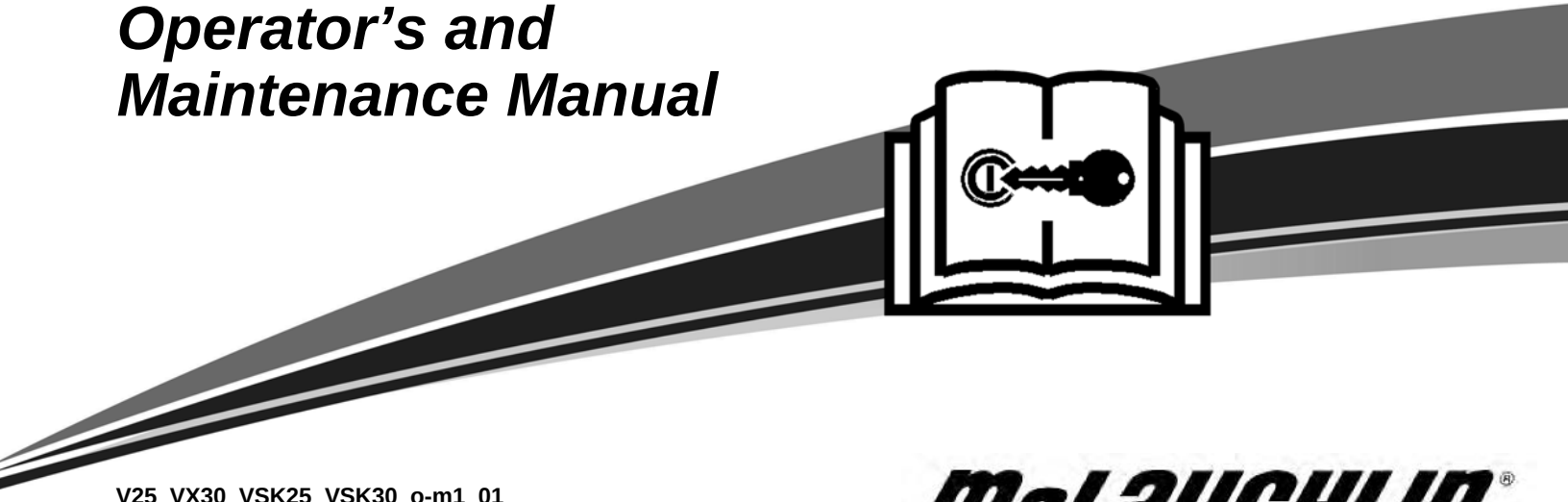
V25 / VX30G / VSK25 / VSK30G Vacuum Excavators

Operator's and Maintenance Manual



V25_VX30_VSK25_VSK30_o-m1_01
Serial No. 5001 -
Order No. 105400ES6
Cabled Assembly No. E850011

McLAUGHLIN®
A VERMEER COMPANY

Introduction

This manual explains the proper operation of your machine. Study and understand these instructions thoroughly before operating or maintaining the machine. Failure to do so could result in personal injury or equipment damage. Consult your McLaughlin dealer if you do not understand the instructions in this manual, or need additional information.

The instructions, illustrations, and specifications in this manual are based on the latest information available at time of publication. Your machine may have product improvements and features not yet contained in this manual.

To provide a better view, some photographs or illustrations in the maintenance sections may show the machine shields removed. **Never operate the machine with the shields removed – keep all shields in place.** If removing a shield is necessary, return it to its operating position before operating the machine.

McLaughlin reserves the right to make changes at any time without notice or obligation.

Operation and maintenance instructions are included in the two Operator's and Maintenance Manuals provided with the machine. The tethered (cabled) manual must remain attached to the machine for ready reference. Store it in the manual storage box when not in use.

Additional copies of the manuals are available from your dealer. Use the reorder number listed on the front cover to order additional manuals.

Copies of this manual are available in Spanish from your dealer. Other languages may also be available.

Su dispone de ejemplares de este manual en español.

NOTICE TO OWNER

Replacement manuals are free of charge by registering your **used** McLaughlin machine by contacting Vermeer Corporation. To request printed McLaughlin manuals, or to register a used McLaughlin machine, contact the Customer Data Department by telephone: 800-829-0051 or 641-628-3141; email: customerdata@vermeer.com; internet: www.vermeer.com; or, letter: Customer Data Dept., Vermeer Corporation, PO Box 200, Pella IA 50219 USA.

Orientation: Right and left sides of the machine are determined by facing in the direction of forward travel.

TRADEMARKS

VERMEER and VERMEER Logo are trademarks of Vermeer Manufacturing Company.
MCLAUGHLIN, MCLAUGHLIN Logo, and STRONG ARM are trademarks of McLaughlin Group, Inc.
HONDA is a trademark of Honda Motor Company, Ltd.
BRIGGS & STRATTON and VANGUARD are trademarks of Briggs & Stratton Corporation.

McLaughlin New Industrial Equipment Limited Warranty (Vermeer Exclusive Equipment)

EFFECTIVE FEBRUARY 1, 2018 **12 Months / 1000 Hours**

McLaughlin Group, Inc. (hereinafter "McLaughlin") warrants each new Industrial Equipment of McLaughlin's manufacture to be free from defects in material and workmanship, under normal use and service for one (1) full year after initial purchase/retail sale or 1000 operating hours, whichever occurs first. This Limited Warranty shall apply only to complete machines of McLaughlin's manufacture, parts are covered by a separate Limited Warranty. **EQUIPMENT AND ACCESSORIES NOT OF MCLAUGHLIN'S MANUFACTURE ARE WARRANTED ONLY TO THE EXTENT OF THE ORIGINAL MANUFACTURER'S WARRANTY AND SUBJECT TO THEIR ALLOWANCE TO MCLAUGHLIN ONLY IF FOUND DEFECTIVE BY SUCH MANUFACTURER.**

EXTENDED SERVICE CONTRACTS ARE AVAILABLE FOR PURCHASE

WARRANTY TERMS During the Limited Warranty period specified above, any defect in material or workmanship in any warranted item of McLaughlin Industrial Equipment not excluded below shall be repaired or replaced at McLaughlin's option without charge by any authorized independent Vermeer dealer. The warranty repair or replacement must be made by a Vermeer independent authorized dealer at the dealer's location. McLaughlin will pay for replacement parts and such authorized dealer's labor in accordance with McLaughlin's labor reimbursement policy on **CORE SAWS** and **VACUUM EXCAVATORS.** McLaughlin will pay for replacement parts **ONLY** on **PIERCING TOOLS.** McLaughlin reserves the right to supply remanufactured replacement McLaughlin parts as it deems appropriate.

RETAIL PURCHASER RESPONSIBILITY: This Limited Warranty requires proper maintenance and periodic inspections of the Industrial Equipment as indicated in the Operator's/Maintenance Manual furnished with each new Industrial Equipment. The cost of routine or required maintenance and services is the responsibility of the retail purchaser. The retail purchaser is required to keep documented evidence that these services were performed.

This McLaughlin New Industrial Equipment Limited Warranty may be subject to cancellation if the above requirements are not performed.

McLaughlin Industrial Equipment with known failed or defective parts must be immediately removed from service.

EXCLUSIONS AND LIMITATIONS

The warranties contained herein shall **NOT APPLY TO:**

(1) Any defect which was caused (in McLaughlin's sole judgment) by other than normal use and service of the Industrial Equipment, or by any of the following; (i) accident (ii) misuse or negligence (iii) overloading (iv) lack of reasonable and proper maintenance (v) improper repair or installation (vi) unsuitable storage (vii) non-McLaughlin approved alteration or modification (viii) natural calamities (ix) vandalism (x) parts or accessories installed on Industrial Equipment which were not manufactured or installed by Vermeer authorized dealers (xi) the elements (xii) collision or other accident.

(2) Any Industrial Equipment whose identification numbers or marks have been altered or removed or whose hour meter has been altered or tampered with.

(3) Any Industrial Equipment which any of the required or recommended periodic inspection or services have been performed using parts not manufactured or supplied by McLaughlin or meeting McLaughlin Specifications including, but without limitation, engine tune-up parts, engine oil filters, air filters, hydraulic oil filters, and fuel filters.

(4) New Industrial Equipment delivered to the retail purchaser in which the equipment/warranty registration has not been completed and returned to McLaughlin within ten (10) days from the date of purchase.

(5) Any defect which was caused (in McLaughlin's sole judgment) by operation of the Industrial Equipment not abiding by standard operating procedures outlined in the Operator's Manual.

(6) Engine, battery, and tire Limited Warranties and support, which are the responsibility of the respective product's manufacturer.

(7) Transportation costs, if any, of transporting to the Vermeer dealer. Freight costs, if any, of transporting replacement parts to the Vermeer dealer.

(8) The travel time of the Vermeer dealer's service personnel to make a repair on the retail purchaser's site or other location.

(9) In no event shall McLaughlin's liability exceed the purchase price of the product.

(10) McLaughlin shall not be liable to any person under any circumstances for any incidental or consequential damages (including but not limited to, loss of profits, out of service time) occurring for any reason at any time.

(11) Diagnostic and overtime labor premiums are not covered under this Limited Warranty Policy. Oils and fluids are not covered under this Limited Warranty.

(12) Depreciation damage caused by normal wear, lack of reasonable and proper maintenance, failure to follow operating instructions, misuse, lack of proper protection during storage is not covered by this Limited Warranty.
(13) Accessory systems and electronics not of McLaughlin's manufacture are warranted only to the extent of such manufacturer's respective Limited Warranty, if any.
(14) Down hole toolage is not covered under this Limited Warranty.
(15) Wear items which are listed by product group below are not covered by this Limited Warranty:

CORE SAWS:
Slides, rollers, filters, water seal/skirt, tooling and tires.

PIERCING TOOLS:
Wear ring, bushings, hoses (internal and external), couplers, tail bolts, control cam, springs, wear face, anvil nut, e-clip, head lip seal.

VACUUM EXCAVATORS:
Belts after 50 hours, filters, tires, brakes, unloader valve after 250 hours, nozzles, suction hoses including camlocks, gate valves, camlocks, quick disconnects, water pump internal parts, deflector inside spoil tank, sight glass on spoil door, spoil tank door seal, boom tooling, boom hose, boom snout, boom shut off seal, boom packing gland, suction tooling. For vacuum excavators mounted to a truck, the truck's Limited Warranty and support are the responsibility of the respective truck manufacturer.

PARTS WARRANTY: Parts replaced in the warranty period will receive the balance of the first year New Industrial Equipment Limited Warranty, during the first twelve (12) months or 1000 hours, whichever comes first. Replacement parts after the original machine warranty, are warranted to be free from defects of material for ninety (90) days or the part will be repaired or replaced, without labor coverage for removal and reinstallation.

EXCLUSIONS OF WARRANTIES: EXCEPT FOR THE WARRANTIES EXPRESSLY AND SPECIFICALLY MADE HEREIN, MCLAUGHLIN MAKES NO OTHER WARRANTIES, AND ANY POSSIBLE LIABILITY OF MCLAUGHLIN HEREINUNDER IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. MCLAUGHLIN RESERVES THE RIGHT TO MODIFY, ALTER AND IMPROVE ANY PRODUCT WITHOUT INCURRING ANY OBLIGATION TO REPLACE ANY PRODUCT PREVIOUSLY SOLD WITH SUCH MODIFICATION. NO PERSON IS AUTHORIZED TO GIVE ANY OTHER WARRANTY, OR TO ASSUME ANY ADDITIONAL OBLIGATION ON MCLAUGHLIN'S BEHALF.

NO DEALER WARRANTY. The selling dealer makes no warranty of its own and the dealer has no authority to make any representation or promise on behalf of McLaughlin or to modify the terms or limitations of this warranty in any way.

ELECTRONIC SIGNATURES. Each of the parties hereto expressly agrees to conduct transactions by electronic means. Accordingly, the parties agree and intend that all electronic transmissions including, without limitation, electronic signatures, shall be considered equivalent to an original writing as provided under Iowa law, as it may be amended from time to time.

MANUFACTURED BY:

McLAUGHLIN GROUP, INC.
2006 Perimeter Rd.
Greenville, SC 29605, USA

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Receiving and Delivery Report

DEALER PREP

Check or perform the following:

Engine

___ Check battery electrolyte level and state of charge.
___ Check air cleaner condition.
___ Check engine oil level.
___ Check engine operation.
___ Check gauges for proper operation.

General

___ Check that all optional and loose items are included with the machine.
___ Check that *Operator's and Maintenance Manual* is cabled to machine.
___ Check for shipping damage or shortage.
___ Check machine lubrication.
___ Check blower oil level.
___ Check water pump oil level.
___ Check bolts for tightness.
___ Check pump and blower drive belt tension.
___ Check installation and condition of shields.
___ Check wheel lug nuts for tightness (refer to "Specifications," *page 130-1*, for torque specifications).
___ Check tires for air pressure (refer to "Specifications," *page 130-1*, for pressure specifications).

___ Check condition of safety signs and operating decals.
___ Check operation of highway lights.
___ Check that towing hitch and safety towing chains are installed.
___ Check brakes for proper operation.
___ Check that breakaway brake switch is installed and functions.
___ Check all phases of operation.
___ Complete “Dealer/Owner Information”, *page iv*.
___ Complete “Identification Numbers - Record”, *page v*.

DELIVERY

Check and perform the following with the customer:

Machine

___ Review all sections of the *Operator's and Maintenance Manual*.

___ Grease or oil all lubrication points.

Review of Operation

Review and demonstrate with the customer the various aspects of the vacuum excavation system:

___ overview of how the vacuum/excavation system works

___ vacuum/excavation system safety

___ filling spoil tank

___ emptying spoil tank

___ potholing operation

___ vacuum operation

___ spoil tank door open/close

___ water system on/off (if equipped)

DEALER/OWNER INFORMATION

dealer	owner
address	address
city	city
state / province	state / province
zip / postal code	zip / postal code
country	country
phone number	phone number
email address	email address

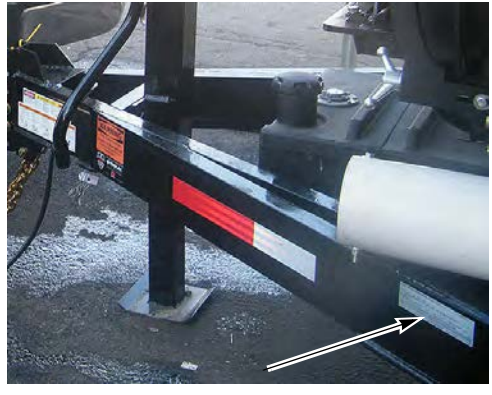
IDENTIFICATION NUMBERS - RECORD

Machine

Model Number_____

Serial Number _____

VIN Number (Trailered Units)_____



Engine

Model Number_____

Serial Number_____

HONDA ENGINE

VANGUARD ENGINE

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Section 10: Safety Messages

General safety messages appear in this Safety Messages section. Specific safety messages are located in appropriate sections of the manual where a potential hazard may occur if the instructions or procedures are not followed.

A signal word "**DANGER**", "**WARNING**", or "**CAUTION**" is used with the safety alert symbol.

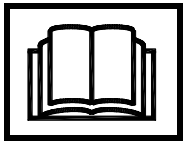
Safety signs with signal word "**DANGER**", "**WARNING**", or "**CAUTION**" are located near specific hazards.

DANGER	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates information considered important, but not hazard-related.

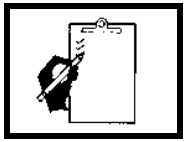
Safety Symbol Explanation

This is the safety alert symbol. This symbol is used in combination with an exclamation mark or other symbols to alert you to the potential for death or serious injury.

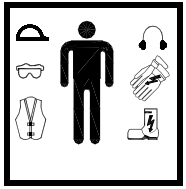
This symbol indicates that at least one part of the machine is not operating correctly. Shutting down the machine may not be necessary, but some maintenance may be required.



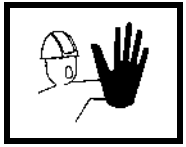
WARNING: Read Operator's Manual and safety signs before operating machine.



WARNING: Check machine before operating. Machine must be in good operating condition and all safety equipment installed and functioning properly.

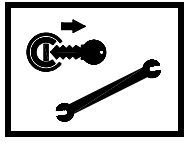


WARNING: Always wear Personal Protective Equipment (PPE). Dress properly. Refer to "Personal Protective Equipment," *page 40-2*, for details. While performing maintenance on the machine, always wear safety glasses and safety shoes. Some working conditions and regulations may require the use of other appropriate PPE, such as hearing protection, hard hat, gloves, face shield, or any other PPE necessary to provide proper safety protection for the work being performed.

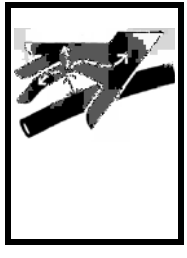


WARNING: Keep spectators away.

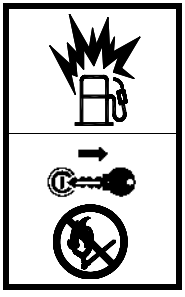
WARNING: Engine exhaust can asphyxiate or poison, resulting in death or serious injury. Operate machine outdoors. If it is necessary to operate engine in an enclosed area, properly vent exhaust gases.



WARNING: Failure to use shutdown procedure can result in unexpected hazard(s). Death or serious injury could result due to entanglement, crushing, cutting, or other hazardous contact. Follow Shutdown Procedure after operating, before performing any service or maintenance, and before transporting. Refer to the *Shutdown Procedure*, page *23-1*.

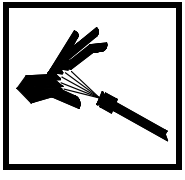


WARNING: Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible. Keep away from any suspected leak. Relieve pressure in the hydraulic system before searching for leaks, disconnecting hoses, or performing any other work on the system. If you must pressurize the system to find a suspected leak, use an object such as a piece of wood or cardboard rather than your hands. When loosening a fitting where some residual pressure may exist, slowly loosen the fitting until oil begins to leak. Wait for leaking to stop before disconnecting the fitting. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.



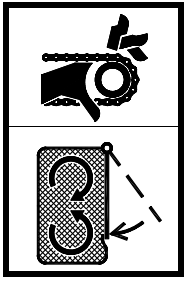
WARNING: Fuel and fumes can explode and burn.

Shut off engine before refueling. No flame. No smoking.



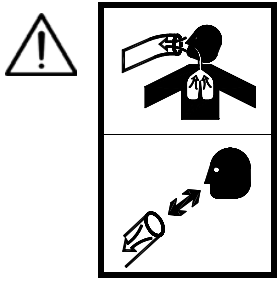
WARNING: Avoid high pressure water. High pressure water from digging tool or wash wand can penetrate body tissue and result in serious injury or death. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Never point the digging tool or wand at anyone or at any part of the body. Never use the high pressure wand to clean any part of your body or clothing.



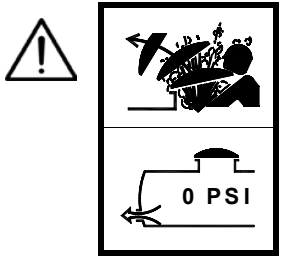
WARNING: Contact with moving parts can result in death or serious injury.

Keep all shields in place when operating.



DANGER: Vacuum can suffocate or damage vision or hearing.

Keep hose end away from face.



WARNING: Cover will blow off when removing wing nuts with pressure in tank.

Relieve tank pressure before opening cover.

DANGER: **Crushing weight.** Spoil and door will cause death or serious injury.

Unlock door only under vacuum. Stay away from door when dumping.

DANGER: Spoil, tank, and door are very heavy and may crush. Trailer mounted systems may roll or tip if not properly secured to towing vehicle.

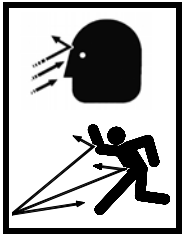
Stay clear of door when dumping the tank. When operating, dumping, or servicing the tank:

- Ensure trailer tongue is properly attached to towing vehicle.
- Chock towing vehicle wheels.
- Apply towing vehicle park brake.

Properly secure skid-mounted unit to transporting vehicle or system before operating or servicing. Chock transporting vehicle wheels and apply park brake.

WARNING: Crushing weight. Death or serious injury may result.

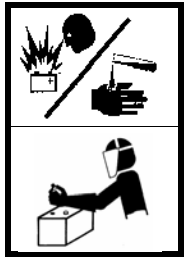
Empty tank before servicing. Always install safety bar before working on raised tank. Always install safety lock pin before working under raised tank door.



WARNING: Machine uses water or air under pressure. Ground engaging tools can cause objects to become airborne. Flying objects can result in injury or property damage.

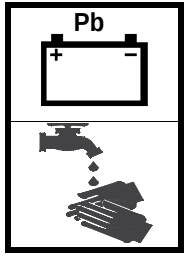
Wear personal protective equipment. Keep all nonessential personnel away from the work area.

DANGER: Electrocution is possible. Contact with electric lines will cause serious injury or death. Locate all underground utilities. Always wear proper personal protective equipment.



WARNING: Battery fumes are flammable and can explode. Keep all burning materials away from battery. Battery explosion can blind. Acid can blind and burn. Tools and cable clamps can make sparks.

Do not smoke. Shield eyes and face. Read instructions.



WARNING: Battery post, 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.

WARNING: Failure to follow any of the preceding safety instructions or those that follow within this manual, could result in death or serious injury. This machine is to be used only for those purposes for which it was intended as explained in this Operator's and Maintenance Manual.

FIRE EXTINGUISHER

A fire extinguisher (not supplied with machine) can be mounted on the trailer near the machine controls.

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Section 15: Intended Use

The McLaughlin V25/VX30G/VSK25/VSK30G Vacuum Excavators are designed solely for use in removing earth, mud, and soil materials in excavation, using suction. These systems use pressurized water to break up materials to be vacuumed.

Always use the machines in accordance with the instructions contained in this *Operator's and Maintenance Manual,* safety signs on the machine, and other material provided by Vermeer Corporation.

Correct maintenance and repair are essential for safety and for efficient operation of the machine. Do not use the machine if it is not in suitable operating condition.

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Section 20: System Controls

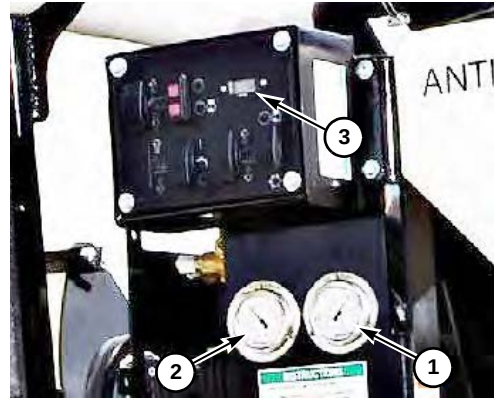
GAUGES

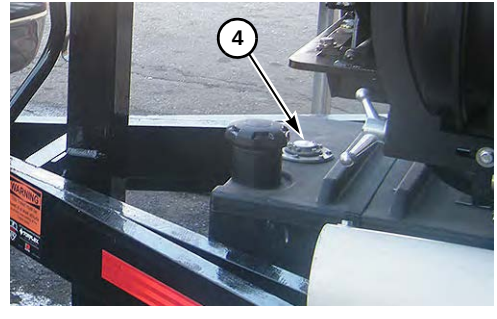
(1) **Water Pressure (if Equipped)** .....

(2) **Vacuum Pressure** .....

(3) **Hourmeter** .....

(4) **Fuel Level** .....



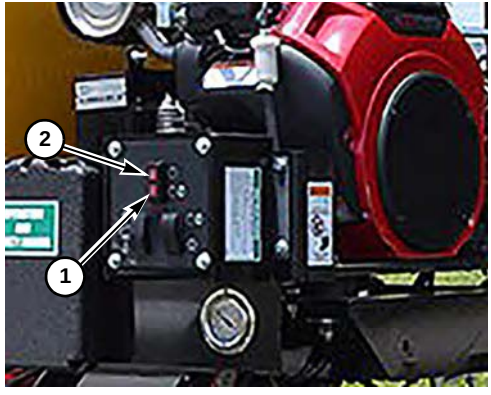


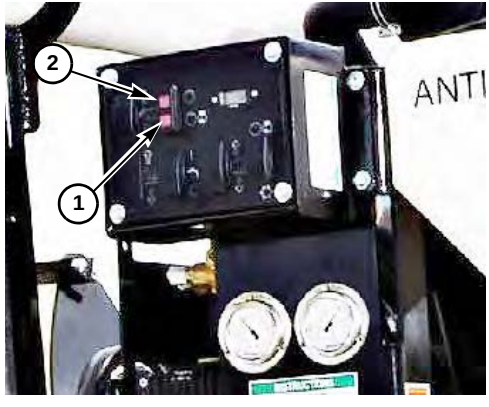
INDICATORS

(1) Tank Full Override
Red light comes on when Tank Full Override is on.

(2) Tank Full
Red light comes on when spoil tank is full of wet material.

When vacuuming dry materials, the Tank Full shutdown sensor does not function.





HONDA ENGINE CONTROLS

(1) Keyswitch (Engine Ignition) . . . . . 

Counterclockwise from vertical . . . . . engine OFF 

1st position clockwise (vertical) . . . . . electrical system ON 

2nd position clockwise. . . . . engine start 

(2) Throttle Lever . . . . . 

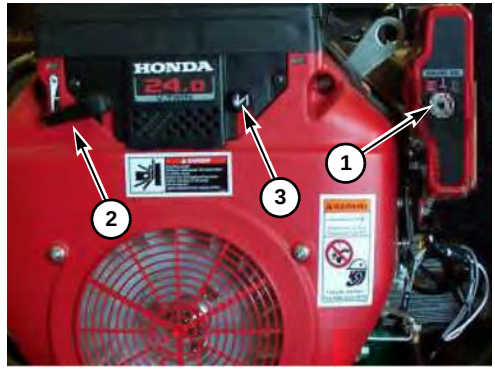
Rotate up . . . . . .increase RPM 

Rotate down. . . . . decrease RPM 

(3) Choke Knob . . . . . 

Pull out . . . . . closed position

Push in. . . . . open position



VANGUARD ENGINE CONTROLS

(1) Starter Switch (Engine Ignition) . . . . . .

Vertical . . . . . engine OFF

1st position clockwise. . . . . engine run/electrical system ON

2nd position clockwise . . . . . .engine start

(2) Throttle Control . . . . . .

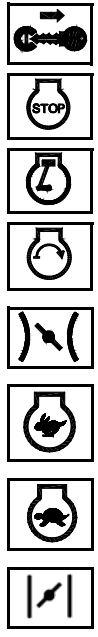
Rotate clockwise. . . . . increase RPM

Rotate counterclockwise . . . . . .decrease RPM

(3) Choke Control . . . . . .

Pull out . . . . . .closed position

Push in . . . . . .open position



SWITCHES

(1) Tank Dump Switch . . . . . .

Up . . . . . raise tank to dumping position

Down . . . . . lower tank to operating position

(2) Tank Full Override/Antifreeze Switch

Up . . . . . tank full override ON - engine continues
. . . . . to run when spoil tank is full

Center . . . . . OFF - engine shuts down when
. . . . . spoil tank is full of wet material

When vacuuming dry materials, the Tank Full shutdown sensor does not function.

Down . . . . . antifreeze system ON (if equipped)

(3) Hydraulic Tank Door Open/Close (if Equipped) . . . . . .

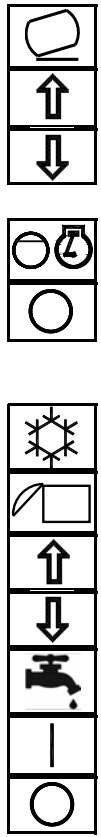
Up and hold. . . . . unlock and open tank door

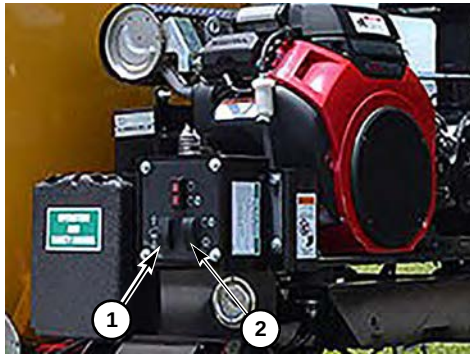
Down and hold . . . . . close and lock tank door

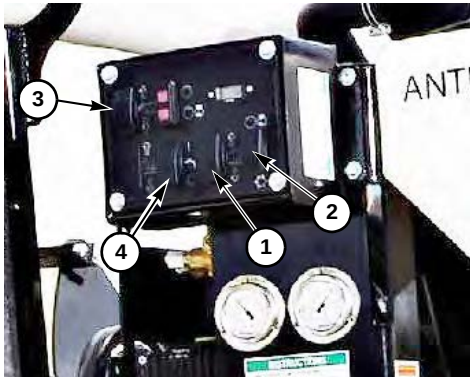
(4) Water Pump Switch (if Equipped) . . . . . .

Up . . . . . water pump ON

Down . . . . . water pump off



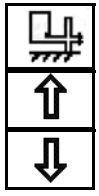


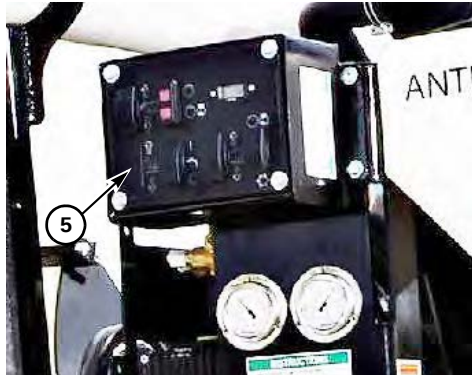


(5) Hydraulic Jack Switch (if Equipped) . . . . . .

Up . . . . . raise hydraulic jack

Down . . . . . lower hydraulic jack





VALVES

Spoil Tank Valves

(1) Upper Gate/Inlet Valve . . . . . .

Rotate clockwise . . . . . open to vacuum spoil into tank

Rotate counterclockwise . . . . . .close

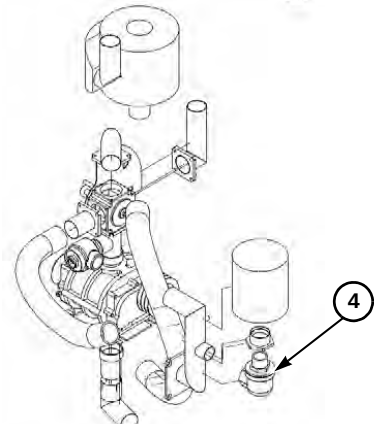
(2) Lower Gate/Dump Valve . . . . . .

Rotate clockwise . . . . . .open to dump liquid from spoil tank

Rotate counterclockwise . . . . . .close

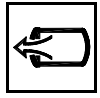
(3) Spoil Tank Sight Gauge
View material level in spoil tank.

(4) Vacuum Relief Valve
Valve controls the maximum amount of vacuum (negative pressure) in the system. Valve opens when vacuum limit is reached in the spoil tank.



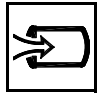
(5) Reverse Flow Control Valve (if Equipped) . . . . . .

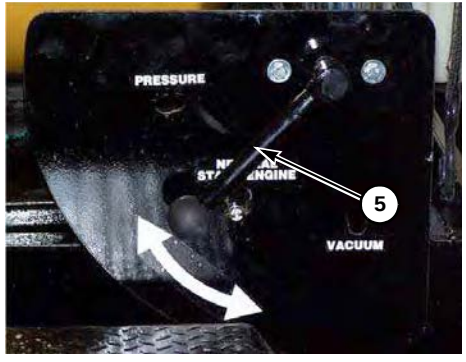
Rotate cw and secure pin in Pressure slot . . . . . pushes air out of . . . . . spoil tank



Center position . . . . .NEUTRAL - move to NEUTRAL before starting

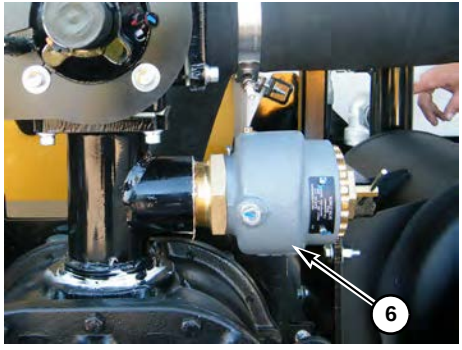
Rotate ccw and secure pin in Vacuum slot . . . pulls air into spoil tank





(6) Pressure Relief Valve

Valve controls the maximum amount of positive pressure in the system, and is only on machines equipped with Reverse Flow Control valve.

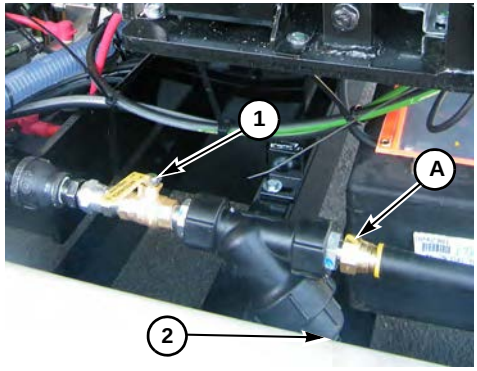


Water System Valves

(1) Water Supply Valve . . . . . .

Rotate in line with valve body . . . . . open - supply water to pump

Rotate perpendicular to valve body . . . . . close - shut off water



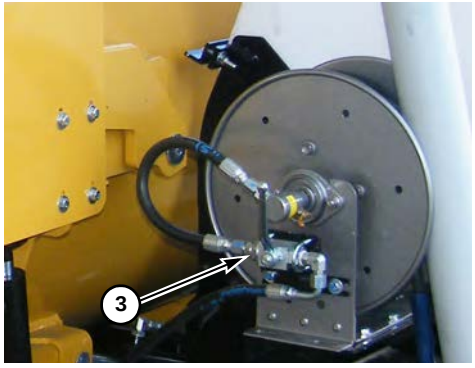
(2) Water Tank Drain

Drain from plug on strainer, or from valve **(A).**

(3) Hose Reel Valve (if Equipped)

Rotate in line with valve body. . . . . open - supply water to hose

Rotate perpendicular to valve body . . . . . close - change tools
. . . . . or when not in use



(4) Tank Cleanout Valve (if Equipped)

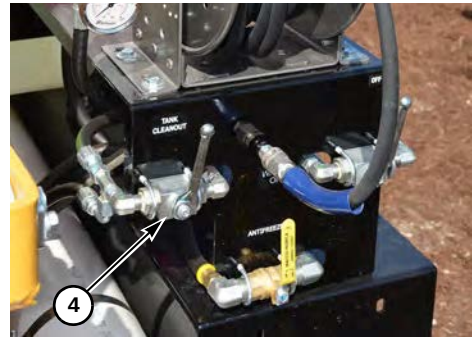
Rotate in line with valve body. . . . . .open - clean out spoil tank if
. . . . . equipped with in-tank washdown

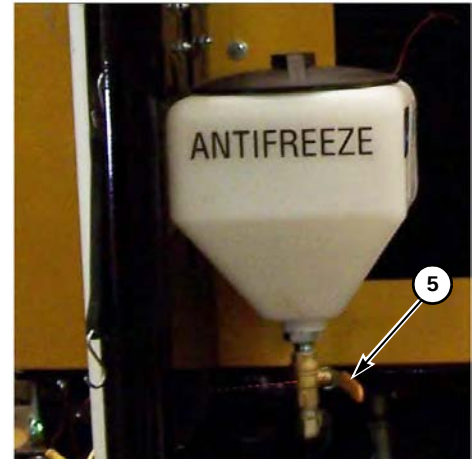
Rotate perpendicular to valve body . . . . . close - not in use

(5) Antifreeze Tank Valve (if Equipped) . . . . . .

Rotate in line with valve body . . . . . open - mix antifreeze with water

Rotate perpendicular to valve body . . . . . close - shut off antifreeze

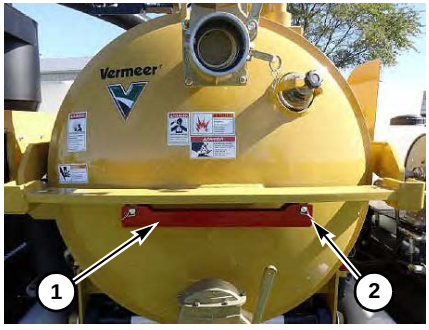


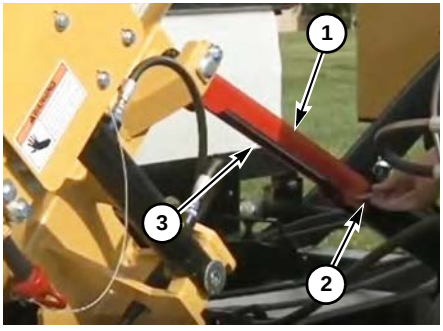


Spoil Tank Safety Brace

Install red safety brace **(1)** over spoil tank lift cylinder **(3)** rod before working near or under the raised tank. Secure brace with safety snap pins **(2).**

The brace does not need to be installed when dumping the spoil tank. Store beneath tank lid bar as shown when not in use.

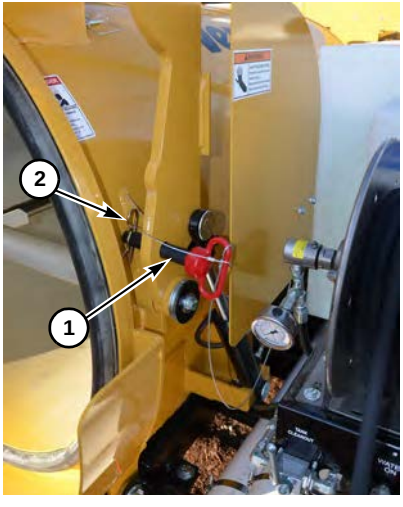




Spoil Tank Lid Safety Lock Pin

On all units equipped with hydraulic spoil tank door, install safety lock pins **(1)** as shown whenever work is performed near or under the raised tank lid. Secure each safety lock pin with cabled hairpin **(2)**.

Place pin in storage location **(3)** when not in use.



HOSE REEL

(1) Hose Reel Lock Pin . . . . . .

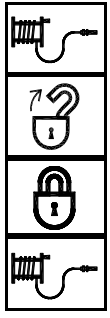
Pull out . . . . . unlock

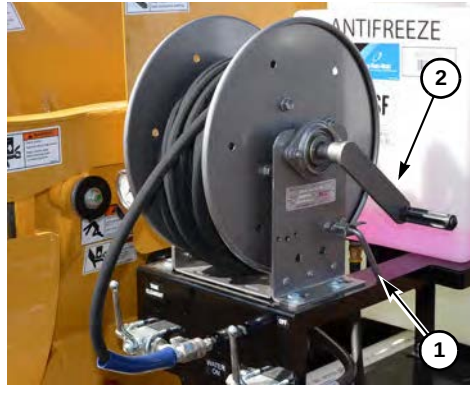
Push in . . . . . lock

(2) Hose Reel Lever . . . . . .

Turn clockwise . . . . . reel hose in

Turn counterclockwise . . . . . reel hose out

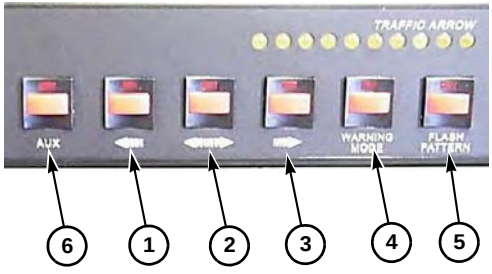




ARROW BOARD (OPTIONAL)

The optional arrow board is located at the back of the machine, on top of the spoil tank. Flashing arrow lights alert oncoming motorists and direct traffic flow around the machine when working on or near a roadway.

The small yellow lights at the top of control panel display the selected light pattern.



(1) Left Arrow ON/OFF Switch . . . . . 
Press to turn left arrow light pattern ON or OFF.

(2) Double Arrow ON/OFF . . . . . 
Press to turn double arrow light pattern ON or OFF.

(3) Right Arrow ON/OFF . . . . . 
Press to turn right arrow light pattern ON or OFF.

(4) Warning Mode . . . . . WARNING MODE
Press to turn preset warning mode light pattern ON or OFF.

(5) Flash Pattern ON/OFF . . . . . FLASH PATTERN
Press to scroll through flashing light patterns until desired pattern is displayed.

(6) Aux. AUX
Not currently used.

LIGHTS

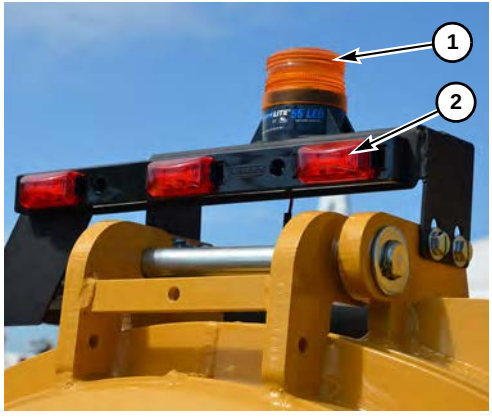
Machine is equipped with a standard amber warning beacon. Optional LED lights and work light, all mounted on the top of the spoil tank, are available.

(1) Warning Beacon

Amber warning beacon flashes whenever engine ignition key is On.

(2) Marker Lights

Red marker lights are lit whenever vacuum unit tow vehicle lights are ON.



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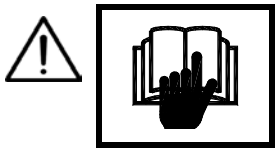
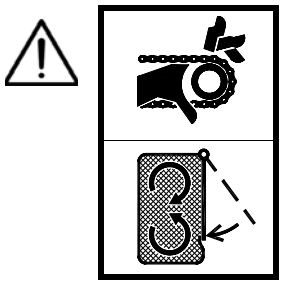
Section 22: Starting Procedure



WARNING: Read Operator's Manual and safety signs before operating machine.



WARNING: Contact with moving parts can result in death or serious injury.

Keep all shields in place when operating.

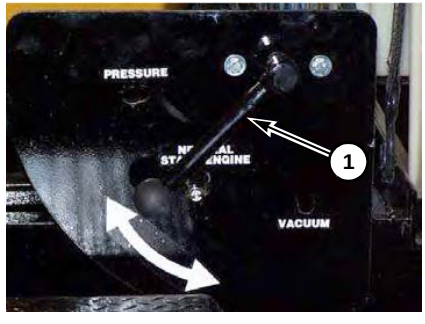
STARTING THE ENGINE

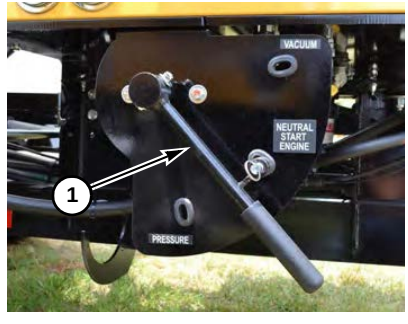
Step 1: If equipped, ensure Reverse Flow Control Valve **(1)** is in NEUTRAL position.

Step 2: **Honda Engine:** Move engine throttle control approximately 1/3 of the way toward MAX. speed position.

Vanguard Engine: Move engine throttle control to FAST position.

Step 3: Pull engine choke control out to closed position when starting a cold engine.





NOTICE: Leave choke control pushed in (open) when restarting a warm engine.

Step 4: Turn ignition key fully clockwise to start engine. Release key once engine starts.

Step 5: Allow engine to warm up for 3–5 minutes before operating machine. Gradually push choke control in to open position as engine warms up.

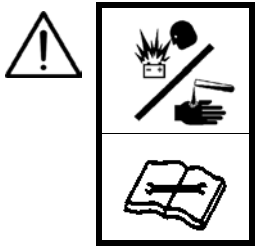
NOTICE: If engine fails to start after 5 seconds, release ignition switch. Wait one minute before operating the starter again.

COLD WEATHER STARTING

Before operating in cold weather (below 32°F (0°C)), refer to the Engine Operation Manual for recommended engine oil, fuel, and starting procedures. Let engine run 2–3 minutes before gradually releasing the choke. Do not use aerosol starting fluids.

JUMP-STARTING

Battery Explosion - Avoid



WARNING: Battery fumes are flammable and can explode. Keep all burning materials away from battery. Battery explosion can blind. Acid can blind and burn. Tools and cable clamps can make sparks.

Do not smoke. Shield eyes and face. Read instructions.

Do not jump-start or charge a battery that is frozen or low on electrolyte.

Avoid explosion hazard. If equipped with battery caps, they must be in place and tight to reduce risk of battery explosion.

NOTICE: Use only a 12-volt system for jump-starting. Do not allow vehicle used to jump-start to be in contact with the disabled machine. Vehicles in contact have a ground connection which allows a spark to occur at the battery when the positive jumper cable is connected or removed.Use only approved jumper cables. Avoid inadvertent contact between cables and surrounding components.

Battery Burns - Avoid

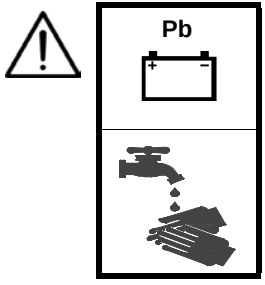
Battery contains sulfuric acid which can cause severe burns. Avoid contact with eyes, skin, and clothing.

In case of acid contact:

External: Flush with plenty of water. If eyes have been exposed, flush with water for 15 minutes and get prompt medical attention.

Internal: Drink large quantities of water or milk, follow with milk of magnesia, beaten egg, or vegetable oil. Call a physician immediately.

Jump-Starting Procedure



WARNING: Battery post, 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.

Step 1: Turn ignition switch OFF.

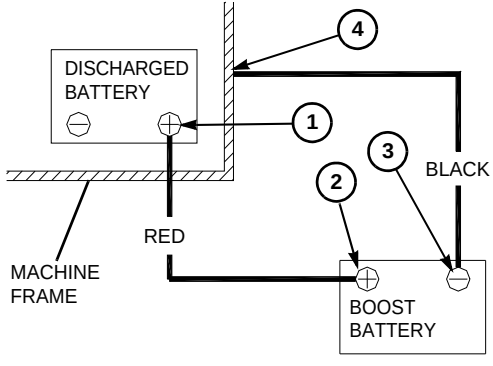
Step 2: Connect jumper cables in the following order:

a. Red to discharged battery POSITIVE (+) terminal **(1)**.

b. Red to boost battery POSITIVE (+) terminal **(2)**.

c. Black to boost battery NEGATIVE (-) terminal **(3)**.

d. Black to frame **(4)** of machine with the discharged battery. Make connection away from battery, hydraulic lines, and moving parts.



NOTICE: To avoid sparks near the battery, always disconnect black jumper cable at point **(4)** before making any adjustment to the red jumper cable at point **(1)**.

Step 3: Start engine.

Step 4: Remove cables in REVERSE order, and install red cover over the positive cable clamp.

Section 23: Shutdown Procedure

STOPPING THE MACHINE

NOTICE: For your safety and the safety of others, use the shutdown procedure before servicing, cleaning, unclogging, or inspecting the machine.

A variation of this procedure may be used if instructed within this manual, or if an emergency requires it.

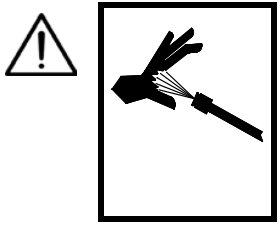
Step 1: Reduce engine speed to idle.

Step 2: Verify all switches are in OFF/DOWN position.

Step 3: If equipped, move Reverse Flow Control Valve handle to NEUTRAL.

Step 4: Shut off engine and remove ignition key.

Step 5: Relieve water pressure from water-assisted tool(s) by squeezing trigger. Disconnect tool(s) from hose.



WARNING: Avoid high pressure water. High pressure water from digging tool or wash wand can penetrate body tissue and result in serious injury or death. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Never point the digging tool or wand at anyone or at any part of the body. Never use the high pressure wand to clean any part of your body or clothing.

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Section 30: Transporting the Machine

DANGER: Spoil, tank, and door are very heavy and may crush. Trailer mounted systems may roll or tip if not properly secured to towing vehicle.

Stay clear of door when dumping the tank. When operating, dumping, or servicing the tank:

- Ensure trailer tongue is properly attached to towing vehicle.
- Chock towing vehicle tires.
- Apply towing vehicle park brake.

Properly secure skid-mounted unit to transporting vehicle or system before operating or servicing. Chock transporting vehicle wheels and apply park brake.

Reporting Safety Defects

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying McLaughlin Group, Inc.

If NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual issues between you, your dealer or McLaughlin Group, Inc.

To contact NHTSA, you may either call the DOT Auto Safety Hotline toll-free at 1-888-DASH-2DOT (1-888-327-4236), or file a report on-line at: www.nhtsa.dot.gov/hotline/, or write to: NHTSA, U.S. Department of Transportation, 400-7th St. SW, Washington, D.C. 20590. You can also obtain other information about motor vehicle safety from the Hotline.

TOWING VEHICLE SELECTION

WARNING: Loss of steering or braking control can cause death or serious injury. Use a towing vehicle that is large enough for sufficient steering and braking control.

- **Towing Vehicle:** the towing vehicle should have sufficient suspension capacity to resist downward loads at the hitch during transportation.
- **Towing Vehicle Brake Controller:** The towing vehicle must be equipped with an electric brake controller that automatically applies the towed machine's electric brakes when stopping.
- **Towing Vehicle Hitch:** The towing vehicle hitch must have a towing capacity of at least 10,000 lb (4535 kg) up to 20,000 lb (9070 kg) and a vertical tongue capacity of 540 lb (245 kg) up to 2,480 lb (1125 kg), depending on machine model. Refer to *Specifications, page 130-1* for model-specific weights.

NOTICE: Tongue weight and towing capacity vary based on machine options, water tank levels, and spoil tank material density. To stay under the gross vehicle weight rating, limit spoil tank material density to 10 lb/gal (1.1 kg/L) with a full water tank. Empty the water tank to transport with a spoil tank density up to 12.7 lb/gal (1.5 kg/L). Refer to "Material Density Chart," *page 130-6*, for material density information.

NOTICE: A fully or partially loaded unit will travel differently than an empty unit. Longer stopping distances are required. Liquid will move or "slosh" when tow vehicle stops.

Obey all applicable laws regarding the use of lights, safety chains, and other possible requirements concerning road use. Use good judgment and drive carefully.

TRAILER BREAKAWAY BRAKE

WARNING: Do not use breakaway device as a park brake.

The trailer provided with the machine is equipped with a breakaway brake system. The breakaway brake engages if the trailer ever separates from the towing vehicle.

Prepare Machine for Transport

Before transporting the machine:

- Ensure Strong Arm attachment is locked in transport position.
- Ensure Hose Reel Lock Pin is in locked position.
- Ensure all machine components and tooling are stored properly. Secure all tools and accessories carried on the vehicle.
- Follow *Shutdown Procedure*, page *23-1*, and relieve water system pressure.
- Close all valves and doors. Ensure spoil tank door is fully closed and latched.
- Ensure tires and rims are in good condition, and tires are inflated properly.
- Check condition and operation of trailer lights and brakes.
- Follow remaining procedures in this section for safely attaching to tow vehicle.

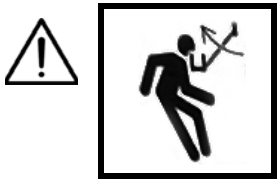
Vacuum Tools - Store for Transport

(1) Potholing/Vacuuming Tool/Spray Wand

(2) Hoses

Place tools in storage tubes or brackets and secure with lock pins. Note that storage locations may vary by model and configuration.

Strong Arm Attachment (Option) - Store for Transport



WARNING: Swinging arm. Serious injury will result. Arm can swing when tank is raised.

Always lock Strong Arm attachment in stowed position when not in use.

NOTICE: Strong Arm attachment is not available on skid units.

Strong Arm attachment **(1)** must be locked in transport position before transporting machine. Move Strong Arm attachment to stowed position. Engage retainer **(2)** and pin.

STOWED POSITION

ATTACH TO TOWING VEHICLE

WARNING: Safety towing chains may uncouple from towing vehicle if chain hook latches are damaged or missing. Do not tow vehicle with damaged or missing hook latches.

NOTICE: It is recommended that towing vehicle be equipped with mud flaps.

Hitch Height - Adjust

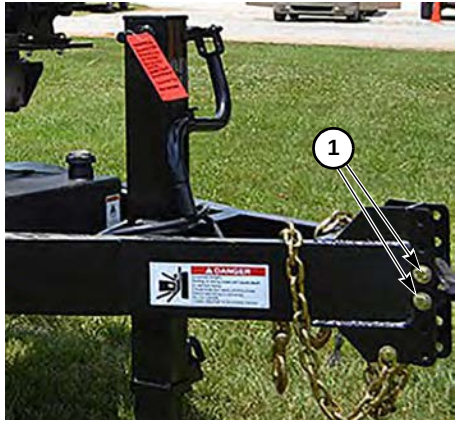
Before attaching the machine to the towing vehicle, compare height of towing vehicle hitch to the trailer hitch. Hitch heights need to be approximately the same to keep the machine level during transport.

To adjust the hitch:

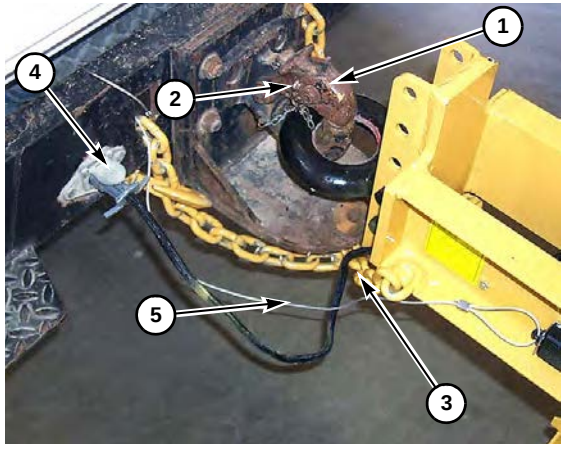
Step 1: Remove hitch bolts **(1)**.

Step 2: Raise or lower trailer hitch to match towing vehicle height.

Step 3: Install hitch bolts and tighten. Torque 5/8-11 x 5-1/2" bolts with lock washers, flat washers, and nuts to 254 ft-lb (345 Nm).



Pintle Ring - Attach



Step 1: Pull up on release lever and pull back latch assembly **(1)** to open.

Step 2: Place pintle ring over the hitch.

Step 3: Push latch assembly forward and down until release lever is in locked position.

Step 4: Install keeper pin **(2)**.

Safety Chain/Electrical Connector/Breakaway Cable - Attach

Step 1: Cross safety chains **(3)** under the tongue and attach them to the towing vehicle.

Keep chains as short as possible, but leave enough slack to turn corners.

Step 2: Attach electrical connector **(4)** to the towing vehicle. Check that highway lights and electric brakes are functioning properly.

Step 3: Attach breakaway cable **(5)** to the towing vehicle bumper or frame. Leave sufficient slack to allow for turning radius of the trailer.

NOTICE: Adjust breakaway cable length so the breakaway system applies the brakes only after both the hitch and safety towing chains have disconnected. The breakaway system is not to be used as a park brake.

Step 4: Remove and stow wheel chocks.

Jack - Raise

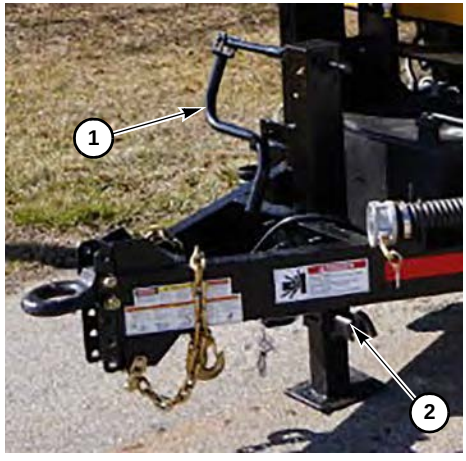
Step 1: Turn handle **(1)** and raise jack.

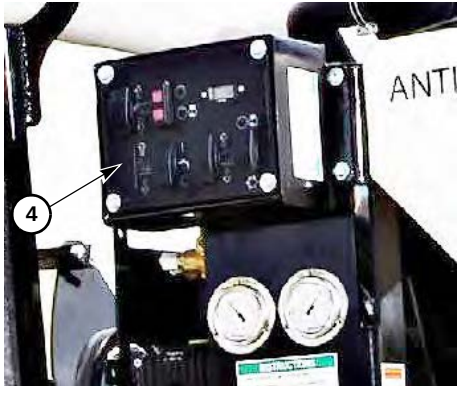
Step 2: Pull pin **(2)** at base of jack.

Step 3: Fully raise jack foot.

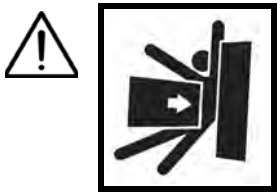
Step 4: Insert pin.

If equipped with hydraulic jack **(3),** use switch **(4)** to raise jack.





DISCONNECTING FROM THE TOWING VEHICLE



DANGER: Crushing weight. Rolling or tilting trailer will cause death or serious injury.

Chock towing vehicle wheels, and apply park brake before operating or servicing.
Do not operate unless attached to the towing vehicle.

Step 1: Park on a flat, level site before disconnecting vacuum unit from towing vehicle.

Step 2: Follow *Shutdown Procedure*, page *23-1*.

Step 3: Chock wheels to prevent trailer from moving when disconnected from tow vehicle.

Step 4: Pull pin and lower jack foot. Or hydraulically lower jack if equipped.

Step 5: Use jack to raise trailer tongue until weight is removed from towing vehicle.

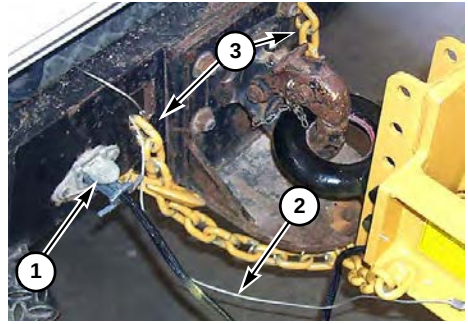
Step 6: Disconnect highway light connector **(1)** and stow on trailer tongue.

Step 7: Disconnect breakaway cable **(2)** from towing vehicle and stow on trailer tongue.

Step 8: Unhook safety chains **(3)** and stow on trailer tongue.

Step 9: Pull up on release lever and pull back pintle latch assembly to open.

Step 10: Raise tongue until towing vehicle is free of pintle ring.



SKID UNITS - TRUCK/TRAILER MOUNTING

Transport Vehicle Selection

Truck or trailer selection requires careful study of not only the gross weight involved but also of the way total gross weight is distributed.

Truck

Weight properly distributed to front and rear axles:

- gives the best ride and steering
- eliminates premature failure due to overloaded axles, springs, tires, or related components
- provides necessary traction at front and rear axles

Consult your truck dealer or manufacturer for proper load distribution and for recommendations in the event of uneven load distribution or axle overload/underload.

Trailer

Weight properly distributed above the trailer axle(s):

- eliminates premature failure due to overloaded axles, springs, tires, and related components
- provides proper tongue weight to the towing vehicle for trailer tracking and towing vehicle traction

Installation

WARNING: Before mounting on a truck or trailer, read the truck or trailer manual for safety precautions and information. Do not cut or drill any holes in the transport vehicle floor or frame without consulting a manual for the specific transport vehicle. Take protective measures and use caution when cutting or drilling around air and fuel tanks, hoses, and other nearby components.

Lift vacuum excavator into position with suitable lifting equipment. Securely bolt vacuum excavator skid to the transport vehicle.

NOTICE: Lift vacuum excavator with tanks empty. Attempting to lift with tanks full may damage the mounting cradle and require lifting equipment with larger capacity.

Locate vacuum excavator so the engine and controls can be easily accessed. Workers using the vacuum excavator will need safe and easy access to the controls, tools, and spoil tank. Provide steps or a ladder from the ground level to the bed of the truck or trailer.

Transporting or Storing Machine in Freezing Conditions

NOTICE: Do not let water pump run dry. Ensure antifreeze level is visible at all times. Running the water pump dry will result in water pump damage.

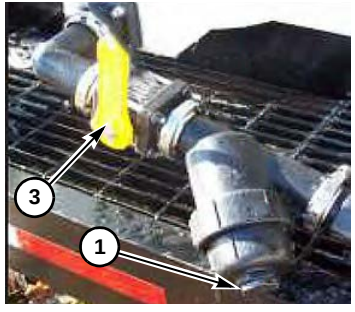
All vacuum excavators equipped with a water system must be filled with antifreeze if being transported or stored in freezing conditions. If not filled with antifreeze, the vacuum excavator is susceptible to system damage from freezing water. A water recirculation kit is also available, which transfers water from the hose reel back to the water tanks, to help avoid water freeze.

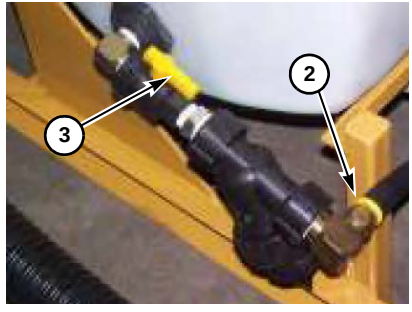
Step 1: Remove drain plug **(1)** from strainer or drain fitting **(2),** and drain excess water from the system.

Step 2: Install drain plug or fitting.

Step 3: Verify no tools are connected to the high pressure water hose.

Step 4: Place end of high pressure water hose into water tank, or connect to water recirculation connection if supplied.





Step 5: **If equipped with antifreeze tank:** Refer to “If Equipped with Antifreeze System,” *page 30-12*.

If not equipped with antifreeze tank: Refer to “If Not Equipped with Antifreeze System,” *page 30-14*.

If Equipped with Antifreeze System

After completing Steps 1–4:

Step 6: Close Water Supply ball valve **(3)**.

Step 7: Pour 1–2 gal (3.8–7.6 L) antifreeze into antifreeze tank. Open Antifreeze valve.

Step 8: Open the Upper Gate/Inlet valve **(4).**

Step 9: Follow “Starting Procedure,” *page 22-1*, and set throttle at low speed.

Step 10: Turn water pump on at switch **(5).**

Step 11: If equipped, open Hose Reel ball valve **(6)**.

Step 12: Press and hold *Antifreeze Switch* **(7)** in down position.

Step 13: Watch water flow from end of water hose. As soon as antifreeze comes out of hose, release *Antifreeze Switch*.

Step 14: Close Hose Reel ball valve if equipped. Close Upper Gate/Inlet Valve.

NOTICE: Do not allow antifreeze tank to empty. Add more antifreeze mixture to tank if needed. Allowing the water pump to run dry will result in water pump damage.

Step 15: **If equipped with Tank Cleanout valve:** Follow steps 17–19.

If not equipped with Tank Cleanout valve: Skip to step 20.

Step 16: Open Lower Gate/Dump valve **(8)** on spoil tank door. Open Tank Cleanout valve.

Step 17: Press and hold *Antifreeze Switch* in down position.

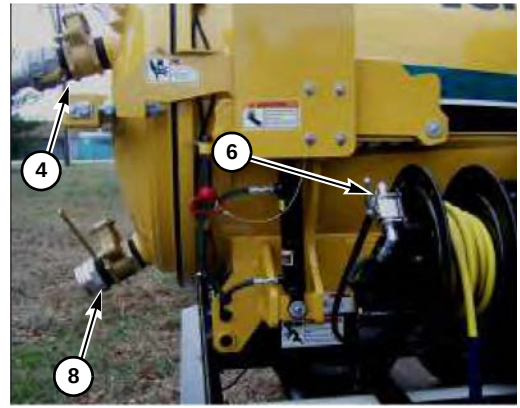
Step 18: Watch fluid flow from Lower Gate/Dump valve. As soon as antifreeze emerges, release *Antifreeze Switch.* Close Lower Gate valve and Tank Cleanout valve.

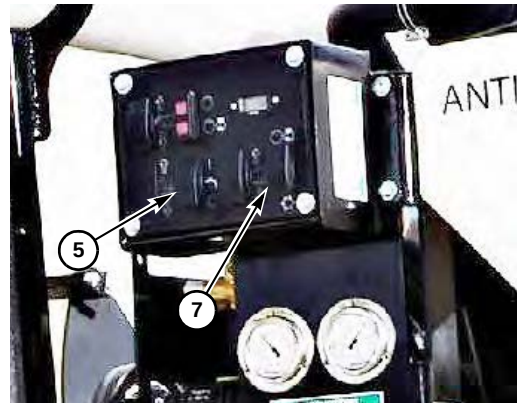
Step 19: Press and hold *Antifreeze Switch* in down position.

Step 20: Open Water Supply ball valve, allowing excess antifreeze to flow into the suction plumbing. Release *Antifreeze Switch.*

Step 21: Close Antifreeze valve.

Step 22: Turn water pump off. Turn engine off.





If Not Equipped with Antifreeze System

After completing Steps 1–5:

Step 6: Leave Water Supply ball valve **(3)** open.

Step 7: Pour 2–3 gal (7.6–11.4 L) antifreeze into fresh water tank.

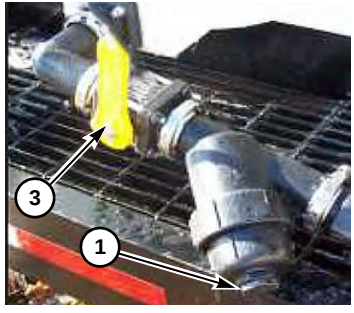
Step 8: Open Upper Gate/Inlet valve **(4).**

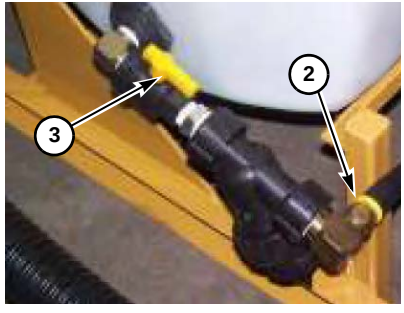
Step 9: Start engine, and set throttle at low speed.

Step 10: Turn water pump on at switch **(5).**

Step 11: If equipped, open Hose Reel ball valve **(6)**.

Step 12: Watch water flow from end of water hose. As soon as antifreeze comes out of hose, close Hose Reel ball valve if equipped.





Step 13: Close Upper Gate/Inlet Valve.

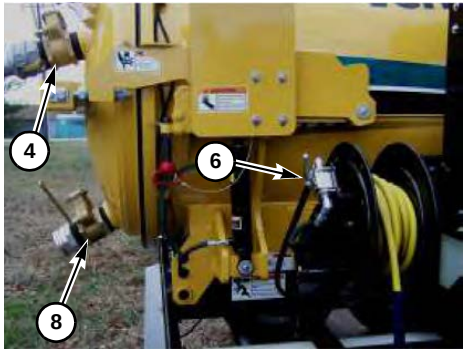
Step 14: Add more antifreeze to fresh water tank if needed. Do not allow tank to empty.

Step 15: **If equipped with Tank Cleanout valve:** Follow steps 16–17.

If not equipped with Tank Cleanout valve: Skip to step 18.

Step 16: Open Lower Gate/Dump valve **(8).** Open Tank Cleanout valve.

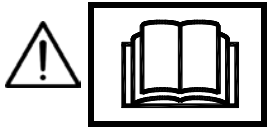
Step 17: Watch fluid flow from Lower Gate/Dump valve. As soon as antifreeze emerges, close Lower Gate valve and Tank Cleanout valve.



Step 18: Turn water pump off. Follow "Shutdown Procedure," *page 23-1*.

Section 40: Preparing Machine and Work Area

OPERATOR QUALIFICATIONS



WARNING: Read *Operator's and Maintenance Manual* and safety signs before operating machine.

Allow only responsible, properly instructed individuals to operate machine.

Become familiar with the controls, operation and use of the machine under the supervision of a trained and experienced operator.

The operator must be familiar with workplace safety rules and regulations, and must be mentally and physically capable of operating the machine safely.

The operator should be trained in slurry vacuum excavation and cable locating.

PERSONAL PROTECTIVE EQUIPMENT

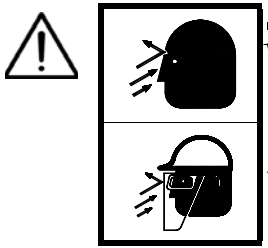
WARNING: Wear required personal protective equipment. Always wear a hard hat, wraparound eye protection or goggles, and hearing protection. When warranted wear full face shield, electrically insulated gloves, and electrically insulated boots. Wear close-fitting clothing and confine long hair. Avoid jewelry, such as rings, wristwatches, necklaces, or bracelets.

Operating the machine will require you to wear protective equipment. You should always wear a hard hat, hearing protection, wraparound eye protection or goggles. When vacuum excavating at a site where underground electrical utilities are present, always wear electrically insulated boots and gloves. If operating conditions warrant, such as use of pressurized air resulting in thrown material, wear a full face shield. If working near traffic, you may need to wear reflective clothing.

Hearing protection is required when operating the machine. Hearing protection devices provide differing levels of sound reduction. It is important to select a device that is adequate and appropriate for your specific work environment. Actual sound levels may vary widely, depending on your working conditions. To determine the level of hearing protection your work environment requires, enlist the help of your local environmental noise specialist.

Other workers in the immediate area must also wear hard hats, safety shoes, hearing protection, and eye protection. Electrically insulated boots and gloves are required when vacuum excavating near energized electric lines.

Eye protection must consist of wraparound safety glasses or goggles, and if conditions warrant, a full face shield.



WARNING: Thrown material can result in eye and face injuries.

Use eye and face protection.

NOTICE: Face shields must meet ANSI Standard Z87.1 - 2010 'Face shields', and must be marked 'Z87+'. Face shields are available from various sources, including Vermeer dealers.

SOUND LEVELS

Sound pressure and sound power levels were determined according to test procedures specified in ISO 3744 and ISO 6394.

Equivalent Continuous A-Weighted Sound Pressure:

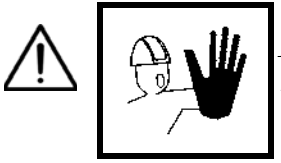
at Operator's Ear . . . . . not available at time of printing

at Operator's Station . . . . . not available at time of printing

Guaranteed Sound Power Level as determined by EU Directive 2000/14/EC. . . not available at time of printing

NOTICE: The stated sound levels are representative for a given operating condition. Operating conditions may vary at each job site. The actual sound levels for your application and operating conditions may be different.

PREPARE THE AREA

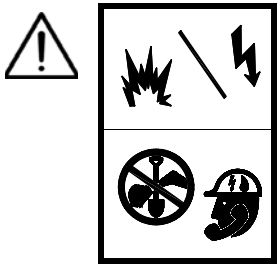


WARNING: Keep all spectators and other workers away from the machine and work area while in operation.

Loose flying debris can injure or blind bystanders. Allow only authorized personnel with proper safety equipment in the work area.

Locate Buried Utilities

Call Your One-Call System First



WARNING: Striking an electrical line can cause electrocution. Striking gas line can cause an explosion. Cutting a fiber optic cable could result in eye damage caused by laser light. Death or serious injury possible.

Locate utilities before digging. Call 1-888-258-0808, or access www.call811.com (U.S. only); or contact local utility companies or national regulating authority.

Before you start any digging project, contact the local One-Call system in your area and any utility company that does not subscribe to the One-Call system. For areas not represented by One-Call Systems International, contact the appropriate utility companies or national regulating authority to locate and mark underground installations. If all utilities are not properly located, you may have an accident or suffer injuries; cause interruption of services; damage the environment; or experience job delays.

The One-Call representative will notify participating utility companies of your proposed digging activities. Utilities will then mark their underground facilities by using the following international marking codes:

Red	Electric	Green/Brown	Sewer
Yellow	Gas, Oil or Petroleum	White	Proposed Excavation
Orange	Communication, Telephone, TV	Pink	Surveying
Blue	Potable Water		

OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning excavation or underground drilling operation. When actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If utility cannot be precisely located, it must be shut off by the utility company.

Look for Evidence of Underground Placement

Visually check for:

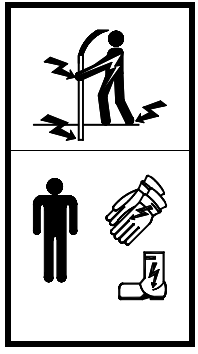
- notices of underground placements
- manhole covers
- drop boxes
- recent trenching activity

Mark Excavation Area

WARNING: When exposing utility lines for avoidance in a digging application, verify exposed line is the correct line. Excavations may contain multiple lines or abandoned lines, as well as the line intended to be exposed.

When potholing for non-destructive exposure of underground utilities prior to excavating, trenching, or boring, coordinate with all local utilities and mapping services. The area of proposed excavation must be marked. The One-Call system must be 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 search the area to be excavated to determine if unmarked facilities exist, and to help determine a more precise location of marked facilities. Consult area utility maps or seek advice on non-metallic pipes such as sewer or storm water lines that may be unmarked.

Striking a Utility

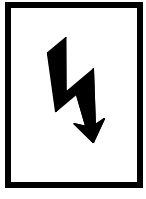


WARNING: Striking an electrical line with a vacuum excavation tool or lance/wand can result in electrocution. Death or serious injury could result if not wearing electrically insulated gloves and boots. Ensure operators wear proper personal protective equipment.

If strike occurs, do the following:

- Do not touch any part of vacuum/excavation machine or tow vehicle.
- Contact utility company to shut off electrical power.
- Do not allow anyone to approach the machine or any connected equipment.
- Do not resume operation until utility company declares area safe.

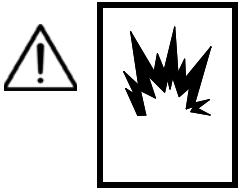
Electricity



DANGER: Electric shock can kill. If strike occurs, release the digging tool. Do not touch any part of the vacuum/excavation system or the attached towing vehicle. Have someone who is clear of the area contact the utility company to shut off electrical power. Do not allow anyone to approach the machine or the towing vehicle.

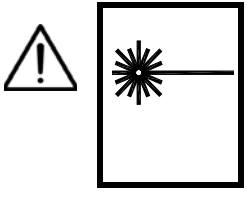
Some circuit breakers automatically reset. Do not assume power has been permanently disconnected until you confirm that the utility company has locked out power to that line.

Gas



DANGER: Working where flammable gas is present or striking a gas line could result in an explosion. Death or serious injury could result from flying debris, burns or force of explosion. Immediately shut off engine, evacuate area, and contact utility company. Do not return until tility company gives permission to do so.

Fiber Optic



WARNING: Damaged or open fiber optic cable emits laser light which may be invisible and exposes microscopic glass shards. Blindness or serious eye injury could result if exposed to laser light. Damage to skin, lungs and eyes could result due to contact with microscopic glass shards. Do not look into the cable. Do not handle cable. Contact appropriate utility company.

Electrocution Prevention

DANGER: Electrocution is possible. Contact with electric lines will cause death or serious injury. Locate all underground utilities. Always wear proper personal protective equipment.

DANGER: When vacuum excavating near energized electric lines, wear dielectric boots and gloves.

Refer to the operating instructions, and take these precautions to prevent electrocution:

- Call your One-Call system, and any utility company that does not subscribe to the One-Call system, before the start of your potholing project. Locate underground utilities by qualified persons.
- When potholing operation approaches the estimated location of a utility, the exact location of the underground installation must be found by safe and acceptable means.
- Always wear the necessary electrically insulated gloves and boots that are required for each job function. Refer to “Electrically Insulated Gloves - Inspect” and “Electrically Insulated Boots” on the following pages.
- Never stand on the ground and touch metal parts on machine or water truck when operating.
- If a strike occurs, never step onto or off the machine.
- Disconnect from public water supply before potholing where electrical cables may be buried.

If a strike occurs while you are touching the ground, you could be electrocuted when your body becomes a direct current path to the ground. Wear electrically insulated gloves and boots.

Anyone assisting the operator while standing on the ground during vacuum excavation near energized power lines must wear electrically insulated gloves and boots.

Electrically Insulated Gloves

If electrically insulated gloves are not available locally, they can be obtained through Vermeer Corporation.

Rubber electrically insulated gloves, when in good condition and correctly used, help protect the wearer from death, serious injury, and electrical burns. Gloves must be at least Class 2, with a voltage rating of 17,000 volts or more. Wear leather protectors over gloves. They protect the gloves, but do not protect against death, serious injury, or other potential dangers from electrical shocks or burns.

If working at a jobsite where underground electrical utilities are present, the operator and anyone assisting the operator during potholing must wear electrically insulated gloves and boots.

Correct care of gloves is essential to wearer safety.

- Visually inspect gloves and leather protectors before each use. Refer to “Electrically Insulated Gloves - Inspect,” *page 40-11.*
- Do not fold gloves. Folding causes dangerous cracks. Store gloves in glove bag when not in use.
- Do not store gloves inside out. This causes damage from ozone and severely strains the rubber.
- Keep gloves clean. The gloves will be more comfortable to wear, and damage will be more visible.
- Prevent snags. Do not wear rings, watches, jewelry, or other sharp objects on hands or arms when wearing gloves.
- Prevent contact with wood or metal splinters or other sharp objects which may damage gloves.
- Prevent contact with chemicals, which can damage gloves. If contact is made with chemicals, wipe gloves off immediately. Clean gloves with a mild soap, then rinse with clear water and let them air dry.
- The ASTM In-Service specifications call for an electrical retest of gloves at a test lab every 6 months. This test is to recertify the non-conductivity of the gloves. Contact your Vermeer dealer for the location of the test lab in your area or a listing of the test labs.

Electrically Insulated Gloves - Inspect

Visually inspect insulated gloves and leather protectors before each use.

- Check for signs of physical damage or chemical deterioration such as swelling, softness, hardening, stickiness, ozone deterioration, or sun-checking from prolonged exposure to sunlight.
- Check whether red or yellow inner layer shows through black outer layer, indicating gloves have been cut or snagged. If damaged at all, do not use them.
- Check leather protectors. Look for metal particles, embedded wire, abrasive materials, or substances that could cause puncture, abrasion, contamination, or deterioration. Adequate flashover distance of 2" (5 cm) between the top of protector and the bead of rubber glove should be maintained. Minimum uncovered distance must be 1" (2.5 cm) above the protector cuff top for each 10,000 volts.
- Check insides of each glove and air test for pinholes:

Step 1: Place glove on your hand, and pull cuff up over your fingers, turning glove inside out.

Step 2: Holding glove pointing down, grasp cuff and twirl it upward toward your body to close the cuff.

Step 3: Squeeze rolled cuff into a “U” shape to trap air inside glove. Hold cuff with one hand and squeeze glove with your other hand. Hold glove near your ear and listen and feel for air escaping through a hole. Pop out glove fingers by squeezing inflated glove and check for damage.

Step 4: Turn glove right side out.

Step 5: Repeat with other glove.

Electrically Insulated Boots

If electrically insulated boots are not available locally, they can be obtained through Vermeer Corporation.

Rubber electrically insulated boots, when in good condition and correctly used, also protect the wearer from death, serious injury, and electrical burns. The boots must meet or exceed electrical hazard protection requirements when tested at 14,000 volts.

If working at a jobsite where underground electrical utilities are present, the operator and anyone assisting the operator during potholing must wear electrically insulated gloves and boots.

Inspect boots before each use. Check for cracks, holes, and unusual wear on the sole. If there is damage, discard boots. Damaged boots will not provide adequate electrical protection.

After each use, rinse boots with water to remove mud, chemicals, and debris. The boots are made with natural rubber, so it is important to use a rubber protectant or furniture polish. This keeps rubber soft and prevents pinholes, stress cracks, dry rotting, and ozone deterioration.

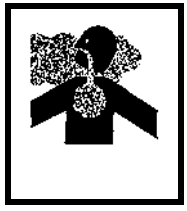
Jobsite Assessment

Ensure you understand and comply with all jobsite rules that might apply to your work situation.

Examine work area for any obstructions, conditions, or situations which may impair machine operation or create a safety hazard for the operator or other persons. Use information in this manual combined with your own good judgment when identifying these hazards and implementing hazard avoidance measures.

WARNING: The weight of your machine may cause the ground to give way. Machine can fall into excavation or tip over. Death or serious injury could result. Keep well away from edges of embankments or excavation.

When work is planned inside or around structures such as buildings, bridges, and low-hanging tree limbs, check for adequate overhead and side clearances. Be sure to account for the height of the Strong Arm attachment.



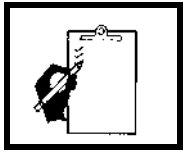
WARNING: Engine exhaust can asphyxiate. If inhaled directly or continuously, the combustion fumes produced by the engine can be very dangerous and/or lethal for the human body. If work has to be done in enclosed environments, take all necessary precautions to ensure the circulation of fresh air and protect the respiratory tract using a suitable mask.

Good ventilation is very important. Sparks from the electrical system and engine exhaust can cause an explosion or fire in a flammable or explosive atmosphere. Do not operate this machine in an area with flammable dust or vapors.

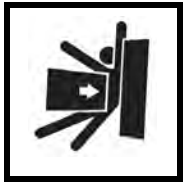
Carbon monoxide fumes from the engine can asphyxiate. Operate only outdoors or provide adequate ventilation if indoor operation is essential.

If operating near or on roadways, make sure local authorities are contacted for regulations regarding traffic control and safety. Properly warn and divert motor and pedestrian traffic. Use all necessary signs, cones, barricades, flag persons, and lighting devices needed for the work situation.

PREPARE THE MACHINE



WARNING: Check machine before operating. Machine must be in good operating condition and all safety equipment installed and functioning properly.



DANGER: Crushing weight. Rolling or tilting trailer may result in death or serious injury.

Chock towing vehicle wheels, and apply park brake before operating or servicing. Do not operate unless attached to the towing vehicle.

Engine Fluids - Check

Check engine crankcase oil level at dipstick.

NOTICE: Engine is equipped with an oil pressure sensing switch. When oil pressure decreases below an acceptable level, the engine will significantly slow down or shut off.

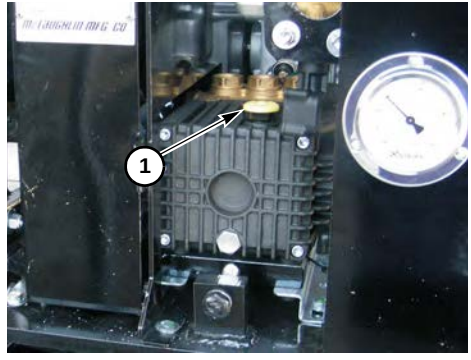
Water Pump & Blower Oil Level - Check

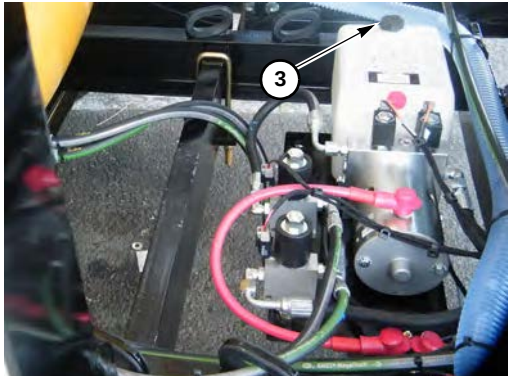
(1) Water Pump Fill Cap/Dipstick (VX30/VSK30 Units Only)

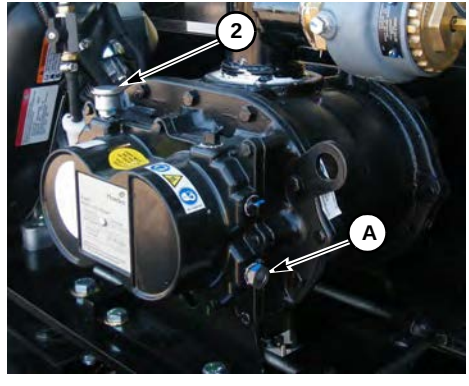
(2) Blower Fill Port

Fill at each breather port to middle of sight glass **(A).** Fill each gear end separately. Do not fill past middle of each sight glass. (Front-facing breather port and sight glass shown.) Watch for leaks.

(3) Hydraulic Pump Fill Cap (Option)







Fresh Water Tank(s) - Fill

The vacuum excavating system may be equipped with water tank(s) as listed below. Ensure water tank(s) are at least half full before potholing. Fill tank with clean water through tank lid **(1)**.

NOTICE: The water should not contain contaminants such as salt, calcium, or debris that might plug the nozzles.

Model	Fresh Water Tank Configuration
VSK25-100G	one 50-gallon (189 L) tanks
VSK30-500G	two 125-gallon (473 L) tanks
VSK30-800G	two 205-gallon (776 L) tanks
VSK30-1200G	two 205-gallon (776 L) tanks
VX30-500G	two 125-gallon (473 L) tanks
VX30-800G	two 205-gallon (776 L) tanks
VX30-1200G	two 50-gallon (189 L) tanks

Water Strainer - Clean

Clean water strainer daily before starting the machine, or during operation if water flow becomes restricted.

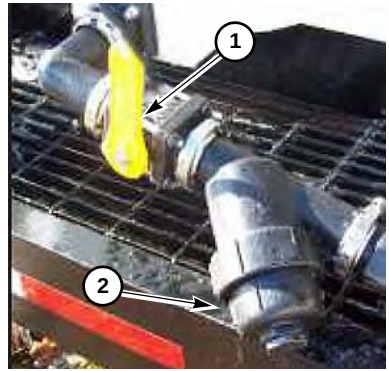
Step 1: Close Water Supply valve **(1)**.

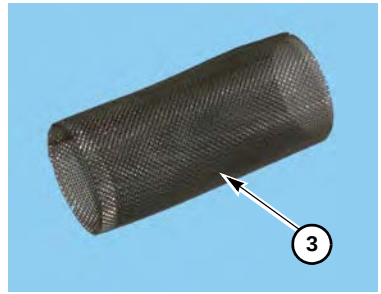
Step 2: Remove plug-and-cap fitting **(2)** from strainer housing.

Step 3: Remove and clean screen **(3)** by flushing with water.

Step 4: Install screen and fitting.

Step 5: Open Water Supply valve.





Vacuum Hoses and Tools - Check

Check all vacuum hoses and tools for blockages and damage. Ensure nozzles are clean, free of clogs, and work properly. Replace nozzles as necessary. Check fittings and condition of hoses. Tighten or replace as necessary. Replace broken and worn tools.

Filters - Check

Check all filters. Clean or replace filters as necessary.

MACHINE LOCATION

- Locate machine on stable, level ground.
- Position machine as close to the area to be excavated as possible.
- Set towing vehicle park brake and chock wheels.

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Section 50: Operating the Vacuum Excavator

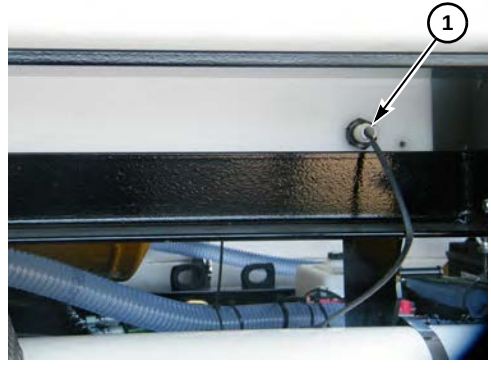
Cold Weather Precautions

Use antifreeze when the temperature drops below freezing. Immediately after using water tools, flush water system with antifreeze. Refer to "Transporting or Storing Machine in Freezing Conditions," *page 30-12*, for instructions.

Operating Features

Water Tank Low Level Sensor

The water tank is equipped with a low water sensor switch **(1).** When water level in tank is low, the switch will turn the water pump off. Refill fresh water tank and turn on the water pump before resuming vacuuming or potholing.

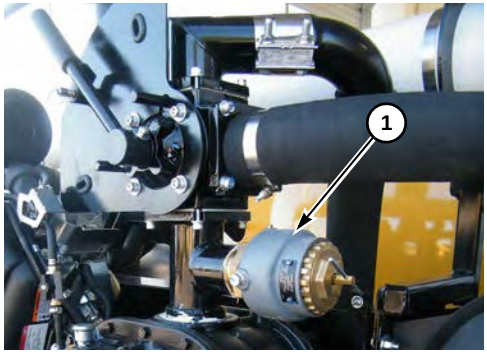


Spoil Tank Level Float Switch

The spoil tank is equipped with a float switch that monitors material levels in the tank. The switch will shut down the engine when the spoil tank is full, unless the *Tank Full Override Switch* is ON.

Pressure Relief Valve

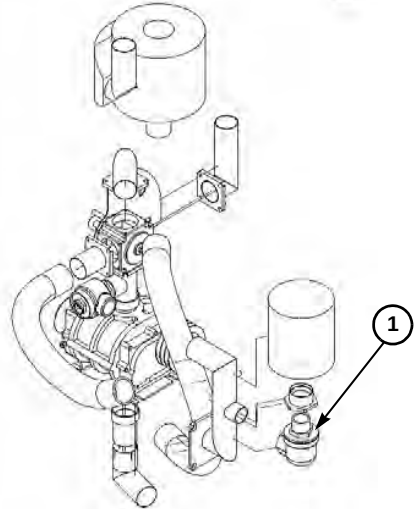
Units equipped with a Reverse Flow Control valve include a Pressure Relief valve **(1),** preset to relieve positive system pressure at 2500 psi (173 bar).



Vacuum Relief Valve

The system includes a Vacuum Relief valve **(1)** preset to relieve vacuum (negative) system pressure at 13" HG standard, or 15" HG for high altitude conditions, with a tolerance of +/- 1" HG.

On units equipped with a manual spoil tank door, the whistling sound emitted when the relief valve opens indicates that it is safe to unlock the door.



VACUUM HOSES AND TOOLING - CONNECT

Step 1: Remove vacuum hose from storage.

Step 2: Install hose end into coupler on Upper Gate/Tank Inlet port **(1).** Lock cam levers.

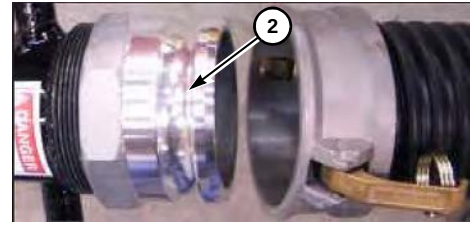
Step 3: Attach additional vacuum hoses if needed for distance.

Step 4: Remove any tooling to be used from tool storage.

Step 5: Attach tooling **(2)** onto the end of vacuum hose. Lock cam levers.

Potholing

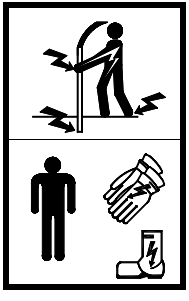
Connect water supply hose from hose reel to water connector **(3)** on rotary nozzle lance or optional reduction tool.



OPERATING INSTRUCTIONS

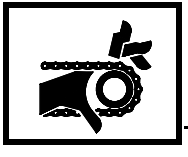
WARNING: Read manual. Death or serious injury may result.

Read and understand all safety and operating instructions BEFORE operating any equipment.



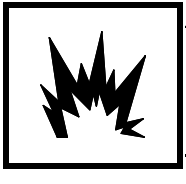
WARNING: Electric shock can kill.

Wear electrically insulated gloves and boots.



WARNING: Entanglement in rotating pulleys and belts may result in serious injury.

Do not operate without guards in place.



WARNING: Fire or explosion can kill.

Do not vacuum hazardous or flammable material. Consult federal, state, and local regulations regarding classifications of hazardous material.

WARNING: Do not operate unit where flammable gas is present.

These instructions assume that all of the preparation procedures have been followed. Refer to *Preparing Machine and Work Area, page 40-1*.

Operating Precautions

- Verify that spoil tank rear door is shut, locked, and properly sealed.
- Open Upper Gate/Inlet valve **(1)** to vent tank before starting engine. Close valve after engine has started.
- Ensure Lower Gate/Dump valve is closed.
- High pressure water can cut utility lines. Test water pressure on a sample of the material to be located.
- Do not direct pressurized water at overhead lines. Water conducts electricity.
- Before opening rear door, open inlet valve to vent tank. Keep hands and fingers clear when closing the door.
- Engine speed is preset at the factory. This speed should not be changed. Damage to engine or pump may result.

NOTICE: Failure to follow these instructions will result in reduced performance of the vacuum excavator.

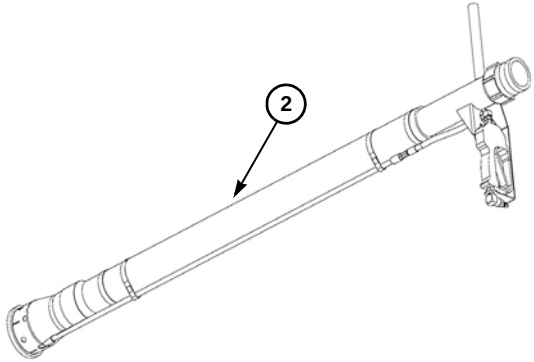
Material Disposal

- Know the contents of the material being excavated or remediated.
- Know the local regulations for disposal of liquid material and/or mud.
- Know the place and plan for disposal of the material in the spoil tank.

Operation - Potholing

Perform potholing excavation using the rotary nozzle lance **(1)** with vacuum tooling, or optional “one-man” reduction tool **(2)** with attached water line. These tools use high pressure water to reduce the soil to a size small enough to be vacuumed. The water helps prevent damage to the utility from direct contact with the tool.

The reduced soil is vacuumed out of the pothole, creating a small pothole to see and identify buried utilities **(3).** This process may require two persons, with one using the rotary lance and the other vacuuming the spoil.



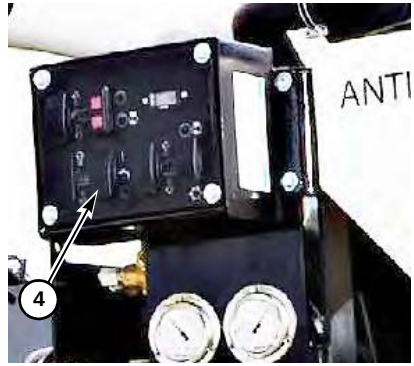
Step 1: Follow all instructions in “Prepare the Machine,” *page 40-14*, to correctly position machine.

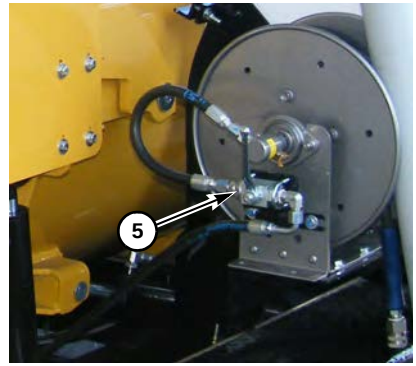
Step 2: Follow the “Starting Procedure,” *page 22-1*.

Step 3: Follow necessary traffic control measures.

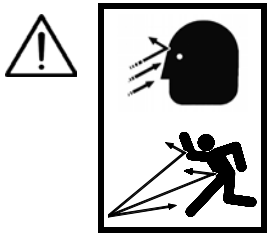
Step 4: **If potholing in a grassy area:** Use a spade or other appropriate digging tool to loosen and remove the grass plug over the area to be excavated.

If potholing under asphalt or concrete: Use a hydraulic or air-operated breaker or saw to remove the top material and expose the earth.



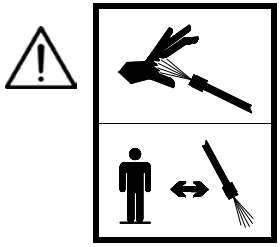


Step 5: Turn on *Water Pump Switch* **(4).** Open Hose Reel valve **(5)**.



WARNING: Machine uses water or air under pressure. Ground engaging tools can cause objects to become airborne. Flying objects can result in injury or property damage.

Wear personal protective equipment. Keep all nonessential personnel away from the work area.



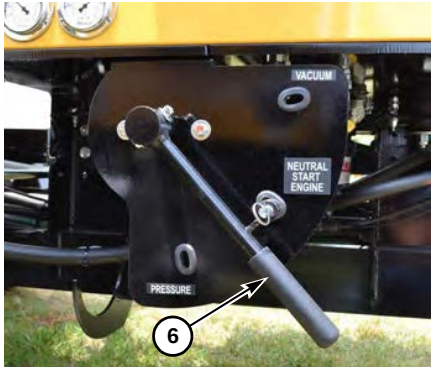
WARNING: High pressure water can penetrate skin. Serious injury possible.

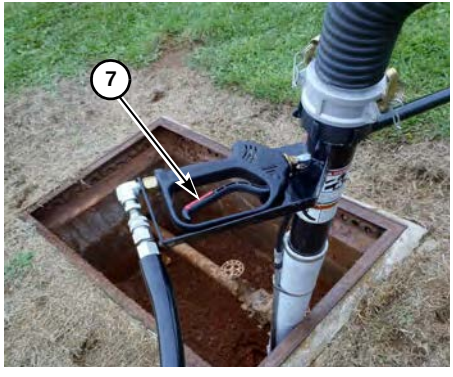
Keep nozzles away from body. Wear protective clothing. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Step 6: If equipped with Reverse Flow Control **(6),** place in Vacuum position. Open Upper Gate/Inlet Valve.

Step 7: Position rotary nozzle lance and vacuum tooling, or optional reduction tool vertically at the desired potholing location.

Step 8: Grasp handles on tool, and squeeze water supply trigger **(7)**. Move tool in a semicircular motion. The water jets will excavate a cylindrical hole in the ground.





Step 9: As tool descends to the proper depth, occasionally release water supply trigger and remove tool from hole to check if utility has been located.

Step 10: As digging continues to expose the utility, be aware of changes in soil conditions. A soft area that allows faster penetration typically means the tool is approaching the utility.

Step 11: When resistance is encountered, stop. Remove the tool from the pothole and identify the utility or obstruction.

Step 12: If the utility cannot be completely exposed from one hole, enlarge the hole using the tool until the complete utility is visible. It is important to observe the entire utility to determine its size.

NOTICE: If utility is not located, increase size of the hole or move to a new location.

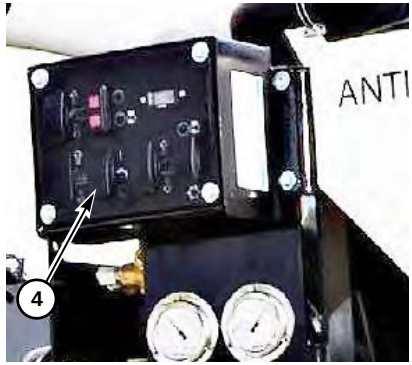
Step 13: When the utility has been located, release water supply trigger. Shut OFF water pump and engine.

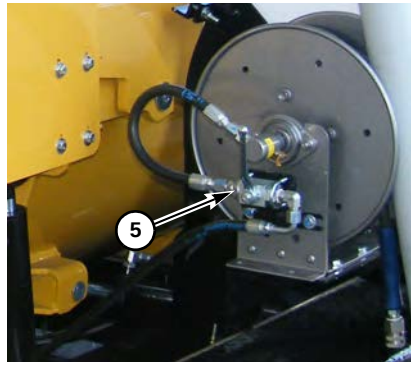
Step 14: When fluid level in the spoil tank reaches capacity, the engine is automatically shut down to prevent overfilling. When this occurs, empty the spoil tank. Refer to "Dumping Spoil Tank," *page 50-15*.

Step 15: When finished potholing, close Hose Reel ball valve **(4),** and turn Water Pump Switch **(5)** OFF.

Step 16: If engine did not shut off automatically, follow the *Shutdown Procedure*, page *23-1*, and remove ignition key.

Step 17: Squeeze the water supply trigger to release trapped water pressure prior to unhooking.

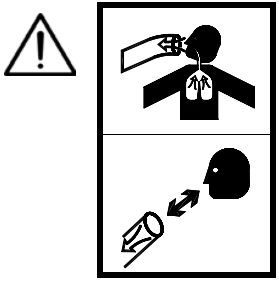




Step 18: Disconnect hoses. Securely store all tools and hoses before traveling to the spoil disposal site.

Operation - Vacuum Excavation

During vacuum excavation, the vacuum tool uses a powerful air stream to remove wet or dry material.



DANGER: Vacuum can suffocate or damage vision or hearing.

Keep hose end away from face.

Step 1: Follow all instructions in “Prepare the Machine,” *page 40-14*, to correctly position machine.

Step 2: Follow the “Starting Procedure,” *page 22-1*.

Step 3: Follow necessary traffic control measures.

Step 4: Connect vacuum hose(s) and tooling **(1).** Refer to “Vacuum Hoses and Tooling - Connect,” *page 50-3*.

NOTICE: Short hose lengths are recommended to reduce vacuum hose clogging. If clogging occurs, refer to “Reverse Flow (Option),” *page 50-12*.

Step 5: If equipped with *Reverse Flow Control* **(2),** place in Vacuum position. Open Upper Gate/Tank Inlet valve.

Step 6: As long as vacuum hose is connected to the spoil tank and the engine is running, the vacuum tool will be vacuuming. To stop vacuuming, turn off engine.

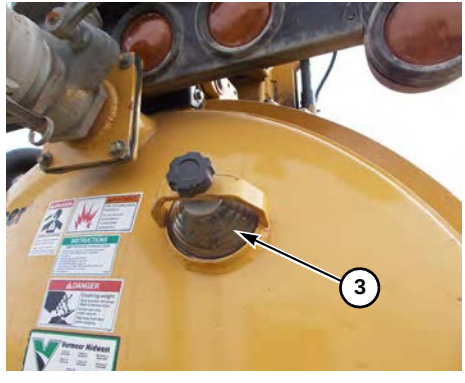
Step 7: When vacuuming liquids, do not completely submerge vacuum tool in the fluid. Keeping tool partially out of the fluid allows airflow through the vacuum tube to move material more quickly to the spoil tank. This technique is also effective when vacuuming deep vertical distances.

Step 8: When fluid level in the spoil tank reaches capacity, the engine is automatically shut down to prevent overfilling. When this occurs, empty the spoil tank. Refer to “Dumping Spoil Tank,” *page 50-15*.

Step 9: When vacuuming dry materials, the Tank Full shutdown sensor does not function. Stop vacuuming when spoil tank level reaches sight glass **(3),** or when debris can be heard circulating in the cyclonic separator.

Step 10: If engine did not shut off automatically, follow the *Shutdown Procedure*, page *23-1*, and remove ignition key.

Step 11: Disconnect hoses. Securely store all tools and hoses before traveling to the spoil disposal site.



Reverse Flow (Option)

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

Step 1: When vacuuming, set *Reverse Flow Control* **(1)** to Vacuum position.

Step 2: If a clog occurs, close Upper Gate/Inlet valve.

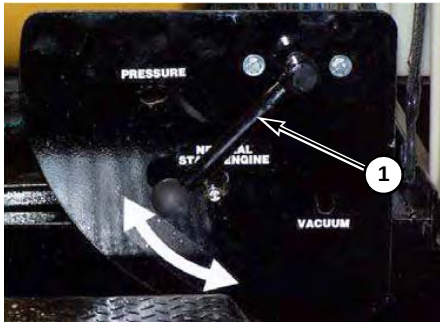
Step 3: Move *Reverse Flow Control* to Pressure position.

Step 4: Allow system pressure to build to 5 psi (34 kPa). Pressure Relief valve will not allow system pressure greater than 5 psi (34 kPa).

Step 5: Ensure hose is positioned in safe direction.

Step 6: Open Upper Gate/Tank Inlet valve.

Step 7: Once obstruction is relieved and air flow is reestablished, return *Reverse Flow Control* to Vacuum position.



Removing Debris From Spoil Tank

To transfer material from spoil tank to a designated area:

Step 1: Attach hose to Lower Gate/Dump valve **(1).**

Step 2: Ensure *Reverse Flow Control* valve is in NEUTRAL position.

Step 3: Start engine, and run in high speed.

Step 4: Move *Reverse Flow Control* valve to Pressure position.

Step 5: Point hose safely to designated dumping area. Open Lower Gate/Dump valve.

Step 6: Discharge material from spoil tank to designated area.

Step 7: Move *Reverse Flow Control* valve to NEUTRAL position.

Step 8: Close Lower Gate/Dump valve. Turn off engine.

At this point, operator can either resume work, or remove solid waste from the tank. Refer to “Dumping Spoil Tank,” *page 50-15*.

Strong Arm Attachment (Option)

WARNING: Swinging arm. Serious injury will result. Arm can swing when tank is raised.

Always lock Strong Arm attachment in stowed position when not in use.

NOTICE: Strong Arm attachment is not available on skid units.

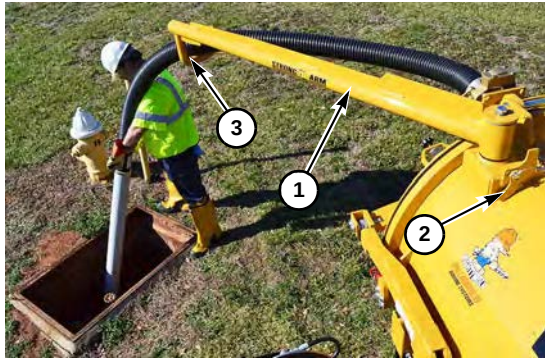
The Strong Arm attachment **(1)** is used for manually maneuvering the suction hose as well as supporting the weight of the hose. Strong Arm attachment provides 200° rotation and extends 6 ft (1.8 m) from the spoil tank.

Step 1: Remove pin and disengage retainer **(2).** Manually swing Strong Arm attachment into position adjacent to hose.

Step 2: Use support bar **(3)** to support the weight of the hose as shown.

Step 3: After use, clean and store suction hose and Strong Arm attachment.

Store Strong Arm attachment in stowed position shown when not in use. Ensure Strong Arm is stored before raising tank. Engage retainer **(2)** and pin.



DUMPING SPOIL TANK

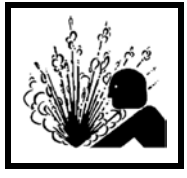
Manual Locking Door (VSK25-100G Only)

DANGER: Crushing weight. Spoil and door will cause death or serious injury.

Unlock door only under vacuum. Stay away from door when dumping.

DANGER: Crushing weight. Rolling or tilting trailer will cause death or serious injury.

Chock towing vehicle tires and apply park brake before operating or servicing.
Do not operate unless attached to the towing vehicle.



DANGER: EXPLOSION HAZARD! CONTENTS UNDER PRESSURE!

Relieve tank pressure before opening. Failure to comply will result in death or serious injury.

WARNING: Pinch point. Serious injury may result.

Keep hands clear when closing door or lowering tank.

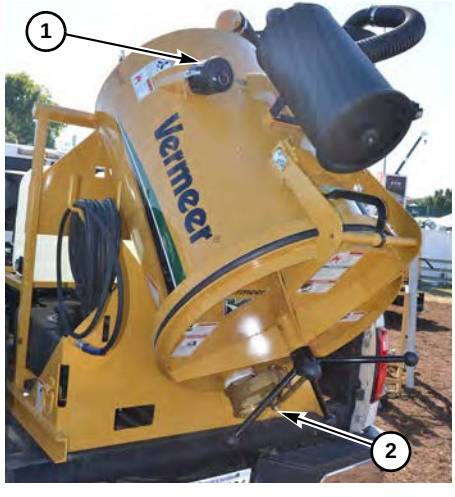
NOTICE: Before beginning vacuum operations, a plan and site for disposing of material in the spoil tank should be established.

Step 1: Before arriving at the disposal site, verify fresh water tank (if equipped) has adequate water for cleanup.

Step 2: After arriving at disposal site, engage park brake and chock towing vehicle wheels.

Step 3: Open the Upper Gate/Inlet valve **(1)**.

Step 4: Open Lower Gate/Dump valve **(2)** to drain excess liquids.

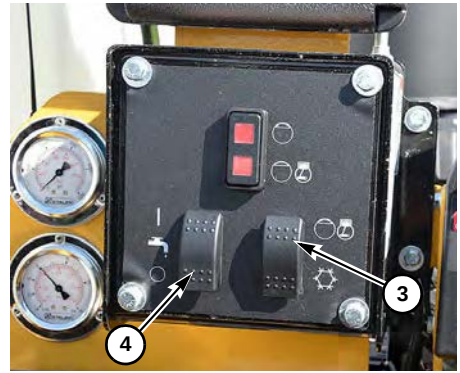


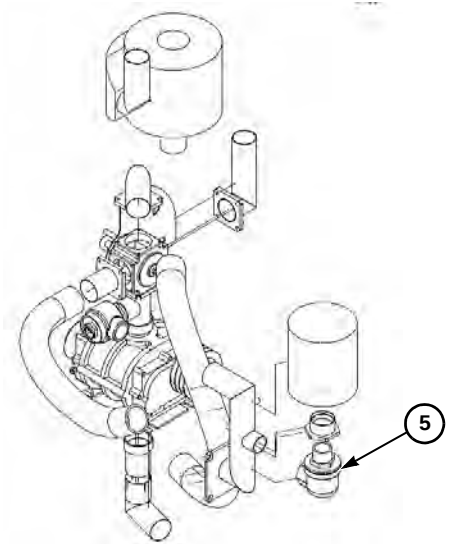
Step 5: At the operator console, if the Spoil Tank Full Light is ON, turn Tank Full Override Switch **(3)** ON.

Step 6: Turn Water Pump Switch **(4)** OFF.

Step 7: Start engine and run at low idle. Close Upper Gate/Tank Inlet valve.

Step 8: With the engine running at idle, and all inlet valves closed, vacuum will be reached when the Vacuum Relief Valve **(5)** opens. The valve makes a whistling sound when it opens.





Step 9: With the Vacuum Relief Valve whistling, the door can be unlocked. Turn door handle **(6)** counterclockwise until fully loose.

Step 10: Return to operator console, and turn off engine. Remove ignition key. Keep all personnel clear of the rear of the machine.

Step 11: Wait for vacuum to drop. As vacuum drops, the door will release, allowing the spoil to dump from the tank. Material in spoil tank is very heavy. Stay clear of the door.

Step 12: Once tank has been emptied, it may be cleaned. If not cleaning machine after dumping, wipe the door seal and mating flange clean to avoid damaging the seal when closing and locking the door.

Step 13: Open cyclonic separation door **(7),** and remove debris. Close door.

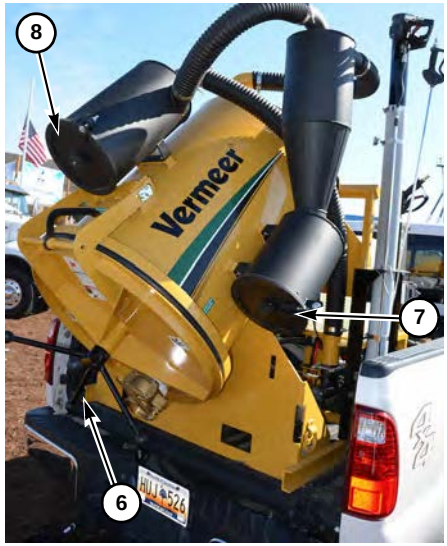
Step 14: Check air filter. Open air cleaner door **(8)** and inspect air filter element. If dirty, remove element and clean with low-pressure water. The spray wand **(9)** may be used. Install element after it has dried.

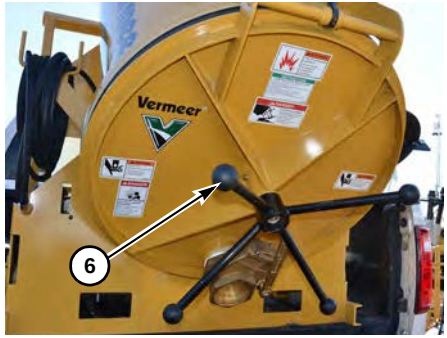
Clean air filter element at least once daily. Replace damaged air filter elements immediately.

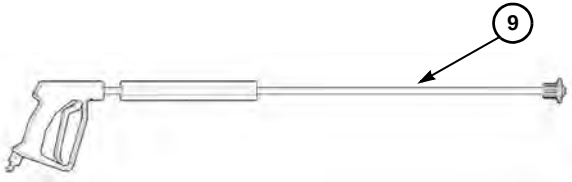
NOTICE: Do not operate unit without the air filter installed. Blower damage will result.

Step 15: Close and lock spoil tank door.

Step 16: Securely store all tools and hoses before leaving the spoil disposal site.







Hydraulic Locking Door (All Units Except VSK25-100G)

DANGER: Crushing weight. Spoil and door will cause death or serious injury.

Unlock door only under vacuum. Stay away from door when dumping.

DANGER: Crushing weight. Rolling or tilting trailer will cause death or serious injury.

Chock tires and apply park brake before operating or servicing.
Do not operate unless attached to the towing vehicle.

NOTICE: Before beginning vacuum operations, establish a plan and site for disposing of spoil tank material.

Step 1: Before arriving at the disposal site, verify fresh water tank (if equipped) has adequate water for cleanup.

Step 2: After arriving at disposal site, engage park brake and chock towing vehicle wheels.

Step 3: Open the Upper Gate/Tank Inlet valve **(1)** to relieve tank pressure.

Step 4: Open Lower Gate/Dump valve **(2)** to drain excess liquids.

Step 5: At the operator console, if the Spoil Tank Full Light is ON, turn *Tank Full Override Switch* **(3)** ON.

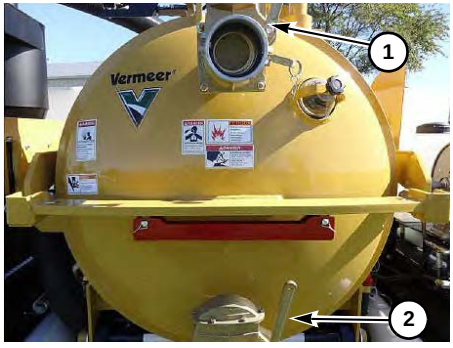
Step 6: Turn *Water Pump Switch* **(4)** OFF.

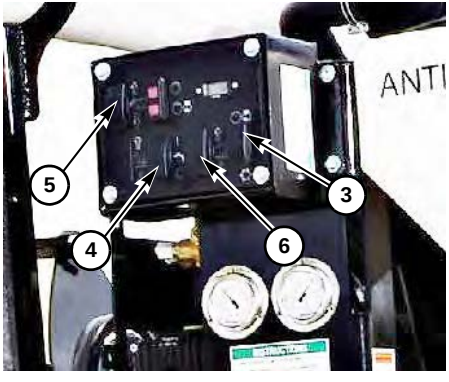
Step 7: Start engine and run at low idle. Close Upper Gate/Inlet valve.

Step 8: Press and hold top of *Tank Door Open / Close Switch* **(5).** The door will unlock and open.

Step 9: Once door is open, raise the tank using *Tank Dump Switch* **(6).** Material in spoil tank is very heavy. Stay clear of the door when raising tank.

Step 10: Once tank has emptied, it may be cleaned while in the raised position. If not cleaning machine after dumping, wipe the door seal and mating flange clean to avoid damaging the seal when closing and locking the door.





Step 11: Open cyclonic separation door **(7),** and remove debris. Close door.

Step 12: Check air filter **(8)**. Open air cleaner door and inspect air filter element. If dirty, remove element and clean with low-pressure water. The spray wand **(9)** may be used. Install element after it has dried.

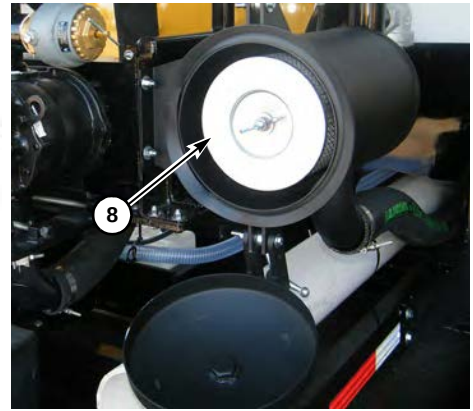
Clean air filter element at least once daily. Replace damaged air filter elements immediately.

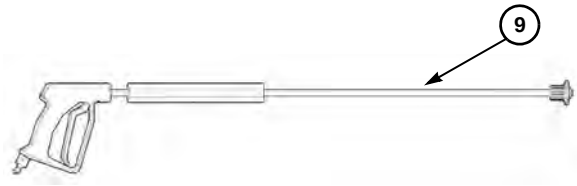
NOTICE: Do not operate unit without air filter installed. Damage to blower will result.

Step 13: Lower spoil tank, then close and lock the door by pressing and holding bottom of *Door Open / Close Switch.*

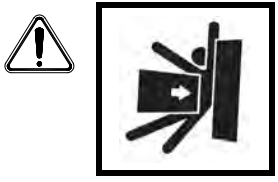
Step 14: Follow the *Shutdown Procedure*, page *23-1*, and remove ignition key.

Step 15: Securely store all tools and hoses before leaving the spoil disposal site.



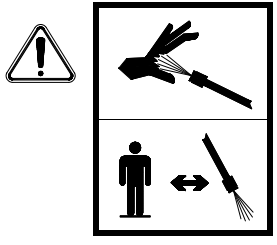


MACHINE - CLEAN



DANGER: Crushing weight. Rolling or tilting trailer will cause death or serious injury.

Chock towing vehicle tires and apply park brake before operating or servicing.
Do not operate unless attached to the towing vehicle.



WARNING: High pressure water can penetrate skin. Serious injury possible.

Keep nozzles away from body. Wear protective clothing. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

Spoil Tank - Clean

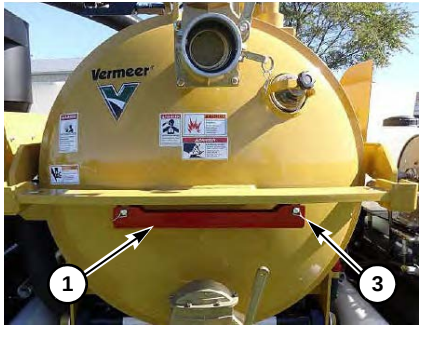
Empty spoil tank before proceeding.

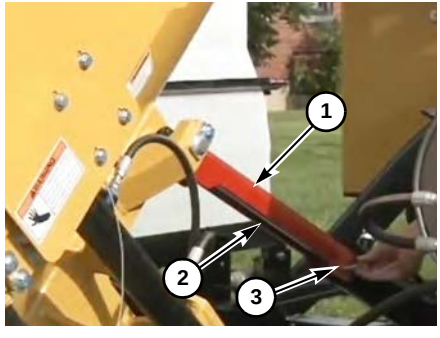
Step 1: Start engine.

Step 2: With the spoil tank empty and tank door unlocked, raise the tank.

Step 3: If equipped with hydraulic tank lift and locking door:

a. Install safety bar **(1)** over cylinder **(2)** rod. Secure bar with safety snap pins **(3).**





b. Install safety lock pin **(4)** and secure with hairpin **(5)** to support raised tank door.

NOTICE: Always install safety bar and safety lock pin before working under raised tank or raised door.

Step 4: Attach spray wand to the water hose.

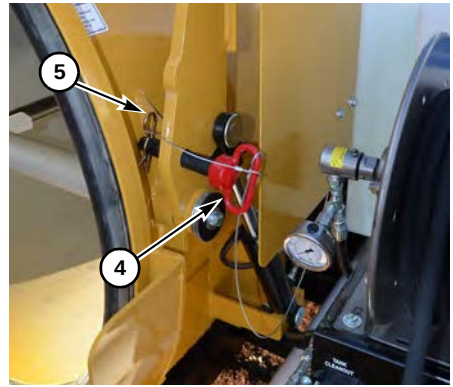
Step 5: Run engine at high speed.

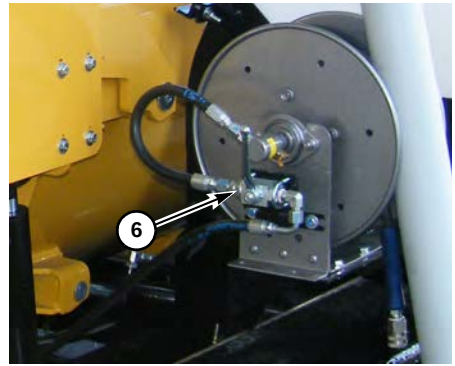
Step 6: Turn *Water Pump Switch* ON.

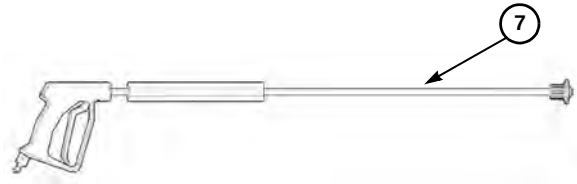
Step 7: Open Hose Reel ball valve **(6).** (VSK25-100G is not equipped with Hose Reel ball valve.)

Step 8: Clean unit using the spray wand **(7)** and/or automatic tank cleanout if equipped. Turn nozzle to raise or lower spray pressure.

Step 9: Carefully clean door seal with the spray wand. Door seal may be damaged if the spray wand is held too close to the seal or sprayed with high pressure.







Step 10: *(Option)* Open Tank Cleanout valve **(8)** to turn on automatic tank cleanout system. Material will be washed out of spoil tank. Close Tank Cleanout valve when tank is clean.

Step 11: Close Hose Reel ball valve. Turn *Water Pump Switch* OFF.

Step 12: Squeeze spray wand trigger to release water pressure from water hose.

Step 13: Remove and store safety bar and safety lock pin.

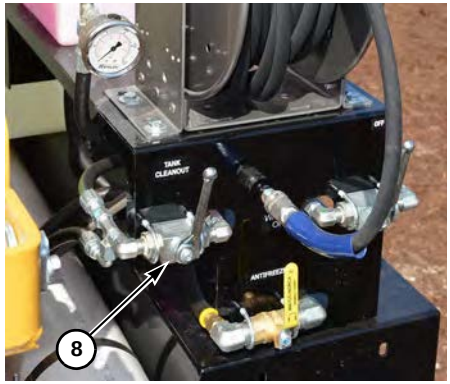
Step 14: Lower spoil tank. Close and lock spoil tank door. Lower engine speed to idle.

Step 15: Follow the *Shutdown Procedure*, page *23-1*, and remove ignition key.

Step 16: Clean Cyclone Separator as directed in the following section.

Step 17: Clean tools and hoses as directed in "Tools and Hoses - Clean," *page 50-25*.

Step 18: Securely store all tools and hoses prior to departing.

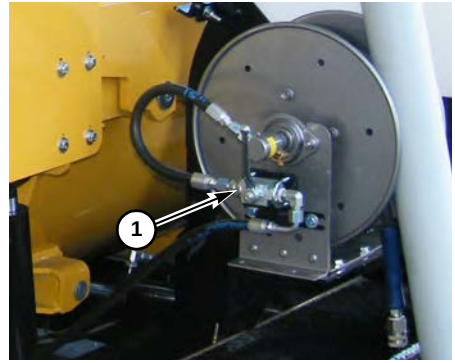


Cyclone Separator Housing - Clean

Open and clean cyclone separator housing **(1)** after dumping the spoil tank. Wipe housing clean with a towel. Do not spray water into the housing while the engine is running.

Tools and Hoses - Clean

Clean all tools and hoses prior to storage. Debris buildup on tools and hoses will reduce performance.



Step 1: Connect dirty tool and hoses to spoil tank inlet.

Step 2: Connect spray wand to the high pressure water hose.

Step 3: Start engine and operate at high speed.

Step 4: Turn *Water Pump Switch* ON.

Step 5: Open Hose Reel ball valve **(1).** (VSK25-100 is not equipped with Hose Reel ball valve.)

Step 6: Reduce pressure on spray wand to minimum setting by adjusting the spray nozzle.

Step 7: Use the spray wand to wash off the tool and hose. (Material on the inside of the tool and hose is vacuumed into the spoil tank.)

Step 8: Clean remaining hoses with water. Do not spray with high pressure water tools, which can damage hoses.

Step 9: Check hoses for holes, cracks, etc. Salvage damaged hoses by cutting off damaged section(s). Replace hoses when necessary.

Step 10: When finished, close Hose Reel ball valve, and turn *Water Pump Switch* OFF.

Step 11: Squeeze spray wand trigger to release water pressure from water hose.

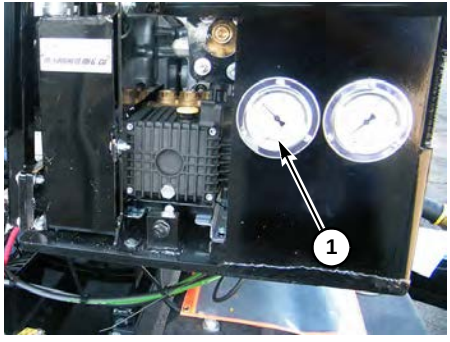
Step 12: Lower engine speed to idle.

Step 13: Follow the *Shutdown Procedure*, page *23-1*, and remove ignition key.

Step 14: Securely store all tools and hoses prior to departing.

Vacuum Gauge - Reset

Vacuum gauge **(1)** pointer may not reset at zero, due to internal case pressure. Reset gauge if it shows a vacuum when the machine is turned off and tank ports are open.



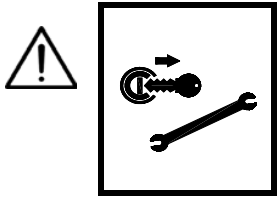
Step 1: Open control panel or gauge mounting panel.

Step 2: Move lever on top of gauge to Open position. Allow gauge to vent.

Step 3: Move lever to Closed position.

Step 4: Close panel.

Section 60: Maintenance



WARNING: Failure to use shutdown procedure can result in unexpected hazard(s). Death or serious injury could result due to entanglement, crushing, cutting, or other hazardous contact. Follow Shutdown Procedure after operating, before performing any service or maintenance, and before transporting. Refer to *Shutdown Procedure*, page *23-1.*

Visually inspect machine daily before starting the machine.

Make no modifications to your equipment unless specifically recommended or requested by Vermeer Corporation.

Maintenance intervals are included for reference only. Before performing any maintenance, refer to the following sections for safety guidelines and correct procedures. Make no modifications to your equipment unless specifically recommended by McLaughlin Group, Inc.

- The maintenance sections of this *Operator's and Maintenance Manual* contain maintenance instructions for the machine. Do not attempt any maintenance procedure that is not fully understood, or that cannot be safely and accurately performed with the available tools and equipment.
- If an issue is encountered that is not understood or cannot be solved, contact your authorized independent Vermeer dealer.
- To provide a better view, some photographs or illustrations in the maintenance sections may show the machine shields removed. **Never operate the machine with the shields removed - keep all shields in place.** If removing a shield is necessary, return it to its operating position before operating the machine.

SAFETY SIGNS - MAINTAIN

Safety signs and decals located on your machine contain important and useful information that will help you operate your equipment safely and correctly. Refer to “Safety Signs - Maintain,” *page 80-4*, for maintenance information.

ENGINE MAINTENANCE

Refer to the Engine Operation Manual, supplied with each machine, for maintenance instructions that are not included in this manual.

HOURMETER - CHECK FOR MAINTENANCE INTERVAL

The hourmeter on the power unit is designed to determine maintenance intervals for the machine. The hourmeter indicates the total number of hours the engine has been in operation.

Maintenance intervals are based on normal operating conditions. When operating under severe conditions, the maintenance intervals should be shortened.

MACHINE - GREASE

As a general rule, grease machine after it is shut down for the day. This protects metal under seals from corrosion caused by condensation as temperature drops.

Ensure all fittings and nozzle of grease applicator are clean before applying grease. If any grease fittings are missing, replace them immediately.

RECOMMENDED FLUIDS

Refer to *Specifications, page 130-1*, for fluid and lubricant requirements.

WATER PUMP MAINTENANCE

Refer to the Pump Operation Manual supplied with machine for instructions.

BLOWER MAINTENANCE

Refer to the Blower Operation Manual supplied with machine for instructions.

MAINTENANCE INTERVAL CHART

Initial = Initial maintenance on new machine. Regular maintenance interval may be different.

● = Regular maintenance interval.

NOTICE: Severe service operations can accelerate component wear. Factors for severe service include, but are not limited to, dusty environments, high load factors and extended periods at low idle. Engines that operate under severe conditions may need more frequent maintenance intervals in order to ensure maximum reliability and retention of full service life.

Service	Maintenance Intervals - Service Hours											
	10 or Daily	20	50 or Weekly	100	200	250	300	400	500	600	Add'l. Periodic	As Req'd
Brake System - Check	●											
Engine Oil Level - Check (Honda & Vanguard	●											
Engine Air Cleaner - Check (Honda)	●											
Engine Muffler and Controls - Check (Vanguard)	●											
Fuel Tank - Fill	●											
Machine - Clean and Inspect	●											
Pintle Hitch - Inspect	●											
Pump and Blower Oil Level- Check	●											
Tank Full Shutdown Switch - Check	●											
Vacuum Hose and Water Hose - Check	●											
Vacuum Air Filter - Check/Clean	●											
Engine Oil - Change (Honda)		Initial										
Machine - Grease			●									
Machine Components - Check/Clean			●									
Pressures - Check			●									
Water Pump Oil - Replace			Initial									

Service	Maintenance Intervals - Service Hours											
	10 or Daily	20	50 or Weekly	100	200	250	300	400	500	600	Add'l. Periodic	As Req'd
Engine Oil - Change (Honda & Vanguard)				●								
Engine Oil Filter - Replace (Vanguard)				●								
Air Cleaner - Clean/Service (Honda & Vanguard)				●								
Engine Spark Plugs - Service (Honda & Vanguard)				●								
Engine Exhaust System - Service (Vanguard)				●								
Blower Oil - Change				Initial								
Machine Components - Check/Maintain				●								
Overall Machine - Check				●								
Safety Signs - Maintain				●								
Amber Beacon - Check				●								
Tires and Rims - Check				●								
Engine Oil Filter - Replace (Honda)					●							
Battery Electrolyte Level & Terminals - Check/Clean					●							
Engine Valve Clearance - Check/Adjust (Vanguard)						●						
Breakaway Brake Circuit - Test						●						
Brakes, Electric - Test/Adjust						●						
Brake Controller (Optional) - Test/Adjust						●						
Engine Spark Plug - Replace (Honda)							●					
Engine Idle Speed - Check/Adjust (Honda)							●					
Engine Valve Clearance - Check/Adjust (Honda)							●					
Engine Fuel Filter - Replace (Honda)							●					
Engine Air Cleaner Filter - Replace (Vanguard)								●				
Engine Fuel Filter - Replace (Vanguard)								●				
Engine Cooling System - Service								●				
Engine Oil Cooler Fins - Clean								●				

Service	Maintenance Intervals - Service Hours											
	10 or Daily	20	50 or Weekly	100	200	250	300	400	500	600	Add'l. Periodic	As Req'd
Blower Oil - Change								●				
Water Pump Oil - Change								●				
Engine Air Cleaner Filter Element - Replace (Honda)									●			
Engine Fuel Tube - Check/Replace (Honda)									●			
Engine Air Cleaner - Replace Secondary Filter (Vanguard)										●		
Wheel Bearings - Grease										●		
Belts - Inspect										●		
Engine Combustion Chamber - Clean (Honda)											1000	
Water Pump - Service											1500	
Engine System - Check												●
Battery - Replace												●
Belts - Tighten/Replace												●
Belt Alignment - Check												●
Sheaves - Inspect												●
Highway Lights - Replace												●
Nozzles - Inspect/Clean/Replace												●
Slip Hook - Replace												●
Towing Chain - Replace												●
Storage												●

Section 65: Maintenance - 10 Service Hours or Daily

ENGINE MAINTENANCE

Before starting the engine for the day, perform daily engine maintenance tasks. Refer to this section and to the Engine Operation Manual.

Engine Maintenance - Honda

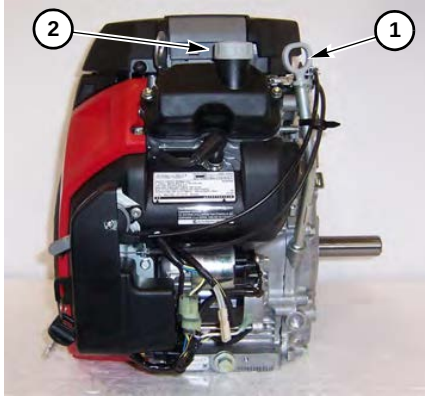
- Check engine oil level.
- Check engine air cleaner.

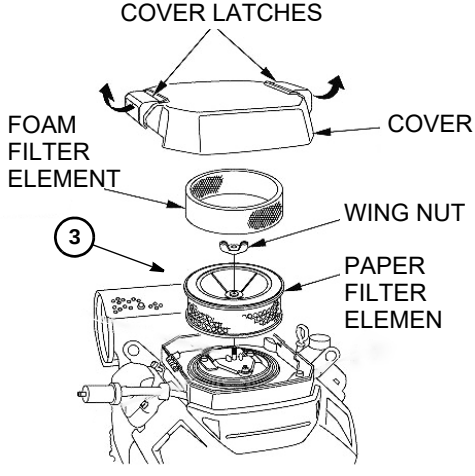
(1) Engine Oil Dipstick

(2) Engine Oil Fill

(3) Air Cleaner
Clean foam filter element with low pressure water as needed. Replace if worn or damaged.

NOTICE: Replace damaged elements immediately. Never operate machine without the element installed.





Engine Maintenance - Briggs & Stratton Vanguard

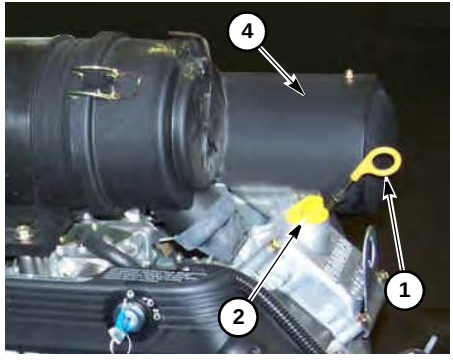
- Check engine oil level.
- Check area around muffler and controls.

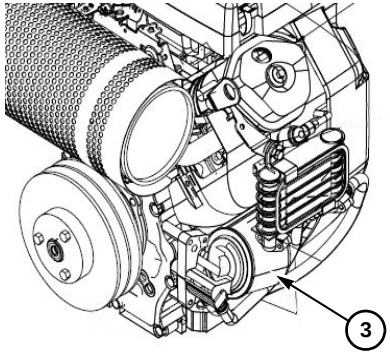
(1) Engine Oil Dipstick

(2) Engine Oil Fill

(3) Engine Oil Filter

(4) Muffler

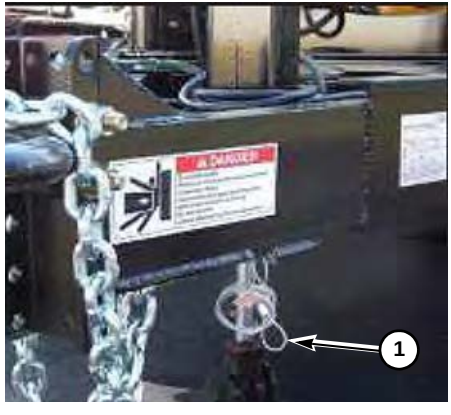




BRAKE SYSTEM - CHECK

Check that breakaway cable **(1)** is present and in good condition.

Check brakes daily for proper operation. Adjust as necessary. Refer to “Brakes, Electric - Adjust,” *page 90-2*, for instructions.

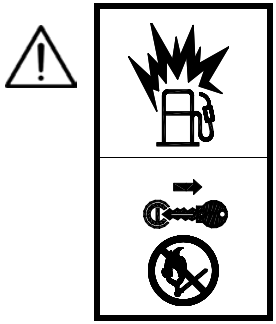


FLUID LEVELS - CHECK

Check fluid levels daily before operating the machine. Refer to “Lubricants,” *page 130-1*, for fluid specifications.

Also inspect the machine and make any necessary adjustments and repairs before starting the engine.

Fuel Tank



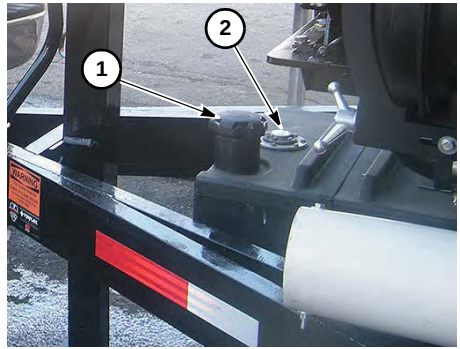
WARNING: Fuel and fumes can explode and burn. Fill fuel tank outdoors. Clean up spilled fuel.

Shut off engine before refueling. No flame. No smoking. Do not allow any hot or burning material near machine.

Fill fuel tank at the end of each day to prevent condensation. Do not fill to the very top; leave room for expansion.

(1) Fuel Tank Cap

(2) Fuel Gauge



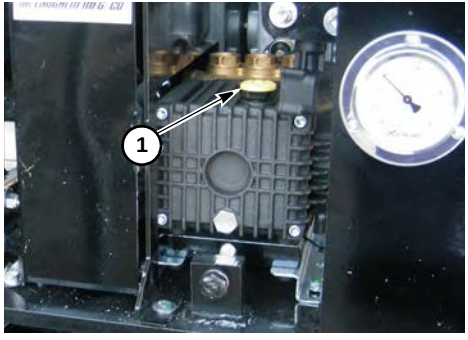
Water Pump & Blower Oil Level - Check

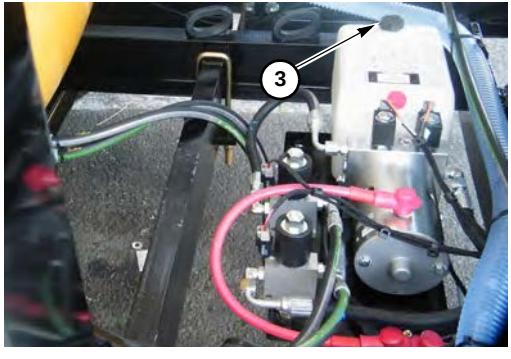
WARNING: Never attempt to change or add oil while blower or water pump is running. Personal injury or equipment failure will result. Allow unit to cool down before attempting any maintenance.

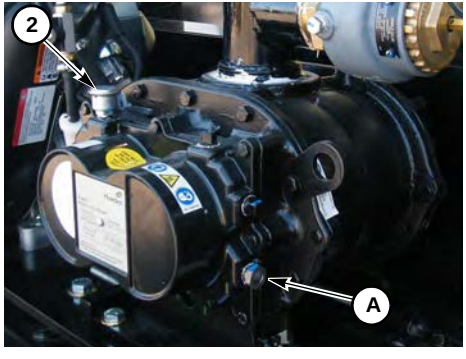
(1) Water Pump Fill Cap/Dipstick (VX30/VSK30 Units Only)

(2) Blower Fill Port
Fill at each breather port to middle of sight glass **(A).** Fill each gear end separately. Do not fill past middle of each sight glass. (Front-facing breather port and sight glass shown.) Watch for leaks.

(3) Hydraulic Pump Fill Cap (Option)







MACHINE - CLEAN

Clean machine daily at end of operation.

Door Seal - Clean

Clean door seal daily and after emptying the tank.

Tools - Clean/Check

Remove dirt and mud from tools daily. Do not allow mud to build up on the inside of the tool, which will restrict the flow of debris and reduce tool performance. Ensure nozzles are clean, unclogged, and working properly. Replace nozzles as needed. Check fittings and condition of hoses daily. Tighten or replace as necessary. Replace broken and worn-out tools.

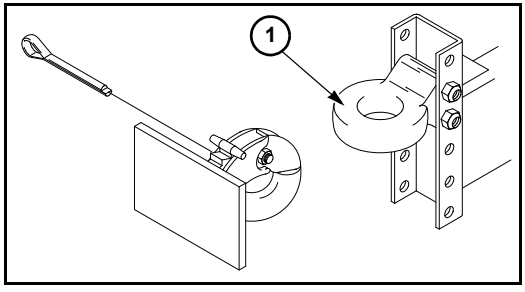
Refer to “Machine - Clean,” *page 50-22*, for additional instructions.

Water Tank In-Line Strainer - Clean

Clean water strainer daily before starting the machine, or during operation if water flow becomes restricted. Refer to “Water Strainer - Clean,” *page 40-17*.

PINTLE HITCH - INSPECT

Inspect pintle hitch for cracks, damage, or wear. If wear exceeds 3/16" (5 mm) from the original surface profile, replace pintle ring **(1)**. Check mounting bolts for signs of loosening or damage. Torque mounting bolts to 254 ft-lb (345 Nm). Contact your Vermeer dealer for approved parts.



TANK FULL SHUTDOWN SWITCH - CHECK

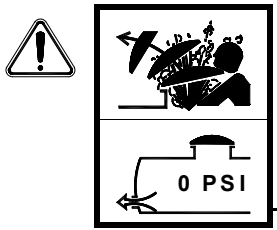
Ensure Tank Full Shutdown Switch shuts off the engine when spoil tank is full. If switch does not function properly, contact a Vermeer dealer.

VACUUM HOSE AND WATER HOSE - CHECK

Check condition of the vacuum hose and high pressure water hose.

Replace sections of vacuum and water hose as necessary.

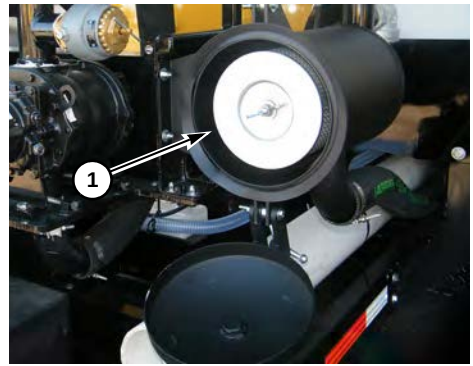
VACUUM AIR FILTER - CHECK/CLEAN



WARNING: Cover will blow off when removing wing nuts with pressure in tank.

Relieve tank pressure before opening cover.

Check vacuum air filter cleanliness. Check filter after 10 hours of potholing or after every tankful of dry vacuuming. Clean filter daily.



Step 1: Relieve tank pressure by opening Upper Gate/Inlet valve.

Step 2: Remove four wing nuts and cover.

Step 3: Lift out filter element **(1)**.

Step 4: Inspect filter element. If dirty, clean filter element with spray wand at low water pressure.

Step 5: When dry, install filter element.

Step 6: Install cover and tighten wing nuts. Close Upper Gate/Inlet valve.

Step 7: Follow the *Shutdown Procedure*, page *23-1*.

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Section 70: Maintenance - 20 Service Hours

ENGINE MAINTENANCE - HONDA

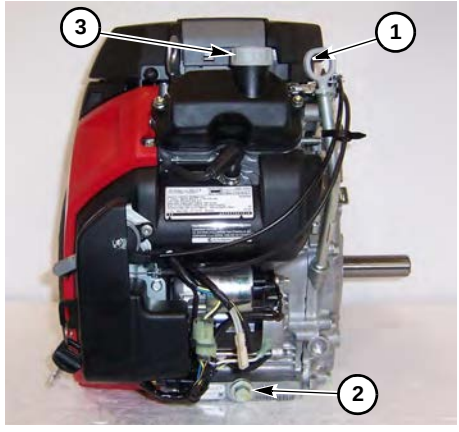
- Initial engine oil change

Perform Honda engine maintenance after initial 20 hours or month of operation, whichever comes first. Refer to the Engine Operation Manual supplied with the machine for instructions.

(1) Engine Oil Dipstick

(2) Engine Oil Drain Plug

(3) Engine Oil Fill Cap



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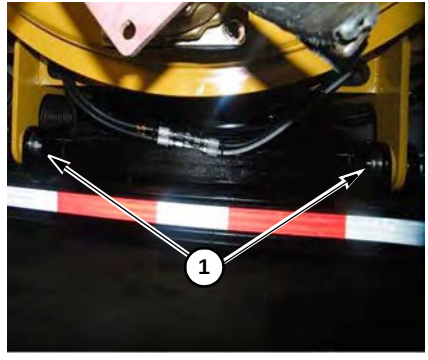
Section 75: Maintenance - 50 Service Hours or Weekly

MACHINE - GREASE

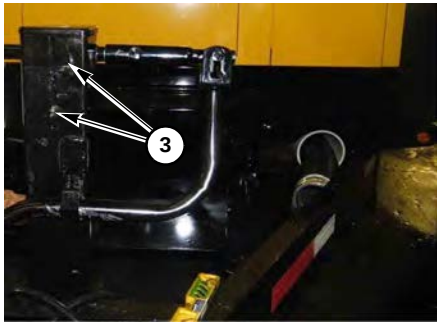
(1) **Tank Pivot Tube (Hydraulic Door Units Only)**
Two shots . . . . . two grease points



(2) **Tank Door (VSK25-100G Unit Only)**
One shot .....one grease point

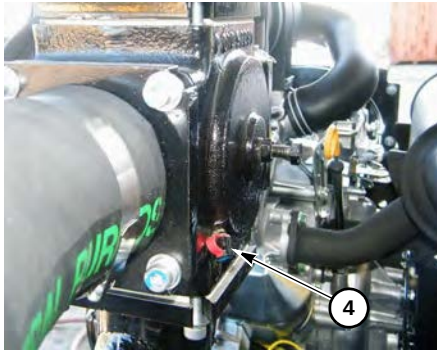
(3) Trailer Manual Jack

Two shots .....two grease points



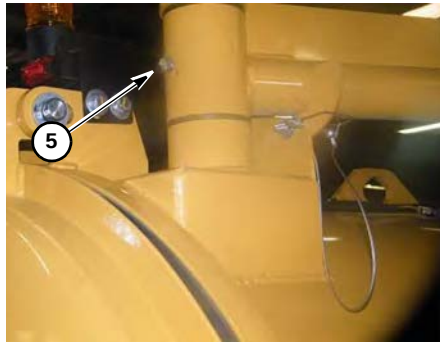
(4) Reverse Flow Valve (Option))

One shot ..... two grease points, one each side



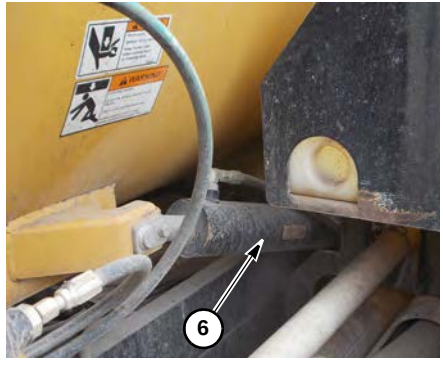
(5) Strong Arm Attachment Pivot

One shot .....one grease point



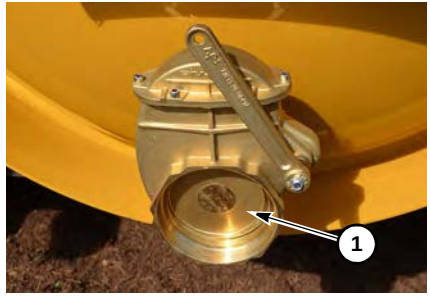
(6) Tank Lift Cylinders

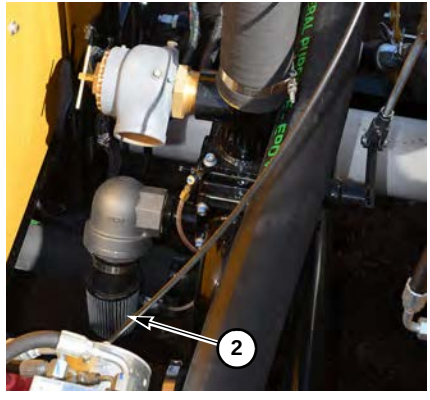
One shot .....one grease point at bottom of each cylinder



MACHINE COMPONENTS - CHECK/CLEAN

- Clean water tank shutdown switch using low pressure water to prevent float from sticking.
- Check water tanks for any foreign debris such as sand or dirt. If present, use vacuum to remove.
- Wash out gate valve gates **(1)** to prevent damage to gate. Gates are the plates inside the valves that open and close using the valve handle.
- Clean blower filter **(2)** to prevent dirt and debris from entering the blower through relief. Replace filter if worn or damaged.





PRESSURES - CHECK

Fluid Pressure

View pressures on the water pressure gauge during operation of the following tools. View standby water pressure when tool is not in use.

- Standby Water Pressure: 2900–3100 psi (200–214 bar)
- Rotary Lance (VX30 & VSK30 only): 2700–3000 psi (186–207 bar)
- Water System Wand: 1400–1600 psi (97–110 bar)
- Potholing Tool: 1600–2000 psi (110–138 bar)

Vacuum / Pressure

- Ensure gauge is at zero when engine is OFF. If not, refer to “Vacuum Gauge - Reset,” *page 50-26*.
- When machine is in operation, full vacuum should be 14–16" (36–41 cm) HG. In high altitude locations, full vacuum should be 12–14" (30–36 cm) HG.
- When machine is in operation, pressure should be 4–6 psi (28–41 kPa).

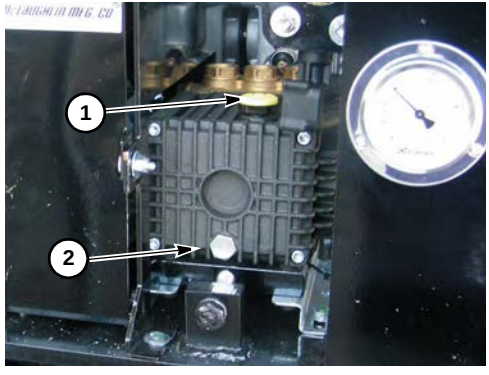
WATER PUMP OIL - INITIAL CHANGE

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 any maintenance.

(1) Oil Fill Cap/Dipstick

(2) Oil Drain

Change oil every 500 hours after initial oil change. Refer to the Water Pump Operation Manual supplied with the machine for instructions.



Section 80: Maintenance - 100 Service Hours or Monthly

Engine Maintenance - Honda

- Engine Oil - Change
- Air Cleaner - Clean
- Spark Plug - Check/Adjust
- Spark Arrester - Clean

Perform the above Honda engine maintenance every 100 service hours or 6 months. Refer to the Engine Operation Manual supplied with the machine for instructions.

Engine Maintenance - Briggs & Stratton Vanguard

- Engine Oil - Change
- Engine Oil Filter - Replace
- Air Cleaner Pre-Cleaner - Clean
- Air Cleaner Filter Element - Service
- Spark Plugs - Replace
- Exhaust System - Service

Perform the above Briggs & Stratton Vanguard engine maintenance every 100 service hours or annually. Refer to the Engine Operation Manual supplied with the machine for instructions.

BLOWER OIL - INITIAL CHANGE

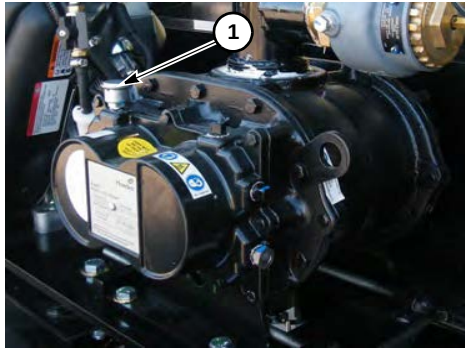
WARNING: Never attempt to change or add oil while blower is running. Personal injury or equipment failure will result. Allow unit to cool down before attempting any maintenance.

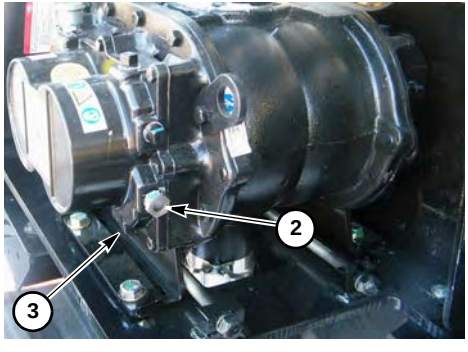
(1) Oil Fill Port
Fill at each breather port to middle of sight glass **(2).** Fill each gear end separately. Do not fill past middle of each sight glass. (Front-facing breather port, sight glass, and drain plug shown.) Watch for leaks.

(2) Oil Sight Glass

(3) Oil Drain Plug

Change oil every 500 hours after initial oil change. Refer to the Blower Operation Manual supplied with the machine for instructions.





MACHINE COMPONENTS - CHECK/MAINTAIN

- Inspect all suction hoses and air connection hoses for any signs of cracks. Replace damaged hoses.
- Inspect door seals for splits or cuts. Replace damaged seals.

OVERALL MACHINE - CHECK

Shields and Guards - Check that all shields and guards are installed and are fastened securely to the machine. Replace or repair any shields or guards that are damaged or have missing parts.

Safety Signs - Check the machine for any worn or missing safety signs and operating decals.

Hardware - Check the machine for loose, worn, or missing parts and hardware. Tighten any loose parts and replace any worn or missing parts (refer to the *Parts Manual* for replacement parts).

Frame - Check frame and contact Vermeer or McLaughlin immediately if you notice any bends, cracks, or breaks.

Highway Lights - With lights plugged into towing vehicle, check that the taillights and license plate light are operating properly (Refer to the *Maintenance - As Required* section, “Highway Lights,” *page 120-3*).

Reflectors - Check that reflectors are present. Replace missing or damaged reflective materials.

Safety Signs - Maintain

Safety signs and decals located on your machine contain important and useful information that will help you operate your equipment safely and correctly. Refer to the *Parts Manual* for locations.

To assure that all safety signs and decals remain in place and in good condition, follow these instructions:

- Keep all safety signs clean. Use soap and water - not mineral spirits, abrasive cleaners, or other similar cleaners that will damage the sign.
- Replace any damaged or missing safety signs. When attaching signs, the temperature of the mounting surface must be at least 40°F (5°C). The mounting surface must be clean and dry.
- When replacing a machine component with a safety sign attached, replace the safety sign also.

Replacement signs can be purchased from your Vermeer dealer.

AMBER BEACON - CHECK

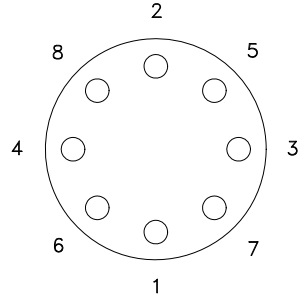
Check that amber beacon flashes when engine ignition key is on. If beacon does not function properly, contact your Vermeer dealer.

TIRES AND RIMS - CHECK

WARNING: Tire explosion can result if the following procedures are not performed:

- Maintain correct tire pressure. Do not inflate tire above recommended pressure.
- Low tire pressure can result in internal tire damage. Inflate to recommended pressure.
- Replace any tire with cuts or bubbles. Replace any damaged rims.
- Do not weld or heat wheel assembly. Heating will increase tire pressure.

- Check tires and rims for damage.
- Check for loose or missing lug nuts.
- Check tires for correct pressure. Refer to *Specifications, page 130-1*, for correct pressure based on tire size.
- Check lug nuts for tightness. Refer to *Specifications, page 130-1*, for correct lug nut torque based on tire size.
- If the wheel has been removed, tighten lug nuts in the sequence shown. Re-torque after 50 and 100 miles. Check every 100 service hours thereafter.



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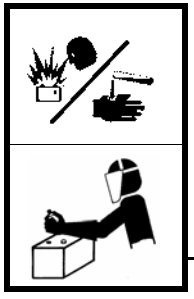
Section 85: Maintenance - 200 Service Hours

ENGINE MAINTENANCE - HONDA

- Engine Oil Filter - Replace

An Engine Operation Manual is supplied with each engine. Refer to the manual for engine service requirements.

BATTERY ELECTROLYTE LEVEL AND TERMINALS - CHECK



WARNING: Battery fumes are flammable and can explode. Keep all burning materials away from battery. Battery explosion can blind. Acid can blind and burn. Tools and cable clamps can make sparks.

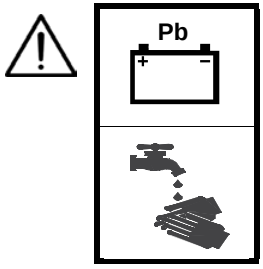
Do not smoke. Shield eyes and face. Read instructions.

- Use a flashlight to check electrolyte level.
- Work in a well-ventilated area.
- Avoid breathing fumes from battery.
- Avoid contact with skin, eyes, or clothing.
- Keep flame and sparks away, and do not smoke.
- Keep out of reach of children.
- Do not short across battery terminals or allow tools to short from battery terminals to frame.
- Do not jump-start or charge a battery with frozen electrolyte.

In case of acid contact:

External: Flush with plenty of water. If eyes have been exposed, flush with water for 15 minutes and get prompt medical attention.

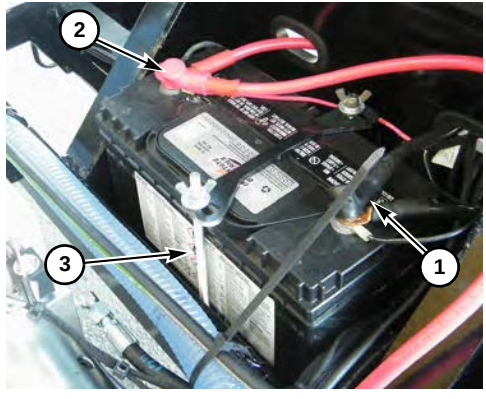
Internal: Drink large quantities of water or milk, follow with milk of magnesia, beaten egg, or vegetable oil. Call a physician immediately.



WARNING: Battery post, 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.

Clean Battery Terminals and Check Electrolyte Level



Step 1: Remove negative (-) cable **(1)**, then remove positive (+) cable **(2)**.

Step 2: Remove the hold-down bracket **(3)** and battery.

Step 3: Clean terminals and cable clamps with a stiff wire brush.

Step 4: Apply a light coating of petroleum jelly around the base of each terminal.

Step 5: Remove battery cell caps if equipped; fill each cell with distilled water (never add acid). Install cell caps.

NOTICE: In freezing weather, run the engine immediately after filling the battery to allow water and electrolyte to mix.

Step 6: Install battery and hold-down bracket.

Install the positive (+) cable and red cover **(2)** first. Then install negative (-) cable **(1)**.

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Section 90: Maintenance - 250 Service Hours

ENGINE MAINTENANCE - BRIGGS & STRATTON VANGUARD

- Valve Clearance - Check/Adjust

Refer to the Engine Operation Manual supplied with the machine for instructions.

BREAKAWAY BRAKE CIRCUIT - TEST

WARNING: Do not use breakaway device as a park brake.

The trailer provided with your equipment has an electric or surge breakaway brake which engages if the trailer separates from the towing vehicle. The electric system requires a 12-volt 5-amp/hr battery. Perform the following system test:

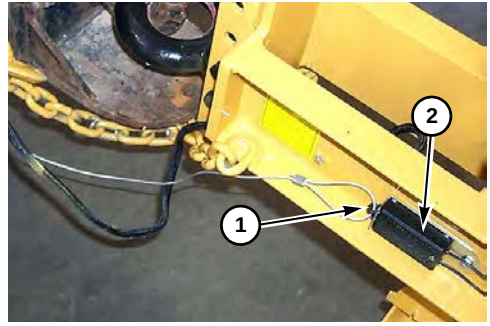
Step 1: **If equipped with electric brake:** Disconnect trailer electrical connector. Pull pin **(1)** out of switch **(2)**.

If equipped with surge brake: Pull brake lever forward.

Step 2: Attempt to move trailer forward with the towing vehicle. Substantial brake drag should be noticed. If no brake drag is noticed, check the battery condition and brake circuit wiring.

Step 3: When testing is complete: For electric brake, insert pin back into switch. Connect trailer electrical connector. For surge brake, engage brake lever.

NOTICE: Prolonged or frequent activation of the switch will discharge the machine battery.



BRAKES, ELECTRIC - TEST

Electrical current from the tow vehicle controls the brakes. To function properly, the brakes must be correctly adjusted, and the electrical components must be reliable.

Step 1: Engage brakes while coasting at 20–30 mph (30–50 km/h) in a traffic-free area. The trailer braking force should easily be noticed in the tow vehicle.

Step 2: If not operating properly, adjust brakes (see following section) and check the following electrical components:

- Check all wire connections.
- Check trailer plug for corrosion.
- Check magnets for wear or shorting (perform while adjusting brakes).
- Check automatic brake controller.

BRAKES, ELECTRIC - ADJUST

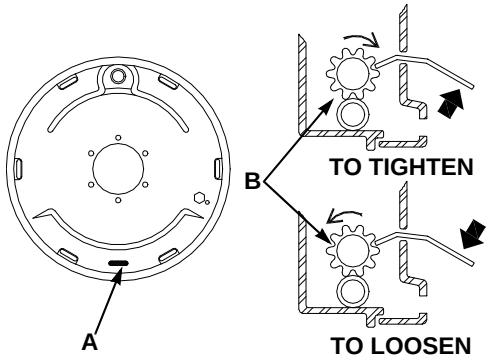
Step 1: Jack one wheel up off the ground. Block machine to prevent it from falling.

Step 2: Remove dirt plug **(A)** in backing plate.

Step 3: While spinning the wheel, turn adjuster screw **(B)** clockwise until the wheel has a heavy drag. Then turn adjuster screw counterclockwise only until wheel turns freely.

Rotate wheel only in the direction of forward rotation when adjusting brakes.

The adjuster screw may be turned with a screwdriver or with a standard brake adjusting tool.



Step 4: Install dirt plug.

Step 5: Remove blocking and jack.

Step 6: Repeat above steps for the other brakes.

BRAKE CONTROLLER (OPTIONAL) - TEST/ADJUST

Refer to manufacturer's procedures to test and adjust the brake controller. If your towing vehicle is already equipped with an electric brake controller, it must be capable of automatic and manual brake application.

Do not use a brake controller that is purely manually operated. If your towing vehicle is equipped with a manually operated controller, remove it and install one that can be applied both automatically and manually.

When the controller is properly adjusted, there should be no sensation of the trailer pushing or pulling the towing vehicle during a stop. Once this setting is reached, no further adjustment should be required.

This adjustment does not affect maximum braking capacity of the trailer brakes.

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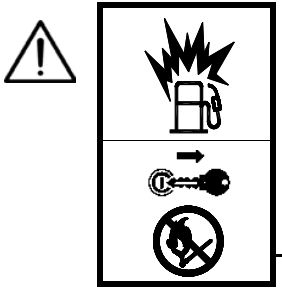
Section 95: Maintenance - 300 Service Hours

ENGINE MAINTENANCE - HONDA

- Spark Plug - Replace
- Idle Speed - Check/Adjust
- Valve Clearance - Check/Adjust
- Fuel Filter - Replace

An Engine Operation Manual is supplied with each engine. Refer to the manual for engine service requirements.

Fuel Filter (Honda) - Replace



WARNING: Fuel and fumes can explode and burn.

Shut off engine before refueling. Keep heat, flames, and sparks away from fuel. Always clean up spilled fuel.

(1) Fuel Filter

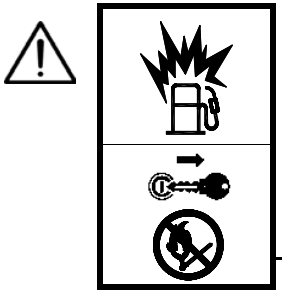
Section 100: Maintenance - 400 Service Hours

ENGINE MAINTENANCE - BRIGGS & STRATTON VANGUARD

- Air Cleaner Filter - Replace
- Fuel Filter - Replace
- Cooling System - Service
- Oil Cooler Fins - Clean

An Engine Operation Manual is supplied with each engine. Refer to the manual for engine service requirements.

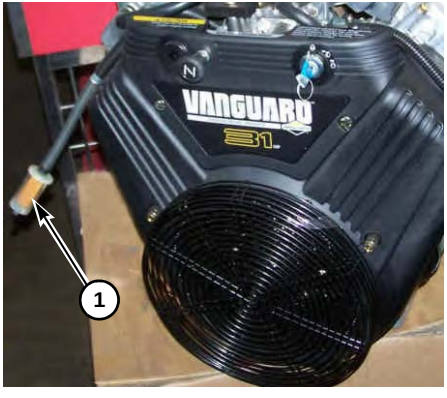
Fuel Filter (Vanguard) - Replace



WARNING: Fuel and fumes can explode and burn.

Shut off engine before refueling. Keep heat, flames, and sparks away from fuel. Always clean up spilled fuel.

(1) Fuel Filter



BLOWER OIL - CHANGE

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.

(1) Oil Fill Port
Fill at each breather port to middle of sight glass **(2).** Fill each gear end separately. Do not fill past middle of each sight glass. (Front-facing breather port, sight glass, and drain plug shown.) Watch for leaks.

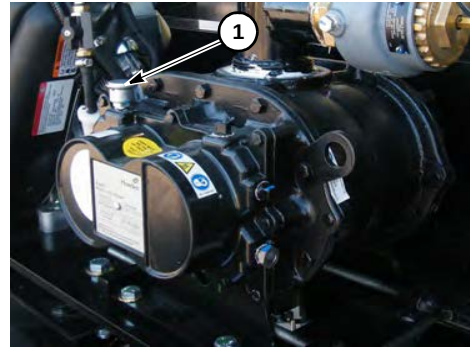
(2) Oil Sight Glass

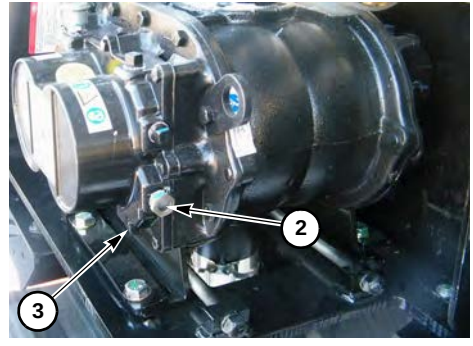
(3) Oil Drain Plug

Change water pump oil every 400 service hours or twice yearly.

NOTICE: Change oil more frequently if oil quality deteriorates or operating conditions are severe.

Refer to the Blower Operation Manual supplied with the machine for instructions.



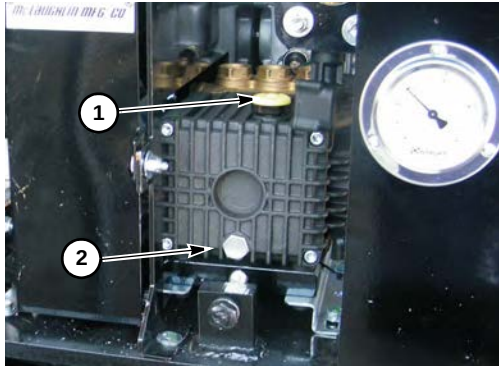


WATER PUMP OIL - CHANGE

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 any maintenance.

(1) Oil Fill Cap/Dipstick

(2) Oil Drain



Change water pump oil every 400 service hours or every 3 months, whichever comes first.

NOTICE: Change oil more frequently if oil quality deteriorates or operating conditions are severe.

Refer to the Water Pump Operation Manual supplied with the machine for instructions.

Section 105: Maintenance - 500 Service Hours or Twice Yearly

ENGINE MAINTENANCE - HONDA

- Air Cleaner - Replace Filter Element
- Fuel Tube - Check/Replace

Perform the above Honda engine maintenance every 500 service hours or every two years. Refer to the Engine Operation Manual supplied with the machine for instructions.

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Section 110: Maintenance - 600 Service Hours or Twice Yearly

Engine Maintenance - Briggs & Stratton Vanguard

- Air Cleaner - Replace Secondary Filter Element

Perform the above Briggs & Stratton Vanguard engine maintenance every 600 service hours or annually. Refer to the Engine Operation Manual supplied with the machine for instructions.

Wheel Bearings - Grease

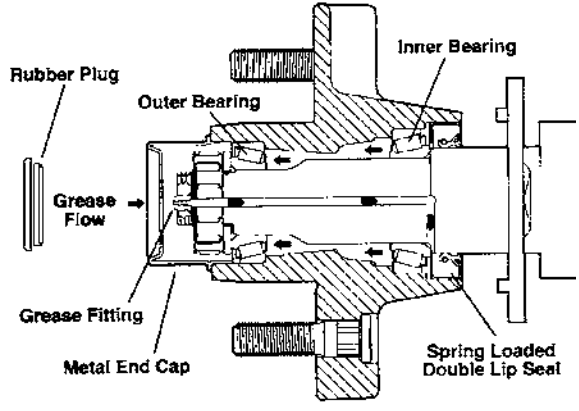
Step 1: Remove center rubber plug from the metal end cap.

Step 2: Place a standard grease gun onto grease fitting at the end of the spindle. Ensure grease gun nozzle fully engages the fitting.

Step 3: Pump grease into the fitting. The old displaced grease will begin to flow back out the cap around the grease gun nozzle.

NOTICE: Rotate hub or drum while adding grease.

Step 4: When new clean grease is observed, remove grease gun, wipe off any excess, and install rubber plug.



BELTS - INSPECT

Refer to “Belts - Tighten/Replace,” *page 120-4*, for belt tightening and replacement instructions.

- Inspect and verify condition of the belts; replace as necessary.
- Look for signs of aging such as frayed edges and cracks.
- Tighten belts if necessary.

Section 115: Maintenance - Additional Periodic

1000 Service Hours or Yearly

Engine Maintenance - Honda

- Combustion Chamber - Clean

Refer to the Engine Operation Manual supplied with the machine for instructions.

1500 Service Hours or Yearly

Water Pump Service

- Seal - Check/Replace
- Valve - Check/Replace
- Accessories - Check/Replace

NOTICE: If system performance decreases, check above components immediately.

Replace above components if wear or damage is found. If no wear or damage is found, recheck every 500 hours. Refer to the Water Pump Operation Manual supplied with the machine for instructions.

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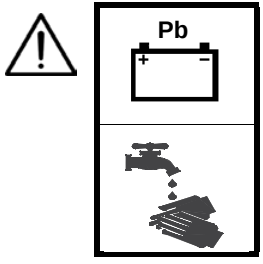
Section 120: Maintenance - As Required

ENGINE SYSTEM - CHECK

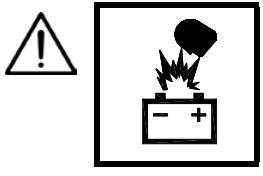
Refer to the Engine Operation Manual supplied with each machine for service requirements.

BATTERY - REPLACE



WARNING: Battery post, 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.



WARNING: Battery fumes are flammable and can explode. Keep all burning materials away from battery. Do not smoke. Tool and cable clamps can make sparks. Shield eyes and face.

This machine has a 12-volt electrical system. The replacement battery must be a 12-volt battery. Refer to "Machine Specifications," *page 130-3*, for battery specifications.

Step 1: Remove negative (-) cable **(1)**. Then remove positive (+) cable **(2)**.

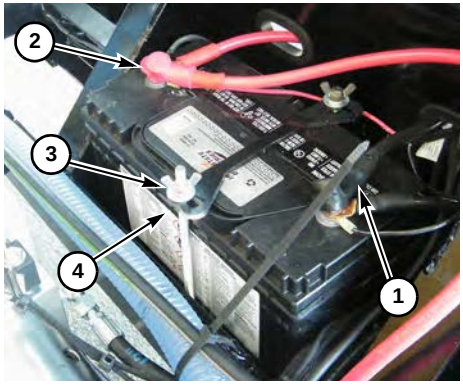
Step 2: Loosen nuts **(3)** and remove hold-down bracket **(4)**.

Step 3: Remove battery.

Step 4: Apply a light coating of petroleum jelly around the base of each terminal of the new, fully charged battery.

Step 5: Install the new battery and the hold-down bracket.

Step 6: Install positive (+) cable and red cover **(2)**; then install negative (-) cable and black cover **(1)**.



NOZZLES - INSPECT/CLEAN/REPLACE

Inspect nozzles on all water tools. Replace damaged nozzles. Always replace a nozzle with a nozzle of the same type and orifice size. Consult *Parts Manual* for replacement part number.

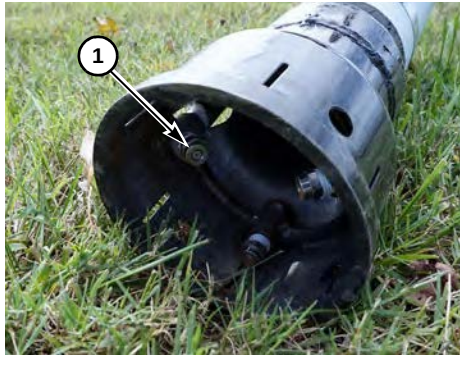
(1) Nozzle

To inspect / clean / replace:

Step 1: Remove nozzle.

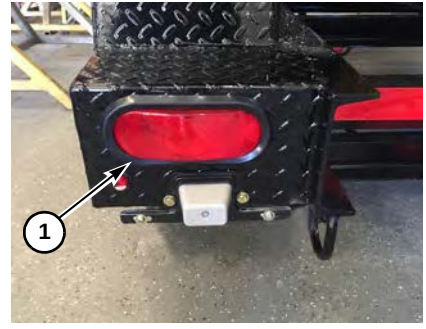
Step 2: Blow out nozzle.

Step 3: Replace or reinstall nozzle in each tool as needed.



LIGHTS - REPLACE

Highway Lights



Step 1: Unplug light connector from terminal.

Step 2: Remove light from grommet **(1)**.

Step 3: Replace light.

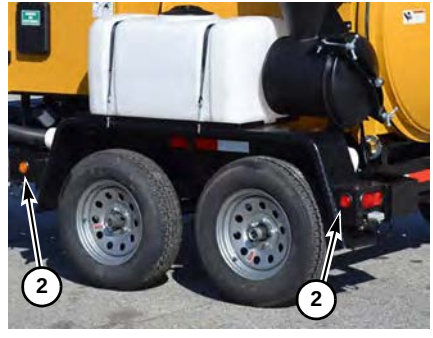
Step 4: Plug light connector into terminal.

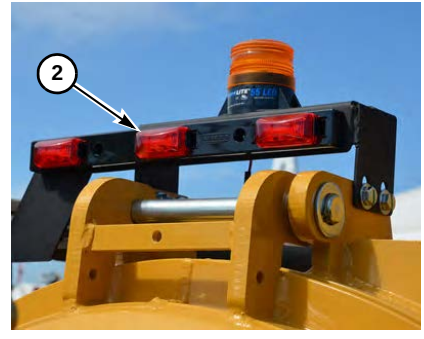
Additional Lights

Replace as needed:

(2) Marker Lights

(3) Arrow Board Lights





BELTS - TIGHTEN/REPLACE

The belt tensioning system utilizes a movable blower and water pump. The fine adjustment bolts are used for belt alignment.

(1) Blower Adjustment Bolts (Both Sides)

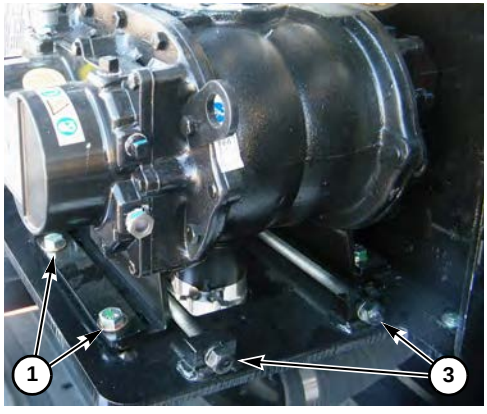
(2) Water Pump Adjustment Bolts (Both Sides)

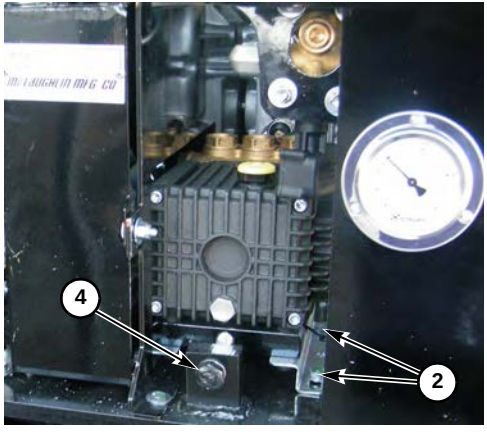
(3) Blower Fine Adjustment Bolts

(4) Water Pump Fine Adjustment Bolt

Blower belt tension specs:
New belts - 18 lb*f* at 3/8" deflection, center of belt span
Used belts - 15 lb*f* at 3/8" deflection, center of belt span

Water pump belt tension specs:
New belts - 13 lb*f* (58 N) at 3/8" (965 mm) deflection, center of belt span
Used belts - 11 lb*f* (49 N) at 3/8" (965 mm) deflection, center of belt span





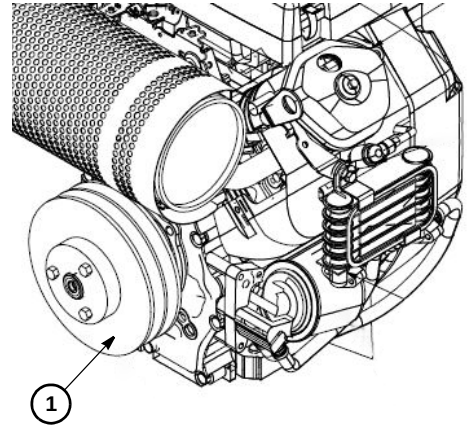
Sheaves - Inspect

WARNING: Do not clean the sheaves while the machine is running. Shut off engine before removing or installing sheaves. Take sheaves off machine to inspect, clean and repair them.

WARNING: Do not install damaged or worn sheaves on equipment. Repair or replace them.

- Damaged, worn or dirty sheaves **(1)** will substantially reduce belt life.
- Nicks or gouges can cut the belt.
- Dirt in the grooves can damage the belt and will allow the belt to bottom out, slip and become damaged.
- A sheave groove gauge can be used to determine uneven and abnormal wear.

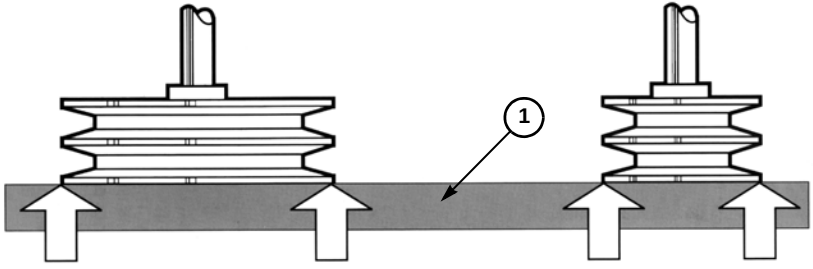
NOTICE: When placing the new belt in the groove, the top of the belt should be flush with the outer diameter of the sheave. If the belt top is below the outer diameter of the sheave, the groove is worn.

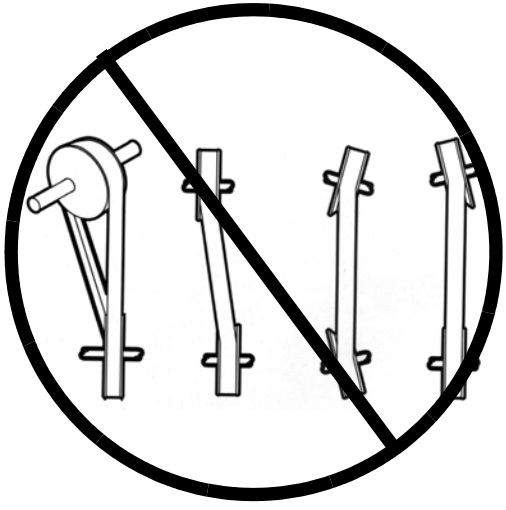


Belt Alignment - Check

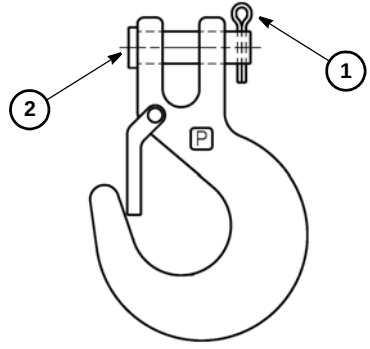
Use a straightedge **(1)** to check belt alignment when installing new belts, performing maintenance, or replacing the sheaves. Proper belt alignment is essential to maintain long belt life.

When checking sheave alignment, the straightedge should touch the sheaves at the four points indicated with arrows. Check both front and back alignment.





SLIP HOOK - REPLACE



Replace towing chain slip hook if the latch is damaged, missing, or does not snap closed to the hook.

Step 1: Remove cotter pin **(1)** and slip hook pin **(2)** to remove slip hook from the chain link.

Step 2: Slide new slip hook onto chain link and install slip hook pin and cotter pin.

TOWING CHAIN - REPLACE

Replace towing chain **(1)** if the chain has been dragged, kinked, or damaged.

STORAGE

Preparing for Storage

- Park machine on level ground and chock the wheels. Use the jack to support the tongue. If possible, store machine in a dry, protected place.
- Clean all mud, dirt, grease, and other foreign material from the machine. To inhibit rusting, repaint areas with missing paint.
- Repair or replace any worn or damaged parts and decals. Refer to the *Parts Manual* for ordering replacements.
- Refer to the Engine Operation Manual supplied with machine for engine storage instructions.
- Refer to the Blower Operation Manual supplied with machine for blower storage instructions.
- Refer to the Pump Operation Manual supplied with machine for water pump storage instructions.
- Remove battery and store inside where the temperature will not drop below 32°F (0°C). Check fluid level and charge fully. Check battery every 30 days and charge if necessary.
- Lubricate all grease points on the machine.
- Do not subject units to excessive vibration during storage.
- If stored outdoors, provide coverage such as a tarpaulin or lean-to.
- Do not leave belts fully tensioned.

Storing Machine in Freezing Conditions

Refer to “Transporting or Storing Machine in Freezing Conditions,” *page 30-12*, for procedure.

Blower Corrosion Protection

24-hour Storage:

Step 1: Follow “Starting Procedure,” *page 22-1*.

Step 2: Move Reverse Flow Control valve to Pressure position.

Step 3: Allow engine to run for 10–15 minutes to completely dry out blower.

Step 4: Follow the *Shutdown Procedure*, page *23-1*.

Longer-Term Storage:

If unit is to be stored under adverse conditions or for extended periods of time, take the following additional precautions to prevent damage.

- Store blower in a clean, dry, heated (if possible) area.
- Ensure certain inlet and discharge air ports are tightly covered to prevent foreign material from entering.
- Protect all exposed, non-painted surfaces against rust and corrosion.
- Provide adequate protection to avoid accidental mechanical damage.
- With blower operating, inject a rust inhibitor through the vacuum relief valve on the inlet side of blower to prevent internal rusting.
- Fill oil reservoirs with normal operating oil to prevent rusting of gears, bearings, and other components.

NOTICE: Before running the blower, change blower oil.

- Rotate blower shaft (10–25 turns) weekly during storage. Inspect blower shaft near shaft seal area monthly, and spray with rust inhibitor if needed.
- For long-term storage (over six months), contact blower manufacturer Customer Service for recommendations.

Removing from Storage

- Inspect internals to ensure absence of rust.
- Remove all protective coverings.
- Drain any water and sediment from fuel tank. Fill fuel tank.
- Check battery fluid level, charge battery, and install in machine.
- Refer to the Engine Operation Manual supplied with machine for restoring engine to operation.
- Refer to the Blower Operation Manual supplied with machine for restoring blower to operation.
- Refer to the Pump Operation Manual supplied with machine for restoring water pump to operation.
- Lubricate all grease points on the machine.
- Refer to *Maintenance - 10 Service Hours or Daily, page 65-1*, for additional service points.

Section 125: Troubleshooting

ENGINE SYSTEM

Refer to the Engine Operation Manual, supplied with each machine, for troubleshooting procedures.

VACUUM EXCAVATOR

Symptom	Cause	Solution
Vacuum will not build within tank.	Rear door on tank not sealed	Clean door seal. Close door completely.
	Suction line plugged	Unplug suction line.
	Float ball stuck against the seal	Remove float ball from seal.
	Air leaks	Check for air leaks in lines between tank and pump.
	Vacuum pump malfunctioning	Check vacuum pump. Refer to pump owner's manual furnished with the machine for servicing information.
	Vacuum gauge malfunctioning	Replace gauge if it is giving a faulty reading.

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Section 130: Specifications

LUBRICANTS

Lubricant/*Recommendation*	Capacity	**Specification**/Notes
Engine Oil (with Filter)	With filter:	Engine must be level when checking engine oil.
Honda: 4-stroke automotive detergent oil	1.8 qt (1.7 L)	SAE 10W30 or SAE 5W30 SAE 5W30 at -13° to 5°F (-25 to -15°C)
Briggs & Stratton Vanguard: High-quality detergent oil	78–80 oz (2.3–2.4 L)	SAE 30 - Below 40°F (4°C) use of SAE 30 may cause hard starting. 10W30 - Above 80°F (27°C) use of 10W30 may cause increased oil consumption. Check oil level more frequently. 5W30 at -20 to 40°F (-29 to 4°C) Synthetic 5W30 at -20 to 100°F (-29 to 38°C) Vanguard Synthetic 15W-50 at 20 to 120°F (-7 to 49°C)
Electric Hydraulic Power Pack		Bucher Hydraulic Inc. 12v Electric Hydraulic Power Pack
ATF Dexron II or equivalent	4.5 qt (4.3 L)	Use caution not to get dirt or other contaminants into system when servicing. Filter all fluid through a 10-micron filter before adding. 0 to 120°F (-18 to 40°C) SAE 10 or ATF Dexron II 32 to 175°F (0 to 80°C) SAE 20
Blower		Howden Roots Vac Pump 575 RH Shaft Top Out
Roots Synthetic Oil, Mobil DTE BB, Texaco R&O 220, Amoco 220, or equal non-detergent motor oil	28 oz (820 ml) gear end; 15 oz (440 ml) drive end (approx.)	ISO 100 below 0°F (-18°C) ISO 150 at 0 to 32°F (-18 to 0°C) ISO 220 at 32° to 90°F (0 to 32°C) ISO 320 above 90°F (32°C)

Lubricant/*Recommendation*	Capacity	**Specification**/Notes
Water Pump		General Pump TX1510S34
General Pump Series 100 oil or SAE 30 non-detergent motor oil	14 oz (414 ml)	SAE 30
Grease Vermeer Ultra LC Grease	As required	EP NLGI Grade 2 with additives to protect against wear, rust and oxidation. Fittings and grease applicator nozzle must be clean before applying grease. Replace all missing fittings.
General Lubricating Oil Vermeer Ultra Gold 10W30	As required	SAE 10W30

MACHINE SPECIFICATIONS

General/Tow	VSK25-100G	V25-500G	V25-800G	V25-1200G	VX30-500G	VX30-800G	VX30-1200G
Empty Weight*	1480 lb/ 671 kg	3900 lb/ 1769 kg	4760 lb/ 2159 kg	7000 lb/ 3175 kg	4940 lb/ 2241 kg	5800 lb/ 2631 kg	7220 lb/ 3275 kg
Length	98" (249 cm)	182" (462 cm)	193" (490 cm)	220" (559 cm)	215" (546 cm)	219" (556 cm)	223" (567 cm)
Width	54" (137 cm)	93" (236 cm)	90" (229 cm)	99" (251 cm)	96" (244 cm)	99" (252 cm)	99" (252 cm)
Height	80" (203 cm)	81" (206 cm)	90" (229 cm)	104" (264 cm)	81" (206 cm)	92" (234 cm)	104" (264 cm)
Brake Type	N/A	Electric	Electric	Electric	Electric	Electric	Electric
Hitch Type	N/A	Pintle	Pintle	Pintle	Pintle	Pintle	Pintle
GVWR	N/A	10,000 lb/ 4536 kg	12,000 lb/ 5443 kg	16,000 lb/ 7258 kg	10,000 lb/ 4536 kg	16,000 lb 7258 kg	20,000 lb 9072 kg
Trailer Axles	N/A	(2) 6000 lb/ 2722 kg	(2) 6000 lb 2722 kg	(2) 8000 lb 3629 kg	(2) 6000 lb 2722 kg	(2) 8000 lb 3629 kg	(2) 10,000 lb 4536 kg
Tires	**VSK25-100G**	**V25-500G**	**V25-800G**	**V25-1200G**	**VX30-500G**	**VX30-800G**	**VX30-1200G**
Size	N/A	ST235/80 R16	ST235/80 R16	ST215/75 R17.5	ST235/80 R16	ST215/75 R17.5	ST235/75 R17.5
Pressure	N/A	80 psi (550 kPa)	80 psi (550 kPa)	123 psi (850 kPa)	80 psi (550 kPa)	123 psi (850 kPa)	127 psi (880 kPa)
Lug nut torque	N/A	120 ft-lb (163 Nm)	120 ft-lb (163 Nm)	210 ft-lb (285 Nm)	120 ft-lb (163 Nm)	210 ft-lb (285 Nm)	210 ft-lb (285 Nm)

*Calculate full weights using 8 lb/gal (1 kg/L) for water and 10 lb/gal (1.2 kg/L) for spoil.

Capacities	
Spoils tank	**VSK25-100G:** 100 gal (379 L) **V25-500G, VSK25-500G, VX30-500G, VSK30-500G:** 500 gal (1893 L) **V25-800G, VSK25-800G, VX30-800G, VSK30-800G:** 800 gal (3028 L) **V25-1200G, VSK25-1200G, VX30-1200G, VSK30-1200G:** 1200 gal (4542 L)
Fresh water tank(s) total	**VSK25-100G:** 100 gal (379 L) **VX30-500G, VSK30-500G:** 250 gal (946 L) **VX30-800G, VSK30-800G:** 410 gal (1552 L) **VX30-1200G, VSK30-1200G:** 100 gal (379 L)
Water pump pressure	4 gpm (15.1 L/min) @ 3000 psi (207 bar)
Vacuum pump/blower	575 cfm 15" (381 mm) HG; 13" (330 mm) HG in high altitude applications, with a tolerance of +/- 1" HG VSK25-100G only: 10" (254 mm) HG
Spoil tank offload pressure	5 psi (34 kPA)
Fuel tank	14 gal (53 L) unleaded gasoline
Battery	12V, Capacity 575 amps CCA for 30 sec. @ 0°F (-18°C) **Reserve Capacity:** 130 minutes of 25-amp output at 80°F (27°C) **High CFM Capacity:** 950 amps CCA for 30 sec. @ 0°F (-18°C) **Reserve Capacity:** 110 minutes of 25-amp output at 80°F (27°C)

Engine: VSK25-100G, V25-500G, V25-800G, V25-1200G	
Model	Honda GX660
Maximum power	24 hp (17.9 kW) @ 3,600 rpm
Fuel type/capacity	Unleaded gasoline, 14 gal (53 L)
Oil capacity	1.8 qt (1.7 L) with filter
Cooling medium/capacity	Forced air

Engine: VX30-500G, VX30-800G, VX30-1200G, VX30-500G, VX30-800G, VX30-1200G	
Model	Briggs & Stratton Vanguard 31hp
Maximum power	31 hp (23.1 kW)
Fuel type/capacity	Unleaded gasoline, 14 gal (53 L)
Oil capacity	78–80 oz (2.3–2.4 L)
Cooling medium/capacity	Forced air

MATERIAL DENSITY CHART

Material weight of water is 8.3 lb/gal.

Material weight of water with bentonite is 8.5–8.7 lb/gal.

	Specific Gravity	lb per cu ft	lb per cu yd	kg per cu m	Material Weight - lb/gal			
					0% H_20	25% H_20	50% H_20	75% H_20
Earth, loam, dry, excavated	1.25	78	2106	12479	10.4	9.9	9.4	8.8
Earth, moist, excavated	1.44	90	2430	1442	12.0	11.1	10.2	9.2
Sand, loose	1.44	90	2430	1442	12.0	11.1	10.2	9.2
Caliche	1.44	90	2430	1442	12.0	11.1	10.2	9.2
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	10.8	9.6
Sand, dry	1.6	100	2700	1601	13.4	12.1	10.8	9.6
Clay, wet lump	1.6	100	2700	1601	13.4	12.1	10.8	9.6
Sand, rammed	1.68	105	2835	1682	14.0	12.6	11.2	9.7
Gravel, dry, 1/4–2″	1.68	105	2835	1682	14.0	12.6	11.2	9.7
Earth, soft loose mud	1.73	108	2916	1730	14.4	12.9	11.4	9.8
Sand and gravel, dry	1.73	108	2916	1730	14.4	12.9	11.4	9.8
Clay, wet excavated	1.83	114	3078	1826	15.2	13.5	11.8	10.0
Sand, water-filled/wet	1.92	120	3240	1922	16.0	14.1	12.2	10.2
Earth, dense	2	125	3375	2002	16.7	14.6	12.5	10.4
Sand and gravel, wet	2	125	3375	2002	16.7	14.6	12.5	10.4
Gravel, wet, 1/4–2″	2	125	3375	2002	16.7	14.6	12.5	10.4
Sand, wet packed	2.08	130	3510	2082	17.4	15.1	12.8	10.6

Variables Affecting Water Volume

The following factors will affect the volume of water required for excavation:

- Material type
- Material purity
- Compaction
- Water content
- PSI of water wand
- GPM of water flow
- CFM of vacuum
- IN/HG of vacuum
- Individual operator

Antifreeze Dilution Chart

- **Freeze point** is the temperature at which ice crystals begin to form.
- **Burst point** is the temperature at which the fluid will freeze solid and start to expand.

Dilution	Freeze Point	Burst Point
50% H_20 & 50% Freeze Guard	10°F (-12°C)	-50°F (-46°C)
60% H_20 & 40% Freeze Guard	15°F (-9°C)	0°F (-17°C)
75% H_20 & 25% Freeze Guard	21°F (-6°C)	15°F (-9°C)

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Revision History

Revision	Date	Page(s)	Description
o-m1_00	11/18	All	1st edition original manual released.
o-m1_01	01/19	Front Cover	Correction of Serial Number.

⚠WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or 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.

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