TORNADO
INFRASTRUCTURE EQUIPMENT

HVT13 | HYDROVAC TIP-TANK

OPERATION & MAINTENANCE MANUAL

TORNADO INFRASTRUCTURE EQUIPMENT (NORTH AMERICA) INC.
4100 77 ST., RED DEER, AB T4P 3P7

TOLL FREE: 877 340 8141

OFFICE: 403 742 6121

SALES@TGHL.CA

TORNADOTRUCKS.COM



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- Follow all safety instructions, hazard warnings, and procedural guidance provided.
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- Improper maintenance or inspection practices; or
- Use of the equipment in unsafe or non-compliant environments.

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1 Introduction

1.1 Intended Use

Each hydrovac truck is built with a focus on quality, precision, and durability. When maintained properly, your unit is engineered to provide reliable performance over many years of service.

This manual is intended to guide operators and maintenance personnel in the proper use, servicing, and care of the hydrovac trucks. It includes preventive maintenance recommendations to help address common operational challenges. Because operating conditions can vary by region, some procedures may need to be adapted to local climates or terrain. For assistance with region-specific procedures or extreme operating conditions beyond standard temperatures of 0°F to 115°F (-18°C to 46°C), please contact support.

This equipment is designed to be operated, serviced, and repaired only by trained, qualified, and competent personnel who are familiar with its specific characteristics and who follow all relevant safety procedures. Use of the truck outside of the instructions in this manual, or beyond its intended operating limits, is not supported and may lead to unsafe conditions or equipment damage.

1.2 Contact Us

Tornado Infrastructure Equipment (North America) Inc.
4100 77 Street
Red Deer, AB
T4P 3P7
Canada

Phone: .....+1 (403) 742-6121
Toll Free (Canada only): .....+1 (877) 340-8141

Parts information: ..... parts@tghl.ca
Product service: ..... service@tghl.ca
Warranty information or claims: ..... warranty@tghl.ca

1.3 How to Use This Manual

This operator's manual is provided to support the safe and effective use of the HVT-13 hydrovac trucks. All personnel who operate, maintain, or work near these trucks should review the entire manual and ensure they are familiar with its contents before working with the equipment.

The manual is organized into four chapters, with an appendix that provides supplemental information on optional equipment. Each chapter addresses a specific area of use and care:

- **Chapter 1 – Introduction**
  Provides information on how to use the manual, contact information for support, and a basic overview of the hydrovac and its systems.
- **Chapter 2 – Safety Information**
  Provides crucial information for safe operation of the hydrovac equipment.
- **Chapter 3 – Controls & Operations**
  Describes the hydrovac's controls and indicators and explains procedures for operating the equipment.
- **Chapter 4 – Maintenance**
  Provides a maintenance schedule and the associated procedures for properly maintaining the hydrovac equipment.
- **Appendix A – Hydrovac Options**
  Provides information related to optional equipment available on the hydrovac truck.

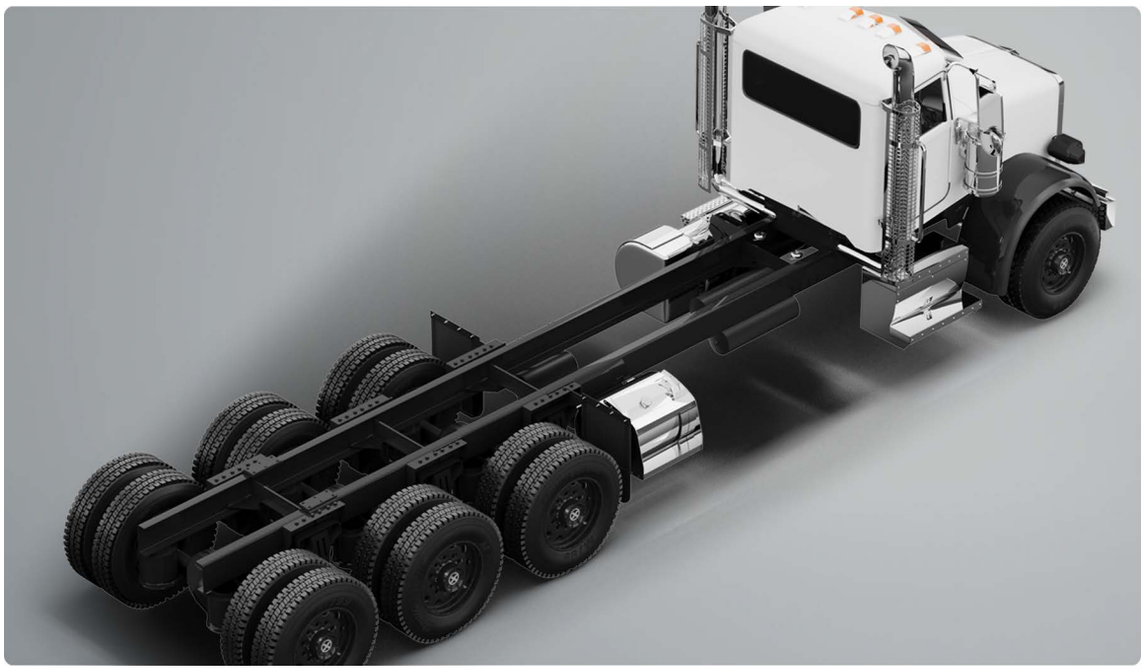
It is important to understand that both this manual and hands-on training are essential for proper preparation to operate or maintain this equipment.

1.4 Major Components

The following figures illustrate the major components of the hydrovac truck.

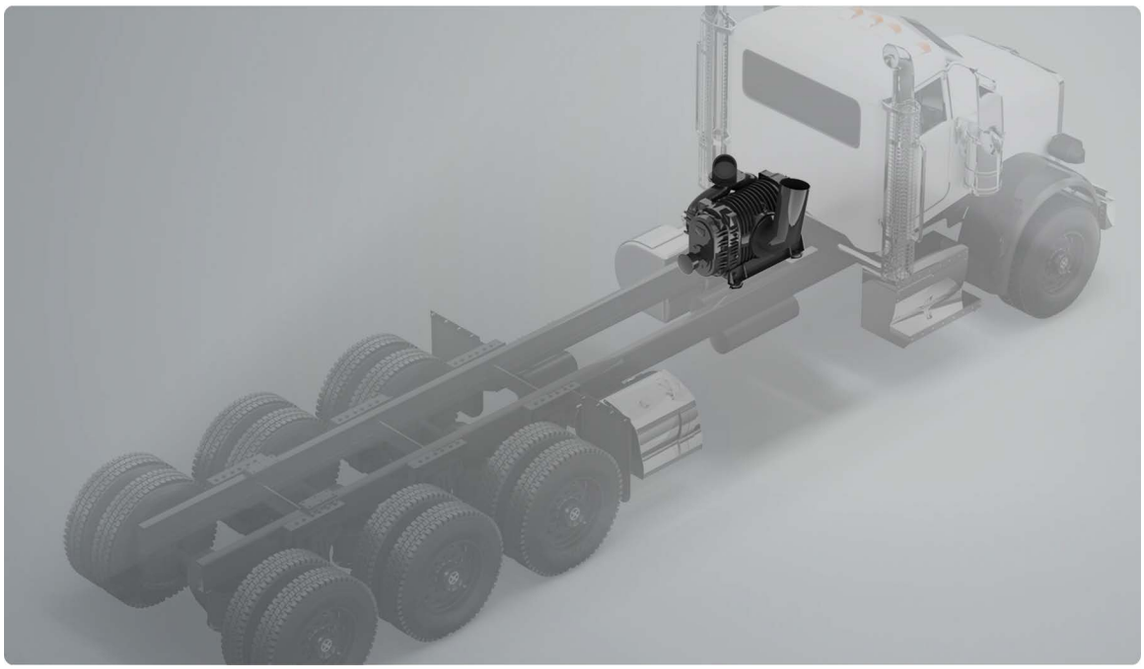
- The diesel truck chassis supports and powers the hydrovac equipment. Refer to the chassis owner's manual for information on operation and maintenance of the chassis.

***Figure 1-1.** Major Components - Truck Chassis*



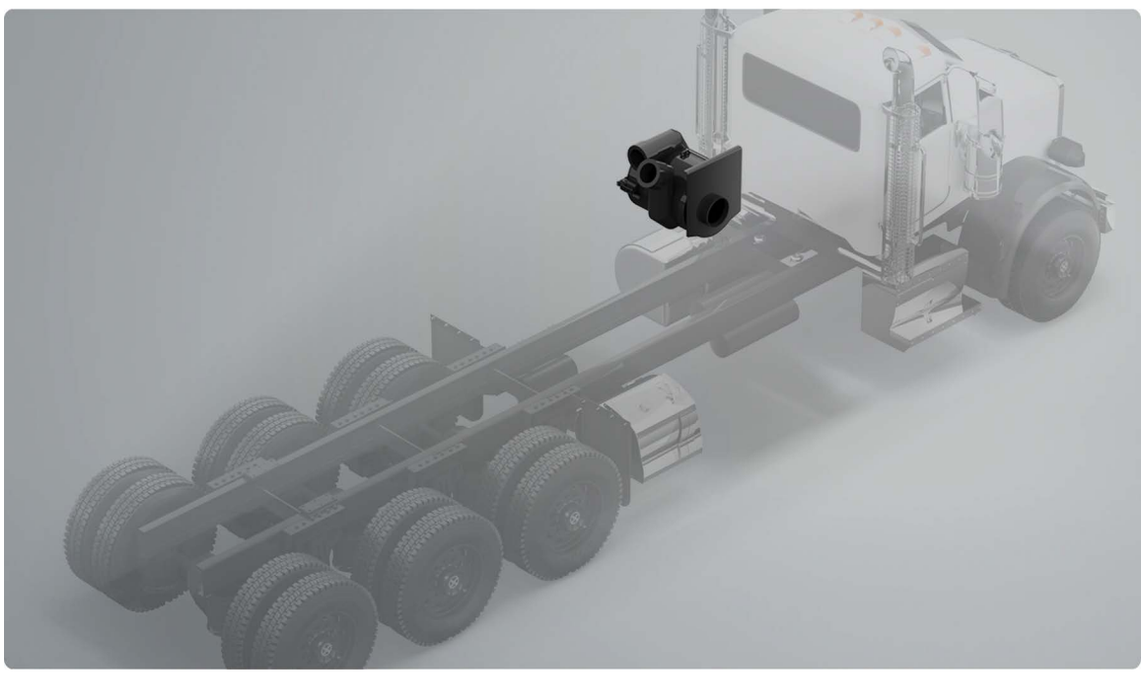
- The blower creates the primary air movement creating suction through the boom. The blower is driven by the transfer case.

Figure 1-2. *Major Components - Blower*



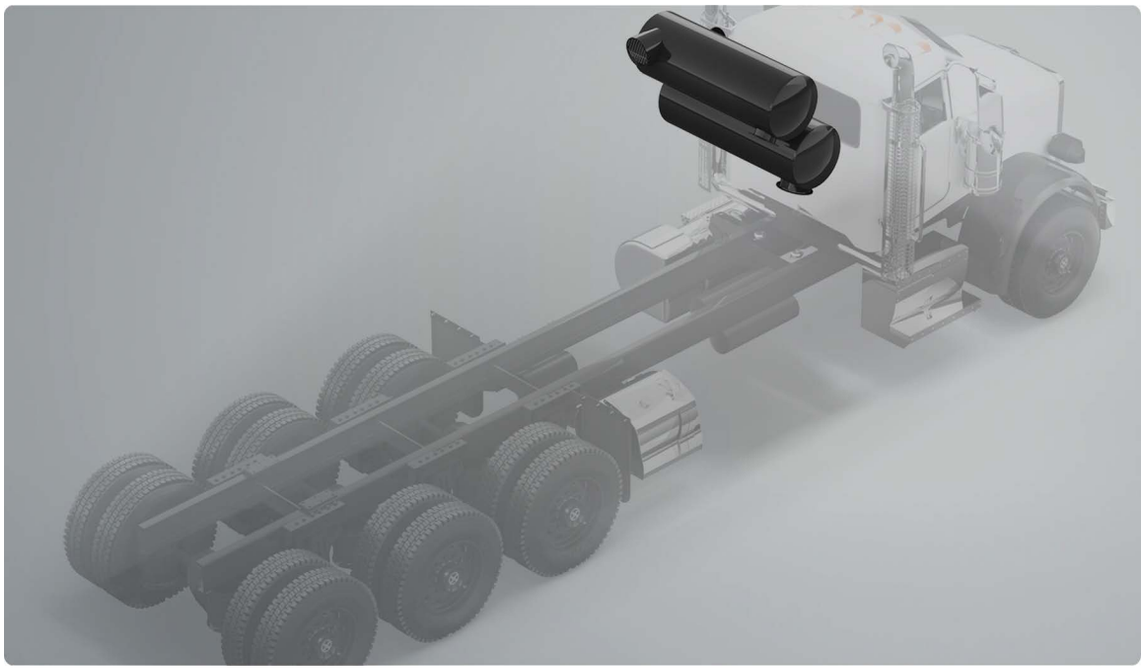
- The air filter is a pleated element capable of 10 µm (ten micron) filtration, removing dust from the airflow before it is vented out of the system.

Figure 1-3. *Major Components - Air Filter*



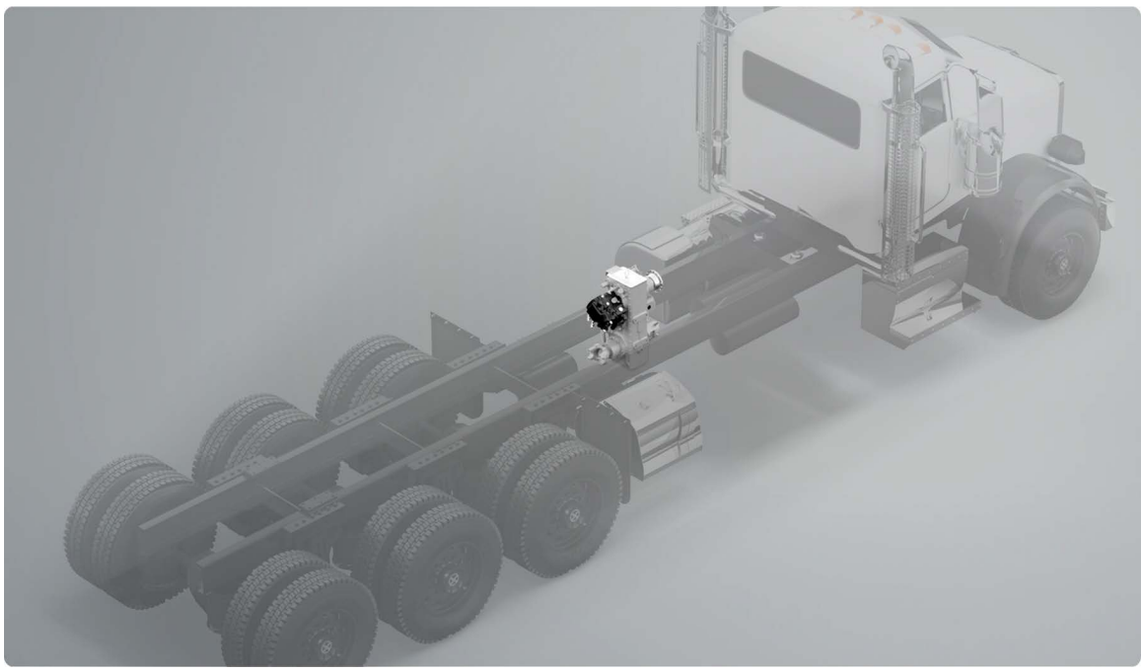
- There are two silencers on the hydrovac—a cooling silencer that channels intake air upstream of the blower and a discharge silencer that directs airflow downstream of the blower. These devices minimize environmental noise levels.

Figure 1-4. *Major Components - Silencers*



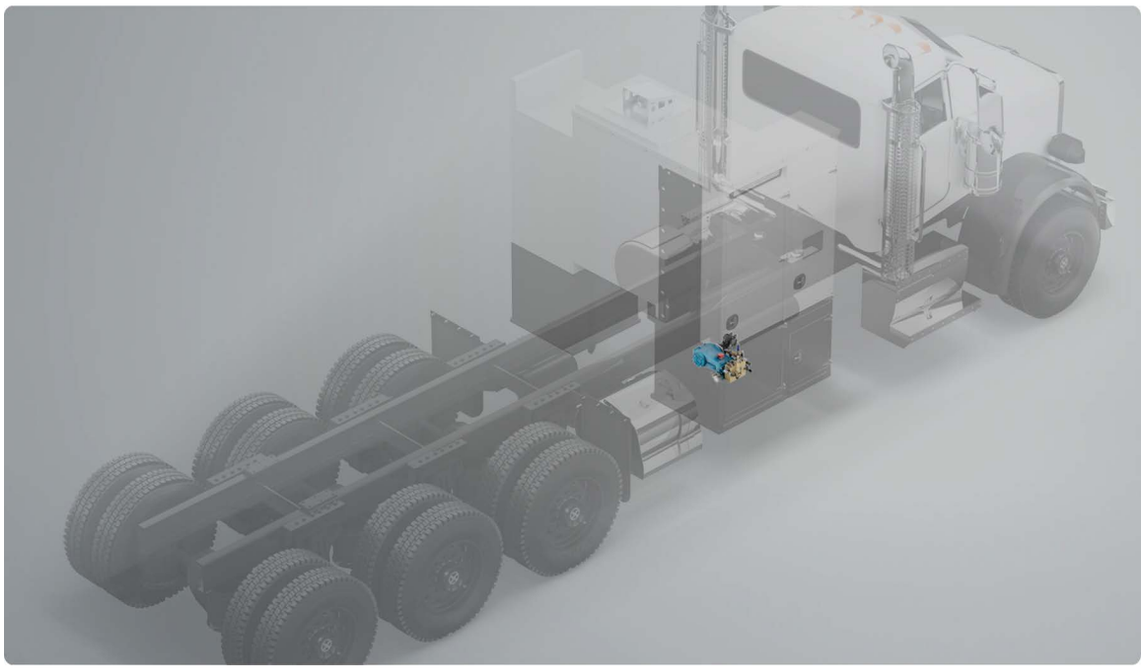
- The transfer case is installed in a split-shaft configuration on the truck driveshaft. Outputs of the transfer case drive the hydraulics and the blower.

Figure 1-5. *Major Components - Transfer Case*



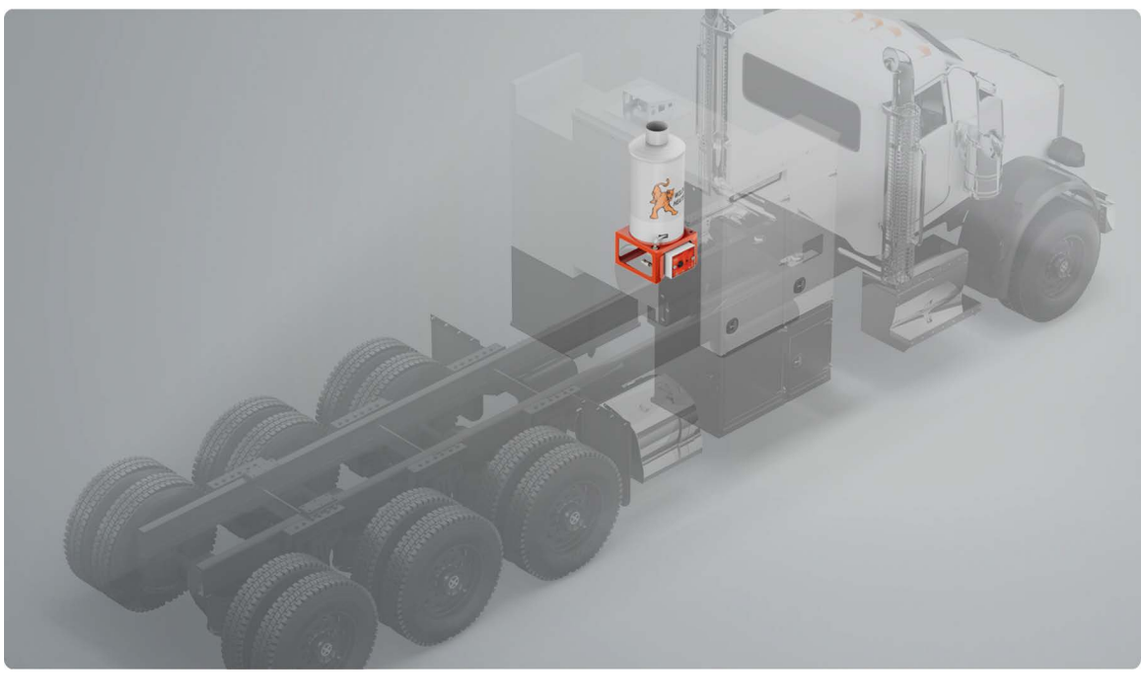
- The water pump provides pressurized water at up to 2800 psi for excavation operations. It is driven by a hydraulic motor.

***Figure 1-6.** Major Components - Water Pump*



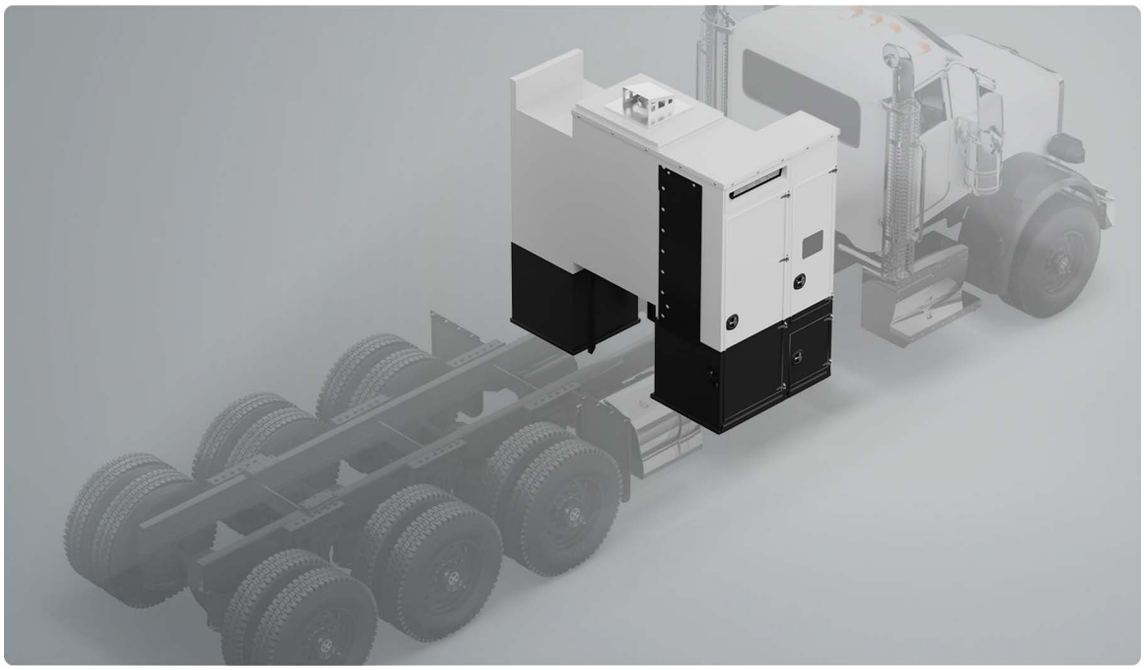
- The water heater is located in the wash cabinet and provides hot water for excavation operations in cold weather. The water heater draws diesel from the truck's fuel tank.

***Figure 1-7.** Major Components - Water Heater*



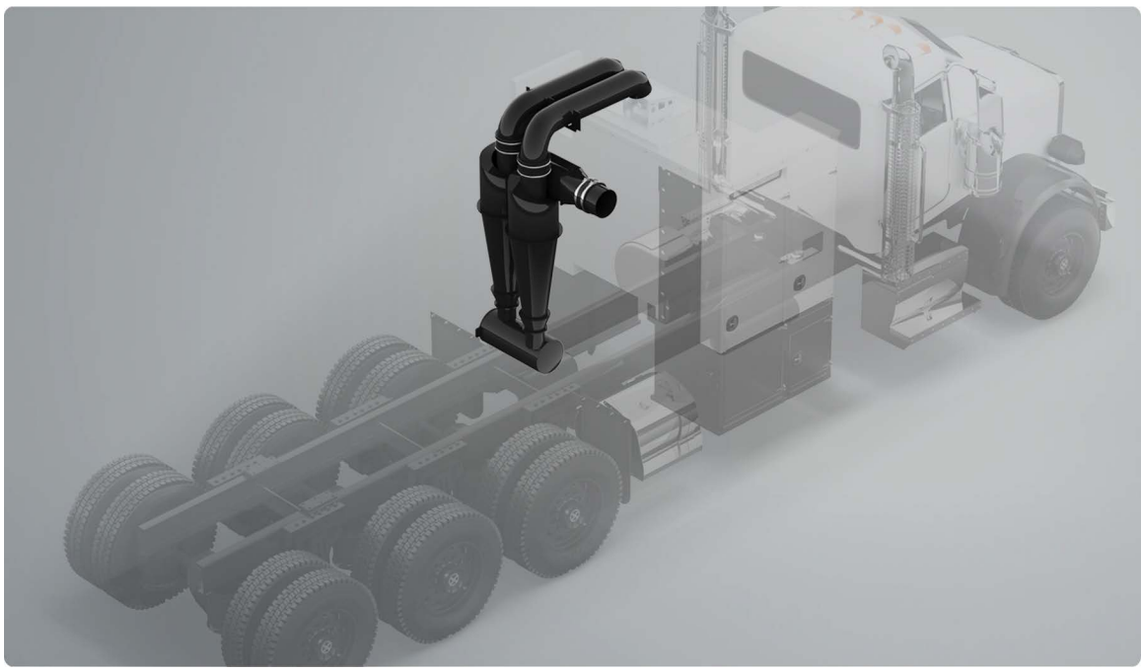
- The wash cabinet encloses and protects key equipment, including the main control panel, water heater, and water pump, and provides storage for tools and accessories. It allows operators easy access for use and monitoring.

Figure 1-8. *Major Components - Wash Cabinet*



- Two cyclonic separators direct the airflow in a circular path where centrifugal force causes the airborne materials to be separated from the air stream and drop out.

Figure 1-9. *Major Components - Cyclones*



- The debris tank is a tip-tank style design that operates by a hydraulic lift cylinder raising the tank, allowing vacuumed debris to be offloaded. The debris tank and water tanks tip together as one unit during dumping.

Figure 1-10. *Major Components - Debris Tank*



- The unit has four interconnected water tanks for clean water storage, mounted directly to the debris tank. The front tanks include sight glasses to monitor the water level. All tanks are connected by a transfer pipe to keep the water level equal, and each tank is equipped with a drain valve for service and maintenance.

Figure 1-11. *Major Components - Water Tanks*



- A hydraulically operated boom is used to vacuum dirt, water, and debris during excavation operations. The boom is controlled either manually or via the handheld remote controller. Multiple dig tubes are provided to extend the reach of the boom during excavation.

Figure 1-12. *Major Components - Boom*



- Manual control levers for the boom, dump door, and tipping of the tank are located in a control cabinet on the passenger side near the rear of the truck.

Figure 1-13. *Major Components - Control Cabinet*



1.5 Airflow Diagram

Airflow within the system is generated by a helical tri-lobe blower, which is powered by the transfer case and ultimately driven by the truck's driveshaft. This blower creates suction that draws air, along with water and debris, through the boom and into the debris tank. Once separated from solids and liquids, the air continues through the filtration system and is discharged back into the atmosphere. The steps outlined below provide a detailed overview of the airflow path within the HVT-13 unit. Figure 1-14 shows a simplified diagram for reference.

***Figure 1-14.** Airflow Diagram*



1. **Material pickup –** The boom hose draws in air, water, and debris from the excavation area. The boom supports the hose, allowing the operator to raise, lower, extend, retract, or rotate it as needed.
2. **Debris tank entry –** Air and debris pass through the turret and into the debris tank. The float ball in the tank is designed to cut off airflow from the debris tank to the blower when the tank is full.
3. **Cyclonic separation –** The air stream then moves through a crossover into the cyclone. Centrifugal force removes heavier particles from the air stream, which fall into a particulate trap at the bottom of the cyclone.
4. **Vacuum breaker –** The vacuum breaker can be activated using either the HMI or the handheld remote controller to intentionally stop suction at the end of the boom hose. This allows the operator to dislodge the hose if it becomes sealed against a surface and can potentially relieve a system blockage. Activating the vacuum breaker diverts the intake to the atmosphere, ending the vacuum upstream of the air filter without shutting down the blower. The vacuum breaker is also opened when the machine stop button is pressed.
5. **Air filtration –** A pleated air filter rated for ten micron filtration captures any remaining particles traveling in the air stream. From here, the cleaned air is routed to the blower.

6. **Discharge –** The blower exhausts air through a high-efficiency discharge silencer, returning it to the atmosphere while minimizing noise.
7. **Blower intake –** The blower ducting draws air from two sources: the air filter and additional cooling air from the cooling silencer, which also helps reduce noise levels.

1.6 Water Flow Diagram

The hydrovac truck includes four interconnected clean water tanks that straddle the debris tank. This water supplies the hose reel and is used for excavation or cleaning, depending on the attachment connected to the dig hose. Figure 1-15 shows a simplified diagram of the water flow through the hydrovac.

> ***NOTE:*** *See "Water Tank Filling" on page 67 for details on filling the water tanks.*

Figure 1-15. *Water Flow Diagram*



1. **Water supply –** Clean water is stored in the water tanks and flows through a shutoff valve to a hydraulically driven water pump.
2. **Pump to water heater –** From the pump, water passes through an unloader valve and enters the supply line leading to the water heater. The water heater is used only when hot water is needed, such as during excavation in cold weather.
3. **Heating and monitoring –** Water exiting the water heater flows through temperature and pressure gauges before traveling to the control valve located upstream of the hose reel.
4. **Bypass operation –** To reduce pump wear caused by pressure surges when flow is stopped, a bypass line returns water to the pump feed line at the unloader. The bypass is triggered if the operator closes a downstream valve or releases the trigger on an attached washout gun while the pump is running.

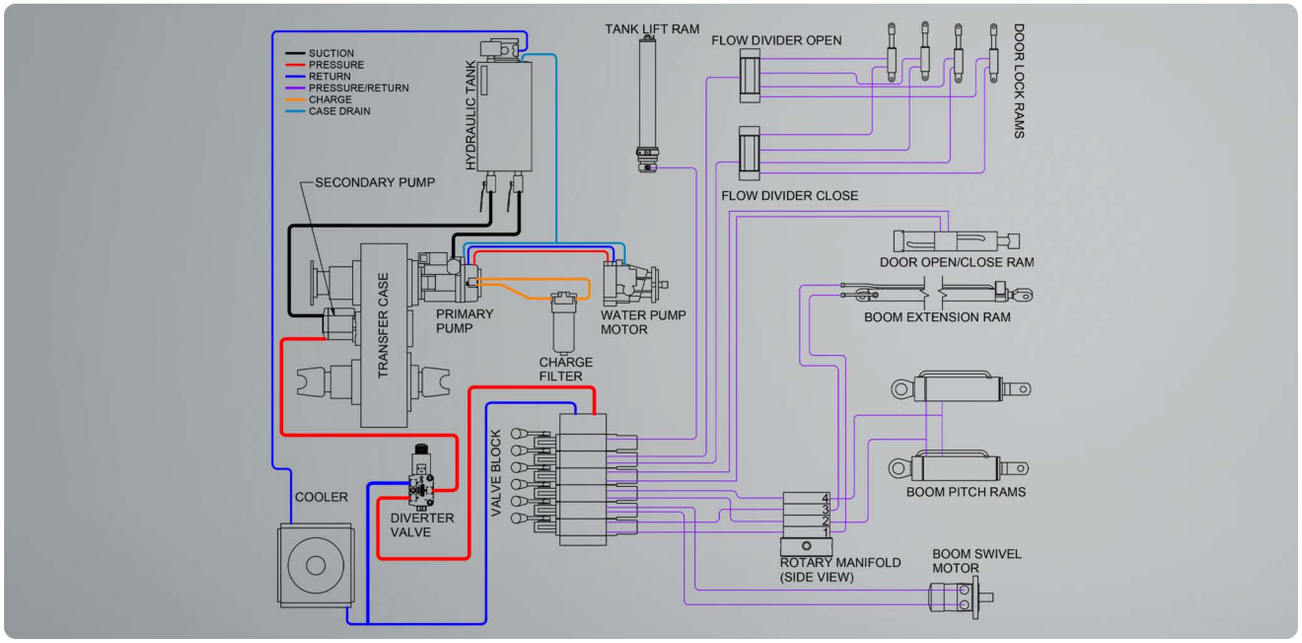
1.7 Hydraulic System Diagram

There are two independent hydraulic circuits on the hydrovac, and they share a common hydraulic tank (also referred to as the hydraulic reservoir). The two circuits are:

- **Water pump (primary) circuit –** Powers the water pump in the wash cabinet.
- **Valve block (secondary) circuit –** Powers hydraulic rams and other components that are not part of the water pump circuit. These components are controlled by the valve block.

Hydraulic fluid flows through both circuits while the hydraulics are engaged using the cab controls.

Figure 1-16. Hydraulic System Diagram



1.7.1 Water Pump Circuit

The water pump circuit is a closed loop circuit. In addition to the shared hydraulic tank, it consists of:

- **Suction line shutoff valve –** Located on the underside of the hydraulic tank.
- **Primary hydraulic pump –** Mounted to the top pump pad of the transfer case. The primary pump is a variable displacement axial piston pump.
- **Water pump motor –** Mounted to the water pump inside the wash cabinet. The water pump motor is a fixed displacement axial piston motor.
- **Charge filter –** Mounted to the rear exterior wall of the wash cabinet and connected to the remote charge filtration ports of the primary hydraulic pump.

The working fluid travels in a loop between the pump and the motor; the motor's speed is set by varying the amount of fluid that the pump outputs per revolution. Fluid in the loop is constantly exchanged with the hydraulic tank at a low rate, with fluid entering the loop via the suction port on the pump and returning to the tank via the shared drain line connected to the motor and pump's case drain ports.

1.7.2 Valve Block Circuit

The valve block circuit is an open loop circuit. In addition to the shared hydraulic tank, it consists of:

- **Suction line shutoff valve –** Located on the underside of the hydraulic tank.
- **Secondary hydraulic pump –** Mounted to the middle pump pad of the transfer case. Also called the gear pump.
- **Valve block –** Located inside the rear passenger-side control cabinet. Controls power to each of the following items:
  - Boom swivel motor
  - Boom pitch ram
  - Boom extension/retraction ram
  - Dump door open/close cylinder
  - Dump door lock/unlock cylinders
  - Tank lift ram
- **Cooler fan –** Located on the rear exterior wall of the wash cabinet. This heat exchanger cools the hydraulic fluid.
- **In-tank return filter –** Located on top of and extending into the hydraulic tank.
- **Diverter valve –** Located on the front side of the wash cabinet. Upon a machine stop function, it will intercept the fluid that is being provided to the valve block and redirect it back to the cooler fan.

The working fluid is pumped from the hydraulic tank to the valve block, returning to the tank through the cooler fan and return filter. Hydraulic fluid is circulated through this circuit regardless of whether the functions on the valve block are in use in order for the hydraulic fluid in the tank to be constantly cooled and filtered. However, if a machine stop is pressed, the fluid will instead loop through the diverter valve until the machine stop is disengaged.

1.8 HVT-13 Specifications

The HVT-13 hydrovac is designed to navigate worksites ranging from industrial parks to suburban alleyways.

Figure 1-17. HVT-13 Truck Configuration



SPECIFICATIONS – HVT-13 CONFIGURATION	
Item	**Description**
Blower	JUROP 1500 PD vacuum blower 5018 CFM PD blower 27 in. Hg maximum vacuum
Water Pump	Cat 2565T13 Triplex wash pump (20 GPM, 3000 max. psi)
Water Heater	Easy Kleen 440,000 BTU/hour heater
Boom Hose Diameter	8 in.
Boom Reach	26 ft.
Boom Rotation	270 deg.
Water Capacity	1100 imp. gal. total
Debris Capacity	13.26 cu. yd. +/- 3% outage
Control System	Vortex 2.0
Operating Noise Rating	117 dB (see “Noise Emission” on page 36)
Chassis Specifications	Tridem axle

2 Safety Information

This chapter outlines essential safety information specific to the HVT-13 hydrovac truck. It is critical that all operators, technicians, and service personnel read and understand the safety information provided in this chapter and throughout the rest of this manual prior to operating, maintaining, or working around the equipment.

Safe operation of this equipment requires more than just adherence to this manual. Operators must also receive proper training and comply with their employer's safety policies, site-specific requirements, and all applicable federal, state/provincial, and local regulations. The hydrovac equipment should always be operated by two operators.

2.1 Safety Alerts

This manual uses standardized safety alert symbols and terminology to identify hazards and prevent injury. The following alert levels are used:

⚠ WARNING!

A WARNING indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

A CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTE: *A note indicates information considered important, but not hazard-related (e.g., messages relating to property damage or operating tips).*

2.2 Emergency Guidelines

Operators must develop and follow site-specific emergency response plans in coordination with their company policies, local regulations, and worksite requirements. The emergency response guidelines and procedures in this manual are intended to provide general principles that can support those plans.

⚠ WARNING!

Failure to act quickly and correctly during an emergency can result in serious injury, permanent disability, or death. All operators must be familiar with emergency shutdown procedures, evacuation protocols, and site-specific response plans prior to starting work.

2.2.1 Emergency Preparedness

In order to prepare for an emergency, operators should:

- Conduct regular safety meetings and tailgate talks to reinforce emergency procedures.
- Know the location of muster points and evacuation routes.
- Verify that emergency response equipment is present, accessible, and suitable for the potential hazards, including, at minimum:
  - First aid kit – should include all standard first aid supplies, as well as burn dressings, tourniquets, and wound care materials.
  - Eye wash station – must provide a clean, sterile, and reliable flow of a solution suitable for flushing contaminants from the eyes in case of exposure.
  - Fire extinguisher – should be suitable for both oil and electrical fires and compliant with local transport authority regulations (e.g., DOT or CTA).
  - Emergency contact list and site-specific response procedures.
- Ensure that equipment is properly maintained and in good condition. Verify the proper function of all machine stop buttons daily prior to starting work.

NOTE: *There is a 5 lb. fire extinguisher in the cab of every chassis upon delivery.*

2.2.2 General Emergency Guidelines

In the event of an emergency:

- Immediately stop work if any situation arises that poses an immediate danger to health or safety.
- If it can be done safely and quickly, shut off the truck or press one of the machine stop buttons (see “Machine Stop Buttons” on page 17).
- Evacuate the area, keeping a safe distance from equipment and potential hazards.
- Notify emergency response services and follow the site-specific emergency response plan.

Hydrovac operations often take place around high-risk utilities, including gas, electrical, water, and communication lines. While the required emergency response will vary depending on the type of utility involved and the specific circumstances of the incident, all utility strikes must be treated as safety-critical events.

Operators must immediately stop work, secure the site, and escalate the incident according to jurisdictional, company, and site-specific requirements. They must also be trained to recognize utility types and understand the appropriate response procedures for each.

2.2.3 Electric Line Strike Guidelines

In the event of an electrical line strike:

- Cease all operations and release controls immediately.
- Do not touch any part of the hydrovac truck or any other objects or personnel that could be energized.
- If inside the truck cab or wash cabinet, remain inside until cleared by emergency personnel unless another more immediate hazard requires you to evacuate.
- Warn all personnel to stay clear of the truck.
- If bailing from the equipment is required, avoid contact with metal wherever possible and jump clear from the equipment in one motion: keep both feet together, do not touch the truck and the ground at the same time, and aim to land balanced with your feet together.
- Evacuate to a safe distance from the truck and other energized hazards by shuffling with both feet on the ground and close together.
- Notify emergency responders and contact the utility owner to shut off the power.
- Follow site-specific emergency protocols.
- Do not return to the equipment or allow others into the area until the utility owner confirms the site is safe and power is isolated.

2.2.4 Gas Line Strike Guidelines

In the event of a gas line strike:

- Cease all operations immediately.
- If it can be done safely and quickly, shut off the truck or press one of the machine stop buttons, then remove or disable any potential ignition sources.
- Warn all personnel in the area that a gas line has been struck. Evacuate the area immediately, upwind or crosswind if safe to do so.
- Notify emergency responders and contact the utility owner.
- Follow site-specific emergency protocols for gas leaks.
- Do not return to the equipment or allow others into the area until the utility owner confirms the site is safe.

2.2.5 Communication Line Strike Guidelines

In the event of a communication line strike:

- Cease all operations immediately.
- Assess for additional hazards, but never look into the cut ends of a fiber optic or unidentified cable as vision damage can occur.
- Notify the utility owner.
- Follow any site-specific reporting requirements.

2.3 Emergency Procedures

In the event of an emergency and if safe to do so, operators should immediately either:

- Shut off the truck by turning the ignition switch off, or
- Press one of the two machine stops located on the truck.

NOTE: *Turning off the truck using the ignition switch is preferred if both options are equally safe to pursue.*

2.3.1 Machine Stop Buttons

CAUTION

Engaging a machine stop does not shut down the equipment and does not disable all controls. The hydraulic and blower circuits will continue operating at reduced speed.

The following will occur after fully pressing one of the machine stops on the truck:

- The engine speed decreases, reducing hydraulic pressure.
- The vacuum breaker opens, stopping suction.
- The water pump turns off.
- The hydraulic pressure to the rear valve block is disabled.
- The tank vibrator control signal is disabled, turning off the power command to the vibrator.
- The remote control system is disabled.
- The E-Stop pop-up message displays on the HMI.

Pressing the red button on the handheld remote controller or Remote Enable on the control panel when operating in Remote Mode shuts off the water pump, opens the vacuum breaker, and disables all remote functions, but it does not function as a machine stop. For information on truck interlocks, see “Interlocks” on page 47.

Figure 2-1. *Machine Stop Button Locations*



2.3.2 Resetting Machine Stop Buttons

After an emergency situation has been resolved and it is safe to resume operation, reset the truck-mounted machine stop buttons by pulling them back out. The following will occur when the machine stop is reset:

- The E-Stop pop-up message on the HMI disappears.
- The water pump remains turned off and the water pump % setpoint is set to 1%.
- The hydraulic pressure to the rear valve block and the tank vibrator control signal are re-enabled.
- The Aarcomm® receiver is re-enabled and all handheld remote controller functions will work again. If the remote controller was in operation at the time the machine stop button was pressed, it will continue operation as before upon reset.
- The Engine RPM Down and Vacuum Valve Open controls are released back to operator control.

NOTE: *When the machine stop is first pressed, the Engine RPM Down function will start, but takes several seconds to fully complete. Resetting the machine stop before this function has fully transitioned will stop it at its current state. In other words, the engine speed holds at whatever it decreased to before resetting.*

2.3.3 Fire Extinguishers

A fire extinguisher should be stored in the truck cab. If appropriate, place a fire extinguisher near the truck but away from possible sources of ignition when working. The fire extinguisher should always be classified for both oil and electric fires.

2.3.4 Coolant Isolation

The system has shutoff valves to isolate the hydrovac coolant loop from the truck engine's coolant system. The shutoff valves are located on the passenger side in the truck frame rail close to the blower assembly.

CAUTION

Spilled coolant is an environmental and health hazard. Avoid contact with coolant fluid. Perform spill containment and remediation procedures in accordance with appropriate regulations if a leak occurs.

These valves serve two purposes:

1. The valves can be closed in warm weather to prevent coolant from flowing through the hydrovac system unnecessarily.
2. In the event of a leak in the hydrovac coolant loop, the valve can be closed to isolate the hydrovac coolant piping from the truck engine coolant loop so that the truck can be driven to a service shop if it is safe to do so.

***Figure 2-2.** Coolant Isolation Valves*



2.4 Safety and Informational Decals

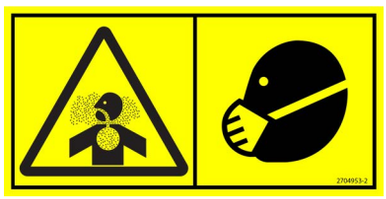
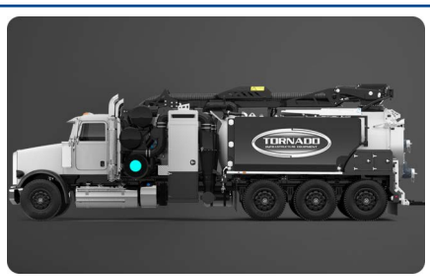
Hydrovac trucks are equipped with safety decals placed at key locations to warn operators and maintenance personnel of potential hazards. These decals provide immediate visual alerts and are essential for safe operation. Each decal corresponds to a specific hazard and is located near the relevant equipment or risk zone. Operators must become familiar with the meaning of each decal and always follow the related safety precautions. Personnel must never remove, obscure, or deface safety decals. If a decal becomes unreadable or damaged, it must be reported and replaced immediately.

Other decals are not safety-related but convey information that is important for the operator to know.

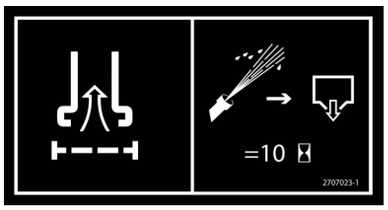
⚠ WARNING!

Safety decals serve as critical reminders and immediate hazard alerts. Do not rely on them as a substitute for reading and understanding the full safety guidance in this manual.

SAFETY AND INFORMATIONAL DECALS

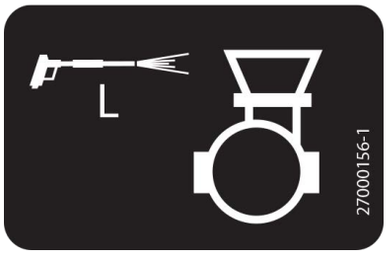
Decal	Location	Description
		**WARNING – Flammable Material Hazard:** Indicates the presence of flammable materials. Operators should follow correct procedures to lubricate blower. See “Blower Diesel Flush” on page 81.
		**CAUTION – Hot Parts:** Indicates that the surface temperature of equipment and components may be hot and contact can cause burns. Only touch when cool or if wearing gloves. See “Hot Surfaces and Burn Risks” on page 30.
		**CAUTION – Silica Dust:** Indicates that operators should use breathing protection as exposure to silica dust can cause lung disease.

SAFETY AND INFORMATIONAL DECALS



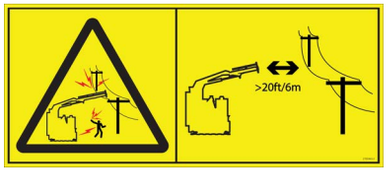


NOTICE – Cyclone Cleanout: Indicates that the cyclone should be cleaned every 10 blower hours or daily, whichever comes first. See “Cleaning Cyclone” on page 103.

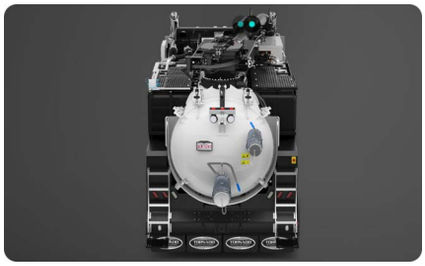




Cyclone Cleanout: Indicates the location of the cyclone cleanout port used for cleaning the cyclone. See “Cleaning Cyclone” on page 103.







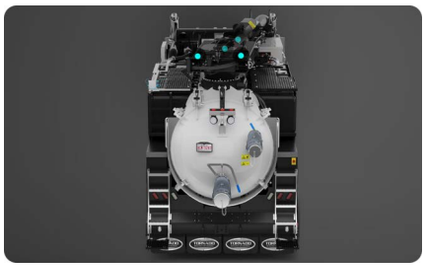
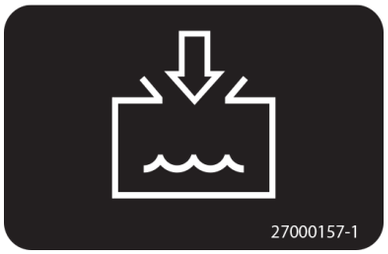
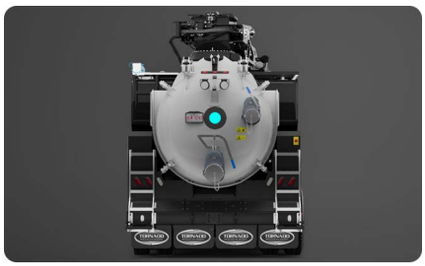
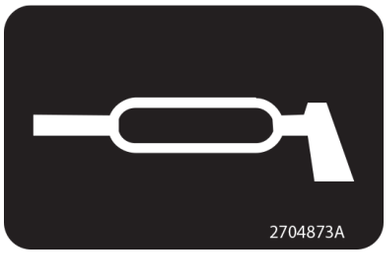
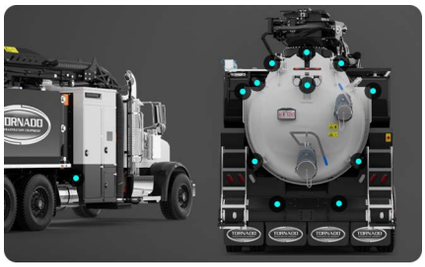


DANGER – Electrocution Hazard: Indicates that overhead power lines pose an electrocution hazard and should be avoided.

- Serious injury or death can result from electrocution.
- Check for overhead wires and obstructions before raising or moving boom or tank and use a spotter.
- Do not leave boom or tank raised while vehicle is unattended.
- Do not move vehicle unless equipment is stowed for transport (see “Transport Positions” on page 39).
- Be aware of the vehicle’s surroundings before operating any of the hydraulic functions to prevent death, injury, or equipment damage.
- If unsure of power line voltage, maintain the largest required safe clearance distance from power lines, or contact the local utility owner to determine clearance requirement.

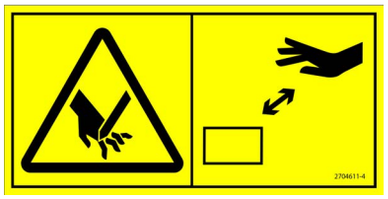
See “Overhead Power Line Contact Risks” on page 30.

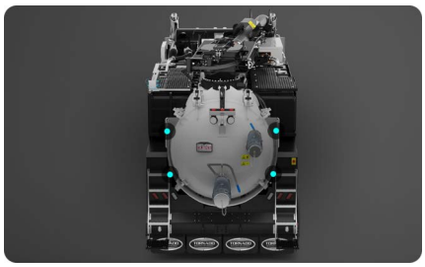
SAFETY AND INFORMATIONAL DECALS

		**Tie-Off Location:** Indicates an approved fall protection anchor point. See “Fall Protection” on page 34 and “Working on Debris Tank” on page 87.
		**Water Fill Port:** Indicates the location of the camlock port used to fill the water tanks.
		**WARNING – Fire or Explosion:** Indicates that operators should never vacuum flammable or combustible substances as fire or explosion can cause death or serious injury. See “Permitted Debris” on page 38.
		**DANGER – Confined Space:** Indicates the risk of suffocation, toxic exposure, or entrapment when entering a confined space. Use proper procedures for entering or stay away. See “Confined Space Entry” on page 35.
		**Grease Point:** Indicates a grease point. See “Greasing Hydrovac System Components” on page 102.

SAFETY AND INFORMATIONAL DECALS









WARNING – Moving Parts: Indicates to keep clear of the moving part.

- Keep arms, legs, and clothing away.
- Any loose and/or dangling objects on person may get caught and cause severe injury or death.



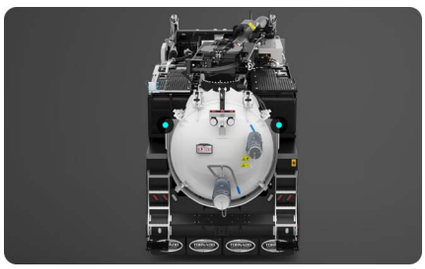


WARNING – One Call Notification: Indicates that underground utilities should be located and verified before digging or drilling as contact can cause death or serious injury. See “Buried Utility Contact Risks” on page 31.



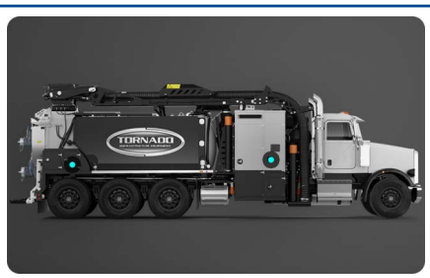
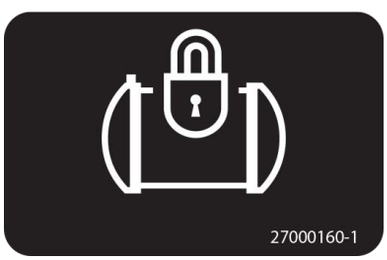




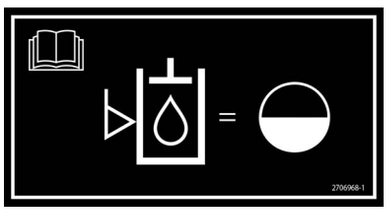
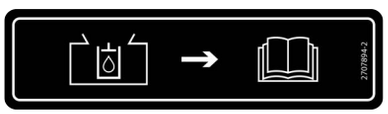


WARNING – Crushing Weight/Hazard: Indicates that the component carries a risk of crushing and can cause death or serious injury. Stay away or secure raised component with locking device and use correct equipment and procedures. See “Crush and Pinch Point Hazards” on page 28.

SAFETY AND INFORMATIONAL DECALS

		**CAUTION – Wear Hearing Protection:** Indicates that operators should wear hearing protection as exposure to high noise levels can cause hearing loss.
		**CAUTION – Flying Objects:** Indicates that flying objects may be thrown by the machine. Operators should wear safety glasses and hard hat.
		**WARNING – Read Manual:** Indicates that special procedures must be followed to safely operate the component as misuse of equipment can cause death or serious injury.
		**Tank Lift Lockout Valve:** Indicates the location of the tank lift lockout valve. Keep the valve closed when the tank is not being raised/lowered to prevent unwanted movement.

SAFETY AND INFORMATIONAL DECALS

		**Anti-freeze:** Indicates that the winterization tank contains windshield wiper fluid with anti-freeze.
		**NOTICE – Checking Hydraulic Oil Level:** Indicates that the hydraulic fluid level should be checked according to procedures. See “Checking Hydraulic Fluid” on page 95.
		**NOTICE – Changing Hydraulic Fluid:** Indicates that operators should read the manual before changing the hydraulic fluid. See “Changing Hydraulic Fluid” on page 96.
		**WARNING – Pressurized Fluid/Air:** Indicates that pressurized fluid or air could pierce skin and cause severe injury. See “High-Pressure Fluid Hazards” on page 33.

2.5 General Safety Principles

This section outlines fundamental safety principles that apply to various aspects of hydrovac truck operation, maintenance, and transport. These principles are not a substitute for detailed procedures but serve as foundational expectations that must be consistently followed to reduce the risk of injury or equipment damage. These principles must be observed in combination with company safety programs and jurisdictional regulations. Operators are expected to stop work and seek clarification whenever a task or condition appears unsafe.

2.5.1 Training and Authorization

- Only trained and authorized personnel may operate, maintain, or inspect the hydrovac unit.
- Operators must be familiar with all controls, emergency shutdown procedures, and safety systems before use.
- New operators should receive hands-on orientation and competent supervision.

2.5.2 Personal Protective Equipment (PPE)

- Always wear the required PPE when performing hydrovac operations. See “Personal Protective Equipment (PPE) Requirements” on page 27 for detailed PPE requirements.
- Additional PPE or enhanced safety measures may be necessary depending on specific tasks, environmental conditions, or site-specific hazards.

2.5.3 Pre-Operational Checks

- Ensure all pre-use inspections and maintenance tasks are completed before operating the equipment.
- Do not operate the unit if any component is damaged or not functioning properly.
- Mark the proposed path of excavation with suitable paint and have underground utilities located before starting work.
- See “Pre-Operations Checklist” on page 74 for a list of some essential pre-use actions.

2.5.4 Lockout/Tagout (LOTO)

- Always isolate and lock out energy sources before performing maintenance or inspection activities.
- Verify that systems are de-energized before beginning work.
- Always follow proper LOTO procedures for your company, site, and jurisdiction.

2.5.5 Situational Awareness

- Stay alert to surroundings, especially when operating near traffic, trenches, overhead obstructions, other workers or vehicles, bystanders, or nearby structures.
- Be aware of boom and dump door movement, equipment blind spots, and other dynamic hazards.
- Maintain visual and verbal contact with co-workers at all times.
- Operate equipment in accordance with this manual. If abnormal sounds, movements, or conditions are observed, immediately stop operation and investigate the cause before resuming work.

2.5.6 Weather and Environmental Hazards

- Do not operate the truck during lightning storms, high winds, or other dangerous weather conditions.
- Use extreme caution in icy or wet conditions. Avoid climbing icy, wet, or snow-covered equipment.
- Only operate the hydrovac on firm, stable, and level ground. Avoid parking near steep slopes, on soft surfaces, or on uneven surfaces that could cause the unit to tip or shift unexpectedly.

2.5.7 Communication and Emergency Planning

- Maintain clear and consistent communication between all crew members.
- Ensure all workers are aware of site-specific emergency procedures, and know the locations of emergency shutoffs (see “Machine Stop Buttons” on page 17), fire extinguishers, and first aid kits.
- First aid kits and other emergency response equipment must be maintained and readily accessible at the job site.
- Confirm that all required safety documentation—including permits, hazard assessments, and emergency response plans—have been completed, reviewed, and fully understood by the crew.
- Ensure a reliable means of contacting emergency services is available on site, such as a two-way radio or mobile phone with adequate reception.

2.6 Personal Protective Equipment (PPE) Requirements

Proper personal protective equipment (PPE) is mandatory for all hydrovac operations and must be selected based on the type of task, the potential hazards involved, and any site-specific or regulatory requirements. All operators and personnel working with or near the hydrovac truck must wear PPE that meets or exceeds relevant safety standards. Personnel must also be trained to recognize when specialized PPE is required.

2.6.1 Minimum PPE Requirements

- **Eye protection –** Safety glasses or goggles that meet the requirements of the latest version of the ANSI/ISEA Z87.1 (United States) or CSA Z94.3 (Canada) standards.
- **Foot protection –** Protective footwear with steel or composite toe protection and puncture-resistant soles that meets the requirements of the latest version of the ASTM F2413 (United States) or CSA Z195 (Canada) standards for your site conditions.
- **Hearing protection –** Double hearing protection—earplugs plus earmuffs—is required at all times, as sound levels from hydrovac equipment frequently exceed the protection limits of single hearing protection. For more information, see “Noise Emission” on page 36.
- **High-visibility clothing –** Garments or outerwear rated Class 2 or Class 3 that meets the requirements of the latest version of the ANSI/ISEA 107 (United States) or CSA Z96 (Canada) standards for your site conditions.
- **Flame-resistant (FR) clothing –** Garments or outerwear that meets applicable regulatory and site-specific requirements for fire protection in the operating jurisdiction.
- **Head protection –** Hard hat that meets the latest version of the ANSI Z89.1 (United States) or CSA Z94.1 (Canada) standards.

2.6.2 Task-Specific PPE Requirements

Depending on the tasks performed and site conditions, the following additional PPE may be required:

- **Face shield –** Required whenever there is the potential for exposure to high-pressure spray or flying debris during excavation.
- **Chemical-resistant and liquid penetration–resistant gloves –** Required where exposure to hazardous chemicals is possible or when working near pressurized water or hydraulic systems.
- **Chemical-resistant or waterproof outerwear –** Required where exposure to hazardous chemicals is possible; recommended in especially wet or cold conditions.
- **Fall protection –** Required when working at height, including on top of the truck (see “Fall Protection” on page 34).
- **Insulated gloves –** Required for handling components that may be hot during or after operation.

NOTE: *This is not a complete list of all PPE that may be required. Certain tasks, site-specific hazards, or regulatory requirements may necessitate additional PPE.*

2.6.3 PPE Inspection and Maintenance

- Inspect PPE before each use. Do not use damaged, worn, or expired PPE.
- Clean and store PPE according to manufacturer instructions.
- Replace PPE immediately if compromised during use.

2.7 Mechanical and Thermal Hazards

Hydrovac trucks contain numerous moving and pressurized components that present serious mechanical hazards. Operators must be constantly aware of the potential for pinch points, crush zones, unexpected equipment movement, and exposure to hot surfaces.

2.7.1 Crush and Pinch Point Hazards

Operators and personnel must stay alert to potential pinch or crush points around moving equipment. Critical hazard areas include the following:

- **Boom assembly –** The rotating turret, telescoping segments, hydraulic cylinders, boom arm, and boom hose all pose potential mechanical hazards. These components can rotate, extend, lift, drop, or swing suddenly if control is lost or the system is activated unexpectedly.
- **Dump door assembly –** The hydraulically controlled dump door can open and close with great force. Injury risks are present from both the door movement and the surrounding hydraulic rams, such as the door-locking mechanisms.
- **Tip tank –** The area under the raised debris tank poses a significant crush hazard. Personnel must never enter the area under the debris tank unless the tank is fully lowered into its cradle or the tank prop is engaged and properly seated (see “Working Under Raised Debris Tank” on page 89). Additionally, operators must ensure there is sufficient clearance from nearby objects before raising the debris tank.

- **Hose reel –** This rotating equipment is powered by pneumatic control and can rewind rapidly if the valve's lever is engaged. Because the reel is unguarded and rotates with force, it can catch loose clothing or limbs if approached too closely.

⚠ WARNING!

Never stand between moving parts, underneath raised equipment, or in the path of rotating, swinging, or descending components. Contact may cause serious injuries, amputations, or death.

Lockout/tagout (LOTO) procedures must be followed when performing inspections or servicing equipment near hazardous zones, including the engagement of any locking pins or manual supports. Confirm that systems are de-energized and that hydraulic and pneumatic pressure is relieved before entry or servicing.

2.7.2 Unexpected Movement and Hydraulic Failure

⚠ WARNING!

- Do not rely on hydraulics to support raised equipment—failure may cause sudden collapse or movement.
- Always treat hydraulic hoses and related components as pressurized unless proper LOTO has been performed by qualified personnel.
- High-pressure fluid injection injuries require immediate medical attention to prevent serious injuries or death.

Sudden or unintended equipment movement—especially of the boom, debris tank, or dump door—can result from control failure, hydraulic leaks, or a loss of system pressure. These failures may occur abruptly and without warning.

- Always assume equipment is pressurized until verified otherwise.
- Never enter or position yourself beneath elevated booms, raised debris tanks, or opened dump doors without verifying engineered lockout mechanisms are engaged.
- Use LOTO procedures during maintenance activities.
- Never tamper with hydraulic components and never adjust hydraulic hoses unless qualified to do so.

Stable ground is also essential for safe operation—parking or working on uneven, soft, or unstable terrain increases the risk of tipping or unintended movement. Operators must assess ground conditions prior to work and continually during operations to ensure safe and stable footing for the equipment.

2.7.3 Hot Surfaces and Burn Risks

Several components may reach high temperatures during operation:

- **Blower housing –** Becomes extremely hot within minutes of operating.
- **Cabinet heaters –** Exterior surfaces heat up quickly and retain heat after shutdown.
- **Hydraulic fittings, hoses, and cylinders –** Can become hot after extended use.
- **Water pump casing –** May become hot after extended operation.
- **Water heater–heated plumbing –** Plumbing downstream of the water heater becomes hot after using the water heater.
- **Hot water discharge –** Water discharged from the hose or connected dig wand is hot when the water heater is used.

CAUTION

- Avoid contact with hot components to prevent burns. Allow time for equipment to cool completely before inspecting or servicing.
- In addition to the equipment listed, components of the truck chassis such as the exhaust stacks may become very hot during operation.

2.7.4 Communication and Visual Markings

Maintain clear communication with team members when working around hazard zones or operating equipment. Always confirm equipment status (e.g., active, locked out, de-energized) before approaching or entering operational zones.

Hazard zones are often identified with decals or warning labels placed near the equipment (see “Safety and Informational Decals” on page 20). Always familiarize yourself with these decals or labels and ensure they remain visible and legible. Do not remove or obscure safety decals.

2.8 Electrical and Underground Utility Hazards

Hydrovac work is frequently performed near overhead power lines and buried utilities. Contact with electrical or underground services can result in electrocution, fire, explosion, environmental damage, or service disruption. Operators must remain vigilant and follow safe work procedures at all times. Follow all jurisdictional, company, and site-specific laws and other requirements for working around utilities.

2.8.1 Overhead Power Line Contact Risks

Hydrovac operators must understand that overhead electrical lines pose a serious hazard—not only through direct contact but also by arcing across air gaps or passing through the ground. Operators must be trained to recognize and respond to the signs of an electrical strike, such as arcing electricity, popping noises, smoke, power outages, or electrical strike alarms (see “Electric Line Strike Guidelines” on page 16).

⚠ WARNING!

Overhead power lines may cause fatal electrocution, fire, or explosion if contacted or approached too closely. Never position the boom or debris tank above power lines and always maintain a safe clearance distance, treating lines as energized unless confirmed otherwise by the utility owner.

A minimum allowable clearance must be maintained at all times between equipment and overhead power lines based on the voltage class of the conductor. The data in the table below was obtained from 29 CFR 1926.1408(a)(2)(iii) and is provided for reference only. Operators must defer to the regulations and standards applicable to their jurisdiction, worksite, and company.

POWER LINE MINIMUM CLEARANCE DISTANCES

Nominal AC Voltage	Minimum Clearance Required
Less than 50 kV	15 ft.
50 kV to 200 kV	20 ft.
200 kV to 350 kV	25 ft.
350 kV to 500 kV	35 ft.
500 kV to 750 kV	45 ft.

Always identify the locations and heights of all overhead lines on the jobsite prior to starting work so that you can maintain safe clearance distances. The following are some additional precautions that should be taken:

- Ensure the debris tank and boom are stowed for transport before driving the truck (see “Transport Positions” on page 39).
- Use a designated spotter when operating the boom near power lines.
- Avoid raising the debris tank when power lines are nearby.
- Do not operate during high winds or when visibility is compromised.
- Follow utility owner permit and isolation procedures if working near energized conductors.
- Never enter the minimum allowable clearance zone or the area above the power lines unless one of the following conditions is met:
  - An authorized person has confirmed that electrical distribution and transmission lines have been de-energized and grounded at the point of work.
  - Insulating barriers have been installed by the utility company.

2.8.2 Buried Utility Contact Risks

Although hydrovac excavation is generally considered a “safe” daylighting method, high-pressure water jets can still damage buried utilities, especially if used improperly. See “Gas Line Strike Guidelines” on page 16 for appropriate response actions.

⚠ WARNING!

Damage to buried utilities can cause explosions, electrocution, fire, hazardous gas release, or environmental release that leads to death or serious injury.

The following precautions and preventive measures must be taken to avoid damaging buried infrastructure such as gas lines, underground power lines, fiber optics, and other piping or cables.

- Mark the proposed path of excavation with suitable paint (e.g., white).
- Always acquire utility locates prior to starting any excavation:
  - In the United States, call 811 or 888-258-0808.
  - In Canada, refer to resources available at https://www.clickbeforeyoudig.com/.
  - Also contact any local utilities that do not participate in the above services.
- Inspect the worksite for signs of buried utilities, such as signage, gas or water meters, manhole covers, or other features that might indicate unidentified buried utilities.
- Always adjust water pressure to suit the material being excavated and soil conditions. Operators should always use the lowest water pressure suitable for their task.
- Always obtain authorization before working near underground utilities and ensure high-risk utilities—such as high-pressure gas and high-voltage power lines—are monitored by the utility owner.

If Common Ground Alliance standards are followed, the color coding of marked utilities is as follows:

COMMON GROUND ALLIANCE COLOR CODES

Color	Utility
Red	Electric
Yellow	Gas, oil, steam
Orange	Communication (e.g., fiber optic)
Blue	Potable water
Green	Sewer/drain

2.9 Vacuum System and High-Pressure Fluid Hazards

Hydrovac equipment uses high-pressure water, hydraulic fluid, and powerful vacuum suction to excavate. These systems pose significant hazards if misused or approached carelessly.

2.9.1 Vacuum System Hazards

The vacuum system generates powerful suction, capable of drawing in loose objects, harmful debris, and even body parts if improperly handled. The boom hose opening is the most prominent hazard point in regular operations, but the vacuum breaker, air filter, cyclones, and internal space of the debris tank are also subject to high vacuum pressure. Any time there is a problem, the operator should open the vacuum breaker to break the suction.

⚠ WARNING!

Exposure to high suction forces or extremely low pressures can cause serious injury or death. Never place your head, face, or any part of your body near a vacuum hazard, even briefly. Never direct the boom hose at someone else and never allow anyone to enter the debris tank while the equipment is running.

Key precautions:

- Keep the boom hose inlet away from yourself and others during operation.
- Never attempt to retrieve items or to unclog a blocked hose by reaching into the boom hose inlet while the blower is running.
- Ensure only trained personnel operate the hydrovac equipment.
- Secure any loose clothing, tools, and other objects that could be otherwise drawn into the vacuum.

2.9.2 High-Pressure Fluid Hazards

Water pressure used for excavation could reach pressures up to 3100 psi and hydraulic fluids can reach pressures up to 2800 psi. Direct contact with high-pressure fluid jets may cause serious injuries, including injection injuries, lacerations, and severe damage to sensitive tissues, like eyes.

⚠ WARNING!

High-pressure injection injuries often appear small but are extremely dangerous and require emergency medical treatment. High-pressure water jets and hydraulic fluid sprays can easily penetrate skin and cause lacerations, infection, or permanent damage to sensitive organs. Avoid contact with high-pressure fluids and never direct pressurized water toward people or animals.

High-pressure water can also damage underground utilities. Always use an appropriate water pressure both for any utilities being exposed and for the soil conditions; using a higher pressure increases the risk of utility damage and increases the severity of potential injuries.

Additional precautions:

- Ensure only trained personnel operate the hydrovac equipment and that there are no bystanders near the excavation site.
- Never spray toward reflective surfaces or excavations where rebound towards yourself or others could occur.
- Reduce water pressure to suit any nearby or buried infrastructure and the soil conditions.
- Wear suitable PPE to protect against water injection injuries when using the dig wand or servicing hydraulic components.

Fluid injection injuries are medical emergencies. Surface wounds may appear minor while masking serious internal damage. If someone is sprayed with high-pressure water or hydraulic fluid, assume that an injection injury has occurred and perform the following actions:

- Cease all operations immediately.
- Do not delay medical care. Inform medical personnel that the injury involved a high-pressure water jet.
- Follow company-specific emergency procedures and documentation protocols.

2.9.3 Prevention Measures

High-pressure systems and vacuum suction offer powerful excavation capabilities, but demand strict control and respect for safety protocols at all times.

- Only use engineered nozzles.
- Inspect wands, hoses, and fittings before each use, replacing any damaged or worn components before use.
- Maintain constant communication between crew members.
- Keep excavation sites clear of other personnel and avoid the line of fire.

2.10 Fall Protection

Inspection and maintenance of hydrovac units periodically requires access to the top of the debris tank and tank platform. These elevated work areas present a serious fall hazard, especially under wet or icy conditions. Follow all jurisdictional, company, and site-specific laws and other requirements for working at heights.

⚠ WARNING!

Falling from the top of the hydrovac unit can result in serious injury or death. Always wear fall protection equipment when working at height and follow safe access procedures.

2.10.1 Fall Protection Requirements

Key fall protection requirements:

- Fall protection is required at all times when accessing or working on top of the hydrovac unit.
- Only fall protection certified and authorized personnel may access the tank platform or other areas on top of the debris tank.
- Workers must use a complete fall-arrest system consisting of a full-body harness, connecting device, and engineered anchorage. The system must meet the applicable requirements of the latest versions of the ANSI/ASSP Z359 Fall Protection Code (United States) or the CSA Z259 Fall Protection series (Canada).
- A second crew member must be present during elevated work to assist or respond in case of emergency.

NOTE: *If workers will be tied off to one of the engineered anchor points (see the Tie-Off Location decal in “Safety and Informational Decals” on page 20) on top of the debris tank while also working on the debris tank, a suitable fall-restraint lanyard must be used instead of a fall-arrest lanyard. See “Working on Debris Tank” on page 87.*

2.10.2 Safe Access Practices

- Ensure the debris tank is fully lowered into its cradle.
- Disengage the hydraulic systems before anyone climbs or works on top of the tank. Never operate the boom, dump door, or any other hydraulic system while someone is on an elevated part of the hydrovac.
- Only use built-in ladders or approved mobile access platforms equipped with handrails to access the top of the tank.
- Maintain three points of contact when ascending or descending ladders.
- Raise and lock the maintenance platform handrail when ascending the tank, then unlock and stow the handrail when descending the tank.
- Never climb ladders with tools or equipment in hand. Use hands-free carrying options, tool lanyards, and/or taglines to move items.
- Do not access elevated surfaces during high winds, rain, snow, or icy conditions.
- Clear away any snow, ice, or obstructing debris before stepping onto that area of the platform or tank.
- Inspect anti-slip grip tape before stepping onto that area of the tank. Replace grip tape if missing or worn.

2.11 Confined Space Entry

The debris tank of the hydrovac unit is considered a confined space due to limited access points, poor ventilation, and the potential for atmospheric hazards. Entry into the compartment requires specific authorization, procedures, and safety controls. Follow all jurisdictional, company, and site-specific laws and other requirements for confined space entry.

⚠ WARNING!

Entering the debris tank without proper confined space entry procedures can result in suffocation, toxic exposure, or entrapment, potentially causing negative health effects or even death. Follow all confined space entry requirements before entering the debris tank.

2.11.1 Tank Entry Requirements

Before entering the debris tank, all the following confined space safety requirements must be met:

- LOTO of the truck chassis. This includes ensuring both door safety locks are properly engaged when working in or around the open debris tank.
- A confined space entry permit issued by an authorized person.
- Pre-entry and continuous atmospheric testing to verify acceptable levels for working within that environment.
- A trained rescue team and suitable rescue plan must be in place.
- A rescue harness and personal monitor must be worn.
- If necessary, suitable respiratory protective equipment or other PPE must be worn and engineered ventilation solutions applied.

- If necessary, intrinsically safe tools and equipment must be used.
- Adherence to all additional safety requirements and documentation for the company, jobsite, and jurisdiction.

2.11.2 Other Confined Spaces

Hydrovac operators may encounter other confined spaces during work, such as manholes, utility vaults, and excavated holes or trenches. While this manual focuses on the confined spaces of the truck itself, operators must also:

- Recognize the signs of confined spaces on site.
- Follow all site-specific protocols and regulatory requirements for accessing and working in these confined spaces.
- Avoid entry unless authorized, trained, and equipped to do so.

2.12 Noise Emission

Hydrovac equipment produces high noise levels, and appropriate hearing protection is required at all times when operating the machine (see “Personal Protective Equipment (PPE) Requirements” on page 27).

The following table details the noise emission levels for the HVT-13 hydrovac in a test environment (see Note); however, actual noise emission in jobsite conditions could be different.

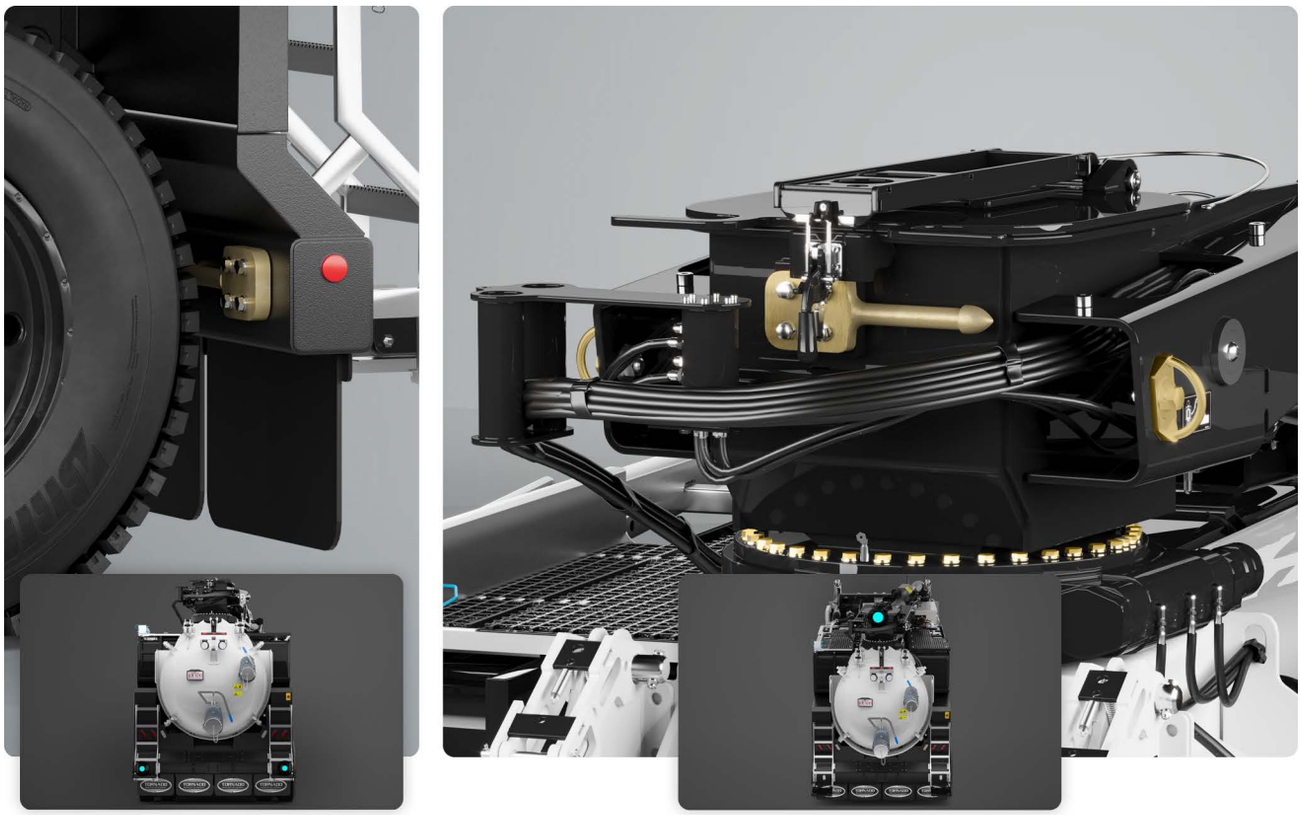
HVT-13 NOISE LEVEL	
Declared Single-Number Noise Emission	**Value**
A-weighted sound power level, L*WAd*	117 dB
Declared Dual-Number Noise Emission	**Value**
A-weighted emission sound pressure level, L*pA*, *at operator position A*	93 dB
Uncertainty, K*pA*	1 dB

NOTE: *Noise emission values were determined according to noise test codes ISO 4871:1996, ISO 6395:2008, ISO 6396:2008, and ISO 6396:2008/Cor. 1:2009.*

2.13 Grounding Points

There are three static grounding points located around the truck: two on the rear bumper and one on the boom turret. They are used to prevent unwanted electrostatic discharge in sensitive environments.

***Figure 2-3.** Grounding Points*



2.14 Regulatory Compliance

Operators and employers must comply with all applicable rules and regulations related to operating the equipment. While this manual incorporates safety best practices, it does not replace legal or regulatory requirements.

Key areas of regulatory compliance may include:

- **Occupational health and safety (OHS) –** Follow regional OHS legislation, including rules on confined space entry, PPE, fall protection, and working near utilities.
- **Environmental protection –** Adhere to environmental regulations regarding waste handling, water disposal, and emissions.
- **Transportation compliance –** Ensure compliance with regional transportation regulations concerning vehicle inspections, weight limits, securing loads, and licensing requirements.
- **Training and certification –** Ensure all operators are trained and competent in hydrovac operation, and that high-risk tasks are supervised by a qualified person.
- **Record keeping –** Maintain equipment logs, inspection records, and operator training documentation as required by law or company policy.

***NOTE:** Regulations vary by region. Operators must consult with their employer or designated safety representative to determine applicable regulations for each job.*

3 Controls & Operations

3.1 Operator Preparation

1. Complete proper training and read this manual in its entirety before using equipment.
2. Always comply with applicable local laws and safety regulations. Ensure all appropriate documentation and safety measures are in place prior to starting work.
3. Ensure that you are able to contact emergency services if necessary. Check for cellular phone service or verify radio function prior to starting work.
4. Ensure all required inspections and maintenance have been completed prior to using the equipment and that the equipment is in good working condition.
5. Use equipment only for intended purposes. Stop operation and investigate anything that does not look, sound, or feel right.

CAUTION

All personnel should fully review “Chapter 2: Safety Information” on page 14 and be aware of the appropriate responses to different types of emergency situations and the emergency procedures.

3.2 Permitted Debris

The HVT-13 hydrovac model is a vacuum excavation machine capable of vacuuming a wide variety of nonhazardous, nonflammable liquids and solid debris. The machine is designed to perform soft excavation for exposing utilities for visual verification and potholing applications. If you are unsure if a type of debris can be excavated, contact your sales representative for more information.

3.3 Stowed Positions

⚠ WARNING!

Failure to properly stow equipment before driving or raising the tank may result in equipment collisions, utility strikes, or dislodged equipment and tools. This may cause property damage, serious injury, or death.

The HVT-13 hydrovac model has distinct stowed positions for both dumping and transport. Operators must ensure equipment is properly stowed before driving or dumping to ensure safety, prevent equipment damage, and ensure compliance with transport regulations.

3.3.1 Transport Positions

Before moving the vehicle, operators must ensure that the following equipment is stowed in the transport position:

1. **Tank –** The tank is fully lowered onto the tank cradle with the tank lift lockout valve closed to prevent accidental movement.
2. **Dump door –** The dump door is fully closed and locked shut with the door lockout valve closed to prevent accidental operation.
3. **Boom assembly –** The boom is retracted to the red reflector position and placed into the road cradle (the inside cradle position) with the boom hose set onto the boom hose holder (see Caution).
4. **Dig tubes –** All dig tubes are securely stored, either at the rear passenger side of the wash cabinet or behind the back of the cab on the boom hose holder.
5. **Dig wands –** All dig wands are secured in their designated storage location inside the passenger side of the wash cabinet.
6. **Hose reel –** The hose is fully reeled in with the hose reel door closed.
7. **Cabinet doors –** All wash cabinet, electrical cabinet, control cabinet, and rear toolbox doors are closed and locked.
8. **Handrail and ladders –** The handrail should be folded down and locked, and any bumper steps should be locked in the upright position.
9. **Other loose objects –** All other loose objects, such as hand tools, traffic cones, hoses, and job materials, are properly stored or secured to prevent movement while driving.

Figure 3-1. Transport Positions



CAUTION

During stowing, the boom extension must be retracted until the red reflector aligns with the boom arm but remains fully visible. Attempting to stow the boom in its cradle while it is extended or retracted beyond this position may cause equipment damage.

3.3.2 Dumping Positions

Prior to raising the tank for dumping or maintenance, operators must ensure that the following equipment is stowed in the dumping position:

1. **Chassis –** The hydrovac truck is parked on stable, level ground with adequate clearance from surrounding objects or hazards.
2. **Dump door –** The dump door is opened and the door safety locks are engaged.
3. **Boom assembly –** The boom is placed into the dump cradle (the outer cradle position).
4. **Water tanks –** The water tank fill volume must be at or below the bottom sight glass prior to raising the debris tank.
5. **Cabinet doors –** The control cabinet and rear toolbox doors are closed and locked.
6. **Handrail and ladders –** The handrail should be folded down and locked, and any bumper steps should be locked in the upright position.
7. **Other loose objects –** All loose objects, such as hand tools, hoses, safety lanyards, and job materials, are removed from the debris tank, water tanks, fenders, and other elevated surfaces to prevent falling objects or unintended movement.

***Figure 3-2.** Dumping Positions*



3.4 Cab Controls

The following sections describe the controls in the truck cab for operating the hydrovac equipment systems.

> ***NOTE:** The truck cannot be driven while the hydraulics and blower are operating.*

3.4.1 Engaging Hydraulics

The generalized steps for engaging hydraulics are outlined below for automatic transmissions. However, the exact steps that must be followed vary based on engine size, transmission type, and hydrovac equipment options. Operators must always follow the engagement instructions for their specific equipment as detailed on the instruction plates included in their truck cab.

1. Ensure the truck is running at low idle speed, both tanks are aired up to above 100 psi, the truck is in neutral, and the parking brake is set.
2. Press and hold the brake pedal.
3. Press and hold the Hydraulics On/Off button for approximately 3 seconds.
4. Observe the dash keypad and wait for the transfer case to engage (see “Dash Keypad Interlocks and Colors” on page 43).
5. Shift the transmission into direct drive, then release the brake pedal.

6. Verify that the Hydraulics On/Off button turns red, indicating that the driveshaft is spinning.
7. Set the engine to operating speed using the panel keypads (see “Panel Keypads and Rotary Dial” on page 46) or handheld remote controller (see “Remote Control” on page 73).

NOTE:

- ***Low idle*** *speed indicates the operator should reduce the truck’s RPM all the way down when the truck is engaged. This will reduce the engine’s speed to 850 RPM.*
- ***Operating*** *speed/level indicates the operator should increase the truck’s RPM all the way up. This will increase the engine’s speed to 1550 RPM.*

To disengage the hydraulics:

1. Reduce the engine speed to low idle using the panel keypads or handheld remote controller.
2. Press and hold the brake pedal, then shift the transmission into neutral.
3. Observe the dash keypad and wait for the driveshaft to stop spinning.
4. Press and hold the Hydraulics On/Off button for approximately 3 seconds.
5. Observe the dash keypad and ensure it shows the hydraulics are not engaged.

3.4.2 Engaging Blower

The generalized steps for blower engagement are outlined below for automatic transmissions. However, the exact steps that must be followed vary based on engine size, transmission type, and hydrovac equipment options. Operators must always follow the engagement instructions for their specific equipment as detailed on the instruction plates included in their truck cab.

1. Ensure the truck is running at low idle speed, both tanks are aired up to above 100 psi, the truck is in neutral, and the parking brake is set.
2. Ensure the driveshaft is not spinning (see “Dash Keypad Interlocks and Colors” on page 43) and the boom hose opening is not blocked.
3. Press and hold the brake pedal.
4. Press and hold the Blower On/Off button for approximately 3 seconds.
5. Observe the dash keypad and wait for the blower to engage.
6. Shift the transmission into direct drive, then release the brake pedal.
7. Verify that both the Hydraulics On/Off and Blower On/Off buttons turn red, indicating that the driveshaft is spinning.
8. Set the engine to operating speed using the panel keypads or handheld remote controller.

CAUTION

- Never operate the blower without the filter in place and the filter housing door securely closed to prevent major equipment damage or injuries.
- If the blower is engaged, shifting into neutral at high engine speed may cause the blower to spin in the wrong direction, causing serious equipment damage. Except in the case of emergencies, always reduce engine speed before disengaging the blower.

To disengage the blower:

1. Reduce the engine speed to low idle and open the vacuum breaker.
2. Press and hold the brake pedal, then shift the transmission into neutral.
3. Observe the dash keypad and wait for the driveshaft to stop spinning.
4. Press and hold the Blower On/Off button for approximately 3 seconds.
5. Observe the dash keypad and ensure it shows the blower is not engaged.

3.4.3 Dash Keypad Interlocks and Colors

The dash keypad buttons will illuminate to provide feedback to the operator on safety interlocks and status information (see “Interlocks” on page 47), as described in the following table:

DASH KEYPAD COLOR CODES	
Color	**Description**
Amber	Not engaged and the boom is in a cradle.
Dark Blue Flashing	Not engaged and the boom is lifted off a cradle.
Amber Flashing	A fault is detected during transfer case engagement.
Green	Engaged, the driveshaft is not spinning, and the boom is in a cradle.
Light Blue Flashing	Engaged, the driveshaft is not spinning, and the boom is lifted off a cradle.
Red	The driveshaft is spinning; do not engage or disengage.

***Figure 3-3.** Dash Keypad*



3.4.4 Work Lights

Press the Work Lights On/Off button to toggle the work lights on/off. The truck is equipped with the following work lights:

- One light bar on the top of the driver side of the wash cabinet
- One light bar on the top of the passenger side of the wash cabinet
- Two round spot lights on the main boom arm
- Two round spot lights on the dump door

3.4.5 Amber Warning Beacons

Press the Beacon On/Off button to toggle the amber warning beacons on/off. There are two amber warning beacons on top of the truck cab (driver side and passenger side) and one located on the rear of the tank.

3.4.6 Cameras

The truck is equipped with a rear view camera and a side view camera on the passenger side to improve visibility when reversing. A summary of key functions can be found below. Refer to the manufacturer's documentation for more details on functions and settings.

CAMERA CONTROLS	
Item	**Description**
Power Button	Toggles the camera system on/off.
Menu Button	Displays the settings menu or selects an item in the menu.
View Selection Button	Toggles between the rear and side camera views.
Arrow Down Button	Navigates the menu options and decreases the value for selected items.
Arrow Up Button	Navigates the menu options and increases the value for selected items.
Rotate Image/Back/Exit Button	In normal operation, this button rotates the image. In settings mode, pressing it will take you back to the previous selection, or at the top level, it exits settings mode.

3.5 Control Panel

The truck is equipped with a main control panel that is located inside the passenger side of the wash cabinet.

***Figure 3-4.** Control Panel*



CONTROL PANEL	
Item	**Description**
Machine Stop	See “Machine Stop Buttons” on page 17 for details.
Human Machine Interface (HMI)	See “Human Machine Interface (HMI)” on page 50 for details.
Panel Keypads and Rotary Dial	See “Panel Keypads and Rotary Dial” on page 44 for details.

3.5.1 Panel Keypads and Rotary Dial

This section describes the functions of the panel keypads and rotary dial located on the main control panel.

PANEL KEYPAD AND ROTARY DIAL BUTTONS	
Item	**Description**
Remote Enable	Toggles to enable/disable remote control function (see Note 2 below and "Remote Control" on page 73 for details). Illuminates blue when toggled on.
Boom Lockout	Toggles to enable/disable control of the boom with the handheld remote controller. This button does not disable the boom controls in the control cabinet from moving the boom. • Not illuminated = Boom enabled (lockout OFF) • Red = Boom disabled (lockout ON)
Heater Select	Toggles the fan speed for all heaters. • Orange = Low speed • Green = High speed
Work Lights	Toggles work lights on/off. Illuminates green when toggled on.
Hydraulic Cooler Toggle	Overrides the automatic controls to manually toggle the hydraulic cooler fan on/off (see Note 3). Illuminates green when toggled on.
Transfer Case Cooler Toggle	Overrides the automatic controls to manually toggle the transfer case cooler fan on/off (see Note 3). Illuminates green when toggled on.
Engine RPM Increase	Press and hold to increase engine speed. Illuminates green while pressed.
Engine RPM Decrease	Press and hold to decrease engine speed. Illuminates green while pressed.
Manual Mode	Press to select manual operation of the water pump from the control panel (see Note 1).
Remote Mode	Press to select remote operation of the water pump using the handheld remote controller (see Note 2).
Enable Pump	Press to start the water pump after selecting Manual Mode. Press again to stop the water pump.
Option Mode	Available for optional functions and can be configured to work with the rotary dial, if required (not currently programmed).
Rotary Dial	Turn to increase or decrease the pump percentage

NOTE:

1. *Manual operation of the water pump requires both Manual Mode and Enable Pump to be toggled on. Selecting Manual Mode disables water pump control from the handheld remote controller, and all pump commands are controlled from the control panel.*
2. *Remote operation of the water pump requires both Remote Mode and Remote Enable to be toggled on. Selecting Remote Mode disables the rotary dial and the Enable Pump button, and all pump commands are controlled from the handheld remote controller.*
3. *The HMI will show "Warning" or "Critical" when the hydraulic or transfer case temperature is high or critically high. The cooler fan turns on automatically whenever the temperature exceeds 140°F (60°C).*

3.5.2 Engaging Water Pump

Before engaging the water pump, ensure the truck has been de-winterized and the water pump has been primed (see “De-Winterization and Pump Priming” on page 70).

To operate the water pump via the control panel:

1. Press Manual Mode.
2. Set the water pump percentage using the rotary dial or select a preset using the HMI.
3. Press Enable Pump to start the pump.

To disengage the water pump via the control panel, press Enable Pump again.

NOTE: *Switching modes or pressing any of the mode buttons will shut off the water pump.*

To operate the water pump via remote control:

1. Ensure that Remote Enable is toggled on at the control panel.
2. Press Remote Mode.
3. Set the water pump percentage using the handheld remote controller or select a preset using the HMI.
4. On the remote controller, press Water On.

To disengage the water pump via the remote controller, press Water Off.

3.6 Interlocks

The following sections detail the interlocks present on the hydrovac truck.

3.6.1 Machine Stops

The truck is equipped with machine stop buttons that act as interlocks when engaged. For more information, see “Machine Stop Buttons” on page 17.

3.6.2 Transfer Case

If the blower is engaged without the hydraulics being engaged, the truck will engage both the hydraulics and the blower at the same time. The blower cannot operate without the hydraulics engaged first. Likewise, disengaging the hydraulics will also disengage the blower if it is running. For additional information, see “Dash Keypad Interlocks and Colors” on page 43.

The vacuum breaker will only operate when the blower is engaged. Whenever the blower is engaged or disengaged, the vacuum breaker automatically opens.

3.6.3 Water Pump Operation

The water pump will be automatically disengaged if any of the following occur:

- A machine stop is activated.
- The red button on the handheld remote controller is pressed (if the pump was operating in Remote Mode).
- The mode is changed.
- The water pressure remains above the critical threshold for more than 20 seconds (see “HMI Widgets” on page 52).

In addition to the water pump engagement and disengagement, interlocks also control the pump’s water pressure setting.

- Once a water pressure preset is enabled on the HMI, it will override any manual commands to adjust water pump speed using the rotary dial or handheld remote controller.
- If the water pump is disengaged, the pump speed setting will be automatically adjusted to 1% upon re-enabling the pump. However, if a pressure preset was active upon disengagement, the pump will immediately reactivate the last-used pressure preset following re-engagement and begin ramping up the pressure.

NOTE: *The selected pressure preset must be turned off to regain control via the rotary dial or remote controller.*

3.6.4 Weight System

The iWeigh alarms affect the vacuum breaker and engine speed, depending on which alarm is triggered. For information on the iWeigh system and its alarms, see “iWeigh Scale” on page 78.

3.6.5 Cooling Fans

Both cooling fans will automatically turn on and override the manual control buttons on the keypad if:

- The setpoint temperature of 140°F (60°C) is reached.
- The system has detected a temperature sensor failure of either an open or short circuit.

3.6.6 Control Cabinet Door Sensor

If the door to the control cabinet is opened while Remote Enable is toggled on at the control panel, the boom, tank, and door functions are grayed out and disabled on the handheld remote controller. Closing the door will re-enable the functions on the remote controller.

3.6.7 Tank Sensor

A warning buzzer will activate in the cab if the parking brake is released when the tank is raised or the boom is not in one of the cradle positions.

The tank vibrator is disabled if the tank is down. The vibrator will only operate if the hydraulics are engaged, the boom is in the dump cradle, the tank is raised, and the machine stop is not pressed.

3.6.8 Remote System

Pressing the red button on the handheld remote controller or Remote Enable on the control panel when operating in Remote Mode shuts off the water pump, opens the vacuum breaker, and disables remote functions.

There are also other controls in place for the remote system. A function may work with the valve block controls but may appear not to function with the handheld remote controller. These functions will appear grayed out on the remote controller.

Some examples:

- The boom cannot be extended or retracted while it is stored in either cradle position. This is to prevent accidental damage by inadvertently extending the boom into the back of the truck cab.
- The tank cannot be raised while the boom is in operation.

The interlocks are listed in the table below:

REMOTE CONTROL INTERLOCKS			
Function	**Boom in Road Cradle**	**Boom in Dump Cradle**	**Boom in Operation**
Boom Raise	Enabled (Disabled if tank lifted)	Enabled (Disabled if tank lifted)	Enabled (Disabled if tank lifted)
Boom Lower	Disabled	Disabled	Enabled
Boom Left	Disabled	Disabled	Enabled
Boom Right	Disabled	Disabled	Enabled
Boom Extend	Disabled	Disabled	Enabled
Boom Retract	Disabled	Disabled	Enabled
Vacuum On	Enabled	Enabled	Enabled
Vacuum Off	Enabled	Enabled	Enabled
Water Pump On	Enabled	Enabled	Enabled
Water Pump Off	Enabled	Enabled	Enabled
Door Lock	Disabled	Enabled	Disabled
Door Unlock	Disabled	Enabled	Disabled
Door Open	Disabled	Enabled	Disabled
Door Close	Disabled	Enabled	Disabled
Tank Raise	Disabled	Enabled	Disabled
Tank Lower	Disabled	Enabled	Disabled
RPM Increase	Enabled	Enabled	Enabled
RPM Decrease	Enabled	Enabled	Enabled
Pressure Increase	Enabled	Enabled	Enabled
Pressure Decrease	Enabled	Enabled	Enabled

3.7 Human Machine Interface (HMI)

The following subsections describe the navigation and functions of the human machine interface (HMI).

3.7.1 HMI Layout and Navigation

This section describes the controls found on the HMI. Upon startup, the HMI will display a splashscreen. Press any button on the HMI to access the main screen, which is divided into quadrants that can be set to one of the available widgets.

The HMI will display a “Warning” (yellow) or “Critical” (red) pop-up message when a setting exceeds the respective setpoint value (as listed in “HMI Widgets” on page 52). Press any button on the HMI to dismiss the pop-up message.

NOTE: *You can only display each widget option in a single quadrant at a time. Selecting an option that is already displayed will reset the original quadrant back to the last-used widget.*

Figure 3-5. HMI Controls



HMI CONTROLS	
Item	**Description**
Open Menu	Open the menu for the respective quadrant.
Close Menu	Return to the previously selected widget.
Selection Buttons	Select the adjacent option.
Open I/O	Open the Inputs/Outputs screen.

3.7.2 HMI Hour Meters and Message Center

The bottom-right quadrant of the HMI displays icons that will illuminate when the IoT and remote controller are connected. It also displays the cumulative operating hours for the transfer case, water pump, and blower. When the equipment is engaged and the transfer case driveshaft is actively spinning, the upward pointing chevrons turn green for the affected equipment, indicating that the meter is logging hours. They remain grayed out when the system is not logging hours.

Below the hour meters is the message center, which will display messages or warnings regarding truck operation.

NOTE: *The transfer case hour meter only increases when the hydraulics are engaged.*

Figure 3-6. *HMI Hour Meters and Message Center*



3.7.3 HMI Widgets

Select Open Menu to open the menu for the respective quadrant. Use a selection button to select one of the widget options to display in that quadrant, or select Next Page to cycle through the options.

- The Water Pump widget displays the current water pressure and temperature, as well as the current water pump mode (Off, Remote, or Manual). It also displays a bar graph showing the percentage of output to the pump. The selection buttons allow the operator to select from preset water pressure settings; the selected preset button will illuminate in green. While the water pump is disengaged, a pressure preset can be customized by pressing and holding its respective selection button, then using the PSI Up and PSI Down options that appear on the HMI.
    - Warning pressure: 2900 psi
    - Critical pressure: 3100 psi

Figure 3-7. *HMI Water Pump Widget*



- The Temperatures widget displays the current temperature of the following gauges:
  - Water exiting the water heater
    - Warning temperature: 221°F (105°C)
    - Critical temperature: 230°F (110°C)
  - Sump oil at the bottom of the blower
    - Warning temperature: 265°F (129°C)
    - Critical temperature: 290°F (143°C)
  - Hydraulic oil entering the hydraulic cooler
    - Warning temperature: 185°F (85°C)
    - Critical temperature: 413°F (212°C)
  - Transfer case oil entering the transfer case cooler
    - Warning temperature: 194°F (90°C)
    - Critical temperature: 212°F (100°C)

Figure 3-8. *HMI Temperatures Widget*



- The Engine widget displays the current engine RPM and temperature, as well as the current fuel and diesel exhaust fluid (DEF) volumes. There is also a messages section that will display any engine codes. Select Next Msg or Prev Msg to cycle through the available messages.

Figure 3-9. *HMI Engine Widget*



- The Weight widget displays the tare, gross weight, and net weight of the truck, as well as the Alarm 1 and Alarm 2 setpoints. The selection buttons allow you to cycle through and adjust the alarm setpoints and tare settings. For more information on the weight system, see “iWeigh Scale” on page 78.

Figure 3-10. *HMI Weight Widget*



- The Blower widget displays the status of the interlocks required to close the vacuum breaker and the status of the vacuum breaker. The vacuum breaker valve can be manually opened or closed from this widget.

Figure 3-11. *HMI Blower Widget*



- The Maintenance widget displays a summary of the scheduled maintenance for the hydrovac (for more information, see “Chapter 4: Maintenance” on page 87). Select SW Info to view information on the installed software versions, then select Maint. to return to the Maintenance screen.

Figure 3-12. *HMI Maintenance Widget*



- The Vibrator widget displays the status of the interlocks required to activate the tank vibrator and its output status. Pressing Run Cycle starts or stops the vibrator. The widget also displays the cycle count and the cycle duration; press Cycles Up or Cycles Down to increase or decrease the cycle count.

NOTE: *The maximum number of cycles is 12, and each vibrator cycle is 10 seconds long (5 seconds on and 5 seconds off). The cycle duration increases based on cycle count and cannot be changed separately.*

Figure 3-13. *HMI Vibrator Widget*



- The Settings widget displays the screen brightness, pressure units, temperature units, and weight units settings. Select Edit to cycle through the options to adjust the settings.

Figure 3-14. *HMI Settings Widget*

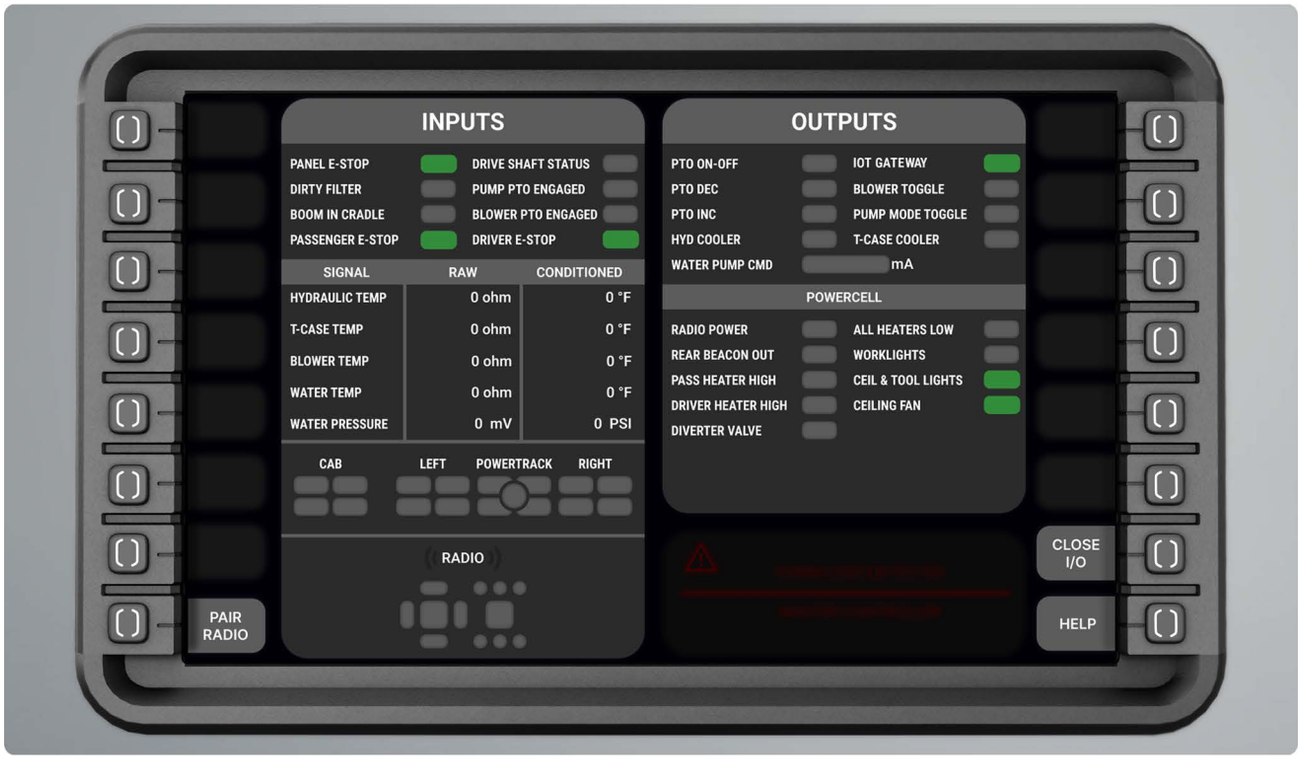


3.7.4 HMI Inputs/Outputs Screen

Select Open I/O to access the Inputs/Outputs screen, which displays the status of various input and output variables. The indicator is illuminated green if the input/output is active.

NOTE: *PTO (power take-off) is shorthand for "hydraulics".*

Figure 3-15. HMI Inputs/Outputs Screen



HMI INPUTS/OUTPUTS SCREEN	
Item	**Description**
Panel E-Stop	Indicates whether the machine stop button on the control panel is engaged.
Rear E-Stop	Indicates whether the rear machine stop button on the control cabinet is engaged.
Boom in Road Cradle	Indicates the status of the position sensor on the boom cradle. If the indicator is green, the boom is stowed in the road cradle.
Boom in Dump Cradle	Indicates the status of the position sensor on the boom cradle. If the indicator is green, the boom is stowed in the dump cradle.
Tank in Cradle	Indicates the status of the position sensor on the tank cradle. If the indicator is green, the tank is stowed in the cradle.
Drive Shaft Status	Indicates whether the driveshaft is spinning above or below 25 RPM. If the indicator is green, it is spinning above 25 RPM.
Pump PTO Engaged	Indicates the status of the feedback air pressure switch. If the indicator is green, the green airline to the transfer case has air pressure above 60 psi and the hydraulics are engaged.

HMI INPUTS/OUTPUTS SCREEN	
Blower PTO Engaged	Indicates the status of the feedback air pressure switch. If the indicator is green, the black airline to the transfer case has air pressure above 60 psi and the blower is engaged.
Dirty Filter	Indicates that the charge filter switch on the rear of the wash cabinet is closed. A closed switch could indicate that the filter is dirty, so it should be inspected and replaced, if necessary.
Valve Bank Door SW	Indicates the status of the position sensor in the control cabinet. If the indicator is green, the control cabinet door is closed.
PTO On/Off	Indicates an output from the control panel commanding the engine/transmission into PTO mode. Typically indicates that the hydraulics are engaged.
PTO Decrease Speed	Indicates an output from the control panel commanding the engine to decrease speed.
PTO Increase Speed	Indicates an output from the control panel commanding the engine to increase speed.
Hydraulic Cooler On/Off	Indicates when the control panel has turned on the hydraulic cooler fan. Typically occurs automatically when the hydraulic fluid temperature reaches its setpoint or when the Hydraulic Cooler toggle is manually enabled on the panel keypads.
Water Pump Command	Indicates how much current is being applied to the hydraulic pump.
IoT Gateway Power	Indicates control system power to the IoT gateway is turned on.
Blower Toggle On/Off	Indicates an output from the control panel commanding the blower air solenoid to shift the transfer case, engaging the blower driveshaft. Typically indicates that the blower is engaged.
Pump Mode Toggle On/Off	Indicates an output from the control panel commanding the hydraulic air solenoid to shift to engage the transfer case. Typically indicates that the hydraulics are engaged.
Transfer Case Cooler On/Off	Indicates when the control panel has turned on the transfer case cooler fan. Typically occurs automatically when the transfer case temperature reaches its setpoint or when the Transfer Case Cooler toggle is manually enabled on the panel keypads.
Radio Power On/Off	Indicates control system power to the Aarcomm® radio system is turned on. Radio power is controlled by the panel keypads.
Rear Beacon Output	Indicates control system power to the rear tank beacon is turned on. Beacons are controlled using the dash keypad.
Passenger-Side Heater High	Indicates control system power to the passenger-side wash cabinet heater is turned on at high speed. Fan speed is controlled using the panel keypads.
Driver-Side Heater High	Indicates control system power to the driver-side wash cabinet heater is turned on at high speed. Fan speed is controlled using the panel keypads.
Diverter Valve	Indicates if the diverter valve is enabled, allowing hydraulic control from the valve block. The indicator will illuminate green during normal operation.
All Heaters Low	Indicates control system power to all heater fans is turned on at low speed. Fan speed is controlled using the panel keypads.

HMI INPUTS/OUTPUTS SCREEN	
Work Lights	Indicates control system power to the exterior work lights is turned on. Work lights are controlled using the dash or panel keypads.
Driver-Side Cabinet Lights	Indicates control system power to the interior lights in the driver-side wash cabinet is turned on. By default, it is always on and cannot be turned off, but the lights will only be on when the cabinet door is open.
Passenger-Side Cabinet Lights	Indicates control system power to the interior lights in the passenger-side wash cabinet and control cabinet is turned on. By default, it is always on and cannot be turned off, but the lights will only be on when the respective door is open.

NOTE: *If an indicator is on but the item is not working, check if a fuse is blown.*

The Inputs section also shows the raw and conditioned temperature/pressure values for different truck components. The following table indicates where each sensor is located.

HMI INPUTS SENSORS	
Item	**Sensor Location**
Hydraulic Temperature	On the hydraulic cooling fan on the front of the wash cabinet
Transfer Case Temperature	On the transfer case cooling fan on the front of the wash cabinet
Blower Temperature	On the underside of the blower on the rear passenger side near the oil-level sight glass
Water Temperature	At the water heater's outlet
Water Pressure	On the plumbing of the water pump

⚠ WARNING!

Equipment can move when using this screen as the keypad and remote controller buttons will function normally when the hydraulics are engaged unless the engine is off or the truck is in neutral. Contact with moving parts may cause serious injuries, amputations, or death. This screen can be used during normal operation if a second operator assists.

The bottom of the Inputs section shows the input of the dash keypad buttons in the cab of the truck (see "Cab Controls" on page 41) and the rotary dial/keypad buttons on the main control panel (see "Panel Keypads and Rotary Dial" on page 46). Pressing any of the keypad buttons will illuminate that button's indicator on this screen while the button is being held. It is recommended that the buttons be tested when the hydraulics are engaged but the transmission is in neutral.

The Radio area indicates the input status of the corresponding buttons on the handheld remote controller. If the handheld remote controller and truck ignition are turned on, pressing any of the remote controller's buttons will illuminate that button's indicator on this screen while the button is being held. The following outputs are displayed:

- Boom Up/Down
- Door Unlock/Lock
- Boom Left/Right
- Door Open/Close
- Boom In/Out
- Debris Dozer In/Out
- Vacuum On/Off
- Engine Speed Increase/Decrease
- Water Pump On/Off
- Water Pressure Increase/Decrease
- Battery Percent

The handheld remote controller can be paired to the receiver from this screen by pressing the Pair Radio button. See "Pairing a Handheld Remote Controller" on page 74.

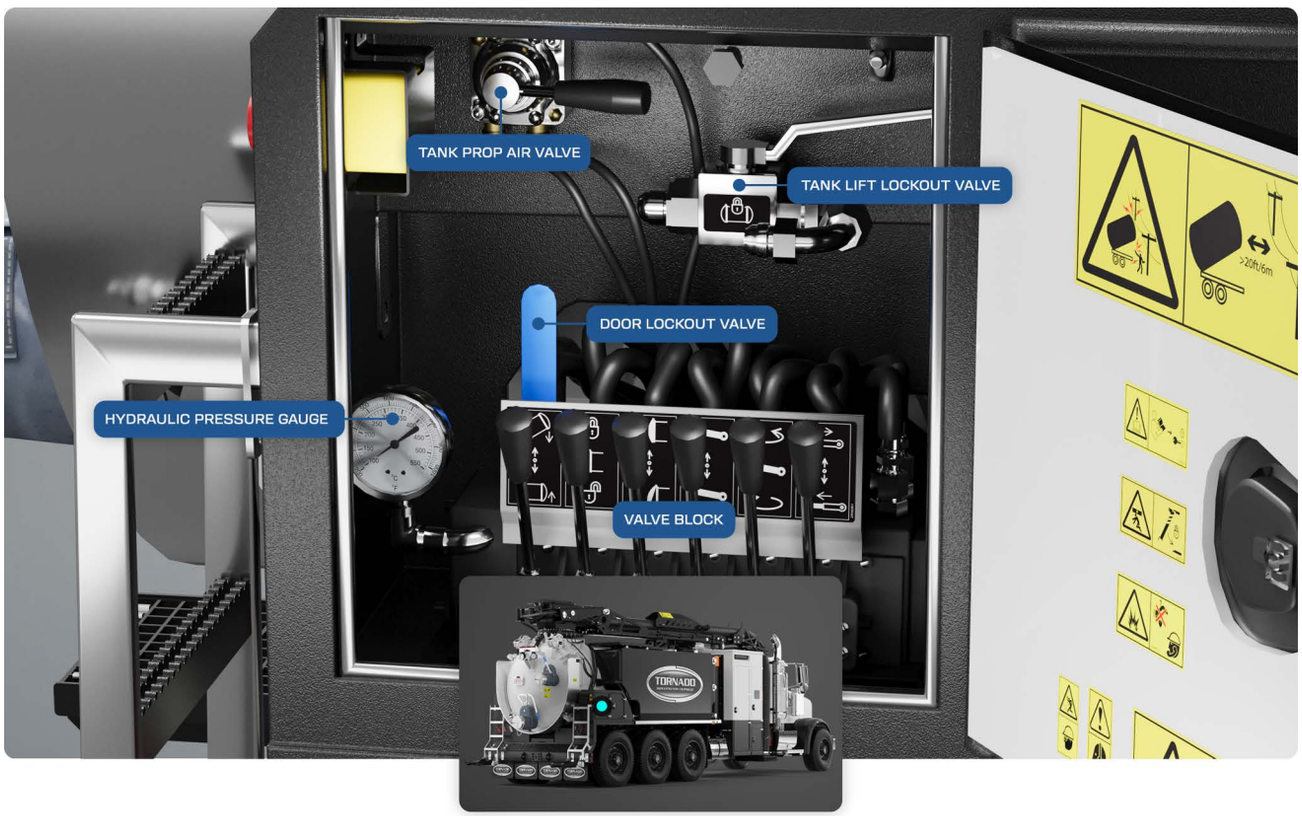
3.8 Mechanical Functions

This section describes the control cabinet and the basic operation of the boom and dump door.

3.8.1 Control Cabinet

The control cabinet—located at the rear passenger side of the truck—contains the control levers, a lockout valve, and a pressure indicator. These components allow the operator to manually control boom movement, to operate the debris tank's dump door, and to control the vacuum breaker.

Figure 3-16. Control Cabinet



CONTROL CABINET	
Item	**Description**
Hydraulic Pressure Gauge	Indicates the pressure in the hydraulic system.
Tank Lift Lockout Valve (See Caution)	Ball valve that locks the tank in position.
Tank Lift Lever (See Caution)	• Push to lower the tank. • Pull to raise the tank.
Door Lockout Valve	Ball valve that locks out operation of the dump door locking clamps when closed.
Door Lock Lever	• Push to lock the dump door. • Pull to unlock the dump door.
Door Lever (See Caution)	• Push to close the dump door. • Pull to open the dump door.
Boom Lift Lever	• Push to lower the boom. • Pull to raise the boom.
Boom Swing Lever	• Push to move the boom left. • Pull to move the boom right.
Boom Extend Lever	• Push to retract the boom. • Pull to extend the boom.
Tank Prop Air Valve (See Caution)	Two-position air valve that moves the tank prop: • Engage Prop • Disengage Prop

CAUTION

- Do not adjust hydraulic valve settings. Improper adjustment may cause damage to equipment and void the warranty.
- The dump door should be opened before operating the tank lift lever to tip the debris tank.
- The tank prop must be engaged any time the tank lift lockout valve is engaged and work is being performed in or under the debris tank. The tank lift lockout valve should be closed when the tank is not being raised/lowered to prevent unwanted movement of the tank.

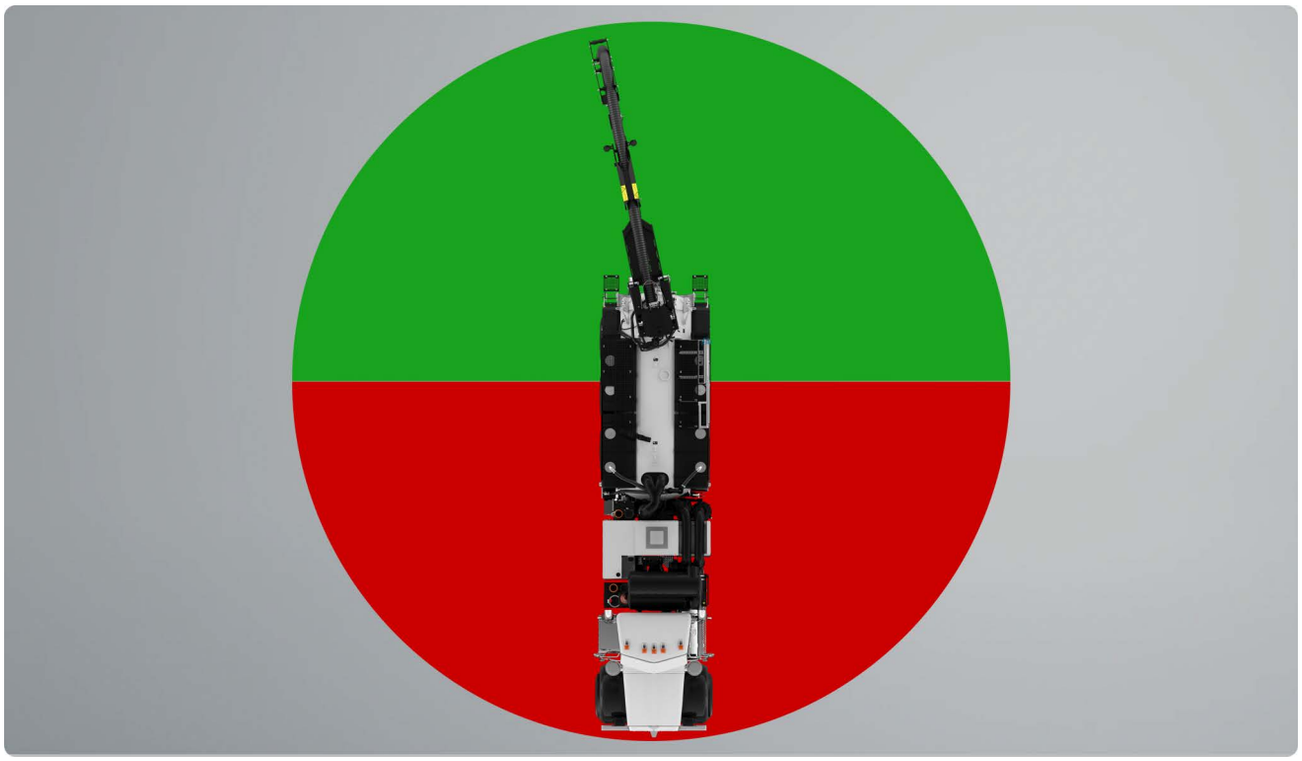
3.8.2 Boom Operation

The boom is used to position the boom hose over the excavation site for debris vacuuming. It can be raised, lowered, extended, retracted, and rotated using the control cabinet levers or the handheld remote controller; however, only the controls in the control cabinet will be referenced in this section for simplicity.

⚠ WARNING!

- Improper operation of the boom can lead to serious injury or death. Critical hazards include overhead power lines, crush injuries, and the high-powered vacuum. Review all safety information prior to operating the boom (see “Chapter 2: Safety Information” on page 14).
- Only operate the boom in the recommended dig zone, toward the rear of the truck. Operating it outside of the recommended dig zone may cause damage to the tank and/or other equipment, and excavating outside of this zone may create a hazard for operators and equipment.

Figure 3-17. Recommended Dig Zone



CAUTION

The boom is not engineered as a lifting device and must not be used to lift, pull, or push other objects. Doing so may damage equipment and void the warranty.

Two operators are required to safely perform this procedure.

1. Verify that all applicable safety precautions have been satisfied before operating the boom.
2. Engage the hydraulics (see “Engaging Hydraulics” on page 41).
3. Pull the boom lift lever to raise the boom out of its cradle.
4. Use the appropriate boom controls to position the boom over the excavation point.

Turn off the blower or open the vacuum breaker while repositioning the boom hose between excavation points to prevent vacuuming unintended objects. The boom, boom hose, and any dig tubes should be securely stowed when not in use (see “Stowed Positions” on page 38).

3.8.3 Dump Door Operation

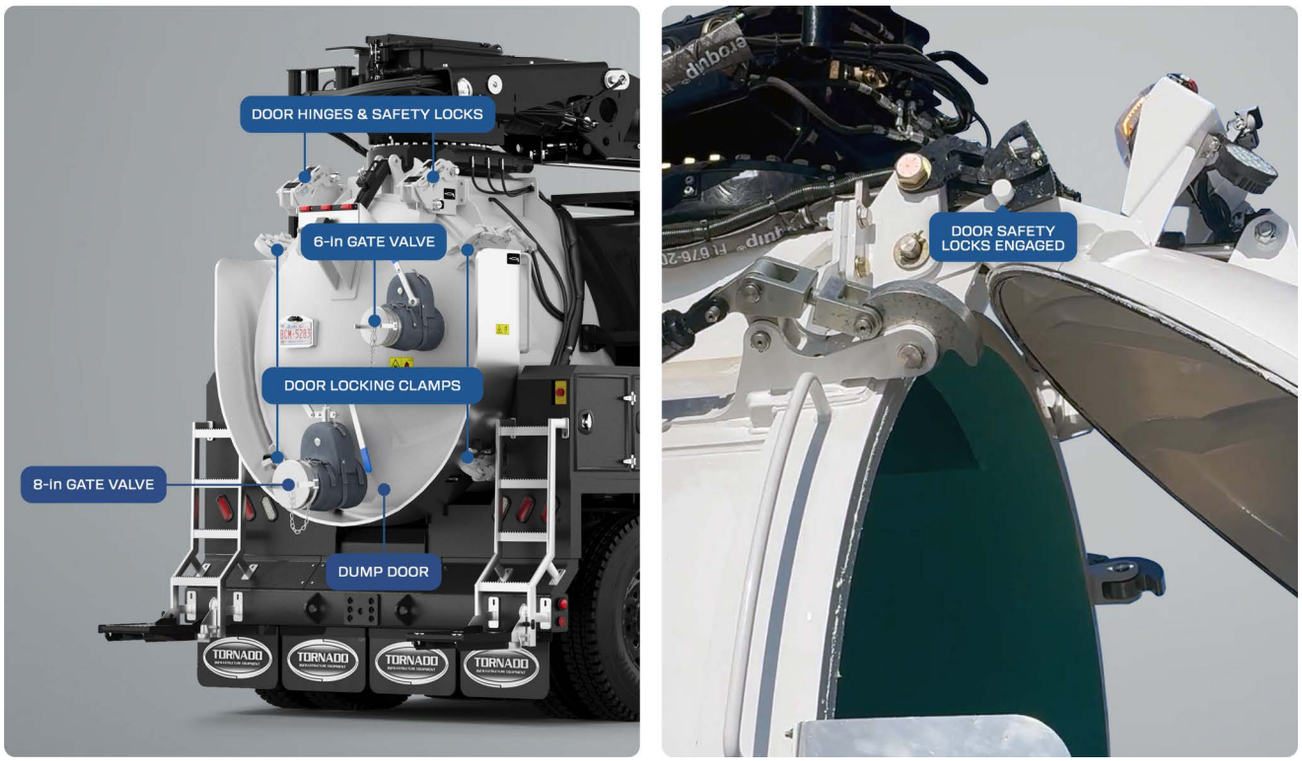
Opening the dump door allows operators to discharge debris from the debris tank or to allow access for maintenance activities. It can be unlocked, locked, opened, and closed using either the control cabinet or the handheld remote controller; however, only the controls in the control cabinet will be referenced in this section for simplicity.

Operators can also connect a hose to the 6 in. gate valve or the 8 in. gate valve to discharge to a storage tank or other discharge point. The 6 in. gate valve allows operators to separate the top layer of immiscible liquids.

⚠ WARNING!

Improper operation of the dump door or improper procedures for accessing the debris tank can lead to serious injury or death. Critical hazards include crush injuries and confined space hazards. Review all safety information prior to operating the dump door (see “Chapter 2: Safety Information” on page 14).

***Figure 3-18.** Dump Door Operation*



To open the dump door:

1. Verify that all applicable safety precautions have been satisfied before operating the dump door.
2. Engage the hydraulics (see “Engaging Hydraulics” on page 41).
3. Ensure operators are standing clear of the rear of the truck, then open the door lockout valve located in the control cabinet.
4. Pull the door lock lever to unlock the dump door, ensuring the door locking clamps are fully retracted to prevent damage while opening.
5. Pull the door lever to open the dump door just until the door safety locks engage (do not open the door fully or the safety locks will not engage), then push the door lever to lower the door until it rests on the safety locks.

NOTE:

- *Always ensure operators are standing clear of the rear of the truck when unlocking and opening the dump door.*
- *See “Confined Space Entry” on page 35 for safety precautions related to working inside the debris tank.*

To close the dump door:

1. Inspect the debris tank, dump door, and door seal to ensure it is safe to close the dump door.
2. Pull the door lever to raise the door fully to disengage the door safety locks.
3. Push the door lever to fully close the dump door, ensuring it is fully closed to prevent damage when locking.
4. Push the door lock lever to lock the dump door, ensuring the door locking clamps are fully extended to ensure a proper seal.
5. Fully close the door lockout valve.

3.9 Water System

The water system includes four interconnected clean water tanks, pump, plumbing, hose reel, and water heater. Two operators are required to safely perform the following procedures.

3.9.1 Water Tank Filling

1. Remove the dust cap from the water fill camlock, located in front of the passenger-side water tanks.
2. Connect a 2 in. water fill hose to the water fill camlock.
3. Connect the other end of the 2 in. hose to the fill station.
4. Start the pump at the fill station.
5. Monitor the sight glasses to confirm water is flowing into the tank.

6. Once the top sight glass is full, stop the pump and let the water settle for 5–10 seconds so it distributes evenly between tanks.
7. Restart the pump and top off the water until the sight glass is full, then stop the pump and shut off the water at the fill station.
8. Disconnect the hose from both the unit and the fill station.
9. Reinstall the dust cap on the water fill camlock.

NOTE: *Stand clear when disconnecting the hose as water will be trapped inside.*

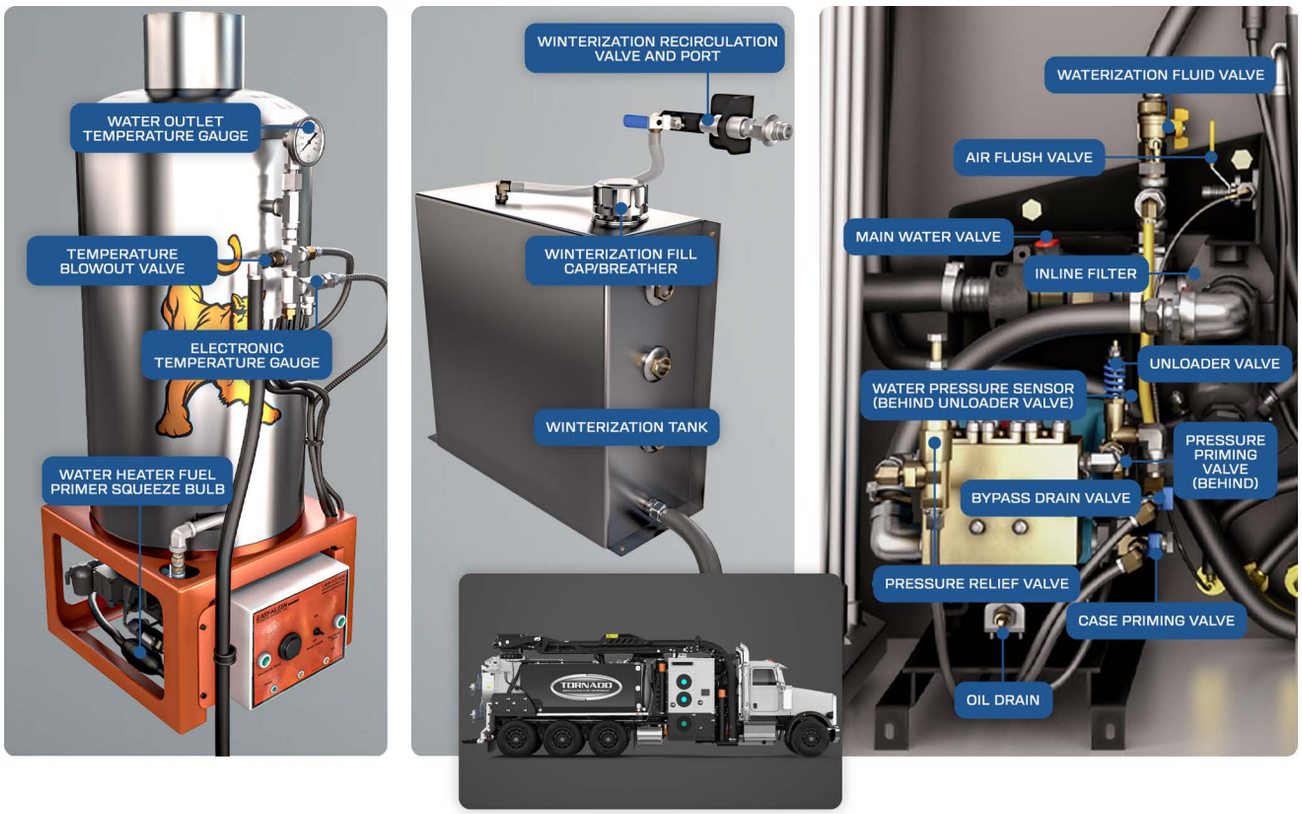
Figure 3-19. *Water Tank Filling*



3.9.2 Water System Controls

Figure 3-20 show the controls for the hydrovac water system.

***Figure 3-20.** Water System Controls*



WATER SYSTEM CONTROLS	
Item	**Description**
Water Outlet Temperature Gauge	Shows the analog water temperature exiting the water heater.
Temperature Blowout Valve	A factory-set safety device that will redirect the water through the valve if the water temperature exceeds 220°F (104°C).
Electronic Temperature Gauge	An electrical temperature sensor. The temperature from this gauge will display on the HMI (see “HMI Widgets” on page 52).
Water Heater Fuel Primer Squeeze Bulb	Primes the water heater’s combustion chamber with diesel fuel from the truck’s fuel tank (see Note).
Winterization Recirculation Valve and Port	Allows winterization fluid to recirculate back into the winterization fluid tank from the dig hose.
Winterization Fill Cap/Breather	Used to add winterization fluid to the holding tank. The cap has a built-in breather.
Winterization Tank	A tank that holds the winterization fluid.
Winterization Fluid Valve	Controls the flow of winterization fluid into the water system plumbing.
Air Flush Valve	Purges water from the system during winterization using high-pressure air from the truck.

WATER SYSTEM CONTROLS	
Main Water Valve	Controls water flow into the water system plumbing.
Inline Filter	A Y-strainer filter that filters large particles from the water prior to it entering the water pump.
Unloader Valve	A factory-set bypass valve that allows manual control of the water pressure in the system and will bypass water back to the water pump inlet manifold.
Water Pressure Sensor	Reads the discharge water pressure for monitoring by the HMI.
Pressure Priming Valve	Used to prime the water pump.
Bypass Drain Valve	Used to drain fluid from the bypass line during winterization.
Pressure Relief Valve	A factory-set safety device to relieve excess system pressure if it exceeds 3200 psi.
Case Priming Valve	Used to prime the water pump and drain air from the water system.
Oil Drain	Used to drain oil from the water pump during service intervals.
Dig Hose Valve (not shown)	Controls the flow of water exiting the hose reel. Connected to the end of the dig hose.
Hose Reel Retraction Valve (not shown)	A momentary lever that retracts the hose reel using high-pressure air from the truck.

NOTE: *If you have to prime the water heater frequently, this may indicate an air leak in the fuel lines.*

3.9.3 De-Winterization and Pump Priming

If the truck is winterized, the water system needs to be de-winterized and the pump primed before it can be used. This procedure starts with winterization fluid reclamation, then moves to pump priming. Two operators are required to safely perform this procedure.

If the truck was not winterized (i.e., no fluid reclamation is required), but there is air trapped in the system that needs to be removed, start this procedure from Step 9.

NOTE:

- *All trucks are winterized from the factory and must be de-winterized during first use.*
- *Winterization fluid will need to be topped up when low and replaced when it becomes too diluted. Replacement periods will vary depending on frequency of winterization and the amount of water still in the system during winterization.*

1. Check the water tank sight glasses to verify there is adequate water available.
2. Engage the hydraulics (see “Engaging Hydraulics” on page 41).
3. Ensure the winterization fluid valve and the internal main water valve are closed.
4. Connect the dig hose valve to the winterization recirculation port.
5. Open the dig hose valve and the winterization recirculation valve.

6. Open the air flush valve 25% and purge the system with air until the clear hose behind the winterization recirculation valve is empty of fluid, indicating the winterization fluid has been reclaimed.
7. Wait approximately 1 minute to allow the system to depressurize following the air purge.
8. Close the dig hose and winterization recirculation valves, then disconnect the dig hose valve from the winterization recirculation port.
9. Have a second operator hold and open the dig hose valve.
10. Open the main water valve.
11. Open the case priming valve for 10–15 seconds or until there is a steady stream of water flowing out under the wash cabinet, then close this valve again.
12. Set the water pump to operate in Manual Mode or Remote Mode, as desired, then engage the water pump (see “Engaging Water Pump” on page 47).
13. Gradually increase the pump speed to 20%. Do not increase the pump speed above 20% until it is fully primed.
14. Allow the pump to run to purge any remaining air from the system (see Note).
15. Disengage the water pump.
16. Close the dig hose valve.

Once all winterization fluid has been purged from the system and the pump is primed, the operator can engage the water system, prepare for excavation, and safely run the pump at a suitable speed for the excavating conditions (see “Excavating with Dig Wand” on page 75). After the system is set up and primed, the water pump can be operated in either Manual Mode or Remote Mode.

NOTE: *If cavitation occurs during the purging session, the pressure side priming valve may be opened to release air from the pump head earlier.*

3.9.4 Engaging Water System

⚠ WARNING!

High-pressure water can cause lacerations and high-pressure injection injuries that lead to serious injuries, health complications, or death (see “Vacuum System and High-Pressure Fluid Hazards” on page 32). Ensure only trained personnel operate the dig wand. Whenever the pump is running, operators must maintain control of the wand and never direct water at people or animals.

NOTE: *Before beginning operations, ensure there is sufficient water in the tank to complete the job.*

If the winterization fluid has been reclaimed and the water pump is fully primed, this procedure can be followed to engage the water system. Two operators are required to safely perform this procedure.

1. Check the water tank sight glasses to verify there is adequate water available.

2. Engage the hydraulics (see “Engaging Hydraulics” on page 41).
3. With the water pump off and the dig hose valve closed, connect the dig wand or other desired attachments to the dig hose valve.
4. Open the main water valve and the dig hose valve.
5. Set the water pump to operate in Manual Mode, then engage the water pump (see “Engaging Water Pump” on page 47), ensuring the dig hose or attachments are aimed in a safe direction.
6. Gradually increase the pump speed to 20%, observing pump behavior to ensure no cavitation is occurring.
7. If pump cavitation is observed, open the pressure priming valve until trapped air is released.
8. Once you verify that no cavitation is occurring, increase the water pump speed to an appropriate level based on excavating conditions (see “Excavating with Dig Wand” on page 75).

To disengage the water system, turn off the water pump and ensure the dig hose valve is open to release any pressure.

3.10 Water Heater System

The water heater is a diesel-fired heating system that warms the truck’s water supply before use. By delivering hot, pressurized water to the digging wand, it allows efficient excavation in frozen or compacted ground, prevents system freeze-ups, and ensures safe, reliable year-round operation.

⚠ WARNING!

- Carbon monoxide exposure or equipment fires may result from improperly used or maintained equipment. Ensure exhaust is safely vented, and follow all safety and maintenance procedures in the water heater manufacturer’s documentation.
- Operators should avoid contact with heated water, plumbing, and internal water heater components that could present a burn risk.

The water heater operates independently of the HMI’s Vortex control system and must be controlled at the heater’s dedicated control panel. Operating procedures, including ignition and shutdown instructions, are provided in the water heater manufacturer’s operations manual and must be followed at all times.

The water system can be engaged before or after turning on the water heater. However, the burner will only ignite once the flow switch detects water moving through the system. If water flow stops, the burner automatically shuts off. Power to the control panel remains on, so unless the water heater is switched off, the burner will automatically reignite once water flow is restored.

NOTE:

- *When shutting down the water heater, you must allow water to continue to run through the unit until the coil is completely cooled to the inlet water temperature.*
- *Pressing any machine stop button will shut off the water flow, disabling the water heater’s burner. If the water heater control switch remains on, the burner will automatically reignite once water flow is restored.*

3.11 Remote Control

Remote control allows the operator to control a number of operating functions wirelessly via a handheld remote controller. This controller communicates with the Aarcomm® receiver located in the rear passenger wash cabinet.

When the handheld remote controller is powered on and linked, its functions will be displayed on the digital screens adjacent to the corresponding control buttons. Press and hold the green button to switch the screen icons and controls to their alternate functions.

Figure 3-21. *Handheld Remote Controller*



3.11.1 Enabling Remote Control

To turn on and link the handheld remote controller to the receiver using the control panel:

1. Power on the receiver by pressing Remote Enable on the panel keypad on the control panel. The button will illuminate blue.
2. Press and hold the red button on the handheld remote controller to begin linking to the receiver.
3. Press and hold the green button on the handheld remote controller.
4. Release the red button on the handheld remote controller.
5. Release the green button on the handheld remote controller.

When the handheld remote controller is successfully linked, the LED light on the remote controller will briefly flash green before turning to solid green. A white strobing beacon light on top of the boom turret will turn on when the handheld remote controller is linked and engaged, showing nearby personnel that the equipment is being remotely operated.

NOTE: *On the main control panel, Remote Enable needs to be toggled on and the rotary dial needs to be set to Remote Mode for the water pump controls to be enabled on the handheld remote controller. See "Engaging Water Pump" on page 47 for details.*

3.11.2 Turning Remote Control Off

Powering off the handheld remote controller requires two steps:

1. Press and release the red button on the handheld remote controller.
2. Press Remote Enable on the panel keypad on the main control panel to disable the remote handheld controller.

3.11.3 Pairing a Handheld Remote Controller

To pair a new or different handheld remote controller to the receiver using the HMI:

1. Ensure the handheld remote controller is off by pressing and releasing the red button.
2. In the HMI, navigate to the Inputs/Outputs screen (see "HMI Inputs/Outputs Screen" on page 60) and select Pair Radio. The icons should highlight green.
3. On the handheld remote controller, press and hold the three round buttons on the bottom left-hand side.
4. Press and hold the red button for 1 second, then release the red button.
5. Release the three round buttons.
6. "Match Mode Successful" will display on the remote controller screen and normal use can continue.

NOTE: *Refer to Aarcomm's documentation for other methods that are available to activate pairing.*

3.12 Pre-Operations Checklist

The following lists outline actions and checks that must be performed before moving or operating the hydrovac truck. These lists outline basic minimum requirements and may not be comprehensive for all cases.

3.12.1 Before Traveling

Every time the hydrovac will be driven, the following checks or actions must be performed beforehand:

- Perform all required equipment inspections and maintenance.
- Ensure the hydrovac is not overweight.
- Verify all equipment is disconnected, closed and locked, and/or properly stowed (see "Transport Positions" on page 39).
- Verify the water pump and water heater are turned off.
- Verify the blower and hydraulics are disengaged.
- Verify the handheld remote controller is returned to its charging station.

- Remove and stow all wheel chocks.
- Verify the beacon and work lights are turned off.
- Ensure all regulatory pre-trip actions are completed.

3.12.2 Before Operating Hydrovac Equipment

Every time operators will be conducting any excavating or dumping operations, the following checks or actions must be performed beforehand:

- Perform all required equipment inspections and maintenance.
- Verify that all job hazard analysis and emergency response requirements are met, including verifying the proper function of all machine stop buttons before starting work.
- Verify that all utility locates (above and below ground) were completed and are clearly identified and that there is sufficient clearance from any power lines.
- Verify that there is sufficient clearance around the equipment for movement, and any excavation sites are located within the recommended dig zone of the truck.
- Verify water and debris tank levels are adequate for the operations being performed.
- Verify the hydrovac is positioned on stable ground and is level.
- Verify the parking brake is set and the wheels are chocked, if appropriate.
- Verify the dump door is fully closed and locked, the door lockout valve is closed, and both rear gate valves are closed prior to excavating.
- Verify the tank is seated in its cradle and the tank lift lockout valve is closed prior to excavating.
- Verify the handheld remote controller is charged and within range, if using.
- Verify the beacon and work lights are turned on, if appropriate.
- Verify the platform handrail is stowed and no personnel are on top of the hydrovac unit.

3.13 Excavation

The following sections describe excavation procedures for the hydrovac systems. Ensure all pre-work actions have been performed prior to starting excavation activities (see “Before Operating Hydrovac Equipment” on page 75).

3.13.1 Excavating with Dig Wand

Prior to starting excavation or similar operations (e.g., cleaning the debris tank), ensure the water system has been de-winterized and the pump has been primed (see “De-Winterization and Pump Priming” on page 70).

⚠ WARNING!

High-pressure water can cause lacerations and high-pressure injection injuries that lead to serious injuries, health complications, or death (see “Vacuum System and High-Pressure Fluid Hazards” on page 32). Ensure only trained personnel operate the dig wand. Whenever the pump is running, operators must maintain control of the wand and never direct water at people or animals.

Two operators are required to safely perform this procedure.

1. Check the water tank sight glasses to verify there is adequate water available.
2. Pull out an appropriate length of dig hose from the hose reel.
3. Connect the dig wand or other attachments to the dig hose valve as desired.
4. Open the dig hose valve, ensuring the dig hose or attachments are aimed in a safe direction.
5. Engage the water system and run the pump at low speed (see “Engaging Water System” on page 71).
6. Increase the water pump speed to the desired level based on both the soil conditions and the material of any utilities being exposed.
7. Optionally, engage the water heater (see “Water Heater System” on page 72).
8. Firmly hold the dig wand over the area to be excavated, ensuring you and others are out of the line of fire. Keep the dig wand moving during operation (see Note).
9. Continuously monitor the water tank fill levels, stopping operation and turning off the water pump when the water level is low (see “Monitoring Operation” on page 77).

NOTE:

- *If water unexpectedly stops spraying from the dig wand nozzle or does not spray as expected, the nozzle may be clogged or damaged. Turn off the hydrovac equipment, close the isolation and dig hose valves, and inspect the nozzle—clean or replace as needed.*
- *Ensure you keep the dig wand moving as directing high-pressure water at the same point for a prolonged time increases the risk of damaging utility lines or pipes.*

3.13.2 Vacuuming Debris with Boom Hose

⚠ WARNING!

The high-powered vacuum can draw in body parts or cause suffocation leading to serious injury or death (see “Vacuum System and High-Pressure Fluid Hazards” on page 32). Never expose yourself or others to the boom hose while the equipment is running. In the event of an emergency, press one of the machine stop buttons on the truck chassis or the control panel to stop suction at the boom hose.

Two operators are required to safely perform this procedure.

1. Engage the hydraulics (see “Engaging Hydraulics” on page 41).
2. Position the boom hose in the area to be excavated.
3. Engage the blower (see “Engaging Blower” on page 42).
4. Close the vacuum breaker to begin suction.
5. Monitor the debris tank fill levels (see “Monitoring Operation” on page 77).
6. Open the vacuum breaker to break suction as needed during operations.

NOTE:

- *Prolonged deadheading (blocked suction) should be avoided. Allow the system to move air occasionally by releasing the dig tube from a sumped position or, if necessary, opening the vacuum breaker.*
- *If opening the vacuum breaker still does not resume airflow, there is a blockage somewhere in the system. Shut down and turn off all systems and resolve the blockage.*
- *Do not throw garbage or cans into the excavation site as they can cause the filter to plug up.*

3.14 Monitoring Operation

Always monitor equipment and material levels during excavation and debris vacuuming. This helps maintain safe and efficient operation.

1. Monitor water tank levels:
   - While excavating with water, always remain aware of the water tank levels by regularly checking the tank sight glasses at the front of the tank.
   - Refill the water tank once levels reach the bottom sight glass to ensure you do not run out of water.
   - Never allow the tank to run dry, as operating the pump without water will cause damage.
2. Monitor debris tank levels and truck weight:
   - Monitor the debris tank level and overall truck weight using the onboard weight scale to stay within legal and safe limits.
   - The debris tank level can also be checked using the inspection port lid on top of the tank. Shut down the vacuum before removing the lid.
   - Overfilling can cause severe damage to the blower.
3. Monitor equipment sensors:
   - Monitor equipment temperatures and other sensor data provided in the HMI to ensure all values are in range (see “HMI Layout and Navigation” on page 50).

CAUTION

Overfilling the debris tank or operating the water pump with an empty water tank can cause serious equipment damage and create unsafe conditions.

***Figure 3-22.** Monitoring Levels*



3.14.1 iWeigh Scale

The iWeigh® scale is an onboard weighing system that measures the weight (load) being carried by the truck by reading air pressure from the rear axle air bags and a strain sensor on the front axle. This option allows operators to read their tare weight and gross vehicle weight using the Air-Weigh app. Scan the QR codes located on the bottom of the steering column (facing the driver's seat) to download the app and access the user guide.

The iWeigh scale is a combined monitoring tool and safety feature. It allows the operator to set alarms that trigger when an overweight condition is detected. These alarms are set independently, so operators can enable either alarm, both alarms, or neither. The alarms are interlocked with the Vortex control system and trigger the following actions when their respective weight threshold is reached:

- **Alarm 1** reduces the truck's engine speed to low idle and opens the vacuum breaker to cut off the vacuum. The vacuum breaker cannot be closed until the operator overrides Alarm 1 by pressing any button on the HMI to dismiss the pop-up message or by increasing the engine speed. Note that once overridden, Alarm 1 will not activate again if more weight is added unless a higher weight threshold is set on the HMI. See "HMI Widgets" on page 52 for more information.
- **Alarm 2** opens the vacuum breaker but does not affect the truck's engine speed. It can be overridden by pressing any button on the HMI to dismiss the pop-up message. Alternatively, the operator can continue working by continuously holding the Vacuum On button of the handheld remote controller to close the vacuum breaker, but the vacuum breaker will open again if the button is released.

NOTE:

- *The truck needs to be on level ground for the weight to be accurate. Pressing TARE on the HMI will zero out the current weight of the truck and display only the weight added to the truck going forward. Care must be taken when calibrating and monitoring the truck's weight.*
- *The alarm value should not be set higher than the truck's gross vehicle weight rating. It is the responsibility of the operator to adhere to legal weight requirements.*
- *Refer to the OEM manual for further details on calibrating and operating the scale.*

3.15 Dumping Debris and System Shutdown

This section outlines the procedures for dumping collected debris and shutting down the hydrovac system. These steps are critical to ensure safe operation and to prevent premature wear or damage to system components. Failure to follow these procedures may result in equipment malfunction, increased maintenance requirements, or safety hazards caused by unexpected component failure.

Additionally, operators must ensure all pre-work actions have been performed prior to starting dumping activities (see "Before Operating Hydrovac Equipment" on page 75).

⚠ WARNING!

- Misuse of the machine can cause death or serious injury. Read and understand the operator's manual and all other safety instructions before use and know how to use all controls. To help avoid injury, only unlatch the door with the tank fully lowered. Do not lift the tank if the dump door is closed. Stay clear of the dump door and the rear of the tank when lifting the tank or operating the dump door.
- Silica dust exposure can cause lung disease and breathing protection should be used. To help avoid injury, use water spray or other means to control dust. Follow US Occupational Safety and Health Administration (OSHA) or other applicable regulating guidelines for appropriate breathing protection or dust control methods.

3.15.1 Emptying Debris Tank

⚠ WARNING!

- The water tank volume must be at or below the bottom sight glass prior to dumping the debris tank.
- Crushing can cause death or serious injury. Ensure the door has opened and is locked into place before working beneath the open door.
- Entering the debris tank without proper confined space entry procedures can result in suffocation, toxic exposure, or entrapment, potentially causing negative health effects or even death. See “Confined Space Entry” on page 35.

CAUTION

- Never drive with the debris tank or the dump door raised.
- Only dump in approved disposal areas. Debris tank contents are considered controlled waste.

NOTE: *It is recommended that the handheld remote controller be used when emptying the debris tank.*

1. Prior to dumping, empty the water tank so that the water is at or below the bottom sight glass.
2. Ensure the boom is in the transport position (see “Transport Positions” on page 39) and haul to an approved dumping location.
3. Park the truck on stable, level ground and ensure the air bag system is fully engaged.
4. Engage the hydraulics (see “Engaging Hydraulics” on page 41).
5. Move the boom to the dumping position (see “Dumping Positions” on page 40).
6. Open the door lockout valve (see “Dump Door Operation” on page 66) and tank lift lockout valve in the control cabinet.
7. Optionally, open the bottom tank gate valve and/or the decant gate valve to partially drain fluid from the debris tank.
8. Ensure the control cabinet and rear toolbox doors are closed and Remote Enable is toggled on at the main control panel (see “Control Panel” on page 45).
9. Push the Door Unlock button on the handheld remote controller to disengage the dump door locking clamps.
10. Push and hold the Door Open button to raise the dump door and empty loose debris. Raise the door until the safety locks engage, then slightly lower the door until it rests on the safety locks.
11. Push the Tank Raise button to raise the debris tank all the way up and engage the tank vibrator using the HMI (see “HMI Widgets” on page 52) to dump all remaining debris.
12. Push the Tank Lower button to lower the tank to a more suitable angle for washing.
13. Remove the wash wand from storage, pull the appropriate length of dig hose from the hose reel, and connect the wash wand.

14. Engage the water pump and adjust the water pressure (see “Engaging Water Pump” on page 47).
15. Use the wash wand to thoroughly rinse the inside of the tank and around the door seal.
16. Push the Tank Lower button to lower the debris tank to the full horizontal position.
17. Push the Door Open button briefly to fully raise the dump door to disengage the door safety locks, then push the Door Close button until the dump door is fully closed.
18. Push the Door Lock button to engage the dump door locking clamps.
19. Close the door lockout valve and the tank lift lockout valve.
20. Move the boom to the transport position and stow the wash wand and dig hose.

***Figure 3-23.** Emptying Debris Tank*



3.15.2 Blower Diesel Flush

To prevent internal corrosion and potential freeze-up in cold climates, the blower must be flushed with diesel after operation whenever moisture buildup on the impeller lobes is suspected (see Note 1). This step is critical for maintaining seal integrity and minimizing blower wear.

⚠ WARNING!

- Diesel is flammable. Use extreme caution during this procedure to avoid contact with hot parts that may ignite the fluid.
- During this procedure, if white smoke is seen from the discharge silencer vent or if a strong diesel odor is suddenly present during flushing, the valve must be released immediately. Do not flush for more than 10 seconds, as excess diesel may damage the air filter and reduce system performance.

1. Open the vacuum breaker.
2. Run the blower at low idle speed for at least 10 minutes to allow sufficient cool down (see Note 2).
3. Close the vacuum breaker.
4. Open and hold the diesel flush valve for 5–10 seconds, then release it (see Note 3).
5. Open the vacuum breaker.

NOTE:

1. *Failure to lubricate the blower can lead to premature seal failure and increased blower lobe wear. In cold climates, failure to lubricate the blower could result in the blower lobes freezing in place, causing damage to the drive components when starting the blower.*
2. *For operations in hotter ambient temperatures, cooling for more than 10 minutes may be required.*
3. *The diesel flush valve is spring-loaded. If the valve does not fully close after being released, it must be replaced immediately to mitigate potential equipment damage.*

Figure 3-24. *Blower Diesel Flush*



3.15.3 System Shutdown

Perform the following steps when shutting down the equipment after excavating or if preparing for transport.

1. If the water heater was used, shut it off and run water through the system until the coil is completely cooled to the inlet water temperature.
2. Disengage the water system. If shutting down in cold weather, winterize the equipment, if applicable (see “Winterization Procedure” on page 83).
3. Return all equipment to its proper transport positions (see “Transport Positions” on page 39).
4. If appropriate, flush the blower with diesel (see “Blower Diesel Flush” on page 81).
5. Run the engine at low idle speed with no load for at least 10 minutes to cool the blower. If the diesel flush procedure was followed, this step is not necessary.
6. Disengage the blower.
7. Disengage the hydraulics.
8. Shut off the truck if finished, or perform the pre-travel actions before transport to another location (see “Before Traveling” on page 74).

CAUTION

Failure to correctly perform the required shutdown steps, including the diesel flush when conditions demand it, can result in significant equipment damage and unsafe operating conditions.

3.15.4 Winterization Procedure

Winterization is an important measure to protect your equipment from damage in freezing temperatures or during prolonged periods of inactivity. Two operators are required to safely perform this procedure.

1. At a suitable dumping location, open all five drain ports on the water tanks.
2. Once water is no longer flowing out of the water tank drains, remove the inline water filter and open the main water valve to drain water from the plumbing system.
3. Engage the hydraulics (see “Engaging Hydraulics” on page 41) and increase the engine speed to operating levels.
4. Open the tank lift lockout valve in the control cabinet.
5. Ensure the control cabinet and rear toolbox doors are closed and Remote Enable is toggled on at the main control panel (see “Control Panel” on page 45).
6. Slightly lift the tank up to about a 20-degree incline.
7. Once water stops flowing from all water tank valves, lower the tank.
8. Close the tank lift lockout valve.
9. Reinstall the inline water filter.
10. Close the main water valve.

11. Pull the dig hose to a suitable location, then open the dig hose valve.
12. Purge as much water as possible from the system by holding the air flush valve open about 25% until water stops coming out, then release the air flush valve to close it. Allow the system to depressurize.
13. Open the winterization fluid valve.
14. Open the case priming valve for 10–15 seconds or until there is a steady stream of winterization fluid, then close the valve.
15. Set the water pump to operate in Manual Mode, then engage the water pump (see “Engaging Water Pump” on page 47), ensuring the dig hose is aimed in a safe direction.
16. Gradually increase the pump speed to 20%.
17. Watch the dig hose valve’s outlet. Once you see winterization fluid coming out, close the dig hose valve for 5–10 seconds, then open the dig hose valve again and disengage the water pump.
18. Close the dig hose valve.
19. Open and close the main water valve two or three times to allow the winterization fluid to get in the middle and the outside of the ball valve.
20. Tag the truck as being winterized.

⚠ WARNING!

Avoid contact with high-pressure fluids and never direct pressurized water toward people or animals (see “Vacuum System and High-Pressure Fluid Hazards” on page 32). Ensure only trained personnel operate the dig wand.

CAUTION

To prevent environmental harm, only perform the winterization process at a suitable dumping location or ensure all winterization fluid is safely captured to prevent environmental release.

3.16 Misting Valve

When vacuuming dry material while no water is introduced otherwise, you can use the misting valve to help control dust and particulates in the debris tank.

3.16.1 Engaging Misting Valve

1. Connect the dig hose to the misting valve port at the rear of the tank.
2. Open the misting valve.
3. Open the dig hose valve.
4. Engage the water system (see “Engaging Water System” on page 71).
5. Run the water pump at 10% (not higher).

To disengage the misting valve:

1. Disengage the water pump.
2. Close the dig hose and misting valves.
3. Disconnect the dig hose from the misting valve port.

3.16.2 Misting Valve Shutdown and Winterization

1. Disengage the water pump.
2. Close the dig hose valve, then disconnect and stow the dig hose.
3. Allow water to drain from the misting valve.
4. Winterize the water system (see “Winterization Procedure” on page 83).
5. Connect the dig hose to the misting valve and open the dig hose valve.
6. Run the water pump for 5–10 seconds to allow winterization fluid to flow through the misting assembly.
7. Disengage the water pump, close the misting and dig hose valves, and stow the dig hose.
8. Tag the misting valve as being winterized.

4 Maintenance

4.1 Maintenance Precautions

In addition to hazards related to regular operation, maintenance activities may also expose workers to hazards that could cause equipment damage, serious injury, or death. Operators and maintenance personnel must read and understand all safety information in this manual, and receive proper training prior to using or working on the hydrovac equipment.

⚠ WARNING!

- Misuse of the machine can cause death or serious injury. Follow all appropriate safety procedures before use. Know how to use all controls.
- Lower any unsecured, raised components and apply all appropriate lockout-tagout procedures before servicing the equipment.
- Unless otherwise instructed, all maintenance should be performed with the engine off and the equipment fully cooled.
- Unless otherwise instructed, all maintenance should be performed with the machine parked on a level surface.

4.2 Washing Precaution

CAUTION

Water can damage electronics. When cleaning equipment, do not spray electrical components with water.

4.3 Welding Precaution

CAUTION

Welding can damage sensitive electronics. Take measures to protect electronic components and refer to the chassis manufacturer's manual for additional precautions related to welding.

Welding can overload sensitive electronic components, permanently damaging them. Prior to welding on any part of the hydrovac:

- Disconnect all electrical connections from the vehicle batteries.
- Connect the welding equipment's ground as close as practical to the welding point and ensure no electronic components are located along the primary current return path.

NOTE: *Refer to the chassis manufacturer's body builder manual for additional precautions.*

4.4 Working on Debris Tank

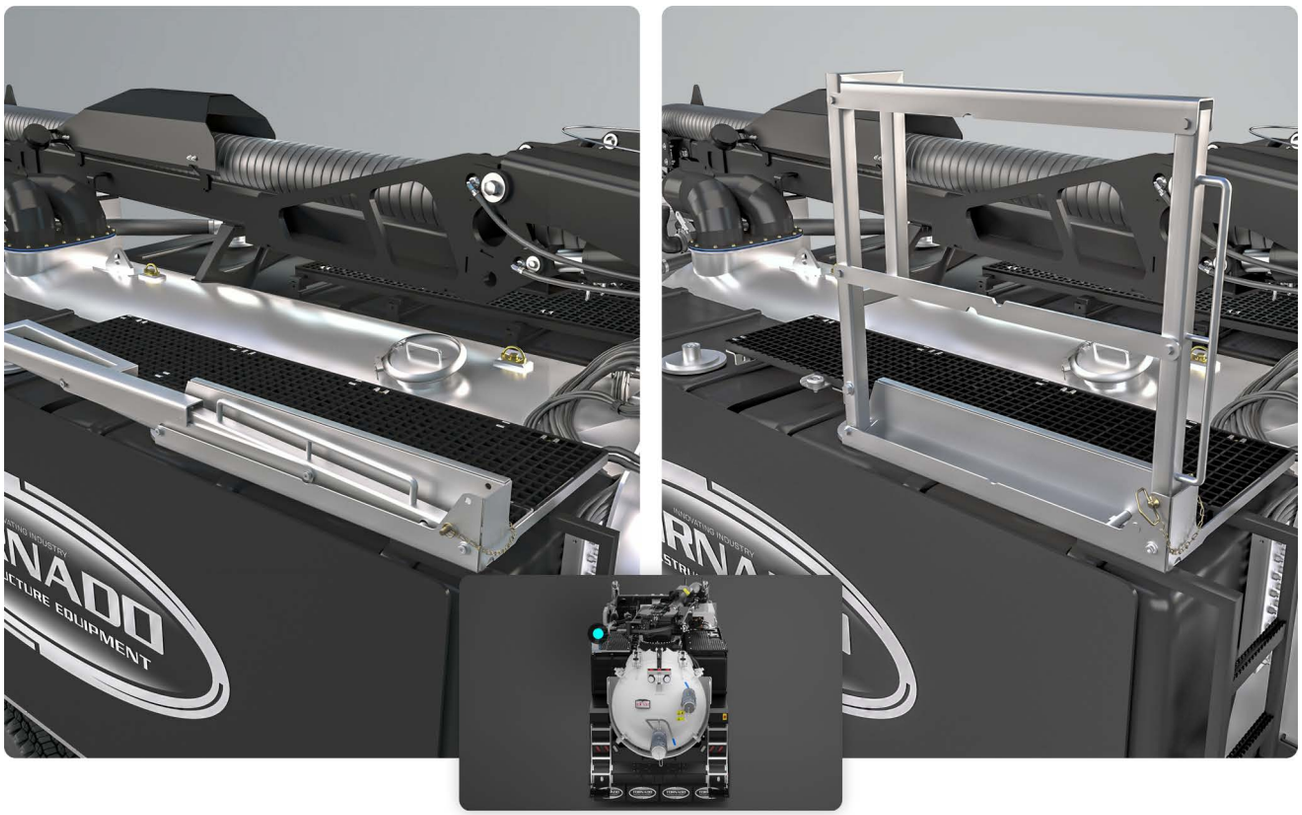
⚠ WARNING!

Falling from heights, failure to avoid pinch points, or collisions with equipment can cause serious injury or death. Fall protection must be used and hydraulic equipment must be safely shut down and locked out while personnel are working at heights (see "Fall Protection" on page 34).

A maintenance platform is available for access to the top of the debris tank when the truck is not in use. The platform can be accessed using the ladder on the rear driver side of the truck. Prior to reaching the top, operators must ensure the handrail is raised and locked. Once on the platform, operators must tie off to one of the available tank anchor points.

The maintenance platform must be inspected prior to use to ensure it is in good condition. The anchor points must also be inspected before use and can only be used for fall protection when properly torqued. If accessing the top of the tank, the hydrovac truck must be shut down and all hydraulic equipment properly locked out. Do not use the platform while the truck is in operation or moving. Always return the handrail to its lowered and locked position after use.

Figure 4-1. *Maintenance Platform and Handrail*



4.4.1 Handrail Operation

CAUTION

Failure to avoid pinch points can cause serious injury. Keep hands and limbs away from moving parts.

The maintenance platform has a handrail that should be raised and locked prior to accessing the top of the platform.

1. Ascend the driver-side ladder to stand on top of the toolbox.
2. Remove the locking pin from the handrail.
3. Lift the handrail into the raised position.
4. Insert the locking pin into the upper bracket hole from the outside of the handrail to secure the handrail in the raised position.
5. Ascend to the maintenance platform and immediately tie off to one of the approved anchor points.

When work on top of the tank is finished, stowing the handrail should also be performed from the toolbox.

1. Disconnect from the anchor point and descend to stand on the driver-side toolbox.
2. Remove the locking pin from the handrail bracket.
3. Lower the handrail.
4. Insert the locking pin into the lower handrail bracket hole to secure the handrail.
5. Descend the ladder to ground level.

NOTE: *Always lower the handrail and lock it into position with the locking pin before transport.*

4.5 Working Under Raised Debris Tank

⚠ WARNING!

- Crushing can cause death or serious injury. Use correct equipment and procedures when raising the debris tank.
- Check for overhead wires and other obstructions before raising the debris tank. Failure to verify tank clearance can result in equipment damage or possible electrocution hazard.
- The tank prop can only be used when the debris tank is empty and the truck is on a level surface. It will not engage if the debris tank is not raised high enough for the tank prop to move into the support position.

1. Move the boom into the dumping position (see “Dumping Positions” on page 40).
2. Open the tank lift lockout valve.
3. Pull the tank lift lever to fully raise the debris tank.
4. Move the tank prop air valve to the Engage Prop position.
5. Slowly lower the debris tank onto the tank prop.
6. Verify the tank prop is properly seated (see Figure 4-2).

***Figure 4-2.** Tank Prop Engagement*



4.6 Hydrovac Maintenance Tasks

The following tables provide a list of periodic maintenance tasks that should be performed to maintain the hydrovac in optimum working condition. Certain maintenance tasks are explained in more detail later in this chapter. If any components are identified to be faulty or worn out, they must be replaced prior to operating the equipment. The definitions of the tasks are as follows:

- **Visual check –** Visually inspect the component.
- **Clean –** Visually inspect and physically clean the component.
- **Lube –** Lubricate the component.
- **Operational check –** Visually inspect the component and operate it in a controlled environment outside of regular operations to test the functionality of related components and determine whether repair or replacements are needed.

4.6.1 Hydrovac Maintenance Daily Tasks

DAILY MAINTENANCE TASKS		
Maintenance Task	**Type**	**Core Location**
All Hoses and Connections	Visual Check	All
Fluid Leaks	Visual Check	All
Machine Stop Buttons	Operational Check	All
Air Filter *(See "Cleaning and Changing Hydrovac Air Filter" on page 100)*	Clean	Chassis

DAILY MAINTENANCE TASKS		
Blower Oil Level *(See "Checking and Changing Blower Oil" on page 98)*	Visual Check	Chassis
Desiccant Breather *(See "Checking and Changing Desiccant Breather" on page 98)*	Visual Check	Chassis
Transfer Case Oil Level *(See "Checking Transfer Case Oil Level" on page 99)*	Visual Check	Chassis
Hydraulic Fluid Level *(See "Checking Hydraulic Fluid" on page 95)*	Visual Check	Wash Cabinet
Inline Water Filter *(See "Cleaning Inline Water Filter" on page 108)*	Clean	Wash Cabinet
Water Pump Oil Level *(See "Checking Water Pump Oil" on page 100)*	Visual Check	Wash Cabinet
Cyclone Cleanout *(See "Cleaning Cyclone" on page 103)*	Clean	Debris Tank

4.6.2 Hydrovac Maintenance Weekly Tasks

All daily maintenance tasks should be performed in addition to the weekly maintenance tasks.

WEEKLY MAINTENANCE TASKS		
Maintenance Task	**Type**	**Core Location**
Grease Points and Manifold *(See "Greasing Hydrovac System Components" on page 102)*	Lube	All
Hydraulic Cylinders	Visual Check	All
Blower Components	Visual Check	Chassis
Blower Diesel Flush *(See Note)*	Lube	Chassis
Water Heater *(See "Water Heater Inspection and Maintenance" on page 108)*	Operational Check	Wash Cabinet
Boom Hose	Visual Check	Boom
Boom Hose Connections	Visual Check	Boom
Rockhead and Deflector Plate	Visual Check	Boom
Wash Wands, Dig Wands, and Dig Tubes *(See "Inspecting Dig Hose and Components" on page 108)*	Operational Check	Equipment

NOTE: *This blower diesel flush may need to be performed more often (potentially daily) in wet or humid conditions (see "Blower Diesel Flush" on page 81).*

4.6.3 Hydrovac Maintenance Monthly Tasks

All daily and weekly maintenance tasks should be performed in addition to the monthly maintenance tasks.

NOTE: *For situations where the hydrovac is operating at a high usage rate (in excess of 200 PTO hours per month), all checks listed below should be performed on a bi-weekly basis.*

MONTHLY MAINTENANCE TASKS		
Maintenance Task	**Type**	**Core Location**
Decals	Visual Check	All
General Damage	Visual Check	All
Battery Cables and Connections	Visual Check	Truck Cab
Blower Run Test – Record Vacuum Pressure *(See "Recording Vacuum Pressure" on page 109)*	Operational Check	Chassis
Isolation Springs	Visual Check	Chassis
Remote Control System	Operational Check	Chassis
Vacuum Breaker	Operational Check	Chassis
Blower Mounting Bolts	Visual Check	Chassis
Silencer Mounting Bolts	Visual Check	Chassis
Tank Prop	Operational Check	Chassis
Control Cabinet Door Sensor	Operational Check	Rear Cabinets
Valve Block	Operational Check	Rear Cabinets
Water Heater *(See "Water Heater Inspection and Maintenance" on page 108)*	Operational Check	Wash Cabinet
Water Pump Isolation Pads	Visual Check	Wash Cabinet
Water Pump Operation	Operational Check	Wash Cabinet
Debris Tank and Dump Door Assemblies *(See "Dump Door and Debris Tank Inspection" on page 104)*	Various	Debris Tank
Water Tank Sight Glasses	Visual Check	Water Tanks
Boom and Turret Assemblies *(See "Boom Inspection" on page 106)*	Various	Boom

4.6.4 Hydrovac Maintenance Annual Tasks

The water heater should be inspected and cleaned either yearly or every 500 water heater hours, whichever comes first (see "Water Heater Inspection and Maintenance" on page 108).

Inspect all electrical connections on the unit annually. Open and inspect the control panel, vibrator connection panel, and Aarcomm® receiver electrical panels for water ingress, corrosion, and loose components, but do not remove the panelboards.

4.7 Maintenance During Periods of Inactivity

When the hydrovac is not in use for extended periods, maintenance must still be performed to prevent component deterioration and ensure reliable startup.

- **Daily and weekly maintenance tasks –** These may be deferred during inactivity, but must be completed before the next operation or at least once every 30 days, whichever comes first.
- **Monthly maintenance tasks –** These must be completed every 30 days, regardless of activity.
- **Blower diesel flush –** Perform at least once every 30 days during periods of inactivity (see “Blower Diesel Flush” on page 81).

The oils and fluids for the hydrovac equipment must be sampled or changed at least once every 12 months, even if the meter-based interval has not yet been reached (see “Recommended Change Intervals” on page 93).

4.8 Change Intervals

4.8.1 Recommended Change Intervals

The following table defines the recommended intervals for changing fluids, filters, and other components in the hydrovac.

MAINTENANCE CHANGE INTERVALS		
Maintenance Task	**Initial Change**	**Routine Change**
Blower Oil	500 blower hours	5000 blower hours
Hydraulic Fluid *(See Note 1)*	N/A	N/A
Transfer Case Oil	100 engine hours	1500 engine hours
Water Pump Oil	50 water pump hours	500 water pump hours
Air Filter	N/A	upon damages
Hydraulic Charge Filter *(See Note 2)*	100 PTO hours	500 PTO hours
Hydraulic Return Filter	100 PTO hours	500 PTO hours
Inline Water Filter	N/A	upon damages
Deflector Plate	N/A	upon damages
Dump Door Seal	N/A	upon damages

NOTE:

1. *Sample hydraulic fluid every 500 PTO hours. Sample must meet or exceed ISO 4406. Change the hydraulic fluid based on sample results.*
2. *Sample oil when a dirty filter warning is displayed on the HMI. Change hydraulic charge filter when dirty or upon listed interval, whichever comes first.*

4.8.2 Recommended Lubricants and Fluids

RECOMMENDED LUBRICANTS AND FLUIDS	
Item	**Description**
Hydraulic Fluid	Chevron Clarity® Hydraulic Oil AW32
CAT PUMPS® Water Pump Lubricant	CAT PUMPS® High Pressure Pump Oil
Transfer Case Lubricant	Mobilube™ 1 SHC 75W-90 or Equivalent
Blower Lubricant	Tennex Factor Synthetic ISO 150
Winterization Fluid	Windshield Wiper Fluid Rated -50°F or Colder

4.9 Changing Hydraulic Charge Filter

The primary hydraulic system charge filter is mounted on the passenger-side exterior rear wall of the wash cabinet and should be changed at the prescribed interval.

To replace the charge filter:

1. Ensure the hydraulic system is shut down and the pressure has been bled from the system by removing the pressure release plug on the bottom of the charge filter.
2. Unscrew the filter canister from the mount.
3. Drain the fluid from the filter canister and remove the filter element and gasket.
4. Inspect the gasket for any signs of damage or wear that might result in leaks. Replace if necessary.
5. Dispose of the used filter element in accordance with local regulations.
6. Inspect the replacement filter element for any signs of shipping or handling damage. Do not install a damaged filter element.
7. Using a clean lint-free rag, clean the filter mounting surface and threads of any debris or contamination.
8. Apply a thin film of clean oil to the gasket and to the filter mounting surface and threads.
9. Install the filter element in the filter canister, and thread the canister onto the mount. Spin the filter canister on until the gasket first contacts the sealing surface.
10. Carefully tighten the filter canister in accordance with the directions on the canister, torquing the canister to 26 ft·lb (35 N·m).
11. Reinstall the pressure release plug, torquing the plug to 20 ft·lb (27 N·m).
12. Bleed any air from the hydraulic system and check for leaks.

NOTE: *Do not overtighten the filter canister or pressure release plug.*

***Figure 4-3.** Charge Filter Replacement*



4.10 Checking and Changing Hydraulic Fluid and Return Filter

CAUTION

Accessing or servicing the closed hydraulic system incorrectly could cause injury or equipment damage. The hydraulic system must be safely depressurized, parts must be installed correctly, and care must be taken to prevent contaminants from entering the system. Only trained personnel should perform these tasks.

4.10.1 Checking Hydraulic Fluid

Use the sight glass at the front of the hydraulic tank to monitor hydraulic fluid levels. Check the fluid level and condition as prescribed (see “Hydrovac Maintenance Daily Tasks” on page 90 and “Recommended Change Intervals” on page 93). New hydraulic fluid can be added via the fill port on top of the tank when appropriate.

Figure 4-4. *Hydraulic Fluid Maintenance*



4.10.2 Changing Hydraulic Fluid

NOTE: *Do not fill or top up the hydraulic fluid if the tank is in the propped position. Doing so will cause a overage of fluid upon lowering the tank cylinder.*

1. Ensure the tank drain valve is closed.
2. Remove the #12 JIC cap from the drain valve.
3. Install the #12 JIC jumper hose to the drain valve and have the other end in a bucket or connected directly to an oil recycling container.
4. Open the tank drain valve.
5. Wait until the flow of hydraulic fluid stops, then close the tank drain valve.
6. Remove the square-head magnetic plug from the bottom of the hydraulic tank. Clean the plug, then reinstall it using a thread sealant approved for hydraulic systems.
7. Remove the #12 JIC jumper hose and reinstall the JIC cap.
8. Fill the hydraulic tank with hydraulic fluid until it reaches the middle of the top sight glass.
9. Run the hydraulic system for about 5 minutes, then shut down and top up the fluid as necessary.

4.10.3 Changing Hydraulic Return Filter

The primary hydraulic system return filter is mounted on the top of the hydraulic tank, inside the wash cabinet.

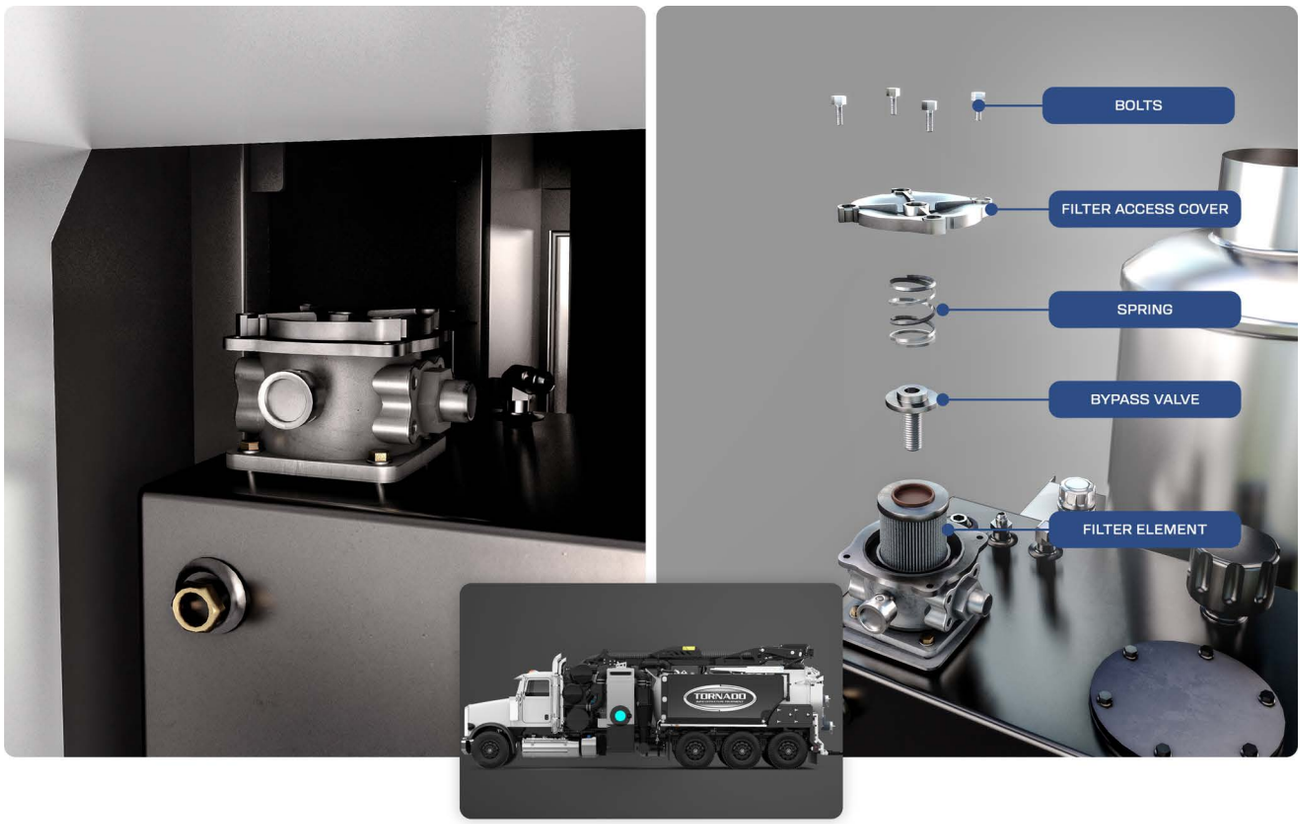
To replace the return filter:

1. Ensure the hydraulic system is shut down and the pressure has been bled from the system.
2. Remove the four bolts and the filter cover.
3. Remove the spring, bypass valve, and filter element.
4. Dispose of the used filter element in accordance with local regulations.
5. Inspect the replacement filter element for any signs of shipping or handling damage. Do not install a damaged filter element.
6. Using a clean lint-free rag, clean the filter mounting surface and threads.
7. Apply a thin film of clean hydraulic fluid to the filter mounting surface and threads.
8. Install the filter element, bypass valve, and spring into the filter housing, ensuring they are properly arranged and seated (see Caution).
9. Install the filter cover and secure it with the four bolts, tightening the bolts evenly across the cover.
10. Bleed any air from the hydraulic system and check for leaks.

CAUTION

To prevent serious equipment damage, care must be taken to install the bypass valve and other parts in the correct orientations. Removal of parts threaded directly into the aluminum tank, such as the return filter housing, should be avoided, but if removed, service personnel must be careful to avoid overtightening threaded components into the aluminum tank.

Figure 4-5. *Return Filter Replacement*



4.11 Checking and Changing Blower Oil and Desiccant Breather

4.11.1 Checking and Changing Blower Oil

The blower oil level should be checked daily prior to running the blower. The blower has two oil reservoirs with sight glasses visible from the driver side and both must be checked. With the equipment parked on level ground and both tanks aired up to above 100 psi, the oil level should reach the top of each sight glass. Add oil via the oil fill ports as necessary (see “Recommended Lubricants and Fluids” on page 94 for the specified lubricant).

Changing oil must also be performed for both reservoirs of the blower. The drain plugs are positioned below the sight glasses.

4.11.2 Checking and Changing Desiccant Breather

The desiccant breather should be inspected daily. The indicator beads will gradually turn from blue to white, and the breather should be replaced once all beads have changed color.

To change the desiccant breather:

1. Loosen the bolts and remove the U-clamp from the top of the breather.
2. Unscrew the breather unit and remove it.
3. Screw in the new breather unit just until the O-ring is fully seated. Do not overtighten.
4. Reinstall the U-clamp and tighten the bolts.

4.12 Checking and Changing Transfer Case Oil

4.12.1 Checking Transfer Case Oil Level

The transfer case oil level should be checked daily.

1. Run the truck for approximately 5 minutes to ensure the cooler circuit is full of oil.
2. Turn the truck off.
3. Immediately check the oil level using the dipstick on the transfer case.
4. Add oil via the oil fill port(s) as necessary (see “Recommended Lubricants and Fluids” on page 94 for the specified lubricant).

CAUTION

The transfer case oil will be hot. Avoid contact to prevent possible burns.

4.12.2 Changing Transfer Case Oil

NOTE:

- *Avoid changing the oil immediately after the truck has been running because the cooler circuit will be full of fluid. Fluid should only be changed after the truck has been off for 3 or more hours to allow the oil to collect in the transfer case and cool down.*
- *The oil capacity of the transfer case and cooler circuit is approximately 3.6 US gal.*

1. Place an oil collection reservoir under the transfer case drain plug.
2. Carefully remove the drain plug and allow all oil to drain out of both the transfer case and the oil cooler circuit.
3. Drain the lines between the secondary hydraulic pump and the oil cooler by disconnecting them at the secondary hydraulic pump.
4. Reinstall and properly tighten the lines you removed and reinstall the drain plug.
5. Fill the transfer case with oil (see “Recommended Lubricants and Fluids” on page 94 for the specified lubricant).
6. Start the truck and run the engine at low idle speed for 5 minutes to allow oil to cycle through the cooler circuit.
7. Turn the truck off.
8. Use the dipstick to check the oil level before using the truck.
9. Dispose of the used fluid in accordance with local regulations.

4.13 Checking and Changing Water Pump Oil

4.13.1 Checking Water Pump Oil

1. Remove the blue cap/dipstick from the middle rear of the water pump.
2. Inspect the dipstick to ensure there is oil on the top set of hashmarks.
3. If necessary, top up the oil.
4. Reinstall the cap/dipstick.

4.13.2 Changing Water Pump Oil

1. Place a small bucket or oil catch pan below the oil drain located in the front center of the water pump.
2. Remove the blue cap/dipstick.
3. Remove the square head cap from the end of the oil drain line.
4. Allow all the oil to flow out.
5. Reinstall the square head cap in the end of the oil drain line.
6. Refill the oil until it reaches the middle of the top set of hashmarks on the dipstick.
7. Run the water pump for 2–3 minutes.
8. Recheck the oil level and top up the oil as necessary.

4.14 Cleaning and Changing Hydrovac Air Filter

The installed hydrovac air filter must be cleaned, fully dried, and inspected before using the blower. Using a dirty or damaged filter element reduces blower efficiency and risks damage to the blower lobes. Carefully clean and inspect the air filter at the end of each shift or immediately if the debris tank is overfilled.

⚠ WARNING!

Silica dust exposure can cause lung disease, and breathing protection should be used. To help avoid injury, use water spray or other means to control dust. Follow US Occupational Safety and Health Administration (OSHA) or other applicable regulating guidelines for appropriate breathing protection or dust control methods.

CAUTION

Handle the filter element with care as operating the hydrovac with a damaged air filter can allow dirt or debris to bypass the filter and enter the blower, causing blower damage or failure.

NOTE: *It is recommended to have two filters to allow one to be drying while the other is in use.*

1. Release the latch on the air filter housing and open the door.
2. Unscrew and remove the wingnut and retaining plate.
3. Grasp the dirty filter element and remove from the filter housing.
4. Clean the dirty filter element using clean, high-volume, low-pressure water and a spray gun attachment. Do not use a pressure wand. Wash downward along the filter pleats to dislodge any debris, until the water runs clean. Work around the filter, then turn the filter over and repeat.
5. Spray from the inside of the filter to flush out any missed debris.
6. Let the filter dry for 24 hours.
7. Inspect the clean and dry filter element and the rubber seals on both ends for any holes, tears, cuts, or other damage that would allow dirt to bypass the filter or otherwise degrade filter performance. If necessary, replace the filter element.
8. Insert and carefully seat the clean, dry filter element onto the retaining ring in the air filter housing.
9. Install the retaining plate and wingnut to secure the filter element.
10. Swing the air filter housing door closed and secure with the door latch.

Figure 4-6. *Air Filter Maintenance*



4.15 Greasing Hydrovac System Components

4.15.1 Greasing Driveshafts

- On the blower driveshaft, apply grease to the grease nipples on the U-joints and slip connection joint until you see it coming out.
- On the transfer case driveshaft, apply grease to the grease nipples on the U-joints and slip connection joint until you see it coming out.

4.15.2 Greasing Dump Door Components

- Apply grease to all five grease nipples on each of the four door locking clamp assemblies (20 points in total) until you see it coming out.
- Apply grease to the grease nipples located at either end of the open and close ram until it is coming out on either side of the ram.
- Apply grease to both door hinge pins until you see it coming out.

4.15.3 Greasing Tank and Boom Components

The tank and boom components are mainly greased via a manifold mounted adjacent to the driver-side rear tank ladder. Apply grease to the fittings on the grease manifold in accordance with the following table. Two operators are required to safely perform this procedure.

TANK AND BOOM GREASE MANIFOLD AMOUNTS

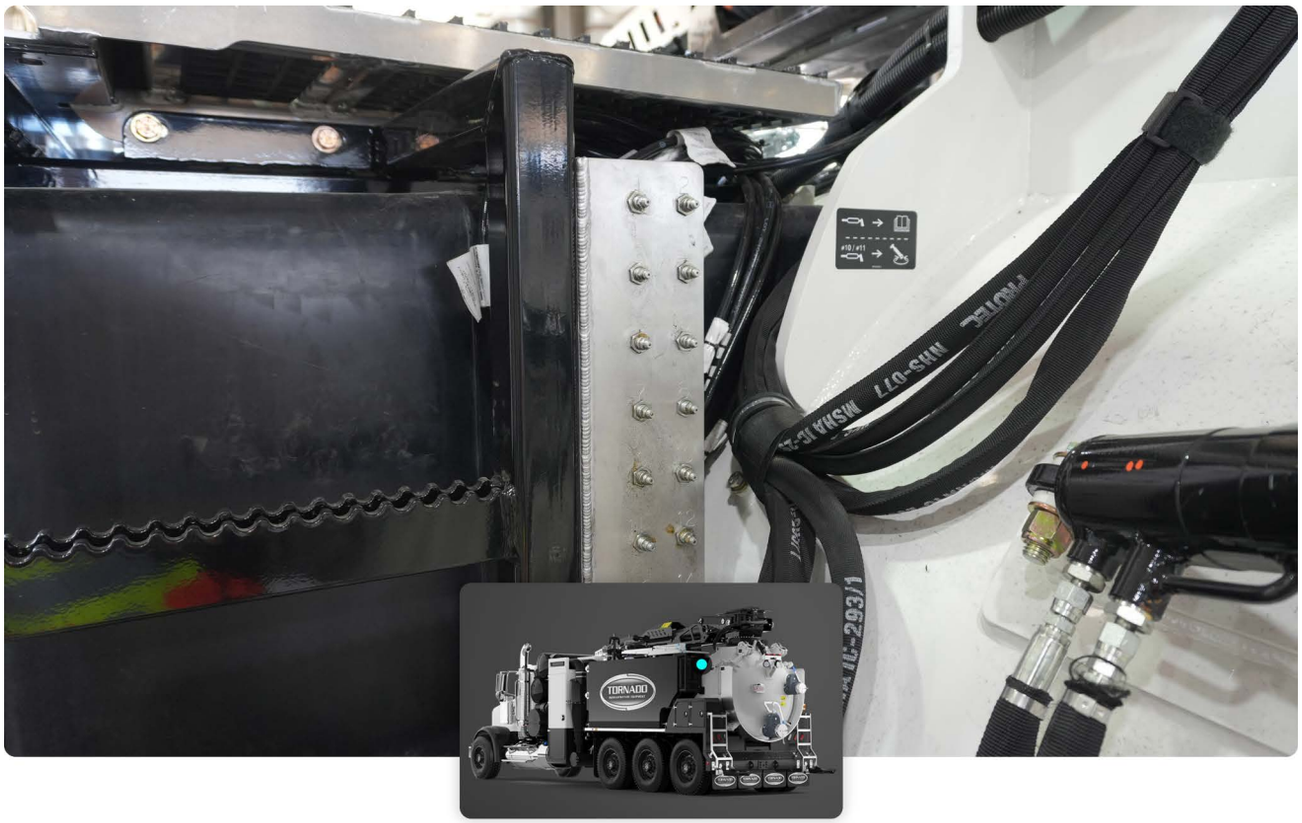
Grease Fitting	Item	Amount of Grease (Number of Pumps)
1	Boom Roller	5
2	Boom Hinge	5
3	Boom Hinge	5
4	Ram Connection	5
5	Ram Connection	5
6	Ram Heel Pin	5
7	Ram Heel Pin	5
8	Turret Worm Bearing	5 (see Note)
9	Turret Worm Bearing	5 (see Note)
10	Turret Open Gear	15 (see Note)
11	Turret Main Bearing	30 (see Note)
12	Tank Lift Cylinder	5
13	Tank Lift Cylinder	5
14	Tank Lift Cylinder	5
15	Tank Lift Cylinder	5

NOTE: *These items require the boom swivel motor to be operating while greasing. Ensure the turret is rotating while applying grease.*

Additionally, apply grease to the following locations:

- Cabinet grease manifold (mounted to the rear of the passenger-side wash cabinet)
  - There are two grease points, one each for the driver-side trunnion block and passenger-side trunnion block (these support the chassis side of the tank lift cylinder assembly).
  - Apply five pumps of grease to each manifold nipple.
- Tank pivot pins (located on the rear fender above the bumper)
  - There are two grease points, one each for the driver side and passenger side.
  - Apply five pumps of grease to each.

Figure 4-7. Grease Manifold and Grease Points



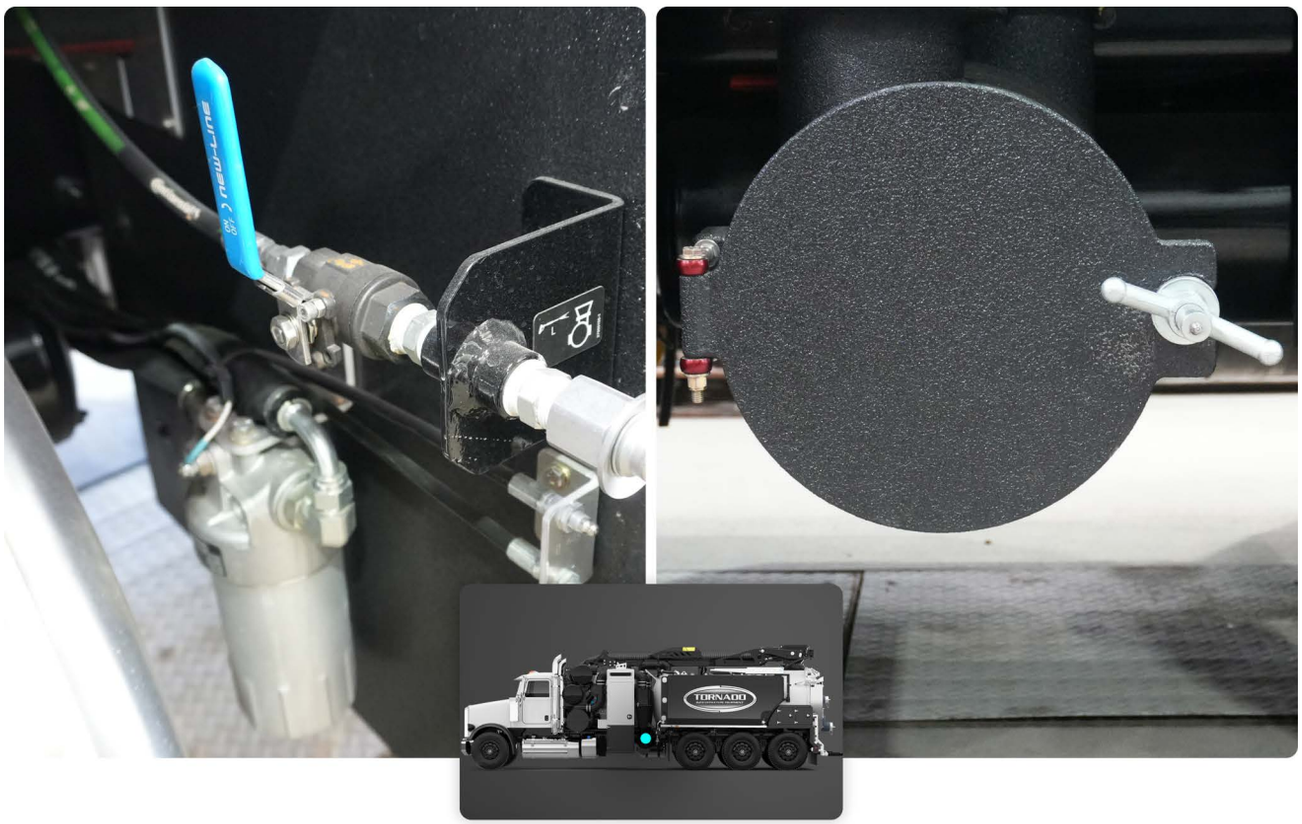
4.16 Cleaning Cyclone

Regular cleaning of the cyclone is essential for extending the lifetime of the blower and hydrovac air filter. Cyclone cleaning should be performed every 10 blower hours or daily, whichever comes first. The cyclone cleanout uses two wash jets to flush debris out of the cyclone.

1. At an approved dumping location, open the cyclone cleanout door located on the driver side of the unit.
2. Connect the dig hose to the cyclone cleanout port located on the rear passenger side of the wash cabinet, and open the cyclone cleanout valve.
3. Engage the water system (see “Engaging Water System” on page 71) and set the water pump percentage to 50%.

4. Run water for approximately 2 minutes, or until the discharge from the cyclone cleanout runs clear.
5. Disengage the water system.
6. Disconnect hoses and perform cleanup.

***Figure 4-8.** Cleaning Cyclone*



4.17 Dump Door and Debris Tank Inspection

1. Inspect the dump door seal for signs of wear, damage, leaks, or other defects that might impair operation. Repair or replace defective components as required.
2. Inspect the dump door surface (inside and outside) for damage or corrosion, and verify the door locking clamps are operating properly. Repair or replace as required.
3. Inspect the door safety locks, hinges, and pins for signs of wear, damage, corrosion, or other defects that might impair operation. Repair or replace defective components as required.
4. Inspect the hydraulic cylinders, hoses, and connections on the dump door, debris tank, and tank lift cylinder for leaks, abrasions, loose or missing components, or other defects that might impair operation. Repair or replace defective components as required.
5. Inspect the debris door's 6 in. gate valve and 8 in. gate valve for signs of leakage, loose or missing hardware, and proper operation of valve levers. Repair or replace defective components as required.
6. Inspect the exterior surfaces and components of the debris tank for signs of wear, damage, corrosion, or other defects that might impair operation. Repair or replace defective components as required.
7. Inspect the interior surfaces and components of the debris tank for signs of wear, damage, corrosion, or other defects that might impair operation. Repair or replace defective components as required.

8. Inspect the shutoff float ball assembly for signs of wear, damage, corrosion, or other defects that might impair operation. Inspect the gasket for wear or damage that might result in leaks. Repair or replace defective components as required.
9. Verify function of the debris tank position sensor by raising and lowering the tank out of and into the cradle, checking that the correct signal is detected for each position on the Inputs/Outputs screen of the HMI (see “HMI Inputs/Outputs Screen” on page 60).

4.17.1 Replacing Dump Door Seal

⚠ WARNING!

- Avoid dump door pinch points and always engage the safety locks to prevent serious crush injuries.
- Wear chemical-resistant disposable gloves while handling super glue, urethane, and other chemicals.
- Avoid sustained overhead work as it can lead to injury.

1. Ensure the truck is turned on and the hydraulics are engaged (see “Engaging Hydraulics” on page 41).
2. Open the dump door and engage the door safety locks (see “Dump Door Operation” on page 66).
3. With the door secured in the open position, reduce the engine speed to low idle and disengage the hydraulics, then turn off the truck.
4. Locate the joint seam of the dump door seal and use the flat edge of a small prybar to pry the seal apart. (See Note 1.)
5. Pull the door seal out of the door groove, using the prybar as needed, until the dump door seal has been fully removed.
6. Clean the dump door’s seal channel thoroughly with a wire wheel or equivalent cleaning tool until bare metal is exposed and all debris and contaminants are removed (see Note 2).
7. Dry fit the rubber seal in the channel to confirm it is the correct length. Do not apply urethane at this stage.
8. Cut the seal ends as square as possible, making sure the edges are flat and the cut is perpendicular to the seal.
9. Apply a thin layer of super glue to one end of the door seal, then firmly press the ends together to form a continuous loop, rubbing them against each other to spread the glue and let air escape (see Note 3). Secure the joint in a bench vice with the rounded edge facing upwards.
10. Spread a small amount of additional super glue just along the accessible rounded edge of the joint, then allow the glued joint to fully cure.
11. Apply black windshield urethane evenly into the channel, just enough to cover the bottom of the groove. Maintain a consistent bead size around the entire perimeter to ensure full seal coverage.
12. Install the door seal into the urethane-filled channel using a large mallet. Position the glued seam at the top center of the door, then work evenly down both sides, alternating back and forth. Complete the installation at the bottom of the door.

13. Generously spray a layer of white lithium grease onto both the door seal and the area of the tank where the door seal makes contact to prevent urethane from bonding to these areas.
14. Turn on the truck, engage the hydraulics, and increase the engine speed to operating levels.
15. Disengage the door safety locks, then close the dump door firmly onto the seal, but do not engage the door locking clamps.
16. Open the dump door and engage the door safety locks, then inspect the seal to ensure it is evenly set into the door groove.
17. Once the door seal is deemed to be properly seated, disengage the door safety locks, then fully close and lock the dump door, ensuring that the door locking clamps are fully engaged.
18. Safely perform the truck shutdown steps (see “System Shutdown” on page 83).
19. Ensure that the dump door remains clamped shut against the door seal until the urethane has fully cured. Do not expose the door seal or urethane to any fluids while the urethane cures.
20. After curing is complete, turn on the truck, engage the hydraulics, and increase the engine speed to operating levels.
21. Unlock and open the dump door, then engage the door safety locks.
22. Clean any excess grease and urethane.

NOTE:

1. *If desired, the dump door can be uninstalled and lifted off of the truck for easier removal and replacement of the door seal (Steps 4–13), but the door must be reinstalled before proceeding with Step 14.*
2. *Ensuring that the door seal channel is free from all debris and contaminants and has proper metal exposure is critical for good urethane adhesion and seal positioning.*
3. *Before gluing the ends of the door seal together, ensure there are no twists in the rubber seal. Do not apply too much glue to the ends.*

4.18 Boom Inspection

Routine inspection of the boom assembly is essential for maintaining safe hydrovac operation and minimizing component wear. Perform the inspections below monthly or every 100 PTO hours, whichever occurs first. Two operators are required to safely perform these procedures.

4.18.1 Boom Mounting Bolts

Inspect all boom turret mounting bolts for correct torque and signs of wear or loosening.

- **Torque specification –** All top (exterior) and bottom (interior) boom turret bolts must be torqued to 285 ft·lb.
- **Torque pattern –** Use the star pattern shown in Figure 4-9 to torque both the interior and exterior bolts. Torque one bolt set completely (top or bottom) before proceeding to the other.
- **Loose hardware –** Any bolts found excessively loose or damaged must be discarded and replaced. Use ¾ in. × 2½ in. Grade 8 bolts with ¾ in. wedge lock washers. Apply Loctite® 242 to threads during installation.

NOTE: *The top (exterior) bolts at positions #2 and #35 are adjacent to a grease nipple. These two bolts require low-profile wedge locking washers.*

Figure 4-9. Boom Mounting Bolts



4.18.2 Boom Structural and Mechanical Inspection

Visually and physically inspect the boom assembly for the following conditions and repair or replace components as needed based on inspection findings.

- **Pivot pins, rollers, and associated fasteners –** Check for wear, looseness, corrosion, or missing components.
- **Boom swivel motor –** Examine for signs of fluid leakage, damage, or irregular operation.
- **Bearing-to-tank seal –** Inspect for deterioration or leaks.
- **Boom cradle sensors –** Place the boom in each cradle position (see “Stowed Positions” on page 38) and verify the correct sensor signal is detected on the Inputs/Outputs screen of the HMI (see “HMI Inputs/Outputs Screen” on page 60).

4.19 Cleaning Inline Water Filter

The inline water filter prevents debris, deposits, and other solid matter from damaging the water pump. To prevent pump damage and ensure efficient operation, the inline water filter must be cleaned daily and the filter screen must be inspected for damage. Damaged filters must be replaced immediately.

1. Unscrew the water filter canister by hand or using an oil filter wrench, if needed.
2. Dump out trapped water from the canister and remove the filter screen.
3. Rinse off the filter screen and canister. If needed, a soft bristled brush can be used to gently clean the filter screen.
4. Inspect the filter screen for damage and replace if needed.
5. Place the filter screen back into the canister. Reinstall the canister into the inline water filter's body by hand. Do not overtighten.

4.20 Inspecting Dig Hose and Components

1. Inspect the dig hose for leaks, cracks, chafing, or other damage that might impair proper operation. Repair or replace defective components.
2. Inspect the washout gun, dig wands, and nozzles for leaks, cracks, or other damage that might impair proper operation. Repair or replace defective components.
3. Inspect the quick disconnects, valves, and hand levers for proper operation. Repair or replace defective components.

4.21 Water Heater Inspection and Maintenance

⚠ WARNING!

Improper operation or maintenance of the water heater may cause burns, fire, explosion, or asphyxiation. The water heater must only use compatible diesel fuel and must never be used without adequate ventilation. All components and plumbing downstream of the heater module can become extremely hot during and after use.

Routine inspection and maintenance of the water heater is important to ensure safe operation and equipment readiness. Damaged, worn, or unclean components can prevent the water heater from starting, reduce performance, or create hazardous conditions.

The following procedures are general guidelines. Always refer to the specific water heater manufacturer's documentation for detailed service intervals, tolerances, and part specifications.

Perform the following steps on a weekly basis:

1. While the equipment is fully cooled, visually inspect all hoses, fittings, and fuel lines for cracks, wear, and signs of leaks.
2. Operate the water heater and perform three heating cycles between 80°F and 120°F. During each cycle, verify that the flow switch works (by momentarily stopping the water flow) and that the burner shuts off automatically once the water reaches 120°F at the heater's outlet.

Perform the following steps yearly or every 500 water heater hours:

1. Check the fuel pressure and adjust if necessary.
2. Inspect the exhaust stack for excessive soot accumulation, then clean and perform further testing if necessary.
3. Inspect and clean the flow switch.
4. Inspect the fuel nozzle and clean if necessary.
5. Measure the flame sensor's electrical resistance during use. Once cooled, clean or replace the sensor if necessary.
6. Look for signs of scaling and perform descaling if necessary.

4.22 Recording Vacuum Pressure

Test the vacuum pressure of the hydrovac each month. Tracking vacuum pressure over time will help identify declines in vacuum efficiency, which may indicate the presence of a system leak.

1. Engage the hydraulics (see "Engaging Hydraulics" on page 41) and the blower (see "Engaging Blower" on page 42).
2. Set the engine to operating speed.
3. Cover the boom hose to deadhead the system (see Note 1).
4. Close the vacuum breaker.
5. Let the system run for 15 seconds to create negative pressure (see Note 2).
6. Record the mercury level on the vacuum pressure gauge (see "Vacuum Pressure Tracker" on page 110).

CAUTION

- The hydrovac generates negative pressure through the boom hose. Do not position your body or other objects near the boom hose opening while the blower is engaged.
- Do not place the board on the boom hose while the vacuum breaker is engaged. Always place the board on while the vacuum breaker is disengaged.

NOTE:

1. *Use the end of the boom hose holder or the boom hose lid (part number HVAC-3731) to cover the boom hose. Alternatively, any flat, sealed surface that can withstand vacuum will suffice.*
2. *If the system has been running for longer than 15 seconds and still has not created negative pressure, it should be inspected for leaks.*

4.22.1 Vacuum Pressure Tracker

VACUUM PRESSURE TRACKER		
Date	Tester	inHg

Appendix A

Hydrovac Options

A.1 Pintle Hitch

An air-compensated pintle hitch is installed on the rear bumper. The pintle hitch is rated for 20 tons and uses the truck air system to hold the drawbar eye closely to absorb shock and reduce wear.

A.1.1 Pintle Hitch Operation

CAUTION

The pintle hitch is designed for use only with compatible pintle hitch trailers. Ensure all required regulatory inspections and practices for towing are performed and that adequately rated safety chains have been properly connected prior to towing.

To open the coupling latch:

1. Rotate the locking pawl up and toward the mounting structure until full rotational travel is reached.
2. Hold the locking pawl in place and rotate the pawl up until it stops on the locking pawl. Hold the pawl in this position.
3. Rotate the latch upward until it stops in the fully open position and hold.
4. Slowly release the pawl. The underside ledge on the pawl will catch the flat front surface of the latch, interlocking the two in the open position. The coupling is now open and ready to couple or uncouple.

To close the coupling latch:

1. Rotate the pawl toward the mounting plate to the fully open position, releasing the latch. The latch should rotate freely down until stopped by the top of the pintle (see Note).
2. Release the pawl. It will swiftly rotate down and engage the latch at its matching machined face. The locking pawl will also rotate down into its closed position in the recessed pocket of the pawl. The coupling latch is now closed.
3. Verify it is properly latched by applying an upward force to the bottom of the latch. There should be minimal movement and the latch should not open. If the latch opens, do not use it until the pintle hitch assembly has been repaired or replaced.

NOTE: *If the latch does not freely rotate down, inspect, clean, and lubricate the rotation point prior to further use.*

Warranty Policies & Procedures

Warranty Coverage

1. **One (1) Year Comprehensive Warranty (the "Comprehensive Warranty")**. Subject to the exceptions, exclusions, and limitations set out herein, Tornado Infrastructure Equipment (North America) Inc. ("Tornado") will warranty each new Tornado Infrastructure Equipment Unit (each a "Unit") to be free from factory defect in material, workmanship, and design error under normal use and service, when operated in accordance with Tornado's factory instructions as contained in the decal instructions, owner's manuals, or other user guidelines provided by Tornado in respect of the applicable Unit, for ONE (1) YEAR (the "Coverage Period") from the date of delivery to the original purchasing end user (the "End User"). Tornado shall not cover, nor shall Tornado be responsible for any costs incurred in connection with repairs made to any Unit outside the Coverage Period or where the Warranty Claim Procedure (as set out and defined herein) has not been followed. Tornado's obligations under this warranty are limited to the repairing of or supplying of replacement parts in exchange for any parts that are defective due to factory material, workmanship, or design error. If a defect in material, workmanship, or design is found during the Coverage Period, Tornado will provide, in Tornado's sole discretion, new, re-manufactured, or Tornado approved repair parts or assembled components needed to correct such covered defects.

   THE EXPRESS WARRANTIES OUTLINED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, AND TERMS AS TO QUALITY, FITNESS, OR PERFORMANCE OF THE GOODS, WRITTEN, ORAL, OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OR CONDITIONS OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND ALL SUCH OTHER WARRANTIES, CONDITIONS, AND TERMS ARE HEREBY DISCLAIMED AND EXCLUDED.

   The End User's sole and exclusive remedy with respect to the quality, performance, or fitness of the applicable Unit shall be as provided in the express warranties described above and Tornado shall have no liability with respect to any non-conformance of or defect whatsoever in the Unit (including any liability for loss of use, revenue or profit, or any other direct, indirect, special, incidental, or consequential damages) whether in warranty, contract, tort, negligence, strict liability, or otherwise.

2. **Warranty on Demonstration Units.** Where any Unit is used as a demonstration or rental unit, in order for an End User of such Unit to qualify for the Comprehensive Warranty, the Unit used as a demonstration or rental unit shall be registered by Tornado under the Comprehensive Warranty as of the date of the first usage of the Unit as a demonstration or rental unit (the "In-Service Date"). For certainty, the period of coverage of the Comprehensive Warranty on any Unit used as a demonstration or rental unit will only run from the In-Service Date specified for such Unit, notwithstanding any subsequent sale of the Unit to an End User. Demonstration units will be classified as In-Service upon first use of that unit for demonstration purposes, and therefore the warranty period will be active for the predetermined time of one year from the In-Service Date.

3. **No Warranty on Third Party Components**. The Unit may include parts or components manufactured by a third party, including, without limitation, those components listed in Schedule "A" hereto (the "Third Party Components"). Tornado does not warrant Third Party Components not manufactured by Tornado. In the case of Third Party Components, Tornado's liability shall be limited to assisting the End User in enforcing the warranty, if applicable, of the manufacturer of the Third Party Components. To the extent that any Third Party Component is warranted by their original manufacturers, and to the extent that such warranty is assignable to End User, Tornado shall assign to the End User any rights and remedies it has relating to such Third Party Component. In no manner shall the foregoing be considered an indemnity or guarantee by Tornado in relation to any warranty offered by a third party in relation to a Third Party Component.

Tornado shall not be liable in respect of any Third Party Component, and shall not be obligated to perform its obligations hereunder in respect of any Third Party Component, to the extent that such Third Party Component is discontinued and in relation to which a standard or drop-in replacement is no longer readily available.

4. **No Warranty on Consumables**. The Unit may contain parts or components in relation to which progressive degradation is expected during the use or operation of the Unit, including, without limitation, seals, bearings, fluid, hoses, coatings, rigging, and other parts, components, or items of a like nature or kind ("Consumables"). The Comprehensive Warranty specifically excludes all Consumables, and Tornado does not warrant or represent the useful life of any Consumable or shop supplies. Tornado will not pay for any shop supplies, bolts, glue, or misc. wiring.
5. **Warranty Registration**. The End User must complete and send to Tornado a warranty registration form for each new Unit within 30 days of delivery to the End User to ensure that the Unit is eligible for warranty. Tornado may, in its sole discretion, refuse warranty coverage in respect of any Unit for which a warranty registration has not been properly filed with Tornado.
6. **Exclusions**. Tornado reserves the right to deny Warranty coverage, in full or in part, if Tornado determines, in its sole discretion, that any serial number on the Unit has been tampered with or removed or that the damage to or deterioration of the Unit is caused by unauthorized or improper use, operation, transportation, or maintenance including, without limitation:
   a. unauthorized repair, alteration, or modification including but not limited to repair, alteration, or modification or parts used in connection therewith not conducted or authorized in writing by Tornado;
   b. use of improper fuels, lubricants, oils (including but not limited to unfiltered oil, dirty oil, and used oil), or other fluids;
   c. collisions, natural disasters, or acts of nature;
   d. improper methods of shipping, transporting, and storage of the Unit; and
   e. failure to follow decal instructions, owner's manuals, or other user guidelines supplied by Tornado with the Unit.

   Tornado recommends that the End User retain all certifications and records of regular maintenance of the Unit, as these documents may be important for purposes of determining the cause of any malfunction or damage to the Unit.
7. **Service Calls Excluded**. The Comprehensive Warranty excludes service calls to and from the site of the Unit. It is the responsibility of the End User to either transport the Unit to the repair facility of Tornado or a Tornado authorized repair facility, or pay the costs of having a Tornado authorized repair person attend to the End User's location.

Warranty Claim Procedures

1. Any and all warranty claims under the Comprehensive Warranty are subject to Tornado's prior approval. The End User shall follow the following process (the "Warranty Claim Procedure") in respect of each warranty claim which is covered by the Comprehensive Warranty (each a "Claim"):
   a. Prior to the commencement of any work on a Unit to be covered by the Comprehensive Warranty, the End User must give notice in writing to Tornado's Warranty Manager or Service Department of the Claim within thirty (30) days of becoming aware of such Claim, together with sufficient particulars of the Claim (including pictures of the damage to the Unit) as may be reasonably required by Tornado's Warranty Manager or Service Department. The failure of the End User to give written notice of a Claim within the aforementioned thirty (30) days shall be a complete bar to such Claim under the Comprehensive Warranty.

b. Upon notification of a Claim from the End User, Tornado's Warranty Manager or Service Department shall review the Claim to determine if the Claim is covered by the Comprehensive Warranty. If required, Tornado's Warranty Manager or Service Department may require and/or authorize further diagnoses and inspections of the Unit to confirm that the Claim will be covered under the Comprehensive Warranty. Where applicable, upon Tornado providing its prior approval to complete any necessary diagnoses or inspections of a Unit which is subject to a Claim, the End User shall, within a reasonable time, make the Unit available to Tornado or a Tornado authorized repair facility to complete all necessary diagnoses and inspections to confirm that the Claim is covered under the Comprehensive Warranty.

c. Upon Tornado confirming that the Claim will be covered by the Comprehensive Warranty, the End User shall, within a reasonable time, make the Unit available to Tornado or a Tornado authorized repair facility to complete all necessary repairs.

d. Where the repairs will be completed by a Tornado authorized repair facility, the End User shall, before causing any repairs to be made to the Unit, provide Tornado with a complete summary and total cost estimate of the required repairs to be completed by a Tornado authorized repair facility, which summary shall include such approval forms and other digital documentation as may be required by Tornado, in its sole discretion (collectively, the "Warranty Claim Estimate") for Tornado's Warranty Manager's prior written approval. Upon Tornado's Warranty Manager granting their prior written approval of the Warranty Claim Estimate, the End User shall cause all required repairs to be completed in accordance with the costs and estimates as set out and approved in the applicable Warranty Claim Estimate. Any amendments to a Warranty Claim Estimate shall be subject to Tornado's Warranty Manager's prior written approval.

2. Any replacement part will be either a new, re-manufactured, or Tornado approved part.

3. Tornado shall not be responsible for any claims or costs associated with any repairs made to any Unit without Tornado's prior written authorization. Notwithstanding the foregoing, Tornado may, in its sole and absolute discretion, review any such after the fact warranty requests on a case-by-case basis.

4. Tornado reserves the right to charge the End User for costs associated in investigating complaints which are found to be caused by problems not associated with a defect in Tornado material, workmanship, or design error.

Schedule A - Third Party Components

- Chassis
- Blower
- Hydraulic System
- Third Party Paint