

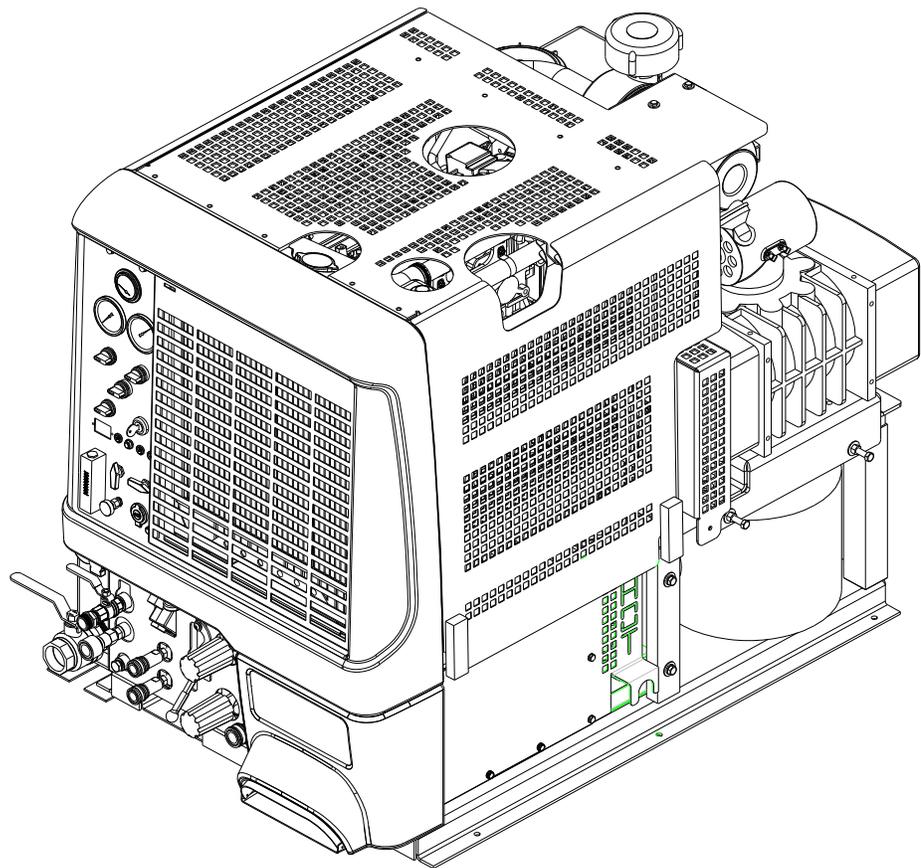
# Everest **PROCHEM**®

MODELS: **EV408**  
**10010150**

**EVHP408**  
**10010160**

**EV650**  
**10010170**

**EVHP650**  
**10010180**



Operating Instructions (ENG)

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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.**

**NOTE: Do not modify unit without written permission from manufacturer.**

## EQUIPMENT LIST:

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

## HOW TO USE THIS MANUAL

This manual contains the following sections:

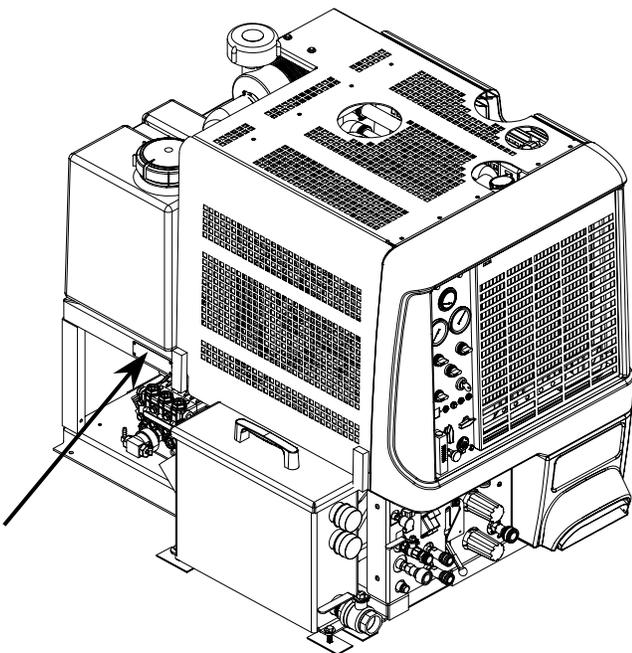
- HOW TO USE THIS MANUAL
- SAFETY
- SYSTEMS
- OPERATIONS
- MAINTENANCE & SERVICE
- PARTS LIST

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 hazardous or unsafe practices of the machine. Levels of hazards are identified that could result in product damage, 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 & Hub
- Chemical Pump
- 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.
- **PRV NO.** – Reference No.
- **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 part number for this manual is in the lower left corner of the cover page.**

## SAFETY

# 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 all vehicle cargo area or trailer rear 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.

**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:**

WEIGHT OF CONSOLE AND WASTE TANK	
408	1215 lbs
650	1300 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 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 solution hose 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.  
**Pressure wash hoses must be rated at 4000 PSI.**

**The winterizing loop hose assembly, 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.

# **SAFETY**

The following symbols are used throughout this guide as indicated in their descriptions:

## **HAZARD INTENSITY LEVEL**

There are three levels of hazard intensity identified by signal words -**WARNING** and **CAUTION** and **FOR SAFETY**. The level of hazard intensity is determined by the following definitions:



**WARNING** - Hazards or unsafe practices which COULD result in severe personal injury or death.



**CAUTION** - Hazards or unsafe practices which could result in minor personal injury or product or property damage.

### ***FOR SAFETY: To Identify actions which must be followed for safe operation of equipment.***

Report machine damage or faulty operation immediately. Do not use the machine if it is not in proper operating condition. Following is information that signals some potentially dangerous conditions to the operator or the equipment. Read this information carefully. Know when these conditions can exist. Locate all safety devices on the machine. Please take the necessary steps to train the machine operating personnel.

#### ***FOR SAFETY:***

**DO NOT OPERATE MACHINE:**

Unless Trained and Authorized.

Unless Operation Guide is Read and understood.

In Flammable or Explosive areas.

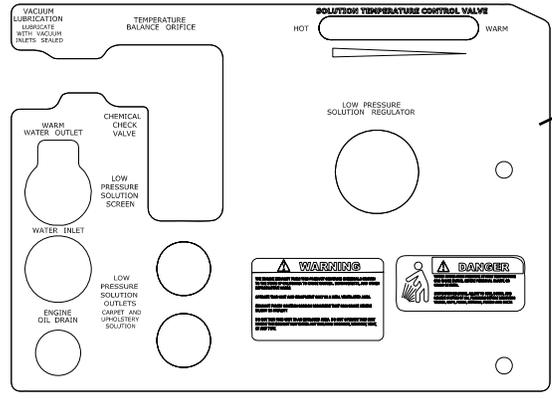
In areas with possible falling objects.

#### ***WHEN SERVICING MACHINE:***

Avoid moving parts. Do not wear loose clothing; jackets, shirts, or sleeves when working on the machine. Use ProChem approved replacement parts.

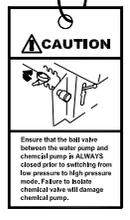
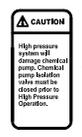
The following **WARNING LABELS** are found on your cleaning unit . These labels point out important **Warnings** and **Cautions** which should be followed at **all** times. Failure to follow warnings and cautions could result in fatality, personal injury to yourself and/or others, or property damage.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

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

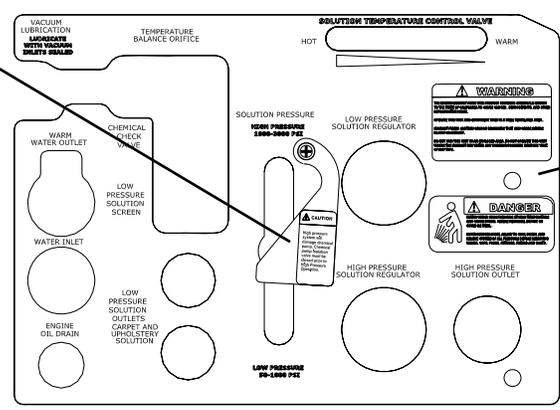


Front panel decal  
Model 408 & 650  
P/N 86179470  
PRV NO. 791288

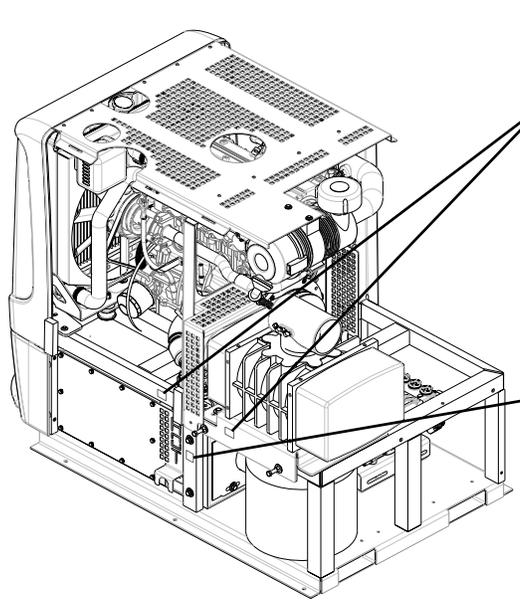
Caution label  
P/N 86186510  
PRV NO.500707



Caution Tag  
P/N 86186500  
PRV NO. 500706



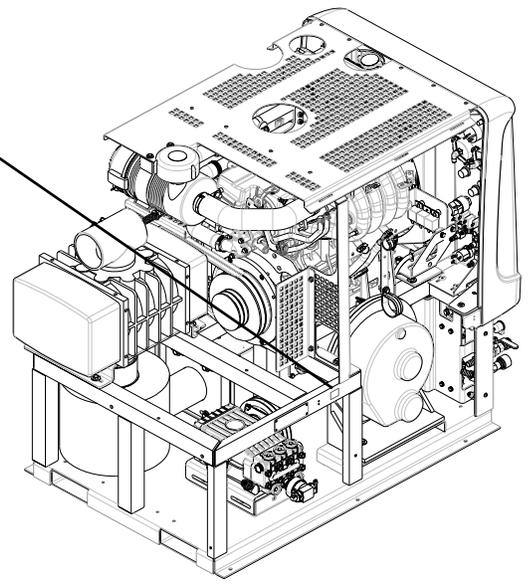
Front panel decal  
HP Model 408 & HP 650  
P/N 86179480  
PRV NO.791289



Warning label  
P/N 86186520  
PRV NO.500769



Caution label  
Part # 86012220



# OPERATION & SYSTEMS

## TECHNICAL SPECIFICATIONS

ITEM	DIMENSION/CAPACITY	
Engine speed	2200 rpm (high speed) 900 rpm (idle speed)	
Water pump rpm	1357 rpm	
Vacuum pump rpm	3125 rpm	
Water flow rate	5 GPM (maximum)	
Water pump pressure (low pressure)	1200 PSI (maximum)	
Water pump pressure (high pressure) (Optional)	3000 PSI (maximum)	
Vacuum relief valve	13" Hg	
Waste tank capacity	100 gallons	
Console weight (Model 408 & HP 408)	1065 lbs	
Console weight (Model 650 & HP 650)	1150 lbs	
Console weight (with waste tank & waste tank accessories) Model 408 & HP 408)	1215 lbs	
Console weight (with waste tank & waste tank accessories) (Model 650 & HP 650)	1300 lbs	
TORQUE VALUES		
Engine pulley	420 inch lbs	35 foot/lbs
Vacuum pump hub	300 inch/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: Quad-jet wand uses four 95015 jets (95° spray angle w/ 15 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: Quad-jet wand uses four 95015 jets (95° spray angle w/ 015 orifice).  
015 x 4 = 060.....06 x 2 tools = 12

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

### 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. 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.

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



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

3. 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 axle trailer only. Single axle trailers are not recommended.
4. The vehicle tires should have a load rating above the combined vehicle and unit weight.
5. Flooring materials that absorb water are not recommended. This could result in rust and corrosion of the vehicle floor.
6. Padding under rubber floor mats should be removed before installing this unit.
7. It is highly recommend that a drip tray is used under the console.

### 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. This unit is not compatible with E-85 fuel.

### ENGINE OIL REQUIREMENTS

Use high quality detergent oil of at least API (American Petroleum Institute) service class SH. **NOTE:** Using less than service class SH oil or extending oil change intervals longer than recommended can cause engine damage. The recommended SAE viscosity grade is 15-W40.

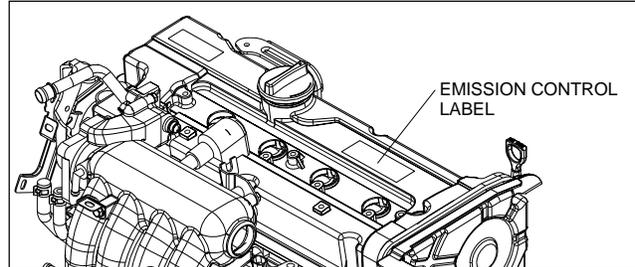
## **OPERATION & SYSTEMS**

### **ELECTRONIC FUEL INJECTION SYSTEM**

This unit is equipped with the latest port fuel 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**

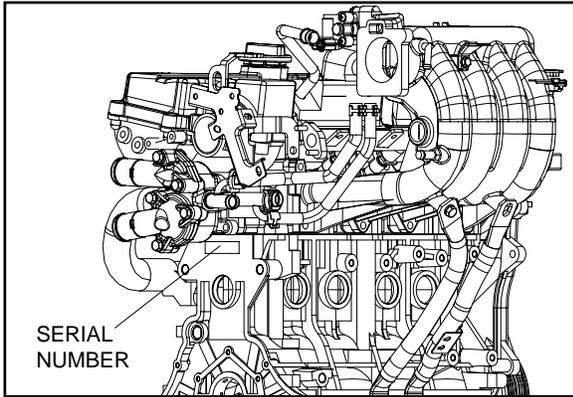
The Zenith Power Products (ZPP) Emission control label is located on the valve cover of the engine near the oil fill cap.



# OPERATION & SYSTEMS

## 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 surface on the back of the engine block, approximately where indicated.



## FUEL PUMP AND FILTER

Your Everest 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 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

# OPERATION & SYSTEMS

## TROUBLE CODES

A feature of the ZPP 416 ECM is that DTC's = Diagnostic Trouble Codes can be displayed to a technician to indicate what historic faults are present without requiring the use of a personal computer. The DTC's can be flashed over the MIL output while the RS232 serial receive input (PC RX) is grounded. This input may be grounded at the diagnostic connector (pin A-brown/white wire). This connector is located behind the intake manifold near the front cylinder. Once the ECM recognizes that the user is requesting flash codes, it will flash or blink default code 1654 3 times in a row. If the machine has been shut down due to a full waste tank you will also observe code 1552 and 1554. After the standard code has been flashed 3 times, the first flash code in the historic faults category will be flashed at the same rate. This will repeat depending on the number of historic faults retained in memory. If there are no historic faults, the standard flash code will be repeated. The codes are retained in memory. Once any issue is resolved and the machine started the light will go out. If an issue has not been resolved the light will remain on and another code stored in history.

Fault Description\* DTC (Diagnostic Trouble Code)  
Default First Flash Code 1654

DIAGNOSTIC TROUBLE CODES	
DTC 16: Crank and/or cam could not synchronize during start 0016	DTC 236: TIP active 0236
DTC 091: FP low voltage 0091	DTC 237: TIP low voltage 0237
DTC 092: FP high voltage 0092	DTC 238: TIP high voltage 0238
DTC 107: MAP voltage low 0107	DTC 261: Injector 1 open or short to ground 0261
DTC 108: MAP pressure high 0108	DTC 262: Injector 1 coil shorted 0262
DTC 111: IAT higher than expected stage 1 0111	DTC 264: Injector 2 open or short to ground 0264
DTC 112: IAT voltage low 0112	DTC 265: Injector 2 coil shorted 0265
DTC 113: IAT voltage high 0113	DTC 267: Injector 3 open or short to ground 0267
DTC 116: ECT higher than expected stage 1 0116	DTC 268: Injector 3 coil shorted 0268
DTC 117: ECT voltage low 0117	DTC 270: Injector 4 open or short to ground 0270
DTC 118: ECT voltage high 0118	DTC 271: Injector 4 coil shorted 0271
DTC 121: TPS1-2 lower than expected 0121	DTC 326: Knock1 excessive or erratic signal 0326
DTC 122: TPS1 voltage low 0122	DTC 327: Knock1 sensor open or not present 0327
DTC 123: TPS1 voltage high 0123	DTC 336: CRANK input signal noise 0336
DTC 127: IAT higher than expected stage 2 0127	DTC 337: Crank signal loss 0337
DTC 129: BP pressure low 0129	DTC 341: CAM input signal noise 0341
DTC 134: EGO1 open / lazy 0134	DTC 342: Loss of CAM input signal 0342
DTC 154: EGO2 open / lazy 0154	DTC 420: Catalyst inactive on gasoline (Bank 1) 0420
DTC 171: Adaptive-learn gasoline bank1 high 0171	DTC 521: Oil pressure sender high pressure 0521
DTC 172: Adaptive-learn gasoline bank1 low 0172	DTC 522: Oil pressure sender low voltage 0522
DTC 174: Adaptive-learn gasoline bank2 high 0174	DTC 523: Oil pressure sender high voltage 0523
DTC 175: Adaptive-learn gasoline bank2 low 0175	DTC 524: Oil pressure low 0524
DTC 182: FT low voltage 0182	DTC 524: Oil pressure sender low pressure 0524
DTC 183: FT high voltage 0183	DTC 562: Vbat voltage low 0562
DTC 217: ECT higher than expected stage 2 0217	DTC 563: Vbat voltage high 0563
DTC 219: RPM higher than max allowed govern speed 0219	DTC 601: Microprocessor failure - FLASH 0601
DTC 221: TPS1-2 higher than expected 0221	DTC 604: Microprocessor failure - RAM 0604
DTC 222: TPS2 voltage low 0222	DTC 606: Microprocessor failure - COP 0606
DTC 223: TPS2 voltage high 0223	DTC 615: Start relay coil open 0615

DIAGNOSTIC TROUBLE CODES	
DTC 616: Start relay ground short 0616	DTC 1554: AUX digital 2 low voltage (AFTER 47 SECONDS, ENGINE SHUTDOWN- WASTE TANK LEVEL HIGH) 1554
DTC 617: Start relay coil short to power 0617	DTC 1611: Sensor supply voltage 1 and 2 out-of-range 1611
DTC 627: Fuel pump relay coil open 0627	DTC 1612: Microprocessor failure - RTI 1 1612
DTC 628: Fuel-pump high-side open or short to ground 0628	DTC 1613: Microprocessor failure - RTI 2 1613
DTC 628: Fuel pump relay control ground short 0628	DTC 1614: Microprocessor failure - RTI 3 1614
DTC 629: Fuel-pump high-side short to power 0629	DTC 1615: Microprocessor failure - A/D 1615
DTC 629: Fuel pump relay coil short to power 0629	DTC 1616: Microprocessor failure - Interrupt 1616
DTC 642: Sensor supply voltage 1 low 0642	DTC 1635: PWM3-Gauge3 open / ground short 1635
DTC 643: Sensor supply voltage 1 high 0643	DTC 1636: PWM3-Gauge3 short to power 1636
DTC 650: MIL open 0650	DTC 1639: PWM5 open / ground short 1639
DTC 652: Sensor supply voltage 2 low 0652	DTC 1640: PWM5 short to power 1640
DTC 653: Sensor supply voltage 2 high 0653	DTC 1641: Buzzer control ground short 1641
DTC 685: Power relay coil open 0685	DTC 1642: Buzzer open 1642
DTC 686: Power relay ground short 0686	DTC 1643: Buzzer control short to power 1643
DTC 687: Power relay coil short to power 0687	DTC 1644: MIL control ground short 1644
DTC 1111: RPM above fuel rev limit level 1111	DTC 1645: MIL control short to power 1645
DTC 1112: RPM above spark rev limit level 1112	DTC 2111: Unable to reach lower TPS 2111
DTC 1155: Closed-loop gasoline bank1 high 1155	DTC 2112: Unable to reach higher TPS 2112
DTC 1156: Closed-loop gasoline bank1 low 1156	DTC 2135: TPS1/2 simultaneous voltages out-of-range 2135
DTC 1157: Closed-loop gasoline bank2 high 1157	DTC 2229: BP pressure high 2229
DTC 1158: Closed-loop gasoline bank2 low 1158	DTC 2300: Spark coil 1 primary open or short to ground 2300
DTC 1521: CHT higher than expected stage 1 1521	DTC 2301: Spark coil 1 primary shorted 2301
DTC 1522: CHT higher than expected stage 2 1522	DTC 2303: Spark coil 2 primary open or short to ground 2303
DTC 1531: Gov1/2/3 interlock failure 1531	DTC 2304: Spark coil 2 primary shorted 2304
DTC 1552: AUX digital 1 low voltage (FORCE IDLE -WASTE TANK LEVEL HIGH) 1552	

## OBD-II TSP/FPP Nomenclature

OBD II = On Board diagnostics

MIL = Malfunction Indicator Light

TPS1 = TPS/FPP-A = Throttle position Sensor/Foot Pedal Position

TPS2 = TPS/FPP-B = Throttle position Sensor/Foot Pedal Position

TCP1=TPS/FPP-D = Throttle control position/Foot Pedal Position

TCP2=TPS/FPP-E = Throttle control position/Foot Pedal Position

IVS=TPS/FPP-F = Idle Validation switch

BP = Barometric pressure

EGO = Exhaust Gas Oxygen

TIP Throttle Inlet Pressure

FT = Fuel Temperature

PWM = Pulse Width Modulation

MAP = Manifold Absolute Pressure

IAT = Intake Air Temperature

ECT = Engine Coolant Temperature

FP = Foot Pedal (not used)

CAM = Cam Sensor Input

CHT = Customer Heat Temperature (not used)

# OPERATION & SYSTEMS

## ZENITH DISTRIBUTOR LOCATIONS

- **ITAL ENGINE COMPANY (09046)**  
97 CYPRESS ST. SW  
REYNOLDSBURG, OHIO 43068
- **CULLUM & BROWN, INC. (09045)**  
1607 WABASH  
WICHITA, KS 67214
- **DIESEL ELECTRIC SERVICE & SUPPLY (09116)**  
652 W. 1700 SOUTH  
SALT LAKE CITY, UT 84104
- **POWER EQUIPMENT COMPANY (09117)**  
15225 INDUSTRIAL RD.  
OMAHA, NE 68144
- **ENGINE WORKS, INC. (09178)**  
1345 PARAMOUNT PKWY.  
BATAVIA, IL 60510
- **FRONTIER EQUIPMENT, LTD. (09185)**  
8029 RIVER WAY  
DELTA, BC CANADA V4G 1L3
- **GULF ENGINE & EQUIPMENT (09229)**  
2306 ENGINEERS RD.  
BELLE CHASSE, LA 70037
- **HAMILTON ENGINE SALES, INC. (09287)**  
5540 N. E. COLUMBIA BLVD.  
PORTLAND, OR 97218
- **H. G. MAKELIM COMPANY (09480)**  
219 SHAW RD.  
SOUTH SAN FRANCISCO, CA 94080
- **LOFTIN EQUIPMENT COMPANY, INC. (09490)**  
12TH NORTH 45TH AVE.  
PHOENIX, AZ 85043
- **M.G. BRYAN EQUIPMENT COMPANY (09503)**  
4834 READING ST.  
DALLAS, TX 75247
- **NORPRO ISUZU ENGINES, INC. (09505)**  
385 TOWN ST.  
HADDAM, CT 06423
- **SOUTHEAST SERVICE & SUPPLY (09698)**  
1721-E OAKBROOK DR.  
NORCROSS, GA 30093
- **TOTAL POWER LTD**  
6670 EXCEISIOR COURT  
MISSISSAUGA, ON CANADA L5T 2J2
- OH, IN, KY, WV,  
PA (WESTERN)**  
PHONE:740/964-0089
- KS, MO**  
PHONE:316/262-5156  
800/362-3222
- UT**  
PHONE:801/972-1836
- NE, IA**  
PHONE:402/330-5100
- IL**  
PHONE:630/879-7977  
800-832-7217
- BC, AB**  
PHONE:604/946-5531
- LA, MS**  
PHONE:504/393-1701
- WA, OR, AK**  
PHONE:503/288-6714  
800/437-3644
- CA**  
PHONE:650/873-4757
- AZ**  
PHONE:602/272-9466
- TX, OK**  
PHONE:214/631-9787
- CT, MA, VT, NH, ME, RI**  
PHONE:860/873-0100
- GA**  
PHONE:770/448-4251  
800/241-4595
- ON**  
PHONE:905/670-1535

## 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.

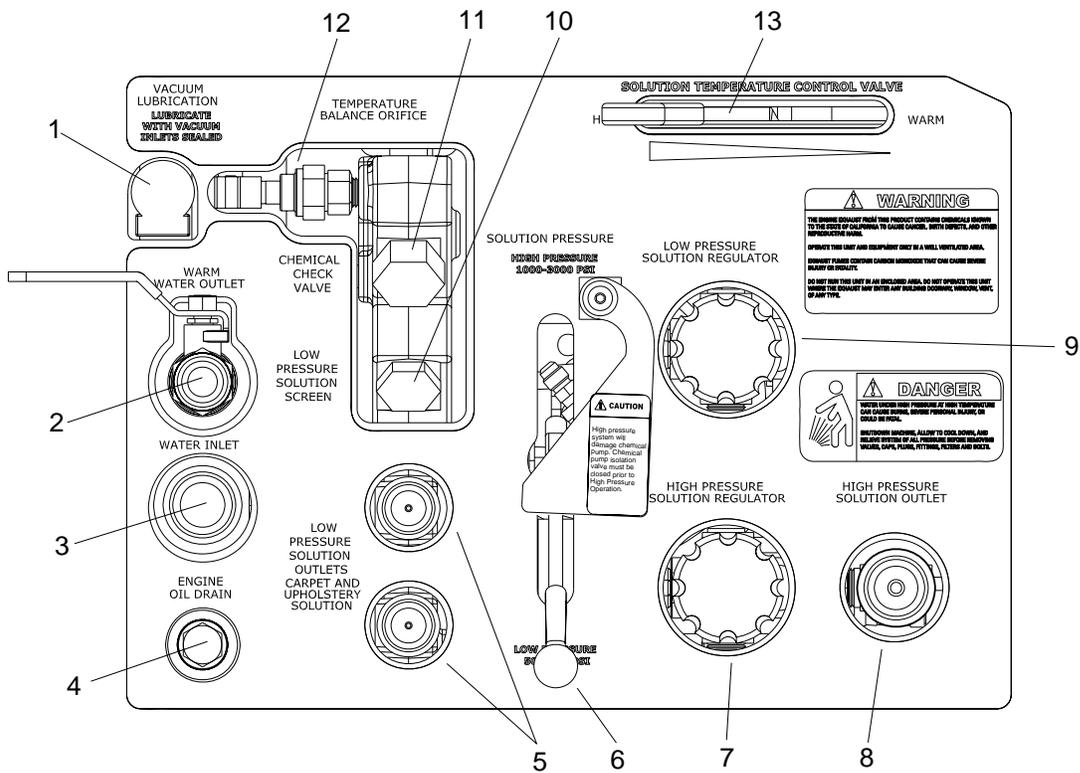
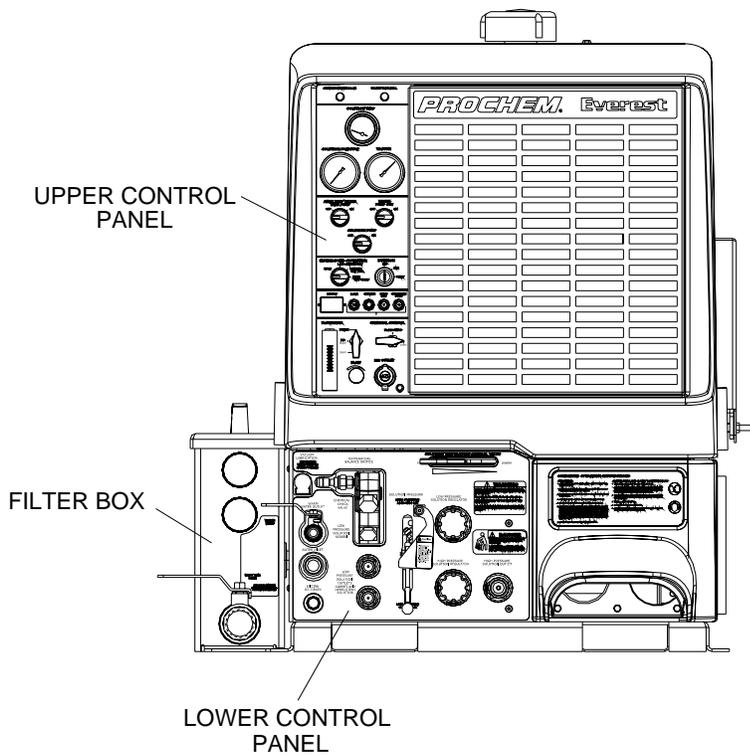
Using a water softener will reduce maintenance and decrease down time caused by hard water scaling. It will also allow cleaning chemicals to be more effective in lower concentrations.

***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



# OPERATION & SYSTEMS



**LOWER CONTROL PANEL**

### LOWER CONTROL PANEL

#### 1. LUBE CUP

The cup allows lubricant spray to reach the vacuum blower.

#### 2. WARM WATER OUTLET

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

#### 3. WATER INLET

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

#### 4. ENGINE OIL DRAIN

The engine oil drain cap is removed to allow the engine oil to be drained.

#### 5. SOLUTION OUTLETS

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

#### 6. PRESSURE SYSTEM VALVE (OPTION)

This lever when in the up position actuates the high pressure system and regulator. When in the down position the low pressure cleaning system and regulator are actuated.

#### 7. HIGH PRESSURE SOLUTION REGULATOR (HP ONLY)

The regulating valve controls the amount of pressure in the pressure washing circuit. By turning the handle clockwise, the pressure will increase. By turning counter clockwise the pressure will decrease.

#### 8. HIGH PRESSURE SOLUTION OUTLET (OPTION)

The high pressure solution outlet is the connecting point for the high pressure hose. This outlet is a quick disconnect that allows pressure wash hose to be plugged into the unit.

#### 9. LOW PRESSURE SOLUTION 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.

#### 10. 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 tool.

#### 11. 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 upstream into the solution system of the unit.

#### 12. TEMPERATURE BALANCE ORIFICE

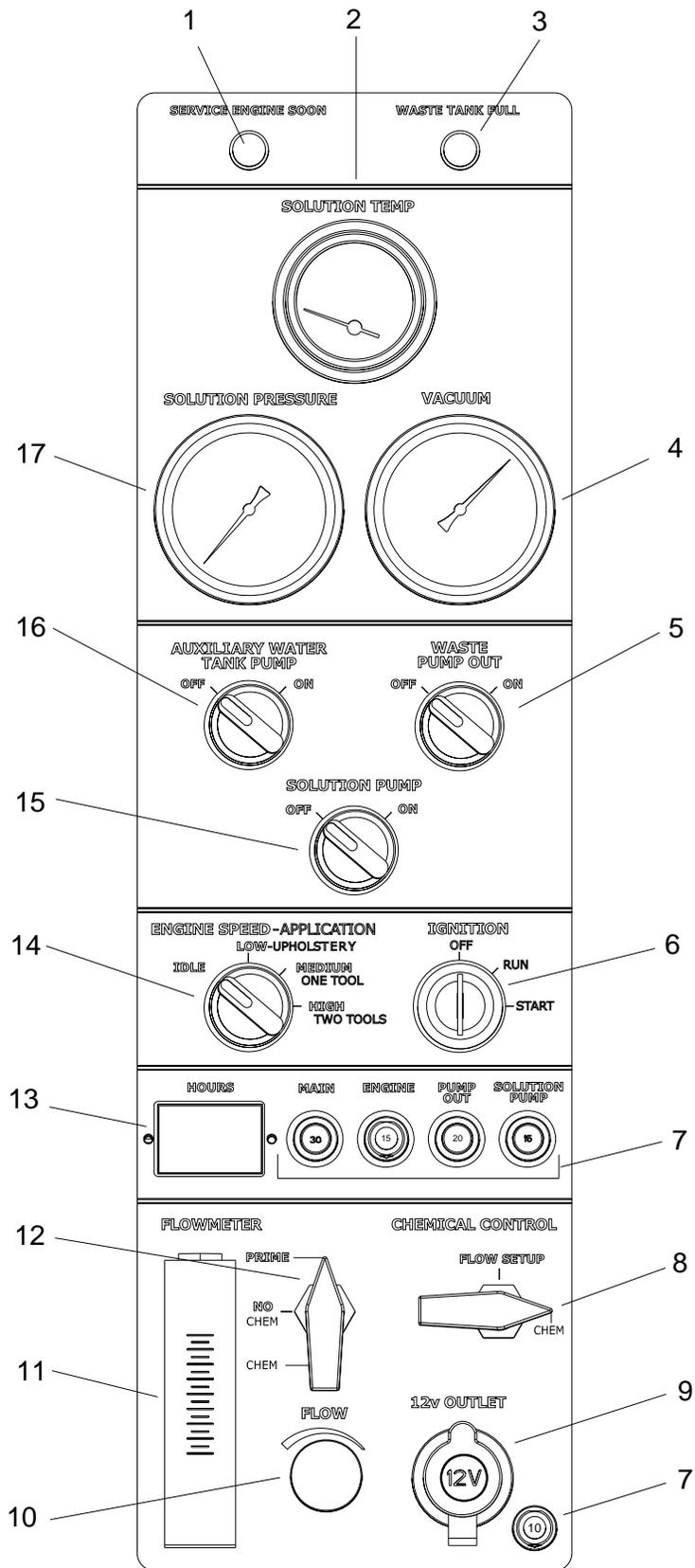
The temperature balance orifice helps to balance and stabilize the solution temperature within the system.

#### 13. SOLUTION TEMPERATURE CONTROL LEVER

This lever directs hot engine and blower exhaust gases through or around the heat exchangers.

# OPERATION & SYSTEMS

## UPPER CONTROL PANEL



## UPPER CONTROL PANEL

### 1. SERVICE ENGINE SOON (AMBER)

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

### 2. SOLUTION TEMPERATURE GAUGE

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

### 3. WASTE TANK FULL INDICATOR LIGHT (RED)

This indicator light is activated when the waste tank is full. This unit is equipped with a slow down feature. This feature will help to protect the engine from damage by causing a slow down for 45 seconds prior to shutting down the engine. When this indicator light is on, it indicates that the waste tank must be emptied before the unit can be brought back into 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 law.**

### 4. VACUUM GAUGE

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

### 5. WASTE PUMPOUT (OPTIONAL)

This switch actuates the optional waste pumpout.

### 6. IGNITION 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.

### 7. CIRCUIT BREAKERS

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

### 8. 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.

### 9. 12 VOLT OUTLET

The 12 volt outlet is used for accessories such as auxiliary lighting.

### 10. 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.

### 11. 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 metering valve knob counter clockwise.

### 12. CHEMICAL SELECTOR 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 counter clockwise the injection system is enabled.

## OPERATION & SYSTEMS

### 13. HOUR METER

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

### 14. 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.

### 15. 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.

### 16. AUXILIARY WATER PUMP SWITCH

The Auxiliary Water Pump Switch is used to actuate an optional fresh water demand pump

### 17. PRESSURE GAUGE

This gauge indicates in Lbs per square inch of mercury how much pressure the system is producing at any given time.

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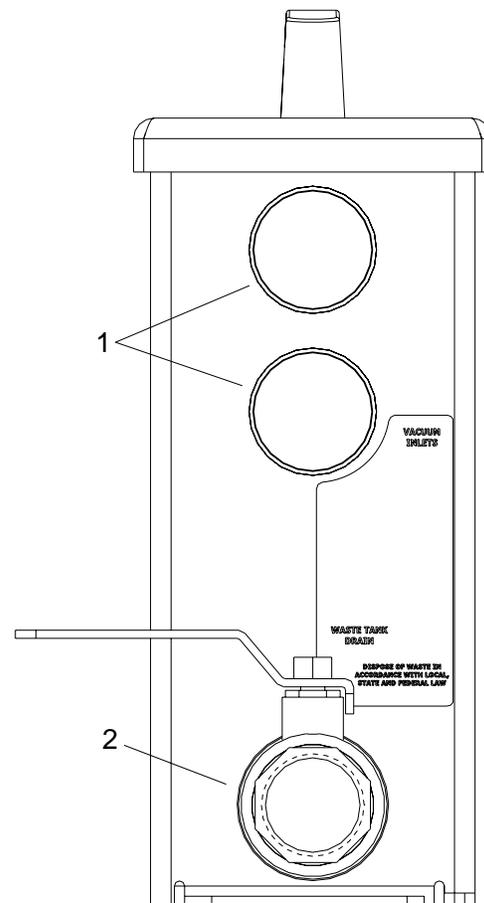
## FILTER BOX

### 1. VACUUM INLETS

The vacuum inlets serve as the connecting point for vacuum hoses.

### 2. WASTE TANK DRAIN

This allows the waste tank to be emptied. Must be closed for operation.



**FILTER BOX**

### **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 where the pressure regulator provides and maintains the desired pressure setting.

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 heater core in the exchanger box. 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 coiled 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 and 3rd heater core located in the heater box. The hot engine/vacuum exhaust gases are forced through the heater core creating the third stage of heat transfer to the cleaning solution.

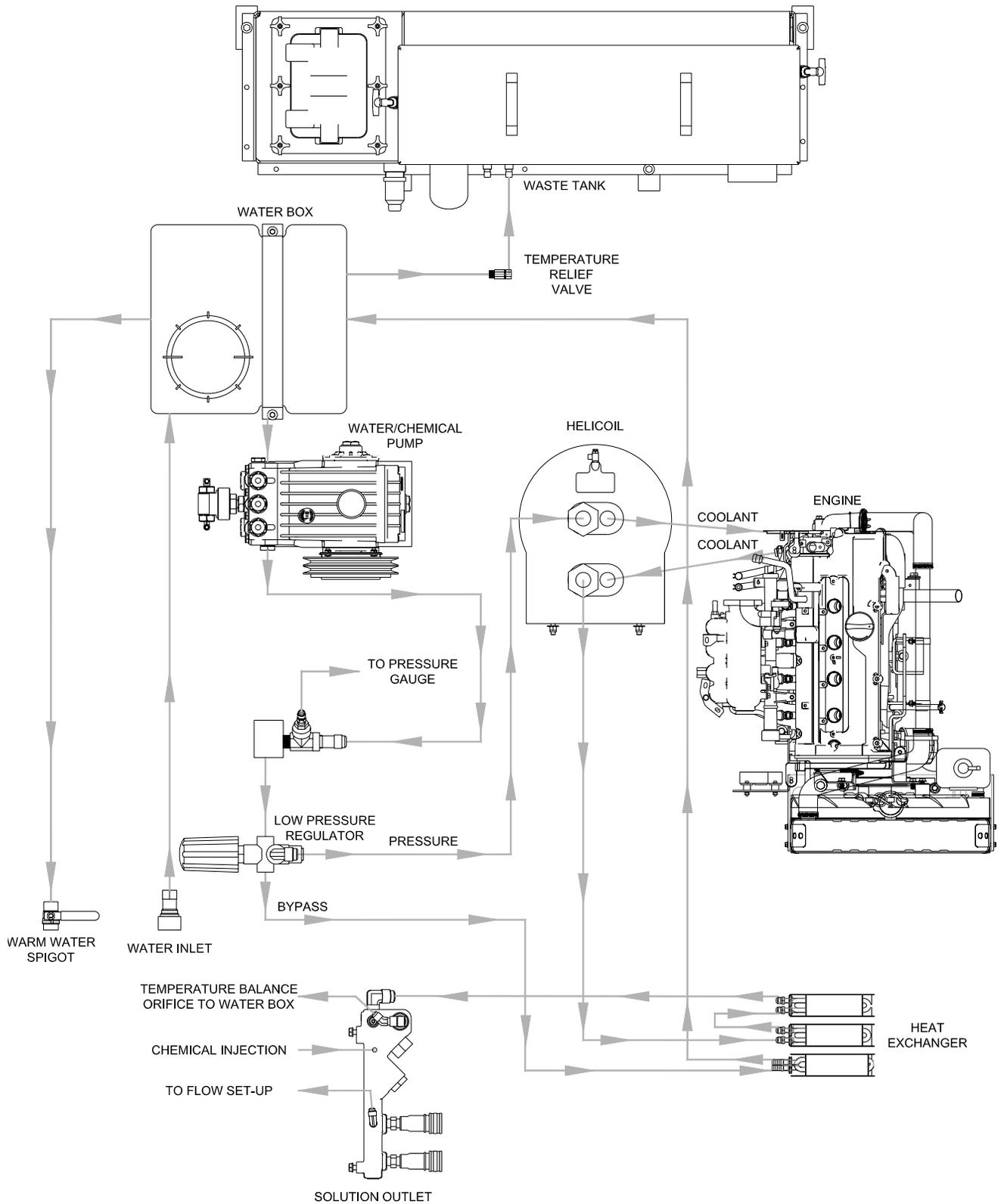
Finally, the hot solution passes to the solution outlet manifold where cleaning chemicals are injected from the chemical pulse pump. This manifold serves as a temperature sensing point and a connecting point for the solution hoses. Also a check valve is located in this outlet manifold prohibiting chemicals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

The cleaning solution then passes through solution 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.

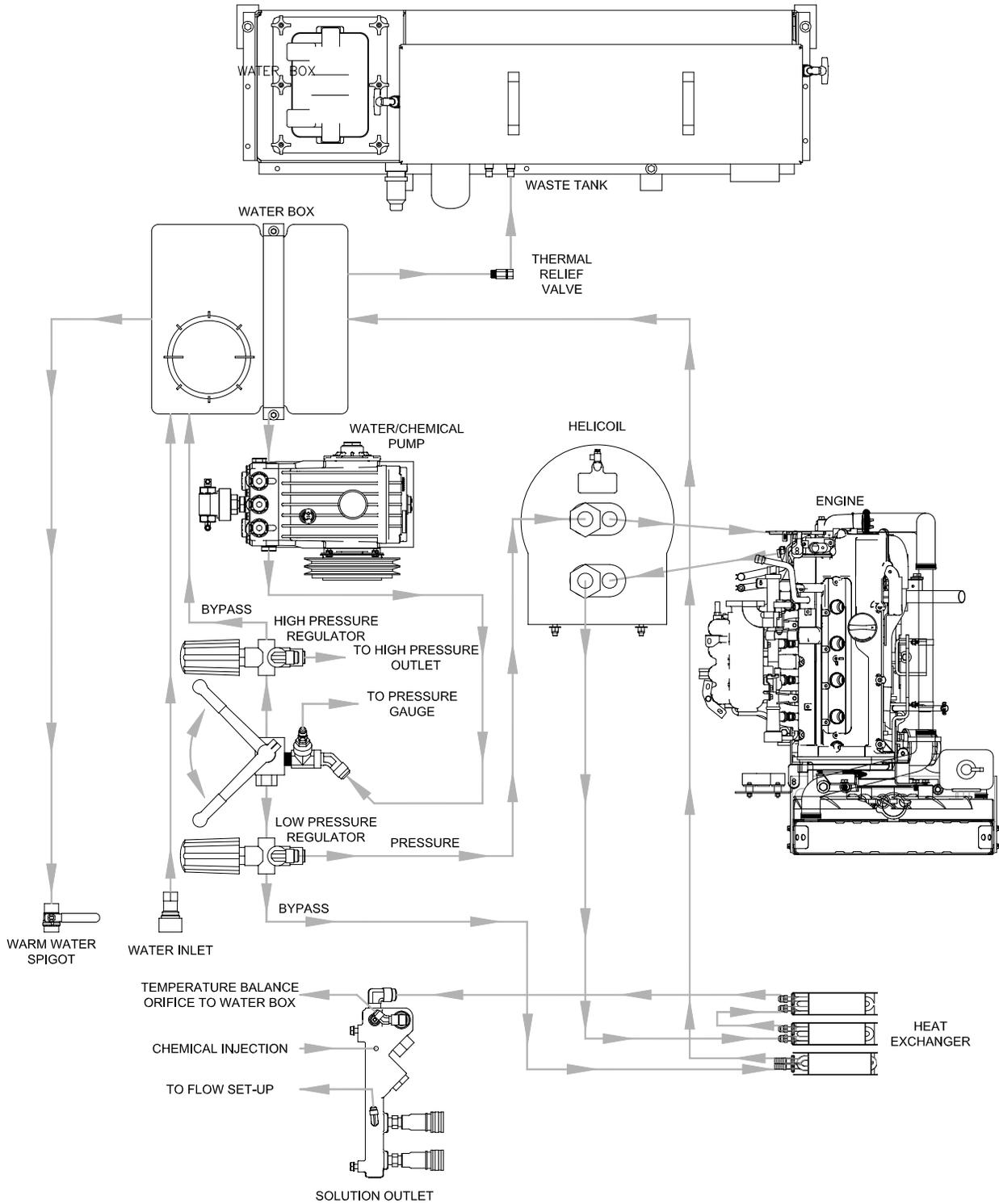
In the optional high pressure model, water is routed directly to the high pressure outlet through the regulator when the lever is in the up position.

# OPERATION & SYSTEMS

## WATER FLOW DIAGRAM LOW PRESSURE



WATER FLOW DIAGRAM W/HIGH PRESSURE OPTION



# OPERATION & SYSTEMS

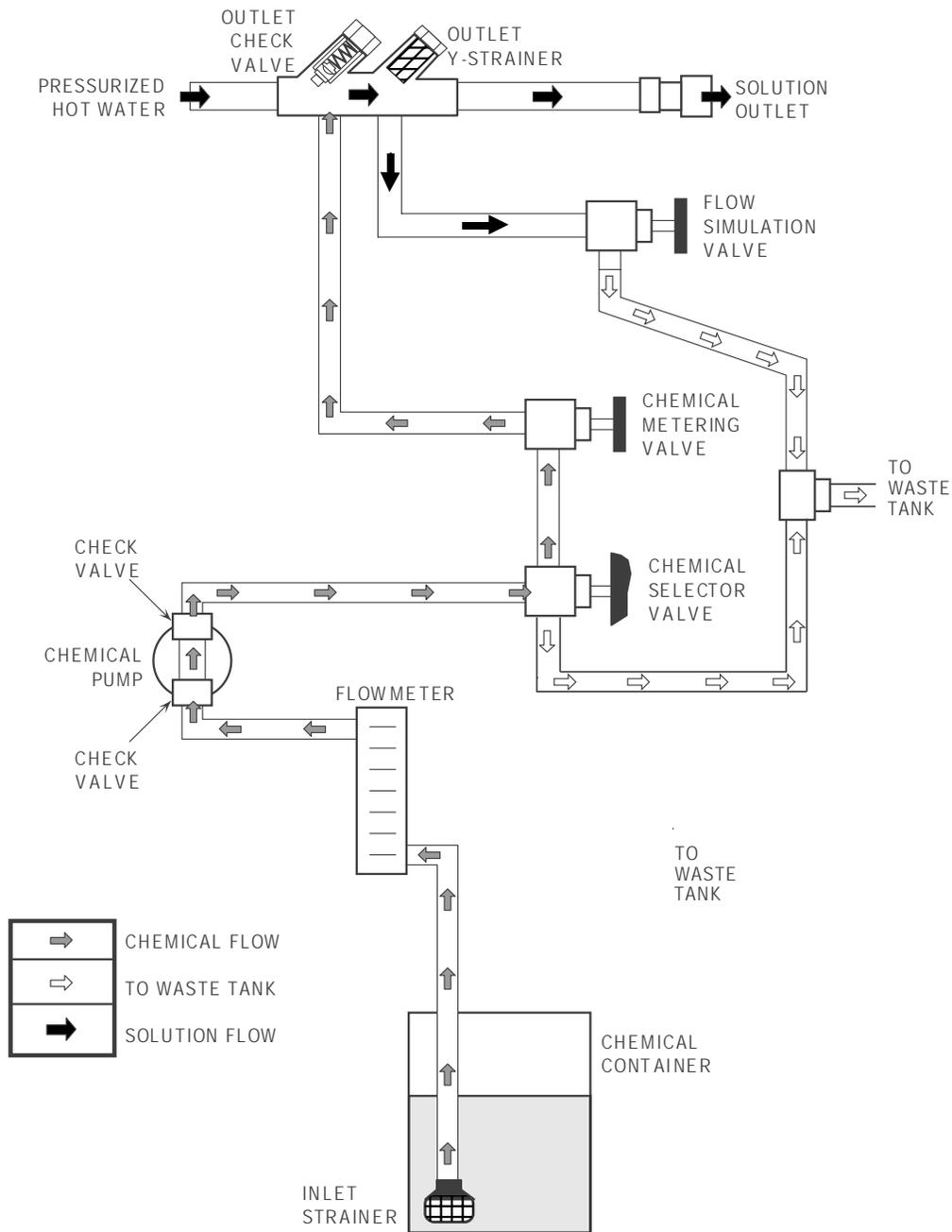
## CHEMICAL INJECTION SYSTEM

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

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 solution 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.

After reaching the chemical pulse pump the chemicals can either go into the waste tank 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.

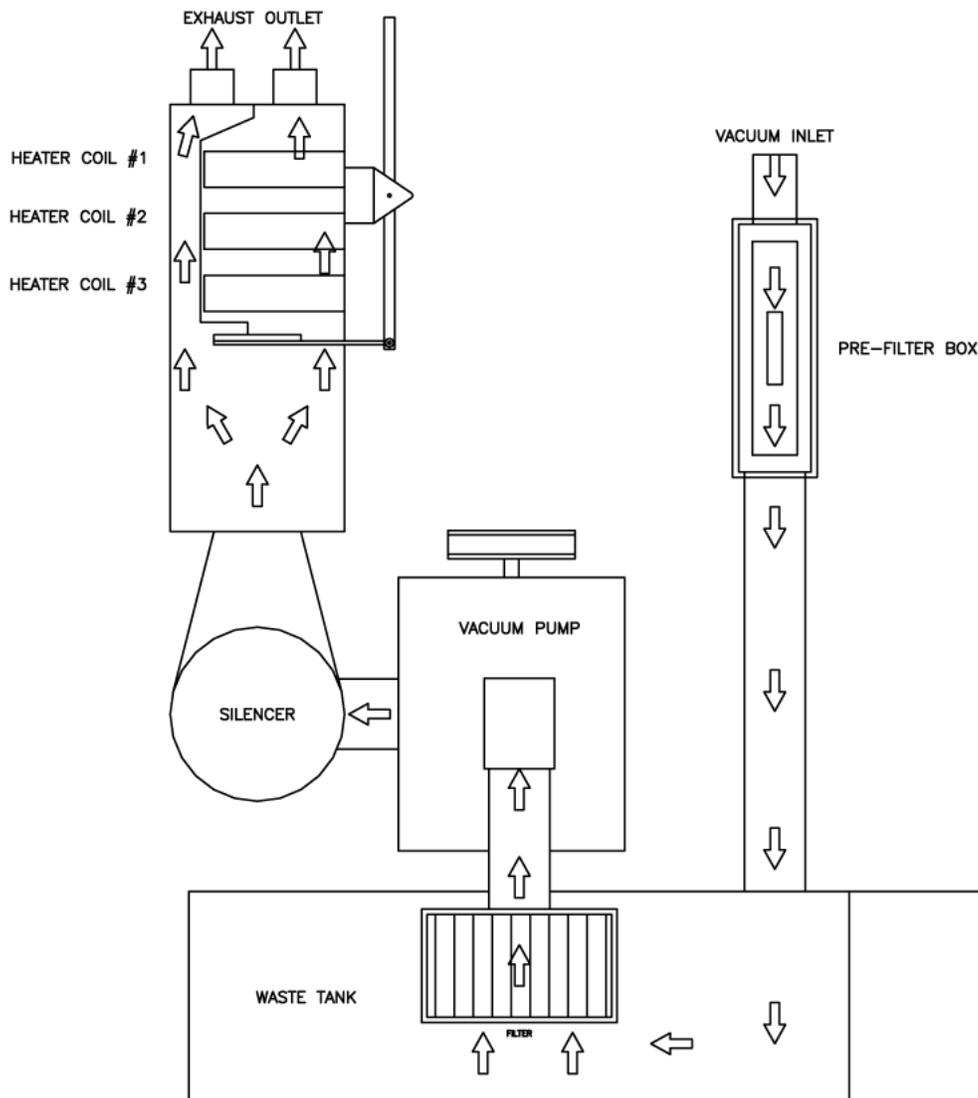


## VACUUM SYSTEM

The engine turns an air pump that 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 cleaning 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 may be 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.



## OPERATION & SYSTEMS

### 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 1.00 to 1.50 gallons of fuel per hour, depending on the speed setting and vacuum load.

### 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)**.

#### **WARNING:**

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

### VACUUM HOSE

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

### PRIMING THE CHEMICAL PUMP

1. Connect water hose to water inlet connection and turn on water supply.
2. Fill chemical container and inspect chemical filter.
3. Connect solution and vacuum hoses to the desired cleaning tool and Filter Box.
4. Insert chemical inlet hose into chemical container.
5. Turn ignition key to start.
6. Set throttle to low speed.
7. Turn water pump on.
8. Turn Chemical Prime valve to prime and allow chemical to circulate. After all air bubbles have been removed from chemical hose, turn the valve to the Chem position. Turn Chemical Flow Setup Valve to the vertical position. Set the desired chemical flow rate while observing the flow meter indicator. When desired flow is reached, turn setup valve to Chem position.

### 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 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.



**NEVER dispose of waste in storm drains, waterways, 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.

## OPERATION & SYSTEMS

### UPHOLSTERY CLEANING

Upholstery tool (See Options in Parts Lists)

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

### SHUTDOWN AND DAILY MAINTENANCE

1. Turn chemical selector valve to off.
2. Allow the unit to run for 2 minutes with the vacuum hose disconnected to remove moisture. Spray water displacing lubricant 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, utilizing 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.
7. Clean the filter box.

### 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.

Pro-Chem also recommends the use of Pro-Chem high-pressure spray wands. Pro-Chem offers a dual barrel wand. 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 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.

### OPERATION

The "HP" units are equipped with a water pump and water delivery system that can support pressure-washing operations up to 5 gallons per minute at 3000 PSI. This system is normally used for high-pressure washing and hard surface cleaning.

1. Move the temperature control lever 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 HP hose to either pressure wash gun or hard surface cleaning tool for high pressure cleaning. Connect other end of hose to high pressure solution outlet.
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.

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

1. Turn off water pump and release pressure.
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” operation.
4. Squeeze pressure washer gun trigger again to remove any residual pressure
5. Disconnect high pressure gun and hose from high pressure disconnect.
6. Open ball valve, located between the chemical pump and water pump.
7. Operate under normal low pressure instruction or follow normal shutdown procedures.

### 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 control lever from the “hot” position to the “warm” position.
2. Ensure that the solution pump switch is in the off position.
3. Operate with all side and rear cargo doors open.

### 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.**

# OPERATION & SYSTEMS

## 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 solution pump on. Open the tool valve until water pressure drops and water stops flowing. Turn solution pump off.
4. Turn water pump off.
5. Fill the water box with approximately two gallons of 100% glycol base anti-freeze.
6. Turn the solution pump on.
7. 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.
8. Prime the chemical system with 50/50 anti-freeze/water mix. Insert the chemical inlet hose into the anti-freeze container. Turn the chemical valve to PRIME until anti-freeze is visible in flow meter.
9. Now turn the chemical valve and Flow Setup Valve to the run position, making certain that the flow meter indicates flow. Turn Chemical Valve to off position.

### HIGH PRESSURE (OPTIONAL)

Move pressure selector valve to high pressure position and key tool until antifreeze is visible. 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.

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

8. Turn the **solution pump switch** OFF. Attach the **winterizing loop hose** with attachment 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. (Contact your dealer for winterizing loop hose.)

### 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. Submerge the chemical inlet hose in water. Turn the **chemical valve** to the PRIME position until clear water is observed in the Flow meter.

Turn the **chemical valve** to the Run position and turn Flow meter valve to vertical 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.

### **WARNING:**

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

# 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 lubricant in lube cup at front of console for 5 sec.
<b>Water Pump</b>	Daily	Check oil level.** Fill to proper level
<b>Pre Filter and 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>	Daily	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 screen
<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>	50 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>Chemical Pump &amp; Check Valves</b>	500 hrs	Replace diaphragm and check valves.
<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*

# MAINTENANCE

## SERVICE SCHEDULE

<b>Heat Exchanger Box</b>	500 hrs	Clean door guides
<b>Water Pump</b>	500 hrs	Change oil**
<b>Pulley Set Screws &amp; Hub Cap Screws</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	Replace
<b>Drive Belts</b>	500 hrs	Check belt tension****
<b>PCV Valve/hoses</b>	750 hrs	Inspect
<b>Check Valve (Solution Outlet)</b>	1000 hrs	Inspect, clean, and repair, if needed.
<b>Vacuum Exhaust Heat Exchanger</b>	1000 hrs	Inspect cores and remove debris.
<b>Vacuum Pump</b>	1500 hrs	Drain, flush, and replace oil *****
<b>Fuel Filter</b>	1500 hrs	Replace
<b>Engine</b>	2500 hrs	Replace spark plugs.
<b>Engine</b>	Yearly*	Replace air cleaner elements.
<b>Waste Tank Filters/Strainers</b>	Yearly	Check for damage and blockage. Replace if needed.
<b>Engine</b>	2 years	Flush radiator and change engine coolant.
<b>Engine</b>	2 years	Replace radiator hoses and hose clamps.
<b>Engine</b>	2 years	Replace timing belt
<b>Engine</b>	5 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, the heat exchange system which is used to provide heat for cleaning operations is also highly dependent on the engine coolant system. Follow the recommended maintenance in the Maintenance Schedule in this manual and your ZPP416 engine owner's manual. Refer any additional questions to your dealer.

### **EXTERNAL FUEL PUMP MAINTENANCE**

The power plant for your 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 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 are necessary to avoid unwanted failure. 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 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**. 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 approved ZPP416 filters.

**Oil Recommendation.** Use high-quality detergent oil of at least API (American Petroleum Institute) service class SH. The recommended SAE viscosity grade **15-W40**.

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

Check the air cleaner element every **250 hours**. Replace the element annually.

3. 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 50/50 coolant to water ratio every 1000 hours or 2 years.
4. Replace the in-line gas filter under the vehicle every 1500 hours.

**NOTE:** For additional engine service information, obtain a “ZPP416” service manual from any authorized Zenith Power Products Service Center. If service or repair is required, contact an authorized Zenith Power Products 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:** It is recommend that you use AEON PD Synthetic Blower Lubricant in 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.

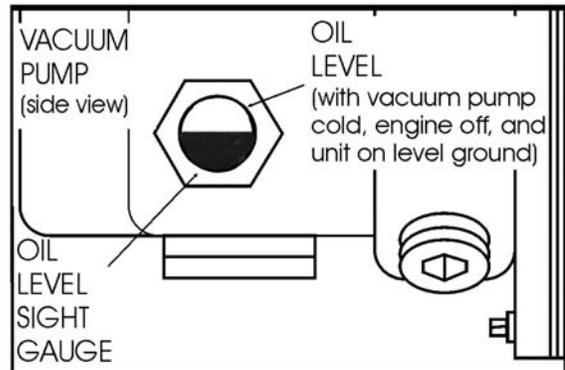
**NOTE: AEON PD is the oil which PROCHEM puts in the vacuum pump at the factory. Topping off or adding petroleum oil to synthetic oil is NOT recommended.**

*If not using AEON PD synthetic blower lubricant, use oils with rust, oxidation inhibitors and anti-foam additives.*

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 lubricant, for **5 seconds** while the unit is running and the vacuum inlets are sealed. Do this at the end of **each working day**.

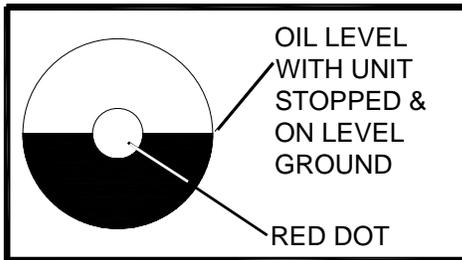


3. Drain, flush and replace oil every 1500 hours or **yearly, whichever comes first**. Change oil more frequently if inspection so indicates. With AEON PD synthetic lubricant, perform the oil change maintenance **every 4500 hours or every 2 years, whichever comes first**.

## 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. Remove yellow filler cap. Oil level should be



between marks on the dipstick or use a mirror and refer to the illustration.

Change the crankcase oil with GP Pump Crankcase Oil, after the **first 50 hours** of operation. Drain and refill the crankcase oil with General Pump Crankcase Oil **every 500 hours** thereafter.

## 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

1. 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 repeat above procedure. 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 bolts which hold the adjusting plate to the frame.
2. Loosen the 4 bolts at the vacuum muffler outlet to heat exchanger box and loosen the 2 bolts at the back of the belt guard.
3. Turn the adjusting bolts until the proper belt tension is achieved (1/4" deflection in the center of the belt, halfway between the pulleys).

4. Retighten all bolts previously loosened.

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

5. 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.

TORQUE VALUES		
COMPONENT	INCH/LBS	FOOT/LBS
Engine pulley	420	35
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 bolts 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 bolts which hold the water pump mount to base.

### WATER PUMP CLUTCH



After removing or replacing water pump clutch, make certain that set screws are tight.

### 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.

### PRE-FILTER STRAINER

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

To remove any water remaining in the pre-filter, run unit at medium or high speed for 10 seconds with strainer removed and box top open.

### 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 and screen need to be kept clean. Cleaning frequency 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.*

## GENERAL SERVICE ADJUSTMENTS:

### PRESSURE REGULATOR

Lubricate the o-rings **every 100 hours**. Use o-ring lubricant.

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 AND SOLUTION 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 solution hose 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. **Pressure wash hoses must be rated at 4000 PSI.**

### WASTE PUMP-OUT (OPTIONAL)

**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.

## ENGINE COOLANT REPLACEMENT

The coolant should be replaced every 2 years. 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 5/16" hose onto the radiator drain petcock. Turn counter clockwise to open and drain coolant.

**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 the radiator petcock.

### REPLACING COOLANT:

1. Fill radiator with 50/50 anti-freeze water mix.
2. Start unit and run on low speed.
3. As the unit warms up, maintain a full radiator with a 50/50 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. top off radiator with 50/50 coolant mix.
6. Re-install radiator cap.
7. Shutdown unit.

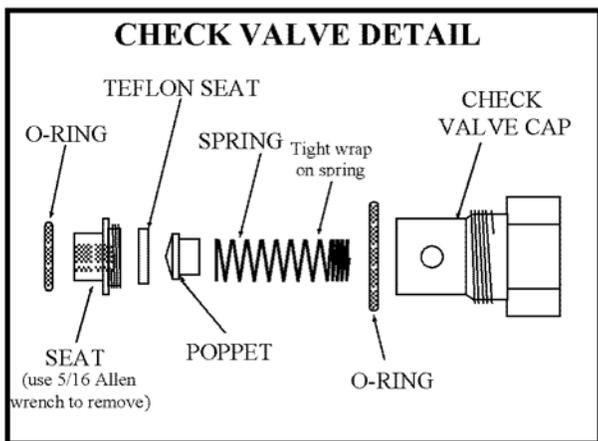
Check radiator overflow bottle. Add coolant to proper "cold" level.

## MAINTENANCE

### CHECK VALVE (SOLUTION OUTLET)

Inspect the check valves whenever doing service 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 and reinstall. (See Suggested Spare Parts list)

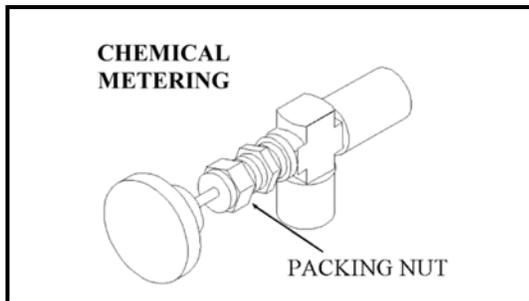
### CHEMICAL PUMP

The only repairs which the chemical pump may require is the replacement of the diaphragm or check valves. To replace the diaphragm, disconnect hose and 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 lubricated 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

Examine the packing nut on the chemical metering valve 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.



## CHEMICAL METERING VALVE

Examine the packing nut on the chemical prime metering valve, flow simulator valve, and chemical metering valve every 2000 hours

## 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, tool valve open and solution pump on, check the pressure gauge. We recommend setting the pressure regulator so that the pressure gauge reads 450 PSI with the tool valve **closed**.

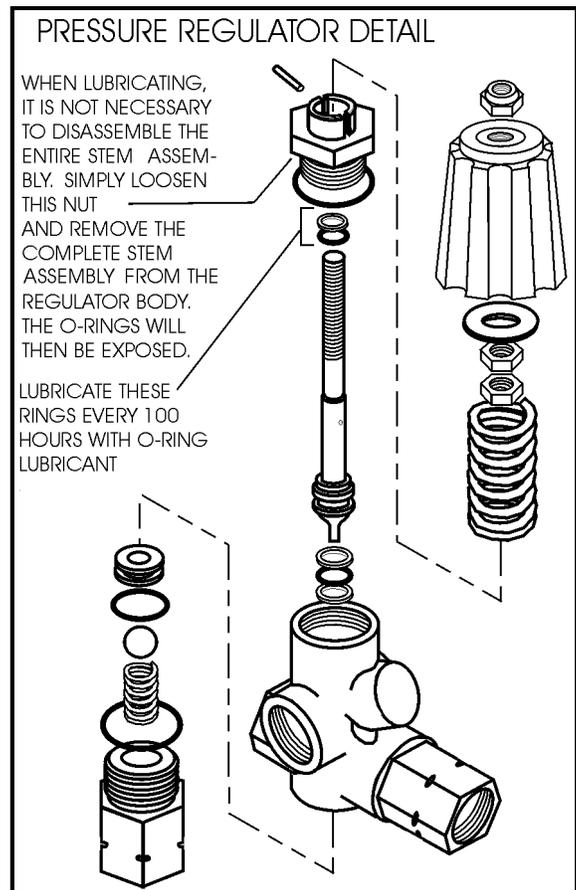
When the tool valve is opened, there is an approximate drop of 100 PSI in pressure. **If there is a pressure drop greater than 100 PSI, it may be necessary to lubricate the o-rings in the pressure regulator.**

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 (OPTIONAL)

To adjust:

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



## 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).
	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
	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
	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) at high speed.	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.	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.	

## 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 pre-filter basket is plugged.	Clean or replace filter. Clean strainer basket.
	Vacuum gauge is giving an improper reading.	Examine the tubing between the vacuum relief valve and the vacuum gauge and remove any blockage.
	Vacuum hose(s) damaged, causing a suction leak.	Inspect hose(s), repair or replace.
	Pre-filter or Waste tank gaskets not sealing properly, not positioned properly.	Inspect the gasket. Repair seal or replace Re-position lid(s).
	Plugged vacuum hose or vacuum plumbing between vacuum inlet and strainer basket.	Unplug vacuum hose or inlet plumbing.
	Loose vacuum pump drive belts.	Tighten the drive belts
	Waste tank drain valve is damaged or left open, causing a vacuum leak.	Repair valve.
	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.	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 or defective.	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.
	HP model, ball valve is closed.	Open valve.
	Hose is kinked or damaged.	Inspect and/or replace hoses
<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.
	Flow setup valve open.	Close valve.

## TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
Water pump does not engage	Water pump has not been activated	Turn solution pump switch to on.
	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.
	Defective water pump clutch.	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	Defective fuel pump.	Replace the fuel pump.
	Out of fuel.	Add fuel.
	Engine is malfunctioning	Refer to ZP416 Engine Operation and Maintenance Manual.
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 temperature has exceeded 230°F, triggering the high temperature switch to shut the unit down.	Determine the cause of the overheating before restarting the unit. Refer to the ZP416 Engine Operation and Maintenance Manual.
	Defective fuel pump.	Replace fuel pump.
	Defective float switch inside the waste tank.	Check switch for proper operation. Replace as necessary.
	Defective 230°F engine coolant high-temperature shutdown switch.	Test switch. If necessary, replace.
	Oil pressure switch on engine has shut down, due to insufficient oil pressure.	Refer to the ZP416 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 ZP416 Engine Operation and Maintenance Manual.

## TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
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  The heat output of the unit is LESS than normal.	Temperature relief valve on water box is stuck open.	Clean temperature relief valve and test. Replace, if necessary.
	Defective temperature gauge.	Test gauge and sensor. Replace failed component.
	Improper tool jet sizing	Refer to manual for proper sizing
	Bypass orifice missing	Replace orifice
	Temperature control lever improperly set	Adjust lever
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.
	Clogged valves.	Clean valves.
	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.

# **NOTES**