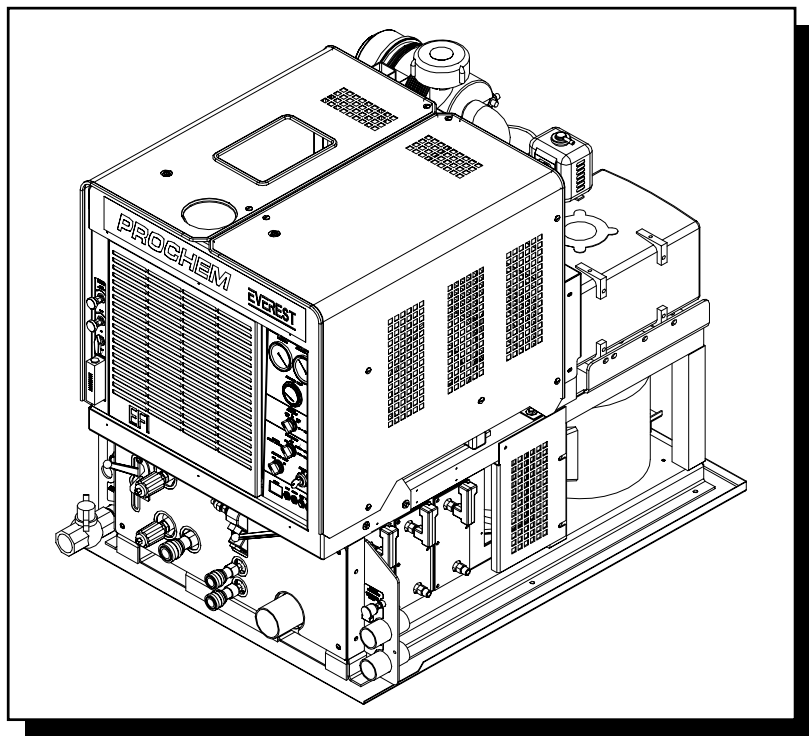


# EVEREST EFI **PROCHEM**®

Operating Instructions (ENG)



MODELS: **EVEREST EFI LP**  
**EVEREST EFI HP**

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***Read instructions before operating the machine.***

<b>MODEL</b> _____
<b>DATE OF PURCHASE</b> _____
<b>SERIAL NUMBER</b> _____
<b>SALES REPRESENTATIVE #</b> _____

<b>YOUR DEALER</b>
<b>NAME:</b> _____
<b>ADDRESS:</b> _____
<b>PHONE NUMBER:</b> _____

**Welcome**...and congratulations on the purchase of your Mobile Cleaning Unit. This instruction manual is a guide for operating and servicing your unit. **Read this manual completely before installing or operating this unit.** This unit offers you personal convenience. All of your instrumentation and controls have been positioned to give you easy access for operation and daily maintenance.

Proper operation and service are essential to the efficient functioning of this unit. When maintained correctly, this unit will have a long, trouble-free life.

The service methods described in this manual are explained in such a manner that servicing may be performed accurately and safely. Proper service varies with the choice of procedure, the skill of the mechanic, and the tools or parts available. Before attempting any repair, make certain that you are thoroughly familiar with this equipment and are equipped with the proper tools. Any questions pertaining to operating or servicing this unit should be directed to your nearest dealer.

***THIS UNIT MUST BE INSTALLED BY THE DEALER FROM WHOM YOU PURCHASED IT IN ACCORDANCE WITH THE PRESCRIBED INSTALLATION PROCEDURES.***

MAKE CERTAIN THAT THE WARRANTY CARD IS FILLED OUT AT THE TIME OF INSTALLATION AND IS RETURNED TO YOUR DEALER.

PROFESSIONAL CHEMICALS CORPORATION  
325 SOUTH PRICE ROAD  
CHANDLER, ARIZONA 85224

Information in this document is subject to change without notice and does not represent a commitment on the part of Professional Chemicals Corporation.

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# RECEIVING YOUR UNIT

## ACCEPTANCE OF SHIPMENT

Every part of your cleaning unit was carefully checked, tested, and inspected before it left our manufacturing plant. **Upon receiving the unit, make the following acceptance check:**

1. The unit should not show any outward signs of damage. If damaged, notify the delivering carrier immediately.
2. Check your equipment and packing list. The cleaning unit should arrive equipped with the following items (unless otherwise specified).

**NOTE: Your distributor from whom you purchased this mobile cleaning unit is responsible for the correct installation of this machine. The dealer is also responsible for initial training of your operators and maintenance personnel in the proper operation and maintenance of this unit.**

## EQUIPMENT LIST:

1. Console.
2. Waste tank
3. Hose clamps for vacuum hoses.
4. 150 ft. of 2" vacuum hose.
5. 2 vacuum hose connectors.
6. 150 ft. of 1/4" high pressure hose with quick connects.
7. 50 ft. water supply hose with quick connect.
8. Installation bolting kit.
9. Installation mounting plates.
10. Operation and service manual for engine, water pump, and vacuum pump manuals.
11. Fuel Pump Assembly and Power Cord.

## HOW TO USE THIS MANUAL

This manual contains the following sections:

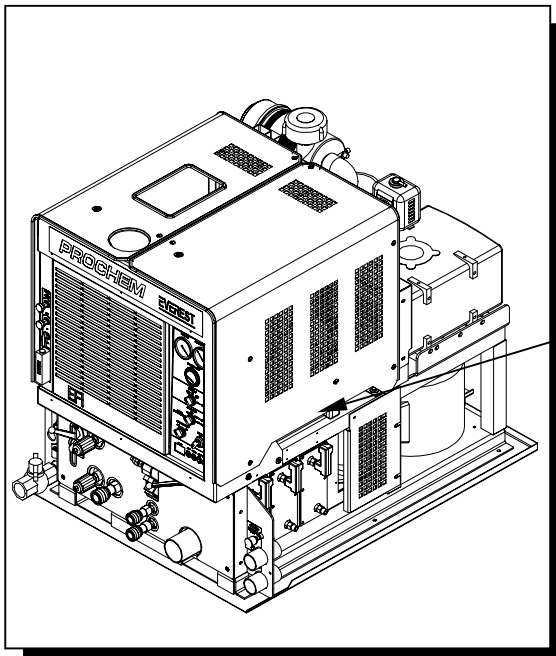
- HOW TO USE THIS MANUAL
- SAFETY
- INSTALLATION REQUIREMENTS
- SYSTEMS
- OPERATIONS
- MAINTENANCE & SERVICE
- PARTS LIST

The HOW TO USE THIS MANUAL section will tell you how to find important information for ordering correct repair parts.

Parts may be ordered from authorized dealers. When placing an order for parts, the machine model and machine serial number are important. Refer to the MACHINE DATA box which is filled out during the installation of your machine. The MACHINE DATA box is located on the inside of the front cover of this manual.

MODEL _____
DATE OF PURCHASE _____
SERIAL NUMBER _____
SALES REPRESENTATIVE # _____

The model and serial number of your machine is on



the side approximately where shown.

The SAFETY section contains important information regarding hazard or unsafe practices of the machine. Levels of hazards is identified that could result in product or personal injury, or severe injury resulting in death.

The OPERATIONS section is to familiarize the operator with the operation and function of the machine.

The MAINTENANCE section contains preventive maintenance to keep the machine and its components in good working condition. They are listed in this general order:

- Engine
- Vacuum Pump
- Water Pump
- Drive Belts, Pulleys & Hubs
- Chemical Pumps
- Hoses
- Vac/Exhaust Heat Exchanger
- General Service Adjustments
- Troubleshooting

The PARTS LIST section contains assembled parts illustrations and corresponding parts list. The parts lists include a number of columns of information:

- **REF** – column refers to the reference number on the parts illustration.
- **PART NO.** – column lists the part number for the part.
- **DESCRIPTION** – column is a brief description of the part.
- **SERIAL NO. FROM** – column indicates the first machine the part number is applicable to. When the machine design has changed, this column will indicate serial number of applicable machine. The main illustration shows the most current design of the machine. The boxed illustrations show older designs. If column has an asterisk (\*), call manufacturer for serial number.
- **NOTES** – column for information not noted by the other columns.

**NOTE: If a service or option kit is installed on your machine, be sure to keep the KIT INSTRUCTIONS which came with the kit. It contains replacement parts numbers needed for ordering future parts.**

**NOTE: The 98# on the lower left corner of the front cover is the part number for this manual.**

# IMPORTANT SAFETY INSTRUCTIONS

When using this machine, basic precautions must always be followed, including the following:

## READ ALL INSTRUCTIONS BEFORE USING THIS MACHINE.

### **WARNING:**

These symbols mean **WARNING** or **CAUTION**. Failure to follow warnings and cautions could result in fatality, personal injury to yourself and/or others, or property damage. Follow these instructions carefully!

### **CAUTION:**

**Read the operator's manual before installing or starting this unit.** Failure to adhere to instructions could result in severe personal injury or could be fatal.

**Operate this unit and equipment only in a well-ventilated area.** Exhaust fumes contain carbon monoxide which is an odorless and deadly poison that can cause severe injury or fatality. **DO NOT** run this unit in an enclosed area. **DO NOT** operate this unit where the exhaust may enter any building doorway, window, vent, or opening of any type.

**Gasoline is extremely flammable and its vapors can explode if ignited.** Store gasoline only in approved containers, in well-ventilated, unoccupied buildings away from sparks or flames. Never carry any gasoline or flammable material in the vehicle. Fumes may accumulate inside the vehicle and ignite, causing an explosion.

**DO NOT** store any type of flammable material in the vehicle.

**This unit must be operated with the vehicle or trailer doors open in order to ensure adequate engine ventilation.**

**DO NOT operate engine if gasoline is spilled.** Avoid creating any ignition source until the gasoline has been cleaned up. Never use gasoline as a cleaning agent.

**DO NOT place hands, feet, hair, or clothing near rotating or moving parts.** Avoid any contact with moving parts! Rotating machinery can cause injury or fatality.

**Never operate this unit without belt guards or heat guards.** The high speed moving parts, such as belts and pulleys, should be avoided while this unit is running. Severe injury, damage, or fatality may result.

**DO NOT service this unit while it is running.** The high-speed mechanical parts as well as high temperature components may result in severe injury or severed limbs.

**Never touch electrical wires or components while the engine is running.** They can be sources of electrical shock.

**Engine components can get extremely hot from operation.** To prevent severe burns, **DO NOT** touch these areas while the engine is running - or immediately after the engine is turned off.

**DO NOT touch the exhaust system while this unit is running.** Severe burns may result.

**Before servicing this unit, allow it to "cool down."** This will prevent burns from occurring.

**Water under high pressure at high temperature can cause burns, severe personal injury, or fatality.** Shut down machine, allow to cool down, and relieve system of all pressure before removing valves, caps, plugs, fittings, filters, and bolts.

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## READ ALL INSTRUCTIONS BEFORE USING THIS MACHINE.



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**Water under high pressure at high temperature can cause burns, severe personal injury, or fatality.** Shut down machine, allow to cool down, and relieve system of all pressure before removing valves, caps, plugs, fittings, filters, and bolts.



**DO NOT leave the vehicle engine running while operating this unit.**

**Dangerous Acid, Explosive Gases!** Batteries contain sulfuric acid. To prevent acid burns, avoid contact with skin, eyes and clothing. Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.

Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present. When disconnecting the battery, **ALWAYS** disconnect the negative (-) terminal FIRST.

**DO NOT smoke around the unit.** Gas fumes may accumulate and be ignited. The battery is also extremely flammable. This will prevent possible explosions.

**DO NOT damage the vehicle in any manner during installation.** When routing fuel lines **DO NOT** place the hose in any location where damage may occur to the hose or vehicle. Avoid any contact with moving parts, areas of high temperature, brake lines, fuel lines, muffler, catalytic converter, or sharp objects.

**DO NOT cut or splice any of the vehicle fuel lines during fuel line installation.** This may result in fuel leaks and potentially dangerous conditions. There is no fuel solenoid shut off on this unit. Use only the provided fuel hose for fuel lines. When traversing the vehicle floor with fuel lines, always use a bulkhead adapter. This will prevent leakage and ensure that the hose is not punctured by vehicle vibration abrasion.

**DO NOT exceed your vehicle's weight limit.** The console with waste tank and accessories weighs approximately 1840 lbs. Make certain to account for any additional accessories in your weight and balance calculations. Make certain that the vehicle has the correct axle rating. This will prevent unsafe vehicle driving conditions.

**We require high-back seats on all vehicles in which units are to be installed for head and neck protection.** We recommend using a metal partition between the seats and equipment.

**DO NOT operate this unit without the water supply attached and turned on.** The water pump and other vital components may be seriously damaged if this unit is permitted to operate dry without water.

**DO NOT operate this unit without the filter installed in the waste tank.**

**Keep your vehicle work area clean.** Wands, stair tools, and other accessories must be securely fastened before driving the vehicle.

**All pressure hoses must be rated for 3000 PSI at 250°F.** Thermoplastic hoses do not meet these specifications and should not be used. Severe burns and injury may result if the hoses do not meet these requirements.

**The winterizing loop hose assembly, Part #10-805380, is for winterizing use only.** If used improperly, live steam may escape from this hose, causing it to whip around. Burns or injury may result.

**Make certain that you receive complete training by the distributor from whom you purchased this unit.**

**This unit uses high pressure and temperature. Improper or irresponsible use may result in serious injury.**

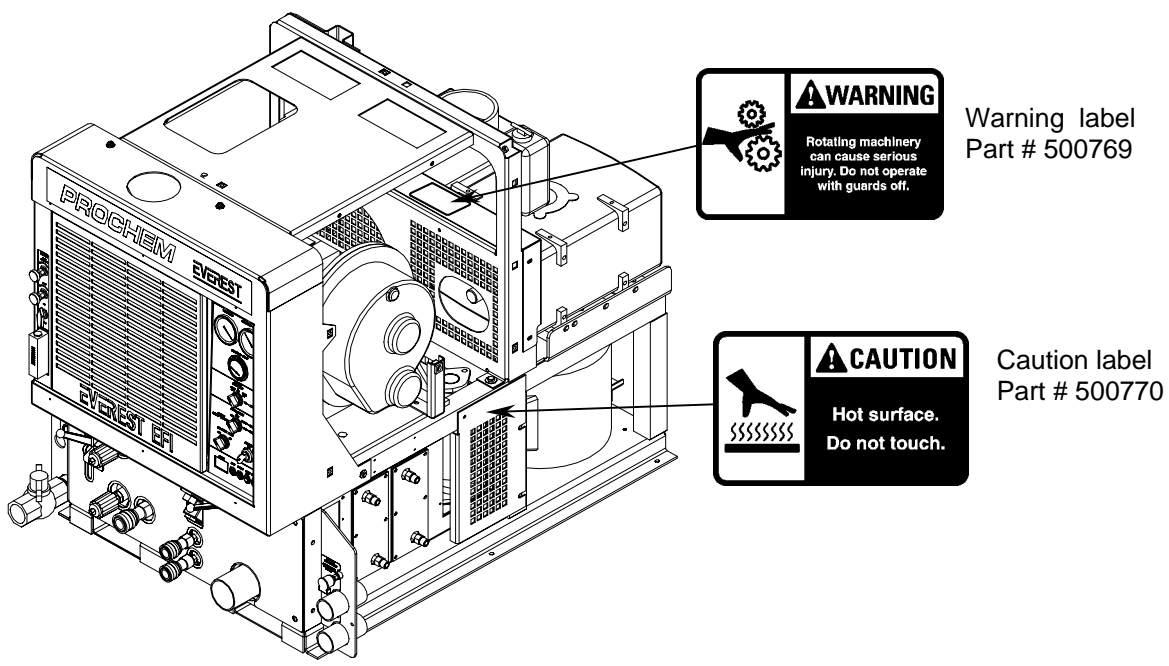
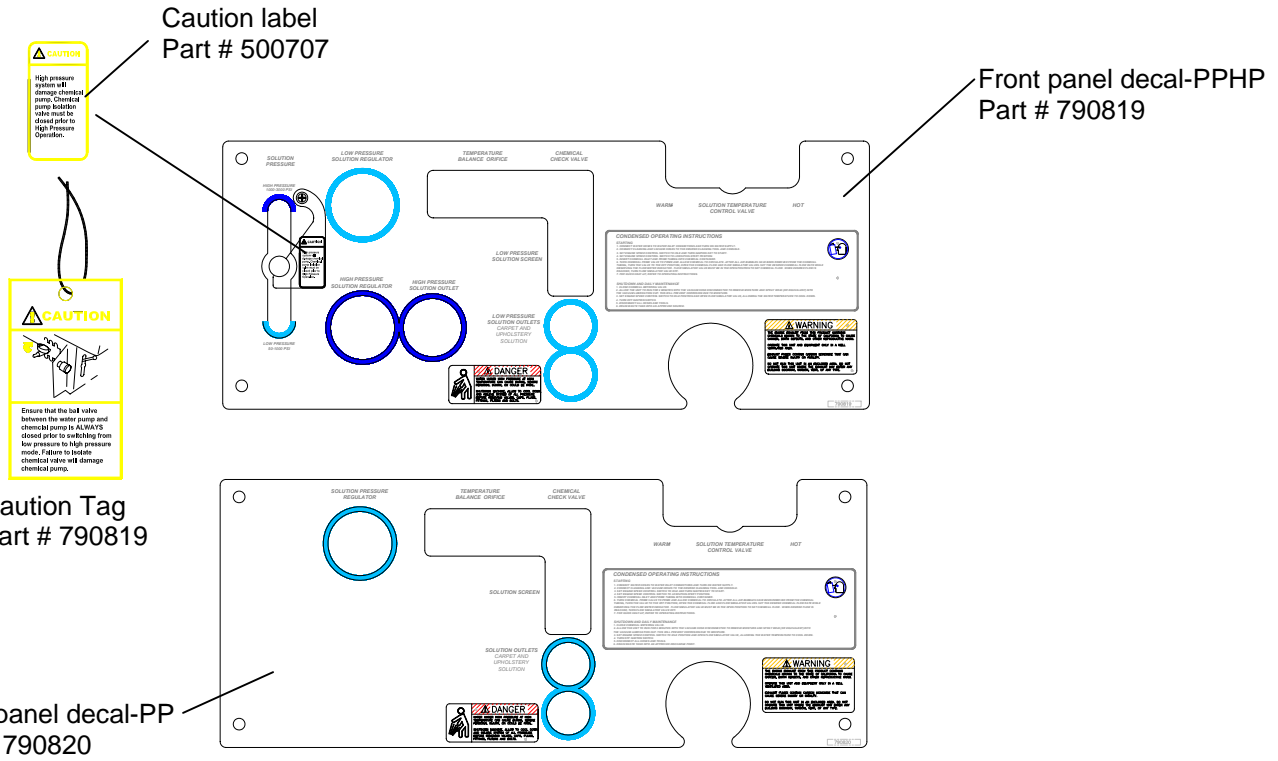
**Do not modify this unit in any manner.** Improper modification can cause severe personal injury or fatality.

**CALIFORNIA PROPOSITION 65 WARNING:** Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

# HAZARD INTENSITY LEVEL

The following **WARNING LABELS** are found on your cleaning unit . These labels point out important **Warnings** and **Cautions** which should be followed at **all** times. Failure to follow warnings and cautions could result in fatality, personal injury to yourself and/or others, or property damage. Follow these instructions carefully! **DO NOT** remove these labels.

**NOTE:** If at any time the labels become illegible, promptly replace them.



**TECHNICAL SPECIFICATIONS**

<b>ITEM</b>	<b>DIMENSION/CAPACITY</b>	
Engine speed	2200 rpm (medium speed) Water Pump ON 900 rpm (idle speed) Water Pump OFF.	
Water pump rpm	1455 rpm	
Vacuum pump rpm	3400 rpm	
Water flow rate	4.5 GPM (maximum)	
Water pump pressure (low pressure)	1000 PSI (maximum)	
Water pump pressure (high pressure)	3000 PSI (maximum)	
Vacuum relief valve	13" Hg	
Waste tank capacity	80 or 100 gallons	
Console weight	860 lbs.	
Console weight (with waste tank & waste tank accessories)	1110 lbs (1840 lbs. If waste tank is full)	
<b>TORQUE VALUES</b>		
Engine hub	480 inch lbs	40 foot/lbs
Vacuum pump hub	192 inch/lbs	16 foot/lbs
Water pump shaft bolt	300 in//lbs	25 foot/lbs

**JET SIZING:**

Recommended **floor tool** tip sizing not exceed a total of ".06". Using larger jet sizes on your cleaning unit may reduce cleaning temperatures.

**Example:**        **Tri-jet wand uses three 9502 jets** (95° spray angle w/ 02 orifice).  
                         **02 x 3 = 06**

When using two floor tools while cleaning with this unit, it is recommended that each tool tip size does not exceed a total of ".045".

**Example:**        **Tri-jet wand uses three 95015 jets** (95° spray angle w/ 015 orifice).  
                         **015 x 3 = 045.....06 x 2 tools = 12**

**Upholstery tool jet size:**                        **80015**  
**Stair tool jet size:**                                **9502**

# OPERATIONS

## INSTALLATION REQUIREMENTS DEALER RESPONSIBILITY

**NOTE:** Your distributor from whom you purchased this mobile cleaning unit is responsible for the correct installation of this machine. The dealer is also responsible for initial training of your operators and maintenance personnel in the proper operation and maintenance of this unit.

1. The unit should **NOT** be mounted in any motor vehicle of less than **3/4 ton capacity**.

### CAUTION:

The console with waste tank and accessories must **NOT** exceed the vehicle's axle weight limit.

2. If mounting in a trailer, make certain that the trailer is rated for the total weight of the **UNIT AND TRAILER**. Electric or hydraulic brakes should be provided, and a strict compliance with any State and Federal vehicle laws must be maintained. Install unit on tandem axel trailer only. Single axle trailers are not recommended.
3. The vehicle tires should have a load rating above the combined vehicle and unit weight.
4. We do not recommend using flooring materials that absorb water. This could result in rust and corrosion of the vehicle floor.
5. Padding under rubber floor mats should be removed before installing this unit.
6. We highly recommend using a drip tray under the console (Part #790552).
7. If using a trailer, the console should be positioned so that it balances properly with respect to the axle. Ten percent (10%) of the overall unit weight should be on the tongue.

**Example:** If loaded trailer weight is 2,000 lbs., tongue weight needs to be a minimum of 200 lbs. to tow properly.

## FUEL REQUIREMENTS

Use unleaded gasoline **ONLY**. **DO NOT** use any gasoline additives. We recommend the use of clean, fresh, unleaded gasoline intended for automotive use. High octane gasoline should **NOT** be used with the engine on this unit.

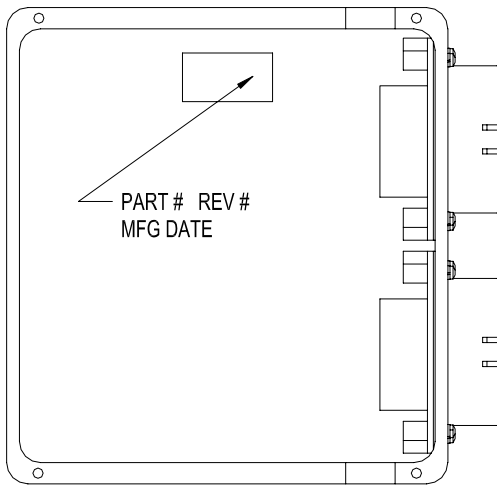
## ENGINE OIL REQUIREMENTS

Use high quality detergent oil of at least API (American Petroleum Institute) service class SF or SG. Select the viscosity based on the air temperature at the time of operation as shown in the following table. **NOTE:** Using less than service class SF or SG oil or extending oil change intervals longer than recommended can cause engine damage.

			20W-20, 20W-40, 20W-50			
			10W-30, 10W-40, 10W-50, 15W-40, 15W-50			
			10W			
			5W-30			
			5W-20			
°F	-22	-4	14	32	59	104
°C	-30	-20	-10	0	15	40
TEMPERATURE RANGE EXPECTED BEFORE NEXT OIL CHANGE						

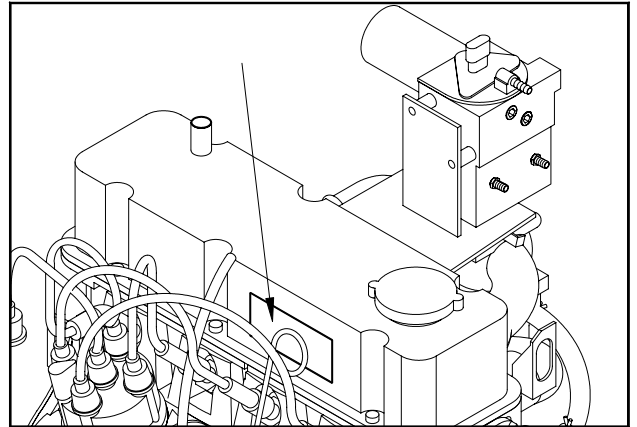
## ELECTRONIC FUEL INJECTION SYSTEM

This unit is equipped with the latest Zenith electronic fuel injection (EFI) technology. The EFI technology provides more effective fuel distribution and improved power management through the use of an electronic “brain” called the electronic control unit (ECU). The ECU also provides improved engine emissions through more effective combustion of the fuel/air mixture. The fuel system, engine set up, and exhaust system are systems approved by the Environmental Protection Agency (EPA). Any alteration or modification to the system must receive approval from the EPA.



## EMISSION CONTROL INFORMATION

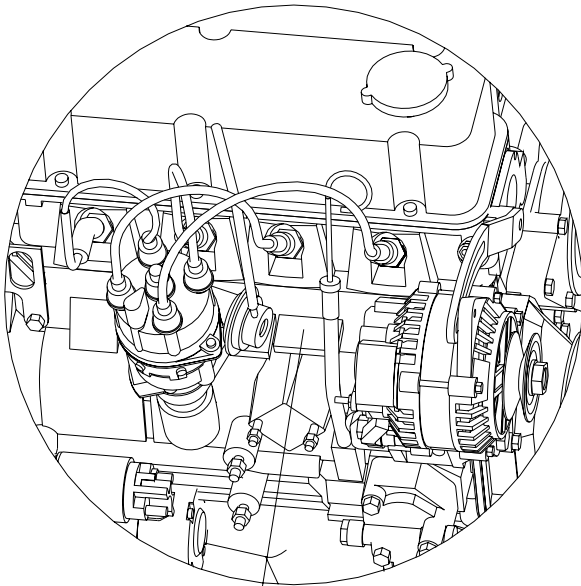
The Zenith Power Products (ZPP) Emission control label is located on the valve head cover of the engine near the oil fill cap.



## OPERATIONS

### DATE STAMP LOCATION

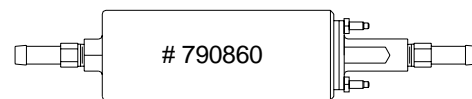
When referring to an engine for assistance from your dealer, ProChem, or ZPP please identify your engine by the serial # and date code stamped on the machined surface next to the oil dipstick.



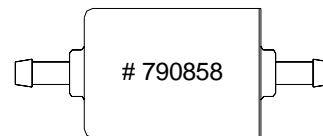
SERIAL NUMBER

### FUEL PUMP AND FILTER

Your Everest EFI console was shipped to the dealer with a specific fuel pump and fuel filter. Ensure that **ONLY** these items are used in the installation of your unit. The EFI system is much more sensitive to unwanted material in the fuel stream. Contamination of the fuel stream may clog the injectors and adversely affect performance. Please be sure to adhere to the filter maintenance schedule located in the Operations Section of this manual.



FUEL PUMP



FUEL FILTER

## ERROR CODES

On rare occasions the engine may experience abnormal operation conditions and shut down. Upon shutdown the amber light in the upper right corner of the instrument panel will repeatedly flash an error code to help you determine the root cause of the shutdown. Double-digit numbers are flashed one digit at a time, (i.e. "12" would be shown as "Flash", pause, "Flash", "Flash"). The codes are listed below for your convenience.

	CONDITION	SEQUENCE	RESULT	TROUBLE CODE	TROUBLE FLAG	CODE/FLAG RETAINED IN MEMORY WITH KEY OFF?
1	ENGINE OIL PRESSURE SWITCH INDICATES LOW OIL PRESSURE		OIL PRESSURE SWITCH INDICATES OIL PRESSURE IS LOW FOR 1 COMPLETE SECOND - ENGINE		2	NO
2	ENGINE OVERHEATING DETECTED (COOLANT >= 239 F)	1	RPM LIMITED TO 950 MAXIMUM FOR 60 SECONDS		3	NO
		2	ONCE 60 SECOND TIME LIMIT IS EXCEEDED - ENGINE SHUTDOWN OCCURS		3	NO
3	TRANSMISSION OIL TEMPERATURE SWITCH INDICATES OVERTEMP	1	RPM LIMITED TO 950 MAXIMUM FOR 60 SECONDS		4	NO
		2	ONCE 60 SECOND TIME LIMIT IS EXCEEDED - ENGINE SHUTDOWN OCCURS		4	NO
4	BEGINNING OF DIAGNOSTIC ROUTINE		NO FAULT CONDITION EXITS - SIGNIFIES BEGINNING OF FLASH CODES	12		YES-ALWAYS PRESENT
5	ENGINE COOLANT SENSOR INDICATES SHORT CIRCUIT OR EXTREME OVERHEATING OF ENGINE (COOLANT TEMP >= 266 F)	1	TROUBLE CODE IS STORED IN MEMORY	14	3	CODE RETAINED IN MEMORY
		2	RPM LIMITED TO 950 MAXIMUM FOR 60 SECONDS	14	3	FLAG CLEARS WHEN IGNITION IS OFF
		3	ONCE 60 SECOND TIME LIMIT IS EXCEEDED - ENGINE SHUTDOWN OCCURS	14	3	FLAG CLEARS WHEN IGNITION IS OFF
6	ENGINE COOLANT SENSOR INDICATES OPEN CIRCUIT		TROUBLE CODE IS STORED IN MEMORY	15		CODE RETAINED IN MEMORY
7	PEDAL POSITION SENSOR OVER VOLTAGE (OVER 4.5 VOLTS)		TROUBLE CODE IS STORED IN MEMORY	21		CODE RETAINED IN MEMORY
8	PEDAL POSITION SENSOR UNDER VOLTAGE (0 VOLTS)		TROUBLE CODE IS STORED IN MEMORY	22		CODE RETAINED IN MEMORY
9	AIR TEMPERATURE SENSOR INDICATES OPEN CIRCUIT		TROUBLE CODE IS STORED IN MEMORY	23		CODE RETAINED IN MEMORY
10	AIR TEMPERATURE SENSOR INDICATES SHORT CIRCUIT		TROUBLE CODE IS STORED IN MEMORY	24		CODE RETAINED IN MEMORY
11	MAP SENSOR CIRCUIT INDICATES HIGH VLOTAGE (4.98)		TROUBLE CODE IS STORED IN MEMORY	33		CODE RETAINED IN MEMORY
12	MAP SENSOR CIRCUIT INDICATES SHORT TO GROUND		TROUBLE CODE IS STORED IN MEMORY	34		CODE RETAINED IN MEMORY
13	OXYGEN SENSOR - LEAN CONDITION DETECTED		TROUBLE CODE IS STORED IN MEMORY	44		CODE RETAINED IN MEMORY
14	OXYGEN SENSOR - RICH CONDITION DETECTED		TROUBLE CODE IS STORED IN MEMORY	45		CODE RETAINED IN MEMORY

# OPERATIONS

## ZENITH DISTRIBUTOR LOCATIONS

- **CAPITAL ENGINE COMPANY (09046)**  
97 CYPRESS ST. SW  
REYNOLDSBURG, OHIO 43068  
**OH, IN, KY, WV**  
**PA (WESTERN)**  
PHONE: 740/964-0089
- **CULLUM & BROWN, INC. (09045)**  
1607 WABASH  
WICHITA, KS 67214  
**KS, MO**  
PHONE: 316/262-5156  
800/362-3222
- **DIESEL ELECTRIC SERVICE & SUPPLY (09116)**  
652 W. 1700 SOUTH  
SALT LAKE CITY, UT 84104  
**UT**  
PHONE: 801/972-1836
- **POWER EQUIPMENT COMPANY (09117)**  
15225 INDUSTRIAL RD.  
OMAHA, NE 68144  
**NE, IA**  
PHONE: 402/330-5100
- **ENGINE WORKS, INC. (09178)**  
1345 PARAMOUNT PKWY.  
BATAVIA, IL 60510  
**IL**  
PHONE: 630/879-7977  
800-832-7217
- **FRONTIER EQUIPMENT, LTD. (09185)**  
8029 RIVER WAY  
DELTA, BC CANADA V4G 1L3  
**BC, AB**  
PHONE: 604/946-5531
- **GULF ENGINE & EQUIPMENT (09229)**  
2306 ENGINEERS RD.  
BELLE CHASSE, LA 70037  
**LA, MS**  
PHONE: 504/393-1701
- **HAMILTON ENGINE SALES, INC. (09287)**  
5540 N. E. COLUMBIA BLVD.  
PORTLAND, OR 97218  
**WA, OR, AK**  
PHONE: 503/288-6714  
800/437-3644
- **H. G. MAKELIM COMPANY (09480)**  
219 SHAW RD.  
SOUTH SAN FRANCISCO, CA 94080  
**CA**  
PHONE: 650/873-4757
- **LOFTIN EQUIPMENT COMPANY, INC. (09490)**  
12TH NORTH 45TH AVE.  
PHOENIX, AZ 85043  
**AZ**  
PHONE: 602/272-9466
- **M.G. BRYAN EQUIPMENT COMPANY (09503)**  
4834 READING ST.  
DALLAS, TX 75247  
**TX, OK**  
PHONE: 214/631-9787
- **NORPRO ISUZU ENGINES, INC. (09505)**  
385 TOWN ST.  
HADDAM, CT 06423  
**CT, MA, VT, NH, ME, RI**  
PHONE: 860/873-0100
- **SOUTHEAST SERVICE & SUPPLY (09698)**  
1721-E OAKBROOK DR.  
NORCROSS, GA 30093  
**GA**  
PHONE: 770/448-4251  
800/241-4595



## CHEMICAL REQUIREMENTS

This cleaning unit, due to its chemical injection pump design, can be used with a variety of water-diluted chemical compounds (either acidic or alkaline), depending on the job to be done. However, to obtain optimum results with this unit, we recommend using the PROCHEM line of chemicals. For information on using the cleaning compounds, refer to the PROCHEM chemical manual.

## WATER REQUIREMENTS

Hard water deposits will adversely affect the plumbing and heat exchange systems on this unit. The map below will give you an idea of where areas of high water hardness may occur. However, any water supply obtained from a well is almost always hard water and a water softener will be needed to protect your equipment.

**NOTE: Equipment malfunction or component failure caused by hard water scaling is NOT covered under the warranty.**

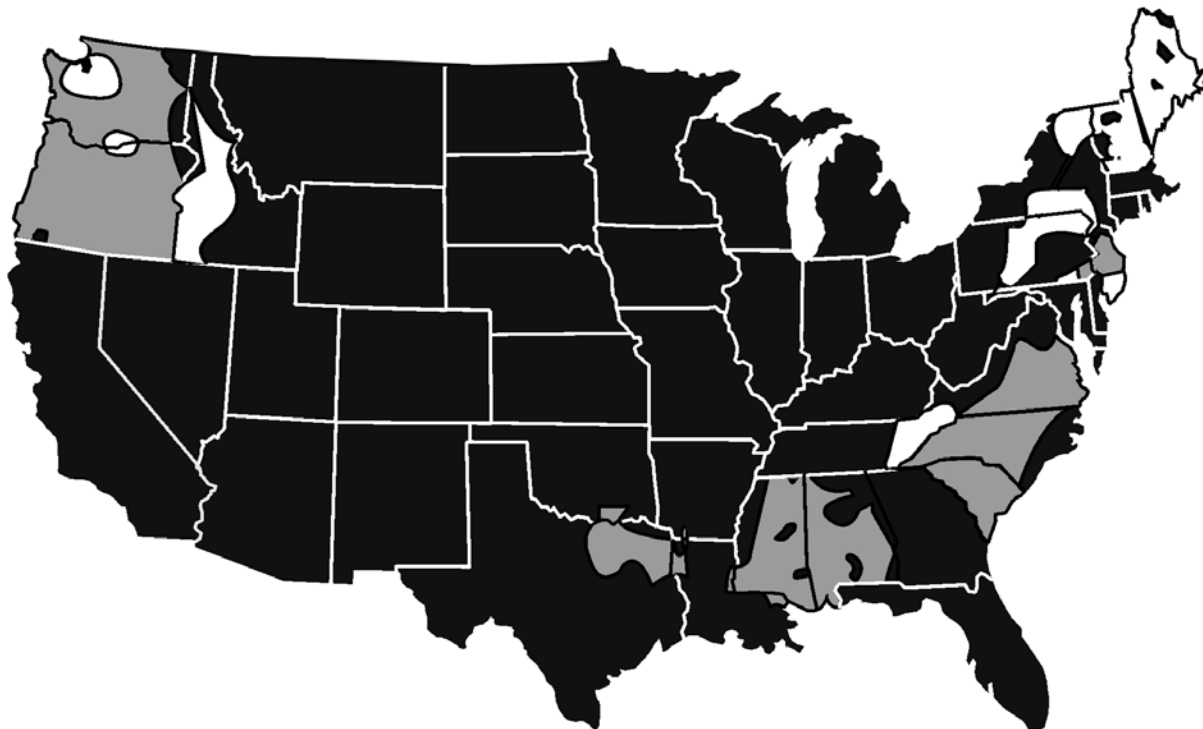
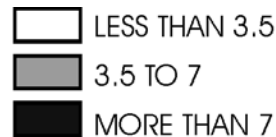
If you are operating this unit in an area where the unit will be using water in which the hardness exceeds

3-1/2 grains, we highly recommend a suitable water softener be installed. If using a water softener, it must have a five (5) GPM (or greater) flow capacity without any hose constrictions.

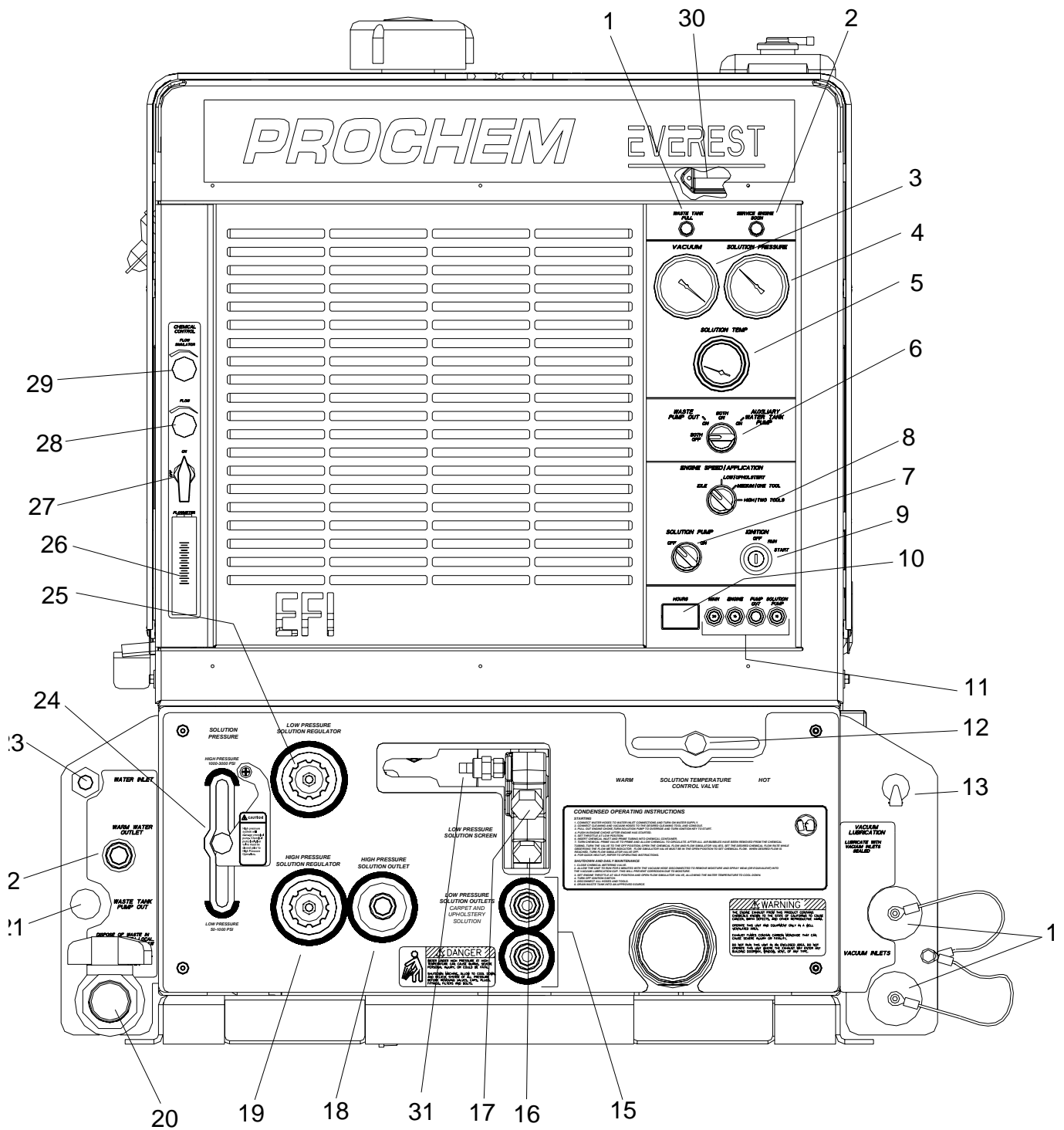
Using a water softener will reduce maintenance and decrease down time caused by hard water scaling. It will also allow cleaning chemicals to be more effective in lower concentrations.

If you require a water softener, PROCHEM has a model to meet your needs. Please contact your nearest distributor for information, price, and availability.

## HARD WATER MAP



# COMPONENTS



## 1. WASTE TANK FULL INDICATOR LIGHT

This indicator light is activated when the waste tank is full. When lit the unit will shutdown protecting the equipment from damage. This also indicates that the waste tank must be emptied before the unit can be brought back in service.

**NOTE: Never dispose of waste water in storm drains, water ways or on ground areas. Always dispose of waste in accordance with local state and federal laws.**

## 2. SERVICE ENGINE SOON

This light, when flashing, signals a problem with the unit. When this occurs, troubleshooting is required.

## 3. VACUUM GAUGE

This gauge indicates in inches of mercury how much vacuum the system is producing at any given time.

## 4. SOLUTION PRESSURE GAUGE

This gauge registers the amount of pressure in the system.

## 5. SOLUTION TEMPERATURE GAUGE

This gauge measures the temperature of the cleaning solution as it exits the machine.

## 6. WASTE PUMPOUT AND AUXILIARY WATER PUMP SWITCH

This four-position switch is for activating the waste pumpout device. It also serves to activate the fresh water transfer pump. For turning on pumps, rotate clockwise. For turning off pumps, rotate counter clockwise.

## 7. SOLUTION PUMP SWITCH

This switch serves to energize the magnetic clutch to turn the water pump on or off. Turn clockwise for activating the pump and counter clockwise for deactivating the pump.

## 8. ENGINE SPEED CONTROL

This serves to set the engine speed and operating parameters. The 'Low', 'Medium' and 'High' settings are set for upholstery cleaning, single wand cleaning, and dual wand cleaning respectively.

## 9. KEY SWITCH

The key switch controls the power for the machine. To turn the machine on, rotate the key clockwise until the starter engages the engine. When machine is running let off the switch and engine will continue to run. To turn power off, rotate key counter clockwise to stop position, engine will then stop.

## 10. HOUR METER

The hour meter records the number of hours the unit has run. This serves as a time recorder for servicing the machine.

## 11. CIRCUIT BREAKERS

These serve to protect the circuits from electrical spike and over loads and protects wires from damage and fire.

## 12. SOLUTION TEMPERATURE CONTROL VALVE

This valve enables additional heat exchangers to contribute more heat to the system if necessary. By moving the lever to the right it adds more heat, by moving to the left it removes heat.

## 13. OIL CUP

The oil cup allows lubricant spray to reach the vacuum blower.

## COMPONENTS

### 14. VACUUM INLETS

The vacuum inlets serve as connecting point for vacuum hoses.

### 15. SOLUTION OUTLETS

The solution outlets are the connecting point for the high pressure cleaning hoses. These outlets are quick disconnects that allow hoses to be plugged into the unit.

### 16. SOLUTION SCREEN

The solution screen is located on the front of the machine. The function of this screen is to trap foreign particles from exiting the machine and plugging the orifices of the cleaning tools. This screen is part of the machine maintenance cleaning.

### 17. CHEMICAL CHECK VALVE

The chemical check valve allows chemicals to enter the system and travel in a singular direction to the wand. The chemical check valve prevents chemicals from traveling up-stream into the solution system of the unit.

### 18. HIGH PRESSURE SOLUTION OUTLET

The high pressure solution outlet is the connecting point for the high pressure hose. This outlet is a quick disconnect that allows pressure washing hoses to be plugged into the unit. (HP unit only)

### 19. HIGH PRESSURE REGULATOR

The regulating valve controls the amount of pressure in the pressure washing circuit. By turning the handle clockwise, It has the effect of increasing the pressure. Turning it clockwise has the effect of lowering the pressure. (HP unit only)

### 20. WASTE OUTLET

This valve allows the waste tank to be emptied. Turning clockwise opens the valve.

**NOTE: This valve must be closed during operation.**

### 21. WASTE PUMPOUT

This auxiliary pump serves to empty the waste collection tank automatically. A float located inside the tank automatically turns off and on when the solution level reaches certain points.

### 22. WARM WATER OUTLET

The warm water outlet allows the cleaning technician to drain hot water from the water box for mixing chemical.



**Water from this valve is hot.**

### 23. WATER INLET

This quick connect allows the water supply hose to be connected to the unit.

### 24. PRESSURE SELECTOR VALVE

This selector valve allows the technician to switch from high pressure to low pressure. By moving the handle to the up position, the high pressure circuit is activated allowing the unit to be used as a pressure washer. By positioning the valve handle to the down position, the low pressure circuit is activated allowing the unit to be used for carpet cleaning. (HP unit only)

### 25. LOW PRESSURE REGULATOR

This pressure regulating valve allows the low pressure circuit to be adjusted by turning the handle clockwise the pressure will increase, by turning counter clockwise the pressure will decrease.

## 26. FLOW METER

The flow meter is a gauge to indicate how much liquid chemical is being introduced in the water system. The quantity can be increased by turning the chemical flow knob counter clockwise.

## 27. CHEMICAL PRIME CONTROL VALVE

This valve allows the chemical to circulate through the chemical system with little or no restriction. It also purges out air that may be trapped in the lines and cavities of the chemical pump. By turning the valve clockwise the injection system is enabled.

## 28. CHEMICAL METERING VALVE

The chemical metering valve regulates the amount of chemical that is injected into the system. Clockwise rotation of the knob closes the valve. Counter clockwise rotation opens the valve, allowing more chemical to enter the system.

## 29. FLOW SIMULATOR VALVE

This valve allows solution to move through the machine and chemical to be injected simulating the cleaning process. This allows the operator to set the chemical flow level without connecting tools to the machine. It is also useful in troubleshooting. The valve is turned off by rotating the knob clockwise and opened by turning the knob counter clockwise.

## 30. PANEL LIGHT

This light is useful if the machine is used in a poorly lit area or night use. It is helpful in reading the instruments and gauges.

## 31. TEMPERATURE BALANCE ORIFICE

The temperature balance orifice helps to balance and stabilize the solution temperature within the system.

## **OPERATIONS**

### **WATER PUMPING AND HEAT TRANSFER SYSTEM**

Cold water enters the console through the water inlet. When the water box is full the valve will automatically shut off.

Water then flows from the water box, through a strainer, into the water pump where it is pumped to the pressure regulator manifold where the pressure regulator provides and maintains the desired pressure setting.

The pressure regulator manifold includes a nitrogen charged accumulator which helps reduce pressure spikes from the pump.

A certain amount of water is by-passed from the pressure regulator due to over pumping capacity of the water pump. Water that is not called for in the cleaning process is channeled through a heat exchanger box into the first heater core from the front of the unit. This bypass water may circulate several times through the bypass heat exchanger allowing the water to be pre-warmed.

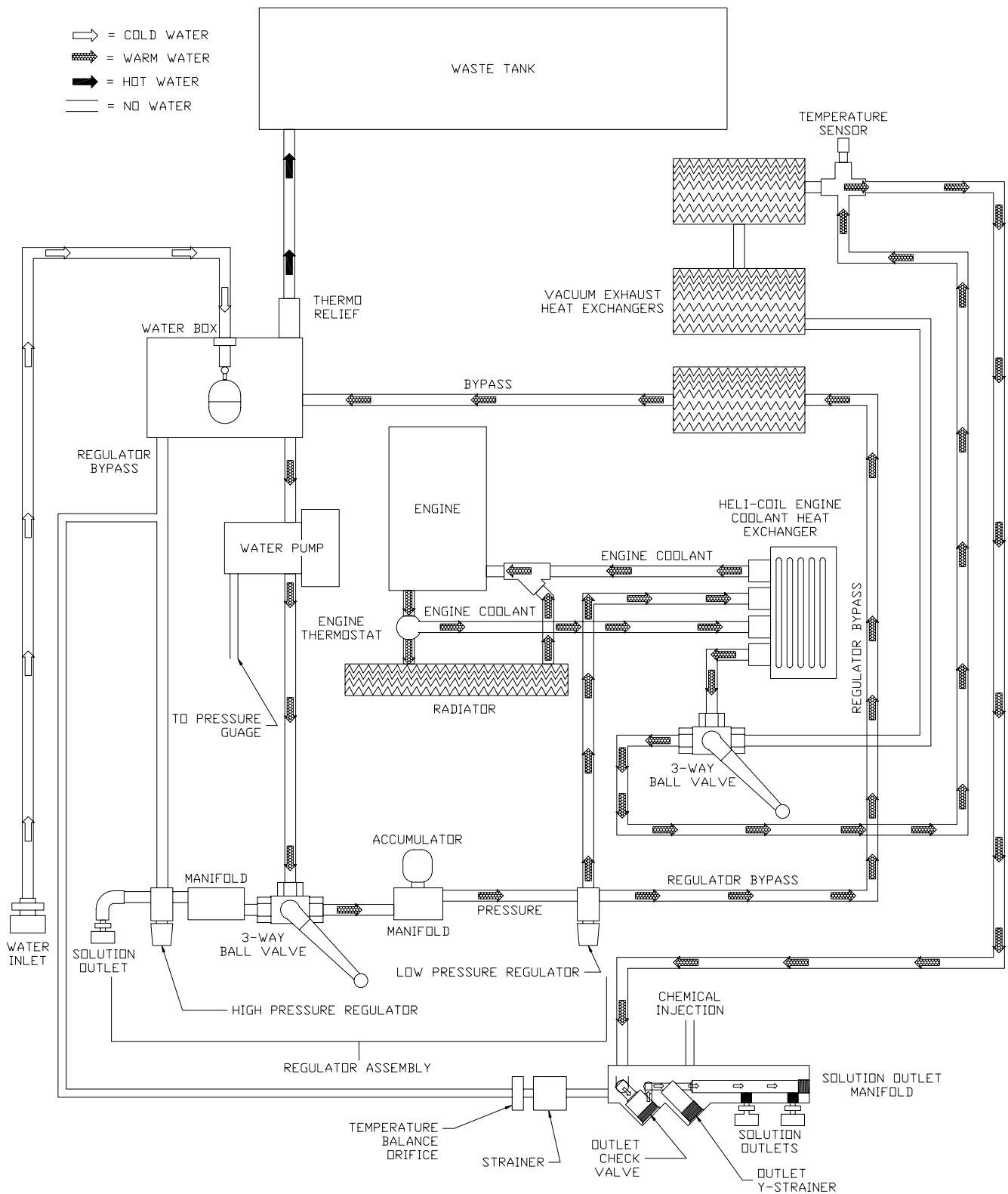
The next stage of heating and water flow is to the helicoil, when water is called for in the cleaning process it flows to the helicoil under pressure. Heat from the engine coolant is exchanged to the cleaning solution through a series of spiraled copper tubing. This allows the engine coolant to travel in a counter rotating direction to the cleaning water during the exchange process creating a very efficient transfer of heat out of the engine and into the cleaning solution.

The third stage of plumbing and heat exchange takes place in the 2nd heater core located in the heater box. These hot engine/vacuum exhaust gases are forced through heater core #2 creating the third stage of heat transfer to the cleaning solution.

Finally, the hot solution passes to the outlet manifold where cleaning chemicals are injected from the chemical pulse pump. This manifold serves as a temperature sensing point and a connecting point for the high-pressure hoses. Also a check valve is located in this outlet manifold prohibiting chemicals from backing up into the system.

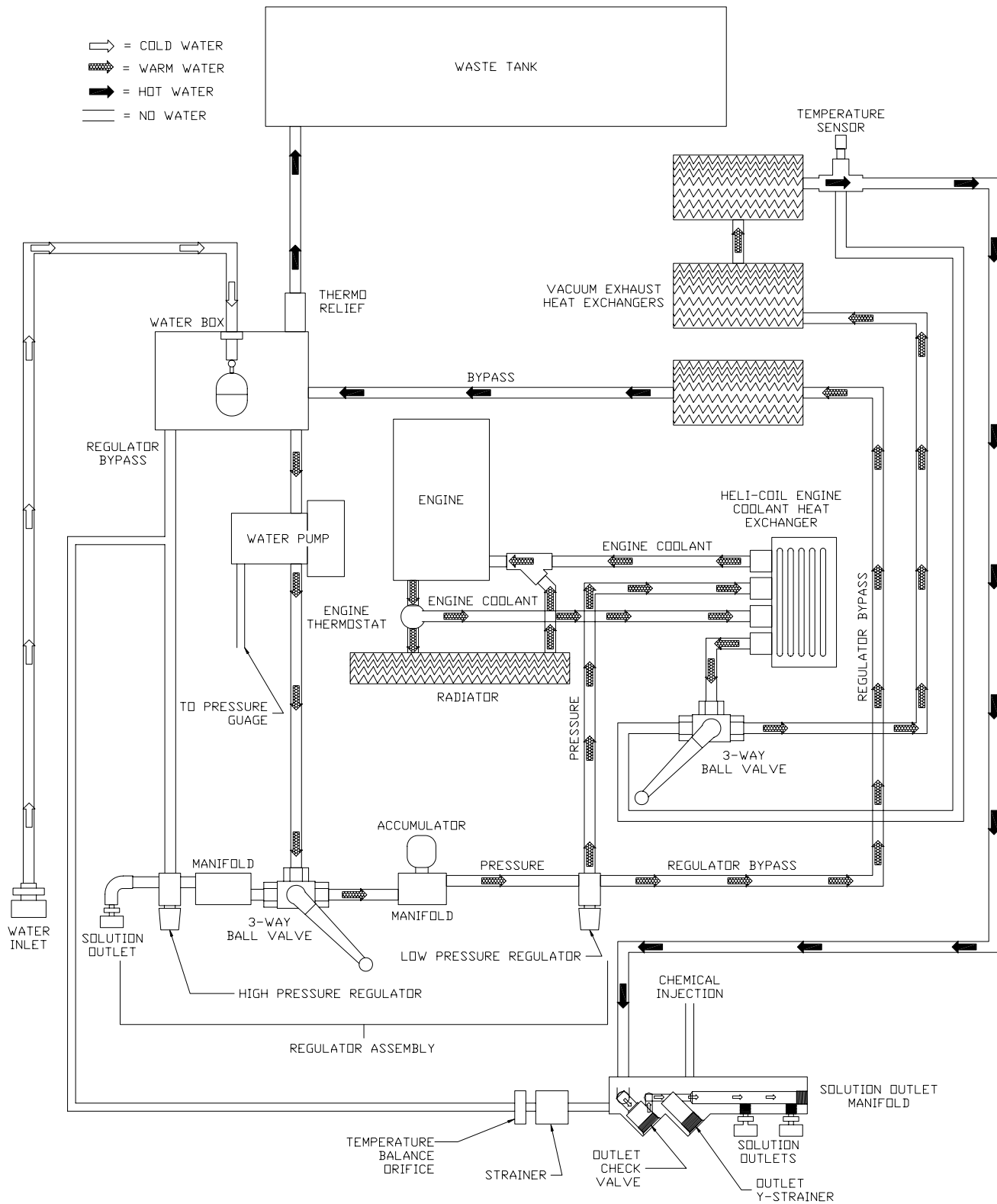
The cleaning solution then passes through high-pressure hoses and is distributed by the cleaning tool to a surface that is being cleaned, completing the water pumping and heating cycle of the cleaning unit.

**SINGLE SYSTEM WATER FLOW DIAGRAM LOW PRESSURE (WARM)**



# OPERATIONS

## SINGLE SYSTEM WATER FLOW DIAGRAM LOW PRESSURE (HOT)





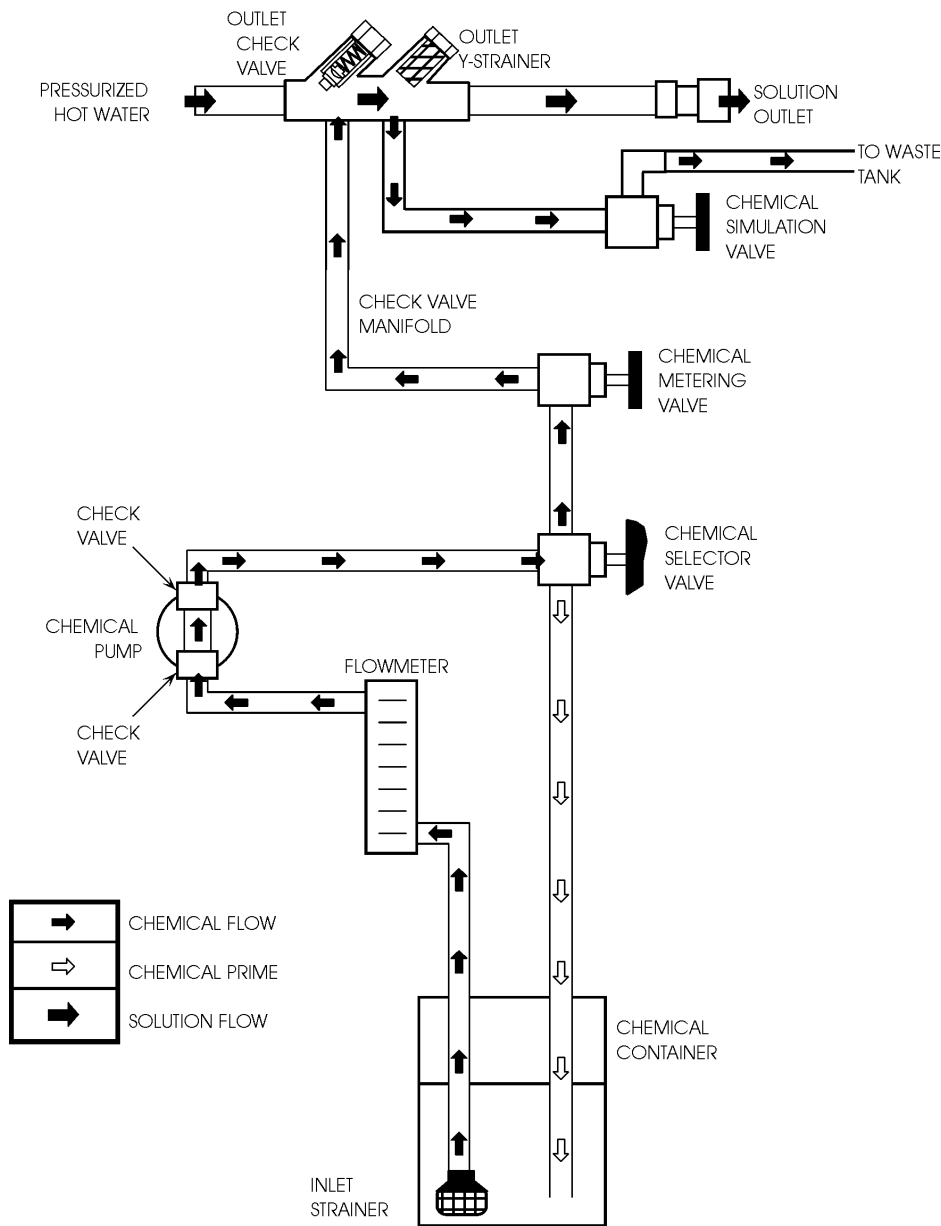
**CHEMICAL INJECTION SYSTEM**

The chemical injection system is unique in that it utilizes the pressure spikes generated by the high-pressure water pump to move chemical into the main pressure stream. The high pressure spikes move the diaphragm in the chemical pulse pump forcing small amounts of liquid chemical to be moved in a single direction of flow with the aid of two check valves.

The chemical is picked up from the container and fed through the flow meter to the chemical pulse pump where it is pressurized.

After reaching the chemical pulse pump the chemicals can either go into a bypass loop to purge air from the system or the chemical can be directed by the chemical selector valve to the metering valve. The metering valve creates an orifice allowing the correct amount of chemical to enter the outlet manifold. The outlet manifold assembly is complete with a check valve that will not allow the chemicals to travel upstream into the plumbing system of the unit.

The chemicals are then mixed with hot pressurized water that make up a solution for the cleaning application.



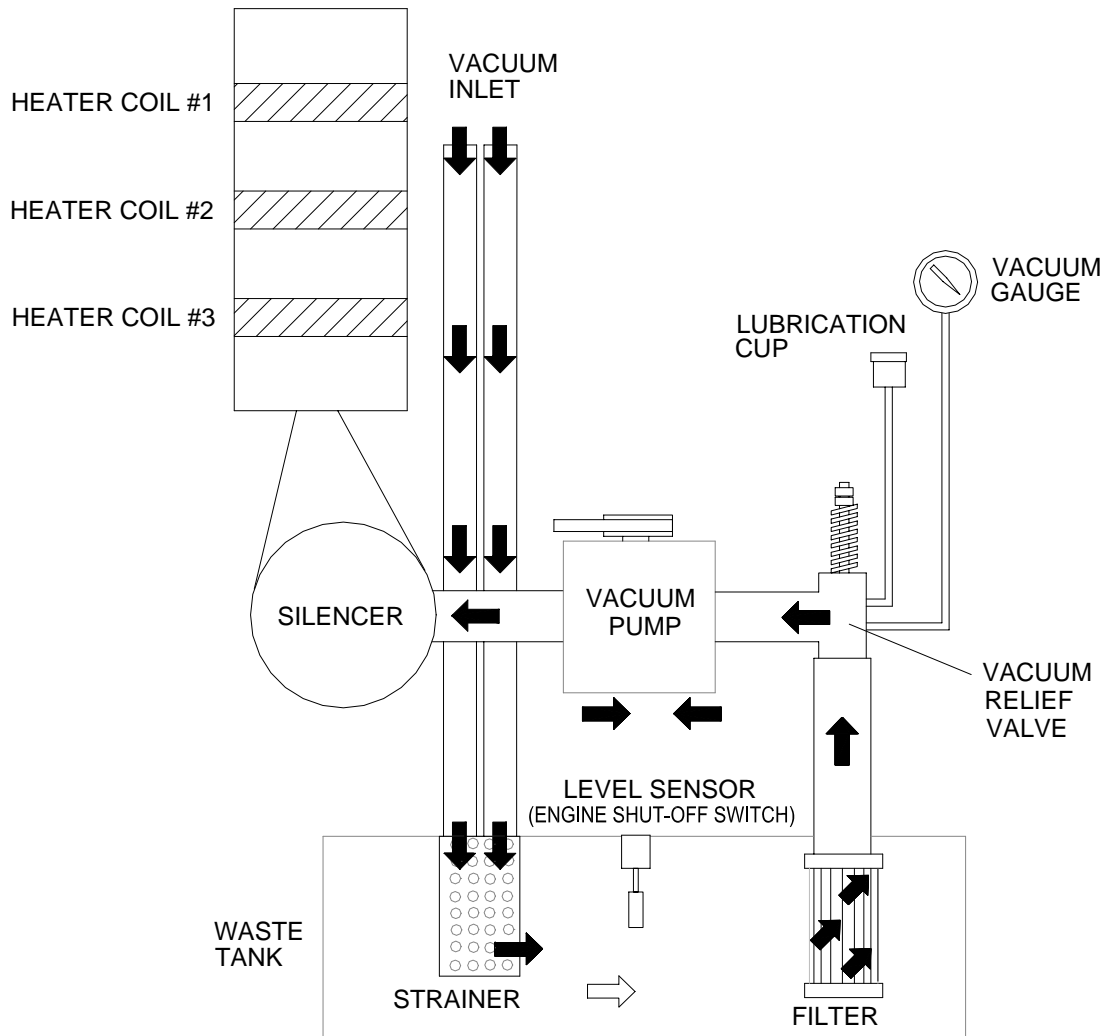
# OPERATIONS

## VACUUM SYSTEM

The engine turning an air pump generates vacuum. The air is channeled in one side of the vacuum pump, compressed and discharged on the opposite side, creating airflow.

The movement of air is used to do the work necessary for the extraction process. A vacuum nozzle applied to the carpet surface removes moisture, dirt and spent chemicals. These elements are conveyed back to a separating tank utilizing hoses and the force of air. Particles of moisture and dirt are separated in the vacuum tank using a series of changes in direction and velocity. The air is then filtered and rushes into the vacuum pump.

The vacuum pump compresses and heats the incoming air. The hot discharged air is forced downstream into a silencer for noise abatement. After exiting the silencer, this hot air is mixed with hot gases from the engine. This mixture of hot gases are then forced through 3 radiators serving as heat collectors. Heat from the engine and vacuum pump is then transferred into the plumbing system raising the water temperature for better cleaning.



**PRE-RUN INSPECTION**

**NOTE:** *Operation of this unit is simple. However, only trained personnel should proceed.*

**⚠ WARNING:**

Operate this unit and equipment only in a well-ventilated area. Exhaust fumes contain carbon monoxide which is an odorless and deadly poison that can cause severe injury or fatality. **DO NOT** operate this unit where the exhaust may enter any building doorway, window, vent, or opening of any type. Do not operate this unit while the exhaust discharge is directed at plants or animals.

**CHECK FOR ADEQUATE FUEL**

Check the fuel tank to be certain there is adequate fuel to complete the job. This unit uses approximately .95 to 1.18 gallons of fuel per hour, depending on the speed setting.

**REMOVE TOOLS FROM VEHICLE**

Remove any **tools** or **hoses** from the van which you will require.

**WATER SUPPLY CONNECTION**

**NOTE:** *Before connecting your water hose to the supply faucet, flush out the faucet until the water is free of any debris. Flush out any debris which may be in your water inlet hose.*

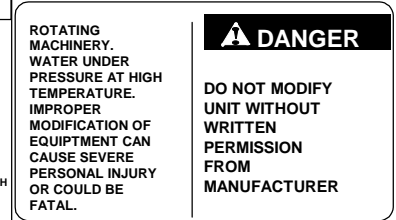
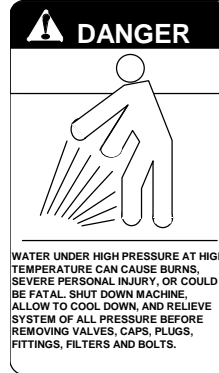
1. Connect the **water supply hose** to the **water inlet** quick-connect at the left front of the console. Connect the hose to the water supply faucet.

**NOTE:** *Never use your waste pump outlet hose as a water inlet hose. Use only clean hoses for water inlet.*

2. Turn the **water supply faucet** on. The water will fill the **water box**.

**PRESSURE HOSE**

Before starting the unit, connect the **pressure hose(s)** to the **outlet connection(s)** at the front of the unit. Connect the **cleaning tool(s)** to the **pressure hose(s)**.



**VACUUM HOSE**

Connect the **vacuum hose(s)** to the **vacuum inlet** connection(s) at the front of the unit. Connect the other end of the **vacuum hose(s)** to the **cleaning tool(s)**.

## OPERATIONS

### PRIMING THE CHEMICAL PUMP


1. Connect water hose to water inlet connection and turn on water supply.
2. Connect cleaning and vacuum hoses to the desired cleaning tool and console.
3. Insert chemical inlet and prime tubing into chemical container.
4. Turn ignition key to start.
5. Set throttle to low speed.
6. Fill chemical container and inspect chemical filter.
7. Turn chemical prime valve to prime and allow chemical to circulate. After all air bubbles have been removed from chemical tubing, turn the valve to the horizontal (off) position and open the chemical metering valve, and the simulation valve. Set the desired chemical flow rate while observing the flow meter indicator. Simulator valve must be in the open position to set chemical flow. When desired flow is reached turn simulator valve off.
8. Set throttle to maximum position with vacuum ports blocked off for quick unit heat up.

### WASTE PUMP (OPTIONAL)

1. If your unit is equipped with an automatic waste pump, connect one end of a garden hose to the pump-out connection on the console and the other end to an appropriate waste disposal.
2. Turn the pump-out switch on the control panel to the ON position. Turn the toggle switch on the pump unit to "ON". The waste pump will operate automatically throughout the cleaning operation.

We recommend that you use a 3/4" I.D. water hose as a waste pump outlet hose. DO NOT use a hose smaller than 5/8" I.D.

NEVER use your automatic waste pump outlet hose as a water inlet hose.

 **WARNING:** NEVER dispose of waste in storm drains, water ways, or on ground areas. Always dispose of waste in accordance with Local, State, and Federal laws.

Your unit should be in the correct throttle position for your cleaning operation or extracting. A float switch located inside the waste tank will automatically shut down the unit when it reaches its full capacity. When this occurs, empty the waste tank before continuing.

### CLEANING

Observe the following guidelines, while cleaning:

1. Before proceeding make sure the nozzles are functioning properly.
  - a. To check, hold the wand about one foot above the surface to be cleaned and open the wand valve. A full spray should be observed from the cleaning nozzles.
  - b. If the nozzles are not showing a full spray pattern, adjust nozzles for proper pattern, clean, or replace nozzles, if required.
2. Normally chemical is applied on the push stroke of the wand when cleaning and vacuuming is done on the pull stroke. For heavily soiled carpets the wand may be used in a scrubbing manner, apply chemical in both push and pull strokes. Always finish up an area with a vacuum stroke.
3. When cleaning, keep the working opening (mouth) flat on the surface being cleaned. Keep the wand moving when the valve is open.
4. The unit will automatically shut-down when the waste tank is full. This will prevent water being drawn into the vacuum pump. If shut-down occurs, empty the waste tank before proceeding.

## UPHOLSTERY CLEANING

Upholstery tool, part #78513

1. Set engine speed control to "Low/Upholstery" setting to minimize excess heat.
2. Use one (1) "80015" spray tip in tool.

## SHUTDOWN AND DAILY MAINTENANCE (LOW PRESSURE)

1. Close chemical metering valve.
2. Allow the unit to run for 2 minutes with the vacuum hose disconnected to remove moisture. Spray WD40 (or equivalent) into the vacuum lubrication cup. This will prevent corrosion due to moisture.
3. Set engine speed control to idle position and allow the water temperature to cool down, unitizing the simulator valve in the open position to bleed off residual hot water left in the system.
4. Turn off ignition switch.
5. Disconnect all hoses and tools.
6. Drain waste tank.

## HIGH PRESSURE (3000 PSI) SYSTEM OPERATION (OPTIONAL)

### CAUTION:

The high-pressure water system can produce water pressures in excess of 3000psi. Water at these pressures will cause severe injury. DO NOT direct any discharges at persons. If contact with a person does occur and penetration of the skin does seem possible, contact medical personnel immediately. This machine is to be used by trained cleaning professionals only. Ensure all operators are trained in the operation of this equipment. Keep cleaning area clear of all persons and objects.

Ensure that proper Personal Protective Equipment (PPE) is used during the operation of this equipment. Failure to use proper PPE could result in injury. Ensure required ventilation and/or breathing apparatuses are used with a chemical injection system. Check with your chemical vendor for proper safety requirements.

## OPERATION

The "HP" units are equipped with a water pump and water delivery system that can support pressure-washing operations up to 4.5 gallons per minute at 3000 PSI. This system is normally used for high-pressure washing and hard surface cleaning.

1. Move the temperature selection valve from the "hot" position to the "warm" position.
2. Allow water temperature to cool to below 160 deg F.
3. Close ball valve located between the chemical pump and the water pump.

### CAUTION:

**Failure to close this valve will result in severe damage to the chemical pump diaphragms.**

4. Connect hose and either pressure washer gun or hard surface cleaning tool to high pressure disconnect.
5. Move the pressure selection valve from the "low pressure" position to the "high pressure" position.
6. Adjust high-pressure regulator to desired operational pressure.

## OPERATIONS

### HIGH PRESSURE SHUTDOWN & RETURN TO LOW PRESSURE SYSTEM

1. Adjust High Pressure regulator to set pressure at 400 psi.
2. Bleed off excessive pressure build-up by operating pressure washer gun for 5 seconds.
3. Move solution selector control valve from "High Pressure" operations to "Low Pressure" operations.
4. Squeeze pressure washer gun trigger again to remove any residual pressure
5. Disconnect high pressure gun and hose from high pressure disconnect.
6. Operate under normal low pressure instruction or follow normal shutdown procedures.

Pro-Chem recommends the use of the **Pro-Chem chemical injector (P/N 61-951538)** for use in combination with any chemical/detergent additives.

Pro-Chem also recommends the use of Pro-Chem high-pressure spray wands. Pro-Chem offers a **dual barrel wand (P/N 60-950505)**. Contact your Pro-Chem dealer for recommendations in your particular application. The operation of the high-pressure system also requires a high-pressure hose capable of handling the increased pressure loads of the high-pressure system. NEVER use your low-pressure system hoses with the high-pressure system. Pro-Chem offers a special **high pressure hose, P/N 10-805513**, rated for pressure washer activities. Only use Pro-Chem approved hoses and fittings. Ensure that your hoses and fittings are rated for your operational pressures.

### DE-FLOODING OPERATIONS

De-flooding operations involve removal of water from carpet and flooring. This differs from normal cleaning operations in that no water or solution is required. An automatic waste pump-out is highly recommended for all de-flooding operations due to the large amount of water removal often required.

1. Move the temperature selection valve from the "hot" position to the "warm" position.
2. Ensure that the system is operating in low-pressure mode (HP units only). Adjust low-pressure regulator to set pressure at 100 psi. If not hooked up to a water source, leave solution pump turned off.
3. Allow solution temperature to cool below 160 deg F.
4. Begin de-flooding operation.

### FREEZING PROTECTION

#### CAUTION:

If the unit is exposed to freezing weather the water in the unit may freeze, causing **SERIOUS DAMAGE** to the unit. To avoid this, the following is recommended during the cold weather season.

**When the unit is not in use, always park it in a heated building.**

**While in operation, avoid long shutdowns as the unit provides heat while running. Shut it down just prior to leaving for the next job.**

**If a heated building is not available, we recommend that you winterize the unit with anti-freeze. At present, it is only possible to winterize units, which do not have an auxiliary water tank. Units with auxiliary water tanks must be stored in a heated building when not in use.**

### WINTERIZING YOUR UNIT

1. Shut off the water supply. Disconnect the **water inlet hose** from the front of your console.
2. Connect all **pressure hoses and tools** that may have water in them.
3. Start the unit and turn water pump on. Open the tool valve until water pressure drops and water stops flowing.
4. Fill the water box with approximately two gallons of 100% glycol base anti-freeze.
5. Start the unit.
6. Open the tool valve until anti-freeze begins to come out of the tool. Recover **ALL** anti-freeze that comes out of the tools into an approved container. We strongly recommend that you recycle and re-use the anti-freeze.

Repeat this procedure with all the remaining tools. After all tools and pressure hoses have been filled with anti-freeze, disconnect and store them.

7. Turn the **solution pump switch** OFF. Attach the **winterizing loop hose** with attachment, Part #10-805380, to the bottom solution outlet connection and the water inlet connection. Turn the **solution pump switch** ON.

Allow the unit to run for approximately 3 minutes with the winterizing loop hose attached.

8. Prime the chemical system with 50/50 anti-freeze/water mix. Insert the chemical inlet and prime discharge tubes into the anti-freeze container. Turn the chemical valve to PRIME until anti-freeze begins to flow out of the prime hose.
9. Now turn the chemical valve and flow simulator valves to the open position, making certain that the flow meter indicates flow and that all anti-freeze drains out of the chemical hose into an approved container, after 30 seconds, turn off both valves.

### HIGH PRESSURE

Turn solution pressure valve to high pressure and key the high pressure wand until anti-freeze begins to come out of the wand. Recover all anti-freeze into an approved container. We strongly recommend that you recycle and re-use the anti-freeze.

After completing these procedures, shut the unit down. The unit is now winterized.

## OPERATIONS

### REMOVING ANTI-FREEZE FROM THE UNIT

1. Connect one end of the **winterizing loop hose** to the bottom solution outlet connection. Place the other end of the loop hose, without the attachment, into an approved container.
2. Start the unit. Allow the anti-freeze to flow into the container until flow stops.
3. Fill the water box with fresh water and repeat step #2.
4. Connect the **water inlet hose** to the water inlet connection on the console. Turn the water supply on.
5. Connect all **solution hoses and any tools** which require purging of anti-freeze to the solution outlet connection(s).
6. Open the tool valves and drain the anti-freeze into an approved container until the flow is clear and all anti-freeze is purged from the tools and hoses.

7. Place the chemical prime hose into the approved container. Submerge the chemical inlet hose in water. Turn the **chemical valve** to the PRIME position until clear water comes through the prime hose, and then remove the prime hose from the container.

Turn the **chemical valve** to the ON (CHEMICAL) position. This will allow water to flow into the other side of the system.

Once all of the anti-freeze is removed, the unit is ready to use.

Eventually, the anti-freeze in your storage container will become diluted with water. If the anti-freeze level drops below 50% of the total, dispose of it and start with fresh 100% anti-freeze.



**When disposing of used anti-freeze, observe local laws and regulations. Do not drain onto the ground or into storm drainage systems.**



**NOTES:**

# MAINTENANCE

## SERVICE SCHEDULE

<b>Engine</b>	Daily	Check engine oil level. *** Fill to proper level
<b>Engine</b>	Daily	Check coolant level in overflow bottle
<b>Vacuum Pump</b>	Daily	Spray WD-40 in lubrication cup at front of console for 5 sec.
<b>Water Pump</b>	Daily	Check oil level.** Fill to proper level
<b>Solution Inlet Tube Strainer</b>	Daily	Check strainer for blockage, remove any debris
<b>Vacuum Inlet Filter (In Waste Tank)</b>	Daily	Clean filter, inspect, replace if damaged
<b>Vacuum Hoses</b>	Daily	Wash out with clean water
<b>Automatic Waste Pump</b>	Daily	Inspect and remove any debris or sediment
<b>Chemical Filter</b>	Daily	Inspect daily
<b>Vacuum Pump</b>	Weekly*	Check oil level. Fill to proper level
<b>Water Box Float Valve</b>	Weekly	Check for proper seating and shut-off
<b>Water Pump Inlet Filter</b>	Weekly*	Check for debris and clean
<b>Temperature Balance Orifice</b>	Weekly	Remove, clean and check
<b>Battery</b>	Weekly*	Check for proper fluid level. Fill with distilled water only
<b>Solution Outlet Y-Strainer</b>	Bi-Weekly*	Inspect and remove any debris or blockage
<b>High Pressure Hoses</b>	100 hrs	Inspect for damage or impending damage
<b>Pressure Regulators</b>	100 hrs	Lubricate o-rings
<b>Engine</b>	100 hrs	Change engine oil***
<b>Engine</b>	100 hrs	Change oil filter***
<b>Engine</b>	100 hrs	Check fan belt tightness
<b>Battery</b>	100 hrs*	Clean battery terminals
<b>Float Valve Seal</b>	200 hrs.	Replace seal
<b>Engine</b>	200 hrs	Check radiator hoses and clamp tightness
<b>Fuel Pump</b>	200 hrs	Check hose connections and wire connections
<b>Flow Simulator And Chemical Valves</b>	200 hrs	Inspect and/or adjust packing nuts
<b>Engine</b>	250 hrs	Service air cleaner elements*
<b>Engine</b>	250 hrs	Check spark plugs for carbon deposits and proper gap
<b>Intake &amp; Exhaust Valve Clearances</b>	250hrs/ 1500 hrs	Check operating temperature
<b>Cylinder Head Bolts &amp; Manifold Nuts</b>	250 hrs/ 2000 hrs	Retighten
<b>Ignition Timing</b>	250 hrs	Inspect
<b>PCV Valve/hoses</b>	750 hrs	Inspect
<b>I.C. Ignition Distributor</b>		

# MAINTENANCE

## SERVICE SCHEDULE

<b>Vacuum Exhaust Heat Exchanger</b>	500 hrs	Inspect cores and remove debris.
<b>Water Pump</b>	500 hrs	Change oil**
<b>Pulley Set Screws &amp; Hub Cap Screws, Water Pump Clutch Shaft Bolts</b>	500 hrs	Check for proper torque valves. Re-torque, if required****
<b>Drive Pulley</b>	500 hrs	Inspect, clean and check for pulley groove wear****
<b>Drive Pulley</b>	500 hrs	Check pulley alignment****
<b>Drive Belts</b>	500 hrs	Inspect and clean****
<b>Drive Belts</b>	500 hrs	Check belt tension****
<b>Chemical Pump &amp; Check Valves</b>	500 hrs	Replace diaphragm and check valves.
<b>Heater Core</b>	500 hrs	Clean and inspect.
<b>Engine</b>	1000 hrs	Replace spark plugs.
<b>Check Valve (Solution Outlet)</b>	1000 hrs	Inspect, clean, and repair, if needed.
<b>Vacuum Pump</b>	1500 hrs	Drain, flush, and replace oil *****
<b>Fuel Filter</b>	1500 hrs	Replace
<b>Engine</b>	Yearly	Flush radiator and change engine coolant.
<b>Engine</b>	Yearly*	Replace air cleaner elements.
<b>Nitrogen Accumulator</b>	Yearly*	Replace Accumulator.
<b>Waste Tank Filters/Strainers</b>	Yearly	Check for damage and blockage. Replace if needed.
<b>Engine</b>	2 years	Replace radiator hoses and hose clamps.
<b>Engine</b>	3 years	Replace ignition wires.

\* Or as often as required

\*\* Change water pump crankcase oil after the first 50 hours

\*\*\*Change engine crankcase oil and filter after the first 50 hours

\*\*\*\*Perform drive belt, pulley and hub maintenance after the first 25 hours of operation, and then again at 100 hours

\*\*\*\*\*If using AEON PD synthetic lubricant, 4500 hours or every 2 years, whichever comes first

## **MAINTENANCE**

### **KEY CHECKPOINTS**

*Note: Initiation of a planned preventative maintenance program will assure that your unit has optimum performance, a long operating life, and a minimal amount of "down" time.*

### **ENGINE COOLANT SYSTEM (RADIATOR) MAINTENANCE**

Your engine radiator coolant system is an important part of the power plant operation. In addition, this heat exchange system is used to provide heat for cleaning operations is also highly dependent on the engine coolant system. Follow the recommended coolant system maintenance in the Maintenance Schedule in this manual and your Nissan A-15 engine owner's manual. Refer any additional questions to your dealer.

### **EXTERNAL FUEL PUMP MAINTENANCE**

The power plant for unit receives fuel from the main gas tank of your van/truck. An external fuel pump that provides this fuel is located on the underside of the van/truck. Loose fittings and hose connections will cause your unit to perform poorly. Follow the recommended fuel pump maintenance in the Maintenance Schedule in this manual. Refer any additional questions to your dealer.

### **SOLUTION SUPPLY SYSTEM MAINTENANCE**

The chemical supply system pulls chemicals from your chemical bottle utilizing a pump that works off the water pump pulsing. Any clogged filters or loose connections will result in a chemical supply system malfunction or a malfunction at the cleaning tool. Maintenance of the solution outlet check valve and strainer are vital to effective cleaning operation and minimal unit downtime. Additionally, the hoses related to supplying water and chemical to the outlet manifold are under high pressures and experience thermal expansion and contraction. Periodic inspections of these hoses for tears, cracks, and failing connectors are necessary to avoid unwanted leaks. To keep your solution supply system functioning properly, follow the chemical pump and solution outlet maintenance in the Maintenance Schedule in this manual. Refer any additional questions to your dealer.

### **HEAT EXCHANGER SYSTEM MAINTENANCE**

The heat exchange system in your unit transfers energy between the unwanted heat of the power plant and the solution supply system of the unit. The heat transfer of this system is highly dependent on the surface area contact in the heat exchanger cores located in the heat exchanger box. This surface area amount is adversely minimized when the supplied water is not softened to recommended levels. Hard water will result in scaling on the inside walls of the heat exchanger tubes. It is recommended that you use a dealer approved water softener to avoid premature heat exchanger core failure. Contact your local dealer for advice on the water hardness levels in your area.

Additionally, the heat exchanger tubes are very sensitive to freezing conditions. As the water freezes during cold conditions, it expands in the heat exchanger tubes and causes damage. Refer to the Freeze Protection instructions section in this manual. Refer any additional questions to your dealer.

### **VACUUM PUMP MAINTENANCE**

The total function of the unit is based around the performance of the vacuum pump. Heat transfer used to raise the temperature of the solution is gained from the air drawn by the vacuum pump and solution is removed from the carpet with the vacuum suction of the vacuum pump. General maintenance actions for the vacuum pump as listed in this manual are vital to prolonged vacuum pump operations. Daily lubrication of the pump is required to avoid seizure of the system. Also, waste tank filters and strainers must be maintained to prevent unwanted debris from entering the vacuum pump.

### **WARNING:**

**DO NOT** service this unit while it is running. The high-speed mechanical parts as well as high temperature components may result in severe injury, severed limbs, or fatality.

**NOTE:** Use the hour meter as a guide for coordinating the maintenance schedule.

### ENGINE

1. Check the engine oil level **daily**, when in use. Make certain that proper oil level is maintained. **NEVER** overfill.
2. Change the break-in oil after the first **50 hours** of operation. Thereafter, change oil every **100 hours** of operation. **USE ONLY NISSAN BRAND OIL FILTERS. USING ANY OTHER TYPE OIL FILTER WILL VOID YOUR ENGINE WARRANTY.**

**Oil Recommendation.** Use high-quality detergent oil of at least API (American Petroleum Institute) service class SF or SG. The recommended SAE viscosity grade for summer is **20W-50**, and **20W-40** winter.

**NOTE:** Using less than service class SF or SG oil or extending oil change intervals longer than recommended can cause engine damage.

3. Re-torque the manifold and exhaust tube nuts, cylinder head bolts, and carburetor attaching nuts after the **first 250 hours** of use.
4. Check the spark plugs every **250 hours**. Clean if necessary. Replace the spark plugs every **1000 hours**. **NOTE:** Never sandblast spark plugs. Spark plugs should be cleaned by scraping or wire brushing.

Clean the air cleaner element every **250 hours**. Replace the element every **2400 hours**

6. Check the coolant level in the radiator overflow container **daily**. If no coolant is seen, remove the cap and add coolant. Change the coolant with a 70:30 coolant to water ratio every **1000 hours or 2 years**.
7. Replace the in-line gas filter under the vehicle **yearly**.

**NOTE:** For additional engine service information, obtain a "Nissan A-15 Service and Repair Manual" from any authorized Nissan Service Center. If service or repair is required, contact an authorized Nissan Service Center. You will need to provide the serial number of the engine.

## MAINTENANCE

### VACUUM PUMP

Refer to the Vacuum Pump Operation and Service Manual for specific instructions.

**Lubrication:** We recommend that you use AEON PD Synthetic Blower Lubricant in the gear end of the vacuum pump for all operating temperatures. AEON PD is formulated especially for positive displacement blower service to provide maximum blower protection at any temperature. One filling of AEON PD will last several times longer than a premium mineral oil.

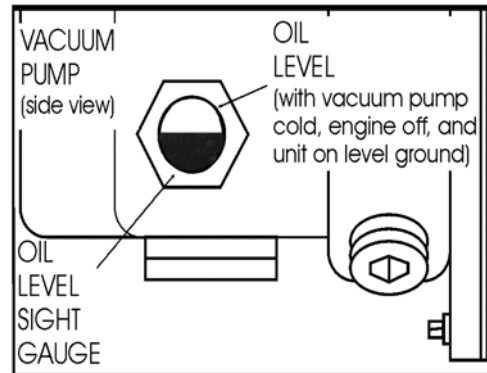
**NOTE: AEON PD (Part# 05-008039) is the oil which PROCHEM puts in the vacuum pump at the factory. Topping off or adding petroleum oil to synthetic oil is NOT recommended.**

*If not using AEON PD synthetic blower lubricant, use oils with rust and oxidation inhibitors, anti-foam additives and the viscosity's listed on the chart on the next page.*

1. Check the oil level **daily** to assure the proper level. **PROPER LEVEL** cannot be overemphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating. Use the illustration as a guide when adding oil.

2. To prevent rust from building up inside the vacuum pump (if moisture exists) we have provided a lubrication cup on the front of the unit.

First run the unit at least **1 minute** to remove any moisture from the vacuum pump. Next, fill the lubrication cup with WD-40, or a similar lubricant, for **5 seconds** while the unit is running and the vacuum inlets are sealed. Do this at the end of **each working day**.



3. Drain, flush and replace oil **every 1500 hours or yearly, whichever comes first**. Change oil more frequently if inspection so indicates. With AEON PD synthetic lubricant, perform the oil change maintenance **every 4500 hours or every 2 years, whichever comes first**.

**WATER PUMP**

Refer to the Water Pump Operation and Service Manual for specific instructions.

1. Check the crankcase oil level **daily** to assure the proper level. Use the illustration as a guide when checking the oil level. If the level has dropped, check for the source of leakage and repair.
2. Use the provided dipstick. Remove red filler cap and insert dipstick. Oil level should be between marks on the dipstick or use a mirror and refer to the illustration.



3. Change the crankcase oil with Cat Pump Crankcase Oil, Part #05-008016, after the **first 50 hours** of operation. Drain and refill the crankcase oil with Cat Pump Crankcase Oil **every 500 hours** thereafter.
4. Other Cat approved oil equivalents are: Mobil DTE 16, Amoco Rykow 68, and Shell Tellus T68.

**VACUUM INLET FILTER (IN WASTE TANK)**

1. The vacuum filter in the waste tank should be removed and cleaned **daily**. If this is done, the filter will last for a long period of time.

**VACUUM RELIEF VALVE**

While the unit is running at full RPM, block the air flow at the vacuum inlet connection and read the vacuum gauge. If adjustment is required, shut the unit down and adjust the vacuum relief valve locking nut tension. Start your unit and read the vacuum gauge. Repeat this process until the relief valve opens at 13" Hg.

**VACUUM PUMP DRIVE BELTS**

To tighten the vacuum pump belts:

1. Loosen the four screws which hold the vacuum pump spacers in place on the bottom side of the adjusting plate.
2. Loosen the 6 bolts at the vacuum muffler outlet to heat exchanger box and loosen the bolt at the back of the machine connecting the muffler bracket to the frame.
3. Turn the adjusting bolts until the proper belt tension is achieved (1/2" deflection in the center of the belt, halfway between the pulleys).
4. Retighten all bolts previously loosened at the vacuum muffler.

**NOTE: When adjusting belt tension, make certain that the engine shaft and vacuum pump shaft remain parallel, and the belt tension is equal throughout the belt width.**

5. After adjusting, re-tighten the four screws which hold the vacuum pump spacers in position. Check belt alignment with straight-edge.

**⚠ CAUTION:**

**Make certain that when you re-torque these screws, that you use a clockwise pattern and continue until proper torque is achieved.**

<b>TORQUE VALUES</b>		
COMPONENT	INCH/LBS	FOOT/LBS
Engine hub	480	40
Vacuum pump hub	300	25

6. Check for pulley groove wear, clean belts and pulley grooves, check for worn belts, proper belt tension, and pulley alignment after the **first 25 hours** and then again at **100 hours**. Check for belt ride in the groove.

## MAINTENANCE

### WATER PUMP DRIVE BELT

To tighten the water pump belt:

1. Loosen the nuts which hold the water pump mount to base.
2. Turn the belt tension adjusting bolt until the proper belt tension is achieved. (1/2" deflection in the center of the belt, halfway between the pulleys).
3. While checking the alignment, tighten the nuts which hold the water pump mount to base.

### WATER PUMP CLUTCH



**CAUTION:** After removing or replacing water pump clutch, make certain that bolt is re-torqued to the proper value.

Torque Value		
Component	Inch pounds	Foot pounds
Water pump shaft bolt	192	16

### FLOAT VALVE (WATER BOX)

The float valve should only be adjusted if the water box is overflowing or the water level in the box is lower than 5-1/2".

1. If the box is overflowing, remove, and check the float valve for debris or damage.

**NOTE:** If the float ball has any water inside it must be replaced.



**When replacing float ball, DO NOT over-tighten, as the rod can puncture the ball. Make sure to tighten the nuts on the rod.**

2. Disassemble the valve and check the piston and seat for damage, replace if needed. See the "Illustrated Parts Listing" for a parts break-down.

### WASTE TANK STRAINER BASKET

The strainer basket located inside the waste tank should be removed and cleaned whenever it is full of debris. This should be done at the end of each job.

### Y-STRAINER (OUTLET)

Inspect the Y-strainer **after the first week** of running the unit by unscrewing the screen and remove any accumulated debris. Inspect the strainer again every **2 weeks**.

The Y-strainer should then be inspected **every month**. However, if the Y-strainer has a frequent build-up of debris it should be inspected and cleaned more often.

### TEMPERATURE BALANCE ORIFICE

Inspect the Temperature Balance Orifice every week. Be sure to drain the water box below 1/2 full. Clean as necessary. The orifice needs to be kept clean. Cleaning in this way will be dependent on the water hardness you are using.

### CHECK VALVE (OUTLET)

Inspect the check valve when rebuilding the chemical pump or as needed. Remove and disassemble the check valve. Check the Teflon seat for debris or abnormal wear. Clean or replace seat if needed.

**NOTE:** Improper seating of the check valve poppet, damaged spring, or o-rings will cause poor operation of the chemical system.

For the procedure, see the "General Service Adjustments" section in this manual for details.

### CHEMICAL PUMP

Rebuild the chemical pump **every 500 hours**. This involves changing the diaphragm and check valves.

For the procedure, see the "Chemical Pump" section in this manual for details.

**NOTE:** *Inspect chemical filter daily.*



## NITROGEN ACCUMULATOR

The nitrogen accumulator is pressurized to 250 PSI and must be replaced periodically. The accumulator cannot be repaired or recharged. We recommend replacement every 1000 hours of use or yearly, whichever comes first.

## PRESSURE REGULATOR

Lubricate the o-rings **every 50 hours**. Use o-ring lubricant Part #05-008035.

For the procedure, see the "General Service Adjustments" section in this manual for details.

## VACUUM HOSES

To assure maximum hose life, we recommend that the hoses be washed out with clean water at the end of each **working day**.

## PRESSURE HOSES

Inspect your pressure hoses for wear after the **first 100 hours** of use. Inspect **every 25 hours thereafter**. If hoses show any signs of damage or impending rupture, **replace the hose**.



**DO NOT attempt to repair pressure hoses!** Repairing pressure hoses may result in severe burns and serious injury!

**All pressure hoses must be rated for 3000 PSI at 250°F. Thermoplastic hoses do not meet these specifications and should not be used.**

## OPTIONAL WASTE PUMP-OUT

**At the end of each work day**, make certain that you remove any debris or sediment which may be inside the waste pump by pumping fresh water through the pump.

## CHEMICAL AND SIMULATOR VALVE

Examine the packing nut on the chemical prime selector valve, flow simulator valve, and chemical metering valve **every 200 hours**.

Keeping these valve packings properly adjusted will eliminate possible leakage from the valve stems and add to overall valve life.

For the procedure, see the "General Service Adjustments" section in this manual for details.

## ENGINE COOLANT REPLACEMENT

Annually the coolant in the Prochem machine should be replaced. This coolant is an integral part of the heating system and needs to be maintained as any other working part of the system. We recommend that this procedure be accomplished by the following steps.

### DRAINING COOLANT:

1. Add 7/16" hose or a 1/4" plastic hose into the radiator drain petcock. Turn counter clockwise to open and drain coolant. After draining approximately 1/2 gallon, open bleed petcock in heli-coil to assure that heli-coil drains also. Allow the coolant to completely drain.

**NOTE: Be sure that used coolant is collected in a proper container and disposed of in accordance with local laws.**

2. After draining is complete, close both the radiator and heli-coil petcocks. Draining is complete.

### REPLACING COOLANT:

1. Fill radiator with 70/30 anti-freeze water mix.
2. Start unit and run on low speed.
3. As the unit warms up, maintain a full radiator with a 70/30 mix.
4. Open petcock slightly on heli-coil to allow any trapped air to escape. When coolant runs out of heli-coil, close petcock.
5. Fill radiator with 70/30 coolant mix.
6. Re-install radiator cap.
7. Shutdown unit.

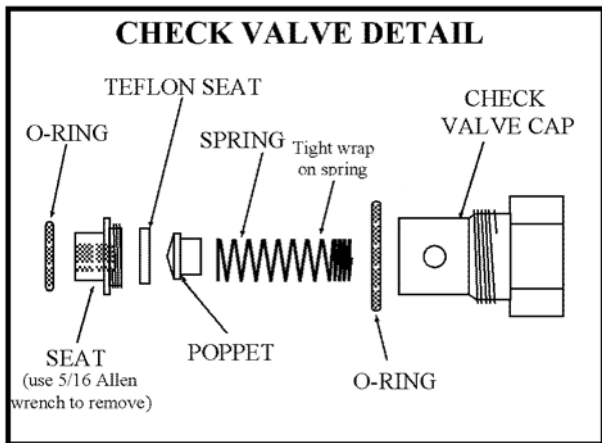
Check radiator overflow bottle. Add coolant to proper "cold" level.

## MAINTENANCE

### CHECK VALVE (SOLUTION OUTLET)

Inspect the check valve whenever doing service on the chemical pump or if flow problems occur in the chemical system:

1. Remove the check valve. Be sure the small o-ring for the seat comes out with the check valve.
2. Remove the seat, using a 5/16" Allen wrench.
3. Check the Teflon seat for debris or wear. Clean or replace Teflon seat if needed.
4. Clean the poppet and spring, inspect for wear or damage, and replace as needed.
5. Re-assemble the check valve. Start the seat by hand, tighten using a 5/16" Allen wrench. **DO NOT** over-tighten seat.



**NOTE: Improper seating of the check valve poppet, damaged spring or o-rings will cause poor operation of the chemical system.**

6. Lubricate the o-rings with o-ring lubricant Part #05-008035 and reinstall.

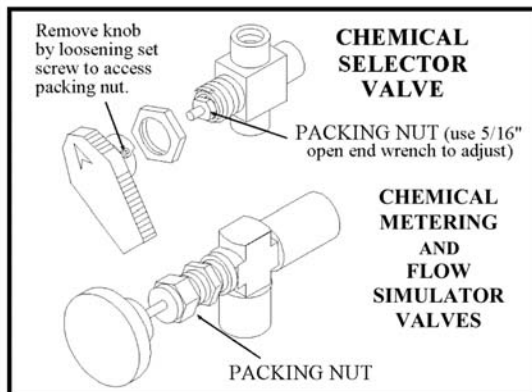
### CHEMICAL PUMP

The only repairs which the chemical pump may require is the replacement of the diaphragm or check valves. To replace the diaphragm, unscrew the cover from the body. When replacing the diaphragm, lubricate the outer edges of the diaphragm with o-ring lubricant Part #05-008035 and reassemble. To replace the check valves, unscrew the check valve caps. Replace the check valves and reassemble, using new o-rings.

**DO NOT** attempt to re-use o-rings once the check valves have been removed. See the "Illustrated Parts Listing" for a parts break-down on the chemical pump.

## PACKING NUT ADJUSTMENT FOR CHEMICAL METERING, FLOW SIMULATOR AND CHEMICAL SELECTOR VALVES

Examine the packing nut on the chemical metering, flow simulator, and chemical selector valves for proper tension every **200 hours**. When turning the knob, there should be a small amount of resistance. If not, slightly tighten the packing nut. **DO NOT** over-tighten. Keeping the valve packings properly adjusted will eliminate possible leakage from the valve stems and add to overall valve life.



## PRESSURE REGULATORS

The pressure regulators hold water pressure at a preset point and bypass excess water back to the water box.

### LOW PRESSURE REGULATOR

To adjust:

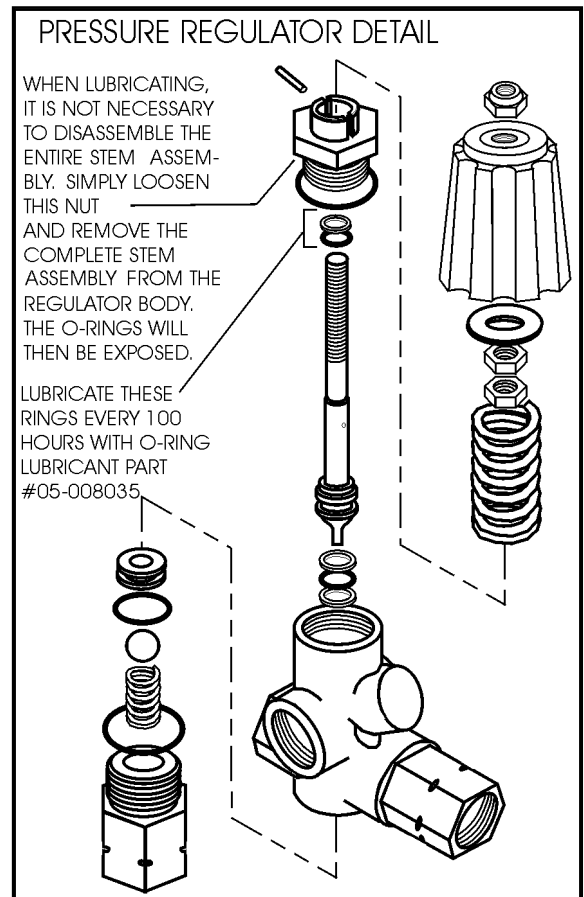
1. With your unit running, close the cleaning tool. Check the pressure gauge. Open the tool valve. We recommend setting the pressure regulator so that the pressure gauge reads 350 PSI with the tool valve **open**.

When the tool valve is opened, there is an approximate drop of 100 PSI in pressure. **If there is a pressure drop greater than 100 PSI, it may be necessary to lubricate the o-rings in the pressure regulator.**

2. If the pressure regulator requires adjustment, turn the adjusting knob (while observing the pressure gauge on the control panel) until the desired pressure is obtained.

### HIGH PRESSURE REGULATOR

To adjust:



Set the high pressure regulator to desired pressure, up to 3000 PSI. Adjust as necessary to meet your cleaning needs.

Wiring Harness:

1. If you find it necessary to disconnect the Amp connectors joining the harness to the ECU, be sure to apply dielectric grease gel (p/n ) to the female Amp connector prior to re-connection.

## TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
<p>Loss of water pump pressure.</p> <p>With the cleaning tool open, the water pressure gauge reads below the normal operating pressure.</p>	Water supply is turned off or the float valve is stuck or improperly adjusted.	Turn the water supply on or up. Check for kinks in the water supply hose. Examine the float valve and adjust or replace.
	Water pump inlet supply line is plugged or drawing air.	Examine the water inlet filter inside the water box. Remove accumulated debris and replace if required. Check for suction leaks and loose clamps or fittings. Tighten any loose fittings or clamps. Replace any ruptured hose(s).
	Orifice improperly installed or Improper engine speed	Using a tachometer, check the engine speed. Full throttle engine speed is 2200 RPM. Idle engine speed is 900 RPM.
	Pressure regulator o-rings are dry.	Lubricate o-rings, using o-ring lubricant Part #05-008035.
	Pressure regulator has worn o-rings	Check o-rings. If necessary, replace.
	Pressure regulator is dirty, stuck open, or improperly adjusted.	Clean or repair regulator. Adjust to working pressure. Lubricate o-rings, using o-ring lubricant Part #05-008035.
	Low pump volume. (Measure the amount of water being returned to the water box from the pressure regulator. It should fill a gallon container about every 17 seconds).	Examine the check valves, plunger cups, and cylinder head on the water pump. Repair, whenever required (refer to the water pump service manual).
	Defective water pressure gauge.	Replace gauge
	Orifice (spray nozzle) in the cleaning tool is worn, defective, or wrong size.	Replace Nozzle or change nozzle size.
	Debris clogging water lines or water inlet disconnect.	Clean or replace as needed.
<p>Loss of solution volume at cleaning tool orifice.</p> <p>Water gauge reads normal.</p>	Belts loose or broken	Re-tension or replace as needed.
	Plugged orifice and/or screen in the cleaning tool.	Unplug or replace orifice and/or screen
	Internal block between the pressure regulator manifold and the outlet Y-strainer, or the Y-strainer screen is clogged	Inspect all lines, remove accumulated debris which is blocking proper flow. Replace any defective hoses. Remove, inspect, and clean the Y-strainer screen. De-scale unit and install a water softener, if necessary.
	Outlet check valve is plugged	Examine the check valve, remove any debris
	Defective quick-connect on one or more of the high pressure hoses.	Replace defective quick-connects(s) on high pressure hoses(s).
	Cleaning tool valve is malfunctioning.	Repair or replace valve.
	Hose inner lining is constricted.	Remove restriction or replace hose.
<p>Uneven temperature fluctuation</p>	Orifice Damaged or left out.	Inspect and correct.
	Clogged temperature balance orifice	Maintain orifice assembly.

## TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
<p>Loss of vacuum</p> <p>While cleaning, the vacuum is not up to specification. Engine RPM is normal.</p>	Waste tank filter or strainer basket is plugged.	Examine the tubing between the vacuum relief valve and the vacuum gauge and remove any blockage.
	Vacuum gauge is giving an improper reading.	Inspect hose(s), repair or replace.
	Vacuum hose(s) is damaged, causing a suction leak.	Inspect the gasket. Repair seal or replace Re-position lid(s).
	Waste tank gaskets not sealing properly, not positioned properly	Unplug vacuum hose or inlet plumbing.
	Plugged vacuum hose or vacuum plumbing between vacuum inlet and strainer basket.	Clean or replace filter. Clean strainer basket.
	Loose vacuum pump drive belts.	Tighten the drive belts
	Waste tank drain valve is damaged or left open, causing a vacuum leak.	Drain the waste tank. Close drain valve, if open. Remove the dump valve and, after inspecting, replace the defective components.
	Vacuum relief valve requires adjustment or has a vacuum leak due to damaged diaphragm.	Re-adjust the vacuum relief valve. If the vacuum does not increase, remove and inspect the relief valve diaphragm. If damaged, replace
	Vacuum exhaust heat exchangers are plugged with lint.	Remove and clean.
Vacuum pump is worn out.	Replace the vacuum pump.	
<p>Loss of chemical</p> <p>With the cleaning tool valve open, no chemical</p>	Chemical pump is improperly primed.	Refer to chemical pump priming instructions.
	The strainer at the inlet end of the chemical inlet line is clogged	Unclog the strainer. If damaged, replace.
	Suction leak in the inlet line leading into the chemical pump.	Inspect inlet lines and flow meter for damage and replace, if required.
	Chemical pump check valve(s) is clogged	Remove any debris from the chemical check valve(s). Replace chemical check valve(s) or seals, if necessary.
	Chemical prime/on-off valve or chemical metering valve is defective.	Replace valve(s).
	Chemical pump diaphragm is ruptured.	Disassemble the chemical pump and replace the damaged diaphragm.
	Defective cylinder in the water pump.	Measure the pump volume. If the pump volume is less than normal, refer to "Loss of Pump Volume" in the Troubleshooting section in this manual.
<p>Chemical flow meter indicates flow with the tool valve closed</p>	External leak in chemical piping	Tighten fittings. Re-apply thread sealant where required. If any fittings are damaged, replace.
	Outlet check valve is full of debris or damaged, not allowing it to close properly	Close the chemical valve on the instrument panel. If the flow meter does not indicate flow, remove debris or replace check valve, if necessary.
	Chemical pump diaphragm is ruptured	Close the chemical valve on the instrument panel. If the flow meter still indicates flow, replace the chemical pump diaphragm.
	Internal leak in chemical valve causing continual flow through prime tube returning to container.	Tighten valve packing nut (see "General Service Adjustments" section in this manual). Replace valve, if necessary.

## TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
Water pump does not engage	Solution pump circuit breaker has been tripped	Check the solution pump circuit breaker on the control panel. Press the circuit breaker reset button.
	Defective electrical connection in the console wiring or defective switch.	Examine switch, electrical connections, and wiring. Repair any defective connections. If there is power going to the switch but not going out, replace the defective switch.
	Water pump has not been activated	Turn solution pump switch to on.
	Defective water pump clutch. NOTE: The clutch may be manually set by inserting two 1/4-20 x 1/2 bolts. Line up the holes on the clutch and insert the bolts. To disengage the pump, remove the bolts.	If there is power in the switch, but not power at the clutch, replace the defective wire. If there is power at the clutch, replace the defective switch.
	Loose or broken water pump belts.	Tighten or replace belts.
Engine will not start  The engine does not turn over	Main circuit breaker on the control panel has been tripped.	After inspecting the unit to determine the cause of the tripped circuit breaker, press the reset button.
	Loose or corroded battery.	Clean, tighten, or replace the battery terminals.
	Dead battery.	Recharge or replace battery.
	Defective ignition switch.	Test ignition switch for power going into the switch. If there is power going in but NO power going out, replace the switch.
	Defective starter motor.	Test the starter motor. If necessary replace.
	Vacuum pump seized.	Refer to Sutorbilt Service & Repair Manual.
Starter turns over engine, but will not start	Waste tank is full.	Empty the waste tank.
	Engine temperature has exceeded 240°F, triggering the high temperature switch to shut the unit down.	Determine the cause of overheating before restarting the unit. See "Excessive Heating" in the "Troubleshooting" section of this manual.
	Defective fuel pump.	Replace the fuel pump.
	Loose or broken wires leading to waste tank float switch.	Repair or replace any broken electrical connections.
	Defective float switch in the waste tank.	Check switch for proper operation, replace as necessary.
	Oil pressure switch (located on engine), high temperature switch (located on engine).	Test these components. If any are defective, replace. Consult the Nissan Engine Operation and Maintenance Manual.

## TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
Starter turns over engine, but will not start	Engine is malfunctioning	Refer to Nissan Engine Operation and Maintenance Manual.
Engine stops running While doing normal cleaning, the engine stops running	Engine is out of gasoline	Add gasoline to the fuel tank.
	Waste tank is full	Empty waste tank.
	Main or engine circuit breaker on the control panel has been tripped.	After inspecting the unit to determine the cause of the tripped circuit breaker, press the reset button.
	Engine coolant temperture has exceeded 240°F, triggering the high temperature switch to shut the unit down.	Determine the cause of the overheating before restarting the unit. Refer to the Nissan Engine Operation and Maintenance Manual.
	Defective fuel pump.	Replace fuel pump.
	Defective float switch inside the waste tank.	Check switch for proper operaton. Replace as necessary.
	Defective 240°F engine coolant high-temperature shudown switch.	Test switch. If necessary, replace.
	Oil pressure switch on engine has shut down, due to insufficient oil pressure.	Refer to the Nissan Engine Operation and Maintenance Manual. <b>DO NOT</b> restart the engine until the cause is determined and corrected.
	No ignition in the engine or engine is malfunctioning.	Refer to the Nissan Engine Operation and Maintenance Manual.
Excessive heating	Flow restriction caused by hard water scaling.	Descale unit, repair or replace damaged plumbing components as necessary. Install water softener.
	Not enough water flow.	Check jet size of tool.
Heat exchanger leaks  <b>NOTE:</b> The exhaust heat exchanger will produce water condensation discharge at times during normal operation. <b>DO NOT</b> confuse this with a leak.	Engine/vacuum exhaust heat exchangers are damaged from frozen water.	Inspect heat exchangers for leaks. Visually inspect for damage. Pressure check after removing from the unit. (Maximum test pressure 1200 PSI).
Loss of temperature	Temperature relief valve on water box is stuck open.	Clean temperature relief valve and test. Replace, if necessary.
The heat output of the unit is LESS than normal.	Defective temperature gauge.	Test gauge and sensor. Replace failed component.
Automatic waste pump is malfunctioning or not operating normally  <b>NOTE:</b> When replacing either the pump or float switch, use new electrical connectors and heat shrink. Inspect connection for watertight seal.	Defective waste pump float switch.	Replace float switch.
	Broken diaphragm.	Replace diaphragm.
	Weak battery.	Charge or replace battery if needed. Check charging station.
	Pump-out circuit breaker on control panel has been tripped.	After inspecting waste pump to determine the cause of the tripped circuit breaker, press the reset button.