OPERATION & PARTS MANUAL

P200E Power Pack

Supplement for the 4800 Series Operator's Manual

Power Pack SN: FA40041F

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Introduction

This supplement to your 4800 Operator's Manual contains important safety, operation, maintenance and parts information for your Akkerman P200E Power Pack. You must read and understand this manual, the 4800 Operator's Manual, and your electric motor Installation, Operation and Maintenance Instructions (refer to page 11-5) booklet before you operate and maintain this equipment. Keep this manual with your Power Pack at all times. Additional copies of this supplement may be purchased from the Akkerman Aftermarket Support Department, or downloaded from the Akkerman web site at www.akkerman.com.

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

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

P200E Power Pack

The Akkerman P200E Power Pack provides hydraulic power for the Akkerman jacking frame. The P200E is powered by one 200 HP electric motor which drives three load sensing, variable volume piston pumps.

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

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

NOTES

Contents

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.

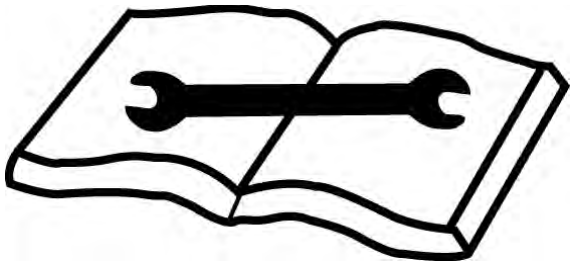
ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!

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 TAGOUT POWER BEFORE SERVICING

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

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

HYDRAULIC OIL/FLUIDS UNDER PRESSURE

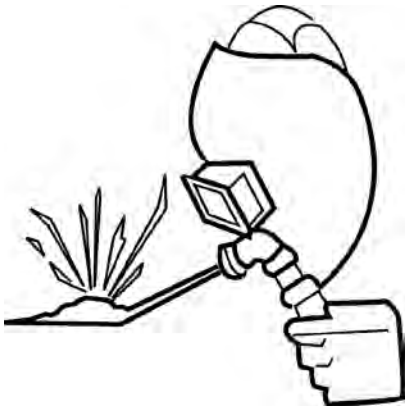
⚠WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury.

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.

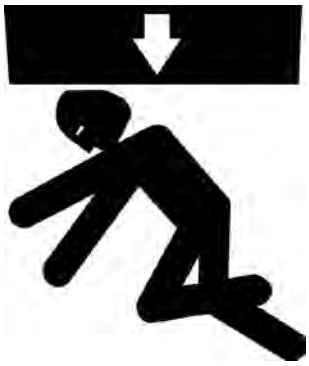
UNAUTHORIZED WELDING



⚠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.

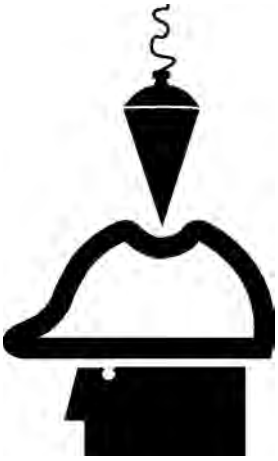
If a hydraulic hose breaks from the boom of a crane/excavator, or the lifting support fails, the boom and/or load can fall instantly.

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.

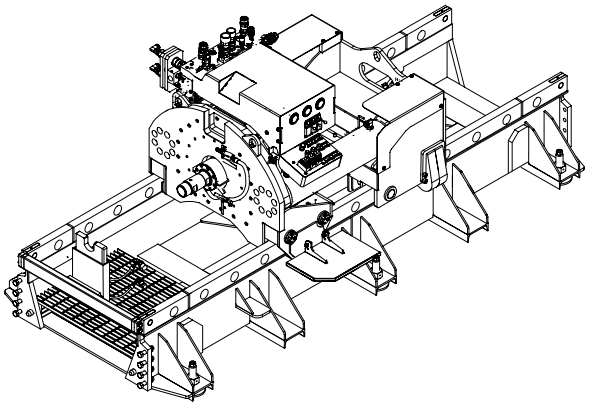
Properly install safety chain assembly or casing auger pin to augers and casings before lowering into or lifting out of shaft.

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 TAGOUT 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

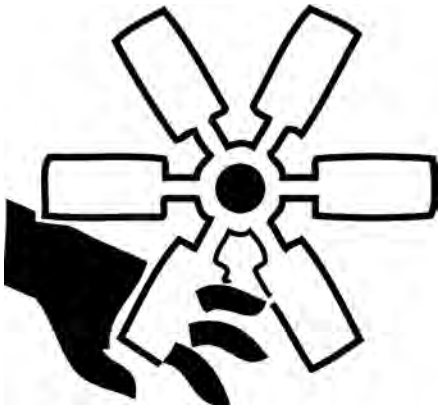
⚠WARNING Moving parts or the mishandling of parts can cause severe personal injury.

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.

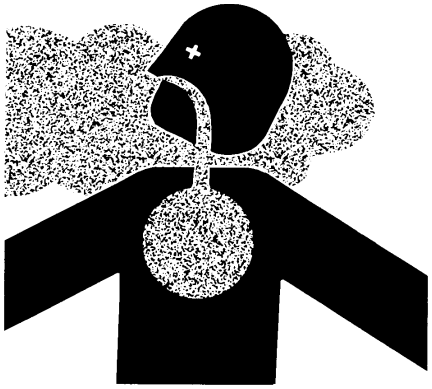
ROTATING COOLING FAN BLADES



⚠WARNING Serious personal injury could result if contact is made with rotating fan blade. Fan blades can rotate at any time power is connected and the main disconnect is in the ON position.

If the power is connected to the power pack and the main disconnect is in the ON position, the fan can rotate anytime the hydraulic oil is at 120°F (49°C) (factory default setting).

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.

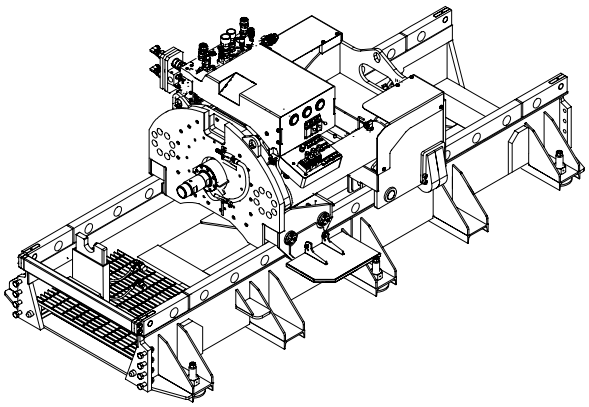
FIRE PREVENTION

⚠CAUTION Fires can cause injury or property damage.

Keep equipment clean. Remove all debris from equipment.

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

HIGH PRESSURE HYDRAULICS



⚠WARNING The GBM contains high pressure hydraulics.

Keep all guards in place.

KEEP AWAY FROM AUGER

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

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

Do not operate without covers and guards in place.

Lockout tagout power before servicing.

SLIPPERY WHEN WET

⚠WARNING Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

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

Remove any buildup of grease, oil, or debris.

KEEP JOB SITE CLEAN AND ORGANIZED

⚠WARNING Tripping can cause serious personal injury.

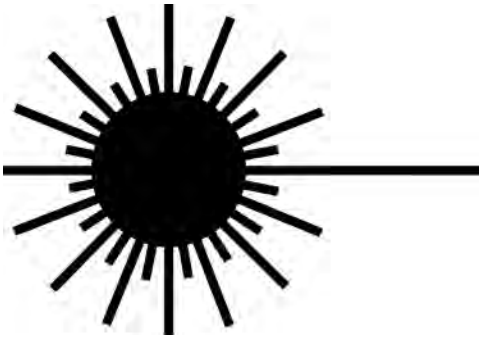
Be sure to keep job site clean and organized.

NO SMOKING IN TUNNEL

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

Do not smoke in tunnel.

AVOID LASER LIGHT EXPOSURE

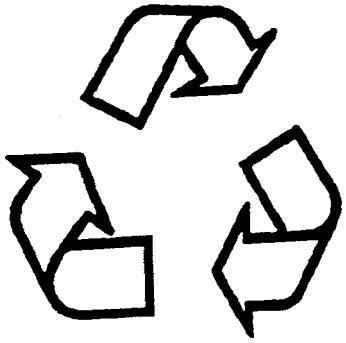


⚠ DANGER Staring into laser light will cause severe injury.

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

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

RECYCLE WASTE



Follow 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.

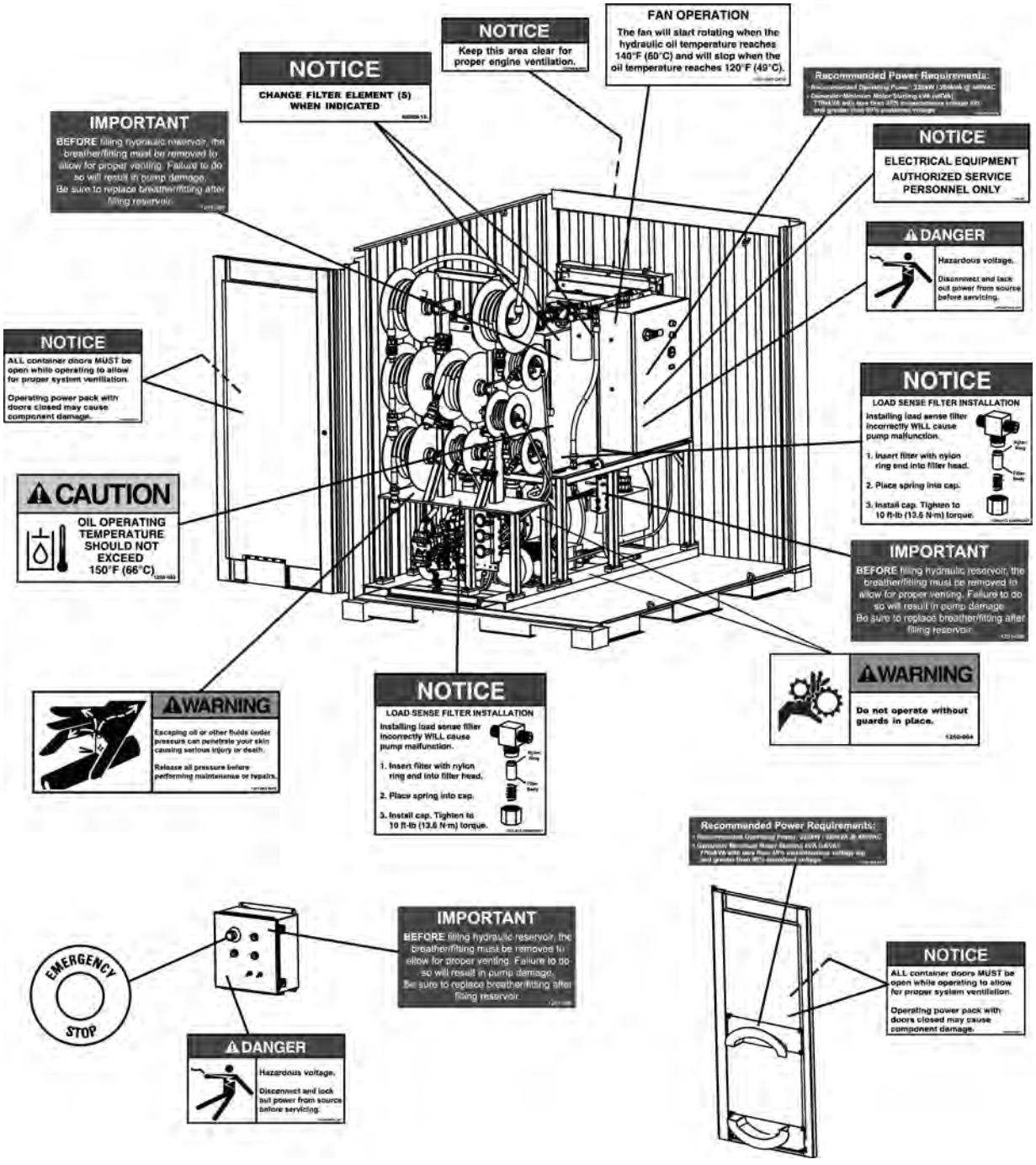
Safety Decals

Keep all safety decals and operational 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 and operational decals immediately if they are damaged, missing, or hard to read.

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

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

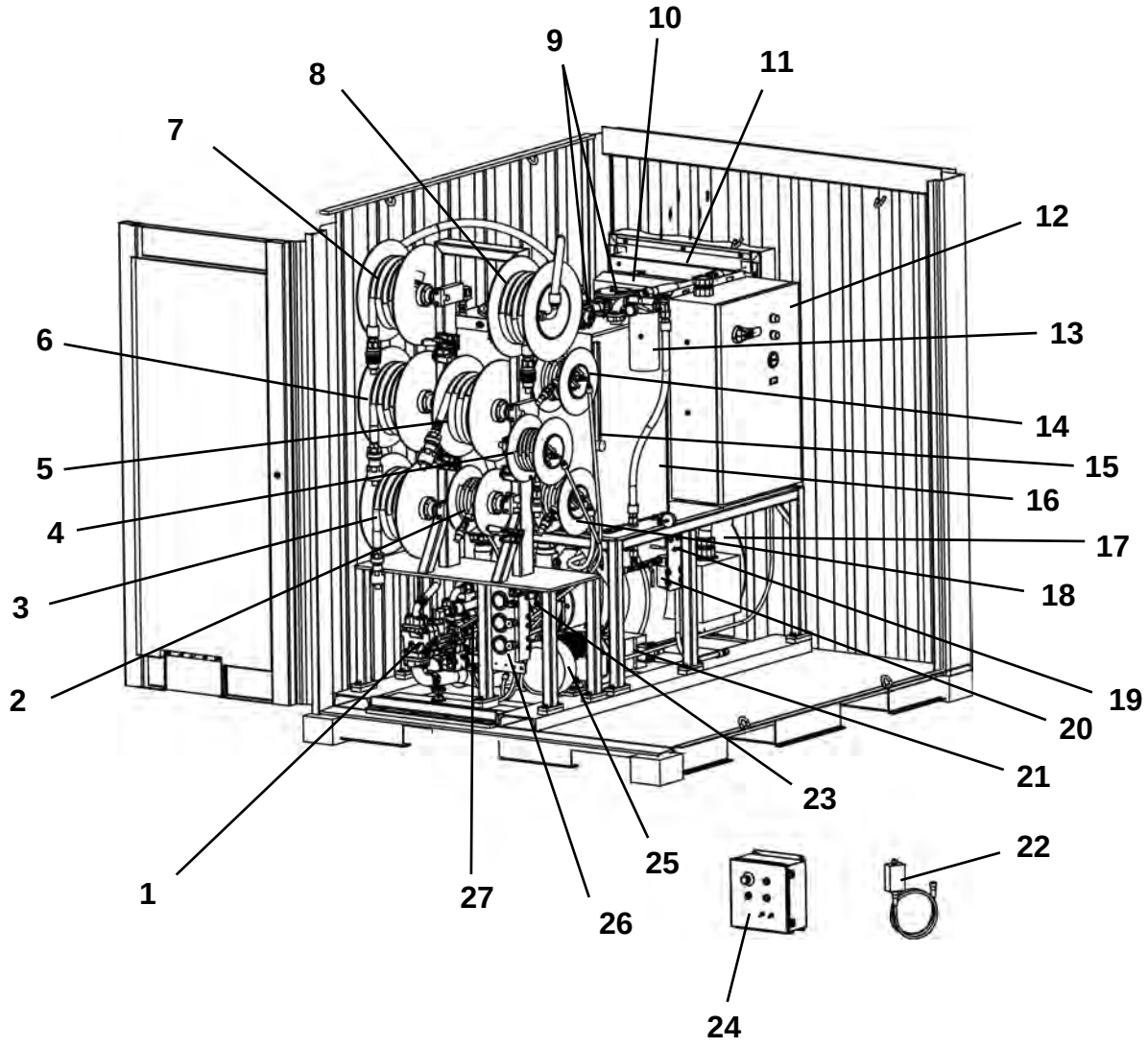
P200E POWER PACK



NOTES

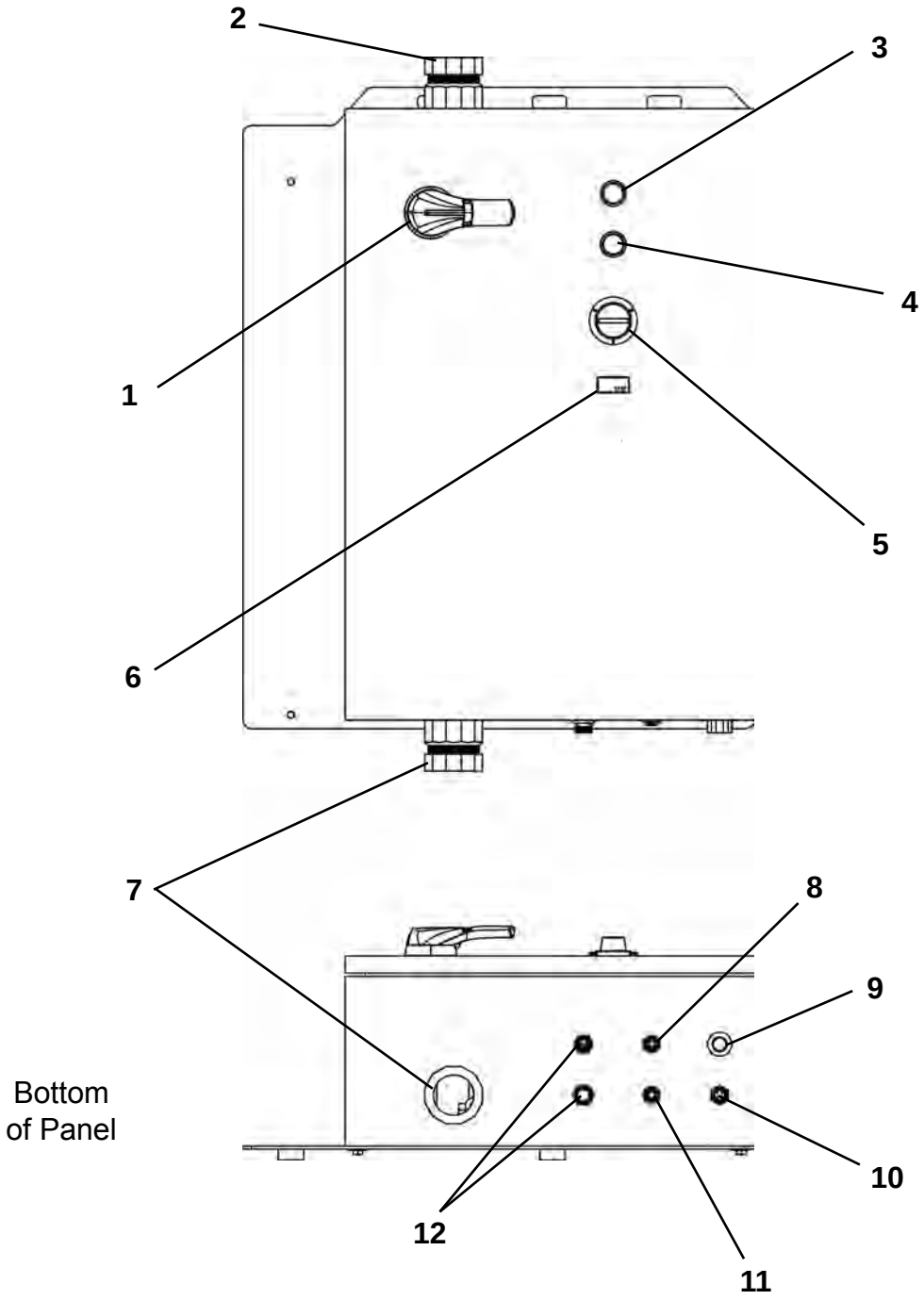
Terminology

P200E POWER PACK



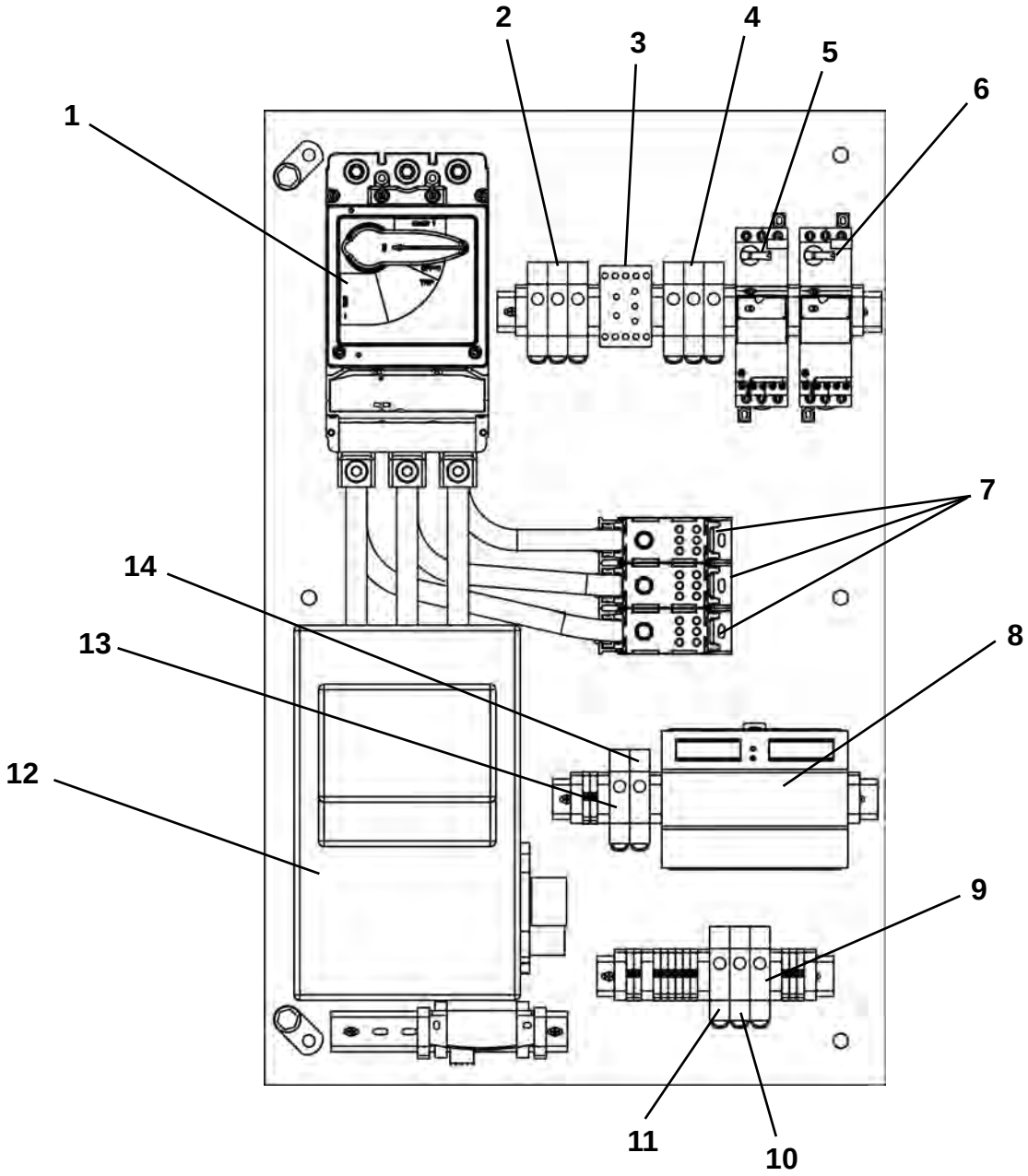
1. Jacking Thrust Pump
2. Thrust Load Sense Connection
3. Thrust Pressure Hose Connect.
4. Powered Cutter Drive Load Sense Connection
5. Powered Cutter Drive Pressure Connection
6. Rotation/PCH Auger Drive Pressure Connection
7. Return Hose Connection
8. Return Hose Connection
9. Cooling Circuit Return Filter
10. Cooling Fan
11. Oil Cooler
12. Main Power Disconnect Panel
13. Case Drain/Oil Fill Return Filter
14. Rotation Load Sense Hose Connection
15. Oil Level Sight Gauge With
16. Hydraulic Reservoir 100 Gal. Oil Temperature Gauge
17. Electric Motor 200 HP
18. Case Drain Hose Connection
19. Oil Fill Switch
20. Oil Fill Pump
21. Cooling Pump
22. Control Pendant
23. Drive Rotation/PCH Auger Drive Pump
24. Control Panel
25. Cooling Motor 5 HP
26. Hydraulic Pressure Gauges
27. Powered Cutter Drive Pump

MAIN POWER DISCONNECT PANEL



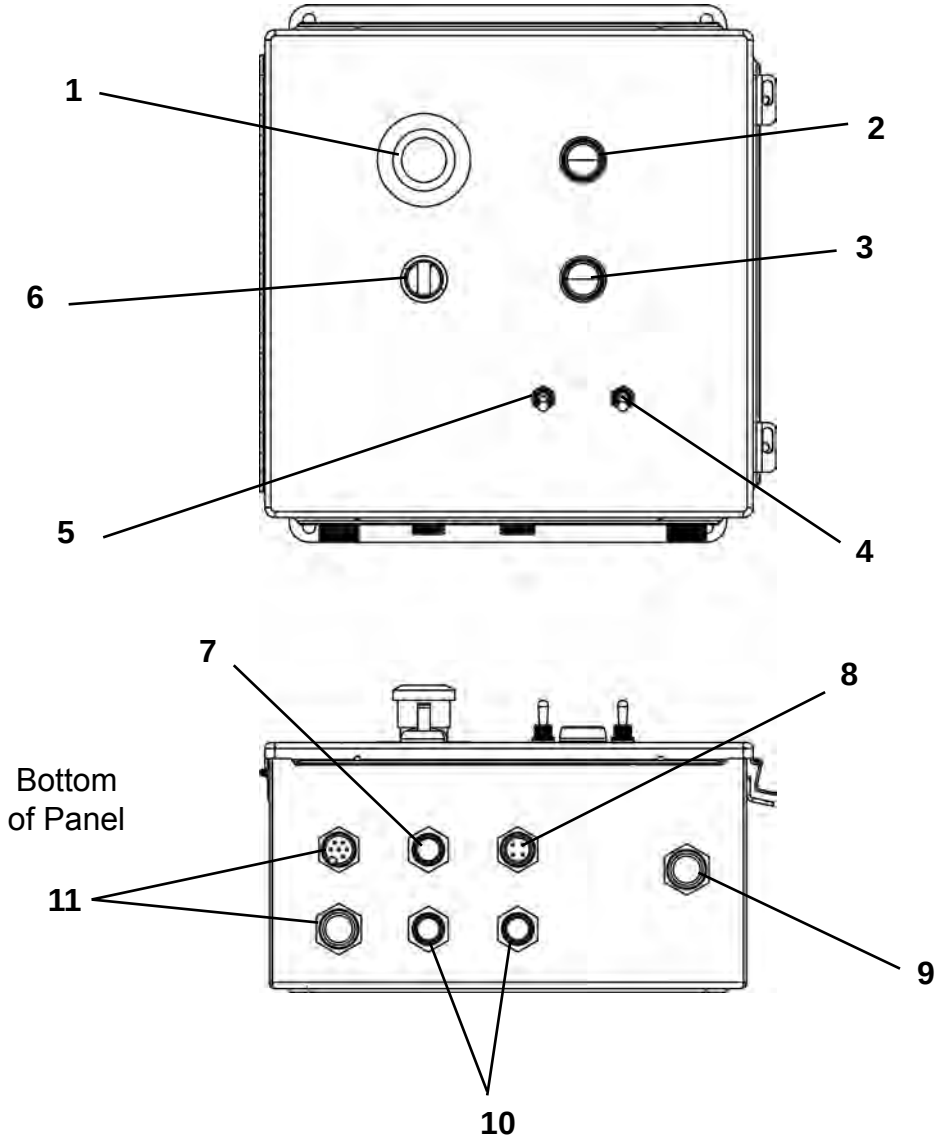
1. Main Disconnect Switch
2. Generator Power
3. Phase OK Indicator
4. Phase Error Indicator
5. Hourmeter
6. Motor Load % Display
7. 200 HP Motor Connection
8. Low Oil Level Switch Connection
9. 5 HP Cooling Pump Connection
10. 2 HP Cooling Fan Motor Connection
11. Oil Temperature Switch Connection
12. Control Panel Connections

MAIN POWER DISCONNECT PANEL (INTERIOR)



1. Main Power Disconnect Switch
2. Phase Detector Fuses
3. Phase Detector
4. 24V Power Supply Fuses
5. 2 HP Cooling Fan Motor Starter
6. 5 HP Cooling Pump Motor Starter
7. Power Distribution Block
8. 24V Power Supply
9. 24 V Conrol Fuse
10. Lights Fuse
11. 12V Power Supply Fuse
12. 200 HP Motor Soft Starter
13. 24 VDC Fuse
14. Soft starter 24 VDC Power

CONTROL PANEL



1. E-Stop
2. Start Button
3. Stop Button
4. Light Switch
5. Oil Transfer Pump Power Switch
6. Panel/Pendant Control Power Switch
7. Oil Transfer Pump Connection
8. Frame (4800) Console Power Connection
9. Control Pendant Connection
10. Light Connections
11. Main Electrical Box Connections

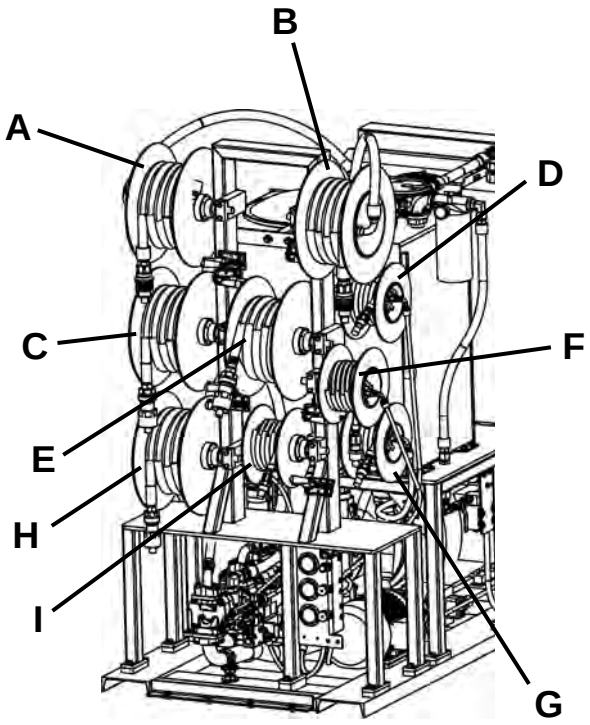
Controls & Instruments

P200E POWER PACK CONTROLS

The P200E power pack provides hydraulic power for the jacking frame and tooling components. The one 200 HP electric motor drives three independent 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 – Return Hose Connection
C – Rotation/PCH Auger Drive Pressure Connection
D – Rotation Load Sense Hose Connection
E – Powered Cutter Drive Pressure Connection
F – Powered Cutter Drive Load Sense Connection
G – Case Drain Hose Connection
H – Thrust Pressure Hose Connection
I – Thrust Load Sense Connection

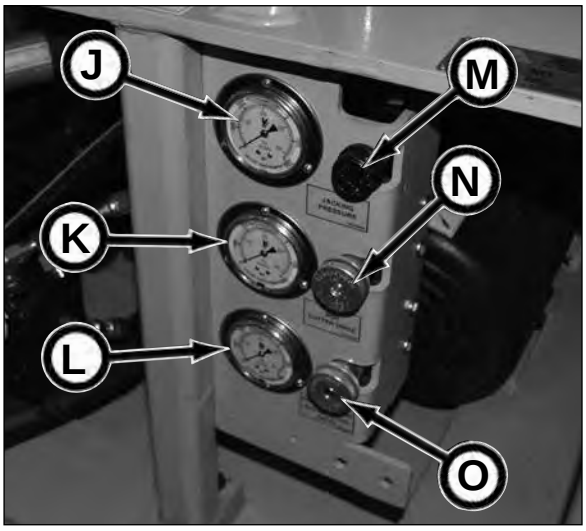


Hydraulic Pressure Gauges & Adjustment Valves
Use the pressure gauges to monitor the GBM jacking thrust (J), PCH cutter drive (K), and drive rotation/PCH rotation drive (L) pressures.

Jacking
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
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 Rotation Drive
Operating range in low pressure is up to 2,000 psi (13.789 MPa) with a maximum pressure of 3,250 psi (22.408 MPa).
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:

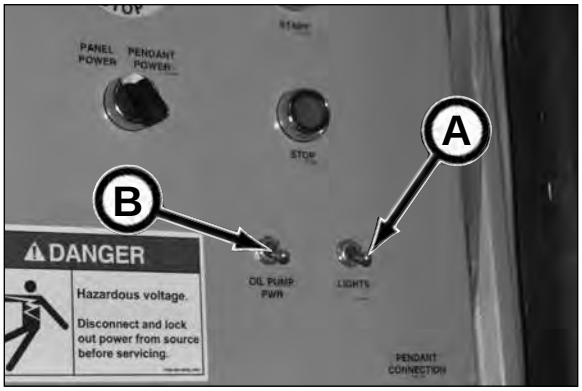
Jacking - 6,000 psi (41.368 MPa) Set the Jacking Speed switch per pipe rating:
Slow - 265 ton, Fast - 100 ton
If your pipe has a lower thrust load pressure rating, use adjustment valve (M) to adjust the pressure to protect the product pipe. To adjust the pressure, refer to Adjusting Thrust Pressure in the Operation section.

PCH Cutter Drive - 5,000 psi (34.474 MPa)
The cutter drive adjustment valve (N) should **only** be adjusted per factory instructions.

Drive Rotation/PCH Rotation Drive - 5,000 psi (34.474 MPa) The rotation adjustment valve (O) should not be adjusted.

(continued on next page)

POWER PACK CONTROLS (continued)



Container Light Switch (A)

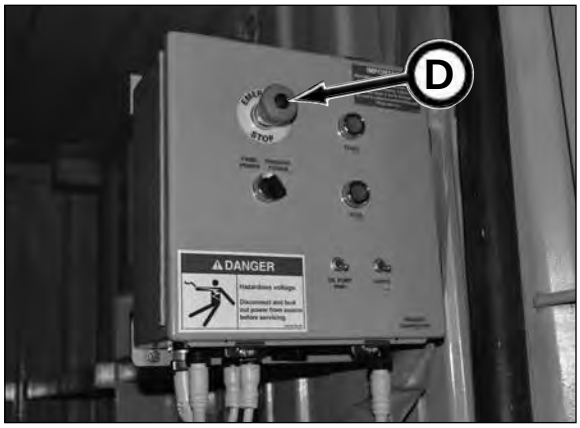
Oil Fill Pump Switch (B)
Turn switch ON to pump hydraulic oil into the hydraulic reservoir.

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 4. Check Hydraulic Return Filter Indicators in Periodic Maintenance section).

Emergency Stop (D)
The Emergency Stop button (D) on the P200E is located on the control panel.



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

The button will light when it is pulled OUT.

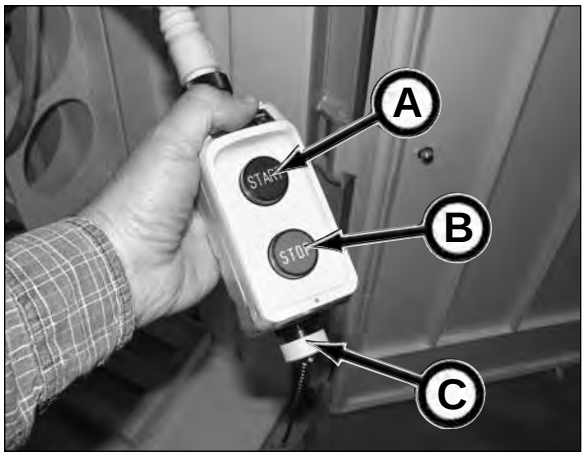
NOTICE The emergency stop button must be pulled out for motor to start.

CONTROL PENDANT

The control pendant allows the operator in the launch shaft to control the power pack motor for the hydraulic operation of the jacking and rotation systems.

There is also a port to connect the 12V guidance system power.

NOTICE The stop button will stop the 200 HP electric motor in the power pack. The stop button is NOT an emergency stop button. The E-Stop button on the control panel must be pulled out for motor to start.



Jacking & Rotation Hydraulic Systems
Depress Start button (A) to start 200 HP electric motor and depress Stop button (B) to stop motor.

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

NOTICE The Panel/Pendant Control Power Switch must be in the Pendant Control position for the the pendant Stop and Start buttons to function. The guidance system power is not affected by the panel/pendant control power switch.

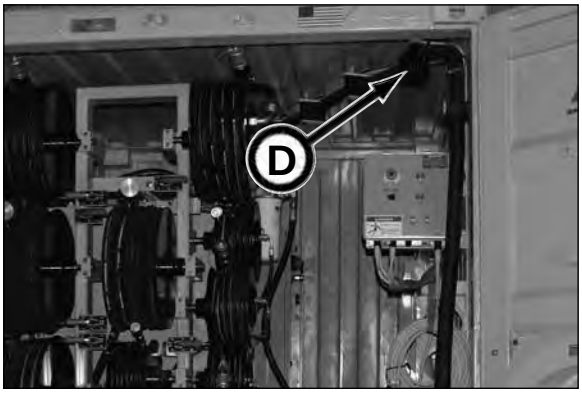
LIGHTS

The power pack is equipped with an operating light (D). An optional light is available.

Flip light switch (E) as follows:

Lights ON - UP

Lights OFF - DOWN



PHASE INDICATORS

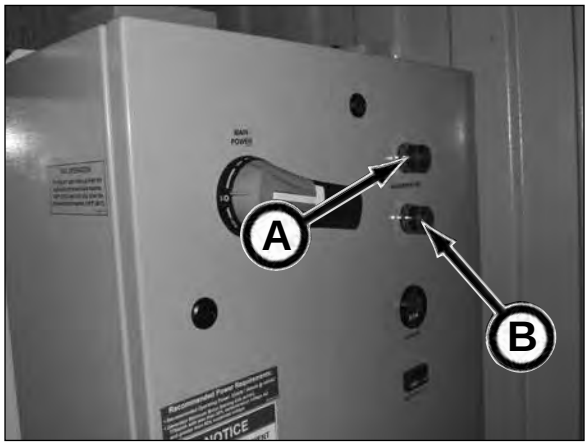
⚠DANGER Failure to lockout tagout power before servicing will cause severe personal injury or death.

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

Any electrical work completed on the power pack must be performed by a certified electrician.

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

If the green Phase OK Indicator light (A) is illuminated, this indicates that the external power source phase power is installed correctly and that the main power can be turned on for the power circuit.



If the red Phase Error Indicator light (B) is illuminated at start-up, this typically indicates that the external power source phase power is installed incorrectly and will not allow power to any of the electrical components. Disconnect and lock out ALL power before attempting to reverse the two generator power leads.

IMPORTANT: DO NOT start up electric components if the red phase indicator light is illuminated. Doing so will run components backwards causing damage.

The red Phase Indicator light will also illuminate in the following conditions:

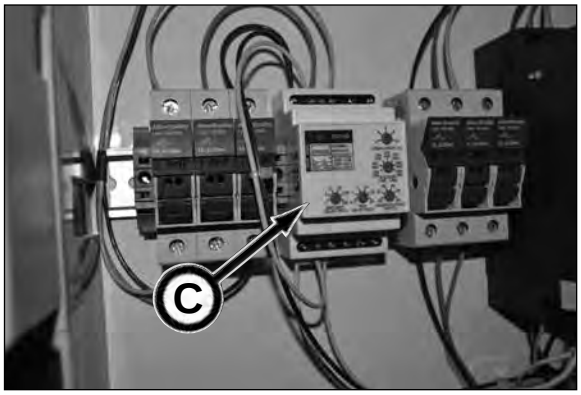
- Undervoltage (less than 95%)
- Overvoltage (greater than 110%)
- Phase imbalance
- Phase loss

If this should occur, contact a certified electrician to troubleshoot the fault by accessing the phase detector. The phase detector is equipped with a LED status light to help determine the fault. Refer to the table to the right for the Phase LED status fault indicators.

LED STATUS TABLE

LED STATUS		STATUS
GREEN	⎍	NORMAL/RELAY ON
	⎍⎍⎍⎍	RESTART DELAY
RED	⎍	REVERSAL
	⎍⎍	LOSS/UNBALANCE
	⎍⎍	UNDERVOLTAGE
	⎍⎍	OVERVOLTAGE

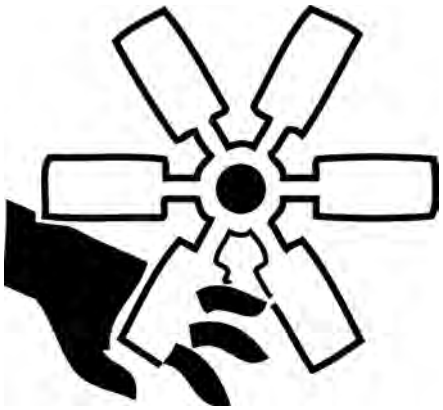
The LED status light (C) is located on the inside of the main disconnect panel.



OIL COOLER FAN CONTROL

⚠WARNING Serious personal injury could result if contact is made with rotating fan blade. Fan blades can rotate at any time power is connected and the main disconnect switch is in the ON position.

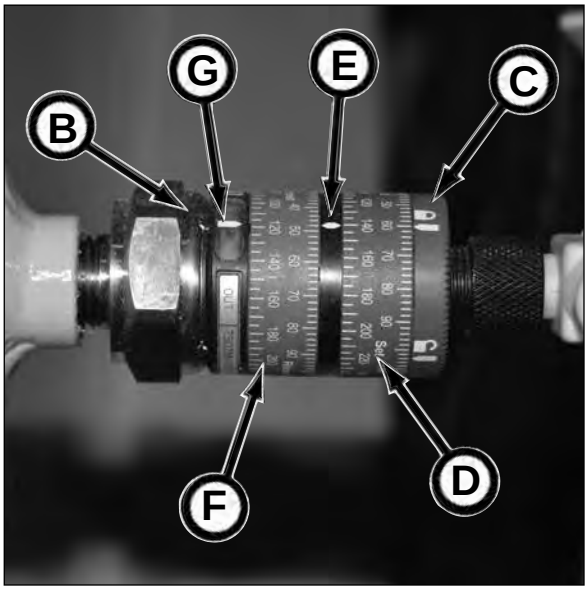
If the power is connected to the power pack and the main disconnect is in the ON position, the fan can rotate anytime the hydraulic oil is at 120°F (49 °C) (factory default setting).



The oil cooler fan (A) is equipped with an automatic temperature control. The fan will turn on at 140°F (60°C) and turn off at 120°F (49°C).

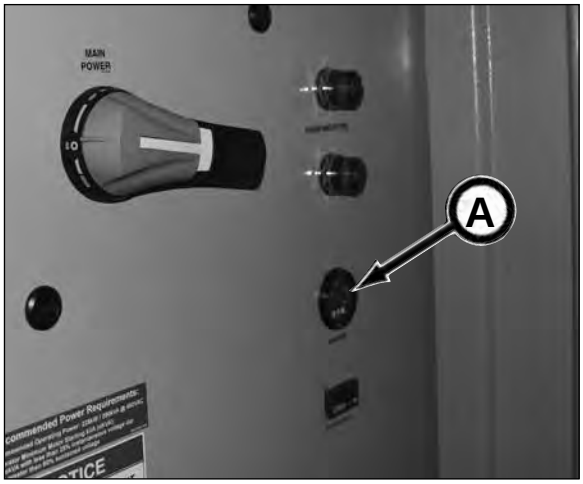
To change the temperature settings from the factory default settings:

1. Gain access to the temperature switch (B).
2. Turn lock/unlock dial (C) to unlock position.
3. Turn high temp dial (D) to desired temperature for fan to turn on and align with arrow (E). Default temperature setting is 140°F (60°C).
4. Turn low temp dial (F) to desired temperature for fan to turn off and align with arrow (G). Default temperature setting is 120°F (49°C).
5. Once the high and low dials are set, turn lock/unlock dial (C) to the lock position.



The Emergency Stop will override the automatic operation.

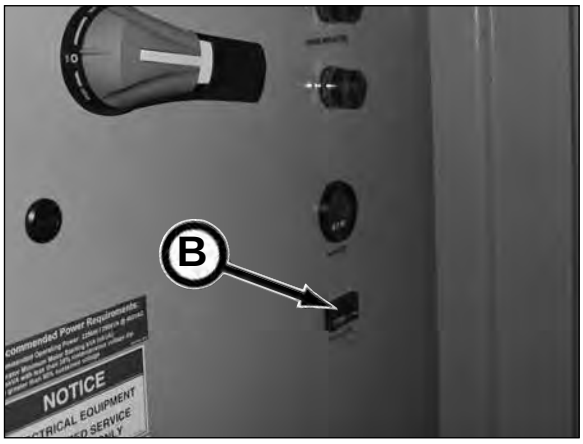
MOTOR HOURMETER



The 200 HP electric motor is equipped with an hourmeter (A) on the main disconnect panel.

The hourmeter displays the operating hours in full hours and 1/10ths hours of the motor and should be used as a guide for scheduling periodic maintenance.

MOTOR LOAD % DISPLAY



The Motor Load % display (B) indicates the 100 HP electric motor full load amperage in %.

The electric motor will operate as follows:

- 100% continuous operation
- 115% intermittent operation
- over 115% operation may result in the hydraulics and motor overheating resulting in the motor thermal overload to trip. In this case the motor will remain inoperable until the prescribed cool-down time has elapsed.

Pre-Start Inspection

⚠WARNING Do not operate this equipment until you have read, study and understand this manual, your GBM Operator's Manual, electric motor Installation Operation and Maintenance Instructions booklet and any additional equipment manuals before you operate and maintain this equipment. A daily inspection of the equipment must be performed to prevent severe personal injury or death and equipment damage.

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

Use the following checklist ✓ as a guide for your daily pre-start inspection. Make a copy of this Pre-Start Inspection checklist. Once it is complete, check off, initial and date each item and file the copy as a record of 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. Thoroughly clean equipment of mud and dirt.
	4. Check condition of personal protective equipment. Replace equipment if defective.
	5. Contractor is responsible for all personnel to wear proper protective equipment on the job site.
	6. Remove combustible or flammable materials from equipment. Store materials properly.
	7. Test air monitoring and ventilation detectors for proper operation.
	8. Test E-Stop operation. If operation is faulty, E-Stop MUST be repaired before operation.
	9. Check controls and switches for proper operation. Repair or replace if damaged or worn.
	10. Check hydraulic reservoir oil level. Add as needed.
	11. Inspect GBM equipment for damage. Repair or replace as needed.
	12. Be sure all covers and guards are in place before operation.
	13. Check for loose or missing hardware. Replace damaged or missing hardware.
	14. Check for worn, loose, or damaged wire. Repair or replace wiring.
	15. Tighten loose clamps or fittings.
	16. Check wire harnesses for frayed or worn insulation or wires. Replace damaged or worn harnesses.
	17. Check for fluid leaks. Repair leak or replace components.
	18. Keep job site clean and organized.
	19. Check equipment for proper lubrication.
	20. Remove all personnel from inside the GBM.
	21. Check for leaks in hydraulic hoses and/or lines (replace defective hoses and/or lines).
	22. Check hydraulic hoses and lines for wear and/or damage. Replace any defective hoses and/or lines.
	23. Remove all tools on GBM.

NOTES

Operation

You must read and understand this manual, the 4800 Series Operator's Manual and your electric motor Installation, Operation and Maintenance Instructions booklet before you operate and maintain this equipment.

USING EMERGENCY STOP

The Emergency Stop button (A) on the P200E is located on the control panel.

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

The button will light when it is pulled OUT.

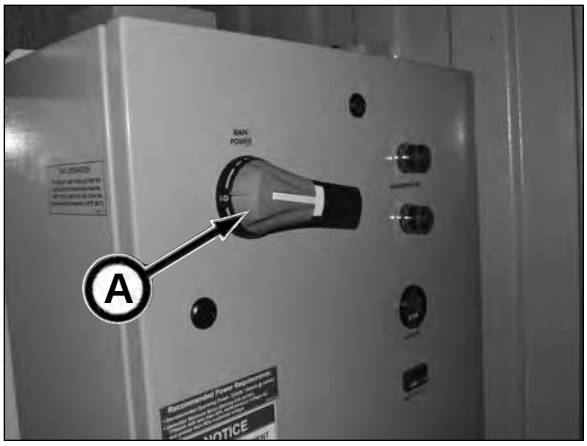
NOTICE The emergency stop button must be pulled out for motor to start.

CONNECTING POWER LEADS

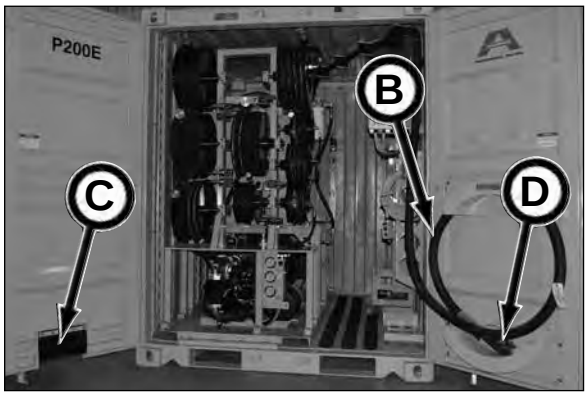
⚠DANGER Hazardous voltage.
This machine is powered by high voltage electricity.

Failure to lockout tagout power before connecting power leads or servicing will cause severe personal injury or death.

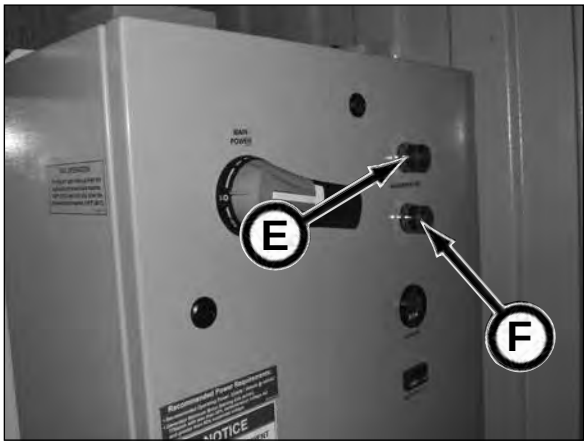
LOCKOUT TAGOUT main power supply before connecting power leads or servicing. ONLY a qualified and trained technician can operate this equipment. Electrical repairs must be performed only by a certified electrician.



1. Lockout tagout generator or other power source.
2. Turn power pack main disconnect (A) to the OFF position.



3. Uncoil power cable (B) and route cable through door flap (C).
4. Connect power pack power cable leads (D) to generator or other power source connection.
5. Turn on generator or other power source.
6. Turn main disconnect to the ON position.



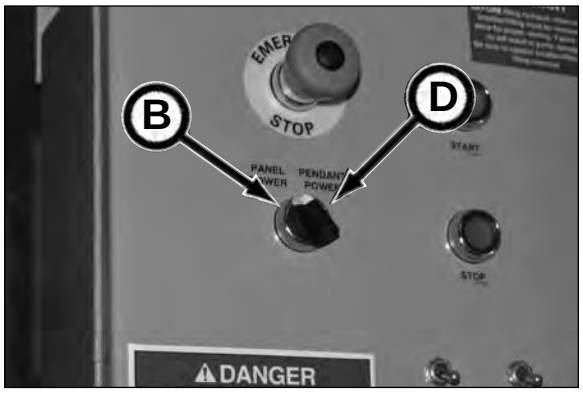
7. Check Phase Indicator lights. If green Phase OK light (E) is not illuminated, proceed to step 8, otherwise continue to step 9.
8. If red Phase Error light (F) is illuminated, a certified electrician must lockout tagout power source and turn power pack main disconnect to the OFF position. Then the electrician must reverse the two generator power leads. Repeat steps 4 - 7. For more information, refer to Phase Indicator in the Controls & Instruments section.
9. The electric motors are now available for operation.

STARTING THE MOTOR

1. Once power is properly hooked up to power pack, the 200 HP motor (A) can be started either at the control panel or at the pendant control:

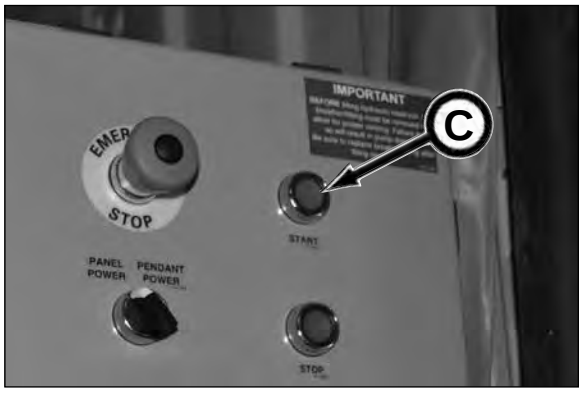
NOTICE The Emergency Stop button must be pulled out for motor to start.

PANEL POWER
Turn Panel/Pendant Power Control switch to the Panel Power position (B).
Depress start button (C) on control panel.



PENDANT POWER
Turn Panel/Pendant Power Control switch to the Pendant Power position (D).
Depress start button (E) on pendant control.

2. The jacking frame is now available for use.

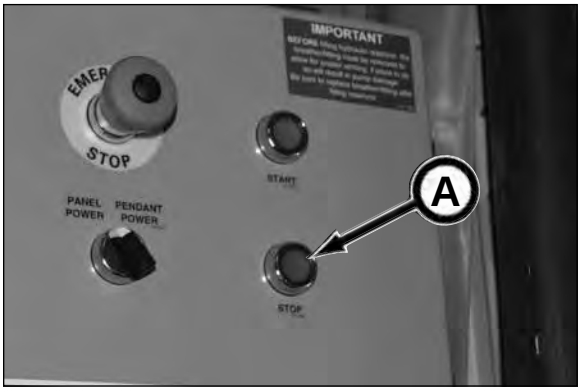


STOPPING THE MOTOR

1. Depending upon whether you are using the control panel or the pendant to control the 200 HP electric motor, stop the motor as follows:

   Control Panel: depress stop button (A)
   Pendant: depress stop button (B)

2. Perform shutdown (refer to Daily Shutdown in this section).



CHECK HYDRAULICS AFTER MOTOR START-UP

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

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

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

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

1. Check all return filter indicators (C). Once operating temperature reaches at least 100°F (38°C), if the filter indicator needle is in the red CHANGE zone, replace filter.

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

ADJUSTING THRUST PRESSURE

NOTICE To protect your product pipe, you must be sure the product pipe rating can withstand the thrust pressure of the GBM. Since the P200E Power Pack is capable of 6,000 psi (200 ton), and if your pipe is rated lower than 265 ton, the GBM thrust pressure **MUST** be readjusted. **Failure to do so WILL break the pipe.**

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 44 tons (GBM 4800 series in low speed) of thrust pressure. Or refer to the thrust pressure chart (to the right or the label on the GBM frame).

THRUST RATE TONNAGE

PSI	FAST	SLOW
500	8	22
1000	16	44
1500	24	66
2000	31	88
2500	40	110
3000	48	133
3500	56	155
4000	64	177
4500	72	199
5000	80	221
5500	87	243
6000	95	265

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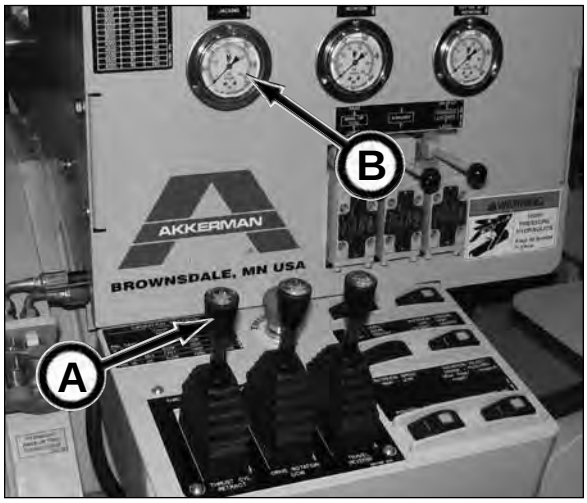
GBM 4800 Series Pressure Chart

3. With the power pack hydraulic hoses connected to the GBM and the power pack running at full RPM, 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. Operating pressure is checked by retracting the jacking cylinders and holding lever after the cylinder base has stopped moving. Observe pressure on gauge.

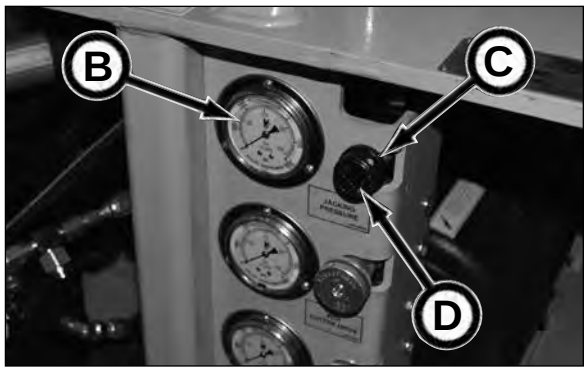


GBM 4800 Series

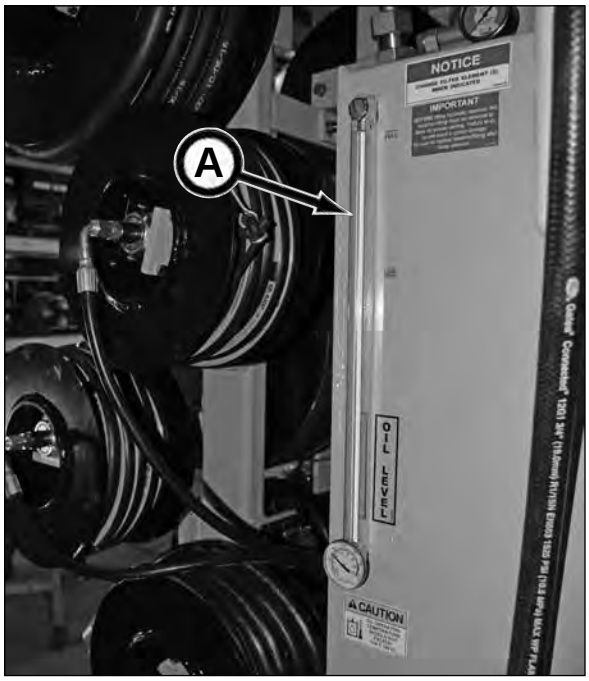
NOTICE Only a qualified service technician is allowed to perform pressure adjustments to the power pack.

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

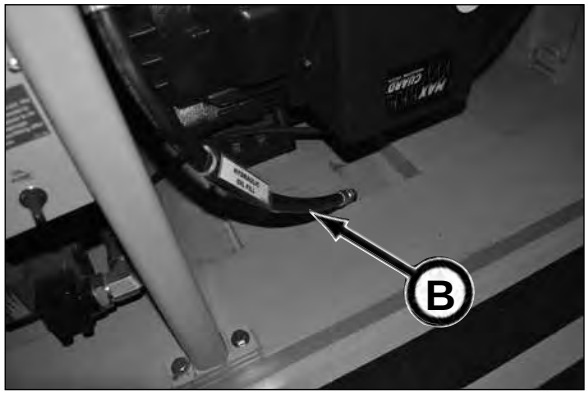
If the pressure needs to be increased, loosen lock collar (C) and turn adjustment dial (D) IN. Once the pressure is properly adjusted, tighten lock collar.



FILLING THE HYDRAULIC OIL RESERVOIR



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-68 Premium Hydraulic Turbine Oil as follows:

1. Remove hydraulic oil fill hose (B) from storage location. Remove cap from hose.

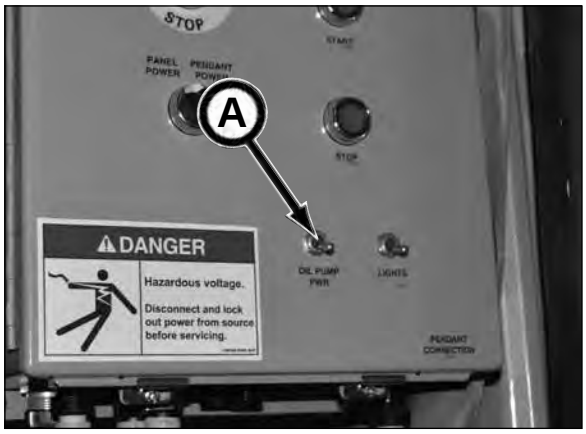
2. Place hose into clean hydraulic oil container.

NOTICE Refer to Fuels & Lubricants section for recommended hydraulic oil.

(continued on next page)

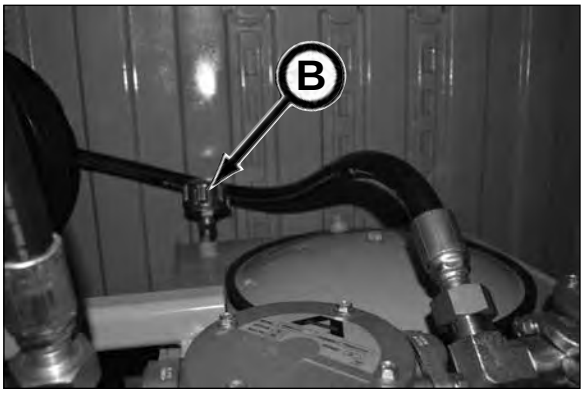
3. Open hydraulic fill shut off valve by moving handle up to the 3 o'clock position.

4. Flip Oil Fill Pump switch (A) on the control panel to the ON position. The switch provides power to the Oil Fill switch in the container.



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

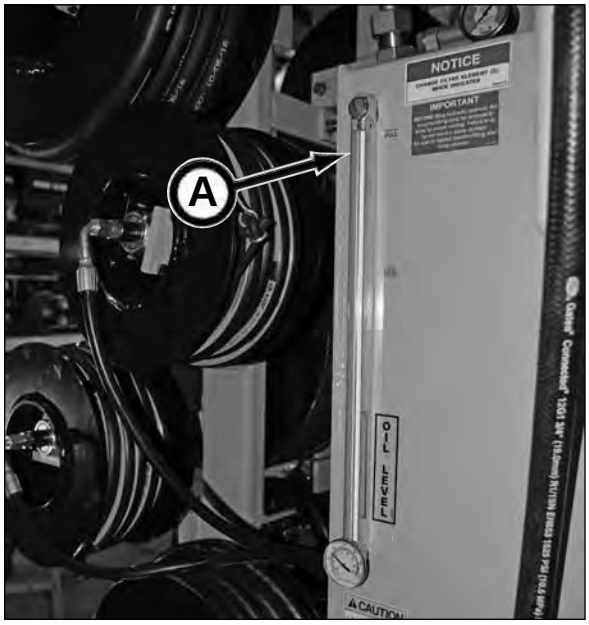
5. Remove breather/fitting (B) from reservoir BEFORE filling reservoir to allow for proper venting during filling process.



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

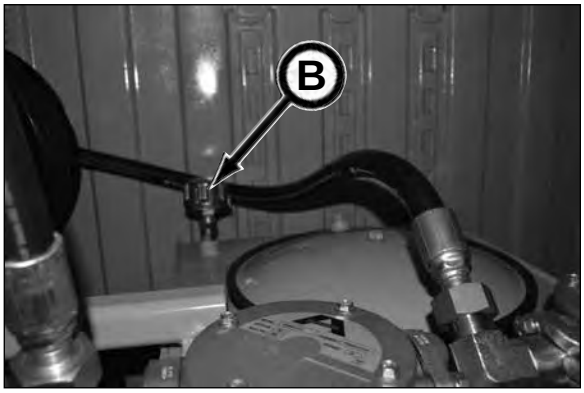
(continued on next page)

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



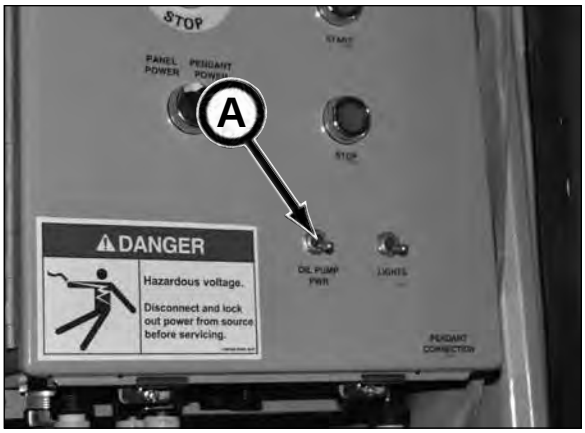
8. Flip Oil Fill Pump switch down to the OFF position.

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



10. Close hydraulic fill shut off valve by moving handle down to the 6 o'clock position.

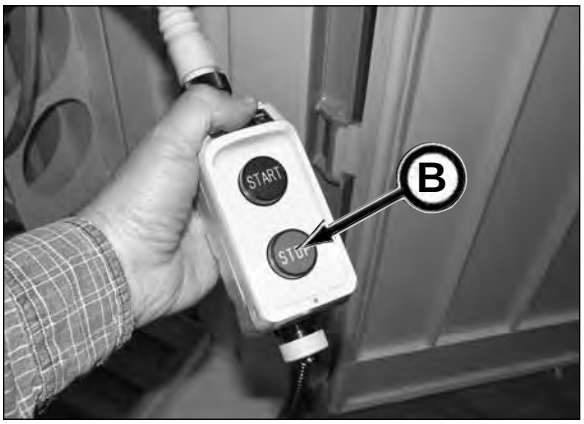
(continued on next page)



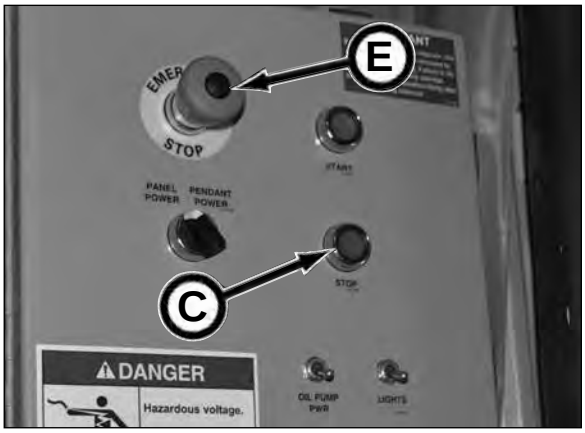
11. Flip Oil Fill Power switch (A) to the OFF position.

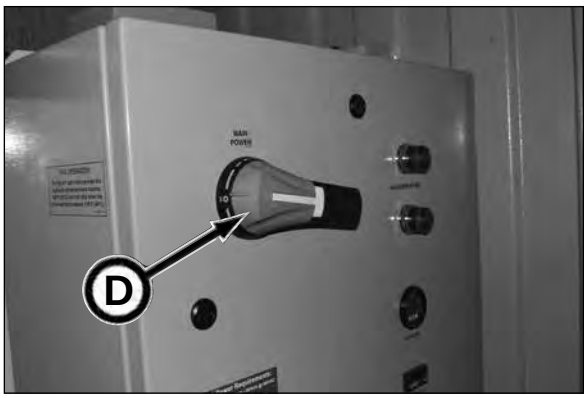
12. Replace cap on fill hose and place hose in storage location.

DAILY SHUTDOWN



1. Shut off motor. Depending upon whether you are using the control panel or the pendant to control the 200 HP electric motor, depress the control pendant stop button (B) or the control panel stop button (C).





2. Turn main power disconnect (D) to OFF position.

3. Push IN E-Stop button (E).

4. Shut down generator or other power source and perform lockout/tagout procedure.

NOTES

Transporting

TRANSPORTING GUIDELINES

1. Know the local, state, and federal transportation regulations.

2. Obtain required permits for transporting.

3. Remove any obstacles from the trailer floor.

4. Clean debris from 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 power pack and guided boring machine to trailer floor.

8. Securely fasten all tooling to trailer floor.

9. Observe all lifting capacities and lifting instructions.

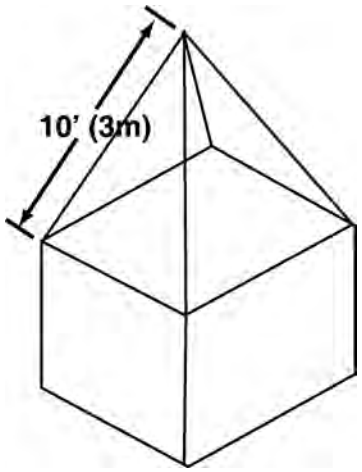
LIFTING INSTRUCTIONS

• Container weight is 10,000 lbs. (4,536 kg).

• Lifting with a crane requires a four part sling with legs a minimum of 10 ft. (3 m) long.

• Container must lift freely. If it is stuck to the ground, it must be broken loose prior to lifting.

• Lifting eyes must be inspected prior to each lift. Any damage must be repaired prior to lifting.



NOTES

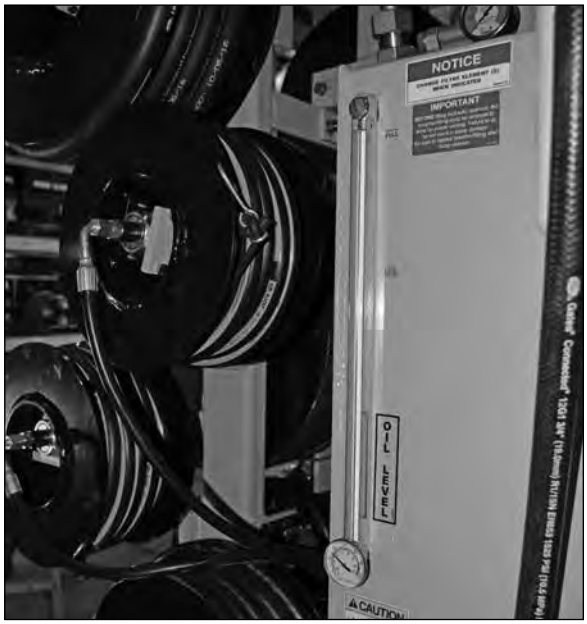
Lubricants

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

POWER PACK HYDRAULIC OIL RESERVOIR LUBRICANT

The power pack oil reservoir is typically filled with ISO-VG-68 Premium Hydraulic/Turbine Oil.

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



NOTICE If using a too heavy of viscosity oil in cold temperatures, hydraulic oil pump damage could result due to pump cavitation. On the contrary, using ISO 32 or 46 oils above 150˚F operating temperatures (oil temp. in reservoir) will result in reduced hydraulic power to functions.

Recommended hydraulic oil:

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

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

ELECTRIC MOTOR GREASE

The electric motor bearings with are lubricated with Mobil Polyrex® EM grease or equivalent (refer to Grease Type below).

GREASE TYPE (unless nameplate states otherwise:
Nameplate Ambient Temperature between -22°F (-30°C) to 150°F (65°C) inclusive:
Recommended grease for standard service conditions is Mobil Polyrex® EM. Equivalent and compatible greases include: Texaco Polystar RB, Rykon Premium #2, Pennzoil Pen 2 Lube, Chevron SRI & Mobil SHC 100.

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

200 HP Electric Motor

STORING LUBRICANTS

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

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

NOTES

Periodic Maintenance

⚠WARNING Review the Safety section in this manual and your 4800 Series Operator's Manual before performing maintenance. Failure to do so, could cause severe injury or death.

LUBRICATION & MAINTENANCE INTERVALS

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

Use the power pack motor hourmeter to determine the proper lubrication and maintenance intervals.

LOCKOUT TAGOUT POWER BEFORE SERVICING

⚠WARNING Severe personal injury or death can result from unexpected power pack start-up or machine movement.

LOCKOUT TAGOUT power before attempting to make repairs or adjustments to this equipment, unless otherwise indicated. Proper lockout tagout will prevent accidents and save lives. Performing the lockout tagout 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.

USING EMERGENCY STOP

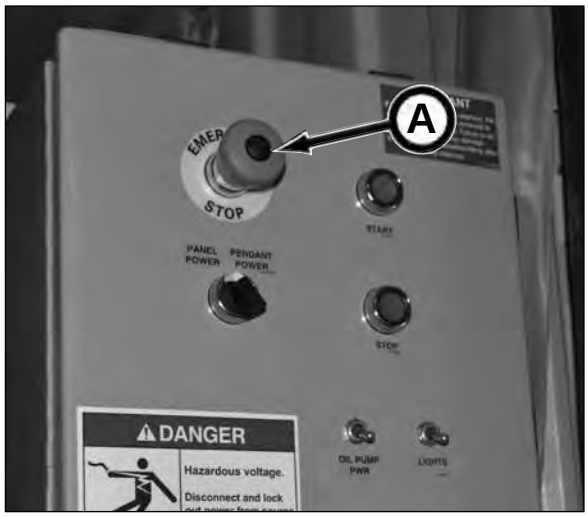
The Emergency Stop button (A) on the P200E is located on the control panel.

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

The button will light when it is pulled OUT.

This button must be pulled out to restart motor.

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



HYDRAULIC OIL/FLUIDS UNDER PRESSURE

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

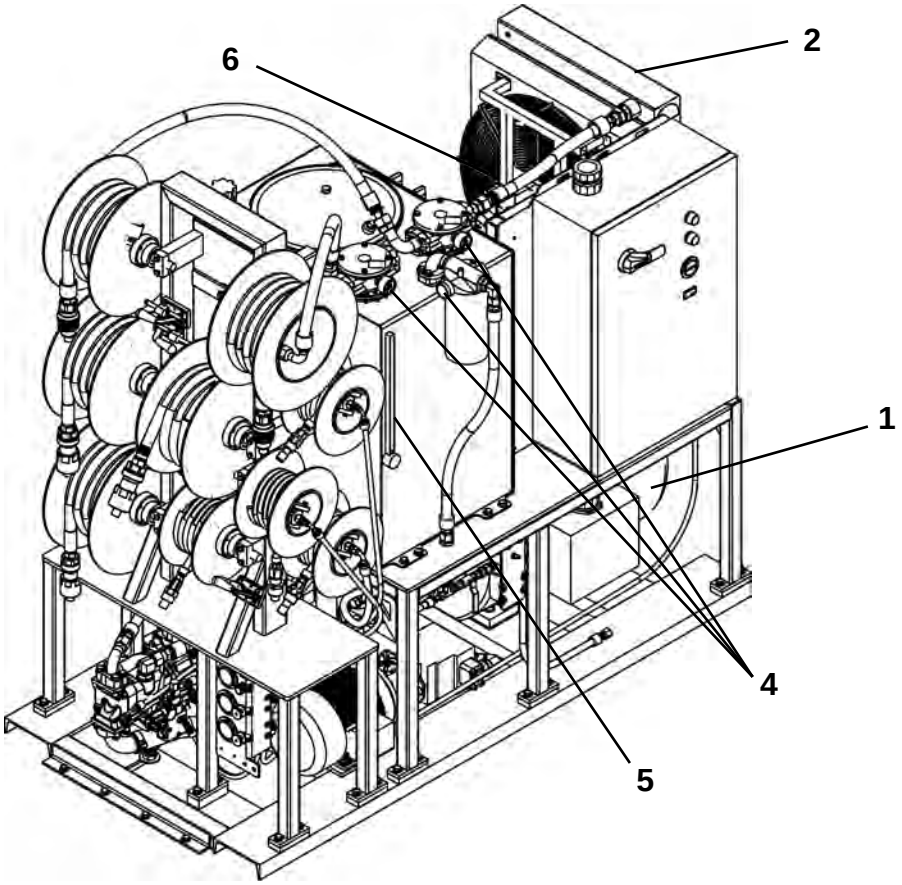
Release all pressure before performing maintenance or repairs. Never weld near pressurized fluid lines.

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 CHART - P200E

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



ELECTRIC MOTOR MAINTENANCE

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Electric Motor	Maintenance	Per maintenance instructions	See pg 11-5

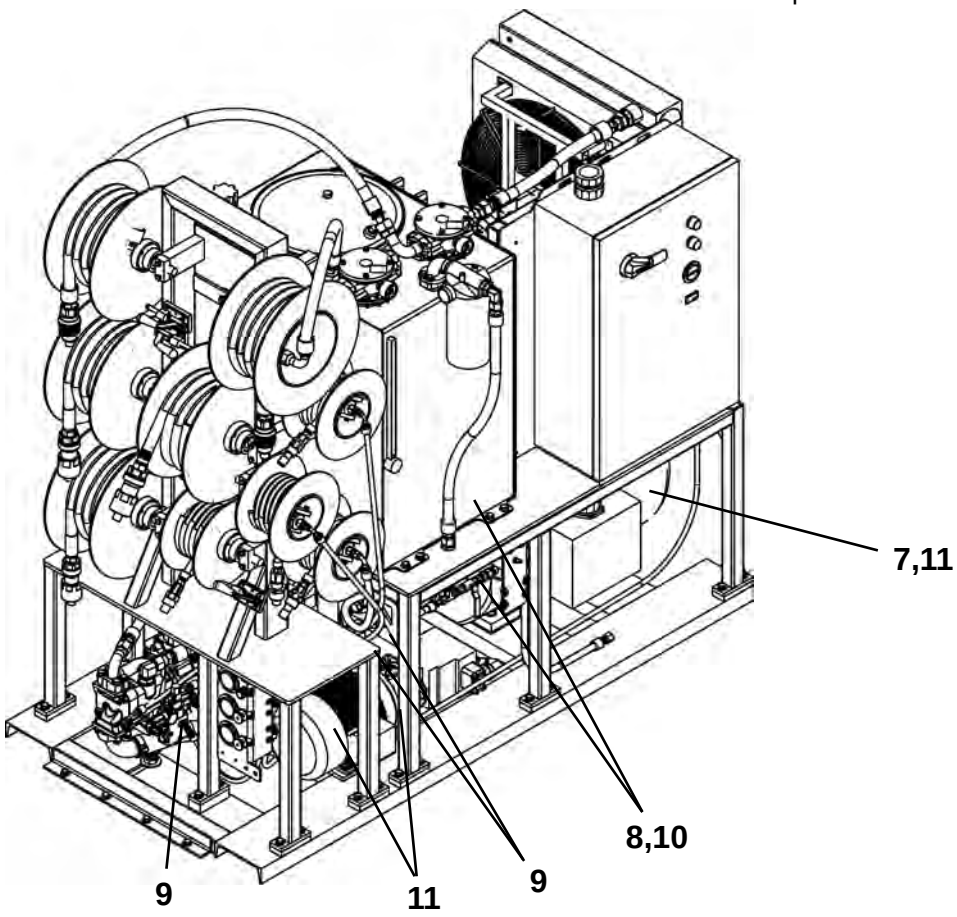
PRIOR TO EACH JOB LAUNCH

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
2.	Oil Cooler	Clean	As needed.	

*DAILY OR EVERY 10 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
3.	Power Pack	Visual Inspection	If parts are damaged or missing, replace.	
4.	Hydraulic Return Filters	Check Indicator	Replace filter as needed per indicator.	Return Filter
5.	Hydraulic Reservoir	Check Fluid Level	Add hydraulic fluid as needed.	ISO-VG-68
6.	Fan	Inspect Fan	If damaged, replace with new.	

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



WEEKLY OR EVERY 50 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
7.	Motor	Check	Ventilation openings clean and drain holes open.	

COMPLETION OF EACH DRIVE

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
8.	Hydraulic Reservoir	Drain water	Drain until water is removed.	

*EVERY 500 HOURS OF OPERATION

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

*EVERY 1000 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
10.	Hydraulic Reservoir	Drain & Fill	Drain and fill with new oil.	ISO-VG-68

ANNUALLY

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
11.	Electric Motor Brgs.	Lubricate (2 places)	2 Shots	Mobil Polyrex EM

ELECTRIC MOTOR MAINTENANCE

1. ELECTRIC MOTOR MAINTENANCE

Perform maintenance on each motor as defined in the Installation, Operation and Maintenance Instructions section, starting on page 11-5.

The motors require inspection of the ventilation openings and lubrication of the motor bearings per the manufacturer's instructions.

PRIOR TO EACH JOB LAUNCH

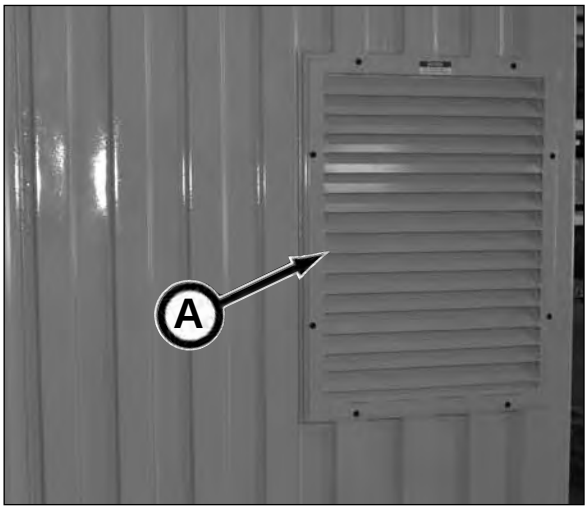
2. CLEAN OIL COOLER

1. Remove louver cover (A) on power pack to gain access to the oil cooler.

⚠WARNING Louver cover is heavy. Use assistance when removing, moving and replacing.

2. Clean oil cooler (B) fins and tubes with compressed air (100 psi maximum).

3. Replace louver and secure with hardware removed in step 1.



Oil Cooler Assembly Shown From Inside Container

DAILY OR EVERY 10 HOURS OF OPERATION

3. VISUALLY INSPECT EQUIPMENT

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

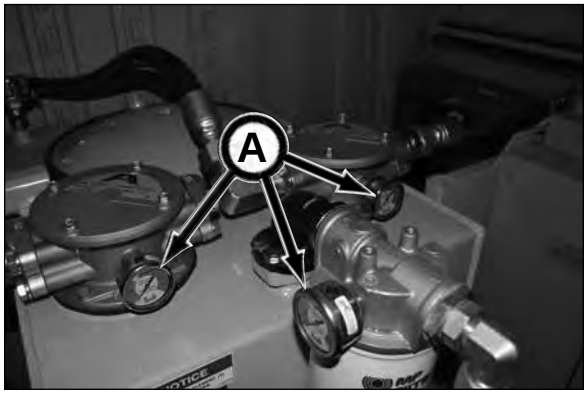
Immediately report any structural problems to your Akkerman aftermarket support representative.

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

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

Tighten hardware as needed. Do not overtighten hardware.

4. CHECK HYDRAULIC RETURN FILTER INDICATORS



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

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

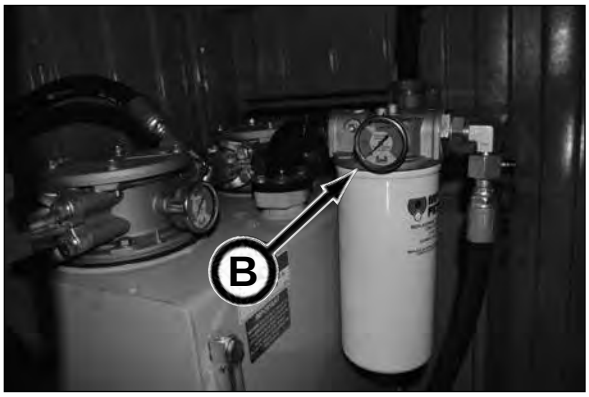
All filters (in-tank and spin-on) and oil require replacement if any of the following situations occur:

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

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

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

When the needle on the gauge is in the red CHANGE zone, replace filter(s) as soon as possible to prevent hydraulic component damage (see Replacing Spin-On Filter or Replacing In-Tank Filters below).



REPLACING SPIN-ON FILTER

1. With power pack shutdown, clean and dry area around return filter and filter head assembly (B).

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.

(continued on next page)

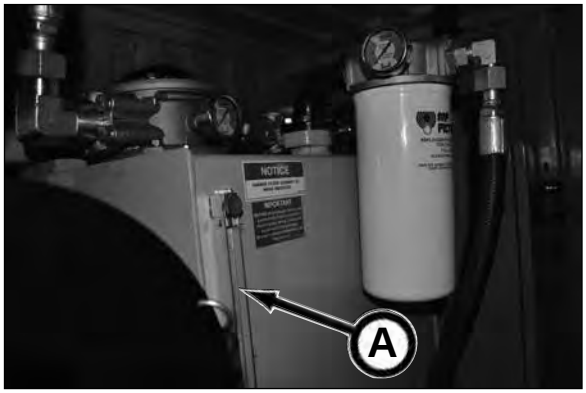
4. Lubricate new filter gasket with a light coating of clean hydraulic oil.

5. Install new filter. Hand tighten only.

6. With the hydraulic hoses disconnected from the GBM, start motors and run until the hydraulic system is warm. Then check for leaks.

7. Shut down motors.

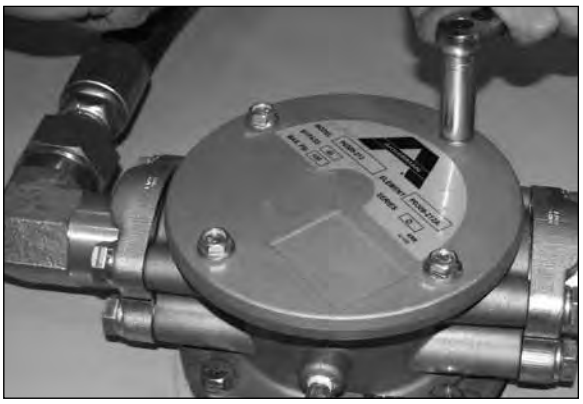
8. Check hydraulic reservoir oil level on gauge (A). Add hydraulic oil, if necessary.



REPLACING IN-TANK FILTER(S)

1. With power pack shutdown, clean and dry area around the filter head assembly.

2. Remove filter head fasteners and retain for later use.

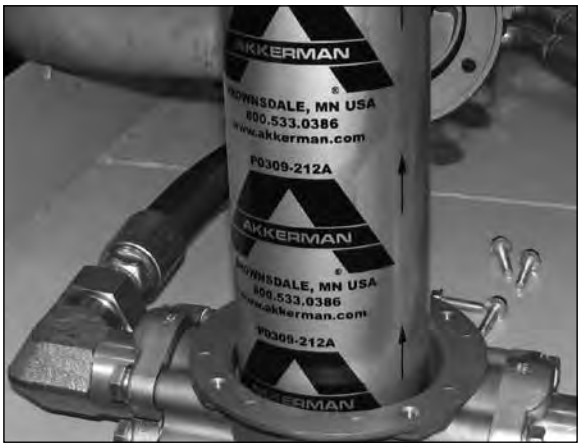


3. Remove head assembly from housing.

4. Remove filter.

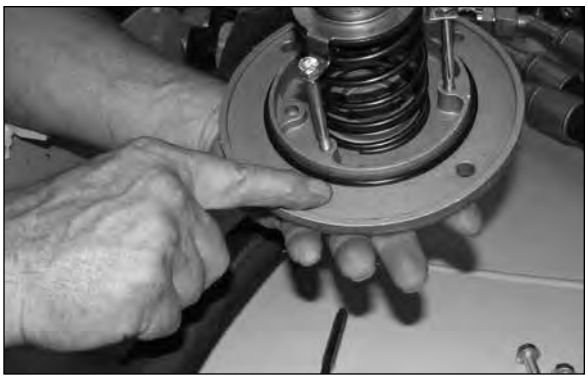
5. Check for metal flakes on filter. If metal flakes are visible, replace all filters and reservoir oil.

6. Dispose of filter properly.

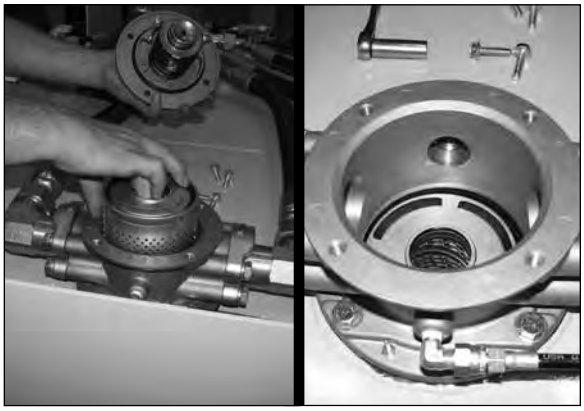


(continued on next page)

7. Check filter gasket in filter head. If worn or damaged replace with new. Install new gasket (if needed) with a light coat of clean hydraulic oil into filter head. Be sure the gasket is not twisted and is correctly in place.



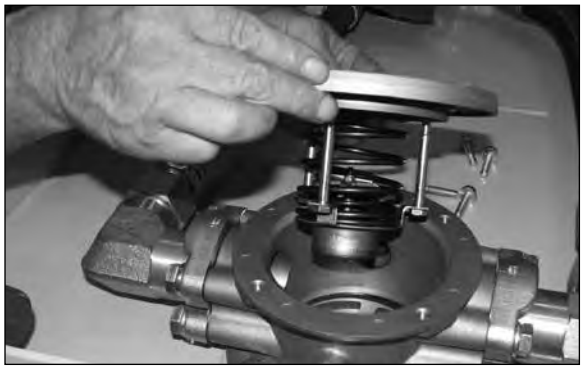
8. Carefully install new filter into filter housing until it is fully seated into housing.



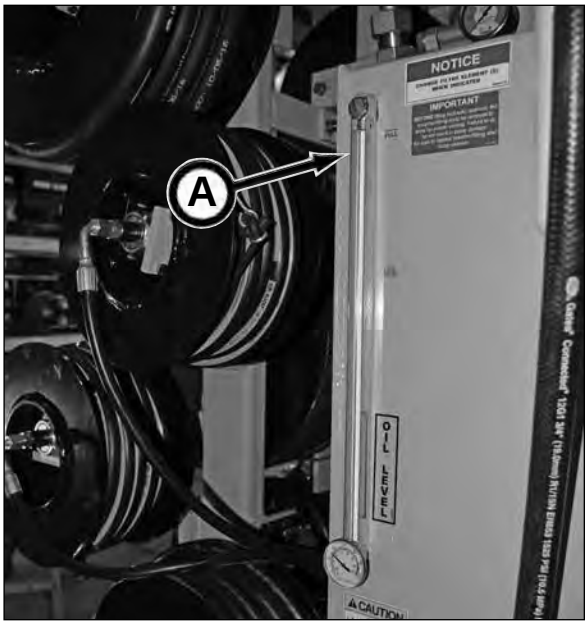
9. Replace filter head assembly onto housing and secure with fasteners removed in step 2.

10. Start up power pack and run until hydraulic system is warm, start boring head and jacking motors and check for leaks.

11. Stop motors and shutdown power pack. Replace other filter(s) as needed.



5. CHECK HYDRAULIC RESERVOIR OIL LEVEL & CONDITION OF OIL

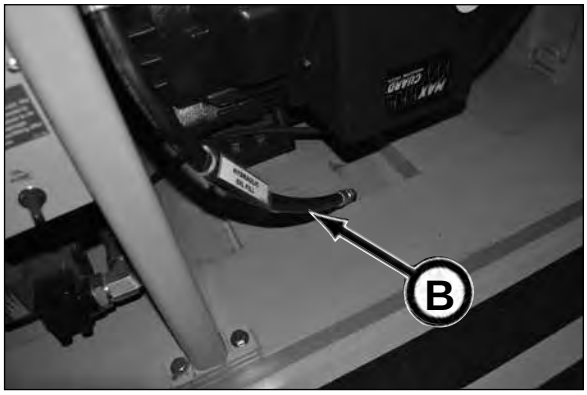


1. Check reservoir hydraulic oil for the following:

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

If any of these conditions are found, the reservoir must be drained, cleaned, and refilled with new, clean hydraulic oil and all hydraulic filters must be replaced. Refer to Every 1000 Hours of Operation, “10. Drain & Fill Hydraulic Oil” in this section.

2. Check hydraulic tank oil level gauge (A).



FILLING RESERVOIR

If the fluid level in the reservoir is less than 3/4 full, fill the reservoir with ISO-VG-68 Premium Hydraulic Turbine Oil as follows:

1. Remove hydraulic oil fill hose (B) from storage location. Remove cap from hose.

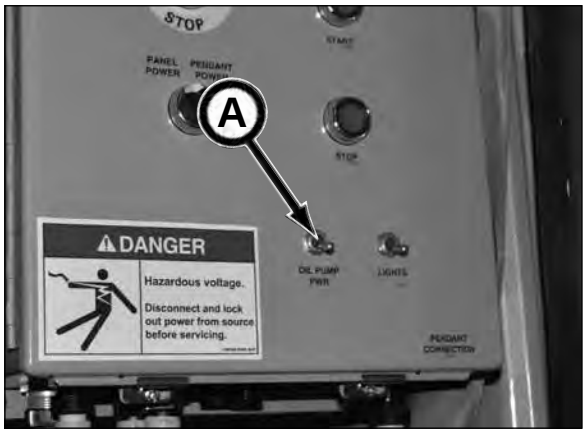
2. Place hose into hydraulic oil container.

NOTICE Refer to Fuels & Lubricants section for recommended hydraulic oil.

(continued on next page)

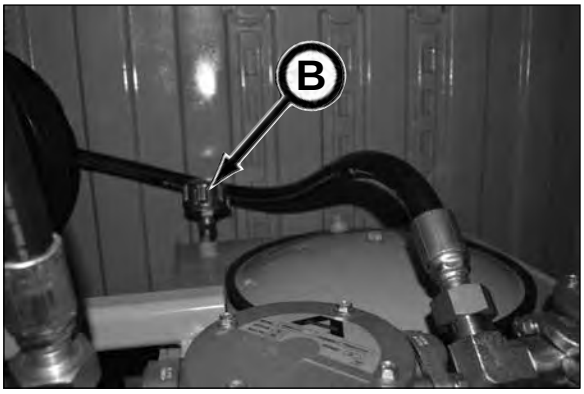
3. Open hydraulic fill shut off valve by moving handle up to the 3 o'clock position.

4. Flip Oil Fill Pump switch (A) on the control panel to the ON position. The switch provides power to the Oil Fill switch in the container.



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

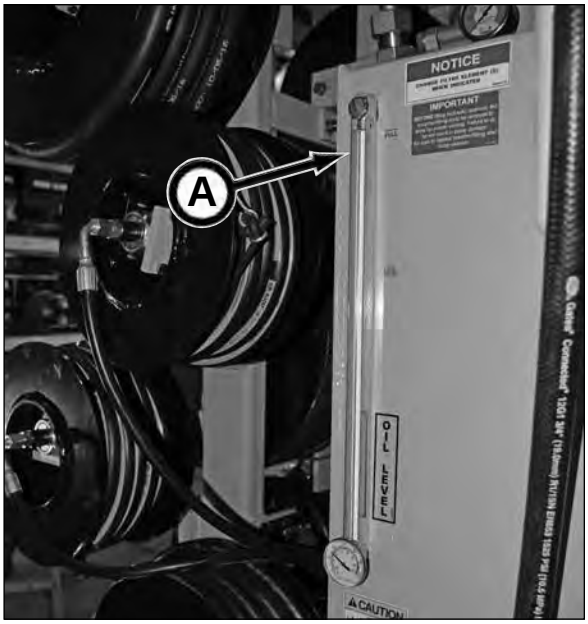
5. Remove breather/fitting (B) from reservoir BEFORE filling reservoir to allow for proper venting during filling process.



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

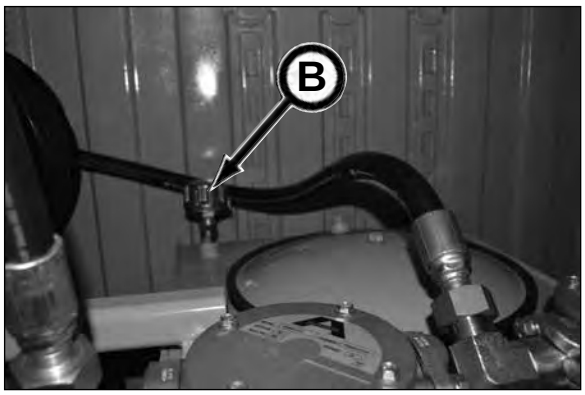
(continued on next page)

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



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

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



10. Close hydraulic fill shut off valve by moving handle down to the 6 o'clock position.

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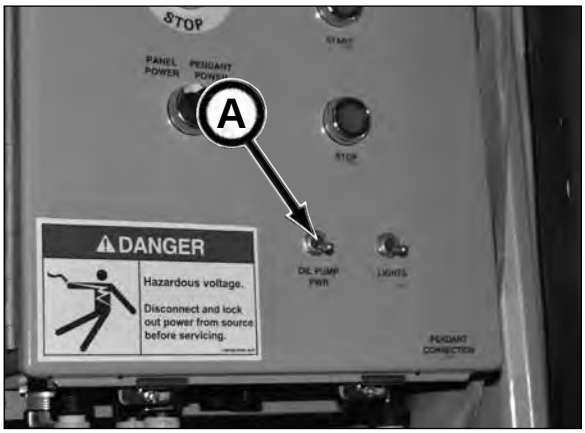


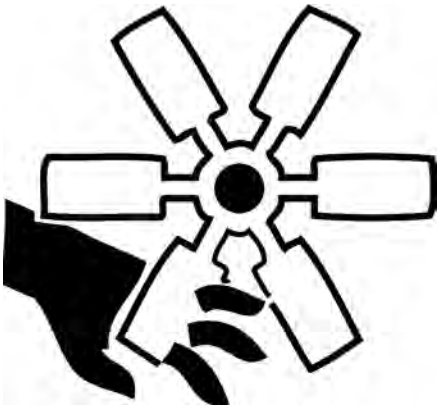
11. Flip Oil Fill Power switch (A) to the OFF position.

12. Replace cap on fill hose and place hose in storage location.

6. INSPECT FAN

WARNING Serious personal injury could result if contact is made with rotating fan blade. Fan blades can rotate at any time power is connected and the main disconnect is in the ON position.

If the power is connected to the power pack and the main disconnect is in the ON position, the fan can rotate anytime the hydraulic oil is at 120°F (49°C) (factory default setting) or someone turns the fan on manually.



With the main disconnect in the OFF position and Emergency Stop pulled out to prevent accidental starting, check fan (B) for cracks, and bent or loose blades. Replace damaged fan.

WEEKLY OR EVERY 50 HOURS OF OPERATION

7. CHECK MOTORS

NOTICE Refer to the electric motor operation and maintenance instruction manual on page 65 for more information.

Inspect the ventilation openings of the 200 HP and 5 HP motors so they are clear to allow the free passage of air. Also, be sure the drain holes are open.

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

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

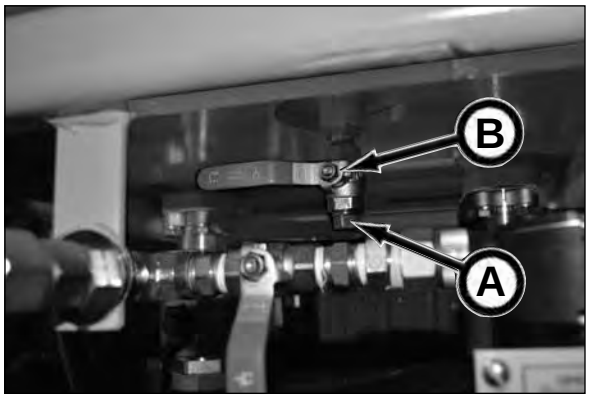
200 HP Electric Motor

5 HP Electric Motor

COMPLETION OF EACH DRIVE

8. DRAIN WATER FROM HYDRAULIC RESERVOIR

Remove water contamination from the hydraulic reservoir by draining water from the reservoir at the completion of each drive.



1. With power pack on level ground, allow oil in hydraulic reservoir to settle overnight.

2. Remove plug (A) and install a 1/2” NPT hose to tank valve fitting.

3. Route hose into a catch pan.

4. Slightly open tank drain ball valve (B) and drain until there is no water in oil.

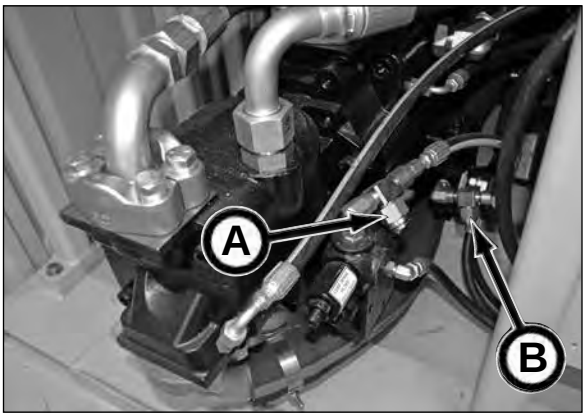
5. Once water is removed from tank, close tank drain ball valve, remove hose (if used) and reinstall plug.

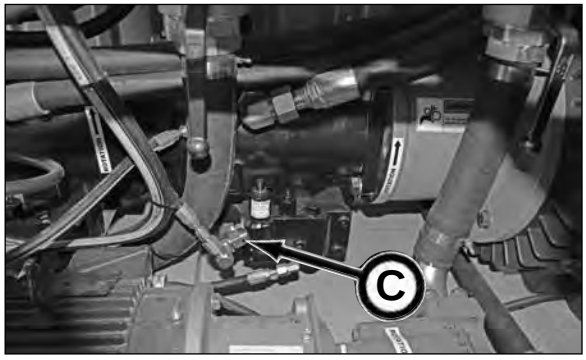
EVERY 500 HOURS OF OPERATION

9. REPLACE LOAD SENSE FILTERS

The load sense filters (3 places) for the jacking (A), cutter drive (B) and the auger rotation (C) pumps must be replaced at:

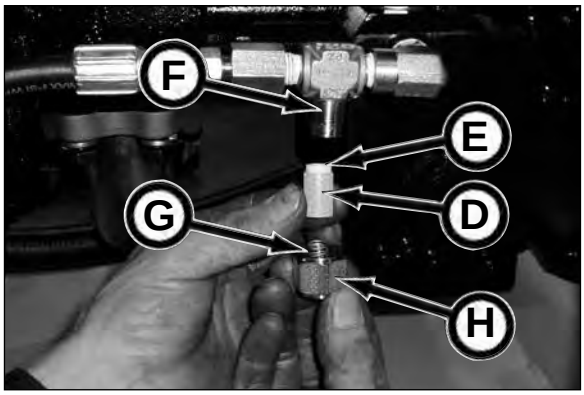
- 500 hours or yearly, which ever occurs first
- a major component fails
- any signs of water contamination
- hydraulic fluid sample indicates large particle contamination
- controls are sluggish

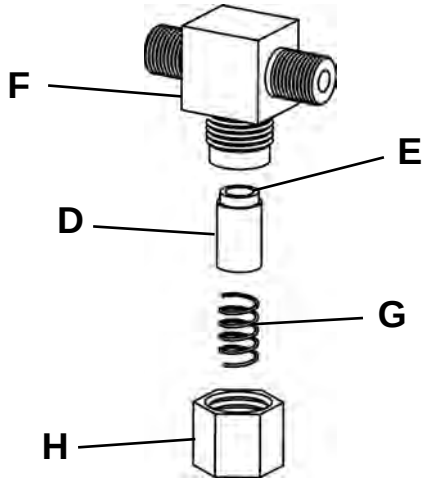




NOTICE Installing a load sense filter incorrectly, WILL cause pump malfunction.

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



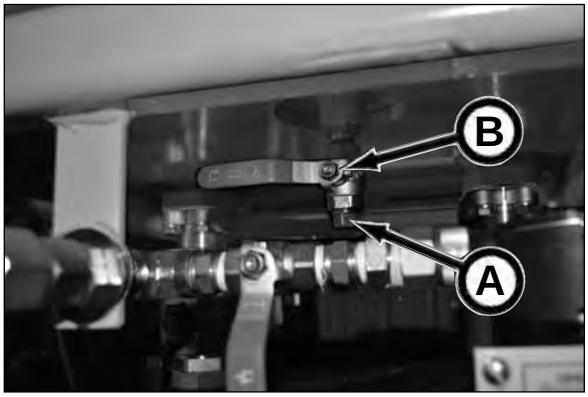


Load Sense Filter Installation

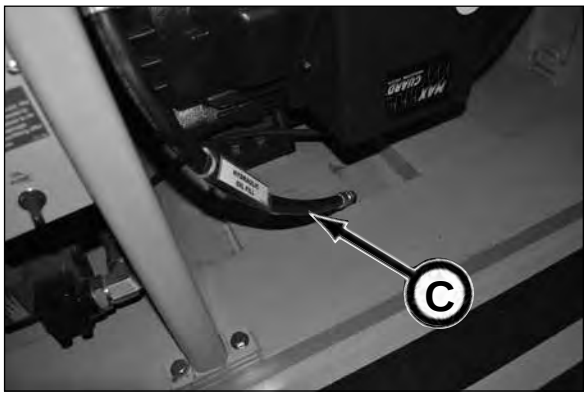
EVERY 1000 HOURS OF OPERATION

10. DRAIN & FILL HYDRAULIC RESERVOIR

1. Drain oil into an appropriate sized catch pan as follows:
   Remove plug (A) from ball valve (B) and install a 1/2 NPT hose to fitting. Open ball valve and drain oil. Close ball valve, remove hose and reinstall plug.



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



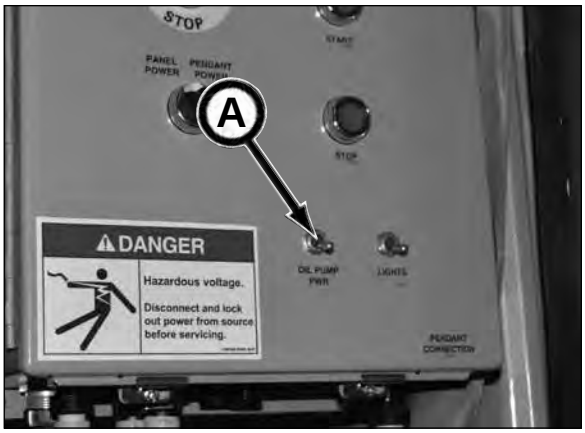
3. Place hose into a clean hydraulic oil container.

NOTICE Refer to Lubricants section for recommended hydraulic oil.

4. Open hydraulic fill shut off valve by moving handle up to the 3 o'clock position.

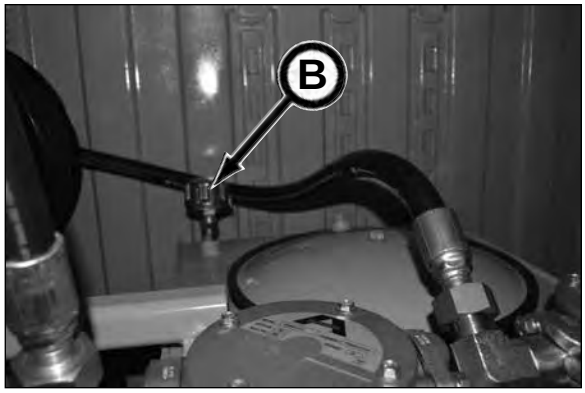
(continued on next page)

5. Flip Oil Fill Pump switch (A) on the control panel to the ON position. The switch provides power to the Oil Fill switch in the container.



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

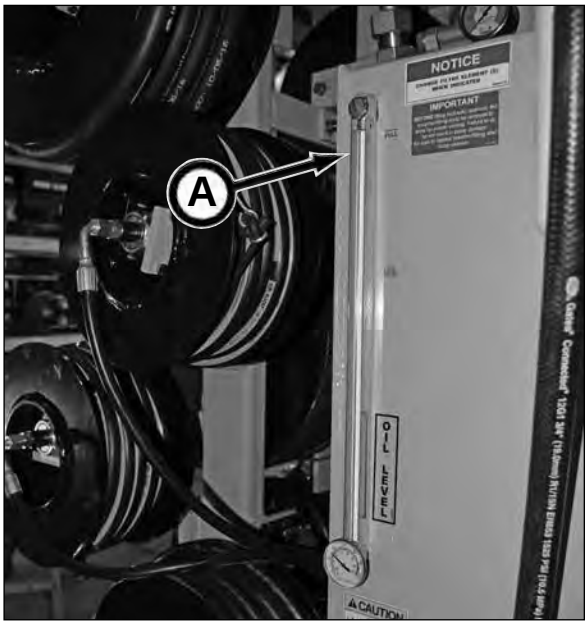
6. Remove breather/fitting (B) from reservoir BEFORE filling reservoir to allow for proper venting during filling process.



7. Flip Oil Fill Pump switch in the container up to the ON position to pump hydraulic oil into the hydraulic reservoir.

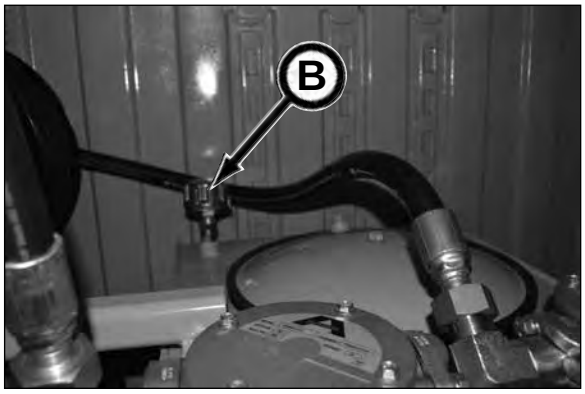
(continued on next page)

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



9. Flip Oil Fill Pump switch down to the OFF position.

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



11. Close hydraulic fill shut off valve by moving handle down to the 6 o'clock position.

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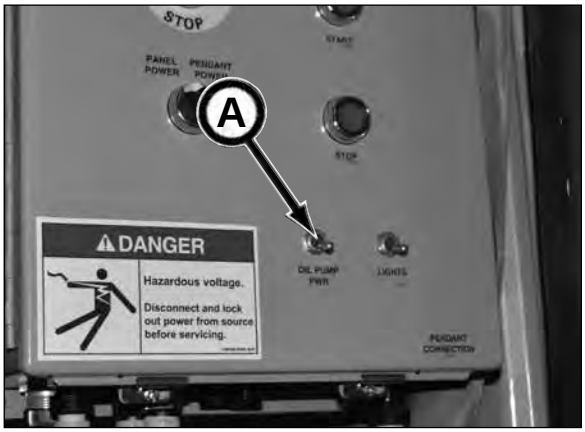


11. Flip Oil Fill Power switch (A) to the OFF position.

12. Replace cap on fill hose and place hose in storage location.

ANNUALLY

11. LUBRICATE MOTOR BEARINGS

NOTICE For additional electric motor maintenance information, refer to the electric motor operation and maintenance instruction manual on page 65 for more information.

Lubricate the electric motor bearings with two shots of Mobil Polyrex® EM grease or equivalent (refer to Grease Type below). There are two lubrication fittings on each electric motor.

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

200 HP Electric Motor

GREASE TYPE (unless nameplate states otherwise):
Nameplate Ambient Temperature between -22°F (-30°C) to 150°F (65°C) inclusive: Recommended grease for standard service conditions is Mobil Polyrex® EM. Equivalent and compatible greases include: Texaco Polystar RB, Rykon Premium #2, Pennzoil Pen 2 Lube, Chevron SRI & Mobil SHC 100.

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

5 HP Electric Motor

Storage

PREPARING FOR STORAGE

1. Repair worn or damaged parts.
2. Check for leaks. Repair or replace as necessary.
3. Wash equipment thoroughly.
4. Electric motors must be stored indoors in a clean, dry, climate controlled location. Avoid locations with large temperature swings that will result in condensation. Motors must be covered to eliminate airborne dust and dirt. If the storage location exhibits high vibration, place isolation pads under motor to minimize damage to motor bearings.
5. Contact the electric motor manufacturer for long term storage requirements.
6. Check condition of wires and cables. Repair or replace as necessary.
7. Repaint equipment where necessary.
8. Drain hydraulic oil, flush oil reservoir, change hydraulic filters, and refill hydraulic reservoir. Check for leaks.
9. Change hydraulic filters and refill hydraulic reservoir. Check for leaks.
10. Wipe up lube spills. Dispose of rags and trash properly.

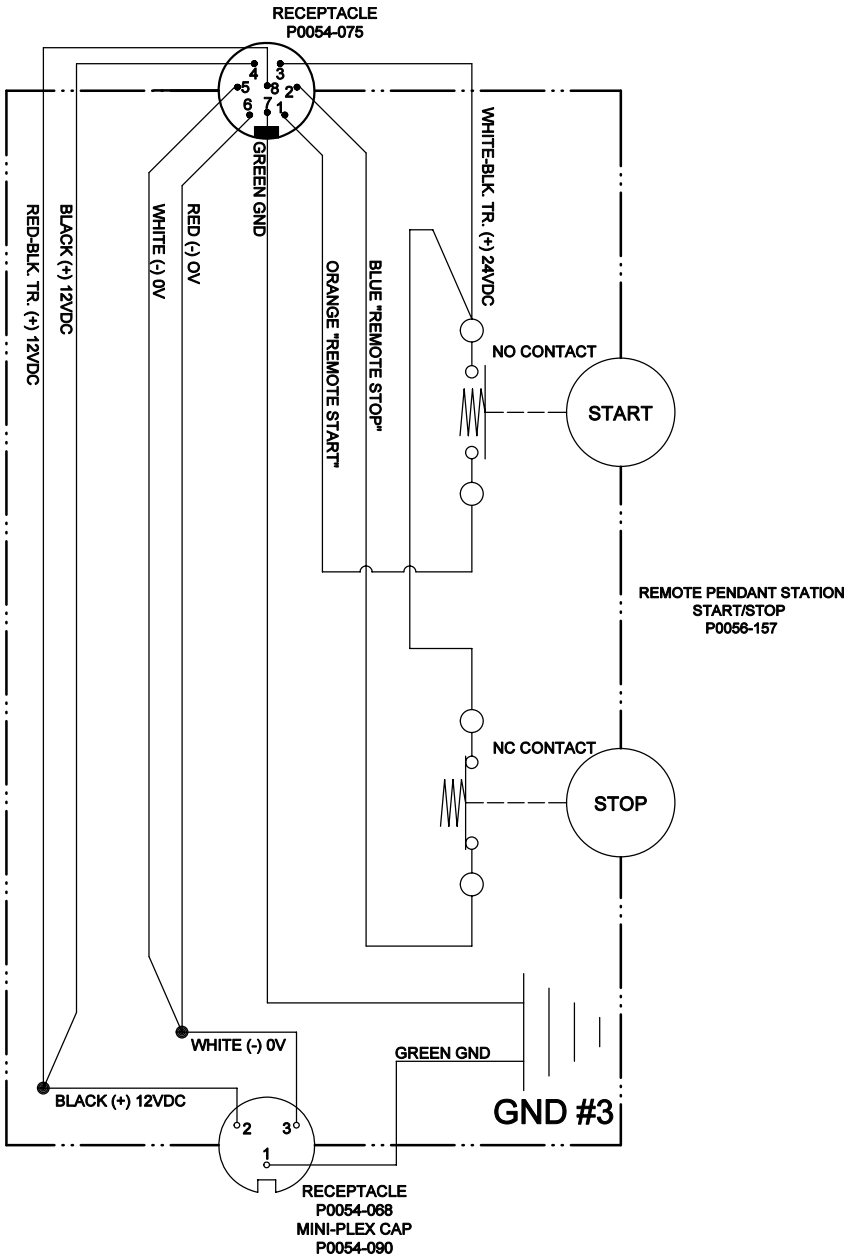
REMOVING FROM STORAGE

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. Check for leaks. Repair or replace as necessary.
5. Check hydraulic oil level. If fluid is low, check for leaks and add oil as required. See Power Pack Oil Reservoir Lubricant in section 8, Fuels & Lubricants.
6. Check condition of all hoses and connections. Tighten, repair or replace with new as needed.
7. Contact the electric motor manufacturer on how to restore the electric motor to service.
8. Before operating, cycle hydraulic functions several times to purge air from the hydraulic system.
9. Review this Operation Manual and your GBM Operator's Manual.

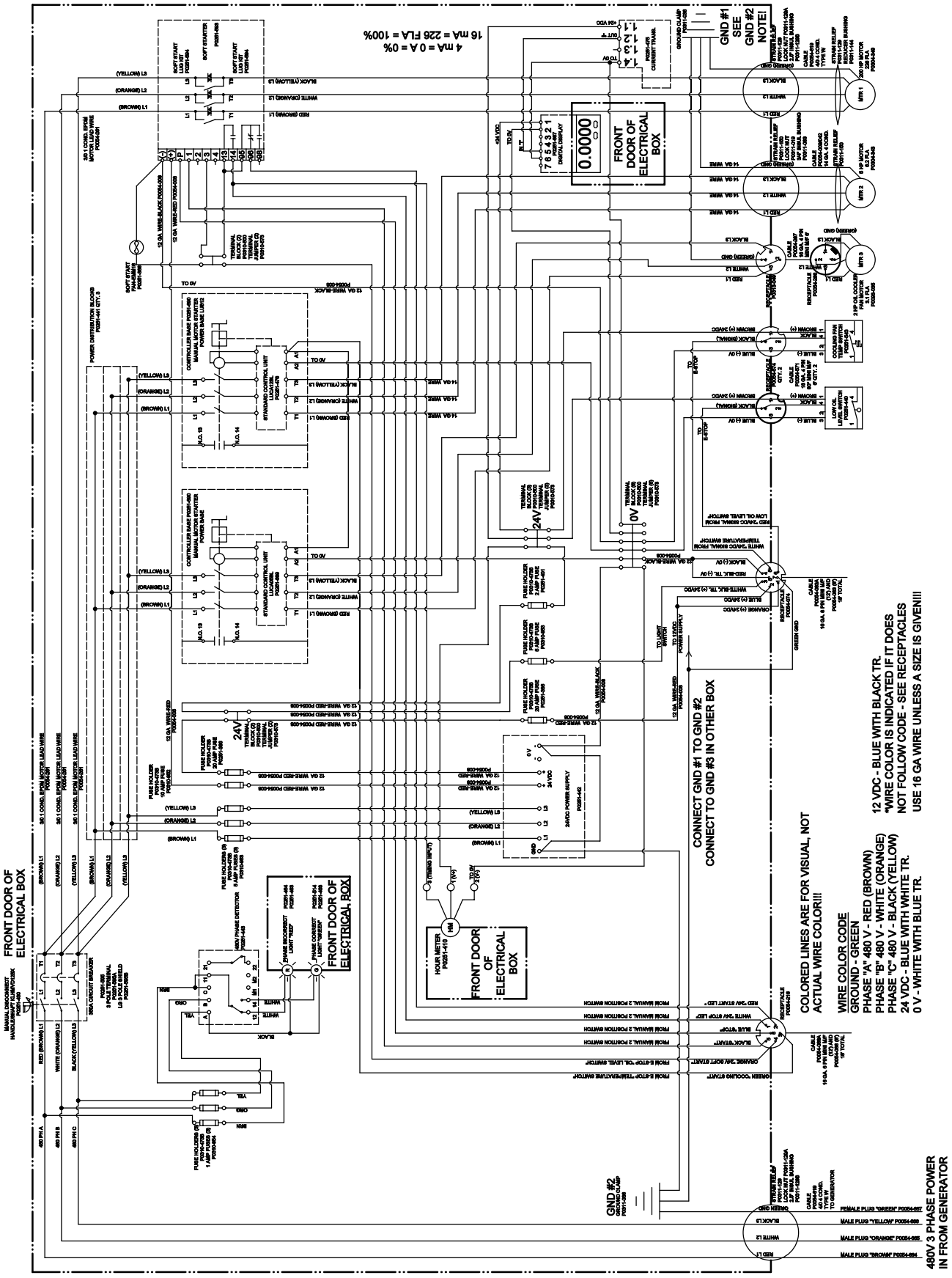
Troubleshooting

IMPORTANT: Only a certified electrician can perform maintenance and troubleshooting on the P200E Power Pack electrical components.

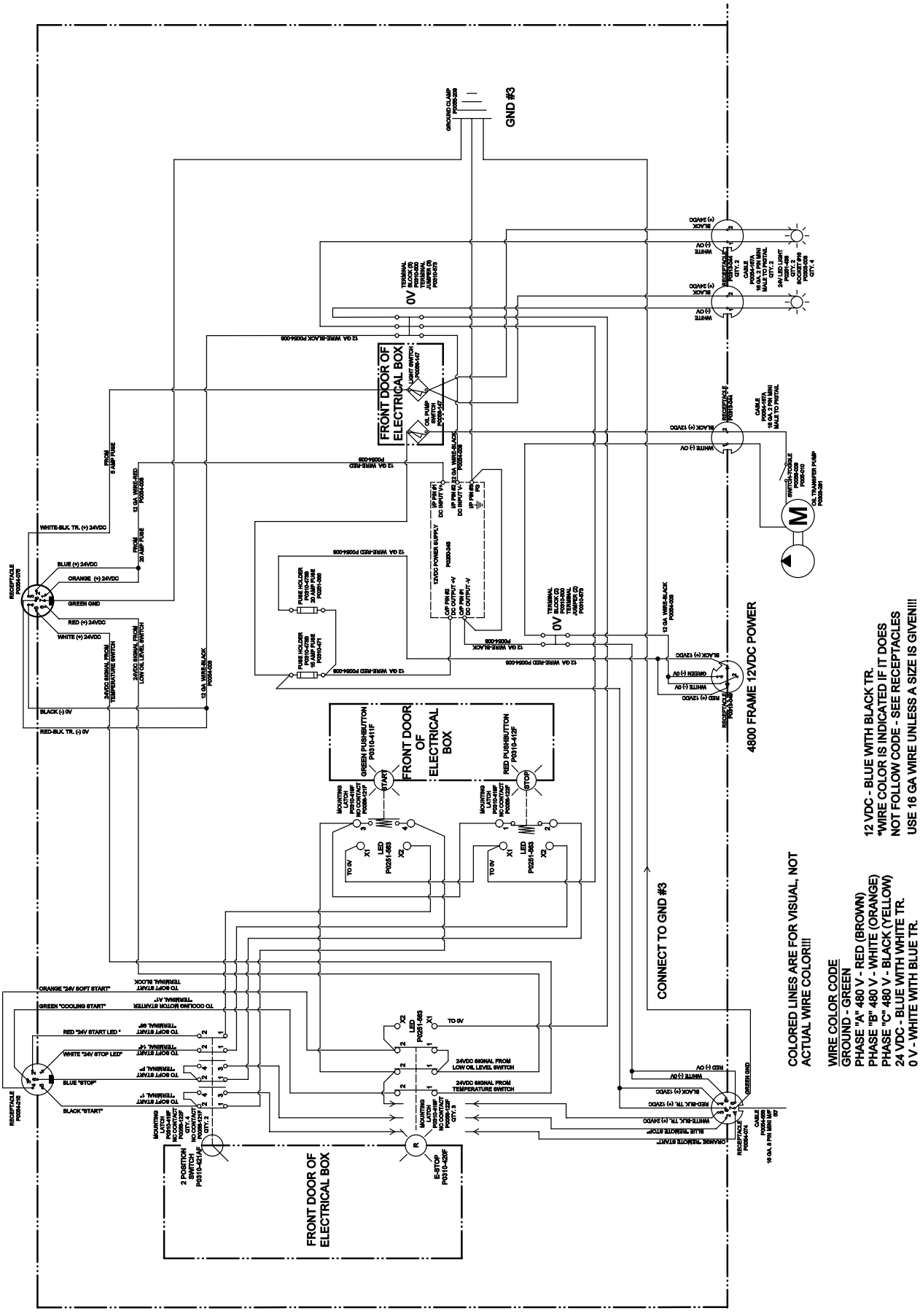
CONTROL PENDANT



P200E ELECTRICAL SCHEMATIC (PART 1 OF 2)



P200E ELECTRICAL SCHEMATIC (PART 2 OF 2)



ELECTRICAL MOTORS

Refer to troubleshooting for the electrical motors in the Installation, Operation and Maintenance Instructions booklet starting on page 11-5.

4.3.2 Motor Trouble-shooting Cause / Corrective Action - Table 4-5

Issue:	Likely Cause:	Corrective Action:
Motor fails to start upon initial installation:		
A.)	Supply voltage is too low or is severely unbalanced (one phase is low or missing).	(1) Check power supply fuses (2) Match motor lead wiring to nameplate connection diagram and supply voltage (3) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (4) Obtain correct motor to match actual supply voltage.
B.)	Motor leads are miswired at conduit box.	
C.)	Driven load exceeds motor capacity.	(1) Verify that motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely. Note: Roller bearings make noise when motor is uncoupled and shaft is rotated (3) Verify that motor starts when disconnected from load (4) Remove excessive / binding load if present.
D.)	Load is jammed.	
E.)	Fan guard is bent and making contact with fan.	Replace fan guard & fan (if blades are damaged).
F.)	VFD with power factor capacitors installed.	Remove power factor correction capacitors if equipped.
G.)	VFD with motor neutral lead grounded.	Ensure that motor neutral lead is ungrounded.
H.)	VFD programmed incorrectly.	(1) Repeat checks listed above (2) Verify that VFD current limit and starting boost are set correctly (3) Double-check motor and feedback parameter settings and VFD permissives (4) Repeat autotune (for vector drives) procedure (7) Consult VFD supplier.
Motor has been running, then slow down, stalls, or fails to restart:		
A.)	Supply voltage has dropped or has become severely unbalanced.	(1) Replace fuse or reset circuit breaker. Allow motor to cool down before resetting manual protector on motor. **Warnings** - See section 1.1 for automatic and manual reset protector warnings (2) Verify that rated and balanced supply voltage has been restored before restarting motor. Measure voltage during restart. Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3).
B.)	Motor is overloaded.	(1) Verify that motor & load turn freely. Repair binding components as needed (2) Reduce driven load to match motor capacity or increase motor size to match load requirements.
C.)	Motor bearings are seized.	
D.)	Load is jammed.	
E.)	VFD will not restart motor after tripping.	(1) Check fault codes on VFD and follow VFD troubleshooting procedures (2) Verify that VFD input voltage is balanced and within limits (3) Remove excessive mechanical load if present.
F.)	Capacitor failure on single phase motor (if equipped).	**Warning: Potential Shock Hazard:** Contact service shop to check capacitor.
Motor takes too long to accelerate:		
A.)	Motor leads are not connected correctly.	Match motor lead wiring to nameplate diagram.
B.)	Supply voltage has dropped or become severely unbalanced.	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (2) Obtain correct motor to match actual supply voltage.
C.)	Load exceeds motor capability.	Determine correct motor size and co replacement motor.
D.)	Faulty start capacitor (Single Phase).	Motor may be too small for load. Record fail. If acceleration time exceeds 3 seconds.
E.)	Mechanical Failure.	(1) Check to make sure motor & load turn ensure motor turns freely.
Motor rotates in the wrong direction:		
A.)	Incorrect wiring connection at motor.	[Single Phase]: Reconnect motor according Some motors are non-reversible.
		[Three Phase]: Interchange any two power
Motor overheats or overload protector repeatedly trips		
A.)	Driven Load is excessive.	(1) If motor current exceeds nameplate \ increased. Correct as needed. (2) If new rating is the same as the old motor. If p general purpose motor may not have the c
B.)	Ambient temperature too high.	Most motors are designed to operate in an Hot Surface Caution)
C.)	Motor cooling fins and/or vent openings blocked.	Remove foreign materials. – clear vent o fins (TEFC motors).
D.)	Insufficient Air Flow.	TEAO (Totally Enclosed Air Over) motors and obtain minimum requirements from mo
E.)	Motor is started too frequently.	See section 3.4.5.3.
F.)	Supply voltage is too low, too high, or unbalanced.	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (2) Reconnect motor per input voltage (3) Obtain correct motor to match power supply.
Motor Vibrates		
A.)	Motor misaligned to load.	Realign load.
B.)	Load out of balance (Direct drive application).	(1) Ensure that load is dynamically balanced. (2) Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is 0.002" runout for shafts extension lengths up to 3.00". Add 0.0005" per every additional inch of shaft length beyond 3.00".
C.)	Uneven tension on multiple belts.	Mixing new with used belts. Replace multiple belt applications with a complete set of matched belts.
D.)	Driven load operating at resonant point / natural frequency.	(1) De-energize motor and record vibration as load coasts from 100% speed to 0 RPM. If vibration drops immediately, vibration source is electrical. If levels do not drop immediately, source is mechanical (2) Redesign system to operate below the resonant point (3) On VFD-driven loads, program skip frequencies to bypass resonant points (4) Increase carrier frequency to obtain <3% THD current (5) On variable torque loads reduce volts/hertz below base speed.
E.)	VFD torque pulsations.	(1) Adjust VFD to obtain <3% THD current @ rated motor current (2) Adjust VFD stability for smooth operation. Vector drives may be unstable at light load.
F.)	Motor miswired at terminal box.	Match motor lead wiring to nameplate connection diagram.
G.)	Uneven, weak or loose mounting support.	Shim, strengthen or tighten where required.
H.)	Motor bearings defective.	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Roller bearings are normally noisy when operated without load. If sleeve bearing, add oil per nameplate instructions. For motors with regreasing provisions, add grease per relubricating instructions (see section 4.2.3). If noise persists contact warranty service.
I.)	Motor out of balance.	Disconnect from load. Set motor on rubber pads on solid floor. Secure a ½ height key in shaft keyway and energize from balanced power supply @ rated voltage. Record vibration levels and compare with appropriate standards. If excessive vibration persists contact motor manufacturer.
Bearings repeatedly fail.		
A.)	Load to motor may be excessive or unbalanced.	(1) If belt drive check system per section 3.3.4. (2) Other than belting, check loading on motor shaft. An unbalanced load will also cause the bearings to fail. (3) Check runouts of mating components, such as a C-face and pump flange.
B.)	Bearings contaminated.	Motor enclosure not suitable for environment. Replace with correct enclosure construction.
C.)	Incorrect grease or bearings for ambient extremes.	See section 4.2.1.
D.)	VFD bearing damage.	Ground brush, common mode filter, or insulated bearings must be added. Contact motor manufacturer.
Motor, at start up, makes a loud rubbing, grinding, or squealing noise.		
A.)	Contact between rotating and stationary components.	Belt squeal during across the line starting is normal. (1) Verify that supply voltage is within limits (see section 3.4.1.3). (2) Ensure that motor lead wiring matches nameplate connection diagram. (3) Isolate motor from load. (4) To locate point of contact, turn motor shaft by hand. (5). If point of contact is not located contact motor service shop.
Start capacitors repeatedly fail.		
A.)	The motor acceleration time is too long.	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
B.)	Motor is being started too frequently.	Excessive starting will damage motor capacitors. Contact motor manufacturer if motor is started more than 20 times/hour or if acceleration time exceeds 3 seconds.
C.)	Motor voltage low.	Verify that voltage at the motor terminals is within limits (see section 3.4.1.3).
D.)	Defective start switch inside motor.	Motor internal switch failure overheats start capacitor. Contact service shop or motor manufacturer.
Run capacitor fails.		
A.)	High ambient temperature.	Verify that the ambient does not exceed motor's nameplate value.
B.)	Input voltage exceeds limit.	Verify that voltage to the motor terminals is within limits (see section 3.4.1.3).
C.)	Power surge to motor (caused by lightning strike or other high transient voltage).	If a common problem, install surge protector.

Installation, Operation and Maintenance Instructions

for AC Induction Motors

A REGAL-BELOIT COMPANY

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE
OWNER: READ AND SAVE THESE INSTRUCTIONS

SAFETY INSTRUCTIONS

⚠ This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ WARNING
Before installing, using, or servicing this product, carefully read and fully understand the instructions including all warnings, cautions, & safety notice statements. To reduce risk of personal injury, death and/or property damage, follow all instructions for proper motor installation, operation and maintenance.

These instructions are not intended as a complete listing of all details for installation, operation, and maintenance. If you have any questions concerning any of the procedures, STOP, and call the appropriate Regal-Beloit motor company.

Table of Contents

motor is suitable for use on Pulse Width Modulated (PWM) type VFD power. In addition, the nameplate must be marked with the inverter rating; for example, “2:1 CT”, “2 to 1 Constant Torque”, etc.

1.0 INSTALLER/OWNER/OPERATOR RESPONSIBILITY:

1.1 ELECTRICAL SAFETY

WARNING: ELECTRICAL SHOCK HAZARD

Electrical connections shall be made by a qualified electrical personnel in accordance with all applicable codes, ordinances and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage. Only qualified personnel who are familiar with the applicable National Code (USA = NEC) and local codes should install or repair electrical motors and their accessories.

WARNING: ELECTRICAL LIVE CIRCUIT HAZARD

Do not touch electrically live parts. Disconnect, lockout and tag input power supply before installing or servicing motor (includes accessory devices). Use a voltmeter to verify that power is off before contacting conductors.

WARNING: ELECTRICAL GROUNDING HAZARD

Failure to properly ground motors, per the National Electrical Code (NEC) Article 430 and local codes may cause serious injury or death to personnel. For general information on grounding refer to NEC Article 250. (Also see “Ground Connections section 3.4.4“).

WARNING: AUTOMATIC RESET PROTECTOR HAZARD

Do not use automatic reset protectors if automatically restarting the motor will place personnel or equipment at risk. . Failure to follow this instruction could result in serious personal injury, death and/or property damage

WARNING: MANUAL RESET PROTECTOR HAZARD

If a tripped manual reset thermal protector is exposed to a temperature less than –7°C (20°F) it may reset and restart the motor automatically. If an application requires a motor with a manual reset thermal protector that will be operated at temperatures less than –7°C (20°F) contact the manufacturer to review the application / motor requirements. Failure to follow this instruction could result in serious personal injury, death and/or property damage

1.2 MECHANICAL SAFETY

WARNING: LOOSE PARTS HAZARD

Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

WARNING: ROTATING PARTS HAZARD

Keep extremities, hair, jewelry and clothing away from moving parts. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

1.3 ENVIRONMENTAL SAFETY

WARNING: HAZARDOUS LOCATIONS

(1) The NEC and the local authority having jurisdiction must be consulted concerning the installation and suitability of motors for use in Hazardous Locations. The local authority having jurisdiction must make the final determination of what type of motor is required. The application and operation is beyond the control of the motor manufacturer.
(2) Division 1 Hazardous Locations motors can only be modified or reworked by the manufacturer or a facility that is Listed under UL’s category “Motors and Generators, Rebuilt for use in Hazardous Locations”. Failure to follow these instructions could result in serious personal injury, death and/or property damage.
(3) Do not use a Hazardous Locations motor with a Variable Frequency Drive (VFD) unless the motor nameplate specifically states that the

2.0 RECEIVING AND INSPECTION

2.1 INITIAL INSPECTIONS

2.1.1 CHECK PACKING LIST AND INSPECT the packaging to make certain no damage has occurred in shipment. If there is visible damage to the packaging, unpack and inspect the motor immediately. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

2.1.2 TURN MOTOR SHAFT by hand to be certain that it rotates freely. Note: Shaft seals and bearing seals may add drag.

2.1.3 CHECK NAMEPLATE for conformance with purchase order requirements and compliance with power supply and control equipment requirements.

2.2 HANDLING:

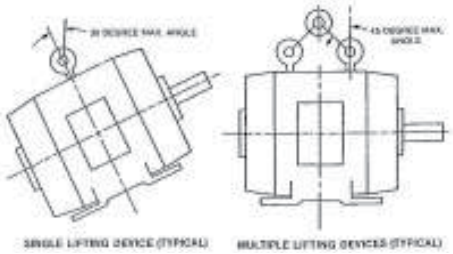
WARNING: FALLING OBJECT HAZARD

Eyebolts or lifting lugs, where provided, are intended for lifting only the motor and accessories mounted by the motor manufacturer (unless specifically stated otherwise on the motor). Utilizing the motor lifting provision to lift other components such as pumps and gear boxes could result in serious personal injury, death and/or property damage.

WARNING: FALLING OBJECT HAZARD

Before using the lifting provision, check the eyebolts and/or other lifting means to assure they are not bent or damaged and are completely threaded, seated & secured to the motor. Equipment to lift motor must have adequate lifting capacity. While lifting the motor DO NOT stand under or in the vicinity of the motor. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

2.2.1 LIFTING ANGLE LIMITATIONS



2.3 STORAGE: Motors, not put into service immediately, must be stored indoors in a clean, dry location. Avoid locations with large temperature swings that will result in condensation. Motors must be covered to eliminate airborne dust and dirt. If the storage location exhibits high vibration, place isolation pads under motor to minimize damage to motor bearings.

2.3.1 BEARING LUBRICATION: Bearings are grease packed at the factory; relubrication upon receipt of motor or while in storage is not necessary. If stored more than one year, add grease per lubrication instructions (Table 4-4) before start-up.

2.3.2 SHAFT ROTATION: It is recommended that the motor shaft be rotated 5 to 10 rotations every three months to distribute the grease in the bearings. This will reduce the chance for corrosion to form on the bearing rolling elements and raceways. Note: Shaft seals and bearing seals may add drag.

2.3.3 DAMP OR HUMID STORAGE LOCATIONS: Treat unpainted flanges, shafts, and fittings with a rust inhibitor. Apply appropriate power to the motor's space heaters (if so equipped)

3.0 INSTALLATION AND OPERATION

⚠ **WARNING:** Only qualified personnel who are familiar with the appropriate national code, local codes and sound practices should install or repair electrical motors and their accessories. Installation should conform to the appropriate national code as well as local codes and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ **WARNING: ELECTRICAL LIVE CIRCUIT HAZARD**
Do not touch electrically live parts. Disconnect, Lockout and Tag input power supply before installing or servicing motor (includes accessory devices). Use a voltmeter to verify that power is off before contacting conductors.

3.1 LOCATION

3.1.1 SELECTING A LOCATION: Consideration should be given to environment and ventilation. Motors should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. A motor with the proper enclosure for the expected operating condition should be selected. Provide accessible clearance for cleaning, repair, service, and inspections (See section 3.1.3 for construction clearances). The location should be considered for possible future motor removal / handling. The free flow of air around the motor should not be obstructed.

3.1.2 AMBIENT TEMPERATURE LIMITS: The ambient temperatures of the air inlet to the motor should not exceed 40°C (104°F) or be less than -30°C (-22°F) unless the motor nameplate specifically states an ambient temperature outside of these limits. The ambient inside an enclosure built around the motor shall not exceed the nameplate ambient. For ambient temperatures outside of these limits consult the motor manufacturer.

⚠ **CAUTION: INSULATION DEGRADATION WARNING**
Insulation at high temperatures ages at an accelerated rate. Each 10°C increase in temperature reduces the insulation life by one half.

⚠ **WARNING: HAZARDOUS LOCATIONS AMBIENT LIMIT:** Division 1 Hazardous Locations motors shall **NOT** be operated below –25°C (-13°F) ambient. (Low temperatures reduce the component mechanical properties.)

3.1.3 CONSTRUCTION SELECTION per LOCATION:

3.1.3.1 DRIPPROOF (OPEN) MOTORS are intended for use indoors where the atmosphere is relatively clean, dry, and non-corrosive. Recommended a minimum clearance of ½ the shaft height between vent openings and the nearest obstruction.

3.1.3.2 TOTALLY ENCLOSED MOTORS are suitable for indoor or outdoor standard service applications.

TEAO or AOM (Totally Enclosed Air Over) motors must be mounted in the air stream. When the motor nameplate states a minimum airflow the motor must be mounted in an air stream meeting this minimum value.

TEFC (Totally Enclosed Fan Cooled) motors must meet a minimum distance of ½ the shaft height between the fan guard grill openings and the nearest obstruction.

3.1.3.3 HAZARDOUS LOCATIONS MOTORS: Hazardous Locations motors are intended for installations in accordance with NEC Article 500. For all installations involving Hazardous Locations motors, consult the applicable national codes, local codes, and the authority having jurisdiction.

Division 1 Installations – includes Class I & II: Use only motors that are UL Listed and CSA Certified or UL Listed and UL Certified for Canada. These motors bear a separate nameplate that includes the UL Listing Mark and CSA Certification Mark or includes the UL Listing Mark and the UL Mark for Canada. This plate also bears the phrase: " Electric motor for Hazardous Locations" and is marked with the Class, Group and Operating Temperature Code.

Division 2 Installations – Class I only: Use only motors that are CSA Certified and bear the CSA Certification Mark. These motors include a phrase on the main motor nameplate that indicates the motor is CSA Certified for Class I, Division 2 / Zone 2 locations.

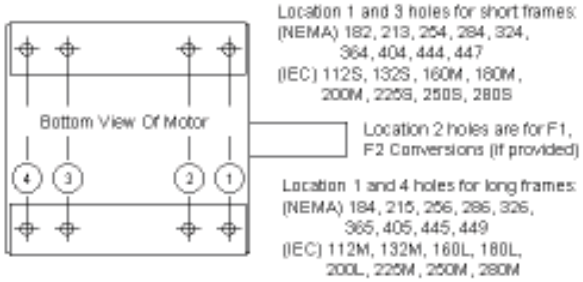
Division 2 Installation – Class II only: Use only Class II motors as described above under "Division I Installations".

⚠ **WARNING: EXPLOSION HAZARD**
A motor should never be placed in an area with a hazardous process or where flammable gases or combustible materials may be present unless it is specifically designed and nameplated for this type of service. Hazardous Locations motors are intended for installations in accordance with NEC Article 500. For all installations involving Hazardous Locations motors, consult the NEC, local codes, and the authority having jurisdiction. Failure to follow these instructions could result in serious personal injury, death and/or property damage. (For other limitations see section 1.3)

3.2 MOUNTING MOTOR:

3.2.1 RIGID BASE (FOOTED): The motor must be securely installed to a rigid foundation or a mounting surface to minimize vibration and maintain alignment between the motor shaft and the load's shaft. The mounting surfaces of the four mounting pads must be flat within 0.01 inches for 210 frame & smaller; 0.015 inches for 250 frame & larger. [IEC 0.25 mm for 130 frame & smaller, 0.38 mm for 160 frame & larger]. This may be accomplished by shims under the motor feet. For special isolation mounting, contact manufacturer for assistance

3.2.2 RIGID BASE HOLE SELECTION -6 OR 8 HOLES



3.2.3 VERTICAL MOUNTING:

CAUTION: ENCLOSURE PROTECTION CAUTION: Most Dripproof rigid base (footed) motors do **NOT** meet "Dripproof" requirements when mounted vertically. If the motor is located in unprotected environments, the addition of a drip cover may be available. Drip covers not available for cast iron rigid base motors.

⚠ **WARNING: FALLING OBJECT HAZARD**
The lifting provision on standard horizontal footed motors is not designed for lifting the motor in a vertical shaft up or shaft down position. (see 2.2.1 lifting angles). Lifting method / provisions for

mounting a rigid base (footed) motor vertically is the responsibility of the installer.

VERTICAL SHAFT DOWN: Most standard horizontal motors thru 449 Fr. (excluding brake motors) can be mounted in a vertical shaft down orientation. For vertical brake motors see section 3.3.6.2.

VERTICAL SHAFT UP:

⚠ **WARNING: HAZARDOUS LOCATIONS VERTICAL MOUNT:** Hazardous locations motors must **NOT** be mounted vertically shaft up without approval by the motor manufacturer. Without proper retaining provisions the rotor may move axially and contact components, creating a spark hazard.

Belted or Radial Load when mounted vertically: The following frame sizes / constructions with applied (axial) down loads within the limit stated are acceptable when mounted vertical shaft up.

Table 3-1 Belted or Radial Load Applications (All speeds)

Frame Size	Enclosure	Construction	Shaft Up OK	Max Applied Down Load[3]
56	TEFC & ODP	Steel	Yes	25 lbs
140	TEFC	Steel & Cast Iron	Yes	25 lbs
	ODP	Steel	Yes	25 lbs
180	TEFC	All	Yes	35 lbs
	ODP	Steel	Yes	35 lbs
210	TEFC	All	Yes	40 lbs
	ODP	Steel	Yes	40 lbs
250	TEFC	All	Yes	40 lbs
	ODP	Steel	Yes	40 lbs
		Cast Iron	No[2]	N/A
280-320	320 TTFC models	Cast Iron	Eng[1]	N/A
	All Other TEFC	Cast Iron & Aluminum	Yes	30 lbs
	ODP	Cast Iron	No[2]	N/A
	TEFC & ODP	Steel	Build Up Only[4]	N/A
360 & Up	TEFC	Cast Iron	Build Up Only[4]	N/A
	ODP	Cast Iron	No[2]	N/A
	TEFC & ODP	Steel	Build Up Only[4]	N/A

Notes:

1 For TEFC model numbers beginning with 324TTFC or 326TTFC consult the motor manufacturer to determine if a build up motor is required.

2 The max applied down load is any applied load external to the motor, including such things as sheave weight, fan loads, axial belt force, pump load, etc. If the application is direct drive with no applied radial load, consult the motor manufacturer.

3 "Build-up only", refers to motors that are specifically ordered and built for shaft up applications. It does not imply that all build-up motors are suitable for shaft up applications.

3.3 APPLICATION ASSEMBLY TO MOTOR:

⚠ **CAUTION: EQUIPMENT DAMAGE:**
Do not connect or couple motor to load until correct rotational direction is established.

3.3.1 GENERAL: PROPER ALIGNMENT of the motor and driven equipment minimizes vibration levels, maximizes bearing life, and extends the overall life of the machinery. Consult the drive or equipment manufacturer for more information.

⚠ **CAUTION: BEARING FAILURE**
During assembly do NOT force components onto the shaft. Striking or hammering the component may result in bearing damage.

3.3.2 DIRECT COUPLING: Use flexible couplings if possible. For applications that apply radial, axial or moment loading on the motor shaft see section 3.3.3.

⚠ **CAUTION: BEARING FAILURE**
Unless approved by the motor manufacturer do **NOT** direct couple a vertical shaft up or roller bearing motor. Direct coupling a vertical shaft up motor or a motor with a roller bearing may result in bearing damage.

3.3.3 DIRECT CONNECTED: Radial loading for direct connected equipment (gears, fans etc.) must be approved by the motor manufacturer unless within the maximum overhung load limits (Table 3-2). Combined loading (axial, radial and/or moments) must be approved by motor manufacturer. For belted loads see section 3.3.4.

Table 3-2 Maximum Radial Load (lbf) @ Middle of the Shaft Extension Length

Frame Number	Motor Rated RPM			
	3600	1800	1200	900
143T	106	166	193	210
145T	109	170	199	218
182T	187	230	261	287
184T	193	237	273	301
213T	319	317	470	510
215T	327	320	480	533
254T	500	631	729	793
256T	510	631	736	820
284T	-	866	990	1100
286T	-	871	1005	1107
324T	-	950	1100	1215
326T	-	950	1113	1230
364T	-	1078	1365	1515
365T	-	1078	1380	1540
404T	-	1388	1590	1762
405T	-	1400	1610	1780
444T	-	1580	1795	2005
445T	-	1520	1795	1985
447T	-	1455	1765	1985
449T	-	1640	1885	2130

Values based on 26,280 hrs B-10 Life
For "End of Shaft" Load multiply value by 0.88
To convert from lbf to N multiply value by 4.4482.

3.3.4 BELTED:

The goal of any belted system is to efficiently transmit the required torque while minimizing the loads on the bearings and shafts of the motor and driven equipment. This can be accomplished by following four basic guidelines:

1. Use the largest practical sheave diameter.
2. Use the fewest number of belts possible.
3. Keep sheaves as close as possible to support bearings.
4. Tension the belts to the lowest tension that will still transmit the required torque without slipping. It is normal for V-belts to squeal initially when line starting a motor

3.3.4.1 Sheave Diameter Guidelines:

In general, smaller sheaves produce greater shaft stress and shaft deflection due to increased belt tension. See Table 3-3 for recommended minimum sheave diameters. Using larger sheaves increases the contact with belts which reduces the number of belts required. It also increases the belt speed, resulting in higher system efficiencies. When selecting sheaves, do not exceed the manufacturer's recommended maximum belt speed, typically 6,500 feet per minute for cast iron sheaves. Determine belt speed by the following formula:

Figure 1

$$\text{BELT SPEED (Ft/min)} = \frac{\text{Shaft RPM} \times 3.14 \times \text{Sheave Dia (inches)}}{12}$$

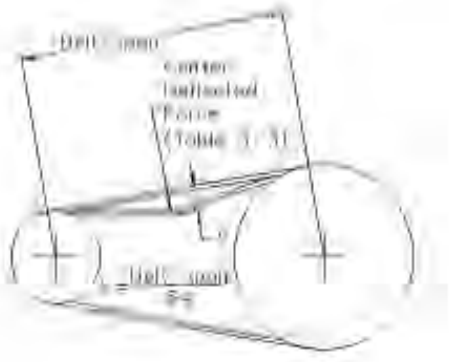
3.3.4.2 Number of Belts

In general, use the fewest number of belts that will transmit the required torque without slipping. See Table 3-3 for recommended maximum number of belts. Each belt adds to the tension in the system, which increases load on the shafts and bearings. Belts are most efficient when operated at or near their rated horsepower.
If the sheaves have more grooves than the number of belts required, use the grooves closest to the motor.

3.3.4.3 Sheave Location

Install sheaves as close to the housing as possible to increase the bearing life of the motor and driven equipment

Figure 2



3.3.4.4 Belt Tension

⚠ CAUTION: Equipment Failure Caution
Belt tensioning by feel is NOT acceptable. Tensioning by "feel" can be very misleading, and can damage motor and equipment.
It is normal for V-belts to squeal initially when line starting a motor.

In general, belt tensions should be kept as loose as possible while still transmitting the required torque without slipping. Belt tensions must be measured with a belt tension gage. These inexpensive gages may be obtained through belt manufacturers, or distributors.

Proper belt tension is determined by measuring the force required to deflect the center of the belt a given distance. The proper deflection (in inches) is determined by dividing the belt span in inches by 64. Calculate the proper deflection and then see Table 3-3 for the required "Deflected Force" to achieve that deflection.
After tensioning the belt, rotate the sheaves for several rotations or operate the system for a few minutes to seat belts into the grooves, then re-tension the belts. New belts will stretch during use, and should be retensioned after the first eight hours of use.

Table 3-3 Recommended Minimum Sheave Diameters, Belt Type, Number of Belts and Deflected Force

Motor Hp	1200 rpm				1800 rpm				3600 rpm			
	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)	Min Sheave Dia (in)	Belt Type	Max # of Belts	Avg. Deflected Force (lbs)
0.75	2.2	3VX	1	3.4	2.2	3VX	1	3.2	2.2	3VX	1	1.2
1	2.4	3VX	1	4.0	2.2	3VX	1	3.1	2.2	3VX	1	1.6
1.5	2.4	3VX	2	3.1	2.4	3VX	2	2.1	2.2	3VX	1	2.5
2	2.4	3VX	3	2.8	2.4	3VX	2	2.9	2.4	3VX	1	2.7
3	3.0	3VX	2	3.3	2.4	3VX	3	2.9	2.4	3VX	2	2.3
5	3.0	3VX	3	4.0	3.0	3VX	3	3.7	2.4	3VX	3	2.5
7.5	3.8	3VX	4	4.7	3.0	3VX	4	4.1	3.0	3VX	2	4.2
10	4.4	3VX	4	5.4	3.8	3VX	4	4.3	3.0	3VX	3	3.8
15	4.4	3VX	5	5.4	4.4	3VX	4	5.4	3.8	3VX	3	4.4
20	5.2	3VX	6	6.0	4.4	3VX	6	4.8	4.4	3VX	3	5.0
25	6.0	3VX	7	5.6	4.4	3VX	7	5.2	4.4	3VX	4	4.7
30	6.8	3VX	7	5.9	5.2	3VX	7	5.3				
40	6.8	5VX	4	11.6	6.0	3VX	7	6.0				
50	8.2	5VX	4	14.6	6.8	3VX	8	5.9				
60	8.2	5VX	5	14.1	7.4	5VX	4	13.3				
75	10.0	5VX	5	14.5	8.6	5VX	4	14.3				
100	10.0	5VX	6	16.0	8.6	5VX	6	13				
125	12.0	5V	7	14.1	10.5	5V	6	13.1				
150	13.2	5V	7	15.4	10.5	5V	7	13.4				
200	15.0	5V	8	16.0	13.2	5V	8	13.1				
250	15.0	8V	6	27.6	14.0	5V	9	13.8				
300	16.0	8V	7	27.1	14.0	5V/8V	11 / 7	23.4				
350	16.5	8V	7	30.3	14.5	5V/8V	12 / 7	26.0				
400	17.5	8V	8	29.1	15.0	5V/8V	13 / 8	25.7				
450	18	8V	8	31.6	16.0	5V/8V	14 / 9	25.2				
500	18.5	8V	9	30.7	16.5	5V/8V	15 / 9	26.9				
600					17.5	8V	11	26.3				
700					19.0	8V	12	27.3				
800					20.0	8V	13	28.2				

Contact Motor Manufacturer when Belting 3600 rpm Motors Greater than 25 HP

Notes:

1. Horsepower is the nameplate motor horsepower, and RPM is the motor (driver) speed.
2. Minimum sheave diameters are from NEMA standards where applicable.
3. **For variable speed applications or values outside these recommendations, consult motor manufacturer.**
4. Selections are based on a 1.4 service factor, 5 to 1 speed ratio and various Power Transmission Manufacturers' catalogs.
5. These selections are for Narrow V-belt sections only. Consult manufacturer for details on conventional V-belt sections (A, B, C, D and E), or other belt types.
6. *Average Deflected Force is per section 3.3.4.4 of this document and is the force required to deflect the center of a belt 1/64 of the belt span distance. Tolerance on this force is ±1 lbf for forces ≤10 lbs, and ±2 lbs for forces >10 lbs as measured utilizing a belt tension gage.
7. When more than one belt is required the belts must be a matched set (matched for length).
8. If possible, the lower side of the belt should be the driving side to increase the length of wrap on the sheave).
9. For belted loads do not exceed 125% of 60 Hz operating RPM.

3.3.5 VFD (Variable Frequency Drives) OPERATION:

⚠ WARNING: VFD Motors with Reset Thermal Protectors
UL Recognition, UL Listing, or CSA certification does not apply to motors that are equipped with a manual or automatic reset thermal protector when the motor is operated on VFD power.

⚠ WARNING: Power Factor Correction Capacitors:
Power factor correction capacitors should never be installed between the drive and the motor.

⚠ CAUTION: VFD / Motor Setup:
It is the responsibility of the startup personnel during set up of the VFD / motor system to properly tune the drive to the motor for the specific application per the VFD user manual. The correct voltage boost and volts per hertz settings are application dependent and unique to each motor design. Failure to connect over temperature devices (when provided) will void the warranty.

3.3.5.1 Overspeed Capability:

Belted loads: Do not exceed 125% of 60 Hz operating RPM.

Table 3-4 Maximum Safe Continuous Speed (RPM) For Coupled and Direct Connected Loads

NEMA / [IEC] Frame Size	2-Pole	4, 6, or 8 Pole
56-180 [80-110]	7200 *	5400 *
210-250 [130-160]	5400 *	4200*
280 [180]	5400 *	3600
320 [200]	4500 *	3600
360 [225]	4500 *	2700
400-440 [250-280]	3600	2700
>440 [>280]	3600	1800

* = Fan cooled motors (Totally Enclosed & Hazardous Locations Motors) are limited to a maximum safe continuous speed of 4000 RPM **For higher speeds or shortened duty cycle contact motor manufacturer**

3.3.5.2 Cable Lengths: For optimum insulation life, limit VFD to motor cable lengths of general purpose motors

to Table 3-5 values. Definite purpose VFD motors may accommodate longer cable lengths. For additional information contact motor manufacturer.

Table 3-5 Max Cable Lengths General Purpose Motors
These values are based on 3 kHz carrier frequency. Add suitable VFD output-side filters when exceeding the listed values.

Frame Size	230V	460 V	575 V
NEMA 56-320	600 ft.	125 ft.	40 ft.
NEMA 360-5011	1000 ft.	225 ft.	60 ft.
IEC 80-200	180 m.	40 m.	12 m.
IEC 225-280.	300 m.	70 m.	18 m.

3.3.5.3 VFD Grounding: Equipment grounding conductors may be run in the same conduit as the AC motor power leads. This wire must be used as the equipment ground for the motor and not as the fourth current carrying wire of a "WYE" motor circuit. The grounded metal conduit carrying the output power conductors can provide EMI shielding, but the conduit does not provide an adequate ground for the motor; a separate grounding conductor must be used. Grounding the motor neutral (WYE) of a VFD powered motor may result in a VFD ground fault trip. Improper grounding of an inverter fed motor may result in frame voltages in excess of 500 Volts. Refer to Grounding section 3.4.4

3.3.5.4 VFD – Single Phase:

CAUTION: SINGLE PHASE MOTOR FAILURE:
Single Phase motors are **NOT** suitable for use on VFD power. Connecting a Single Phase Motor to a VFD voids the warranty.

3.3.5.5 Stray Voltage on Accessory Leads:

VFD's will couple stray (common-mode) voltage to motor-mounted RTDs, thermistors, thermostats and space heaters. The leads of these elements must be properly insulated and control input circuits must be designed to withstand this common-mode voltage.

3.3.6 ACCESSORIES / PROVISIONS:

3.3.6.1 General: Carefully read and understand the accessory manufacturer's instructions, supplied with motor. Contact the manufacturer for additional information.

3.3.6.2 Brake Motors:

⚠ CAUTION: Vertical Motor Premature Brake Failure
Motors with brakes that are designed for vertical applications are equipped with springs to support the brake pressure plate. Mounting a horizontal brake motor vertically shaft up or down may require a pressure plate spring modification. Failure to modify the brake for the vertical application may result in premature brake failure. If in question, consult brake literature or brake manufacturer.

Brake Solenoid Wiring: Do NOT connect the brake solenoid to the output of a VFD. The brake solenoids must be wired to 50/60 Hz line power

3.3.6.3 Space Heaters:

Motors provided with space heaters have two leads that are brought into the conduit box or into an auxiliary box. These leads are marked "H1", "H2" ("H3", "H4" if a second space heater is supplied). See the space heater nameplate on motor for heater rating.

⚠ WARNING: DIVISION 2 EXPLOSION HAZARD
The space heater temperature rating when used in Class I, Division 2 motors shall **NOT** exceed 80% of the auto ignition temperature of the hazardous gas or vapor. See the space heater nameplate on motor for heater Temperature Code and heater rating. Failure to follow this instruction could result in serious personal injury, death and/or property damage

3.3.6.4 Thermal Protection:

General Information: When thermal protection is provided, one of the following will be stamped on the nameplate:

1. **"THERMALLY PROTECTED"** This motor has built in thermal protection. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded. The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, disconnect motor from power supply. After protector cools (five minutes or more) press the reset button and reapply power to the motor. In some cases a motor is marked "Auto" and the connection diagram on the motor will identify T'Stat leads – see "2 " below. (See warnings on Manual and Automatic reset protectors - section 1.1)

2. **"WITH OVERHEAT PROTECTIVE DEVICE"**: This motor is provided with an overheat protective device that does not directly open the motor circuit. Motors nameplated with this phrase have either thermostats, thermisters or RTD's. The leads to these devices are routed into the motor conduit box or into an auxiliary box. The lead markings are defined on the nameplate (normally "P1", "P2") . The circuit controlled by the overheat protection device must be limited to a maximum of 600 volts and 360 volt-amps. See connection decal provided inside the terminal box cover. Failure to connect these over temperature devices (when provided) will void the warranty.

   ⚠ WARNING: EXPLOSION HAZARD
   For Hazardous Locations motors provided with thermostats UL and the NEC require connection of thermostat leads into the control portion of a manual reset start circuit. Failure to follow this instruction could result in serious personal injury, death and/or property damage

Resistance Temperature Detectors (RTD): When winding and/or bearing RTDs are provided the RTD lead markings are defined on the nameplate. (Normally "R1", "R2", "R3" etc.)

3.3.6.5 RTD Alarm & Trip Settings:

Tables 3-6 & 3-7 are suggested initial RTD alarm and trip settings. For motors found to operate significantly below these values the settings may be reduced accordingly.

Table 3-6 Winding RTD – Temperature Limit (°C) 40 °C Max Ambient

Motor Load	Class B Temp Rise≤ 80°C		Class F Temp Rise≤ 105°C	
	Alarm	Trip	Alarm	Trip
Up to 1.0 SF	130	140	155	165
>1.0 to 1.15 SF	140	150	160	165

Table 3-7 Bearing RTD – Temperature Limit (°C) 40 °C Max Ambient

Ambient	Alarm	Trip
Up to 40°C	95	100
> 40°C	110	115
Bearings that are Heat Stabilized to 150 °C	130	135

3.3.7 GUARDS:

⚠ WARNING: ROTATING PARTS HAZARD
When devices are assembled to the motor shaft, be sure to install protective devices such as belt guards, chain guards, and shaft covers. These devices must protect against accidental contact with extremities, hair, and clothing. Consider the application and provide guarding to protect personnel. Remove all unused shaft keys and loose rotating parts to prevent them from flying off and causing bodily injury. Failure to follow this warning could result in serious personal injury, death and/or property damage.

3.4 ELECTRICAL CONNECTIONS:

⚠ WARNING: ELECTRICAL HAZARDS
Before proceeding read Section 1-1 on Electrical Safety. Failure to follow the instructions in Section 1-1 could result in serious personal injury, death and/or property damage

3.4.1 POWER SUPPLY / BRANCH CIRCUIT

⚠ WARNING: POWER SUPPLY INCOMPATIBILITY HAZARD
Check power supply to make certain that voltage, frequency and current carrying capacity are in accordance with the motor nameplate. Failure to match motor nameplate values could result in serious personal injury, death and/or property damage

⚠ WARNING: BRANCH CIRCUIT SUPPLY HAZARD
Motor and control wiring, fusing, overload protection, disconnects, accessories and grounding must always conform to the applicable electrical codes as well as local codes and sound practices.

3.4.1.1 Branch Circuit Supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and correctly sized thermal elements or overload relay protection.

3.4.1.2 Fuses, Breakers, Overload Relays
Short Circuit Current Fuses or Breakers are for the protection of the branch circuit. Starter or motor controller overload relays are for the protection of the motor. Each of these should be properly sized and installed per the applicable electrical codes as well as local codes and practices.

⚠ WARNING: PROTECTIVE DEVICE DISABLED HAZARD
DO NOT bypass or disable protective devices. Protection removal could result in serious personal injury, death and/or property damage

3.4.1.3 AC Power Supply Limits
Motors are designed to operate within the following limits at the motor terminals:
1- AC power is within +/- 10 % of rated voltage with rated frequency applied. (Verify with nameplate ratings) **OR**
2- AC power is within +/- 5% of rated frequency with rated voltage **OR**
3- A combined variation in voltage and frequency of +/- 10% (sum of absolute values) of rated values, provided the frequency variation does not exceed +/-5% of rated frequency.
4- For 3 phase motors the line to line full load voltage must be balanced within 1%.
5- If the motor is rated 208-230V, the voltage deviations must be calculated from 230V.

CAUTION: Reduced Motor Performance
Operation outside of these limits will degrade motor performance and increase operating temperature.

3.4.2 TERMINAL BOX:

3.4.2.1 Conduit Opening: For ease of connections, motors are typically provided with large terminal boxes. Most motors have conduit access in 90 degree increments, the terminal box conduit opening is typically provided via knockouts, holes with covers, or the terminal box is rotate-able. Fabricated conduit boxes may have a removable plate for the installer to provide correctly sized hole(s).

3.4.2.2 Hazardous Locations Motors:

⚠ WARNING: EXPLOSION HAZARDS
(1) Terminal Boxes mounted to motor with a pipe nipple: If a pipe nipple mounted terminal box is removed or rotated it must be reassembled with a minimum of five full threads of engagement.
(2) Component Removal: Do not set a terminal box component on its machined surfaces. Prior to component reassembly wipe clean all machined surfaces.
(3) Machined Surface Gap (Hazardous Locations Terminal Boxes): The gap between mating surfaces with the machined terminal box MUST BE LESS THAN 0.002 inches. This gap must be checked with a feeler gage along the entire perimeter. If there is visible damage to the mating surfaces, or if the gap between these surfaces exceeds 0.002 inches, DO NOT complete the installation and contact the motor manufacturer. Failure to follow these instructions could result in serious personal injury, death and/or property damage

3.4.3 LEAD CONNECTIONS
Electrical connections to be made per nameplate connection diagram or separate connection plate. In making connections follow the applicable electrical code as well as local codes and practices.

⚠ WARNING: ELECTRICAL CONNECTION HAZARD
Failure to correctly connect the motor leads and grounding conductor can result in injury or death. Motor lead connections can short and cause damage or injury if not well secured and insulated.

3.4.3.1 Wire Size (Single Phase) Requirements
The minimum wire size for Single Phase, 115 & 230 Volt Circuits must meet table 3-8 for a given distance between motor and either Fuse or Meter Box.

Table 3-8 Minimum Wire Gage Size Single Phase 115 & 230 Volt Circuits

Distance (Feet) - Motor to Fuse or Meter Box								
Motor	100 Ft.		200 Ft.		300 Ft.		500 Ft.	
HP	115	230	115	230	115	230	115	230
1/4	14	14	10	12	8	10	6	8
1/3	12	14	10	12	6	10	4	8
1/2	10	12	8	10	6	8	4	6
3/4	10	12	6	10	4	8	2	6
1	8	10	6	8	4	6		4
1 1/2	4	10	0	8		6		4
2		8		6		4		2
3		8		6		4		2
5		6		4		2		0

3.4.3.2 Extension Cords (Single Phase Motors):
Where an extension cord(s) is utilized to provide power to the motor the extension cord(s) must be…(1) the proper gauge size per table 3-8, (2) in good working condition (3) properly grounded.

3.4.4 GROUND CONNECTION(S):

⚠ WARNING: ELECTRICAL GROUNDING HAZARD
For general information on grounding (USA) refer to NEC Article 250. Improper grounding of an inverter fed motor may result in frame voltages in excess of 500 Volts. In making the ground connection, the installer must make certain that a good electrical connection is obtained between motor and grounding lead. Failure to properly ground motors, per the applicable national code (such as NEC Article 430) and local codes may cause serious injury or death to personnel.

Primary "Internal" Ground: A grounding conductor must be connected to the grounding terminal provided in the terminal housing. This grounding terminal is either a ground screw, ground lug, or a tapped hole to be used with a separately provided ground screw. The internal grounding feature is accessible inside the terminal housing and must be used as the primary grounding connection.
Secondary "External" Ground: Some motors are provided with a supplemental grounding terminal located on the external surface of the motor frame or feet. This external terminal is for supplemental bonding connections where local codes permit or require such connection

3.4.5 START UP:

⚠ WARNING: ELECTRICAL SHOCK HAZARD:
Be certain that all connections are secure and the conduit box cover is fastened in place before electrical power is connected. Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

⚠ WARNING: LOOSE & ROTATING PARTS HAZARD
Before proceeding read Section 1-2 on Mechanical Safety. Failure to follow the instructions in Section 1-2 could result in serious personal injury, death and/or property damage

⚠ WARNING: EXCESSIVE SURFACE TEMPERATURE HAZARD
Motors with the temperature code stated on the nameplate are designed to operate within this limit. Improper application or operation can cause the maximum surface temperature to be exceeded. A motor operated in a Hazardous Location that exceeds this surface temperature limit increases the potential of igniting hazardous materials. *Therefore, motor selection, installation, operation, and maintenance must be carefully considered to ensure against the following conditions:* (1) Motor load exceeds service factor value, (2) Ambient temperature above nameplate value, (3) Voltages outside of limits (3.4.1.3), (4) Loss of proper ventilation, (5) VFD operation exceeding motor nameplate rating, (6) Altitude above 3300 feet / 1000 meters, (7) Severe duty cycles, (8) Repeated starts, (9) Motor stall, (10) Motor reversing, and (10) Single phase operation. Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ CAUTION: HOT SURFACE
Normal motor surface temperatures may exceed 90 ° C (194° F). Touching the motor frame may cause discomfort or injury. Surface temperatures should only be measured with suitable instruments and not estimated by hand touch.

3.4.5.1 Start Up - No Load Procedure

1. **Check Instructions:** Before startup carefully read and fully understand these instructions including all warnings, cautions, and safety notice statements.
2. **Motor out of storage after more than three months:** Check winding insulation integrity with a Megger. If winding resistance to ground is less than 1.5 Meg-ohms consult the local authorized service shop before energizing the motor.
3. **Check Installation: Mechanical** - Check tightness of all bolts and nuts. Manually rotate the motor shaft to ensure motor shaft rotates freely. Note: Shaft & bearing seals will add drag.
   Electrical - Inspect all electrical connections for proper terminations, clearance, mechanical tightness and electrical continuity. Be sure to verify connections are made per the nameplate connection diagram or separate connection plate. Replace all panels and covers that were removed during installation before energizing the motor.
4. **Energize Motor: Check Rotation**
   If practical check motor rotation before coupling to the load. Unlock the electrical system. Momentarily provide power to motor to verify direction of rotation. If opposite rotation is required, lock out power before reconnecting motor. If motor has a rotational arrow only operate the motor in the rotation identified. Reapply power to ensure proper operation.
5. **Record No Load Amps, Watts & Voltage:**
   Recommend - To establish a baseline value check and record the no load amps, watts, and voltage.

3.4.5.2 Start Up – Load Connected Procedure

1. **Check Instructions:** Before startup carefully read and fully understand these instructions including all warnings, cautions, & safety notice statements.
2. **Coupling Installation:** Check that the connected equipment is properly aligned and not binding. Check that all guards and protective devices are properly installed.
3. **Energize Motor:** When all personnel are clear of the machine, apply power and verify that the load is not transmitting excessive vibration back to the motor though the shaft or the foundation. Verify that motor amps are within nameplate rating. For repeated starts see 3.4.5.3. The equipment can now be fully loaded and operated within specified limits as stated on the nameplate.

3.4.5.3 Jogging and/or Repeated Starts

Do not start more than twice in succession under full load. Repeated starts and/or jogs of induction motors can cause overheating and immediate failure. Contact the motor manufacturer if it is necessary to repeatedly start or jog the motor.

4.0 MAINTENANCE:

⚠ WARNING: Hazardous Locations Motor Repair HAZARD:
Division 1 Hazardous Locations motors can only be modified or repaired by the manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage.

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Electrical connections are to be made by qualified electrical personnel in accordance with all applicable codes, ordinances and sound practices. Failure to follow these instructions could result in serious personal injury, death and/or property damage. Only qualified personnel who are familiar with the applicable national codes, local codes and sound practices should install or repair electric motors and their accessories.

⚠ WARNING: ELECTRICAL LIVE CIRCUIT HAZARD
Do not touch electrically live parts. Disconnect, lockout and tag input power supply before installing or servicing motor (includes accessory devices).

4.1 GENERAL INSPECTION

Inspect the motor approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation and fin openings clear. The following steps should be performed at each inspection:

4.1.1 VENTILATION: Check that the ventilation openings and/or exterior of the motor is free of dirt, oil, grease, water, etc, which can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.

4.1.2 INSULATION: Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. If winding resistance to ground is less than 1.5 Meg-ohms consult the local authorized service shop before re-energizing the motor.

4.1.3 ELECTRICAL CONNECTIONS: Check all electrical connectors to be sure that they are tight.

4.2 LUBRICATION & BEARINGS:

The lubricating ability of grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Longer bearing life can be obtained if the listed recommendations are followed:

NOTE: If lubrication instructions are provided on the motor nameplate, the nameplate instructions will supersede these instructions. Motors marked "Permanently Lubricated" do not require additional service.

⚠ CAUTION: BEARING / MOTOR DAMAGE WARNING
Lubricant should be added at a steady moderate pressure. If added under heavy pressure bearing shield(s) may collapse. Over greasing bearings greatly increases bearing friction and can cause premature bearing and/or motor failure.

4.2.1 GREASE TYPE (unless nameplate states otherwise):
Nameplate Ambient Temperature between -30°C (-22°F) to 65°C (150°F) inclusive: Recommended grease for standard service conditions is Mobil Polyrex ® EM. Equivalent and compatible greases include: Texaco Polystar RB, Rykon Premium #2, Pennzoil Pen 2 Lube, Chevron SRI & Mobil SHC 100.

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

Nameplate Ambient Temperature above 65°C (150°F): Dow Corning DC44 or equivalent, a special high temperature grease is required. Note that Dow Corning DC44 grease does not mix with other grease types.

For RTD settings see Table 3-7.

4.2.2 BEARING OPERATING TEMPERATURE:

⚠ CAUTION: HOT SURFACE

The external surface temperature of the end shield (bracket) bearing hub may reach 100° C (212° F) during normal operation. Touching this surface may cause discomfort or injury. Surface temperatures should only be measured with suitable instruments and not estimated by hand touch.

4.2.3 LUBRICATION INTERVALS: (For motors with regreasing provisions)

Eq. 4.2 Lubrication Interval = [(Table 4-1) hrs] x [Interval Multiplier (Table 4-2)] x [Construction Multiplier (Table 4-3)]

Table 4-1 Lubrication Intervals (Hours) These values are based on average use.

NEMA / [IEC] Frame Size	Operating Speed – RPM (See Table 3.4 for Maximum Operating Speed)					
	<7200	<5400	<4500	<3600	<1800	<1200
56-180 [80-110]	2500 Hrs.	4000 Hrs	5000 Hrs	6000 Hrs.	17000 Hrs.	20000 Hrs.
210-250 [130-160]		2500 Hrs	4000 Hrs	5000 Hrs.	12000 Hrs.	16000 Hrs.
280 [180]		2000 Hrs	3000 Hrs	4000 Hrs.	10000 Hrs.	14000 Hrs.
320 [200]			2000 Hrs	3000 Hrs.	9000 Hrs.	12000 Hrs.
360 [225]			1500 Hrs	2000 Hrs.	8000 Hrs.	10000 Hrs.
400-440 [250 – 280]				1500 Hrs.	4000 Hrs.	7000 Hrs.
>440 [>280]				1000 Hrs.	3000 Hrs.	5000 Hrs.

Seasonal Service: If motor remains idle for more than six months, Lubricate at the beginning of the season, then follow lubrication interval.

Do not exceed maximum safe operating speed Table 3-4 without manufacturer's approval

Table 4-2 Service Conditions

Use highest level Multiplier: Maximum Ambient Temperature and Contamination are independent factors

Severity of Service	Maximum Ambient Temperature	Atmospheric Contamination	Multiplier
Standard	Less than 40° C (104° F)	Clean, Slight Corrosion, indoors, less than 16 hrs per day	1.0
Severe	Above 40° C (104° F) to 50° C	Moderate dirt or Corrosion or outdoors or more than 16 hrs per day	0.5
Extreme	Greater than 50° C or Class H Insulation	Severe dirt or Abrasive dust or Corrosion	0.2

Table 4-3 Construction Multiplier

Construction	Multiplier
Angular Contact or Roller Bearing	0.5
Vertical Motor	0.5
All others	1.0

Table 4-4 Relubrication Amounts

Frame Size		Volume		
NEMA	IEC	Cu. In.	Fluid oz	ml
48-56	80	0.25	0.14	4.0
143-145	90	0.25	0.14	4.0
182-184	110	0.50	0.28	8.0
213-215	130	0.75	0.42	12.5
254-256	160	1.00	0.55	16.0
284-286	180	1.50	0.83	25.0
324-326	200	2.00	1.11	33.0
364-365	225	3.00	1.66	50.0
404-405	250	3.80	2.11	62.0
444-449	280	4.10	2.27	67.0
>449	>280	4.50	2.50	74.0

For regreasing while operating multiply volume by 125%.

4.2.4 LUBRICATION PROCEDURE: (For Motors with Regreasing Provisions)

CAUTION: BEARING DAMAGE WARNING
Added grease must be compatible with the original equipment's grease. If a grease other than those stated in 4.2.1 is to be utilized contact the motor manufacturer. Nameplate information supersedes section 4.2.1 (GREASE TYPE). New grease must be free of dirt. Failure to follow these instructions and procedure below may result in bearing and/or motor damage.

For an extremely dirty environment, contact the motor manufacturer for additional information.

LUBRICATION PROCEDURE:

1. Clean the grease inlet plug or zerk fittings prior to regreasing.
2. (If present) Remove grease drain plug and clear outlet hole blockage.

CAUTION: GREASE DRAIN PLUGGED:
Old grease may completely block the drain opening and must be mechanically removed prior to regreasing. Forcing a blocked drain open by increased greasing pressure may collapse bearing shields and / or force excess grease through the bearings and into the motor.

3. Add grease per Table 4-4
4. Re-install grease inlet and drain plugs (if removed).

⚠ WARNING: EXPLOSION HAZARD
Do NOT energize a Hazardous Locations motor without all grease fittings properly installed.

4.2.5 EXAMPLE: LUBRICATION

Assume - NEMA 286T (IEC 180), 1750 RPM Vertical motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 4-1 list 10,000 hours for standard conditions.
2. Table 4-2 classifies severity of service as "Severe" with a multiplier of 0.5.
3. Table 4-3 lists a multiplier value of 0.5 for "Vertical"
4. (Eq. 4.2) Interval = 10,000 hrs x 0.5 x 0.5 = 2500 hrs

Table 4-4 shows that 1.5 in^3 of grease is to be added.

Relubricate every 2,500 hrs of service with 1.5 in^3 of recommended grease.

4.3 TROUBLE-SHOOTING

⚠ WARNING: READ INSTRUCTIONS:
Before trouble-shooting a motor, carefully read and fully understand the warnings, cautions, & safety notice statements in this manual.

⚠ WARNING: Hazardous Locations Motor Repair:
Motors nameplated for use in Division 1 Hazardous Locations can only be disassembled, modified or repaired by the plant of manufacturer or a facility that is Listed under UL's category "Motors and Generators, Rebuilt for use in Hazardous Locations". Failure to follow these instructions could result in serious personal injury, death and/or property damage

CAUTION: DISASSEMBLY APPROVAL REQUIRED:
Motor disassembly must be performed by a party approved by the motor manufacturer. To disassemble the motor without approval voids the warranty.

4.3.1 GENERAL TROUBLE-SHOOTING WARNINGS

1. **DISCONNECT POWER TO THE MOTOR BEFORE PERFORMING SERVICE OR MAINTENANCE.**
2. **Discharge all capacitors before servicing motor.**
3. **Always keep hands and clothing away from moving parts.**
4. **Be sure required safety guards are in place before starting equipment.**
5. **If the problem persists contact the manufacturer.**

4.3.2 Motor Trouble-shooting Cause / Corrective Action - Table 4-5

Issue:	Likely Cause:	Corrective Action:
Motor fails to start upon initial installation:		
A.)	Supply voltage is too low or is severely unbalanced (one phase is low or missing).	(1) Check power supply fuses (2) Match motor lead wiring to nameplate connection diagram and supply voltage (3) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (4) Obtain correct motor to match actual supply voltage.
B.)	Motor leads are miswired at conduit box.	
C.)	Driven load exceeds motor capacity	(1) Verify that motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely. Note: Roller bearings make noise when motor is uncoupled and shaft is rotated (3) Verify that motor starts when disconnected from load (4) Remove excessive / binding load if present.
D.)	Load is jammed.	
E.)	Fan guard is bent and making contact with fan	Replace fan guard & fan (if blades are damaged)
F.)	VFD with power factor capacitors installed	Remove power factor correction capacitors if equipped
G.)	VFD with motor neutral lead grounded	Ensure that motor neutral lead is ungrounded
H.)	VFD programmed incorrectly	(1) Repeat checks listed above (2) Verify that VFD current limit and starting boost are set correctly (5) Double-check motor and feedback parameter settings and VFD permissives (6) Repeat autotune (for vector drives) procedure (7) Consult VFD supplier.
Motor has been running, then slow down, stalls, or fails to restart:		
A.)	Supply voltage has drooped or has become severely unbalanced	(1) Replace fuse or reset circuit breaker. Allow motor to cool down before resetting manual protector on motor. **Warnings** - See section 1.1 for automatic and manual reset protector warnings (2) Verify that rated and balanced supply voltage has been restored before restarting motor. Measure voltage during restart. Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3).
B.)	Motor is overloaded	(1) Verify that motor & load turn freely. Repair binding components as needed (2) Reduce driven load to match motor capacity or increase motor size to match load requirements.
C.)	Motor bearings are seized	
D.)	Load is jammed.	
E.)	VFD will not restart motor after tripping	(1) Check fault codes on VFD and follow VFD troubleshooting procedures (2) Verify that VFD input voltage is balanced and within limits (3) Remove excessive mechanical load if present.
F.)	Capacitor failure on single phase motor (if equipped)	**Warning: Potential Shock Hazard**: Contact service shop to check capacitor.
Motor takes too long to accelerate:		
A.)	Motor leads are not connected correctly	Match motor lead wiring to nameplate diagram.
B.)	Supply voltage has drooped or become severely unbalanced.	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3). Correct as needed (2) Obtain correct motor to match actual supply voltage.
C.)	Load exceeds motor capability	Determine correct motor size and contact motor representative to obtain replacement motor.
D.)	Faulty start capacitor (Single Phase)	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
E.)	Mechanical Failure	(1) Check to make sure motor & load turn freely (2) Disconnect motor from load & ensure motor turns freely
Motor rotates in the wrong direction:		
A.)	Incorrect wiring connection at motor	[Single Phase] Reconnect motor according to wiring schematic provided. Note: Some motors are non-reversible
		[Three Phase] Interchange any two power supply (phase) leads.
Motor overheats or overload protector repeatedly trips		
A.)	Driven Load is excessive	(1) If motor current exceeds nameplate value, ensure that driven load has not increased. Correct as needed. (2) If new motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a general purpose motor may not have the correct performance.
B.)	Ambient temperature too high	Most motors are designed to operate in an ambient up to 40 °C. (See section 4.2.2 Hot Surface Caution)
C.)	Motor cooling fins and/or vent openings blocked	Remove foreign materials – clear vent openings, fan guard air inlets and frame fins (TEFC motors)
D.)	Insufficient Air Flow	TEAO (Totally Enclosed Air Over) motors: Measure airflow next to motor surface and obtain minimum requirements from motor manufacturer.

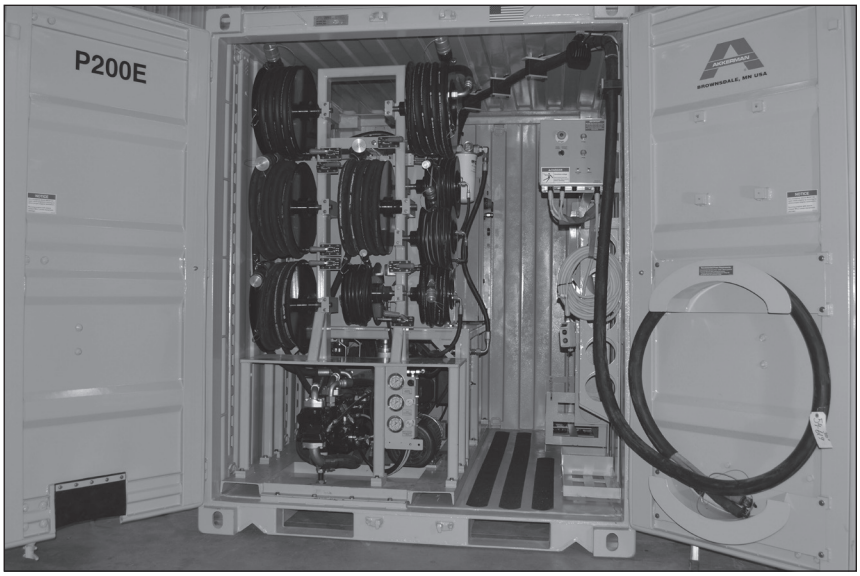
	E.)	Motor is started too frequently	See section 3.4.5.3
	F.)	Supply voltage too low, too high, or unbalanced	(1) Ensure that steady state supply voltage at motor terminals is within limits (see section 3.4.1.3) Correct as needed (2) Reconnect motor per input voltage (3) Obtain correct motor to match power supply.
Motor Vibrates			
	A.)	Motor misaligned to load.	Realign load
	B.)	Load out of balance (Direct drive application)	(1) Ensure that load is dynamically balanced: (2) Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is 0.002" runout for shafts extension lengths up to 3.00". Add 0.0005" per every additional inch of shaft length beyond 3.00".
	C.)	Uneven tension on multiple belts	Mixing new with used belts. Replace multiple belt applications with a complete set of matched belts
	D.)	Driven load operating at resonant point / natural frequency	(1) De-energize motor and record vibration as load coasts from 100% speed to 0 RPM. If vibration drops immediately, vibration source is electrical. If levels do not drop immediately, source is mechanical (2) Redesign system to operate below the resonant point (3) On VFD-driven loads, program skip frequencies to bypass resonant points (4) Increase carrier frequency to obtain <3% THD current (5) On variable torque loads reduce volts/hertz below base speed.
	E.)	VFD torque pulsations	(1) Adjust VFD to obtain <3% THD current @ rated motor current (2) Adjust VFD stability for smooth operation. Vector drives may be unstable at light load.
	F.)	Motor miswired at terminal box	Match motor lead wiring to nameplate connection diagram.
	G.)	Uneven, weak or loose mounting support.	Shim, strengthen or tighten where required.
	H.)	Motor bearings defective	Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Roller bearings are normally noisy when operated without load. If sleeve bearing, add oil per nameplate instructions. For motors with regreasing provisions, add grease per relubricating instructions (see section 4.2.3). If noise persists contact warranty service.
	I.)	Motor out of balance	Disconnect from load. Set motor on rubber pads on solid floor. Secure a ½ height key in shaft keyway and energize from balanced power supply @ rated voltage. Record vibration levels and compare with appropriate standards. If excessive vibration persists contact motor manufacturer.
Bearings repeatedly fail.			
	A.)	Load to motor may be excessive or unbalanced	(1) If belt drive check system per section 3.3.4. (2) Other than belting, check loading on motor shaft. An unbalanced load will also cause the bearings to fail. (3) Check runouts of mating components, such as a C-face and pump flange.
	B.)	Bearings contaminated.	Motor enclosure not suitable for environment. Replace with correct enclosure construction
	C.)	Incorrect grease or bearings for ambient extremes.	See section 4.2.1
	D.)	VFD bearing damage	Ground brush, common mode filter, or insulated bearings must be added. Contact motor manufacturer.
Motor, at start up, makes a loud rubbing, grinding, or squealing noise.			
	A.)	Contact between rotating and stationary components	Belt squeal during across the line starting is normal: (1) Verify that supply voltage is within limits (see section 3.4.1.3). (2) Ensure that motor lead wiring matches nameplate connection diagram: (3) Isolate motor from load. (4) To locate point of contact turn motor shaft by hand. (5) If point of contact is not located contact motor service shop.
Start capacitors repeatedly fail.			
	A.)	The motor acceleration time is too long	Motor may be too small for load. Record acceleration time. Start capacitors may fail if acceleration time exceeds 3 seconds.
	B.)	Motor is being started too frequently	Excessive starting will damage motor capacitors. Contact motor manufacturer if motor is started more than 20 times/hour or if acceleration time exceeds 3 seconds.
	C.)	Motor voltage low	Verify that voltage at the motor terminals is within limits (see section 3.4.1.3).
	D.)	Defective start switch inside motor	Motor internal switch failure overheats start capacitor. Contact service shop or motor manufacturer.
Run capacitor fails.			
	A.)	High ambient temperature	Verify that the ambient does not exceed motor's nameplate value

	B.)	Input voltage exceeds limit	Verify that voltage to the motor terminals is within limits (see section 3.4.1.3).
	C.)	Power surge to motor (caused by lightning strike or other high transient voltage).	If a common problem, install surge protector.

NOTES

Specifications

P200E FEATURES & SPECIFICATIONS



FEATURES

- Assembly comes complete with the GBM P200E Power Pack, remote control pendant, 50 foot hydraulic hose set to connect hoses from the power pack to the GBM 4800 Series jacking frame, emergency stop button & standard tooling for pilot tube installation.
- Standard tooling includes: pilot tube breakout tool, pilot tube scraper, pilot tube to reaming head adapter, steering head kit, theodolite shaft stand, wrench set, and launch shaft breakout tool.
- Access doors on one end for motor access and tooling storage area.
- Powered by one 200HP electric motor for jacking, auger rotation and PCH cutter bit rotation functions.
- Three load sense, variable volume piston pumps provide smooth efficient operation.
- Remote control pendant with 50 feet of cable controls the motor functions in shaft.
- Hydraulic hoses are stored on hose reels for ease of hose routing to jacking frame.
- Quick coupler connections with lock for easy and secure hydraulic hoses at jacking frame.
- The 44 gpm cooling circuit with oil cooler maintains hydraulic oil at low operating temperatures.
- Hydraulic pressure gauges for monitoring jacking and rotation (auger drive & PCH cutter drive) system pressures.
- Equipped with E-Stop control at the operational end of container for quick access.

SPECIFICATIONS

Dimensions
- Height ..... 96 in. (2,438 mm)
- Width ..... 96 in. (2,4383 mm)
- Length ..... 77.5 in. (1,969 mm)

Weight ..... 10,000 lbs. (4,536 kg)

Fluid Capacities
- Hydraulic Reservoir ..... 100 gal (379 L)

Power Source - 480V, 60Hz, 3 Phase
- Electric Motor ..... 200 HP (149 kW)

Power Requirement (Recommended)
..... 225kW / 280kVA @ 480VAC

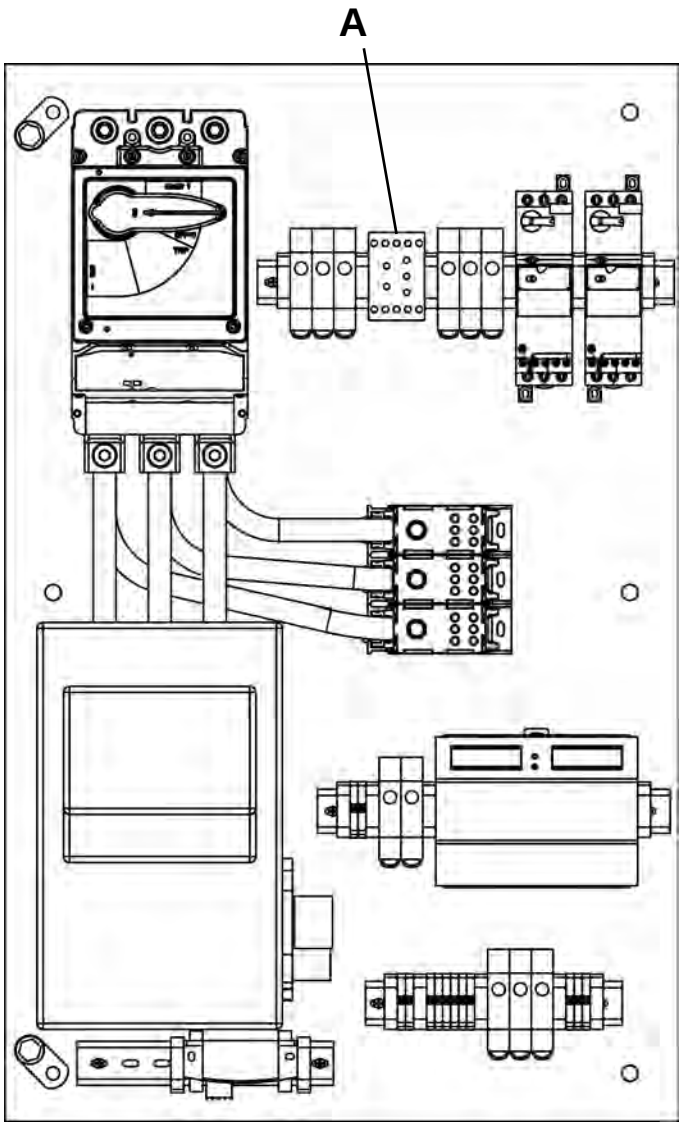
Generator Minimum Motor Starting kVA
770skVA with less than 35% instantaneous voltage dip and greater than 90% sustained voltage

Pumps
- Variable Piston
  - Jacking .... 0 to 34 gpm (0 to 129 L/min)
  - Rotation: Auger ..... 0 to 62 gpm (0 to 235 L/min)
  - Rotation: PCH Cutter Drive ..... 0 to 62 gpm (0 to 235 L/min)
- Operating Pressure (Maximum)
  - Rotation ..... 5,000 psi (34.475 mPa)
  - Jacking ..... 6,000 psi (41.368 mPa)
- Gear Pump (Cooling) .. 44 gpm (167 L/min)

Breakout Tool
- Breaking Torque 12,000 ft-lbs (16,272 N·m)
- Power Source ..... 110 VAC

Pilot Tube/Reaming Head Adapter
.....4.15” OD x 3” ID Hex Core x 5” OD

RELAY SETTINGS

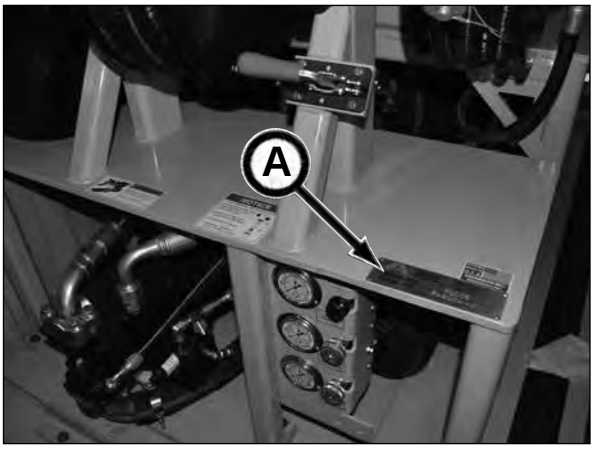


Phase Check Relay (A)

Undervoltage 90%
Nominal Voltage 480
Unbalance 10%
Time Delay Undervoltage (Seconds) 0.1
Time Delay Restart (Seconds) 1

Identification Numbers

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



P200E Power Pack (A)

Model Number _____

Serial Number _____

NOTES

Safety Data Sheets

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

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

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

NOTES

Warranty

Akkerman warrants that all equipment manufactured by it be free from defects due to workmanship or material when normally used and serviced for a period of 90 days from the date of shipment by Akkerman. Normal wear and tear to the equipment, including, but not limited to, wear on the cutter face tooling, hydraulic filters, augers, casings, slurry line and seals is not covered by this warranty. Akkerman does not warrant that the equipment meets the requirements of any particular safety code or rule governing equipment classification. If the Customer has questions about local safety codes, rules or ordinances, authorities local to the project should be consulted.

In order to be considered as a potential warranty claim, the component in question must be returned to Akkerman (freight prepaid) for factory inspection and analysis, and determination of warranty applicability. No warranty is provided for electronics or electrical components of any kind. The validity of all warranty claims are subject to the discretion and determination of the Akkerman Aftermarket Support Department. All such determinations are final.

NOTES

Alphabetical Index

H (continued)

I

J

K

L

M

M (continued)

N

O

O (continued)

P

P (continued)

R

S

T

U

V

W

Parts
Contents

INTRODUCTION

This parts section of the manual contains assembly illustrations of the Akkerman P200E Power Pack. The illustrations in this section are intended to show typical construction of various parts. In some instances, the details of parts illustrated may not exactly represent their actual appearance, but will help to identify parts performing the same functions.

LOCATING PARTS

This manual is organized to help you locate parts information quickly. An Alphabetical Index, Section 16, is provided to determine the page number of the assembly a part is used. If the part number is known, the Numerical Index, Section 18, can also be utilized to find the page number of the assembly.

USE GENUINE AKKERMAN PARTS

The use of second-rate parts could affect the efficient performance of the Power Pack. ALWAYS use genuine Akkerman parts.

PARTS ORDERING

To order fast, accurate, and reliable parts service, call (800) 533-0386, (507) 567-2261, or fax (507) 567-2720, and provide the following information.

1. Model Number
2. Serial Number
3. Part Number, Description, and Quantity
4. Shipping Preference

MEASUREMENTS

The unit of measure in this manual is in inches unless indicated otherwise.

HARDWARE SPECIFICATION

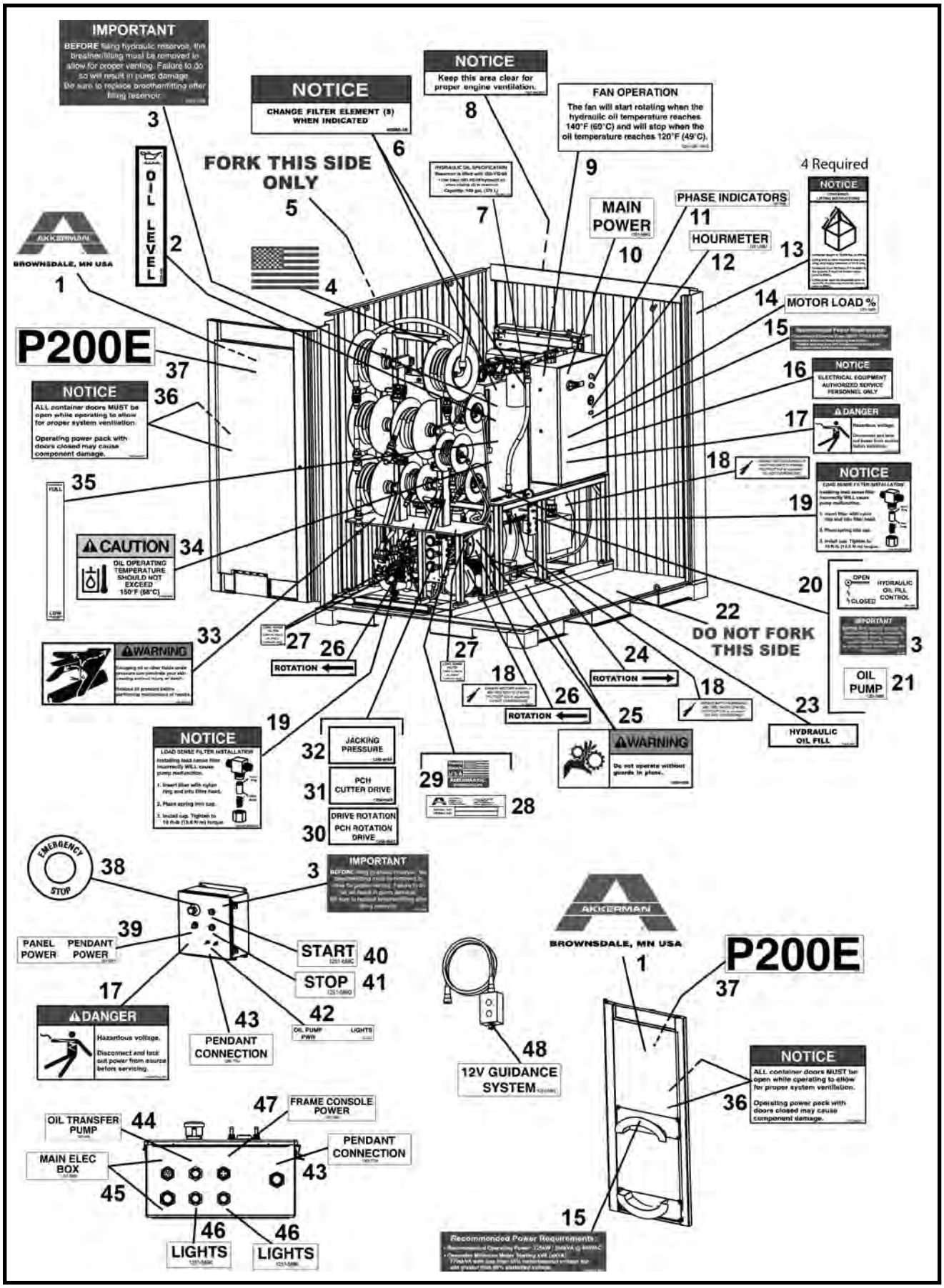
All Akkerman products are assembled with SAE Grade 8 bolts, nuts, and washers. ALWAYS use matched fastener hardware when replacing or repairing the unit.

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

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

NOTES

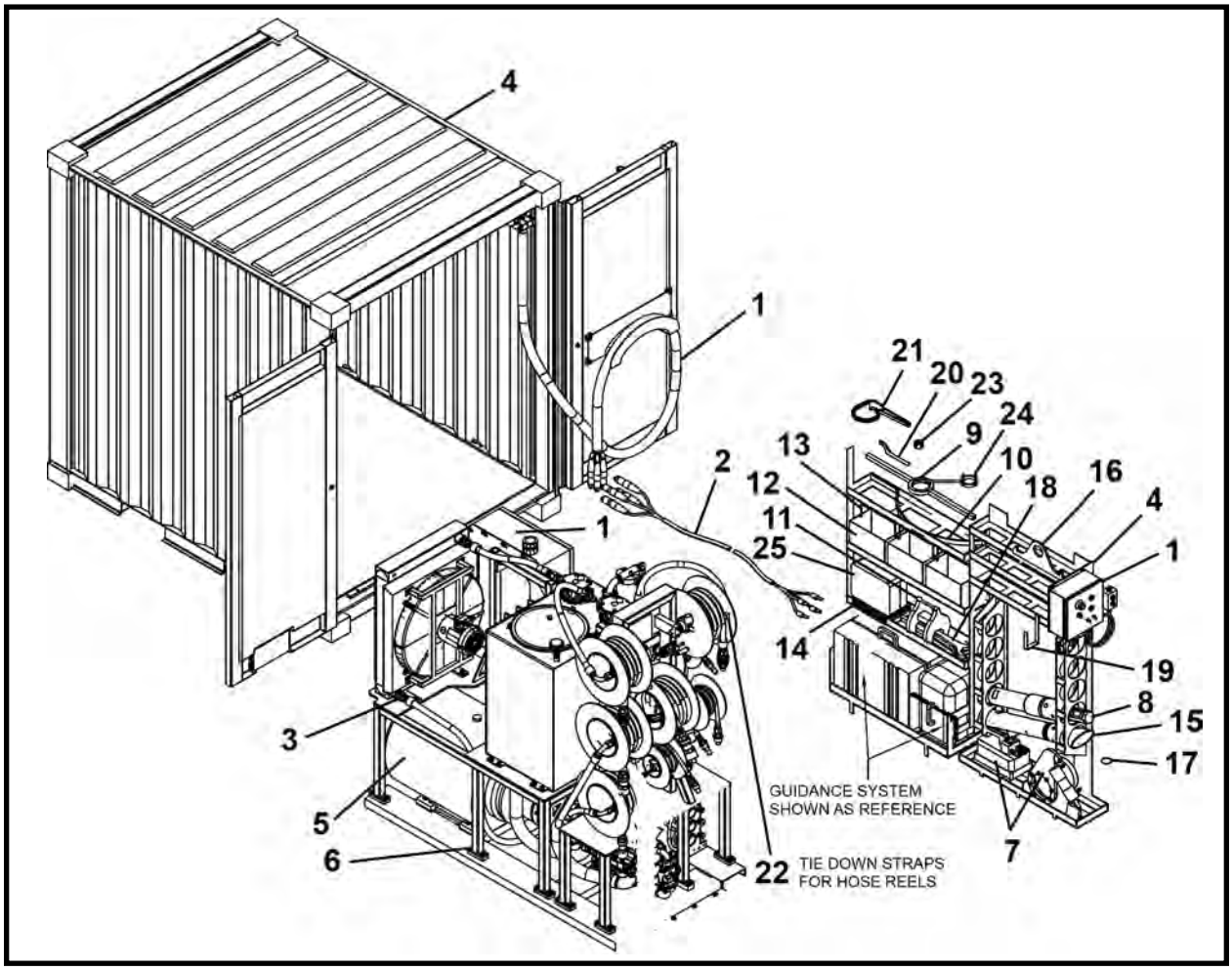
P200E POWER PACK DECALS, 1255-013



P200E POWER PACK DECALS. 1255-013

ITEM	QTY	PART NO.	DESCRIPTION
0	1	1255-013	KIT, P200E Power Pack Decal
1	2	1251-245	DECAL, Akkerman Logo - XL
2	1	1250-649	DECAL, Oil Level
3	3	1251-598	DECAL, Important: Remove Breather
4	1	1250-558	DECAL, Flag USA
5	1	1250-931	DECAL, Fork This Side Only
6	2	40000-16	DECAL, Notice, Change Filter
7	1	1251-695	DECAL, Hydraulic Oil Specification
8	1	1251-664	DECAL, Keep Area Clean For Ventilation
9	1	1251-591	DECAL, Fan Operation
10	1	1251-589G	DECAL, Main Power
11	1	1251-589E	DECAL, Phase Indicators
12	1	1251-589J	DECAL, Hourmeter
13	4	1251-694	DECAL, Lifting Instructions
14	1	1251-589F	DECAL, Motor Load %
15	2	1251-693	DECAL, Recommended Power Requirements
16	1	1250-383	DECAL, Notice, Electrical Equipment
17	2	1250-385	DECAL, Danger, Hazardous Voltage
18	3	1251-349	DECAL, Grease Motors Annually
19	2	1250-872	DECAL, Load Sense FIlter Installation
20	1	1251-696	DECAL, Hydraulic Oil Fill Control
21	1	1251-589B	DECAL, Oil Pump
22	1	1251-196	DECAL, Do Not Fork This Side
23	1	1250-854	DECAL, Hydraulic Oil Fill - Laminated
24	1	3-700R	DECAL, Rotation - Right
25	2	1250-004	DECAL, Keep Guards In Place
26	2	3-700L	DECAL, Rotation - Left
27	3	1250-873	DECAL, Load Sense Filter
28	1	-	PLATE, Serial Number
29	1	1250-544	DECAL, Proudly Made In USA
30	1	1250-958C	DECAL, Drive Rotation/PCH Rotation Drive
31	1	1250-958B	DECAL, PCH Cutter Drive
32	1	1250-958A	DECAL, Jacking Pressure
33	1	1251-593	DECAL, Warning, Contact With Pressurized Hydraulics
34	1	1250-483	DECAL, Caution, Oil Temperature
35	1	1250-932	DECAL, Oil Level
36	4	1251-338	DECAL, Notice, Doors Must Be Open
37	2	1251-691	DECAL, P200E Model
38	1	P0310-474F	DECAL, Emergency Stop
39	1	1251-589H	DECAL, Panel Power / Pendant Power
40	1	1251-589C	DECAL, Start
41	1	1251-589D	DECAL, Stop
42	1	1251-589A	DECAL, Oil Pump Pwr / Lights
43	2	1250-775d	DECAL, Pendant Connection
44	1	1251-589L	DECAL, Oil Transfer Pump
45	2	1251-589M	DECAL, Main Elec. Box
46	2	1251-589K	DECAL, Lights
47	1	1251-589N	DECAL, Frame Console Power
48	1	1251-589I	DECAL, 12V Guidance System

P200E POWER PACK ASSEMBLY, FA40041F



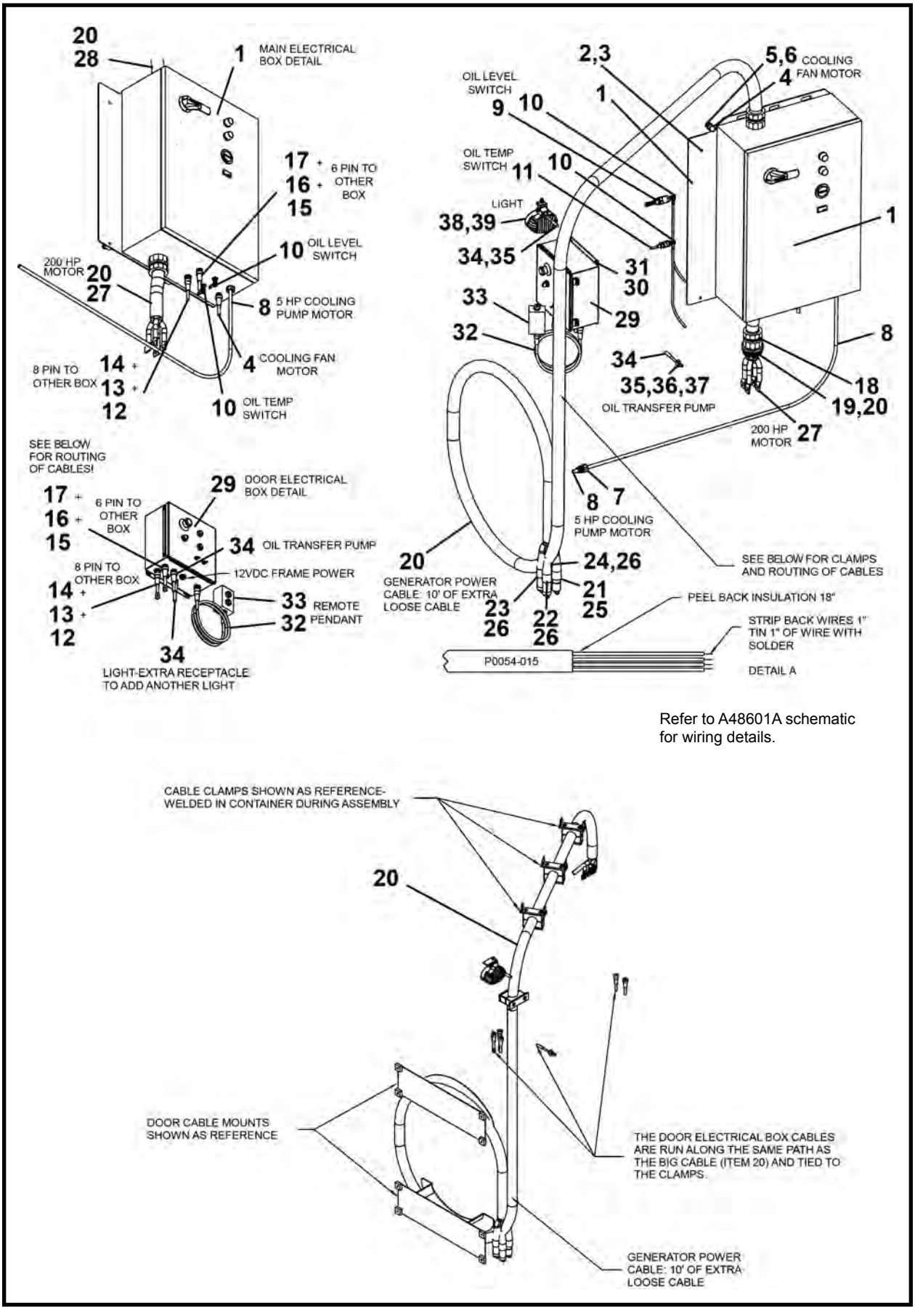
ITEM	QTY	PART NO.	DESCRIPTION
0	1	FA40041F	POWER PACK ASSEMBLY P200E
1*	1	A48601A	ELECTRICAL ASSEMBLY (not shown)
2	1	A48602A	GEN CABLE ASSEMBLY, 25 Ft.
3*	1	A48606A	HYDRAULICS ASSEMBLY (not shown)
4*	1	A48607A	CONTAINER ASSEMBLY
5*	1	A48608A	MOTOR PUMP MOUNT ASSEMBLY
6*	1	A48609A	BASE ASSEMBLY
7	1	FA40230F	DUAL TUBE BREAKOUT TOOL
8	1	FA41403F	ADAPTER, Reaming Head
9	1	FA40482F	SCRAPER, Pilot Tube
10	2	A40118P	SUPPORT, Pilot Tube
11	1	FA42240F	ASSEMBLY, Break-out Tool Launch
12	3	A42686P	BASKET, Container
13	3	A42687P	HANDLE, Basket
14	1	050110A	MANUAL
15	1	FA40245F	ASSEMBLY, Steering Head
16	1	A40540P	LIFTING BAR, Pilot Tube Holder
17	25	P0085-228	ORING
18	1	FA40244F	WRENCH SET
19	1	A47097P	BRACKET, Hose
20	1	F0095-103	WRENCH, Spanner
21	1	F0095-105	WRENCH, Chain
22	9	003060A00	TIE DOWN

P200E POWER PACK ASSEMBLY, FA40041F

ITEM	QTY	PART NO.	DESCRIPTION
23	1	A47915P	WRENCH, Pilot Tube Cap
24	REF	A40740A	WRENCH, Spindle Nut
25*	1	A03883A	ASSEMBLY, Nitrogen Purge
26*	1	1255-013	KIT, Decal P200E (not shown)

* Refer to this section for parts information.

ELECTRICAL ASSEMBLY, A48601A



Refer to A48601A schematic for wiring details.

ELECTRICAL ASSEMBLY, A48601A

ITEM	QTY	PART NO.	DESCRIPTION
0		A48601A	ELECTRICAL ASSEMBLY
1*	1	A48628A	MAIN ELECTRICAL BOX ASSEMBLY
2	4	P0040-006	WASHER, Hardened Flat 3/8
3	4	P0001-06-004	BOLT, Hex 3/8 UNC x 1
4	1	P0054-287	CABLE, 4 Pin 16 GA Mini M/F x 6 Ft
5	1	P0054-286	RECEPTACLE, 4 Pin 16 GA Mini Male x 12 in.
6	1	P0311-018	NUT, Lock 1/2
7	1	P0311-150	CONNECT, Straight Cord 3/4 Aluminum
8	100 LI	P0054-009	CABLE, 4 Con 14 GA Black 600V
9	1	P0251-440	SWITCH, Liquid Level
10	2	P0054-571	CABLE, 4 Pin 4 90° Male 5 Pin 90° Female 18G x 6 Ft
11	1	P0251-543	SWITCH, Single Set Point Temp
12	1	P0054-083A	CABLE, 8 Pin 16 GA Mini Extension 12 Ft
13	1	P0054-196	CABLE, Adapter Extension 6-8 Pole
14	1	P0054-083	CABLE, 8 Pin 16 GA Mini M/F x 6 Ft
15	1	P0054-086A	CABLE, 6 Pin 16 GA Mini M/F x 12 Ft
16	1	P0054-195	CABLE, Adapter Extension 2-5 Pole
17	1	P0054-086	CABLE, 6 Pin 16 GA Mini M/F x 6 Ft
18	1	P0311-129	STRAIN RELIEF 2-1/2
19	1	P0311-144	BUSHING, Reducing 3 - 2-1/2
20	300 LI	P0054-619	CABLE, 4/0 W 4 Cond
21	1	P0054-667	PLUG, 2/0-4/0 Female Green
22	1	P0054-666	PLUG, Male Detach Camloc Yellow
23	1	P0054-665	PLUG, Male Detach Camloc Orange
24	1	P0054-664	PLUG, Male Detach Camloc Brown
25	1	P0054-378	CAP, Protective Female
26	3	P0054-374	CAP, Protective Green
27	4	P0055-211	LUG, Compression 4/0
28	3	P0054-509	CONNECTOR
29*	1	A48629A	DOOR ELECTRICAL BOX ASSEMBLY
30	4	P0040-004	WASHER, Hardened Flat 1/4
31	4	P0001-04-002	BOLT, Hex 1/4 UNC x .5
32	1	P0054-658	CABLE, 8 Pin 16 GA Mini M/F x 50 Ft
33	1	A48128A	REMOTE PENDANT ASSEMBLY
34	2	P0054-167A	PIG, 2 Pin 16 GA Mini Male x 25 Ft
35	2	P0055-206-003	HEAT SHRINK, 3/8 x 3
36	1	P0056-009	SWITCH, Toggle
37	1	P0056-010	BOOT, Toggle Switch
38	2	P0313-008	SOCKET #16
39	1	P0251-438	LIGHT, Flood 24V LED

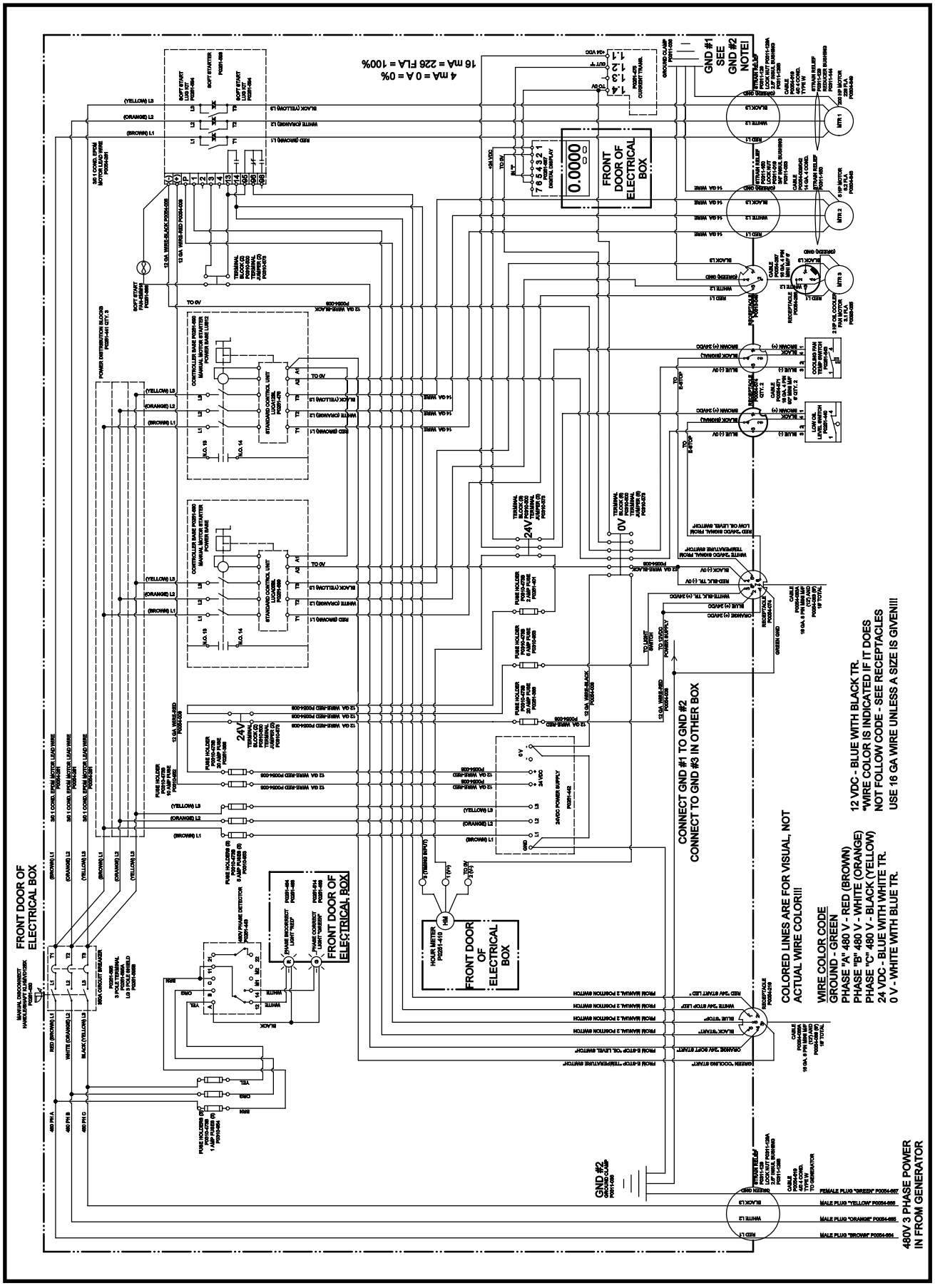
LI - Linear Inch

NOTE: Refer to A48601A schematic for wiring details.

Contact your Akkerman Aftermarket Support representative for soft start setting or adjustments.

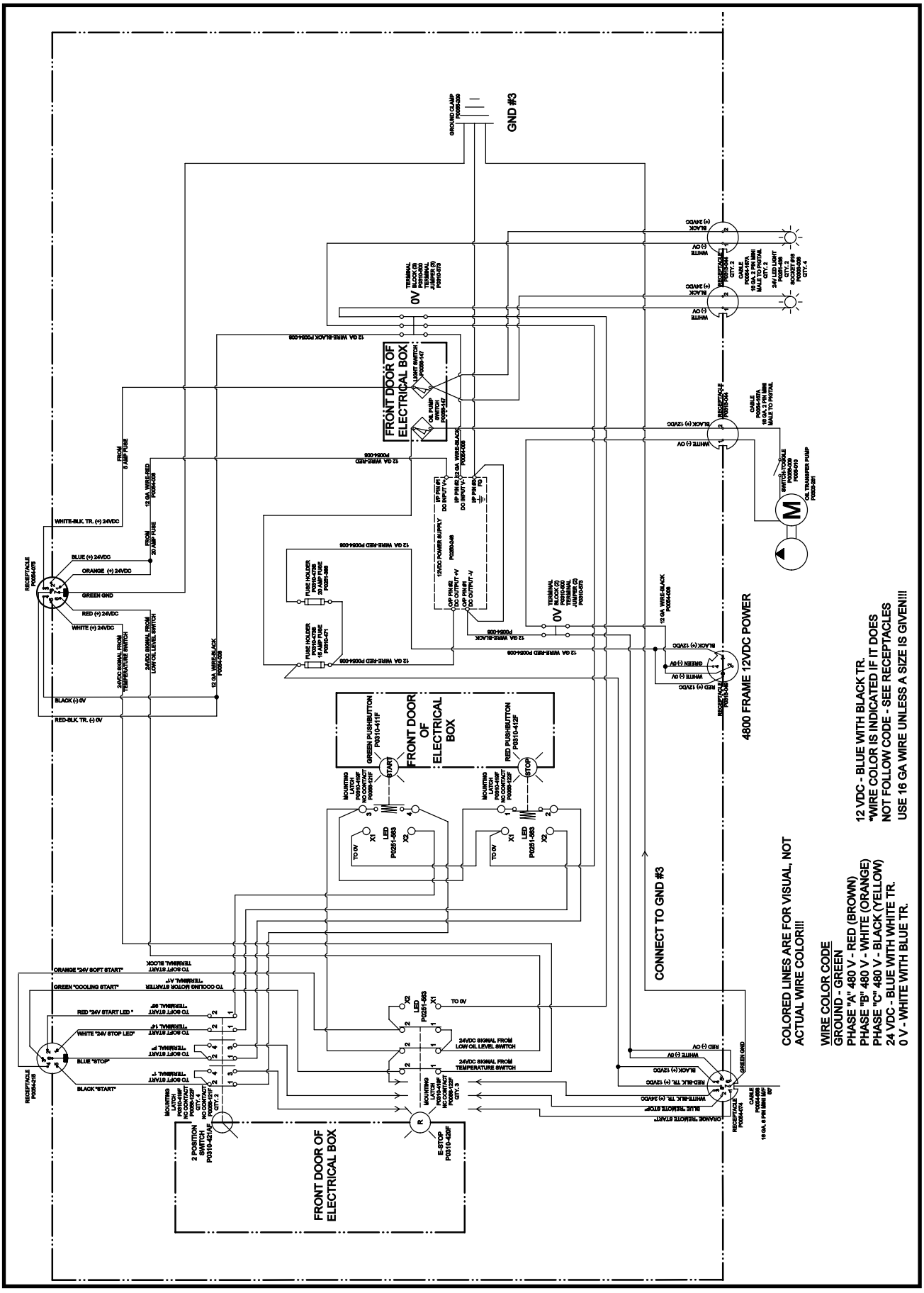
P200E ELECTRICAL SCHEMATIC, A48601A

Part 1 of 2

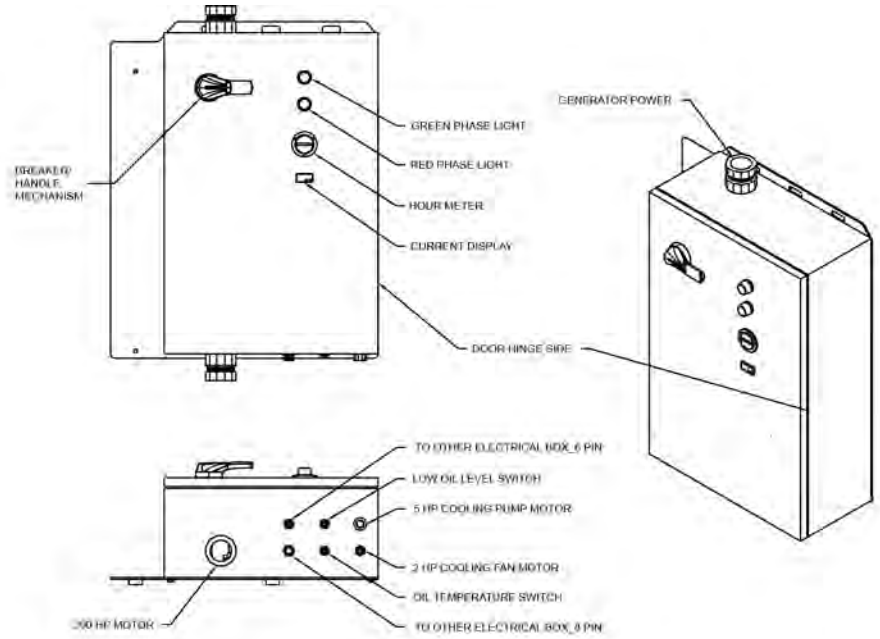


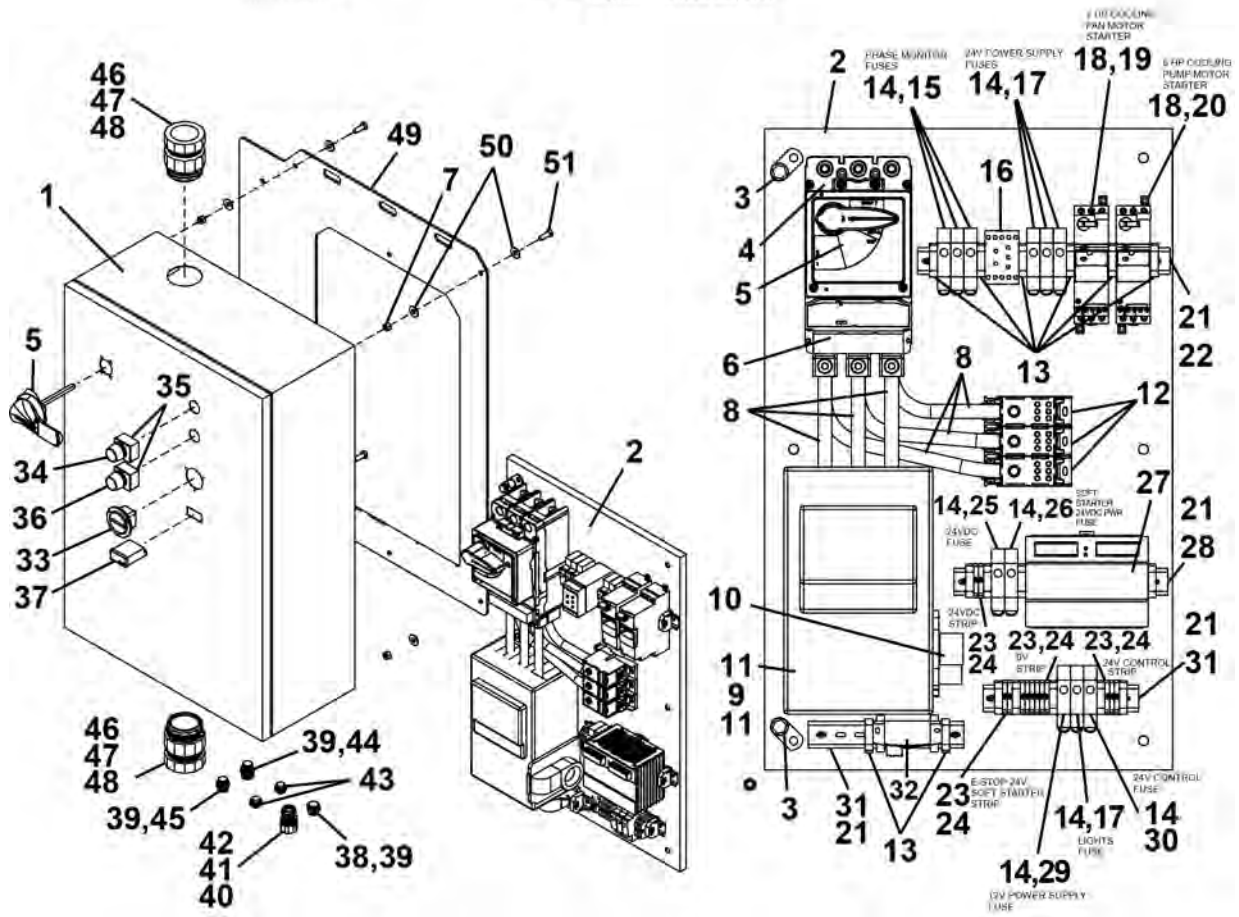
P200E ELECTRICAL SCHEMATIC, A48601A

Part 2 of 2



MAIN ELECTRICAL BOX ASSEMBLY, A48628A





Refer to A48601A schematic
for wiring details.

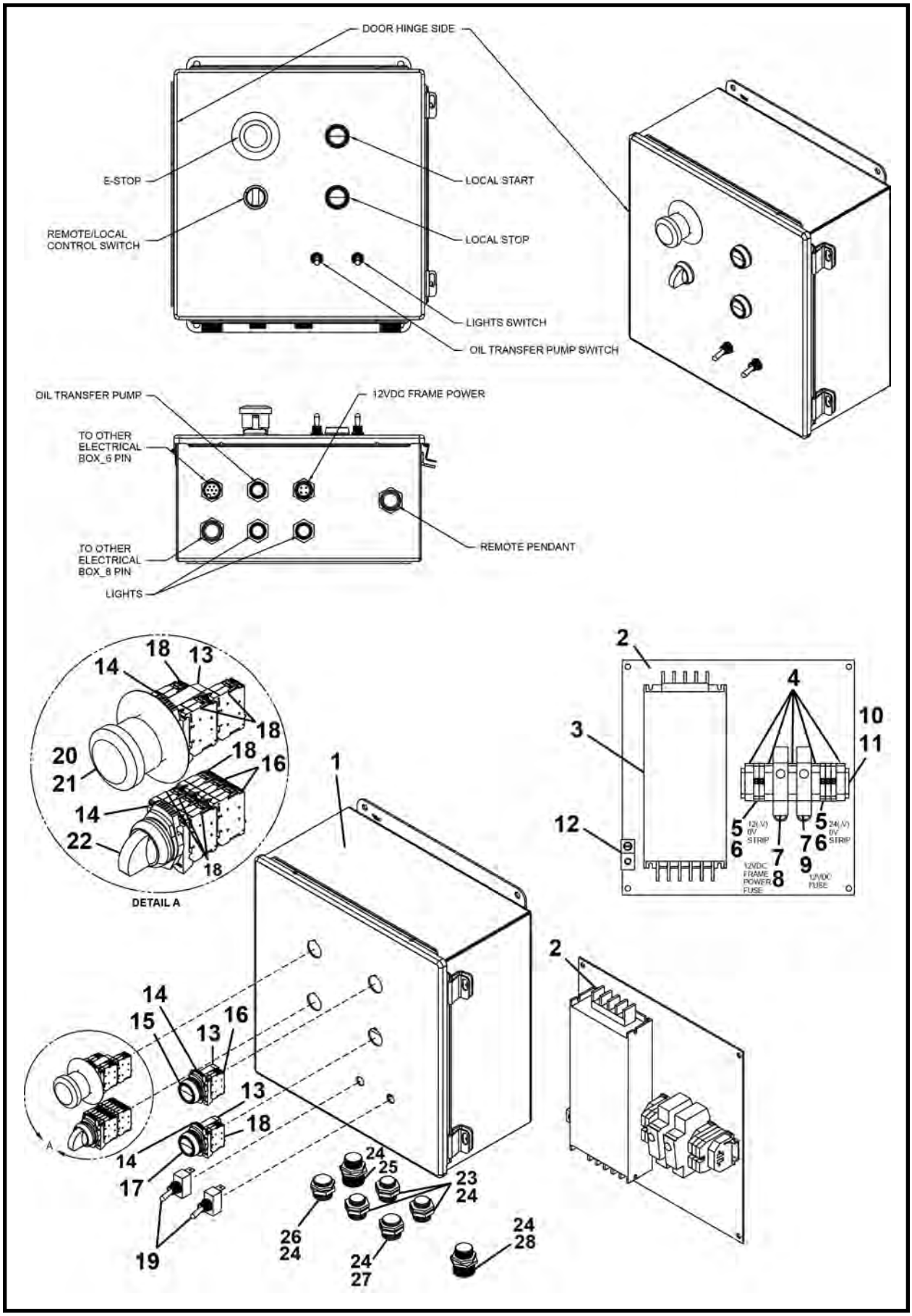
MAIN ELECTRICAL BOX ASSEMBLY, A48628A

ITEM	QTY	PART NO.	DESCRIPTION
0	1	A48628A	MAIN ELECTRICAL BOX ASSEMBLY
1	1	P0251-422	BOX, Electrical
2	1	P0251-422A	STANDOFF, Panel
3	2	P0311-036	CLAMP, Ground
4	1	P0251-595	BREAKER, 200 HP, 350-3 Amp
5	1	P0251-430	HANDLE, Rotary
6	1	P0251-595A	TERMINAL, 3 Pole Aluminum
7	4	P0013-06A-000	NUT, Nyloc 3/8 UNC
8	53 LI	P0054-261	WIRE, Motor Lead 3/0-1/C
9	1	P0251-593	SOFT START, 200 HP
10	1	P0251-366	FAN, Cooling
11	2	P0251-594	LUGS, Line/Load
12	3	P0251-441	BLOCK, Power Distribution
13	17	P0310-571	HOLDER, Fuse, End Stop
14	11	P0310-473B	HOLDER, Fuse DIN Rail Midget
15	3	P0310-954	FUSE, Time Delay 1.4 Amp
16	1	P0251-443	PHASE DETECTOR 480V
17	4	P0310-953	FUSE, Time Delay 5 Amp
18	2	P0251-690	STARTER, Motor
19	1	P0251-689	CONTROL UNIT, Standard
20	1	P0251-476	CONTROL UNIT, Standard
21	14	P0020-83-022	SCREW, Truss Head 8-32 x .375
22	1	P0310-503-013	DIN RAIL - 13 in.
23	13	P0310-500	BLOCK, Terminal DIN Rail
24	13	P0310-573	JUMPER, Terminal Strip
25	1	P0251-386	FUSE, 20 Amp
26	1	P0310-952	FUSE, Time Delay 10 Amp
27	1	P0251-442	POWER SUPPLY 24V 480 DIN Mount
28	1	P0310-503-011	DIN RAIL - 11.0 in.
29	1	P0310-471	FUSE, Time Delay 15 Amp
30	1	P0251-401	FUSE
31	2	P0310-503-008	DIN RAIL - 8.0 in.
32	1	P0251-475	TRANSDUCER, Universal Current
33	1	P0251-410	HOURMETER
34	1	P0251-514	LENS, Plastic Green
35	2	P0251-463	LIGHT, Pilot 480V Red
36	1	P0251-464	LENS, Plastic Red
37	1	P0251-687	DIGITAL DISPLAY
38	1	P0313-049	RECEPTACLE, 4 Cond Female
39	3	P0311-018	NUT, Lock 1/2
40	1	P0311-150	CONNECT, Cord Straight 3/4 Aluminum
41	1	P0311-019	NUT, Lock 3/4
42	1	P0311-033	BUSHING, Insulating 3/4
43	2	P0054-574	RECEPTACLE, 4 Pin 18 GA Micro Female x 4 Ft
44	1	P0054-074	RECEPTACLE, 8 Pin 16 GA Mini Female x 12 in.
45	1	P0054-216	RECEPTACLE, 6 Pin 16 GA Mini Female x 3 Ft
46	2	P0311-129	STRAIN RELIEF, 2-1/2
47	2	P0311-129A	NUT, Lock
48	2	P0311-129B	BUSHING, Insulating
49	1	A48626A	MOUNT, Electrical Box
50	8	P0040-006	WASHER, Hardened Flat 3/8
51	4	P0001-06-004	BOLT, Hex 3/8 UNC x 1

LI - Linear Inch

NOTE: Refer to A48601A schematic for wiring details.

DOOR ELECTRICAL BOX ASSEMBLY, A48629A



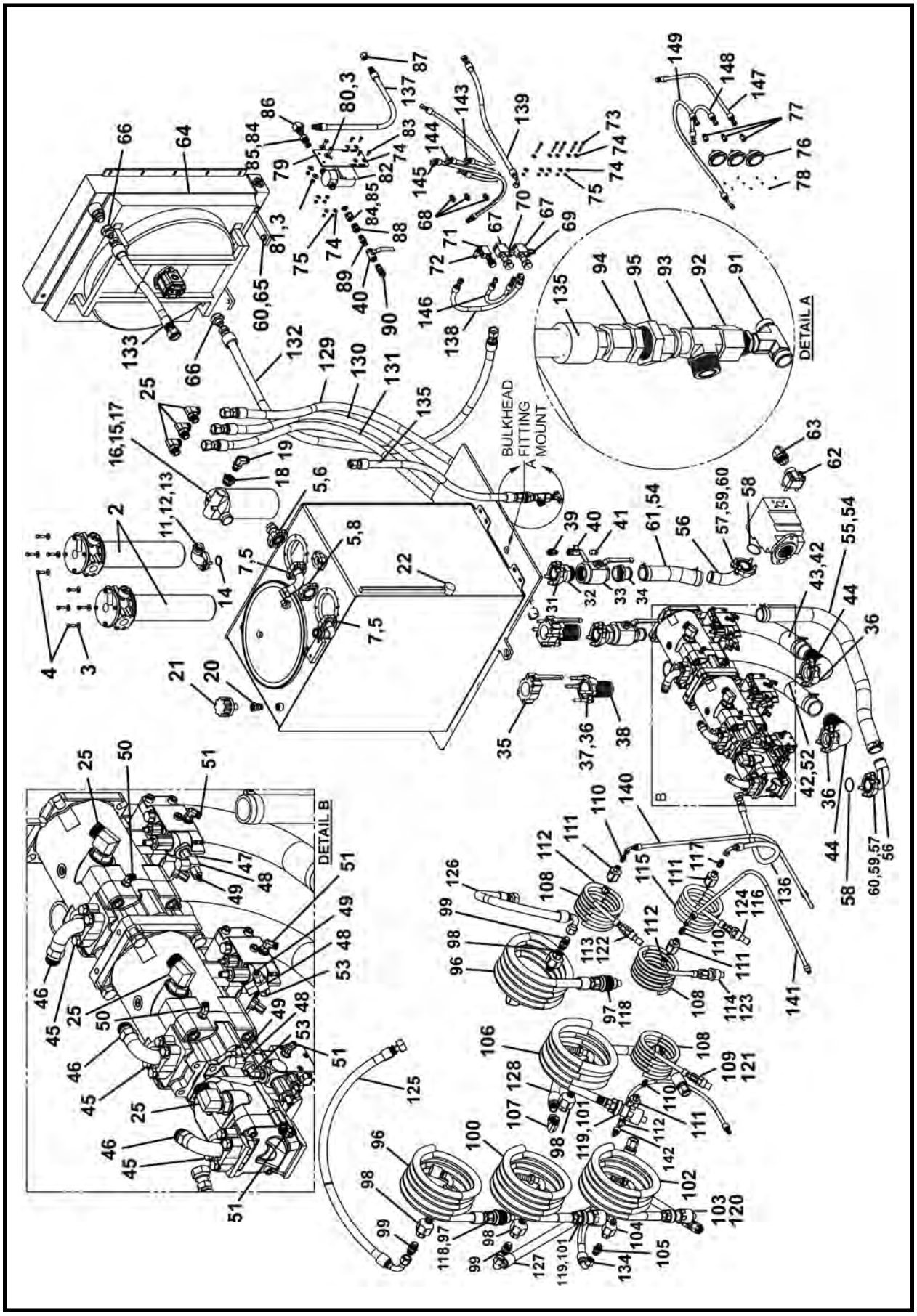
DOOR ELECTRICAL BOX ASSEMBLY, A48629A

ITEM	QTY	PART NO.	DESCRIPTION
0	1	A48629A	DOOR ELECTRICAL BOX ASSEMBLY
1	1	P0310-879	BOX
2	1	P0310-880	PANEL, Back
3	1	P0250-248	CONVERTER, 24VDC-12VDC
4	5	P0310-571	HOLDER, Fuse, End Stop
5	5	P0310-500	BLOCK, Terminal DIN Rail
6	5	P0310-573	JUMPER, Terminal Strip
7	2	P0310-473B	HOLDER, Fuse DIN Rail Midget
8	1	P0251-386	FUSE, 20 Amp
9	1	P0310-471	FUSE, Time Delay 15 Amp
10	2	P0020-83-022	SCREW, Truss Head 8-32 x .375
11	1	P0310-503-005	DIN RAIL - 5.0 in.
12	1	P0055-209	LUGS
13	3	P0251-563	LIGHT, Pilot LED White
14	4	P0310-419F	LATCH, Mounting
15	1	P0310-411F	PUSHBUTTON, Green Illuminated
16	3	P0056-121F	CONTACT
17	1	P0310-412F	PUSHBUTTON, Red Illuminated
18	8	P0056-122F	BLOCK, Contact
19	2	P0056-147	SWITCH, Toggle
20	1	P0310-474F	DECAL, E-STOP
21	1	P0310-420F	PUSHBUTTON, E-Stop Illuminated
22	1	P0310-421AF	SWITCH, 2 Position
23	3	P0313-044	RECEPTACLE, 2 Pin
24	7	P0311-018	NUT, Lock 1/2
25	1	P0054-075	RECEPTACLE, 8 Pin 16 GA Mini Male x 10 in.
26	1	P0054-215	RECEPTACLE, 6 Pin 16 GA Mini Male x 12 in.
27	1	P0313-049	RECEPTACLE, 4 Cond Female
28	1	P0054-074	RECEPTACLE, 8 Pin 16 GA Mini Female x 12 in.

LI - Linear Inch

NOTE: Refer to A48601A schematic for wiring details.

HYDRAULICS ASSEMBLY, A48606A



HYDRAULICS ASSEMBLY, A48606A

ITEM	QTY	PART NO.	DESCRIPTION
0	1	A48606A	HYDRAULICS ASSEMBLY
1	400	P0126-038	OIL, Hydraulic AW-68 (not shown)
2	2	P0309-212	FILTER, Intank 100 GPM
3	12	P0040-006	WASHER, Hardened Flat 3/8
4	8	P0001-06-005	BOLT, Hex 3/8 UNC x 1.25
5	4	P0300-446	ORING, 24SFO
6	1	P0300-844	FITTING, 20MFFOR-24FL
7	2	P0300-845	ADAPTER, 20MFFOR-24L90
8	1	P0300-517	FLANGE, 24FOP
9	1	P0258-059	ADAPTER, PVC 1-1/4 NPT Male
10	1	A40764P	PIPE, PVC 1-1/4 x 18
11	1	P0303-280	ELBOW, To Male 90 Deg.
12	4	P0001-07-005	BOLT, Hex 7/16 UNC x 1.25
13	4	P0040-007	WASHER, Hardened Flat 7/16
14	1	P0300-458	ORING, 20FLOR
15	1	P0309-172	ELEMENT, Filter
16	1	P0309-144B	HEAD, Filter W/25 PSI Bypass
17	1	P0301-105	GAUGE, Filter Indicator
18	1	P0300-658	FITTING, 20MB-12FB
19	1	P0300-372	FITTING, 12MFOR-12MB90
20	1	P0300-208	FITTING, 10MB-12FPX
21	1	P0309-188	BREATHER, Reservoir
22	1	P0301-138	GAUGE, Sight
23	3	A48657P	PIPE, PVC 1.00 x 24
24	3	P0258-061	ELBOW, Street 1 NPT 90°
25	6	P0300-371	FITTING, 16MFOR-16MB90
26	2	A40761P	PIPE, PVC 2.00 x 6.50
27	2	P0258-056	ELBOW, Street 2 NPT 90°
28	2	A48656P	PIPE, PVC 2.50 x 7.00
29	2	P0258-062	ELBOW, PVC 2-1/2 90°M-F
30	2	P0258-063	PIPE, PVC 2-1/2 NPT M-F Straight
31	2	P0300-443	FLANGE, 32CFHS
32	2	P0300-442	FITTING, 32FL-32MB
33	2	P0302-434	VALVE, Ball 2 ORB Suction
34	2	P0220-224	FITTING, 32 Insert-32MB
35	2	P0302-711	VALVE, Butterfly 2-1/2
36	4	P0100-059	FLANGE, Split
37	8	P0001-08-014	BOLT, Hex 1/2 UNC x 3.5
38	2	P0423-129	FLANGE, HBS Barb To Split
39	1	P0300-222	FITTING, 10MB-08MP
40	2	P0302-185	VALVE, Ball 1/2
41	1	P0416-003	PLUG, Square Head 1/2
42	4	P0201-228	CLAMP, T-Bolt
43	1	P0201-225-032	HOSE, Suction 2-1/2 x 32
44	2	P0303-340	BARB, Hose 90
45	3	P0300-420	FITTING, 20SFXO
46	3	P0300-421	FITTING, 20FLH6K-16MJ90
47	1	P0300-572	FITTING, 06MB-04FP
48	3	P0309-203	FILTER
49	3	P0300-268	FITTING, 04MJ-04FP
50	2	P0300-590	FITTING, 04MFFOR-04MB45
51	4	P0300-427	FITTING, 04MFOR-04MB90
52	1	P0201-225-034	HOSE, Suction 2-1/2 x 34
53	2	P0300-528	FITTING, 06MB-04FP90
54	4	P0201-180	CLAMP, T-Bolt

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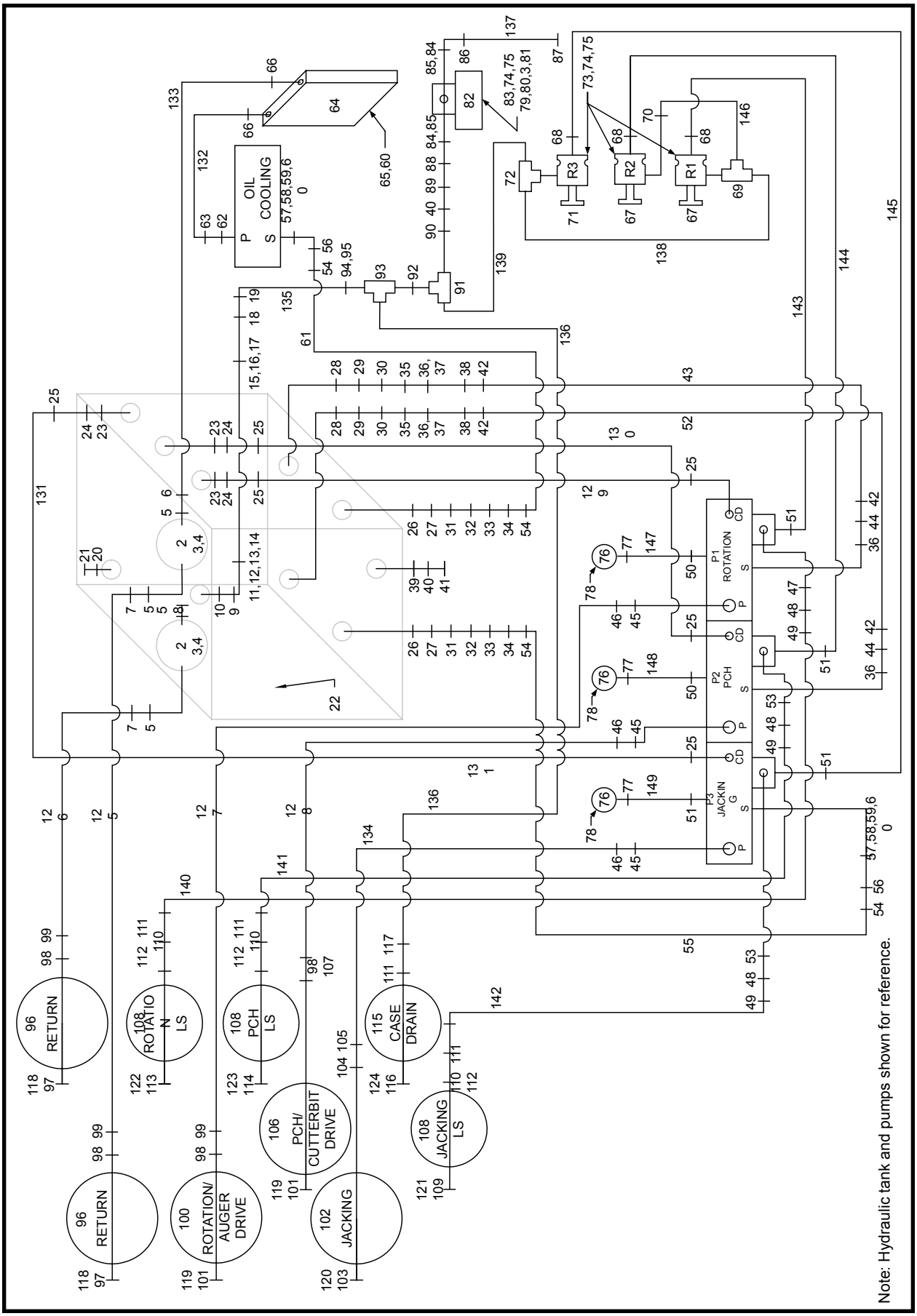
HYDRAULICS ASSEMBLY, A48606A



HYDRAULICS ASSEMBLY, A48606A

ITEM	QTY	PART NO.	DESCRIPTION
55	1	P0201-159-042	HOSE, Suction 2 x 42
56	2	P0220-210	FITTING, 32 Insert-90 Code 61-20FL
57	2	P0300-518	FLANGE
58	2	P0300-460	ORING, 32FLOR
59	8	P0001-08-006	SCREW, Hex Cap 1/2 UNC x 1.5
60	12	P0040-008	WASHER, Hardened Flat 1/2
61	1	P0201-159-012	HOSE, Suction 2 x 12
62	1	P0303-278	FITTING, Elbow Code 61 To SAE Thread
63	1	P0300-450	FITTING, 16MFOR-20MB90
64	1	A49322P	OIL COOLER
65	4	P0001-08-005	SCREW, Hex Cap 1/2 UNC x 1.25
66	2	P0300-849	FITTING, 20FJ-16MJ
67	2	P0302-402	VALVE, Relief 5000 PSI Max
68	3	P0300-310	FITTING, 04MFOR-06MB
69	1	P0300-386	FITTING, 06MFOR-06MB-06MFOR
70	1	P0300-311	FITTING, 04MFFOR-06MB90
71	1	P0302-544	VALVE, Relief 6000 PSI
72	1	P0300-376	FITTING, 06MFOR-06MFOR-06MB
73	5	P0001-04-008	BOLT, Hex 1/4 UNC x 2
74	18	P0040-004	WASHER, Hardened Flat 1/4
75	9	P0003-04-000	NUT, Hex 1/4 UNC
76	3	P0301-146	GAUGE, 6000 PSI
77	3	P0300-594	FITITNG, 4FB-4MFFOR
78	9	P0017-06-323	SCREW, Machine 6-32 x .5
79	1	A48660P	MOUNT, Fill Pump
80	2	P0001-06-004	BOLT, Hex 3/8 UNC x 1
81	2	P0003-06-000	NUT, Hex 3/8 UNC
82	1	P0303-281	PUMP, Transfer
83	4	P0001-04-003	BOLT, Hex 1/4 UNC x .75
84	2	P0093-004	FITTING, Hose
85	2	P0093-005	WASHER, Neoprene
86	1	P0300-023	FITTING, 12MP-08FP90
87	1	P0417-003	CAP, Hex Pipe 1/2
88	1	P0300-012	FITTING, 12MP-08FPS
89	1	P0300-048	FITTING, 08MP-08MP
90	1	P0300-763	FITITNG, 08MP-08FFORX
91	1	P0300-428	FITTING, 08MFOR-08MFOR-08FFORX
92	1	P0300-622	FITTING, 12FFOR-08MFOR
93	1	P0300-588	FITTING, FS6602-12-12-12
94	1	P0300-585	FITTING, 12MFFOR-12MFFOR-BKHD
95	1	P0300-586	FITTING, FS0306-12
96	2	A10356A-600	HOSE ASSEMBLY 1 x 600
97	2	P0100-100	NIPPLE, Half Male 1
98	4	P0302-821	JOINT, Swivel 16 x 16 JIC
99	3	P0300-441	FITTING, 16MJ-16MJ
100	1	A09862A-600-R	HOSE ASSEMBLY 1 x 600 Red
101	2	P0100-099	COUPLER, Half Female 1
102	1	A10303A-600-B	HOSE ASSEMBLY 3/4 x 600 Blue
103	1	P0100-103	COUPLER, Half Female 3/4
104	1	P0302-820	JOINT, Swivel 12 x 12 JIC
105	1	P0300-440	FITTING, 12MJ-12MJ
106	1	A09862A-600	HOSE ASSEMBLY 1 x 600
107	1	P0300-514	FITTING, 16MJ-16FJX90
108	3	A09949A-600	HOSE ASSEMBLY 3/8 x 600
109	1	P0100-110	COUPLER, QD 3/8
110	3	P0300-439	FITTING, 08MJ-06MJ

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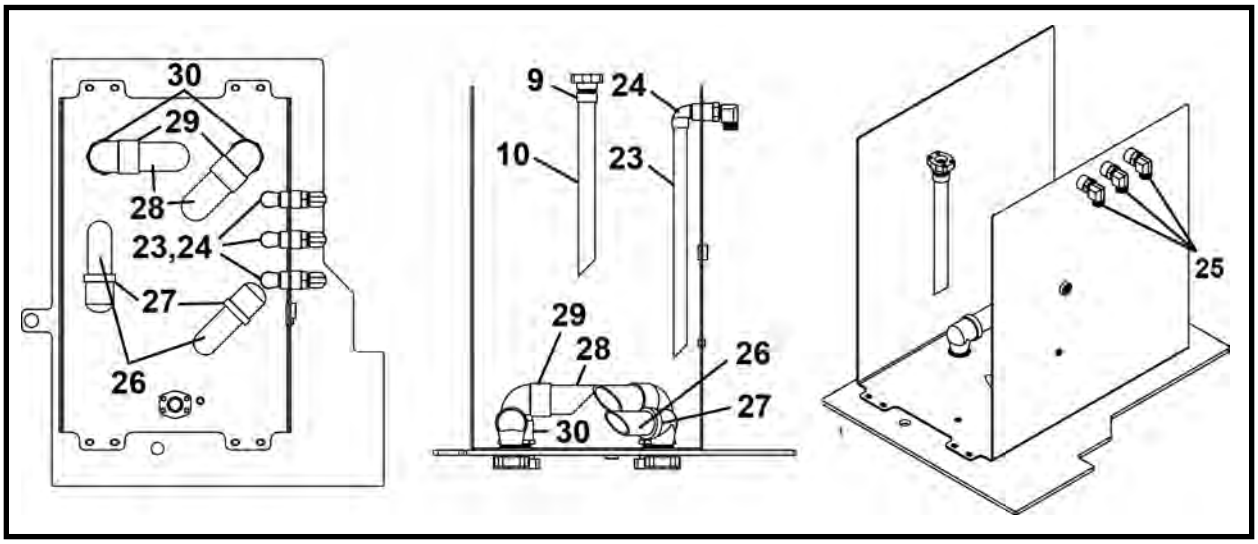
HYDRAULICS ASSEMBLY, A48606A

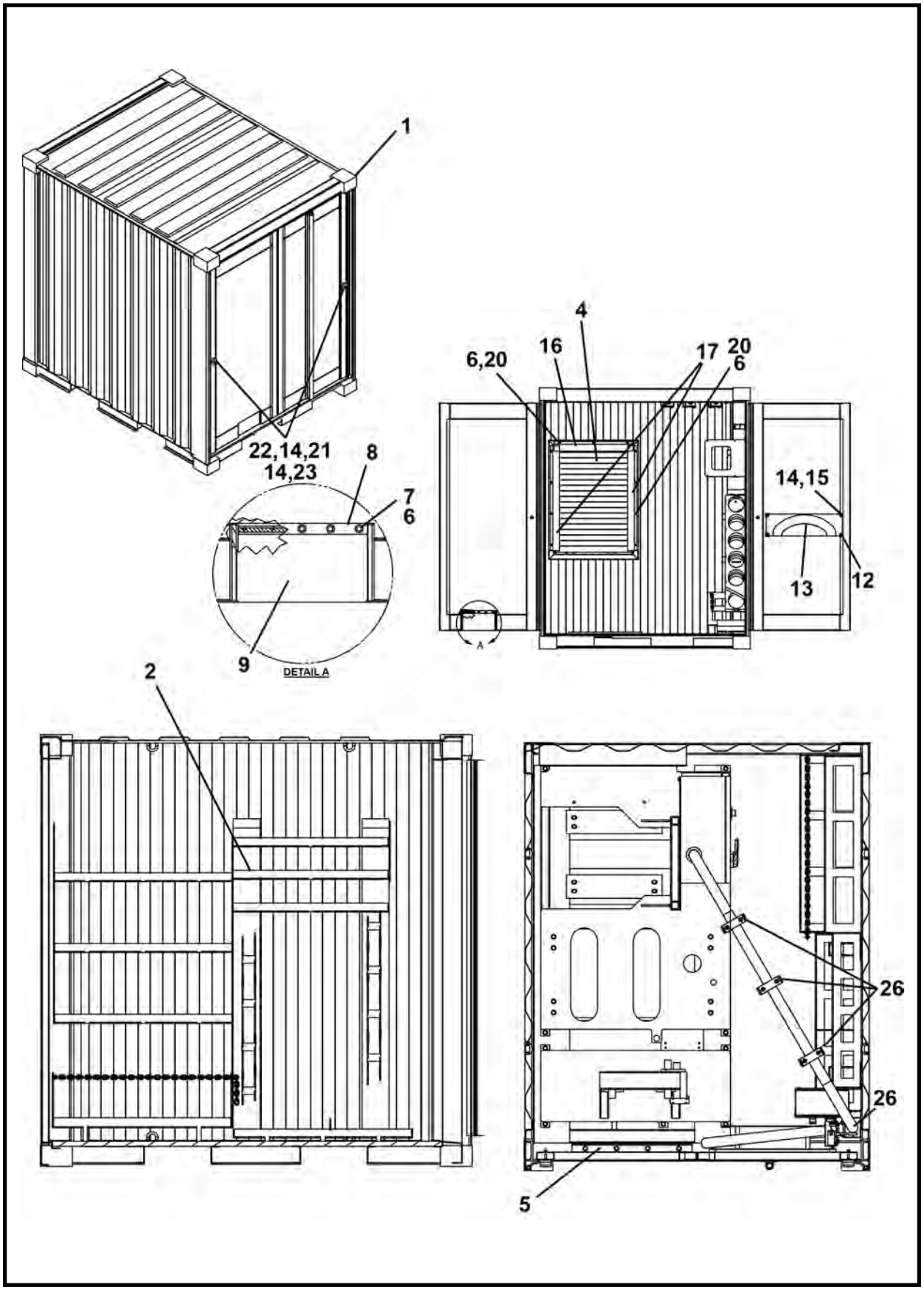


ITEM	QTY	PART NO.	DESCRIPTION
111	4	P0302-819	JOINT, Swivel 8 x 8 JIC
112	3	P0300-454	FITTING, 08FJ-06MJ
113	1	P0100-109	NIPPLE, QD 3/8
114	1	P0100-112	COUPLER, QD 1/2
115	1	A10462A-600	HOSE ASSEMBLY 1/2 x 600
116	1	P0100-111	NIPPLE, QD 1/2
117	1	P0300-438	FITTING, 08MJ-08MJ
118	2	P0100-100A	CAP, Protective Aluminum
119	2	P0100-099A	PLUG, Aluminum
120	1	P0100-103A	PLUG, Protective Aluminum
121	1	P0100-110A	PLUG, Aluminum
122	1	P0100-109A	CAP, Aluminum
123	1	P0100-112A	PLUG, Protective Aluminum
124	1	P0100-111A	PLUG, Protective Aluminum
125	1	A09852A-051	HOSE ASSEMBLY 1 x 51
126	1	A09852A-038	HOSE ASSEMBLY 1 x 38
127	1	A09872A-049	HOSE ASSEMBLY 1 x 49
128	1	A09871A-048	HOSE ASSEMBLY 1 x 48
129	1	A10374A-060	HOSE ASSEMBLY 1 x 60
130	1	A10374A-075	HOSE ASSEMBLY 1 x 75
131	1	A10374A-086	HOSE ASSEMBLY 1 x 86
132	1	A10341A-083	HOSE ASSEMBLY 1 x 83
133	1	A09854A-027	HOSE ASSEMBLY 1 x 27
134	1	A10304A-045	HOSE ASSEMBLY 3/4 x 45
135	1	A10437A-040	HOSE ASSEMBLY 3/4 x 40
136	1	A10373A-032	HOSE ASSEMBLY 1/2 x 32
137	1	A10461A-032	HOSE ASSEMBLY 1/2 x 32
138	1	A10079A-024	HOSE ASSEMBLY 3/8 x 24
139	1	A10471A-028	HOSE ASSEMBLY 3/8 x 28
140	1	A10371A-066	HOSE ASSEMBLY 1/4 x 66
141	1	A10371A-051	HOSE ASSEMBLY 1/4 x 51
142	1	A10371A-040	HOSE ASSEMBLY 1/4 x 40
143	1	A10325A-034	HOSE ASSEMBLY 1/4 x 34
144	1	A10325A-026	HOSE ASSEMBLY 1/4 x 26
145	1	A10325A-031	HOSE ASSEMBLY 1/4 x 31
146	1	A10059A-013	HOSE ASSEMBLY 1/4 x 13
147	1	A10326A-024	HOSE ASSEMBLY 1/4 x 24
148	1	A10326A-015	HOSE ASSEMBLY 1/4 x 15
149	1	A10325A-033	HOSE ASSEMBLY 1/4 x 33

LI - Linear Inch QT - Quart

NOTES

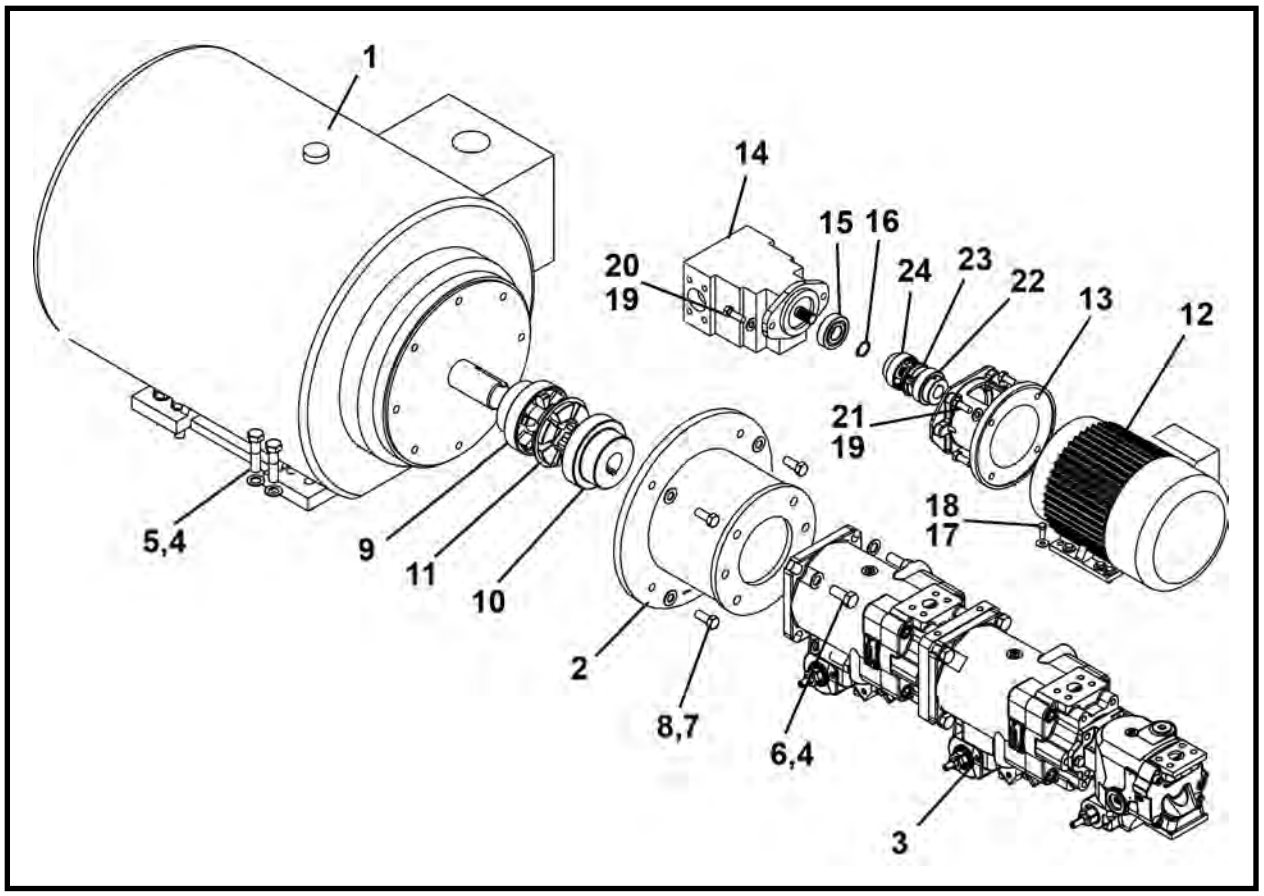
CONTAINER ASSEMBLY, A48607A



CONTAINER ASSEMBLY, A48607A

ITEM	QTY	PART NO.	DESCRIPTION
0	1	A48607A	CONTAINER ASSEMBLY
1	1	P0125-122	CONTAINER
2	1	A48605A	SHELVING
3	-	-	-
4	1	-	LOUVER ASSEMBLY (Includes item 4a -4b)
4a	1	A48644A	Louver
4b	8	P0030-06-004	SCREW, Flat Head Cap 3/8 UNC x 1
5	1	A48651P	MOUNT, Skid
6	16	P0040-004	WASHER, Hardened Flat 1/4
7	5	P0035-008	SCREW, Self Tap 1/4 x 1
8	1	A44722P	MOUNT, Door Flap
9	1	A40749P	RUBBER, Door Flap
10	-	-	-
11	-	-	-
12	-	-	-
13	1	A48649A	MOUNT, Cord
14	8	P0040-006	WASHER, Hardened Flat 3/8
15	4	P0001-06-003	BOLT, Hex 3/8 UNC x .75
16	1	A48652P	RUBBER, Top
17	2	A48653P	RUBBER, Side
18	-	-	-
19	-	-	-
20	11	P0001-04-003	BOLT, Hex 1/4 UNC x .75
21	2	P0253-112	BUMPER, Rubber
22	2	P0001-06-010	BOLT, Hex 3/8 UNC x 2.5
23	2	P0013-06A-000	NUT, Nyloc 3/8 UNC
24	-	-	-
25	-	-	-
26	4	P0059-074	CLAMP, Vibration

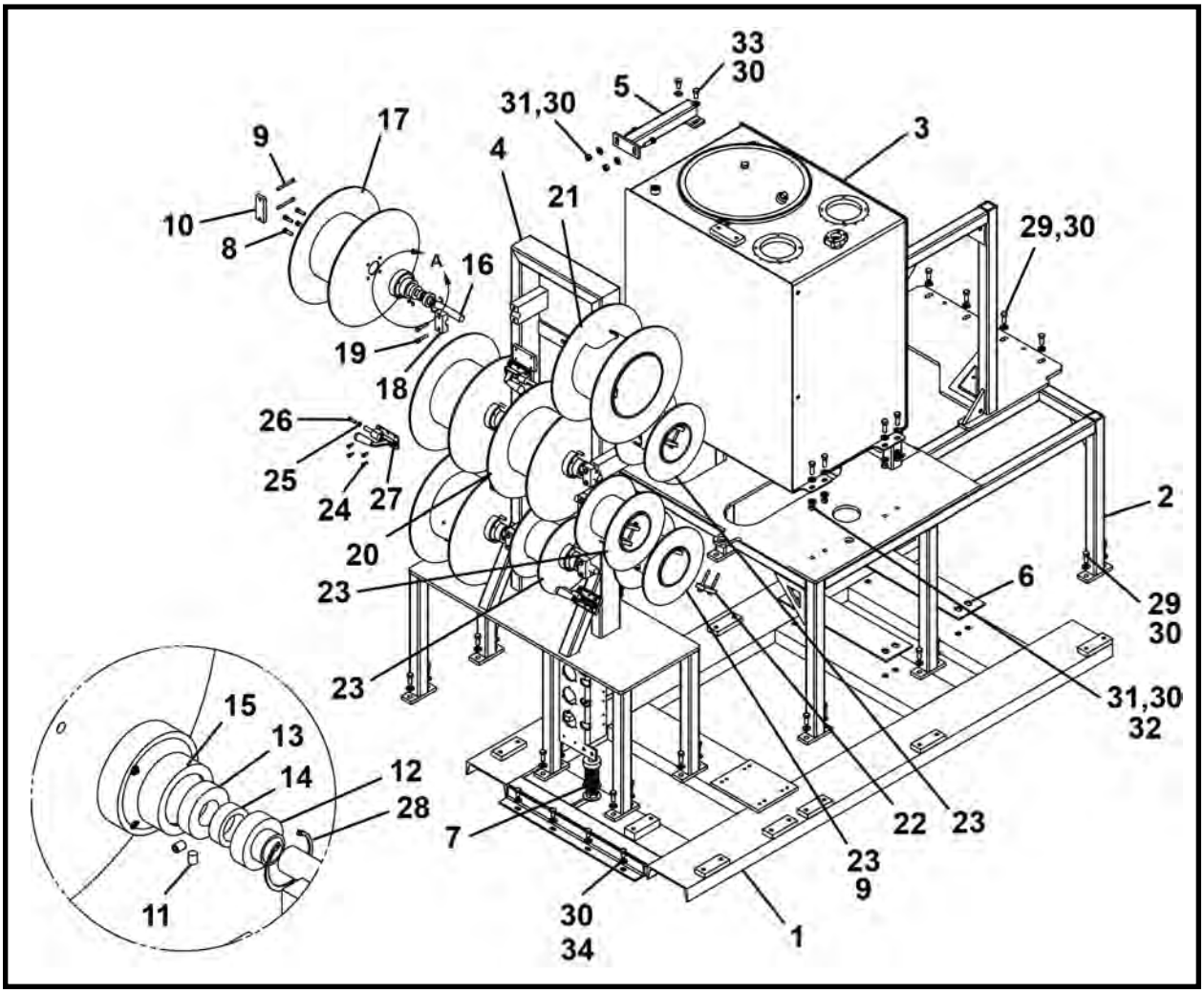
MOTOR / PUMP MOUNT ASSEMBLY, A48608A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	A48608A	MOTOR/PUMP MOUNT ASSEMBLY
1	1	P0304-349	MOTOR, 200HP
2	1	P0305-250	MOUNT, Pump
3	1	P0303-418	PUMP, Gear
4	12	P0040-012	WASHER, Hardened Flat 3/4
5	8	P0001-12-012	BOLT, Hex 3/4 UNC x 3
6	4	P0001-12-007	BOLT, Hex 3/4 UNC x 1.75
7	4	P0040-010	WASHER, Hardened Flat 5/8
8	4	P0001-10-006	BOLT, Hex 5/8 UNC x 1.5
9	1	P0305-148	COUPLING, Motor
10	1	P0305-200	COUPLER
11	1	P0305-184	INSERT
12	1	P0304-350	MOTOR, 5HP 480V
13	1	P0305-210	ADAPTER, Pump Motor
14	1	P0303-374	PUMP
15	1	P0065-293	BEARING
16	1	P0076-061	SNAP RING
17	8	P0040-006	WASHER, Hardened Flat 3/8
18	8	P0001-06-004	BOLT, Hex 3/8 UNC x 1
19	6	P0040-008	WASHER, Hardened Flat 1/2
20	2	P0001-08-006	SCREW, Hex Cap 1/2 UNC x 1.5
21	4	P0001-08-005	SCREW, Hex Cap 1/2 UNC x 1.25
22	1	P0305-239	COUPLING, Half, Motor
23	1	P0305-241	INSERT
24	1	P0305-249	COUPLER

NOTES

BASE ASSEMBLY, A48609A



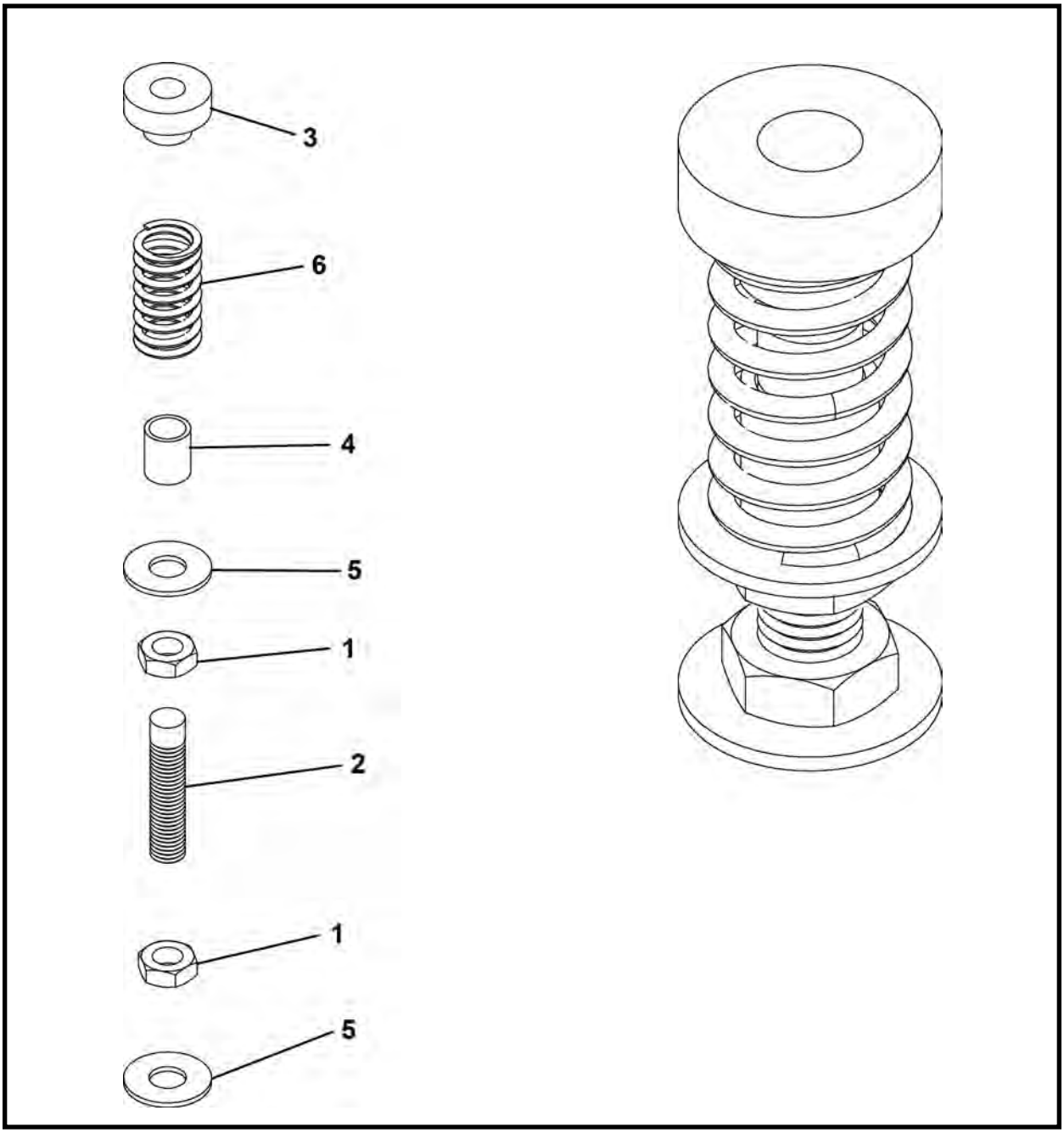
ITEM	QTY	PART NO.	DESCRIPTION
0	1	A48609A	ASSY, BASE-P200E
1	1	A48616A	SKID
2	1	A48630A	STAND
3	1	A48610A	TANK, Hydraulic 100 Gal
4	1	A48613A	BASE, Hose Reel
5	1	A46371A	SUPPORT, Hose Reel
6	2	A48625P	SPACER, Motor
7*	1	A46899A	ASSEMBLY, Short Pump Support
8	36	P0001-06-005	BOLT, Hex 3/3 UNC x 1.25
9	18	P0001-05-012	BOLT, Hex 5/16 UNC x 3
10	5	A42521P	MOUNT, Reel Fitting
11	18	P0033-05-006	SCREW, Socket Set 5/16 UNC x .375
12	9	P0065-214	BEARING, Insert
13	9	P0065-215	BEARING, Ball
14	9	A43555P	SPACER, Hub
15	9	A43556P	HUB, Spool
16	9	A43952P	ROD, Hose Reel
17	3	A42624A	REEL, Left 3/4
18	9	A43560P	MOUNT, Shaft - Front
19	18	P0001-06-007	BOLT, Hex 3/8 UNC x 1.75
20	1	A46067A	REEL, Mid Left 3/4
21	1	A42610A	REEL, Right 3/4

BASE ASSEMBLY, A48609A

ITEM	QTY	PART NO.	DESCRIPTION
22	4	A42518P	MOUNT, Reel Fitting
23	4	A42623A	REEL, RIght 3/8
24	36	P0001-04-003	BOLT, Hex 1/4 UNC x .75
25	9	P0003-05-000	NUT, Hex 5/16 UNC
26	9	P0001-05-004	BOLT, Hex 5/16 UNC x 1
27	9	P0059-061	CLAMP, Toggle
28	9	P0076-024	SNAP RING, Internal
29	26	P0001-08-005	SCREW, Hex Cap 1/2 UNC x 1.25
30	52	P0040-008	WASHER, Hardened Flat 1/2
31	10	P0003-08-000	NUT, Hex 1/2 UNC
32	10	P0001-08-006	SCREW, Hex Cap 1/2 UNC x 1.5
33	2	P0001-08-004	BOLT, Hex 1/2 UNC x 1
34	4	P0001-08-003	BOLT, Hex 1/2 UNC x .75

* Refer to this section for parts information.

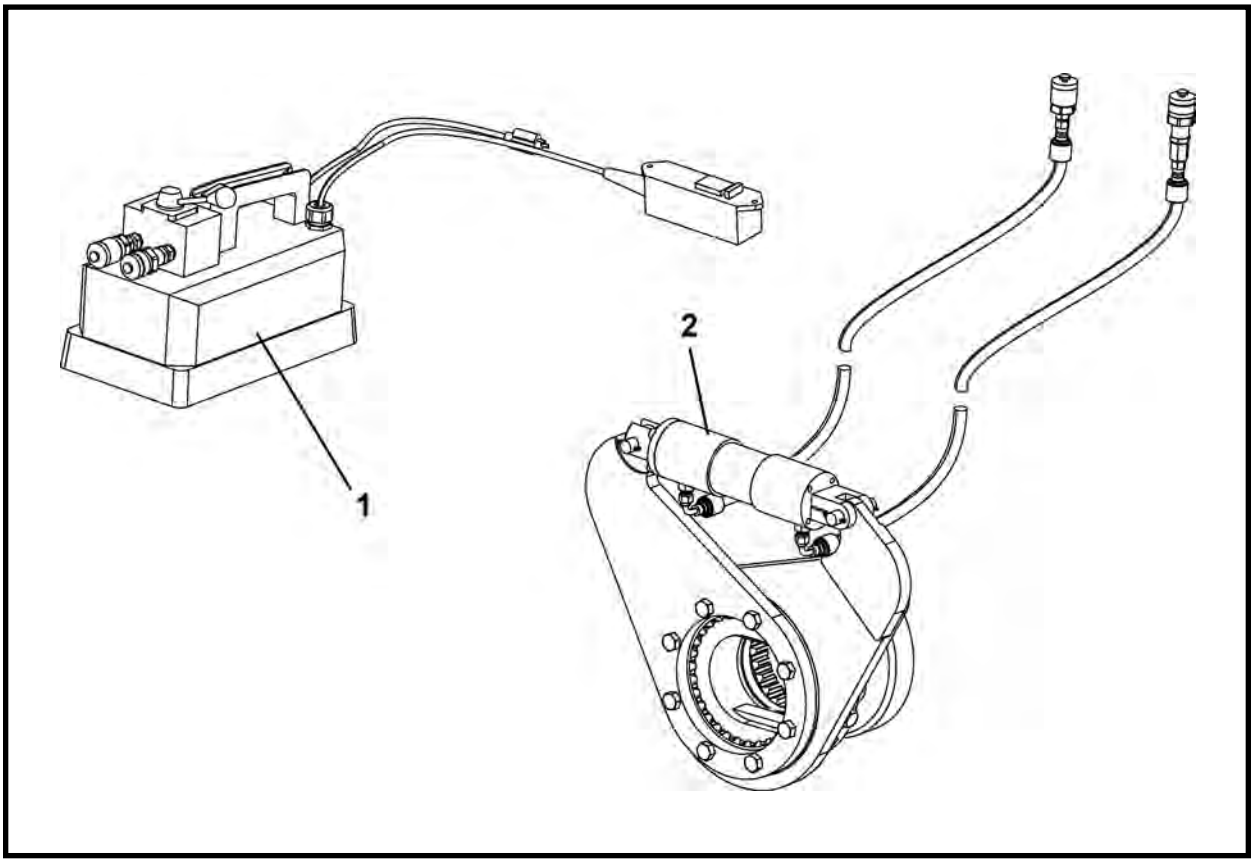
SHORT PUMP SUPPORT ASSEMBLY, A46899A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	A46899A	SHORT PUMP SUPPORT ASSEMBLY
1	2	P0007-16-000	NUT, Jam 1 UNC
2	1	A46897P	SCREW, Short Adjustment
3	1	A42526P	CAP, Spring
4	1	A46898P	SLEEVE, Short Spring
5	2	P0040-016	WASHER, Hardened Flat 1
6	1	P0070-063	SPRING

NOTES

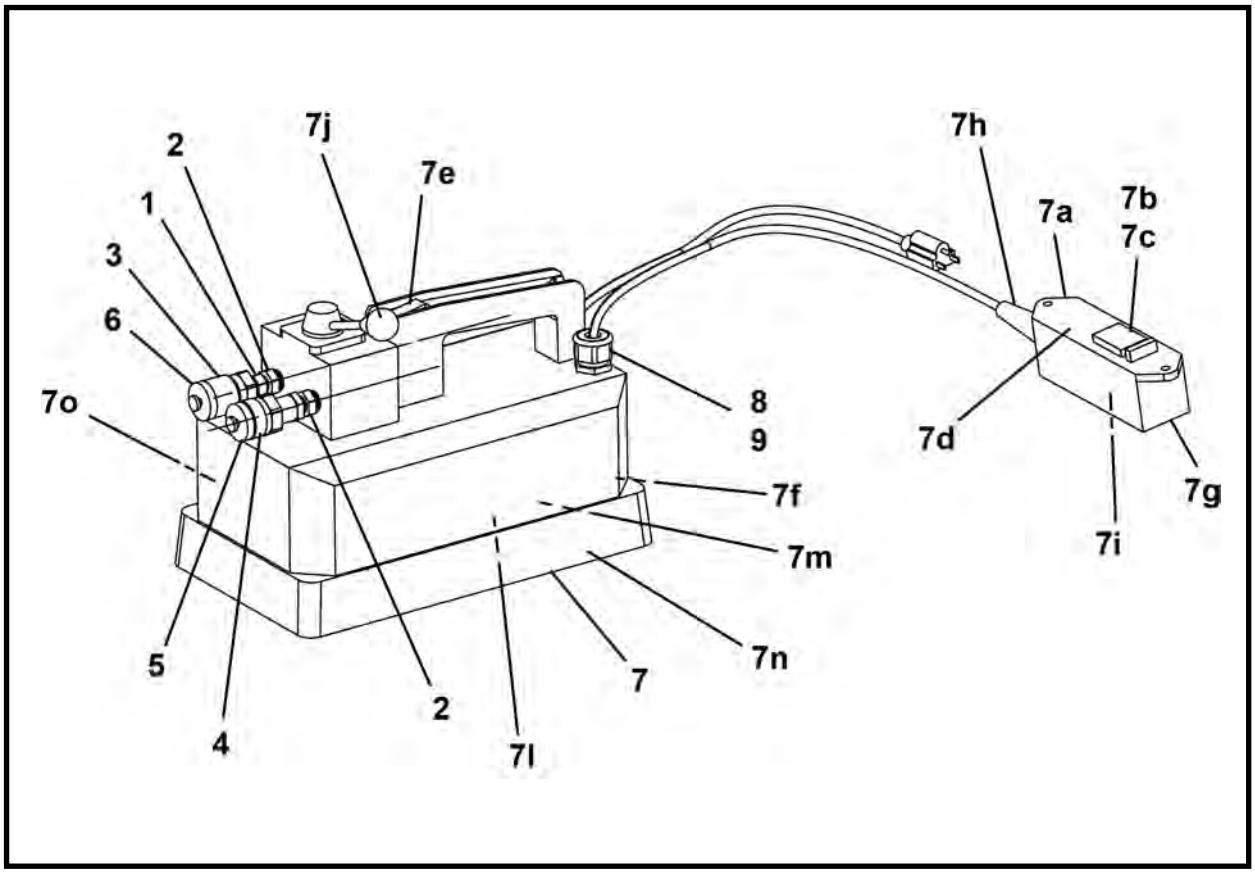
DUAL TUBE BREAKOUT TOOL, FA40230F



ITEM	QTY	PART NO.	DESCRIPTION
0	1	FA40230F	TOOL, Pilot Tube Breakout-120V, Reception Shaft
1*	1	A40257A	POWER PACK 120 V
2*	1	A40491A	ASSEMBLY, Breakout Tool

* Refer to this section for parts information.

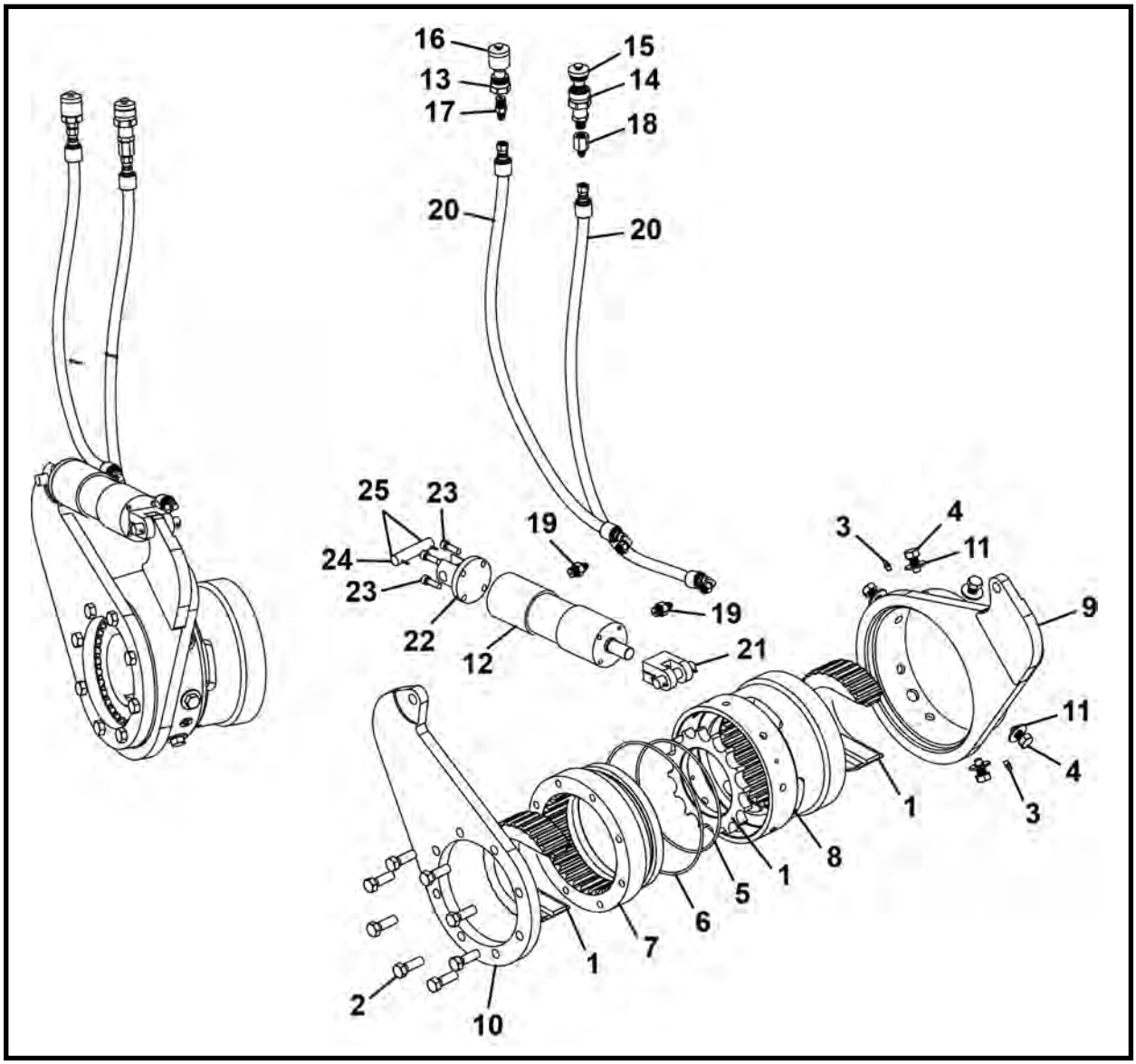
POWER PACK 120V, A40257A



ITEM	QTY	PART NO.	DESCRIPTION
0*	1	A40257A	POWER PACK 120V
1	1	P0300-113	FITTING, 04MP-04MP
2	2	P0300-093	FITTING, 06MP-04FPS
3	1	P0100-010B	NIPPLE
4	1	P0100-010A	COUPLER
5	1	P0100-010E	PLUG, Dust
6	1	P0100-010D	CAP, Dust
7	1	P0303-251	PUMP WITH REMOTE 120V (Includes items 7a - 7o)
7a	1	P0303-251A	COVER, Remote
7b	1	P0303-251B	SWITCH, Remote
7c	1	P0303-251C	COVER, Remote Switch
7d	1	P0303-251D	DECAL
7e	1	P0303-251E	SWITCH, Pump Rocker
7f	1	P0303-251L	RELAY
7g	1	P0303-251G	HOUSING, Switch
7h	1	P0303-251H	ASSEMBLY, Remote Hand Switch With Cord
7i	1	P0303-251I	SWITCH, Pushbutton
7j	1	P0303-251J	KNOB, Shift
7k*	1	P0303-251K	KIT, Repair
7l	1	P0303-251M	RECTIFIER
7m	1	P0303-251N	TRANSFORMER
7n	1	P0303-251P	HOUSING, Plastic
7o	1	P0303-251Q	BLADDER
8	1	P0311-121	RELIEF, Strain
9	1	P0311-018	NUT, 1/2

* Not Shown. Repair kit includes internal: backup washers, o-rings, compression springs, set screws, locknuts, replaceable seats, retaining ring, filter, ball, copper washer, steel ball, and dowel pins.

BREAKOUT TOOL ASSEMBLY, A40491A

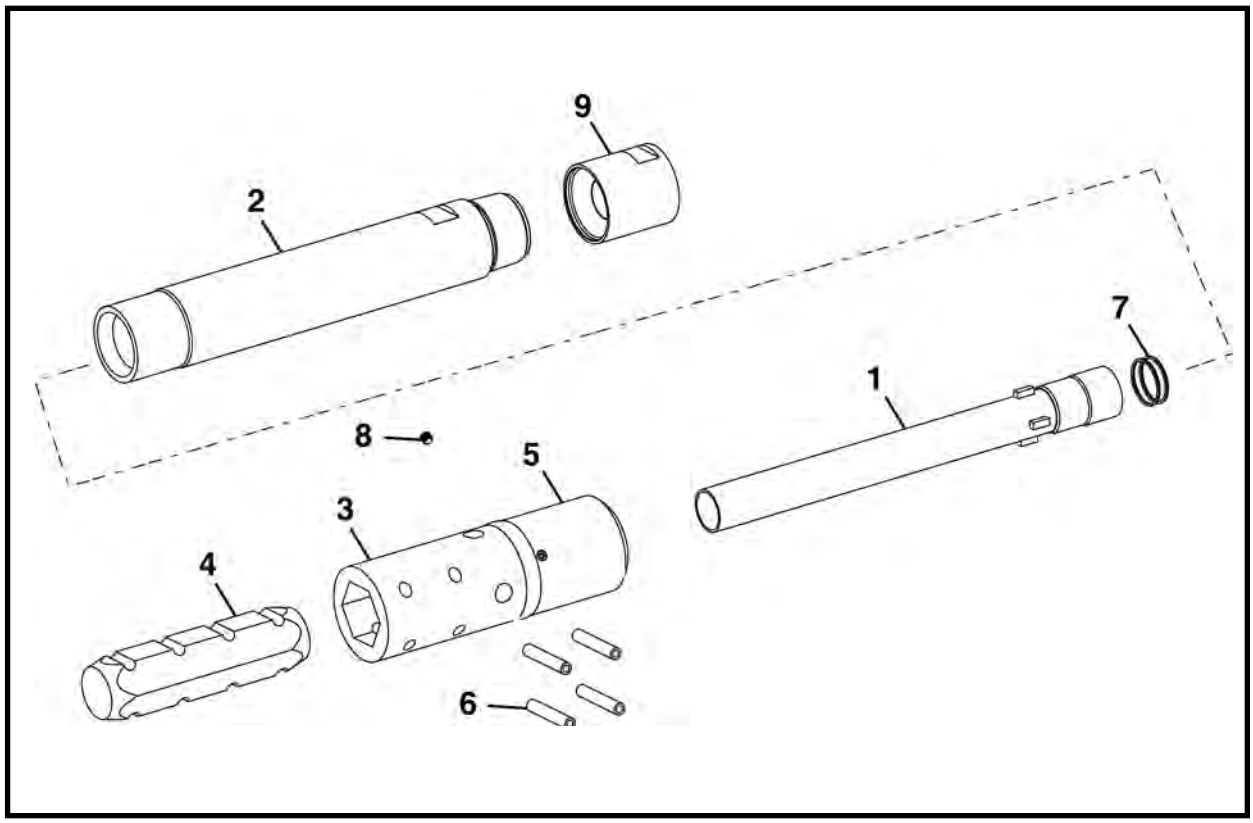


ITEM	QTY	PART NO.	DESCRIPTION
0	1	A40491A	BREAKOUT TOOL ASSEMBLY
1	1	A40231A	INSERTS, Breakout Tool (Includes items 1a - 1b)
1a	2	A40590P	INSERT
1b	1	A40591P	SPACER
2	8	P0001-08-006	SCREW,. Hex Cap 1/2 UNC x 1.5
3	4	P0063-001	FITTING, Grease
4	8	A40490P	BOLT, Retaining
5	1	P0085-261	ORING
6	1	P0085-266	ORING
7	1	A40586P	HUB, Male
8	1	A40585P	HUB, Female
9	1	A40485A	FRAME, Cylinder
10	1	A40489P	ARM, Cylinder
11	8	P0040-008	WASHER, Hardened Flat 1/2
12	1	P0307-146	CYLINDER
13	1	P0100-010B	NIPPLE, Female 1/4 NPT
14	1	P0100-010A	NIPPLE, Male 1/4 NPT

BREAKOUT TOOL ASSEMBLY, A40491A

ITEM	QTY	PART NO.	DESCRIPTION
15	1	P0100-010E	PLUG, Dust
16	1	P0100-010D	PLUG, Cap
17	1	P0300-249	FITTING, 04MJ-04MP
18	1	P0300-268	FITTING, 04MJ-04FP
19	2	P0300-245	FITTING, 04MJ-06MB
20	2	A10405A-120	HOSE ASSEMBLY 1/4 x 120
21	1	P0307-136B	KIT, Clevis
22	1	A40589P	MOUNT, Pivot
23	4	P0031A-05-004	SCREW, Socket Head Cap 5/16 UNF x 1
24	1	P0307-136B1	ROD, Clevis
25	2	P0048-014	PIN, Cotter 3/32 x 1.25

PILOT TUBE ADAPTER, FA41403F



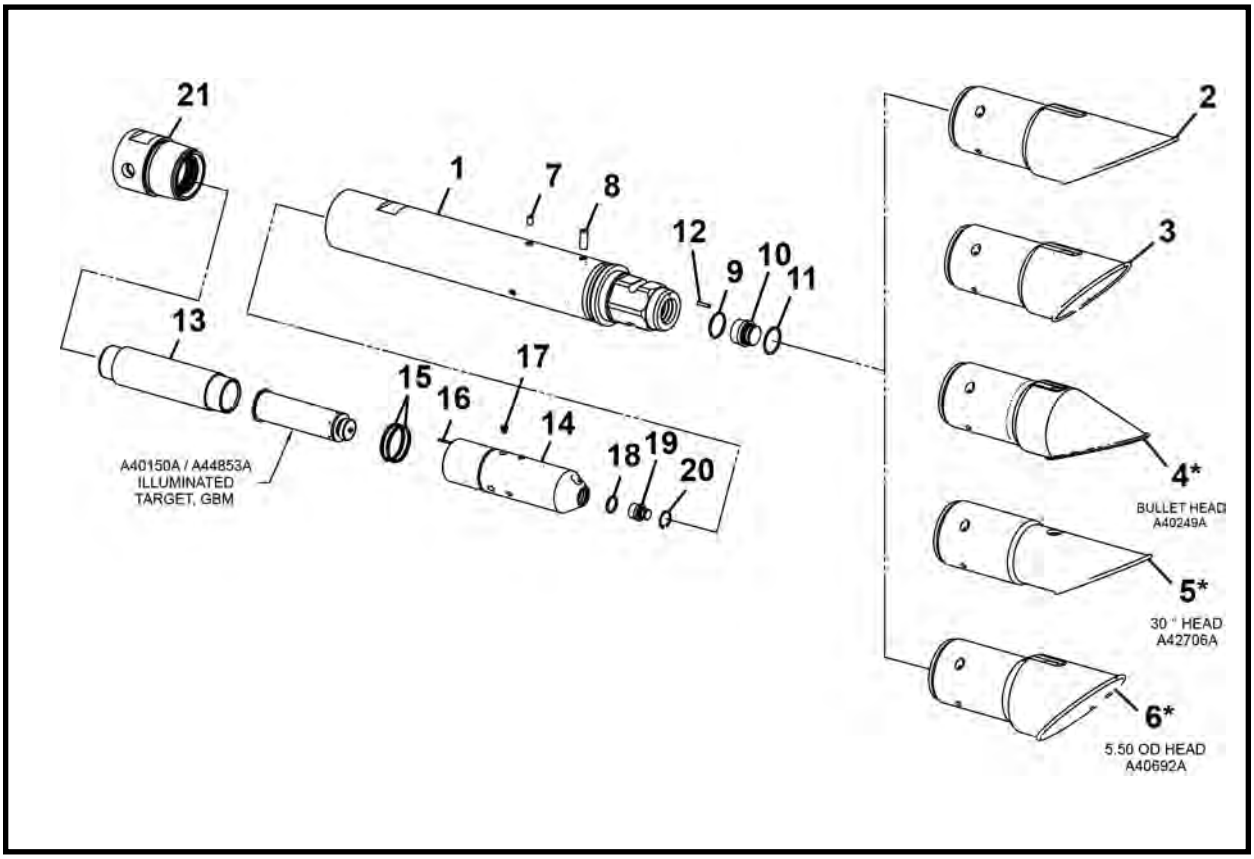
ITEM	QTY	PART NO.	DESCRIPTION
0	1	FA41403F	PILOT TUBE ADAPTER
1	1	NSS	TUBE, Inner
2	1	NSS	TUBE
3	1	NSS	ADAPTER, Female
4	1	A41332P	STEM, Hex Connection
5	1	NSS	BODY, Fluid Outlet
6	4	P0049-201	PIN, Spiral Spring
7	2	P0085-228	ORING
8	3	P0300-144	PLUG
9	1	FA40243F	CONNECTOR, Fluid, Reception Shaft

NSS - Not Sold Separately

NOTE: This is the pilot tube to 3” hex core adapter.

NOTES

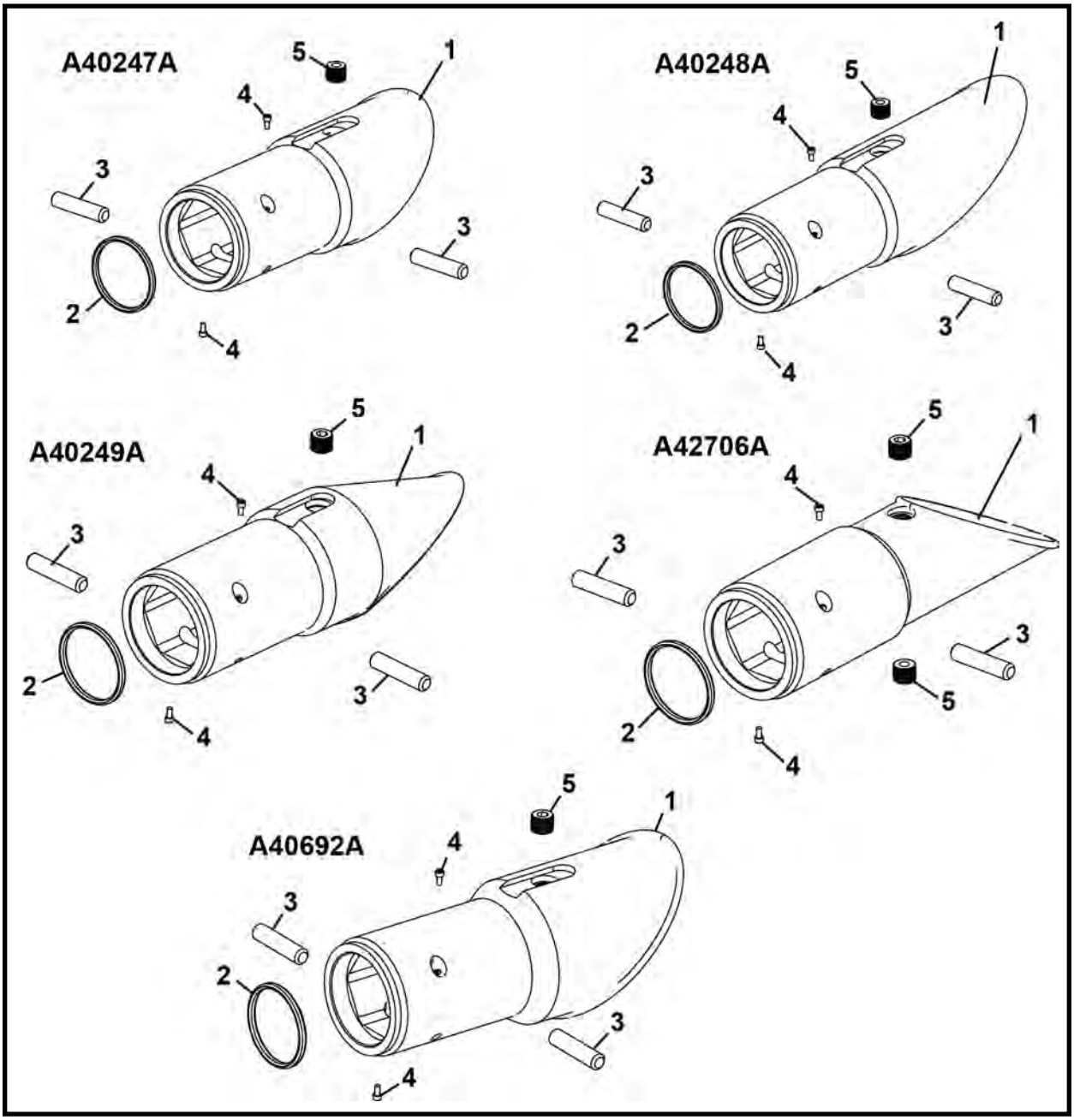
STEERING HEAD ASSEMBLY, FA40245F



ITEM	QTY	PART NO.	DESCRIPTION
0	1	FA40245F	STEERING HEAD ASSEMBLY
1	1	A40246A	ADAPTER, Steering Head
2^	1	A40247A	STEERING HEAD, 45 Degree (5” Diameter)
3^	1	A40248A	STEERING HEAD, 30 Degree (5” Diameter)
4* ^	0	A40249A	STEERING HEAD, Bullet
5* ^	0	A42706A	STEERING HEAD, 30 Degree (4” Diameter)
6* ^	0	A40692A	STEERING HEAD, 45 Degree (5.5” Diameter)
7	3	P0033-06-008	SCREW, Socket Head Cap 3/8 UNC x 0.5
8	1	P0033-08-020	SCREW. Socket Set 1/2-13 UNC x 1.25
9	1	P0085-130	ORING
10	1	P0302-404	VALVE, Check
11	1	P0076-055	RING, Spiral Snap
12	1	P0049-079	PIN, Roll 3/16 x 1
13	1	A40594P	TUBE, Inner
14	1	A40595A	HOLDER, Target
15	2	P0085-229	ORING
16	1	P0049-042	PIN, Spring Roll 1/8 x 1
17	3	P0300-224	PLUG, 02MB-HHP
18	1	P0085-120	ORING
19	1	P0302-405	VALVE, Check
20	1	P0076-056	RING, Snap
21	1	A40250A	CONNECTION, Air & Fluid (Includes item 21a)
21a**	2	P0085-228	ORING

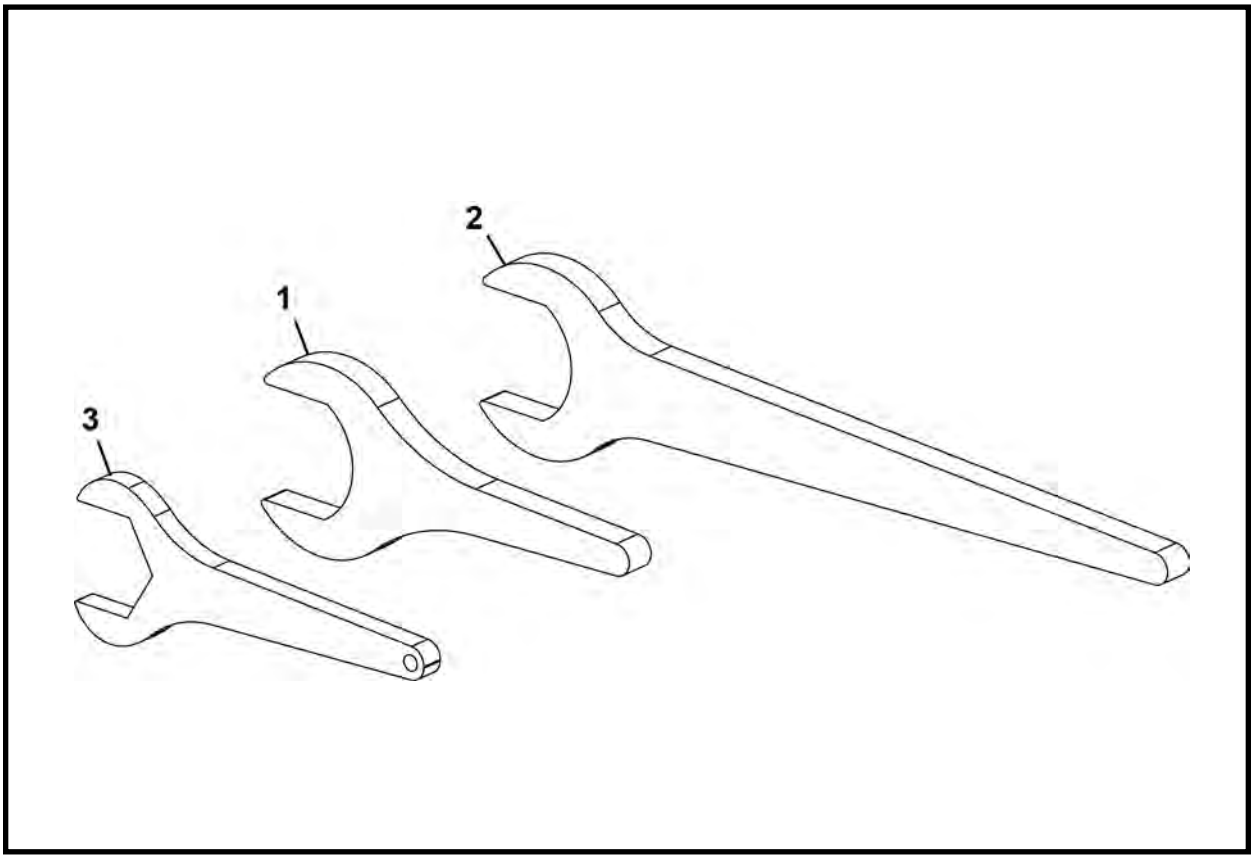
* Optional Steering Heads, not included in Steering Head Assembly, FA40245F.
** Not Shown
^ Refer to this section for parts information.

STEERING HEADS



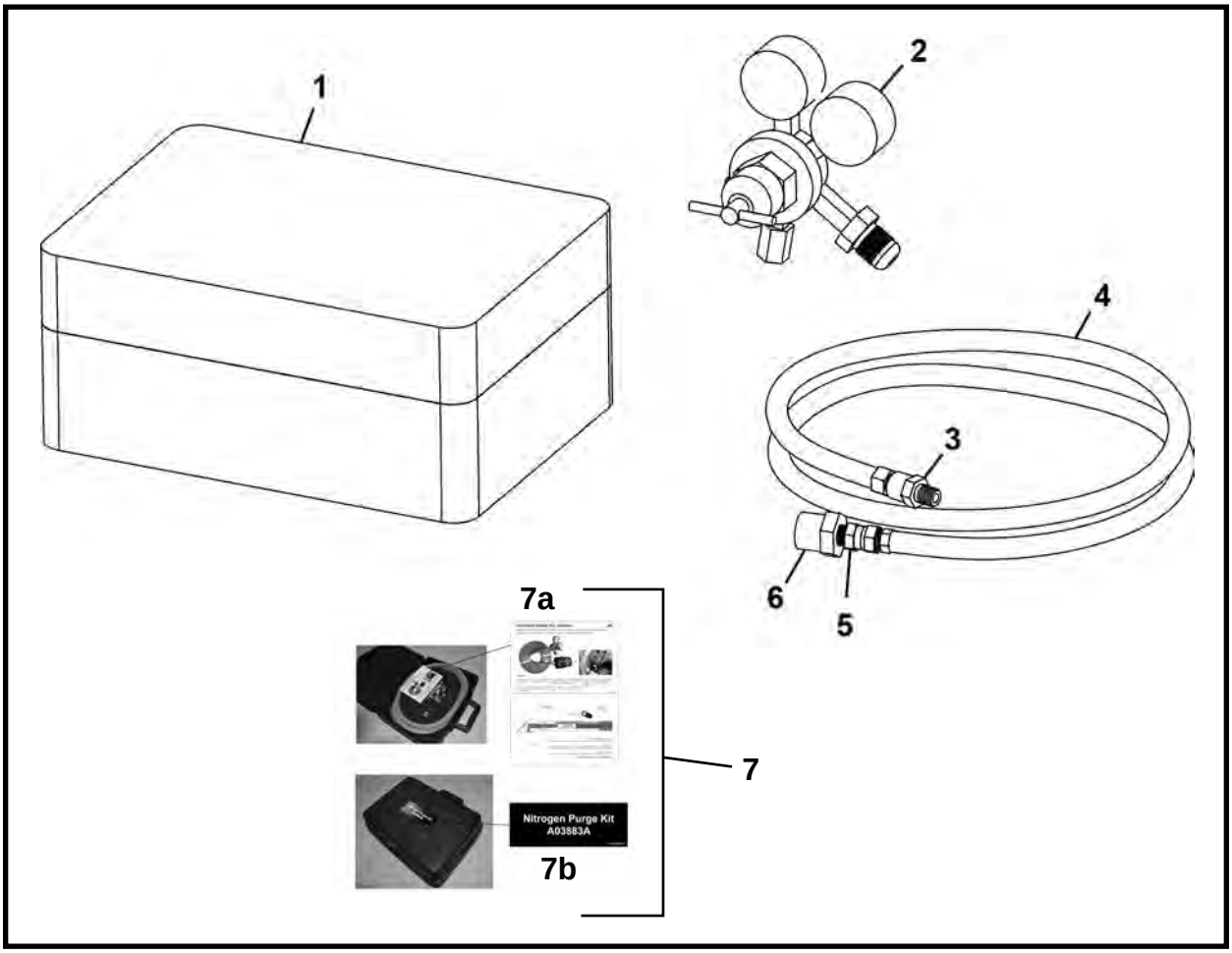
ITEM	QTY	PART NO.	DESCRIPTION
0.1	1	A40247A	STEERING HEAD, 45 Degree (5” Diameter)
0.2	1	A40248A	STEERING HEAD, 30 Degree (5” Diameter)
0.3	1	A40249A	STEERING HEAD, Bullet
0.4	1	A42706A	STEERING HEAD, 30 Degree (4” Diameter)
0.5	1	A40692A	STEERING HEAD, 45 Degree (5.5” Diameter)
1.1	1	A40578P	HEAD, Steering 45 Degree (5” Diameter)
1.2	1	A40579P	HEAD, Steering 30 Degree (5” Diameter)
1.3	1	A40580P	HEAD, Steering Bullet
1.4	1	A42707P	HEAD, Steering 30 Degree (4” Diameter)
1.5	1	A40691P	HEAD, Steering 45 Degree (5.5” Diameter)
2	1	P0085-336	ORING
3	2	A40582P	PIN, Connection
4	2	P0031-1024-001.5	SCREW, Socket Head Cap 10-24 UNC x .375
5	1/2	A40297P	PORT, Lubrication

WRENCH SET, FA40244F



ITEM	QTY	PART NO.	DESCRIPTION
0	1	FA40244F	WRENCH SET
1	1	A40583P	WRENCH, 4.15 OD SWPT - 3.625
2	1	A40584P	WRENCH, 4.15 OD DWPT - 3.625
3	1	A40515P	WRENCH, Shaft Tensioner

NITROGEN PURGE ASSEMBLY, A03883A



ITEM	QTY	PART NO.	DESCRIPTION
0	1	A03883A	NITROGEN PURGE ASSEMBLY
1	1	P0251-121	CASE
2	1	P0201-316	REGULATOR, Purging
3	1	P0201-317	ADAPTER
4	1	P0201-316A	HOSE ASSEMBLY
5	1	P0300-111	FITTING, 04MP-04FPX
6	1	P0300-080	FITTING, 12MP-04FPS
7	1	1255-060	KIT, Decal - Nitrogen Purge (Includes items 7a-7b)
7a	1	050115A	CARD, Nitrogen Purge Kit
7b	1	1251-728	DECAL, Nitrogen Purge Kit

NOTES

Numerical Index