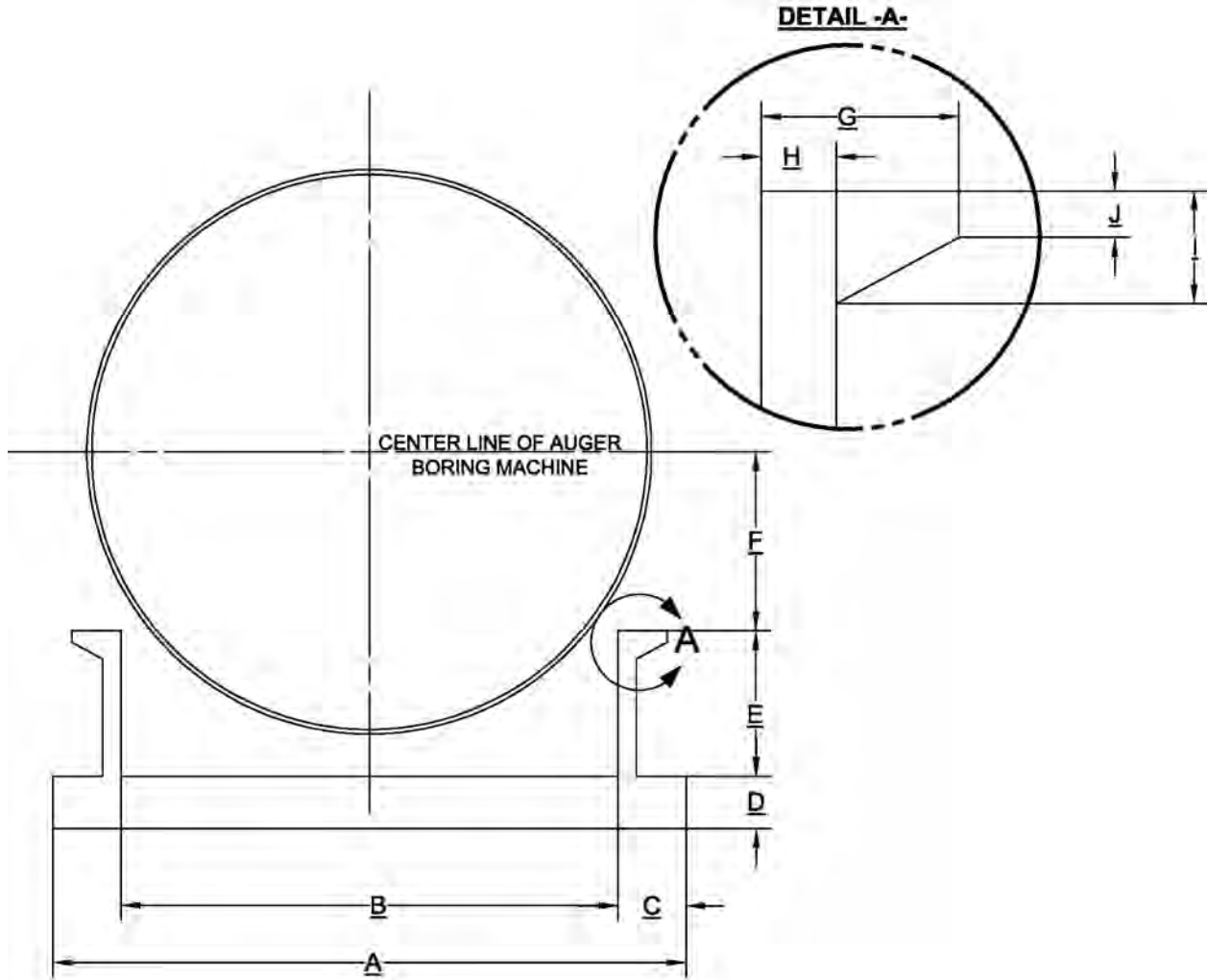
- Once the GBM and Power Pack are properly set up, proceed to Setting Up the Guidance System in this section.



## AUGER BORING DATA SHEET

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

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



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

## QUICK COUPLER INSTALLATION

There are three types of connectors used with the GBM. Use the following instructions to properly install the couplers. BEFORE installation, be sure to clean ALL mating surfaces to prevent contamination.

### 1. FASTER Quick Couplers

The Faster quick couplers are the jacking load sense, jacking pressure, drive rotation/PCH auger drive, and tank quick coupler connections.

#### NOTICE

If coupler is not fully locked, valve assembly damage will occur.

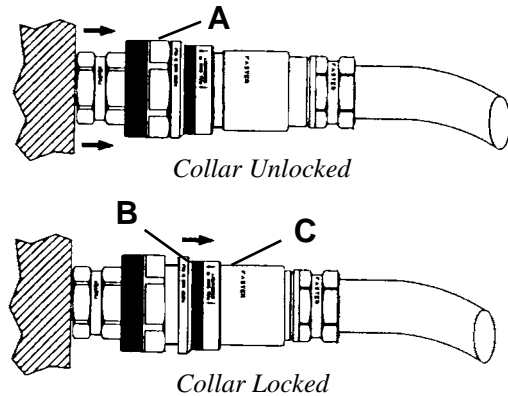
#### CONNECT

a. Rotate main sleeve (A) clockwise (CW) until locking collar (B) snaps against fitting end (C).

b. Check the locking mechanism, by rotating the main sleeve counterclockwise (CCW). If sleeve rotates, then the locking collar is not properly locked.

#### DISCONNECT

c. Pull locking cover back and rotate main sleeve counterclockwise (CCW) until hose is removed.



### 2. PERFECTING Quick Couplers

The Perfecting quick couplers are the cutter head pressure IN and the cutter load sense quick coupler connections.

#### NOTICE

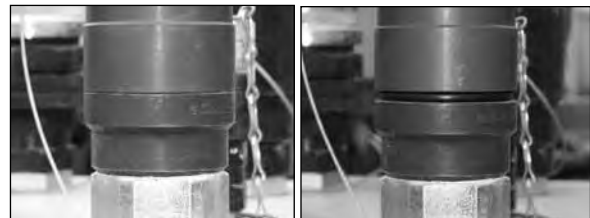
NEVER clamp on the coupler sleeve. This will cause distortion, resulting in coupler damage.

#### 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 hose is removed.



Connection Locked

Connection Unlocked

### 3. MULTIFASTER Quick Couplers

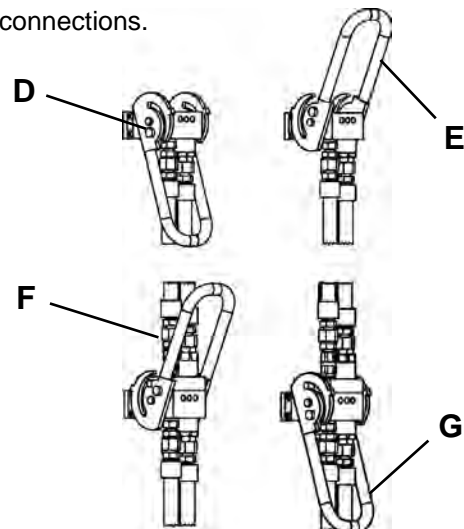
The Multifaster quick connection are the two PCH auger drive connections.

a. Flip up port dust cover, push red release button (D) IN while rotating handle UP (E) to release quick-disconnect.

b. Place male quick-disconnect (F) into position on female quick-disconnect block, and then rotate handle DOWN (G) until release button (D) pops out. Quick-disconnect is now locked into place.

c. When installing next pipe or when removing casing and auger in reception shaft, release disconnect to disable the cutter head functions. Failure to do so could result in serious injury from contact with rotating auger.

d. Reconnect male quick-disconnect after it has been communicated that you can proceed with advancement. The male quick-disconnect MUST be locked into place before cutter head will operate.



Quick-Disconnect Released

Quick-Disconnect Locked

# Operation - Power Pack Operation

## STARTING THE ENGINE - P100Q

**NOTICE** Refer to your engine Operator's Manual for detailed information on the proper break-in/cold weather starting and operation of your engine.

**NOTICE** ALL container doors MUST be open while engine is running to allow proper engine ventilation. Running engine with doors closed WILL cause engine damage.



1. Perform the daily maintenance items listed in section 9, Periodic Maintenance.
2. Clean hose connections prior to connecting hoses.



*P100Q Power Pack Hydraulic Hoses*

3. Connect hydraulic hoses from the power pack to the GBM frame connections BEFORE starting engine. Refer to step 4 below to install hoses to quick couplers.

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



*GBM Hydraulic Connections*

*(continued on next page)*

## Starting The Engine - P100Q (continued)

### 4. Quick Coupler Connection

**NOTICE** If coupler is not fully locked, valve assembly damage will occur.

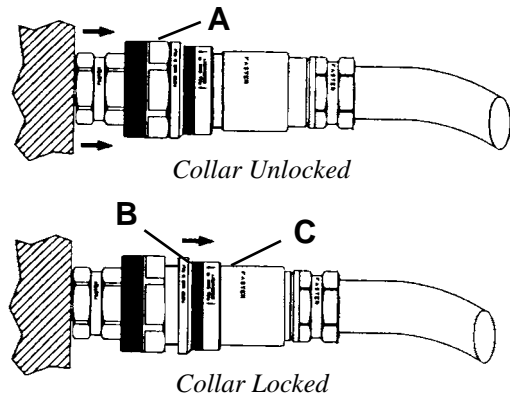
#### CONNECT

a. Rotate main sleeve (A) clockwise (CW) until locking collar (B) snaps against fitting end (C).

b. Check the locking mechanism, by rotating the main sleeve counterclockwise (CCW). If sleeve rotates, then the locking collar is not properly locked.

#### DISCONNECT

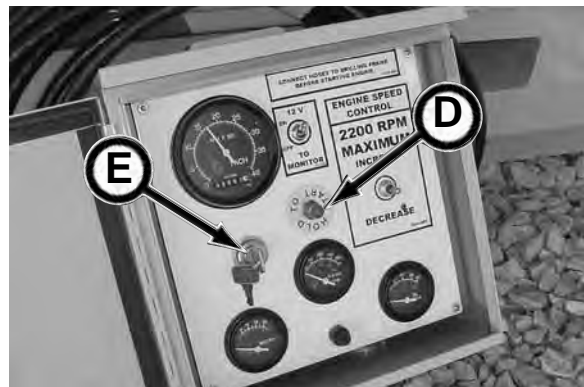
c. Pull locking cover back and rotate main sleeve counterclockwise (CCW) until hose is removed.



**NOTICE** BEFORE starting engine, be sure the thrust, rotation, and oil cooler suction valves are fully open and the valve handles tie strapped to prevent accidental closure.

**NOTICE** Do not operate starter for more than 30 seconds at a time. Doing so may cause the starter to overheat.

5. Depress and hold start button (D) while starting.
6. Turn the ignition switch (E) clockwise to crank the engine. When the engine starts, release the key so it returns to the ON position.
7. After the engine starts, continue to hold the start button until the oil pressure gauge reads at least 15 psi (105 kPa).
8. Check all gauges for normal engine operation. If operation is not normal (refer to Control Pendant - P100Q in the Control & Instruments section), stop the engine and determine the cause.



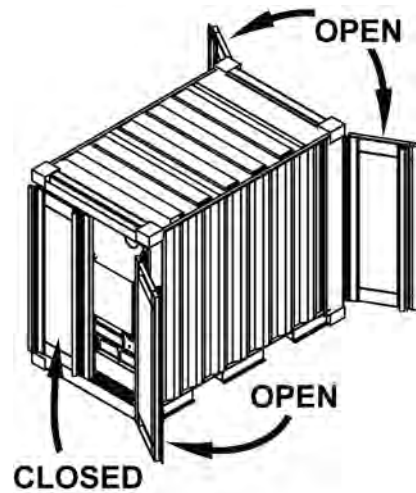
## STARTING THE ENGINE - P150Q

### NOTICE

Refer to your engine Operator's Manual for detailed information on the proper break-in/cold weather starting and operation of your engine.

### NOTICE

While engine is running, three container doors MUST be open and one door closed (as shown) for proper engine ventilation. Failure to do so WILL cause engine damage.



1. Perform the daily maintenance items listed in section 9, Periodic Maintenance.
2. Clean hose connections prior to connecting hoses.



*P150Q Power Pack Hydraulic Hoses*

3. Connect hydraulic hoses from the power pack to the GBM frame connections BEFORE starting engine. Refer to step 4 below to install hoses to quick couplers.

### NOTICE

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



*GBM Hydraulic Connections*

*(continued on next page)*

## Starting The Engine - P150Q (continued)

### 4. Quick Coupler Connection

**NOTICE** If coupler is not fully locked, valve assembly damage will occur.

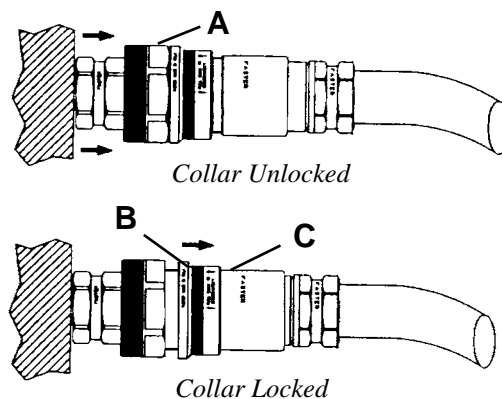
#### CONNECT

a. Rotate main sleeve (A) clockwise (CW) until locking collar (B) snaps against fitting end (C).

b. Check the locking mechanism, by rotating the main sleeve counterclockwise (CCW). If sleeve rotates, then the locking collar is not properly locked.

#### DISCONNECT

c. Pull locking cover back and rotate main sleeve counterclockwise (CCW) until hose is removed.

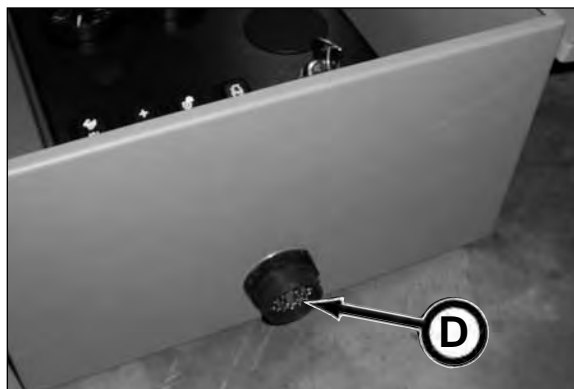


### 5. Check engine oil level. Add oil as necessary.

**NOTICE** BEFORE starting engine, be sure the thrust, rotation, and oil cooler suction valves are fully open and the valve handles tie strapped to prevent accidental closure and the Emergency Stop button is pulled out.



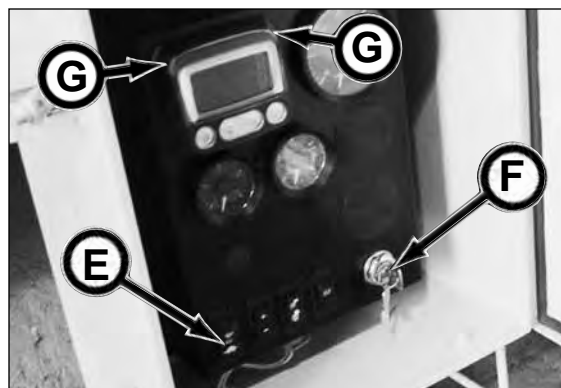
### 6. Connect power pack engine pendant cable to control pendant port (D).



### 7. Set slow idle by pressing lower half (turtle) of high-low speed select switch (E).

**NOTICE** Do not operate starter for more than 30 seconds at a time. Doing so may cause the starter to overheat.

8. Turn the key switch (F) clockwise to the ON position. Once the indicator lights (G) turn off, turn the key switch clockwise to the START position to crank the engine. When the engine starts, release the key so it returns to the ON position.



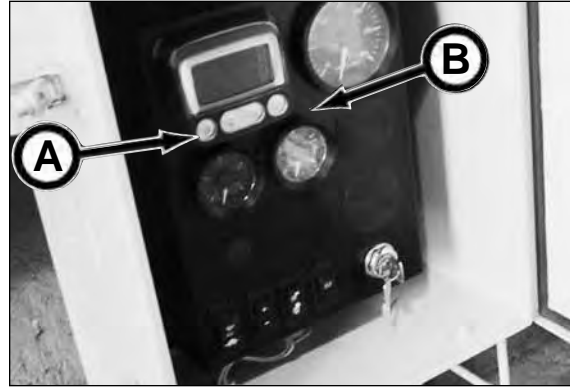
(continued on next page)

### Starting The Engine - P150Q (continued)

9. As soon as the engine starts, check oil pressure gauge (A).

If gauge needle does not rise above minimum oil pressure specification of 105 kPa (1.05 bar) (15 psi) within 5 seconds, stop the engine and determine the cause. Normal engine oil pressure should be 345 kPa  $\pm$  103 (3.45  $\pm$  1.03 bar) (50  $\pm$  15 psi) at rated full load speed (1800 - 2400 rpm) with oil at normal operating temperature of 115°C (240°F).

10. After engine starts, idle engine at no more than 1200 rpm until warm.
11. Watch coolant temperature gauge (B). Do not place engine under full load until it is properly warmed up. The normal engine coolant temperature range is 82° - 94°C (180° - 202°F).
12. Check all gauges 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.



### STOPPING THE ENGINE - P100Q

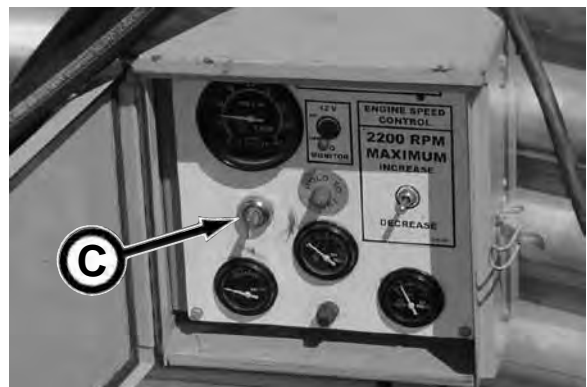
1. Flip the engine speed control down until engine speed is at idle.



#### NOTICE

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

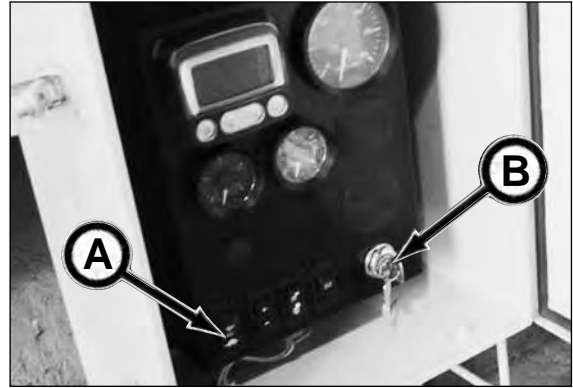
2. Turn ignition switch (C) counterclockwise to the OFF position to stop the engine.
3. Remove ignition key.



## STOPPING THE ENGINE - P150Q

**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 1,000 - 1,200 rpm for at least two minutes to cool.
2. Flip the high-low speed select switch (A) down to low idle.
3. Turn key switch (B) counterclockwise to the OFF position to stop the engine.
4. Remove ignition key.



## EMERGENCY STOP (E-STOP)

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

The button will light when it is pushed IN.

This button must be pulled out to restart engine.

**NOTICE** The emergency stop button must be pulled out for engine to start.



*P100Q Power Pack*



*P150Q Power Pack*

## ADJUSTING THRUST PRESSURE

To protect your product pipe, you must be sure the product pipe rating can withstand the thrust pressure of the GBM. The factory setting is 5,000 psi (34.474 mPa). If your pipe is rated lower than 5,000 psi (34.474 mPa), the GBM thrust pressure must be adjusted.

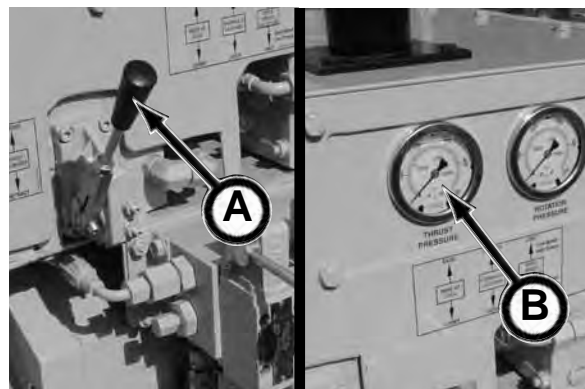
1. Check the thrust pressure rating for your product pipe.



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

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

3. With the power pack hydraulic hoses connected to the GBM and the power pack engine running, fully retract the GBM jacking cylinders by using the thrust cylinder control (A).
4. Check the thrust pressure on the drilling system pressure gauge (B) on the GBM or power pack.



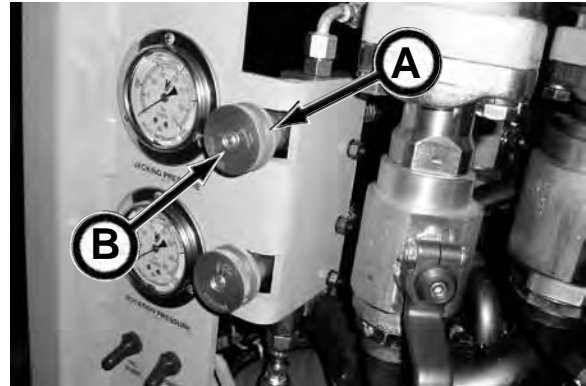
(continued on next page)

**NOTICE**

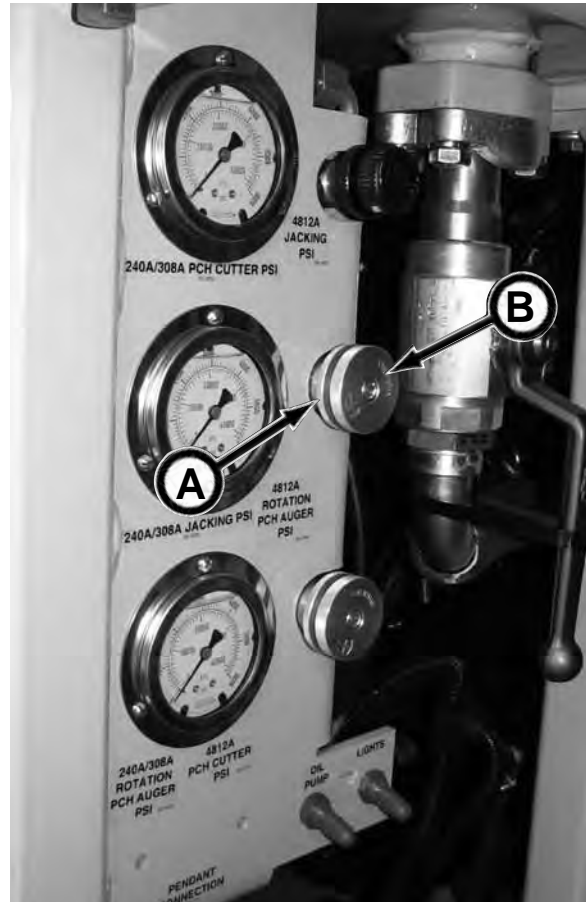
Only a qualified service technician is allowed to perform pressure adjustments to the power pack.

If the pressure needs to 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.



*P100Q Power Pack*



*P150Q Power Pack*

# 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. Remove the 40X eyepiece with barrel and install the 30X eyepiece (included) to telescope.
2. Move telescope to the horizontal position and lock position with vertical lock knob.



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



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



*(continued on next page)*

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

**NOTICE**

It is easier to level theodolite in step 5 if you use the same two leveling screws that you used in step 4.

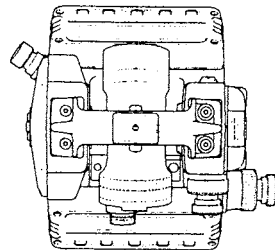
6. Repeat steps 4 and 5 until theodolite is level in both directions.



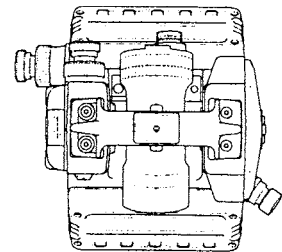
7. Once theodolite is level, rotate theodolite 180° and check plate level (B) to ensure the theodolite is completely level.

If theodolite is not level, proceed to step 8.

If theodolite is level, proceed to step 10.



*Theodolite Leveled In Step 7*



*Theodolite Rotated 180° To Check Level In Step 8*

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



*(continued on next page)*

9. Relevel theodolite (repeat steps 4 through 7).

10. Turn ON theodolite.



11. "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".



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



**NOTICE**

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



(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.

13. Once the stationary object is positioned in the cross hairs, press the RESET button. The LED display will read HA: 00° 00' 00".

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



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

**NOTICE**

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



15. Using the horizontal fine adjust, turn knob until the horizontal alignment reads HA: 180° 00' 00".



16. Look into the telescope. The stationary object should be within the cross hairs.
17. If the stationary object is not within the cross hairs, the theodolite is out of adjustment and must be recalibrated. Refer to the Nikon NE-202 Instruction Manual.

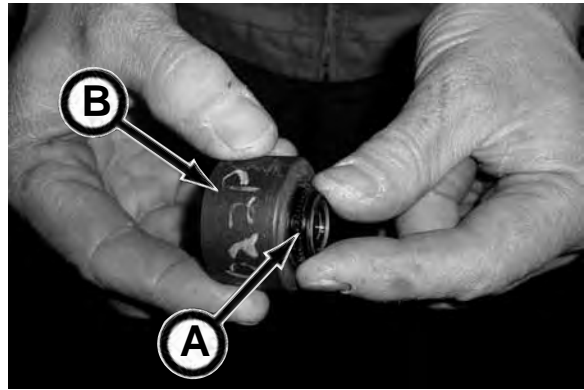


*(continued on next page)*

18. Remove the 30X eyepiece from telescope.
19. 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 19a and 19b.

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



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



## ASSEMBLING THE GUIDANCE SYSTEM FOR THE LATCHING FRAME

1. Install the guidance system mounting base at rear of launch shaft. The base should be centered between the frame rails and 2.5 in. to 2-3/4 in. (63.5 to 70 mm) from frame cross member to front of mounting rods.
2. Using the mounting base as a guide, drive the four rods through the base and into the ground until they are in solid material. The base must have at least a 3" (76 mm) clearance on the bottom side of the plate so the theodolite stand can be mounted.

### NOTICE

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

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

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

*(continued on next page)*



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



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

**NOTICE** If using full leg extension on GBM frame, you may need to either install an extension prior to the elevator column or use longer mounting rods to achieve proper theodolite height.



7. Hand tighten elevator column adapter to lateral slide.



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



*(continued on next page)*

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

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



10. Remove battery cover.

**NOTICE**

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



11. Separate cover from battery holder.

12. Install six new AA batteries into battery holder.



13. Secure battery holder into cover and replace cover.



*(continued on next page)*

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



15. Rotate theodolite 90 degrees and adjust until level.
16. Repeat steps 14 and 15 until theodolite is level in both directions.



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



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

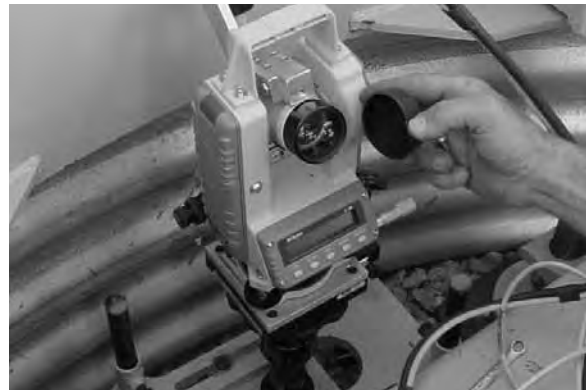
**NOTICE** Place bolts on camera bracket before positioning bracket against theodolite.

**NOTICE** Be sure vertical lock is not set on theodolite.



*(continued on next page)*

19. Remove telescope lens cap.



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



21. Secure LED light cable to counterweight.

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

**NOTICE** BEFORE powering up guidance system and power pack, refer to Tablet PC Start Up & Operation - Checking Guidance System Camera Connections in this section.



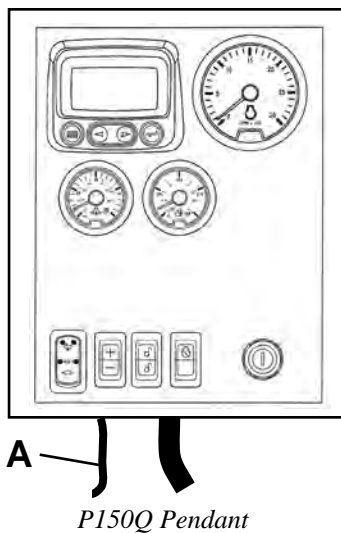
*(continued on next page)*

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

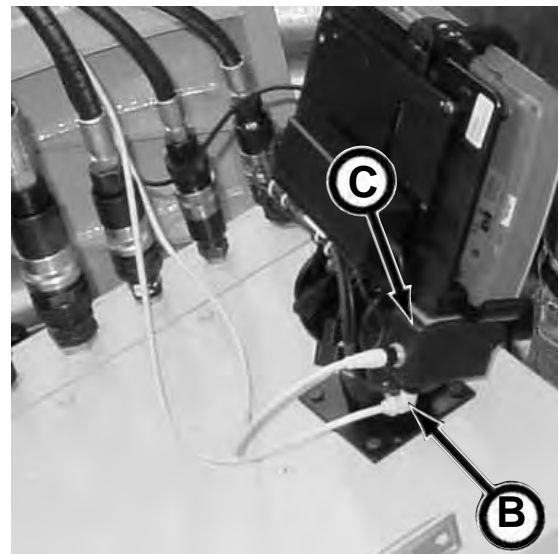


23. Install tablet PC connections:

- a. Attach power cable to pendant (A) and Power In connection (B) on tablet assembly control box (C).



P100Q Pendant

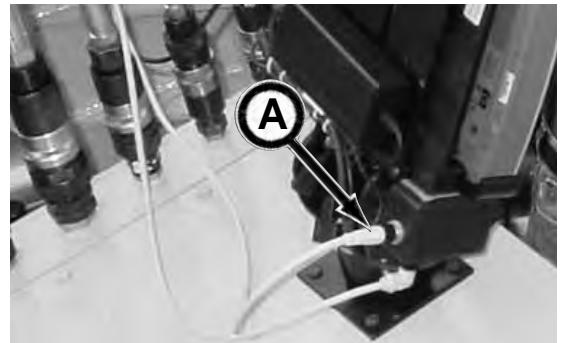


(continued on next page)

b. Connect camera cord from tablet assembly control box to camera connection.



c. Connect LED cable (A) to port on tablet assembly control box.



24. Proceed to Preliminary Theodolite Setup For Line & Grade in this section.

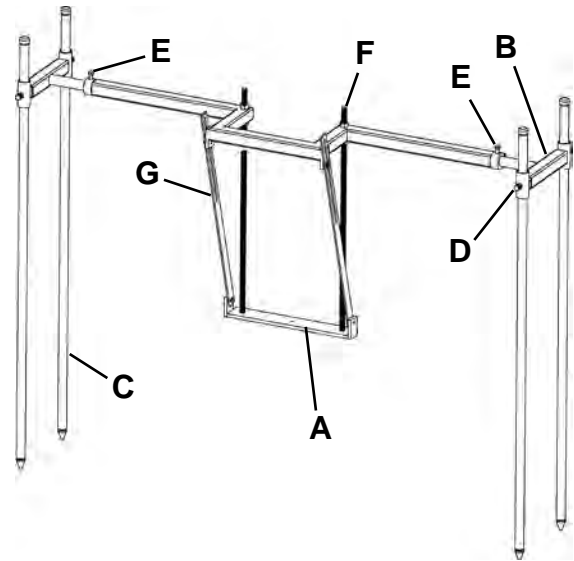
## ASSEMBLING THE GUIDANCE SYSTEM FOR SINGLE STAGE FRAME

1. Install the guidance system mounting stand. The theodolite pad (A) should be centered between the frame rails.
2. Using the stand frame (B) as a guide, drive the four rods (C) into the ground until they are in solid material.

### NOTICE

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

3. Lower the frame over the rods so the frame does not touch the GBM frame or any moving parts (such as the fittings on the thrust cylinders) and secure to frame with set screws.
4. Level frame side to side with set screws (D) on rods.
5. Center theodolite pad assembly with center line of jacking frame and level frame front to back with frame set screws (E) using plumb bob, if possible.
6. Attach lateral slide to theodolite pad (A) with one 5/8 in. brass bolt.



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



**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.

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

(continued on next page)



8. Remove battery cover.

**NOTICE**

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

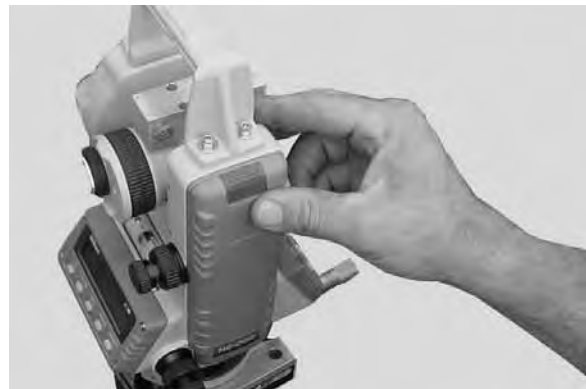


9. Separate cover from battery holder.

10. Install six new AA batteries into battery holder.



11. Secure battery holder into cover and replace cover.

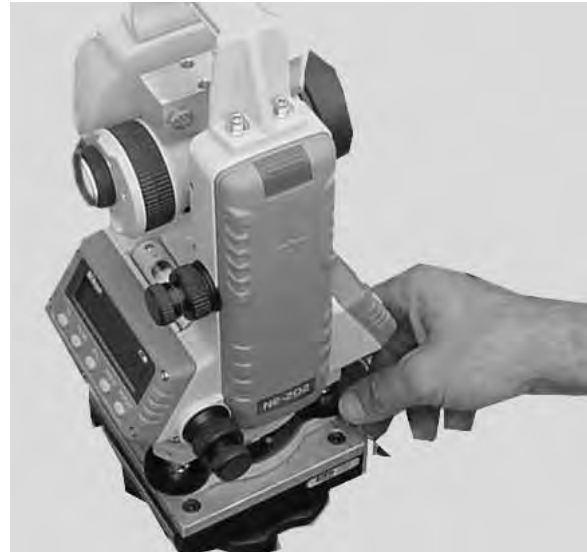


12. Level theodolite with adjustment knobs located on the theodolite base.

*(continued on next page)*



13. Rotate theodolite 90 degrees and adjust until level.
14. Repeat steps 12 and 13 until theodolite is level in both directions.



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



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

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

**NOTICE** Be sure vertical lock in not set on theodolite.

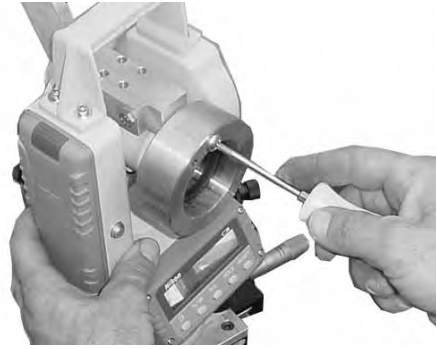


17. Remove telescope lens cap.

*(continued on next page)*



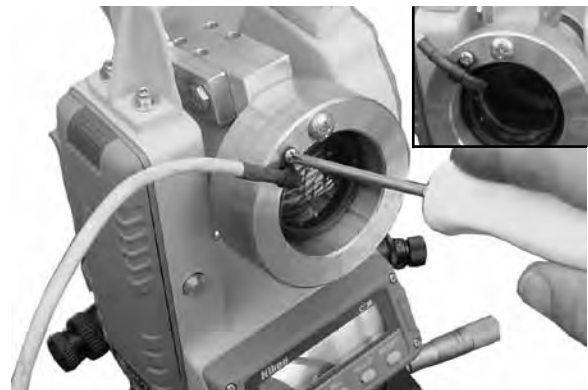
18. Attach counterweight to telescope and secure with one 1/4 x 2 in. screw.



19. Secure LED light cable to counterweight.

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

**NOTICE** BEFORE powering up guidance system and power pack, refer to Tablet PC Start Up & Operation - Checking Guidance System Camera Connections in this section.



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

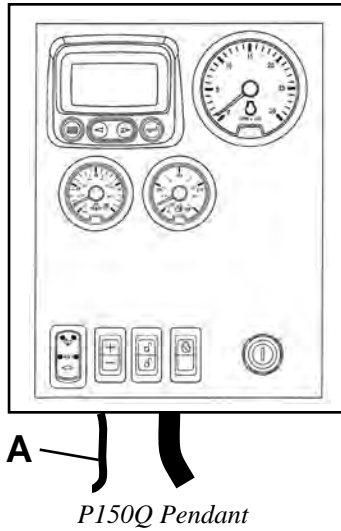


*(continued on next page)*

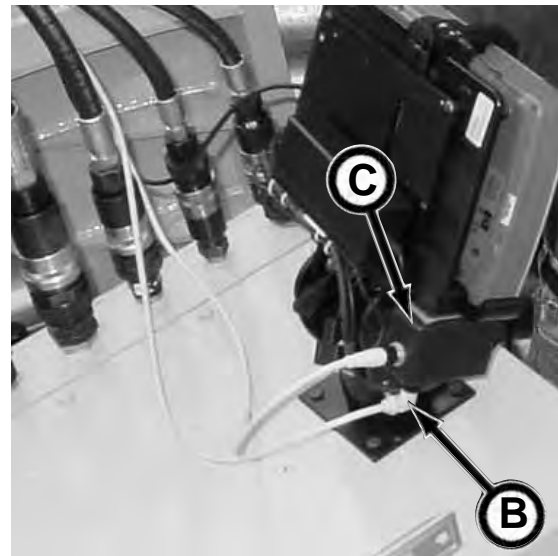
21. Install tablet PC connections:

- a. Attach power cord to pendant (A) and Power In connection (B) on tablet assembly control box (C).

**NOTICE** Tablet PC must be OFF before starting engine.



P100Q Pendant

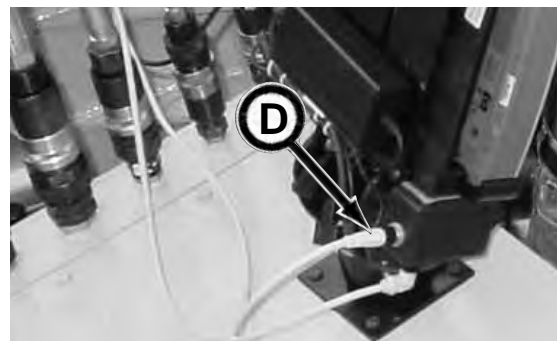


**NOTICE** If equipped with tablet PC system SN FA42035F-086 and before WITH the remote focus assembly kit FA42096F, use the installation instructions provided with the kit to install the tablet PC connections.

- b. Connect camera cord from tablet assembly control box to camera connection.



- c. Connect LED cable (D) to port on tablet assembly control box.



22. Proceed to Preliminary Theodolite Setup For Line & Grade in this section.

## PRELIMINARY THEODOLITE SETUP FOR LINE & GRADE

### NOTICE

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

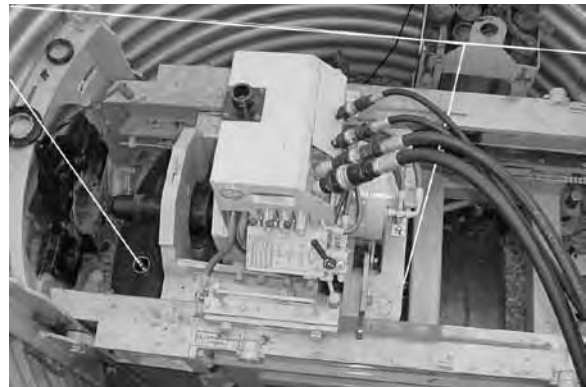
1a. Using the surveying marks on edge of shaft, run a string line between these two marks to set the line of the theodolite. Then use two lines and plumb bobs to transfer the surveying marks to the shaft floor.

### NOTICE

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



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

### NOTICE

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



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

### NOTICE

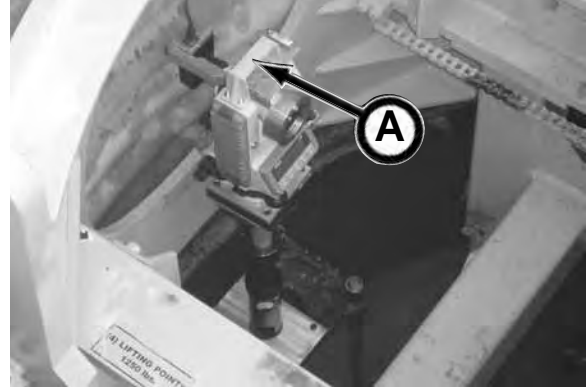
Be sure plumb bob is free to move in oil. Do not allow the plumb bob to touch the bottom or sides of cup.

*(continued on next page)*



### ROUGH CENTER ALIGNMENT

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



### LEVELING THEODOLITE

3. Adjust theodolite until level with the adjustment knobs.



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



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

*(continued on next page)*



6. Turn ON theodolite.



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



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



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



*(continued on next page)*

10. With the vertical fine adjust knob (small knob), adjust the VA reading until  $90^{\circ} 00' 00''$  or 0.00% is displayed.

**NOTICE**

For more information, refer to Understanding Grade Degrees Versus Grade Percent, in the Specifications section.



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

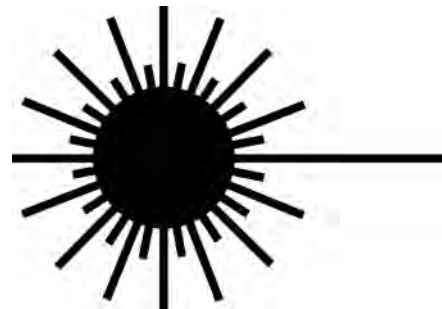
**IMPORTANT! DO NOT USE THE HOLD BUTTON WITH THE GBM SYSTEM!** Doing so will freeze the displayed horizontal angle readout which will remain unchanged regardless of theodolite directional movement.



**⚠ DANGER**

Staring into laser light will cause severe injury.

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



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

**NOTICE**

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

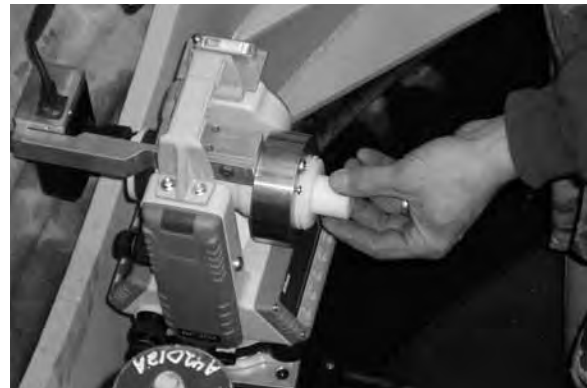


*(continued on next page)*

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



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. Move the gear box assembly as far forward as possible.
- b. Insert the target completely into the drive swivel. Do not turn on target.
- c. The laser bore light should be centered on the middle dot of the target.
- d. If the laser beam is not centered on the middle dot of the target, move the elevation of the theodolite until the laser beam is centered on the target's middle dot by: loosening column lock, raise or lower column with handle and relock column.
- e. Relevel theodolite.



*(continued on next page)*

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



#### PRELIMINARY STRING LINE CALIBRATION

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



#### NOTICE

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



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



*(continued on next page)*

**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 on theodolite 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 by inserting rod (included) through hole in holder and gently push the laser bore sight out of holder.



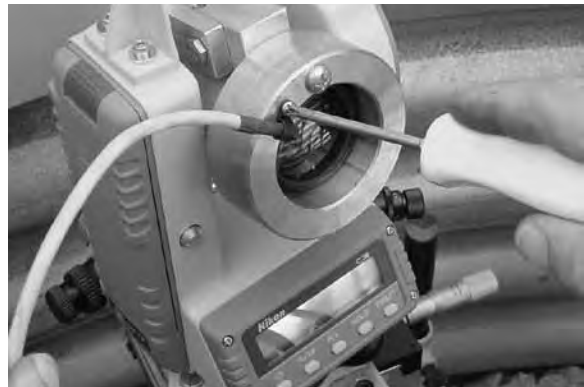
*(continued on next page)*

**⚠ DANGER** Staring into laser light will cause severe injury.

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 cross hairs to display on monitor.



27. Proceed to Tablet PC Start Up & Operation or to Final Theodolite Setup in this section.

## TABLET PC START UP & OPERATION

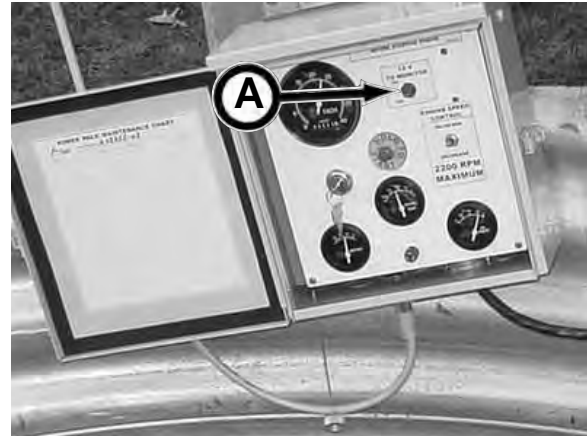
### NOTICE

Before starting up tablet PC, be sure the theodolite zero point calibration is checked, and the guidance system is properly assembled.

1. Start power pack, and flip ON 12V To Monitor switch (A) on pendant. *Later models do not have this switch. As soon as the power pack engine starts, the 12V Monitor power will power up automatically.*

### NOTICE

If the 12V To Monitor switch is not ON, the tablet screen will display a No Camera Present window. If switch is Off, turn switch On, then restart GBM\_System program. You do not need to restart computer.

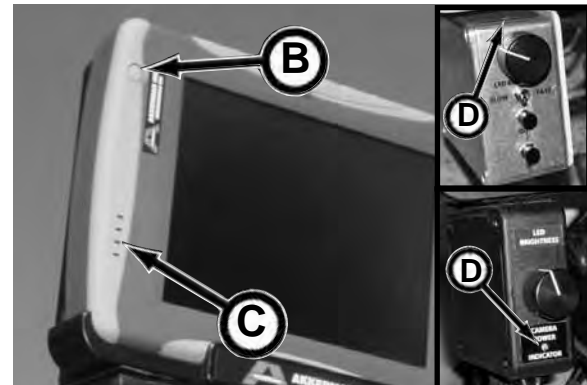


P100Q Pendant

### NOTICE

If you are connecting a new camera to a tablet PC for the first time, refer to Connecting New Camera, in this section, prior to powering up tablet PC as stated in item 2 below.

2. Power ON (B) tablet PC.
3. Check to be sure the PC power indicator light (C) and the Camera Power indicator (see inset) light (D) are illuminated. If not, refer to Checking Guidance System Camera Connections in this section.



4. 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.



(continued on next page)

## On & Off Control

To turn on (boot up) tablet PC, depress power button (A). The GBM\_System program automatically loads once the Windows operating system is loaded.

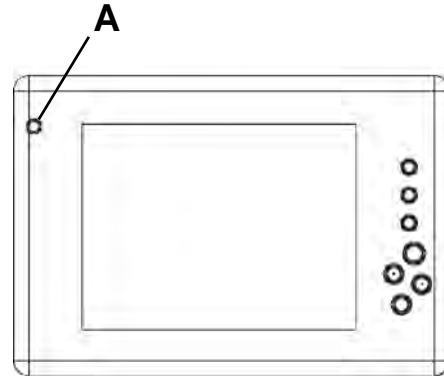
**NOTICE** If a DOS screen appears, the Windows operating system did not load properly. Refer to “Problem: Windows operating system and the Akkerman GBM\_System ... A DOS screen appears” in section 11, Troubleshooting to resolve this issue.

To turn off or shutdown tablet PC power, close the GBM-System program, and depress power button (A) briefly (1 second).

### HARD POWER DOWN

**NOTICE** Use this procedure ONLY as a last resort. This shutdown method will take significantly longer (in excess of 5 minutes) to reboot since the Windows program performs a Disk Check.

If computer does not respond when: depressing the tablet buttons, using the digitizer pen, computer fails to shutdown or is frozen; depress power button (A) and hold for 7 to 10 seconds. Also, refer to section 11, Troubleshooting.

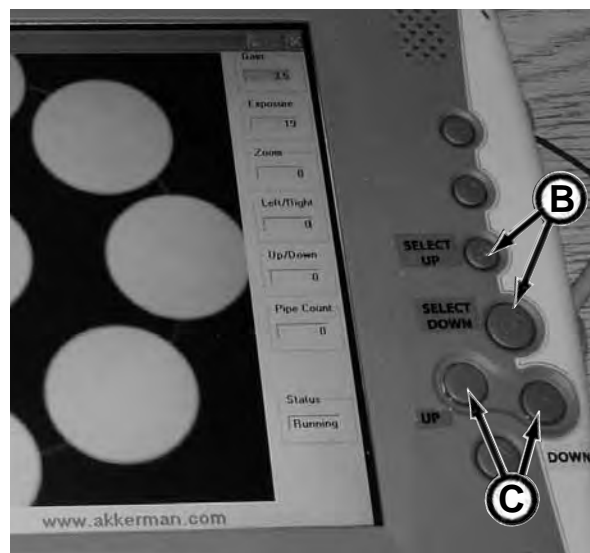


## Gain- Exposure-Zoom-Direction-Pipe Count-Status Control

Adjust the Gain, Exposure, Zoom, Left/Right, Up/Down, Pipe Count and Status fields using either the Select Up or Select Down buttons (B) until desired field is highlighted.

To increase or decrease the values in the fields, use the Up or Down buttons (C).

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



(continued on next page)

## Using Digitizer Pen

When using pen, look on the pointer on the screen, not on the tip of the pen.

Use the pen for many of the same tasks you perform with a mouse:

1. *To select an item on the screen as you would with the left button of an external mouse:*

Tap the item with the tip of the pen.

2. *To double-click an item on the screen as you would with the left button of an external mouse:*

Tap the item twice with the tip of the pen. (You need to lift the pen from the tablet briefly and quickly between taps.)

3. *To select an item as you would with the right button of an external mouse:*

Press and hold down the pen button until a circle of red dots appear with a mouse icon, then lift the pen.

### NOTICE

The pen must be held steady while performing the right click. Otherwise, the computer interprets that you are moving the mouse.

### NOTICE

The button on the side of the pen does not function with the existing software configuration.


## Accessing The Task Bar / Start Button

Access the task bar (A) at the bottom of the tablet screen to select start button, programs, control panel, etc.

With the digitizer pen at a 90 degree angle to the bottom of the tablet screen, hold pen for about one second and lift up pen to unhide the task bar.



## Entering Data

Data will be entered with the digitizer pen through the input panel. There are two ways to gain access to the input panel. Either click the Input Panel icon  on the task bar, or hover the digitizer pen over the character field in which data is to be entered, and click the input panel icon.

### NOTICE

When hovering over a character field, a pause before use will cause the input panel to disappear. Simply hover over the character field to reactivate the input panel.

There are three ways to enter data via the input panel. On the left are three icons which represent the input methods:



*writing pad.* Simply write or print desired data and press INSERT.



*character pad.* Write or print an individual character in the character slots and press INSERT.



*onscreen keyboard.* Click each desired letter on the keyboard using the pen and press INSERT.

(continued on next page)

## Using the Theodolite Remote Focus

The remote focus feature (standard equipment as of SN FA42035F-87 and after, otherwise a remote focus kit is available for SN FA42035F-86 and before) allows the operator to focus the theodolite image on the Tablet PC screen at the controls of the Tablet PC docking station instead of making the necessary adjustments directly on the theodolite focus ring.

The remote focus assembly is equipped with a dual speed focus adjustment; SLOW or FAST. Flip the toggle switch (A) as follows:

SLOW - use for fine focusing.

FAST - use for close or distant focusing.

Other Control Buttons:

- Depress the IN button (B) for gradual adjustment during close focusing.
- Depress the OUT button (C) for gradual adjustment during distant focusing.
- Buttons can be toggled quickly for fine focus adjustment.



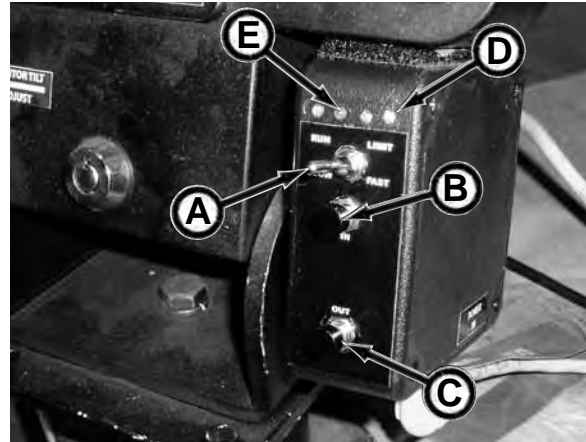
*Guidance System (SN FA42035F-86 & Before) With Remote Focus Control Kit*



*Guidance System (SN FA42035F-87 & After) With Remote Focus Control - Standard Equipment*

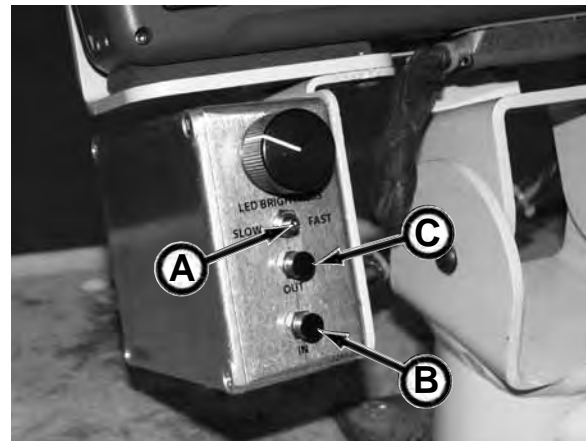
**NOTICE** (If equipped with Remote Focus Kit [SN FA42035F-86 & Before]) When the red LED LIMIT light (D) is illuminated, focus is at the end of travel and you must release button, and then reverse travel direction. Holding button with red LIMIT light illuminated could cause damage to motor and/or belt. The green LED RUN light (E) illuminates when the motor is running.

**NOTICE** (Tablet PC With Remote Focus [SN FA42035F-87 & After]) When the focus is at the end of travel, you will notice that there is no more focus adjustment or the belt will start slipping. Release travel button to prevent premature wear to motor or belt.



*Remote Focus Control Kit (SN FA42035F-86 & Before)*

*(continued on next page)*



*Remote Focus Control (SN FA42035F-87 & After)*

## Cleaning Tablet PC Screen

Use cleaning cloth (included) or other soft, lint-free cloth to clean dust, fingerprints, and smudges. DO NOT use solvents. Moisten with water, if necessary. The cloth is machine washable.



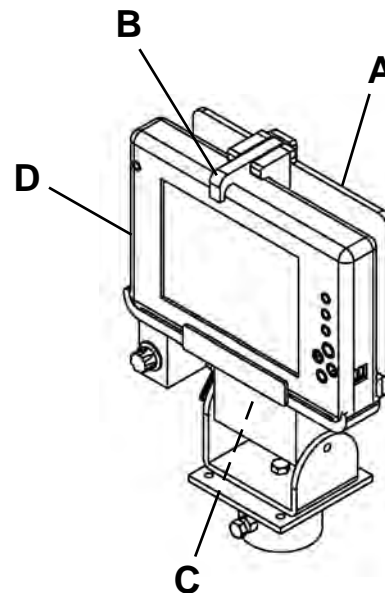
## Docking Station - Removal / Replacement

**NOTICE** There are two styles of docking stations; an old and new style. When removing/replacing docking station, use the instructions for your style of docking station.

### Old Style

**Remove tablet PC from docking station (A) as follows:**

1. Shut down tablet PC.
2. Insert key into docking station lock.
3. Turn key clockwise to unlock docking station/ computer fastener (B).
4. Carefully lift tablet PC to gain access to docking station connector (C).
5. Remove docking station connector from bottom of tablet PC (D) by loosening connector screws.



**Replace tablet PC to docking station as follows:**

1. With the docking station unlocked, fasten docking station connector (C) onto tablet PC by tightening connector screws. DO NOT overtighten.
2. Carefully mount tablet PC (D) into bottom tray of docking station (A).
3. While turning key counterclockwise, push fastener (B) down until computer is locked into place. Be sure hook of fastener mounts over tablet PC.
4. Remove key.

*(continued on next page)*

## Docking Station - Removal / Replacement (continued)

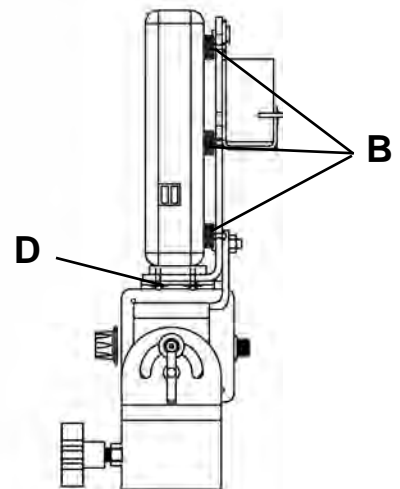
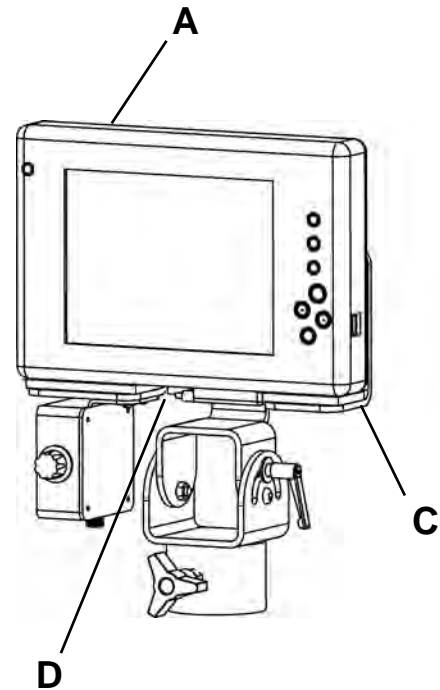
### New Style

**Remove tablet PC from docking station as follows:**

1. Shut down tablet PC (A).
2. Remove five bolts and rubber grommets (B) from docking station (C).
3. Carefully lift tablet PC to gain access to docking station connector (D).
4. Remove docking station connector from bottom of tablet PC by loosening connector screws.

**Replace tablet PC to docking station as follows:**

1. Fasten docking station connector (D) onto tablet PC by tightening connector screws. DO NOT overtighten.
2. Mount tablet PC to docking station by inserting five bolts and rubber grommets through docking station holes. Then line up bolts to tablet PC threaded holes. The rubber grommets must be located between the docking station and the tablet PC. Fasten bolts to tablet PC. DO NOT overtighten.



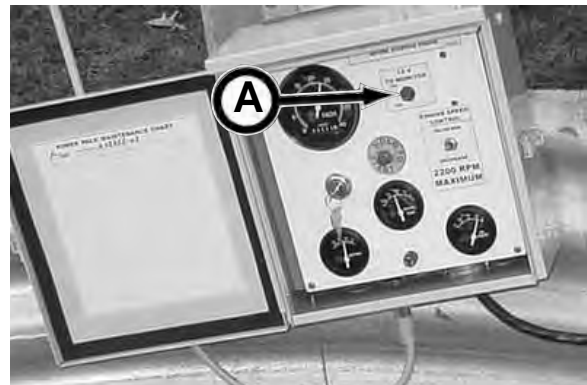
## Connecting New Camera To Computer

When connecting a new camera to the tablet PC, the system requires you to reinstall the camera driver software.

1. Install guidance system (refer to Guidance System Installation in this section) but do not power up tablet PC at this time.



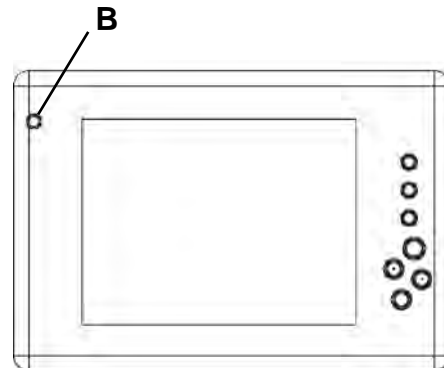
2. Start power pack and flip ON 12V To Monitor switch (A) on pendant. *Later models do not have this switch. As soon as the power pack engine starts, the 12V Monitor power will power up automatically.*



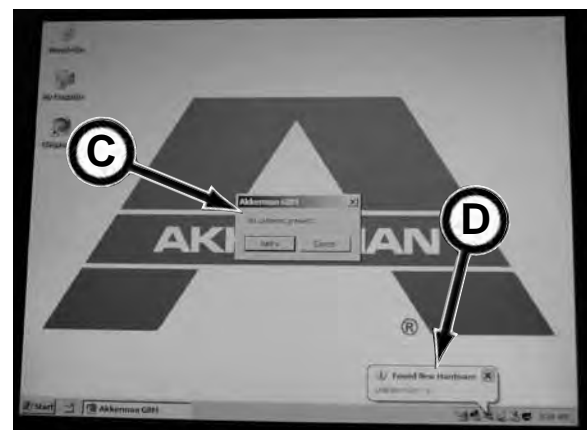
P100Q Pendant

3. With camera connected to tablet PC, power ON tablet PC by depressing switch (B).

**NOTICE** Power is properly connected when both the tablet PC power indicator and the camera power indicator lights are illuminated.

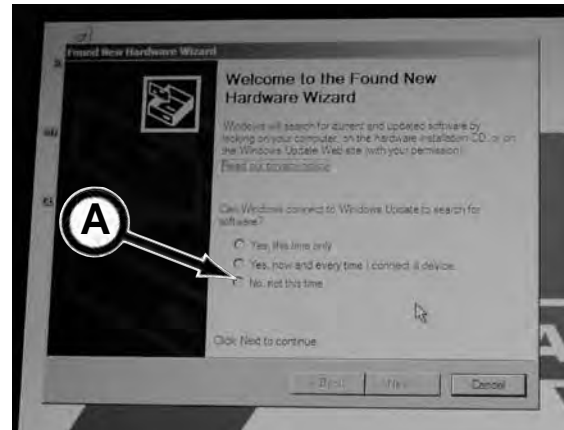


4. Since you are connecting to a new camera for the first time, a “No camera present” window (C) and “Found New Hardware” message window (D) will appear.



(continued on next page)

5. Wait approximately 30 seconds for the Found New Window Hardware Wizard window to appear.
6. In the wizard window, "Can Windows connect to Windows Update to search for software?" Click the "No, not this time" button (A), then click NEXT.



7. The next window asks "What do you want the wizard to do?" Click on Install the software automatically (Recommended) (B) and click NEXT. A window will appear that the driver has not been signed. Click continue anyway.
8. Continue to follow instructions as indicated in the windows.
9. Computer will need to be rebooted after installing camera driver.
10. If camera is still not recognized, contact your Akkerman Product Support representative.

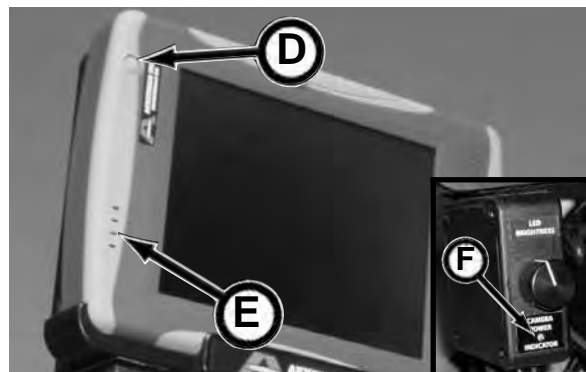


## Checking Guidance System Camera Connections

1. Start generator (if used) and power pack, and flip ON 12V To Monitor switch (C) (P100Q only) on pendant. *Later models do not have this switch. As soon as the power pack engine starts, the 12V Monitor power will power up automatically.*
2. Turn ON tablet PC by pressing power button (D).
3. Check the following:
  - a. Is the power indicator light (E) on the tablet PC lit? If not, either the generator or the power pack is not running, the 12V To Monitor switch is off, the power cable from pendant to Power In connection on tablet PC is not connected properly, or cable is damaged.
  - b. (Some models) Is the Camera Power Indicator light (F) on the control box of the tablet PC assembly lit? If not, properly install camera cable connections, or replace damaged cable.
4. If camera still fails to function properly, refer to section 11, Troubleshooting.



P100Q Pendant



## FINAL THEODOLITE SETUP

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

1. With engine running, flip 12V monitor power ON at pendant. *Later models do not have this switch. As soon as the power pack engine starts, the 12V Monitor power will power up automatically.*

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

**NOTICE** Engine RPM must be at least 1500 RPM to power tablet PC.

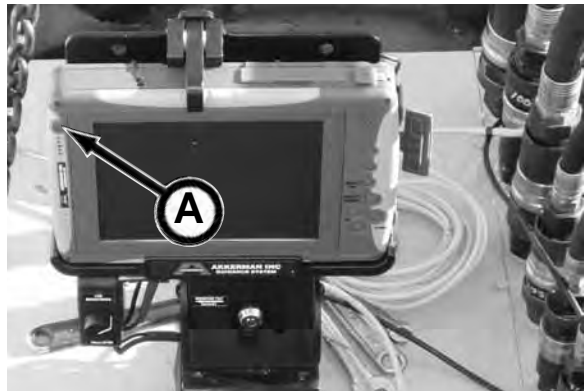
**NOTICE** If the 12V To Monitor switch is not ON, the tablet screen will display a NO Camera Present window. If switch is OFF, turn switch ON, then restart GBM\_System program. You do not need to restart computer.

2. Turn ON tablet PC by depressing power button (A).

**NOTICE** If you are connecting a new camera to a tablet PC for the first time, refer to Tablet PC Start Up & Operation - Connecting New Camera in this section, prior to powering up tablet PC.



*P100Q Pendant*



3. Turn ON target.

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



*(continued on next page)*

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

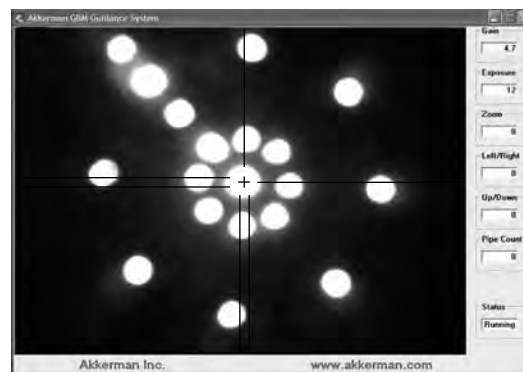


**NOTICE** To improve the target image and crosshairs on the monitor, use the Gain, Exposure, Zoom, Left/Right, Up/Down, and LED brightness controls on the monitor and the focusing ring on the theodolite telescope.

MONITOR STARTING POINT ADJUSTMENTS:

	Gain	Exposure
Target Set Up	2.5	20

Normal Operation: adjust accordingly



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



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

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

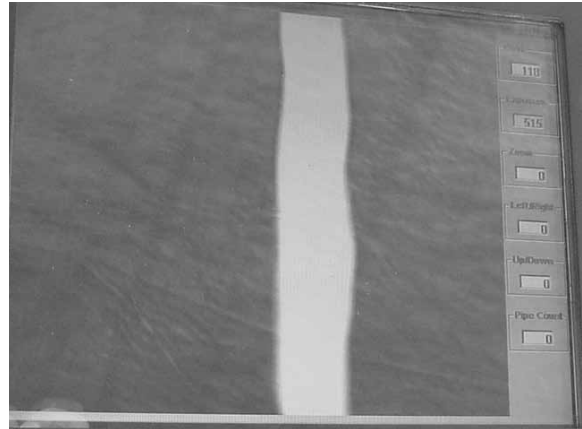
*(continued on next page)*



8. Relevel the theodolite, if necessary.



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



**NOTICE**

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

a. Using the focusing ring on the telescope, focus on the string lines.



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

*(continued on next page)*

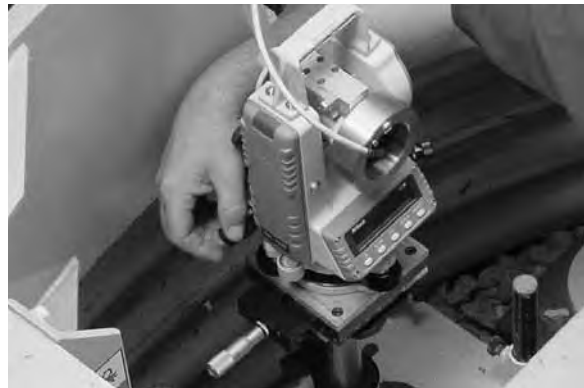


- b. Use the lateral slide to line up the back string line on the monitor crosshairs.

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



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



- d. Continue to line up the front and back string lines until they are both centered with the vertical crosshair on the monitor.
- e. Once the two strings are centered with the monitor crosshairs, the theodolite is now in line with the surveyor's marks.

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



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

**NOTICE** After reset, the horizontal display must be at  $0^{\circ}00'00''$  and must remain at  $0^{\circ}00'00''$  until the end of the drive. In the event the theodolite is bumped or moved and the display is no longer at  $0^{\circ}00'00''$ , the operator must readjust the horizontal adjust back to  $0^{\circ}00'00''$ . Failure to do so will result in the drive being off line.

11. Proceed to Installing Pilot Tubes section.



*Operation*

## **NOTES**

# Operation - Installing Pilot Tubes

## INSTALLING STEERING HEAD ADAPTER TO STEERING HEAD

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

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



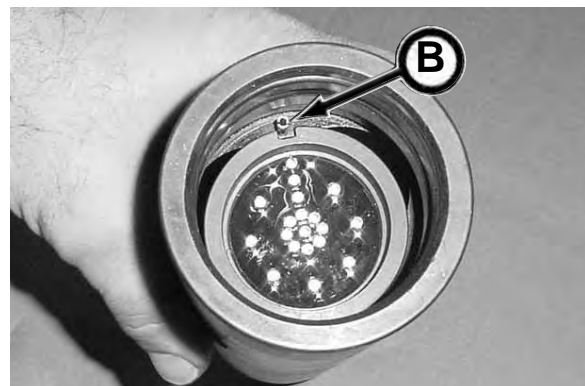
2. (Rechargeable target) Remove cap on target. Turn the target LED lights ON with switch and replace cap on target.



(Replaceable battery target) Remove cap on target. Place two new 1.5 volt, D size, alkaline batteries with the positive polarity going into target tube. Replace cap and turn completely in to illuminate the LED lights and to prevent moisture from entering target tube.



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



*(continued on next page)*

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



- Fully insert inner tube into target holder.

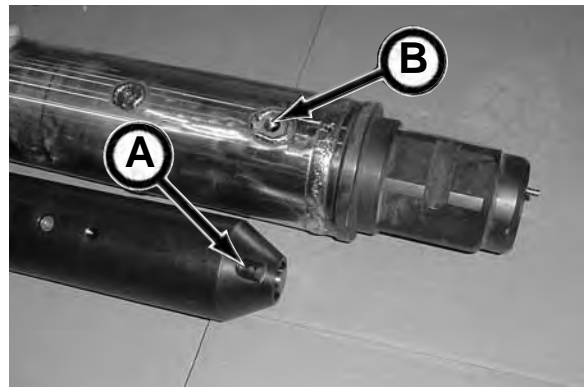


- Loosen three set screws on steering head adapter with a 3/16" allen wrench, so the target assembly can be slid into adapter.

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



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



*(continued on next page)*

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



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



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



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



*(continued on next page)*

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

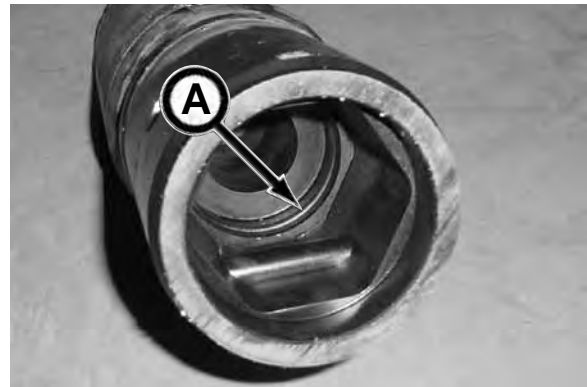
<u>Ground</u>	<u>Steering Head</u>
Very Soft/Unstable	30° (4" Dia.) Head
Soft/Low Blow Count	30° (5" Dia.) Head
Medium	45° (5" Dia.) Head
Very Hard (High Blow Count)	Bullet Head

**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.

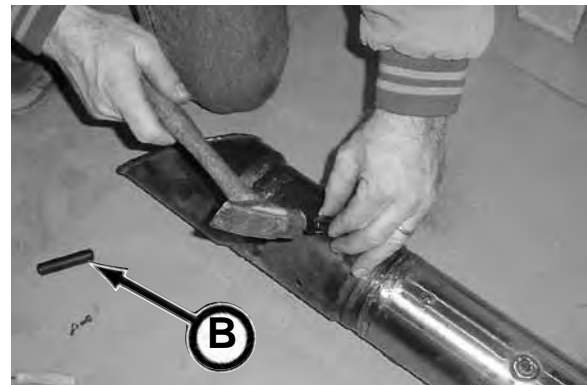


15. Install steering head to steering head adapter by aligning the adapter pin with the countersunk hole in the steering head. Be sure there is no gap between the adapter and steering head surfaces.



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

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



(continued on next page)

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



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

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



19. Proceed to Installing Pilot Tubes in this section.

## INSTALLING PILOT TUBES

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

**NOTICE** To check center line of product pipe setup, use the alignment guide adapter (not shown).

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

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



2. Install steering head to steering head adapter. See 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 without open trenching. Refer to page 6-30-11, step 19 for adding lubrication.



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

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

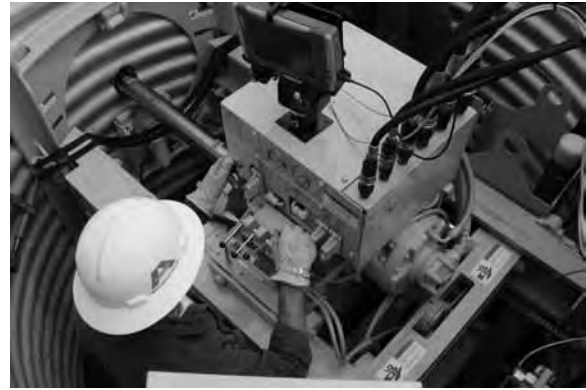


4. Move the Drive Speed Selector to the LSHT (Low Speed High Torque) position.
5. Advance steering head into the ground with the tip UP (see inset), by extending thrust cylinder control lever to forward position.



(continued on next page)

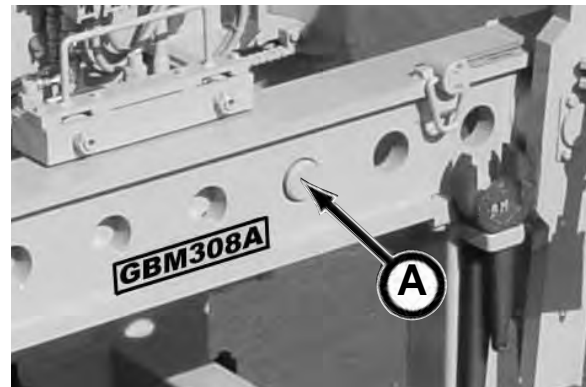
6. (Latching Frame Only) Relatch the latching pins as needed by pushing Hydraulic Latching control UP to unlatch pins, retract thrust cylinders until the latching pins line up with the next set of holes in frame. Then relock latching pins into frame holes by pulling Hydraulic Latching Control DOWN.



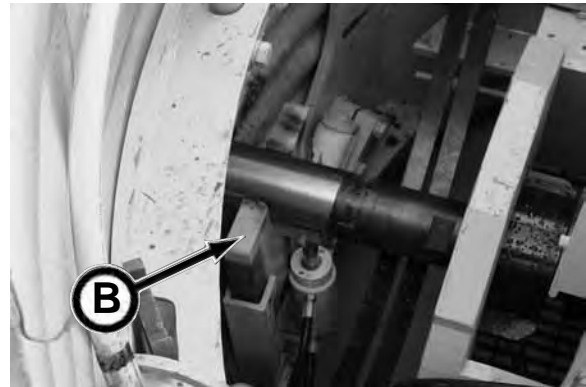
**NOTICE**

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

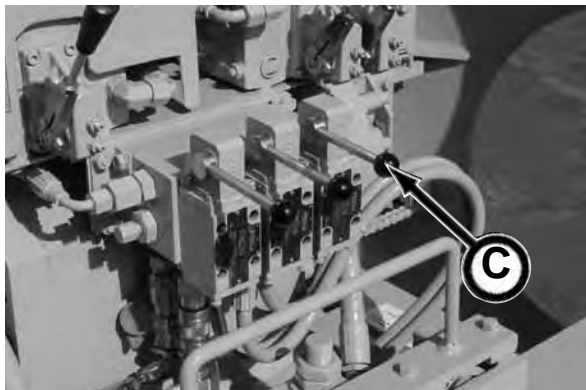
(GBM 339A Only) A latching pin indicator is equipped on the GBM frame to easily view when the latching pins are locked or unlocked.



7. Push adapter the full travel of frame until the notches in the steering head adapter line up with the tube support (B) in the make-up tool.
8. Engage the make-up tool tube support to the notches on steering head adapter by pushing the Make Up Tool control lever UP.



9. (Latching Frame Only) Unlock latching pins by pushing UP on Hydraulic Latching Control (C).



*(continued on next page)*

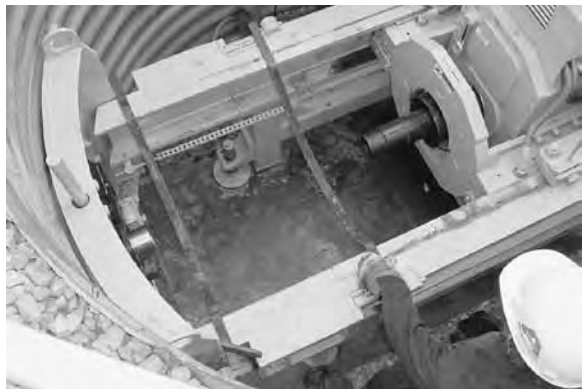
10. Disengage the drive adapter from the steering head adapter by rotating the drive CCW with the auger drive rotation control and using the Thrust Cylinder control to retract the thrust cylinders.



11. Move the gear box assembly to the back of the GBM frame using:  
  
(latching frame) travel motor control and then lock both latching pins into frame with the hydraulic latching control' or  
  
(single stage frame) the thrust cylinder control.



12. Place support bars on frame rails.



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

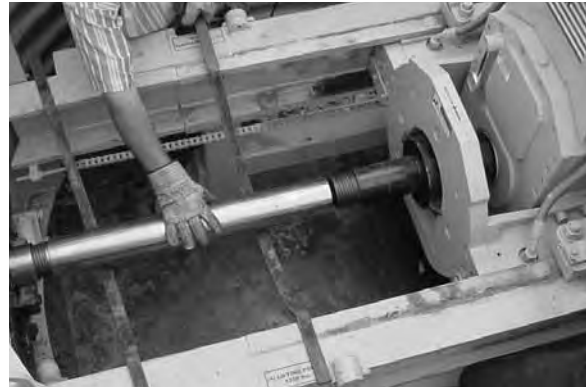


*(continued on next page)*

**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.

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



**NOTICE**

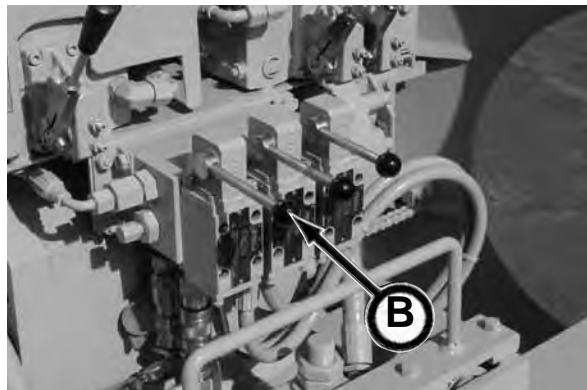
BEFORE you install each pilot tube, inspect o-rings for damage. Replace if damaged. Also, wipe o-rings with a lubricant. DO NOT spray a lubricant on the o-rings. Doing so will make it difficult to identify the target on the monitor due to the reflection of the lubricant in the pilot tube.



15. Advance gear box assembly with travel motor control (latching frame) or thrust cylinder control (single stage frame) while rotating the drive CW (using the drive rotation control) to thread the pilot tube to the drive assembly and steering head adapter.
16. Torque the connection to 1000 psi (2000 ft-lb) on rotation pressure gauge (A) mounted on gear box.



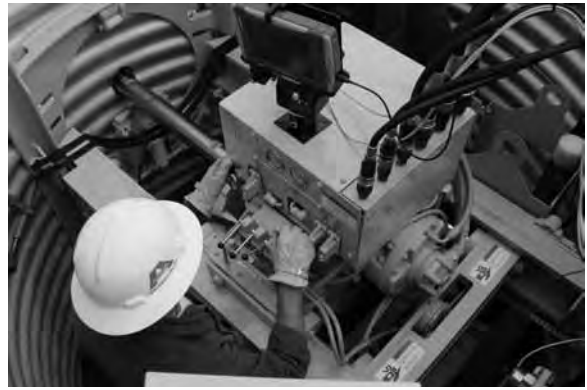
17. Release make-up tool to disengage tube support from steering head adapter by pulling DOWN on Make Up Tool lever (B).



*(continued on next page)*

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

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



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

**NOTICE**

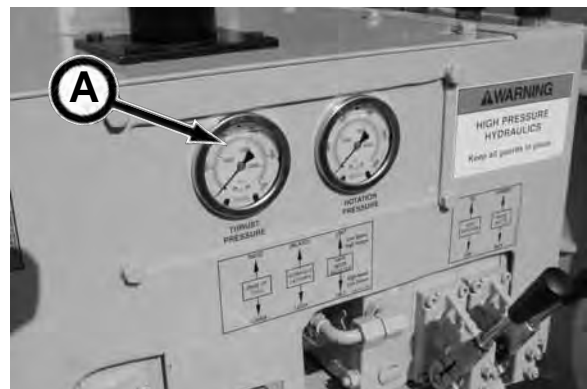
If you cannot rotate the head in low speed high torque (LSHT) without reversing the thrust, the angled face is too aggressive. If necessary, change to a less aggressive head.

**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.



Also, check your jacking pressure on the thrust pressure gauge (A). Working range is up to 4,000 psi (27.579 mPa). Maximum pressure is 5,000 psi (34.474 mPa).



(continued on next page)

**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 without open trenching. Akkerman Inc. highly recommends to always use lubrication for the specific ground conditions on each job site. The lubrication will assist in lowering jacking and rotational pressures on the pilot tubes.

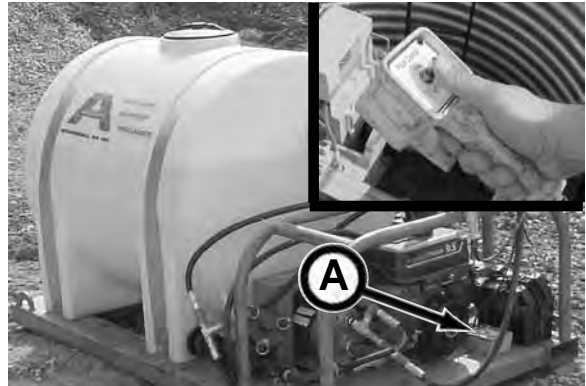


19. Use lubrication (do not use bentonite) to lower the jacking pressure. Generally, if the pressure is running at 2,500 psi (17.237 mPa) and the pressure consistently increases, add lubrication as follows:

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

**NOTICE**

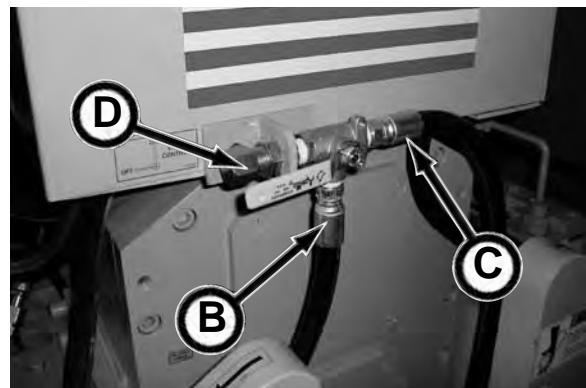
(Lubrication 225 Pump) To use pendant, switch to remote setting on control box (A).



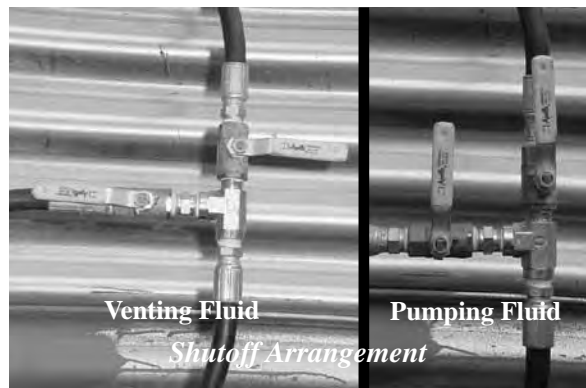
- b. (Lubrication 225 Pump) turn on pump using pump pendant to control the lubrication flow, or use a ball valve to control the lubrication flow.

**NOTICE**

On later models, a lube control is mounted on the GBM gear box cover. Hose (B) is mounted to the fluid connector adapter on the drive swivel. Hose (C) is used for venting the fluid, and install the supply hose to connection (D). The valve is shown in the OFF or closed position.



- c. Control the lubrication flow so there is no lubrication flowing out of the pilot tubes in the launch shaft.
- d. Before loosening pilot tube joints, vent the fluid into a catch pan to relieve pressure and prevent the fluid from entering the inner tube of the pilot tube.



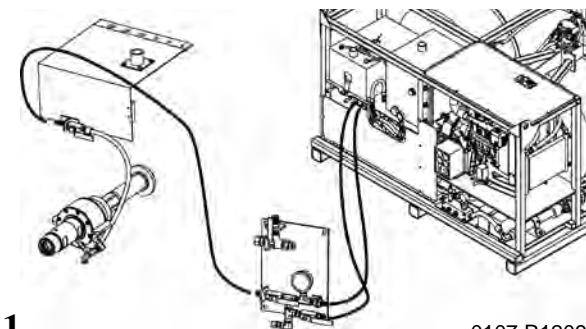
Venting Fluid

Pumping Fluid

*Shutoff Arrangement*

**NOTICE**

If using the Akkerman 2325D or 2325D Jetting & Lubrication Pump, refer to the 2325D/2325E Jetting & Lubrication Pump Operation and Parts Manual lubrication hookup and operation.



*(continued on next page)*



**NOTICE**

Regularly secure frame to the shaft while pushing the pilot tubes using the shaft tensioners and load binders (latching frame only) on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.



*Shaft Tensioner*



*Load Binder (Latching Frame Only)*

23. 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.
24. Engage the make-up tool tube support to the notches on the pilot tube.



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



*(continued on next page)*

26. Remove the drive adapter swivel from gear box. If installed, remove the locknuts and flange on the back of the gear box.



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

***Three Step Method (Typical)***

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

***Power Cutter Head Method***

- If using a powered cutter head, proceed to “Three Step Method: Installing Power Cutter Head” in this section, subsection Installing Upsizing Tool.

***Auger Boring Machine Method***

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



*Operation*

## **NOTES**

# Operation - Installing Upsizing Tool

## AUGER BORING METHOD: WELD-ON REAMING HEAD INSTALLATION

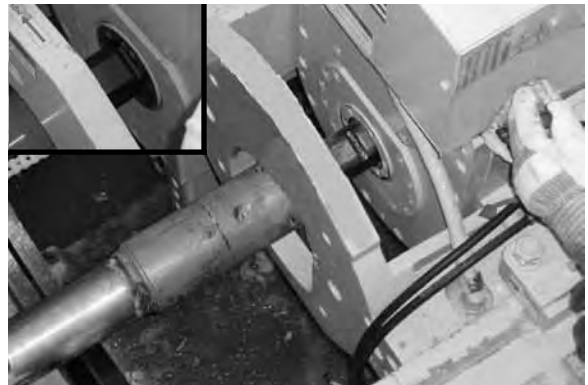
1. Remove guidance system from shaft and store in protective case.



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



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



*(continued on next page)*

(latching frame) or thrust cylinder control (single stage frame).

5. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the rotation pressure gauge.
6. Release make-up tool.
7. Advance adapter into ground until there is enough room to clear the GBM frame.



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



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

*(continued on next page)*



9. In the reception shaft, remove steering head.

a. Remove set screw.



b. Drive out pins.



c. Remove pins.



d. Remove steering head.



*(continued on next page)*

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



10. Remove GBM frame.

11. Install the 10' (3 m) pilot hex tube to the pilot tube adapter with four roll pins. If needed, advance the tubes forward so there is enough room to add the reaming head assembly.



12. Install reaming head assembly to the 10' (3 m) pilot hex tube with four roll pins.

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

14. Weld casing to the reaming head assembly.



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



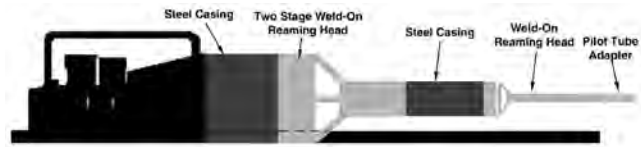
*(continued on next page)*

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



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

- in soft ground, add at least a 10' (3 m) or 20' (6.1 m) casing or more between the single and two stage weld-on reaming heads to hold the line.



- in hard ground, push single stage weld-on reaming head completely to the reception shaft before installing the two stage weld-on reaming head. This will reduce the jacking forces during advancement of the two stage weld-on reaming head.

18. (Two Stage Weld-on Reaming Head) Lower two stage weld-on reaming head with auger onto auger boring track.

**NOTICE**

Some contractors weld a casing section to the two-stage weld-on reaming head prior to lowering onto track.



19. (Two Stage Weld-on Reaming Head) Connect the augers sections and weld the two-stage weld-on reaming head to the casing from the single stage weld-on reaming head.



(continued on next page)

20. Push the weld-on reaming head/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 for the purpose of lubricating the spoils 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, page 6-35-63, for configuration details.



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

Hook up the breakout tool as follows:  
Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

Selector Position:  
Port A - Extend  
Port B - Retract

**⚠ 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 into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

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



*(continued on next page)*

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



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



25. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 24.



*(continued on next page)*

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.



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



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

*(continued on next page)*



**NOTICE**

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



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 switch on controller.



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



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

34. Remove the front jaw insert.



*(continued on next page)*

35. Slide the breakout tool towards the end of the tube and remove the back jaw insert.
36. Slide the breakout tool towards the launch shaft for the next joint removal.



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

**NOTICE**

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

38. Place pilot tube into pilot tube rack.



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



*(continued on next page)*

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



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 from the pilot tube adapter and the 10' (3 m) pilot tube. Be sure to cap the threaded end of the adapter.



*(continued on next page)*

43. Remove the 10' (3 m) pilot tube by removing four roll pins from the 10' (3 m) pilot tube and the reaming head assembly.



44. Once the reaming head assembly and casings reach the reception shaft, remove the reaming head 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.

## AUGER BORING METHOD: OPEN FACE CUTTER HEAD INSTALLATION

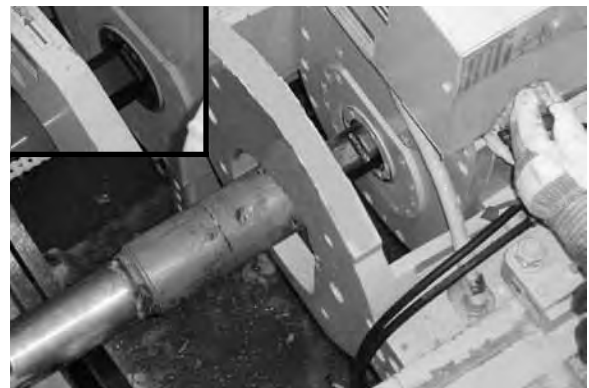
1. Remove guidance system from shaft and store in protective case.



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



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



*(continued on next page)*

4. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the travel motor control (latching frame) or thrust cylinder control (single stage frame).
5. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.



6. Release make-up tool.
7. Advance adapter into ground until there is enough room to clear the GBM frame.



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



*(continued on next page)*

9. In the reception shaft, remove steering head.

a. Remove set screw.



b. Drive out pins.



c. Remove pins.



d. Remove steering head.



*(continued on next page)*

**⚠ WARNING**

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

10. Remove GBM frame.



11. Install the 10' (3 m) pilot hex tube (5" OD) to the pilot tube adapter with four roll pins. If needed, advance the tubes forward so there is enough room to add the lead guide rod.



12. Install 10' (3 m) lead guide rod (for 3" hex - 5" OD) to the 10' (3 m) pilot hex tube (5" OD) with four roll pins.



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

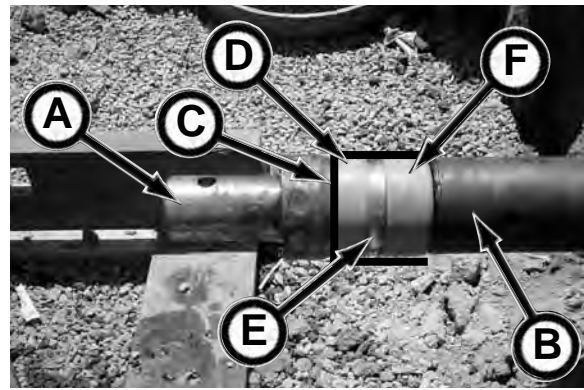


*(continued on next page)*

14. Install 10' (3 m) guide rod extension tube (for 3" hex - 5" OD) to the 10' (3 m) lead guide rod with one 3/4 x 6" socket head cap screw.
15. Before installing guide rod (A) into guide rod extension tube (B), slide the swivel components onto the guide rod as follows: sleeve (C), narrow nylon wear ring (D), then the steel thrust washer (E), and finally the wide nylon wear ring (F) with the taper facing the reception shaft.

**NOTICE**

Sleeve (C) is shown as an outline for photographic purposes only.



16. Slide the guide rod with swivel components into guide rod extension tube.
17. Install the guide rod to the auger boring machine hex shaft with a 3/4" bolt.
18. With the auger boring machine, advance the guide rod/guide rod extension tube into the ground until there is enough room to lower casings.
19. Disconnect the guide rod/pilot tube swivel from the auger boring machine hex shaft.



20. Move auger boring machine to the back of the launch shaft so there is enough room to install the steel casing with auger.
21. Lower steel casing/auger into launch shaft.



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



(continued on next page)

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



**NOTICE**

Lubricant can be pumped from the reception shaft to lubricate the spoils. Install fluid connector on end of pilot tube in the reception shaft. Refer to “Upsizing Tool Lubrication From Reception Shaft” in this section, 6-35-63, for configuration details.



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

Hook up the breakout tool as follows:  
Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

Selector Position:  
Port A - Extend  
Port B - Retract

**⚠ 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 into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.



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



*(continued on next page)*

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



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



28. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 27 as shown.

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



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



*(continued on next page)*

30. 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.



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



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



**NOTICE**

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



*(continued on next page)*

33. 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.



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



35. Slightly retract the cylinder until the breakout tool can be slid towards the launch shaft.  
36. Remove the front jaw insert.



37. Slide the breakout tool towards the end of the tube and remove the back jaw insert.  
38. Slide the breakout tool towards the launch shaft for the next joint removal.



*(continued on next page)*

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

**NOTICE**

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

40. Place pilot tube into pilot tube rack.



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



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



43. 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)*

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



45. Remove the 10' (3 m) pilot tube (5" OD) by removing four roll pins from the 10' pilot tube and the 10' lead guide rod.



46. Remove the 10' (3 m) lead guide rod by removing the 3/4 socket head cap screw from the 10' (3 m) lead guide rod and the 10' guide rod extension tube.



*(continued on next page)*

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

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

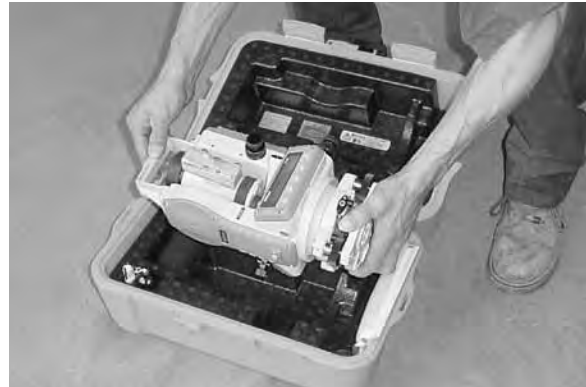


## THREE STEP METHOD: INSTALLING AUGER CASING WITH REAMING HEAD

### NOTICE

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

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



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



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



### NOTICE

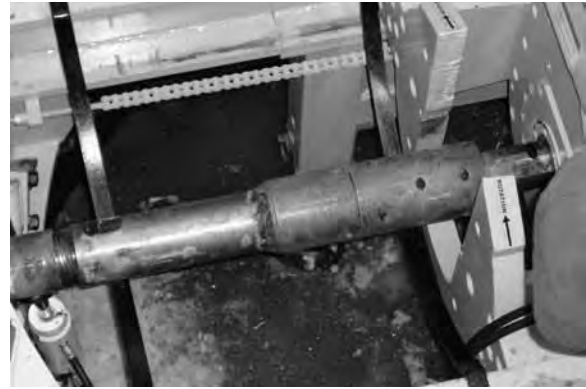
Lubrication will lower jacking pressures during the drive. Refer to Upsizing Tool Lubrication From Reception Shaft in this section, page 6-35-63, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

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



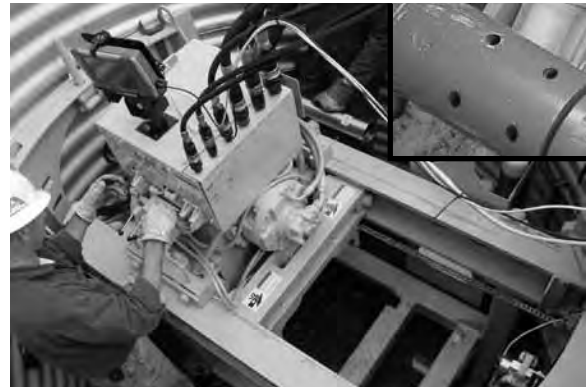
*(continued on next page)*

5. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the travel motor control (latching frame) or thrust cylinder control (single stage frame).
6. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.



7. Release make-up tool.
8. Advance adapter into ground until there is enough room to pin the pilot tube adapter to the reaming head assembly.

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



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

(latching frame) travel motor control and then lock both latching pins into frame with the hydraulic latching control, or  
(single stage frame) the thrust cylinder control.

10. Remove make-up tool.



*(continued on next page)*

**NOTICE**

Lubrication will lower jacking pressures during the drive. Refer to Upsizing Tool Lubrication From Reception Shaft in this section, page 6-35-63, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.



11. Remove hex coupler from pilot tube adapter.

12. 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.



13. In the reception shaft, remove steering head.

a. Remove set screw.



b. Drive out pins.



*(continued on next page)*

c. Remove pins.



d. Remove steering head.



14. Install casing thrust adapter to thrust plate with two 3/4 x 2 in. bolts and washers for 11", 12", and 14" casings, or 3/4 x 3" bolts and washers for 16" and 20" casings.



*(continued on next page)*

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

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

Do not stand or walk under a load.



**NOTICE** Lubrication will lower jacking pressures during the drive. Refer to Upsizing Tool Lubrication From Reception Shaft in this section, page 6-35-63, to determine how to prepare the pilot tube adapter and reaming head fluid connector for lubrication requirements.

15. 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.

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



*(continued on next page)*

17. Install auger drive adapter onto auger shaft.

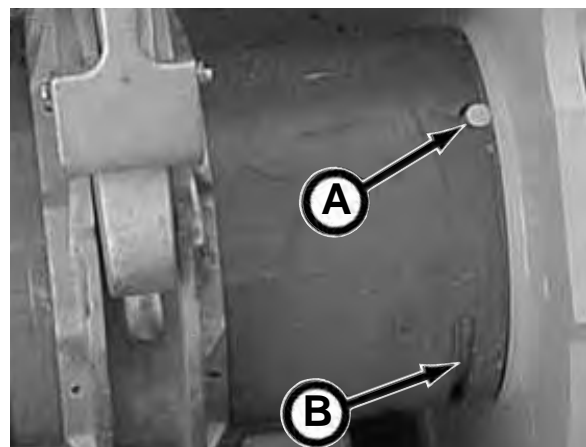


18. Align and engage auger drive adapter with the hex opening in gear box using the drive rotation control and frame travel motor control.



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

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



(continued on next page)

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

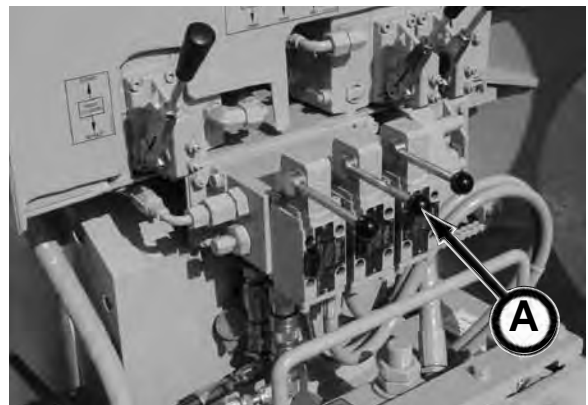


20. Cut an opening in the shaft large enough for the reaming head, thrust casings, powered cutter head (if used) and product pipe to pass through.

21. 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.

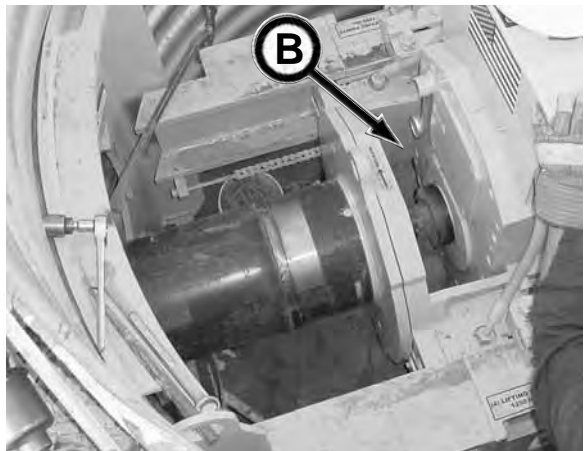


22. Advance the reaming head assembly by extending the thrust cylinders with the thrust cylinder control and rotate the augers in the clockwise direction with drive rotation control.

**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).

(Latching Frame Only) Relatch latching pins as needed.

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



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

(continued on next page)

**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, page 6-35-63, for configuration details.



24. Before retracting gear box, adjust the three roller brackets to casing by loosening clamp, slide roller into position, and retighten clamp. The rollers will support the casing while the gear box is retracted.
25. Move the gear box assembly to the back of the GBM frame using the travel motor control (latching frame) or the thrust cylinder control (single stage frame).



**NOTICE**

(Latching frame only) Be sure latching pins are completely engaged into frame holes before jacking.

**WARNING**

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



26. 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.

**WARNING**

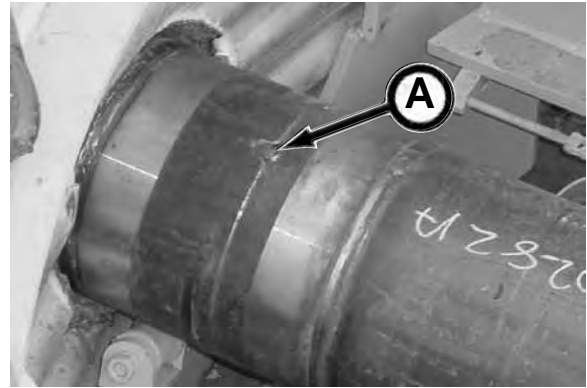
Safety glasses must be worn while using power equipment (air tools). Failure to do so could cause severe injury from flying debris.

27. Slide the thrust casing auger onto the end of the reaming head assembly auger shaft.
28. With the auger fighting 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.



(continued on next page)

29. 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.



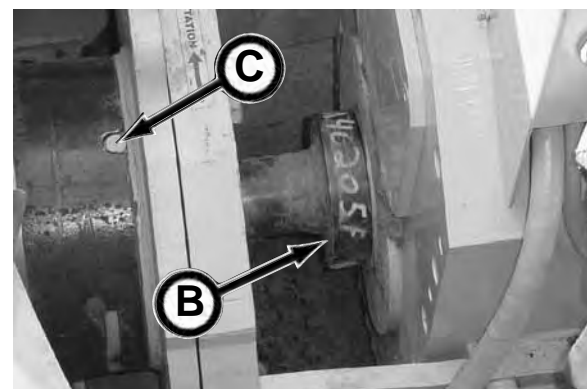
30. Install four casing joint keepers at the 2 o'clock, 4 o'clock, 8 o'clock, and 10 o'clock positions to lock the casings together.



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



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



**NOTICE**

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

*(continued on next page)*

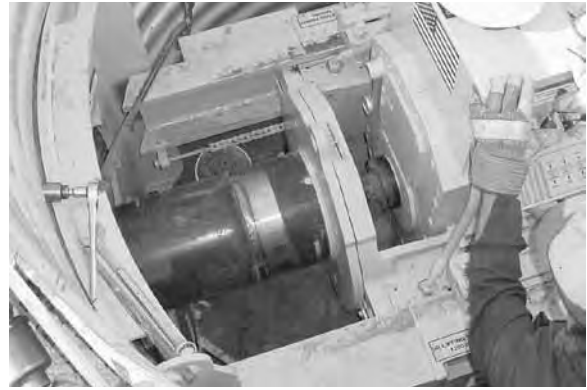
**NOTICE**

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

33. 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. Refer to procedure starting with step 37.



34. Periodically empty the dirt bucket.



35. Replace dirt bucket.



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



*(continued on next page)*

**NOTICE**

Regularly secure frame to the shaft while pushing the casings using the shaft tensioners and load binders (latching frame) on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.



**NOTICE**

Lubricant can be pumped from the reception shaft to lubricate the spoils and casings to reduce jacking forces. Install fluid connector on end of pilot tube in the reception shaft. Refer to “Upsizing Tool Lubrication From Reception Shaft” in this section, page 6-35-63, for configuration details.



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

Hook up the breakout tool as follows:

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

Selector Position:  
Port A - Extend  
Port B - Retract

**⚠ 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 into 120 VAC outlet. If an extension cord is necessary, you must use a three-prong grounded extension cord.

(continued on next page)

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



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



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



41. With the cylinder retracted, slide the breakout tool onto the pilot tube and over the previously installed jaw insert from step 40 as shown.

**NOTICE**

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



(continued on next page)

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



43. Slide breakout tool over both jaw inserts.

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



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



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



*(continued on next page)*

**NOTICE**

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



46. 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.

47. Release switch on controller.



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



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

50. Remove the front jaw insert.



*(continued on next page)*

51. Slide the breakout tool towards the end of the tube and remove the back jaw insert.
52. Slide the breakout tool towards the launch shaft for the next joint removal.



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

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

54. Place pilot tube into pilot tube rack.



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



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

*(continued on next page)*



57. 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.



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



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

**NOTICE**

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



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

*(continued on next page)*



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



62. 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.



*(continued on next page)*



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

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



64. Install safety chain assembly or auger pin to auger to secure auger into reaming head assembly. For proper installation of safety chain, refer to Installing Safety Chain Assembly/ Casing Auger Pin To Auger & Casing in this section.
65. Remove the reaming head assembly from reception shaft.
66. Proceed to “Three Step Method: Installing Product Pipe” in this section, subsection Installing Product Pipe.



OR

If using powered cutter head, proceed to Three Step Method: Installing Powered Cutter Head in this section.

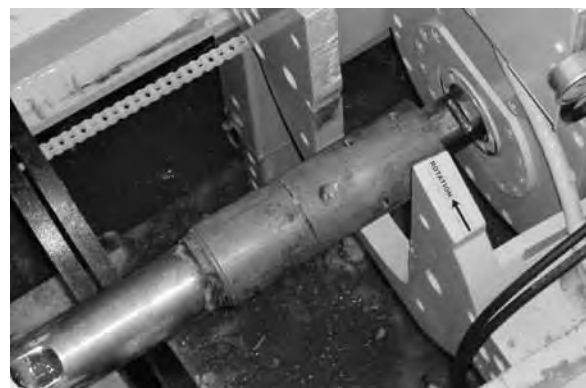
## THREE STEP METHOD: INSTALLING AUGER CASINGS WITH OPEN FACE CUTTER HEAD

### NOTICE

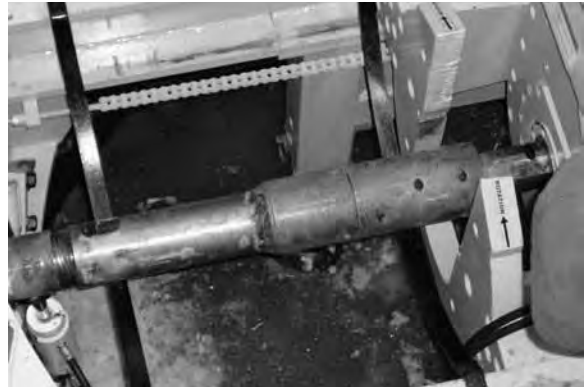
Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

1. Remove guidance system from shaft and store in protective case.
2. (Latching Frame Only) Remove two travel stop brackets in rear of frame.
3. If not already removed, remove the drive adapter swivel from gear box.
4. Insert the pilot tube adapter into the gear box.

*(continued on next page)*



5. With the last pilot tube locked into the make-up tool, thread the adapter into the pilot tube by rotating the adapter in the CW direction with the drive rotation control, while advancing the gear box assembly with the travel motor control (latching frame) or thrust cylinder control (single stage frame).
6. Continue to tighten the connection to 1,000 psi (2,000 ft-lb) torque as shown on the gear box cover pressure gauge.

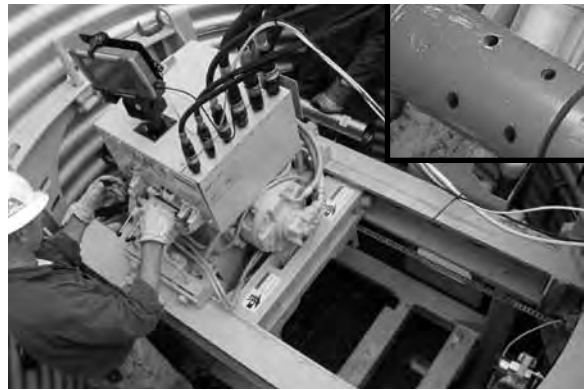


7. Release make-up tool.

**NOTICE** Lubrication will lower jacking pressures during the drive. Refer to Upsizing Tool Lubrication From Reception Shaft in this section, page 6-35-63, to determine how to prepare the pilot tube adapter for lubrication requirements.

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



9. Move the gear box assembly to the back of the GBM frame to allow enough room for the pilot tube swivel by using:

(latching frame) travel motor control and then lock both latching pins into frame with the hydraulic latching control, or  
(single stage frame) the thrust cylinder control.

10. Remove the make-up tool.



*(continued on next page)*

11. Lower pilot tube swivel into launch shaft.



12. 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.

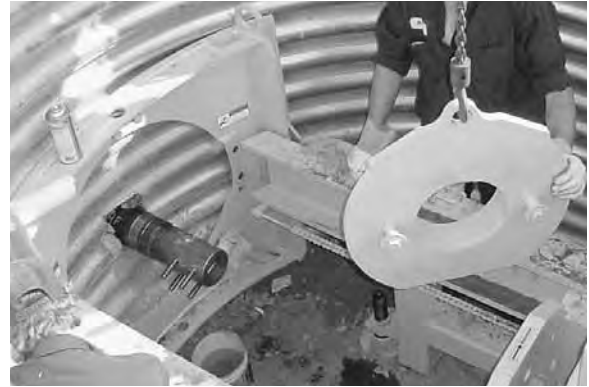


13. Advance swivel until there is enough room to pin the cutter head assembly to the pilot tube swivel.

*(continued on next page)*



14. Move the gear box assembly to the back of the GBM frame to allow enough room for the dirt bucket and cutter head assembly.
15. Install casing thrust adapter to thrust plate with two 3/4 x 2 in. bolts and washers for 11", 12", and 14" casings or four 3/4 x 3 in. bolts and washers for 16" and 20" casings.



16. Lower dirt bucket into shaft.



*(continued on next page)*

17. In the reception shaft, remove steering head.

a. Remove set screw.



b. Drive out pins.



c. Remove pins.



d. Remove steering head.



*(continued on next page)*

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

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

Do not stand or walk under a load.



18. 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 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 cutter head assembly and casings.

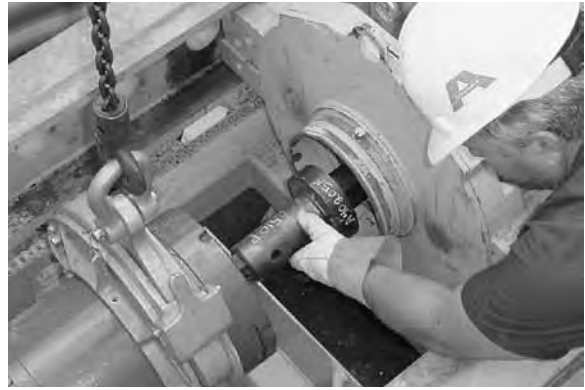


19. Install cutter head hex shaft into pilot tube swivel and secure with four roll pins.



*(continued on next page)*

20. Install auger drive adapter onto auger shaft.



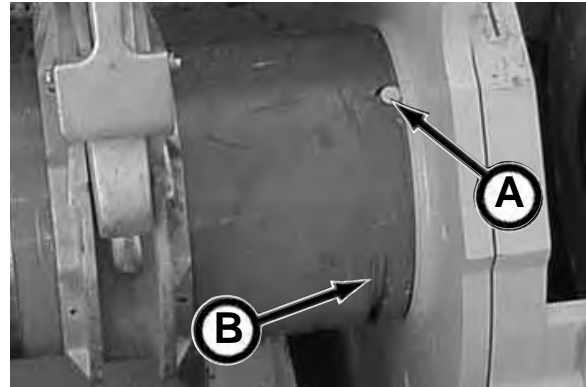
21. Align and engage auger drive adapter with the hex opening in gear box using the drive rotation control and frame travel motor control.



*(continued on next page)*

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

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



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

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



24. 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.

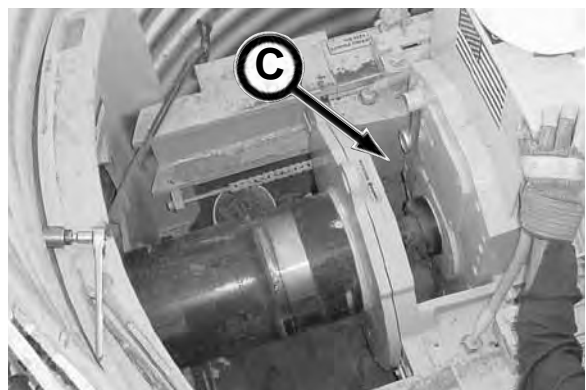


25. Advance the cutter head assembly by extending the thrust cylinders with the thrust cylinder control and rotate the augers in the clockwise direction with drive rotation control.

**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).

(Latching Frame Only) Relatch latching pins as needed.

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



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

*(continued on next page)*

27. Before retracting gear box, adjust the three roller brackets to casing by loosening clamp, slide roller into position, and retighten clamp. The rollers will support the casing while the gear box is retracted.
28. Move the gear box assembly to the back of the GBM frame using the frame travel motor until the latching mechanism is locked (latching frame only).



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

29. Lower thrust casing/auger into launch shaft.

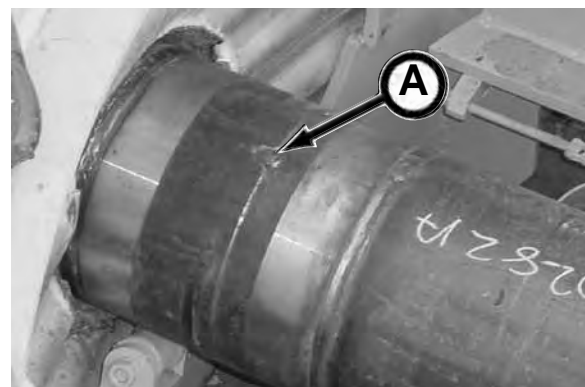
**NOTICE** Install safety chain assembly or auger pin to auger to secure auger into casing. For proper installation of safety chain, refer to Installing Safety Chain Assembly/Casing Auger Pin To Auger & Casing in this section. Also, use a properly rated pipe tong or nylon strap to handle the casings.



30. Slide the thrust casing auger onto the end of the cutter head assembly auger shaft.
31. 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.



32. 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)

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



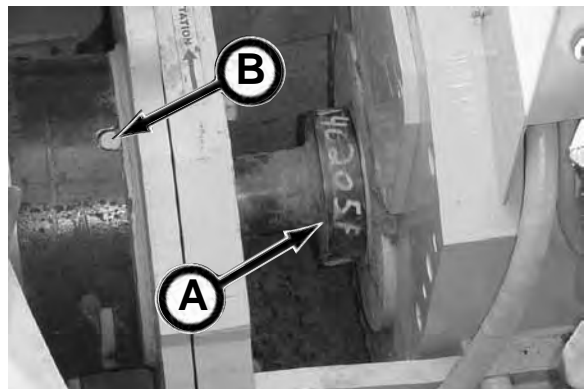
34. Remove auger drive adapter from gear box and insert onto casing auger shaft.



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

**NOTICE**

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



36. 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. Refer to procedure starting with step 40.



(continued on next page)

37. Periodically empty the dirt bucket.



38. Replace dirt bucket.



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



**NOTICE**

Regularly secure frame to the shaft while pushing the casings using the shaft tensioners and load binders (latching frame only) on GBM. Securing the frame to the shaft will keep the frame properly aligned with the pipe line.

*(continued on next page)*



**NOTICE**

Lubricant can be pumped from the reception shaft to lubricate the spoils. Install fluid connector on end of pilot tube in the reception shaft. Refer to "Upsizing Tool Lubrication From Reception Shaft" in this section, 6-35-63 for configuration details.



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

Hook up the breakout tool as follows:  
Clean the areas around the oil ports. Install base end cylinder hose to port A and rod end cylinder hose to port B.

Selector Position:  
Port A - Extend  
Port B - Retract



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



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

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

*(continued on next page)*



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



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

**NOTICE**

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



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



46. Slide breakout tool over both jaw inserts.

**NOTICE**

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

*(continued on next page)*



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



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



**NOTICE**

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



49. 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.

50. Release switch on controller.

*(continued on next page)*



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



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

53. Remove the front jaw insert.



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

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

*(continued on next page)*



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

**NOTICE**

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

57. Place pilot tube into pilot tube rack.



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



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



*(continued on next page)*

60. 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.



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



*(continued on next page)*

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



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

**NOTICE**

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



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



*(continued on next page)*

65. 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)*

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



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

67. Install safety chain assembly to auger to secure auger into cutter head assembly. For proper installation of safety chain, refer to Installing Safety Chain Assembly/Casing Auger Pin To Auger & Casing in this section.
68. Remove the cutter head assembly with auger from reception shaft.
69. Proceed to “Three Step Method: Installing Product Pipe” in this section, subsection Installing Product Pipe.



## UPSIZING TOOL LUBRICATION FROM RECEPTION SHAFT

The upsizing tool can be lubricated from the reception shaft to lower jacking pressures using the reception shaft fluid connector, pilot tube adapter and upsizing tool fluid connector. Use a suitable ground lubricant, such as Baroid EZ-MUD® borehole stabilizer/viscosifier or CON DET® wetting agent.

The lubrication used when installing pilot tubes varies depending on the soil conditions. In most clay type of soils Baroid EZ-MUD® or equivalent is all that is required. In some clays Baroid CON DET® or equivalent should be added to the mix to reduce jacking and rotation operating pressures. In unstable soils use Baroid BORE GEL® boring fluid or equivalent with NO SAG® suspension enhancer to the mixture to prevent the rotation operation of 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.

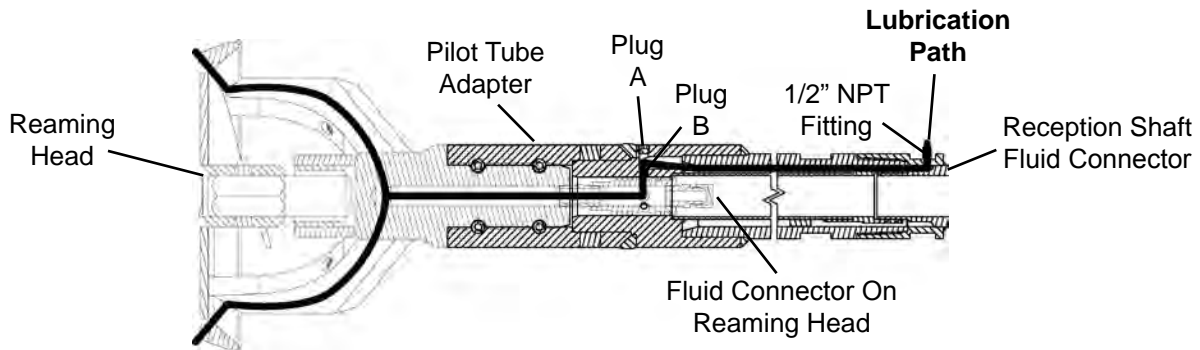
### I. Pilot Tube Adapter With Reaming Head Assembly

#### NOTICE

Plug A (not supplied) is a 1/4" NPT plug. Plug B (supplied) is a 1/8" NPT plug.

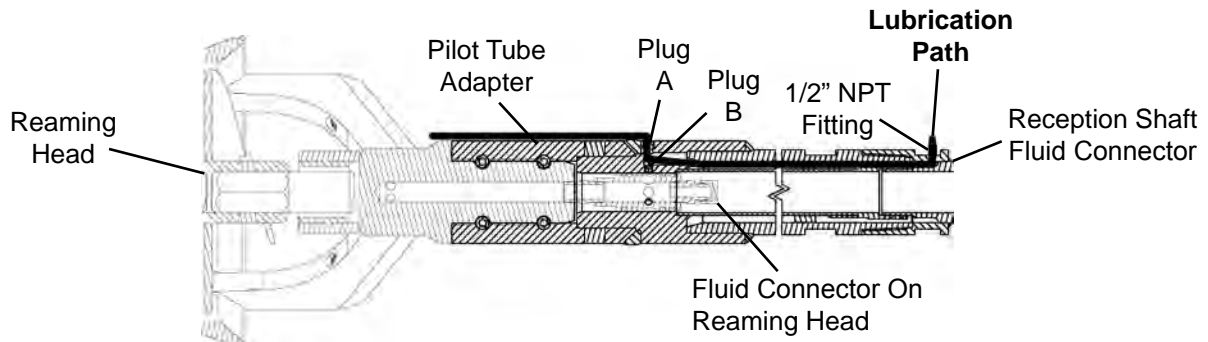
#### 1. To Lubricate Outside Of Casing

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



#### 2. To Lubricate Spoils Only

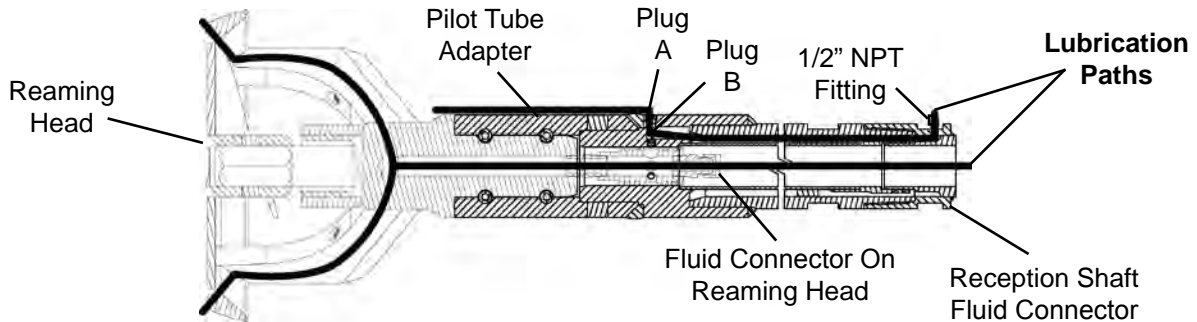
Remove plug A, install plug B, and connect a supply hose to the fitting on the fluid connector. The lubricant will flow through the dual walled pilot tubes and out port A on pilot tube adapter to lubricate the spoils.



### 3. To Lubricate Outside Of Casings And Spoils

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

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

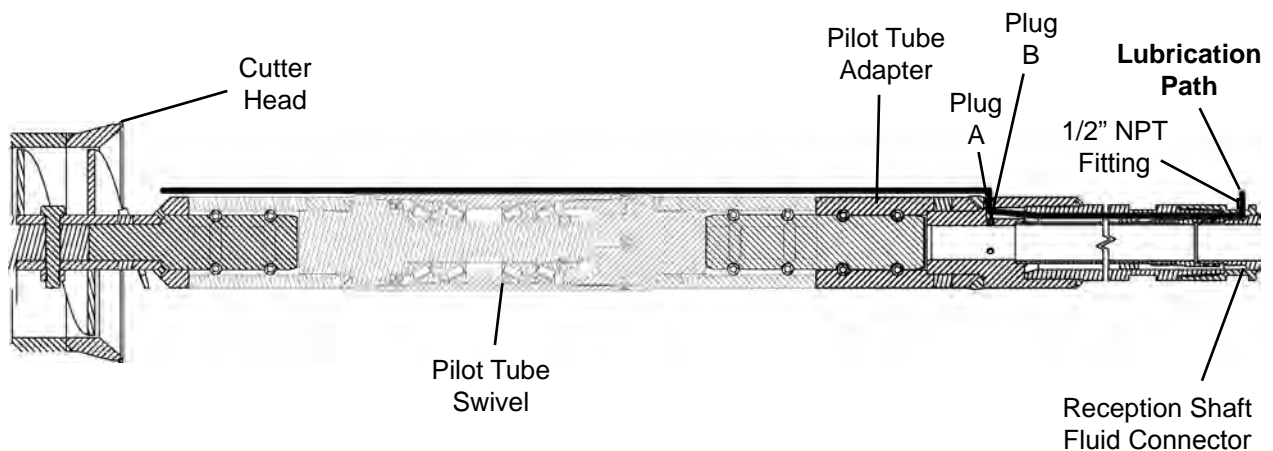


## II. Pilot Tube Adapter With Cutter Head Assembly

**NOTICE** Plug A (not supplied) is a 1/4" NPT plug. Plug B (supplied) is a 1/8" NPT plug.

### To Lubricate Spoils

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



## INSTALLING SAFETY CHAIN ASSEMBLY/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 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.

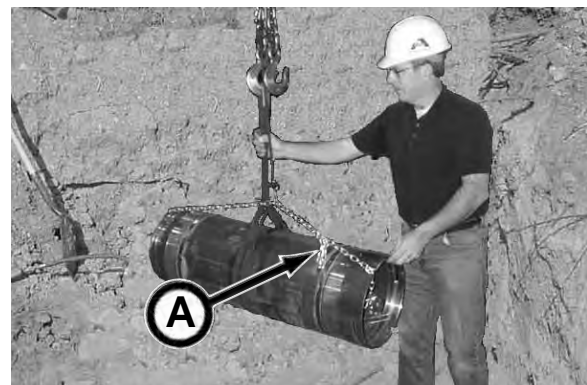
There are two methods of containing the auger in the casing while being lowered into or being raised out of the shafts. Method 1 was an earlier design consisting of the use of a safety chain. Method 2 is the latest design using a pin and clip.

### METHOD 1: Safety Chain Assembly

Secure auger to casing with safety chain assembly as follows:

1. Insert pin through shackle and auger shaft. Secure with cotter pin.
2. Adjust position of second shackle on chain link so the pin can be inserted through shackle and auger shaft. Secure with cotter pin.
3. Secure the end of the chain back onto chain with third shackle (A) to keep the chain from hanging loose.
4. Hook the flexible cord to the chain and hoist to take up any chain slack and for ease of reusing the safety chain assembly on the next auger and casing.

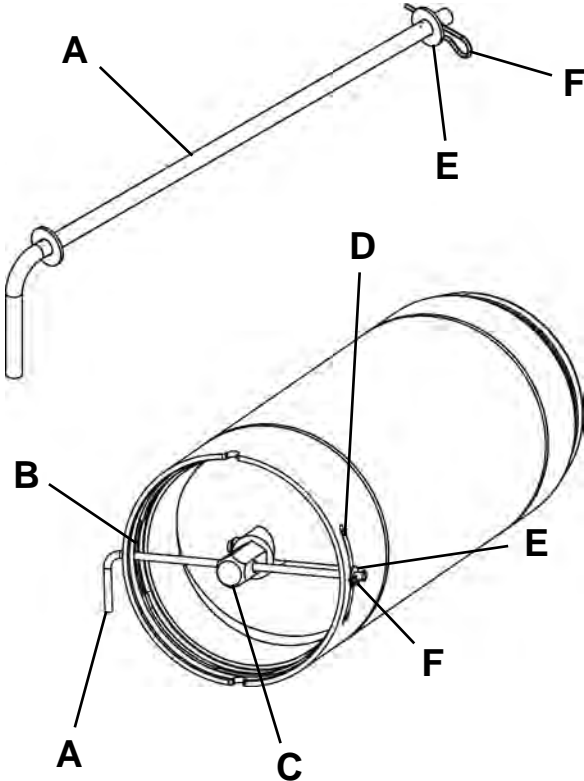
(continued on next page)



METHOD 2: Pin and Clip

Secure auger to casing with an auger pin and clip as follows:

- 1. Insert 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 pin with hardened flat washer (E) and hitch pin clip (F).



## USING THE POWERED CUTTER HEAD

Contractors installing pipe in diameters larger than 20 in. (508 mm) outside diameter now have a more productive choice in their pipeline installation when using the Guided Boring Method; the powered cutter head (PCH).



The powered cutter head proceeds as a three step method; first the pilot tubes are installed by using the Akkerman Guided Boring Machine frame and guidance system. Second, the bore diameter is increased to approximately 11 in. (279 mm) by installing temporary casings and augers. The third step is accomplished by installing the powered cutter head behind the temporary casings and reversing the auger flow direction toward the reception shaft.

After the powered cutter head is connected to the hydraulic supply of the power unit, it is thrust into the soils and its rotating cutterbit excavates the soil to the final diameter needed for the product pipe. The spoils are then transported through the temporary casings to the reception shaft and new pipe sections are added in the launch shaft as needed. When the powered cutter head reaches the reception shaft the hydraulic supply hoses are disconnected and removed from within the pipeline. The cutter head is then lifted from the reception shaft signaling the completion of the bore.

To install the powered cutter head refer to the following detailed information:

<b>6-35-67</b>	<b>Use Jetting &amp; Pipe Lubrication With Powered Cutter Head</b>
<b>6-35-69</b>	<b>Soil Stabilization (Chemical Delivery)</b>
<b>6-35-70</b>	<b>Installing Powered Cutter Head - Front Section</b>
<b>6-35-81</b>	<b>Installing Powered Cutter Head - Rear Section</b>
<b>6-35-90</b>	<b>Removing Powered Cutter Head From Reception Shaft</b>

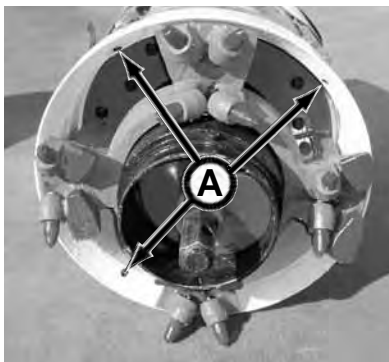
## USE JETTING & PIPE LUBRICATION WITH POWERED CUTTER HEAD

When using the Akkerman Powered Cutter Head (PCH), the contractor must plan for jetting, whether or not it is needed for the project. If a “change of conditions” occurs, and the PCH is not plumbed for jetting or is not being used, in many instances, the PCH will become plugged. In addition to using jetting with the PCH, lubricating the product pipe should also be used to reduce jacking pressure.

### What is Jetting?

• Jetting consists of water or a water / polymer mixture. Baroid’s EZ MUD®, a water soluble polymer or equivalent can be used. Ask your polymer supplier for the proper jetting mixture based on the Geotech report for your project.

### Why use Jetting?



• The three jetting nozzles (A) on the PCH reduces cutter head torque requirements by lubricating the metal parts along with the spoils to reduce or eliminate the clogging of the head or cutter bit.

• Torque of the auger drive is also reduced since the material flows more freely due to less friction on the metal parts.  
• The use of jetting also cleans the cutter bit to improve the cutter bit performance.



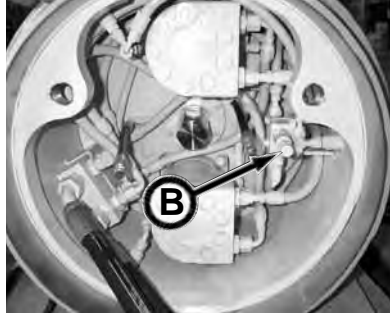
(continued on next page)

**Jetting Supply Requirements**

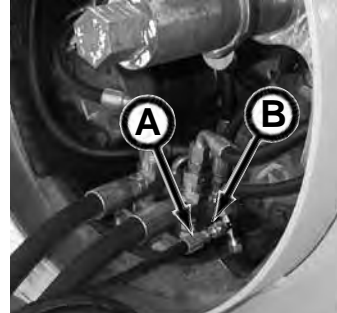
The jetting supply should pump a minimum of 5 gpm @ 1,000 psi (19 lpm @ 6,895 kPa) and a maximum of 7 gpm @ 1,500 psi (26.5 lpm @ 10.342 mPa). The maximum operating pressure is 2,500 psi (17.24 mPa) .

**Jetting Hookup**

Install jetting hose (A) (not shown on model PCH 20) to jetting inlet port (B). When launching front section, install hoses to jetting supply source. Once front section is launched, disconnect jetting hose from jetting supply. Route jetting hose through rear section and then connect to supply source. Install additional supply hoses as needed.



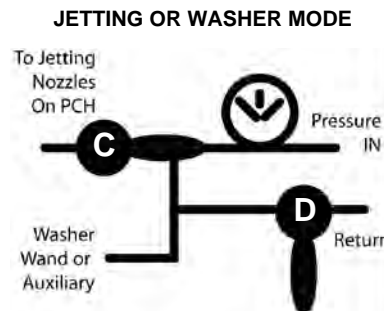
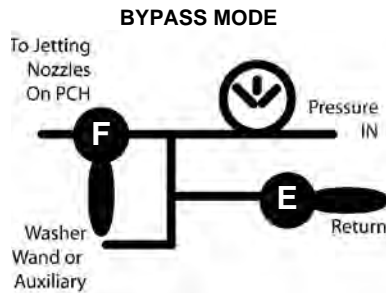
Model PCH 20 - Jetting Port



Model PCH 22.5 - Jetting Port

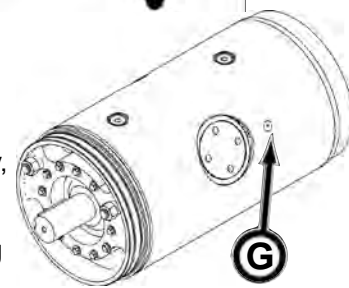
**Using Jetting**

- With jetting properly installed on PCH and jetting supply pump, turn valve (C) to ON position for jetting and turn return valve (D) to OFF position.
- The amount of jetting depends on ground conditions. If your spoils consist of a slurry substance, the amount of jetting should be reduced.
- Only use jetting when advancing pipe to prevent over excavating.
- When shutting down the jetting, be sure to turn return valve (E) to ON position, and then turn jetting valve (F) to OFF position to prevent pressure buildup in jetting hoses.



**Lubricating Product Pipe**

- Lubricating the product pipe around the outside of the pipe has proven to be very effective in reducing the friction between the product pipe and the soil that surrounds it. This lubrication results in a significant decrease in thrust. There are three ports (G) in the rear section of the PCH
- Lubrication type or mixture is based on soil conditions, consistency, clay, sand, etc. Your polymer supplier can help you with the proper lubrication mixture based on your Geotech report for the project.
- Only lubricate while advancing pipe to prevent the lubricant from flowing into launch shaft or into the cutter face causing plugging, resulting in decreased productivity.
- Install supply source to lubrication inlet port (H) on back of rear section.
- Refer to your Lubrication Pump specifications for the maximum operating pressure rating



Lubrication Ports



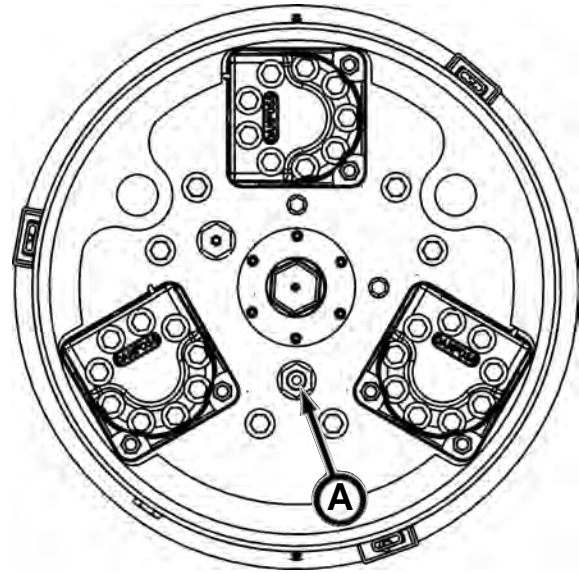
Model PCH 20 - Lubrication Inlet Port



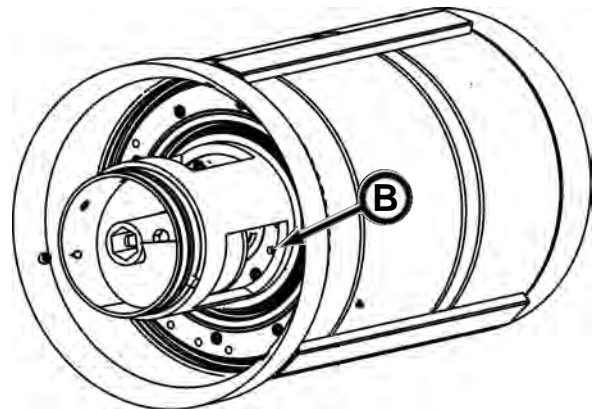
Model PCH 22.5 - Lubrication Inlet Port

## SOIL STABILIZATION (CHEMICAL DELIVERY)

A chemical delivery connection (A) is installed on the Powered Cutter Heads to allow chemicals or polymers to be added into the soil to control soil settlement or erosion thus preventing over-excavation.



Pumping the chemical or polymer mixture into the chemical delivery connection, will discharge the mixture out of the chemical discharge port (B) into the auger casing cavity of the powered cutter head to help stabilize the soil.



### NOTICE

Be sure to connect a 5/8" or 1" hose (not included) (hose must exceed the pump flow and pressure rating specifications) to the chemical delivery connection (#8 MFFOR) prior to launching the PCH rear section, otherwise chemical stabilization via the PCH will not be possible.

Also, if using the chemical delivery feature, keep in mind that if the discharge port is not used at the beginning of the drive and throughout the bore, the discharge port may become plugged.

Consult your local polymer supplier or other soil specialist to help you determine the proper chemical or polymer mixture based on your Geotech report for the project.

## INSTALLING POWERED CUTTER HEAD - FRONT SECTION

### NOTICE

When using the Powered Cutter Head (PCH), the contractor MUST plan for jetting and lubrication, whether or not it is needed for the project. If a “change of conditions” occurs, and the PCH is not plumbed for jetting/lubrication or is not being used, in many instances, the PCH will become plugged. The use of jetting and lubrication helps reduce jacking pressures. For more information, refer to Using Powered Cutter Head Jetting & Lubrication in this section. Akkerman highly recommends to always use jetting and lubrication on a PCH drive.

### NOTICE

As the reaming head and casings are advanced into the reception shaft, the reaming head assembly and casings must be supported to maintain alignment. Failure to do so will deteriorate the bottom of the bore hole resulting in poor grade alignment.

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

### ⚠ WARNING

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

2. Install safety chain assembly or auger pin to auger to secure auger into reaming head assembly. For proper installation of safety chain, refer to Installing Safety Chain Assembly/ Casing Auger Pin To Auger & Casing in this section.
3. Remove the reaming head assembly from reception shaft.
4. Lower winged casing/auger into launch shaft.

### NOTICE

The winged casing/auger is used to prevent rotation of the casing when attached to PCH. If there is rotation, operate the cutter head in the opposite direction to maintain the original casing position. Operate the cutter head direction as needed to maintain the original casing position.



(continued on next page)  
gbmom-050043

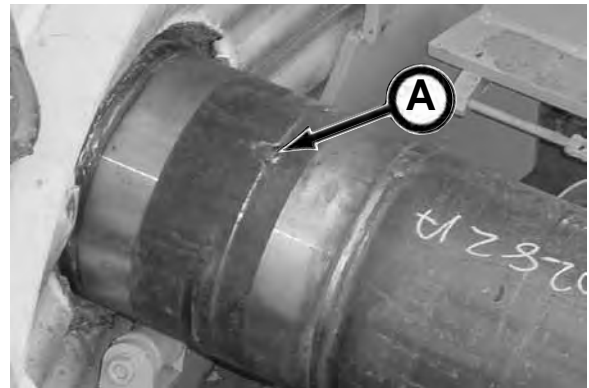
- Slide the winged casing auger onto the end of the front auger shaft.

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

- 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.



- Advance the winged casing to the front casing and align with alignment guides in the 12 o'clock (A) and 6 o'clock positions.



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



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

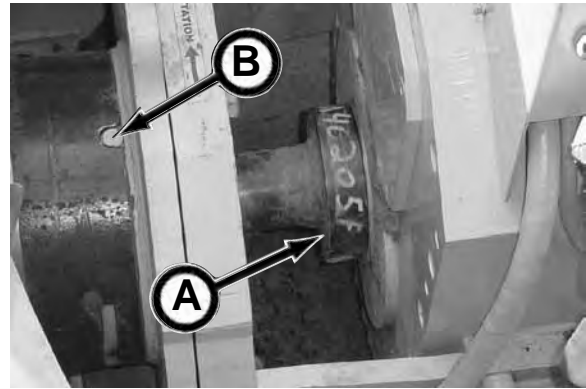
*(continued on next page)*



- Align the auger drive adapter (A) into the gear box while aligning the notches in the winged casing with the alignment guides (B) on thrust plate using the drive rotation control and travel motor control (latching frame) or thrust cylinder control.

**NOTICE**

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



**NOTICE**

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

- Advance the winged casing/auger with the thrust cylinder control and the rotation (CW) control as far forward as possible to allow enough room for the powered cutter head front section.



- With the addition of the winged casing and the powered cutter head sections, a section of casing/auger must be removed in the reception shaft.

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

**NOTICE**

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



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



*(continued on next page)*

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



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

16. Slide the front auger into the lead casing. Secure auger to casing with safety chain assembly or auger pin.
17. Remove auger casing from reception shaft.
18. Continue removing auger casings until the powered cutter head reaches the reception shaft.



19. Remove casing thrust adapter from the GBM frame.



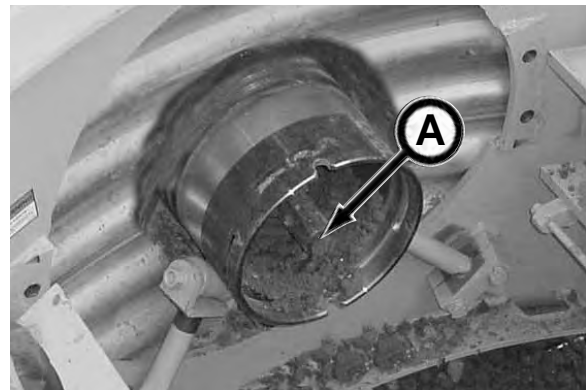
20. Install powered cutter head thrust plate (A) to GBM thrust plate with two 3/4-10 x 2-3/4 in. bolts and flat washers.

**NOTICE** If an increaser kit was added on your PCH, use the original size thrust plate for jacking the front section. When jacking the rear section, the original size thrust plate must be replaced with the increaser kit sized thrust plate.

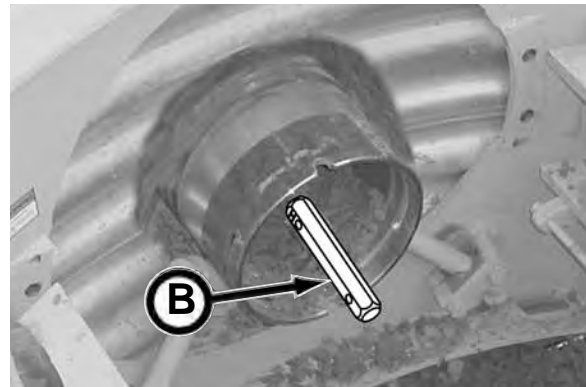


*(continued on next page)*

21. Remove 8" hex connection (A) from winged casing auger. If the hex connection cannot be removed, pull auger back far enough for the bolt to clear casing.



22. Install 12" PCH auger hex shaft (B) into end of wing casing auger. DO NOT pin at this time.



**⚠ 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 stand or walk under a suspended load.

23. Lower powered cutter head (PCH) into launch shaft.



24. Advance gear box so the bell end of the PCH is aligned and flush with PCH thrust plate on GBM frame.



*(continued on next page)*

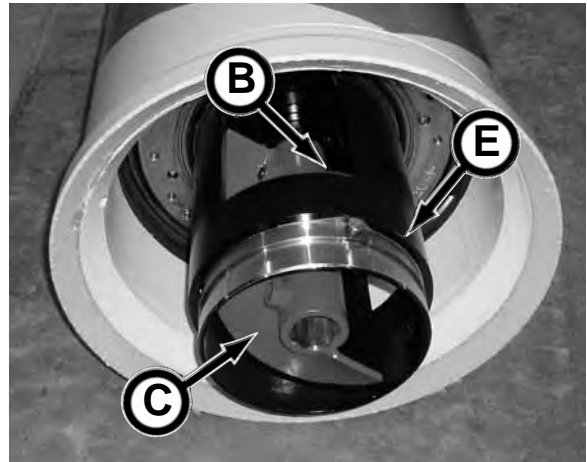
25. Slide spacer auger (A) onto 12" PCH hex shaft so the flighting matches with the winged casing auger flighting.



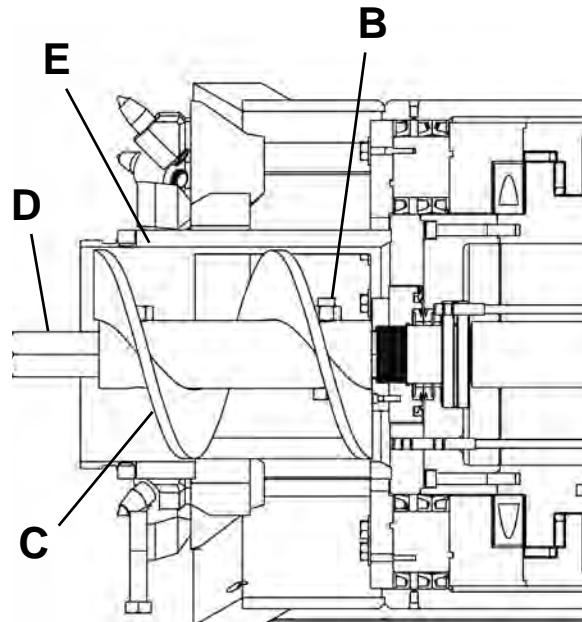
26. Gain access to retaining bolt (B) on PCH auger section (C). Remove bolt.

**NOTICE** Cutter head assembly removed for photographic purposes only.

27. Slide PCH auger section forward and secure to 12" hex shaft connection (D) with one 3/4 x 4 in. bolt and nylock nut. Tighten so end of nut is flush with the end of the bolt. Do not overtighten.
28. Slide PCH auger section back into PCH auger casing (E) and reinstall bolt and nylock nut (removed in step 26) into auger hex drive shaft.

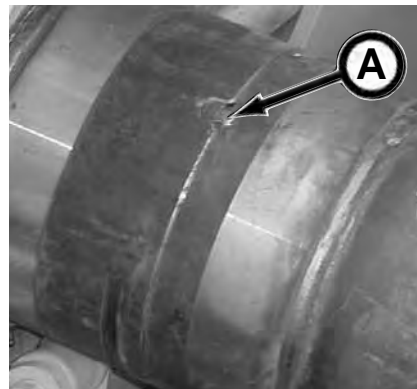


(continued on next page)



Powered Cutter Head

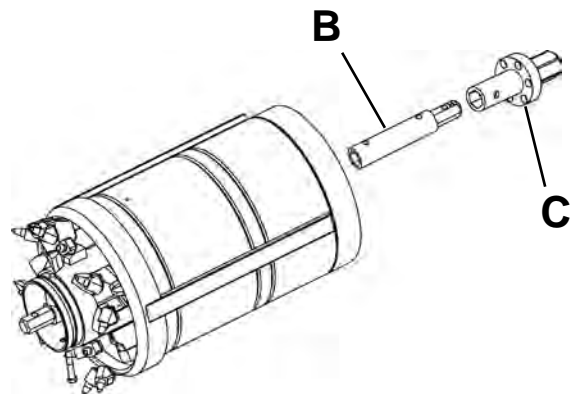
29. Advance PCH auger casing to winged casing by aligning notches on winged casing with top and bottom alignment guides (A) on PCH auger casing.



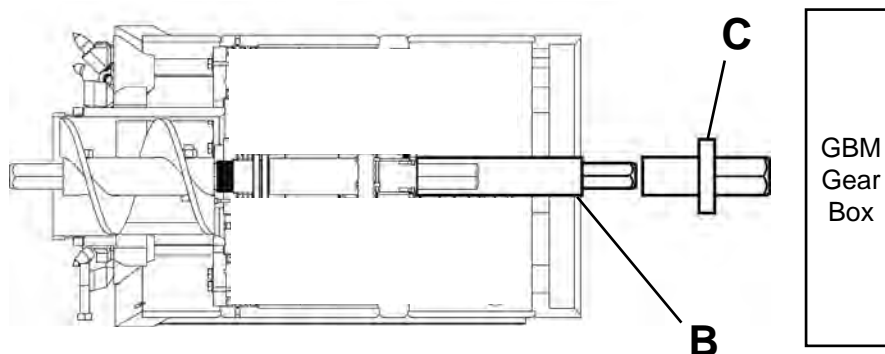
30. Install four casing joint keepers at the 2 o'clock, 4 o'clock, 8 o'clock, and 10 o'clock positions to lock the casings together.



31. With crane (or other lifting device) supporting the PCH, retract the GBM gear box and install the drive extension (B) into the PCH and connect to auger drive adapter (C) in GBM gear box.



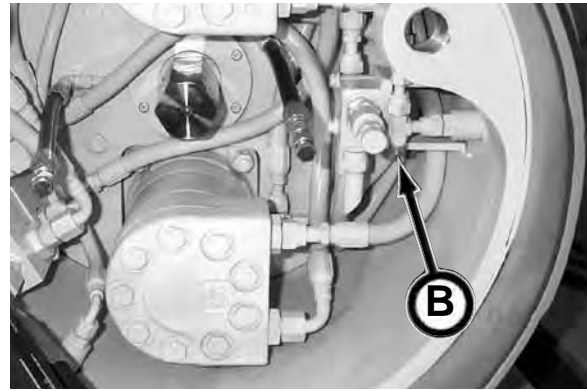
(continued on next page)



32. If not already installed, connect jetting hose to PCH.

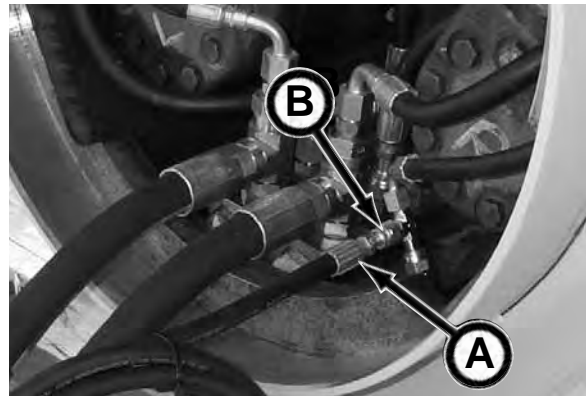
1. Install jetting hose (A) to jetting inlet port (B).
2. When launching front section, install hose to jetting supply source.

**NOTICE** Once front section is launched, disconnect jetting hose from jetting supply and route jetting hose through rear section and then connect to supply source. Add additional hoses as needed.



PCH 20

33. Test jetting nozzles for proper operation and no leaks.



PCH 22.5

34. Advance gear box so the bell end of the PCH is aligned and flush with PCH thrust plate on GBM frame.



35. Disconnect nylon strap from PCH and remove from launch shaft.

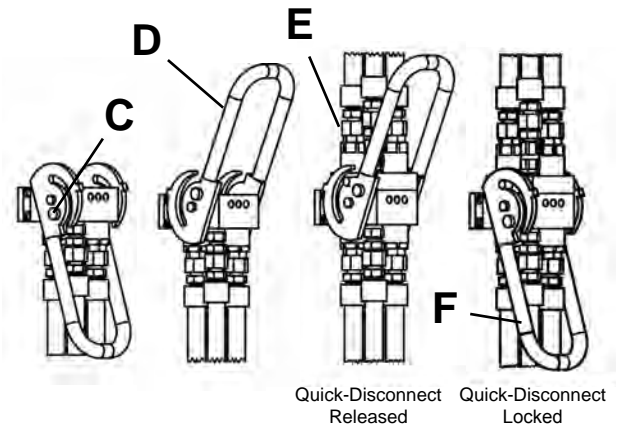
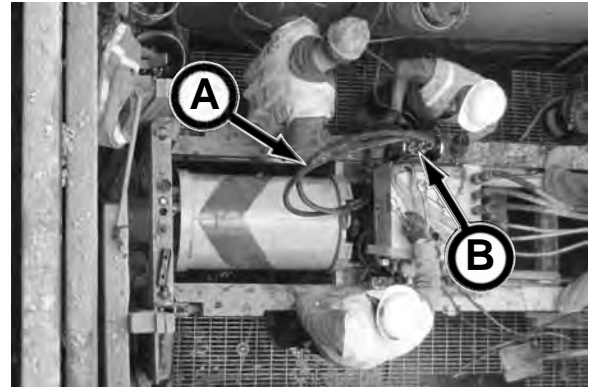


(continued on next page)

36. Connect two jumper hoses (A) to the two 3/4" hose quick disconnects from PCH to the multi-port quick-disconnect (B) on GBM. These are the pressure and return hoses for the cutter head drive.

To connect disconnects to the multi-port quick disconnect, use the following instructions:

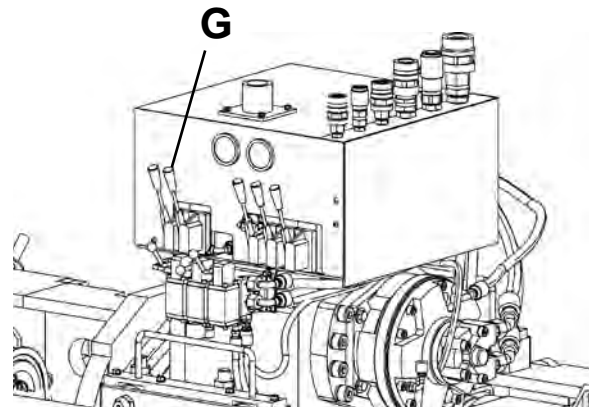
- a. Flip up port dust cover, push red release button (C) IN while rotating handle UP (D) to release quick-disconnect.
- b. Place male quick-disconnect (E) into position on female quick-disconnect block, and then, when the reception shaft personnel state it is clear to proceed with advancement, rotate handle DOWN (F) until release button (C) pops out. Multi-port quick disconnect is now locked into place.



**WARNING** Contact with rotating auger or cutter head can result in serious injury. When installing next pipe or when removing casing and auger in reception shaft, release multi disconnect to disable the cutter head functions. Reconnect male quick disconnect ONLY after it has been communicated from the reception shaft that you can proceed with advancement.

**NOTICE** The male quick-disconnect MUST be locked into place before cutter head will operate.

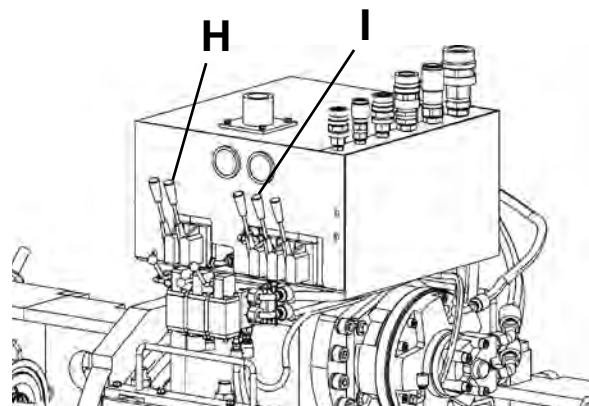
37. Use the PCH cutter head control (G) and check for proper rotation and operation, and be sure there are no leaks.



**NOTICE** Before operating the cutter head and auger, be sure the personnel in the launch and reception shafts are clear of any moving parts.

38. Rotate the cutter head with PCH cutter head control (H), turn on jetting at supply source, and rotate the auger counterclockwise with the auger drive rotation control (I) so the spoils are removed to reception shaft.

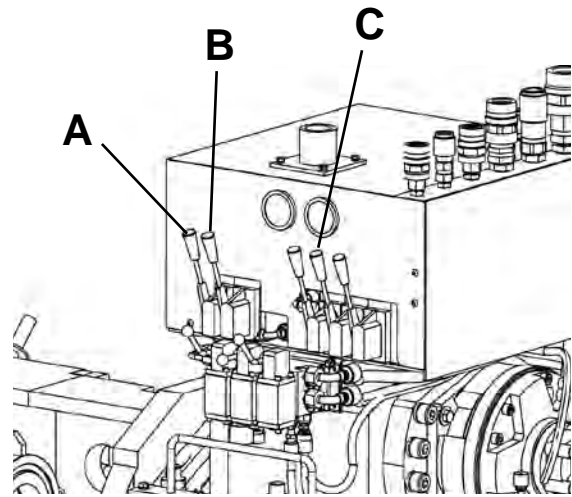
Using a communication device between the launch and reception shafts, contact the personnel in reception shaft to confirm that the auger is rotating in the counterclockwise direction and that the spoils are going into the reception shaft.



(continued on next page)

39. Start jacking the PCH by extending the GBM thrust cylinders using the thrust cylinder control (A) while rotating the PCH cutter head (B) and auger drive (C).

(Latching Frame Only) Relatch latching pins as needed. Be sure latching pins are completely engaged into frame holes before jacking.



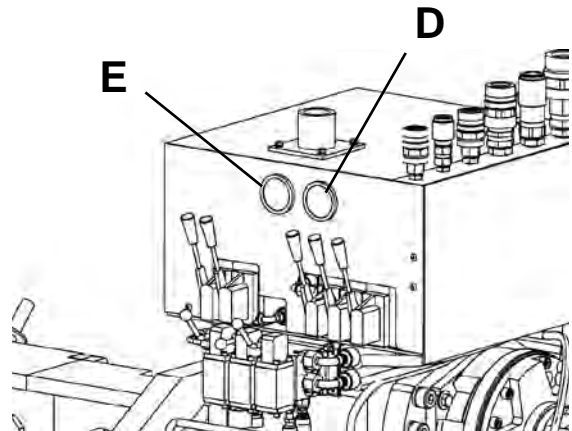
40. While jacking the PCH, monitor the auger drive rotation pressure with gauge (D) and the cutter head operating pressure with gauge (E) to determine advance rate.

Normal operating pressure:

auger -	2,000 - 4,000 psi
	(13.790 mPa - 27.579 mPa)
cutter head -	2,000 - 4,000 psi
	(13.790 mPa - 27.579 mPa)

**NOTICE**

The maximum system operating pressure is 5,000 psi (34.474 mPa). Your operation will stall when operating at 5,000 psi (34.474 mPa).

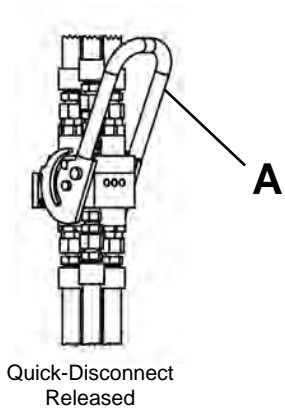


(continued on next page)

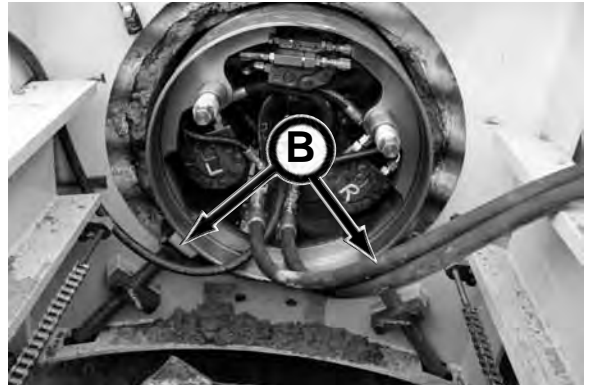
41. Advance PCH as far forward as possible. Turn off all power.



42. Release disconnect to disable the cutter head functions by rotating multi-port quick disconnect handle UP (A).



43. Adjust the bottom two roller brackets (B) to support the PCH.



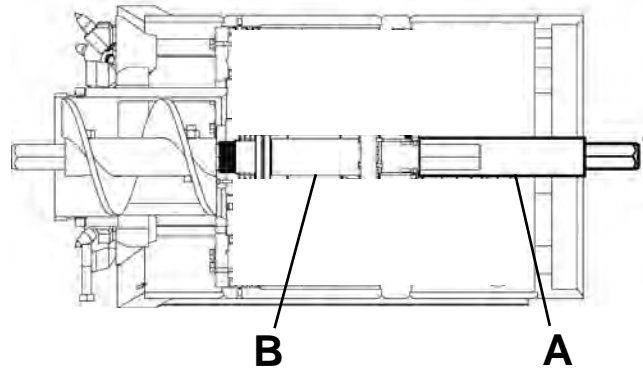
44. Proceed to Installing Powered Cutter Head - Rear Section in this section.

## INSTALLING POWERED CUTTER HEAD - REAR SECTION

1. Once front section of the powered cutter head (PCH) is launched, disconnect the hydraulic jumper hoses between the PCH and the multi-port quick disconnect, and the jetting hose.



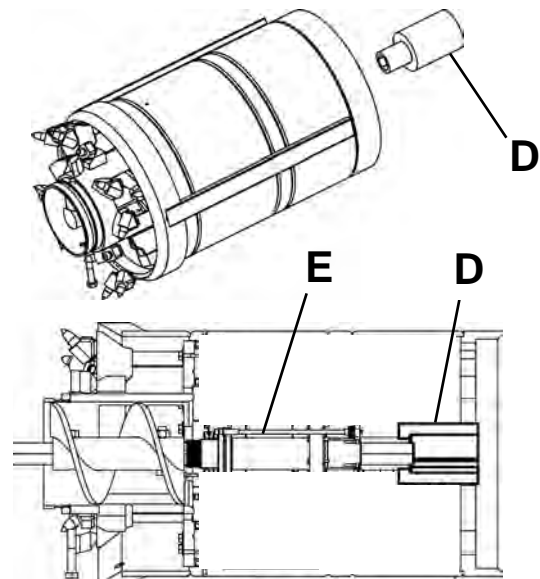
2. Remove drive extension (A) from front section auger shaft (B).



3. Install alignment pins (C) into front section.



4. Connect auger drive adapter (D) onto auger shaft (E) of front section.

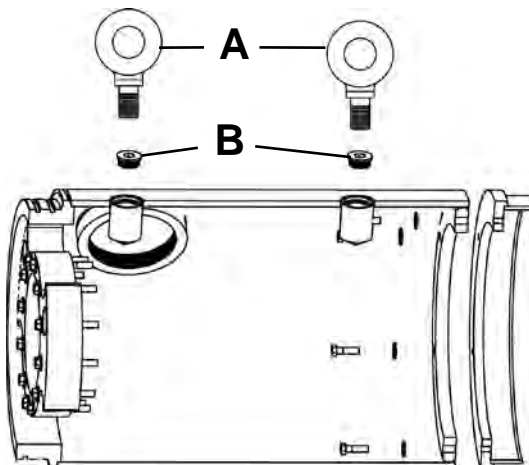


*(continued on next page)*

5. Remove auger drive adapter for GBM gear box.



6. Install lifting eyes (A) by removing o-ring plugs (B) and threading the lifting eyes completely into PCH body.



**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 stand or walk under a suspended load.



**NOTICE** If an increaser kit was added on your PCH, use the original size thrust plate for jacking the front section. When jacking the rear section, the original size thrust plate must be replaced with the increaser kit sized thrust plate.

7. Lower rear section on GBM frame.

8. Lubricate sealing rings on rear section.

*(continued on next page)*



9. Connect 3/4 quick disconnects between front and rear sections.

10. Feed jetting line through rear section.



11. Advance gear box so the bell end of the PCH is aligned and flush with PCH thrust plate on GBM frame.

**NOTICE**

Carefully route hoses through thrust plate so hoses are not pinched.

12. Connect four hydraulic hose disconnects (two- 3/4", two-1") to multi-port quick disconnect from back of rear section. The 3/4" disconnects are the hoses for the powered cutter head drive. The 1" disconnects are the hoses for the powered cutter head auger drive.

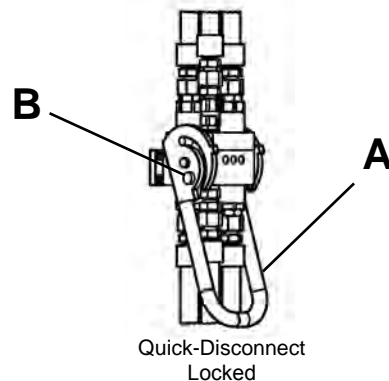


13. Connect jetting hose to supply source.

14. Remove port covers.

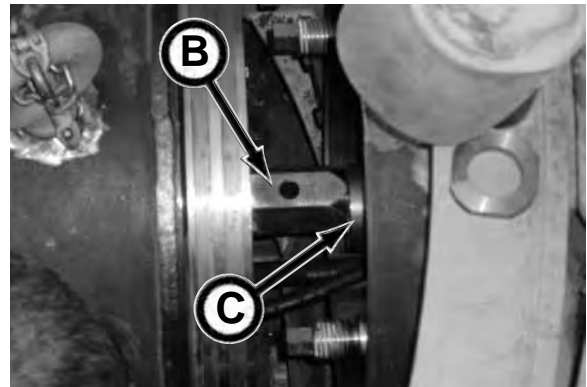
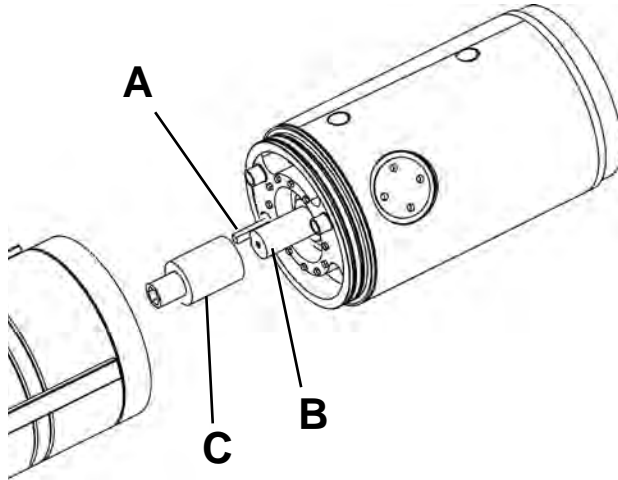


15. Place male quick-disconnect into position on female quick-disconnect block, and then when the reception shaft personnel communicate that it is clear to proceed with the auger drive hookup, rotate handle DOWN (A) until release button (B) pops out. The multi-port quick disconnect is now locked into place.



(continued on next page)

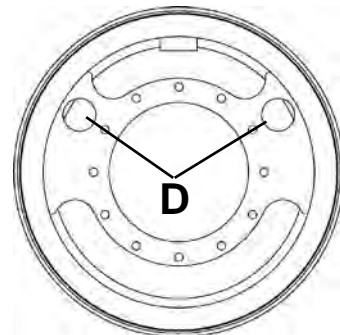
16. Rotate auger drive to align key (A) shaft (B) with auger drive adapter (C).



17. Once key is aligned, advance rear section to front section. Alignment pins should be through openings (D) in rear section.
18. Disconnect lifting straps and remove from launch shaft. Remove lifting eyes and reinstall o-ring plugs.
19. Test auger drive to be sure key shaft is properly installed.



(continued on next page)



20. Install flat washers and retaining nuts to alignment pins. Tighten securely.



21. Reinstall port covers.



22. Advance PCH by rotating cutter head, PCH auger (CCW) drive and extend thrust cylinders.

(Latching Frame Only) Relatch latching pins as needed. Be sure latching pins are completely engaged into frame holes before jacking.



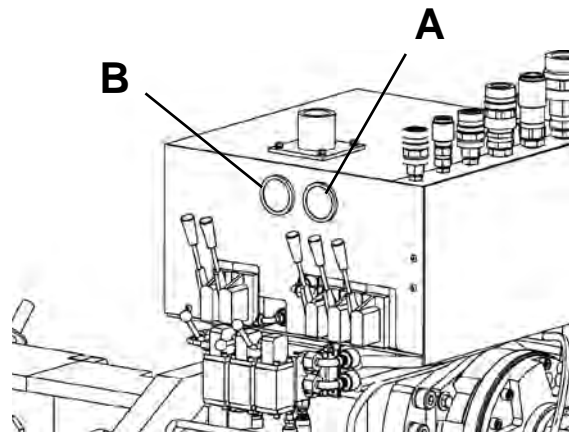
(continued on next page)

23. While jacking the PCH, monitor the auger drive rotation pressure with gauge (A) and the cutter head operating pressure with gauge (B) to determine advance rate.

Normal operating pressure:  
auger - 2,000 - 4,000 psi  
(13.790 mPa - 27.579 mPa)  
cutter head - 2,000 - 4,000 psi  
(13.790 mPa - 27.579 mPa)

**NOTICE**

The maximum system operating pressure is 5,000 psi (34.474 mPa). Your operation will stall when operating at 5,000 psi (34.474 mPa).



24. Advance PCH as far forward as possible so the PCH is supported by the bottom roller brackets.

**WARNING**

When installing next pipe or when removing casing and auger in reception shaft, release multi-port quick disconnect to disable the cutter head functions. Failure to do so could result in serious injury from contact with rotating auger. Lock or reconnect multi-port quick disconnect ONLY after it has been communicated from the reception shaft personnel that advancement can proceed.



25. With the addition of the PCH rear section in the pipe line, a section of casing/auger must be removed in the reception shaft.



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

**NOTICE**

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

27. Slide the casing out to gain access to the auger joint.



(continued on next page)

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



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

29. Slide the front auger into the lead casing. Secure auger to casing with safety chain assembly or auger pin.
30. Remove auger casing from reception shaft.
31. Continue removing auger casings until the powered cutter head reaches the reception shaft.



32. Retract GBM gear box and disconnect the four hydraulic hoses (two 3/4", two 1") and jetting hose.



33. Install pipe lube 5/8" hose to rear section.
34. Connect two 3/4" 100' hydraulic hoses and two 1" x 100' hydraulic hoses to rear section.

*(continued on next page)*



**NOTICE**

To protect your product pipe, you must be sure the product pipe rating can withstand the thrust pressure of the GBM. The factory setting is 5,000 psi (34.5 MPa) or 100 ton. If your product pipe is rated lower than 100 ton, you **MUST** readjust the thrust pressure in the P100Q or P150Q Power Pack. Failure to do so will break the pipe. Refer to Operation section, subsection Power Pack Operation, Adjusting Thrust Pressure.

35. Route the hoses through several pipe (5-8 depending on room) back to multi-port quick disconnect.

**NOTICE**

Be sure to position hoses through pipe so spigot end of pipe goes into the pipeline first.

**NOTICE**

Production is optimized by having the casing in the reception shaft staged to be removed during installation of the next product pipe. To achieve this production, you may have to install a 1' or 2' length pipe behind the cutter head to expose one casing in the reception shaft for removal. Then proceed with normal pipe length.



**⚠ 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 stand or walk under a suspended load.



36. Lower pipe into shaft. Pull hoses through pipe as pipe is being positioned on jacking frame.



**NOTICE**

Be sure fiber ring is in thrust ring of rear section for cushioning or pipe.

37. Route lube and jetting hoses through pipe.

*(continued on next page)*



38. Position spigot end of pipe to the PCH rear section.
39. Route hoses through thrust plate. Be sure hoses will not be pinched.
40. Advance thrust plate to bell end of pipe. Be sure fiber ring is in pipe prior to jacking. Be sure hydraulic hoses will not be pinched while advancing pipe.
41. Reconnect jetting hose. The lube hose does not need to be connected until the third or fourth pipe.
42. Push product pipe into pipeline by rotating PCH cutter head, PCH auger (CCW) drive and extending the thrust cylinders.

**NOTICE**

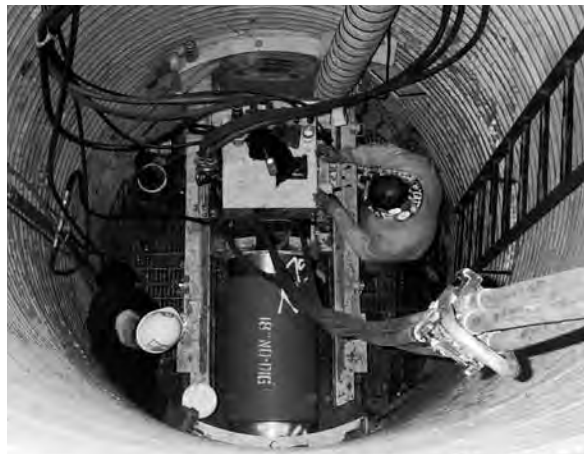
To properly support the product pipe:

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

**WARNING**

When installing next pipe or when removing casing and auger in reception shaft, release multi-port quick disconnect to disable the cutter head functions. Failure to do so could result in serious injury from contact with rotating auger. Lock or reconnect multi-port quick disconnect **ONLY** after it has been communicated from the reception shaft personnel that advancement can proceed.

43. Continue adding pipe and hoses as needed until the powered cutter head reaches the reception shaft. Be sure to connect the lube hose starting with pipe number three or four.
44. With the addition of each section of product pipe, a section of casing/auger must be removed from the reception shaft. Refer to steps 26 - 31 for removing casing/auger from reception shaft.
45. Once the powered cutter head is removed from the reception shaft (refer to Removing Powered Cutter Head From Reception Shaft, in this section), add product pipe as needed until the product pipe reaches the reception shaft per job requirement.
46. Proceed to Removing Powered Cutter Head From Reception Shaft in this section.



## REMOVING POWERED CUTTER HEAD FROM RECEPTION SHAFT

1. Disconnect winged casing from cutter head assembly and remove from reception shaft.

**NOTICE** Do not remove PCH assembly with winged casing attached. Doing so will cause damage to the PCH auger casing.



2. Communicate with the launch shaft personnel to advance PCH until product pipe is exposed.
3. Once the cutter head is supported disconnect the cutter head from the product pipe and remove the hydraulic hoses, jetting hose, and pipe lube hose.



4. Pull hoses back to launch shaft.



5. Remove PCH assembly from reception shaft.
6. Proceed to Powered Cutter Head After Drive, section 9, Maintenance to perform required maintenance after the drive is complete.



# Operation - Installing Product Pipe

## THREE STEP METHOD: INSTALLING PRODUCT PIPE

**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 P100Q or P150Q Power Pack. Failure to do so will break the pipe. Refer to Operation section, subsection Power Pack Operation, Adjusting Thrust Pressure.

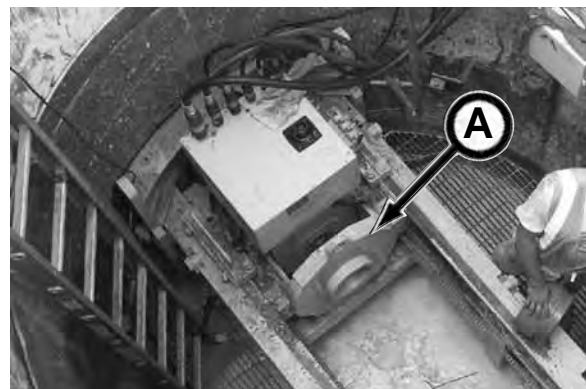
**NOTICE** Though the photos in this procedure depict the latching frame, this procedure also applies to the single stage frame.

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



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

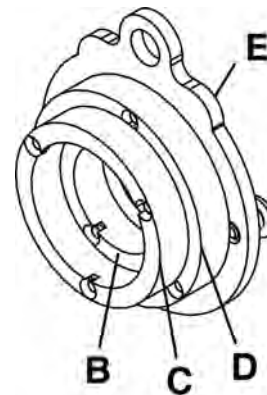
2. Install pipe thrust adapter (A) on front of thrust plate and secure with two 3/4 x 1-1/4 bolts and flat washers.



**NOTICE** The pipe thrust adapter assembly contains three separate pipe adapters; 8" ID (B), 10" ID (C), and 12" ID (D), mounted to the thrust plate (E) for shipping purposes only.

BEFORE using assembly for final pipe installation with the GBM, reassemble so only one pipe adapter is securely fastened to the thrust plate to prevent component damage.

*(continued on next page)*



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 keepers.

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



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

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



(continued on next page)

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 keepers from the casings.

**NOTICE**

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



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)

**⚠ 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 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 safety chain assembly or 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 PULL BACK THROUGH LAUNCH SHAFT

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



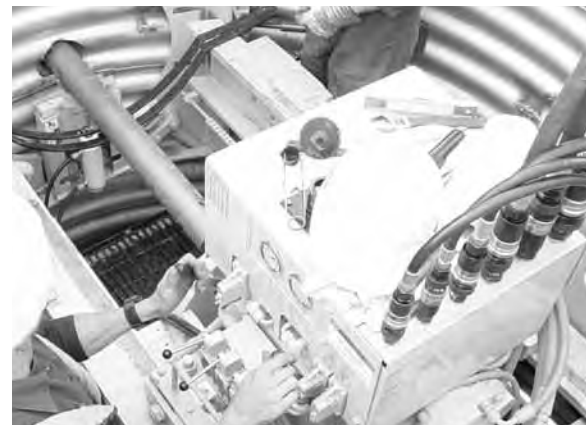
2. With the pilot tube engaged into the make-up tool, thread the drive swivel into the pilot tube by rotating the drive swivel in the clockwise (CW) direction with the drive rotation control.

**NOTICE** Slide pilot tube wiper onto pilot tube if needed to remove soil accumulated on the outside of pilot tube.



3. Disengage make-up tool and pull back pilot tube until the notches of the next pilot tube align with make-up tool by using the thrust cylinder control and the travel motor control (latching frame).

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



4. Engage make-up tool into pilot tube notches.
5. Install launch shaft breakout tool over notches on the pilot tube and drive swivel.



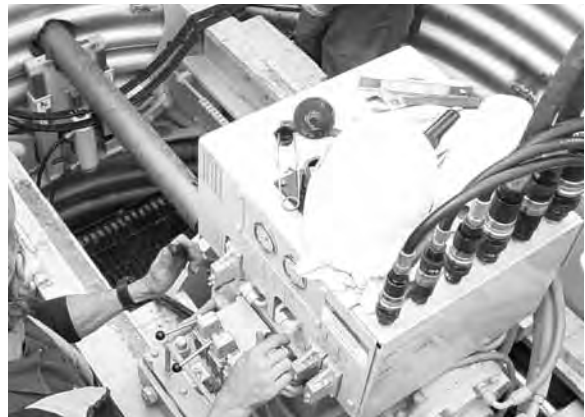
**⚠ WARNING** Flying breakout tool can cause serious personal injury or death. BEFORE loosening (breaking) joint, the tool chain MUST be fastened around pilot tube and swivel.

6. Fasten breakout tool chain around pilot tube and swivel.



7. With the pilot tube locked into the make-up tool, loosen the pilot tube joints by rotating the drive swivel counterclockwise (CCW) by using the drive rotation control.

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



8. Once the joint has been loosened, remove the breakout tool.



9. Remove pilot tube. Install caps and plugs on pilot tube.
10. Continue to pull back pilot tubes as needed.



# Transporting

---

## TRANSPORTING GUIDELINES

1. Know the local, state, and federal transportation regulations.
2. Obtain required permits for transporting.
3. Remove any obstacles from the trailer floor.
4. Clean debris from machine.
5. Load and unload on level ground.
6. If lifting equipment with a hoist or lifting device, the equipment lifting eyes and sling must be inspected for damage before lifting. If damaged, replace.
7. Use chains to fasten the guided boring machine and power pack to trailer floor.
8. Securely fasten all tooling to trailer floor.
9. Observe all lifting capacities and lifting instructions.

**NOTES**

# Fuels & Lubricants

## NOTICE

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

## FUEL SPECIFICATIONS

## NOTICE

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

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

The fuel must meet the following properties:

- Cetane number of 45 minimum
- Cold Filter Plugging Point below the expected low temperature OR Cloud Point at least 9° F (5° C) below the expected low temperature.
- Fuel lubricity should pass a minimum of 3100 gram load level as measured by the BOCLE scuffing test.
- Do not use diesel fuel with sulfur content greater than 1.0%. Sulfur content less than 0.05% (500 ppm) is preferred.
- Bio-diesel fuels may be used ONLY if the fuel properties meet DIN 51606 or equivalent specification.
- DO NOT mix used engine oil or any other type of lubricant with diesel fuel.



## ENGINE OIL - P100Q

## NOTICE

For more information on the engine oil specifications, refer to your engine manual.

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

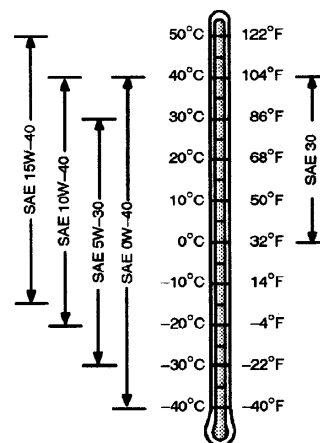
**Change the oil and filters after first 100 hours (maximum) operation.**

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

Multi-Viscosity diesel engine oils are preferred.

Other oils may be used if they meet one or more of the following:

- API Service Classification CH-4
- API Service Classification CG-4
- API Service Classification CF-4
- ACEA Specification E3
- ACEA Specification E2



## ENGINE OIL - P150Q

**NOTICE** For more information on the engine oil specifications, refer to your engine manual.

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

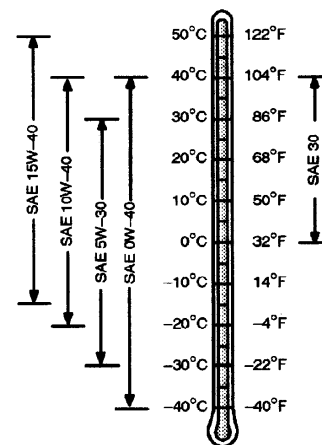
**Change the oil and filters after first 100 hours (maximum) operation.**

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

Multi-Viscosity diesel engine oils are preferred.

Other oils may be used if they meet one or more of the following:

- API Service Category CJ-4
- API Service Category CI-4 PLUS
- API Service Category CI-4
- ACEA Oil Sequence E5
- ACEA Oil Sequence E4



## POWER PACK HYDRAULIC OIL RESERVOIR LUBRICANT

The power pack oil reservoir is typically 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 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



*P100Q Shown*

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

---

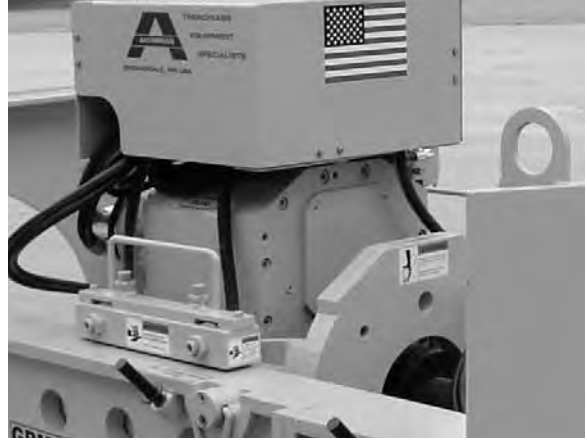
## GEAR BOX LUBRICANT

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

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

### NOTICE

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



---

## GREASE

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

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

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



---

## BREAKOUT TOOL POWER UNIT LUBRICANT

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

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

### NOTICE

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



## ENGINE COOLANT

**⚠ 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.



*P100Q Shown*

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

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

## POWERED CUTTER HEAD BEARING CAVITY & GEAR BOX LUBRICANT

The powered cutter head front section bearing cavity and rear section auger drive gear box are 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.



## STORING LUBRICANTS

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

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



# Periodic Maintenance

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

## 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 hour meter (A) on the control pendant to determine the proper lubrication and maintenance intervals.



*P100Q Pendant*



*P150Q Pendant*

## LOCKOUT POWER BEFORE SERVICING

**⚠ WARNING** Severe personal injury or death can result from unexpected power unit start-up or machine movement.

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



---

## AVOID PINCH POINTS

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

Keep hands away from moving parts.

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

Handle parts carefully to avoid crushing and pinch point hazards.



---

## 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.

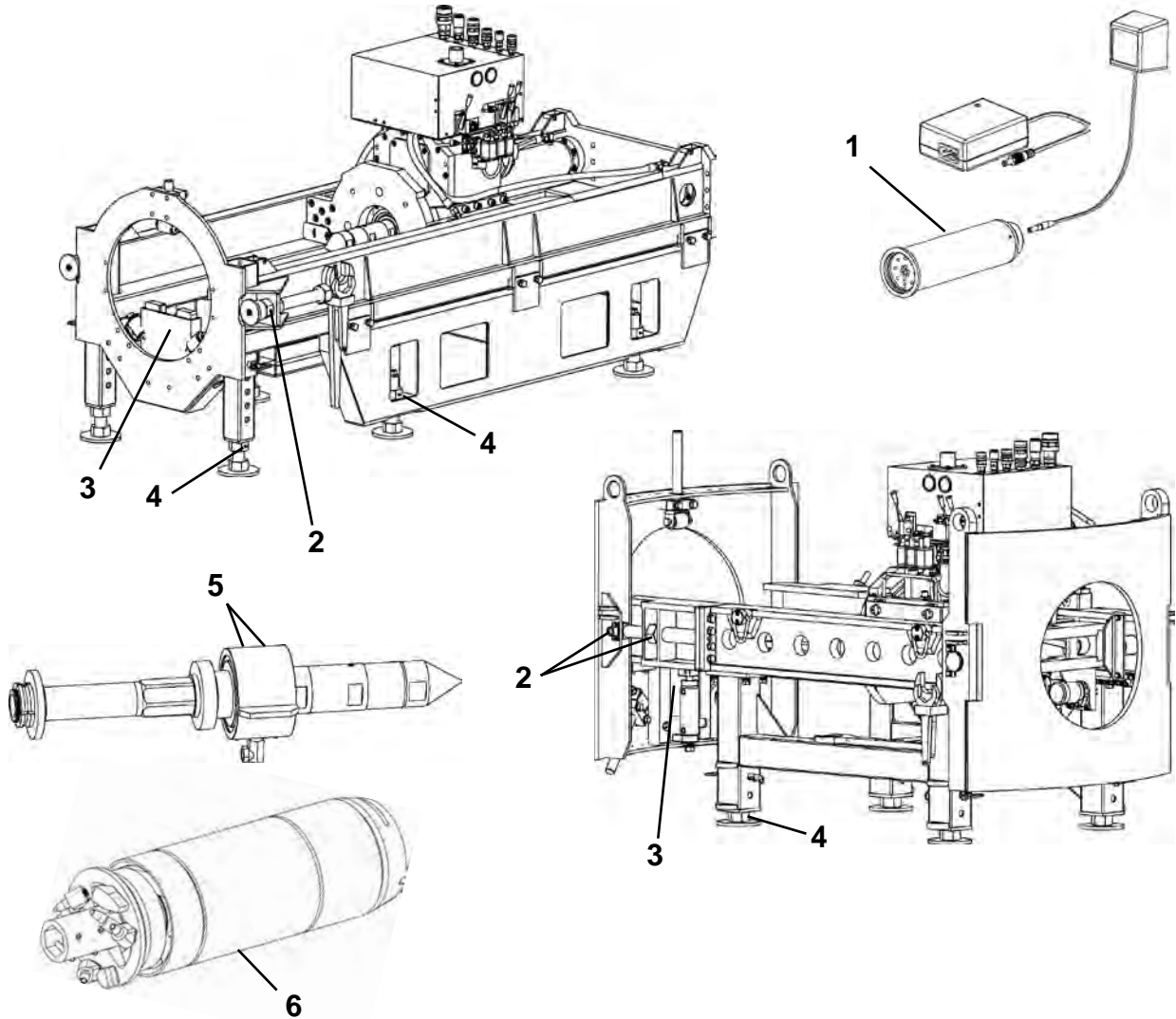
Contact medical help immediately if any oil or fluid is injected into your skin. A serious infection or reaction can emerge without proper medical treatment.



## MAINTENANCE CHARTS - GBM - POWER PACK

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

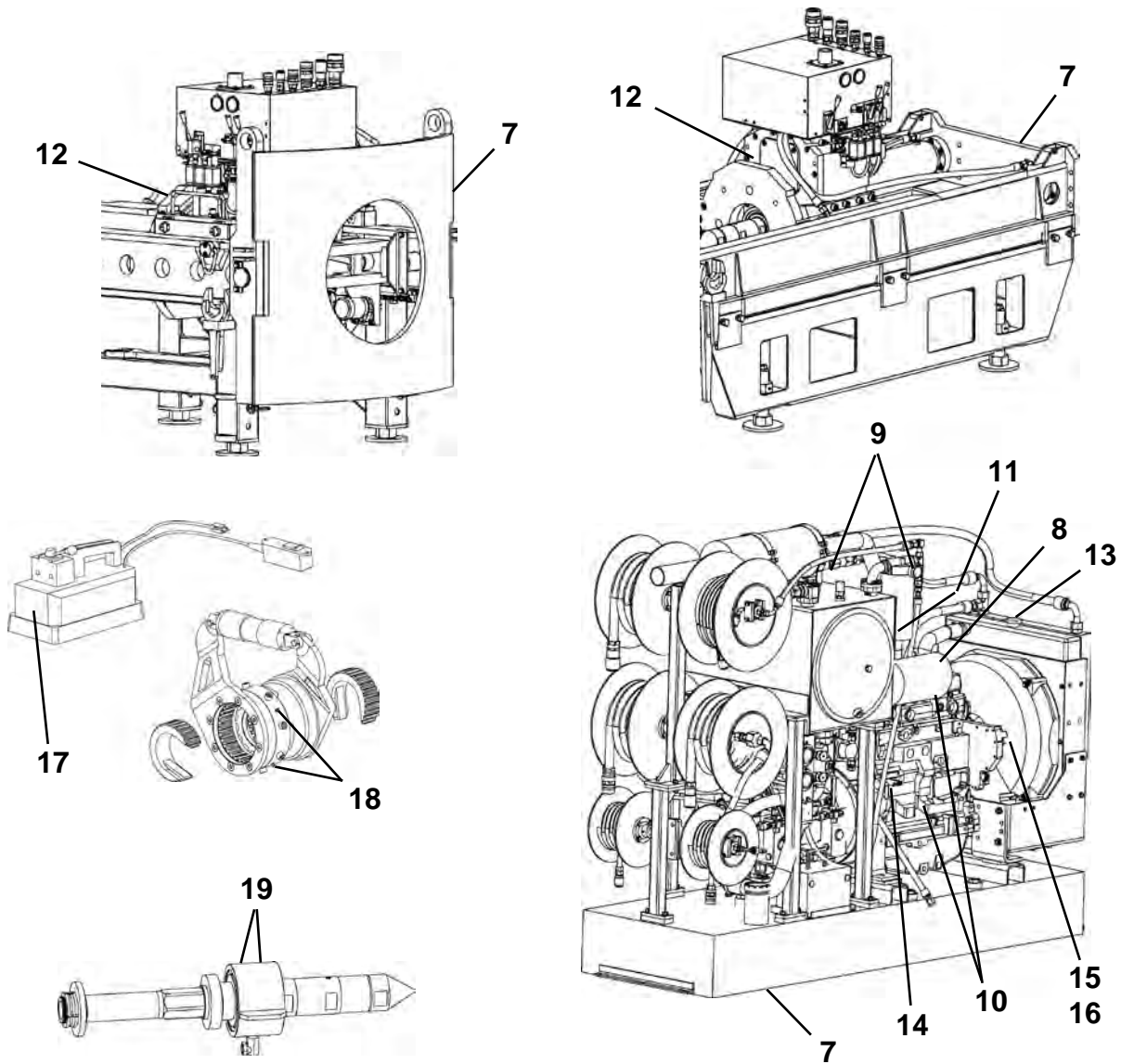
**NOTICE** For Powered Cutter Head maintenance, refer to Powered Cutter Head Maintenance later in this section.



### PRIOR TO EACH JOB LAUNCH

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Target	Charge	Charge 24 hours prior to operation.	
2.	Shaft Tensioner(SSF)	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
	Shaft Tensioner (LF)	Lubricate	Apply anti-sieze compound	Anti-Sieze
3.	Hydraulic Make-Up Tool	Clean		
4.	Leveling Assembly	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
5.	Drive Adapter/Swivel	Lubricate	Lubricate with 3 to 5 shots.	Mobil XHP222
6.	Integral Bearing Swivel Cutter	Lubricate	Purge 2 ounces of oil.	Mobil 636 Gear Oil

LF - Latching Frame    SSF - Single Stage Frame

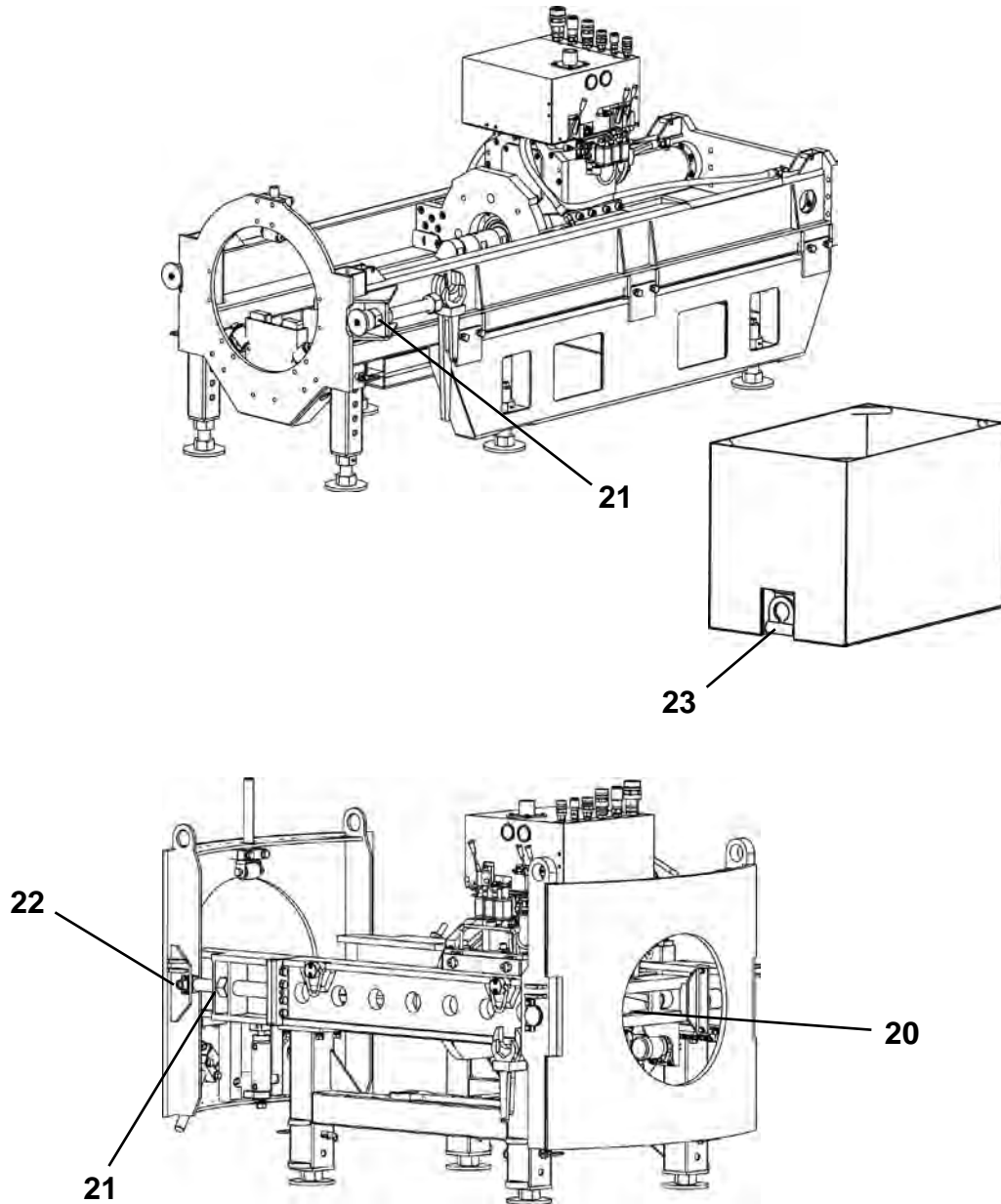


**\*DAILY OR EVERY 10 HOURS OF OPERATION**

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
7.	GBM & Power Pack	Visual Inspection	If parts are damaged or missing, replace.	
8.	Air Cleaner Dust Unloader	Clean Out		
9.	Hydraulic Return Filters	Check Indicator	Replace filter as needed per indicator.	Return Filter
10.	Engine Crankcase**	Check Oil Level	Add oil as needed.	See Section 8
11.	Hydraulic Reservoir	Check Fluid Level	Add hydraulic fluid as needed.	ISO-VG-46 20W
12.	Gear Box	Check Oil Level	Add oil as needed.	Mobil SHC 630
13.	Radiator	Check Coolant Level	Add coolant as needed.	
14.	Fuel/Water Separator	Drain Water	Drain until fuel is visible.	
15.	Fan	Inspect Fan & Guard	If damaged, replace with new.	
16.	Belt	Inspect	If damaged, replace with new.	
17.	Breakout Tool	Check Oil Level	Add oil as needed.	ISO-VG-46 20W
18.	Breakout Tool	Lubricate (4 Places)	Lubricate 2 shots per fitting.	Mobil XHP222
19.	Drive Adapter/Swivel	Lubricate	Lubricate with 3 to 5 shots.	Mobil XHP222

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

\*\* During engine break-in period, change the oil and filter for the first time before 100 hours of operation.



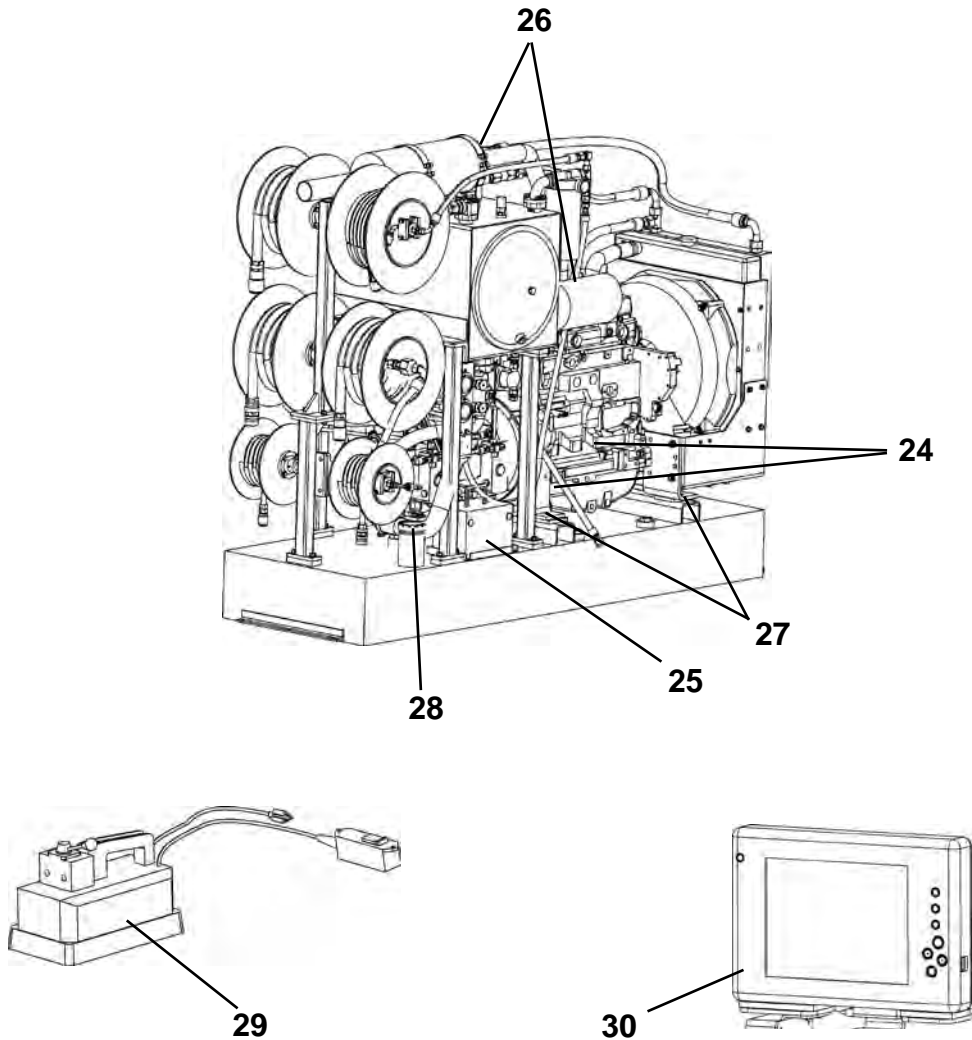
**\*WEEKLY OR EVERY 50 HOURS OF OPERATION**

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
20.**	Latching Mechanism	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
21.	Shaft Tensioner(SSF)	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
	Shaft Tensioner (LF)	Lubricate	Apply anti-sieze compound	Anti-Sieze
22.**	Front Plate Pin	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
23.	Dirt Bucket Lifting Eye	Lubricate	Lubricate until grease is forced out.	Mobil XHP222

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

\*\* Latching Frame Only

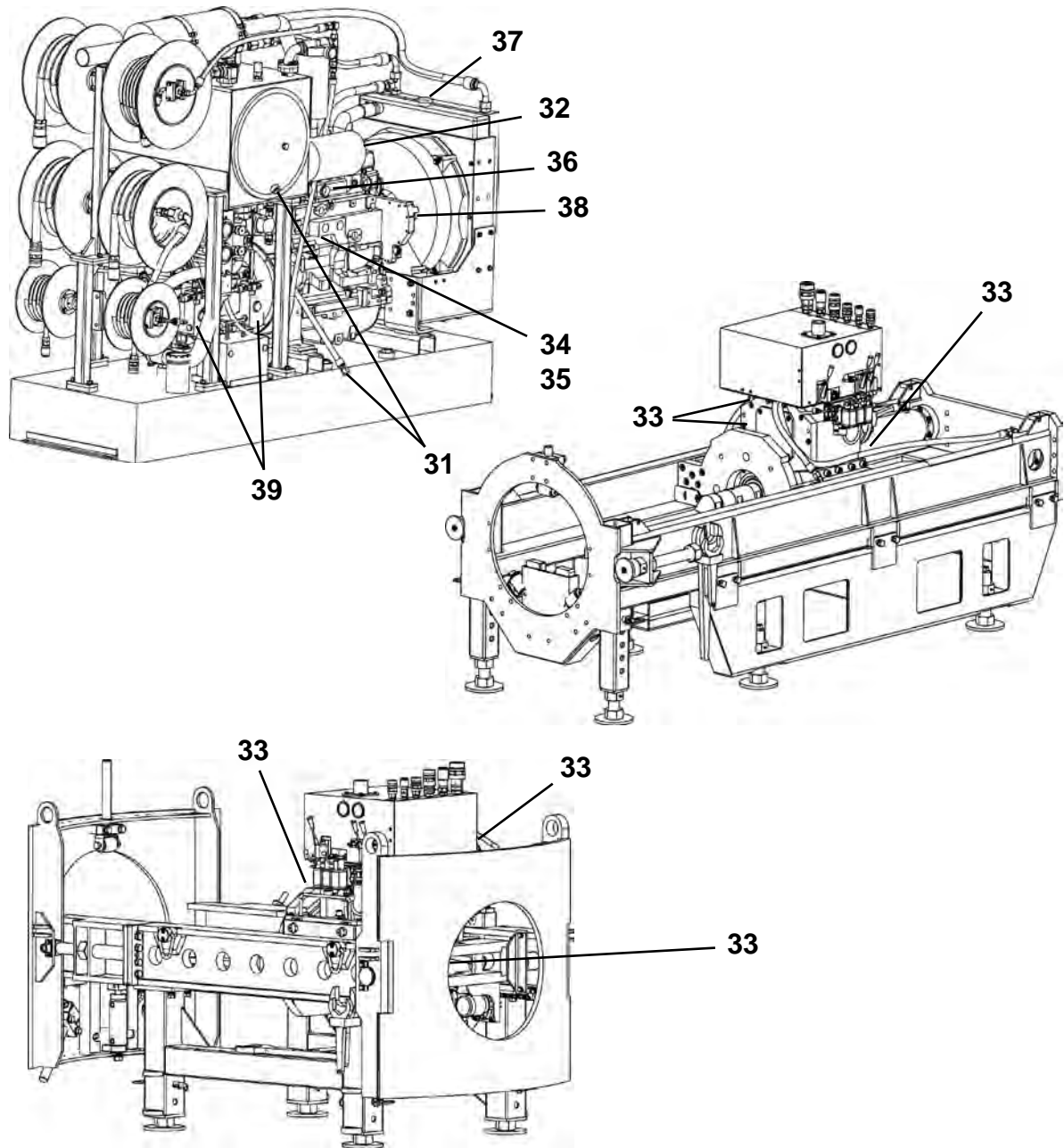
LF - Latching Frame    SSF - Single Stage Frame



**\*MONTHLY OR EVERY 250 HOURS OF OPERATION**

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

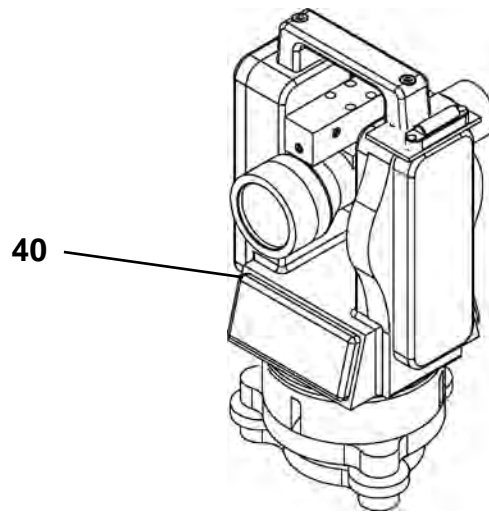
\* Refer to your engine manual for additional engine maintenance information.



**\*EVERY 500 HOURS OF OPERATION**

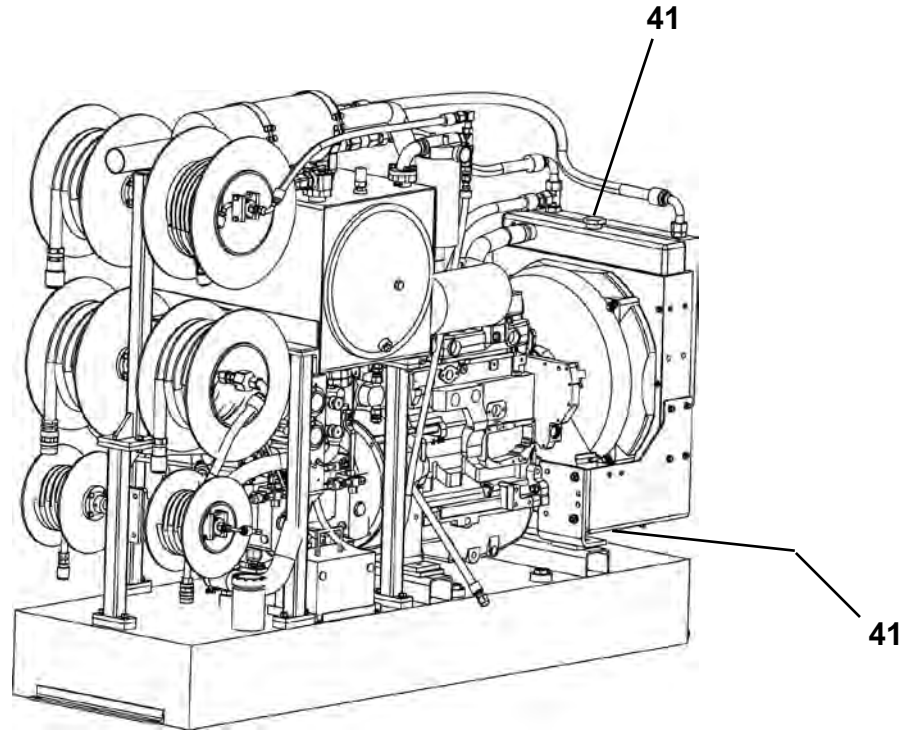
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
31.	Hydraulic Reservoir	Drain & Fill	Drain and fill with new oil.	ISO-VG-46 20W Element(s)
32.	Air Cleaner	Install New		
33.	Gear Box	Drain & Fill	Drain and fill with new oil.	Mobil SHC 630
34.	Fuel System	Replace Fuel Filter		Fuel Filters
35.	Fuel System	Bleed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

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



**\*EVERY 1000 HOURS OF OPERATION**

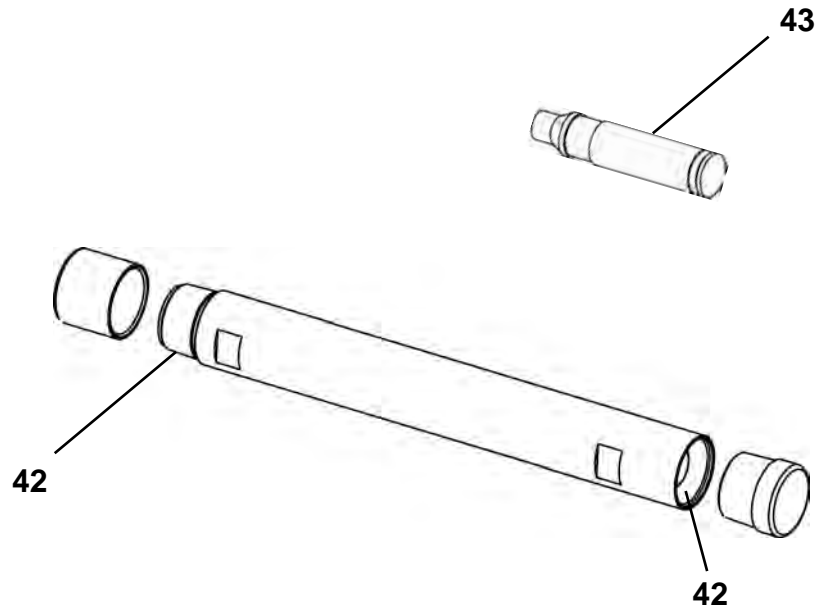
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
40.	Theodolite	Recalibrate	Send to authorized service center.	



**\*EVERY 2000 HOURS OF OPERATION**

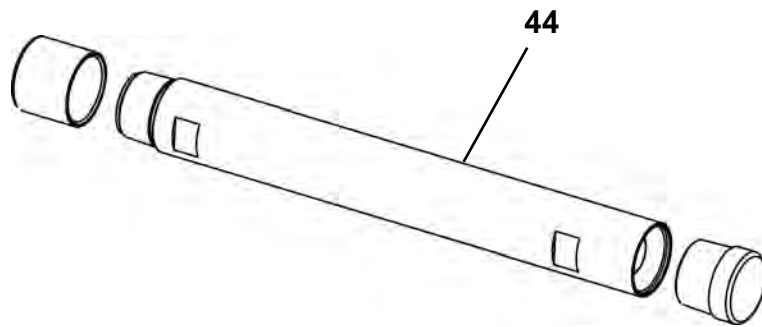
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
41.	Cooling System	Flush & Fill	Refer to engine manual.	Water/Anti-Freeze

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



**AS REQUIRED**

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
42.	Pilot Tube Threads	Inspect & clean	Clean & Relubricate Threads	See Detail
43.	Laser Bore Sight	Replace batteries	Three 392 Button Batteries	Button Batteries



**AFTER EACH DRIVE**

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
44.	Pilot Tubes	Clean	Clean inner tube & annular space.	

## PRIOR TO EACH JOB LAUNCH

### 1. CHARGE TARGET LED BATTERY

There are two target configurations; rechargeable NiCd battery target with an overnight charger and/or smart charger, and a replaceable battery target.

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

When using the overnight charger (A), recharge target NiCd batteries by connecting the AC adapter to the target and plugging the AC adapter into a 120V outlet. Charge for 8-10 hours before operation. The battery should last for 7 days on a full charge. Do not repeatedly over charge the target battery, otherwise the battery life will decrease.

**NOTICE** With the overnight charger, it is best to discharge the batteries fully before recharging due to the “memory” effect of NiCd batteries. If battery charge life appears to be shortened, repeat the fully discharge, fully charge cycle a few times to update the memory in the battery. If battery life continues to be short, dispose of battery properly. Refer to the charger User Manual or contact your Akkerman product support representative for more information.

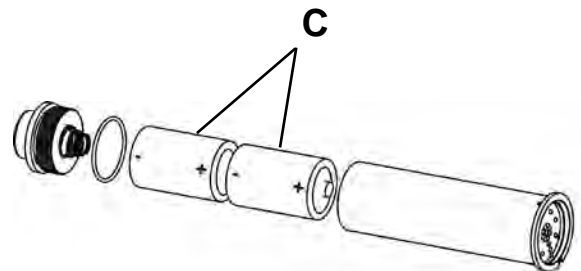
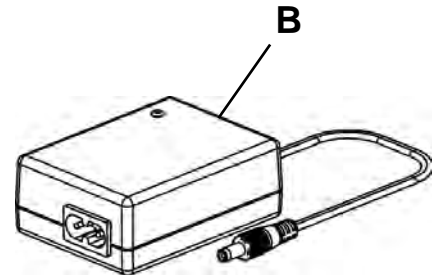
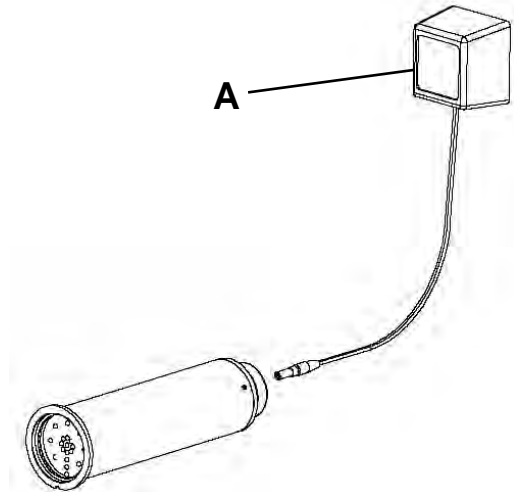
**NOTICE** The smart charger (B) drains the battery, recharges, and does not over charge the battery. A full charge takes approximately 3 hours. *The smart charger will not charge a completely drained battery.* Refer to the charger User Manual or contact your Akkerman product support representative for more information.

The replaceable battery target uses two 1.5 volt, D size, Alkaline batteries (C). Do not mix manufacturers. It is recommended to replace batteries before or after each drive. The batteries should last at least 14 days.

Target ON/OFF:

OFF - Remove batteries, replace cap.

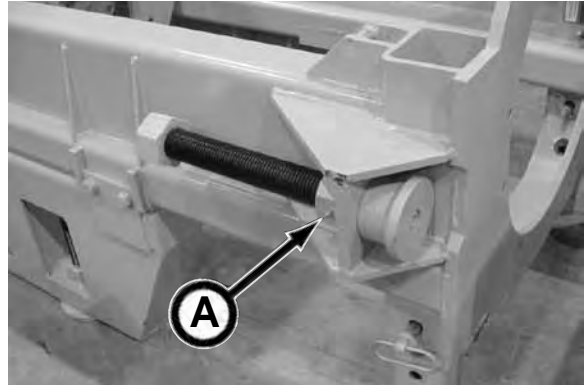
ON - Place batteries into target tube (as shown) and turn cap completely in to prevent moisture from entering target tube.



## 2. LUBRICATE SHAFT TENSIONER

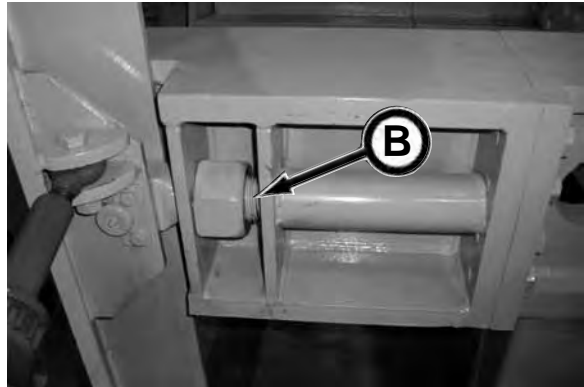
Lubricate single stage frame shaft tensioner (A) with Mobilgrease® XHP222 or equivalent until grease is forced out.

Lubricate daily if subjected to water and mud.



*Single Stage Frame*

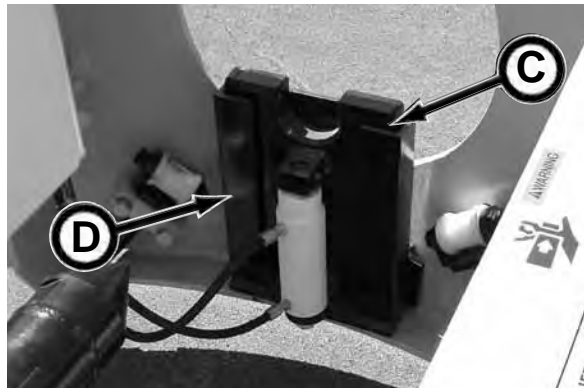
Lubricate latching frame shaft tensioner (B) with an anti-sieze compound.



*Latching Frame*

## 3. CLEAN MAKE-UP TOOL

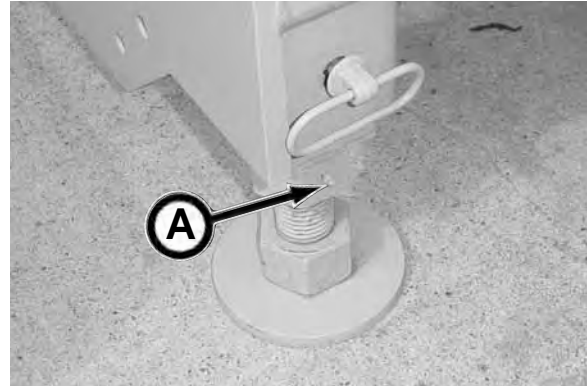
Clean out dirt or debris from make-up tool tube support (C) and housing (D).



#### 4. LUBRICATE LEVELING ASSEMBLY

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

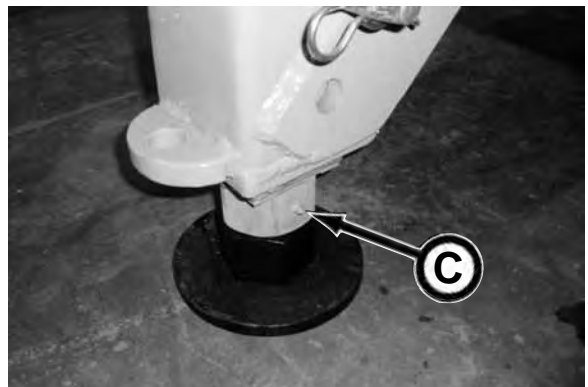
- A - Single Stage Front Leveling Assembly
- B - Single Stage Rear Leveling Assembly
- C - Latching Frame Leveling Assembly



*Single Stage Front Leveling Assembly*



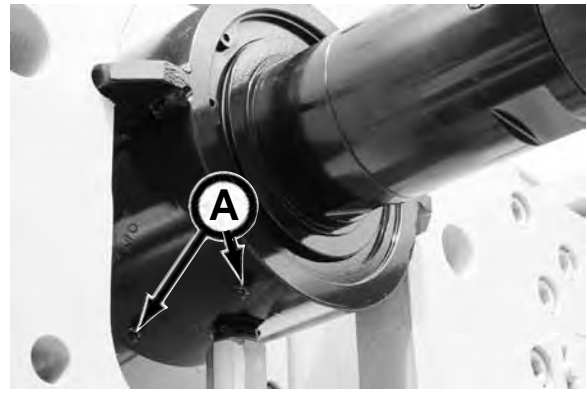
*Single Stage Rear Leveling Assembly*



*Latching Frame Leveling Assembly*

### 5. LUBRICATE DRIVE ADAPTER/SWIVEL

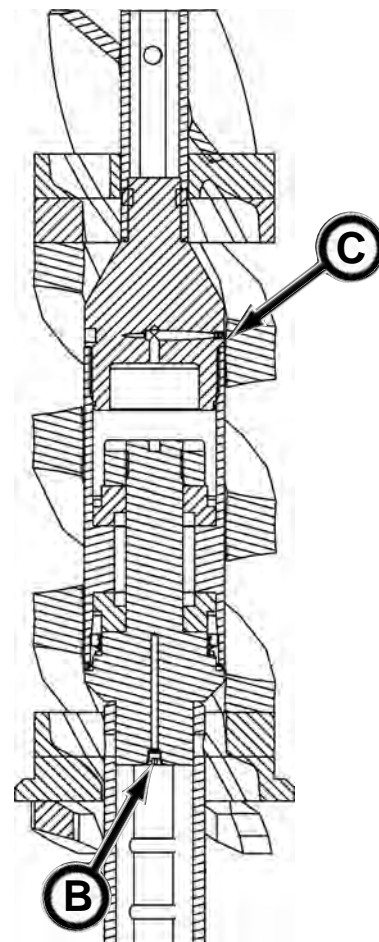
Lubricate drive adapter/swivel (A) (2 places) with 3 to 5 shots of Mobilgrease® XHP222 or equivalent.



### 6. LUBRICATE INTEGRAL BEARING SWIVEL CUTTER

**NOTICE** Use ONLY Mobil® 636 Gear Oil to lubricate bearing swivel. Using lubricant other than Mobil® 636 Gear Oil will damage swivel components.

With auger assembly in vertical position, remove check plug (B). While rotating auger assembly, pump Mobil® 636 Gear Oil into grease fitting (C) of swivel housing until 2 ounces of oil is forced out of check plug hole. Replace check plug.



## DAILY OR EVERY 10 HOURS OF OPERATION

### 7. VISUALLY INSPECT EQUIPMENT

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

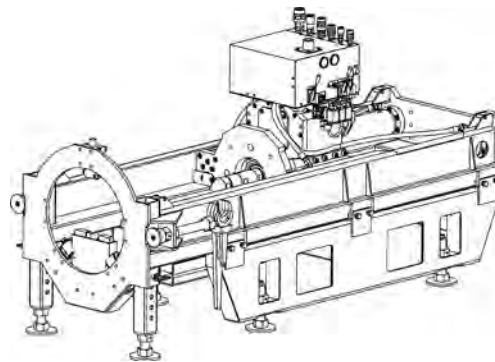
Immediately report any structural problems to your Akkerman product support representative.

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

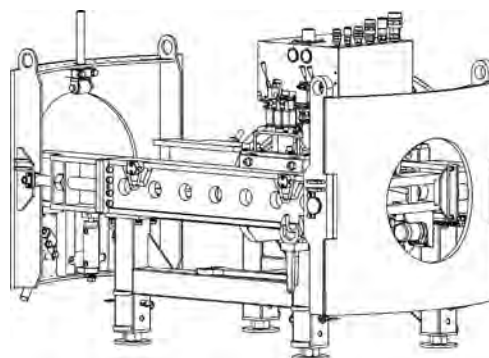
Check air intake and exhaust system hoses and connections. Replace any defective parts.

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

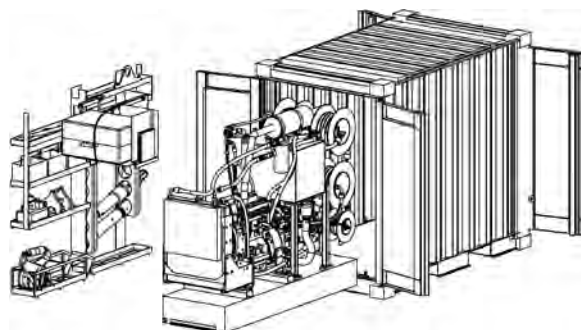
Tighten hardware as needed.



*GBM Single Stage Frame*



*GBM Latching Frame*



*Power Pack*

### 8. 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.



## 9. CHECK HYDRAULIC RETURN FILTER INDICATORS

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

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

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

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



1. Clean and dry area around return filter.
2. Remove filter. Dispose of oil and filter properly.

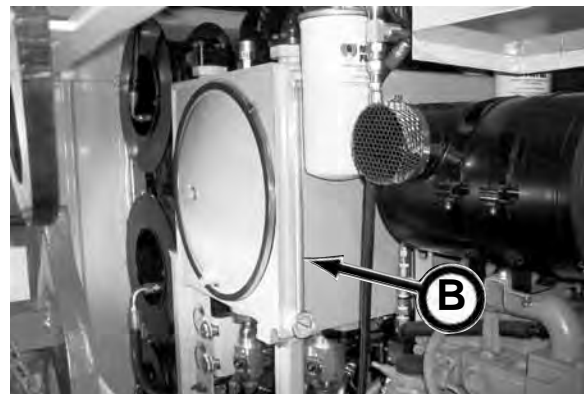
### NOTICE

Remove filter gasket if stuck in filter housing.

3. Fill new filter with clean hydraulic oil.
4. Lubricate new filter gasket with a light coating of clean hydraulic oil.
5. Install new filter. Hand tighten only.
6. With the hydraulic hoses disconnected from the GBM, start engine and run at low idle until the hydraulic system is warm. Then check for leaks.
7. Shut down engine.



8. Check hydraulic reservoir oil level on gauge (B). Add hydraulic oil, if necessary.



## 10. CHECK ENGINE CRANKCASE OIL LEVEL

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

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



P100Q



P150Q

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

**NOTICE** During engine break-in, change the oil and filter for the first time before 100 hours of operation.



P100Q

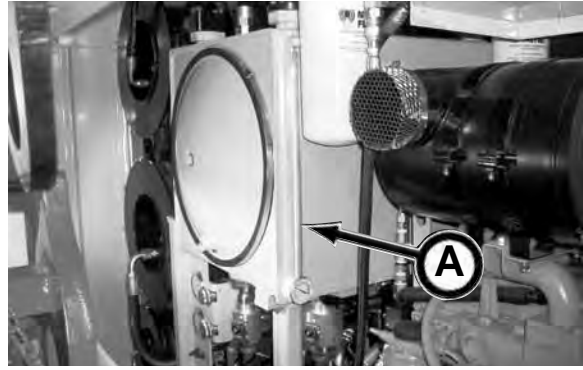


P150Q

## 11. CHECK HYDRAULIC TANK OIL LEVEL

**NOTICE** The photos in this procedure depict the P100Q Power Pack but also applies to the P150Q Power Pack.

Check hydraulic tank oil level gauge (A).



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

1. Remove hydraulic fill hose from storage location. Remove cap from hose.



2. Place hose into hydraulic oil container.

**NOTICE** Refer to Fuels & Lubricants section for recommended hydraulic oil.



3. Open hydraulic fill shut off valve by moving handle up to the 12 o'clock position.

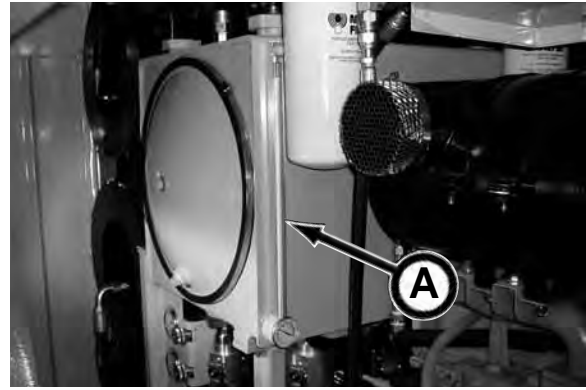


4. Turn Oil Pump switch ON.

*(continued on next page)*



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



6. Turn Oil Pump switch OFF.



7. Close hydraulic fill shut off valve by moving the handle down to the 3 o'clock position.



8. Replace cap on fill hose and place hose in storage location.

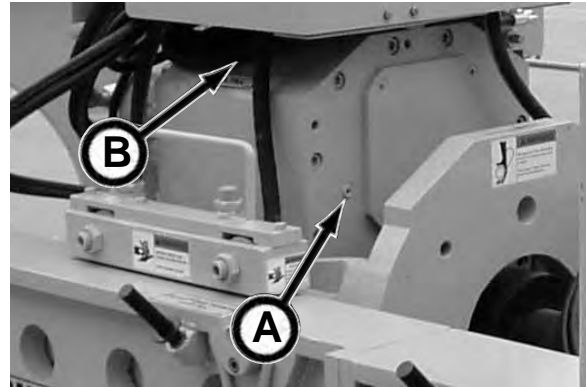


## 12. CHECK GEAR BOX OIL LEVEL

Check gear box oil level by removing check plug (A).

If oil does not flow out of check plug hole, add lubricant into gear box oil fill port (B).

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



## 13. CHECK ENGINE COOLANT LEVEL

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



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

See Engine Coolant in the Fuels & Lubricants section for proper coolant specification. The following coolant capacities are an approximate value. Be sure to check levels after filling. DO NOT OVERFILL.

Coolant Capacity:

P100Q: ..... 9 qt (8.5 L)

P150Q: ..... 9 qt (8.5 L)



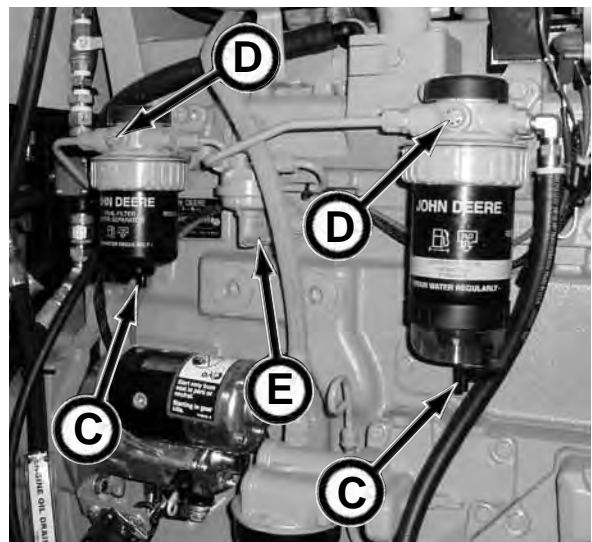
P100Q Shown

## 14. DRAIN FUEL/WATER SEPARATOR (P100Q)

1. Loosen drain plugs (C) at bottom of fuel filters, two or three turns.
2. Loosen air bleed plugs (D) two full turns on fuel filter base and drain water from bottom until fuel starts to drain out.
3. When fuel starts to drain out, tighten drain plugs securely.

After draining water from the fuel filter, the filter must be primed by bleeding all air from the fuel system.

4. Operate primer lever (E) of the fuel supply pump until fuel flow is free from air bubbles.
5. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.
6. Start engine and check for leaks.



If the fuel system needs further bleeding of air, see Bleeding Fuel System in your engine manual.

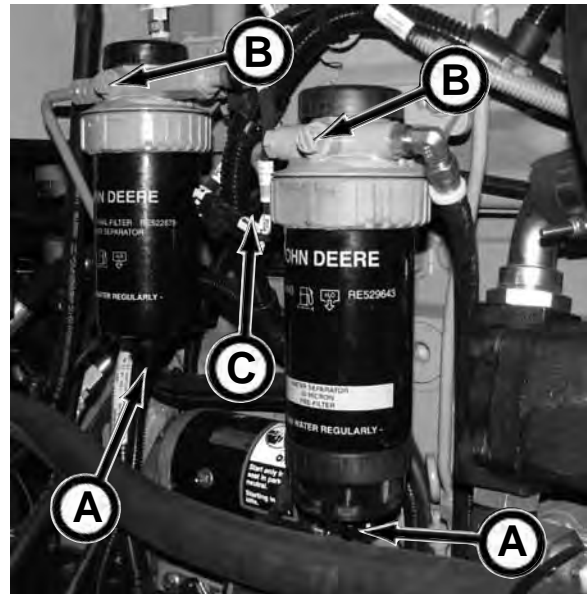
#### 14. DRAIN FUEL/WATER SEPARATOR (P150Q)

1. Loosen drain plugs (A) at bottom of fuel filters, half turn to one turn.
2. Loosen air bleed plugs (B) two full turns on fuel filter base and drain water from bottom until fuel starts to drain out.
3. When fuel starts to drain out, tighten drain plugs securely.

After draining water from the fuel filter, the filter must be primed by bleeding all air from the fuel system.

4. Operate primer lever (C) of the fuel supply pump until fuel flow is free from air bubbles.
5. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.
6. Start engine and check for leaks.

If the fuel system needs further bleeding of air, see Bleeding Fuel System in your engine manual.



## 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 for cracks, and bent or loose blades. Check fan to make sure it is properly mounted. Replace damaged fan and fan guard.

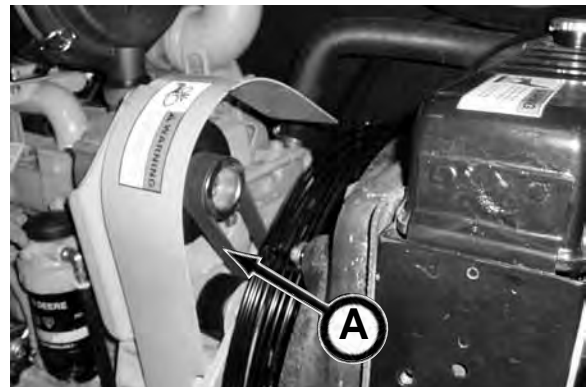


P100Q Shown

## 16. INSPECT BELT

**⚠ WARNING** NEVER operate engine without belt guard in place. Serious personal injury could result if contact is made with rotating belt.

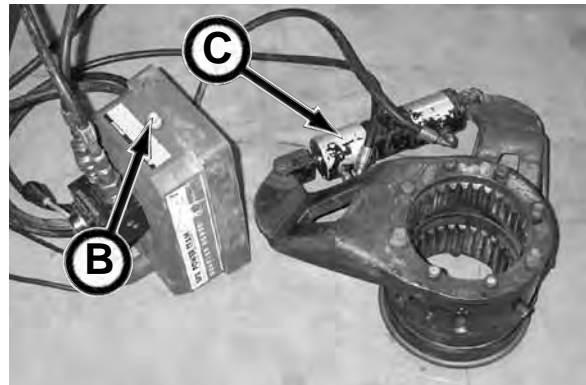
Visually inspect the drive belt (A) for cracking, fraying or pieces of material missing. Replace belts as needed. See your Engine Operator's Manual for belt replacement.



P100Q Shown

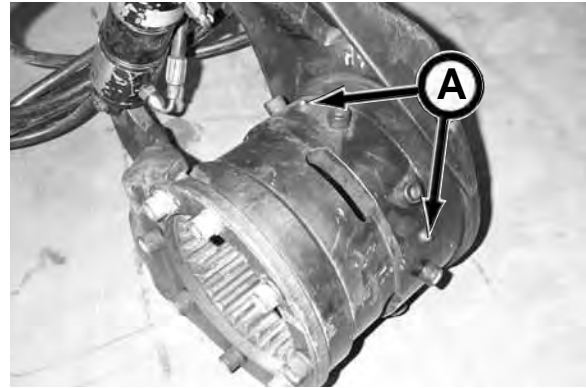
## 17. CHECK BREAKOUT TOOL POWER UNIT OIL LEVEL

1. Clean area around filler cap (B).
2. Retract cylinder (C).
3. Tip the end of the power unit with the filler cap up. Remove filler cap and check that oil is filled to the top of filler collar.
4. If needed, fill reservoir with ISO-VG-46 20W Premium Hydraulic/Turbine Oil or equivalent. Replace filler cap.
5. Bleed air from system as follows: Position cylinder on its side with the fittings up, place the power unit flat on ground, cycle the cylinder several times (fully extend and retract), tip the power unit with the filler cap up, and open filler cap to recheck oil level in reservoir. Add additional oil as needed.
6. Replace filler cap. Tighten cap a half to one full turn after o-ring contacts sealing surface.



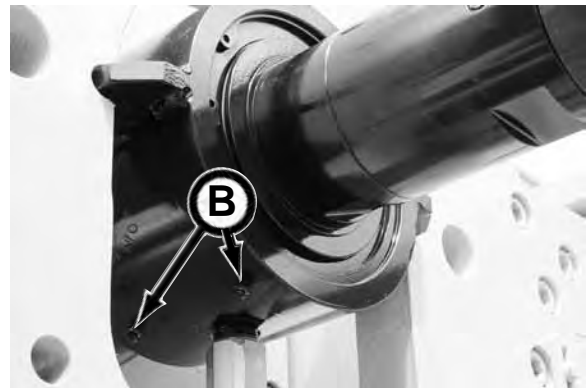
### 18. LUBRICATE BREAKOUT TOOL

Lubricate breakout tool (A) with 2 shots of Mobilgrease® XHP222 or equivalent at each grease fitting (4 places).



### 19. LUBRICATE DRIVE ADAPTER/SWIVEL

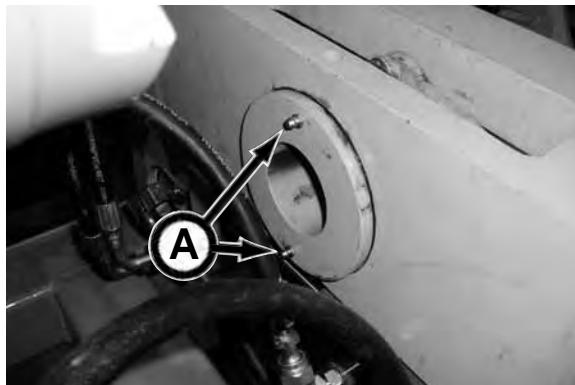
Lubricate drive adapter/swivel (B) (2 places) with 3 to 5 shots of Mobilgrease® XHP222 or equivalent.



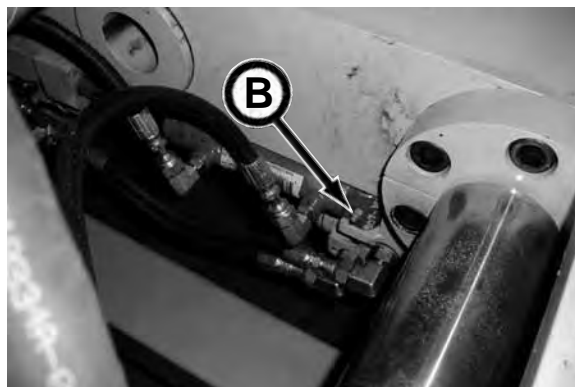
## WEEKLY OR EVERY 50 HOURS OF OPERATION

### 20. LUBRICATE LATCHING MECHANISM (LATCHING FRAME ONLY)

Extend drive cylinders to gain access to grease fittings (A). Lubricate latching mechanism (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.

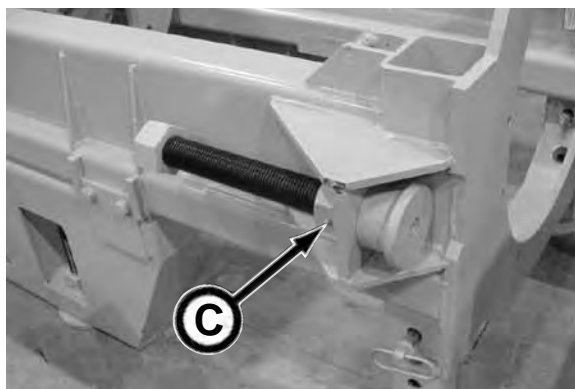


Lubricate latching mechanism cylinder pin (B) with Mobilgrease® XHP222 or equivalent until grease is forced out.



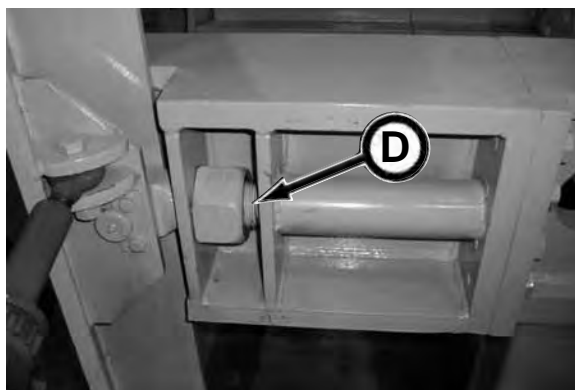
### 21. LUBRICATE SHAFT TENSIONER

Single Stage Frame  
Lubricate shaft tensioner (C) with Mobilgrease® XHP222 or equivalent until grease is forced out.



*GBM Single Stage Frame*

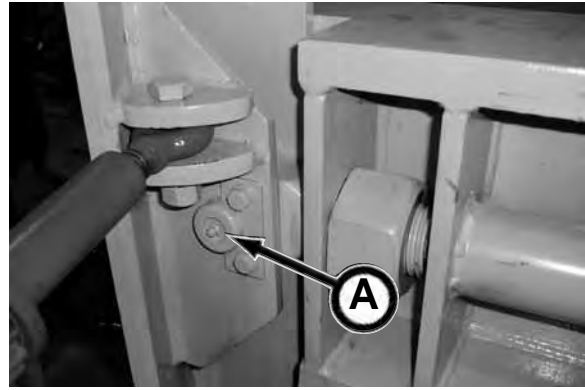
Latching Frame  
Lubricate shaft tensioner (D) threads with an anti-sieze compound.



*GBM Latching Frame*

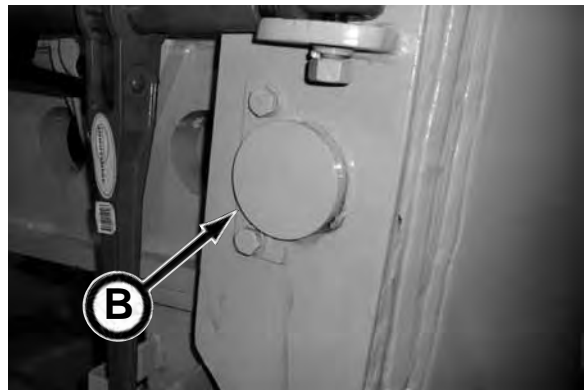
## 22. LUBRICATE PLATE PINS (LATCHING FRAME ONLY)

Lubricate front plate pins (A) (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.



*Front Pins*

Lubricate rear plate pins (B) (2 places) with an anti-sieze compound.



*Rear Pins*

## 23. LUBRICATE DIRT BUCKET LIFTING EYE

Lubricate lifting eyes (C) (2 places) with Mobilgrease® XHP222 or equivalent until grease is forced out.



## MONTHLY OR EVERY 250 HOURS OF OPERATION

### 24. CHANGE ENGINE OIL & FILTER

#### NOTICE

The photos in this procedure depict the P100Q Power Pack but also applies to the P150Q Power Pack.

1. Gain access to the engine oil drain hose.



2. Remove cap from hose.

3. Drain oil into a catch pan of proper size.

4. Reinstall cap to hose.



5. Replace drain hose with tie strap.



6. Clean and dry area around the oil filter (A).



*(continued on next page)*

7. Remove oil filter and clean filter mounting pad.  
Dispose of filter properly.



8. Lubricate gasket on new filter with clean oil.

9. Fill filter with new, clean engine oil.

10. Install new filter and hand tighten according to values printed on the filter. Do not overtighten the filter element.



11. Remove fill cap.

12. Fill engine with engine oil specified in the Fuels & Lubricants section. The following fluid capacities are an approximate value. Be sure to check levels after filling. **DO NOT OVERFILL.**

Oil Capacity:

P100Q: ..... 15.8 qt (15 L)

P150Q: ..... 21.6 qt (20.5 L)

13. Install fill cap. Hold and screw cap handle clockwise to tighten. Clean up spills.



14. Start engine and run until warm and check for leaks.

15. Shutdown engine. Wait approximately 5 minutes to let the oil drain from the upper portion of the engine. Check oil level. Oil level should be on upper mark of dipstick.



## 25. CHECK BATTERY

**⚠ WARNING** Batteries produce 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.

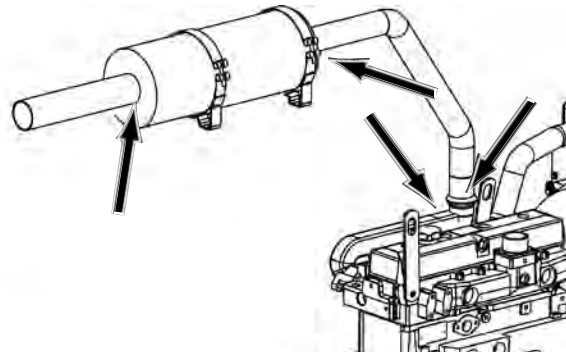


## 26. INSPECT AIR INTAKE & EXHAUST CONNECTIONS

Inspect all air intake (2 places) and exhaust (4 places) connections. Tighten clamps as needed and replace defective parts.



*Air Intake System (P100Q Shown)*



*Exhaust System*

## 27. INSPECT ENGINE MOUNTS

Visually inspect engine mounts for loose hardware or damaged parts.

Tighten all loose hardware and replace defective parts.



*P100Q Shown*

## 28. INSPECT & CLEAN FUEL TANK CAP

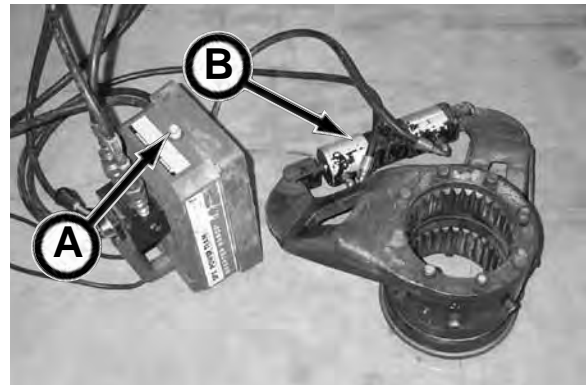
Inspect cap for damage. If cap is damaged, replace with new.

Remove cap and clean any debris or dirt from cap body.



## 29. REPLACE BREAKOUT TOOL POWER UNIT OIL

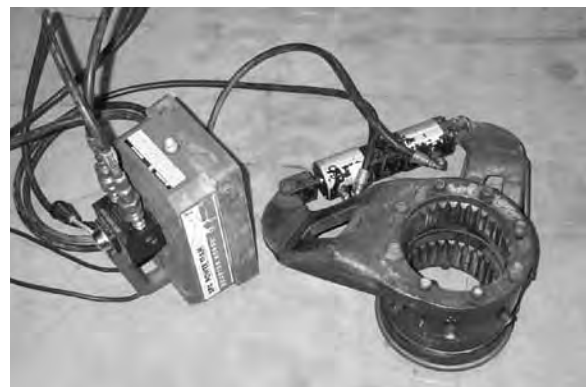
1. Clean area around filler cap (A).
2. Retract cylinder (B).
3. Open filler cap and drain oil from reservoir.
4. Flush reservoir.
5. Refill the reservoir by tipping the end of the power unit with the filler cap up (vertical position). Remove filler cap and fill oil to the top of filler collar with ISO-VG-46 20W Premium Hydraulic/Turbine Oil or equivalent. Replace filler cap.



6. Bleed air from system as follows:
  - a. Position cylinder on its side with the fittings facing up.
  - b. With the power unit flat on ground (horizontal position), cycle the cylinder several times (fully extend and retract).



- c. Tip the power unit with the filler cap up, and open filler cap to recheck oil level in reservoir. Add additional oil as needed.
7. Replace filler cap. Tighten cap a half to one full turn after o-ring contacts sealing surface.



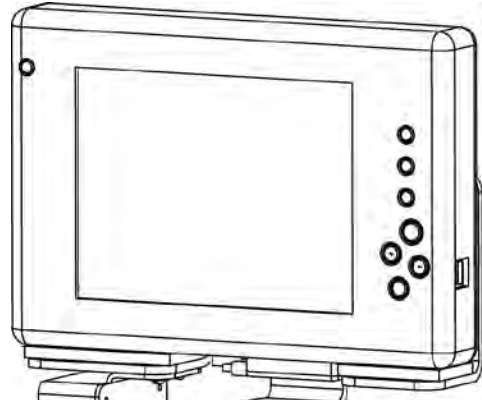
### **30. CHARGE TABLET PC BATTERY**

Charge Tablet PC battery to keep the battery charged properly. Failure to fully charge battery will result in shortened battery life and cause GBM\_System program to load incorrectly at start up.

Be sure to store computer between 50°F and 86°F (10°C and 30°C).

Unused or stored batteries can lose power over time. When using a computer with a battery that has not been used for awhile, connect external power to the computer and fully charge battery before booting up computer.

For more battery performance information, on the task bar located at the bottom of the tablet screen, click the start button and then click Battery Tips.



## EVERY 500 HOURS OF OPERATION

### 31. DRAIN & FILL HYDRAULIC RESERVOIR

#### NOTICE

The photos in this procedure depict the P100Q Power Pack but also applies to the P150Q Power Pack.

1. Remove hydraulic tank drain plug (A) and drain oil into a 40 gal (151 L) catch pan.
2. Replace tank drain plug.



3. Remove hydraulic fill hose from storage location. Remove cap from hose.



4. Place hose into hydraulic oil container.

#### NOTICE

Refer to Fuels & Lubricants section for recommended hydraulic oil.



5. Open hydraulic fill shut off valve by moving handle up to the 12 o'clock position.

*(continued on next page)*



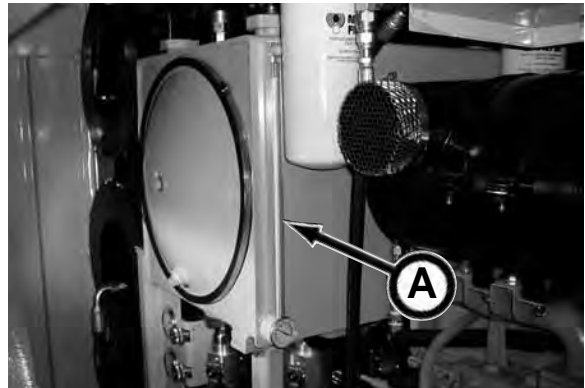
6. Turn Oil Pump switch ON.



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

Fluid Capacities:

P100Q: ..... 40 gal (151 L)  
P150Q: ..... 50 gal (189 L)



8. Turn Oil Pump switch OFF.



9. Close hydraulic fill shut off valve by moving the handle down to the 3 o'clock position.



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



### 32. REPLACE AIR CLEANER FILTERS

**NOTICE** The photos in this procedure depict the P100Q Power Pack but also applies to the P150Q Power Pack.

Replace air cleaner elements at 500 hours or 12 months, whichever occurs first.

1. Clean area around the air cleaner assembly.



2. Unlatch and remove cover.



3. Gently remove primary element. Bumping the element against air cleaner housing may contaminate the clean side of the filter housing with dirt and dust.

4. Properly dispose of primary element.

5. Thoroughly clean out the inside of filter housing with a clean, damp cloth. Dirt left in the filter housing will shorten the life of the filter elements.



6. Gently remove secondary (safety) element. Immediately install a new secondary element to prevent any dirt or dust from entering the air intake system.

**NOTICE** NEVER run the engine without the secondary element in place. Doing so will cause engine damage.

Replacement of the secondary element is usually necessary only when the primary element has a hole in it.

*(continued on next page)*



- 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.

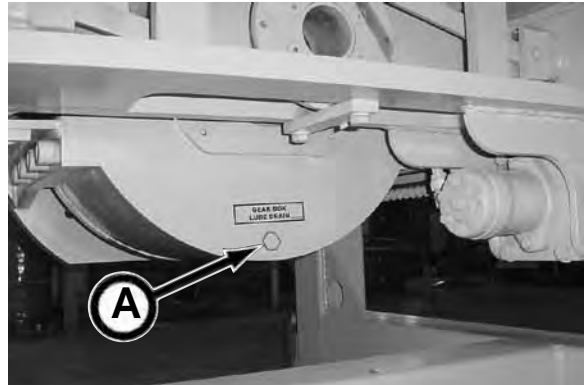


- Replace cover with dust unloader valve facing down (6 o'clock position). Secure the latches.

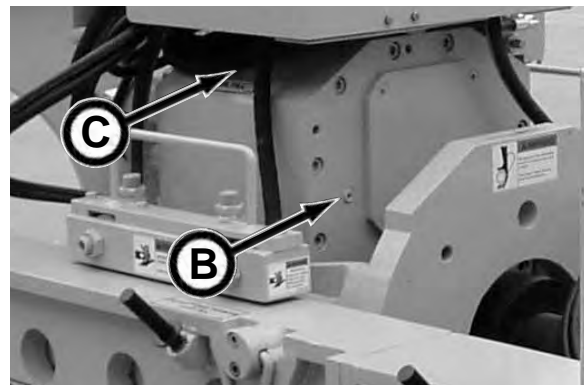


### 33. DRAIN & FILL GEAR BOX OIL

- Clean and dry area around the gear box drain plug.
- Remove drain plug (A).
- Drain gear box oil into a proper sized catch pan. Dispose of oil properly.
- Replace drain plug.



- Remove check plug (B).
- Clean and dry area around the fill plug (C).
- Remove fill plug.
- Fill gear box with approximately 7 gal (26.5 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!
- Replace fill plug and gear box cover.



### 34. REPLACE FUEL FILTERS

1. Clean area around fuel filter assemblies.
2. Loosen drain plugs (A) and drain fuel into a proper container.
3. Hold the retaining ring (B) and rotate it counterclockwise 1/4 turn. Remove ring with filter element (C).

Lifting up on retaining ring as it is rotated helps to get it past the raised locators on the fuel filter.

On the filter with the water separator bowl (D), remove filter element from separator bowl. Drain and clean separator bowl. Dry with compressed air. Install separator bowl onto new element. Tighten securely.

4. Inspect filter mounting base (E) for damage. Clean as needed.
5. Install new filter elements onto mounting base. Be sure element is properly indexed and firmly seated on base. The filter may need to be rotated for correct alignment.

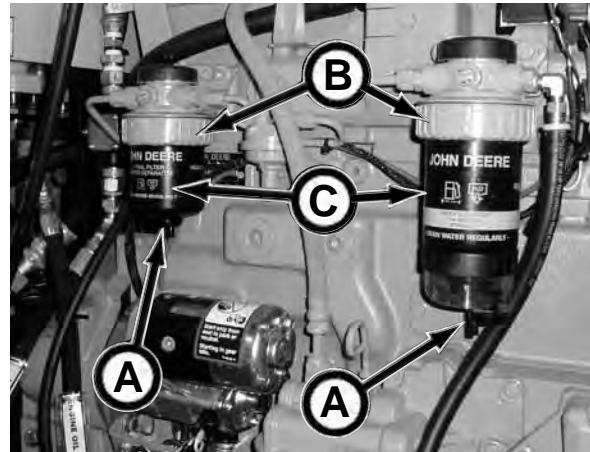
Raised locators on fuel filter must be indexed properly with slots in mounting base for correct installation.

6. Align keys on filter element with slots in filter base.
7. Install retaining ring onto mounting base making sure the dust seal is in place on filter base. Hand tighten ring, about 1/3 turn, until it “snaps” into the detent. Do not overtighten retaining ring.

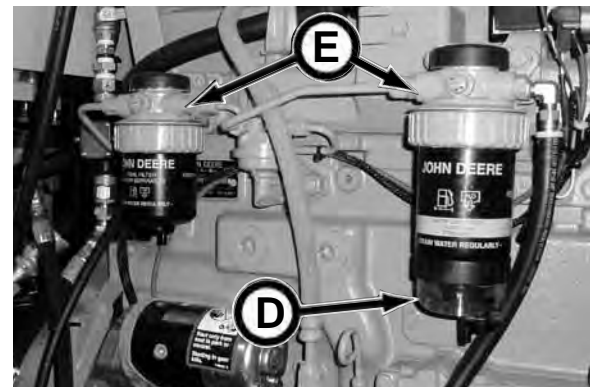
The proper installation is indicated when a “click” is heard and a release of the retaining ring is felt.

A plug is provided with the new element for plugging the used element.

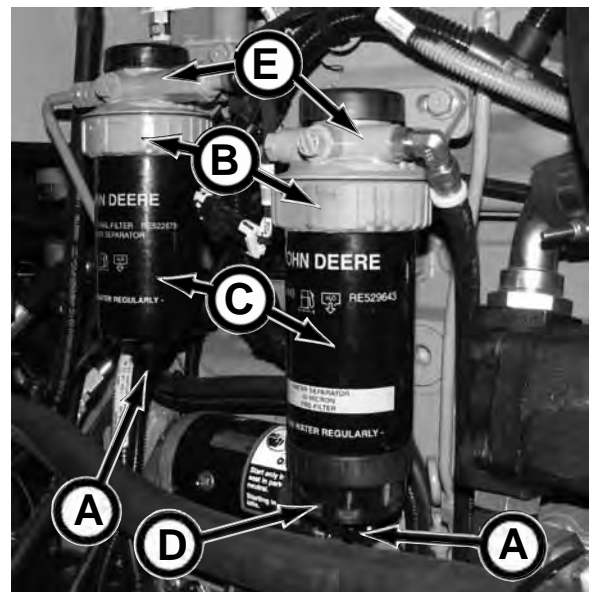
8. Bleed the fuel system (refer to 34. Bleeding The Fuel System in this section).



P100Q



P100Q



P150Q

### 35. BLEEDING THE FUEL SYSTEM

#### NOTICE

The photos in this procedure depict the P100Q Power Pack but also applies to the P150Q Power Pack.

Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the fuel system.

1. Loosen the bleed screw two full turns by hand on fuel filter base.



2. Operate pump primer lever until fuel flow is free from air bubbles.

3. Tighten bleed plug (A) securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.



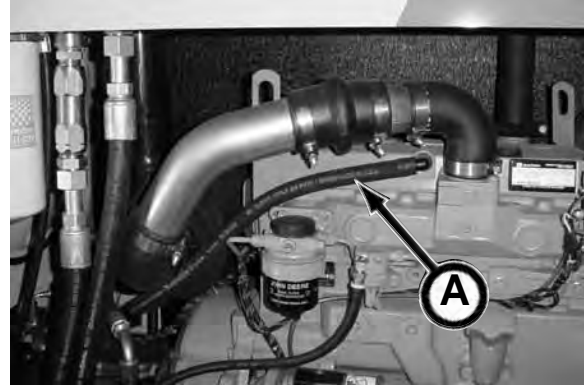
4. Start engine and check for leaks.

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles. Refer to your John Deere engine manual for service information.



### 36. CLEAN CRANKCASE VENT TUBE

1. Remove and clean crankcase tube (A).
2. After cleaning, install tube and tighten hose clamps securely.

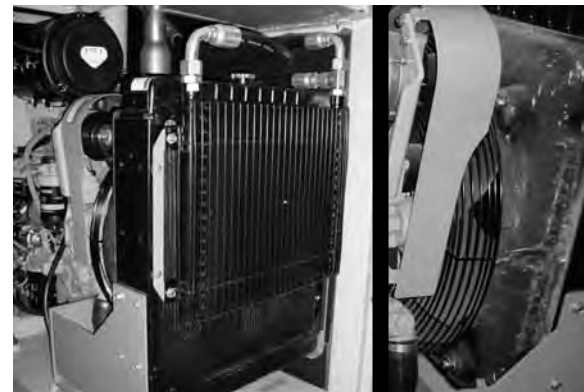


*P100Q Shown*

### 37. CHECK COOLING SYSTEM

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

1. Visually check the cooling system for leaks. Tighten all clamps securely.
2. Check to be sure the coolant level is at the bottom of the filler neck. Add coolant mixture if needed. Refer to Engine Coolant in the Fuels & Lubricants section of this manual.
3. Inspect all cooling system hoses. If the hoses are found to be in a hard, weak, or cracked condition, replace the hose(s).
4. Check the radiator for bent fins. Carefully straighten fins.
5. Check the inlet and outlet tubes for cracks, kinks, dents, or fractured seams. Repairs must be made by a qualified radiator technician.
6. Check the effectiveness of the coolant solution. Refer to your Deere engine manual for service information.
7. Pressure test the cooling system. Refer to your engine manual for service information.



*P100Q Shown*

### 38. CHECK BELT & BELT TENSIONER

1. Inspect the drive belt for excessive wear or damage. If damaged, replace with new.
2. Check the drive belt tensioner for proper operation. If tensioner is not working properly, refer to your Deere engine manual for service information.



*P100Q Shown*

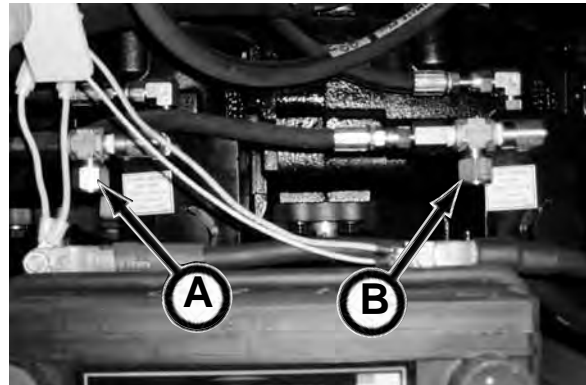
### 39. REPLACE LOAD SENSE FILTERS

The load sense filters 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

P100Q:

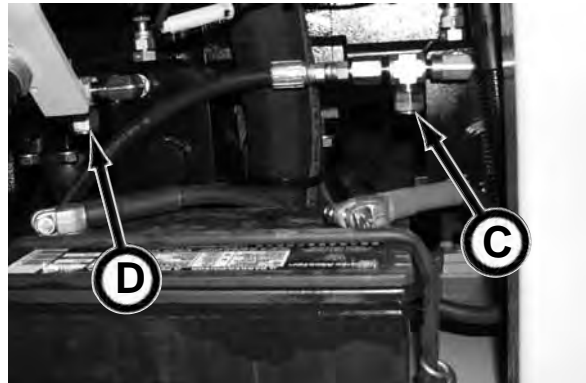
- Rotation Pump Load Sense Filter (A)
- Thrust (Jacking) Pump Load Sense Filter (B)



P100Q

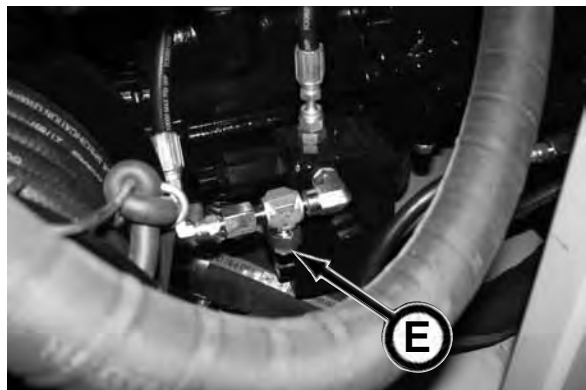
P150Q:

- Powered Cutter Drive Load Sense Filter (C)
- Thrust (Jacking) Pump Load Sense Filter (D)
- Rotation/Auger Drive Pump Load Sense Filter (E)



P150Q

(continued on next page)

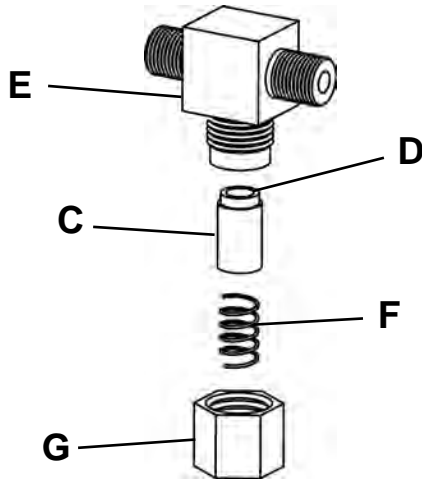
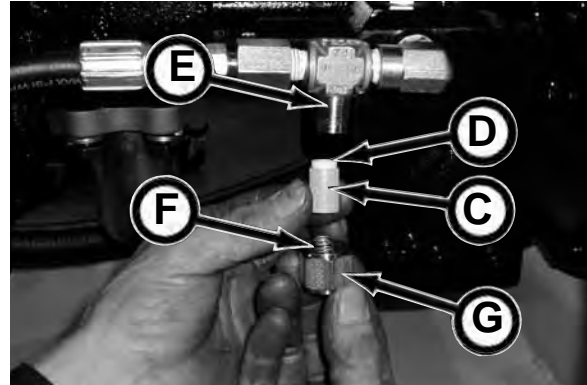


P150Q

**NOTICE**

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

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



*Load Sense Filter Installation*

---

## EVERY 1000 HOURS OF OPERATION

### 40. 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. 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.



## EVERY 2000 HOURS OF OPERATION

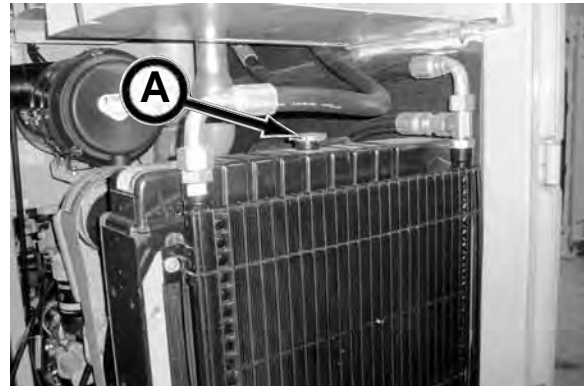
### 41. FLUSH & FILL COOLING SYSTEM

**NOTICE** The photos in this procedure depict the P100Q Power Pack but also applies to the P150Q Power Pack.

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



1. With gloves and eye protection, slowly remove the radiator cap (A).



2. Open engine block drain valve (B) on 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. Remove thermostats (refer to your engine manual for service information) and install cover using old gasket and tighten cap screws to 35 ft-lbs (47 N·m).

5. After coolant has drained, close engine block drain valve and radiator drain valve.

**NOTICE** Never add water or coolant to a hot engine. Doing so will result in engine damage.

6. Refill the cooling system with soft, clean water.

*(continued on next page)*

**CAUTION** Do not run engine longer than 10 minutes. Doing so may cause burns when radiator is draining from an overheated engine.

7. Start the engine and run it for about 10 minutes to thoroughly circulate the water and to stir up possible rust or sediment.
8. Stop engine and immediately drain the water from the system before rust and sediment settle.

**NOTICE** It may be necessary to remove the lower radiator hose (A) to fully drain the system. Be sure to replace radiator hose and tighten clamp after draining.

9. After draining water, close the engine and radiator drain valves.
10. Reinstall radiator cap, and if removed, reinstall the lower radiator hose and clamp.
11. Continue flushing system until scale deposits, rust, sediment and cooling cleaner (if used) are completely removed.

**NOTICE** Cooling system cleaners may need to be used to remove scale formation. See your engine manual for more information.

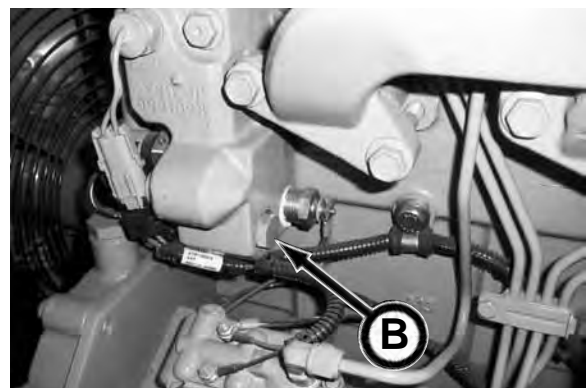
12. Close engine drain plug and radiator plug.
13. (If removed) Reinstall radiator hose and tighten clamp securely.
14. Install thermostats using a new gasket (see your engine manual for more information).
15. Loosen plug (B) in side of thermostat housing (located on back side of engine) to allow air to escape when filling system.

**NOTICE** DO NOT overfill cooling system. A pressurized system needs space for heat expansion without overflowing at top of radiator.

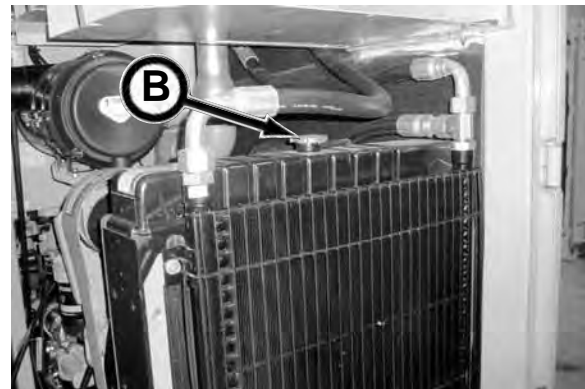
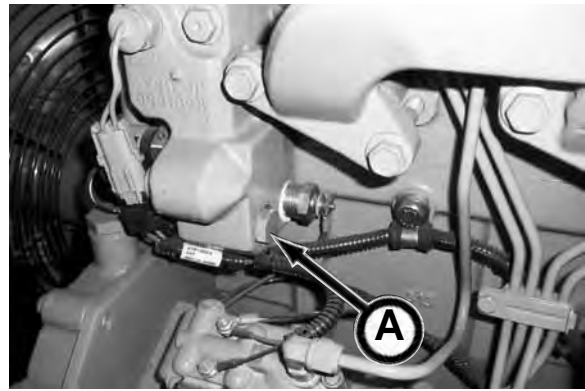
16. Fill coolant into radiator with a 50% mixture of ethylene glycol engine coolant and distilled, deionized, or demineralized water, and a supplemental coolant additive until the coolant level reaches the bottom of the radiator filler neck.

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

*(continued on next page)*



17. Tighten thermostat housing plug (A) when air has been expelled from system.
18. Replace radiator cap.
19. Start engine and operate it for 5 minutes to circulate the water/coolant/SCA (if used) mixture.
20. Shut off engine.
21. SLOWLY remove radiator cap.
22. Check radiator coolant level and fill as needed for coolant to reach the bottom of the filler neck.
23. Replace radiator cap (B).
24. Start engine and run it until it reaches operating temperature. This will mix the coolant uniformly and circulate it throughout the system. The normal engine coolant temperature range is 180° to 202°F (82° to 94°C).
25. Shut off engine. Check coolant level and add if necessary. Check entire coolant system for leaks.



## AS REQUIRED

### 42. INSPECT PILOT TUBE THREADS

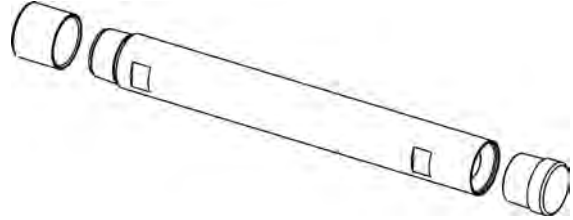
The pilot tube threads must be cleaned and relubricated with Baker Hughes Copper Guard-4® or equivalent. This prevents dirt from damaging threads or unlubricated threads from seizing.

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

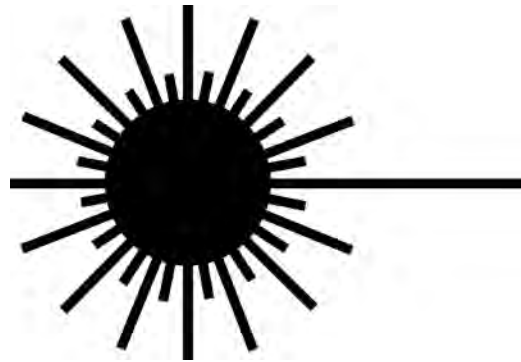
If there is dust or dirt in the pilot tube threads, or poor thread lubrication, a high breakout torque and thread damage will occur. This will cause damage to the reception shaft breakout tool and/or other tooling and accessories. Be sure to ALWAYS store pilot tubes with caps and plugs attached.



### 43. 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.



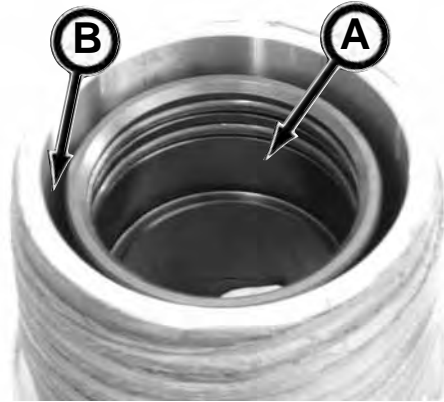
1. Remove the end cap by holding the laser chamber and turning end cap completely counterclockwise.
2. Remove the button batteries from the chamber. Examine the orientation of the batteries. The positive or + side of the batteries face towards the end cap.
3. Insert three new 392, LR41, L736 or equivalent button cell batteries (Akkerman part number P0064-020) into the laser sight with the negative side of the battery into the chamber first.
4. Replace end cap.



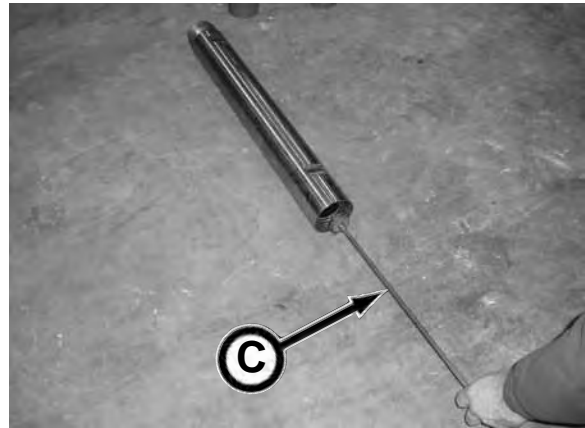
## AFTER EACH DRIVE

### 44. CLEAN PILOT TUBES

After each drive, the pilot inner tube (A) and annular space (B) must be cleaned.



1. Clean the pilot inner tube with tube cleaner (C).  
Be sure to clean the complete inner tube.

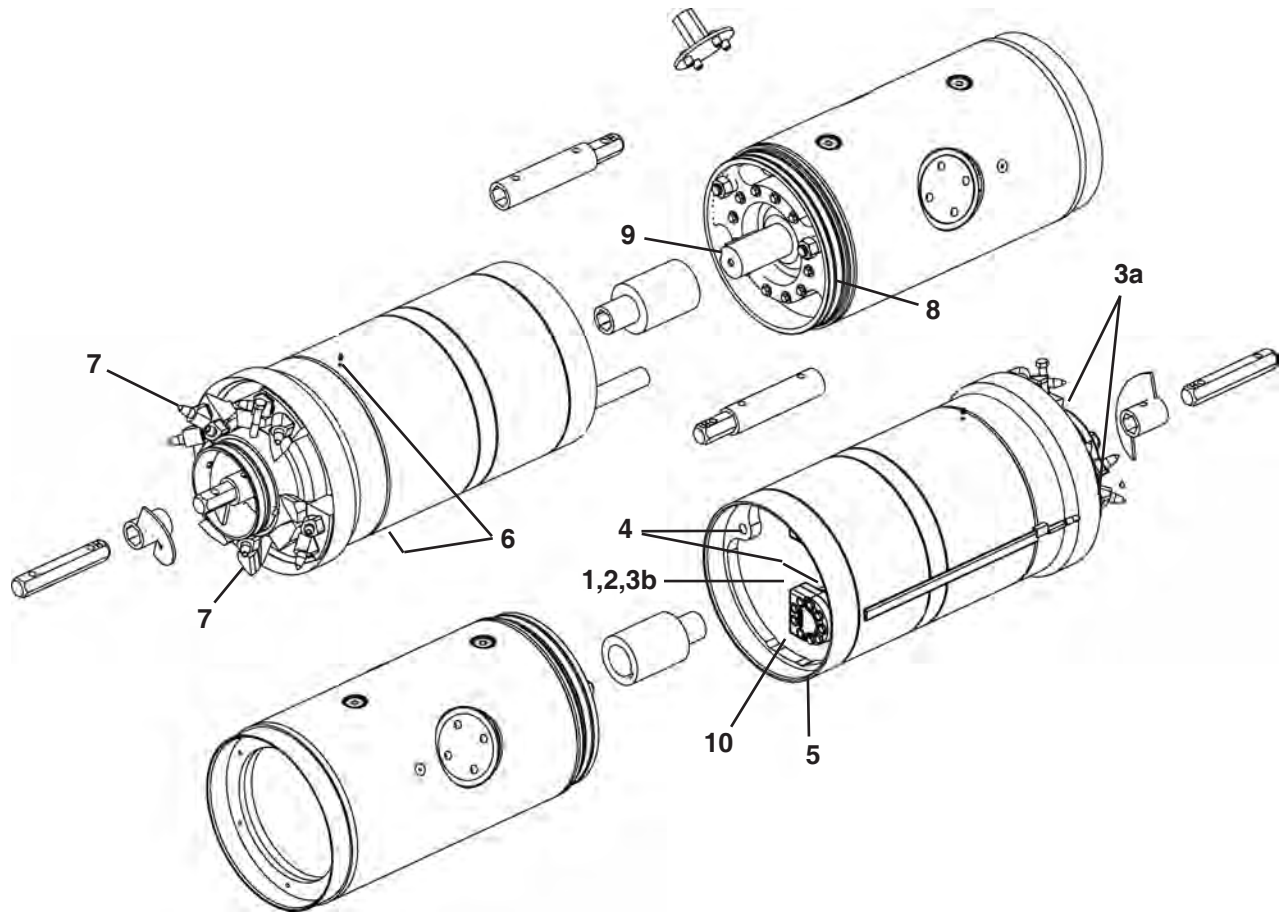


2. Install the fluid connector to the pilot tube.
3. Connect a clean water supply to the fluid connector. Use a minimum water pressure of 10 gal @ 1,000 psi (37.9 L @ 27.6 mPa).
4. Flush the pilot tube annular space while rotating the pilot tube to prevent any contaminants from settling in the pilot tube.



## MAINTENANCE CHARTS - POWERED CUTTER HEAD

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



### PRIOR TO EACH JOB LAUNCH

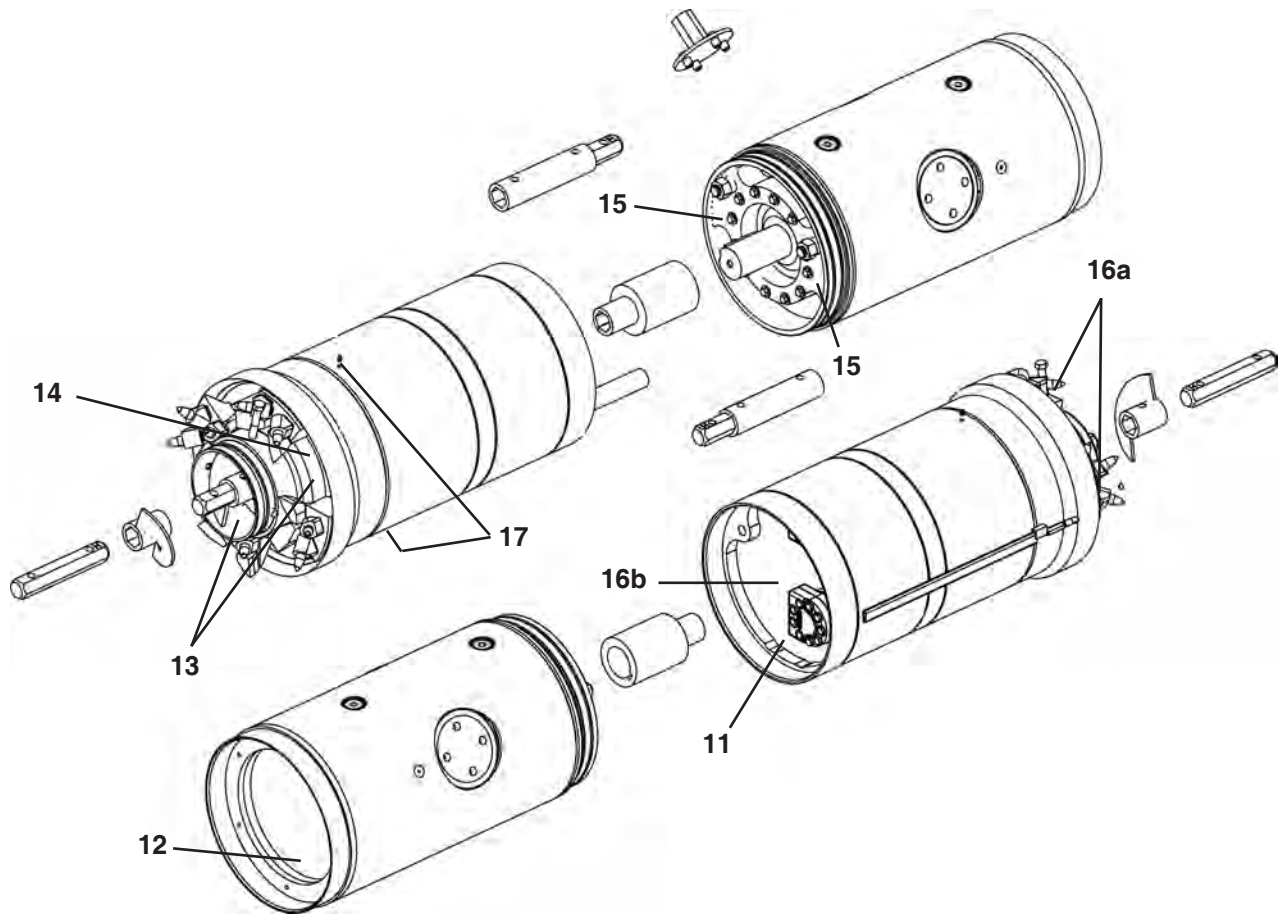
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	FS Bearing Cavity	Oil sample	If oil milky or discolored, contact Akkerman Product Support	Mobil® SHC 630
2.	FS Bearing Cavity	Check oil level	Oil must flow out of check hose port.	Mobil® SHC 630
3.	FS Internal Cutter Face Seals*	Lubricate 3a-PCH20; 3b-PCH22.5	Lubricate until oil is visible on inside of cutter face plate.	Mobil® XHP222
4.	FS Alignment Pins	Lubricate	Lubricate threads	Mobil® XHP222
5.	FS Bell End	Inspect	If damaged, contact Akkerman Product Support	
6.	FS External Cutter Face Seals*	Lubricate	Lubricate until oil is visible on outside of cutter face plate	Mobil® XHP222
7.	Cutter Teeth	Inspect	If damaged, replace with new.	
8.	RS O-rings	Inspect	If damaged, replace with new.	
9.	RS Auger Drive Shaft Key	Inspect	If damaged or missing, replace with new.	PN: A43188P
10.	Jetting Hose	Install to jetting inlet port.		

\* Lubricate seals at initial launch, then immediately after each drive while dirt is soft and flexible thereafter.

FS - Front Section

RS - Rear Section

PN - Part Number



**AFTER EACH DRIVE**

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
11.	FS Jetting Ports	Flush	Maximum of 2,500 psi water.	
12.	RS Lubrication Ports	Flush	Maximum of 500 psi water.	
13.	Mixing & Frt Auger Adapter Chamber	Clean	Do not use direct water pressure.	
14.	Cutter Head Assy.	Check Mounting Bolt Torque	Tighten bolts to 90 ft-lb (Lube) torque.	
15.	Auger Drive Gear Box	Check oil level	Must be visible in sight gauge.	Mobil® SHC 630
16.	FS Internal Cutter Face Seals	Lubricate 15a-PCH20;15b-PCH22.5	Lubricate until oil is visible on inside of cutter face plate.	Mobil® XHP222
17.	FS External Cutter Face Seals	Lubricate	Lubricate until oil is visible on outside of cutter face plate	Mobil® XHP222

FS - Front Section  
 RS - Rear Section  
 PN - Part Number

## PRIOR TO EACH JOB LAUNCH

### 1. OBTAIN FRONT SECTION BEARING CAVITY OIL SAMPLE

Test the quality of the bearing cavity oil:

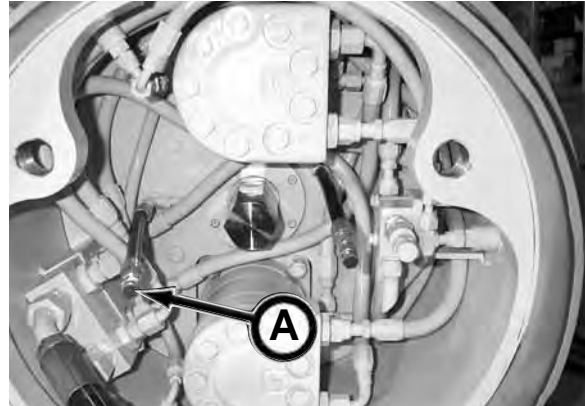
1. Gain access to the check hose (A). Clean area around the check plug.
2. Remove check plug.

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

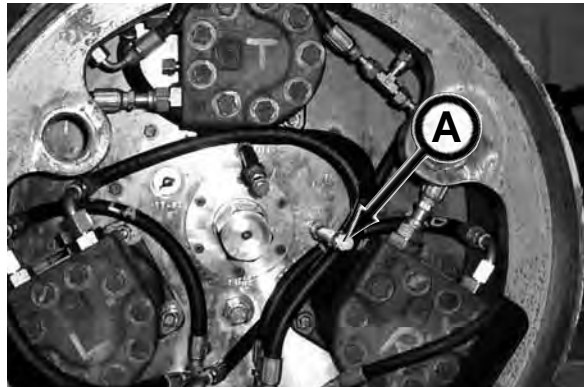
3. Obtain an oil sample. If necessary, use a pipe tong or nylon strap to lift the front section slightly off the ground. Then tip the front section of the powered cutter head until an oil sample is collected..

If the oil is milky or discolored (new oil looks similar to new 10W-30 motor oil), contact your Akkerman Product Support representative before using powered cutter head. Failure to do so WILL cause severe damage to powered cutter head.

4. Replace fill or check.



PCH 20



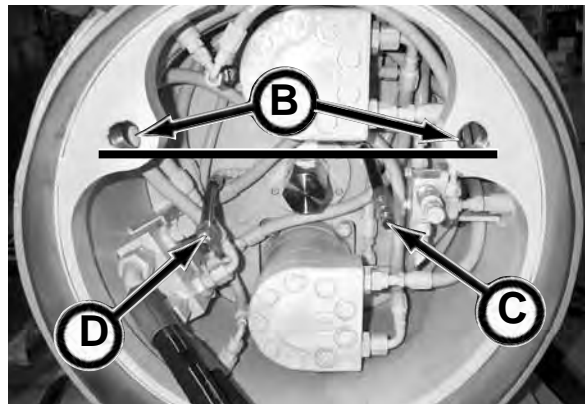
PCH 22.5

### 2. CHECK FRONT SECTION BEARING CAVITY OIL LEVEL

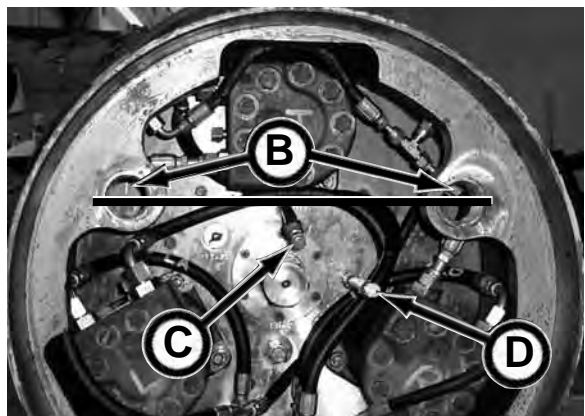
1. With alignment pin holes (B) in the horizontal position, gain access to the fill hose (C) and check hose (D).
2. Remove caps from fill and check hoses.
3. Bearing cavity is at proper level when oil flows out of check hose.

If needed, add Mobil® SHC 630 Synthetic Bearing and Gear Oil through fill hose until oil flows out of check hose.

4. Replace hose caps once cavity is filled.



PCH 20



PCH 22.5

### 3. LUBRICATE FRONT SECTION INTERNAL CUTTER FACE SEALS

**NOTICE** Lubricate seals at initial launch, then immediately after each drive while dirt is soft and flexible thereafter.

1. Remove hex plug to gain access to grease fitting (A) on inside cutter face of front section. The PCH 20 has 2 fittings located 180° from each other on front cutter head area. The PCH 22.5 has only one fitting on rear of front section.
2. Lubricate internal cutter face seals with Mobilgrease® XHP222 Premium Lubricating Grease while intermittently rotating cutter head until lubricant is visible on the inside of cutter face mounting plate on front of machine.
3. Replace hex plug (s).

**NOTICE** Failure to replace plug WILL cause sever damage to powered cutter head.



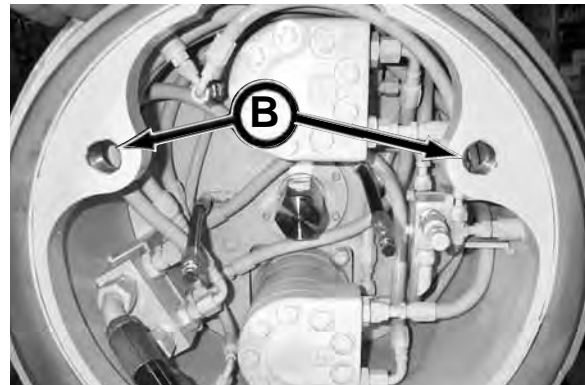
*PCH 20 (2 places)*



*PCH 22.5 (1 place)*

### 4. LUBRICATE FRONT SECTION ALIGNMENT PINS

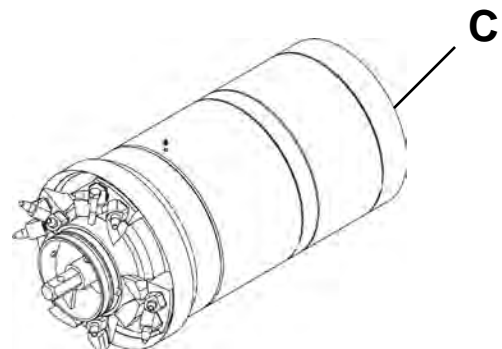
Lubricate alignment pin hole threads (B) with Mobilgrease® XHP222 Premium Lubricating Grease.



### 5. INSPECT FRONT SECTION BELL END

Inspect bell end (C) of front section for damage or excessive wear which may cause the front and rear sections to be improperly sealed.

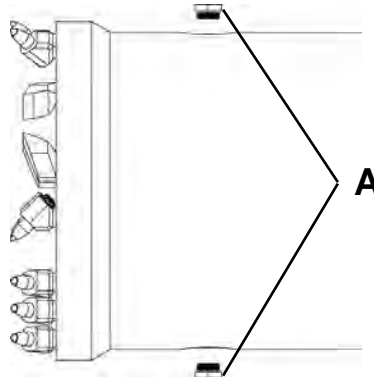
Contact your Akkerman Product Support representative should bell end damage occur.



## 6. LUBRICATE FRONT SECTION EXTERNAL CUTTER FACE SEALS

**NOTICE** Lubricate seals at initial launch, then immediately after each drive while dirt is soft and flexible thereafter.

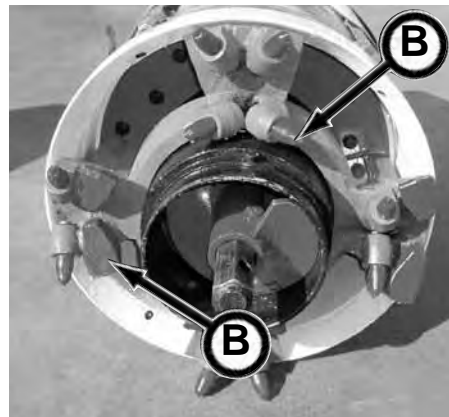
1. Remove plugs (A) at top and bottom of cutter head front section.
2. Install a 1/8 NPT grease fitting.
3. Lubricate external cutter face seals with Mobilgrease® XHP222 Premium Lubricating Grease while rotating cutter head until lubricant is visible around outside of cutter face mounting plate.
4. Remove grease fitting and replace plugs.



**NOTICE** If your powered cutter head is equipped with an increaser kit, remove plugs on increaser shell, remove plugs on cutter head body and install a 1/8 NPT grease fitting. Lubricate external cutter face seals with Mobilgrease® XHP222 Premium Lubricating Grease while rotating cutter head until lubricant is visible around outside of cutter face mounting plate. Remove grease fitting and replace plugs on cutter head body and then replace plugs on increaser shell.

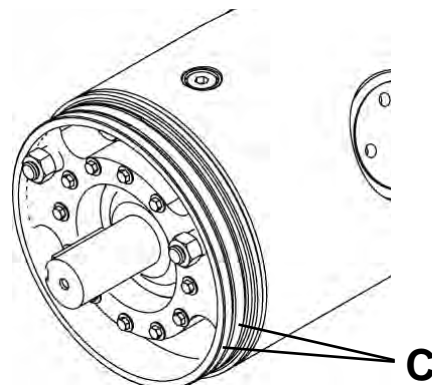
## 7. INSPECT CUTTER BIT TEETH

Inspect cutter teeth (B) for wear or damage. Repair or replace as necessary.



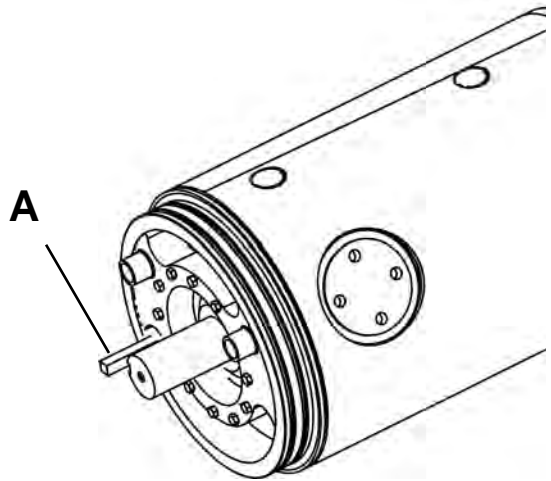
## 8. INSPECT REAR SECTION O-RINGS

Inspect rear section o-rings (C) for damaged. If damaged, replace with new.



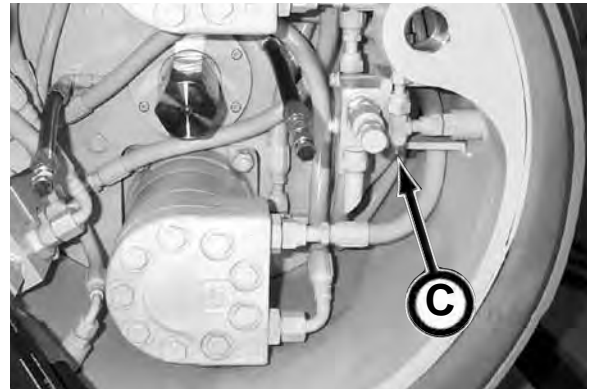
### 9. CHECK AUGER DRIVE SHAFT KEY ON REAR SECTION

The auger drive shaft key must be retained after drive is complete and available for the next drive. If key (A) is missing, order Akkerman part number A43188P.

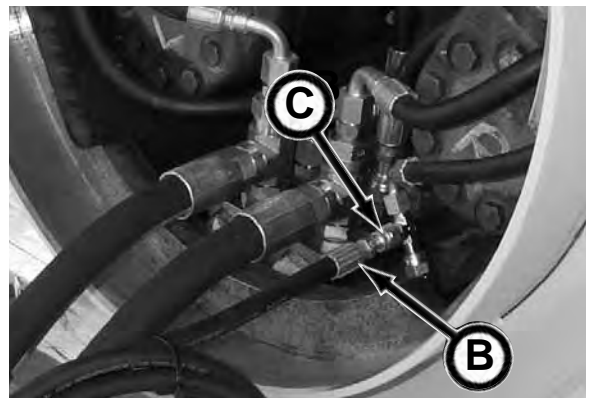


### 10. INSTALL JETTING HOSE TO JETTING INLET PORT

1. Install jetting hose (B) to jetting inlet port (C).
2. When launching front section, install hose to jetting supply source.
3. Once front section is launched, disconnect jetting hose from jetting supply and route jetting hose through rear section and then connect to supply source. Add additional hoses as needed.



PCH 20



PCH 22.5

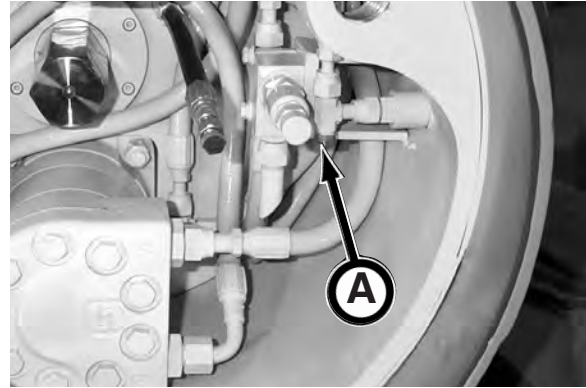
## AFTER EACH DRIVE

### 11. FLUSH FRONT SECTION JETTING PORTS

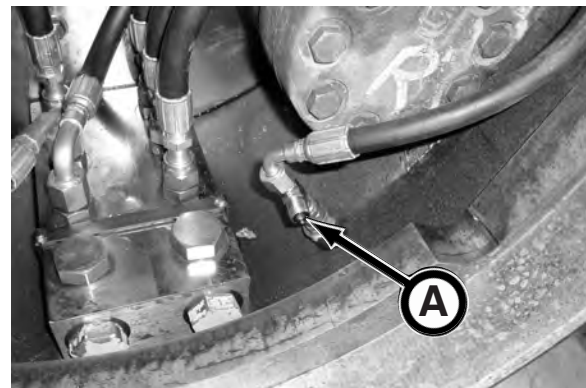
Flush jetting ports with clean water by installing supply source to the jetting inlet port (A).

Use a maximum of 2,500 psi (17,237 kPa) water pressure. In freezing weather, use compressed air to remove water from lines after flushing to prevent machine damage.

Be sure nozzles are clean. If plugged, remove nozzles for cleaning.



PCH 20



PCH 22.5

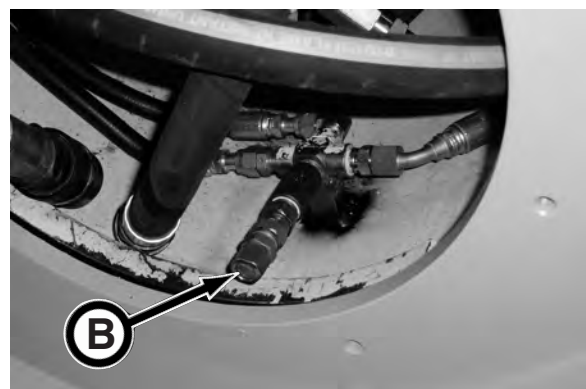
### 12. FLUSH REAR SECTION PIPE LUBRICATION PORTS

Flush pipe lubrication ports with clean water by installing supply source to the lubrication inlet port (B) on back of rear section.

Use a maximum of 500 psi (3,447 kPa) water pressure. In freezing weather, use compressed air to remove water from lines after flushing to prevent machine damage.



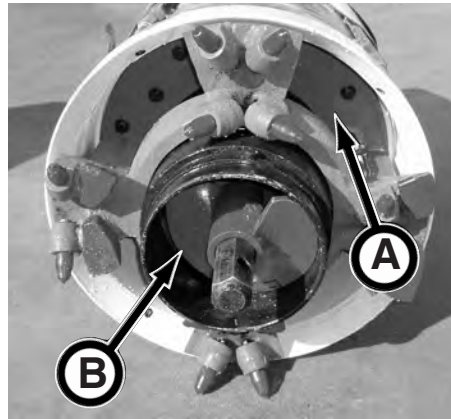
PCH 20



PCH 22.5

### 13. CLEAN MIXING CHAMBER & FRONT AUGER ADAPTER CHAMBER

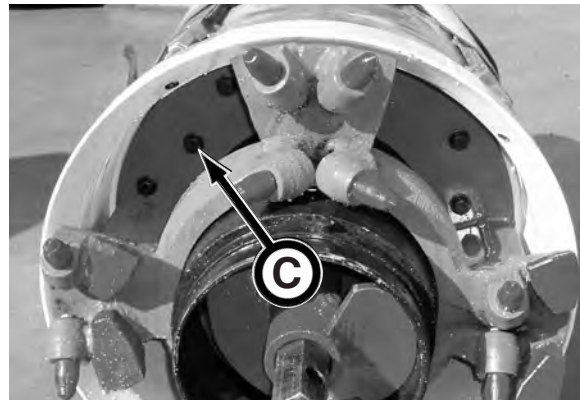
Clean mixing chamber (A) and front auger adapter chamber (B) with water. DO NOT use direct water pressure in mixing chamber. Doing so may cause seal damage.



### 14. CHECK CUTTER HEAD ASSEMBLY MOUNTING BOLT TORQUE

Tighten ALL cutter head assembly mounting bolts (C) to 90 ft-lb (lubricated) (120 N·m) torque.

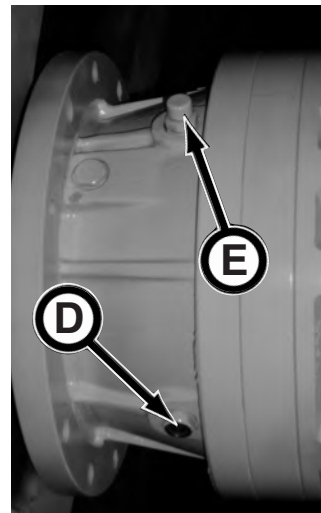
If bolts are damaged, defective, or will no longer hold the 90 ft-lb (120 N·m) torque, the bolt(s) MUST be replaced with new.



### 15. CHECK AUGER DRIVE GEAR BOX OIL LEVEL

Use a mirror to view the gear box sight gauge (D) in the rear section. Oil must be visible in sight gauge.

If necessary, remove fill cap (E) and add Mobil® SHC 630 Synthetic Bearing and Gear Oil as needed until oil is visible in the sight gauge. Replace fill cap.



*Gear Box Removed For Photographic Purposes*



### 16. LUBRICATE FRONT SECTION INTERNAL CUTTER FACE SEALS

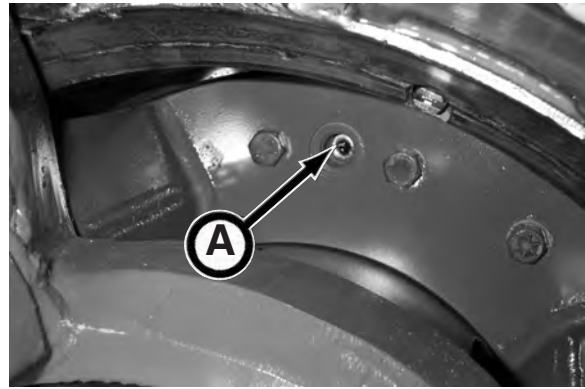
#### NOTICE

Lubricate seals at initial launch, then immediately after each drive while dirt is soft and flexible thereafter.

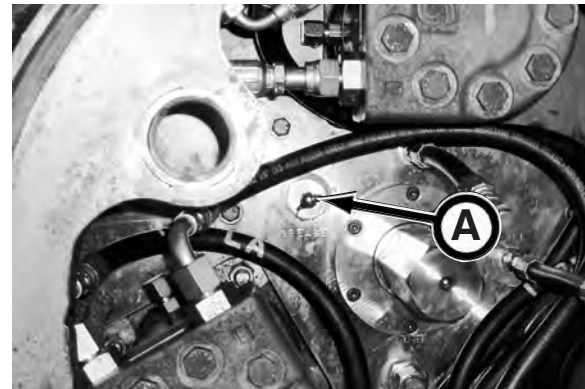
1. Remove hex plug to gain access to grease fitting (A) on inside cutter face of front section.
2. Lubricate internal cutter face seals with Mobilgrease® XHP222 Premium Lubricating Grease while intermittently rotating cutter head until lubricant is visible on the inside of cutter face mounting plate on front of machine.
3. Replace hex plug.

#### NOTICE

Failure to replace plug WILL cause severe damage to powered cutter head.



PCH 20



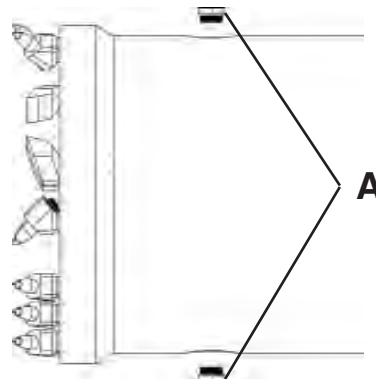
PCH 22.5

### 17. LUBRICATE FRONT SECTION EXTERNAL CUTTER FACE SEALS

#### NOTICE

Lubricate seals at initial launch, then immediately after each drive while dirt is soft and flexible thereafter.

1. Remove plugs (A) at top and bottom of cutter head front section.
2. Install a 1/8 NPT grease fitting.
3. Lubricate external cutter face seals with Mobilgrease® XHP222 Premium Lubricating Grease while rotating cutter head until lubricant is visible around outside of cutter face mounting plate.
4. Remove grease fitting and replace plugs.



#### NOTICE

If your powered cutter head is equipped with an increaser kit, remove plugs on increaser shell, remove plugs on cutter head body and install a 1/8 NPT grease fitting. Lubricate external cutter face seals with Mobilgrease® XHP222 Premium Lubricating Grease while rotating cutter head until lubricant is visible around outside of cutter face mounting plate. Remove grease fitting and replace plugs on cutter head body and then replace plugs on increaser shell.

## **NOTES**

# Storage

---

## PREPARING FOR STORAGE

1. Repair worn or damaged parts.
2. Wash all equipment thoroughly.
3. Lubricate all grease points on the Guided Boring Machine. Grease threads on bolts used for adjustments.
4. Drain gear box. Add Mobil SHC 630 or equivalent until oil level 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. Drain water and sediment from fuel system. Dispose of water and sediment properly.
8. Add proper fuel stabilizer for a full tank. Fill fuel tank completely.
9. Store diesel fuel in plastic, aluminum, or steel containers specially coated for diesel fuel storage.
10. Loosen all belts.
11. Clean air cleaner.
12. Restart engine and operate machine long enough to warm the oil. Check for leaks after machine warms up.
13. Remove battery (negative cable first) and store it in a cool, dry place. Remove corrosion from cables and battery case. Use baking soda to neutralize acid. Place battery on wood (not concrete) and connect a small trickle charger to it to maintain charge; OR charge battery every 30 days it is in storage, if necessary.
14. Repaint equipment where necessary.
15. Drain hydraulic oil, flush oil reservoir, change hydraulic filters, and refill hydraulic reservoir. Check for leaks.
16. Change hydraulic filters and refill hydraulic reservoir. Check for leaks.
17. Wipe up lube spills. Dispose of rags and trash properly.
18. If possible, store equipment under cover and out of the weather in a ventilated area.
19. If the engine will be stored over 6 months, refer to your engine manual for preparing the engine for long term storage.
20. Guidance system Tablet PC must be charged each month to extend battery life. Failure to do so will shorten battery life and cause GBM\_System program to load incorrectly at start up.

---

## REMOVING FROM STORAGE

1. Clean equipment thoroughly.
2. Check to make sure all decals including safety decals are clean and readable.
3. Check condition of wires and cables. Repair or replace as necessary.
4. 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.
7. Check gear box oil level. Add oil as needed. See Gear Box 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. See 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. Charge guidance system tablet PC battery.
16. Review this Operator's Manual.

# Troubleshooting

## Guided Boring Machine

Problem	Cause	Solution
No power to guidance system.	Switch on control pendant is OFF.	Turn switch ON.
	Connections are loose or disconnected.	Secure all connections.
	Blown monitor fuse.	Replace fuse.
	Voltage is less than 10 VDC.	Check voltage.
Valve functions (jacking, rotation, travel) do not operate.	Power pack engine is not running.	Start up engine.
	Insufficient oil in hydraulic reservoir.	Check oil level and fill as needed.
	Quick couplers are not properly connected.	Connect quick couplers on gear box properly.
	No oil flow.	Open inlet valve on power pack.
	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.
Latches on latching frame do not engage.	Thrust block shifting causing frame rails to misalign.	Reposition frame and modify thrust block to maintain parallel frame rails.
Hydraulic make-up tool operates incorrectly.	Hoses are installed in wrong port.	Switch hoses.
Break-out tool does not operate.	Break-out tool is unplugged.	Plug in break-out tool.
	Power source defective.	Repair power source.
	Defective switch on controller.	Replace switch.
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

Problem	Cause	Solution
Engine cranks but will not start.	No fuel.	Check fuel in tank. Open fuel shut-off valve.
	Fuel filter plugged or full of water.	Replace fuel filter and/or drain water from filter.
	Injection pump not getting fuel or air in fuel system.	Bleed fuel system.
	Wire harness or wires disconnected on injector pump.	Repair loose connections or replug harness.
Engine hard to start or will not start.	No fuel.	Check fuel in tank. Open fuel shut-off valve.
	Air in fuel line.	Bleed fuel system.
	Cold weather.	Use cold weather starting procedure.
	Crankcase oil too heavy.	Use proper oil viscosity.
	Clogged fuel filter.	Replace filter element.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed fuel system.
	Defective high water temperature sensor.	Replace water temp. sensor.
Engine shuts down during operation.  switch.	Defective low oil pressure switch.	Replace low pressure
	Low engine oil level.	Add oil to engine crankcase.
Engine knocks.	Low coolant temperature.	Remove and check thermostat.
	Low coolant temperature.	Remove and check thermostat.
Engine runs irregularly or stalls frequently.	Clogged fuel filter.	Replace filter element.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed fuel system.
	Defective thermostat.	Remove and check thermostat.
Below normal engine temperature.	Defective temperature gauge or sender.	Check gauge, sender, and connections.
	Engine overloaded.	Reduce load on engine.
Lack of power.	Intake air restriction.	Service air cleaner.
	Clogged fuel filter.	Replace fuel filter.
	Improper type of fuel.	Use proper fuel.
	Below normal engine temperature.	Remove and check thermostat.
	Restricted fuel hose.	Clean or replace fuel hose.
	Torque limiter out of adjustment.	Readjust torque limiter. Contact your Akkerman product support rep.

**Power Pack Engine (continued)**

<b>Problem</b>	<b>Cause</b>	<b>Solution</b>	
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.	
	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.

*(continued on next page)*

**Power Pack Engine (continued)**

<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
Undercharged system.	Excessive engine idling.	Increase engine rpm when heavy electrical load is used.
	Poor electrical connectors on battery, ground strap, starter, or alternator.	Inspect and clean or replace as necessary.
	Defective battery.	Test battery.
	Defective alternator. 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.

## Powered Cutter Head (PCH)

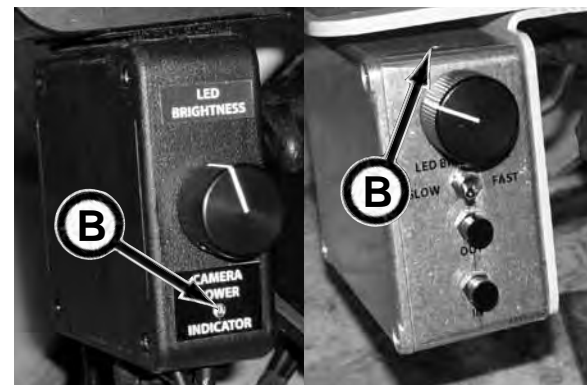
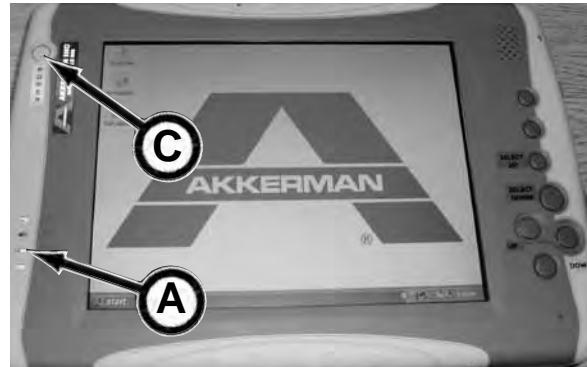
<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
High auger torque	Too many spoils.	Reduce advance rate of PCH.
	Sticky spoils.	Add polymer to spoils.
	Long drive length.	Add polymer to reduce load.
	Improper connections on quick disconnects.	Check to be sure all connections on quick disconnects are fully engaged.
Cutter head operating pressure too high.	Advance rate too fast.	Slow advance rate.
	No polymer in water at jetting.	Add polymer to water jetting.
	Spoils are sticky/dry.	Increase jetting psi.
	Improper connections on quick disconnects.	Check to be sure all connections on quick disconnects are fully engaged.
Casings rotate from 12 o'clock position.	Running cutter head in one direction only.	Run cutter bit in opposite direction until casing is in original 12 o'clock position.
		Operate cutter bit in opposite direction on every other pipe.
Thrust not advancing when operating cutter head.	Thrust psi higher than cutter head pressure.	Position control of cutter at mid stroke to limit flow to cutter head or until thrust advances.
Must stop mid way in product pipe installation to remove casing.	Temporary casing not timed with product pipe.	Add 1' or 2' section of product pipe behind PCH.
Oil leaking in PCH valve second section.	Case drain reliefs dumping out due to high return pressure.	Operate at slower speed, reduced volume.
	Oil too cold.	Operate at lower gpm until oil is warm.

## Tablet PC

### Problem:

### Computer Stops Responding

1. Check for any power disruption with the generator (if used), power pack, and/or tablet PC. Power is properly connected if both the tablet PC power indicator (A) and the camera power indicator (B) lights are illuminated.
2. Check to be sure the camera and power cables are in good condition and are properly connected without kinks. Kinked or damage cables WILL cause image to freeze or lock up. Replace damaged cables.
3. Press PC control buttons (Select Up, Select Down, etc) on computer to check if they operate.
4. If buttons do work, quit program and restart program. It is not necessary to restart the computer. Restarting the computer will result in a needless time delay.
5. If buttons still do not work, you must perform a Hard Power Down (see On & Off Control in section 6, Operation, sub section Guidance System - Tablet PC Start Up & Operation) using POWER button (C).
6. Restart computer (press power button for one second).
7. If problems continue, the hardware acceleration may require adjustment. Refer to steps 8 through 11.
8. Click Start Button on task bar. Click Settings. Click Control Panel. Click Display.
9. In the Display Properties window, click Settings tab, Advanced tab, and finally the Troubleshoot tab.
10. Move Hardware Acceleration slider bar (D), one setting to the left towards None.

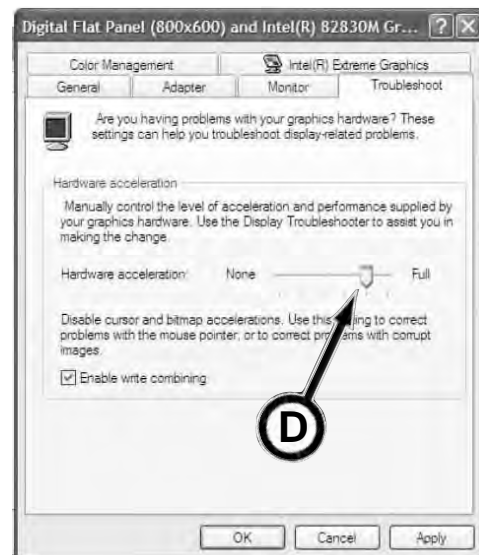


(SN FA42035F-86  
& Before)

(SN FA42035F-87  
& After)

**NOTICE** Readjusting the hardware acceleration from Full position towards None, will slow the display rate of the moving GBM target.

11. Once set, click OK.



## Tablet PC (continued)

### Problem:

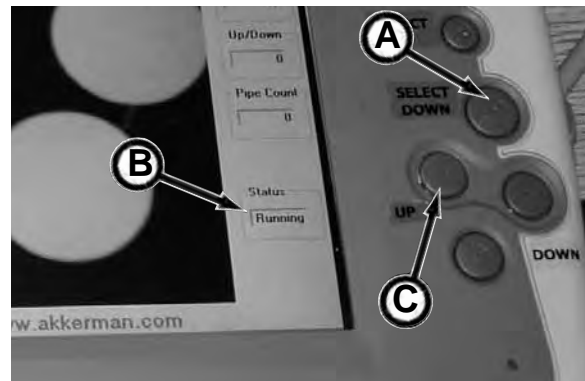
Image Freezes But Function Keys Operate

1. Check to be sure the camera and power cables are in good condition and are properly connected without kinks. Kinked or damage cables WILL cause image to freeze or lock up. Replace damaged cables.

### NOTICE

Power is connected properly when both the tablet PC power indicator and camera power indicator lights are illuminated.

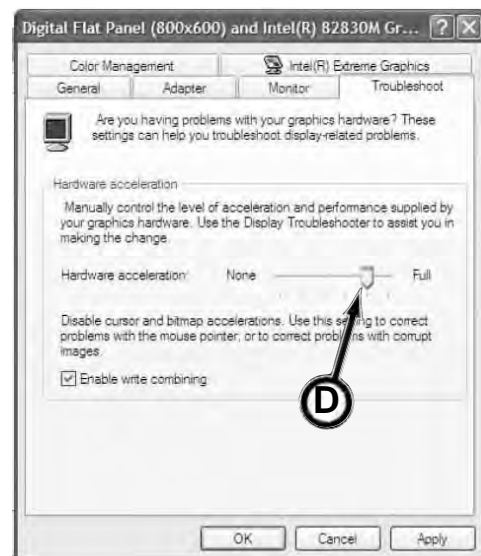
2. With GBM\_System program running, press Select Down button (A) until Status field (B) is highlighted.
3. Press UP button (C) to "Quit?".
4. Click Select Down (A) to enter.
5. With GBM program icon highlighted, press Select Down button again to view a live digital video image.
6. If image is still frozen, close program by tapping pen on  in upper right-hand corner of program window, then restart program and repeat steps 2 through 5.
7. If image continues to be frozen after performing step 6, or a "No Camera Present" window appears with the camera connected, close GBM\_System program and restart the computer.



8. If problems continue, the hardware acceleration may require adjustment. Refer to steps 9 through 12.
9. Click Start Button on task bar. Click Settings. Click Control Panel. Click Display.
10. In the Display Properties window, click Settings tab, Advanced tab, and finally the Troubleshoot tab.
11. Move Hardware Acceleration slider bar (D), one setting to the left towards None.

### NOTICE

Readjusting the hardware acceleration from Full position towards None, will slow the display rate of the moving GBM target.



12. Once set, click OK.

## Tablet PC (continued)

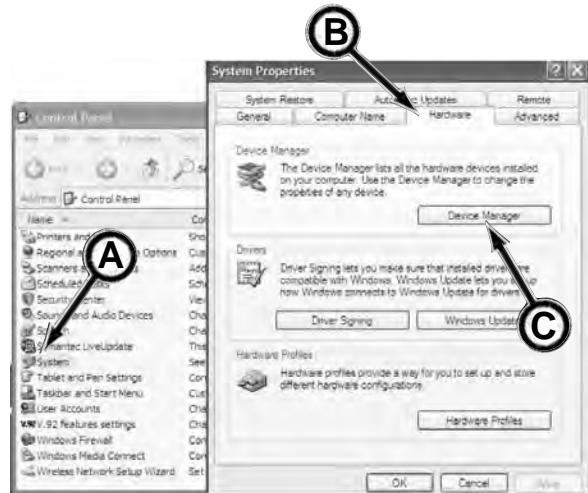
**Problem:**

Camera Is Not Recognized

**NOTICE**

If connecting new camera to computer for the first time, refer to Connecting New Camera to Computer in section 3, Operation.

1. Disconnect and reconnect camera power.
2. Gain access to Task Bar and click Start Button on task bar.
3. Click Settings, then Control Panel. Your computer may list the Control Panel directly from the Start Menu.
4. Double click System icon (A).
5. In the System Properties window, click the Hardware tab (B).
6. Click Device Manager button (C).



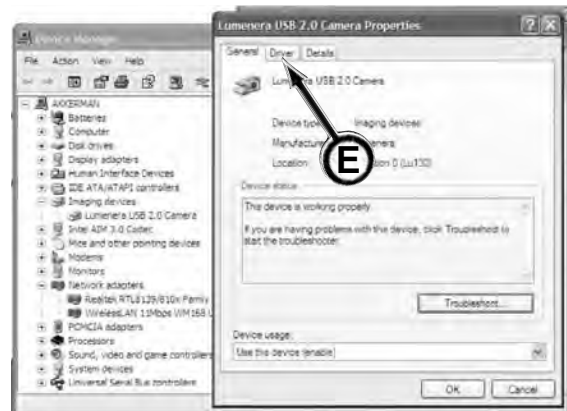
7. In the Device Manager window, click the + on the Imaging devices line to expand its contents. A Lumenera USB 2.0 Camera or Unconfigured Camera line (D) will appear.

**NOTICE**

Camera may appear under “USB devices” as an “Unconfigured device.”



8. If camera does not respond, there will be a yellow ! (exclamation mark) in front of Lumenera USB 2.0 Camera or Unconfigured Camera line. If so, right click on the Lumenera USB 2.0 Camera line and click Properties.
9. In the Lumerera USB 2.0 Properties window, click the Driver tab (E).



(continued on next page)

## Tablet PC (continued)

*Problem:*

Camera Is Not Recognized (continued)

10. Click Update Driver (B).



11. The wizard then appears with a “Can Windows connect to Windows Update to search for Software?” Click the “No, not this time” button (C), then click NEXT.



12. On the question “What do you want the wizard to do?” Click on Install the software automatically (Recommended) (D) and click NEXT. A window will appear that the driver has not been signed. Click continue anyway.



13. Continue to follow instructions as indicated in the windows.

14. Computer will need to be rebooted after installing camera driver.

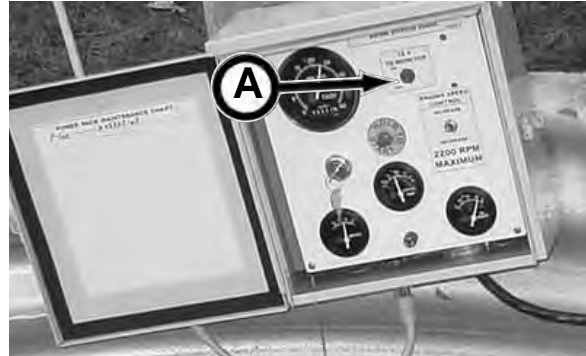
15. If camera is still not recognized, contact your Akkerman Product Support representative.

## Tablet PC (continued)

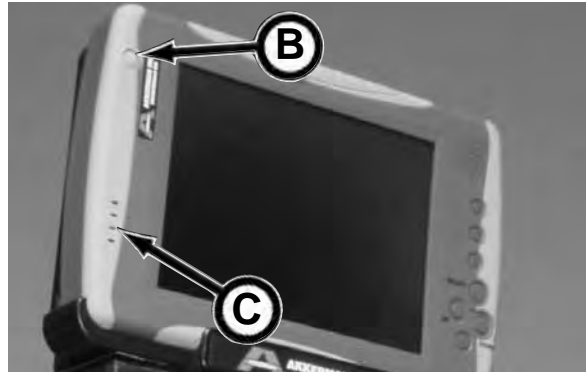
**Problem:**

Checking Guidance System Camera Connections

1. Start generator (if used) and power pack, and flip ON 12V To Monitor switch (A) on pendant. *Later models do not have this switch. As soon as the power pack engine starts, the 12V Monitor power will power up automatically.*



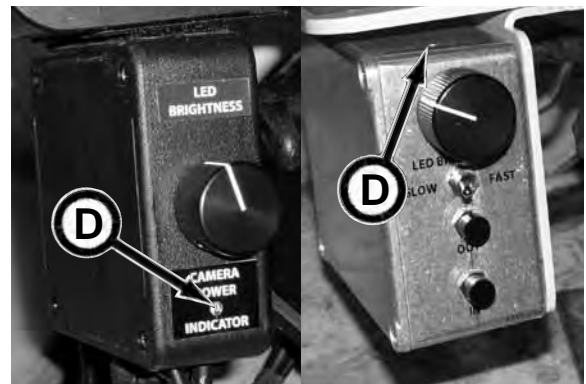
2. Turn ON tablet PC by pressing power button (B).
3. Check the following:



- a. Is the power indicator light (C) on the tablet PC illuminated? If not, either the generator or the power pack is not running, the 12V To Monitor switch is off, the power cable from pendant to Power In connection on tablet PC is not connected properly, or cable is damaged.

- b. (Some models) Is the Camera Power Indicator light (D) on the control box of the tablet PC assembly illuminated? If not, properly install camera cable connections, or replace damaged cable.

4. If camera still fails to function properly, refer to other troubleshooting options in this section.



(SN FA42035F-86 & Before)

(SN FA42035F-87 & After)

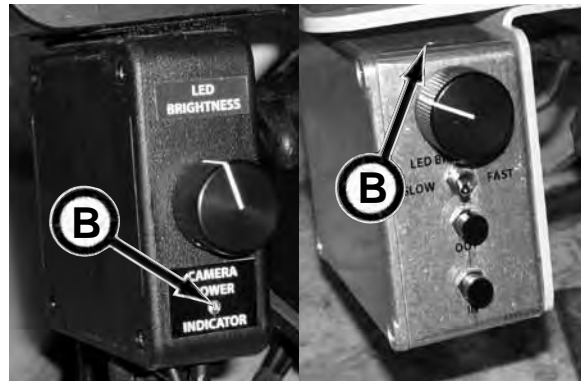
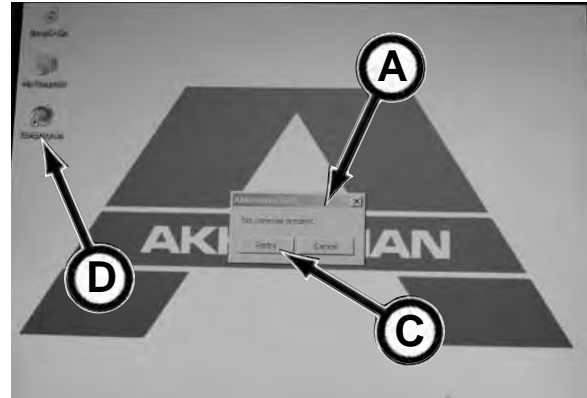
## Tablet PC (continued)

*Problem:*

No Camera Present

With power connected to tablet PC (power indicator on tablet PC is illuminated) a “No Camera Present” window (A) appears.

1. The Camera Power Indicator light (B) on control box is not illuminated.
2. Plug in camera power. The camera power indicator light is now illuminated.
3. Click Retry (C) on “No Camera Present” window and the GBM\_System program (D) will automatically start up.
4. If camera still fails to function properly, refer to other troubleshooting options in this section.



(SN FA42035F-86  
& Before)

(SN FA42035F-87  
& After)

## Tablet PC (continued)

**Problem:**

Windows operating system and the Akkerman GBM\_System program does not load. A DOS screen appears.

When the Tablet PC battery power becomes too low, a DOS screen (A) will appear, therefore preventing the Windows operating system and GBM\_System program from loading properly. If this should occur, perform the following procedure:

1. Supply power to the Tablet PC. This will charge the battery while the computer is on.

If the computer battery will not take a charge (indicated by an orange light never changing to the green light on the computer or disconnecting external power and the computer shuts down), the computer battery must be replaced. Contact your Akkerman Product Support representative for more information.



**NOTICE** The DOS screen shown may or may not appear like the screen on your computer.

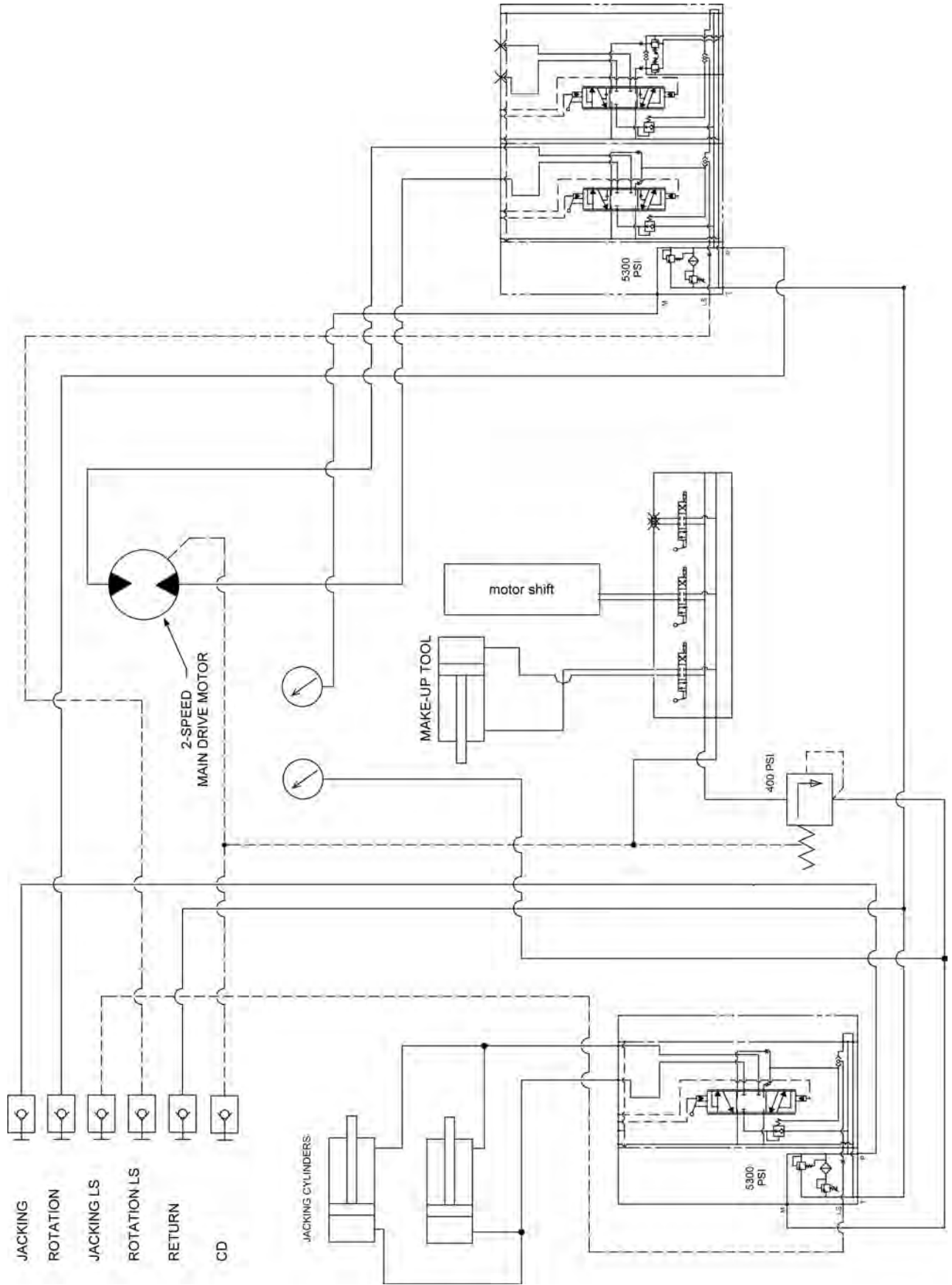
2. Touch the digitizing pen anywhere on the tablet PC screen. This will pop up the green F1 and F2 function buttons.
3. Click F2 button (B) to load the Windows operating system and the Akkerman GBM\_System program.



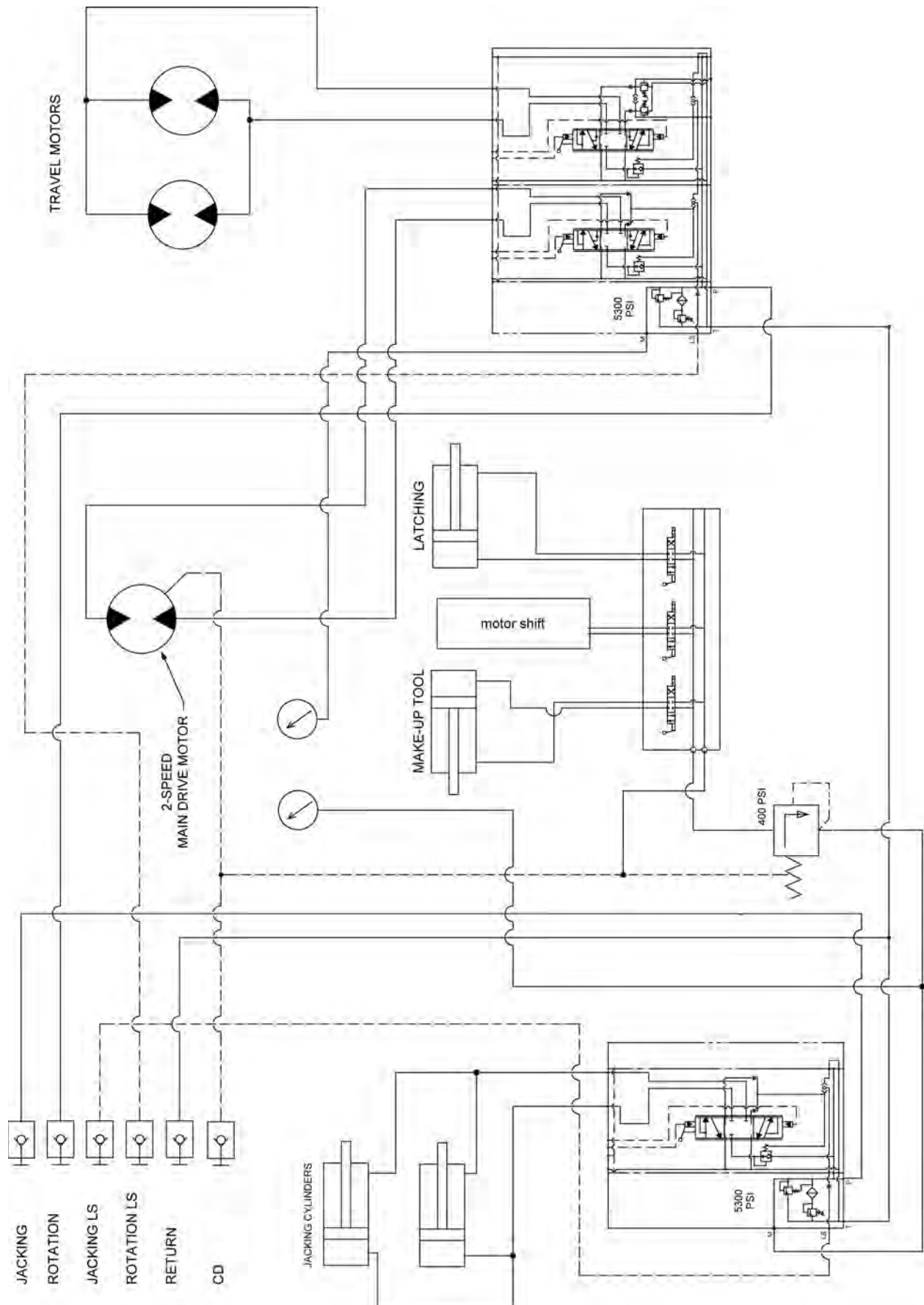
**NOTICE** Do not click the F1 button. Doing so will take you to the BIOS (Basic Input/Output System) settings. Only an experienced computer technician should change the BIOS settings. Changes to the BIOS settings will affect the operation of the computer and other devices, such as the camera.

**NOTICE** Charge Tablet PC battery at least once a month to keep the battery properly charged. Failure to do so will result in shortened battery life and cause programs to load improperly.

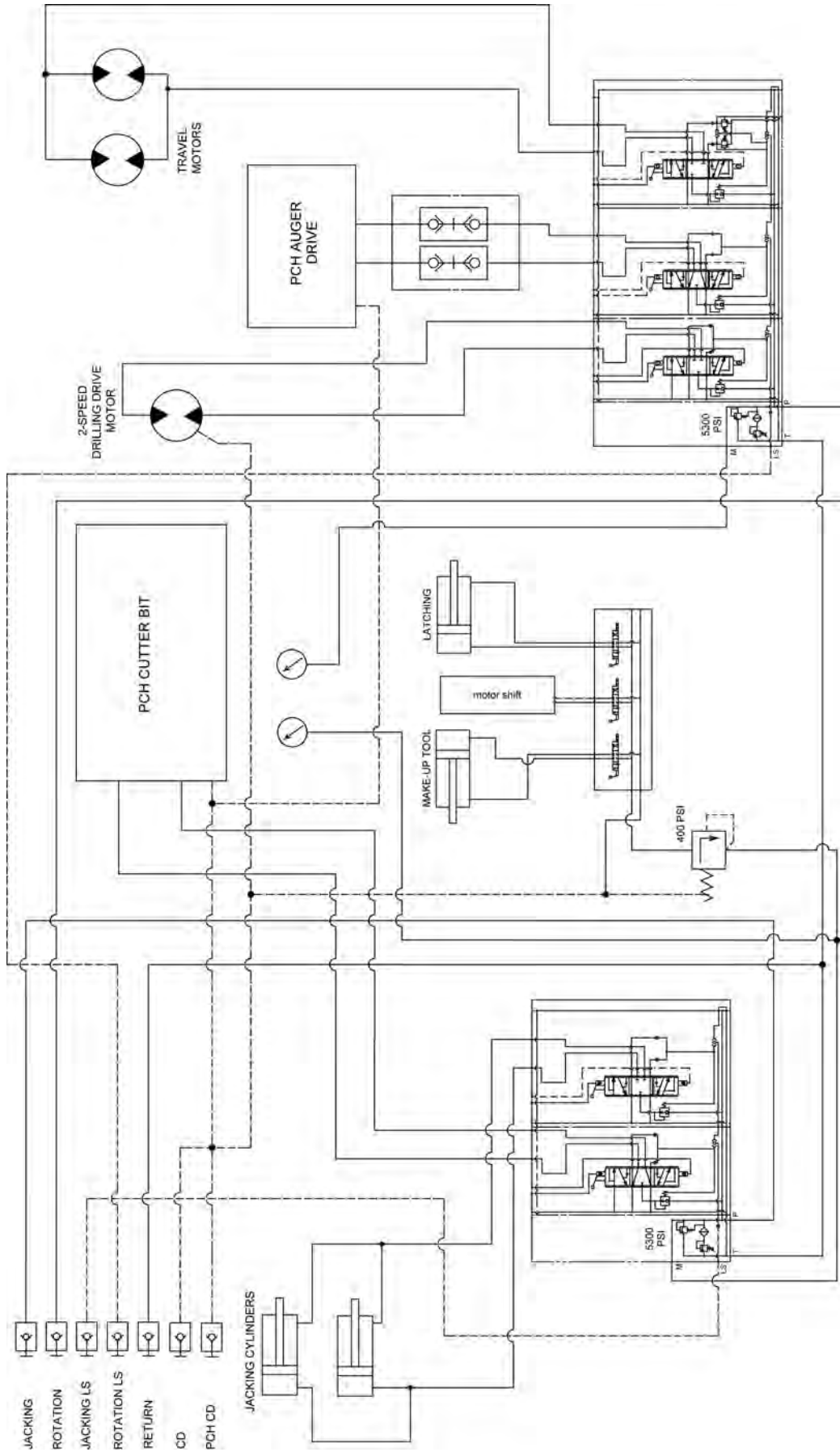
# HYDRAULIC SCHEMATIC - 240A SINGLE STAGE FRAME



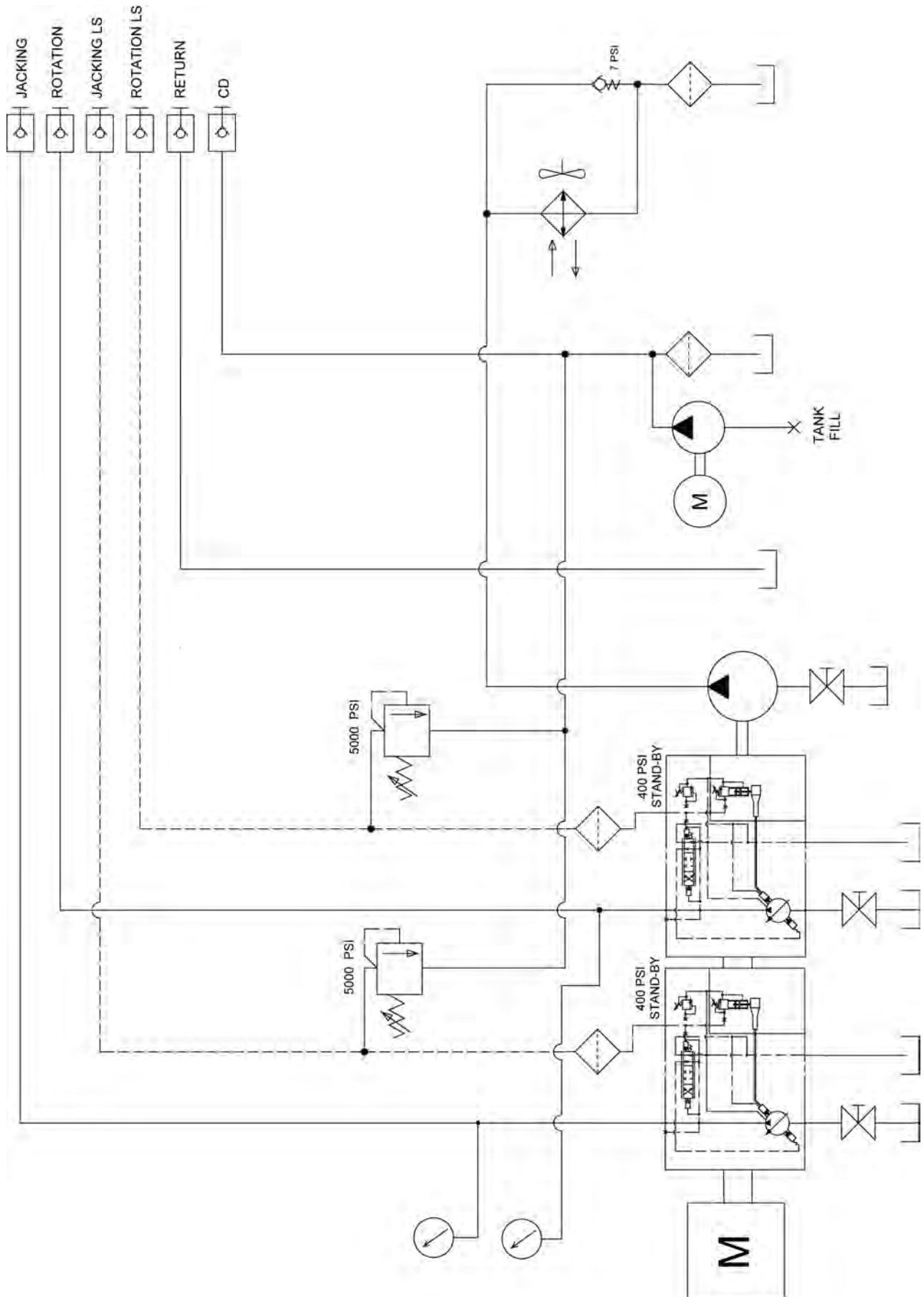
# HYDRAULIC SCHEMATIC - 308A LATCHING FRAME (WITHOUT PCH CONTROLS)



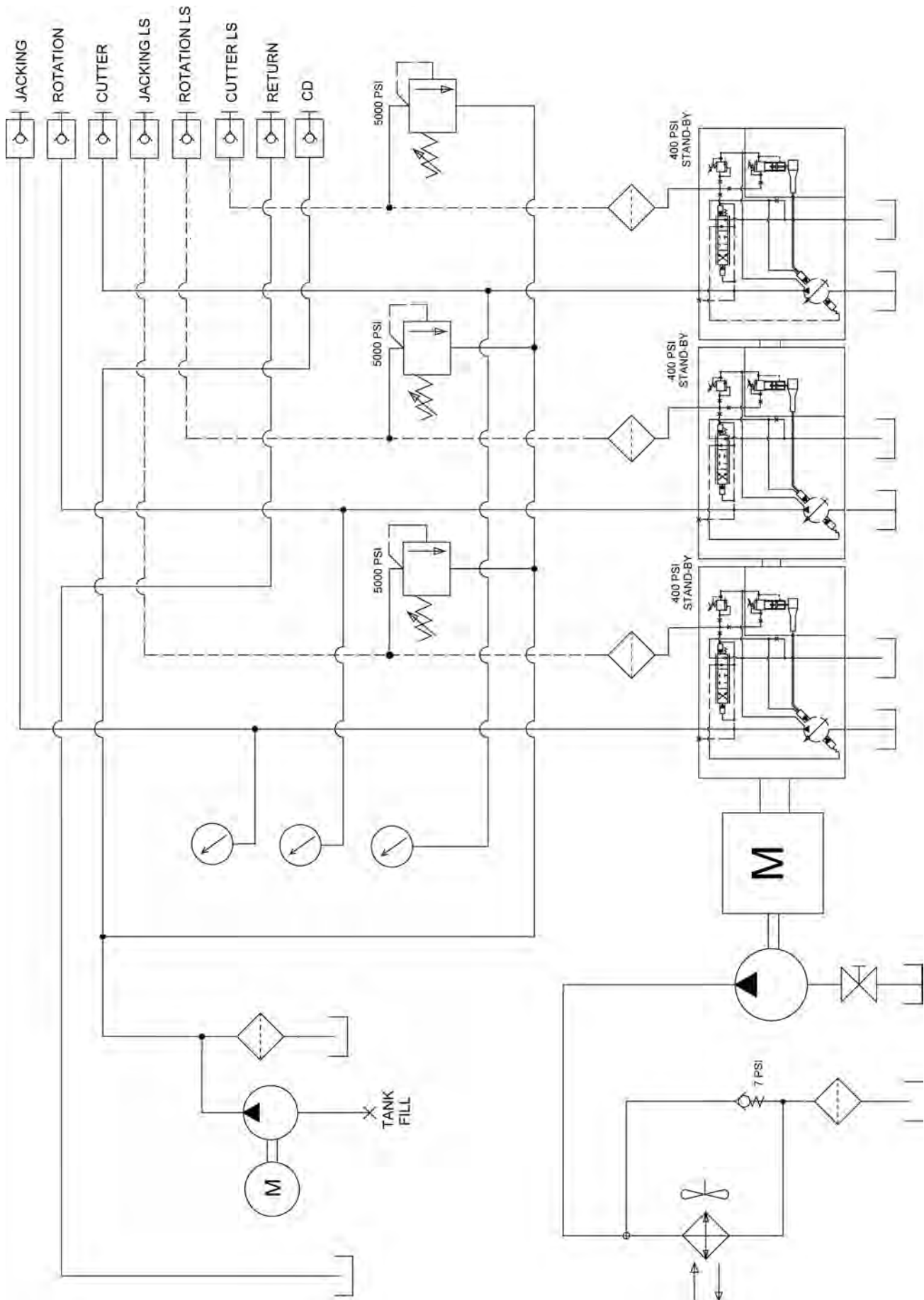
# HYDRAULIC SCHEMATIC - 308A & 339A LATCHING FRAME (WITH PCH CONTROLS)



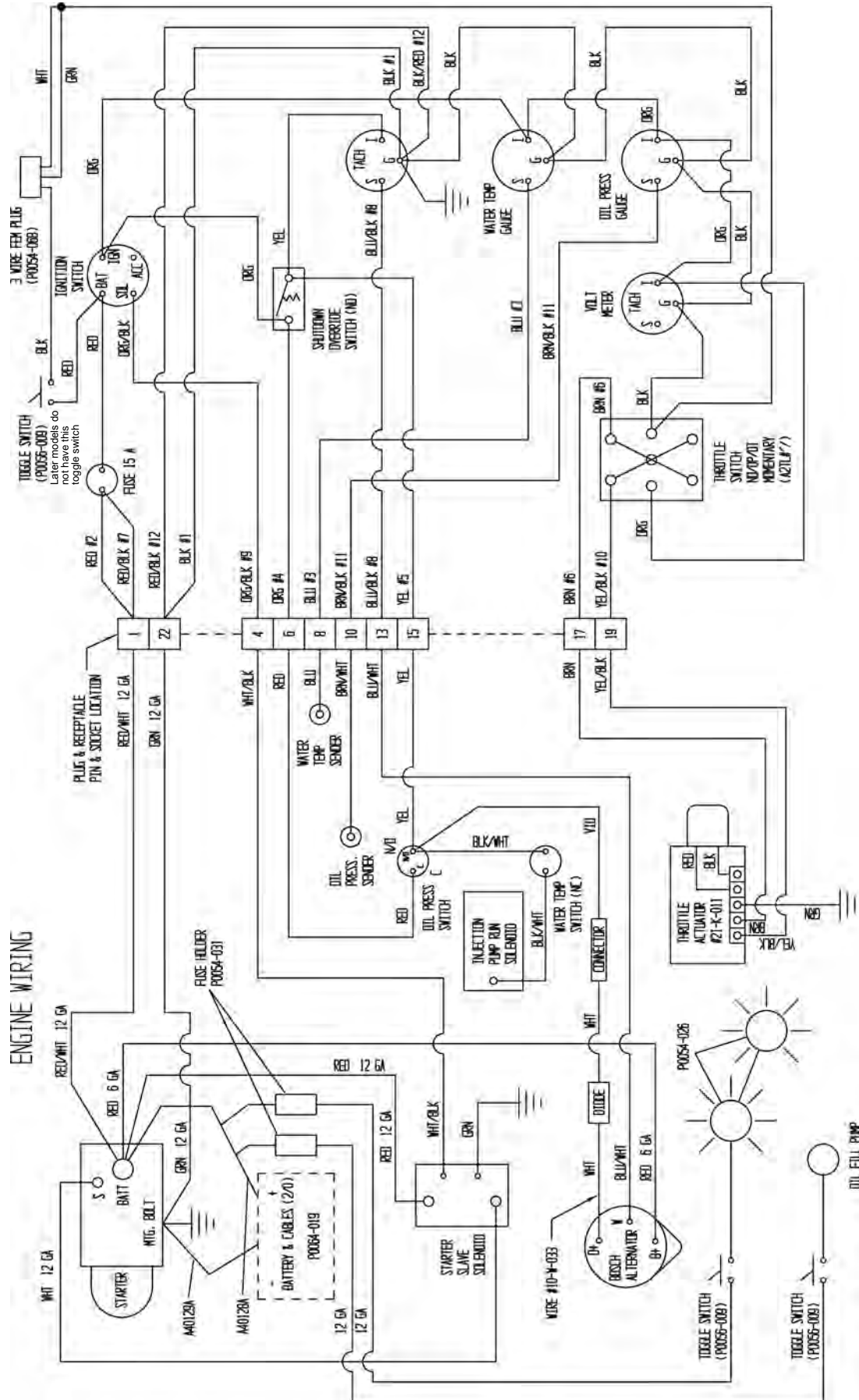
# HYDRAULIC SCHEMATIC - P100Q POWER PACK



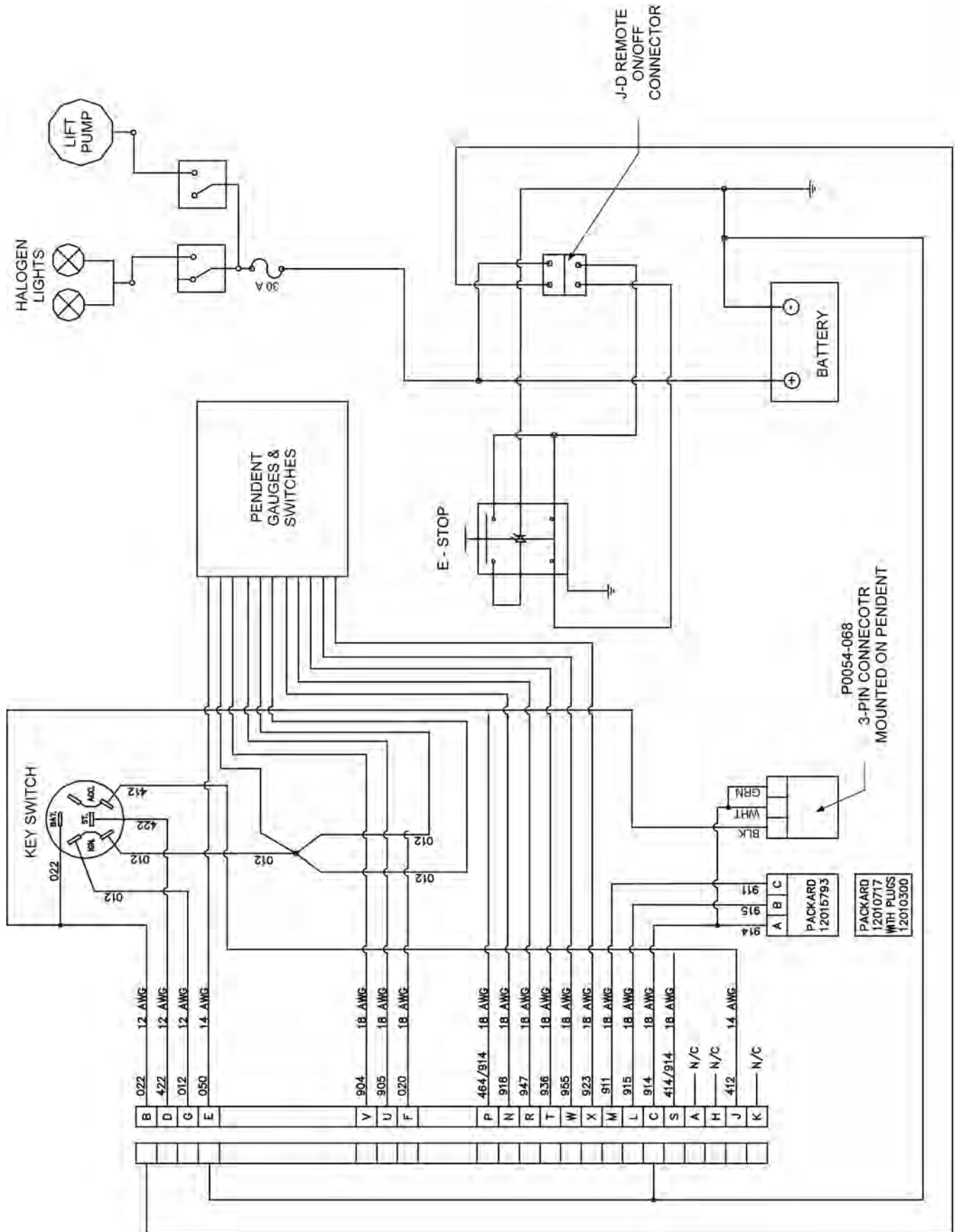
# HYDRAULIC SCHEMATIC - P150Q POWER PACK



# ELECTRICAL SCHEMATIC - P100Q POWER PACK



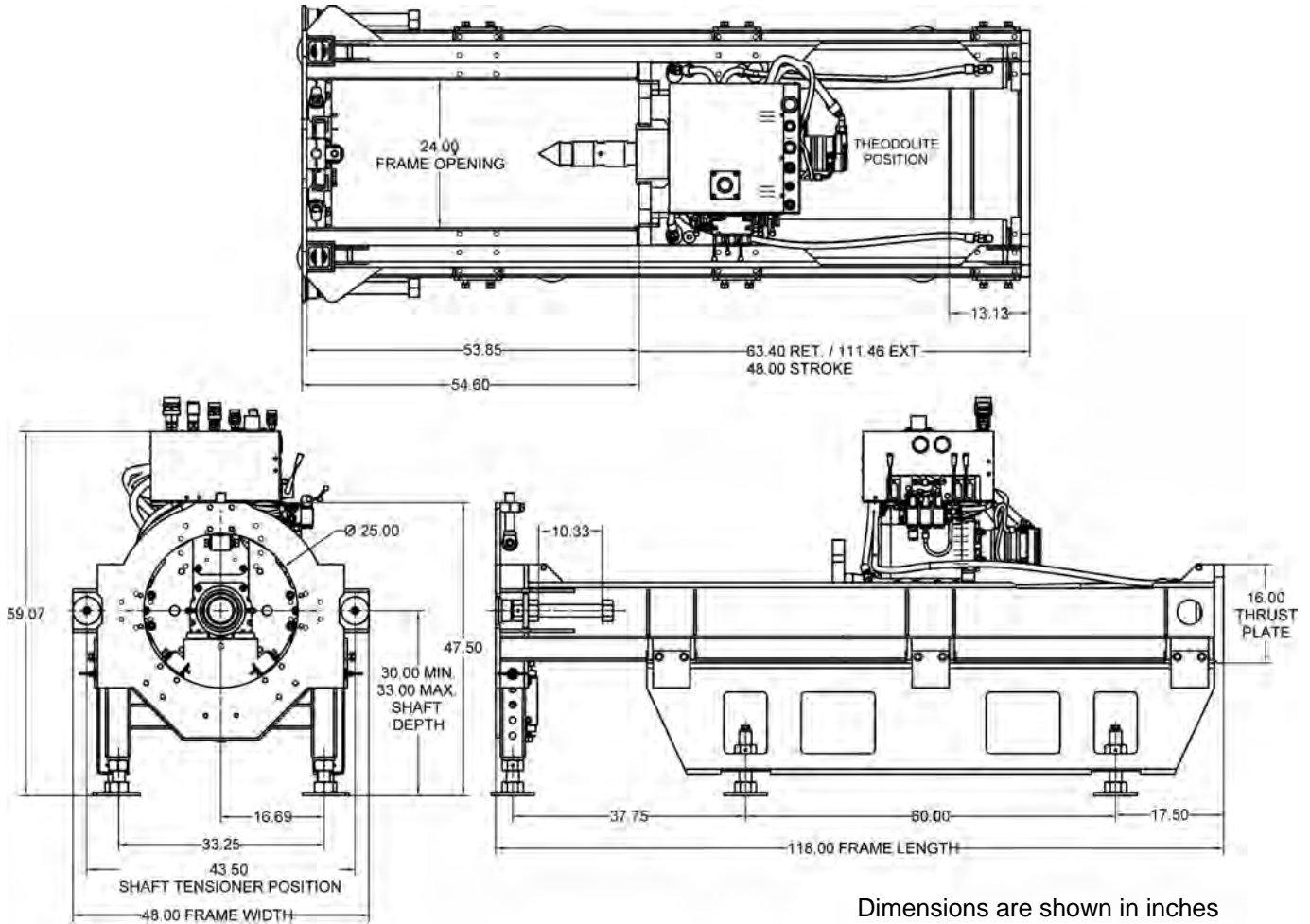
# ELECTRICAL SCHEMATIC - P150Q POWER PACK



## **NOTES**

# Specifications

## GBM - 240A SINGLE STAGE FRAME



Dimensions are shown in inches

### Dimensions

Width .....	48 in. (1,219 mm)
Length .....	118 in. (2,997 mm)
Height .....	55 in. (1,397 mm)

Assembly Weight ..... 6,000 lbs. (2,722 kg)

Cylinder Stroke ..... 48 in. (1,219 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34.475 mPa)

Elevation (from shaft floor to drive center) ..... 27 to 33 in. (686 to 838 mm)

Operating Grade (Maximum) ..... 10%

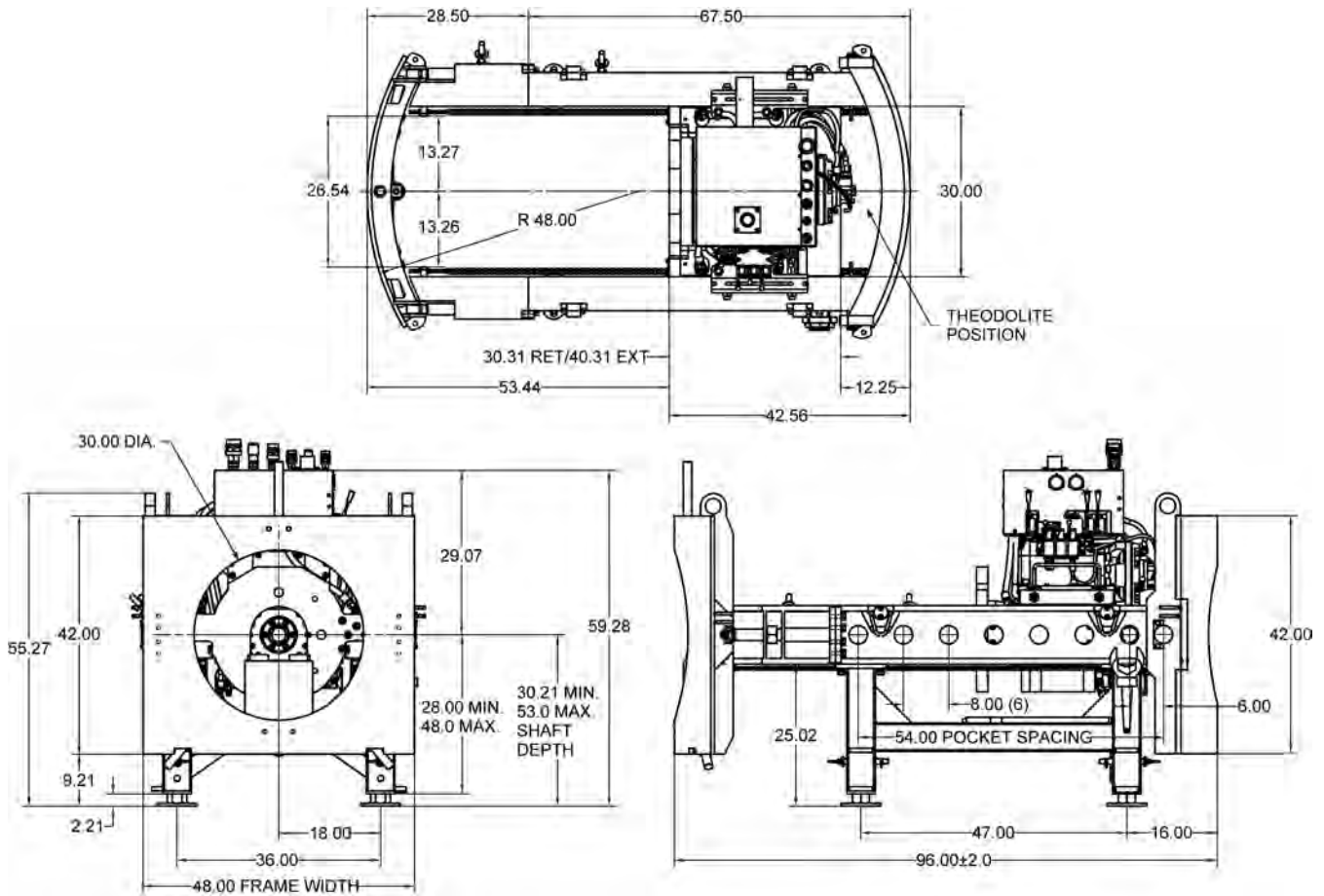
### Gear Box

Rotational Torque (output torque in low speed @ 5,000 psi) .....	10,500 ft-lbs. (14,238 N-m)
Jacking Force .....	100 Ton (91 mt)
Pull Back Force .....	50 Ton (45 mt)
Fluid Capacity .....	7 gal (26.5 L)

Hydraulic Motor .....	Two Speed
High Speed (SAI/VIS) .....	70/50 rpm
Low Speed .....	25 rpm

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

## GBM - 308A LATCHING FRAME



Dimensions are shown in inches

### Dimensions

Width .....	48 in. (1,219 mm)
Length .....	92 in. (2,337 mm)
Height .....	62 in. (1,575 mm)

Assembly Weight With Shaft Adapters ..... 6,000 lbs. (2,722 kg)

Latching Positions On Center ..... 8 in. (203 mm)

Cylinder Stroke ..... 10.5 in. (267 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34.475 mPa)

Elevation (from shaft floor to drive center) ..... 31 to 48 in. (787 to 1,219 mm)

Operating Grade (Maximum) ..... 10%

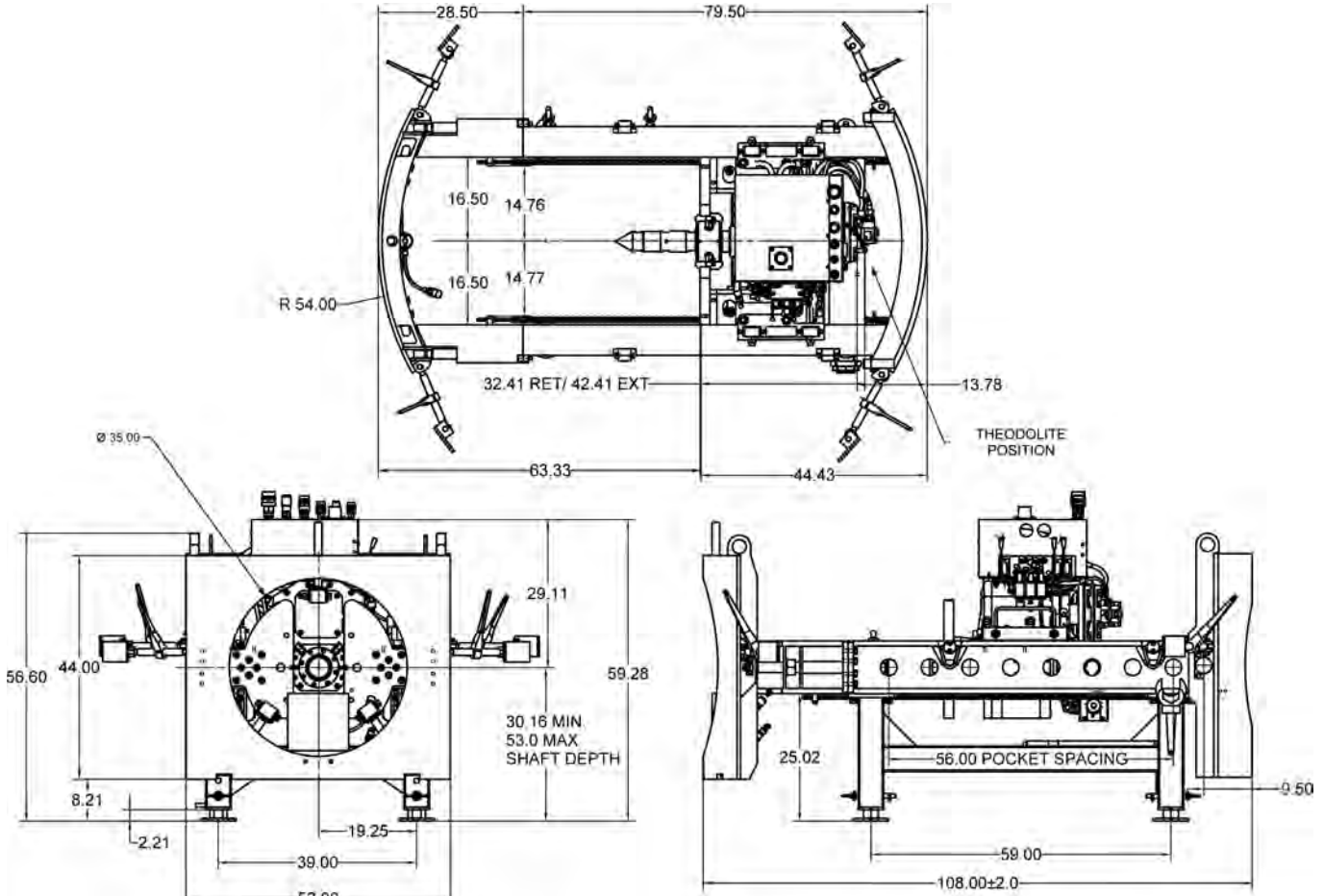
### Gear Box

Rotational Torque (output torque in low speed @ 5,000 psi).....	10,500 ft-lbs. (14,238 N·m)
Jacking Force .....	100 Ton (91 mt)
Pull Back Force .....	50 Ton (45 mt)
Fluid Capacity .....	7 gal (26.5 L)

Hydraulic Motor .....	Two Speed
High Speed (SAI/VIS).....	70/50 rpm
Low Speed .....	25 rpm

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

## GBM - 339A LATCHING FRAME



Dimensions are shown in inches

**Dimensions**

Width .....	52 in. (1,321 mm)
Length .....	104 in. (2,642 mm)
Height .....	62 in. (1,575 mm)

Assembly Weight With Shaft Adapters ..... 6,600 lbs. (2,994 kg)

Latching Positions On Center ..... 8 in. (203 mm)

Cylinder Stroke ..... 10.5 in. (267 mm)

Operating Pressure (Maximum) ..... 5,000 psi (34.475 mPa)

Elevation (from shaft floor to drive center) ..... 31 to 48 in. (787 to 1,219 mm)

Operating Grade (Maximum) ..... 10%

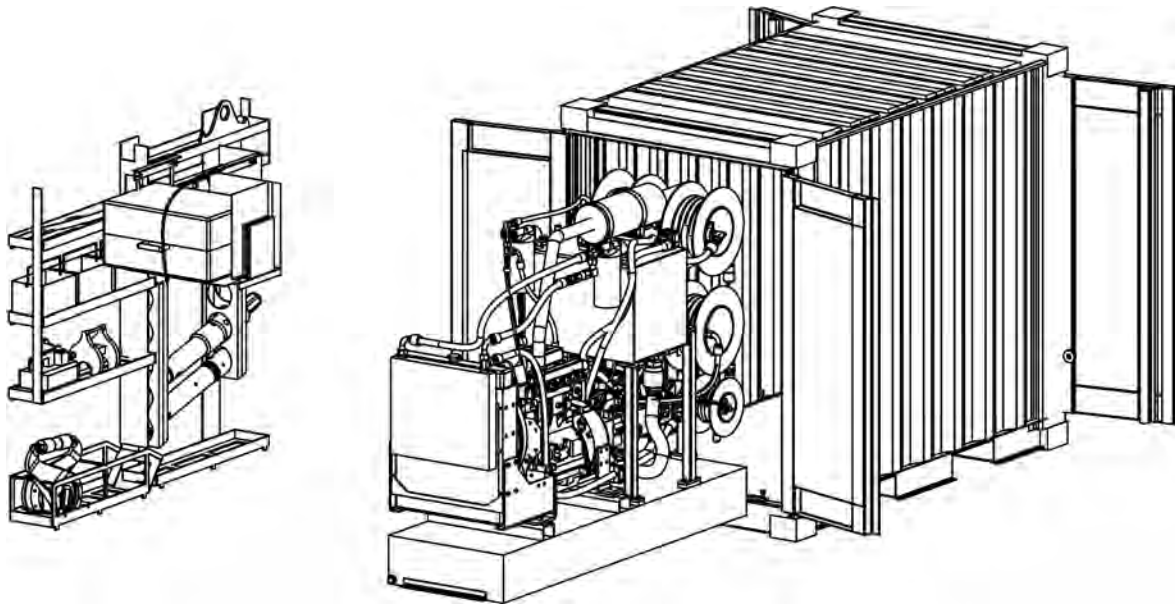
**Gear Box**

Rotational Torque (output torque in low speed @ 5,000 psi).....	10,500 ft-lbs. (14,238 N·m)
Jacking Force .....	100 Ton (91 mt)
Pull Back Force .....	50 Ton (45 mt)
Fluid Capacity .....	7 gal (26.5 L)

Hydraulic Motor .....	Two Speed
High Speed (SAI/VIS).....	70/50 rpm
Low Speed .....	25 rpm

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

## GBM - P100Q POWER PACK



### Dimensions

Height .....	82 in. (2,083 mm)
Width .....	58 in. (1,473 mm)
Length .....	96 in. (2,438 mm)
Weight .....	6,600 lbs. (2,994 kg)

### Fluid Capacities

Fuel Tank .....	100 gal (378 L)
Hydraulic Reservoir .....	40 gal (151 L)
Engine Oil .....	15.8 qt (15 L)
Coolant .....	9 qt (8.5 L)

### Power Unit

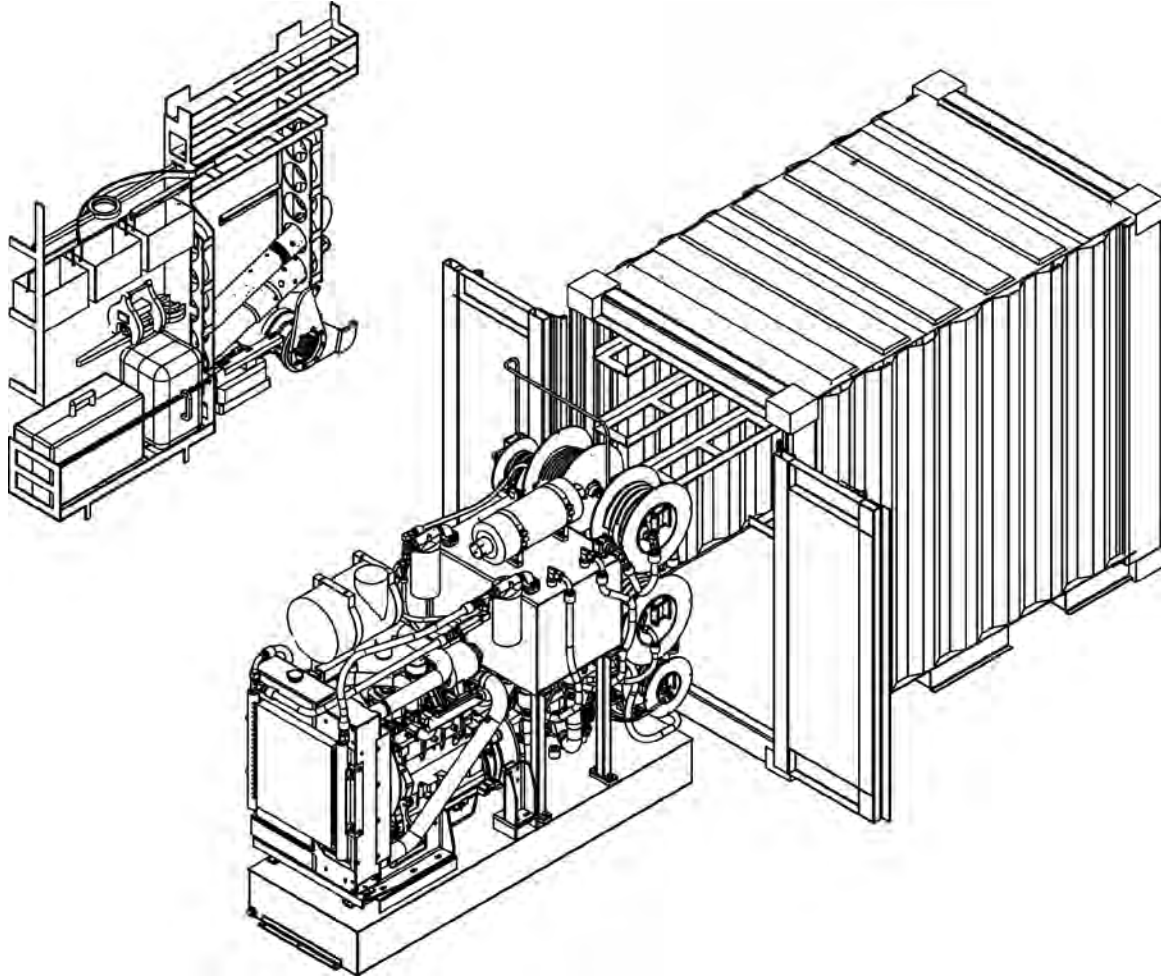
JD 4.5 L 4045 Engine .....	99 HP (74 kW)
----------------------------	---------------

### 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 (34.475 mPa)
Gear Pump (Cooling) .....	25 gpm (95 L/min)

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

## GBM - P150Q POWER PACK



### Dimensions

Height .....	82 in. (2,083 mm)
Width .....	58 in. (1,473 mm)
Length .....	96 in. (2,438 mm)
Weight .....	8,500 lbs. (3,855 kg)

### Fluid Capacities

Fuel Tank .....	100 gal (378 L)
Hydraulic Reservoir .....	50 gal (189 L)
Engine Oil .....	21.6 qt (20.5 L)
Coolant .....	9 qt (8.5 L)

### Power Unit

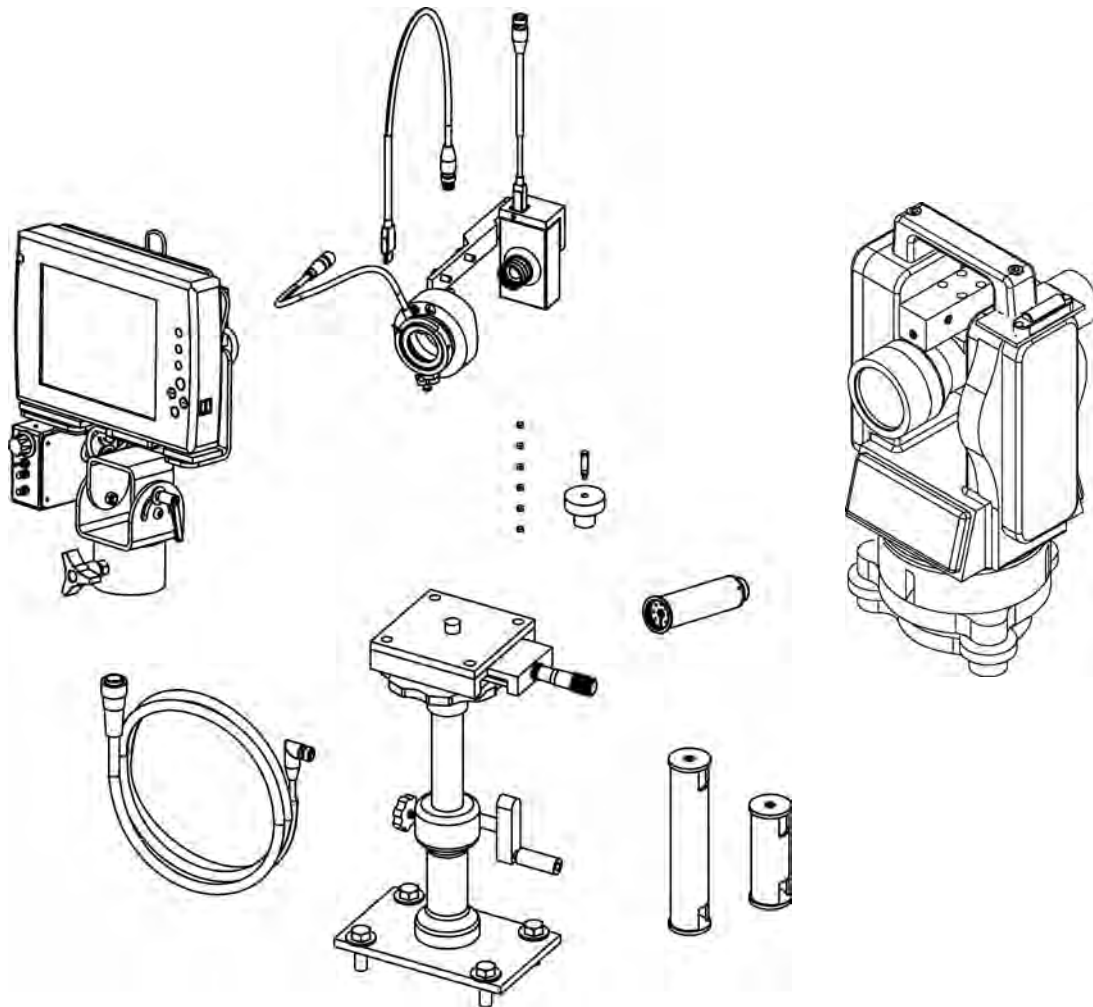
JD 4.5 L 4045 Engine .....	154 HP (115 kW)
----------------------------	-----------------

### Pumps

Variable Piston	
Jacking .....	0 to 34 gpm (0 to 129 L/min)
Rotation .....	0 to 34 gpm (0 to 129 L/min)
PCH Cutterbit .....	0 to 34 gpm (0 to 129 L/min)
Operating Pressure (Maximum) .....	5,000 psi (34.475 mPa)
Gear Pump (Cooling) .....	25 gpm (95 L/min)

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

## GUIDANCE SYSTEM

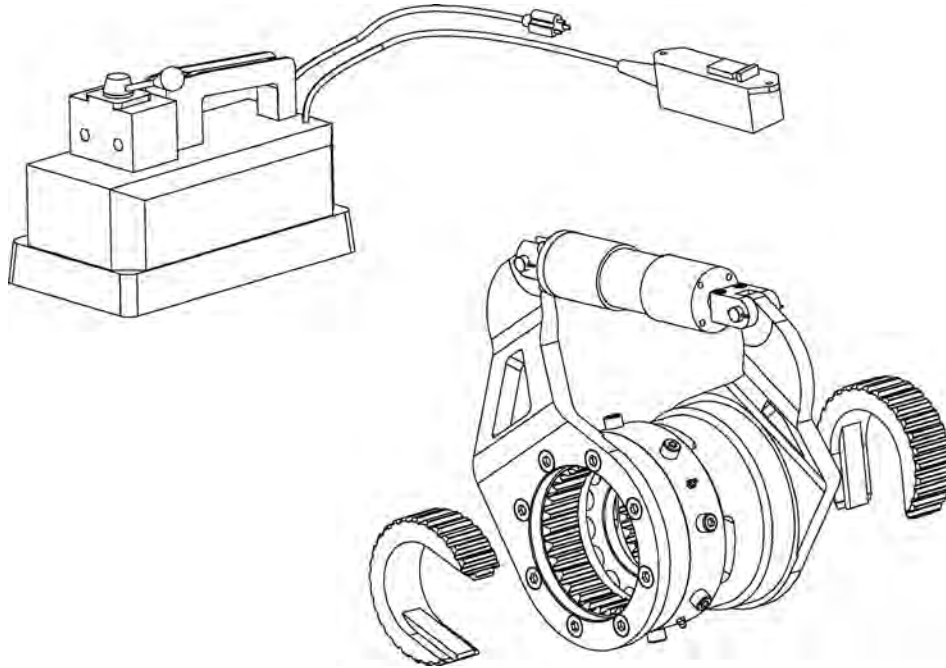


Dimensions (width x length x height)	Theodolite Accuracy .....	5 sec (1.5 mgon) DIN
Theodolite Case	Bore Sight	
..... 12 x 19.5 x 12 in. (305 x 495 x 305 mm)	Laser .....	Visible Red Diode
Monitor Case	Minimum Range for Sighting String Lines	..... 30 in. (762 mm)
..... 15 x 24 x 10 in. (381 x 610 x 254 mm)	Operation .....	on/off end cap
Target .....	Type .....	visible red diode laser
Rechargeable	Power Supply .....	(3) 392 button batteries
Battery Life .....	Construction .....	brass
Up to 6 Days Per Charge		
Replaceable (Two 1.5 Volt D Size Alkaline Batteries)		
Battery Life .....		
Up to 14 Days		

- The guidance system consists of a theodolite, illuminated target, target charger, tablet assembly, camera, lateral slide assembly, elevator column assembly, counterweight, alignment holder, bore sight laser, and protective cases.
- The theodolite is used to align and maintain line and grade with a designed accuracy of .25 inch up to 300 feet.
- The rechargeable or replaceable, battery powered, illuminated target is positioned in the steering head.
- The video surveillance system consists of a 1.4 mega-pixel camera mounted on the theodolite which transfers digital video of the illuminated target to the monitor.
- The target image is computer enhanced and displayed on the tablet monitor.
- The lateral slide and elevator column adjusts the micro calibration of the horizontal line and vertical grade.
- The theodolite focus is controlled from the remote focus on the docking station.

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

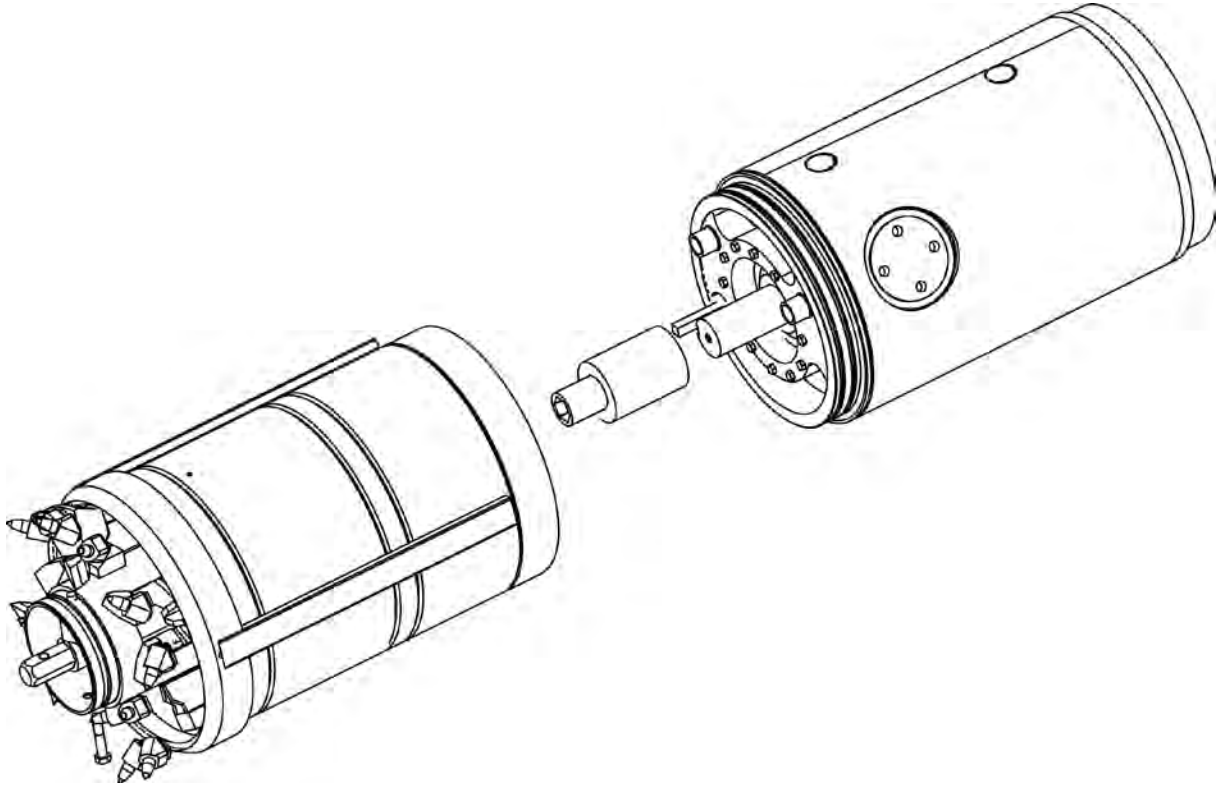
## BREAKOUT TOOL POWER UNIT



Power Unit	..... 110 VAC, 1/4 HP, 60 Hz,
.....	..... 120 Cu-In/Min. To 400 PSI
.....	..... 10 Cu-In/Min. To 5,000 PSI
Breakout Torque	.....2,439 ft-lbs @ 1,000 PSI
.....	..... 12,193 ft-lbs. @ 5,000PSI
Make Up Torque	..... 1,965 ft-lbs. @1,000 PSI
.....	..... 9,825 ft-lbs. @ 5,000 PSI

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

## POWERED CUTTER HEAD



Assembly Length ..... 72 in. (1,829 mm)  
 Two sections may be launched separately

### Diameter

#### Powered Cutter Head Body

PCH 20 ..... 20 in. (508 mm)  
 PCH 22.5 ..... 22.5 in. (572 mm)  
 PCH 28.5 ..... 28.5 in. (724 mm)  
 Overcut ..... 1.5 in. (38 mm)

### Weight (approximate)

#### Front Section

PCH 20 ..... 1,800 lbs. (816.5 kg)  
 PCH 22.5 ..... 2,000 lbs. (907 kg)  
 PCH 28.5 ..... 3,000 lbs. (1,361 kg)

#### Rear Section

PCH 20 ..... 900 lbs. (408 kg)  
 PCH 22.5 ..... 1,000 lbs. (454 kg)  
 PCH 28.5 ..... 1,700 lbs. (771 kg)

### Drive System

#### Auger Drive

Max. Torque ..... 10,500 ft•lbs (14,238 N•m)  
 Max. Speed ..... 50 rpm

#### Cutterface Power

PCH 20 ..... 32 hp (24 kW)  
 PCH 22.5 ..... 48 hp (36 kW)  
 PCH 28.5 ..... 61 hp (45.5 kW)

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

## TORQUE CHART

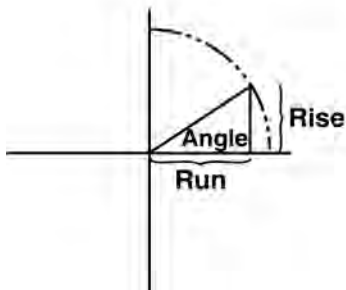
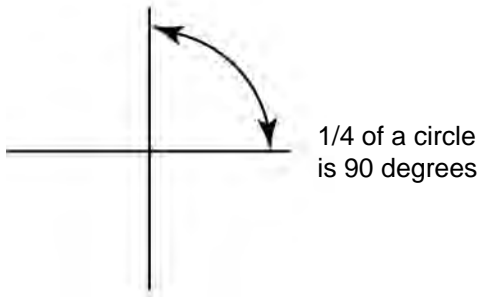
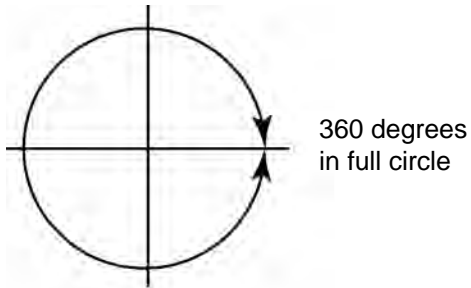
Use these torque values as a guideline when tightening hardware unless otherwise specified in this manual.

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

## 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.

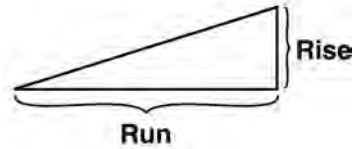
### DEGREES GRADE



$$\text{tangent (angle)} = \frac{\text{rise}}{\text{run}}$$

$$\text{angle} = \text{arctangent} \left( \frac{\text{rise}}{\text{run}} \right)$$

### 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      Given Degrees, calculate Percent Grade

$$\text{Degrees} = \text{arctangent} (\text{percent grade} \div 100)$$

$$\text{Percent Grade} = 100 \times \text{tangent} (\text{Degrees})$$

$$45^\circ = 100\% \text{ Grade}$$

$$\text{Degrees decimal} = \text{degrees} + \frac{\text{minutes}}{60} + \frac{\text{seconds}}{60 \times 60}$$

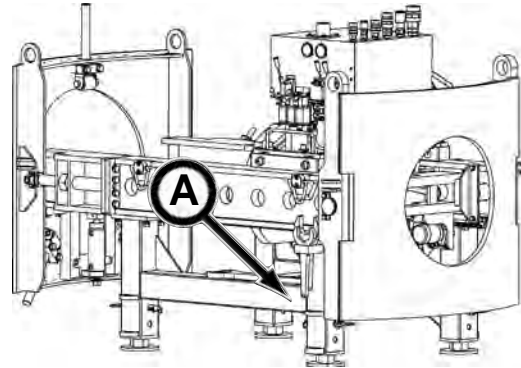
# Identification Numbers

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

## GBM - LATCHING FRAME (A)

Model Number \_\_\_\_\_

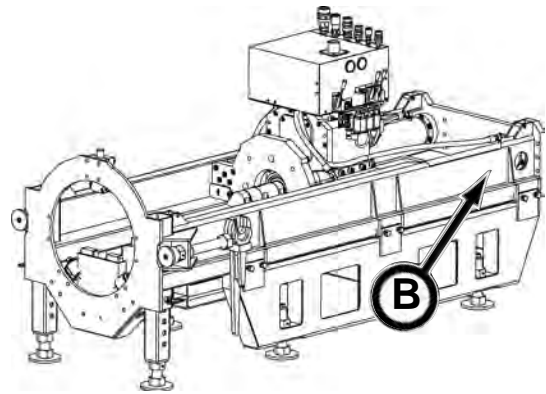
Serial Number \_\_\_\_\_



## GBM - SINGLE STAGE FRAME (B)

Model Number \_\_\_\_\_

Serial Number \_\_\_\_\_



## POWER PACK (C)

Model Number \_\_\_\_\_

Serial Number \_\_\_\_\_



## ENGINE (D)

Model Number \_\_\_\_\_

Serial Number \_\_\_\_\_

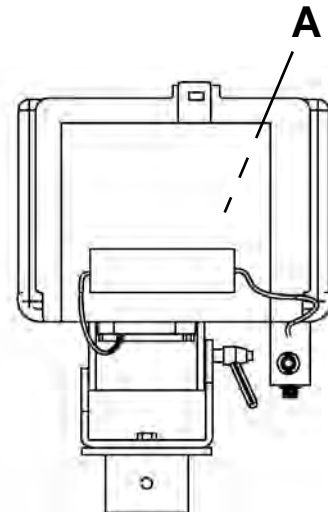


**TABLET PC (A)\***

Model Number \_\_\_\_\_

Serial Number \_\_\_\_\_

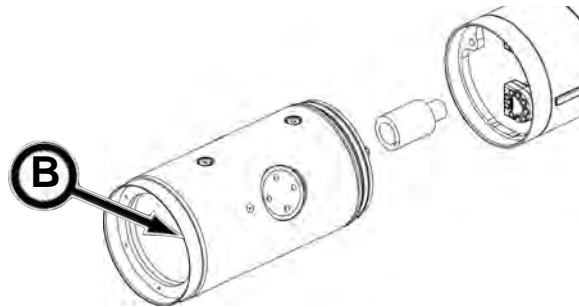
\* Docking Station must be removed to access serial number on tablet PC.  
Refer to Docking Station - Removal/Replacement  
in section 6, Operation, sub section Guidance System.



**POWERED CUTTER HEAD (B)**

Model Number \_\_\_\_\_

Serial Number \_\_\_\_\_



# Material Safety Data Sheets

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

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

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

## **NOTES**

# Warranty

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

*Warranty*

## **NOTES**

# Index

## A

Adjusting Thrust Pressure .....	6-20-7
Adjustments, Monitor .....	6-25-35
After Each Drive,	
Maintenance Chart .....	9-11
Maintenance Procedure .....	9-46
PCH Maintenance Chart .....	9-48
PCH Maintenance Procedure.....	9-53
Alignment, Rough Center .....	6-25-19
As Required, Maintenance Chart .....	9-10
As Required, Maintenance Procedure.....	9-45
Assembling Guidance System	
Latching Frame.....	6-25-6
Single Stage Frame.....	6-25-13
Auger Boring	
Cutter Face Installation.....	6-35-13
Data Sheet.....	6-15-5
Machine Set Up .....	6-15-3
GBM Set Up With .....	6-15-3
Auger Casings, Handling .....	1-4
Auger Pin To Casing/Auger, Installing .....	6-35-65
Auger, Keep Away From .....	1-7
Avoid Laser Light Exposure.....	1-8
Avoid Pinch Points .....	1-5, 9-2

## B

Battery Safely, Maintain .....	1-2
Be Alert for Safety Information .....	1-1
Bearing Cavity & Gear Box Lubricant, PCH .....	8-4
Beware of Suspended Loads .....	1-3
Bob, Using Plumb .....	1-3
Boring Cutter Face Install, Auger.....	6-35-13
Boring Data Sheet, Auger .....	6-15-5
Boring Machine Set Up With GBM .....	6-15-3
Breakout Tool Power Unit	
Lubricant .....	8-3
Specifications.....	12-7
Button, Hold .....	6-25-35

## C

Calibration,	
Preliminary String Line .....	6-25-23
Theodolite Zero Point .....	6-25-1
Camera & Theodolite .....	4-4
Camera Connection, Check.....	6-25-33
Camera, Tablet PC Connect New.....	6-25-32
Casing Install:	
Three Step Method.....	6-35-25, 6-35-43
Casing Installation With	
Cutter Head .....	6-35-43
Reaming Head.....	6-35-25
Casing Removal.....	6-35-40, 6-35-60
Casing, PCH Winged Installation.....	6-35-70
Casings, Handling Auger .....	1-4
Center Alignment, Rough.....	6-25-19
Chart, Torque .....	12-9
Check, Set Elevation.....	6-25-22

## C (continued)

Chemical Delivery .....	6-35-69
Clean & Inspect Equipment .....	1-4
Clean & Organized, Keep Job Site.....	1-6
Cleaning Screen, Tablet PC.....	6-25-30
Clothing, Wear Protective .....	1-1
Connect New Camera, Tablet PC.....	6-25-32
Connections, Tablet PC .....	6-25-11, 6-25-17
Contents .....	ii
Control Pendant	
P100Q.....	4-10
P150Q.....	4-14
Control,	
Drive Rotation .....	4-1
Hydraulic Latching .....	4-2
Make Up Tool.....	4-2
PCH Auger .....	4-4
PCH Rotation.....	4-4
Tablet PC Direction.....	4-5
Tablet PC On & Off.....	6-25-27
Tablet PC Status .....	4-5
Thrust Cylinder .....	4-1
Travel Motor.....	4-1
Controls & Instruments .....	4-1
Controls, Power Pack	
P100Q .....	4-8
P150Q .....	4-12
Coolant, Engine.....	8-4
Cooling System.....	1-7
Coupler Installation, Quick .....	6-15-6
Cutter Face Head Installation ABM .....	6-35-13

## D

Daily Or Every 10 Hours	
Maintenance Chart .....	9-4
Maintenance Procedure .....	9-16
Data, Entering .....	4-7
Data, Tablet PC Entering .....	6-25-28
Decals, Safety	
Latching Frame.....	2-2
Power Pack P100Q .....	2-3
Power Pack P150Q .....	2-4
Single Stage Frame.....	2-1
Decals, Safety.....	2-1
Delivery, Chemical .....	6-35-69
Digitizer Pen, Using .....	6-25-28
Direction Control, Tablet PC.....	4-5
Docking Station,	
Tablet PC .....	6-25-29, 6-25-30
Drive Rotation Control.....	4-1
Drive Speed Selector .....	4-2

## E

Electrical Schematic, P100Q .....	11-18
Electrical Schematic, P150Q .....	11-19
Elevation, Check, Set.....	6-25-22
Emergency Stop .....	6-20-6
Engine Coolant.....	8-4

**E (continued)**

Engine Oil Specifications	
P100Q.....	8-1
P150Q.....	8-2
Engine, Power Pack, Troubleshooting.....	11-2
Engine, Starting The	
P100Q Power Pack.....	6-20-1
P150Q Power Pack.....	6-20-3
Engine, Stopping The	
P100Q Power Pack.....	6-20-5
P150Q Power Pack.....	6-20-6
Entering Data, Tablet PC.....	4-6, 6-25-28
Equipment, Inspect & Clean.....	1-4
E-Stop.....	6-20-6
Every	
500 Hours, Maintenance Chart.....	9-7
500 Hours, Maintenance Procedures.....	9-32
1000 Hours, Maintenance Chart.....	9-8
1000 Hours, Maintenance Procedures.....	9-41
2000 Hours, Maintenance Chart.....	9-9
2000 Hours, Maintenance Procedures.....	9-42
Exposure.....	4-5, 6-25-35
Exposure, Avoid Laser Light.....	1-8

**F**

Filter Indicator, Hydraulic Return.....	4-9, 4-13
Final Theodolite Setup.....	6-25-34
Fire Prevention.....	1-6
Focus, Using Remote.....	4-7, 6-25-29
Frame Guidance System,	
Latching.....	6-25-6
Single Stage.....	6-25-13
Frame, Latching,	
308A, Specifications.....	12-2
339A, Specifications.....	12-3
Frame, Single Stage, 240A, Specifications.....	12-1
Fuel Specifications.....	8-1
Fuels & Lubricants.....	8-1

**G**

Gain.....	4-5, 6-25-35
Gauges, Hydraulic Pressure.....	4-3
GBM Frame Set Up In Shaft.....	6-15-1
GBM Installation Options.....	6-5-2
GBM Troubleshooting.....	11-1
Gear Box & Bearing Cavity Lubricant, PCH.....	8-4
Gear Box Lubricant.....	8-3
Grade & Line Preliminary Setup.....	6-25-18
Grease.....	8-3
Ground Conditions.....	6-30-4
Guidance System	
Camera Connect.....	6-25-33
Setup.....	6-25-1
Assembling Latching Frame.....	6-25-6
Assembling Single Stage Frame.....	6-25-13
Specifications.....	12-6
Guidelines,	
Operation.....	6-5-1
Transporting.....	7-1

**H**

Handling Auger Casings.....	1-4
Hard Power Down.....	4-5
High Pressure Hydraulics.....	1-6
Hold Button, Theodolite.....	6-25-4, 6-25-21, 6-25-35
HSLT (High Speed Low Torque).....	4-2
Hydraulic Latching Control.....	4-2
Hydraulic Oil/Fluids Under Pressure.....	1-2
Hydraulic Pressure Gauges.....	4-3
Hydraulic Return Filter Indicators.....	4-9, 4-13
Hydraulic Schematic	
240A.....	11-13
308A Without PCH Controls.....	11-14
308A/339A With PCH Controls.....	11-15
P100Q.....	11-16
P150Q.....	11-17

**I**

Identification Numbers.....	13-1
Inspect Equipment, Clean.....	1-4
Inspection, Pre-Start.....	5-1
Install Casing With	
Cutter Head.....	6-35-43
Reaming Head.....	6-35-25
Install Steer Head Adapter To Steer Head.....	6-30-1
Installation	
Auger Boring Machine.....	6-5-4
Cutter Face Head - Auger Boring Rig.....	6-35-13
Guidelines.....	6-5-1
Options.....	6-5-1
Product Pipe: Three Step Method.....	6-40-1
PCH.....	6-5-3
Quick Coupler.....	6-15-6
Three Step Method.....	6-5-2
Weld-On Reaming Head.....	6-35-1
Installing	
Auger Pin To Casing/Auger.....	6-35-65
PCH – Front Section.....	6-35-70
PCH – Rear Section.....	6-35-81
Pilot Tubes.....	6-30-1, 6-30-6
Product Pipe: Three Step Method.....	6-40-1
Safety Chain To Casing/Auger.....	6-35-65
Upsizing Tool.....	6-35-1
Instruments & Controls.....	4-1
Intervals, Lubrication & Maintenance.....	9-1
Introduction.....	i

**J**

Jetting & Pipe Lubrication, PCH.....	6-35-67
Jetting Hookup, PCH.....	6-35-68
Jetting Supply Requirements, PCH.....	6-35-68
Jetting, PCH, Why.....	6-35-67

**K**

Keep Away From Auger.....	1-7
Keep Away From Moving Parts.....	1-3
Keep Job Site Clean & Organized.....	1-6

**L**

Laser Light Exposure, Avoid .....	1-8
Latching Frame Hydraulic Assembly,	
308A .....	11-12
339A .....	11-14
Latching Frame,	
308A, Specifications .....	12-2
339A, Specifications .....	12-3
Guidance System .....	6-25-6
Launch Shaft	
Set Up .....	6-10-1
GBM Frame Set Up .....	6-15-1
Pilot Tube Pull Back .....	6-45-1
Level Theodolite .....	6-25-1
Leveling Theodolite .....	6-25-19
Light Exposure, Avoid Laser .....	1-8
Line & Grade Preliminary Setup .....	6-25-18
Line Calibration, Preliminary String .....	6-25-23
Loads, Beware Of Suspended .....	1-3
Lockout Power Before Servicing .....	1-2, 9-1
Log Of Progress .....	6-30-15
LSHT (Low Speed High Torque) .....	4-2
Lubricant,	
Breakout Tool Power Unit .....	8-3
Gear Box .....	8-3
Power Pack Oil Reservoir .....	8-2
Lubricants & Fuels .....	8-1
Lubricants, Storing .....	8-4
Lubricating Product Pipe, PCH .....	6-35-68
Lubrication & Maintenance Intervals .....	9-1
Lubrication From Reception Shaft .....	6-35-63
Lubrication,	
Pilot Tube .....	6-30-11
Powered Cutter Head .....	6-35-67

**M**

Maintain Battery Safely .....	1-2
Maintenance & Lubrication Intervals .....	9-1
Maintenance Chart,	
After Each Drive .....	9-11
As Required .....	9-10
Daily Or Every 10 Hours .....	9-4
Every 500 Hours .....	9-7
Every 1000 Hours .....	9-8
Every 2000 Hours .....	9-9
Monthly Or Every 250 Hours .....	9-6
PCH After Each Drive .....	9-48
PCH Prior To Each Job .....	9-47
Prior To Each Job Launch .....	9-3
Weekly Or Every 50 Hours .....	9-5
Maintenance Charts	
GBM - Power Pack .....	9-3
PCH .....	9-47
Maintenance Procedures,	
After Each Drive .....	9-46
As Required .....	9-45
Daily Or Every 10 .....	9-16
Every 500 Hours .....	9-32

**M (continued)**

Maintenance Procedures, (continued)	
Every 1000 Hours .....	9-41
Every 2000 Hours .....	9-42
Monthly Or Every 250 .....	9-27
PCH After Each Drive .....	9-53
PCH, Prior To Job .....	9-49
Prior To Each Job .....	9-12
Weekly Or Every 50 .....	9-25
Maintenance, Periodic .....	9-1
Make Up Tool Control .....	4-2
Manual, Read Operator's .....	1-1
Material Safety Data Sheets .....	14-1
Miscellaneous – Operation .....	6-45-1
Monitor Adjustments .....	6-25-35
Monitor, Tablet PC .....	4-5
Monthly Or Every 250 Hours,	
Maintenance Chart .....	9-6
Maintenance Procedure .....	9-27
Moving Parts, Keep Away From .....	1-3
MSDS .....	14-1
Multi-port Quick Disconnect .....	6-35-78

**N**

No Smoking In Tunnel .....	1-7
Numbers, Identification .....	13-1
Numbers, Serial .....	13-1

**O**

Oil Reservoir Lubricant, Power Pack .....	8-2
Oil Specifications	
P100Q, Engine .....	8-1
P150Q, Engine .....	8-2
Open Cutter Face Head Install ABM .....	6-35-13
Operation .....	6-0-1
Operation Guidelines & Installation .....	6-5-1
Operation Guidelines .....	6-5-1
Operation – Miscellaneous .....	6-45-1
Operation,	
Power Pack .....	6-20-1
Tablet PC Start Up & .....	6-25-26
Operator's Manual, Read .....	1-1

**P**

PC Connections, Tablet .....	6-25-11, 6-25-17
PC Start Up & Operation, Tablet .....	6-25-26
PC Tablet Check Camera Connect .....	6-25-33
PC Tablet Troubleshooting .....	11-6
PC Tablet,	
Access Start Button .....	6-25-28
Access Task Bar .....	6-25-28
Cleaning Screen .....	6-25-30
Connect New Camera .....	6-25-32
Docking Station .....	6-25-29, 6-25-30
Entering Data .....	6-25-28
Gain Exposure Control .....	6-25-27
Hard Power Down .....	6-25-27
On & Off Control .....	6-25-27
Using Digitizer Pen .....	6-25-28

**P (continued)**

PCH	
After Each Drive, Maintenance Procedure.....	9-53
Auger Control.....	4-4
Bearing Cavity & Gear Box Lubricant .....	8-4
Installing Front Section .....	6-35-70
Installing Rear Section.....	6-35-81
Jetting & Pipe Lubrication.....	6-35-67
Maintenance Chart .....	9-47
Maintenance Chart, After Each Drive.....	9-48
Prior To Each Job, Maint. Procedure.....	9-49
Product Pipe Lubrication .....	6-35-68
Removing From Shaft.....	6-35-90
Rotation Control.....	4-4
Using.....	6-35-67
Pendant, Control	
P100Q.....	4-10
P150Q.....	4-14
Periodic Maintenance .....	9-1
Pilot Tube	
Lubrication .....	6-30-11
Pull Back To Launch Shaft.....	6-45-1
Pilot Tube Removal.....	6-35-6, 6-35-18
.....	6-35-35, 6-35-54
Pilot Tubes, Installing .....	6-30-1, 6-30-6
Pinch Points, Avoid .....	1-5, 9-2
Pipe & Jetting Lubrication, PCH .....	6-35-67
Pipe Count, Tablet PC.....	4-5
Plumb Bob, using.....	1-3
Points, Avoid Pinch .....	1-5
Power Before Servicing, Lockout .....	1-2, 9-1
Power Down,	
Hard .....	4-5
Tablet PC Hard .....	6-25-27
Power Pack Controls	
P100Q.....	4-8
P150Q.....	4-12
Power Pack Electrical Assembly, P100Q .....	11-21
Power Pack Engine	
P100Q, Starting The .....	6-20-1
P150Q, Starting The .....	6-20-3
Troubleshooting .....	11-2
Power Pack Engine, Stopping The	
P100.....	6-20-5
P150.....	6-20-6
Power Pack	
Hydraulic Assembly, P100Q .....	11-18
Oil Reservoir Lubricant .....	8-2
Operation .....	6-20-1
Power Pack,	
Adjusting Pressure.....	6-20-7
P100Q, Specifications .....	12-4
P150Q, Specifications .....	12-5
Power Unit Lubricant, Breakout Tool .....	8-3
Power Unit, Breakout Tool, Specifications.....	12-7
Powered Cutter Head	
Lubrication .....	6-35-67
Specifications.....	12-8
Troubleshooting .....	11-5

**P (continued)**

Powered Cutter Head,	
Front Section Install.....	6-35-70
Using.....	6-35-67
Practice Safe Maintenance .....	1-4
Preliminary	
String Line Calibration .....	6-25-23
Theodolite Setup.....	6-25-18
Preparing For Storage .....	10-1
Pressure Hydraulics, High .....	1-6
Pressure,	
Adjusting Power Pack.....	6-20-7
Adjusting Thrust.....	6-20-7
Hydraulic Oil/Fluids Under.....	1-2
Pre-Start Inspection .....	5-1
Prevention, Fire .....	1-6
Prior To Each Job Launch	
Maintenance Chart .....	9-3
Maintenance Procedures .....	9-12
PCH Maintenance Procedures.....	9-49
PCH Maintenance Chart .....	9-47
Product Pipe,	
Installing: Three Step Method.....	6-40-1
Lubricating, PCH.....	6-35-68
Progress, Log Of .....	6-30-15
Protective Clothing, Wear .....	1-1
Pull Back, Pilot Tube .....	6-45-1

**Q**

Quick Coupler Installation .....	6-15-6
Quick Disconnect, Multi-port.....	6-35-78

**R**

Read Operator's Manual .....	1-1
Reaming Head Install, Weld-On .....	6-35-1
Reaming Head Install: Three Step.....	6-35-25
Reaming Head Installation, Two-Stage .....	6-35-5
Reception Shaft Set Up .....	6-10-1
Recycle Waste .....	1-8
Refueling .....	1-5
Remote Control Pendant	
P100Q.....	4-10
P150Q.....	4-14
Remote Focus, Using .....	4-7, 6-25-29
Removal, Pilot Tube.....	6-35-6, 6-35-18, 6-35-35
.....	6-35-54
Removal, Steering Head.....	6-35-3, 6-35-15
.....	6-35-27, 6-35-47
Removing Casing.....	6-35-40, 6-35-60
Removing From Storage.....	10-2
Removing PCH From Shaft .....	6-35-90
Rough Center Alignment.....	6-25-19

**S**

Safe Maintenance, Practice .....	1-4
Safely, Maintain Battery .....	1-2
Safety .....	1-1
Safety Chain To Casing/Auger, Installing .....	6-35-65

**S (continued)**

Safety Data Sheets, Material .....	14-1
Safety Decals .....	2-1
Latching Frame .....	2-2
Power Pack P100Q .....	2-3
Power Pack P150Q .....	2-4
Single Stage Frame .....	2-1
Safety Information, Be Alert For .....	1-1
Schematics	
Electrical	
P100Q .....	11-18
P150Q .....	11-19
Hydraulic	
240A .....	11-13
308A Without PCH Controls .....	11-14
308A/339A With PCH Controls .....	11-15
P100Q .....	11-16
P150Q .....	11-17
Selector, Drive Speed .....	4-2
Serial Numbers .....	13-1
Servicing, Lockout Power Before .....	1-2
Set Up	
GBM With Auger Boring .....	6-15-3
Launch & Reception Shafts .....	6-10-1
Set Up, Shaft .....	6-10-1
Set, Check Elevation .....	6-25-22
Setup,	
Final Theodolite .....	6-25-34
Guidance System .....	6-25-1
Preliminary Theodolite .....	6-25-18
Shaft & Tunnel Ventilation, Test .....	1-5
Shaft Set Up .....	6-10-1
Shaft, GBM Frame Set Up In .....	6-15-1
Shaft, Removing PCH From .....	6-35-90
Single Stage Frame	
Guidance System .....	6-25-13
Hydraulic Assembly, 240A .....	11-16
Specifications .....	12-1
Slippery When Wet .....	1-6
Soil Stabilization .....	6-35-69
Specifications .....	12-1
308A .....	12-2
339A .....	12-3
Breakout Tool Lube .....	8-3
Breakout Tool Power Unit .....	12-7
Engine Coolant .....	8-4
Fuel .....	8-1
Gear Box Lube .....	8-3
Grease .....	8-3
Guidance System .....	12-6
P100Q, Engine Oil .....	8-1
P150Q, Engine Oil .....	8-2
PCH Gear Box/Bearing Cavity Lube .....	8-4
Power Pack Oil Reservoir Lube .....	8-2
Power Pack, P100Q .....	12-4
Power Pack, P150Q .....	12-5
Powered Cutter Head .....	12-8
Single Stage Frame, 240A .....	12-1

**S (continued)**

Stabilization, Soil .....	6-35-69
Start Button, Accessing .....	6-25-28
Start Up & Operation, Tablet PC .....	6-25-26
Starting the Power Pack Engine	
P100Q .....	6-20-1
P150Q .....	6-20-3
Status Control, Tablet PC .....	4-5
Steer Head Adapter To Steer Head .....	6-30-1
Steering Head For Ground Conditions .....	6-30-4
Steering Head Removal .....	6-35-3, 6-35-15
.....	6-35-27, 6-35-47
Steering Heads .....	6-30-4
Stop, Emergency .....	6-20-6
Stopping the Power Pack Engine	
P100Q .....	6-20-5
P150Q .....	6-20-6
Storage .....	10-1
Storage,	
Preparing For .....	10-1
Removing From .....	10-2
Storing Lubricants .....	8-4
String Line Calibration, Preliminary .....	6-25-23
Suspended Loads, Beware Of .....	1-3
System Setup, Guidance .....	6-25-1
System,	
Assembling Guidance Latching Frame .....	6-25-6
Assembling Guidance Single Stage .....	6-25-13
System, Cooling .....	1-7
System, Guidance, Specifications .....	12-6

**T**

Tablet PC	
Check Camera Connect .....	6-25-33
Cleaning Screen .....	6-25-30
Connections .....	6-25-11, 6-25-17
Docking Station .....	6-25-29, 6-25-30
Gain Exposure Control .....	6-25-27
Hard Power Down .....	6-25-27
Monitor .....	4-5
Start Up & Operation .....	6-25-26
Troubleshooting .....	11-6
Tablet PC,	
Access Start Button .....	6-25-28
Access Task Bar .....	6-25-28
Connect New Camera .....	6-25-32
Entering Data .....	6-25-28
On & Off Control .....	6-25-27
Using Digitizer Pen .....	6-25-28
Task Bar, Accessing .....	6-25-28
Task Bar/Start Button .....	4-6
Telescope, Tilt .....	6-25-3, 6-25-20
Terminology –	
Auger Boring Method .....	3-22
Camera Optics .....	3-12
GBM Tooling -11 to 16" OD .....	3-16
GBM Tooling-20 to 31.5"OD .....	3-18
Guidance System .....	3-7
Latching Frame 308A SN20 & Before .....	3-2

**T (continued)**

Terminology (continued)	
Latching Frame 308A SN21 & After, 339A.....	3-4
PCH Valve Package Option 308A.....	3-3
Power Pack P100Q.....	3-5
Power Pack P150Q.....	3-6
Powered Cutter Head.....	3-14
Remote Focus Kit.....	3-9
Single Stage Frame 240A.....	3-1
Tablet PC Assembly With Remote Focus.....	3-10
Tablet PC Assembly Without Remote Focus ...	3-8
Tablet PC Controls.....	3-11
Theodolite.....	3-13
Test Shaft & Tunnel Ventilation.....	1-5
Theodolite & Camera.....	4-4
Theodolite	
Hold Button.....	6-25-4, 6-25-21
Setup, Final.....	6-25-34
Setup, Preliminary.....	6-25-18
Zero Point Calibration.....	6-25-1
Theodolite, Leveling.....	6-25-1, 6-25-19
Three Step Method, Installation.....	6-5-2
Three Step Method: Casing Install..	6-35-25, 6-35-43
Thrust Cylinder Control.....	4-1
Thrust Pressure, Adjusting.....	6-20-7
Tilt Telescope.....	6-25-3, 6-25-20
Torque Chart.....	12-9
Transporting.....	7-1
Travel Motor Control.....	4-1
Troubleshooting.....	11-1
240A Hydraulic Assembly.....	11-16
308A Hydraulic Assembly.....	11-12
339A Hydraulic Assembly.....	11-14
GBM.....	11-1
P100Q Electrical Assembly.....	11-21
P100Q Hydraulic Assembly.....	11-18
P150Q Electrical Assembly.....	11-19
P150Q Hydraulic Assembly.....	11-17
Power Pack Engine.....	11-2
Powered Cutter Head.....	11-5
Tablet PC.....	11-6
Tube Lubrication, Pilot.....	6-30-11
Tube Pull Back, Pilot, Launch Shaft.....	6-45-1
Tubes, Installing Pilot.....	6-30-1, 6-30-6
Tunnel & Shaft Ventilation, Test.....	1-5
Tunnel, No Smoking In.....	1-7
Two-Stage Reaming Head Install.....	6-35-5

**U**

Unauthorized Welding.....	1-3
Upsizing Tool Lube From Reception Shaft ...	6-35-63
Upsizing Tool, Installing.....	6-35-1
Using Digitizer Pen.....	4-6
Using Plumb Bob.....	1-3
Using Powered Cutter Head.....	6-35-67
Using Remote Focus.....	4-7, 6-25-29

**V**

Ventilation, Test Shaft & Tunnel.....	1-5
---------------------------------------	-----

**W**

Warranty.....	15-1
Waste, Recycle.....	1-8
Wear Protective Clothing.....	1-1
Weekly Or Every 50 Hours,	
Maintenance Chart.....	9-5
Maintenance Procedure.....	9-25
Welding, Unauthorized.....	1-3
Weld-On Reaming Head Install.....	6-35-1
Winged Casing Installation, PCH.....	6-35-70

**Z**

Zero Point Calibration, Theodolite.....	6-25-1
Zoom.....	4-5

**CALIFORNIA**

**Proposition 65 Warning**

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.