HYDRAMASTER

Corporation
11015 47th Avenue W, Mukilteo, WA 98275

SpitFire 4.0

Machine Serial Number:_____

D-182-031

Revised February 4, 2000

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General Information

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Section 1-1

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 problem, component manual troubleshooting charts have been included for your convenience.

Unlike a garden tractor, lawn mower or cement mixer, all having one or two functions to perform, the truckmounted carpet cleaning plant has many functions to perform simultaneously.

- The engine has to run at a consistent RPM.
- The vacuum has to pull air and dirty water back from cleaning site.
- The water pump provides stable pressure at proper water flow for cleaning.
- The chemical has to be injected into the water stream at the right concentration.
- The heating system must maintain proper heat.
- The vacuum tank must store dirty water until drained.

As you can see, it is not just a turnkey operation with one thing to worry about, **Does it start?**

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.

Hours	**Telephone Numbers**
Monday - Friday	(425) 775-7276 Parts
8:00 am to 5:00 P.M.	(425) 775-7275 Service
PACIFIC STANDARD TIME	(800) 426-4225 Parts / Service FAX

Precautions

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

CAUTION

THROUGH-FLOOR DRILLING: Be cautious when drilling holes through the van floor. Many vans have critical components mounted directly below the van floor that could be damaged by a misplaced drill bit. (See Product Support Bulletins 92102, 94062 and 94063 at the end of the manual.)

CAUTION

ENGINE COOLING: Units employing internal combustion 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.

CAUTION

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

WARNING

MOVING PARTS: Never touch any part of the machine that is in motion. Severe bodily injury may result.

CAUTION

ACID RINSE AGENTS: The increased demand for "clear water" rinsing results in the need for special care when using these acid based chemicals in your equipment. The negative side of these products is the corrosive effects the acid can have on metals, including swivels, pumps, heat exchangers, etc.

HydraMaster's ***ClearWater Rinse*** has been formulated to protect vital components. HydraMaster will not warranty parts that have been damaged from using unprotected acid products that have obviously caused failures.

CAUTION

HARD WATER PROTECTION: Failure to take appropriate measures to prevent scale build up can result in system failure and loss of warranty on affected parts. Test the water in your immediate and surrounding areas with hard water test strips. Assume all water obtained from wells is hard. If you are operating in a "Hard Water Area" (3.5 grains or more per gallon), use a water softening system.

CAUTION

FREEZE PROTECTION: There is often little warning before a cold spell. Therefore, not protecting this equipment from freezing will result in costly downtime. Placing an electric heater in the truck or parking the truck indoors will help to insure against freezing, but should not be the primary method of freeze protection.

CAUTION

EXHAUST SYSTEM: Do not allow flammable material (i.e. oil, fuel, plastic or wood products) to come in contact with the exhaust system.

WARNING

HOT SURFACES: 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.

WARNING

HEARING PROTECTION: The Occupational Safety and Health Administration (OSHA) recommends the use of hearing protection when a technician is exposed to an average of 85 decibels (this is an average of exposure over an 8 hour period). This equipment can produce 85 decibels to a distance of 10 feet. Please check with your local state agencies to see if OSHA standards apply to your application.

WARNING

NO SMOKING: It is unsafe to smoke in or around the vehicle.

WARNING

CARBON MONOXIDE: 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, windows, air conditioning units or kitchen fans.

WARNING

TOXIC FUMES: Do not occupy the vehicle when the cleaning equipment is operating. Toxic fumes may accumulate inside a stationary vehicle.

WARNING

ENGINE EXHAUST: The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

WARNING

PORTABLE GAS TANK: Never operate this machine with a portable gas can inside the truck. Doing so increases the risk of a fire or explosion.

WARNING

PORTABLE PROPANE TANK: Do not use a portable tank inside of the truck or van. It is dangerous and illegal in most states.

WARNING

TRANSPORTATION OF FUEL CONTAINERS: Transportation in a vehicle of any vented fuel container that presently has or has ever contained a flammable liquid is strictly forbidden by HydraMaster Corporation and by federal and state regulation

System Operation

The SpitFire heat exchanger system is a highly engineered cleaning plant designed by HydraMaster Corporation. The system utilizes a dynamic heating system comprised of three separate exhaust heat exchangers for capturing "free heat."

The water flow is as follows:

Water is fed into the machine under tap pressure. It flows through one preheater and then is automatically combined with a cleaning solution as it enters the mix tank. The solution is then picked up by the high pressure pump and pressurized to the desired level. The water then splits flow, as demanded by the technician. The majority of the water flows to the bypass valve assembly, then back through the secondary exhaust heat exchanger, and back to the mix tank.

The water demanded by the technician flows from the water pump through the primary exhaust heat exchanger then out to the cleaning tool.

When the cleaning solution reaches a preset high temperature, it is released from the system and directed to the recovery tank. Then cool water enters the system to regulate the temperature.

As there is no guess work in the manufacture of these highly advanced cleaning plants, there must be none 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.

Machine Specifications

Frame:	24" W x 33" L x 29" H Steel with Baked-on Epoxy Finish
Weight:	370 lbs.
Engine:	Vanguard 20 HP Briggs and Stratton Pressurized Oil System Spin-on Filter and Oil PSI Protection Switch
Ignition:	Electronic, Keystart
Vacuum Blower:	Roots 45 URAIJ
Chemical System:	Electro-mechanical, Meter Controlled
Heating System:	1 Stainless Steel Exhaust Exchanger 1 Copper Shell and Tube Exchanger 1 Copper and Aluminum Block Exchanger
Instruments:	Water Pressure Gauge, Liquid Filled, 0-1000 PSI Hour Meter, Machine Runtime Keyed Ignition, Start/Stop Chemical Flowmeter, Clear Acrylic, 0-10 GPH Vacuum Gauge Temperature Gauge
Recovery Tank:	50 Gallon Aluminum, Epoxy Finish
Cleaning Wand:	Stainless Steel with Heat Shield Replaceable Grip Rebuildable Solution Valve

High Pressure Hose: ¼" High Temperature Lined/Vinyl Covered Hose Rated to 1250 PSI

Vacuum Hose: 2" Reinforced, 1½" Reinforced.

Standard Equipment:

Machine Power Console
Full Instrumentation
Roots Vacuum Blower
SpitFire™ Water Heating Package
Vacuum Recovery Tank
Carpet Cleaning Wand
Chemical Jug
100 ft, 2" Vacuum Hose
10 ft, 1½" Wand Whip Line
100 ft, Super Flex Solution Line
Battery Box
Van Decal Package
Van Installation Kit
Operation Manual
HydraMaster Jacket

Spare Parts

Downtime on the unit can be very expensive, because your truckmounted unit is capable of generating several hundred dollars per day. In order to minimize such downtime, it is strongly recommended by the manufacturer that you purchase and keep in your truck the parts listed below.

Parts Orders

To expedite your parts needs, please call your sales representative. In most instances, he either stocks or has access to parts through a regional service center. If further assistance is needed, 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 Dept. Phone..... (425) 775-7276
HydraMaster Parts Dept. Toll Free Fax..... 1-800-426-4225

Spare Parts List (078-100)

PART NO	DESCRIPTION	QTY
010-015	Belt, Gates AX31	1
049-014	Filter, Vanguard Oil	2
049-007	Filter, S/S Vacuum Pump	1
049-016	Filter, ¼" Replacement Y	1
049-023	Screen, Garden Hose	1
049-012	Filter, Vanguard Air	1
049-030	Filter Bag, 92+ Truck Mount	2
052-050	Quick Connect, 440 Male	3

PART NO	DESCRIPTION	QTY
052-051	Quick Connect, 440 Female	2
052-052	Quick Connect, 660 Male	1
052-053	Quick Connect, 660 Female	1
057-043	Gasket, Recovery Tank	1
074-003	Gauge, Hi PSI (0-1000)	1
074-013	Meter, Chemical Flow	1
078-015	Kit, Chemical Flowmeter	1
078-101	Kit, Seal & Spring Hi PSI	1
078-140	Kit, Hypro Seal	1
106-016	Plug, Vanguard Spark	2
106-045	Plug, HD4 Coupling - 1" OD x ⅞" LG, EPDM	8
131-037	Wrap, Exhaust Insulation	1
157-001	Switch, Tethered Mercury	1
157-115	Mini-Rocker with Terminal	1
157-022	Switch, Relay	2
169-022	Valve, 1½" Full Port	1
169-062	Valve, ¼ Anti-Siphon	1
169-120	Valve, Chemical System	1

Responsibilities

The ***Purchaser's*** responsibilities are:

Prior to arrival of unit, install ⅝" exterior plywood flooring in the vehicle and cover it with artificial turf.

CAUTION

In Dodge vans the fuel tanks are located directly against the floor. Caution must be used when drilling any holes through the floor. (See Product Support Bulletin 94062 at the end of this manual.)

To purchase heavy duty 42 - 60 amp hour battery and have the battery 'slow' charge if new.

CAUTION

If the battery is not fully charged, damage can occur to the engine charging regulator.

Reading of owner's 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**.*

The ***Sales Representative's*** responsibilities are:

ACCEPTANCE OF SHIPMENT:

1. If the 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.

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

CORRECT INSTALLATION INCLUDES:

- Vehicle of proper load carrying capacity (recommendation: ½ ton).
- Installation of through-floor fittings for gasoline fuel lines.
- Placing the unit and recovery tank in your vehicle and securing them with bolts or tie down cleats.
- Connecting gasoline lines.
- Connecting the battery.
- Checking the pump, vacuum blower and engine oil levels prior to staring the unit.
- Starting the unit to check the engine and see that all systems function normally.
- Checking all hoses, wands, etc. for correct operation.

TRAINING:

- A thorough review of the operation manual with purchaser
- Instruction and familiarization in: how to correctly start up and shut down the unit, how to correctly clean with the unit, 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, hard water damage and how to avoid it;
- A thorough review of the unit warranty and warranty procedures.
- A thorough review of hard water precautions and warnings.
- How to determine hard water areas.
- Use of water softening systems.

Vehicle Prep

When selecting a truck, remember the preferable vehicle for a SpitFire 4.0 installation is a cargo van with a heavy-duty suspension package and a half ton capacity. If a fresh water tank is added, a three quarter ton or larger capacity van, with a 2,400 pound payload capacity, is required.

TRUCK PREPARATION

The manufacturer recommends the installation of plywood flooring, covered with polypropylene backed Astroturf (do not use rubber-backed), in the vehicle prior to installation of machine.

CAUTION

Be cautious when drilling any holes through the van floor. Many vans have critical components mounted directly below the van floor that could be damaged by a misplaced drill bit. (See Product Support Bulletin 94062 at the end of this manual.)

This provides 'metal to wood' mounting rather than 'metal to metal', provides insulation and makes an attractive van interior. Astroturf should be color-keyed to the van interior. See Figure 1-1 for correct placement of the plywood flooring.

Figure 1-1 **Plywood Installation**

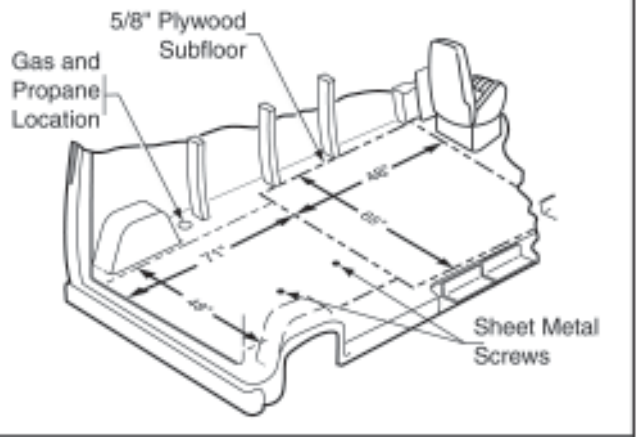
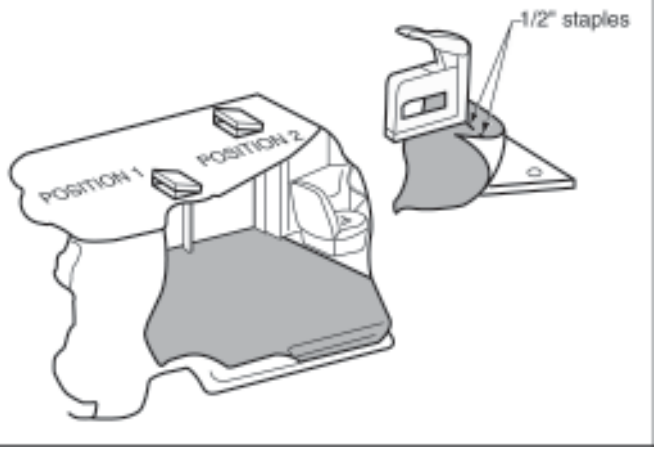


Figure 1-2 **Astroturf and Roof Vent**



Materials Needed:

1. Two sheets of 4 x 8 x ⅝" exterior plywood
2. One 6' x 12' piece of commercial Astroturf
3. Sixteen 1½" sheet metal screws
4. One quart marine adhesive (optional)
5. One staple hammer with ½" staples

PLACEMENT OF UNIT IN VEHICLE

There are two recommended unit placements:

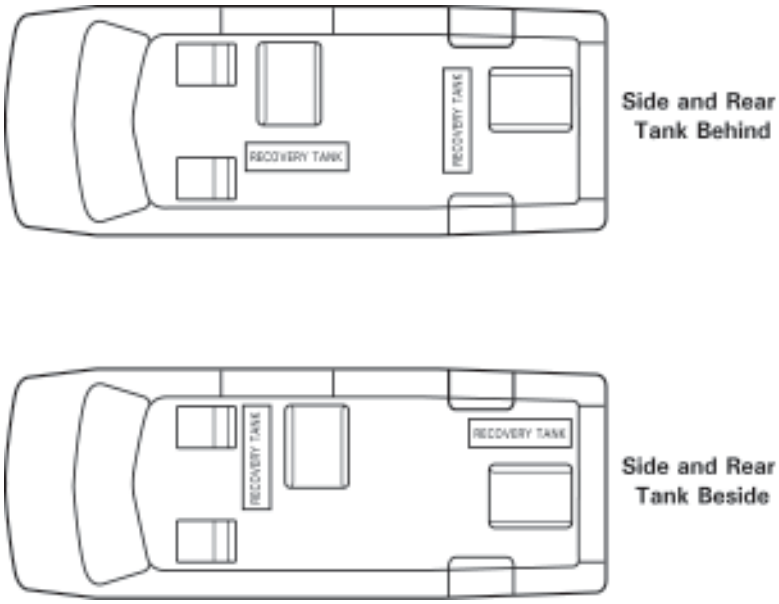
SIDE DOOR:

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

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 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 improves weight distribution inside the van (engine and component weight line up over drive shaft). Also, it is physically easier to load the unit into the rear door due to the height of the van bed.

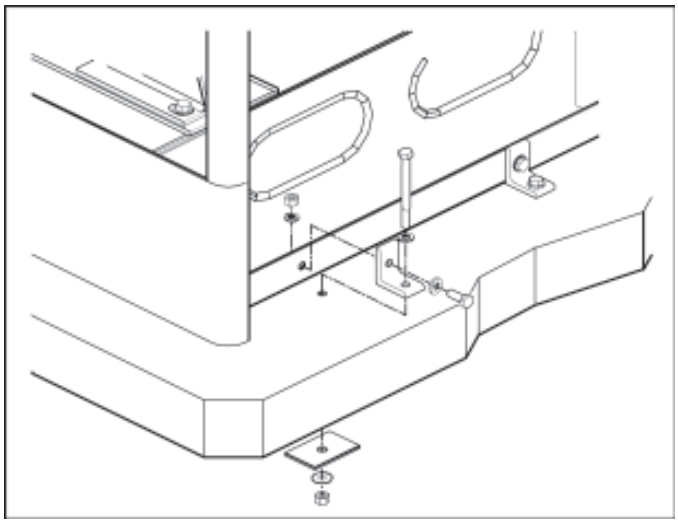
Figure 1-3 **Recommended Placement**



Machine Tie Down Cleats

Secure the machine to the floor of the van with the four tie down cleats provided. This safety measure will ensure that the machine will not slide inside the van. See the following illustration for the correct installation.

Figure 1-4 **Installation using Tie-down Cleats**



Ensure that the machine is well secured to the floor of the van with the hardware supplied. A sudden or crash stop will cause the machine to rocket forward! Protect yourself and the machine. **SECURE IT**!

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 the installation of aluminum vents in the truck roof to allow heat to escape..

WARNING

Never operate this machine with 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

WARNING

Do not use a portable propane tank inside of the truck or van. It is dangerous and illegal in most states.

WARNING

Transportation in a vehicle of any vented fuel container that presently holds or has ever held a flammable liquid is strictly forbidden by Hydra-Master Corporation and by federal and state regulation.

WARNING

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

Local Water Precautions

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The quality of water varies greatly. Many areas 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. This influences the reliability and efficiency of equipment in direct proportion to the level of hardness.

HARD WATER ADVISORY

HydraMaster recognizes that any hard water deposits which might occur within the water system of our truckmounts is a serious problem. The precision technology of truckmount heat exchanger systems is intolerant of any foreign material. Hard water deposits will ultimately decrease the performance of the system and are expected to seriously lower the reliability of the machine.

To validate a machine's warranty, HydraMaster requires that all machines operating in designated "Hard Water Areas" (3.5 grains or more per gallon) be fitted with a water softening system or a properly installed magnetic-type de-scaler must be used and maintained. Periodic de-scaling or acid-rinsing alone is not adequate in these areas.

HydraMaster does not recommend any particular type or brand, however the relative effectiveness of some types of magnetic de-scalers or softeners may require additional periodic use of de-scaling agents.

HydraMaster also recommends, in the strongest possible terms, that machines in all areas be fitted with a water softening system for improved operation and reliability.

HydraMaster has included five hard water test strips with your machine. These

can be used to test the water in your immediate and surrounding areas as they can vary greatly. Assume all water obtained from wells is hard.

CAUTION

Failure to take appropriate measures to prevent scale build up can result in **system failure** and **loss of warranty** on affected parts.

HARD WATER AREA MAP

The following map defines areas in the United States which compromise fluid related components such as hoses, fittings, heaters, pumps, valves and water cooled engines. For other countries, hard water area maps can be obtained from geological societies.

WATER SOFTENER

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. The manufacturer strongly urges the use of water softener units in areas exceeding 3½ grains per gallon. Failure to use a water softener in these areas will invalidate the machine's warranty. Using a hard water area map as a reference, determine the quality of water in your area and take action immediately, if necessary.

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 by an increased life of machine parts, reduced chemical costs and continued cleaning efficiency. The water softener will also increase the *effectiveness* of the cleaning chemicals, 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. For example: If the softener will treat 900 gallons of water and the machine uses an average of 30 gallons per hour, for an average of 5 hours a day, this equals 150 gallons per day. In 6 days the machine would use 900 gallons of water. Therefore, the softener would need to be changed every 6 working days for maximum softening.

WASTE WATER 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. These must be processed before being safe for streams, rivers and reservoirs.

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

In most cases, an acceptable method of waste water 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, 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 waste water 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 waste water 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 waste water and pump it out simultaneously to the cleaning operation.

The hidden benefit of this process is that the technician does not 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 noncompliance can be serious. Always check local laws and regulations to be sure you are in compliance.

Cleaning and Chemicals

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Section 2-1

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.

PRECAUTIONS

There are no short cuts to good carpet cleaning. It requires time, cleaning knowledge and the use of good chemicals. Therefore, the manufacturer recommends the use of spotting agents and traffic lane cleaners, as required, prior to the actual cleaning of carpeting.

The use of some chemicals through your mobile carpet cleaning plant can seriously damage the internal plumbing, high pressure pump and heater. These harmful chemicals include concentrated acid (see the pH chart at the end of this section), solvents, and some paint, oil, and grease removers with a high concentration of solvents.

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

CAUTION

The increased demand for "clear water" rinsing results in the need for special care when using these acid based chemicals in your equipment. The negative side of these products is the corrosive effects the acid can have on metals, including swivels, pumps, heat exchangers, etc.

HydraMaster's ***ClearWater Rinse*** has been formulated to protect vital components. HydraMaster will not warranty parts that have been damaged from using unprotected acid products that have obviously caused failures.

CLEANING STROKE PROCEDURE

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 carpet that is not smooth. 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 and prevent saturation when cleaning wand is stopped twice at the same point at the rear of the cleaning stroke. This is illustrated at the end of this section.

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 following illustration.
2. Obstructed, cut or kinked 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.)

Figure 2-1: pH Chart

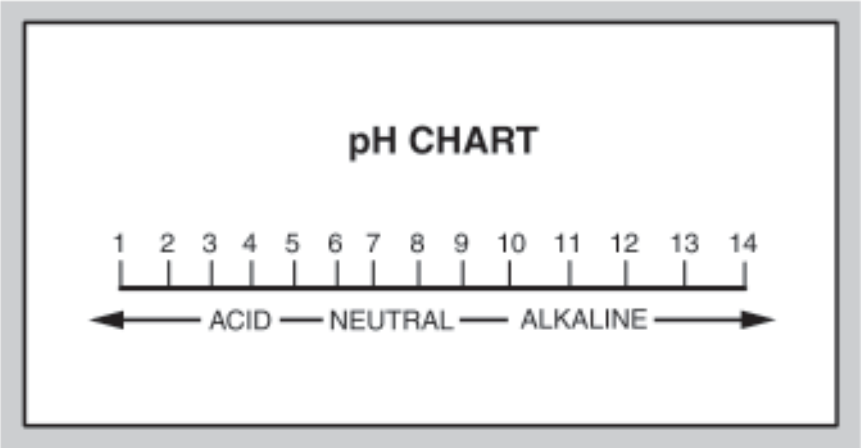
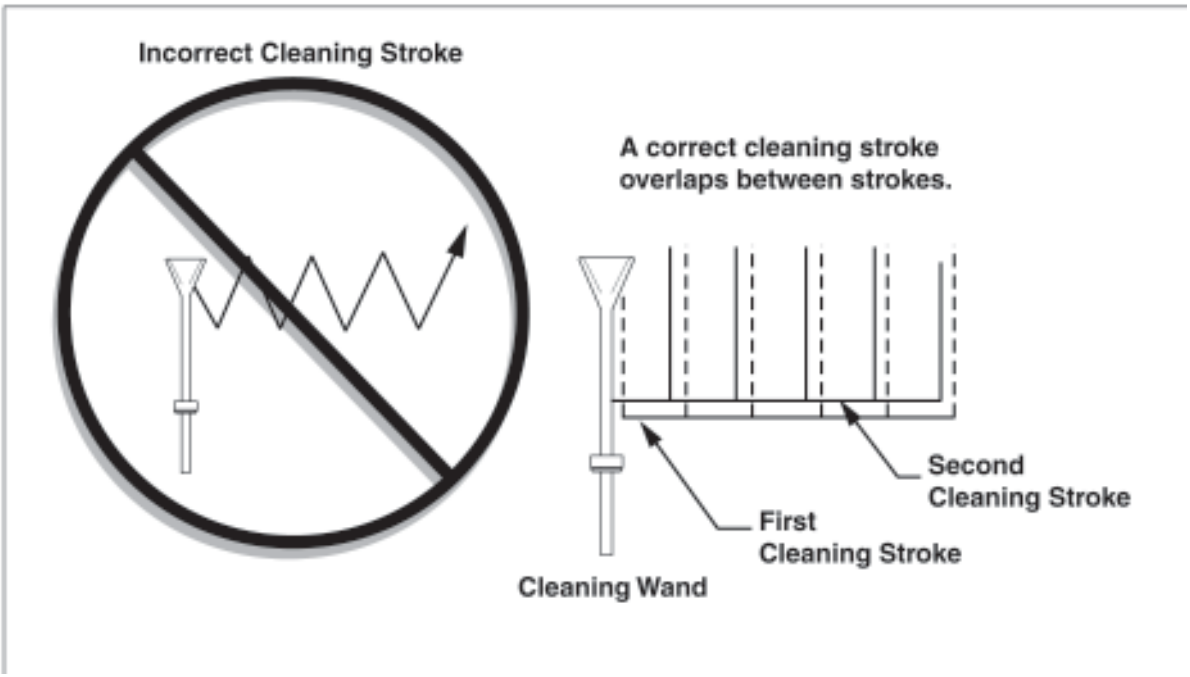


Figure 2-2: Cleaning Stroke Procedure



Operating Instructions

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Section 3-1

START UP

1. Perform daily and periodic maintenance as specified in this Owner's Manual.
2. Connect all required hoses.
3. Connect the cleaning tool to the length of hose required to perform the cleaning.
4. **CAUTION:** Mix tank must be full prior to ignition.
5. Place the throttle in the 'Slow' position. This is approximately 1800 RPM.
6. Start engine (choke as required).

NOTE: If the engine will not start depress the oil pressure bypass switch and hold until the engine begins running.

Allow the engine to run for 3 to 5 minutes. Then increase the engine RPM to 'Fast' for normal carpet cleaning. This is approximately 3000 RPM.

7. Spray the wand to void all air from the system. When the mix tank begins a fill cycle, the chemical flowmeter may be adjusted to your desired setting. Set your cleaning pressure at 300 PSI.

NOTE: A chemical flowmeter set at 5 GPH is a 1 to 30 mix ratio and 10 GPH is a 1 to 15 ratio. When the flowmeter is set at 10 GPH, you will be using what most chemical manufacturers recommend at 5 GPH.

8. Run the machine for several minutes under load (8 to 10" HG) until your desired temperature is achieved.

9. Commence cleaning operation.

SHUT DOWN

1. Flush clear water through the chemical system for 10 seconds. Turn off chemical flowmeter.
2. Cool the machine by spraying the cleaning wand into the vacuum hose for three to five minutes. The chemical will be flushed from the unit, hoses and cleaning tool.

NOTE: If the machine is not properly cooled, the mix tank can overflow.

3. Remove the vacuum hose.
4. At this time, the blower should be lubricated with an oil based lubricant.

NOTE: If freeze guarding is necessary, perform the freeze guard procedure at this time.

5. Throttle the machine down.
6. Turn the machine off.
7. Drain the mix tank.
8. Drain the vacuum tank. The vacuum filter should be cleaned prior to mobilization of the van.

NOTE: In accordance with the EPA, state and local laws, **do not dispose of waste water into gutters, storm drains, streams, reservoirs, etc**.

FLOOD DAMAGE WORK FOR STANDARD SPITFIRE

CAUTION

When using equipment for flood damage, you *must* have a fresh water source hooked up at all times to allow a cold water source into the machine. This will prevent overheating during long periods of vacuum recovery.

Exhaust Diverter System

The Exhaust Diverter System consists of two components; the diverter valve and the pump clutch. The diverter valve directs the flow of the exhaust through the triple heat exchanger or directly out of the machine via the diverter exhaust muffler. The pump clutch allows the pump to be turned on and off through a switch. This will enable the machine to be used for flood extraction without the need for an inlet garden hose connected to the machine. Thus preventing excessive filling of the recovery tank through the temperature control system.

The SpitFire can run in two different modes:

Cleaning Mode

To run the machine in Cleaning mode:
Push in the heat exchanger bypass lever. It is not necessary to turn the pump clutch switch to the "ON" position due to a micro-switch that turns the pump clutch on automatically.

Note: This means that the pump clutch cannot be manually turned off when running in this mode.

Flood Damage Mode

To run the machine in Flood Damage mode:
Pull out the heat exchanger bypass lever. Turn the Pump Clutch to the "OFF" position.

CAUTION

HOT SURFACES: When the machine is being run or after it has been shut down, caution should be used around the muffler and the exhaust diverter surfaces as they become hot during operation

WARNING

Do not use excessive force when engaging and disengaging the heat exchanger bypass lever. This may cause damage to the exhaust diverter.

WARNING

In order for the valve to operate properly, it should periodically be engaged and disengaged.

Freeze Guard

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Section 4-1

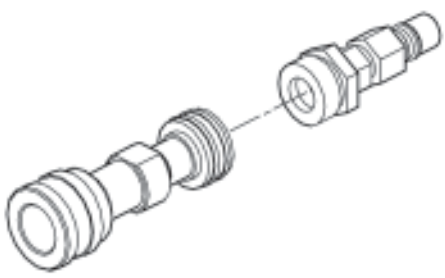
VACUUM FREEZE GUARD PROCEDURE:

To freeze guard your machine:

1. Start the machine.
2. Spray all of the water out of the system until the engine stops.
3. Add a half gallon of 50/50 antifreeze and water mix to the chemical mix tank and draw the antifreeze into the flow meter.

When using the recirculation kit (part no. 078-058), fill a third of the mix tank with a 50/50 antifreeze mix. Verify that the upper float is not lying horizontal, but floats below.

Figure 4-1 Recirculation Fitting



Attach the recirculation fitting provided in the kit to the garden hose quick connect (see illustration to right) and this combination to the front of the machine.

Attach one section of female/female solution hose to the outgoing solution fitting on the front of the machine and the other end to the garden hose and recirculation fitting combination that is attached to the front of the machine(or as many sections as you want, if you wish to freeze guard your hoses).

4. Start the machine. Allow it to run for 2 to 3 minutes.

With the recirculation kit, skip ahead to step 6.

5. Remove the quick connect fitting from the end of the garden hose. Attach the garden hose quick connect to the machine. Using a vacuum hose attached to the recovery tank, vacuum the water out of the garden hose quick connect.

6. Spray the antifreeze and water mix out of the machine and into a container to reclaim the solution. Run the machine until it stops.

   NOTE: The reclaimed antifreeze solution may be used 3 times before being discarded.

   NOTE: **To freeze guard hoses and wand**, perform the above step with all the hoses and wand attached.

The machine is now freeze guarded. Remember to flush antifreeze from the system prior to carpet cleaning.

Recovering Antifreeze For Re-use:

Before cleaning with the machine again, flush the remaining anti-freeze solution from the system into a sealable container so that it may be used again. To do this, spray water through the hoses and wand until all signs of antifreeze are gone.

CAUTION

One manufacturer of antifreeze cautions: **"WHEN DISPOSING OF USED ANTIFREEZE COOLANT:** Follow local laws and regulations. If required, dispose at facilities licensed to accept household hazardous waste. If permitted, dispose in sanitary sewer systems. Do not discard into storm sewers, septic systems, or onto the ground."

WARNING

This warning appears on the label of one brand of antifreeze: **"HARMFUL OR FATAL IF SWALLOWED.** Do not drink antifreeze coolant or solution. If swallowed, induce vomiting immediately. Call a physician. Contains Ethylene Glycol which caused birth defects in animal studies. Do not store in open or unlabeled containers.

"KEEP OUT OF REACH OF CHILDREN AND ANIMALS."

FREEZE PROTECTION OF THE PUMP-IN SYSTEM

1. Drain the fresh water tank.
2. Remove the garden hose adapter from the pump-in pump hose and position the hose so it is pointing outside the van.
3. Turn on the pump-in pump and run for 1-2 minutes till all the water is purged from the hose.

NOTE: The next time the unit is used it may take a few minutes before the mix tank begins to fill.

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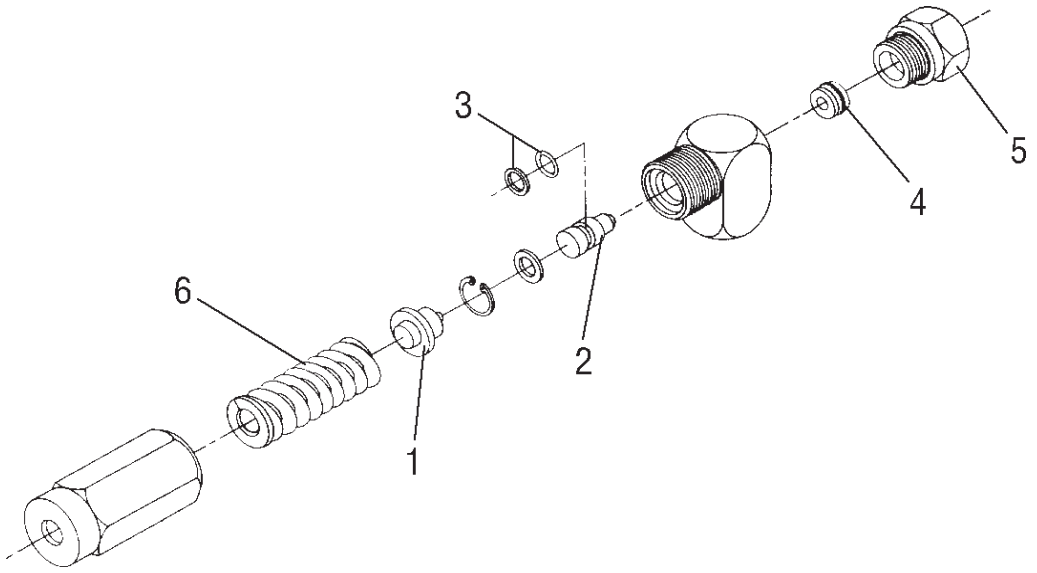
Figure 5-3: **Bypass Valve Assembly**



169-101 Valve, Bypass Truckmount

ITEM	PART NO	DESCRIPTION	QTY
1	105-101	Thrust Plate, Bypass Valve	1
2	105-102	Piston Plate, Bypass Valve	1
3	097-028	Seal Set for Bypass Valve	1
4	148-044	Seat and O-Ring, Bypass Valve	1
5	097-005	O-Ring, By-Pass Valve Fitting	1
6	155-019	Spring, High PSI Bypass	1
Not Shown:			
	078-102	Kit, By-Pass Repair (Complete, Incl. 078-101)	1
	078-101	Kit, Seal and Spring High PSI Bypass (Includes Items 3 and 6)	1

Pump Maintenance

SpitFire 4.0
Section 6-1

DAILY

Check the oil level and the condition of the oil. The oil level should be up to the center of the sight glass on the back of the pump.

Use a 30 weight, non-detergent oil.

CAUTION

If the oil becomes discolored and contaminated, one of the oil seals may be damaged. Refer to the Service Section.

Do not operate the pump if the crankcase has been contaminated with water.

CAUTION

Do not leave contaminated oil in the pump housing or leave the housing empty. Remove contaminated oil as soon as it is discovered and replace it with clean oil.

PERIODICALLY

Change the oil after the first 100 hours of operation, and every 400 operating hours thereafter. When changing, remove the drain plug on the oil drain center located on the frame so all oil and accumulated sediment will drain out.

CAUTION

Do not turn the drive shaft while the oil reservoir is empty.

CAUTION

Protect the pump from freezing.

Service

The next few pages explain how to disassemble and inspect all easily-serviceable parts of the pump.

CAUTION

Do not disassemble the hydraulic end unless you are a skilled mechanic. For assistance, contact HydraMaster (425-775-7275) or the distributor in your area.

1. Servicing the Valves (See Figure 6-1)

A. Remove the hex valve plugs (top—discharge, bottom—Inlet).

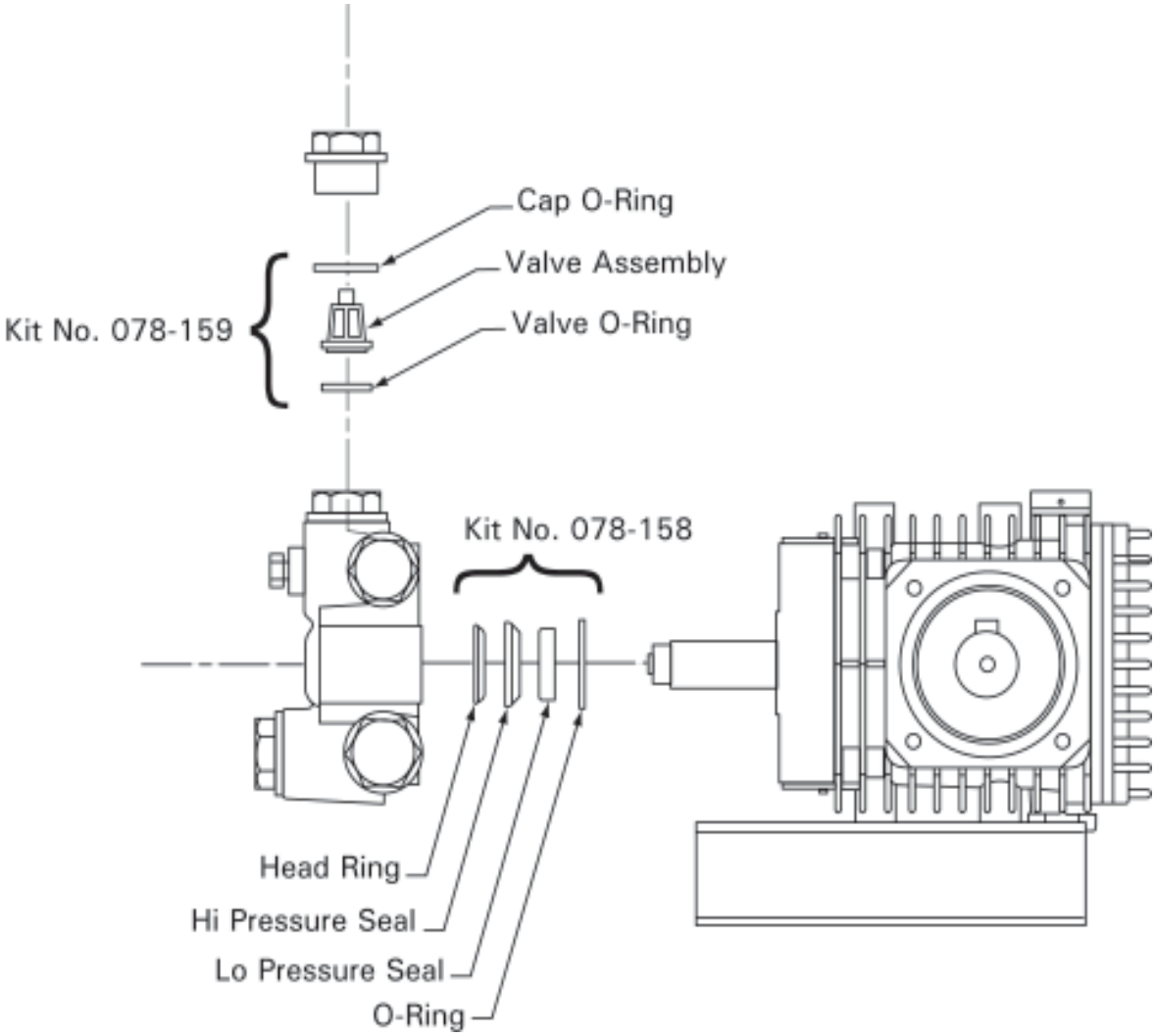
B. Unthread the valve plug and examine the o-ring under the plug for cuts or distortion. Replace it if it is worn. Lubricate new o-rings before installing.

C. Grasp the valve retainer by the tab at the top with needle-nose pliers, then remove the o-ring at the bottom of the valve chamber.

D. Inspect all valve parts for pitting, gouges, or wear. If wear is excessive, replace valve assembly.

E. Reinstall valve assemblies:
   1. Using a clean towel, clean the valve chamber.
   2. Install the o-ring into the high pressure manifold.
   3. Install the valve assemblies into the high pressure manifold (the metal side of the valve faces the manifold).
   4. Replace the o-ring on the hex valve plug.
   5. Torque the plug to 30 foot pounds.

Figure 6-1 **Servicing the Valves**



2. Removing the High Pressure Manifold

A. Using an M6 allen wrench, remove all eight of the socket head bolts.

B. Rotate the crankshaft by hand to start separation of the manifold head from the crankshaft.

C. Insert two flat-head screwdrivers on opposite sides to further separate the manifold from the crankshaft.

CAUTION

To avoid damage to either plunger or seal, keep the manifold properly aligned with the ceramic plungers when removing it.

D. Remove the seal retainer from the manifold and inspect for wear.

E. Examine the ceramic plunger for cracks or scoring (refer to *Servicing the Plungers* for replacement).

3. Servicing the Low Pressure Seals and High Pressure Seals (See Figure 6-1)

A. Remove the low pressure seal from the seal retainer using a 90 degree pick tool.

B. Remove the high pressure seal from the manifold

C. Inspect the low pressure seal and high pressure seal for wear and replace if necessary.

D. Reinstall the low pressure seal:
   1. Install the low pressure seal into the seal retainers with the garter spring down.

E. Reinstall the high pressure seal:
   1. Lubricate the seal chamber in the manifold.
   2. Carefully square the high pressure seal into position by hand with the grooved side down (metal back facing out).
   3. Examine the seal retainer's o-ring and replace if worn. Lubricate the new o-ring before installing.
   4. Next, press the seal retainers into the manifold until completely seated.

4. Servicing the Plungers

A. Using a hex tool, loosen the plunger retainer about three to four turns. Push the back to separate it from the retainer and finish unthreading the plunger retainer by hand.

B. Unthread the plunger retainer with sealing washer.

C. Remove the ceramic plunger, keyhole washer and barrier slinger from the plunger rod.

5. Reinstall the ceramic plungers:

1. Examine the sealing washer on the plunger retainer and replace it if it is cut or worn. Lubricate the new sealing washer for ease of installation and to avoid damage.
2. Apply Loctite 242™ to the threads of the plunger retainer and press it into the ceramic plunger. Thread hand tight, then torque the bolt to 4.4 foot pounds.
3. Install the seal retainer with holes to the top and bottom, and forward.

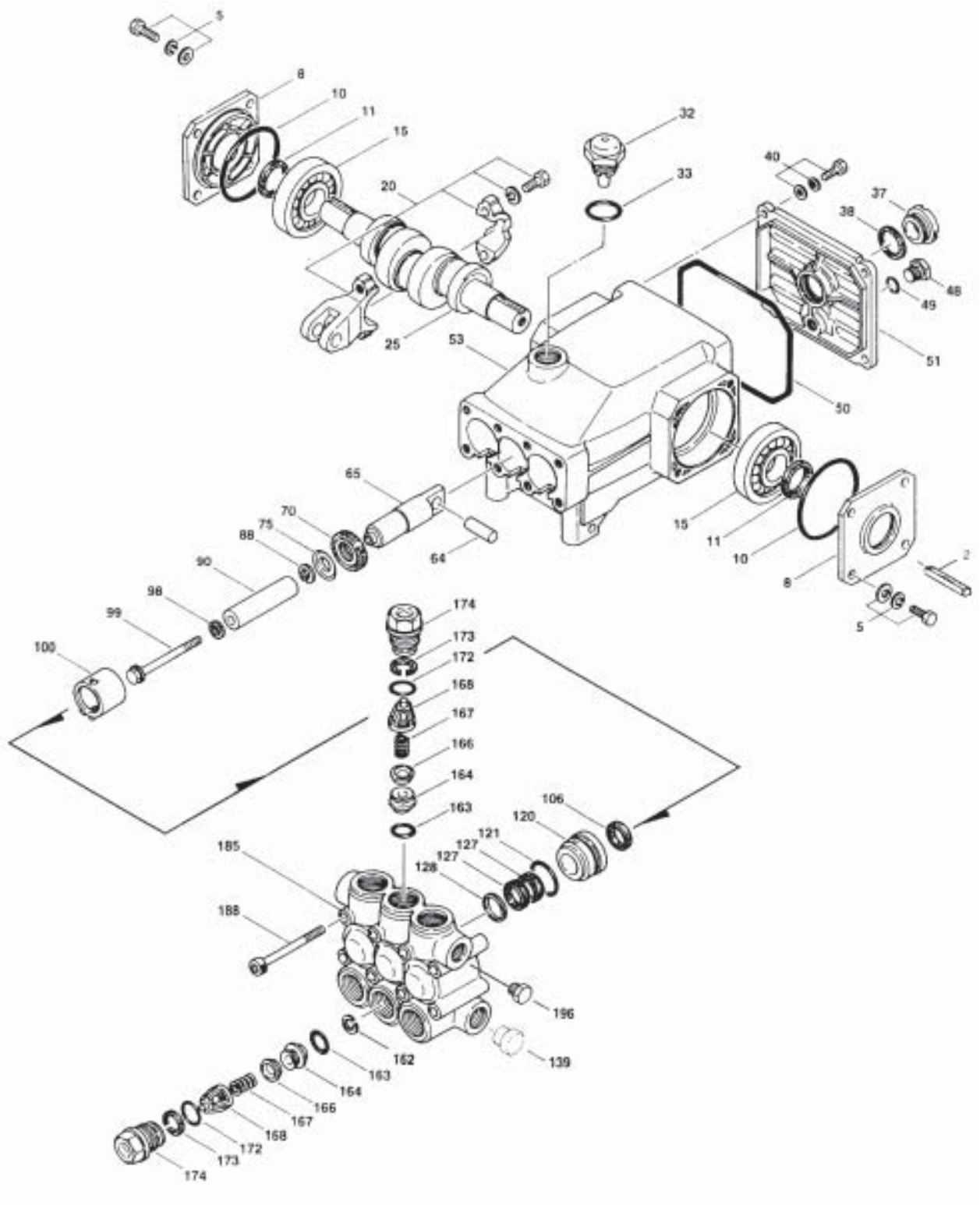
6. Reinstall High Pressure Manifold

A. Slip the seal retainer over the ceramic plungers with the holes to the top and bottom and forward.
B. Turn the shaft by hand to line up the plungers so that the end plungers are parallel.
C. Lightly lubricate the plungers and carefully slide the manifold head onto the plungers while supporting it from the underside to avoid damaging the plungers.
D. Reinstall the socket head bolts and torque to 4.4 foot pounds.

7. Servicing the Crankcase

A. While manifold, plungers, and seal retainers are removed, examine the crankcase seals for wear.
B. Rotate the crankshaft oil seal externally for drying, cracking or leaking.
C. Consult your HydraMaster distributor if crankcase servicing is necessary.

Figure 6-2: Cat Pump



Cat Pump Parts List

ITEM	PART NO.	DESCRIPTION	QTY
2	30047	Key, M5	1
5	92519	Screw, Sems HHC, Bearing Cover, M6x16	8
8	46901	Cover, Bearing	2
10	14028	O-Ring, Bearing Cover	1
11	43222	Seal, Oil, Crankshaft	2
15	14480	Bearing	½
20	46743	Rod, Connecting, Assembly	2
25	46829	Crankshaft, Dual End	3
32	45690	Cap, Oil Filler	1
33	14179	O-Ring, Oil Filler Cap	1
37	43987	Gauge, Oil, Bubble	1
38	44428	Gasket, Flat, Oil Gauge	1
40	92519	Screw, Sems HHC, Crankcase Cover, M6x16	4
48	25625	Plug, Drain, ¼" x 11	1
49	23170	O-Ring, Drain Plug	1
50	46939	Cover, Crankcase	1
51	14041	O-Ring, Crankcase Cover	1
53	46534	Crankcase	1
64	46615	Pin, Plunger Rod	3
65	46975	Rod, Plunger	3
70	147-013	Seal, Crankcase Oil for 3CP Cat Pump	3
75	43900	Slinger, Barrier	3
88	45697	Washer, Keyhole	3
90	46976	Plunger, M43	3
98	46730	Seal, Washer	3
99	48201	Retainer, Plunger with Stud, M6	3
100	46541	Retainer, Seal	3
106	43243	Seal, LPS with Spring	3
120	46625	Case, Seal	3
121	13976	O-Ring, Seal case	3
125	46652	Seal, HPS	3
139	22179	Plug, Inlet ½"	1

Cat Pump Parts List

ITEM	PART NO.	DESCRIPTION	QTY
163	17547	O-Ring 85, Valve Seat	6
164	46658	Seat	6
166	43723	Valve	6
167	43750	Spring	6
168	44565	Retainer, Spring	6
172	17615	O-Ring 75, Valve Plug	6
174	46756	Plug, Valve	6
185	46616	Manifold, Head	1
193	87870	Bolt, HSH, Manifold Head (M8x65)	8
196	22187	Plug, Discharge ⅜“	1
250	108-055	Protector, 3CP Cat Pump Shaft	1
260	114-003	Rail Angle, 3CP Cat	1
265	30651	Complete Mounting Kit	1
270	30246	Pulley and Key Assembly	1
299	814841	Complete Head	1
300	078-271	Kit, Seal for 3CP Cat Pump	1
310	078-270	Kit, Valve for 3CP Cat Pump	1
350	30696	Valve Seal Removal Tool	1

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Pump Troubleshooting

Cavitation

- Inadequate fluid supply because of:
  - -inlet line collapsed or clogged
  - - air leak in inlet line
  - -worn or damaged inlet hose
- Fluid too hot for inlet suction piping system
- Air entrained in fluid piping system
- Aeration and yurbulence in supply tank
- Inlet suction vacuum too high
- High pressure seals worn
- Worn pump valve parts.

Symptoms of Cavitation:

- -Excessive pump valve noise (chattering)
- -Premature failure of spring or retainer
- -Volume or pressure drop
- -Rough-running pump.

Drop in Volume or Pressure

- Air leak in suction piping.
- Clogged suction line.
- Pressure gauge inoperative or not registering accurate.
- Suction line inlet above fluid level in tank.
- Inadequate fluid supply.
- Pump not operating at proper RPM.
- Worn pump valve parts.
- Foreign material in inlet or outlet valves.
- Worn low pressure seals.
- Cavitation.
- Belt slippage.

Water Pulsations

- Foreign object lodged in pump valve.
- Air in suction line.
- Valve spring broken.
- Cavitation.
- Aeration or turbulence in supply tank.
- Stuck inlet or discharge valve.

Valve Wear

- Normal wear.

Loss of Oil

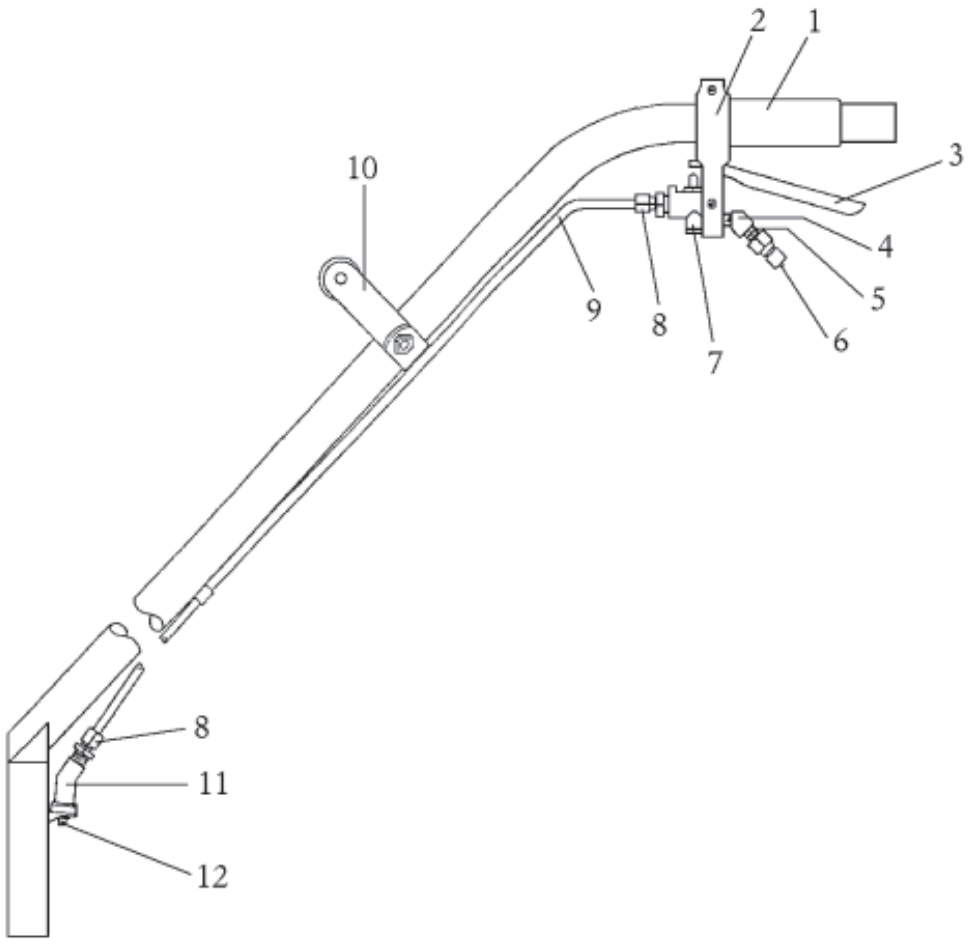
- External seepage.
- Frozen pump.
- Worn crankshaft seal.
- Oil drain piping or fill cap loose.

Premature Failure of Valves or Seals

- Excessive cavitation.
- Foreign object in the pump.
- Pump running too fast.
- Valve or seal material incompatible with fluid being pumped.
- Excessive inlet pressure.
- Scored plungers.
- Running pump dry for excessive periods of time.
- Excessive temperatures of fluid being pumped.

Cleaning Wand Parts

SpitFire 4.0
Section 7-1



Wand Assembly Parts List

ITEM	PART NO.	DESCRIPTION	QTY
1	061-007	Handle Grip	1
2	015-203	Bracket, Low Pressure Wand Valve Holder	1
3	167-018	Trigger, Wand Low PSI	1
4	052-082	Elbow, ¼" Brass 45 Street	1
5	052-072	Nipple, ¼ Brass Close	1
6	052-050	Quick Connect, 440 Male with Viton	1
7	169-074	Valve, High PSI Brass	1
8	052-152	Compression, ¼" Male HydraHoe Fitting	2
9	168-001	Tube, HydraHoe Solution ¼" OD s/s	1
10	061-024	Handle Kit, Wand – Pressure Guide (see below)	1
11	052-450	Elbow, For Jet Assembly Wands	1
12	076-004	Jet, #11004 ¼" VV s/s	1
Handle Assy (Item 10)			
	094-035	Nut, 5/16-18 s/s Nylock Half	2
	143-012	Bolt, 5/16-18 x ¾" HHC s/s	2
	061-006	Handle, Pressure Guide	1

Vacuum System

SpitFire 4.0
Section 8-1

The vacuum pump in this machine is commonly referred to as a 'positive displacement 'lobe' type blower. 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, bearings or drive system.

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

Caution should be used when machine is being run for test purposes and the vacuum inlet on top of the machine is open.

To protect the vacuum blower from overloading and damaging itself, there is a vacuum relief system installed on the vacuum tank. When the vacuum tank inlet is completely sealed off, a maximum of 12 HG will be attained.

At the end of each day, an oil based lubricant should be sprayed into the blower lubrication port before shutting down the machine. Lubricate the vacuum blower *daily* to prevent rust deposits and moisture that will decrease the life of the vacuum blower.

CAUTION

Foam passing through the blower could lead to serious problems.
It is important to keep the vacuum tank foam free.

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

CAUTION

The vacuum tank is protected from overflowing by a vacuum tank float kill switch. The switch is not activated by foam, only by liquid.

VACUUM TANK FILTER BAGS

HydraMaster filter bags are designed to trap 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 slipped around the incoming dirty water inlet in the vacuum tank.

UNCONTESTED WARRANTY

The Roots Division of Dresser Industries, Inc. states in their February 1993 Roots Blower specification sheet, "Roots is the leader in blower warranties - the first to introduce an uncontested warranty that guarantees repair or replacement of any Universal RAI-J™ that malfunctions for any reason. We'll protect you or your customer for a full 18 months from date of original start-up or 24 months from date of shipment, whichever occurs first."

Blower Troubleshooting

SpitFire 4.0
Section 8-3

No.	Problem/Possible Cause	Solution
1.0	**There is no vacuum or a loss of vacuum.**	
1.1	The *stainless steel filter* is clogged.	Clean or replace the filter.
1.2	The *filter bag* is clogged.	Clean or replace the filter bag.
1.3	The *vacuum tank dump valve* is "open" or defective.	If water drips from the valve when the machine is not running, the valve will cause a vacuum loss when the machine is running. Replace it if it is defective.
1.4	The *vacuum hose* is plugged.	Remove the obstruction by reversing the vacuum hose.
1.5	There is a restriction in the *cleaning tool*.	Remove the obstruction.
1.6	The *vacuum tank seal* is defective.	Replace the seal.
1.7	The *hose* from the blower to the recovery tank is kinked or has collapsed inside.	Replace or reshape the hose. **NOTE:** A special reinforced hose is required for replacement.
1.8	There is a hole in the *recovery tank*.	Inspect the tank for leaks using smoke and weld the tank if it is required.
1.9	There is a hole in the *vacuum hose*.	Repair or replace the hose.
1.10	The *vacuum release* is loose.	Readjust the vacuum release.
1.11	The *engine speed* is too low.	Adjust the speed.

No.	Problem/Possible Cause	Solution
1.12	The *vacuum blower's end plates* or *lobes* are worn.	Replace the worn components. **NOTE:** This must be accomplished by a qualified technician.
1.13	There are *vacuum leaks* around the *top collector box.*	A vacuum leak can usually be detected by spraying a mist of WD40 or blowing smoke towards the leak. The mist or smoke will be sucked into the leak. When you see the leak, repair it.

No.	Problem/Possible Cause	Solution
2.0	**The blower is noisy.**	
2.1	There is an *exhaust leak* between the blower and the silencer.	Inspect the fittings to determine where the air leak is. Repair as necessary.
2.2	The *blower* is out of oil or the gears may be bad. **NOTE:** Permanent damage may result from a lack of lubrication.	Add oil. If the noise continues, replace the gears or blower. **NOTE:** Replacement of the gears must be accomplished by a qualified technician.
2.3	The *silencer* is bad.	Inspect it for an external hole. Repair or replace the silencer.
2.4	The *lobes* are hitting.	Replace the blower.
2.5	The *engine* is running at the wrong speed. This is noticeable because the blower noise increases with speed.	Adjust the engine to run at the proper speed.
2.6	The *bearings* are worn.	Remove and replace the bearings as required. **NOTE:** This process must be accomplished by a qualified technician.

No.	Problem/Possible Cause	Solution
3.0	**The blower will not turn.**	
3.1	The *lobes* are locked up because of rust, burnt chemical foam, or a sugar-like substance has been vacuumed up from the carpet.	a. Most *burnt foam* and *rust* can be removed by soaking the lobes with liquid wrench. After soaking the lobes, with the machine running, pour a half gallon of hot water into the top of the blower. Then spray WD40 or Pennz Lube into the top of the blower to displace The water. b. Any *sugar-like substances* can be removed by soaking the lobes with hot water.
3.2	There is debris in the *blower*.	Remove the debris. A stainless steel filter is provided at the vacuum inlet in the vacuum tank to prevent this problem.
3.3	The *blower* has broken gears or shattered lobes.	Rebuild or replace the blower. **NOTE:** Rebuilding the blower must be accomplished by a qualified technician.

No.	Problem/Possible Cause	Solution
4.0	**The shaft turns, but the lobes do not.**	
4.1	The *shaft* is broken inside the blower.	Replace the blower.

Engine Troubleshooting

SpitFire 4.0
Section 9-1

No.	Problem/Possible Cause	Solution
1.0	**The engine will not turn over.**	
1.1	The *battery cable* is loose or the terminals corroded.	Clean and tighten the battery terminal connections.
1.2	The *battery* is dead.	Recharge or replace the battery.
1.3	There is a problem with the *fuse link*.	Check the link. If it is defective, replace it.
1.4	There is a problem with the *starter solenoid*.	With the ignition switch in the "Start" position, check the following on the solenoid. Check for + 12 volts on: a. The small terminal with the blue wire from the ignition switch, b. The large terminal with the cable from the battery. c. The large terminal with the cable going to the starter. If the voltage is present on the first two checkpoints, but not on the large terminal going to the starter, replace the solenoid.
1.5	The *ignition switch* is defective. replace it.	Test the switch for entering voltage. If there is voltage entering the switch but not exiting the center post when the switch is fully engaged, then
1.6	The *vacuum blower* has seized.	Refer to the Blower, Chapter 10.

No.	Problem/Possible Cause	Solution
1.0	**The engine will not turn over. (cont.).**	
1.7	The *starter motor* is defective.	Remove the belt(s) from the engine. Check to see if the engine will turn over manually. Check that the engine is grounded to the minus side of the battery. With the ignition key in the **Start** position, check the starter motor for +12 volts. If all of the above conditions are met and the starter will not turn, replace it.
1.8	The *engine* is malfunctioning.	Refer to the Engine Operation and Maintenance manual included in your Owner's manual or see the local engine repair facility.
1.9	The *ground cable* underneath the motor has fallen or broken off.	Reattach the cable.

No.	Problem/Possible Cause	Solution
2.0	**The starter turns the engine over, however the engine will not start. (There is no spark*.)**	*Check for spark at the spark plugs. If there is no spark, examine the Troubleshooting guide below. However if there is a spark, see **Troubleshooting Problem Number 3.0** on the following pages for possible fuel problems.
2.1	The *recovery tank* is full.	Empty the tank.
2.2	The *recovery tank float* is causing the engine to shut down.	Disconnect the float. If the unit starts, replace the defective float.
2.3	The *engine* is malfunctioning.	Refer to the Engine Operation and Maintenance manual included in your Owner's manual.
2.4	The *magnetron* is malfunctioning.	Check the magnatron. If it is adjusted properly, all of the wires should be tight and not grounded out. Remove all of the wires from the engine kill lug. If there is still no spark, replace it.
2.5	A *spark plug* is faulty.	Check for worn, fouled or improperly gapped spark plugs. Replace if necessary. **CAUTION:** Allow the engine to cool completely before attempting to remove the plugs.
2.6	The *engine kill relay* is malfunctioning.	Remove either end of the wire that runs from the relay to the engine kill lug. If the engine starts, replace the relay.
2.7	The *oil pressure switch* is causing the engine to shut down.	Check the engine oil level. If it is at the proper level, then disconnect the oil pressure switch. If the unit starts, then replace the switch.
2.8	The *lower float in the chemical mix tank* is defective.	Unplug the wire from terminal 86 on the kill relay. If there is water in the mix tank and the engine starts, replace the switch.

No.	Problem/Possible Cause	Solution
3.0	**The starter turns the engine over, however the engine will not start. (There is no gas*.)**	*Check for spark at the spark plugs. If there is no spark, examine the Troubleshooting guide below. However if there is a spark, see **Troubleshooting Problem Number 3.0** on the following pages for possible fuel problems.
3.1	The *fuel pump* is defective.	Remove the fuel line from the engine and place it in a container to see if the fuel is being pumped when the ignition is on. Replace the fuel pump if it is defective.
3.2	There is a poor *battery ground* to the fuel pump.	Repair the loose ground connection.
3.3	The *fuel pump* is sucking air between the gas tank and the inlet side of the fuel pump.	Examine the gas inlet side of the fuel pump. Tighten any loose fittings or clamps. Replace any ruptured hose.
3.4	The *fuel filter* is clogged.	Inspect the filter. Replace if necessary.
3.5	The *quick connect* in the fuel line is clogged.	Clean or replace the quick connect.

No.	Problem/Possible Cause	Solution
4.0	**The engine runs poorly or dies after running for awhile.**	
4.1	The *air or gas filter* is clogged.	Inspect both filters. Replace the clogged one.
4.2	There is a poor *battery ground* to the *fuel pump*.	Inspect the electrical grounds. Repair any loose ground connections.
4.3	The *fuel pump* is sucking air between the gas tank and the fuel pump.	Examine the pump's gas inlet side. Tighten any loose fittings or clamps Replace ruptured hoses.
4.4	The *fuel pump* is defective.	Remove the fuel line from the engine and place it in a container to see if the fuel is being pumped when the the ignition is turned on. Replace the fuel pump if it is defective.
4.5	There is *excessive engine load*.	Clean and adjust the recovery tank relief valve. Adjust for 14 inches of lift under a full load.
4.6	The *engine* overheats from poor ventilation.	Remove any air restriction from around the engine. Add a roof vent or external fan, if necessary.
4.7	The *engine* overheats from carbon build up in the *combustion chamber.*	Refer to a local engine dealer.
4.8	The *engine* overheats from too much oil in the *crankcase*.	Check the oil level and correct if necessary.
4.9	The *engine* is malfunctioning.	Refer to the Engine Operation and Maintenance manual or see the Briggs & Stratton dealer.

No.	Problem/Possible Cause	Solution
4.0	**The engine runs poorly or dies after running for awhile. (cont.)**	
4.10	A *clogged heat exchanger* is causing back pressure.	This will cause the engine to run slow and spit gas from the carburetor. Remove the stainless steel hose from the end of the stainless steel heat exchanger. If the engine runs good without the hose, remove the copper heat exchanger under the machine and clean the debris.
4.11	**On duel tank Fords**, the engine is pulling through the 'Tank Switching Valve'.	Do not try to pull gas from both gas tanks.
4.12	A *PCV valve* is defective.	Remove and check the air cleaner for oil saturation. If it is saturated, replace the PCV valve and air filter.

Electrical System -Standard

SpitFire 4.0
Section 10-1

The SpitFire electrical system, in keeping with the entire machine concept, has been kept to a minimum so as to keep any necessary troubleshooting as easy as possible.

The entire electrical system operates on 12 volts DC which is provided by a battery. Battery levels are sustained by a 16 amp alternator inside the engine.

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

The orange wire going from the engine starter solenoid to terminal #5 on the ignition switch is a fusible link and provides protection to the electrical system in case of failure.

Ignition Switch:

Terminal No.	Wire Color	Function
1	Not Used	
2	White	To Carburetor Solenoid (when used)
3	Black	To Stop Switch Terminal on Engine
4	Yellow	To Solenoid (tab terminal)
5	Orange	To Battery (battery terminal on solenoid)
6	Red	To Regulator / Rectifier

Switch Position	Continuity
1 Off	1 + 3 + 6
2 Run	2 + 5 + 6
3 Start	2 + 4 + 5

Figure 10-1 **Wiring Schematic**
D3212 Rev G

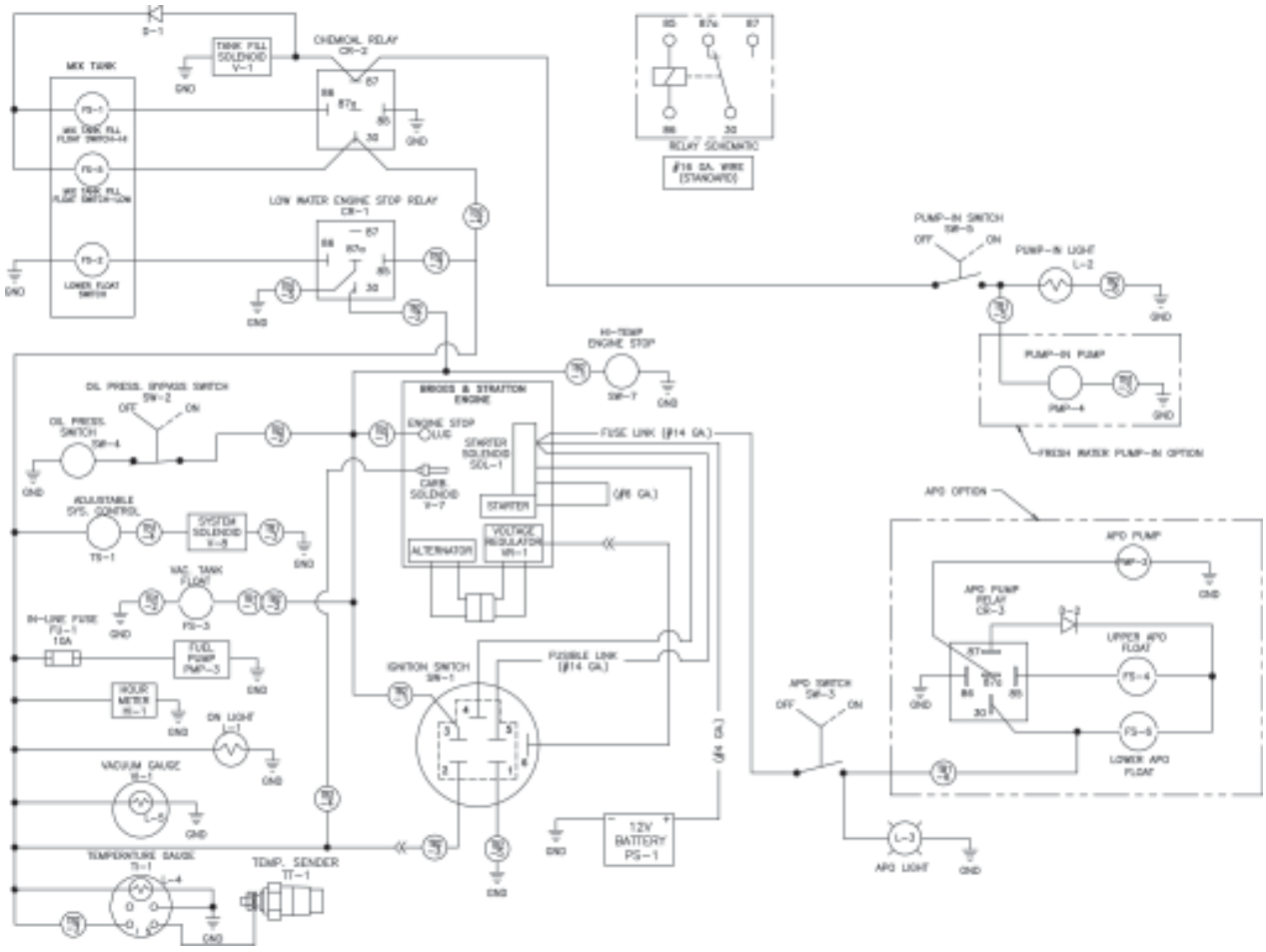


Figure 10-3 Wiring Diagram
D3213, Sht 1 Rev K

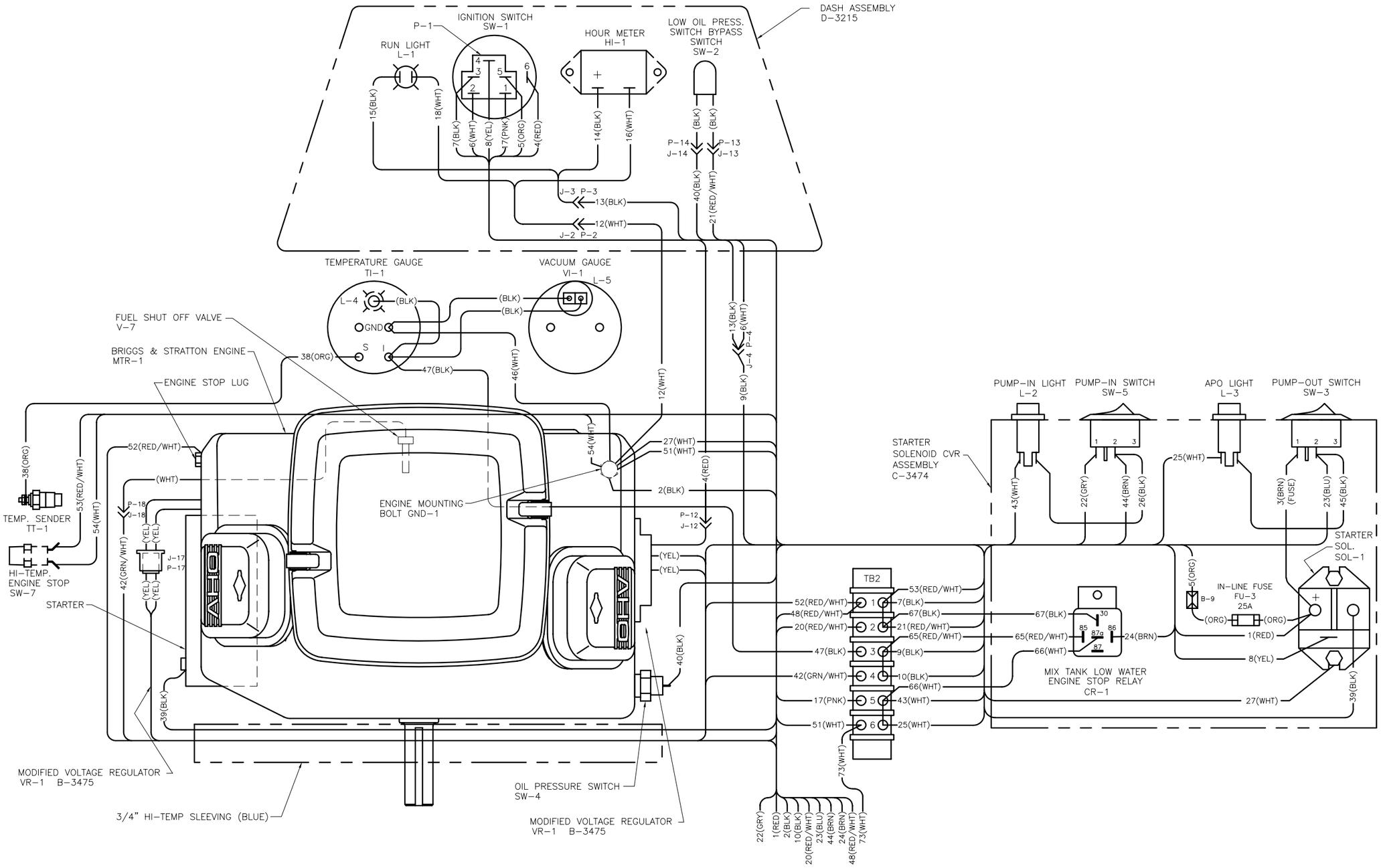
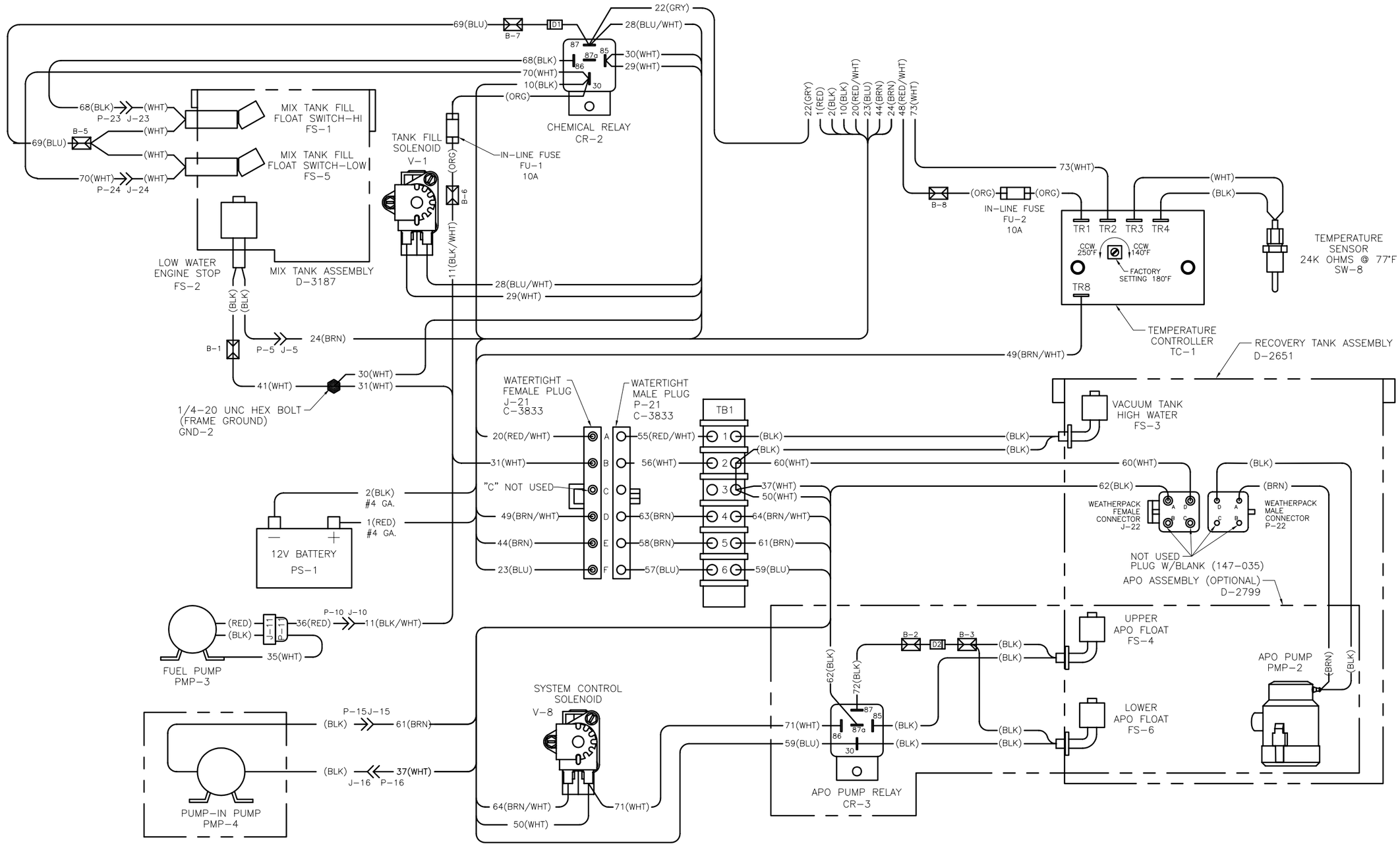


Figure 10-4 Wiring Diagram
D3213, Sht 2 Rev K



Electrical System
with Exhaust Diverter System

Figure 10-4 **Wiring Schematic**
D4111 Rev C

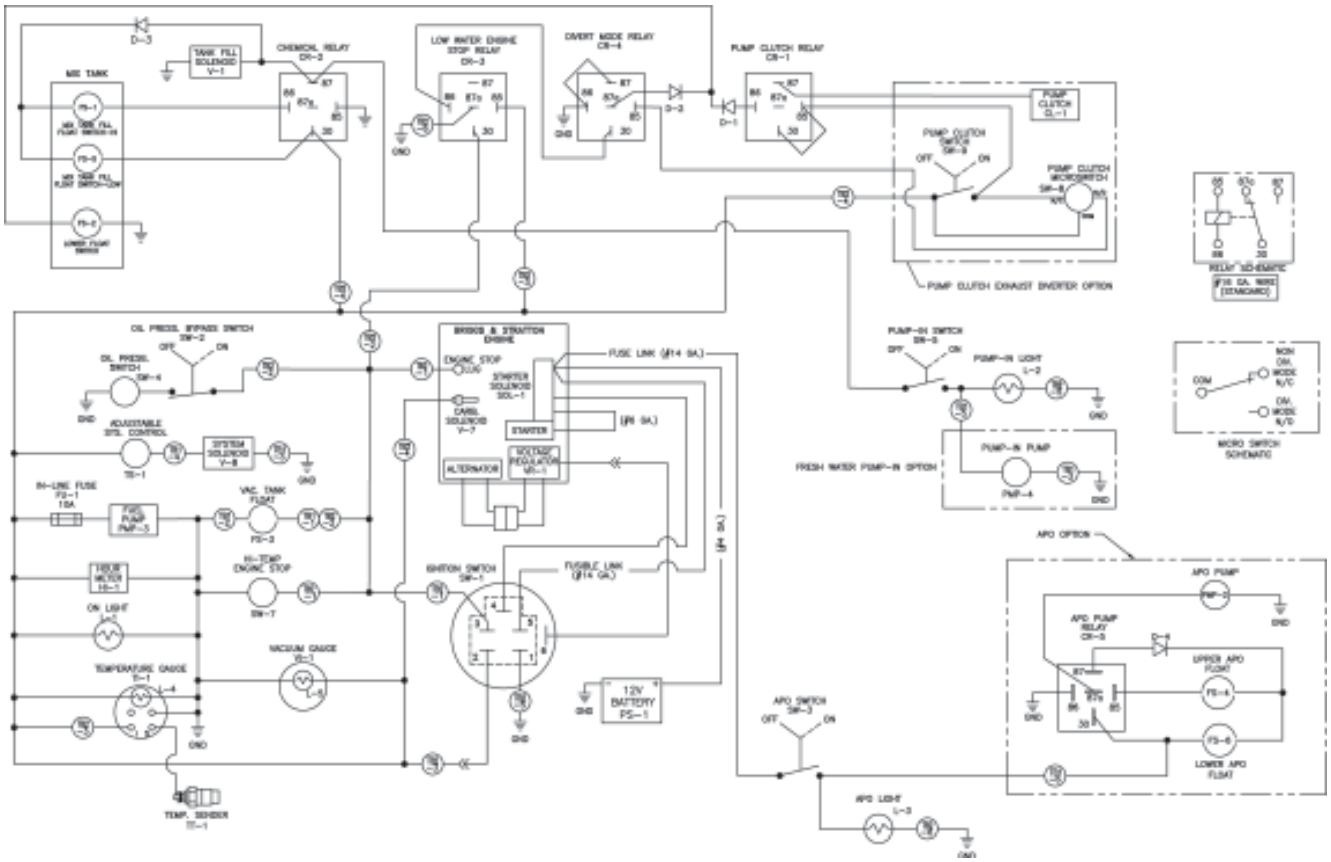


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Figure 10-3 Wiring Diagram
D4110, Sht 1 Rev B

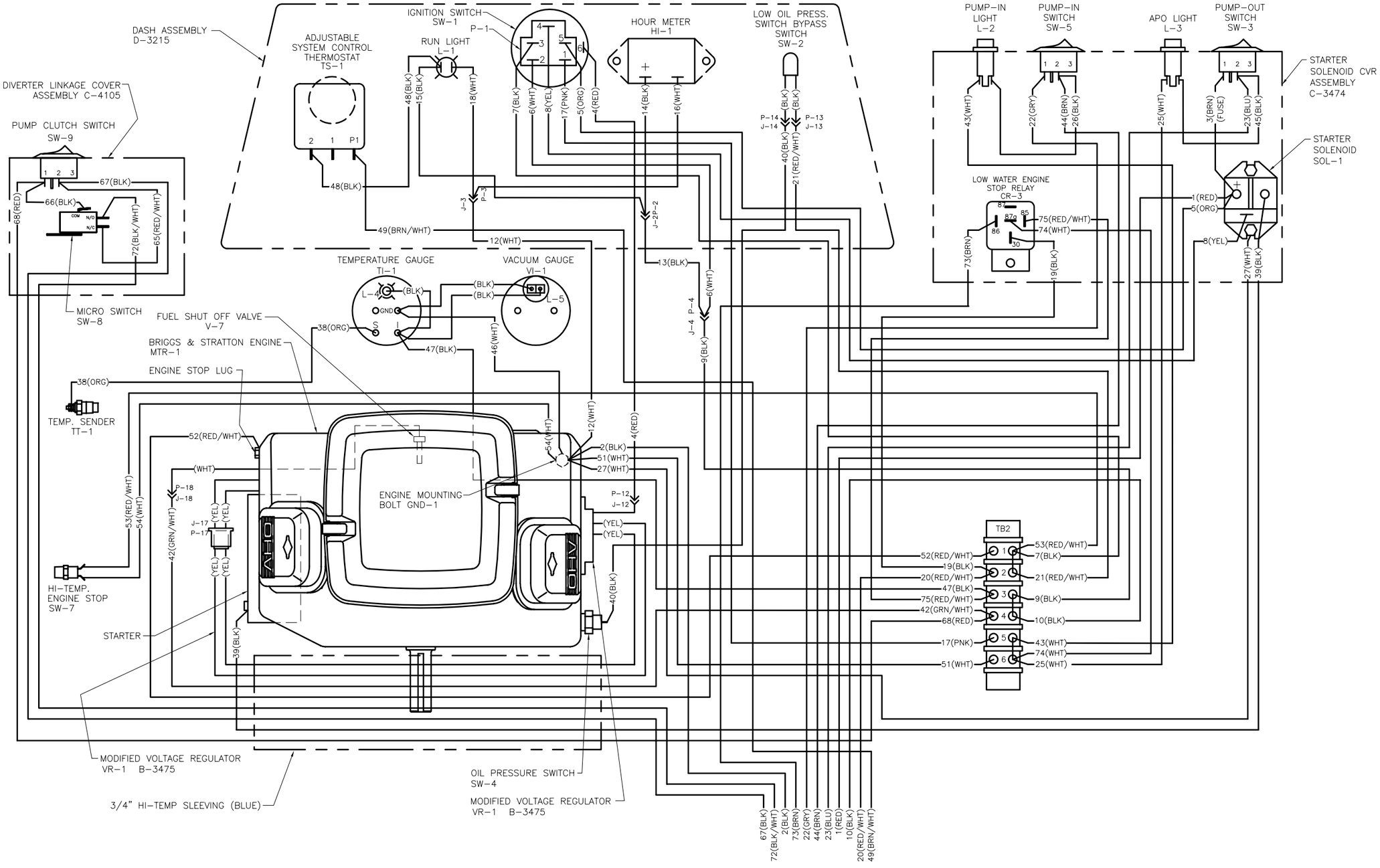
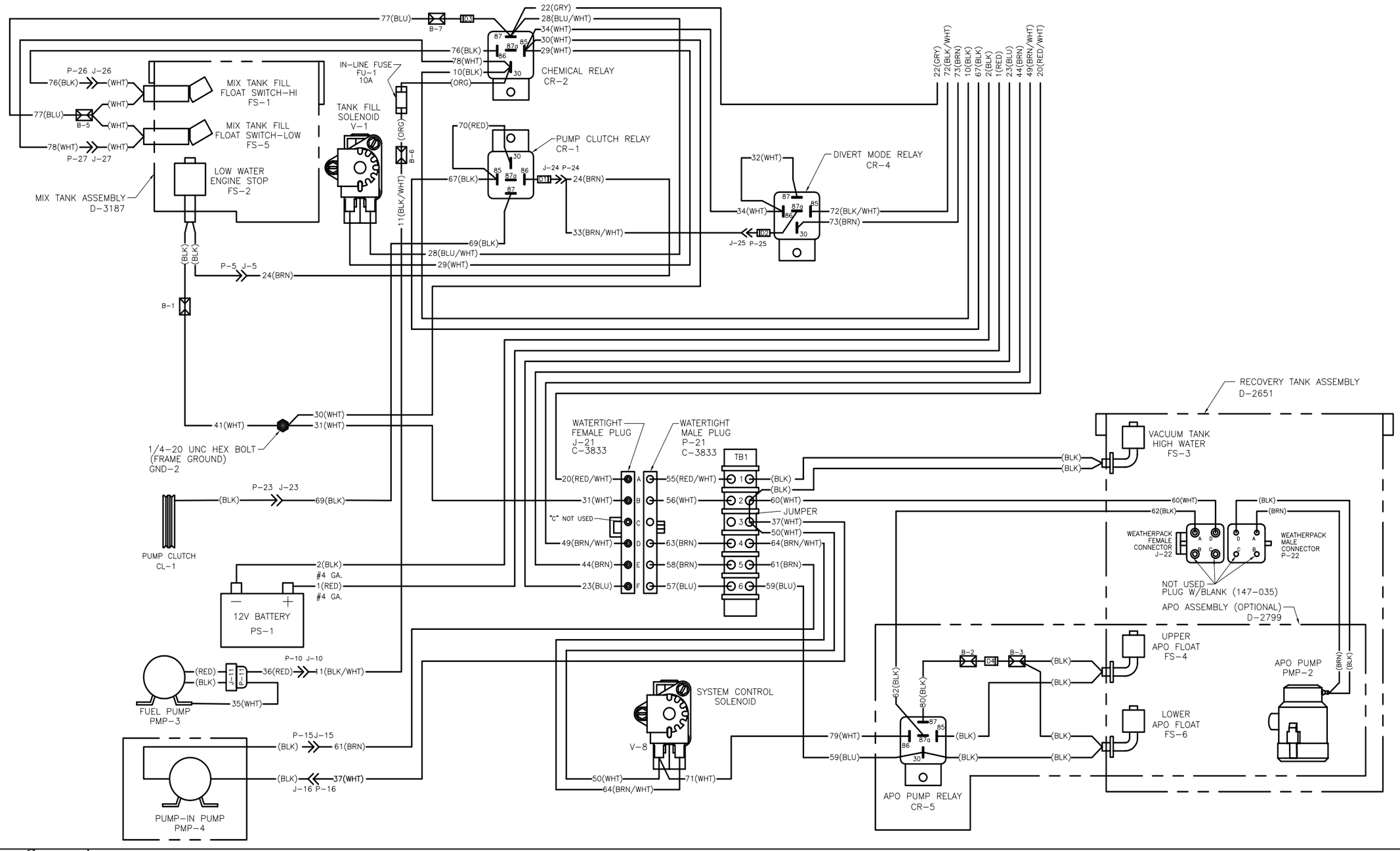


Figure 10-4 Wiring Diagram
D4110, Sht 2 Rev B



Electrical Troubleshooting

No.	Problem/Possible Cause	Solution
1.0	**The engine is not charging the battery.**	
1.1	The *regulator/rectifier* is bad.	Check the B+ voltage from the regulator/rectifier to ground. With the engine running at normal RPM the voltage should be 12.5 to 14.5 DC volts. If necessary, replace the regulator/rectifier.
1.2	The *stator winding* is bad.	Check for AC voltage at the regulator/rectifier. The stator should be producing an AC voltage of around 25 to 40 volts. Check your Owner's manual for the exact voltage. If necessary, replace the stator winding.

No.	Problem/Possible Cause	Solution
2.0	**The fusible link is blown.**	
2.1	The *fusible link* is weak or there is an electrical short in the system.	Replace the weak link. Check the unprotected wires for a short circuit. Check under the dash panel for a loose wire or a wire that has rubbed it's insulation off and is shorting out to ground. Unscrew each individual wire (except the white wires) one at a time until the breaker does not trip. Then trace that circuit.

Machine Maintenance

SpitFire 4.0
Section 11-1

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. All recommended maintenance must be performed by competent service personnel.

Important: Record the date and machine hours on the maintenance log.

We have provided a maintenance log for your convenience at the end of this section.

Records of maintenance must be kept and copies may be required to be furnished to HydraMaster before the warranty is honored.

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.

OPERATIONAL MAINTENANCE

DAILY:

- Check engine oil level.
- Check high pressure pump oil. Add as necessary.
- Inspect garden hose screen. Clean as needed.
- Visually inspect machine for loose wires, oil leaks, water leaks, etc.
- Lubricate blower with an oil based lubricant through blower inlet.

WEEKLY:

- Inspect vacuum tank s/s filter and filter bag for tears, holes, etc. Clean, repair or replace as needed.
- One time change of oil and oil filter ***after first 20 hours*** of use.

WEEKLY (cont.):

- Check oil level in blower.
- Check drive system screws. Tighten as needed.
- Check pump drive belt for wear.
- Check pump pulleys.
- Check high pressure water lines for wear or chafing.
- Check all nuts and bolts. Tighten as needed.
- Inspect vacuum relief valve. Clean and lubricate as necessary.
- Clean vacuum tank thoroughly with high pressure washer.
- Check wiring for chafing.
- Flush water and chemical system with 50/50 white vinegar solution.
- Change engine oil (every 50 hrs.).

MONTHLY:

- Change oil filter (every other oil change).
- Check engine air cleaner filter. Clean as necessary.
- Remove pressure bypass valve piston plate. Grease plate. Reinstall.
- Check water level in battery. Clean connections as needed.

QUARTERLY:

- Check fuel lines.
- Clean and gap spark plugs.
- Check drive coupler for cracks or wear. Replace as necessary.
- Change oil in blower.
- Change pump oil.
- Grease blower bearing fittings.

AS REQUIRED: DE-SCALING

Scale deposits on the interior of the heating system can cause a noticeable loss in heating performance. Deposits of this kind result from hard water deposits, excessive chemical use, improper chemicals, etc. The frequency with which de-scaling procedures are required will vary. If your area has particularly hard water or you see evidence of deposits in the water system, you may have to de-scale monthly.

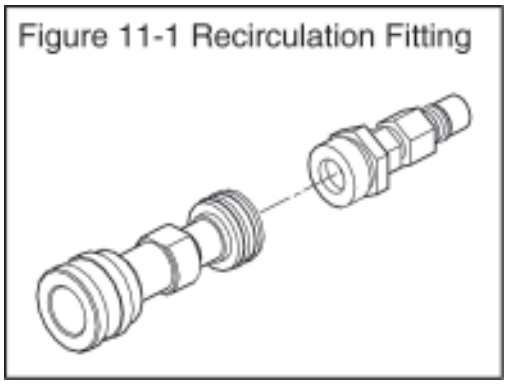
To de-scale your system, add an appropriate de-scaler chemical to your mix tank. Circulate it through the heating system. Let it stand. Flush and repeat as necessary. Clean all screens and strainers, and check them frequently following de-scaling.

NOTE: If you are using T.M. DeScaler through the flow meter, make sure to run clean water through the flow meter after this procedure.

To de-scale using the recirculation kit (part no. 078-058), start with an empty mix tank. Fill a third of the mix tank with T.M. DeScaler. Follow the recommendations on the T.M. DeScaler label for proportions. Verify that the upper float is not lying horizontal, but floats below.

Attach the recirculation fitting provided in the kit to the garden hose quick connect (see illustration) and this combination to the front of the machine.

Figure 11-1 Recirculation Fitting



Attach one section of female/female solution hose to the outgoing solution fitting on the front of the machine and the other end to the garden hose and recirculation fitting combination that is attached to the front of the machine (or as many sections as you want, if you wish to de-scale your hoses).

Start the machine and allow it to run for three to five minutes. Do not leave the T.M. DeScaler solution in the system. Flush the system with clean water and turn the machine OFF.

OVERALL MACHINE MAINTENANCE

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.

The 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 hoses 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 and thoroughly clean, removing all lint build-up. Inspect for damage and reinstall.
- Remove filter bag. Thoroughly clean and reinstall. If the bag is torn, replace it.

- 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.

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How to Order Parts

SpitFire 4.0

Section 12-1

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

WARRANTY PARTS ORDERS

1. Call the local distributor where you purchased your equipment and ask for the Service Department.

2. Have the following information ready:
   - A. Equipment Model
   - B. Date of Purchase
   - C. Hours on the Unit
   - D. Unit Serial Number
   - E. Description of Malfunction

3. Once it has been determined which parts are needed to correct the problem with your machine, make arrangements with your distributor to either perform the repairs or ship the parts to you.

PARTS ORDERS

Call your local distributor. In most instances, they either stock or have access to parts through a regional service center.

EMERGENCIES

If, for any reason, your distributor is unable to supply you with the necessary parts, they may call us and arrange for expedited shipping.

HydraMaster sells parts only through authorized distributors and service centers.

ONE FINAL NOTE

Any questions you have regarding the warranty program should be directed to the:

HydraMaster Customer Service Department
(425) 775-7275,
8 a.m. to 5 p.m.
Monday through Friday (PST).

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 covers only defective materials and/or workmanship for the periods listed. **Labor and/or diagnostic reimbursement is specifically excluded.**

Warranty Information

SpitFire 4.0
Section 13-1

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 an oil based 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.

VACUUM 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 flowmeter 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 HEATING SYSTEM:

- Over pressurization of the system (recommended maximum working pressure-800 PSI).
- Failure to protect against freezing.

HARD WATER DEPOSITS:

- Failure to use or maintain a water softening system or a properly installed magnetic-type de-scaler with machine operating in designated "Hard Water Areas" (3.5 grains or more per gallon).

WARRANTY PROCEDURE

Warranty coverage is available to you ONLY through:

HydraMaster Corporation
11015 47th Avenue W, Mukilteo, WA 98275.

When warranty parts are needed, write **HydraMaster Warranty Dept.** at the above address, or call:

Warranty/Service Dept. (425) 775-7275.
8:00 am to 5:00 pm Pacific Time.

No collect calls will be accepted.

When calling, be sure to have machine information and serial number ready for the service representative.

IMPORTANT: HydraMaster's warranty policy provides replacement parts without charge for thirty (30) days to customers maintaining current account status. An invoice 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.**

FOR FUTURE REFERENCE:

Model No. _____

Serial No. _____

Date of Purchase: _____

Purchased From (Distributor): _____

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Accessories

SpitFire 4.0
Section 14-1

Genuine HydraMaster Accessories & Detergents

This section of your Owners Manual is devoted to Accessories and Detergents which we have found to be helpful and useful. These products can enhance your cleaning and reduce your labor costs!

HydraMaster Machine accessories are the most innovative collection available in the cleaning industry. Our patented **RX-20 Rotary Extractors** have changed the shape of steam cleaning. Our hoses and tanks are of the finest quality construction.

SafeClean Detergents have been specially prepared, not only to give you exceptional cleaning, but also to optimize your truckmount's operation and reliability. Most detergents don't work well under the high heat, high pressure conditions of truckmount use. SafeClean will maintain your machines's water pump and water heating systems at peak efficiency and help ensure fewer breakdowns.

For more information, or to order

Genuine HydraMaster Accessories and Detergents

Call your nearest authorized HydraMaster Distributor.

For machine parts lists, please call HydraMaster Customer Service at 1-425-775-7276

Product Updates

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For machine parts lists, please call HydraMaster Customer Service at 1-425-775-7276