2006 Perimeter Rd. Greenville, SC 29605
Toll Free: 800-435-9340 - Phone: 864-277-5870
Fax: 864-235-9661 - www.mclaughlinunderground.com
Email: mmole@mightymole.com

Safety and Operation Manual
VX50 Series III Vacuum System

Table of Contents
Section

Forward……2
Hazard Alert Decal……..3
Hazard Alert Decal Placement……..8
Operation Controls and Placement…… 18
Specifications and Maintenance…….. 19
Operation of Machine ……24
Warranty and Return Policy…….. 40

Manual Part No. E850006 Rev.2

© 2019 by McLaughlin Group, Inc. **Revised 4.26.2019**
All rights reserved. No part of this manual may be reproduced in any form, or by any means without prior written permission of McLaughlin Group, Inc.

FORWARD

This manual contains important safety information and operational instructions for your McLaughlin system. Read and understand this manual before operating this equipment.
Failure to do so may result in serious personal injury or equipment damage.

Keep this manual with the equipment at all times for future reference. If you sell this equipment, be sure to give this manual to the new owner. A replacement copy of this manual is available through your local Vermeer dealer or by contacting McLaughlin Group, Inc. directly at:

McLaughlin Group, Inc.
2006 Perimeter Road
Greenville, SC 29605
Toll free: 800-435-9340
Worldwide: 864-277-5870
Fax: 864-235-9661
Email: mmole@mightymole.com
www.mclaughlinunderground.com

The illustrations, instructions and specifications in this manual are subject to change. McLaughlin Group, Inc. reserves the right to make product changes at any time. Contact your McLaughlin Group, Inc. dealer for the latest information on McLaughlin equipment.

Hazard Alert Decals

BE AWARE OF SAFETY INFORMATION

This is the safety-alert sign. This symbol is placed in the manual and on your machine to alert you to potential bodily injury or death.

SIGNAL WORDS

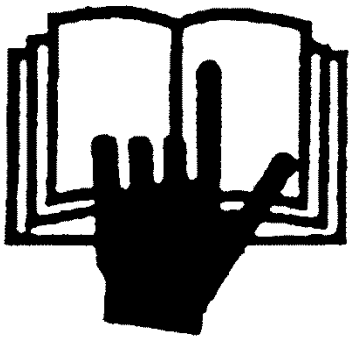
The safety-alert icon is used with the following signal word: DANGER, WARNING, AND CAUTION. When you see these words in the manual or on decals on your machine, carefully read and follow all instructions. Watch for these words and learn their meanings.

DANGER **Imminent hazard which, if not avoided, will result in death or serious injury.**

WARNING **Potentially hazardous situation which, if not avoided, could result in death or serious injury.**

CAUTION **Potentially hazardous situation which, if not avoided, may result in minor personal injury or property damage.**

READ YOUR OPERATOR'S MANUAL



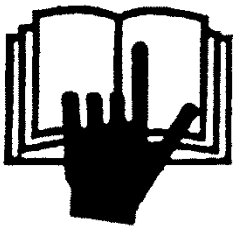
**Read and understand the operator's manual
for your machine. Do not operate your machine unless you have read and understand the warnings and instructions contained in it. Contact your McLaughlin dealer if your manual becomes damaged or lost.
Keep hands, feet and clothing away from moving parts.**

**Keep all shields and guards in place. Do not
modify or remove guards.**

Turn off the machine before servicing.

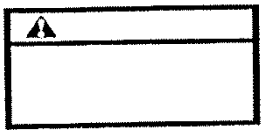
Specific Hazard Alert Symbols

READ MANUAL



Carefully read and understand all safety decals and proper operating techniques.

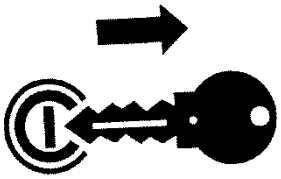
The safety decals in this manual contain important information. Understanding these decals will help you operate your equipment properly. Replace missing or damaged decals.



Allow only authorized personnel to operate equipment. Closely supervise inexperienced operators.

SERVICE AND MAINTENANCE

Make sure the machine is always in good working condition. Safety devices must always be installed and be functioning property.



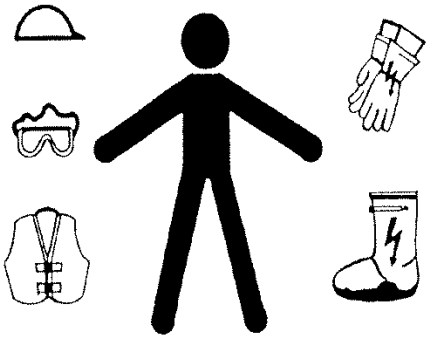
Check machine daily before operating.

Do not modify this machine. Use only McLaughlin repair parts

Follow service and maintenance intervals.

PERSONAL PROTECTIVE EQUIPMENT

Proper protective equipment is required for safe operation of this equipment.



Protective Equipment:

1. **Hard hat**
2. **Safety Glasses/Shield**
3. **Safety Vest**
4. **Ear Protection**
5. **Electric Gloves**
6. **Electric Boots**

Wear close fitting clothes. Avoid jewelry such as bracelets, necklaces and watches. Restrain hair.

DANGER: ELECTROCUTION IS POSSIBLE. CONTACT WITH ELECTRIC LINES WILL CAUSE SERIOUS INJURY OR DEATH. LOCATE ALL UNDERGROUND UTILITIES. ALWAYS WEAR PROPER PERSONAL PROTECTION EQUIPMENT.

DANGER: WHEN VACUUM EXCAVATING, NEAR ENERGIZED ELECTRIC LINES WEAR DIELECTRIC BOOTS AND GLOVES.

LOCATE UNDERGROUND UTILITY LINES

Before starting work, make sure all underground utilities have been properly located.

Inadvertent contact with buried utilities may cause death or serious injury. Contact with electric lines can cause electrocution. Contact with gas lines can cause explosion or fire.

MOVING PARTS

Keep hands, feet and clothing away from moving parts.

Keep all shields and guards in place. Do not modify or remove guards.

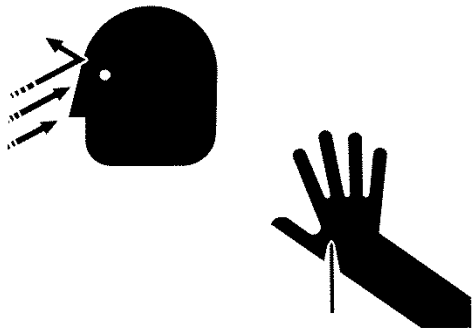
Turn off the machine before servicing.

HIGH PRESSURE AIR AND FLUIDS

This machine may use water, air, and hydraulic fluid at high pressure.

Water from wand and air from lance can cause serious injury. Wear protective clothing.

Relieve pressure before servicing.



FLAMMABLE LIQUID

Fumes and/or fuel can explode or catch fire.

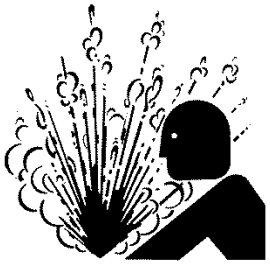
Shut off engine before refueling.

Keep engine and trailer free of fuel. Wipe up any spilled fuel immediately.

HOT FLUID UNDER PRESSURE

Hot fluid can burn or scald.

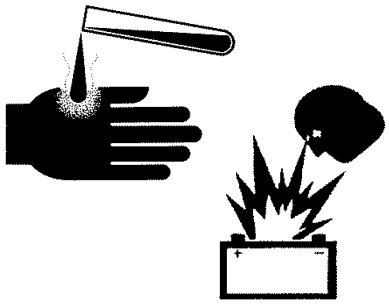
Wear protective clothing when servicing.



BATTERY ACID AND FLAMMABLE FUMES

The battery contains acid which can cause severe burns. Avoid contact with eyes, skin and clothing.

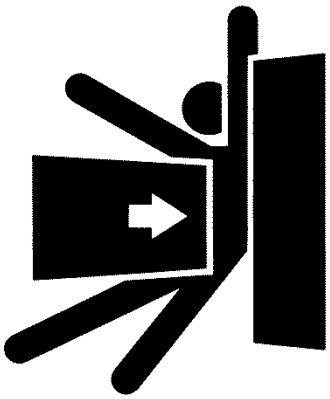
Fumes from the battery may explode. Keep sparks and flame away from battery. Cables and tools may cause sparks. Protect eyes and face from battery.



CRUSHING WEIGHT

The spoil, tank, and door are very heavy. Stay clear of the door when dumping the tank.
Trailer mounted systems may roll or tip if not properly secured to the towing vehicle. The following must be followed for operation, dumping, and servicing the tank.

1. **The trailer tongue must be properly attached to the towing vehicle.**
2. **The towing vehicle's tires must be chocked.**
3. **The towing vehicle's parking brake must be applied.**



SUFFOCATION HAZARD

This machine produces a high volume of air flow.

Direct contact of the mouth and/or nose to the vacuum air flow can result in death by suffocation.

Do not allow hoses or tools to come in contact with skin, hair and clothing.

Never put the suction end of a tool or hose near your face. The vacuum can collapse your lungs.

Never use this machine in a manner that is inconsistent with its intended design.

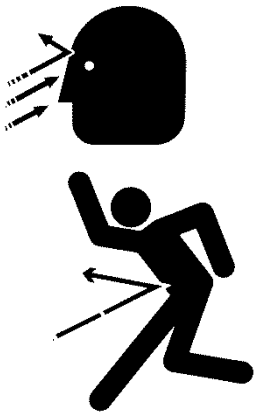
FLYING OBJECT HAZARD

This machine uses either water or air under pressure.

The ground engaging tools can cause objects to become airborne.

Flying objects can cause injury or property damage.

Keep all nonessential people away from the work area.



TRANSPORTING MACHINE

Make sure all components are stored properly.

Turn off the engine and relieve water system pressure.

Trailer units should be verified for the following:

1. **The hitch, safety chains, and trailer wiring is properly connected.**
2. **The jack is in its fully retracted position.**

Close all valves and doors.
Remove wheel chocks.

REMEMBER: A fully loaded or partially loaded unit will pull differently than when it is empty. A loaded unit requires longer stopping distances.
Also, liquid tends to "slosh" when stopping.

Make sure that the tires are inflated properly and that the brakes work properly.

WARNING: FAILURE TO FOLLOW ANY OR ALL OF THE SAFETY INSTRUCTIONS IN THIS MANUAL, COULD RESULT IN DEATH OR SERIOUS INJURY. DO NOT USE THIS MACHINE IN A MANNER THAT IS INCONSISTENT WITH ITS INTENDED DESIGN.

Hazard Alert Decal Placement

HAZARD ALERT DECAL MAINTENANCE

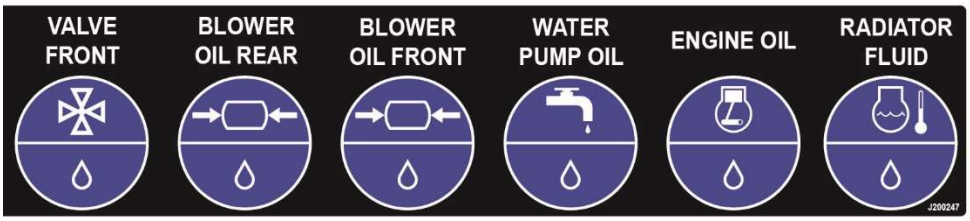
Hazard alert decals on your machine contain important information that will help
you operate the equipment safely.

Decals maintenance:

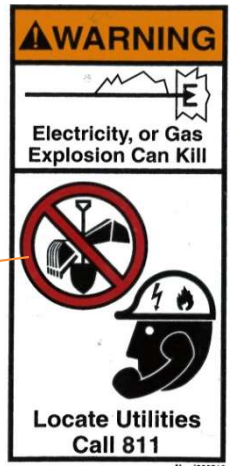
1. **Keep decals clean. Clean with soap and water. Do not use harsh chemicals,**
   or spray decals directly with a high pressure washer.
2. **Replace decals when they become damaged or hard to read. Clean the**
   surface of dirt, grease and oil before applying.
3. **When replacing a machine component with a decal on it, replace the decal**
   also.
4. **See your local dealer or contact McLaughlin for replacement decals.**
5. **Replacement part number appears on each decal, as well as in this manual.**

POWER PACKS

REMOTE OIL DRAIN PORTS

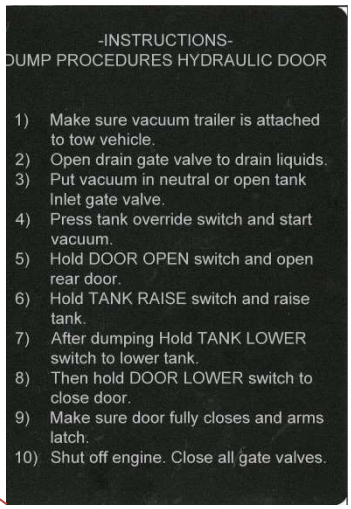


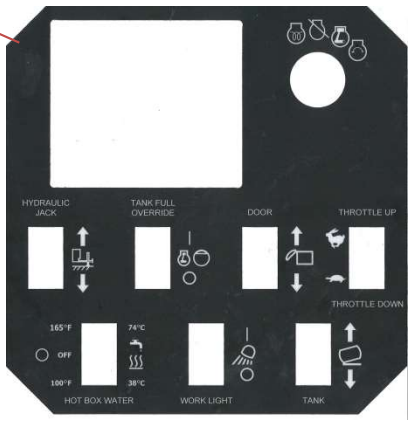
POWER PACKS - CURB SIDE



DIESEL POWER PACKS - CURB SIDE

DIESEL POWER PACKS - CURB SIDE CONT'D





BATTERIES

TRAILER TONGUES

TRAILER TONGUES CONT'D

WATER COMPONENTS

RADIATORS

FUEL TANKS

SPOIL TANKS

Vermeer

DANGER
EXPLOSION HAZARD!
CONTENTS UNDER PRESSURE!
Relieve tank pressure before opening.
Failure to comply will result in death or serious injury.
J200423 rev.1

WARNING
Pinch point.
Serious injury may result.
Keep hands clear when closing door or lowering tank.
J200455

DANGER
SUFFOCATION HAZARD.
Vacuum hoses will cause death or serious injury.
Keep hoses and tools away from face and body.

Vermeer

WARNING
FIRE OR EXPLOSION POSSIBLE.
Do not vacuum flammable or combustible substances.
J200473

DANGER
Crushing weight.
Spoil and door will cause death or serious injury.
Unlock door only under vacuum.
Stay away from door when dumping.

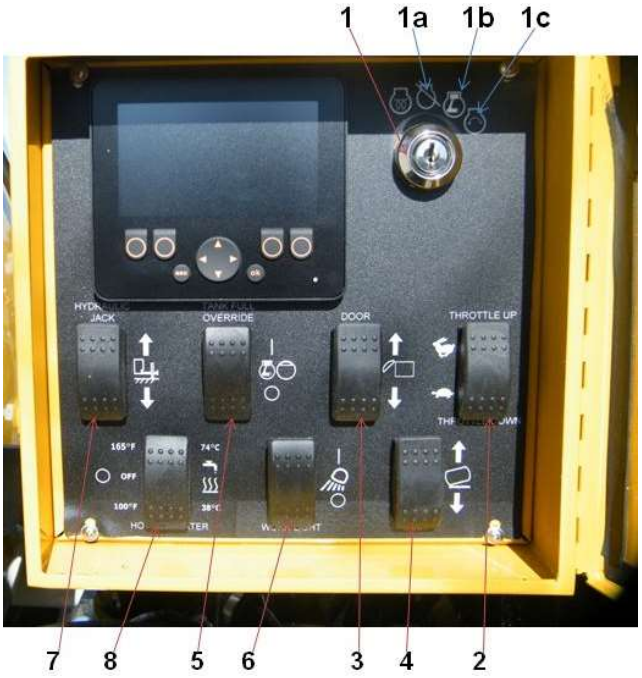
SPOIL TANKS (CONT.)

BOOM

BOOM CONT'D

TOOLS

DIESEL CONTROLS



1. IGNITION SWITCH
    a. OFF
    b. RUN
    c. START
2. THROTTLE SWITCH (5 SPEED SETTINGS)
3. TANK DOOR RAISE/LOWER
4. TANK RAISE/LOWER
5. TANK FULL OVERRIDE SWITCH
6. WORK LIGHT SWITCH
7. HYDRAULIC JACK SWITCH
8. WATER/HOT BOX SWITCH

BOOM CONTROLS

VACUUM TANK DOOR

The vacuum tank door should only be opened without vacuum. The area behind the unit must be clear of all personnel before opening the door.

To Open The Door:

1. **Remove the plug from the inlet port.**
2. **Move Vacuum/Pressure selector to the neutral position.**
3. **Turn off the engine and remain at the control panel until the vacuum releases the door.**
4. **Press the Door Open switch.**
5. **With the area behind and around the door clear of personnel, the tank may be raised.**
6. **Turn off the engine and remain at the control panel until the vacuum releases the door.**

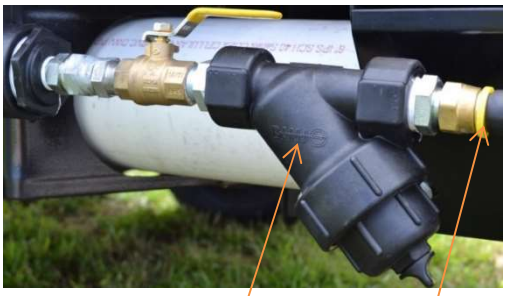
DANGER: CRUSHING WEIGHT. SPOIL AND DOOR WILL CAUSE DEATH OR SERIOUS
INJURY. UNLOCK DOOR ONLY UNDER VACUUM. STAY AWAY FROM DOOR WHEN DUMPING.

WATER SYSTEM

Water Tank Ball Valve and In-Line Strainer

The Water Tank Ball Valve is located on the operator's side of the vacuum.

1. **On Turn handle in line with the valve.**
2. **Off Turn handle perpendicular to the valve.**



IN-LINE STRAINER **DRAIN**

The ball valve on the water tank must always be open when the water pump is drawing water from the tank.
Operating the water pump with the ball valve closed will result in damage to the water pump. Close the ball valve to clean the strainer or service the water system without draining the tank.

The in-line strainer protects the water pump from particles that may cause damage. A drain plug is located at the bottom of the strainer which may be used to drain the entire system. The strainer should be checked daily for debris and cleaned.

WATER SYSTEM

Water Assisted Tools

Water Assisted Tools have the water control on the tool.
A trigger lever controls the water flow.

1. **On—squeeze the trigger lever.**
2. **Off—release the trigger lever.**

TRIGGER LEVEL

Changing tool in operation:

1. **Close the ball valve for the hose reel.**
2. **Squeeze the trigger lever to relieve pressure in the hose.**
3. **Disconnect the Water Supply Hose and change tools.**
4. **Open the ball valve for the hose reel.**

WATER SYSTEM

Control Valves

The Control Valves are located below the hose reel. The valve labeled Tank Cleanout controls the in-tank cleanout.

1. **On Turn handle in line with the body.**
2. **Off Turn handle perpendicular to body.**

Use this valve to relieve system pressure in the Water hose.

NOTE: To relieve system pressure, tool must be disconnected from hose.

TANK CLEANOUT

HOSE REEL VALVE

WATER SYSTEM

Antifreeze and Valve

The antifreeze tank is plumbed into the water pump inlet.
The antifreeze tank ball valve is at the rear of the machine, below the hose reel. The valve should remain closed, except during the antifreeze procedure. Always verify that the antifreeze tank is not empty and the water tank ball valve is closed before opening the antifreeze ball valve.
(Refer to page 25 for Antifreeze Procedure)

ANTIFREEZE TANK

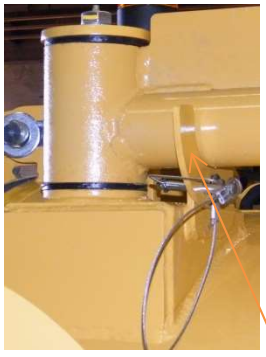
BALL VALVE

Options

Strong Arm

The Strong Arm is used to support the vacuum hose while vacuuming.

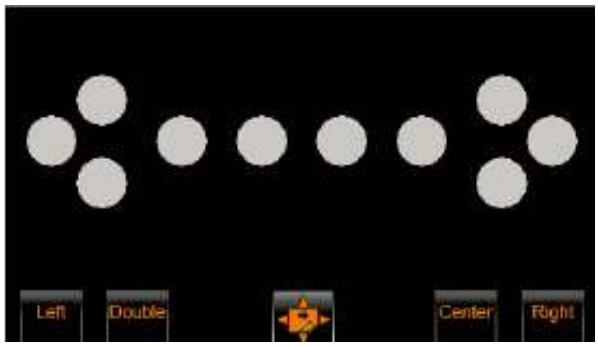
Note: Strong Arm must be in locked, transport position during transport.



STRONGARM PIN/LOCK

Arrow Board

The Arrow Board is located at the back, on the top of the Spoil Tank. It signals directions to on-coming traffic to go around machine while working.



- **Press corresponding soft-key switch to select arrow board pattern.**
- **Pressing the soft-key switch of the pattern that is currently ON will turn it OFF.**
- **The CENTER pattern is the default when the machine is first powered up.**

Push UP or RIGHT arrow soft-keys to go to MAIN screen.

Push DOWN or LEFT arrow soft-keys to go to ENGINE screen.

Options

Hot Box

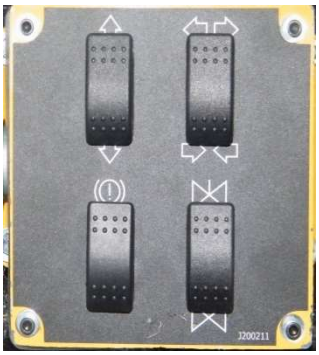
The Hot Box is located on side of the trailer skid.
The Hot Box is used to heat the water used b the machine.

Note: The Hot Box cannot be operated while transport. If operated during transport the fl can be blown out and will cause the unit to fi with fuel. If it ignites, damage to the hot box machine and bodily injury is possible.

Reverse Flow

<u>Pressure</u> - pushes air out of the tank ports and boom if supplied.
<u>Neutral</u> - air circulates inside the blower. Use this position to start the engine.
<u>Vacuum</u> - pulls air into the tank.

Emergency Manual Override Boom Operation



The intent of the manual override switches is to provide
a means to operate the boom to get it into the storage
cradle in the occurrence that the transmitter has become damaged or lost.

Hydraulic Jack

The Hydraulic Jack is located at the front of the trailer. The Hydraulic Jack is used to automatically raise/ lower trailer tongue.

MAINTENANCE

GAS ENGINE (Per Specs in Honda GX670 Operator's Manual)

Part	Part #	First 50 hrs	Every 400 hrs	Every 500 hrs	Every 3000 hrs	Every 1 YEAR
Engine Oil	15W40 CJ-4/ACEA E9/ECF-3	✓Daily	X			
Engine Coolant	50/50 mixture of PROPYLENE GLYCOL AND WATER (must meet ASTM D6210 specifications)	✓Daily				
Oil Filter (Kubota)	T700077	X	X			
Fuel Filter (primary) (Kubota)	8090544-07			X		
Air Filter (Kubota)	8090544-12	✓Daily				X
Fuel-Water Separator Filter	8090941-01	X				
Hydraulic Oil	Industrial Type Hydraulic Fluid	✓Daily				
Water Pump Oil	General Pump Series 100 Oil or SAE30, Non-Detergent, Motor oil	✓Daily				
Blower Oil	Industrial Type, Heavy Duty, Non-Detergent Motor Oil	✓Daily, X	X			
Diesel Particulate Filter					X	

HYDRAULIC TEMPERTURE RANGE **0-120°F (-18°-40°C) SAE 10 GRADE HYDRAULIC OIL or DEXTRON II ATF**
32-175°F (0-80°C) SAE 20 GRADE HYDRAULIC OIL
3QTS (2.8L)

BLOWER TEMPERTURE RANGE

0°F (-1°C) AND UNDER	**SAE 20**
30-90°F (-1-32°C)	**SAE 30**
90°F (32°C) AND ABOVE	**SAE 40**

******WATER PUMP – (Remove fill cap and fill crankcase to dot on oil gauge window.)**

******Refer to Component Manual specific Component Specifications.**

WARNING: NEVER ATTEMPT TO CHANGE OR ADD OIL WHILE ENGINE IS RUNNING. PERSONAL INJURY OR EQUIPMENT FAILURE WILL RESULT. ALLOW UNIT TO COOL DOWN BEFORE ATTEMPTING ANY MAINTENANCE.

ANTIFREEZE PROCEDURE

1. Drain water tanks and wye strainer.
2. Close main water supply valve.
3. Fill antifreeze tank.
4. Open antifreeze ball valve
5. Disconnect tooling from hose. Open hose reel ball valve.
6. Start engine. Press and hold the far left soft button labeled as antifreeze on LCD screen until antifreeze is coming from hose. Release soft button. Close reel ball valve.
7. Open tank cleanout valve.
8. Press and hold antifreeze button until you see antifreeze coming from drain valve on spoil tank. Release antifreeze button.
9. Close tank cleanout valve
10. Press antifreeze button 5 times to winterize bypass circuit.
11. Turn machine off.
12. Close antifreeze ball valve and open main supply ball valve.

BLOWER

Recommended Fluid Type: Industrial Type, Heavy Duty, NON-DETERGENT Motor Oil
Temperature Range:

30° F (-1°C) and under	SAE 20
30-90° F(-1-32°C)	SAE 30
90° F (32°C) and above	SAE 40

Fill each gear end separately.
Remove breather from each gear end.
Pour oil through the breather port.
Keep oil at proper level in each sight gauge.
Service Intervals: Check oil level daily. Change oil every 500 hrs or twice annually.

Belt tension: Check belts daily for the first week, weekly thereafter. Tension should be maintained by the tension idler.

WARNING: NEVER ATTEMPT TO CHANGE OR ADD OIL WHILE BLOWER IS RUNNING. PERSONAL INJURY OR EQUIPMENT FAILURE WILL RESULT. ALLOW UNIT TO COOL DOWN BEFORE ATTEMPTING ANY MAINTENANCE.

WATER PUMP

Belt Tension:	Check belts daily for the first week, weekly thereafter. Tension should be maintained by the tension idler.
Recommended Fluid Type:	General Pump Series 100 oil or SAE 30, NON-DETERGENT, Motor Oil. Remove fill cap and fill crankcase to dot on oil gauge window.
Service Intervals:	Check oil level daily. Change oil after 50 hr. break-in period. Change oil every 400 hrs. or every 3 months, whichever comes first.

WARNING: NEVER ATTEMPT TO CHANGE OR ADD OIL WHILE WATER PUMP IS RUNNING. PERSONAL INJURY OR EQUIPMENT FAILURE WILL RESULT. ALLOW UNIT TO COOL DOWN BEFORE ATTEMPTING MAINTENANCE.

AIR FILTER ELEMENT

Service Intervals: Inspect element daily. Clean with low pressure water as needed. Replace when worn. **Replace damaged elements immediately. Never operate without the element.**

CYCLONE SEPARATOR

Service Intervals: Open and clean housing after dumping tank. Wipe clean with a towel. Do not spray water into the housing while the engine is running.

GREASE GUN LUBE POINTS

2	Tank Pivot Bar	2 Pumps
1	Trailer Jack	2 Pumps (Manual crank only)
2	Engine Shaft	2 Pumps
2	Tank lift cylinders	2 Pumps
4	Boom cylinders	2 Pumps (Boom Units Only)
1	Boom Bearing	2 Pumps per Bolt Spacing (Continue all around bearing)
1	Boom Brake Pin	1 Pump (Boom Units Only)
1	Boom Tube Seal	2 Pumps (Boom Units Only)
1	Reverse Flow Valve	4 Pump

Service Intervals: Grease all fittings weekly.
Use an EP NLGI 2 Grease with additives to protect against wear, rust and oxidation.

ELECTRIC - HYDRAULIC POWER PACK

Recommended Fluid Type:	Industrial Hydraulic Fluid.	
Temperature Range:	0-120°F (-18°-40°C)	SAE 10 grade hydraulic oil or Dextron II ATF
	32 - 175°F (0-80°C)	SAE 20 grade hydraulic oil.
Capacity:	3 qtrs. (2.8 L)	
Relief Valve Setting:	3000 psi (206.8 bar)	
Service Intervals:	200 hrs. or annually, whichever comes first.	
Filter:	Clean screen filter if the pump loses performance.	

DOOR SEAL

Clean the door seal daily and after emptying the tank.

TOOLS

Remove dirt and mud daily. Do not allow mud to buildup on the inside of the tool. This will restrict the flow of debris and reduce the performance of the tool. Check that nozzles are clean and working properly. Unplug clogged nozzles. Clean and replace nozzles as necessary. Check daily the fittings and the condition of the hoses on the tools. Tighten or replace as necessary. Replace broken and worn-out tools.

VACUUM HOSES

Clean hoses with water. Do not spray with high pressure water tools. High pressure water from the high pressure water tools can cut the hoses. Check hoses for holes, cracks etc. Salvage damaged hoses by cutting off the damaged section. Replace hoses when necessary.

TRAILER

The trailer provided with your equipment has an Electric or Surge Break-away brake. This brake engages if the trailer ever separates from the towing vehicle.

WARNING: DO NOT USE BREAK AWAY DEVICE AS PARKING BREAK.

Operation: Secure cable to the tow vehicle hitch. Leave slack in cable to allow for the turning radius of the trailer.

System check. System requires a 12Volt, 5A / hr battery.
(Not required on surge brakes.)

1. Disconnect trailer electrical connector.
2. Pull out the cable switch on trailer with electric brakes. Pull the surge brake lever forward on surge brake trailers.
3. Pull the trailer forward with the tow vehicle.
4. The brakes of the trailer should be engaged and provide resistance to motion.
5. Install the cable switch.
6. Connect the trailer electrical connector.

Service Intervals.

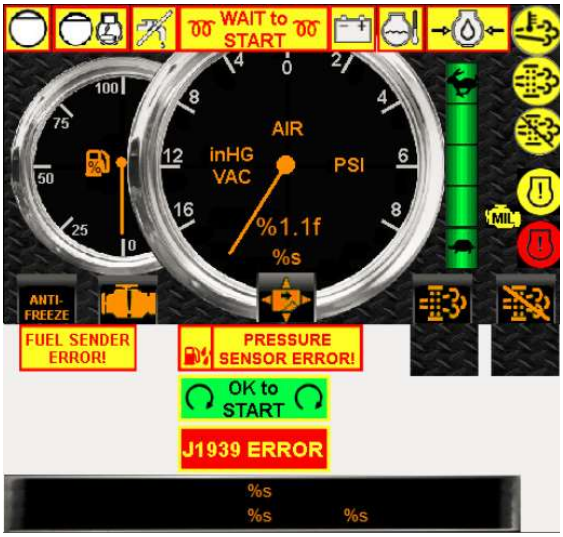
Wheel bearings:	Grease Annually. Remove center plug in axles and grease with standard wheel bearing grease.
Brakes:	Check brakes daily. Adjust as necessary.
Tires:	Check tires for wear and correct air pressure daily.

DANGER: ELECTROCUTION POSSIBLE. CONTACT WITH ELECTRIC LINES WILL CAUSE DEATH OR SERIOUS INJURY. LOCATE ALL UNDERGROUND UTILITIES. ALWAYS WEAR PERSONAL PROTECTION EQUIPMENT.

DANGER: DAMAGED GLOVES OR BOOTS DO NOT PROVIDE ADEQUATE ELECTRICAL PROTECTION.

LCD Display Screens

Screen is displayed for three (3) seconds, and then automatically switches to ENGINE screen.



Automatically switches to this screen after being on any of the following screens for thirty (30) seconds:

- Momentary soft-key switch. Used to turn on water pump relay when water level is low.

- Push to go to ECU reported engine error codes.

- Push UP or RIGHT arrow soft-key to go to ENGINE screen
- Push DOWN or LEFT arrow soft-key to go to ARROW BOARD screen.

- Push for half (0.5) a second to request REGEN. This switch can only be used, and will only be visible, if the engine is running, REGEN conditions are met and a REGEN cycle is not taking place.
- Push for half (0.5) a second to request inhibiting REGEN. This switch can only be used, and will only be visible, if the engine is running and REGEN is *not* already happening.
- If the ECU accepts the request, the REGEN Inhibit indicator will light up.

- Screen shows Active Engine codes being reported by ECU.

- Push any arrow soft-key to go to MAIN screen.

Possible “Pop-Up” Indicators

	Spoil tank is full		Engine can be started/cranked
	Spoil tank override is ON		Communications error with engine ECU
	Engine glow plugs are heating		Water in fuel
	Engine glow plugs are heating; wait to start		High exhaust temperature
	Battery voltage is low		Diesel particulate filter (DPF) regen needed.
	Engine water temperature is high		Diesel particulate filter (DPF regen inhibited
	Engine oil pressure is low		Engine warning (alert) indicator
	Fuel Sender signal is out of range Full = 240 ohms Empty = 33 ohms		Engine shutdown (action) indicator
	Vacuum pressure signal is out of range +15 psi = 5VDC -14.7 psi (-30inHg) = 0VDC		Engine malfunction indicator lamp

Operation of Machine

PRE-OPERATING INSTRUCTIONS

Before operating the vacuum system on a job site, the operator should be trained in vacuum excavation and cable locating. All sections of the manual should be read and understood. Prior to excavation, the operator should:

1. Check all fluid levels in the engine, vacuum pump, and water pump.
2. Check all vacuum hoses and tools for blockages and damage.
3. Check all filters and clean or replace as necessary.

CAUTION: DO NOT OPERATE WITHOUT FILTER SYSTEM INTACT.

4. Inspect all safety equipment, boots, gloves, etc. for wear and damage. Replace if necessary.
5. Check any utility maps for locations of buried utilities that need to be exposed.
6. If excavations are to be conducted near or on roadways, make sure local authorities are contacted for regulations regarding traffic control and safety.
7. Know the contents of the material you are excavating or remediating.
8. Know the local regulations for disposing of liquid material and/or mud.
9. Have a place or a plan for the disposal of the material taken into the tank

WARNING: DO NOT VACUUM HAZARDOUS OR FLAMMABLE MATERIAL WITH THIS SYSTEM. CONSULT FEDERAL, STATE, AND LOCAL REGULATIONS REGARDING CLASSIFICATIONS OF HAZARDOUS MATERIAL.

STARTING THE DIESEL ENGINE

WARNING: MOVING PARTS. DEATH OR SERIOUS INJURY MAY RESULT. DO NOT OPERATE WITHOUT GUARDS IN PLACE.

1. Open inlet gate valve in Spoil Tank.
2. Move air flow handle to neutral position.
3. Rotate key clockwise to ACC position.
4. LCD screen will come on.
5. When the screen states OK to start rotate key to the start position.
6. Let engine warm up until the message “warming engine” disappears.

COLD WEATHER STARTING:
Refer to engine maintenance section for proper oil requirements before operating in cold temperature conditions.

IMPORTANT: Do not use aerosol Starting Fluids.

SHUTDOWN PROCEDURE

1. Reduce engine speed to idle.
2. Move air flow handle to neutral position.
3. Shut off the engine and remove the key.
4. Relieve water pressure from the Water Assisted Tools by squeezing trigger.

IMPORTANT: Never use main power disconnect switch to stop engine.

JUMP STARTING

WARNING: FLAMMABLE FUMES. FUMES MAY EXPLODE OR CATCH FIRE. KEEP AWAY SPARKS AND OPEN FLAME. BATTERY ACID CAN BURN SKIN AND EYES. PROTECT FACE, HANDS AND BODY WHEN SERVICING.

Use only a 12 volt system for jump starting. Use only an approved set of jumper cables. Avoid inadvertent contact with cables and surrounding components.

1. Connect first RED clamp to POSITIVE (+) terminal of discharged battery.
2. Connect second RED clamp to POSITIVE (+) terminal of charged battery.
3. Connect first BLACK clamp to machine frame of the machine with the charged battery.
4. Connect second BLACK clamp to machine frame of the machine with the discharged battery.

CONNECTING VACUUM HOSES AND TOOLING

1. Remove vacuum hose from storage.
2. Install male hose end into female hose end on tank inlet port and lock the cam levers. If there is a boom on the machine, attach the male hose end into the female hose end on the end of the boom and lock the cam levers.
3. Attach additional vacuum hoses as needed for distance.
4. Remove the necessary tooling from the tool storage.
5. Attach necessary tooling onto the end of the vacuum hose and lock the cam levers.

JOB SITE PREPARATIONS

When pot-holing for non-destructive exposure of underground utilities prior to excavating, trenching or boring, coordinate with all local utilities and mapping services. The area of the proposed excavation should be marked. The one call service should have been contacted and the area marked or cleared. Any underground plant owners not participating in the one call system should be notified and have their underground facilities marked. Use a pipe and cable locator to do a search of the area to be excavated to determine if any unmarked facilities exist. This may also help determine a more precise location of any marked facilities. Consult area utility maps or seek advice on nonmetallic pipes such as sewer or storm water lines that may not be marked.

WARNING: WHEN EXPOSING UTILITY LINES FOR AVOIDANCE IN A DIGGING APPLICATION, VERIFY THAT THE EXPOSED LINE IS THE CORRECT LINE. EXCAVATIONS MAY CONTAIN MULTIPLE LINES OR ABANDONED LINES, AS WELL AS THE LINE TO BE EXPOSED.

Establish and maintain traffic control procedures to keep the vacuum crew safe during the operation. Traffic cones or barricades should be used to establish a “safe” area around the vacuum work site. When working in low light conditions, use work lights to illuminate the area and provide visibility.

Determine the proper safety equipment to wear. When doing vacuum slurry excavation proper safety equipment should be worn consisting of eye protection, high visual clothing or vest, hard hat, gloves, ear protection and steel cap work boots. When doing vacuum slurry excavation around energized power lines dielectric insulated boots should be worn. This is to protect the operator from becoming shocked or electrocuted if the reduction tool comes into accidental contact with a leaking power line.

Electric boots should be maintained by following the manufacturer's specific instructions. Read and follow those directions carefully. They are contained in section 5 of this manual. Replace worn out or torn boots. Always wear personal protective equipment including hard hat, reflective vest, work boots and safety glasses. Ear protection should also be used when operating the vacuum system.

WARNING: DO NOT WEAR LOOSE FITTING CLOTHING OR LONG HAIR.THEY CAN BE SUCKED INTO THE VACUUM HOSE AND CAUSE SERIOUS INJURY .

Keep bystanders and spectators away from the vacuum system and work site. Loose flying debris can injure or blind bystanders. Allow only authorized personnel with proper safety equipment in the work area.

POTHOLING EXCAVATION (Systems Supplied With Water Only)

Potholing excavation is achieved by use of the reduction tool or rotary lance and vacuum tool. This tool combines the operations of "reducing" and "removing" material from the ground. The end result being a small pothole that allows for the visual identification of buried utilities. In the reduction step, high pressure water is used to reduce the soil to a size small enough to be vacuumed. It is important to let the water do the "reducing" of the soil so as not to damage the utility being exposed with the end of the tool. In the removing step the "reduced" soil is vacuumed out of the excavated pothole.

To begin the job site operation:

1. Position the vacuum unit as close to the area to be excavated as possible.
2. Set the parking brake and chock wheels. (Trailer units must remain hooked to the towing vehicle.)
3. Start the power unit and allow the engine to warm up. (Refer to the Start-Up Procedure in this section of the manual.)
4. Place necessary traffic control measures.
5. Use proper personal safety protection equipment, including electric boots when necessary.
6. When preparing to pothole in a grassy area, use a spade or other appropriate digging tool to loosen and remove the grass plug over the area to be excavated. If pot-holing under asphalt or concrete, use a hydraulic or air operated breaker or saw to remove the top material and expose the earth.
7. Connect the water line to the high pressure rotary lance.
8. Attach the vacuum hose to the suction tool.
9. Attach the vacuum hose to the inlet port on the spoil tank. If additional hose is needed, attach using the cam lock fittings provided on the hose ends. Short hose lengths are recommended to reduce vacuum hose clogging. If the vacuum hose is connected to the spoil tank and the engine is running with the selector lever in vacuum, the suction tool will be vacuuming. To stop the vacuuming, move the selector to the neutral position.

DANGER: SUFFOCATION HAZARD; WILL CAUSE SERIOUS INJURY OR DEATH. KEEP HOSES AND VACUUM TOOLS AWAY FROM FACE AND BODY.

10. Open the hose reel ball valve.
11. Position the rotary lance vertically at the desired potholing location.(Never point the rotary lance upward and pull the trigger on the tool. This will cause the rotary nozzle to become damaged internally)
12. Squeeze the rotary lance trigger lever and move the rotary lance in a semi-circular motion with the handle. This will allow the rotary nozzle to excavate a cylindrical hole in the ground.
13. After the hole is started place the suction tool over the area you are potholing. This will vacuum all material into the debris tank.

WARNING: FLYING OBJECTS CAN CAUSE SERIOUS INJURY OR BLINDNESS. WEAR EYE PROTECTION.

WARNING: HIGH PRESSURE WATER CAN CAUSE SERIOUS INJURY. WEAR PROTECTIVE CLOTHING AND DO NOT POINT HIGH PRESSURE WATER TOOLS TOWARD BODY PARTS.

14. As the reduction step continues to expose the utility, be aware of changes in soil conditions. A soft area that allows faster penetration will usually mean that the excavated hole is approaching the utility. When resistance is encountered, stop. Remove the tooling from the pothole and identify the utility or obstruction.
15. If the utility cannot be completely exposed from one hole, the hole size must be enlarged to allow observation of the complete utility. It is important to be able to observe the entire utility to determine its size.
16. The spoil tank is equipped with a “full tank” engine shut down sensor for fluid applications. When the fluid level in the tank reaches capacity, a sensor will automatically shut down the engine. This prevents overfilling the tank and sending fluid into the filtration system. When the vacuum system automatically shuts down, empty spoil tank. (Refer to the section titled Emptying the Spoil Tank.) (There is a secondary ball and cage vacuum shutoff as well)
17. When finished potholing, close the hose reel ball valve. If the spoil tank is, the engine will shut down automatically. If the tank is not full, shut down engine and remove key. Squeeze the rotary lance trigger lever to release trapped water pressure prior to unhooking. All tools and hoses should be securely stored before traveling to the spoil disposal site.

VACUUM EXCAVATION

Vacuum excavation is the processes of removing material whether wet or dry by a powerful air stream. This is accomplished use of the vacuum tool.

WARNING: DO NOT VACUUM HAZARDOUS MATERIAL WITH THIS SYSTEM. CONSULT FEDERAL, STATE, AND LOCAL REGULATIONS REGARDING CLASSIFICATIONS OF HAZARDOUS MATERIAL.

To begin the job site operation:

1. Position the vacuum unit as close to the area to be excavated as possible.
2. Set the parking brake and chock wheels.
3. Place necessary traffic control measures.
4. Start the power unit and allow the engine to warm up. (Refer to the Start-up Procedure in this section of the manual.)
5. Use proper personal protection equipment.
6. Attach the vacuum hose to the vacuum tool.
7. Attach the vacuum hose to the inlet port on the spoil tank. If additional hose is needed, attach using the cam lock fittings provided on the hose ends. Short hose lengths are recommended to reduce vacuum hose clogging. If the vacuum hose is connected to the spoil tank and the engine is running with the selector in the vacuum position, the vacuum tool will be vacuuming. To stop the vacuuming, move the selector to the neutral position.

DANGER: SUFFOCATION HAZARD WILL CAUSE SERIOUS INJURY OR DEATH. KEEP HOSES AND VACUUM TOOLS AWAY FROM FACE AND BODY.

8. When vacuuming fluids, it is more efficient to turn the liquid into an aerosol by not completely submerging the vacuum tool in the fluid. By keeping part of the vacuum tool out of the fluid, the airflow through the vacuum tube will move the material quicker to the spoil tank. This technique is also effective when vacuuming deep vertical distances.
9. The spoil tank is equipped with a “full tank” engine shut down sensor for fluid applications. When the fluid level in the tank reaches capacity, a sensor will automatically shut down the engine. This prevents overfilling the tank and sending fluid into the filtration system. When the vacuum system automatically shuts down, empty spoil tank. (Refer to the section titled Emptying the Spoil Tank.)
10. When vacuuming dry materials, the “full tank” shutdown sensor will not work. Vacuuming should be stopped when the debris level in the spoil tank has reached the sight glass or when debris can be heard circulating in the cyclone separator.
11. When finished, the engine should be shut down if not automatically shut down and the key removed. All tools and hoses should be securely stored before traveling to the spoil disposal site.

EMPTYING THE SPOIL TANK - HYDRAULIC LOCKING DOOR

WARNING: DO NOT VACUUM HAZARDOUS MATERIAL WITH THIS SYSTEM. CONSULT FEDERAL, STATE, AND LOCAL REGULATIONS REGARDING CLASSIFICATIONS OF HAZARDOUS MATERIAL.

Emptying the vacuum spoil tank presents several hazards that the operator should be aware of.

DANGER: CRUSHING WEIGHT. SPOIL AND DOOR WILL CAUSE DEATH AND SERIOUS INJURY. UNLOCK DOOR ONLY UNDER VACUUM. STAY AWAY FROM DOOR WHEN DUMPING.

DANGER: CRUSHING WEGHT. ROLLING OR TILTING UNIT WILL CAUSE DEATH OR SERIOUS INJURY. CHOCK TIRES AND APPLY PARKING BRAKE BEFORE OPERATING OR SERVICING. DO NOT OPERATE OR SERVICE UNLESS ATTACHED TO VEHICLE.

Before beginning vacuum operations, a plan and site for disposing of the spoil in the tank should be established.

1. Before arriving at the disposal site, verify the water tank has an adequate level for cleanup if equipped.
2. After arriving at the disposal site, set the parking brake and chock the wheels.
3. Open the inlet port.
4. It is recommended that liquids be drained from the tank, prior to raising the tank. Use the gate valve located in the bottom of the door to drain excess liquids.
5. At the operator's console, turn the vacuum tank full override switch on. Override is only required when the spoil tank is full.
6. Start the engine.
7. Press and hold the door open switch . The door will unlock and open.
8. Once the door is open, press and hold the tank raise switch.
9. Once the tank has been emptied, it may be cleaned while in the raised position. Units not cleaned after dumping should have the door seal and mating flange wiped clean of debris that may damage the seal when sealing the door.
10. Open the cyclone door and remove debris. Close the cyclone door.
11. Lower the tank and close the door. Turn the engine key counter-clockwise to the off position and remove the key.
12. The air filter should be cleaned once a day. Open the air filter door and inspect the air filter element. If the air filter element is dirty, remove and clean with low pressure water. The air filter may be cleaned with the spray wand. The cleaned air filter may be installed after it has been cleaned and allowed to dry. Damaged air filters should be replaced immediately. The unit should not be operated without the air filter element; damage to the blower will result.
13. Secure all tools and hoses prior to leaving the spoil disposal site.

TANK CLEANING

DANGER: CRUSHING WEGHT. ROLLING OR TILTING UNIT WILL CAUSE DEATH OR SERIOUS INJURY. CHOCK TIRES AND APPLY PARKING BRAKE BEFORE OPERATING OR SERVICING. DO NOT OPERATE OR SERVICE UNLESS ATTACHED TO VEHICLE.

Units with spoil in the tank should follow the instructions for emptying the spoil tank before proceeding.

1. Start the engine.
2. With the tank empty and the door open, raise the tank. (Operator must install the door safety pin while working under the raised door.)
3. Attach the spray wand to the water hose and open the supply ball valve.
4. Run the engine at high speed.

WARNING: HIGH PRESSURE WATER CAN CAUSE SERIOUS INJURY. WEAR PROTECTIVE CLOTHING AND DO NOT POINT HIGH PRESSURE WATER TOOLS TOWARD BODY PARTS.

6. The unit may now be cleaned with the spray wand and automatic tank cleanout. Care should be taken when cleaning the door seal with the spray wand. The door seal may be damaged if the spray wand is held in close proximity to the door seal or sprayed with high pressure.
7. The automatic tank cleanout is operated by opening the tank cleanout ball valve. Material will be washed out of the spoil tank. Close the tank cleanout valve when the tank is adequately clean.
8. Close the hose reel ball valve.
9. Release trapped water pressure in the water hose by squeezing the trigger on the spray wand gun.
10. Lower the tank and remove the door safety pin. Close the door. Run the engine at low. Turn the key to the off position and remove the key.
11. Secure all tools and hoses prior to departing.

TOOL AND HOSE CLEANING

All tools and hoses should be cleaned prior to storage. Debris build up on the tools and hoses will reduce performance

.

1. Connect the dirty tool and hoses to the spoil tank inlet.
2. Connect the spray wand to the high pressure water hose.
3. Start the engine and operate at high speed.
4. Open the hose reel ball valve.

WARNING: HIGH PRESSURE WATER CAN CAUSE SERIOUS INJURY. WEAR PROTECTIVE CLOTHING AND DO NOT POINT HIGH PRESSURE WATER TOOLS TOWARD BODY PARTS.

5. Reduce the pressure on the spray wand to its lowest setting.
6. Use the spray wand to wash off the tool and hose. Material on the inside of the tool and hose will be vacuumed into the spoil tank.
7. When finished, close the hose reel ball valve.
8. Release trapped water pressure in the water hose by squeezing the trigger on the spray wand gun.
9. Run the engine at low. Turn the engine off and remove the key.
10. Secure all tools and hose prior to departing.

WATER SYSTEM FREEZE PROTECTION

All vacuum systems supplied with a water system should be filled with antifreeze if being stored or transported in freezing conditions. Systems not filled with antifreeze are susceptible to freezing water system damage.

UNITS SUPPLIED WITH WATER SYSTEMS ONLY

1. Fully drain the water system by opening the drain valve.
2. Remove the drain plug from the strainer and remove excess water from the system.
3. Reinsert the drain plug.
4. Verify no tools are connected to the high pressure water hose.
5. Place the end of the high pressure water hose in the water tank.
6. Close the supply ball valve at the wire strainer.
7. Fill the antifreeze tank and open the antifreeze ball valve.

CAUTION: DO NOT LET THE WATER PUMP RUN DRY. MAKE SURE A LEVEL OF ANTIFREEZE IS VISIBLE AT ALL TIMES. RUNNING THE WATER PUMP DRY WILL RESULT IN WATER PUMP DAMAGE.

8. Open the spoil tank inlet and start the engine. Operate the engine at low speed during Anti-freezing.
9. Open the hose reel ball valve.
10. Press and hold the antifreeze soft button on the LCD screen.
11. Watch the flow coming out of the end of the water hose. Release the antifreeze button as soon as antifreeze is detected coming out of the hose. Remember not to let the antifreeze in the tank to run completely out.
12. Close the hose reel ball valve.
13. Open the gate valve in the tank door and open the tank cleanout ball valve.
14. Press and hold the antifreeze button.
15. Watch the flow coming out the tank door valve. Release the antifreeze button as soon as antifreeze is detected. Close the gate valve in the tank door and close the tank cleanout valve.
16. Press and hold the antifreeze switch momentarily. This will push antifreeze through the bypass side of the unloader.
17. Open the water tank ball valve allowing antifreeze to flow into the suction plumping. Close the antifreeze ball valve.
18. Turn the engine off. The system is antifreezed.

REVERSE FLOW

Reverse flow is used to unclog obstructions from hoses or remove debris from spoil tank.

1. When vacuuming, flow control valve is in vacuum position.
2. When clog occurs close gate valve on tank and or (optional) boom.
3. Move flow directional valve to pressure.
4. Allow system to build to 5 p.s.i., pressure relief valve will now allow system to go passed 5 p.s.i.
5. Make sure hose is positioned in safe direction.
6. Open gate valve to the obstructed hose.
7. Once obstruction is relieved return flow control valve into vacuum.

REMOVING DEBRIS FROM SPOIL TANK

1. Attach hose to lower gate valve to transfer spoil material from tank to designated ares.
2. Make sure flow control valve is in neutral.
3. Start the unit and put the unit in high throttle.
4. Move the control flow valve to pressure.
5. Open the lower gate valve with hose attached and pointed in safe direction.
6. Place the flow valve back into neutral.
7. Close bottom gate valve and turn machine off.
8. At this point operator can either go back to work or remove solid waste from the tank.

BOOM

1. Remove the remote from the curbside door.
2. Start the unit and switch throttle to high.
3. Using the remote, raise the boom so it clears all obstruction in the travel path.
4. Use the remote to unlock the pin on manual boom and grab the rope to swing the boom into position.
5. Let go of button to lock pin into place.
6. (Hydraulic Boom) Use the remote to move boom into desired position.
7. Using the remote lower the boom so the hose handle can be easily removed and first section of hose can easily be attached.
8. Attach first section of hose then raise the boom to attach second section of hose. Attach hose handle to the lowest section of hose at an easy operating position and attach the remote for easy operation.
9. At this point boom is ready for operational use.

CLEAN UP

1. Remove hose handle and remote and then remove first section of hose. Lower the boom to a position to easily remove second section of hose.
2. Retract boom and Raise boom to clear all obstruction in travel path. Unlock pin and swing boom back into position on top of bracket.
3. Clean hoses and place them into designated storage space.
4. Lower engine throttle and turn off engine. Store the remote back into place inside door.

MATERIAL DENSITY CHART: AEM Vacuum Excavation Equipment Committee

NOTE: The weight of H2O is 8.3 lb. per Gal.

	Specific Gravity	Lb. per cu. Foot	Lb. per cu. Yard	Kg. per cu. Meter		0% H20 lb. per Gal.	25% H20 Lb. per Gal.	50% H20 Lb. per Gal.	75% H20 lb. per Gal.
Earth, loam, dry, excavated	1.25	78	2,106	10.4		10.4	9.9	9.36	8.83
Earth, moist, excavated	1.44	90	2430	1442		12	11.1	10.17	9.23
Sand, loose	1.44	90	2430	1442		12	11.1	10.17	9.23
Caliche	1.44	90	2430	1442		12	11.1	10.17	9.23
Earth, packed	1.52	95	2565	1522		12.7	11.6	10.5	9.4
Earth, wet, excavated	1.6	100	2700	1601		13.4	12.1	10.83	9.57
Sand, dry	1.6	100	2700	1601		13.4	12.1	10.83	9.57
Clay, wet lump	1.6	100	2700	1601		13.4	12.1	10.83	10.83
Sand, rammed	1.68	105	2835	1682		14	12.6	11.17	9.73
Gravel, dry, ¼-2”	1.68	105	2835	1682		14	12.6	11.17	9.73
Earth, soft loose mud	1.73	108	2916	1730		14.4	12.9	11.37	9.83
Sand & gravel, dry	1.73	108	2916	1730		14.4	12.9	11.37	9.83
Clay, wet excavated	1.83	114	30778	1826		15.2	13.51	11.77	10.04
Sand, water filled/wet	1.92	120	3240	1922		16	14.11	12.17	10.24
Earth, dense	2	125	3375	2002		16.7	14.61	12.51	10.4
Sand & gravel, wet	2	125	3375	2002		16.7	14.61	12.51	10.4
Gravel, wet, ¼-2”	2	125	3375	2002		16.7	14.61	12.51	10.4
Sand, wet packed	2.08	130	3510	2082		17.4	15.11	12.84	10.57

VARIABLES AFFECTING VOLUME OF H2O REQUIRED FOR EXCAVATION

1. Material type
2. Material purity
3. Compaction
4. Water Content
5. PSI of water wand
6. GPM of water flow
7. CFM of vacuum
8. IN/HG of vacuum
9. Individual operator

Source: Pocket Ref by Thomas J. Glover, Copyright 1989□1999, 2nd Edition, pg 427□436

WARRANTY

RETURN GOODS POLICY

LIMITED WARRANTY

The Manufacturer warrants its products to be free from defects in material and workmanship for a period of twelve months from the date of shipment from the factory. The Manufacturer shall not be responsible for any damage resulting to or caused by its products by reason of installation, improper storage, unauthorized service, alteration of the products, neglect or abuse, or use of the product in a manner inconsistent with its design. This warranty does not extend to any component parts not manufactured by Manufacturer; however, Manufacturer's warranty herein shall not limit any warranties made by manufacturers of component parts which extend to Buyer.

Claims for defects in material and workmanship shall be made in writing to Manufacturer within ten days of discovery of defect. Manufacturer may either send a service representative or have the product returned to its factory at Buyer's expense for inspection. Upon notification of defect, Manufacturer will issue a return goods authorization number to Buyer. The return goods authorization number must accompany the product returned. If judged by the Manufacturer to be defective in material or workmanship, the product will be replaced or repaired at the option of the manufacturer, free from all charges except authorized transportation. Buyer shall be responsible for all maintenance services consisting of lubrication and cleaning of equipment, replacing expandable parts, making minor adjustments, and performing operating checks, all in accordance with procedures outlined in Manufacturer's maintenance literature.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND NO REPRESENTATIONS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, (INCLUDING BUT NOT LIMITED TO A WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), ARE MADE BY THE MANUFACTURER IN CONNECTION WITH THE MANUFACTURE OR SALE OF ITS PRODUCTS. NO EMPLOYEE, DISTRIBUTOR, OR REPRESENTATIVE IS AUTHORIZED TO CHANGE THIS WARRANTY ON BEHALF OF MANUFACTURER THE REMEDIES OF BUYER SET FORTH HEREIN ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER REMEDIES. THE LIABILITY OF MANUFACTURER WHETHER IN CONTRACT, TORT, UNDER ANY WARRANTY, OR OTHERWISE SHALL NOT EXTEND BEYOND ITS OBLIGATION TO REPAIR OR REPLACE, AT ITS OPTION ANY PRODUCT OR PART FOUND BY MANUFACTURER TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP. MANUFACTURER SHALL NOT BE LIABLE FOR COST OF INSTALLATION AND/OR REMOVAL OR BE RESPONSIBLE FOR DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE.

GENERAL RETURNS OF MERCHANDISE

1. All returns must be pre-authorized
    A. Please call our parts department for an RGA number
    B. Please include RGA number on the outside of box
    C. Include any required paper work or special instructions
    D. Items returned without an RGA number will not be accepted
2. All returns are subject to a 20% restock charge.
3. Special items are non-returnable
    A. Non-stock parts
    B. Custom parts
    C. If you are unsure about a parts status when ordering, ask your McLaughlin representative
    D. If the item fits on of the above conditions.
4. Items must be returned within thirty days of original order date.
5. Items not returned within 30 days from the date of RGA is issued will not be accepted.
6. The item(s) must be in new condition. Used item(s) are not returnable.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

CALIFORNIA
Proposition 65 Warning

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.