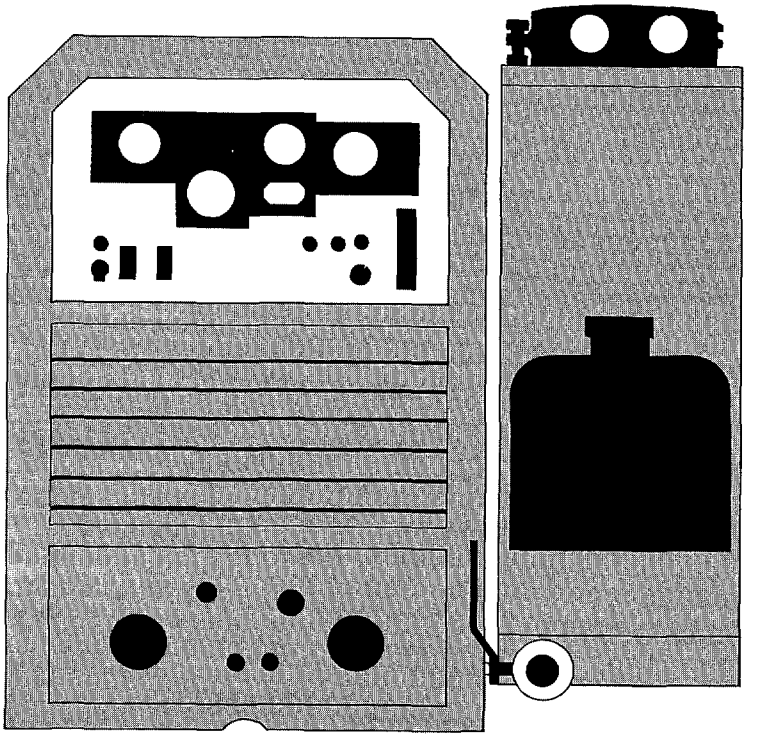
OWNERS MANUAL

4.0 HydraCat 4.5



HYDRAMASTER Corporation

#182-009

TABLE OF CONTENTS

GENERAL INFORMATION

OPERATING INSTRUCTIONS & PRECAUTIONS

LIST OF ILLUSTRATIONS

LIST OF PHOTOS

GENERAL INFORMATION

This manual contains installation and operation instructions as well as information required for proper maintenance, adjustment and repair of this unit. Since the first and most important part of repair work is the correct diagnosis of the trouble, a general troubleshooting section and component manual troubleshooting charts have been included for your convenience.

Unlike a garden tractor, lawnmower or cement mixer, all having one or two functions to perform, the truck-mounted carpet cleaning plant has many functions to perform simultaneously.

* Engine has to run at a consistent RPM.
* Vacuum has to pull air and dirty water back from cleaning site.
* Water pump provides stable pressure at proper water flow for cleaning.
* Chemical has to be injected into the water stream at the right concentration.
* Heater must maintain proper heat.
* Vacuum tank must store dirty water until drained.

HOW THE SYSTEM WORKS

The water system takes incoming water at tap (low) pressure, combines it with chemicals from the chemical system and pumps it under pressure through the heating system, and out to the cleaning tool. After being sprayed into the carpet, the water/chemical/soil solution is extracted by the vacuum system and returned to the waste recovery tank.

There is no guess work in the manufacture of these highly advanced cleaning plants. There must also be no guess work in preparing it to get the job done in the field. It is the purpose of this manual to help you properly understand, maintain and service your cleaning plant. Follow the directions carefully and you will be rewarded with years of profitable trouble-free operation.

It is imperative that **no section** be overlooked when preparing for operation of this equipment.

SPARE PARTS RECOMMENDATION

Because your truck-mounted unit is capable of generating several hundred dollars per day, down-time on the unit can be very expensive.

In order to minimize such down-time, it is strongly recommended by the manufacturer that you purchase and keep in your truck the following spare parts:

PART NO.	DESCRIPTION	QTY.
078-015	Flow meter kit	1
078-019	Wand valve plunger kit	1
078-034	Pressure bypass valve kit	1
076-005	Spray jet 8006E	1
049-029	Recovery tank filter bag	2
078-001	Cat 290 short cup kit standard	1
078-004	Cat 290 hot cup kit (Optional)	1
049-023	Screen, garden hose	6
052-050	440 Male quick connect	1
052-051	440 Female quick connect	1
052-052	660 Male quick connect	1
052-053	660 Female quick connect	1
106-015	Engine spark plug	2
010-021	HydraCat pump drive belt	1

MACHINE SPECIFICATIONS

FRAME: 23" W, 59" L, 34" H. Steel with baked-on epoxy finish.

WEIGHT: HydraCat 4.0: 630 lbs. (dry weight)
HydraCat 4.5: 750 lbs (dry weight)

COWLING: Steel with baked-on Epoxy finish.

ENGINE: HydraCat 4.0 : P220 20 BHP Onan
HydraCat 4.5: P224 24 BHP Onan

IGNITION: Electronic, Keystart.

HI-PRESSURE PUMP: Tri-Plex piston -- Cat 290 -- 3.5 GPM -- 1200 PSI -- @ 1200 RPM.

VACUUM BLOWER: HydraCat 4.0: 4ML
HydraCat 4.5: 4LL
Sutorbuilt W/12 HG Safety Relief.

CHEMICAL SYSTEM: Electro-mechanical, meter controlled.

HEATER: Propane fired, thermostatically controlled (180,000 BTU).

INSTRUMENTS: 0-1000 High pressure gauge, Temperature gauge, Vacuum gauge, Hour meter, Chemical flow meter, Ignition key, Start and on indicator lights, Pump clutch switch, Circuit breakers.

RECOVERY TANK: 70 gallon aluminum, Epoxy finish.

CLEANING WAND: Stainless steel with heat shield, Grip and replaceable vacuum lips with stainless steel solution valve.

HI-PRESSURE HOSE: 1/4" High-temperature lined/vinyl covered, Hose rated to 1250 PSI.

VACUUM HOSE: 2" reinforced, 1 1/2" reinforced.

STANDARD EQUIPMENT: Power console, Sound suppression package, Electric Pump Clutch, Water heater, Vacuum Recovery tank, Carpet cleaning wand, Chemical jug, Chemical jug holder, Chemical jug fill line, Operation manual, 150 ft. 2" vacuum hose, 10 ft. 1 1/2" vacuum hose, 150 ft. Super-flex solution line, 10 ft. drain line, 50 ft. water supply line, [illegible] kit, Freeze guard system, Battery box with holder, Van decal package, Fuel system kit, Installation kit.

ADDITIONAL EQUIPMENT, HYDRACAT 4.5: Oversize air handling package, High-output component power pack, Super dual silencer system, electronic tachometer.

◆ WARNING ◆

The manufacturer uses this symbol throughout the manual to warn of possible injury or death.

◆ CAUTION ◆

This symbol is used to warn of possible equipment damage.

HOW TO ORDER PARTS

To obtain a proper diagnosis of your malfunction, and to order warranty replacement parts, it is important that you proceed in the following manner:

1. Call HydraMaster Warranty/Service Department at (206) 775-7275.
2. Give the Warranty/Service representative the following information:
   - A. Name of your company and your address.
   - B. Equipment model (i.e. HydraCat, BobCat 2, etc.).
   - C. Date of purchase.
   - D. Hours on the unit.
   - E. Serial number of unit.
   - F. Name of person authorized to order parts.
   - G. Salesman unit purchased from.
   - H. Description of malfunction.
   - I. Pressure readings on high pressure gauge with wand turned on and off.
3. If warranty replacement parts are needed, please specify method of shipment desired. **NOTE:** All replacement parts are sent freight collect, via:
   - A. U.P.S.
   - B. Air Freight
   - C. Air Mail
   - D. Air Express
   - E. Auto Freight
4. Do not give malfunctioning parts to a HydraMaster sales or service representative. **All parts must be returned directly to HydraMaster, Freight prepaid.**

PARTS ORDERS

To expedite your parts needs, please call your sales representative. In most instance, he either stocks or has access to parts through a regional service center. In the event parts are unavailable locally, contact the factory and coordinate your needs. If this becomes necessary, always indicate the method of shipment you desire, i.e. UPS. Blue Label, Air Freight, Air Express, etc.
HydraMaster Parts Department. Phone (206) 775-7276.

ONE FINAL NOTE

Any questions you have regarding the warranty program should be directed to the Warranty/Service Department personnel at HydraMaster Corporation.

We shall always endeavor to be fair in our evaluation of your warranty claim, and shall provide you with a complete analysis of our findings.

HydraMaster Warranty Policy (inside back cover)
Effective February 1, 1989
HydraMaster warranty covers only defective materials and/or workmanship for the periods listed. Labor, and/or diagnostic reimbursement is specifically excluded.

PURCHASER'S RESPONSIBILITY

PRIOR TO ARRIVAL OF UNIT:

1. Install 5/8" exterior plywood flooring in vehicle and cover with artificial turf.
2. Have belly mounted propane tank installed on vehicle. Tank must be propane vapor type.

◆ CAUTION ◆

3. Purchase heavy duty 42-60 amp hour battery and have battery 'slow' charged if new. If battery is not fully charged damage can occur to the engine charging regulator.

READING OF OWNERS MANUAL: It is the purchaser's responsibility to read the unit operation manual and to familiarize himself with the information contained therein. **Special attention should be paid to all CAUTIONS and WARNINGS.**

SALES REPRESENTATIVE'S RESPONSIBILITY

ACCEPTANCE OF SHIPMENT:

1. If unit shows any outward signs of damage, do not sign the delivery receipt until you have closely inspected the unit and noted any damage on the delivery receipt. Have the freight company representative acknowledge the damage by signing the notation of damage on the delivery receipt.

2. The salesman from whom you purchased your unit is responsible for supervising the correct installation of the unit in your vehicle and thoroughly training you in its operation, maintenance and precautions.

CORRECT INSTALLATION INCLUDES: Installation of through-floor fittings for propane and gasoline fuel lines; installing propane regulator included with unit, outside vehicle; placing unit and recovery tank in vehicle and securing them with bolts or tie down cleats; connecting all propane and gasoline lines; connecting battery; checking pump, vacuum blower and engine oil levels, prior to starting unit; starting unit to check engine to see that all systems function normally; also checking all hoses, wands, etc., for correct operation.

TRAINING SHALL INCLUDE: Thorough review of the operation manual with purchaser; instruction and familiarization in: how to correctly start up and shut down unit; how to correctly clean with the unit; how, where and how often to check and change component oil levels; how the unit's systems work; how to troubleshoot the unit; how to do basic repairs; safety precautions and their importance; freezing damage and how to avoid it and a thorough review of the unit warranty and warranty procedures.

HOURS
Monday -- Friday
8:00 am To 5:00 pm
PACIFIC STANDARD TIME

TELEPHONE NUMBERS

(206) 775-7272 General Offices
(206) 775-7276 Parts Department
(206) 775-7275 Service/Warranty
(206) 771-7156 FAX

TRUCK SELECTION

The preferable vehicle for HydraCat installation is a panel van with a heavy-duty suspension package. The capacity of the van should be a heavy-duty 1/2 ton at the minimum and more preferably a 3/4 ton capacity.

TRUCK PREPARATION

The manufacturer recommends the installation of plywood flooring covered with poly propylene backed astroturf (do not use rubber-backed) in the vehicle prior to installation of machine. This provides a metal to cushion mounting rather than metal to metal, provides insulation and makes an attractive van interior. Astroturf should be color keyed to van interior.

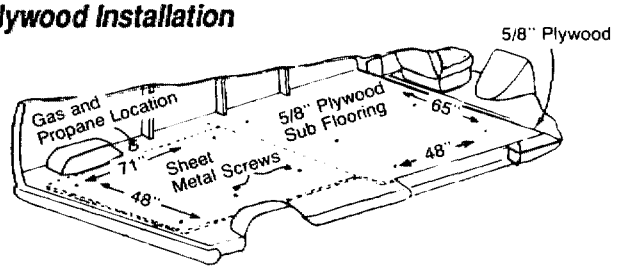
Materials Needed:
1. 2 sheets 4x8x5/8" exterior plywood
2. 6'x12' piece of commercial astroturf
3. 16 - 1 1/2" sheet metal screws
4. 1 quart marine adhesive (optional)
5. 1 staple hammer w/1/2" staples

(See illustration for correct placement of plywood flooring)

TRUCK PREPARATION ILLUSTRATION

FIRST, cover the truck bed with 5/8" plywood using metal screws to secure it as shown.

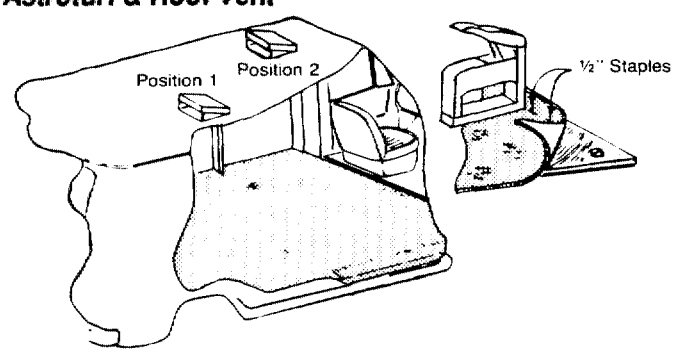
Plywood Installation



SECOND, select the appropriate color astroturf to match your van and cover the plywood and staple in place. A standard van requires a piece 6 feet by 12 feet.

THIRD, HydraMaster strongly recommends an aluminum roof vent be installed over the location selected for mounting the machine. HydraMaster also highly recommends a flue be installed between the top of the heater and the roof vent. This will allow hot air from the heater to escape.

Astroturf & Roof Vent



PLACEMENT OF UNIT IN VEHICLE

There are two recommended unit placements:

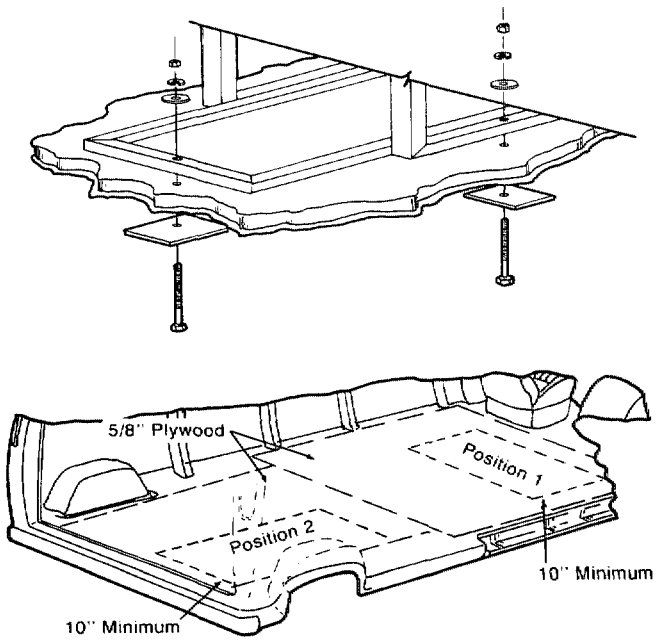
A. SIDE DOOR: Most installations are side door. This provides rear access for accessories and hoses as well as unobstructed access to component/working side of machine, thus making it a bit easier to perform maintenance and/or repair without removing unit from the truck.

B. REAR DOOR: Although this location partly limits working access, it does direct the noise away from the cleaning site. Some cleaners in the colder areas prefer this location because it puts the weight mass over the rear wheels for better traction in ice and snow. Rear mounting requires the unit to be slid to the right side as far as possible. This not only provides adequate working space on the component side of the unit but also makes better weight distribution inside the van (engine and component weight line up over drive shaft). Also, it is physically easier to load unit into rear door due to height of van bed.

◆ WARNING ◆

*Ensure that machine is well secured to the floor of van with hardware supplied. Sudden or crash stop will cause machine to rocket forward, all 750 lbs. worth! Protect yourself and the machine. **SECURE IT!***

Machine Tie Down Cleats

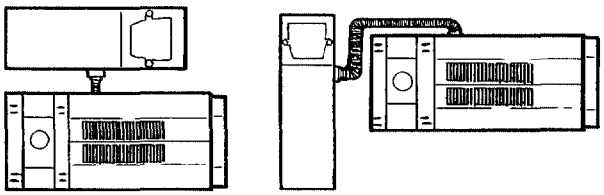


MACHINE INSTALLATION

There are two ways of positioning the machine in the truck as shown. There are also two locations for the vacuum recovery tank to be positioned. First, the standard way with the tank directly alongside the machine. Second, with the tank across the back of the machine as shown on the illustration on the next page; this location is most space efficient. Whichever way you select, make sure the tank and machine are secured to the floor of the van to insure driver safety.

It is important that the machine be placed as close to the door as possible so that outside air can be pulled into the engine for proper cooling.

Machine Configuration



◆ WARNING ◆

It is recommended by the manufacturer that the exhaust from the front of the machine be vented down under the truck to prevent carbon monoxide from entering the job site. ***Always park the truck so the exhaust is blowing away from the job site.***

The manufacturer also recommends that installation of aluminum vents in the truck roof to allow heat from the heater to escape.

◆ WARNING ◆

Never operate this machine with a portable propane tank or a portable gas can inside the truck, doing so increases the risk of a fire or explosion.

Mount a fire extinguisher just inside the rear or side door for emergencies.

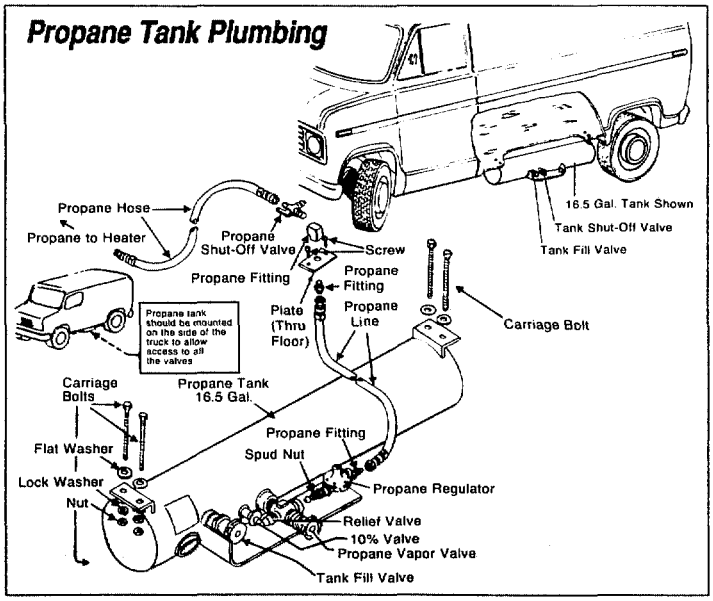
PROPANE TANK LOCATION

Either the 10 gallon or 16.5 gallon propane tank will fit this location. Have you local propane dealer install the tank you select and purchase. The machine will come with the proper propane regulator. ***(Tank must have vapor outlet.)***

◆ WARNING ◆

Professional installation of fuel systems is strongly recommended. Always ensure compliance with state and local regulations pertaining to fuel installations.

Propane Tank Plumbing

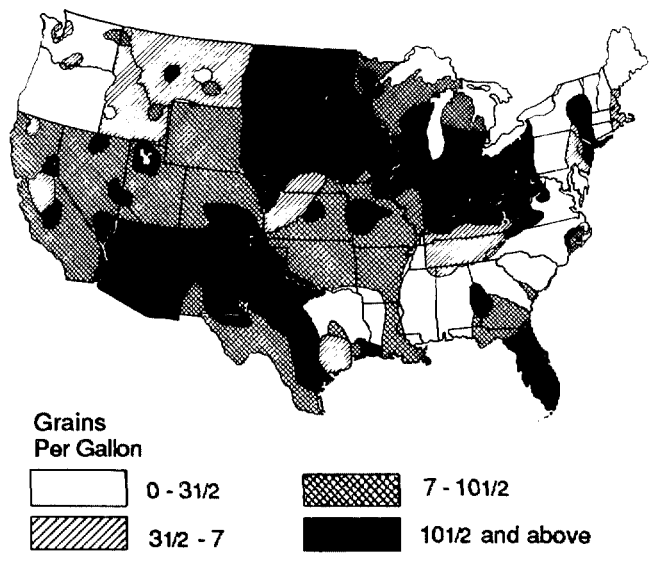


HARD WATER AREA MAP

The quality of water varies greatly throughout the United States and influences the reliability and efficiency of equipment in direct proportion to its level of hardness. The map below defines areas which compromise fluid related components such as hoses, fittings, heaters, pumps, valves and water cooled engines.

Cleaning efficiency and equipment life is increased, chemical use decreased and the appearance of cleaned carpets enhanced when water softeners are incorporated in hard water areas. Manufacturer strongly urges the use of water softener units in areas exceeding 3 1/2 grains per gallon. Using the legend as a reference, determine the quality of water in your area and take action immediately should it be necessary.

Water Hardness



WATER SOFTENER

Many areas of the country have an excess of minerals in the water which results in what is commonly called "hard water". These minerals tend to adhere to the insides of heater coils and other parts of the machines causing damage and a loss of cleaning effectiveness.

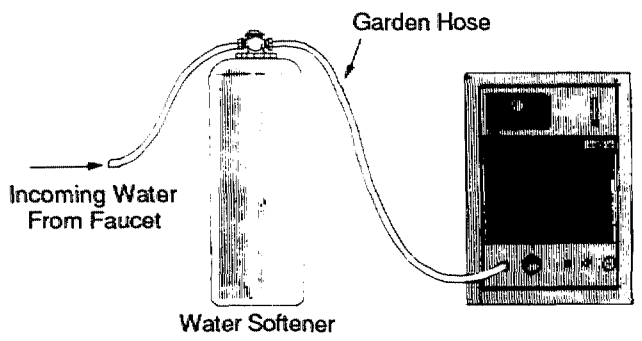
Reports from several of our machine users commending the results of the use of water softeners in conjunction with their machines prompts us to recommend the procedure to everyone in a "hard water" area.

The relatively low cost of a water softener service is more than made up for in the increased life of machine parts and continued cleaning efficiency. The water softener will also increase the effectiveness of the cleaning chemical being used, therefore, less chemical will be needed.

Contact a water softener distributor in your area for information on the rental of a simple water treatment unit to carry in your truck. Be sure to change the water softener in accordance with the capability of the softener. Example: If the softener will treat 900 gallons of water and machines uses an average of 30 gallons per hour of use, and an average of 5 hours a day, would be 150 gallons a day. 5 days would equal 750 gallons of water, therefore, the softener would be changed every 6 working days for maximum softening.

(See illustration, next page)

Water Softener Hook-up



WASTEWATER DISPOSAL ADVISORY

There are laws in most communities prohibiting the dumping of recovered "gray" water from carpet cleaning in any place but a sanitary treatment system.

This cleaning rinse water, recovered into your unit's vacuum tank, contains materials such as detergents, which must be processed before being safe for streams, rivers and reservoirs.

IN ACCORDANCE WITH THE EPA, STATE AND LOCAL LAWS, DO NOT DISPOSE OF WASTEWATER INTO GUTTERS, STORM DRAINS, STREAMS, RESERVOIRS, ETC.

In most cases, an acceptable method of wastewater disposal is to discharge into a municipal sewage treatment system after first filtering out solid material such as carpet fiber. Access to the sanitary system can be obtained through a toilet, laundry drain, carwash drain, RV dump, etc. Permission should first be obtained from any concerned party or agency.

One disposal method which usually complies with the law is to accumulate the wastewater and haul it to an appropriate dump site. Another solution to the disposal problem is to equip yourself with an Automatic Pump-Out System. These systems are designed to remove wastewater from the extractor's recovery system and actively pump the water through hoses to a suitable disposal drain. Properly designed, they will continuously monitor the level of wastewater and pump it out simultaneously to the cleaning operation. The hidden benefit of this process is that the operator doesn't have to stop his cleaning to empty the recovery tank. HydraMaster makes an A.P.O. System available which can be ordered with new equipment or installed later.

The penalties for non-compliance can be serious. Always check local laws and regulations to be sure you are in compliance.

MACHINE ADJUSTMENTS

Although this unit has been factory adjusted, it may require additional adjustments to achieve optimum performance; i.e. altitude may require carb adjustment and ambient temperatures may require heat control adjustment. When required, consult an authorized representative.

OPERATING INSTRUCTIONS

START UP

1. Perform daily/periodic maintenance as specified by the owners manual.
2. Connect all required hoses.
3. Connect cleaning tool to length of hose required to perform cleaning.

◆ CAUTION ◆

4. Mix tank must be full prior to ignition.

5. Start engine (choke as required). Engine is at operating speed (recommended - 2600 RPM). Allow warm-up period of 2-5 minutes.
6. Spray wand to void all air from system. When the mix tank begins a fill cycle, the chemical flow meter may be adjusted to your desired setting.

NOTE: Recommended carpet cleaning pressure is 300 PSI.

7. Once all air is voided from system, heater may be ignited.

NOTE: If not familiar with operation of this heater, refer to heater section of the manual.

A. Open propane valve on the tank.
B. Ignite pilot on the heater.
C. To ignite burner, turn dial to "on" position.

NOTE: If you suspect that the unit has been frozen - **DO NOT** light the heater. Thaw the heater and check for leaks.

8. Turn on burner, adjust dial to normal or slightly below for 200°F.
9. Commence cleaning operation.

NOTE: Chemical flow meter set at 5 GPH is a 1 to 30 mix ratio and 10 GPH is 1 to 15 ratio.

NOTE: Hot climate operation (above 90°F).
When operating this unit in a hot climate, HydraMaster highly recommends some additional precautions.

1. Operate with side and rear doors fully open.
2. Vent heater through the top of van.
3. If vapor lock conditions arise, machine cover may need to be raised to allow additional heat to escape from compartment.

NOTE: Cold climate operation (below 0°F).
When operating this unit in a cold weather application, HydraMaster highly recommends some additional precautions.

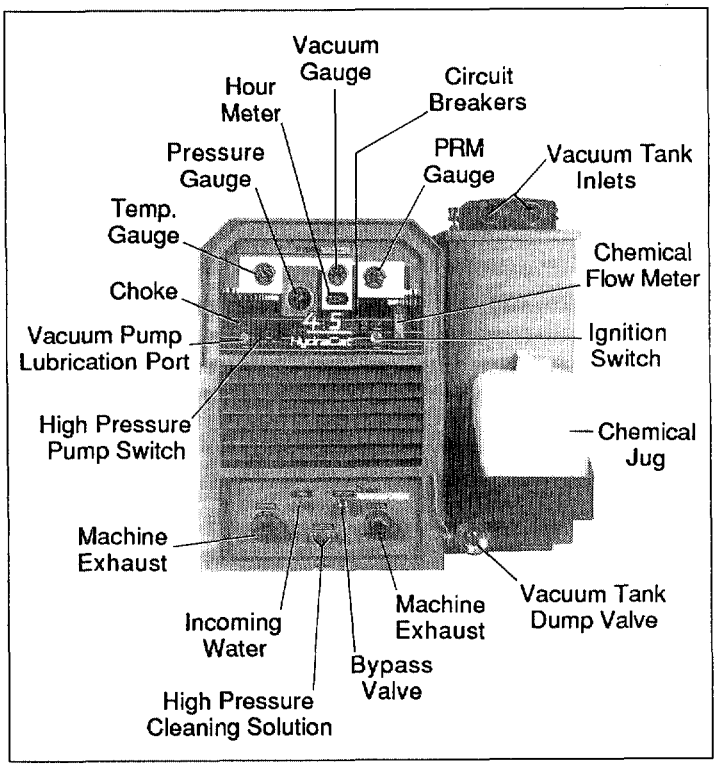
1. If possible carry your own fresh water supply.
2. Hook up to hot water source if possible to keep your incoming garden hose from freezing.
3. Do not close van doors in front of machine.
4. Be aware that solution lines laying on frozen ground may freeze.
5. Contact local propane dealer about cold weather propane use.

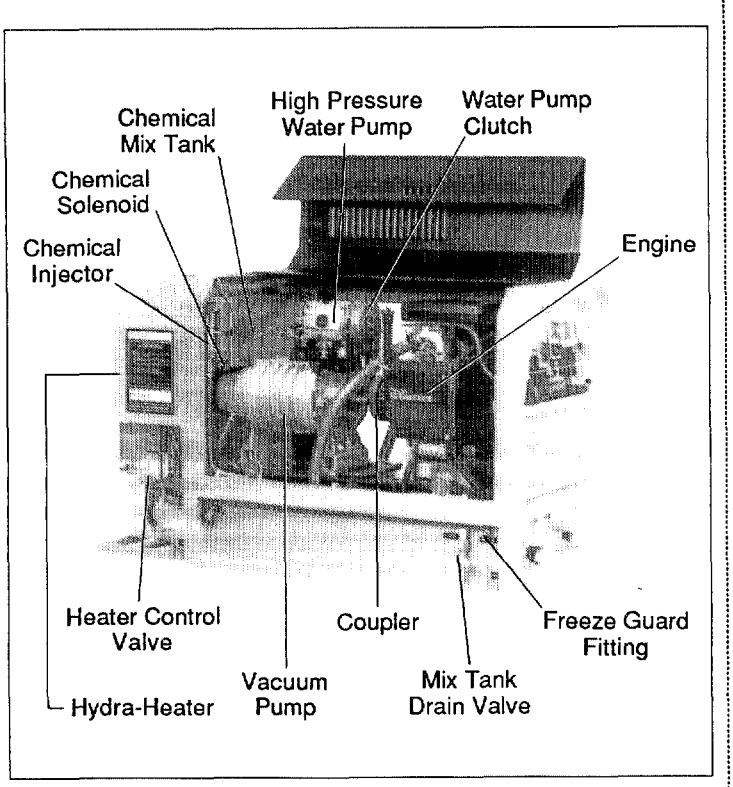
SHUT DOWN

1. Turn heater to **"off"** position. Spray wand for at least 3 minutes to allow the heater coils to cool.
2. Close valve on propane tank and through floor hook up.
3. Remove vacuum hose.
4. Flush clear water through chemical system for 10 seconds. (Vinegar should be rinsed through system weekly.) Turn off chemical flow meter.
5. Turn on cleaning tool to flush chemical from unit hoses and cleaning tool.

NOTE: If freeze guard is necessary, perform steps 1 & 2 of freeze guard procedure at this time.

6. At this time, the blower should be lubricated with Pennzguard.
7. Shut engine down.
8. Drain vacuum tank. Vacuum filter should be cleaned prior to mobilization of van. **NOTE:** If freeze guard is necessary, perform steps 3-7 of freeze guard procedure at this time.





OPERATION PRECAUTIONS

NO SMOKING

◆ WARNING ◆

It is unsafe to smoke in or around the vehicle.

ENGINE COOLING

◆ CAUTION ◆

Units employing air cooled engines must not be enclosed within a van with doors and windows closed. Excessive temperatures within the engine will result in premature engine failure and a compromise of applicable warranty.

LEVEL OPERATION

◆ CAUTION ◆

During operation, van or trailer must be parked on level ground not to exceed + or -10°. Failure to insure proper leveling may prevent proper internal lubrication of engine, vacuum and/or high pressure components.

FREEZE PROTECTION

◆ CAUTION ◆

Mother nature gives little warning as to her cold spells. Therefore, protecting this equipment from freezing will save costly down-time. Placing an electric heater in the truck or parking the truck indoors, will help to insure against freezing.

LIGHTING HEATER

◆ WARNING ◆

Never put your face down close to the opening of the heater when lighting.

STRONG PROPANE ODOR

◆ WARNING ◆

Never light the heater if you smell a strong odor of propane around the heater.

HOT SURFACES

◆ WARNING ◆

During the operation of this equipment many surfaces on the machine will become very hot. When near the van for any reason care must be taken not to touch any hot surface, such as heater, engine, exhaust, etc.

MOVING PARTS

◆ WARNING ◆

Never touch any part of the machine that is in motion, severe bodily injury may result.

CARBON MONOXIDE

◆ WARNING ◆

*This unit generates toxic fumes. Position the vehicle so that the fumes will be directed **AWAY** from the job site.*

***DO NOT PARK** where exhaust fumes can enter a building through open doors or windows, air conditioning units or kitchen fans.*

FREEZE PROTECTION

Any freezing of this machine is not covered by warranty and during the colder months of operation, careful protection should be of utmost concern.

THE FOLLOWING PRECAUTIONS ARE RECOMMENDED:

1. Run machine before leaving for the first job to insure nothing has frozen the night before, including hoses and wand.
2. Insulate the garden hose from the cold ground by running it through an extra 1 1/2 inch vacuum hose.
3. In colder climates, insulating the truck walls and floor boards will help protect the unit.
4. Don't procrastinate during the cleaning operation or the hot water solution line will also freeze on the ground. The solution line should be insulated in extremely cold climates.
5. Whenever possible, the truck and machine should be stored in a heated garage at night or over the weekend. If not possible, place a 1500 watt electric heater inside the truck, aimed directly at the machine. Never use a propane heater - it causes excessive moisture on the truck ceiling and the possibility of it going out is higher. If the machine and truck are left outside with a heater, you should first drain of possible water from the machine cleaning tools and hoses. (They freeze also.)

TO DRAIN THE MACHINE FOLLOW THESE STEPS:

1. Siphon a 50/50 mixture of anti-freeze and water through the chemical flow meter.
2. Drain the mix tank.
3. Connect the freeze guard hose to the recovery tank.
4. Connect the other end of the freeze guard fitting to the freeze guard fitting located on the side of the machine.
5. Connect an open 440 quick connect to the fittings marked "cleaning solution" on the front of the machine. (An alternative would be to connect your solution hoses and wand, so as to freeze guard them also. If you choose to do this you will also need to hold the trigger down on the wand.)
6. Start the unit, allowing the vacuum from the machine to drain the lines.
7. * Remove the garden hose inlet adapter from the end of the garden hose. Connect the adapter to the incoming water quick connect on the front of the machine.
8. * Place a vacuum hose over the garden hose quick connect and allow the vacuum from the machine to drain the lines.

* An alternative to #7 & 8 would be to make an adapter to allow you to use the premade freeze guard hose.

NOTE: Prior to freeze guarding your machine make sure the heating system has been cooled down.

ALTERNATE PROTECTION USING ANTI-FREEZE:

1. Follow the draining procedure.
2. Connect solution hoses and wand to machine.
3. Pour a 50/50 anti-freeze solution into mix tank.
4. Turn on machine and engage clutch. Spray the wand.
5. Continue to add anti-freeze solution until mixture comes out of wand set.
6. Remove and store hoses.

If you are using an anti-freeze solution to protect your machine from freezing. It is necessary to flush the machine in preparation for use. Simply connect the unit to fresh water and spray the wand until anti-freeze solution is discharged. The anti-freeze solution may be recovered by spraying into an empty container. This solution can be used several times.

BE SURE IT'S PROTECTED! **Freezing will cause GRIEF, MONEY and DOWN-TIME. Don't mess with Mother Nature!**

CLEANING AND CHEMICAL PRECAUTIONS

Your mobile carpet cleaning plant has been engineered using the latest and most sophisticated technology available, to produce the finest carpet cleaning results possible. Despite this, however, it remains only a tool of the carpet cleaning trade, and it can produce only as good a job as the person operating it.

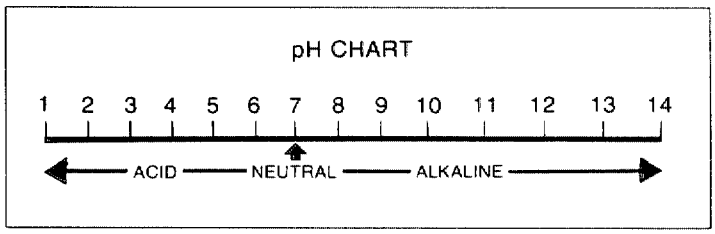
There are not short cuts to good carpet cleaning. It requires time, cleaning knowledge and the use of good chemicals.

The manufacturer recommends the use of spotting agents, and traffic lane cleaners prior to the actual cleaning of carpeting, as required.

The use of some chemicals through your mobile carpet cleaning plant can seriously damage the internal plumbing, high pressure pump and heater. (Chemical such as concentrated acids, solvents, and some paint oil and grease removers w/high concentration of solvents.)

The manufacturer recommends only the use of chemicals containing rust and corrosion inhibitors and water softening agents to prevent chemical build-up which may lead to component failure and warranty invalidation.

NOTE: At no time should a chemical solution with a pH of less than 7 or higher than 10 be used in the unit.

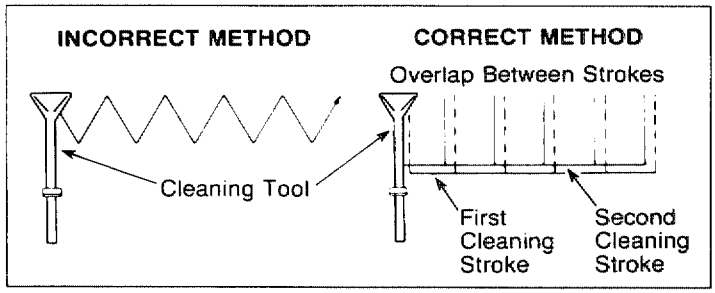


CLEANING STROKE PROCEDURE/OVER-WETTING

PURPOSE: To eliminate excess moisture remaining in the carpet fiber and the sawtooth appearance which results from diagonal movement of the cleaning tool on all types of carpet.

PROCEDURE: Always move the cleaning tool in smooth forward and backward strokes. Apply slight pressure to the forward stroke while the solution is injected into the carpet. When extracting (drying), apply firm pressure on the forward stroke to ensure a positive "lock" for the vacuum and minimize the "hopping" effect resulting on unsmooth carpet. During the forward and reverse strokes, movement to the right or left should only be accomplished at the extreme rear of the stroke. Overlapping is also important to ensure even application of solution to prevent saturation when cleaning wand is stopped twice at the same point at the rear of the cleaning stroke.

Failure to adopt this procedure can result in increased chance of "clean streaks", fiber shrinkage, brown out, and longer drying periods.



OVER-WETTING

Over-wetting is annoying to all concerned and sometimes leaves a bad impression of the cleaning process used.

THESE ARE SEVERAL AREAS THAT WILL CAUSE OVER-WETTING:

1. Too few vacuum strokes or improper saw tooth vacuum strokes as shown in the previous illustration.
2. Obstructed, kinked or cut hoses.
3. Vacuum tank drain valve left partially open.
4. Clogged vacuum blower filter or vacuum tank lid not sealing properly.
5. Cleaning a heavily foam-saturated carpet without defoamer. (We recommend crystal type.)

WATER AND CHEMICAL FLOW OPERATION

This electro-mechanical system has been designed to be simple and trouble free. Incoming water flows first through the Solenoid Control Valve (1) and the low pressure Chemical Injector (2) which are both mounted on the exterior of the mix tank. As the water passes through the Chemical Injector, it is automatically proportioned with a predetermined quantity of detergent. The Mix Tank (3) is equipped with two different float switches, the Water Level Float (4) responds to the level in the tank and will maintain the proper volume of solution to be reserved for the water pump. The secondary, Low Water Float switch (5) is a safety switch that is designed to protect your system from sudden or unexpected loss of water supply. If, for example, the water source at the house were turned off, the water level of the mix tank would drop, activating the secondary switch, which automatically disengages the system and prevents the water pump from running dry.

The desired chemical injection ratio may be obtained by an adjustment of the Chemical Flow Meter (6) during the fill cycle of the mix tank. Water must be flowing into the mix tank in order to adjust the chemical mix. The chemical will flow from the Chemical Jug (7) to the Chemical Flow Meter, then to the Chemical Injector where it is proportioned into the Mix Tank at the desired chemical setting.

NOTE: With this unique chemical system, the chemical flow is proportioned only during the filling cycles of the Mix Tank, not during the direct spraying of the wand. Therefore, it is possible that as your wand is spraying, you may have no chemical flow. Also, the converse is true in that you may not be spraying your wand, but if the mix tank is in a filling cycle, your Chemical Flow Meter may be active at the desired flow rate.

The chemical proportioning system will mix chemical with water at a 1 to 30 ratio when the Flow Meter is set at 5 GPH, or a 1 to 15 ratio when the Flow Meter is set at 10 GPH.

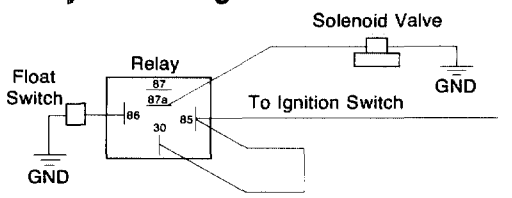
At this point in the flow, solution (water with chemical) will now be siphoned from the bottom of the Mix Tank to the inlet of the Water Pump (8). When the wand is not using solution by spraying, the solution will be bypassed from the bottom of the brass Pressure Relief Valve (9), back to the Mix Tank.

When the wand is spraying, the solution continues its flow to the Water Heater (10) . The coils of this heater have a capacity of up to 2 gallons, therefore it is extremely important that all air pockets are bled out of the heater prior to initial start-up. This may be achieved by running the water system, without the heater on, for approximately 60 seconds.

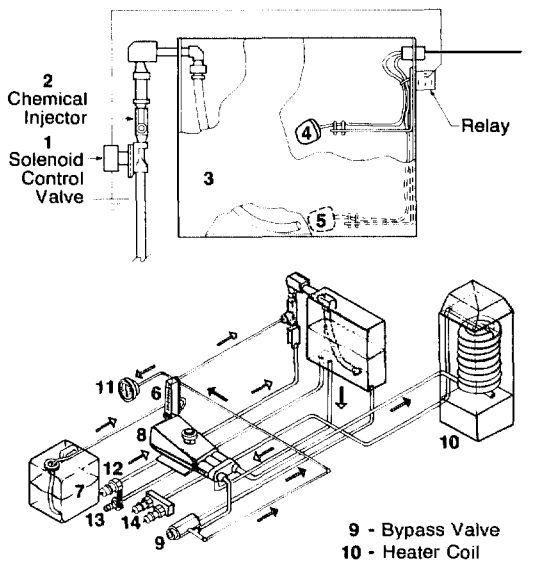
CHEMICAL SYSTEM MAINTENANCE

The chemical lines may need to be flushed with vinegar periodically to prevent abnormal chemical build-up. This flushing may be done by removing the clear plastic hose from the Chemical Jug and inserting it into a one quart container of vinegar. This should be done with the Chemical Flow Meter setting on 10 GPH and the Water Heater "off". Simply spray water from the wand until the quart of vinegar is exhausted, the repeat the process with one quart of clear water to void all lines of vinegar.

Chemical System Wiring

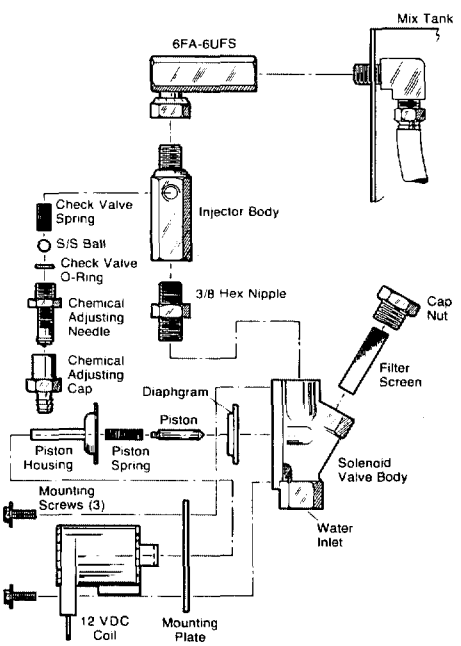


Water Flow



9 - Bypass Valve
10 - Heater Coil
11 - Pressure Guage
12 - Incoming Water
13 - Tank Drain
14 - To Wand
6 - Chemical Flow Meter
7 - Chemical Jug
8 - High Pressure Pump
→ High Pressure
→ Low Pressure

Chemical Proportion and Level Control



CHEMICAL TANK TROUBLE SHOOTING GUIDE

PROBLEM: Little or no chemical flow

Solution

Check that hoses at the Mix Tank (3) are secure. Check that the hose from the top of the Flow Meter (6) to the Chemical Injector (2) is secure with no kinks or leaks. Check that the adjusting cap on the side of the injector is not screwed all the way in. Check the s/s check valve inside the injector for chemical build-up and proper operation. Check the hose from the bottom of the Flow Meter to the Chemical Jug (7) for kinks, cracks, or bubbles.

Check the screen on the end of the hose which goes into the Chemical Jug. To check this screen for proper function, remove it from the plastic hose. If you cannot blow through it, then rinse it out with vinegar.

Check the Chemical Flow Meter (6) for obstructions or a sticking float.

Is incoming water pressure less than 30 PSI?

Cracked or defective Chemical Flow Meter (6)?

Check the filter screen in the Solenoid Control Valve (1).

PROBLEM: Inability to adjust chemical with the Flow Meter

Solution

Debris lodged behind teflon seat in Flow Meter valve.

Teflon seat on the valve stem may be loose. If deteriorated, replace O-Ring.

PROBLEM: Solution reversing from Mix Tank, filling the Chemical Jug

Solution

Anti-siphon device clogged by chemical build-up (Anti-siphon device is located in the Chemical Injector (2) body — see page 9, Water Flow illustration). Check for debris.

PROBLEM: Mix Tank overflows

Solution

Float switch (4) in the Mix Tank not moving freely, or defective.

To check switch: With a 12 volt test light and the float in the "up" position, there should be power through the switch.

To check relay: First check wiring against diagram. With 12 volt test light, and the *Float Switch (4) in the "up" position there should* **NOT** *be power at the Solenoid* Valve. With the Float Switch in the "down" position there should be power at the Sloenoid Valve.

Solenoid Valve defective: Remove Solenoid Valve, disassemble and inspect diaphragm for cracks or tears.

PROBLEM: Mix Tank does not keep up with water output

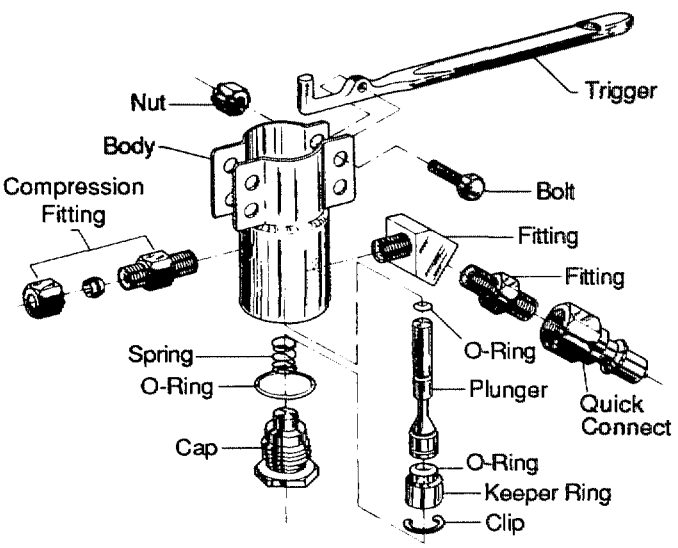
Solution

Check incoming water pressure. Check garden hose quick connect assembly screen.

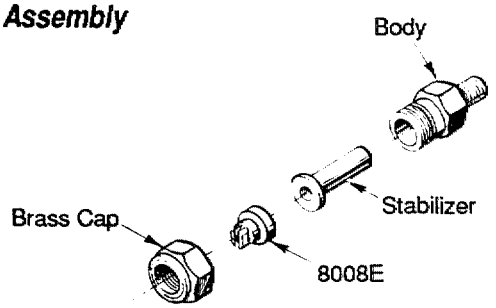
Check garden hose and/or feed hose to the Mix Tank for clog, kinks, or blockage.

Float Switch (4) in Mix Tank hanging up (not moving freely). Check filter screen in Solenoid Valve (1).

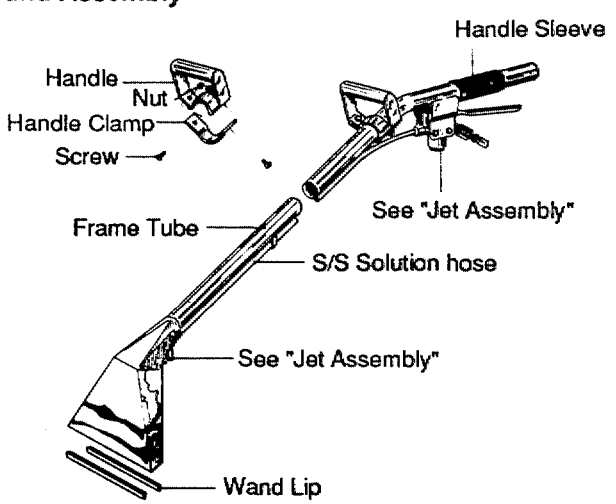
Wand Valve Assembly



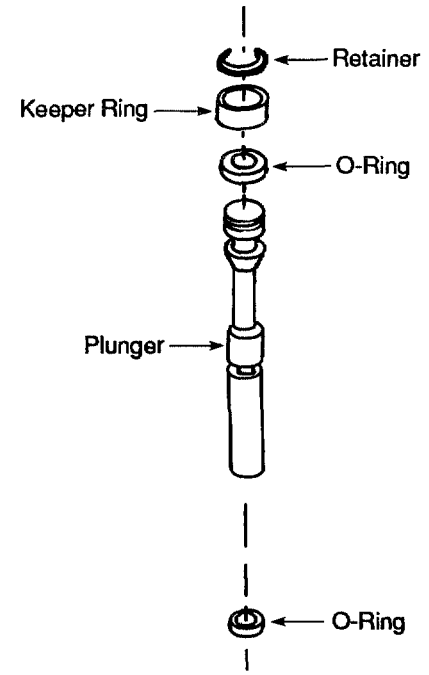
Jet Assembly



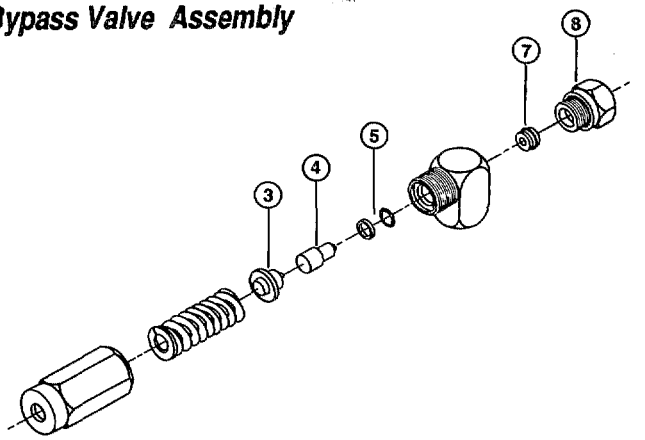
Wand Assembly



Wand Valve Stem Assembly



Bypass Valve Assembly



BYPASS PARTS LIST

REF. NO.	PART NO.	DESCRIPTION	QTY.
3	000-105-101	Thrust plate, Bypass valve	1
4	000-105-102	Piston plate, Bypass valve	1
5	000-078-101	Kit, seal for Bypass valve	1
7	000-148-004	Seal & O-Ring, Bypass valve	1
8	000-097-005	O-Ring, Bypass valve fitting	1

WATER FLOW TROUBLE SHOOTING GUIDE

PROBLEM: Loss of pressure

Cause	*Solution*
Defective or blocked check valves in high pressure pump cylinder head.	Disassemble cylinder head and replace or clean applicable check valve.
Delaminated, kinked or clogged hose between the mix tank and the high pressure pump.	Remove and replace defective hose.
Defective pressure relief valve or debris in pressure relief valve. **NOTE**: The high pressure bypass valve is designed to fully close when the cleaning tool is turned on. Any foreign matter collecting on the piston will prevent full closure of the valve and allow a portion of the water to continue to circulate instead of being routed to the cleaning tool. To correct this situation, the bypass valve must be disassembled and cleaned (refer to illustration provided above for bypass disassembly).	Disassemble and clean pressure relief valve as illustrated in drawing above. Replace defective or worn out bypass cup. Replace bypass valve.
Defective or worn cups.	Remove and replace piston cups as defined by pump manual.
Loose drive belt for high pressure pump.	Readjust belt as required or replace if defective.
Pump inlet Y strainer clogged	Check tank for water. Clean strainer. Clutch disengaged?

PROBLEM: Excessive water flow

Cause	*Solution*
Worn out spray jet. **NOTE:** Cleaning tools designed to spray a constant flow of 11/2 GPM will average 1 gallon of flow per minute in actual working situations since flow is not continuous. An average flow of 1 GPM results in 6000 gallons of flow for every 100 hours of unit operation. Spray tips are capable of flow rates for approximately 20,000 gallons. They should be replaced therefore, approximately every 350 hours. Worn spray jets allow a greater average rate of flow thus reducing desired temperature levels.	Remove and replace spray jet.
Reduction of flow.	Due to increased length of sloution hose. **NOTE:** For every 50 feet of hose, beyond 100 feet in total length, a measurable loss of flow is experienced. This condition is a result of the increased friction experienced by the water as it passes through the hose. Therefore, it is necessary to increase the pressure at the machine 40 PSI for every additional 50 feet of cleaning solution hose over 100 feet.

VACUUM SYSTEM INFORMATION

The vacuum blower incorporated in this machine is a positive displacement lobe type, manufactured by Cooper Industries. The performance and life of this unit is greatly dependent on the care and proper maintenance it receives.

Because of the close tolerances between the lobes and housing of the vacuum blower, solid objects entering the inlet will damage the internal lobes, gears and bearing or direct drive coupler.

To prevent this, a stainless steel filter screen has been placed at the vacuum inlet inside the vacuum recovery tank. This stainless steel screen is finger tight and should be removed for cleaning weekly.

◆ CAUTION ◆

When machine is being run for test purposes and the vacuum inlet on top of machine is open, caution should be used.

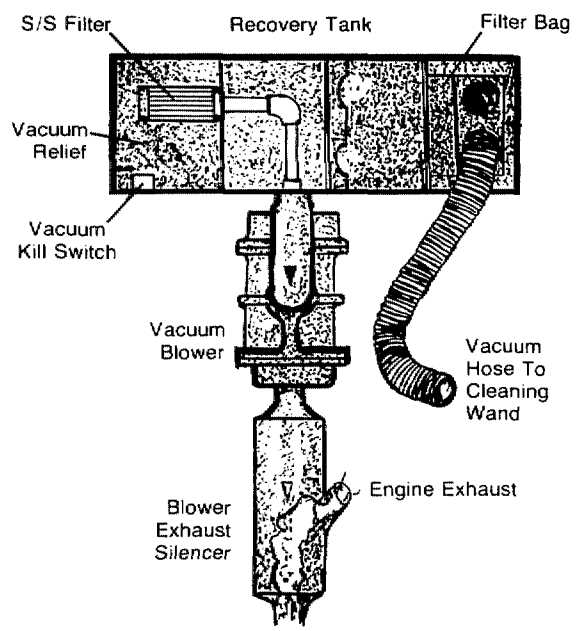
To protect the vacuum blower from overloading and damaging itself, there is a vacuum relief system installed on the vac tank. When the vacuum tank inlet is completely sealed off, a maximum of 14 HG will be attained. A hole on the top blower pipe elbow acts as the lubrication point. At the end of each day, LPS 1 or Pennzguard should be sprayed in before shutting down the machine. See blower lubrication illustration. If you fail to lubricate the vacuum blower daily, rust deposits and moisture will decrease the life of the vacuum blower.

Read the vacuum blower manual carefully for proper oil change and grease application. The maintenance log may differ slightly from the manual, but the truck-mounted carpet cleaning machine application is very demanding of the vacuum blower and therefore it should be maintained more regularly.

◆ CAUTION ◆

***NOTE:** Vacuum tank is protected from overflowing by a vacuum tank, float kill switch. This switch is not activated by foam, only by liquid.*

Vacuum Flow

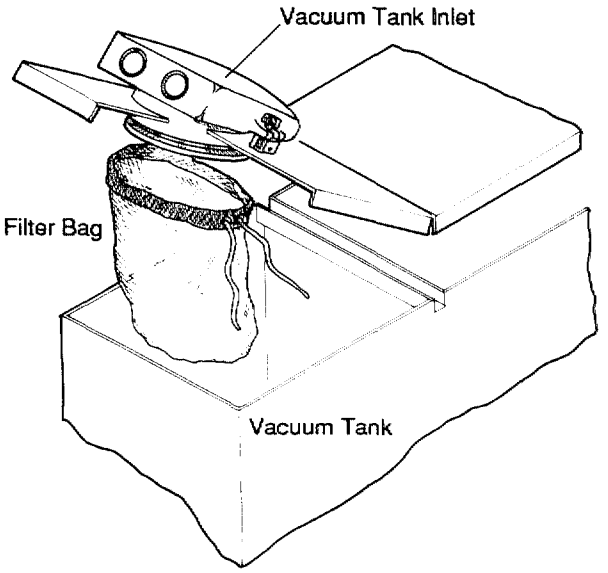


VACUUM TANK FILTER BAGS

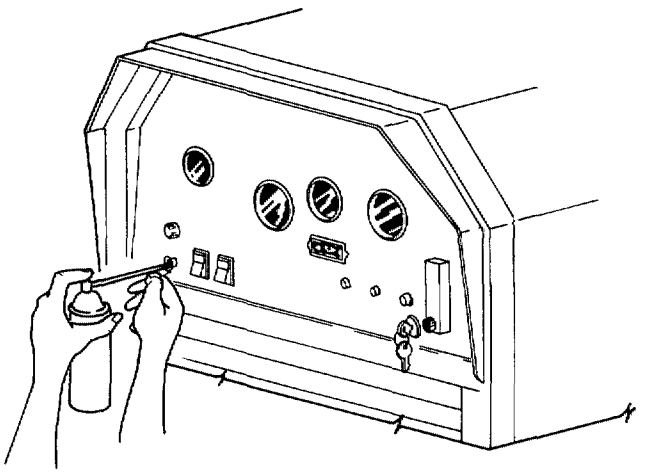
HydraMaster filter bags are designed to trap all of the lint, sand and dirt that would normally collect at the bottom of your vacuum tank. The use of these bags, if emptied at the end of each job, will eliminate the build-up of much of the debris in the tank. The drawstring top of these bags is designed to be tied to the incoming dirty water inlet in the vacuum tank.

To reorder bags use part number 049-029.

Vacuum Tank Filter Bags



Blower Lube Port



Spray lubricant into blower lube port for 3 to 5 seconds, then immediately shut off machine. Use only LPS 1 or Pennzguard moisture displacing lubricants.

VACUUM BLOWER WARRANTY

FULLER warrants products of its manufacture to be free from defects in material and workmanship if properly installed, maintained, and operated under normal conditions with competent supervision.

No person, agent, representative or dealer is authorized to give any warranties on behalf of FULLER nor to assume for FULLER any other liability in connection with any of FULLER'S products.

This warranty shall extend for two (2) years from date of installation provided this equipment has been put into service within six months after shipment from the FULLER factory. If repairs or replacements are made by the Purchaser without FULLER'S prior written consent, FULLER'S warranty shall cease to be in effect. No allowance will be granted for any repairs or alterations made by the Purchaser without FULLER's prior written consent.

Machinery, equipment and accessories furnished by FULLER, but manufactured by others, are warranted only to the extent of the original manufacturer's warranty to FULLER.

FULLER agrees at its option to repair at the point of shipment or to replace without charge f.o.b. point of shipment, any part or parts of products of FULLER'S manufacture, which within the specified warranty period shall be proved to FULLER'S satisfaction to have been defective when shipped, provided the Purchaser promptly notifies FULLER, in writing, of such alleged defect.

FULLER'S liability to Purchaser, whether in contract or in tort arising out of warranties, representations, instructions, or defects from any cause shall be limited to repairing or replacing of the defective part or parts as aforesaid, f.o.b. point of shipment.

No liability whatsoever shall attach to FULLER until said products have been paid for. EXCEPT AS STATED IN THIS SECTION AND IN THE PRECEDING SECTION TITLED 'WARRANTY' AND EXCEPT AS TO TITLE, THERE ARE NO GUARANTEED OR WARRANTIES OF MERCHANTABILITY, FITNESS, PERFORMANCE OR OTHERWISE, EXPRESS, IMPLIED OR STATUTORY, AND FULLER SHALL HAVE NO LIABILITY FOR CONSEQUENTIAL, INCIDENTAL OR OTHER DAMAGES, HOWSOEVER CAUSED.

DATE INSTALLED _____ MODEL_____ SERIAL #_____

FULLER COMPANY 2966 East victoria Street Compton, California 90224

VACUUM BLOWER LUBRICATION

At the gear end the timing gear teeth are lubricated by being partially submerged. The gear teeth serve as oil slingers for gear end bearings. At the drive end of the bearings are grease lubricated.

FILLING PROCEDURE

Remove square head vented oil fill plug (A) on gear end. Remove oil level plug (B) located in the head plate. Fill gear case until oil drips out of the oil level hole (B). Use lubricants as listed. Add fresh oil as required to maintain proper level. The oil should be drained, flushed and replaced every 1500 hours or more frequently if inspection so indicates. The oil drain plug is at (C).

NOTE: Older units may have the oil fill level and drain holes located in the cast iron gear case instead of in the head plate. Bearings on drive end of blower require grease lubrication every 100 hours of operation. Bearings which require grease lubrication will have a grease fitting (D) at each bearing. When regreasing, the old grease will be forced out of the vents during operation. To prevent damage to seals, these vents must be kept open at all times.

Vacuum Blower Motor Lubrication

LUBRICATION INSTRUCTIONS FOR OIL LUBRICATED GEARS AND BEARINGS

Add fresh oil as required to maintain proper level. Drain and refill every 1500 hours of operation under normal service, more frequently when required. Use a good quality oil.

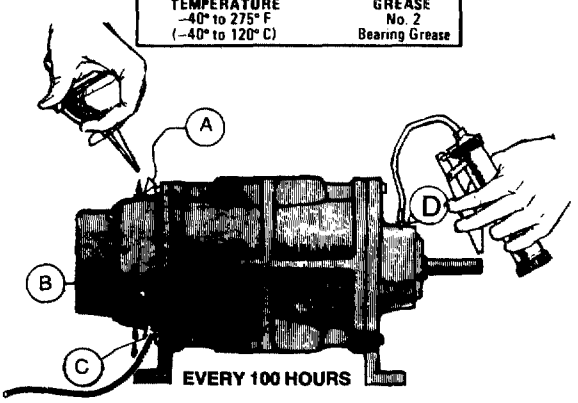
BLOWER DISCHARGE TEMPERATURE	OIL GRADE U.S.A.*	OIL VISCOSITY CENTISTOKES @ 40° C
-40° to 32° F (-40° to 0° C)	SAE 10W	45
32° to 100° F (0° to 38° C)	SAE 20	100
100° to 275° F (38° to 135° C)	SAE 40	200
over 275° F (135° C)	SAE 50	250

*In applications with extreme variations in ambient temperature a 20W - 50W multiple viscosity oil is recommended.

FOR GREASE LUBRICATED BEARINGS

Service every 500 hours of operation

BLOWER DISCHARGE TEMPERATURE	TYPE GREASE
-40° to 275° F (-40° to 120° C)	No. 2 Bearing Grease



VACUUM BLOWER TROUBLE SHOOTING GUIDE

PROBLEM: Loss of pressure

Cause	*Solution*
Collapsed vacuum hose between blower and vacuum tank.	Remove and replace hose. **NOTE:** A special reinforced hose is required for replacement.
Clogged stainless steel liner.	Remove and clean or replace stainless steel filter.
Defective vacuum tank seal.	Remove and replace vacuum tank seal.
Defective or "open" vacuum tank pump valve.	Close valve. Replace valve.
Fractured weld on vacuum tank.	Re-weld as required or replace tank.
Collapsed or kinked vacuum hose.	Reshape hose if possible and/or eliminate kinks.
Plugged vacuum hose.	Remove obstructions by reversing the vacuum hose.
Restriction in cleaning tool.	Remove obstruction.
Worn end plates or lobes in vacuum blower.	Replace worn components. **NOTE:** Must be accomplished by a qualified technican.
Defective relief valve.	Inspect and replace if necessary.

PROBLEM: Blower is seized

Cause	*Solution*
Rust.	Spray rust dissolving lubricant onto lobes to emulsify rust and attempt to rotate vacuum lobes.
Foreign matter.	Disassemble and remove foreign matter and repair as required. **NOTE:** Disassembly must be accomplished by qualified technican.

***Note:** The above mentioned, rust, foreign matter and seizing are often caused from foam traveling through the blower.*

PROBLEM: Noise in vacuum blower

Cause	*Solution*
Worn gears.	Remove and replace gears. **NOTE:** Replacement of gears must be accomplished by qualified technican. Timing of vacuum blower has been changed due to worn components. Replacement of components must be accomplished by qualified technican.
Lack of lubrication. **NOTE:** Permanent damage may have resulted from lack of lubrication.	Lubricate as specified by applicable vacuum blower manual. See index.
Worn bearings.	Remove and replace bearings as required. Must be accomplished by qualified technican.
Debris and/or foreign material build-up. **NOTE:** A stainless steel filter is provided in vacuum inlet located in vacuum blower components.	Disassemble vacuum blower and remove foreign material. **NOTE:** Disassembly should be accomplished by qualified technican only. Replacement of worn parts is necessary.
Loose or missing mounting bolts.	Tighten or reinstall mounting bolts.

HEATING SYSTEM INFORMATION

The propane heater incorporated in this equipment is a special design for use in the carpet cleaning industry. It's high pressure coils and thermostatic temperature control make it simple to operate and reliable. Once the desired temperature is set, the heater will then go 'on' and 'off' according to the water temperature within the heater. As water is used through the cleaning tool, cold water entering the heater will activate the thermostatically controlled propane valve thereby firing the heater to maintain a consistant flow of hot water. Once the cleaning wand is shut off and the flow of water through the heater stops, the heater will continue to burn until the set temperature is attained.

It is possible with this design that the flame may be on when the wand is off, likewise, it is possible the flame may be off when the wand is on.

◆ CAUTION ◆

This heater is designed to burn vapor propane gas only. Any liquid propane entering the heater may cause damage to the control valve on the heater. It will also cause improper burning and a soot build-up on the coils. Therefore, it is necessary to shut off the heater and close the valve at the tank between cleaning locations. Failure to do this allows sloshing liquid to enter the vapor feed line to the heater.

IMPORTANT: Overfilling of the propane tank will cause many problems. To avoid this, advise the attendant filling the tank **not to fill the tank over 90%.** When filling the tank, watch the 10% valve and immediately stop filling when

white liquid starts spurting from the 10% valve. To prevent damage to the propane regulator, always close the valve on the tank before filling.

The propane regulator is pre-set at the factory at 6 oz. of propane. This reading is taken at the control valve on the heater (see figure A No. 6). To prevent road dust and moisture from entering the propane regulator, keep the white plastic cover (supplied) on the regulator at all times.

To avoid restriction of air flow at base of heater, keep articles such as chemical containers, hose, boxes, etc. from within 18 inches of base of heater. **NOTE:** This restricted situation also creates an over rich condition which results in soot build-up.

IMPORTANT: If a new propane tank has been installed or hoses have been disconnected, air may enter propane hoses and must be purged prior to attempting to light the pilot burner. Should this condition exist, operator must depress the pilot button for 1-5 minutes and attempt to ignite the pilot light at 15 second intervals. A very slight hissing noise should be evident while performing this operation.

◆ WARNING ◆

Check heater for propane leaks regularly as loading and unloading hoses, tools, etc., may accidentally bump against heater fitting or pipes.

SEE ADDITIONAL CAUTIONS IN 'OPERATION PRECAUTIONS' SECTION, PAGE 7.

HEATER OPERATING INSTRUCTIONS

◆ CAUTION ◆

Heater must be filled with water prior to igniting.

A. TO START PILOT:
1. Adjust thermostat control knob on unitrol to desired setting (#3).
2. Adjust upper dial to pilot position (#1).
3. Depress pilot button (#2).
4. Depress sparking button to light pilot (#4).

IF PILOT FAILS TO LIGHT:
Is propane tank full?
Is propane tank valve open?
Has air been properly bled from propane line?
Is ignitor system working?

WHEN PILOT LIGHTS:
Wait ten seconds, depressing button manually, then release button.

◆ WARNING ◆

Always keep face away from main burner opening to avoid ignition flash burn.

B. TO LIGHT MAIN BURNER:
1. Turn upper knob to "on" position. Flame will come on.

If you do not get the burner to flame, the pilot has expired. You must turn upper dial to "off" position. Do not attempt to re-light the pilot for 60 seconds. To light the main burner, repeat instructions as above (TO START PILOT), 1 through 4.
OR,
Water may already be at controlled temperature.
Flame will turn off when thermostat senses maximum temperature.

C. TO ACHIEVE PROPER CARPET CLEANING TEMPERATURE:
1. Complete procedures A & B.
2. With 100' of hose, turn cleaning wand on for 5 minutes and the temperature should stabilize.
3. Once a constant temperature is established, turn cleaning wand 'off'. The flame on the heater burner should remain on for 10-15 seconds.
   A. If the flame expires prior to 10 seconds, turn the thermostat dial to a higher reading, then repeat C 1-3.
   B. If the flame remains lit after 15 seconds, turn the thermostat dial to a lower reading, then repeat C 1-3.

D. TO SHUT DOWN HEATER:
1. Turn upper dial #1 to 'off' position.

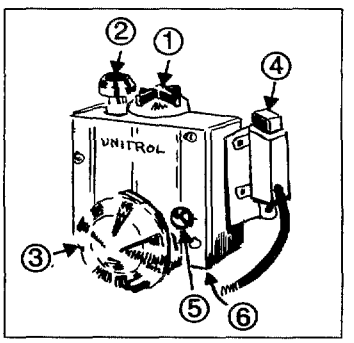
◆ CAUTION ◆

2. Turn cleaning wand on for 3 to 5 minutes to cool heater core. If heater core is not cooled, it is possible that the heat retained in the core will cause boiling back into a chemical mix tank. This results in damages to Cat pump.

3. Close propane tank valve while wand is on the heater is cooling.

PILOT BURNER ADJUSTMENT:
1. Remove pilot adjustment cap #5.
2. Adjust pilot key to provide properly sized flame.
3. Replace pilot adjustment cap.

Allen head pipe plug #6 can be removed for monometer insertion to read propane ounces.



HEATER TROUBLE SHOOTING

PROBLEM: Excessive heat. Flames protruding outside the lower openings.

Cause/Solution

1. Maladjustment of propane regulator. **NOTE:** Propane regulators are factory preset and may be readjusted by authorized personnel.
   A. Contact manufacturer to determine correct procedure.
   B. Have your local propane dealer use a manometer at the Unitrol to reset the propane regulator to 7 oz. maximum.
2. Overfilled propane tank. Propane heaters are designed to operate on vapor propane only. Overfilling a propane tank allows liquid propane to enter all heater related components and permits an over-rich burning condition to occur. This condition usually requires the core to be cleaned of soot and carbon deposits. Cleaning is a messy, dirty job and very inconvenient, so do not let it happen to you!

PROBLEM: Pilot light

Cause/Solution

1. Pilot light will not ignite. **NOTE:** Do not use a needle or pin to clean pilot orifice — use compressed air or solvent only.
   A. Verify propane reaching ignitor. **NOTE:** A kinked or crushed hose may impede propane flow.
   B. Remove and clean orifice.
   C. Verify ignitor spark is operating correctly.

CAT PUMP MODEL 290 OPERATING INSTRUCTIONS

◆ CAUTION ◆

*CAT PUMPS are positive displacement pumps. Therefore, a properly designed pressure relief mechanism **MUST** be installed in the discharge piping. Failure to install such relief mechanism could result in personal injury or damage to the pump or system. Cat Pumps Corporation does not assume any liability or responsibility for the operation of a customer's high pressure system.*

Products described hereon are covered by one or more of the following U.S. patents: 3558244, 3652188, 3809508, 3920356, and 3930756

CAT PUMPS CORPORATION
P.O. Box 885 MINNEAPOLIS, MN 55440
Phone (612) 780-5440 — Telex 29-0276

● N.V. CAT PUMPS INTERNATIONAL S.A. ●
Harmoniestraat 29
B 2000 Antwerp, Belgium
Phone (03) 237-72-24 — Telex 33947

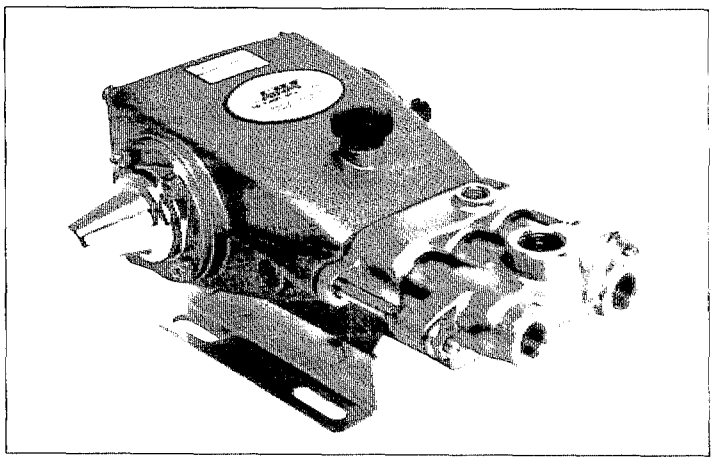
● CAT PUMPS — A.G. ●
Loretohoehe 5
CH-6300 ZUG, Switzerland
Phone (42) 21-31-40 — Telex 865 160 cpag ch

● CAT PUMPS DEUTSCHLAND GmbH ●
Rostocker Strasse 9
6200 Wiesbaden-Bierstadt, West Germany
Phone 0612-56 00 01/2 — Telex 41 86713

● CAT PUMPS (U.K.) LTD. ●
27 Station Industrial Estate, Fleet
Hampshire GU13 8QY, England
Phone Fleet 22031 — Telex 858898

SPECIFICATIONS

Volume: 3.5 GPM (13 L/M)
Discharge Pressure: 1200 PSI (83 BAR)
Maximum Inlet Pressure: -8.5 to + 40 PSI (-0.6 to + 2.8 BAR)
RPM: 1200
Bore: 0.787" (20mm)
Stroke: 0.472" (12mm)
Crankcase Capacity: 10 oz. (.3 L)
Maximum Fluid Temperature: 160°F (71°C)
Inlet Port (1): 1/2" NPT (1/2" NPT)
Chemical Injection Port (1): 1/4" NPT (1/4" NPT)
Discharge Ports (2): 3/8" NPT (3/8" NPT) (1): 1/2" NPT (1/2" NPT)
Pulley Mounting: Either side (Either side)
Shaft Diameter: 0.650" (16.5mm)
Weight: 12.1 lbs. (5.5 kg)
Dimensions: 10.77"x9.06"x5.14" (273.5x230x130.5mm)



CAT PUMP WARRANTY

This Cat Pump ("product") is warranted by the manufacturer to be free from defects in workmanship and material for one year from date of manufacturer's shipment. This warranty is limited to repairing or replacing products which manufacturer's investigation shows were defective at the time of shipment by the manufacturer. All products subject to this warranty shall be returned F.O.B. Cat Pumps Corp., Minneapolis, Minnesota 55430, U.S.A. for examination, repair or replacement.

The express warranty set forth herein is in lieu of all other warranties, express or implied, including without limitation any warranties of merchantability or fitness for a particular purpose and all such warranties are hereby disclaimed and excluded by the manufacturer. Repair or replacement of defective products as provided above is the sole and exclusive remedy provided hereunder and the manufacturer shall not be liable for any further loss, damages or expenses, including incidental or consequential damages, directly or indirectly arising from the sale or use of this product.

This warranty is subject to the following warranty conditions:
Important Conditions- LUBRICATION - fill crankcase to the top of oil gauge window per specifications with Cat Pump oil or equilvalent SAE 40 weight hydraulic oil with antiwear and rust inhibitor additives. Change initial fill after 50 hour run-in period. Change oil every three months or at 500 hour intervals thereafter. Prrrrm-a-lube seals need no lubrication. Blue dot seals and wick must receive three drops of Cat Pump oil per wick every 50 hours of operation.

GOOD LUBRICATION IS THE EASIEST, MOST EFFICIENT AND LEAST EXPENSIVE OF PREVENTATIVE MAINTENANCE.

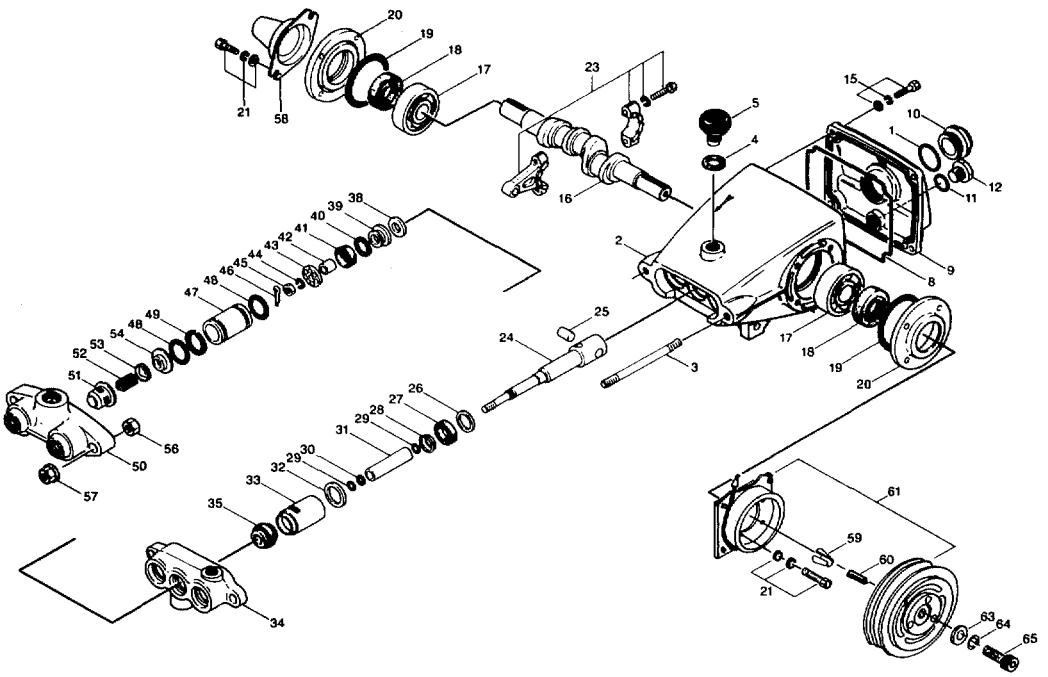
RPM and PRESSURE - Pump operation must be within RPM and pressure specifications. Pressure relief valve must be installed.

DO NOT PUMP ACIDS OR ABRASIVE FLUIDS with this unit. Consult Cat Pumps for additional information on questionable fluids.

FREEZING CONDITIONS - Pump must be protected from freezing conditions.

USE OF OTHER THAN CAT PUMP PARTS OR THEIR EQUIVALENT VOIDS THE WARRANTY

PISTON MODEL 290 Exploded View



PARTS LIST MODEL 290

ITEM	PART NO.	DESCRIPTION	QTY.
1	20285	O-Ring (Buna-N)	1
2	44274	Crankcase	1
3	85680	Stud (M8 x 82)	2
4	44377	O-Ring, oil filler cap	1
5	44374	Oil filler cap	1
8	43340	O-Ring, crankcase cover	1
9	43339	Crankcase cover	1
10	43987	Bubble oil gauge	1
11	23170	O-Ring, drain plug	1
12	25625	Drain plug	1
15	92520	Sems comb head screw (M6 x 20)	6
16	43804	Crankshaft	1
17	14487	Rearing	2
18	24159	Oil seal (Buna-N)	2
19	26536	O-Ring, oil seal case	2
20	27950	Oil seal case	2
21	92519	Sems comb head screw (M6 x 16)	8
23	101799	Connecting rod	3
24	101800	Piston rod	3
25	16948	Piston pin	3
26	20017	Seal washer	3
27	25301	Oil seal	3
28	25327	Barrier slinger	3
29	25392	O-Ring, sleeve	3
	28771	O-Ring, sleeve (Viton)	3
30	29003	Back-up ring, Sleeve (Teflon)	3
31	29614	Sleeve (29743 Unchromed)	3
32	26854	Seal washer	3
33	28597	Seal retainer	3
34	25128	Inlet manifold	1
	25635	Inlet manifold - stainless steel	1

ITEM	PART NO.	DESCRIPTION	QTY.
35	30315	Prrrrrm-A-Lube seal	3
	30325	Prrrrrm-A-Lube seal (Viton)	3
38	27004	Inlet valve	3
39	30543	Bac-Cup piston	3
40	30544	Bac-Cup ring (Teflon)	3
41	43172	Cup (Viton)	3
	43474	Bac-Cup assembly	3
42	27983	Piston spacer	3
43	27002	Piston retainer	3
44	27006	Conical washer - s/s (M6)	3
45	27000	Nut - s/s (M6)	3
46	14158	Cotterpin	3
47	101802	Cylinder (43834 Unch)	3
48	23172	O-Ring, cylinder (Buna-N)	6
	11377	O-Ring, cylinder (Viton)	6
49	21985	Bac-Cup ring, cylinder	3
50	24459	Discharge manifold	1
	25634	Discharge manifold - s/s	1
51	43442	Valve spring retainer	3
52	43360	Valve spring	3
53	43723	Valve	3
54	43434	Discharge valve seal	3
56	81109	Hex nut (M8)	2
57	101804	Hex flange nut (M8)	2
58	25130	Shaft protector	1
Electric Clutch Assembly			
59	152-005	Tapered sleeve	1
60	077-005	Key, electric clutch	1
61	036-005	6" electric clutch	1
62	143-084	8-30 mm socket head screw	1
63	174-004	Flat washer (5/16 US)	1
64	174-018	Lock washer (5/16 US)	1

GENERAL INFORMATION FOR CAT PUMP REPAIR

As you remove your discharge manifold, there is a set of 3 check valves (which usually fall out during dis-assembly). If the surfaces of these check valves are dirty, or show signs of chemical build-up, it is probable that they would remain open causing pressure loss or pulsation. Upon inspecting the valves, make sure that the teflon button in the valve spring retainers are still intact. Also examine the discharge manifold. Look for problems such as cracks, chemical buildup or warpage due to freezing. If this discharge manifold is warped, it will cause the check valves to stick and will result in loss of pressure.

The Cat pump cups are often the source of pressure loss. Upon inspection they may appear melted or torn, but often they will look good. Replace them anyway. There is no sure method of visually inspecting the cups. HydraMaster recommends changing cups whether they look good or not.

Anytime your pump is being dismantled, HydraMaster recommends replacement of all 'o' rings and seals. This is merely a convenience to the customer to make sure that the Cat pump is in top operating condition.

The Prrrrrm-A-Lube seals located within the intake manifold will allow air to enter the pump if they are worn. Again, it is difficult to visually pinpoint a defective Prrrrrm-A-Lube seal. Replace them all.

Repairing of Cat pumps is not a difficult task. However, before disassembling make sure you have the proper parts required.

1 - short (or hot) cut kit
3 - Prrrrm-A-Lube seals
6 - piston sleeve 'o' rings
1 - bottle Cat oil

Read instructions thoroughly, supplied in the Cat pump manual prior to disassembly and follow directions as stated. Oil all seals thoroughly prior to installation. (Remember, a newly scarred seal is no better than one you just took out.)

SERVICING THE VALVE ASSEMBLIES

DISASSEMBLY

1. Remove the fasteners securing the discharge manifold to the crankcase of the pump.
2. Support the discharge manifold and tap from the backside and a soft mallet to separate from the crankcase and gradually work free from cylinders.
3. Valve assemblies will remain in the manifold. Pump models with the o-ring groove on the outside of the valve seat require the assistance of a reverse pliers to remove the valve seat. The valve, spring and retainer will then fall out when the manifold is inverted.

Pump models without the o-ring groove on the outside of the valve seat permit the seat, valve, spring and retainer all to fall out when manifold is inverted.

REASSEMBLY

1. Place retainers in manifold chambers.
2. Next insert spring into center of retainer.
3. Inspect the valves for wear, ridges or pitting and replace if necessary.

NOTE: Seating side of flat valves may be lapped on flat surface using 240 *grit paper. Quiet valves due to their shape must be replaced.*

Insert valve over spring with recessed (dish) side down.

4. Next examine the seating surface of the flat valve seats and lap with 240 grit paper or replace if evidence of excessive wear. Quiet valve seats should be replaced if worn. Lap new quiet valve and seat to assure positive seal.
5. Some pump models have o-rings for ease of installation and to avoid damaging elastomers.

NOTE: First install o-ring in groove on seat (towards seating surface), then back-up ring.

NOTE: Models without outer groove on seat require the o-ring to be placed on lip of retainer.

6. Insert valve seats into manifold chambers.
7. Position manifold back onto pump.

NOTE: Lubricate o-rings on cylinder and exercise caution when slipping manifold over cylinders to avoid damaging cylinder o-rings.

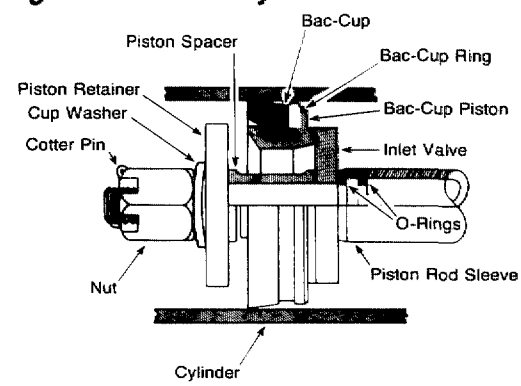
8. Replace fasteners and torque per specification chart.

NOTE: Replace all original shims when used. When new manifold is used reshim pump.

◆ CAUTION ◆

When starting the pump, check to see that there is no cylinder motion as this will cause premature failure of the cylinder o-rings. Center cylinder motion can be eliminated by switching with one of the end cylinders.

Pumping Section Cut-away



078-001 Cup Kit
3 Cup 6 O-Ring, Cylinder
3 Cotterpin
1 Instruction Sheet
1 Cup Inserter

078-003 Seal Kit
3 Prrrrm-A-Lube Seal
3 Cotterpin
2 Abrasive Paper
1 Instruction Sheet

30431 Sleeve and Seal Kit
3 Prrrrm-A-Lube Seal
3 Barrier Slinger
3 Cotterpin
3 Sleeve
6 O-Ring, Sleeve
1 Instruction Sheet

078-006 Valve Kit
3 Valve Spring Retainer
3 Valve Spring
3 Valve
3 Valve Seat
3 O-Ring, Cylinder
1 Instruction Sheet

30860 Piston Kit
6 O-Ring, Cylinder
3 Back-Up Ring, Cylinder
3 Bac-Cup Piston
3 Bac-Cup Ring
3 Cup
3 Piston Spacer
3 Piston Retainer
3 Conical Washer (M6)
3 Nut (M6)
3 Cotterpin
3 Inlet Valves
1 Instruction Sheet

SERVICING THE PUMP

DISASSEMBLY

1. Remove discharge manifold as described.
2. Grasp cylinders by hand and with an up and down motion, pull cylinders from inlet manifold.
3. Remove cotterpin, nut, and washer from piston rod.
4. Next remove retainer, spacer, and piston/cup assembly.
5. Remove inlet valve.

REASSEMBLY

1. Examine inlet valve surfaces for pitting, scale or grooves. Reverse valve and sand inlet side of valve using 240 grit paper for clean surface or replace if evidence of excessive wear. Slip onto rod.
2. Examine piston seating surfaces and sand clean on flat surface using 240 grit paper. If extreme pitting or shar edges, replace piston.
3. Examine cup for wear, cracking, tearing or separation from the piston. If worn replace and lubricate before installing on piston

NOTE CUP INSTALLATION: Wipe cup inserter with oil. Slip bac-cup ring (when used) onto piston. Push cup over inserter and square with all surfaces. Faulty cup installation causes premature cup failure.

4. Next replace piston spacer and retainer on rod.
5. Replace washer, thread on nut and torque per specification chart.

NOTE: Always replace with new Stainless Steel Cotterpin and turn ends under.

6. Examine cylinder walls for scoring or etching which causes premature wear of cups and replace if worn.
7. Lubricate cylinder walls for scoring or etching which causes premature wear of cups and replace if worn.
8. Position discharge manifold onto pump, replace fasteners and torque per specification chart.

SERVICING SLEEVES AND SEALS

DISASSEMBLY

1. Remove discharge manifold and piston assemblies as described.
2. Remove inlet manifold containing seals.
3. Grasp sleeves and with a pulling and twisting motion remove the sleeves from the piston rod.

NOTE: Grasp sleeve with pliers only if replacing worn sleeves, as this procedure will mar the sleeves.

4. Next remove seal retainer.
5. Remove and examine o-rings and/or back-up rings on piston rod for wear and replace.

REASSEMBLY

1. Lubricate new o-rings and/or back-up rings and slip onto piston rod. Install the first o-ring in the groove on the piston rod. Next position back-up ring against the shoulder in front of the first o-ring. Then install the second o-ring. Exercise caution as you slip the o-ring over the thread end of the piston rod.
2. Examine sleeves for scoring or etching and replace. Immerse sleeves in oil and carefully twist and push sleeve onto rod (machined counter bore end first).
3. Next install seal retainers. If wicks are used, replace wicks, thoroughly saturate with oil, place in seal retainer and install retainer.
4. Place inlet manifold on pair of clearance blocks with crankcase side down and drive out old seals.
5. Invert inlet manifold with crankcase side up and install new seals. Lubricate circumference of seal and install Prrrrm-A-Lube seal with garder spring down. If using blue dot seal, blue dot should be facing up when installed.
6. Slip lubricated seal inserters onto piston rod ends, position inlet manifold onto pump and remove seal inserters.

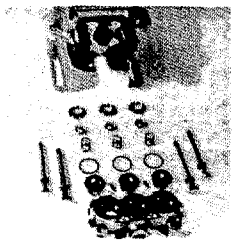
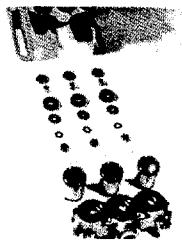
NOTE: Replace original quantity washers on studs before replacing inlet manifold.

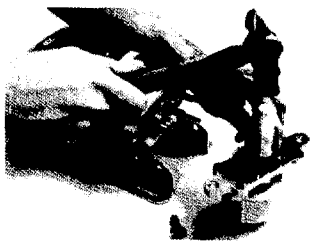
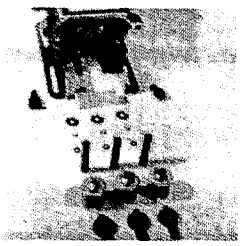
NOTE: Some models secure inlet manifold to crankcase. Replace fasteners and torque per specification chart.

7. Reassemble piston assemblies and discharge manifold as described.

SERVICING CRANKCASE

1. While inlet manifold, sleeves and seal retainers are removed, examine crankcase seals for wear.
2. Check oil level and for evidence of water in oil.
3. Rotate crankshaft by hand to feel for smooth bearing movement.
4. Examine crankshaft oil seal externally for drying, cracking or leaking.
5. Consult factory or your local distributor if crankcase service is evidenced.

CAT PUMP TROUBLE SHOOTING GUIDE

PROBLEM: Pulsation

Cause	*Solution*
Debris in discharge valves of pump.	Clean or replace discharge valves.
Worn Prrrrm-A-Lube seals.	Replace.

PROBLEM: Low pressure

Cause	*Solution*
Worn nozzle.	Replace nozzle of proper size.
Belt slippage.	Tighten or replace; use correct belt.
Air leak in inlet plumbing.	Disassemble, reseal, and reassemble.
Relief valve stuck, partially plugged or improperly adjusted; valve seat worn.	Clean and adjust relief valve; check for worn and dirty valve seats. Kit available.
Inlet suction strainer clogged or improper size.	Clean. Use adequate size. Check more frequently.
Worn piston assembly. Abrasives in pumped fluid or serve cavitation. Inadequate water supply.	Install proper filter. Suction at inlet manifold must be limited to lifting less than 20 feet of water or -8.5 PSI vacuum.
Fouled or dirty inlet or discharge valves.	Clean inlet and discharge valve assemblies.
Leaky discharge hose.	Replace worn valves, valve seats.
	Replace discharge hose.

PROBLEM: Pump runs extremely rough, pressure is very low

Cause	*Solution*
Restricted inlet or air entering the inlet plumbing.	Proper size inlet plumbing; check for air tight seal.
Inlet restrictions and/or air leaks. Damaged cup or stuck inlet or discharge valve.	Replace worn cup or cups, clean out foreign material, replace worn valves.
Worn inlet manifold seals. Prrrrm-A-Lubes.	Replace worn seals.

PROBLEM: Cylinder O-Rings blown next to discharge manifold

Cause	*Solution*
Pressures in excess of rated PSI.	Check for plugged nozzle, closed valves or improperly adjusted bypass valve.
Warped manifold. Freezing.	Replace manifold.

PROBLEM: Leakage at the cylinder O-Rings at the discharge manifold and black, powdery substance in the area of the O-Ring

Cause	*Solution*
Loose cylinders. Cylinder motion caused by improper torque on the discharge manifold.	Retighten. Do not tighten too much or the ears of the manifold will be bowed, causing looseness in the center cylinder.

PROBLEM: Water leakage from under the inlet manifold

Cause	*Solution*
Worn inlet manifold seals. Prrrrm-A-Lube. Leaking sleeve O-Ring.	Install seals. If piston rod sleeves are scored, replace sleeves and sleeve O-Rings.

PROBLEM: Oil leak between crankcase and pumping section

Cause	*Solution*
Worn crankcase piston rod seals.	Replace crankcase piston rod seals.

PROBLEM: Oil leaking in the area of the crankshaft

Cause	*Solution*
Worn crankshaft seal or improperly installed oil seal retainer packing.	Remove oil seal retainer and replace damaged gasket and/or seals.
Bad bearing.	Replace bearing.

CAT PUMP TROUBLE SHOOTING GUIDE

PROBLEM: Excessive play in the end of the crankshaft pulley

Cause	*Solution*
Worn ball bearing from excessive tension on drive belt.	Replace ball bearing. Properly tension belt.

PROBLEM: Water in crankcase

Cause	*Solution*
May be caused by humid air condensing into water inside the crankcase.	Change oil at 3 month or 500 hour intervals using Cat pump crankcase oil (other approved oil every month or 200 hours) P.N.: 06100.
Leakage of manifold inlet seals and/or piston rod sleeves O-Ring.	Replace seals, sleeves and O-Rings.

PROBLEM: Oil leaking from underside of crankcase

Cause	*Solution*
Worn crankcase piston rod seals.	Replace seals, sleeve and O-Rings.

PROBLEM: Oil leaking at the rear portion of the crankcase

Cause	*Solution*
Damaged or improperly installed oil gauge or crankcase rear cover O-Ring, and drain plug O-Ring.	Replace oil gauge or cover O-Ring, and drain plug O-Ring.

PROBLEM: Oil leakage from drain plug

Cause	*Solution*
Loose drain plug or worn drain plug O-Ring.	Tighten drain plug or replace O-Ring.

PROBLEM: Loud knocking noise in pump

Cause	*Solution*
Pulley loose on crankshaft.	Check key and tighten set screw.
Broken worn bearing.	Replace bearings.

PROBLEM: Frequent or premature failure of the inlet manifold seals

Cause	*Solution*
Scored rods or sleeves.	Replace rods and sleeves.
Over pressure to inlet manifold.	Reduce inlet pressure per instructions.

PROBLEM: Short cup life

Cause	*Solution*
Abrasive material in the fluid being pumped.	Install proper filtration on pump inlet plumbing.
Excessive pressure and/or temperature of fluid being pumped.	Check pressures and fluid inlet temperature; be sure they are within specified range.
Over pressure of pumps.	Reduce pressure.
Running pump dry.	Do not run pump without water.
Front edge of piston sharp.	Replace with new piston.

PROBLEM: Strong surging at the inlet and low pressure on the discharge side

Cause	*Solution*
Foreign particles in the inlet or discharge valve or worn inlet and/or discharge valves.	Check for smooth lap surfaces on inlet and discharge valve seats. Discharge valve seats, and inlet valve seats may be lapped on a very fine oil stone; damaged cups and discharge valves cannot be lapped but must be replaced.

HYDRACAT ELECTRICAL SYSTEM

The entire electrical system operates on 12 volts DC which is provided by a battery. Battery levels are sustained by a 20 amp alternator designed with the engine.

NOTE: When new battery is installed insure it is properly charged before installation or damage to the charging regulator may occur.

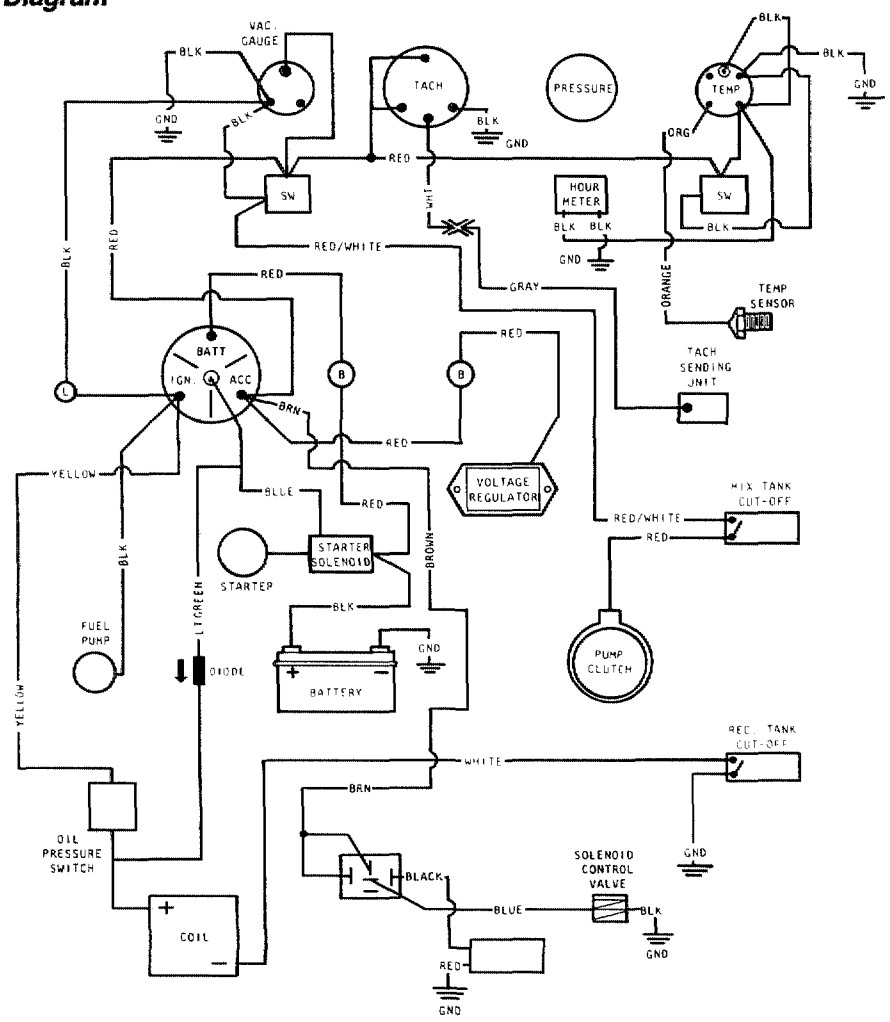
PROBLEM: Low battery voltage

Cause	*Solution*
Defective battery.	Remove and replace.
Corroded battery terminals.	Clean terminals and battery posts.
Low battery fluid.	Add water to appropriate level.
Loose wiring within electrical system.	Examine all terminal connections and verify that they are secure.
Electrical short in wiring system.	Examine electrical systems for bare wires.
Poor ground connection.	Examine terminal and remove corrosion if necessary.

PROBLEM: Inoperative hour meter

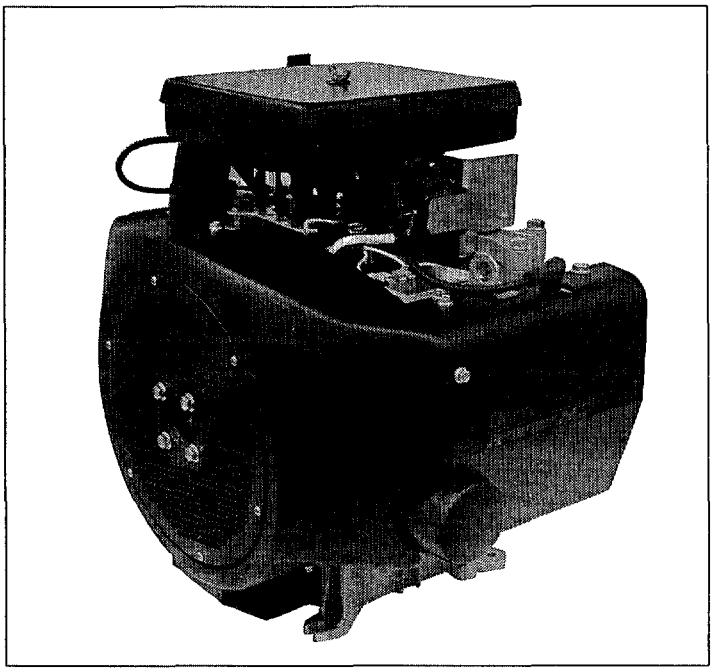
Cause	*Solution*
Time is not advancing correctly.	Verify 12 volt DC is available at the hour meter with the ignition switch turned on. This can be accomplished with a volt meter or a test lamp. Remove and replace hour meter if 12 volt is available. A nylon gear within the clock may have been jammed due to sudden jolt of the machine or truck. You may try simply tapping on the meter to try to free the nylon gear.

HydraCat Electrical Diagram



ONAN PERFORMER

Gasoline Engine
Air Cooled
24 bhp (17.9 kw) at 3600 rpm
20 bhp (14.9 kw) at 3600 rpm



ONAN ENGINE STANDARD FEATURES

Electronic Ignition
Electric Starter, Solenoid Type
Mechanical Flyball Governor (variable speed)
Top Access Oil Fill and Level Indicator
Oil Pump
Fuel Filter
Anti-Flood Choke
Replaceable Dry Element Air Cleaner with Polyurethane Wrapper
Rotating Blower Screen
Valve Rotators (exhaust)
Cobalt Alloy Exhaust Seats
Chrome Cobalt Faced Exhaust Valves
Intake Valve Stem Seals
High Capacity Oil Base
Full-Flow, Spin on Oil Filter

OPTIONAL FEATURES

Fixed Speed Governor
Crossover Exhaust Manifolds
Vacuum Pulse Fuel Pump
Exhaust Silencers
Low Oil Pressure Switch
Flywheel Alternator, 20 or 35 amp with Regulator
(installed on cylinder air housing)
Stationary Blower Wheel Guard
High Capacity Air Cleaner
Engine Control Panel
PTO Modifications: Internally Splined Crankshafts, Hydraulic Pump Adapters, Front PTO Shaft

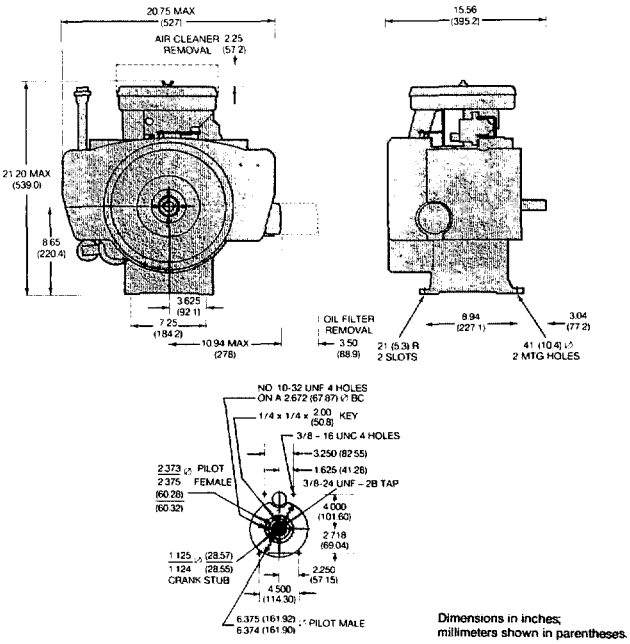
PERFORMANCE CHARACTERISTICS

RECOMMENDED FOR VARIABLE SPEED OR CONTINUOUS DUTY TO 3600 RPM.

Production engines when shipped will develop after deduction for non-standard accessories, not less than 85% of maximum corrected bhp. After run-in to reduce friction and the performance of service, engines should develop not less than 95% of maximum corrected bhp.

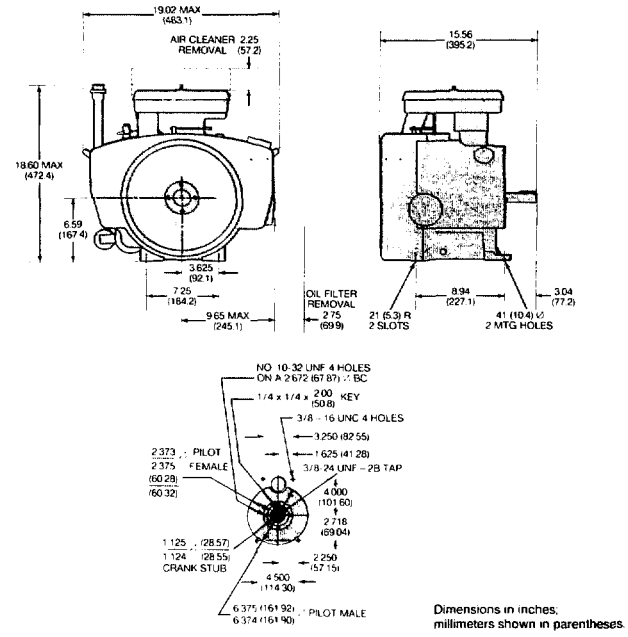
Engine power decreases approximately 3.5% for each 1000 ft. (305 m) above sea level and 1% for each 10°F (5.5°C) above 60°F (15.5°C). For continuous duty at constant load do not exceed 80% of available horsepower. For heavy duty applications requiring maximum output, the Extended Service Life package is recommended. Performance curves obtained and corrected in conformance with SAE J607b.

Basic Dimensions - P224



Dimensions in inches; millimeters shown in parentheses.

Basic Dimensions - P220



Dimensions in inches; millimeters shown in parentheses.

ONAN ENGINE DETAIL

Cycle: 4
Cylinders: 2, horizontally opposed
Compression Ratio: 7.0 to 1
Piston Speed: 1800 fpm (9144 mm/s) at 3600 rpm
Net Weight: 127 lb (57.6 kg) dry, approximate.
Breather System: Closed, recirculating.
Cooling System: Pressure air-cooled, radial flow blower. Cooling air volume 1000 cfm (1699 m^3/hr) at 3600 rpm.
Fuel System: Modern downdraft carburetor with fixed main jet, limited adjustment idle system. Semi-automatic choke operation with anti-flooding feature. Combustion air required at 3600 rpm, 50 cfm (85 m^3/hr).
Governor: Constant speed cam-gear driven. Adjustable mechanical flyball, 300 rpm drop to 3600 rpm.
Ignition System: Solid state breakerless ignition with fixed timing, 12 volt negative ground. RFI suppression spark plug wires meet UL and CSA interference requirements.
Starter: Positive engagement solenoid type starter. 12 volt negative ground.
Lubrication System: Positive displacement, gear-design oil pump. Full pressure lubrication to main and connecting rod bearings and governor. Fixed bypass, oil pressure control. Oil fill tube and level indicator. Removable aluminum oil base. Capacity, 2.7 qt (2.56 L); add 0.3 qt (0.3 L) for oil filter.
Power-Take-Off: Rear mount PTO pilot and keyed crankshaft extension. Rotation, CCW when facing PTO shaft. Front mount PTO pilot.
Main Bearings: Steel-backed aluminum precision inserts, replaceable. I.D.: 2 in (50.8 mm); Length: 1 in (25.4 mm).
Camshaft: Cast iron alloy. Replaceable lead babbitt bearings (2).
Connecting Rods: Forged steel. Replaceable bearings.
Crankshaft: Ductile iron. Machined-in oil passages. Simultaneous oil feed from both ends of crankshaft.
Cylinders, Crankcase: Aluminum alloy with integrally cast pearlitic iron cylinder liners.
Cylinder Heads: Removable, aluminum alloy. High turbulence combustion chambers.
Pistons: Aluminum alloy. Three ring, two compression, one oil control. Cooled and lubricated by oil spray.
Tappets: Barrel type, adjustable.
Valves: Exhaust, chrome-colbalt faced. Intake, steel alloy. Replaceable valve guides.
Valve Seats: Replaceable intake and exhaust.
Valve Rotators: Exhaust valves.

GENERAL INFORMATION

Engine Model Reference Identify your model by referring to the model and specification (spec letter) as shown on the unit nameplate. Always use these numbers and the engine serial number when making reference to your engine.

HOW TO INTERPRET MODEL AND SPEC NO.

P / 2 / 20 / G / 1 / 10464 / A

1 2 3 4 5 6 7

1. Factory code for general identification of basic engine series.
2. Number of cylinders.
3. BHP rating.
4. Fuel required (G = horizontal shaft, V = vertical shaft).
5. Engine duty cycle.
6. Factory code for designated optional equipment, if any.
7. Specification (spec letter) which advances with factory production modifications.

◆ WARNING ◆

Incorrect service or replacement of parts can result in severe personal injury and/or equipment damage. Service personnel must be qualified to perform electrical and/or mechanical service.

HOT WEATHER OPERATION

When operating the engine in temperature above 100°F, pay particular attention to the following items to prevent damage:

1. Keep the engine cooling fins clean and free of obstruction.

◆ CAUTION ◆

Plugged or clogged cooling fins can cause overheating and engine damage. Ensure cooling fins are kept clean and debris does not accumulate.

◆ WARNING ◆

Contact with rotating machinery can result in severe personal injury or death. Stay clear of rotating components and ensure protective shields and guards are in place and secured before operating machinery.

2. See that nothing obstructs air flow to and from the engine.
3. Ensure that you are using the proper grade and weight of oil for ambient temperatures. Check the oil level each time you fill the fuel tank.
4. Check the battery water more frequently. High temperatures can cause faster evaporation.
5. Change crankcase oil and filter more frequently.

COLD WEATHER OPERATION

When the engine is being used in temperatures below 32°F (0°C), check the following items closely:

1. Use the correct grade and weight of oil for the temperature conditions. Change the oil only when the engine is warm. If an unexpected temperature drop occurs when the engine is filled with summer oil, beforestarting the engine, move it to a warm location until the oil will flow freely.
2. Use fresh fuel. Fill the fuel tank after each day's use to protect against moisture condensation.
3. Keep the battery in a well-charged condition.

DUST AND DIRT

1. Keep unit clean. Keep cooling system clean.
2. Service air cleaner as frequently as required.
3. Change crankcase oil and filter more than.

OUT-OF-SERVICE PROTECTION

Protect an engine that will be out-of-service for more than 30 days as follows:

1. Run the engine until it reaches normal operating temperature.
2. Turn off the fuel supply and run the engine until it stops.
3. Drain oil from oil base while the engine is still warm. Refill with fresh crankcase oil and attach a tag stating viscosity used.
4. Remove spark plugs. Pour 1 ounce (2 tablespoons or 28 grams) of rust inhibitor or SAE #50 oil into the cylinders. Crank the engine over a few times. Reinstall spark plugs.
5. Service air cleaner as outlined in MAINTENANCE.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.

10. If battery equipped, disconnect and follow standard battery storage procedure.

RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperatures.
3. Clean and check battery. Measure specific gravity (1.260 at 77°F [25°C]) and verify level to be at a split ring. If specific gravity is low, charge until correct value is obtained. If the level is low, add distilled water and charge until specific gravity is correct.
4. Check that fuel filter and fuel lines are secure, with no leaks.
5. Check that carburetor throttle lever and governor linkage move freely.
6. Connect battery.
7. Start Engine. Exhaust smoke is normal when the engine is started and is usually caused by the rust inhibitor oil.

◆ WARNING ◆

EXHAUST GAS IS DEADLY!

Exhaust gases from all fuels (including diesel, gasoline, liquid propane, natural gas) contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

Dizziness
Nausea
Headache
Weakness and Sleepiness
Throbbing in Temples
Muscular Twitching
Vomiting
Inability to Think Coherently

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY.

If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired. Protection against carbon monoxide inhalation includes proper installation, ventilation and regular, frequent visual and audible inspections of the complete exhaust system.

ENGINE MAINTENANCE

◆ WARNING ◆

Accidental starting of the engine can result in severe personal injury or death. Disconnect the negative battery cable and spark plug wires while servicing engine, controls, or associated equipment.

DAILY CHECKS OR EVERY 8 HOURS

The operator should daily make a complete visual and audible inspection of the engine. Check the following before starting the engine for the first time each day:

1. Check all fuel lines and fittings for possible leakage.
2. Inspect exhaust system for possible leakage and cracks. Locate leaks in muffler and piping while the engine is operating. Repair all leaks immediately after they are detected for personal safety.
3. Inspect air cleaner system for leaks. Make certain all clamps and fittings are tight and free of potential leaks.
4. Check crankcase oil level with the engine off. If engine has been run, allow a minimum of 10 minutes for the oil to drain down before checking. If oil level is at or below ADD mark on dipstick (Figure 1), add sufficient oil of t he proper viscosity as specified in ENGINE SET-UP to bring oil level to the FULL mark. Do not operate engine with oil level below the ADD mark or above the FULL mark.

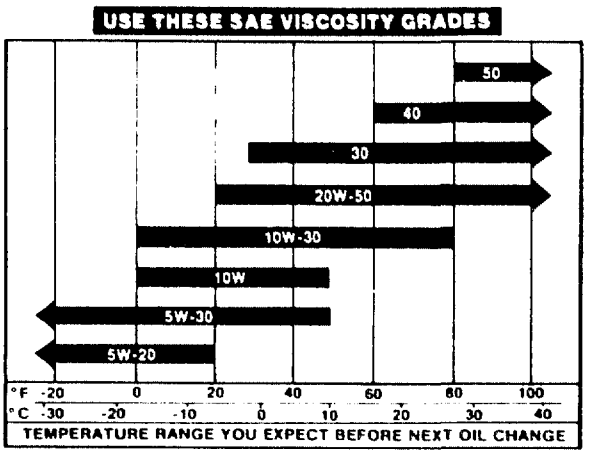
OIL SYSTEM

CRANKCASE OIL CHANGE

Refer to Periodic Maintenance Schedule (located in the Operator's Manual) for oil change interval. If operating in extremely dusty, high ambient, or low ambient conditions, change oil more often.

Run engine until thoroughly warm before draining oil. Stop the engine, place a pan under the drain outlet and remove the oil drain plug. After the oil is completely drained, clean and replace the drain plug. Fill crankcase with correct amount of oil. Refer to SPECIFICATIONS for crankcase capacity. Use oils meeting the API classification SF, SF/C, or SF/CD. Refer to chart to determine the proper viscosity grade of oil to use Straight weight oils are recommended for severe duty use and at temperatures above 32°F (0°C) for minimum oil consumption

Oil Viscosity



◆ WARNING ◆

Hot crankcase oil can cause burns if it comes in contact with skin. Wear protective clothing and keep fingers and hands clear when draining oil.

◆ CAUTION ◆

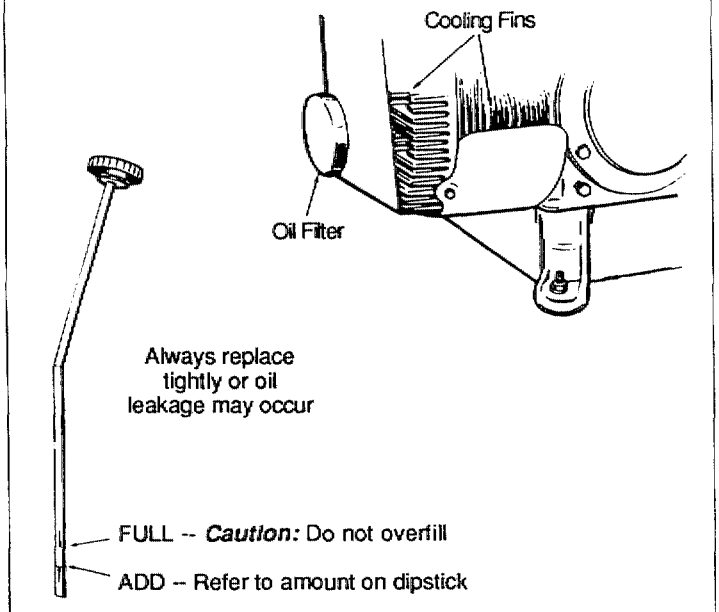
Excess oil can cause high oil consumption, high operating temperatures, and oil foaming. Do not over fill crankcase.

◆ WARNING ◆

Crankcase pressure can blow out hot oil, which can cause severe personal injury. Do not check oil while the engine is running.

Oil level should be to the FULL mark of the dipstick. Start engine and run for a short time to check for oil leaks around the drain plug.

Oil Filter Location



OIL FILTER CHANGE

Refer to Periodic Maintenance Schedule (Page 29) for oil filter change interval. If operating in extremely dusty, high ambient, or low ambient conditions, change oil filter more often.

Spin off oil filter element and discard it. Thoroughly clean filter mounting surface and make sure new gasket is inserted in the element. Apply a thin film of clean oil to the gasket. Spin element down by hand until gasket just touches mounting pad and then turn down an additional 1/2-3/4 turn. Do not overtighten.

With oil in crankcase, start engine and check for leaks around filter element. Retighten only as much as necessary to eliminate leaks; do not overtighten.

CRANKCASE BREATHER

The crankcase breather prevents pressure from building up in the crankcase. It also prevents oil contamination by removing moisture or gasoline vapors and other harmful blow-by materials from the crankcase. These vapors are routed to the carburetor where they are mixed with incoming air and burned in the combustion chamber. A sticky breather valve can cause oil leaks, high oil consumption, rough idle, reduced engine power, and a rapid formation of sludge and varnish within the engine

CRANKCASE BREATHER SERVICE

If the crankcase becomes pressurized as evidenced by oil leaks at the seals or excessive oil in the air cleaner housing, use the following procedure to service.

◆ WARNING ◆

Most part cleaning solvents are flammable and can cause severe personal injury or death if used improperly. Follow the manufacturer's recommendations when cleaning parts.

P220 (Spec A and B): Remove the breather tube from the valve cover (P220 Crankcase Breather illustration). Remove capscrew, flatwashers, valve cover, pack, spring, washer, reed valve, and breather baffle. Discard gasket and clean all parts in parts cleaning solvent.

◆ CAUTION ◆

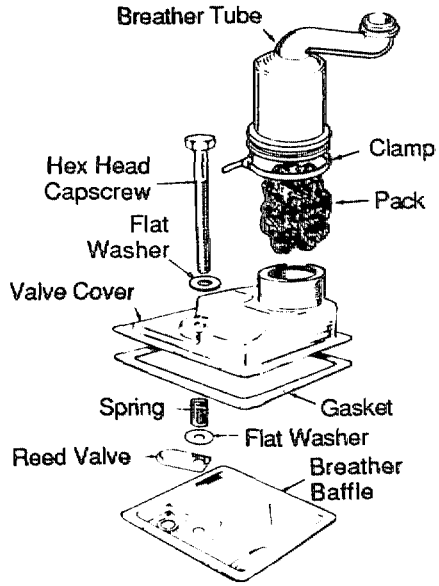
Overtightening the valve cover can cause engine damage. Do not overtighten valve cover.

The reed valve must be flat with no sign of a crease. Assemble using a new gasket. Refer to ASSEMBLY TORQUES for valve cover capscrew torque specification.

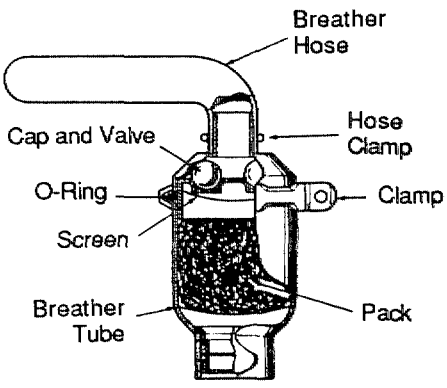
P216, P218, P220 (Beginning Spec C): The crankcase breather does not require servicing. Replace breather if it's broken or cracked, or if crankcase becomes pressurized as evidenced by oil leaks at the seals or excessive oil in the air cleaning housing.

P224: Remove hose clamp and breather hose from cap and valve assembly. Loosen clamp and remove cap and valve assembly and wash in solvent. Replace cap and valve assembly if balls do not move freely after washing in solvent. Remove screen and pack. Wash pack in solvent. Install pack in breather tube and position screen as shown in P224 illustration shown below. Install cap and valve, tighten clamp and attach breather hose and hose clamp.

P220 Crankcase Breather



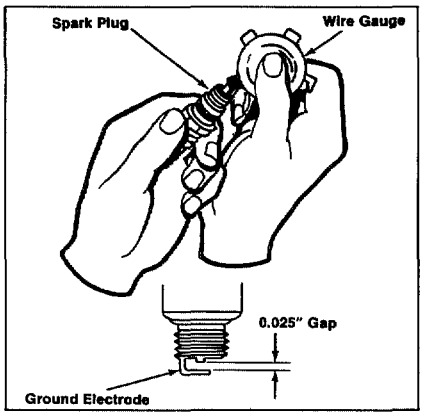
P224 Crankcase Breather



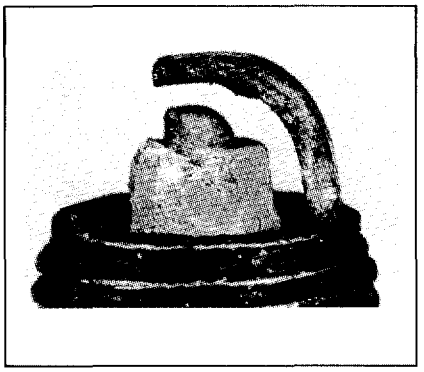
IGNITION

SPARK PLUGS: Refer to Periodic Maintenance Schedule for spark plug service interval. Replace spark plugs that show signs of fouling or electrode erosion. Refer to Specifications for spark plug gap.

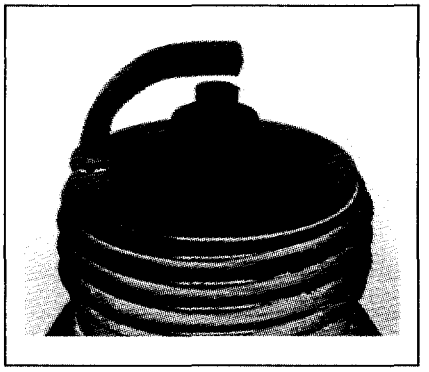
SOLID STATE IGNITION: Ignition timing is set at the factory and is not adjustable. The solid state ignition components are not adjustable and require no routine maintenance.



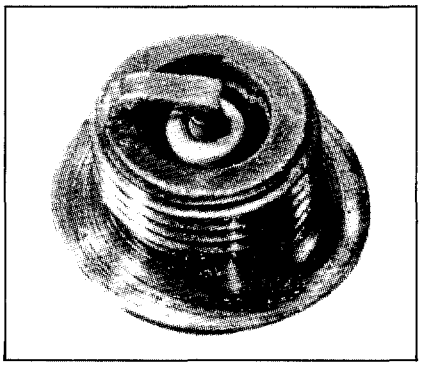
Servicing Spark Plug



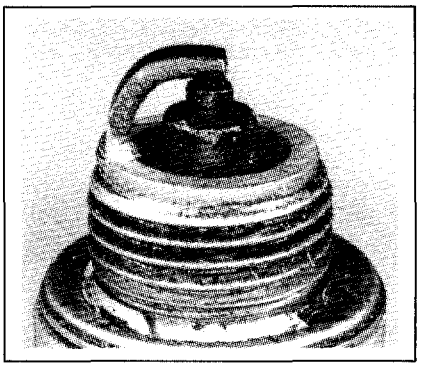
Worn: On a worn plug, the center electrode will be rounded and the gap will be eroded .010" or more than the correct gap. Replace a worn spark plug immediately.



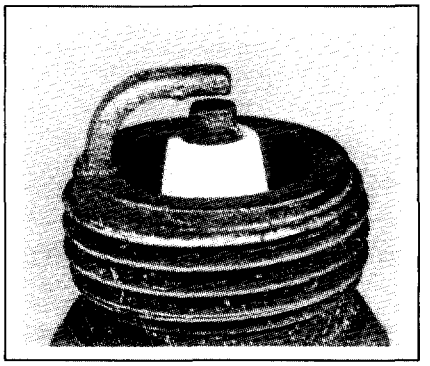
Carbon Fouled: Soft, sooty, black deposits indicate incomplete combustion. Incomplete combustion is usually caused by overrich carburetion, weak ignition, or poor compression.



Normal: A plug taken from an engine operating under normal conditions will have light tan or gray colored deposits. If the center electrode is not worn, a plug in this condition could be regapped and reused.



Wet Fouled: A wet plug is caused by excess fuel, or oil in the combustion chamber. Excess fuel could be caused by operating the engine with too much choke. Oil in the combustion chamber is usually caused by worn piston rings or valve guides.



Chalky White Deposits: Chalky white colored deposits indicate overheating. This condition is usually accompanied by excessive gap erosion. A clogged grass screen, clogged cooling fins, and lean carburetion are some causes of over-heating.

SPARK PLUGS CONDITION DIAGNOSIS

Engine misfire or starting problems are often caused by spark plugs in poor condition or with improper gap setting.

SERVICE

Every 100 operating hours remove the spark plugs, check condition, and reset gaps or replace with new plugs as necessary (see illustration above).

1. Before removing the spark plugs, clean the area around the base of plugs to keep dirt and debris out of the engine.
2. Remove the plugs and check condition. Replace the plugs if worn or if reuse is questionable.

◆ CAUTION ◆

Do not clean the spark plugs in a machine using abrasive grit. Some grit could remain in spark plugs and enter the engine causing extensive wear and damage.

3. Check the gaps using a wire feeler gauge. Adjust gaps to 0.025" by carefully bending the ground electrode.
4. Reinstall the spark plugs into cylinder heads. Torque plugs to 10/15 ft. lb.

INSPECTION

Inspect the spark plugs as soon as they are removed from the cylinder heads. The deposits on the tips are an indication of the general condition of piston rings, valves, and carburetor. Normal and faulty spark plugs are shown in the photos shown above.

COOLING SYSTEM

Refer to Periodic Maintenance Schedule (Page 29) for cooling system service interval. Clean cooling fins and chaff screen sooner if required. Remove any dust, dirt or oil which may have accumulated.

EXHAUST SYSTEM

Make regular visual and audible inspections of the exhaust system throughout the entire life of the engine. Locate leaks in muffler and piping while the engine is operating. Repair all leaks immediately after they are detected for personal safety.

◆ WARNING ◆

Breathing exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily and repair leaks immediately.

AIR CLEANER

ELEMENT: Refer to Periodic Maintenance Schedule (Page 29) for air cleaner service and replacement interval. Service or replace more often when operating under severe operating conditions. Service by gently tapping element (see illustration on next page) on a flat surface.

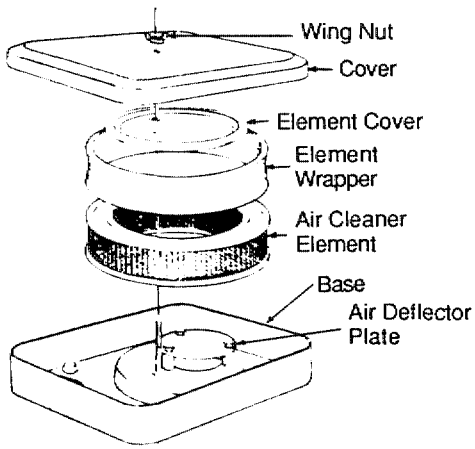
ELEMENT WRAPPER (If Equipped): Refer to Periodic Maintenance Schedule (Page 29) for element wrapper service interval. Wash in water and detergent and squeeze dry like a sponge. Ring with water. Allow to dry,

(Continues, next page)

(Continued from previous page)

then coat evenly with two tablespoons (28 grams) of SAE 30 engine oil. Knead into and wring out excess oil from element wrapper. Failure to adequately wring out excess oil from wrapper may cause drop in engine horsepower due to an increased restriction of inlet air. Install over air cleaner element.

Air Cleaner Assembly



BATTERY

Disconnect negative ground strap from the battery before working on any part of the electrical system or engine. Disconnect positive terminal before charging battery to avoid damaging ignition system alternator or regulator.

◆ WARNING ◆

Ignition of explosive battery gases can result in severe personal injury. Do not smoke or allow any ignition source near the battery.

CLEANING BATTERY: Keep the battery clean by wiping it with a damp cloth whenever dirt appears excessive.

If corrosion is present around the terminal connections, remove battery cables and wash the terminals with an ammonia solution or a solution consisting of 1/4 pound of baking soda added to 1 quart of water.

Be sure the vent plugs are tight to prevent cleaning solution from entering the cells.

After cleaning, flush the outside of the battery, the battery compartment, and surrounding areas with clear water.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or non-conductive grease to retard corrosion.

CHECKING SPECIFIC GRAVITY: Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell.

Hold the hydrometer vertical and take the reading. Correct the reading by adding four gravity points (0.004) for every five degrees the electrolyte temperature is above 80°F (27°C) or subtracting four gravity points for every five degrees below 80°F (27°C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if the reading is below 1.215.

CHECKING ELECTROLYTE LEVEL: Refer to Periodic Maintenance Schedule (Page 29) for checking electrolyte level interval.

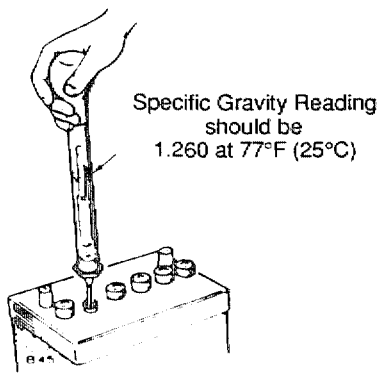
Fill the battery cells to the bottom of the filler neck. If cells are low on water, add distilled water and recharge. If one cell is low, check case for leaks. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

◆ CAUTION ◆

Water added to battery electrolyte in freezing weather can damage the battery. Do not add water to battery unless the engine is run long enough (two or three hours) to ensure a thorough mixing of water and electrolyte.

STORING BATTERY: If the engine is to be stored for more than 30 days, remove the battery. With the electrolyte level at the bottom of the split ring, charge the battery before storing it. After every 30 days the battery is in storage, bring it back up to full charge. To reduce self-discharge, store the battery in as cool a place as possible so long as the electrolyte does not freeze.

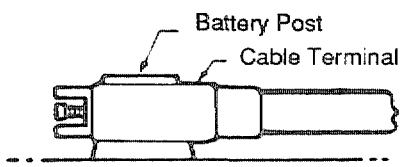
Specific Gravity Test



BATTERY TERMINALS

Keep the battery terminals clean and tight. Push the cable terminal down flush with or slightly below the top of the battery post. After making connections, coat the terminals with a light application of petroleum jelly or grease to retard corrosion.

Battery Cable Connection



Poor contact at the battery cable connections is often a source of trouble. Make sure battery cables are in good condition and that contacting surfaces are clean and tightly connected. Do not reverse battery leads. Use recommended battery tools when disconnecting leads to avoid mechanical battery damage.

BATTERY JUMP STARTING

Occasionally, it may be necessary to jump start (charge) a weak battery using a charged booster battery. If jump starting is necessary, the following

procedure is recommended to prevent starter damage, battery damage, and personal injuries.

1. Disconnect engine load.
2. Use a battery of the same voltage (12V) as is used with your engine.
3. Attach one end of the positive booster cable (red) to the positive (+) terminal of the booster battery. Attach the other end of the positive cable to the positive (+) terminal of your engine battery.

PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS						
	8	25	50	100	200	500	1000
Inspect Engine Generally	X[1]						
Check Oil Level	X						
Service Air Cleaner Element and Element Wrapper		X[2]					
Change Crankcase Oil (all engines without filter)		X[2]					
Change Crankcase Oil (standard base with filter)		X[3]	X[2]				
Change Crankcase Oil (high capacity base with filter)		X[3]		X[2]			
Replace Oil Filter		X[3]		X[2]			
Check Battery Electrolyte Level			X				
Clean Cooling Fins			X[2]				
Replace Air Cleaner Element					X[2]		
Replace Fuel Filter					X		
Check or Replace Spark Plugs						X	
Check Valve Clearnace (standard engines)					X[4]		
Check Valve Clearance (LP & natural gas conversion engines)						X[4]	
Check Valve Clearance (extended service life engines)							X[4]
Clean Carbon and Lead Deposits (cylinder head)							X[5]

Follow a regular schedule of inspection and servicing, based on operating hours. Keep an accurate logbook of maintenance, serving, and operating time. Use the factory recommended Periodic Maintenance Schedule (based on favorable operating conditions) to serve as a guide to get long and efficient engine life. Regular service periods are recommended for normal service and operating conditions. For severe duty, extreme temperature, etc., service more frequently. Neglecting routine maintenance can result in engine failure or permanent damage.

For any abnormalities in operation, unusual noises from the engine or accessories, loss of power, overheating, etc., contact your nearest Onan Service Center.

Maintenance Schedule Footnotes:

1- Check for fuel leaks. With engine running, visually and audibly check exhaust system for leaks.

2- Perform more often when running under severe operating conditions.

3- Required for initial break-in only.

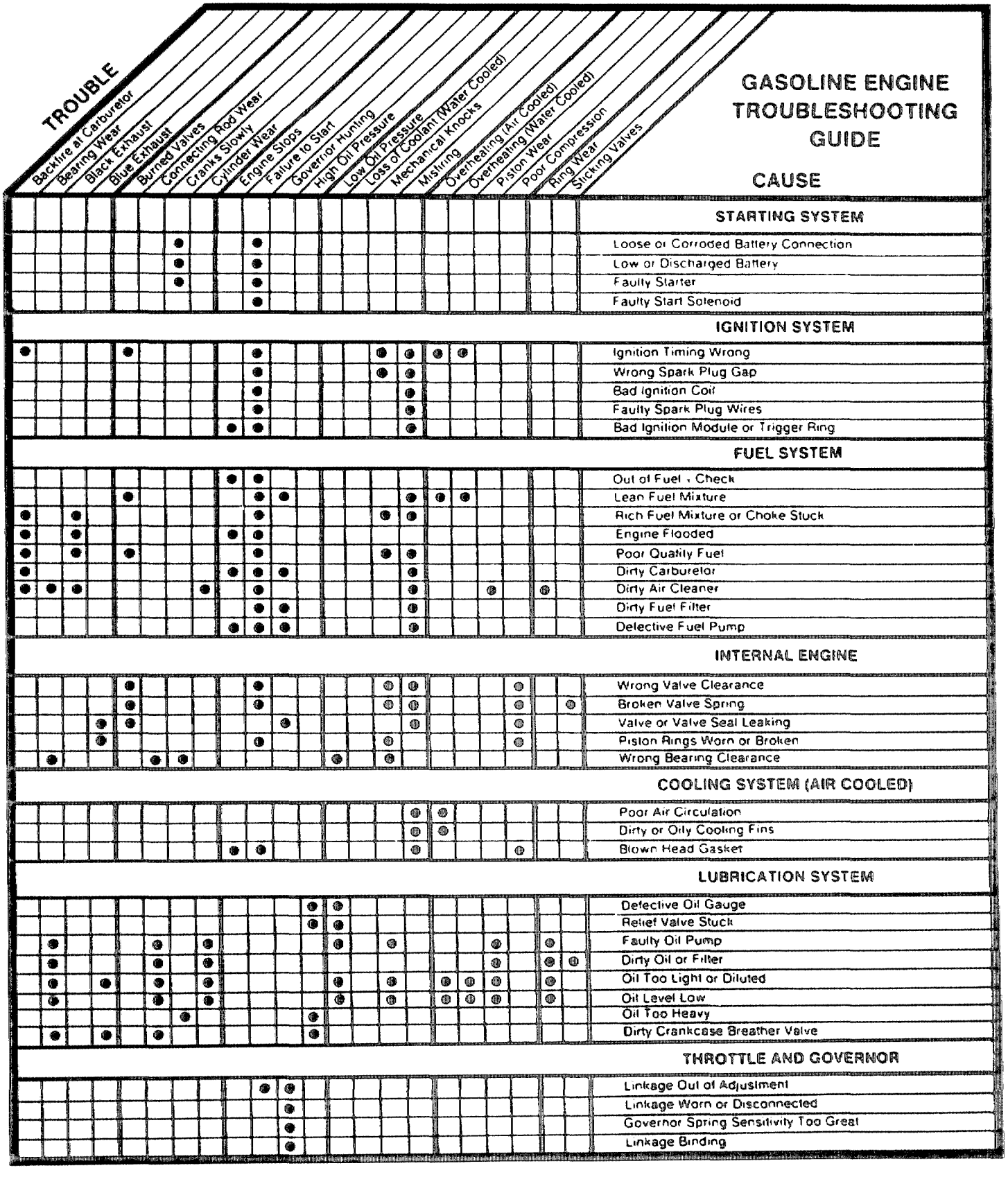
4- For detailed maintenance, contact an Onan Service Center or refer to the SERVICE MANUAL.

5- Clean carbon more frequently when running under continuous light load and/or on leaded fuel. Use of Onan 4C carburetor and combustion cleaner is recommended every 200 hours to help reduce carbon buildup.

◆ WARNING ◆

Breathing exhaust gases can result in severe personal injury or death. Do not use air cleaner, exhaust elbow, or connecting parts as a supporting step. Damage to these and connecting parts can cause an exhaust leak.

ENGINE TROUBLE SHOOTING



ENGINE TROUBLE SHOOTING GUIDE

When troubles occur, be sure to check the simple causes which, at first, may seem too obvious to be considered. For example, a starting problem could be caused by an empty fuel tank.

Some common causes of engine troubles are listed below — use this as a guide to locate causing factors.

PROBLEM: Engine cranks but will not start
Solution
Empty fuel tank.
Clogged fuel line.
Spark plug leads disconnected.
Keyswitch or kill switch in "off" position.
Faulty spark plugs.
Faulty ignition module.
Dirt or water in fuel system.

PROBLEM: Engine starts but does not keep running
Solution
Restricted fuel tank vent.
Dirt or water in fuel system.
Faulty choke or throttle controls/cables.
Loose wires or connections which kill terminal of ignition module to ground.
Carburetor improperly adjusted.
Faulty cylinder head gaskets.
Faulty fuel pump.

PROBLEM: Engine starts hard
Solution
Loose wires or connections.
Dirt or water in fuel system.
Clogged or restricted fuel lines.
Faulty choke or throttle controls/cables.
Faulty spark plugs.
Carburetor improperly adjusted.
Incorrect valve-to-tappet clearance.
Low compression.

PROBLEM: Engine will not crank
Solution
Battery is discharged.
Loose or faulty wires or connections.
Faulty keyswitch or ignition switch.
Faulty electric starter/starter solenoid.
Seized internal engine components.

PROBLEM: Engine runs but misses
Solution
Dirt or water in fuel system.
Spark plug leads loose.
Loose wires or connections which intermittently short kill terminal of ignition module to ground.
Carburetor improperly adjusted.
Engine overheating.
Incorrect valve-to-tappet clearance.
Faulty ignition module.

PROBLEM: Engine will not idle
Solution
Idle speed adjusting screw improperly set.
Dirt or water in fuel system.
Idle fuel adjusting screw improperly set.
Restricted fuel tank vent.
Faulty spark plugs.
Incorrect valve-to-tappet clearance.
Low compression

PROBLEM: Engine overheats
Solution
Grass screen, cooling fins, or shrouding clogged.
Excessive engine load.
Low crankcase oil level.
High crankcase oil level.
Carburetor improperly adjusted.

PROBLEM: Engine knocks
Solution
Low crankcase oil level.
Excessive engine load.

PROBLEM: Engine loses power
Solution
Low crankcase oil level.
High crankcase oil level.
Restricted air cleaner element.
Dirt or water in fuel line.
Excessive engine load.
Engine overheating
Faulty spark plugs.
Carburetor improperly adjusted.
Low compression.

PROBLEM: Engine uses excessive amount of oil
Solution
Incorrect oil viscosity or type.
Clogged or improperly assembled breather system.
Worn or broken piston rings
Worn cylinder bores.
Worn valve stems and/or valve guides.

MAINTENANCE PROCEDURES

To avoid costly repairs and down-time, it is imperative to develop and practice good maintenance procedures from the beginning. These procedures fall into daily, weekly, monthly and quarterly increments, and are outlined below. We have provided a maintenance log for your convenience on next page; it is recommended that you affix a copy of the log on the vehicle door near your unit for convenience and to serve as a maintenance reminder.

DAILY

Check engine oil level.
Inspect garden hose screen - clean as needed.
Visually inspect machine for loose wires, oil leaks, water leaks, etc.
Inspect recovery tank s/s filter and filter bag for tears, holes, etc. - clean, repair or replace as needed.
Lubricate blower with Pennzguard through blower inlet.

WEEKLY

Change engine oil. (25-30 hours of operation.)
Check engine air cleaner filter - clean as necessary.
Check high pressure pump oil - add as necessary.
Check drive coupler set screws - tighten as needed.
Check pump drive belt for wear - tighten as needed.
Check pump pulleys - tighten as needed.
Check fuel lines for wear/chafing.
Check all nuts and bolts - tighten as needed.
Check heater burner assy. union for tightness/leaks.
Clean vacuum tank thoroughly with high pressure washer.
Flush water and chemical system with 50/50 white vinegar solution.
Check engine RPM's - adjust to 2600 rpm on 4.5
2800 rpm on 4.0

MONTHLY

Grease blower bearing fittings.
Remove pressure bypass valve stem, grease cup and stem, reinstall.
Check water level in battery. Clean connections as needed.

QUARTERLY

Change oil in blower.
Check engine compression.
Check for combustion chamber carbon deposit.
Change spark plugs.

IMPORTANT:
Record date and machine hours on maintenance chart.

OVERALL CARE OF UNIT

MAINTAINING THE ORIGINAL APPEARANCE OF YOUR UNIT IS IMPORTANT FOR TWO REASONS:

1. It represents a big dollar investment for your cleaning business and its appearance should reflect that fact. A dirty machine is not professional!

2. Maintenance, troubleshooting, and repair is much easier to accomplish on a clean well maintained unit. Regular cleaning of the machine offers you an opportunity to visually inspect all facets of the machine and spot potential problems before they occur.

FOLLOWING MAINTENANCE IS RECOMMENDED BY THE MANUFACTURER AT THE FREQUENCY INDICATED.

AFTER EACH JOB:
Check recovery tank, s/s/ filter and filter bag as required.

DAILY:
Wipe machine down thoroughly with a damp cloth; flush recovery tank out thoroughly. Empty filter bag and inspect for rips, tears, etc. - replace as needed; remove, thoroughly clean and reinstall stainless steel filter screen in recovery tank; inspect and clean vacuum slot on cleaning wand; check wand head for sharp edges that could tear carpet - file down as needed; clean wand to maintain original appearance; wipe down vacuum and high pressure hoses as needed - visually inspect for cuts, etc.

WEEKLY:
Wipe down entire unit as needed - apply good coat of auto wax to all painted surfaces inside and out, and to control panel; thoroughly clean recovery tank using high pressure hot water (unit with optional high pressure cleaning gun may be used for this); remove stainless steel filter in recovery tank, thoroughly clean removing all lint build-up, inspect for damage and reinstall. Remove filter bag, thoroughly clean and reinstall - if torn, replace; empty chemical from chemical container, wash out thoroughly to remove any chemical build-up; inspect chemical feed line strainer and use 50% white vinegar/water solution to remove any chemical build-up; thoroughly clean wand and inspect for clogged jet, debris in vacuum slot and leaking fittings at valve. Apply light coat of auto wax to wand. Thoroughly clean vacuum and high pressure hoses including hose cuffs - inspect for wear or damage to hoses and quick connect fittings. Inspect garden hose connect/adapter screen for debris, remove and clean thoroughly. Inspect all lines for wear or abrasions that may cause possible leaks.

MAINTENANCE LOG

DAILY CLEANING & INSPECTION

Engine oil - check
Garden hose screen - clean
Machine - general inspection
Clean vac tank filter bag after every job
Blower inlet - spray with LPS 1 after last job

WEEKLY SERVICE

MAX HRS	SERVICE	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS
25	BLOWER check oil level							
25	PUMP OIL check (top of sight gauge)							
25	DRIVE SHAFT SYSTEM tighten set screws							
25	BELTS & PULLEYS check tightness							
25	HIGH PRESSURE LINES check for chafing							
25	NUTS & BOLTS check tightness							
25	BATTERY LEVELS check							
25	VACUUM TANK clean							
25	WIRING check for chafting							
25	CHEMICAL SYSTEM flush w/vinegar							

MONTHLY SERVICE

100	ENGINE OIL change							
100	BLOWER grease bearing							
100	ENGINE AIR CLEANER clean							
100	BY PASS VALVE grease cup & stem							

QUARTERLY SERVICE (3 MONTHS)

300	BLOWER OIL change							
300	ENGINE compression							
300	SPARK PLUGS change							

MAINTENANCE LOG

DAILY CLEANING & INSPECTION

Engine oil - check
Garden hose screen - clean
Machine - general inspection
Clean vac tank filter bag after every job
Blower inlet - spray with LPS 1 after last job

WEEKLY SERVICE

MAX HRS	SERVICE	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS
25	BLOWER check oil level							
25	PUMP OIL check (top of sight gauge)							
25	DRIVE SHAFT SYSTEM tighten set screws							
25	BELTS & PULLEYS check tightness							
25	HIGH PRESSURE LINES check for chafing							
25	NUTS & BOLTS check tightness							
25	BATTERY LEVELS check							
25	VACUUM TANK clean							
25	WIRING check for chafting							
25	CHEMICAL SYSTEM flush w/vinegar							

MONTHLY SERVICE

100	ENGINE OIL change							
100	BLOWER grease bearing							
100	ENGINE AIR CLEANER clean							
100	BY PASS VALVE grease cup & stem							

QUARTERLY SERVICE (3 MONTHS)

300	BLOWER OIL change							
300	ENGINE compression							
300	SPARK PLUGS change							

MAINTENANCE LOG

DAILY CLEANING & INSPECTION

Engine oil - check
Garden hose screen - clean
Machine - general inspection
Clean vac tank filter bag after every job
Blower inlet - spray with LPS 1 after last job

WEEKLY SERVICE

MAX HRS	SERVICE	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS
25	BLOWER check oil level							
25	PUMP OIL check (top of sight gauge)							
25	DRIVE SHAFT SYSTEM tighten set screws							
25	BELTS & PULLEYS check tightness							
25	HIGH PRESSURE LINES check for chafing							
25	NUTS & BOLTS check tightness							
25	BATTERY LEVELS check							
25	VACUUM TANK clean							
25	WIRING check for chafting							
25	CHEMICAL SYSTEM flush w/vinegar							

MONTHLY SERVICE

100	ENGINE OIL change							
100	BLOWER grease bearing							
100	ENGINE AIR CLEANER clean							
100	BY PASS VALVE grease cup & stem							

QUARTERLY SERVICE (3 MONTHS)

300	BLOWER OIL change							
300	ENGINE compression							
300	SPARK PLUGS change							

MAINTENANCE LOG

DAILY CLEANING & INSPECTION

Engine oil - check
Garden hose screen - clean
Machine - general inspection
Clean vac tank filter bag after every job
Blower inlet - spray with LPS 1 after last job

WEEKLY SERVICE

MAX HRS	SERVICE	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS	DATE/HRS
25	BLOWER check oil level							
25	PUMP OIL check (top of sight gauge)							
25	DRIVE SHAFT SYSTEM tighten set screws							
25	BELTS & PULLEYS check tightness							
25	HIGH PRESSURE LINES check for chafing							
25	NUTS & BOLTS check tightness							
25	BATTERY LEVELS check							
25	VACUUM TANK clean							
25	WIRING check for chafting							
25	CHEMICAL SYSTEM flush w/vinegar							

MONTHLY SERVICE

100	ENGINE OIL change							
100	BLOWER grease bearing							
100	ENGINE AIR CLEANER clean							
100	BY PASS VALVE grease cup & stem							

QUARTERLY SERVICE (3 MONTHS)

300	BLOWER OIL change							
300	ENGINE compression							
300	SPARK PLUGS change							

NOTES

WARRANTY INFORMATION

To avoid misunderstandings which might occur between machine owners and manufacturer, we are listing causes of component failure that specifically voids warranty coverage. Such causes as listed below shall constitute **abuse or neglect.**

BLOWER: Failure to lubricate impellers daily with LPS-1 or WD-40 lubricant. Failure to lubricate bearings as recommended in blower manual. Failure to maintain proper oil levels in the blower. Failure to use the correct oil grade and viscosity as recommended in blower manual. Failure to properly maintain blower safeguard systems such as waste tank filter screen, vacuum safety relief valve and waste tank automatic shut-off system. Allowing foam to pass through blower.

HIGH PRESSURE WATER PUMP: Failure to maintain proper oil level as recommended in pump manual. Failure to change oil in pump at recommended intervals. Failure to protect pump against freezing. Failure to maintain pump protection shut-off system. Failure to use water softener in hard water areas. Use of improper chemicals.

VAC TANK: Failure to properly maintain filtering devices in tank. Failure to clean tank as recommended by manufacturer. Failure to maintain vacuum safety release in tank lid. Use of improper chemicals.

CHEMICAL PROPORTIONER: Use of improper chemical. Failure to use water softener in hard water area. Operating machine without proper chemical filter screen. Failure to protect against freezing.

CONTROL PANEL: Failure to protect flow meter and water pressure gauge against freezing.

VACUUM AND SOLUTION HOSES: Failure to protect hoses against freezing. Failure to protect hoses against burns from engine/blower exhaust. Damage to hoses from being run over by vehicles. Kinking or cracking from failure to store or unroll hoses correctly. Normal wear and tear from everyday use.

CLEANING WAND: Failure to protect against freezing. Obvious physical abuse of wand.

WATER HEATER: Over pressurization of the system (recommended maximum working pressure - 800 PSI). Failure to protect against freezing. Modification of the gas delivery system.

WARRANTY PROCEDURE

Warranty coverage is available to you ONLY through HydraMaster Corporation, 20309 64th Ave. West, Lynnwood, Washington 98036. When warranty parts are needed, write **HydraMaster Warranty Dept.** at the above address, or call the Warranty/Service Dept. at (206) 775-7275. **No collect calls will be accepted. Hours of Warranty/Service Dept. are 8:00 am to 5:00 pm Pacific Time.**

.

IMPORTANT: HydraMaster's warranty policy provides replacement parts without charge for thirty (30) days to customers maintaining current account status. An invoice dated thirty (30) days from date of replacement parts shipment will be sent to the customer for the amount of the parts sent. The customer's faulty parts **must be** returned for evaluation prior to the expiration of the thirty (30) day period. Upon warranty approval, a credit will be issued the customer for the replacement parts invoice. **Warranty disapproval or failure to return the faulty parts within the thirty (30) day period allowed will result in the customer being charged for the replacement parts sent.**

GOLDEN GUARANTEE®
LIMITED
WARRANTY PLAN

HydraMaster warrants truckmount machines of its manufacture to be free from defects in material and workmanship if properly installed, maintained, and operated under normal conditions with competent supervision. No person, agent, representative or dealer is authorized to give any warranties on behalf of HydraMaster nor to assume for HydraMaster any other liability in connection with any of HydraMaster's products. This warranty shall extend to the original purchaser of said equipment for the periods listed by component below from date of installation. If repairs or replacements are made by the Purchaser without HydraMaster's written consent, Hydramaster's warranty shall cease to be in effect. No allowance will be granted for any repairs or alterations made by the Purchaser without HydraMaster's prior written consent.

Machinery, equipment and accessories furnished by HydraMaster, but manufactured by others, are warranted only to the extent of the original manufacturer's warranty to HydraMaster.

HydraMaster agrees at its option to repair at the point of shipment, or to replace without charge any parts or parts of products of HydraMaster's manufacture, which within the specified warranty period shall be proved to HydraMaster's satisfaction to have been defective when shipped, provided the Purchaser promptly notifies HydraMaster, in writing, of such alleged defect. HydraMaster will pay all freight and transporation charges, via normal ground shipping means, for replacement of parts covered under this warranty. This warranty covers parts, as specified, and does not cover labor which may be necessary in completing repairs. HydraMaster's liability to Purchaser, whether in contract or in tort arising out of warranties, representation, instructions, or defects from any cause shall be limited to repairing or replacing the defective part or parts. To qualify for warranty coverage, defective parts must be returned to HydraMaster within 30 days. No liability whatsoever shall attach to HydraMaster until said products have been paid for.

Except as stated in this section and in the preceding section titled "Warranty" and except as to title, there are no guarantees or warranties of merchantability, fitness, performance or otherwise, express, implied or statutory, and HydraMaster shall have no liability for consequential, incidental or other damages, howsoever caused.

FRAME/COVER ASSEMBLIES: ..... 3 years

VACUUM RECOVERY TANK/CHEMICAL MIX TANKS: ..... 3 years

ENGINE: (Through original Manufacturer. On Direct Drive units see original Manufacturer's warranty.) ..... 2 years

VACUUM BLOWER: (Through original Manufacturer. See Cooper Industries warranty.) ..... 2 years

CHEMICAL PROPORTIONING SYSTEM: ..... 1 year

CLEANING WAND ..... 1 year

INTERNAL MACHINE HOSES ..... 1 year

HIGH PRESSURE BY PASS VALVE ..... 1 year

EXTERNAL MACHINE HOSES ..... 1 year

BELTS, FITTINGS, FILTER SCREENS, GAUGES ..... 1 year

WATER HEATER OR HEAT EXCHANGER ..... 1 year

HIGH PRESSURE PUMP. (Through original Manufacturer) ..... 1 year

All components not specifically referenced in the above schedule are covered under this warranty for a period of one (1) year, excepting those parts which are considered, by HydraMaster, to be expendable in normal use.

Freezing of any water or chemical related component will VOID all warranties on water or chemical related components, internal or external, of this equipment.

Deposits and build-up in the water system, chemical system or heater system due to hardness in the water used or chemicals which result in deposits, will void all warranties on affected components.