HYDRAMASTER

Corporation
11015 47th Avenue W, Mukilteo, WA 98275

SpitFire 3.2

Machine Serial Number_____

D-182-019

Revised October 19, 2005

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Introduction

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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 truck-mounted 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 turn-key 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 pm	(425) 775-7275 Service
PACIFIC STANDARD TIME	(800) 426-4225 Parts / Service FAX

System Operation

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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 pre-heater 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 operator. The majority of the water flows to the by-pass valve assembly, then back through the secondary exhaust heat exchanger, and back to the mix tank. The water demanded by the operator flows from the water pump through the primary exhaust heat exchanger then out to the cleaning tool.

When the cleaning solution reaches a pre-set 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

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Frame: 22"W x 29"L x 27"H
Steel with baked-on Epoxy finish

Weight: Spitfire 3.2: 350 lbs.

Engine: Vanguard 14 HP Briggs and Stratton
Pressurized oil system
Spin-on filter and oil PSI protection switch

Ignition: Electronic, keystart

Vacuum Blower: Roots 33 RAI

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

Recovery Tank: 50 Gallon Aluminum, Epoxy finish

Cleaning Wand: Stainless steel with heat shield
Replaceable grip
Rebuildable solution valve

High Pressure Hose: 1/4" High temperature lined / vinyl covered
Hose rated to 1250 PSI

Vacuum Hose: 2" reinforced, 1 1/2" 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, 1 1/2" Wand Whip-line
100 ft, Super Flex Solution Line
Battery Box
Van Decal Package
Van Installation Kit
Operation Manual
HydraMaster Jacket

Spare Parts

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Down-time on the unit can be very expensive, because your truck-mounted unit is capable of generating several hundred dollars per day. In order to minimize such down-time, 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

Parts List (078-092)

PART NO	DESCRIPTION	QTY
010-011	Belt, Gates #9335	1
049-014	Filter, Vanguard Oil	2
049-007	Filter, S/S Vacuum Pump	1
049-016	Filter, 1/4" 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
052-051	Quick Connect, 440 Female	2

PART NO	DESCRIPTION	QTY
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, Chem Flowmeter	1
078-101	Kit, Seal & Spring Hi PSI	1
106-016	Plug, Vanguard Spark	2
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, 1 1/2" Full Port	1
169-062	Valve, 1/4 Anti-Siphon	1
169-120	Valve, Chemical System	1
152-008	Sleeve, #6 Drive Coupler	1
078-140	Kit, Hypro Seal	1

Responsibilities

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The ***Purchaser's*** responsibilities, prior to arrival of unit, are:

To install 5/8" 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.

To read the 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 as follows:

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 supervising the correct installation of the unit in your vehicle and thoroughly training you in its operation, maintenance and precautions.

CORRECT INSTALLATION

- 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

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When selecting a truck, remember the preferable vehicle for a SpitFire 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 poly propylene 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 Bulletins 92102, 94062 and 94063 at the end of this manual.)

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

Figure 1-1: **Plywood Installation**

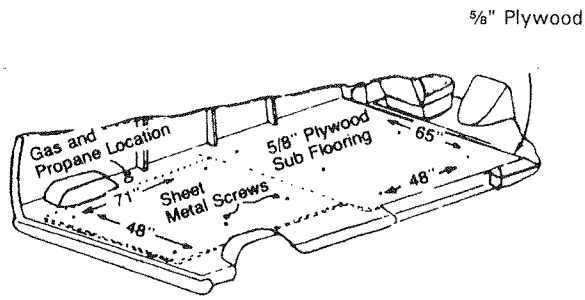
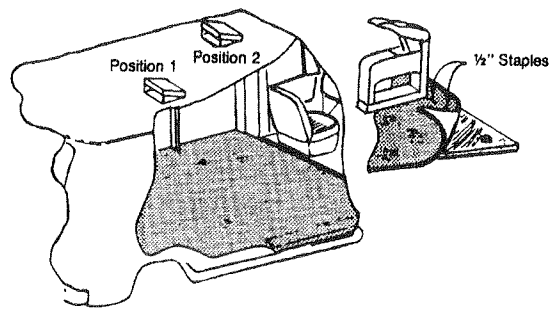


Figure 1-2: **Astroturf and Roof Vent**



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 with 1/2" staples

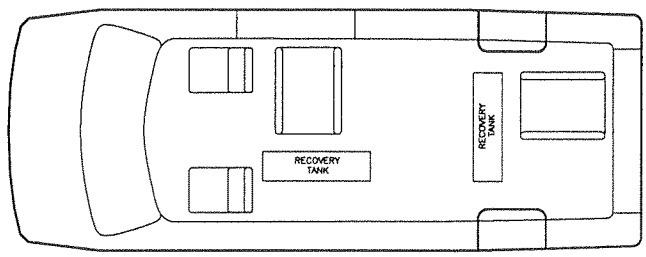
PLACEMENT OF UNIT IN VEHICLE

There are two recommended unit placements:

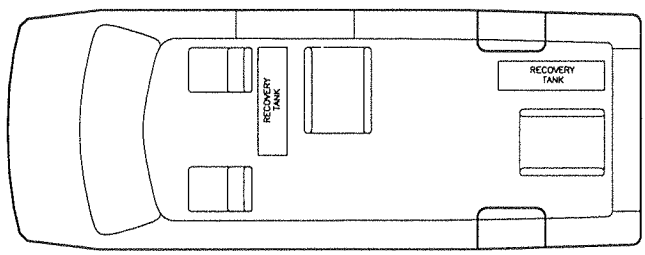
A. SIDE DOOR: Most installations are side door. This provides rear access for accessories and hoses as well as unobstructed access to the component/working side of the machine, thus making it a bit easier to perform maintenance and/or repair without removing the unit from the truck.

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 the unit into the rear door due to the height of the van bed.

Figure 1-3



SIDE AND REAR TANK BEHIND

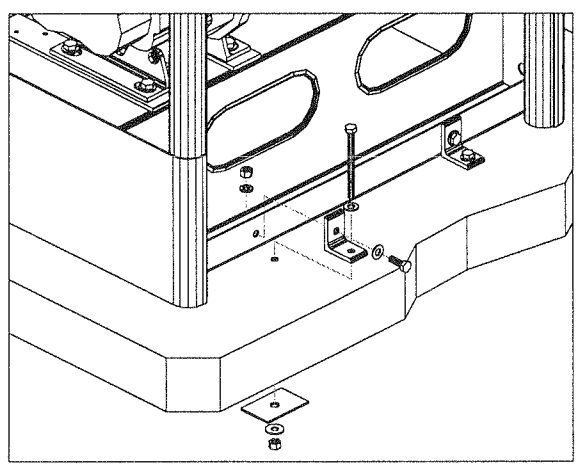


SIDE AND REAR TANK BESIDE

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



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 has or has ever contained a flammable liquid is strictly forbidden by HydraMaster 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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Section 1-15

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.

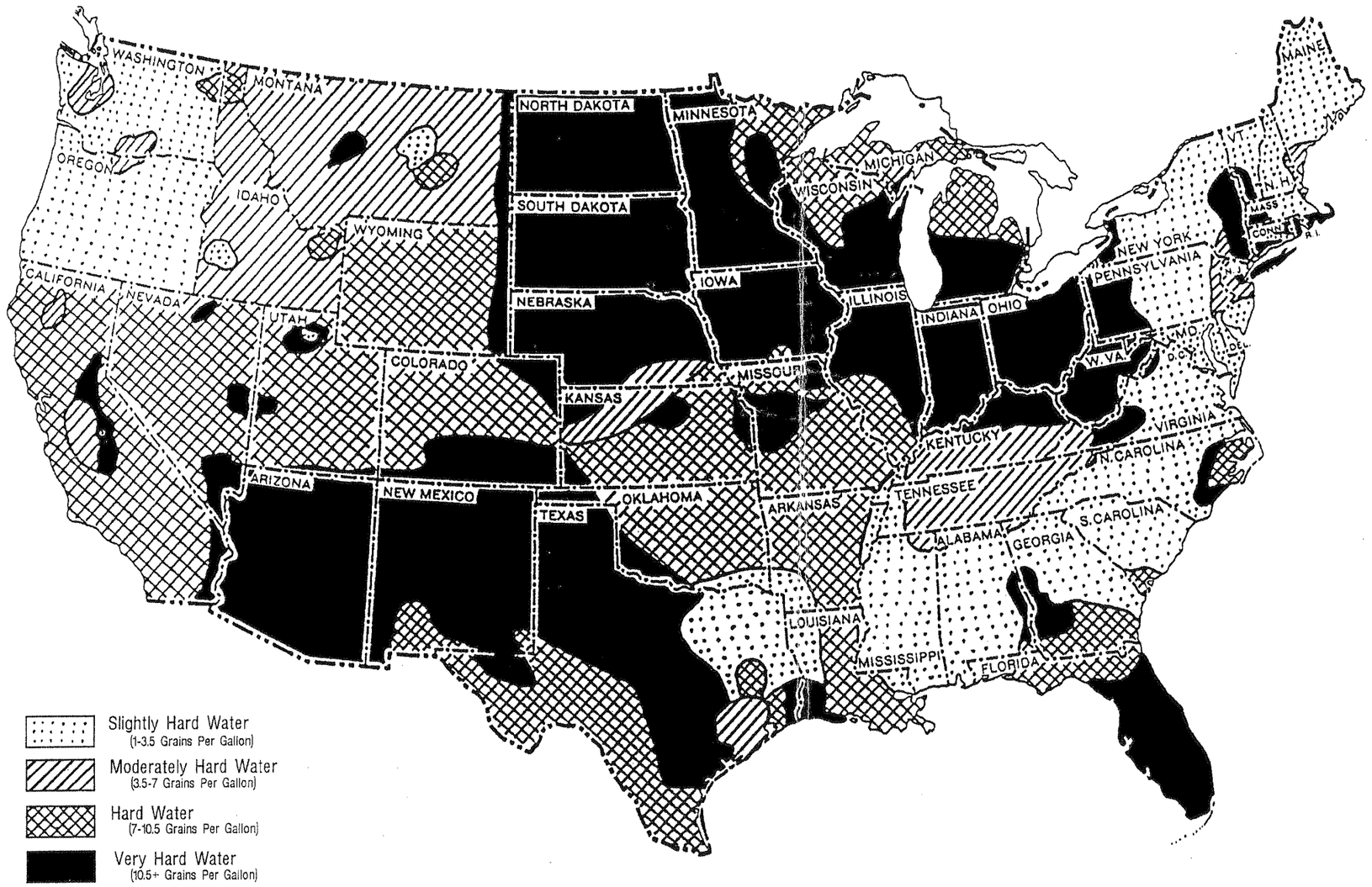
In most cases, an acceptable method of waste water disposal is to discharge into a municipal sewage treatment system after first filtering out solid material such as carpet fiber. Access to the sanitary system can be obtained through a toilet, laundry drain, RV dump, etc. Permission should first be obtained 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 non-compliance can be serious. Always check local laws and regulations to be sure you are in compliance.

Figure 1-5: **Hard Water Map**



Source: Water Treatment Fundamentals, Water Quality Association, 1996.

Machine Assemblies and Parts Lists

Figure 1-6 **Machine Assembly - Front Left View**
D-2793 Rev K

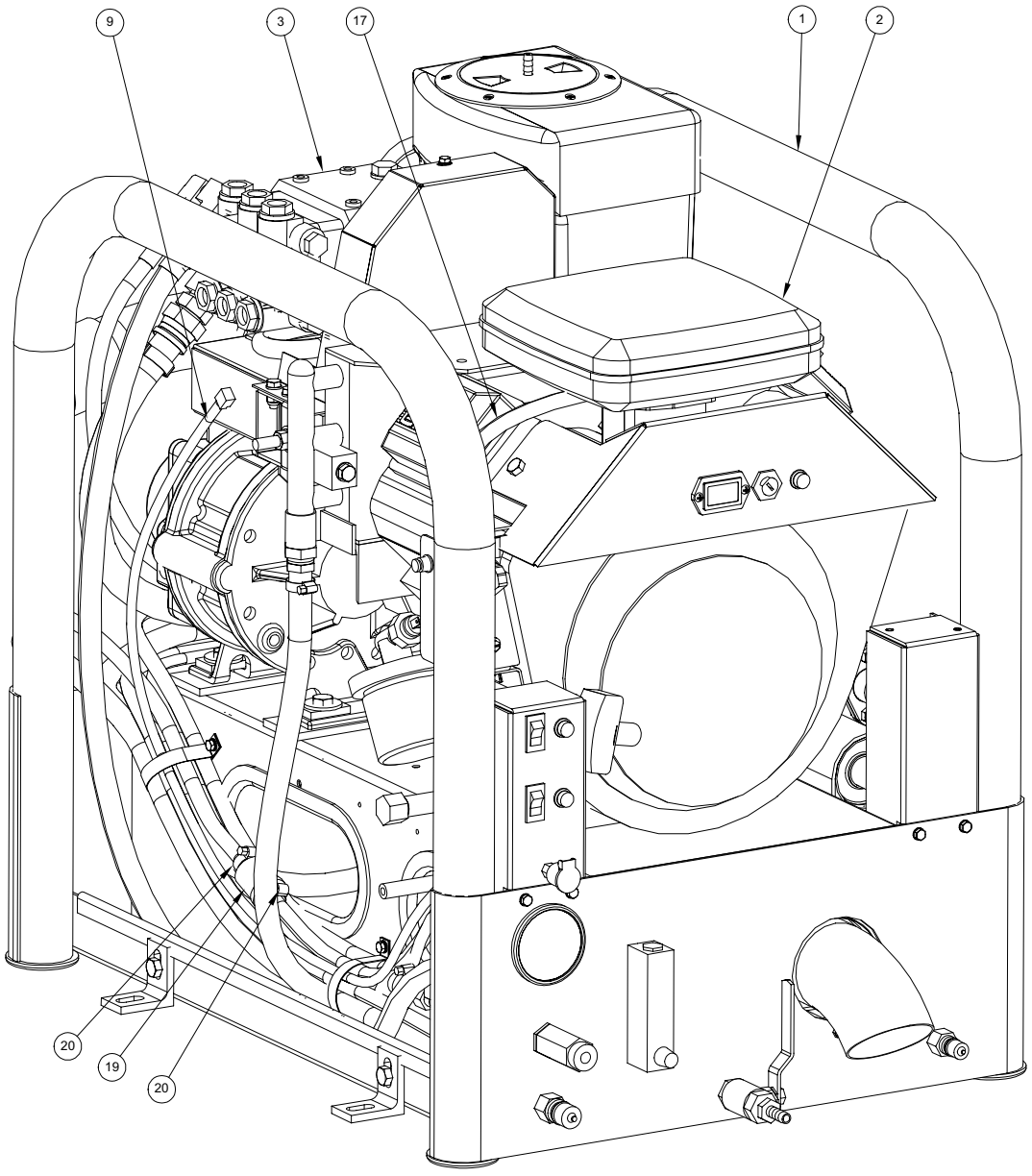


Figure 1-7 **Machine Assembly - Front Right View**
D-2793 Rev K

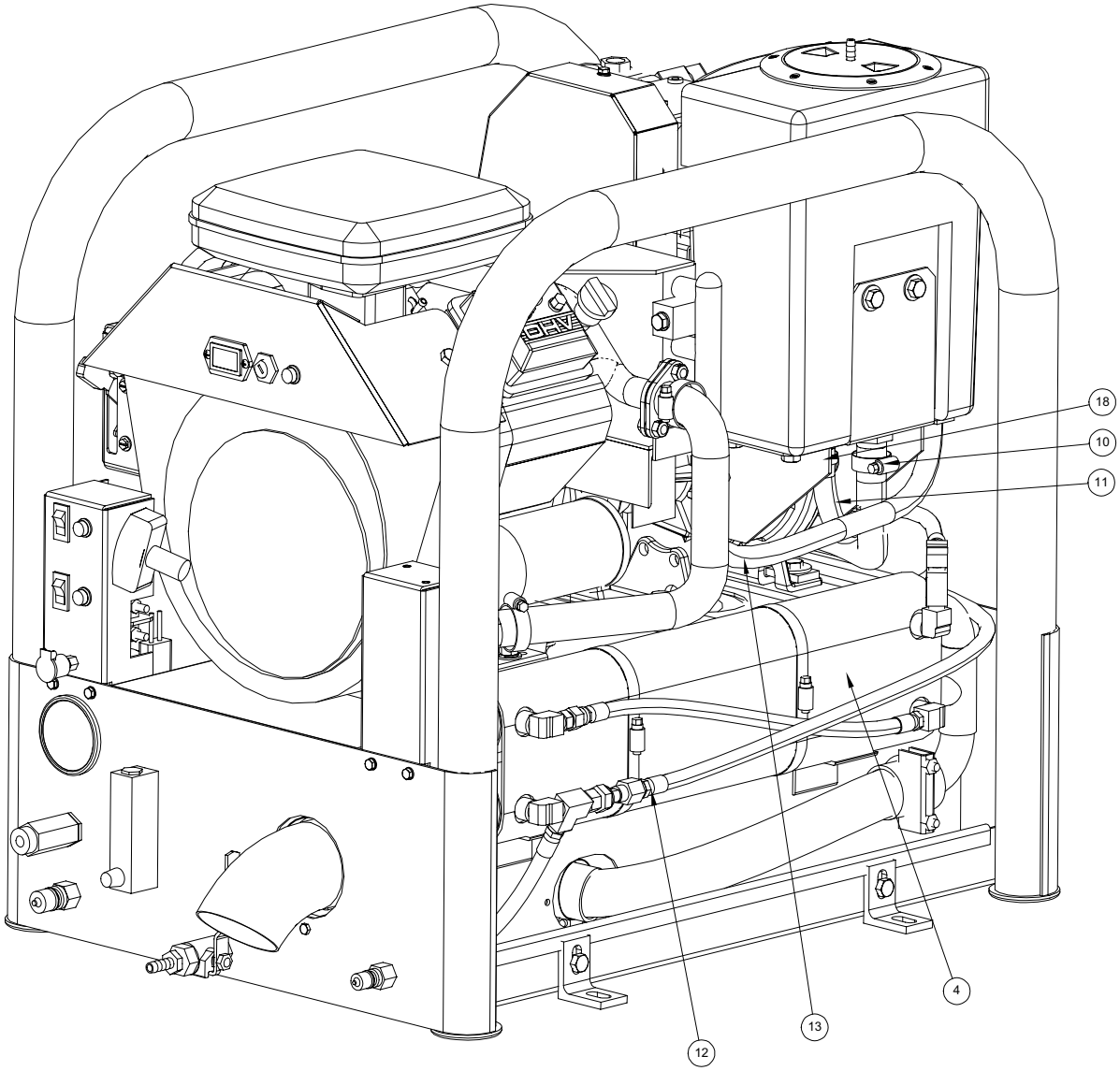


Figure 1-8 **Machine Assembly - Rear Left View**
D-2793 Rev K

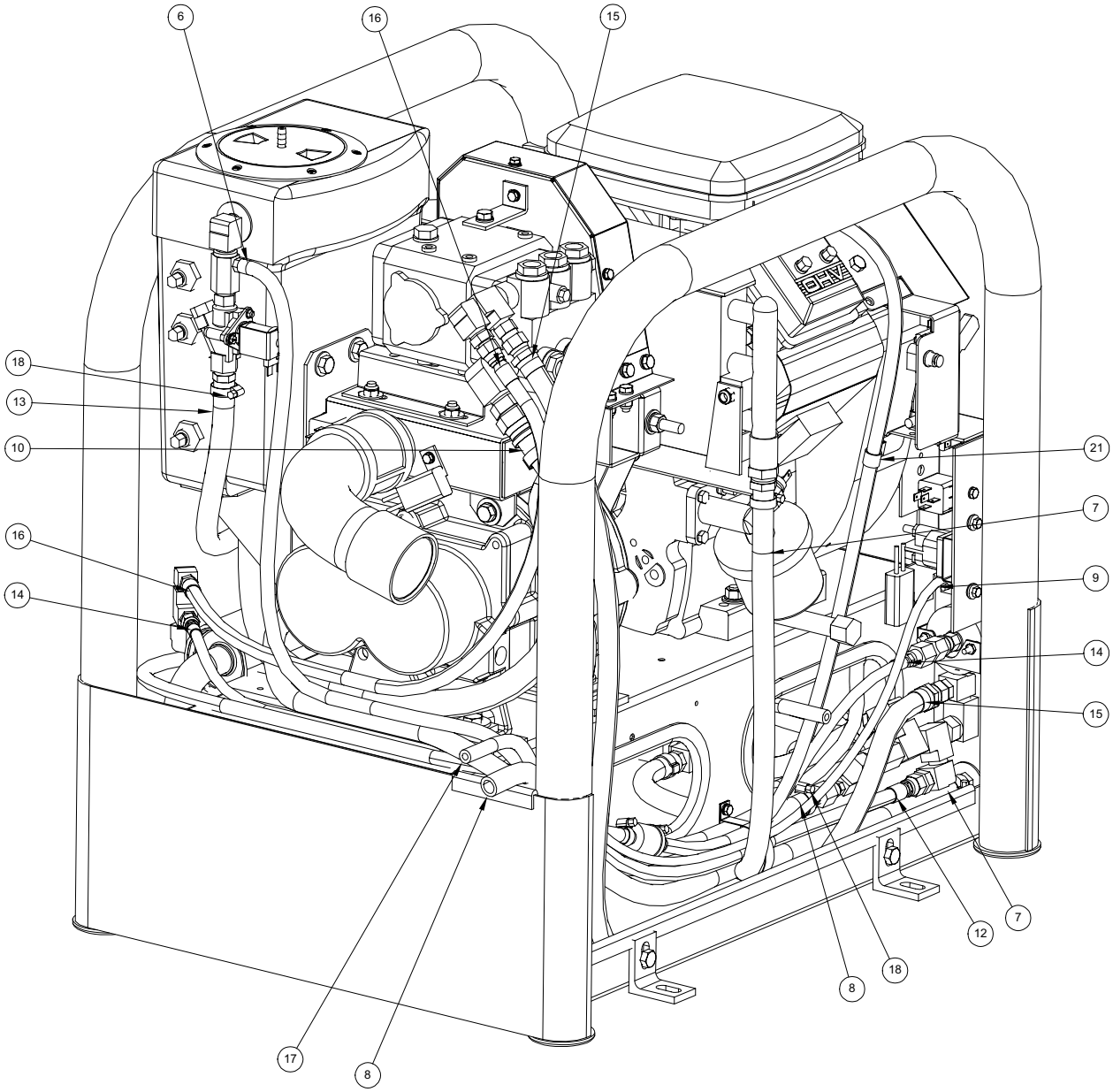
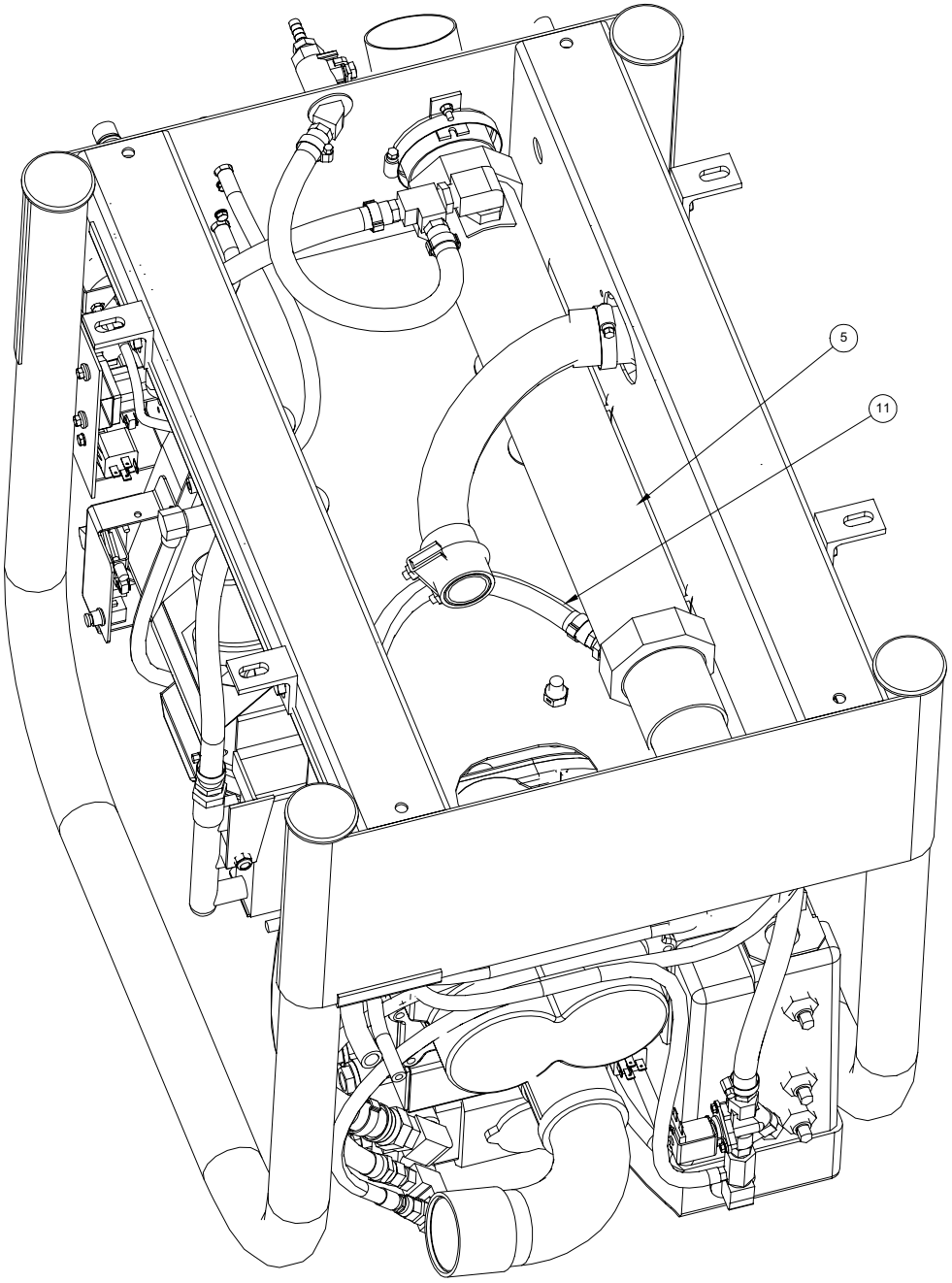


Figure 1-9 **Machine Assembly - Bottom View**
D-2793 Rev K

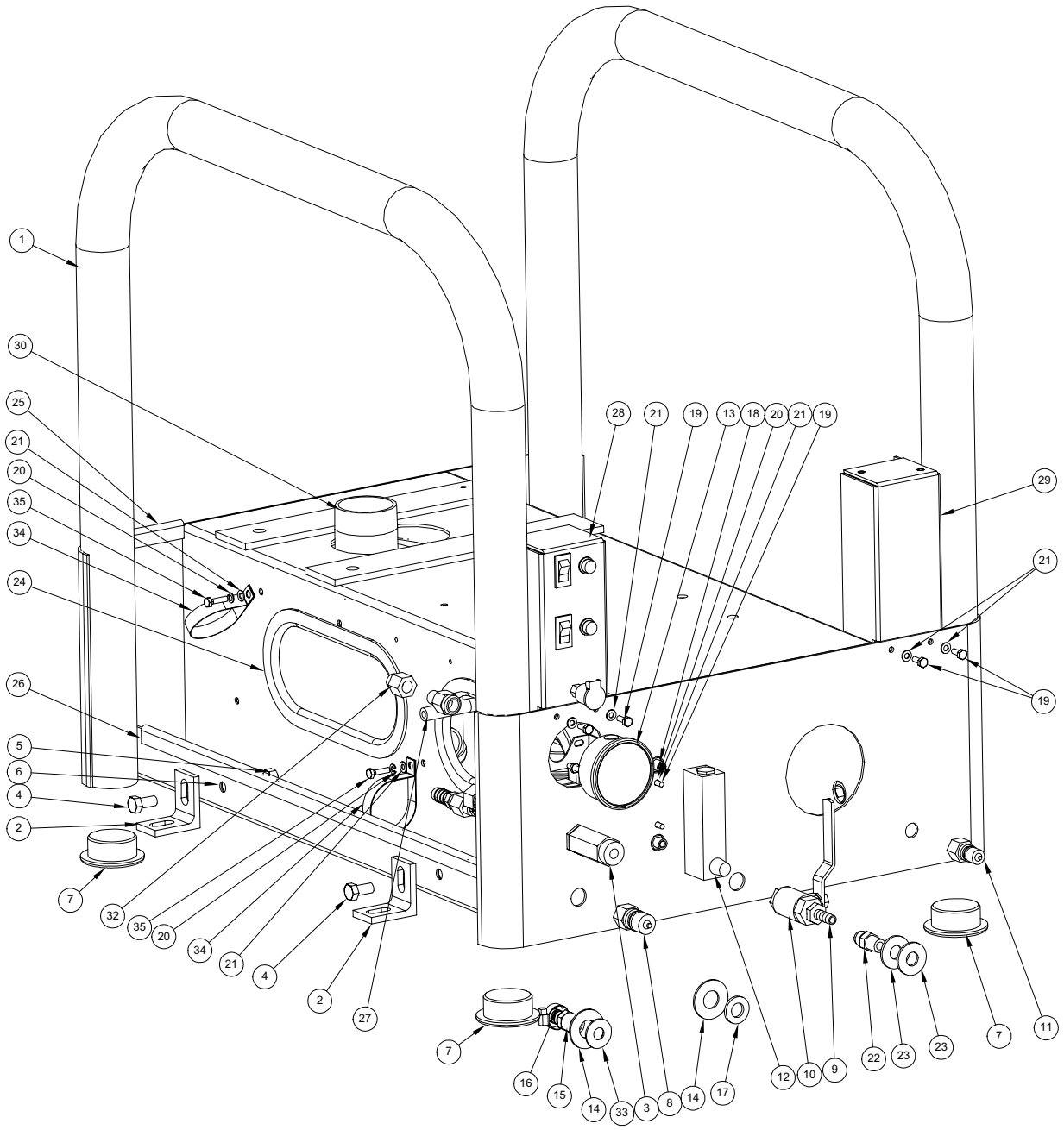


SILENCER REMOVED FOR CLARITY

Machine Assembly Parts List

Item	Part Number	Description	Qty
1	**Fig. 1-10**	Assembly, Frame - Spitfire 3.2	1
2	**Fig. 1-13**	Assembly, Engine 16 HP Vanguard - Spitfire 3.2	1
3	**Fig. 1-17**	Assembly, Pump & Blower - Spitfire 3.2	1
4	**Fig. 1-21**	Assembly, Dual Heat Exchanger - Spitfire 3.2	1
5	**Fig. 1-22**	Assembly, Lower Heat Exchanger - Spitfire 3.2	1
6	000-068-015	Hose, 1/4" I.D. - Bulk	1
7	000-068-018	Hose, 1/2" I.D. Rubber - Bulk	1
8	000-068-018	Hose, 1/2" I.D. Rubber - Bulk	1
9	000-068-030	Hose, 5/32" I.D. - Bulk	1
10	000-068-410	Hose, 3/4" I.D. x 30" Lg. Pump Pick Up w/ 3/4" Ends	1
11	000-068-485	Hose,1/2" I.D. x 47" Lg. Rubber w/ 3/8 NPT & 3/8 SAE	1
12	000-068-510	Hose, 3/8" x 56" Lg. Teflon w/ 1/4 NPT x 3/8 JIC Femal	1
13	000-068-531	Hose, 1/2" I.D. x 30" Lg. Black 1/2 NPT x 3/8 SAE(1/2"	1
14	000-068-534	Hose, 3/16" I.D. x 44.50" Lg. Teflon w/ 1/8 NPT x 1/4 J	1
15	000-068-588	Hose, Throb CDS 4.6 & 4.8	1
16	000-068-619	Hose, 3/8" I.D. x 32" Lg. Teflon	1
17	000-068-660	Hose, 1/4" I.D. Fuel Trident	1
18	000-033-004	Clamp, Size #6	3
19	- - -	Filter, B&S Fuel (Comes w/ Engine)	1
20	000-033-003	Clamp, Size #4 Mini	2
21	000-033-046	Clamp, 1/2 Wide x 1/2 Tube	1

Figure 1-10 **Frame Assembly**
D-5904 Rev A



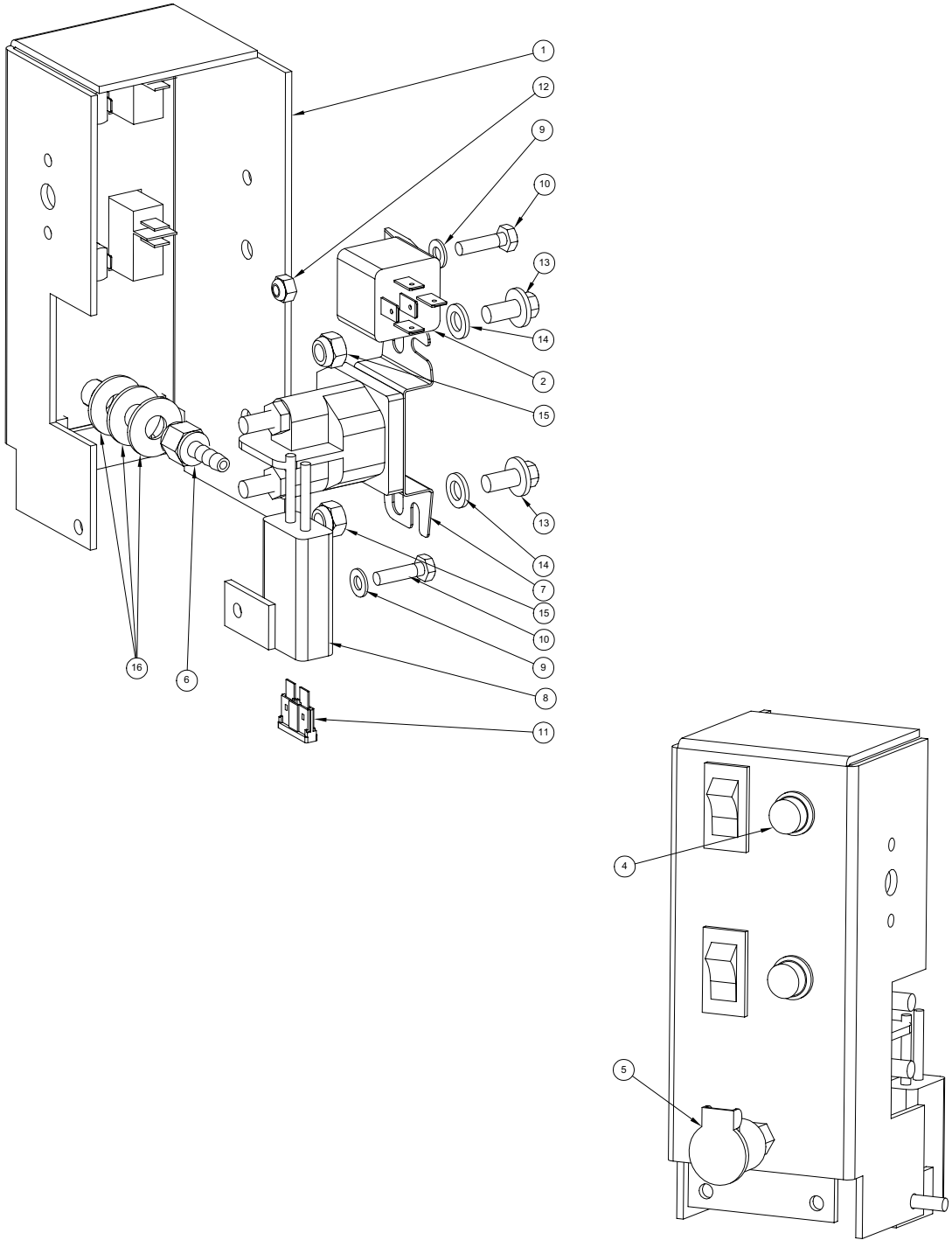
Frame Assembly Parts List

Item	Part Number	Description	Qty
1	000-055-024	Frame, Weldment - Spitfire 3.2	1
2	000-015-265	Bracket, Machine Tie Down - Sp 3.2	4
3	**Fig. 1-12**	Assembly, By-Pass Valve - Spitfire 3.2	1
4	00-143-017-	Screw, 3/8"-16UNC x 3/4" Lg. Hex Head	4
5	000-094-014	Nut, 3/8"-16UNC Hex Zink Plated	4
6	000-174-021	Washer, 3/8" Lock	4
7	000-106-040	Plug, Frame End	4
8	000-052-052	Quick Connect, 660 Male w/ Viton Standard	1
9	000-052-104	Insert, #66 (3/8" NPT x 3/8" Barb)	1
10	000-169-064	Valve, 3/8" NPT Full Port Ball	1
11	000-052-050	Quick Connect, 440 Male w/ Viton Standard	1
12	000-074-013	Meter, Chemical Flow	1
13	000-074-007	Gauge, Pressure (0-1500 PSI)	1
14	000-174-034	Washer, 0.688" I.D. x 1.50" O.D. x 0.078" Thk.	2
15	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	1
16	000-033-004	Clamp, Size #6	1
17	000-057-055	Gasket, Garden Hose	1
18	000-052-097	Insert, #24 (1/8" NPT x 1/4" Barb)	2
19	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	6
20	000-174-014	Washer, #10 Lock	4
21	000-174-001	Washer, #10 Flat	8
22	000-052-533	Nipple, 3/8" JIC x 1/4" NPT	1
23	000-174-007	Washer, 1/2" Flat	2
24	000-131-021	Trimlok, 5/8" x 1/8" Rubber	2
25	000-131-021	Trimlok, 5/8" x 1/8" Rubber	1
26	000-131-021	Trimlok, 5/8" x 1/8" Rubber	2
27	000-068-025	Hose, 1/4" I.D. Clear - Bulk	1
28	**Fig. 1-11**	Assembly, Starter Solenoid Cover - Spitfire 3.2	1
29	000-041-192	Cover, Heat Exchanger - Weldment - Sp 3.2	1
30	000-093-027	Silencer, 2" Compact	1

Frame Assembly Parts List

Item	Part Number	Description	Qty
31	000-135-052	Regulator, Hi PSI Snubber	1
32	000-052-066	Coupler, 1/4" FPT x 1/8" FPT	1
33	000-174-038	Washer, 7/16" S.A.E. Flat	1
34	000-033-067	Clamp, 2" Cushion Loop	2
35	000-143-132	Screw, #10-24UNC x 0.75" Lg. Hex Head	2

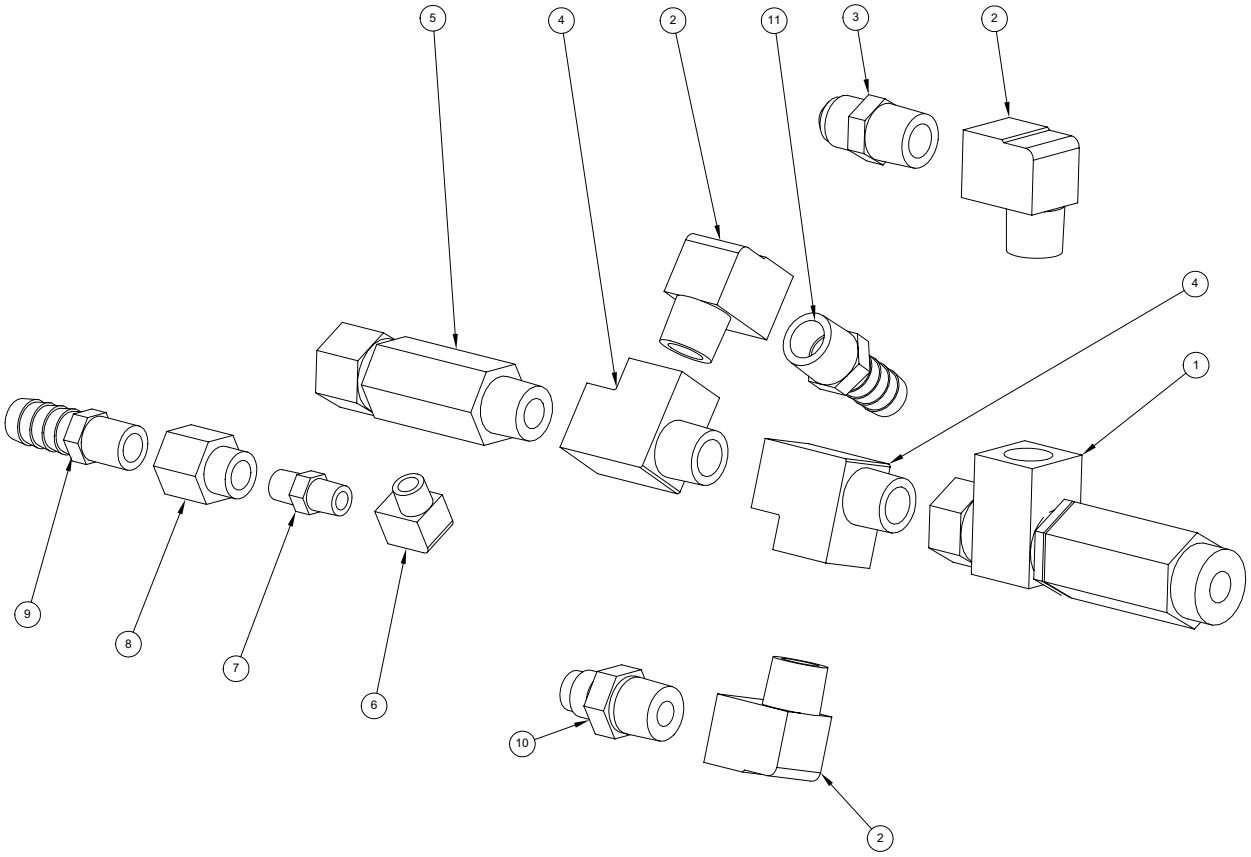
Figure 1-11 **Starter Solenoid Cover Assembly**
D-3474 Rev A



Starter Solenoid Cover Assembly Parts List

Item	Part Number	Description	Qty
1	000-041-179	Cover, Starter Solenoid	1
2	000-157-022	Switch, Relay	1
3	000-157-115	Switch, 16 AMP Mini Rocker	2
4	000-084-006	Lamp, Red Pilot - Round	2
5	000-052-272	Cup, Gravity Feed Oil Blower Lubrication Port	1
6	000-052-096	Insert, #F23 (1/8" FPT x 3/16" Barb)	1
7	000-157-012	Switch, Starter Solenoid 14 HP B&S	1
8	000-056-006	Fuse Holder, Inline Weather Proof	1
9	000-174-001	Washer, #10 Flat	2
10	000-143-132	Screw, #10-24UNC x 0.75" Lg. Hex Head	2
11	000-056-008	Fuse, 15 AMP Plug In	1
12	000-094-034	Nut, #10-24UNC Nylock	1
13	000-143-141	Screw, 1/4"-20UNC x 1/2" Lg. Whiz Lock	2
14	000-174-003	Washer, 1/4" Flat	2
15	000-094-009	Nut, 1/4"-20UNC Hex Nylock	2
16	000-174-032	Washer, 3/8" Flat	3

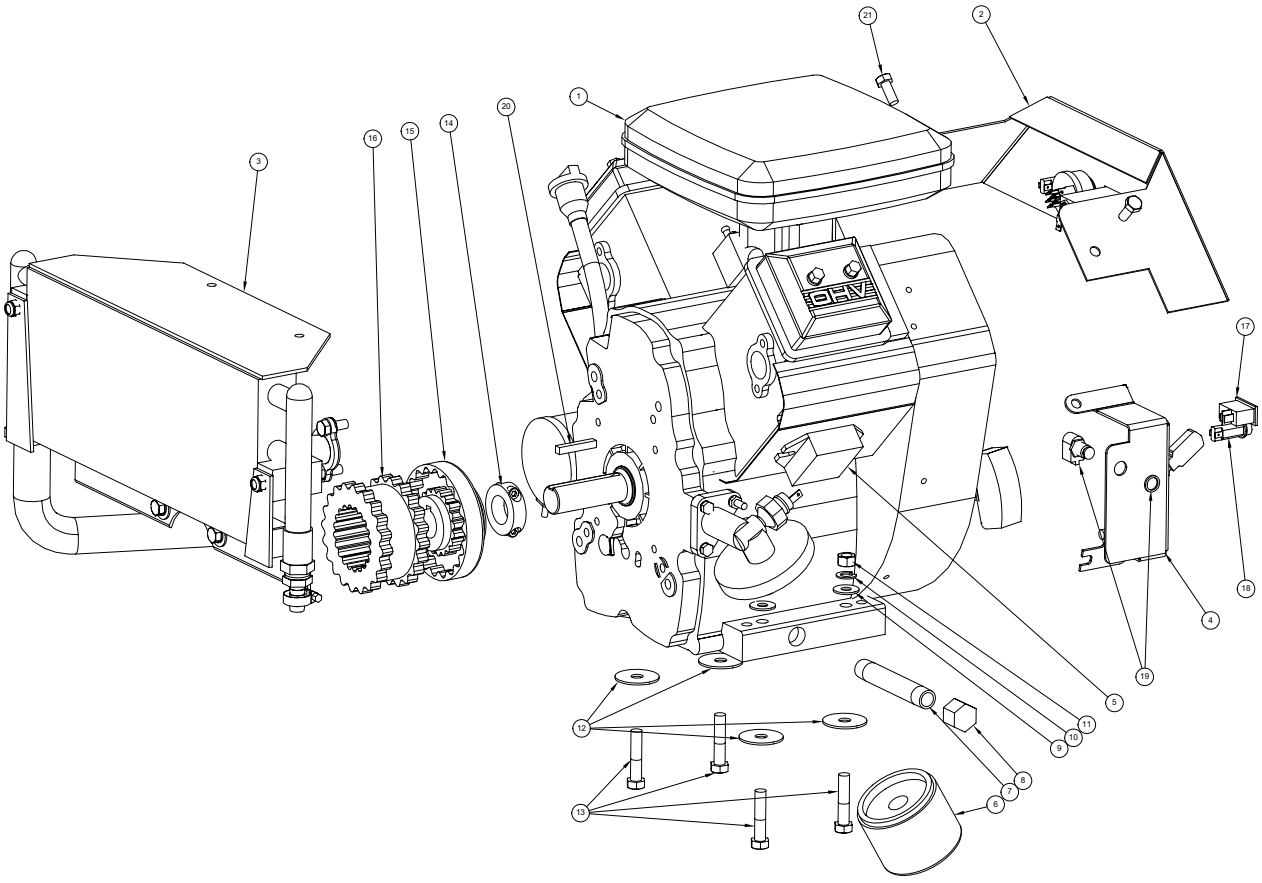
Figure 1-12 **By-Pass Valve Assembly**
C-5907 Rev -



By-Pass Valve Assembly Parts List

Item	Part Number	Description	Qty
1	000-169-158	Valve, By-Pass w/ Red Spring (0-1000 PSI)	1
2	000-052-086	Elbow, 3/8" NPT Street	3
3	000-052-128	Nipple, 3/8" NPT x 3/8" Male Propane	1
4	000-052-023	Tee, 3/8" NPT Male Street	2
5	000-169-011	Valve, Hi Temp Control 180°	1
6	000-052-084	Elbow, 1/8" NPT Street	1
7	000-052-069	Nipple, 1/8" NPT Hex	1
8	000-052-066	Coupler, 1/4" FPT x 1/8" FPT	1
9	000-052-117	Insert, #48 (1/4" NPT x 1/2" Barb)	1
10	000-052-528	Nipple, 3/8" M JIC x 3/8" NPT	1
11	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	1

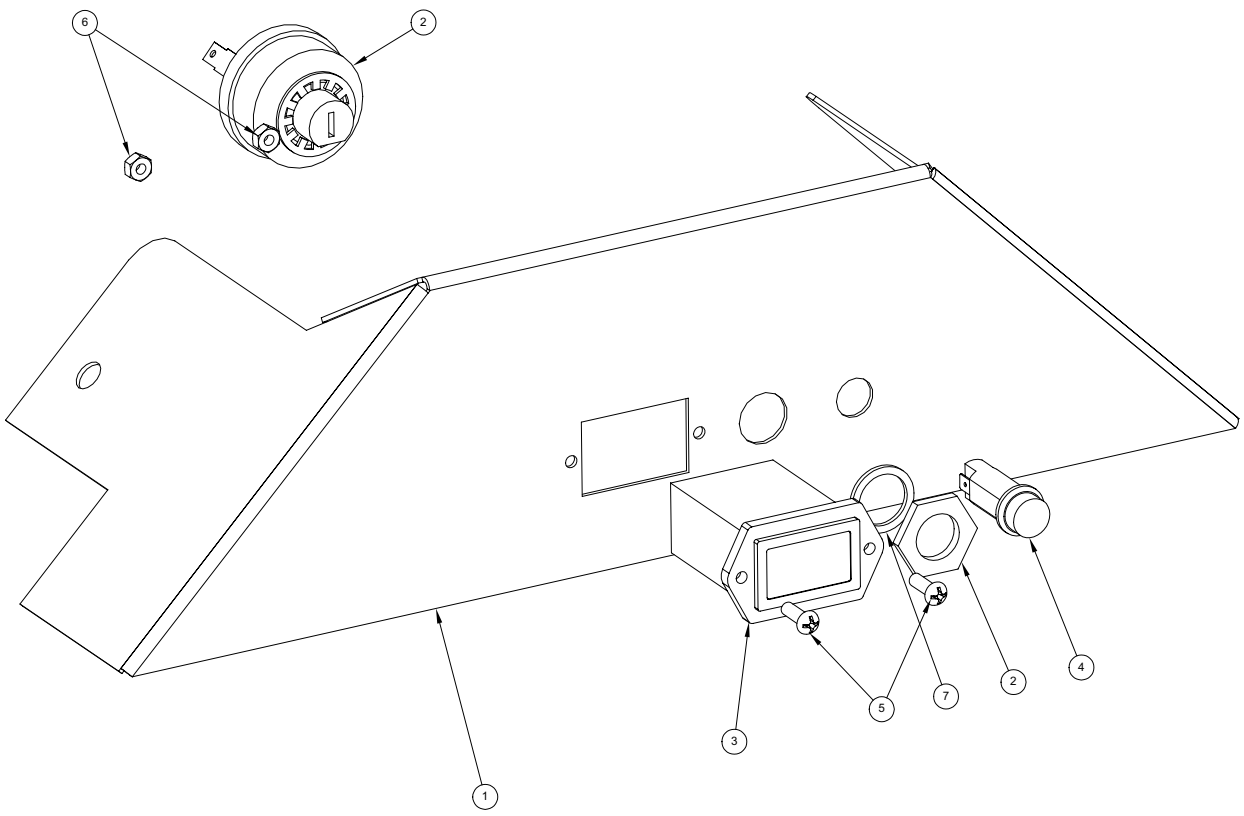
Figure 1-13 **Engine Assembly**
D-2649 Rev H



Engine Assembly Parts List

Item	Part Number	Description	Qty
1	000-047-008	Engine, B&S Vanguard 16 HP V-Twin	1
2	**Fig. 1-14**	Dash Assembly - Spitfire 3.2	1
3	**Fig. 1-15**	Exhaust Assembly, Spitfire 3.2	1
4	- - -	Throttle Box Modification - Spitfire 3.2	1
5	**Fig. 1-16**	Voltage Regulator Modification	1
6	000-049-014	Filter, 16 HP Oil - All B & S	1
7	000-052-408	Nipple, 3/8" NPT x 4" Lg.	1
8	000-027-008	Cap, 3/8" FPT	1
9	000-174-004	Washer, 5/16" Flat	4
10	000-174-057	Washer, 3/8" Lock	4
11	000-094-014	Nut, 3/8"-16UNC Hex Zink Plated	4
12	000-174-013	Washer, 3/8" Fender	4
13	000-143-022	Screw, 3/8"-16UNC x 1.75" Lg. Hex Head Grd 8	4
14	000-020-012	Collar, Spitfire Engine Shaft - Double Screw Type	1
15	000-039-017	Coupler, #6 x 1" Bore	1
16	000-152-008	Sleeve, #6 Drive Coupler	1
17	000-157-115	Switch, 16 Amp Mini Rocker	1
18	000-084-006	Lamp, Red Pilot - Round	1
19	000-157-009	Switch, Momentary - Oil PSI Over Ride	1
20	000-077-006	Key, 0.25" x 1.5" Lg.	1
21	000-143-185	Screw, 8mm x 20mm Grade 8.8 Hex Head	2

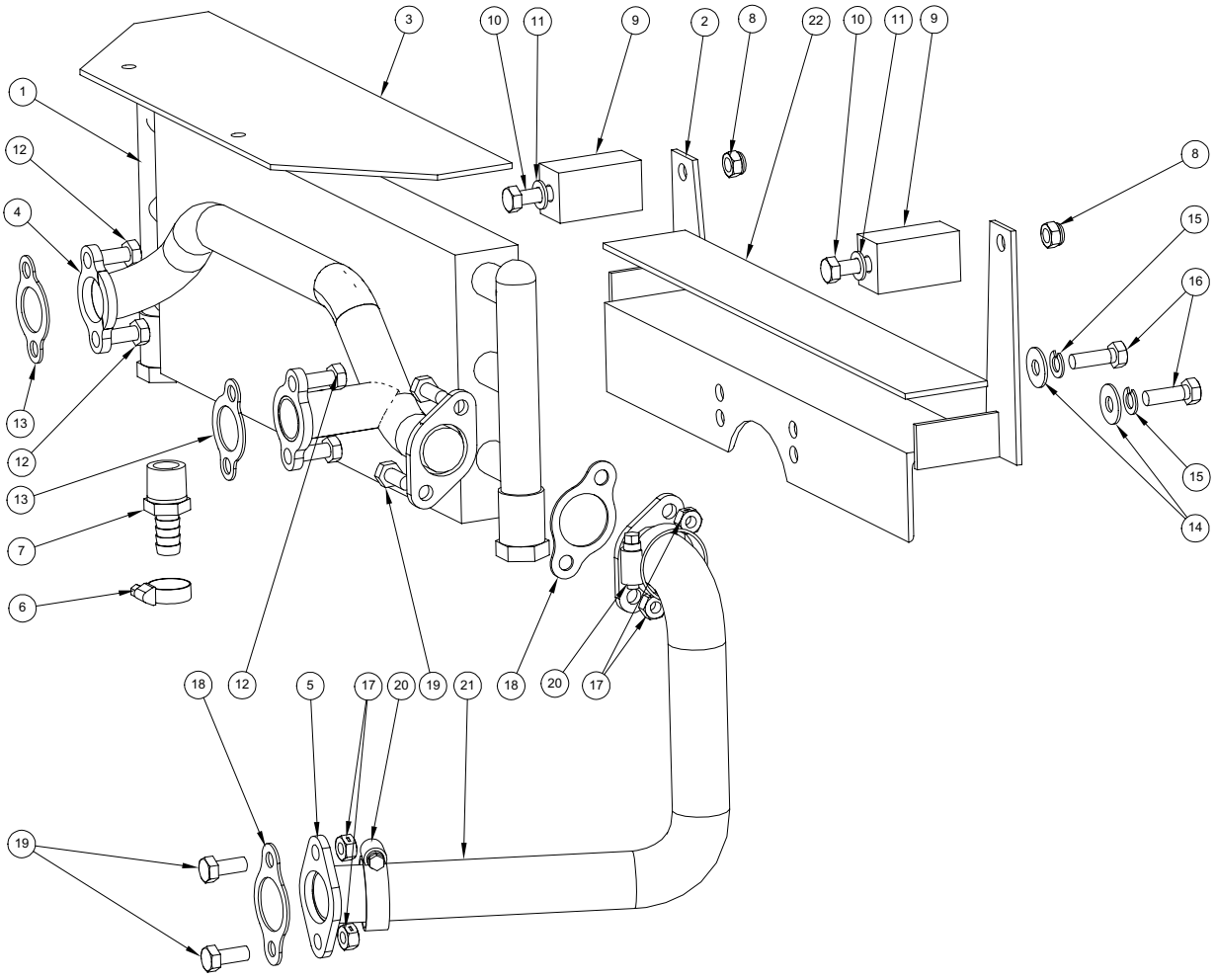
Figure 1-14 **Dash Assembly**
D-2718 Rev B



Dash Assembly Parts List

Item	Part Number	Description	Qty
1	000-100-044	Dash, Spitefire 3.2	1
2	000-157-017	Switch, Ignition B&S 14 HP	1
3	000-074-011	Meter, Rectangular Hour	1
4	000-084-006	Lamp, Red Pilot - Round	1
5	000-143-050	Screw, #8-32UNC x 0.50" Lg. Round Head Phillips	2
6	000-094-002	Nut, #8-32UNC Hex	2
7	000-174-058	Washer,2 1/32" I.D. x 27/32" O.D. Nylon	1

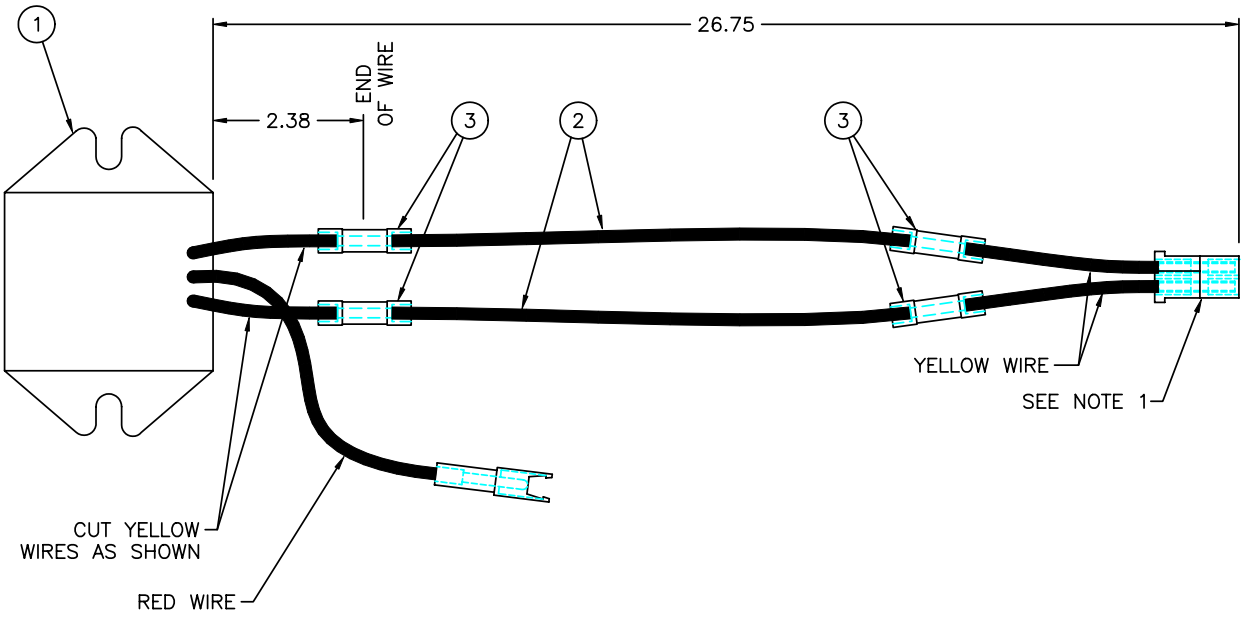
Figure 1-15 **Exhaust Assembly**
D-5909 Rev -



Exhaust Assembly Parts List

Item	Part Number	Description	Qty
1	000-113-002	Radiator, Spitfire 3.2	1
2	000-015-242	Bracket, Lower Support - Radiator	1
3	000-015-300	Bracket, Upper Support - Radiator	1
4	000-090-034	Manifold, Exhaust Modified	1
5	000-125-053	Tube, Exhaust Manifold To Hx - Sp 3.2	1
6	000-033-004	Clamp, Size #6	1
7	000-052-107	Insert, #88 (1/2" NPT x 1/2" Barb)	1
8	000-094-038	Nut, 5/16"-18UNC Nylock	2
9	000-012-003	Block, Radiator Mount Pad	2
10	000-143-092	Screw, 5/16"-18UNC x 2.25" Lg. Hex Head	2
11	000-174-049	Washer, 5/16" Flat	2
12	000-143-185	Screw, 8mm x 20mm Grade 8.8 Hex Head	4
13	000-057-010	Gasket, Exhaust Manifold - Vanguard	2
14	000-174-004	Washer, 5/16" Flat	2
15	000-174-018	Washer, 5/16" Lock	2
16	000-143-090	Screw, 5/16"-24UNF x 1.00" Lg. Hex Head	2
17	000-094-081	Nut, 5/16"-18UNC Hex 2-Way Locking	4
18	000-057-016	Gasket, Exhaust Manifold	2
19	000-143-012	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head	4
20	000-033-020	Clamp, Size #16	2
21	000-131-046	Insulation Sleeving, 0.054" Thk. x 1-1/2" Exhaust Tube	1
22	000-131-009	Insulation, 1/8" x 12" - Bulk	1

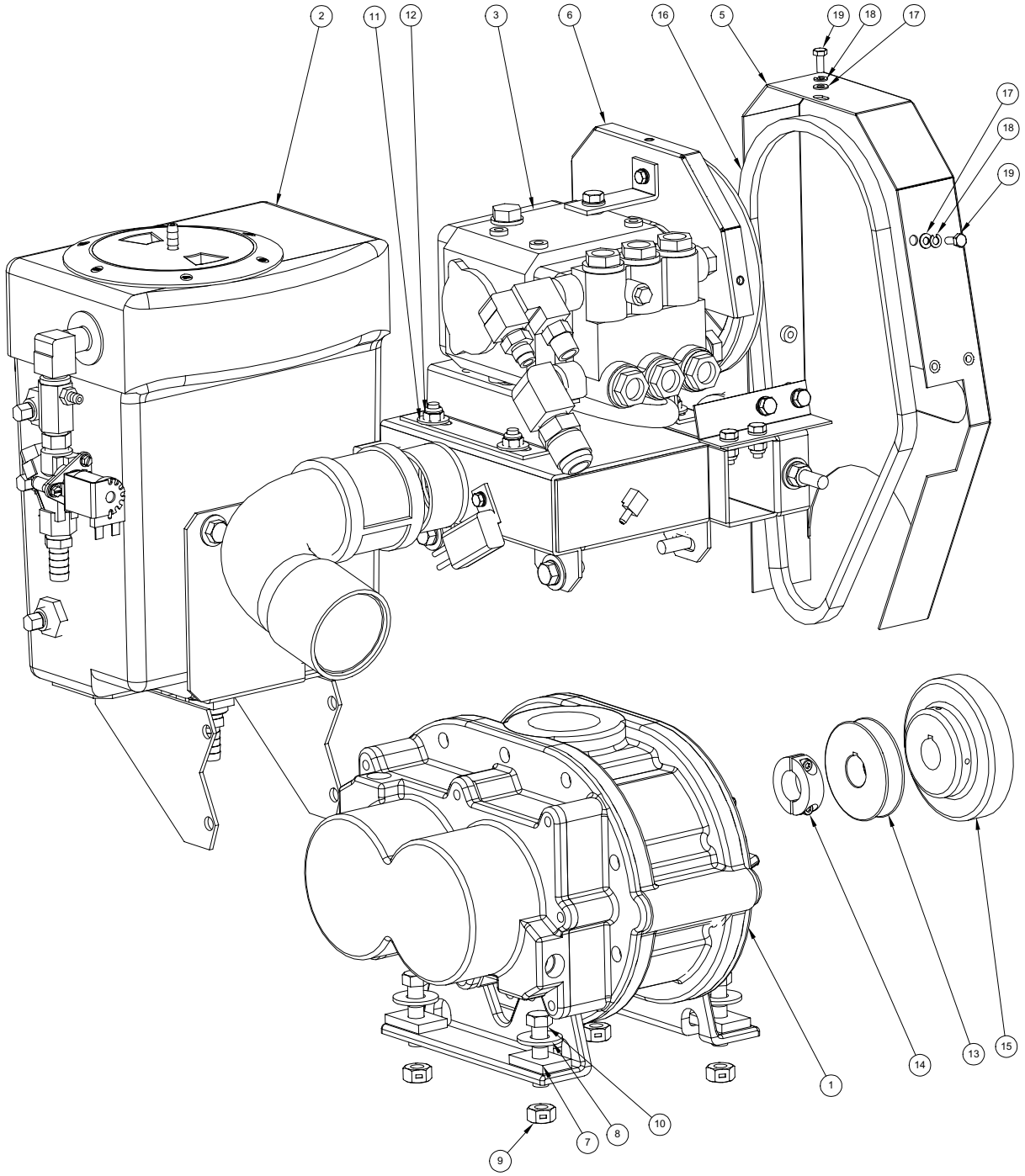
Figure 1-16 **Voltage Regulator Modification Assembly**
B-3475 Rev -



Voltage Regulator Modification Assembly Parts List

Item	Part Number	Description	Qty
1	- - -	Briggs & Stratton Voltage Regulator (Comes w/ Engine)	1
2	000-178-026	Wire, 16 AWG Yellow	2
3	000-037-033	Connector, #22 Pink Butt	4

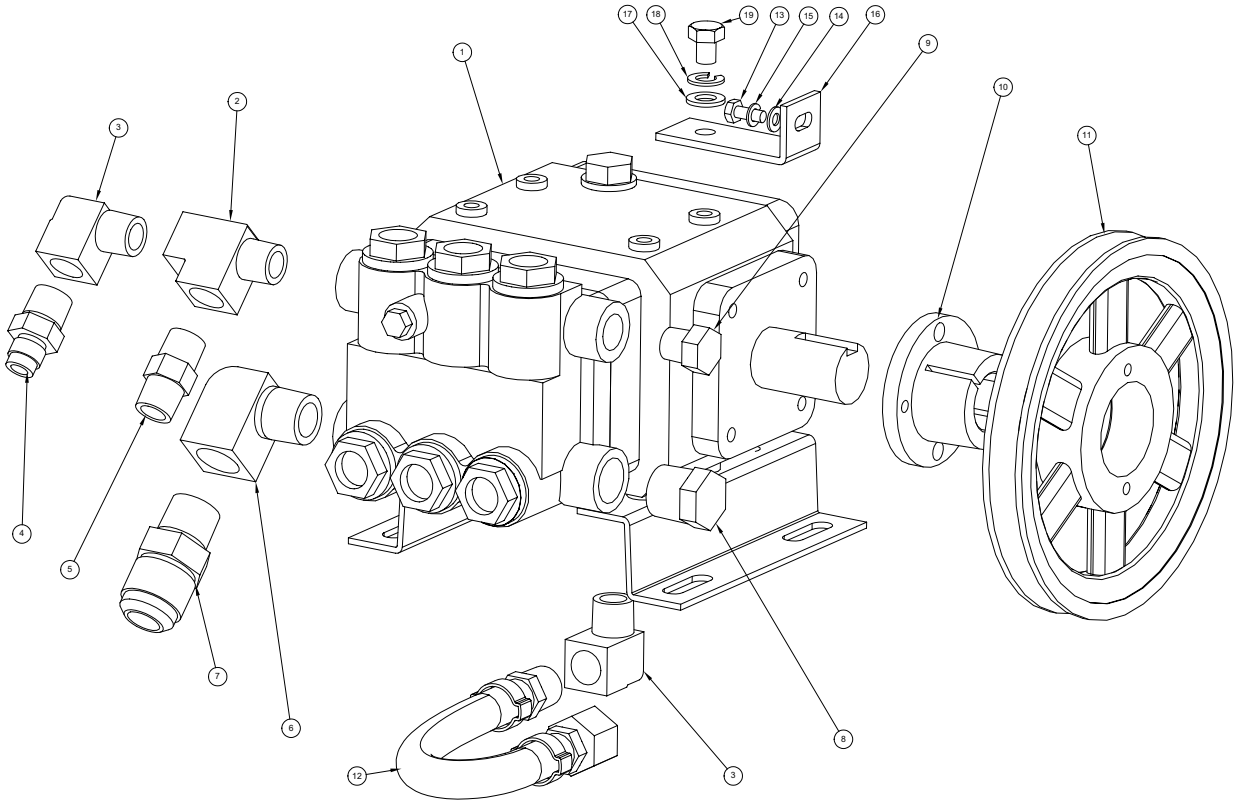
Figure 1-17 **Pump & Blower Assembly**
D-4050 Rev B



Pump & Blower Assembly Parts List

Item	Part Number	Description	Qty
1	000-111-133	Blower, 3003 Competitor Plus	1
2	**Fig. 1-20**	Assembly, Water Box - Spitfire 3.2	1
3	**Fig. 1-18**	Assembly, Pump - Spitfire 3.2	1
4	**Fig. 1-19**	Assembly, Collector Box - Spitfire 3.2	1
5	000-108-136	Protector, Belt Guard - Front - Sp 3.2	1
6	000-108-137	Protector, Belt Guard - Rear - Sp 3.2	1
7	000-174-068	Washer, Blower Feet	4
8	000-174-012	Washer, 1/2" SAE H/D Flat	4
9	000-094-102	Nut, 7/16"-14UNC Two-Way Locking Hex	4
10	000-143-028	Screw, 7/16"-14UNC x 1.75" Lg. Hex Head Grd 5 Zinc	4
11	000-174-004	Washer, 5/16" Flat	4
12	000-094-038	Nut, 5/16"-18UNC Nylock	4
13	000-109-006	Pulley, 2-3/4" x 3/4" Bore	1
14	000-020-015	Collar, 7/8" Clamping	1
15	000-039-006	Coupler, #6 x 7/8"	1
16	000-010-054	Belt, Boxxer Pump Drive	1
17	000-174-001	Washer, #10 Flat	3
18	000-174-014	Washer, #10 Lock	3
19	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	3

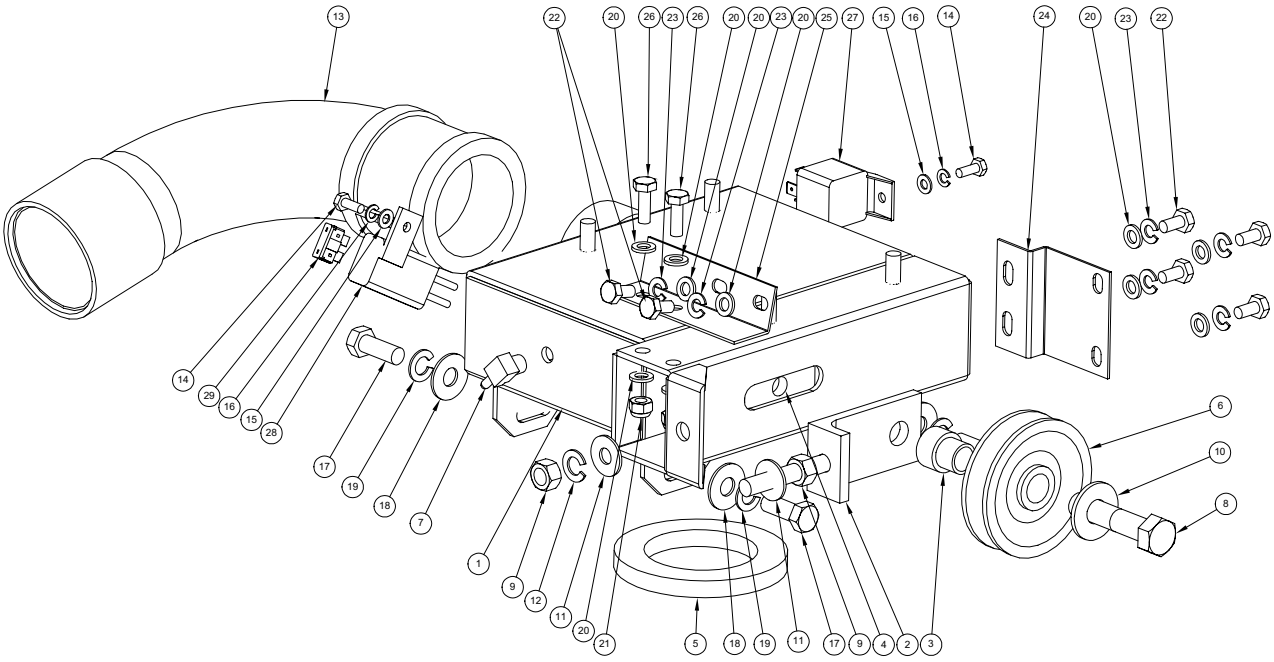
Figure 1-18 **Pump - Hydra II - Assembly**
D-5906 Rev -



Pump - Hydra II - Assembly Parts List

Item	Part Number	Description	Qty
1	000-111-042	Pump, Hydra II Hi PSI 3.5 Gpm	1
2	000-052-023	Tee, 3/8" NPT Male Street	1
3	000-052-086	Elbow, 3/8" NPT Street	2
4	000-052-528	Nipple, 3/8" M JIC x 3/8" NPT	1
5	000-052-074	Nipple, 3/8" NPT Hex	1
6	000-052-087	Elbow, 1/2" NPT Street	1
7	000-052-547	Nipple, 1/2 NPT x 3/4 SAE	1
8	000-106-004	Plug, 1/2" NPT Hex	1
9	000-106-003	Plug, 3/8" NPT Hex	1
10	000-020-013	Coupler, H x 24mm Spitfire 3.2 & 4.0	1
11	000-109-017	Pulley, Spitfire Pump	1
12	000-068-219	Hose, Spitfire Pump Drain	1
13	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	1
14	000-174-001	Washer, #10 Flat	1
15	000-174-014	Washer, #10 Lock	1
16	000-015-909	Bracket, Pump To Belt Guard - Sp 3.2	1
17	000-174-049	Washer, 5/16" Flat	1
18	000-174-018	Washer, 5/16" Lock	1
19	000-143-571	Screw, 8mm x 1.25 x 10mm Lg. Hex Head Z/P	1

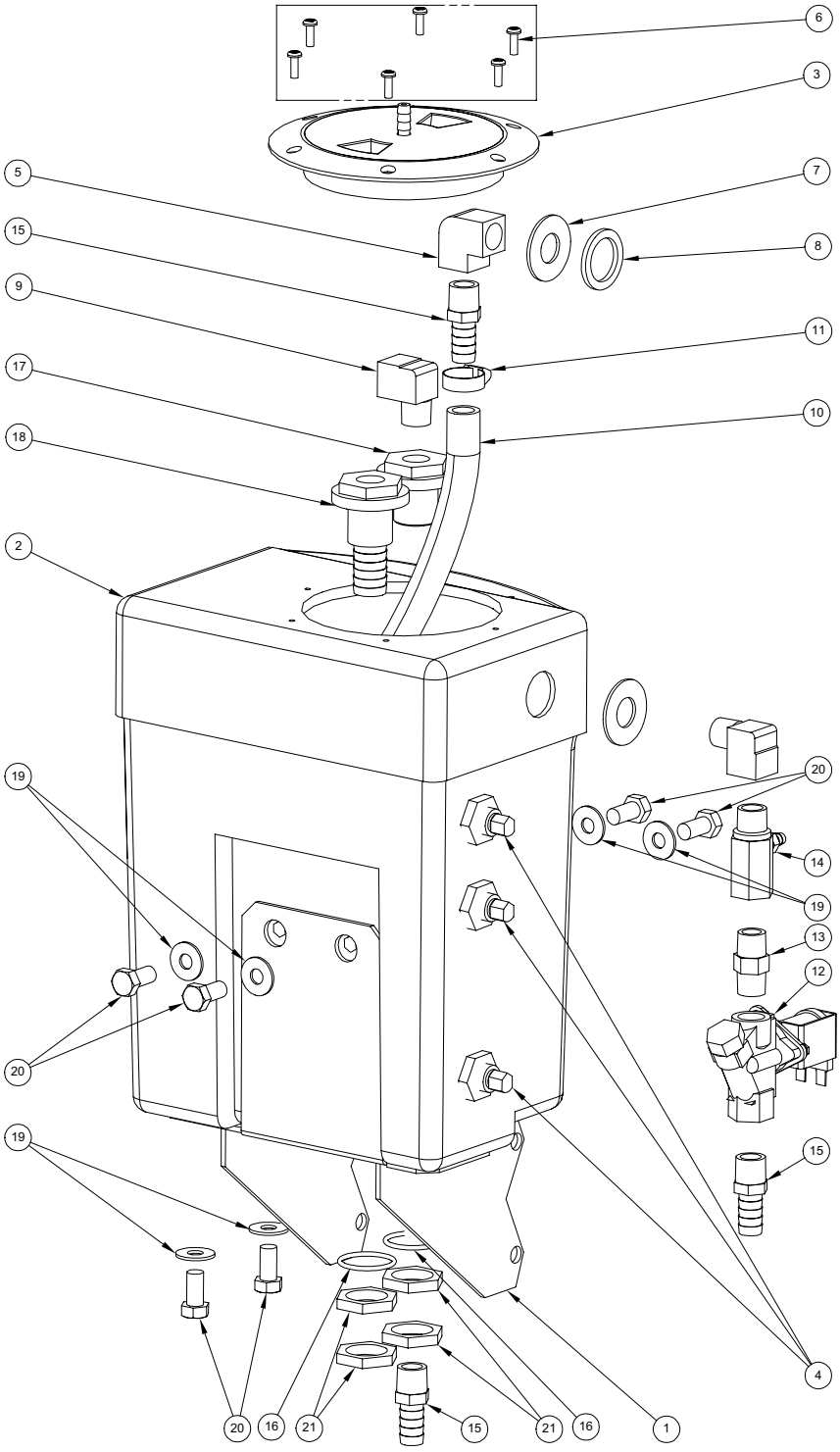
Figure 1-19 **Collector Box Assembly**
D-5908 Rev A



Collector Box Assembly Parts List

Item	Part Number	Description	Qty
1	000-013-061	Box, Blower Collector - Spitfire 3.2	1
2	000-015-746	Bracket, Pump Idler - Boxxer 421	1
3	000-154-049	Spacer, Pump Idler Mounting - Boxxer 421	1
4	000-105-250	Plate, Pump Idler - Spitfire 3.2	1
5	000-057-197	Gasket, Collector Box To Blower - Spitfire 3.2	1
6	000-109-093	Pulley, 3" x 0.635/0.640 Bore, "A" Sect. Ball Bearing	1
7	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	1
8	000-143-041	Screw, 1/2"-13UNC x 2.25" Lg. Hex Head	1
9	000-094-014	Nut, 3/8"-16UNC Hex Zink Plated	2
10	000-174-012	Washer, 1/2" SAE H/D Flat	1
11	000-174-032	Washer, 3/8" Flat	2
12	000-174-057	Washer, 3/8" Lock	1
13	000-001-027	Adapter, Blower To Collector Box - Spitfire	1
14	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	2
15	000-174-001	Washer, #10 Flat	2
16	000-174-014	Washer, #10 Lock	2
17	000-143-018	Screw, 3/8"-16UNC x 1.00" Lg. Grade 8	4
18	000-174-005	Washer, 3/8" Flat	4
19	000-174-021	Washer, 3/8" Lock	4
20	000-174-003	Washer, 1/4" Flat	10
21	000-094-009	Nut, 1/4"-20UNC Hex Nylock	2
22	000-143-333	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head	6
23	000-174-019	Washer, 1/4" Lock	6
24	000-015-905	Bracket, Belt Guard Mounting - Left - Sp 3.2	1
25	000-015-904	Bracket, Belt Guard Mounting - Right - Sp 3.2	1
26	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	2
27	000-157-022	Switch, Relay	1
28	000-056-006	Fuse Holder, Inline Weather Proof	1
29	000-056-007	Fuse, 10 AMP Plug In	1

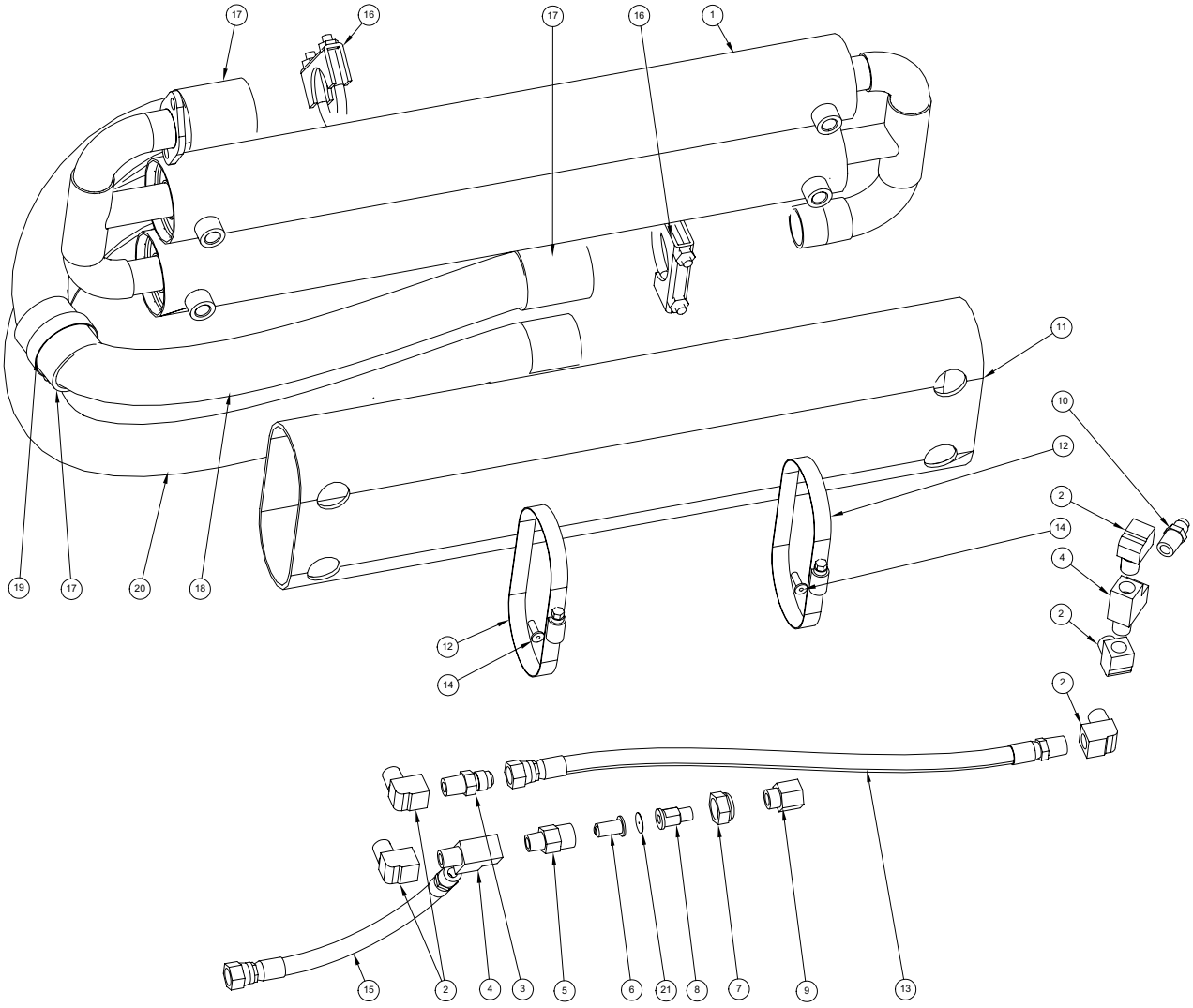
Figure 1-20 **Water Box Assembly**
D-5905 Rev A



Water Box Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-851	Bracket, Water Box Mounting - Sp 3.2	1
2	000-159-105	Tank, Poly Water Box	1
3	000-041-004	Cover, Poly Water Box Mod. w/ Vent	1
4	000-157-031	Switch, Side Mount w/ Bulkhead Fitting	3
5	000-052-142	Elbow, 3/8" FPT x FPT	1
6	000-143-314	Screw, #8 x 1/2" Lg. Pan Head	6
7	000-174-034	Washer, 0.688" I.D. x 1.50" O.D. x 0.078" Thk.	2
8	000-057-052	Gasket, 1" Garden Hose	1
9	000-052-086	Elbow, 3/8" NPT Street	2
10	000-068-327	Hose, 1/2" I.D. Clear Braid - Bulk	1
11	000-033-004	Clamp, Size #6	1
12	000-169-120	Valve, Chemical & Hi-Temp Solenoid - 12 Volt	1
13	000-052-074	Nipple, 3/8" NPT Hex	1
14	000-181-008	Venturi, Low PSI Injector - Modified	1
15	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	3
16	000-097-041	Oring, 1/2" Bulkhead	2
17	000-052-660	Bulkhead, 3/8" FPT x 3/8" FPT	1
18	000-052-661	Insert, 3/4" Barb x Straight	1
19	000-174-032	Washer, 3/8" Flat	6
20	00-143-017-	Screw, 3/8"-16UNC x 3/4" Lg. Hex Head	6
21	000-094-097	Nut,1-14" Brass Water Box	4

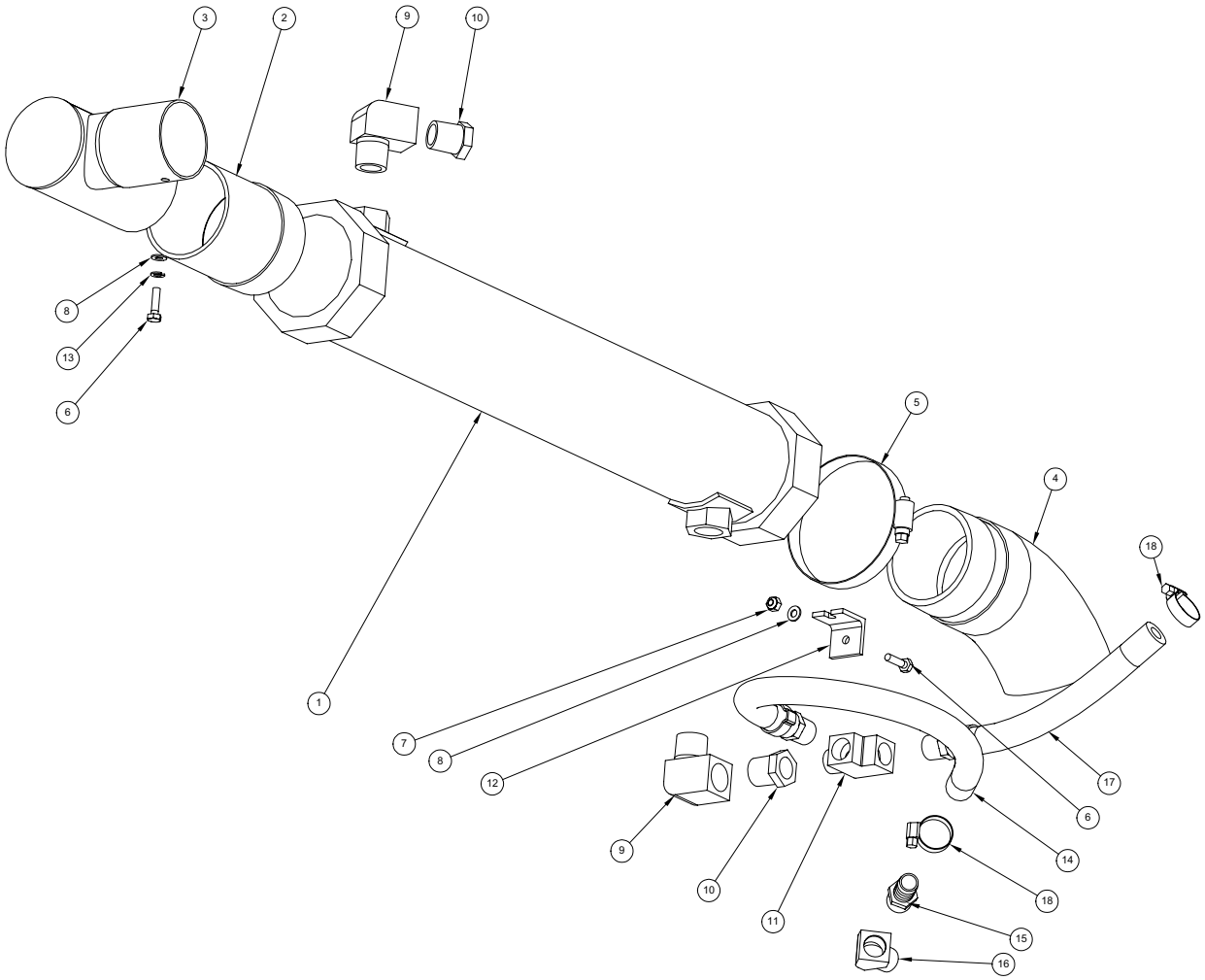
Figure 1-21 **Dual Heat Exchanger Assembly**
D-3090 Rev B



Dual Heat Exchanger Assembly Parts List

Item	Part Number	Description	Qty
1	000-038-026	Heat Exchanger, Dual - Spitfire 3.2	1
2	000-052-085	Elbow, 1/4" NPT Street	5
3	000-052-533	Nipple, 3/8" JIC x 1/4" NPT	1
4	000-052-090	Tee, 1/4" NPT Branch M-F-F	2
5	000-052-171	Housing, 1/4 Brass Filter	1
6	000-049-052	Filter Cartridge, 1/4"	1
7	000-094-028	Nut, Brass Jet Assembly	1
8	000-052-585	Nipple, Teejet Mod. For Orifice	1
9	000-052-066	Coupler, 1/4" FPT x 1/8" FPT	1
10	000-052-527	Nipple, 1/4" SAE x 1/4" NPT	1
11	000-108-023	Protective Insulation Blanket - Spitfire 3.2	1
12	000-033-060	Clamp, Size #80 Hose	2
13	000-068-530	Hose, 3/8" x 7.5" Lg. Teflon w/ 1/4" NPT & 3/8" JIC F	1
14	000-140-005	Rivet, 3/16" x 0.50" Lg. Pop (Ab6-6A)	2
15	000-068-533	Hose, 3/8" x 9" Lg. Teflon w/ 1/4" NPT & 3/8" JIC F En	1
16	000-033-068	Clamp, 1-1/2" Muffler	2
17	000-131-037	Wrap, Exhaust Insulation - 2" Wide - Bulk	3
18	000-131-046	Insulation Sleeving, 0.054" x 1-1/2" Exhaust Tube Wrap	1
19	000-033-009	Clamp, Size #24 Hose	1
20	000-068-260	Hose, 1-1/4" x 31" Lg. S/S Flex Exhaust	1
21	000-180-010	Orifice, 0.039" Plate	1

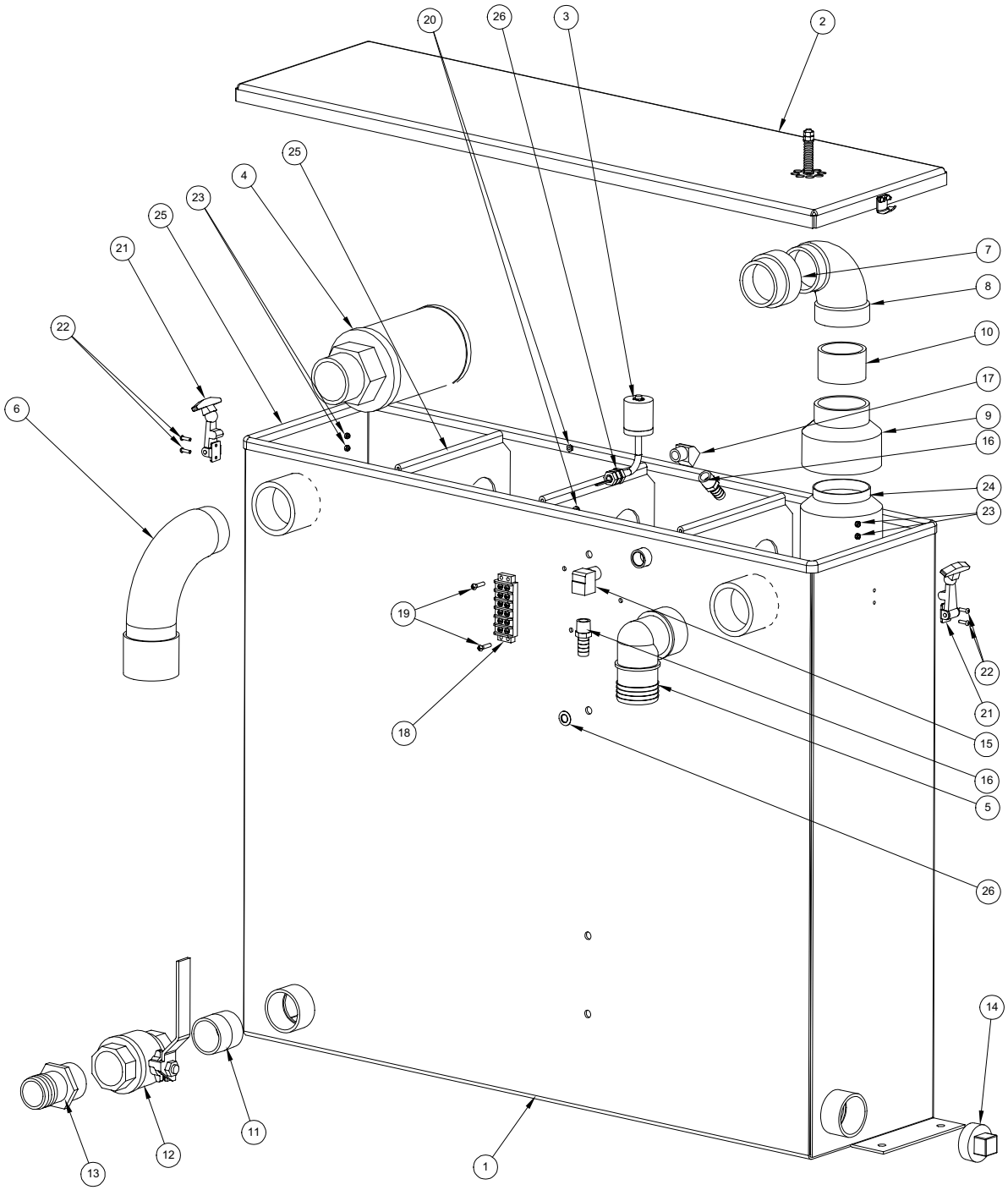
Figure 1-22 **Lower Heat Exchanger Assembly**
D-2665 Rev B



Lower Heat Exchanger Assembly Parts List

Item	Part Number	Description	Qty
1	000-038-018	Core, 3" Copper Heat Exchanger - Spitfire 3.2	1
2	000-052-343	Adapter, Heat Exchanger Inlet	1
3	000-001-017	Adapter, Silencer Outlet - Spitfire 3.2	1
4	000-052-321	Exhaust Turn Down Fitting	1
5	000-033-013	Clamp, Size #48 Hose	1
6	000-143-132	Screw, #10-24UNC x 0.75" Lg. Hex Head	2
7	000-094-034	Nut, #10-24UNC Nylock	1
8	000-174-001	Washer, #10 Flat	2
9	000-052-087	Elbow, 1/2" NPT Street	2
10	000-052-064	Bushing, 1/2" NPT x 3/8" FPT	2
11	000-052-023	Tee, 3/8" NPT Male Street	1
12	000-015-297	Bracket, Mix Tank Mount - SP 4.0	1
13	000-174-014	Washer, #10 Lock	1
14	000-068-536	Hose, 1/2" x 16" Lg. Black w/ 3/8" NPT & 3/8 SAE F En	1
15	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	1
16	000-052-083	Elbow, 3/8" NPT Street x 45°	1
17	000-068-297	Hose, 1/2" x 14" Lg. Black w/ 3/8" Ends	1
18	000-033-004	Clamp, Size #6	2

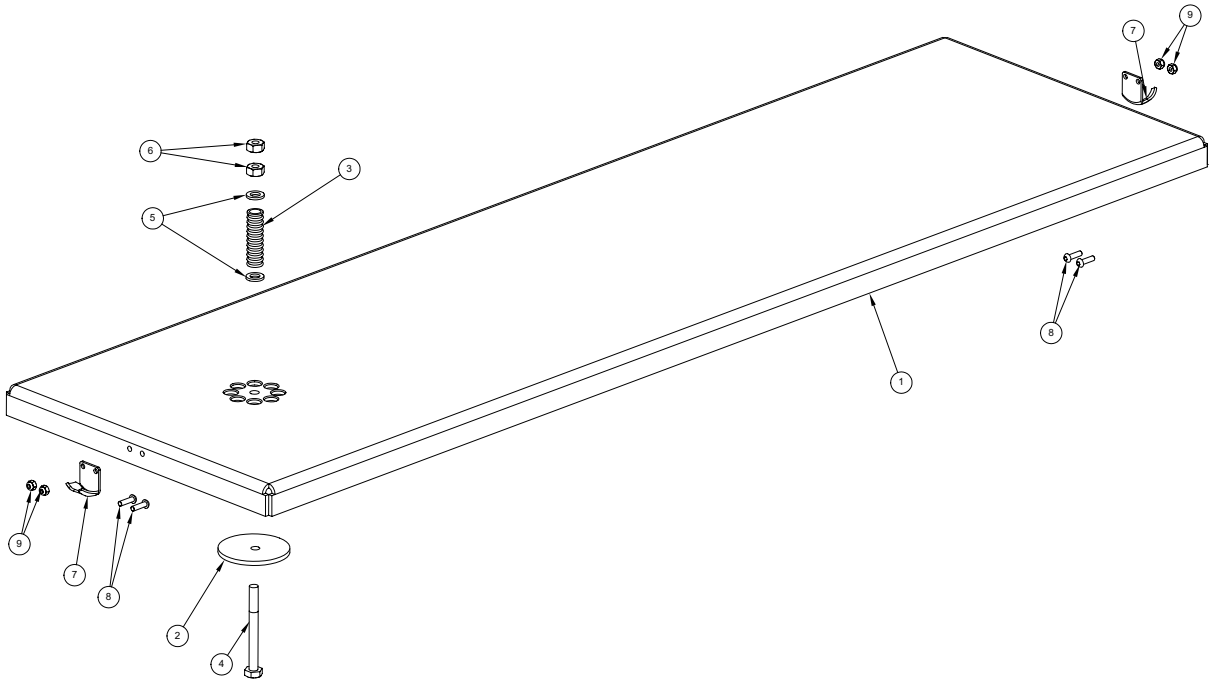
Figure 1-23 **Recovery Tank Assembly**
D-2651 Rev L



Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-159-041	Tank, Recovery - Weldment - Spitfire	1
2	**Fig. 1-24**	Assembly, Recovery Tank Cover - Spitfire	1
3	**Fig. 1-25**	Assembly, Float Switch s/s - Recovery Tank	1
4	000-049-007	Filter, 2" NPT Blower s/s	1
5	000-052-224	Elbow, 2" NPT x 2" Barb	1
6	000-001-036	Adapter, Ø2.75 x 2" NPT Tank Inlet Elbow	1
7	000-052-219	Adapter, 2" NPT x 2" F Slip	1
8	000-052-223	Elbow, 2" F Slip x 2" M Slip	1
9	000-052-404	Adapter, 3" F Slip x 2" F Slip	1
10	000-125-052	Tube, 2" PVC x 1.50" Lg. Filter Bag Adapter Sleeve	1
11	000-052-182	Nipple, 1-1/2" NPT Close Galvanized	1
12	000-169-022	Valve, 1-1/2" Full Port Ball	1
13	000-052-226	Insert,1-1/2" NPT x 1-1/2" Barb (Grey)	1
14	000-106-019	Plug, 1-1/2" NPT	1
15	000-052-086	Elbow, 3/8" NPT Street	1
16	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	2
17	000-052-083	Elbow, 3/8" NPT Street x 45°	1
18	000-012-002	Block, 6 Post Terminal	1
19	000-143-051	Screw, #8-32UNC x 0.75" Lg. Binder Head Phillips	2
20	000-094-059	Nut, #8-32UNF Nylock	2
21	000-086-008	Latch, Bungie	2
22	000-143-539	Screw, #6-32UNC x 0.50" Lg. Button Head Allen	4
23	000-094-063	Nut, #6-32UNC Nylock	4
24	000-049-030	Filter Bag, 92+Truck Mount	1
25	000-131-121	Bumper Materail - Split	1
26	000-174-029	Washer, 3/8" Rubber Back	2

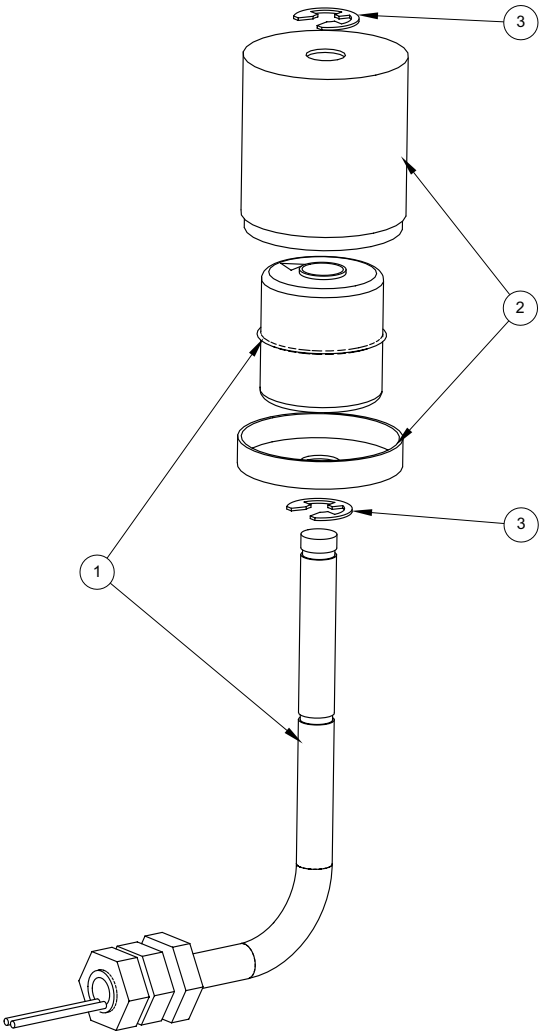
Figure 1-24 **Recovery Tank Cover Assembly**
C-2704 Rev F



Recovery Tank Cover Assembly Parts List

Item	Part Number	Description	Qty
1	000-041-170	Cover, Recovery Tank - Weldment - Spitfire	1
2	000-105-005	Plate, Vacuum Relief - Recovery Tank	1
3	000-155-002	Spring, Vacuum Relief Valve	1
4	000-143-009	Screw, 1/4"20UNC x 2.50" Lg. Hex Head	1
5	000-174-003	Washer, 1/4" Flat	2
6	000-094-010	Nut, 1/4"-20UNC Hex	2
7	000-086-008	Latch, Bungie - Strike	2
8	000-143-539	Screw, #6-32UNC x 0.50" Lg. Button Head Allen	4
9	000-094-063	Nut, #6-32UNC Nylock	4

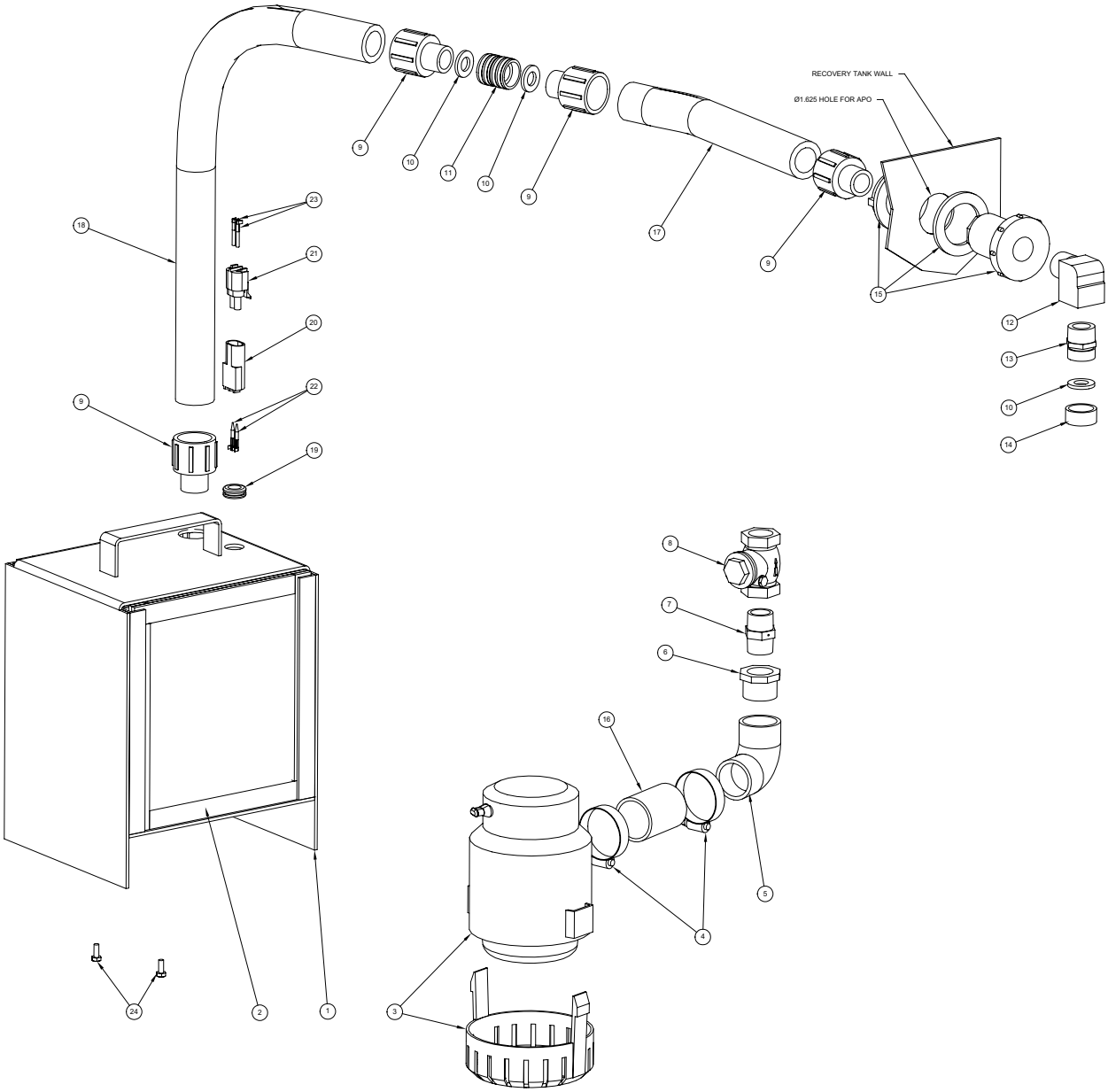
Figure 1-25 **Float Switch - s/s - Recovery Tank Assembly**
B-6092 Rev -



Float Switch - s/s - Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-157-080	Switch, Recovery Tank Float	1
2	000-108-110	Shield, Poly Float Splash	1
3	000-139-010	Ring, Snap Ring (E-Clip) x 5/16"	2

Figure 1-26 **APO Assembly**
D-2799 Rev C



APO Assembly Parts List

Item	Part Number	Description	Qty
1	000-055-041	Frame, APO - Top Exit Style - Weldment	1
2	000-049-058	Screen, APO Filter - Boxxer	2
3	000-111-012	Pump, Truck Mount Waste Pump Out	1
4	000-033-009	Clamp, Size #24 Hose	2
5	000-052-234	Elbow, 1" F Slip x 1" F Slip	1
6	000-052-235	Bushing, 3/4" FPT x 1" M Slip	1
7	000-052-329	Nipple, 3/4" Hex - Modified	1
8	000-169-009	Valve, 3/4" FPT Swing Check	1
9	000-052-236	Adapter, 3/4" NPT x 1" F Slip	4
10	000-057-055	Gasket, Garden Hose	3
11	000-052-244	Swivel, 3/4" Female Garden x 3/4" Female Garden	1
12	000-052-340	Elbow, 3/4" NPT Street	1
13	000-052-281	Nipple, 3/4" NPT x 3/4" Male Garden Hose	1
14	000-027-014	Cap, Garden Hose	1
15	000-052-339	Coupler, 3/4" FPT x 3/4" FPT Bulkhead Fitting	1
16	000-052-185	Cuff, 1-1/2" Vacuum Hose - Modified	1
17	000-068-204	Hose, Ø1" I.D. Kana Flex	1
18	000-068-204	Hose, Ø1" I.D. Kana Flex	1
19	000-060-009	Grommet, 1/2" I.D. w/ 3/32" Groove	1
20	000-037-047	Connector, 2 Pole - Male Water Tight	1
21	000-037-048	Connector, 2 Pole - Female Water Tight	1
22	000-037-050	Terminal, Male Pin- 4 Pole Water Tight	2
23	000-037-102	Pin Terminal, #18 w/o Insulation - Female	2
24	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	2

Figure 1-27 **85 Gallon Rotomolded Tank Assembly - Front View**
D-5566 Rev A

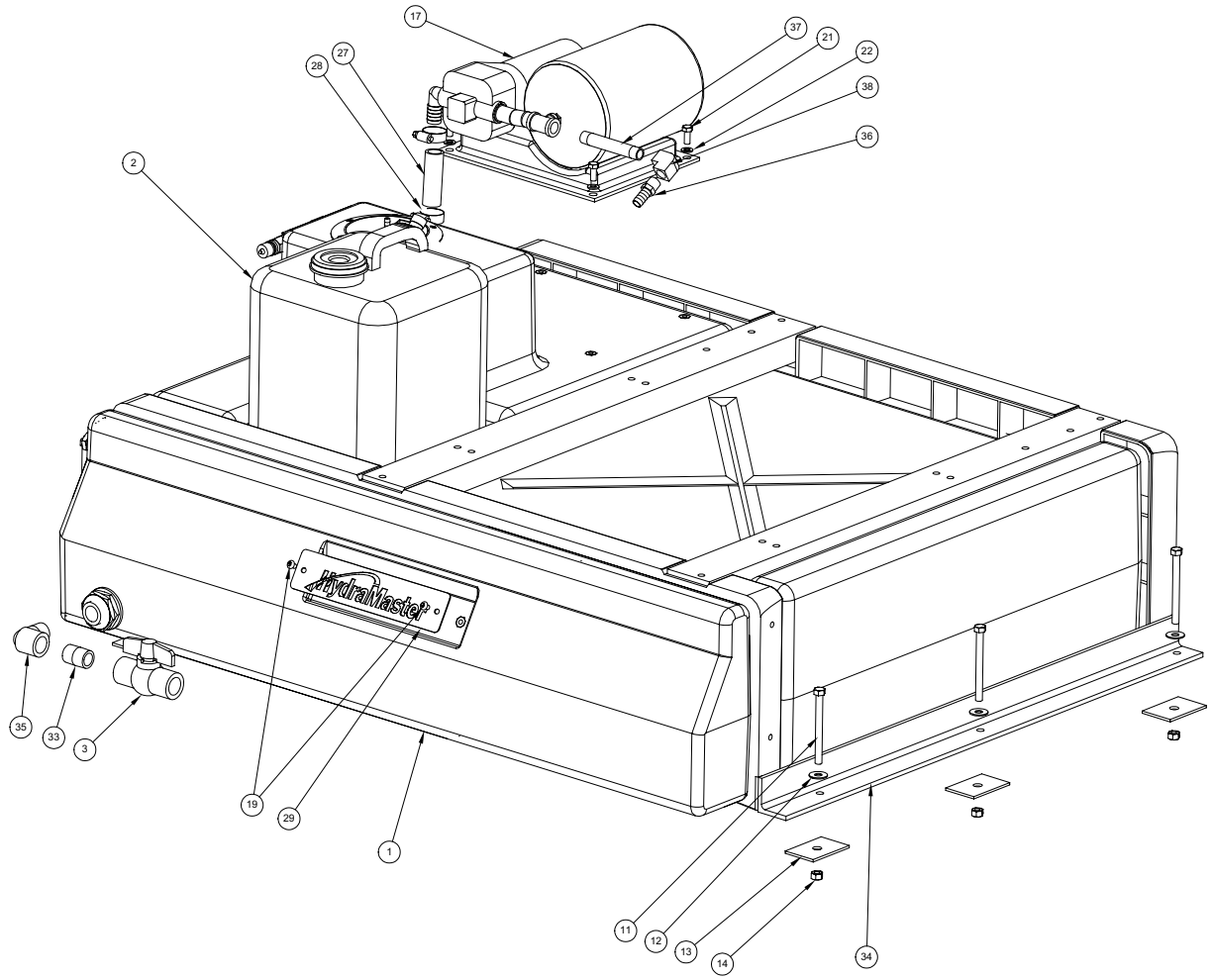
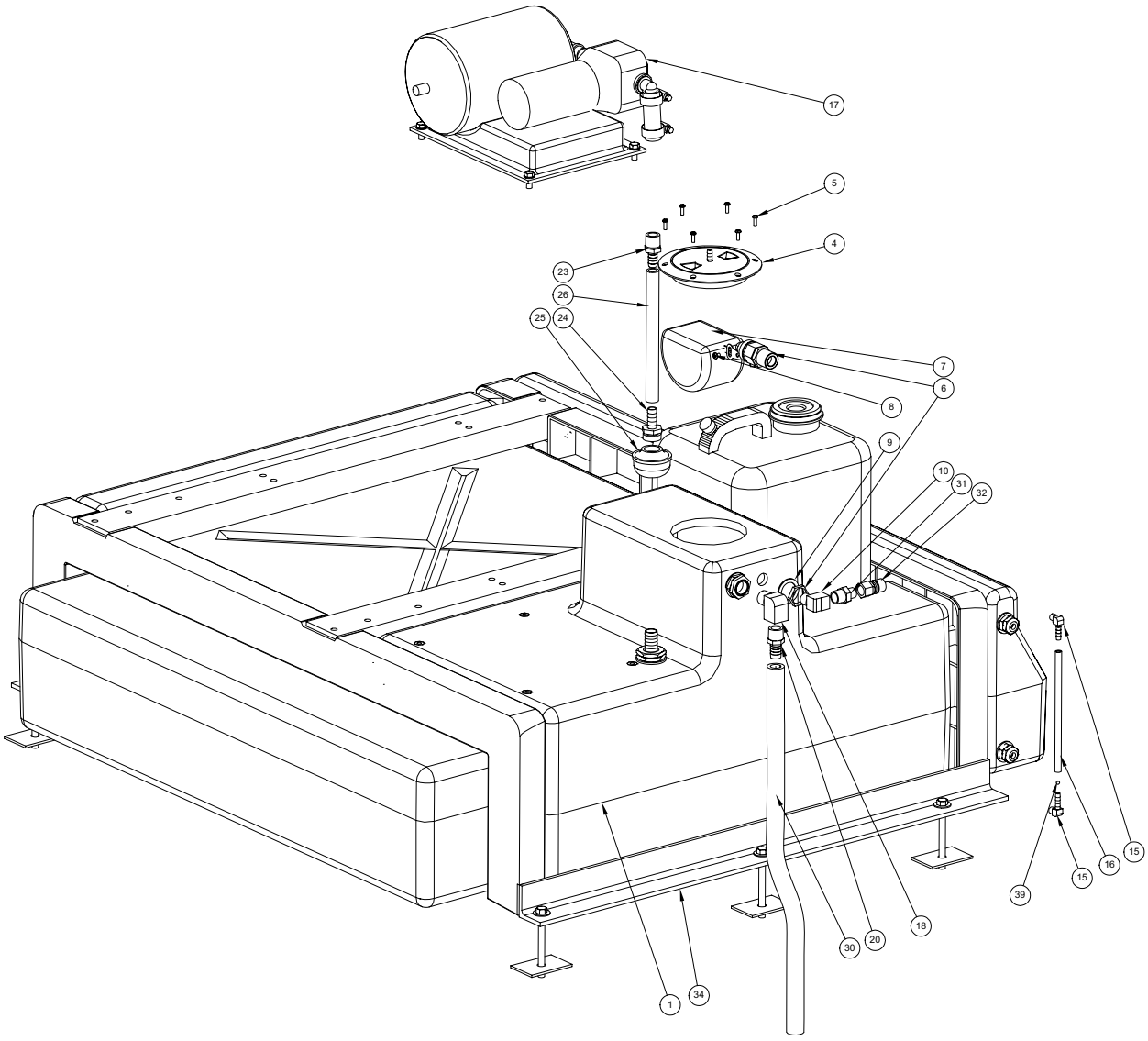


Figure 1-28 **85 Gallon Rotomolded Tank Assembly - Rear View**
D-5566 Rev A



85 Gallon Rotomolded Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-159-116	Tank, Boxxer Fresh Water - Rotomolded	1
2	000-159-016	Jug, 5 Gallon Plastic Chemical - Standard	1
3	000-169-202	Valve, 3/4" FPT Ball Valve	1
4	000-041-004	Cover, Poly Water Box Mod. w/ Vent	1
5	000-143-314	Screw, #8 x 1/2" Lg. Pan Head	6
6	000-169-167	Valve, Mechanical Incoming Water - Water Box	1
7	000-005-007	Float, Water Box	1
8	000-143-336	Screw, #10-32UNF x 0.25" Lg. Pan Head Phillips	1
9	000-174-063	Washer, 1.5" O.D. x 1.073" I.D. x 0.075" Thk.	1
10	000-052-086	Elbow, 3/8" NPT Street	1
11	000-143-198	Screw, 3/8"-16UNC x 4" Lg. Hex Head Full Thread	6
12	000-174-005	Washer, 3/8" Flat	6
13	600-011-003	Tie Down Cleat Washer	6
14	000-094-015	Nut, 3/8"-16UNC Hex 2-Way Locking	6
15	000-052-253	Elbow, 1/8" NPT x 1/4" Barb	2
16	000-068-025	Hose, 1/4" I.D. Clear	1
17	000-111-170	Pump, Flojet Fresh Water	1
18	000-052-087	Elbow, 1/2" NPT Street	1
19	000-143-565	Screw, 1/4-20 UNC x 0.375" Lg. Button Head	2
20	000-052-130	Insert, #810 Brass	1
21	000-143-012	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head	4
22	000-174-049	Washer, 5/16" Flat	4
23	000-052-107	Insert, #88 (1/2" NPT x 1/2" Barb)	1
24	000-052-160	Insert, 3/4" M Garden x 1/2" Barb	1
25	000-049-020	Filter, Screen - Medium	1
26	000-068-018	Hose, 1/2" I.D Bulk	1
27	000-068-069	Hose, 3/4" I.D. Weatherhead Blue - Bulk	1
28	000-033-029	Clamp, Size 12 Hose	2
29	000-105-313	Plate, Hydramaster Name- Roto Tank	1
30	000-068-020	Hose, .625" I.D. - Green Stripe	1

85 Gallon Rotomolded Tank Assembly Parts List

Item	Part Number	Description	Qty
31	000-052-075	Nipple, 3/8" NPT x 1/2" NPT	1
32	000-052-052	Quick Connect, 660 Male w/ Viton Standard	1
33	000-052-326	Nipple, 3/4" NPT Close	1
34	000-055-169	Frame, Rotomolded Fresh Water Tank - Boxxer	1
35	000-052-726	Elbow, 3/4" Street (Grey)	1
36	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	1
37	000-052-408	Nipple, 3/8" NPT x 4" Lg.	1
38	000-052-142	Elbow, 3/8" FPT x FPT	1
39	000-005-008	Sight Float Bead, 5mm Red Wally Whale	1

Figure 1-29 **85 Gallon Rotomolded Tank w/ SpitFire 3.2 Assembly - Right View**
D-5819 Rev A

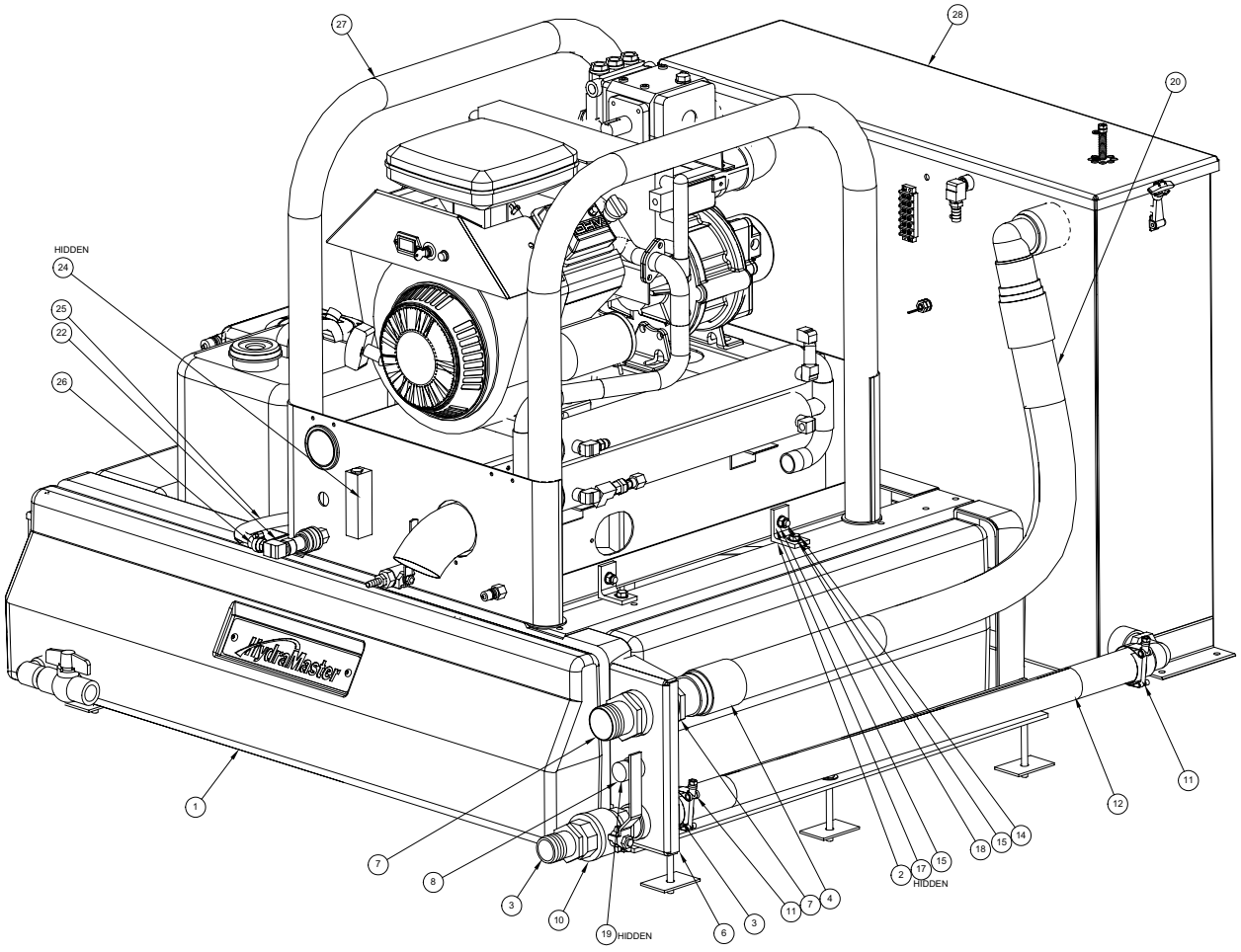
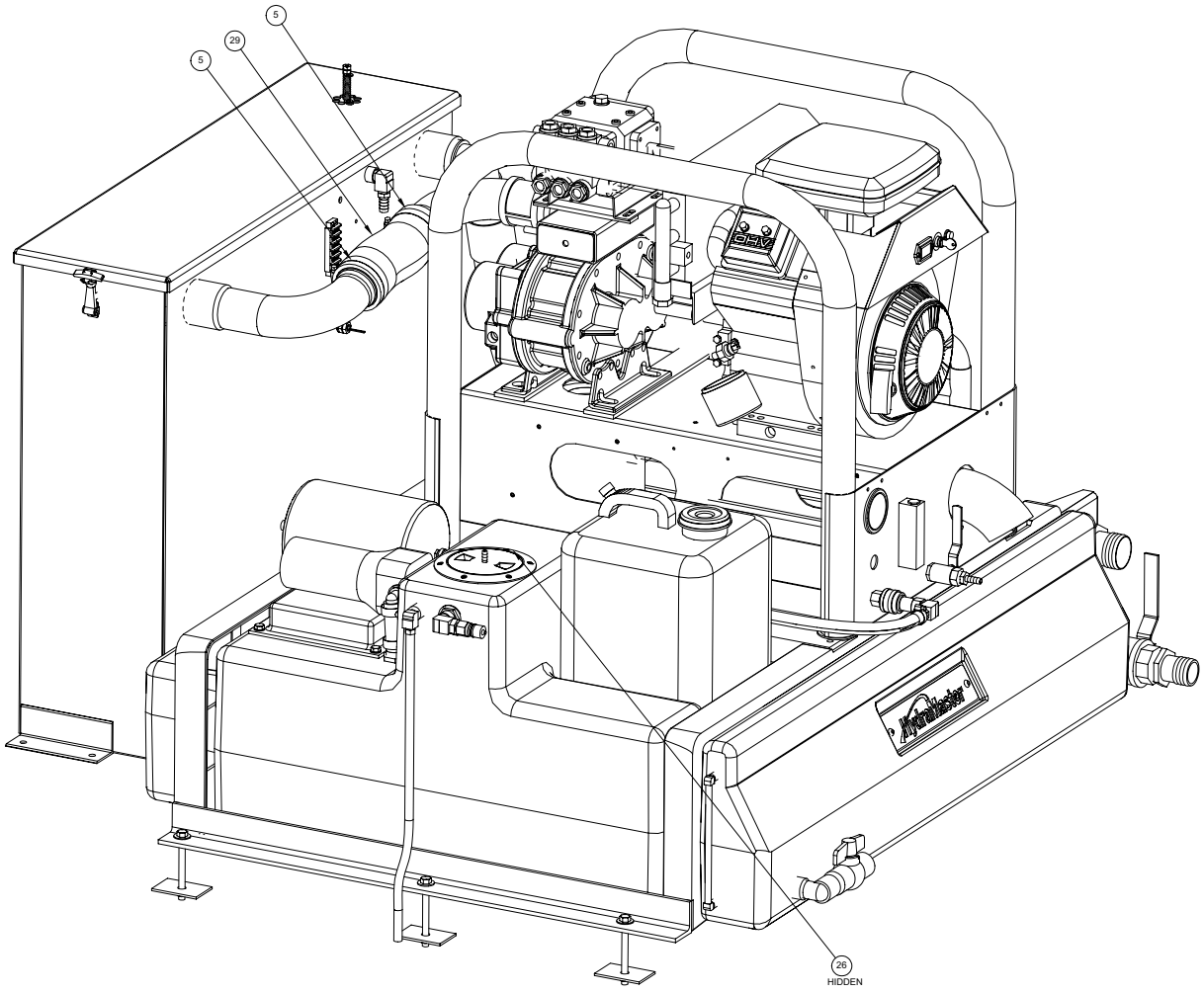


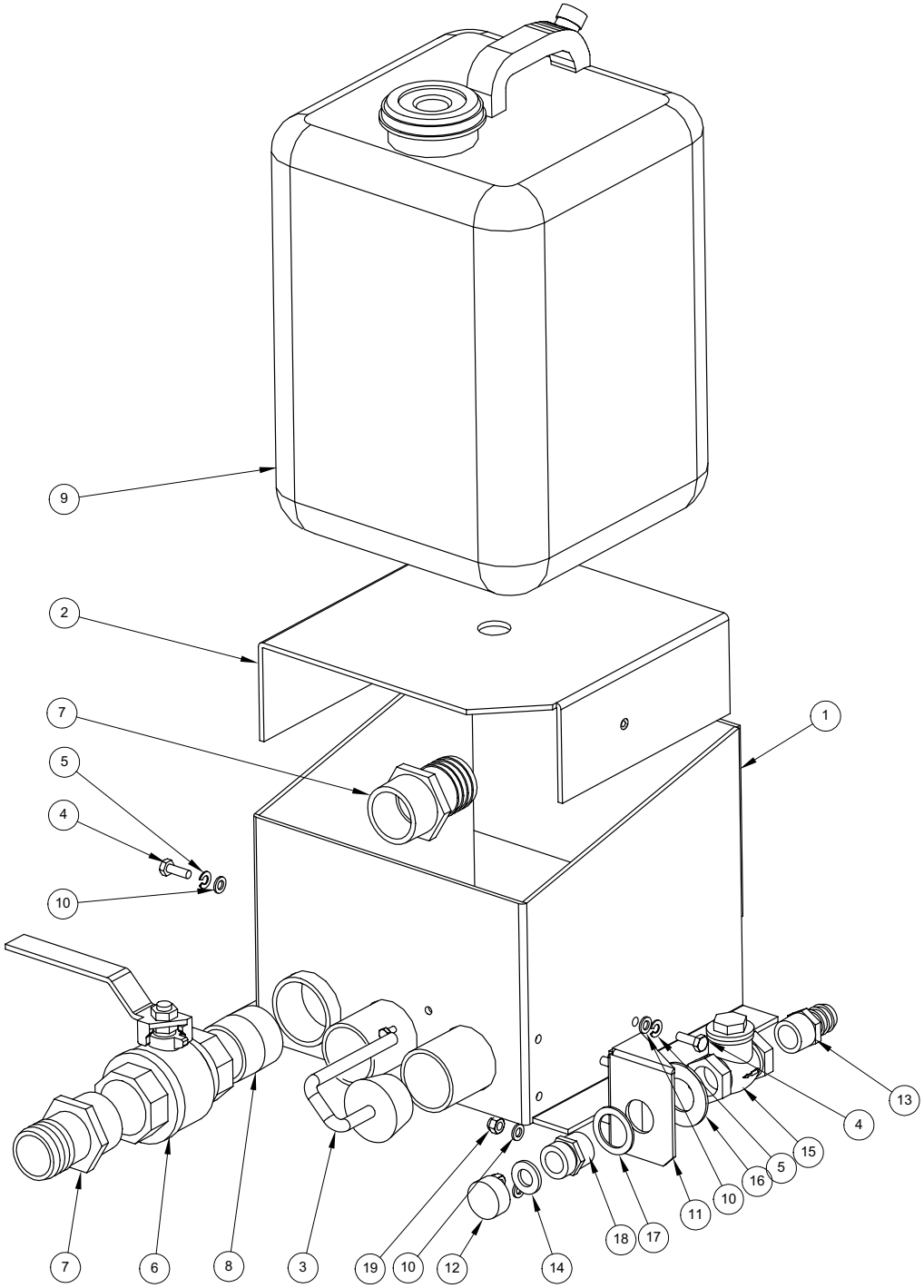
Figure 1-30 **85 Gallon Rotomolded Tank w/ SpitFire 3.2 Assembly - Left View**
D-5819 Rev A



85 Gallon Rotomolded Tank w/ SpitFire 3.2 Assembly Parts List

Item	Part Number	Description	Qty
1	**Fig. 1-27/28**	Assembly, Rotomolded Tank - Boxxer	1
2	000-015-265	Bracket, Machine Tie Down - Sp 3.2	4
3	000-052-226	Insert,1-1/2" NPT x 1-1/2" Barb (Grey)	2
4	000-052-169	Cuff, 2" Vacuum Hose	2
5	000-033-012	Clamp, Size #44 Hose	2
6	000-015-884	Bracket, Dump & Vacuum Mounting - Boxxer	1
7	000-052-221	Insert, 2" NPT x 2" Barb (Grey)	2
8	000-027-014	Cap, Garden Hose	1
9	000-052-281	Nipple, 3/4" NPT x 3/4" Male Garden Hose	1
10	000-169-022	Valve, 1-1/2" Full Port Ball	1
11	000-033-063	Clamp, 1-1/2" T-Bolt	2
12	000-068-135	Hose, 1.5" I.D. Red Stripe	1
13	000-052-182	Nipple, 1-1/2" NPT Close Galvanized	1
14	00-143-017-	Screw, 3/8"-16UNC x 3/4" Lg. Hex Head	4
15	000-174-057	Washer, 3/8" Lock	8
16	000-094-014	Nut, 3/8"-16UNC Hex Zink Plated	4
17	000-174-032	Washer, 3/8" Flat	4
18	000-143-096	Screw, 3/8"-16UNC x 1.00" Lg. Hex Head	4
19	000-057-055	Gasket, Garden Hose	1
20	000-068-039	Hose, 2" I.D. Grey Vacuum (Black 068-042)	1
21	000-052-053	Quick Connect, 3/8 Female	1
22	000-052-086	Elbow, 3/8" NPT Street	1
23	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	1
24	000-033-117	Clamp, 1" Cushion Loop w/ 7/16" Mount Hole	1
25	000-068-018	Hose, 1/2" I.D. Black Bulk	1
26	000-033-004	Clamp, Size #6	2
27	**Fig. 1-6 - 1-9**	Assembly, Machine - Spitfire 3.2	1
28	**Fig. 1-23**	Assembly, Recovery Tank For 85 RMT - Sp 3.2	1
29	000-068-133	Hose, 2.75" I.D.	1

Figure 1-31 **Chemical Jug Tray Assembly**
C-4945 Rev C



Chemical Jug Tray Assembly Parts List

Item	Part Number	Description	Qty
1	000-166-021	Tray, Chemical Jug - Outer - Weldment	1
2	000-166-025	Tray, Chemical Jug - Inner	1
3	000-078-039	Vacuum Inlet Stopper	1
4	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	2
5	000-174-019	Washer, 1/4" Lock	2
6	000-169-022	Valve, 1-1/2" Full Port Ball	1
7	000-052-226	Insert,1-1/2" NPT x 1-1/2" Barb (Grey)	2
8	000-052-182	Nipple, 1-1/2" NPT Close Galvanized	1
9	000-159-016	Jug, 5 Gallon Plastic Chemical - Standard	1
10	000-174-003	Washer, 1/4" Flat	4
11	000-015-720	Bracket, Apo Outlet Mounting - Weldment	1
12	000-027-014	Cap, Garden Hose	1
13	000-052-338	Insert, #1212 (3/4" NPT x 3/4" Barb)	1
14	000-057-055	Gasket, Garden Hose	1
15	000-169-009	Valve, 3/4" FPT Swing Check	1
16	000-174-050	Washer, 1" Flat	1
17	000-174-063	Washer, 1.5" O.D. x 1.073" I.D. x 0.075" Thk.	1
18	000-052-281	Nipple, 3/4" NPT x 3/4" Male Garden Hose	1
19	000-094-009	Nut, 1/4"-20UNC Hex Nylock	2

Cleaning and Chemicals

SpitFire 3.2
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 (chemicals such as concentrated acid, solvents, and some paint, oil, and grease removers with 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.

♦ 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.

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

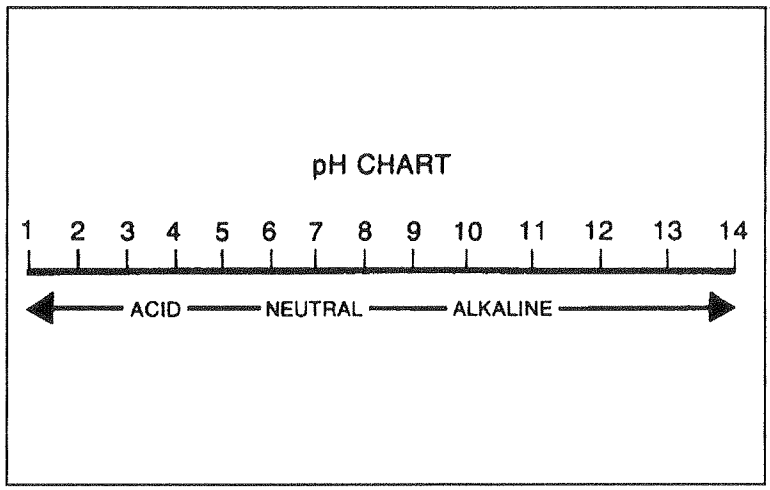
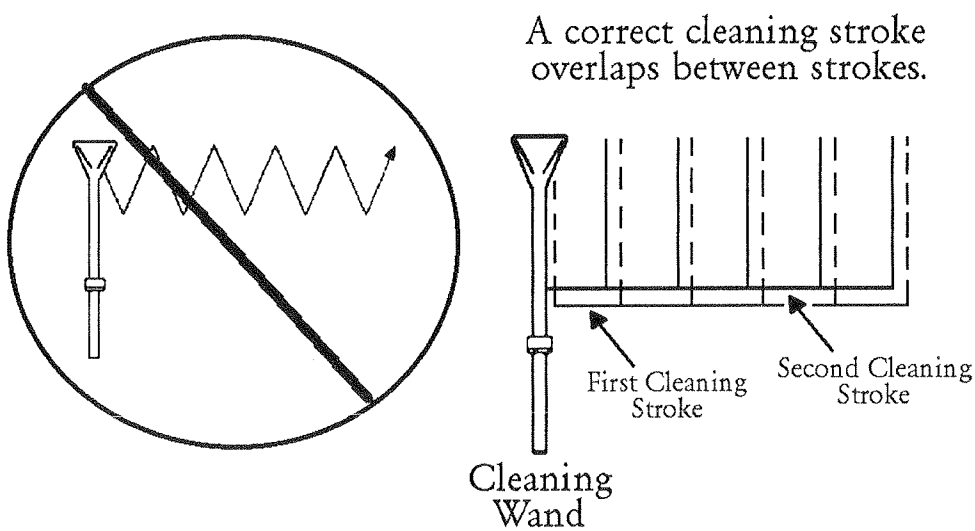


Figure 2-2: **CLEANING STROKE PROCEDURE**



Operating Instructions

SpitFire 3.2
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 by-pass 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 3200 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

♦ 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.

Precautions

SpitFire 3.2
Section 3-3

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.

♦ 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 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.

♦ 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 acid products that have obviously caused failures.

♦ CAUTION ♦

FREEZE PROTECTION: Mother nature gives little warning as to her cold spells. Therefore, not protecting this equipment from freezing will result in costly down-time. 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 the heating system, engine, exhaust, etc.

♦ WARNING ♦

HEARING PROTECTION: The Occupational Safety and Health Administration (OSHA) recommends the use of hearing protection when an operator 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

know to the State of California to cause cancer, birth defects or other reproductive harm.

♦ WARNING ♦

PORTABLE GAS CAN: 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 propane 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.

Freeze Guard

SpitFire 3.2
Section 4-1

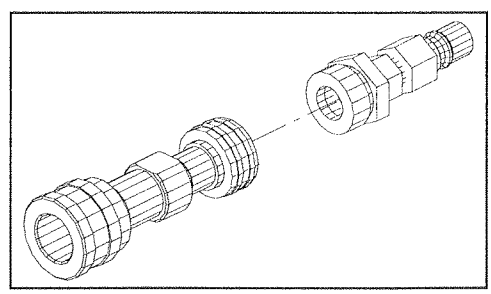
1. Start the machine.

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.

   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 1: The reclaimed antifreeze solution may be used 3 times before being discarded.
   NOTE 2: *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 antifreeze 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.

Water and Chemical System

SpitFire 3.2
Section 5-1

This electro-mechanical system has been designed to be simple and trouble free.

WATER/CHEMICAL FLOW OPERATION

Incoming water flows first through the Solenoid Control Valve and the low pressure Chemical injector 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 is equipped with a Water Level Float that responds to the level in the tank and will maintain the proper volume of solution to be reserved for the water pump.

The desired chemical injection ratio may be obtained by an adjustment of the Chemical Flowmeter 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 to the Chemical Flowmeter, 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 Flowmeter 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 Flowmeter is set at 5 GPH, or a 1 to 15 ratio when the

Flowmeter is set at 10 GPH.

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 Flowmeter setting 10 GPH. Simply spray water from the wand until the quart of vinegar is exhausted. Then repeat the process with one quart of clear water to void all lines of vinegar.

Figure 5-1: Water Flow Diagram

D2760, Rev B

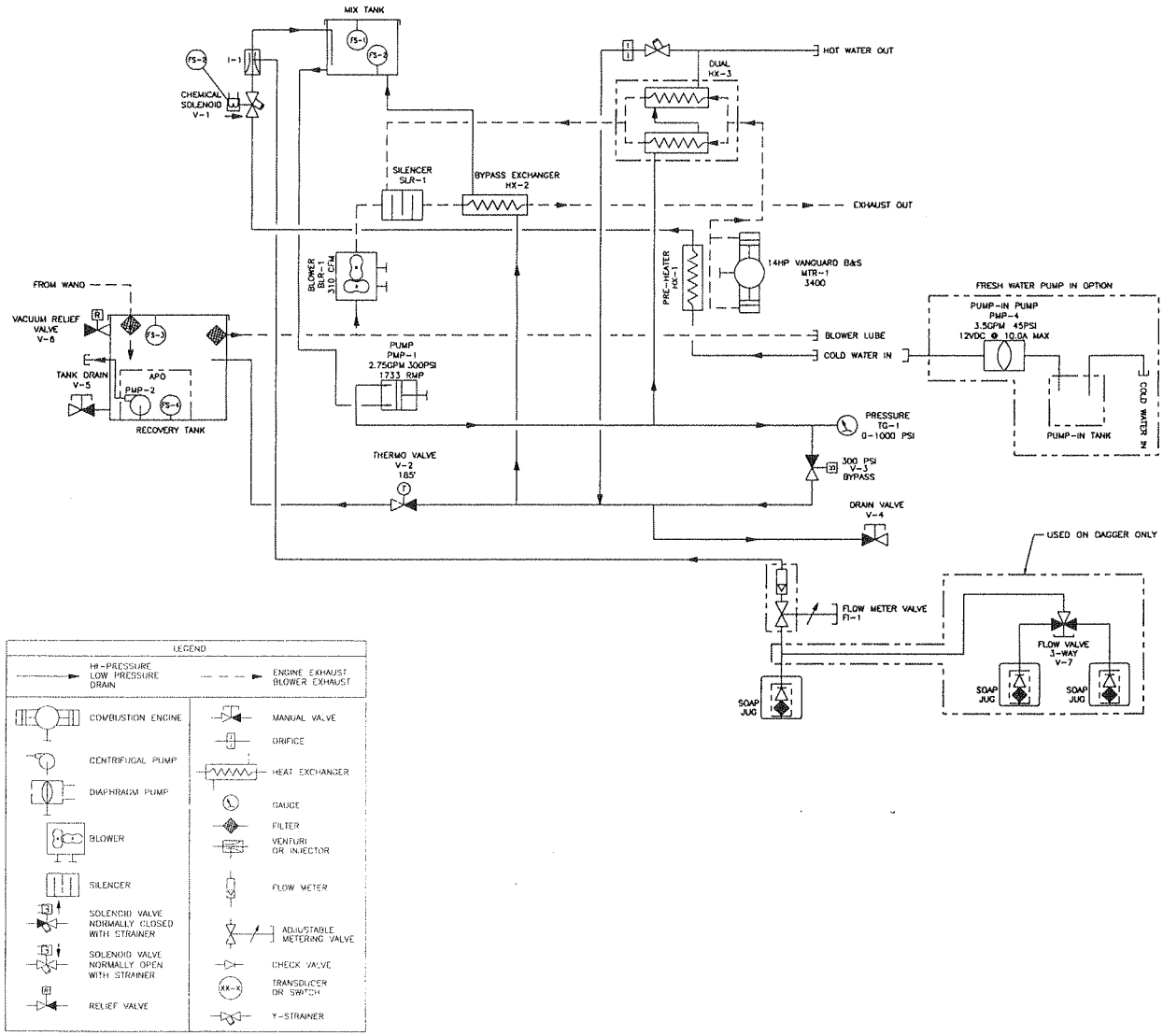


Figure 5-2: **Proportioner Diagram**

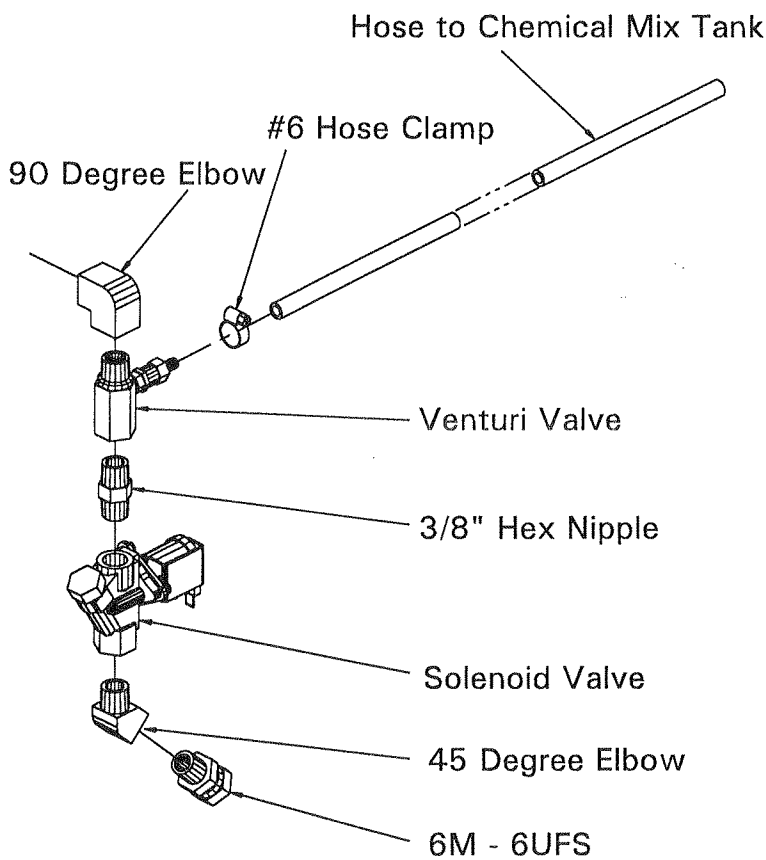
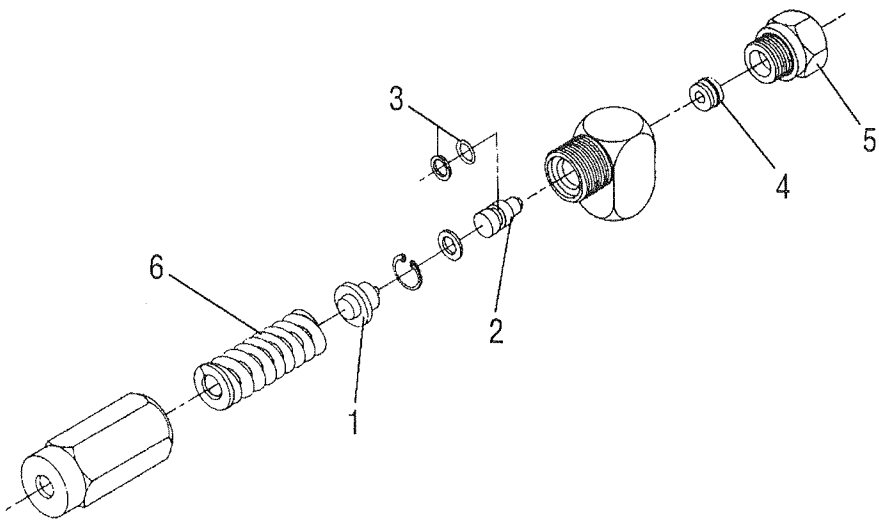


Figure 5-3: **By-Pass Valve Assembly**



169-101 Valve, By-Pass Truckmount

ITEM	PART NO	DESCRIPTION	QTY
1	105-101	Thrust Plate, By-pass Valve	1
2	105-102	Piston Plate, By-pass Valve	1
3	097-028	Seal Set for By-pass Valve	1
4	148-004	Seat and O-Ring, By-pass Valve	1
5	097-005	O-Ring, By-pass Valve Fitting	1
6	155-019	Spring, High PSI By-pass	1
Not Shown:			
	078-102	Kit, By-pass Repair (Includes Items 1-5)	1
	078-101	Kit, Seal and Spring High PSI By-pass (Includes Items 3 and 7)	1

Chemical Tank Troubleshooting

SpitFire 3.2
Section 5-6

SpitFire Water System

No	Problem / Possible Cause	Solution
1	**There is a loss of water pressure.**	
1.1	The *mix tank water supply hose* is missing. This will cause aeration and turbulence in the tank.	Look inside the mix tank and determine if a water inlet hose is present. If the hose is missing, order a new hose from your HydraMaster distributor and install it.
1.2	Foreign material is blocking the outlet hole for the pump in the bottom of the *mix tank*.	Inspect the outlet hole leading to the pump in the bottom of the mix tank. Remove any foreign material blocking the hole.
1.3	Foreign material is blocking the *water supply hose* leading to the pump from the mix tank.	Remove the water supply hose between the mix tank and the pump. Sight through the hose. Remove any foreign material from the hose. Reattach the hose.
1.4	The *water supply hose* from the mix tank to the pump is kinked or blocked.	Remove the hose and clean it. If it is kinked, order a replacement hose from your HydraMaster distributor.

No	Problem / Possible Cause	Solution
1.5	The end of the *mix tank water supply hose* is pointed directly at the pump inlet hole in the bottom of the mix tank.	Inspect the mix tank and determine the orientation of the water hose. If it is pointing directly at the pump inlet hole in the bottom of the tank, reposition the hose to point towards the opposite side of the tank from the inlet.
1.6	The *mix tank supply hose* is blocking the outlet hole leading to the pump in the bottom of the mix tank.	The water inlet hose may have to be shortened or lengthened to avoid blocking the outlet hole.
1.7	There is an air leak in the *water supply hose* from the mix tank to the pump.	Inspect the supply hose for worn or damaged areas. Also check for loose fittings. Replace the hose or fittings if necessary.
1.8	The *water supply hose* from the mix tank to the pump collapses when the machine is running hot.	Allow the machine to reach full water operating temperature (approximately 10 minutes). Inspect the water supply hose between the mix tank and the pump. If the hose appears to be collapsing, remove the hose and order a replacement hose from your HydraMaster distributor. Reinstall the new hose.
1.9	There is foreign material in the inlet or outlet valves of the *pump*.	Inspect the valves and remove any foreign material.
1.10	The controlled *orifice* is loose and water is flowing around it.	Clean the orifice and tighten the fittings around it. This may require adding an "O" ring around the jet. Also, check the fitting for wear. If there is excessive wear, replace the fitting with part #052-025.

No	Problem / Possible Cause	Solution
1.11	The *by-pass valve* is malfunctioning.	Remove the plunger and lube the "O" rings. Clean the walls of the by-pass valve with a bristle brush and de-scaler. **NOTE:** Use a water resistant high temperature lube.
1.12	The *glide seals and valves* in the pump are defective. **NOTE:** Do not operate the engine at low RPMs for long periods of time because damage may occur to the pump.	Repair the pump as necessary.

No	Problem / Possible Cause	Solution
2	**The water temperature is too low.**	
2.1	The *thermo valve* is stuck open and water is flowing continually past the valve.	This is a non-serviceable valve. Replace it.
2.2	The *orifice* (spray nozzle) in the cleaning tool is worn, defective, or the wrong size.	Replace or change the orifice size. The SpitFire uses a 11004 T-jet.
2.3	The incoming *water supply* is extremely cold.	Keep the incoming water supply hoses away from ice and snow during winter months.
2.4	There is an *exhaust* leak.	Inspect the exhaust system for leaks. Tighten any loose clamps. Weld or replace any broken parts.
2.5	There is excessive *pressure*.	Adjust the pressure regulator for less pressure.
2.6	There is *exhaust wrap* missing.	Replace any missing wrap.
2.7	The *engine* speed is low.	Reset the engine speed. Refer to the Engine Operation and Maintenance manual.
2.8	A *heat exchanger* is scaled.	De-scale the heat exchanger or remove it and take it to a radiator shop to be boiled out.
2.9	A *heat exchanger* is carbon-coated.	a. For a **stainless steel heat exchanger**, clean it with oven cleaner or have it acid-dipped, "hot tanked". b. For a **copper tube heat exchanger**, carefully unplug the tubes by poking a small rod through them. Then take the heat exchanger to a radiator shop to be boiled out.

No	Problem / Possible Cause	Solution
2.10	The *preheater* mounted behind the motor is scaled.	Remove the preheater. At a radiator shop, give it a hot tank treatment.

No	Problem / Possible Cause	Solution
3	**The water temperature is excessive.**	
3.1	The *filter* in front of the controlled orifice is clogged.	Inspect the filter. Clean it if necessary.
3.2	The controlled *orifice* is clogged.	Inspect the controlled orifice. Clean it if necessary.
3.3	The *thermo valve* is not opening and no water is flowing through the valve.	This is a non-serviceable valve. Replace it.
3.4	The *engine* speed is too low or too high.	Reset the engine speed. Refer to the Engine Operation and Maintenance manual.

No	Problem / Possible Cause	Solution
4	**There is pressure on the gauge, but no water coming out of the wand.**	
4.1	The *wand jet* is plugged.	Inspect and clean the jet.
4.2	The *quick connect* on one or more of the high pressure hoses is defective.	Remove and clean or replace the defective quick connect(s).
4.3	The *cleaning tool* has a clogged valve.	Remove the valve stem. Clean the valve. Replace the "O" rings and stem if they are bad.
4.4	The high pressure *quick connect* on the front of the machine is clogged.	Remove and clean or replace the quick connect.
4.5	The inner lining on a *hose* is constricted.	Remove the restriction or replace the hose.

No	Problem / Possible Cause	Solution
5	**The water in the mix tank will not keep up with the wand.**	
5.1	There is dirt in the *solenoid valve* along side of the mix tank.	Take the valve apart and clean it.
5.2	The *upper float* is bad.	Remove the wire on terminal 87a on the chemical relay. With a volt-OHM meter check for voltage between the end of the wire you removed and a ground. There should be no voltage reading on the meter with the float in the down position. Replace the float if necessary.
5.3	The *mix tank relay* is bad.	With the upper float in the mix tank in the up position, there should be no voltage reading on terminal 87a on the chemical relay. With the float in the down position, there should be +12 volts on terminal 87a. Replace the relay if it is defective.
5.4	The *water supply* is improperly adjusted.	The water supply should be two (2) gallons per minute or more.
5.5	The *water inlet supply hose filter* is clogged or the hose is kinked.	Remove the obstructions.
5.6	There is a problem with the *pump-in pump*.	Check the amount of water the pump-in pump is supplying. It should supply a minimum of 2 GPM if you use one wand or one RX20.

No	Problem / Possible Cause	Solution
6	**There is water coming out of the exhaust.**	
6.1	There are small amounts of water usually seen at start up.	This is *normal*! There is no solution! The water is condensation.
6.2	One of the *heat exchangers* is damaged from frozen water.	Determine which heat exchanger is bad. Replace it if it is necessary.
6.3	The *recovery tank* is full.	Empty the tank.
6.4	There is excessive foam in the recovery tank.	Apply a powdered or liquid defoamer to counter act this reaction to the excessive chemical in the carpet.

No	Problem / Possible Cause	Solution
7	**The mix tank overflows.**	
7.1	The *upper float in the mix tank* is malfunctioning.	Remove the wire on terminal 87a on the chemical relay. With a volt-OHM meter check for voltage between the end of the wire you removed and a ground. There should be no voltage reading on the meter with the float in the down position. Replace the float if necessary.
7.2	There is dirt in the *solenoid valve* next to the mix tank.	Remove one of the wires from the solenoid valve and turn the key on. If the water continues to flow, then take the solenoid apart and remove the foreign matter. Replace the solenoid valve if necessary.
7.3	The *chemical relay* is bad.	With the upper float in the mix tank in the up position, there should be no voltage reading on terminal 87a on the chemical relay. With the float in the down position, there should be +12 volts on terminal 87a. Replace the relay if it is defective.

Chemical System

No	Problem / Possible Cause	Solution
1	**There is a loss of, or erratic, chemical flow.**	
1.1	The anti-siphon *foot valve* is clogged or missing causing the solution to reverse from the mix tank to the chemical jug.	Inspect the anti-siphon screen and remove any debris. Rinse it out in warm water or a vinegar solution.
1.2	The *flowmeter* is cracked allowing air intake which causes a loss of chemical suction.	Check for hairline cracks in the flowmeter. Fittings in the back of the meter can be tightened too much causing a crack. Freezing can also cause cracks. Replace the flowmeter if necessary.
1.3	There *water pressure* to the machine is too low causing a loss of chemical suction. The volume of water entering the mix tank is not be enough to siphon the chemical.	Unscrew the spring from the foot valve if you are in a low water pressure area. After removing the spring, the chemical hose must sit vertically in the jug enabling the ball in the foot valve to seat by gravity. (This is only a temporary fix.) **Also check the incoming garden hose filter.**
1.4	The *chemical feed hose* is cracked or split causing a loss of chemical suction.	If given the opportunity, the chemical venturi will suck air rather than water. Check for air leaks in the upper and lower hoses. Replace any defective hoses.
1.5	The *proportioning venturi* is closed causing a loss of chemical suction.	Remove the venturi and soak it in warm water or a vinegar solution. Adjust the side port for proper suction.

No	Problem / Possible Cause	Solution
1.6	The *mix tank supply hose* is internally colapsed causing reduced flow of inlet water or reversed flow of solution from mix tank to chemical jug.	Replace the hose.

Pump Maintenance

SpitFire 3.2
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.

SpitFire 3.2
Section 6-3

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

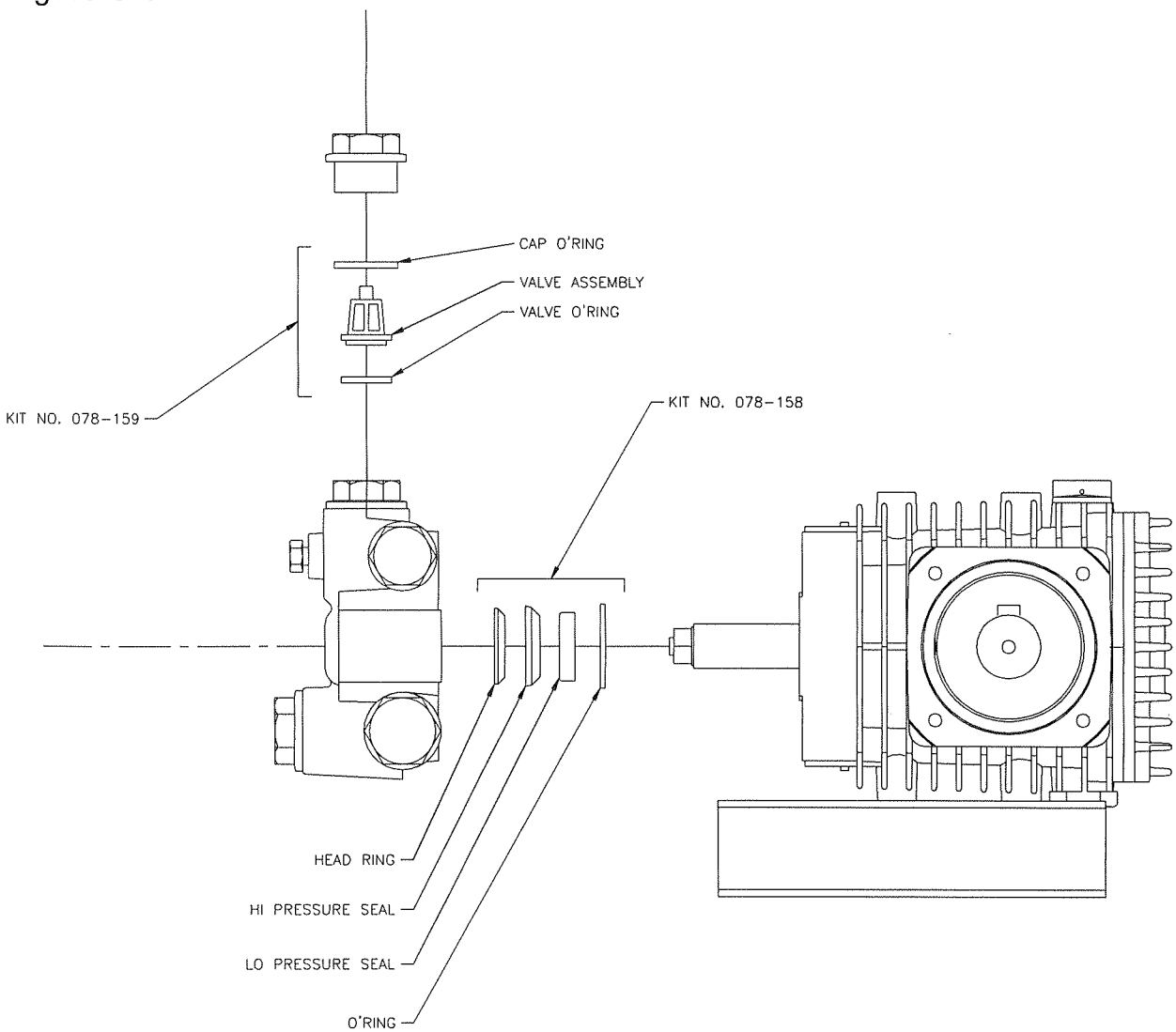
♦ CAUTION ♦

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



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

♦ 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 plunger 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.
D. 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.

5. 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.

6. 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.

Pump Troubleshooting

SpitFire 3.2
Section 6-7

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 turbulence in supply tank.
Inlet suction vacuum too high.
High pressure seals worn.

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.

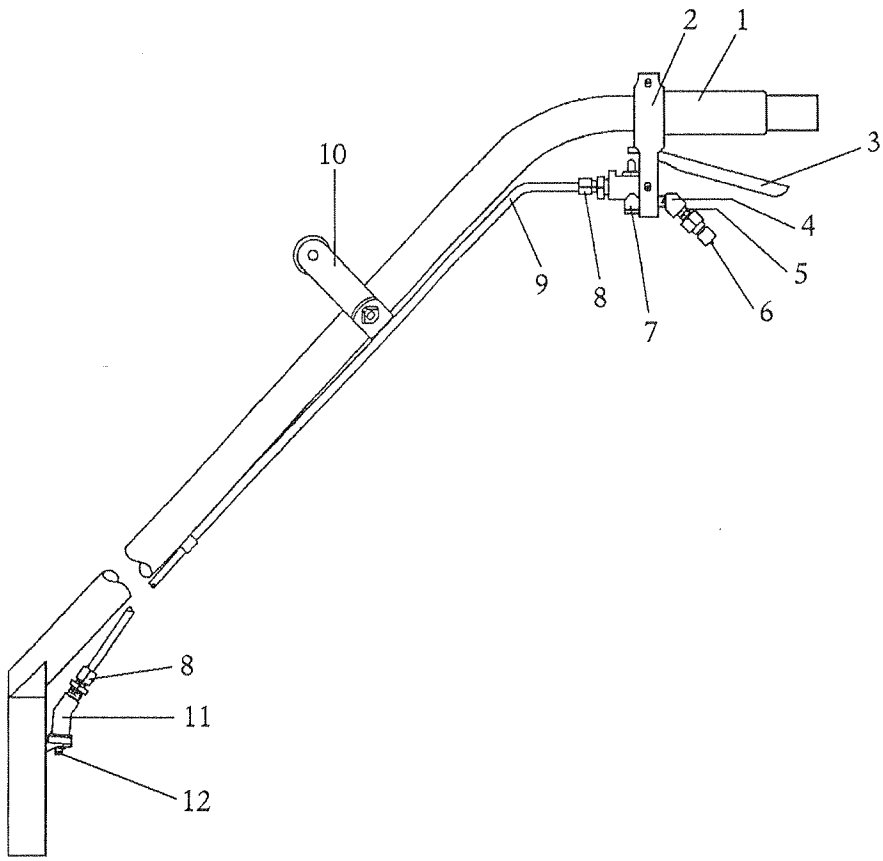
Valve Wear
- Normal wear.

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 3.2
Section 7-1



Wand 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 Assembly (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 3.2
Section 8-1

The vacuum blower in this machine is a positive displacement lobe type. 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 ♦

When machine is being run for test purposes and the vacuum inlet on top of the 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 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. If you fail to lubricate the vacuum blower daily, rust deposits and moisture will decrease the life of the vacuum blower.

♦ CAUTION ♦

Foam passing through the blower could lead to serious problems. Therefore, 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 truck-mounted 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 3.2
Section 8-3

No	Problem / Possible Cause	Solution
1	**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 *hose* on the live hose reels is collecting water.	Unroll the entire length of the hose each time you use it.
1.5	The *vacuum hose* is plugged.	Remove the obstruction by reversing the vacuum hose.
1.6	There is a restriction in the *cleaning tool*.	Remove the obstruction.
1.7	The *vacuum tank seal* is defective.	Replace the seal.
1.8	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.
1.9	There is a hole in the *recovery tank*.	Inspect the tank for leaks using smoke and weld the tank if it is required.
1.10	There is a hole in the *vacuum hose*.	Repair or replace the hose.
1.11	The *vacuum release* is loose.	Readjust the vacuum release.
1.12	The *engine speed* is too low.	Adjust the speed.

No	Problem / Possible Cause	Solution
1.13	The *vacuum blower's* end plates or lobes are worn.	Replace the worn components. **NOTE:** This must be accomplished by a qualified technician.
1.14	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	**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	**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	**The shaft turns, but the lobes do not.**	
4.1	The *shaft* is broken inside the blower.	Replace the blower.

Engine Troubleshooting

SpitFire 3.2
Section 9-1

No	Problem / Possible Cause	Solution
1	**The engine will not turn over.**	
1.1	There is a loose *battery cable or* corroded battery *terminals*.	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 yellow wire from the ignition switch, b. the large terminal with the cable from the battery, and 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.	Test the switch for entering voltage. If there is voltage entering but no voltage exiting at the yellow wire when the switch is fully engaged, then replace the switch.
1.6	The *vacuum blower* has seized.	Refer to The Blower, Chapter 10.

No	Problem / Possible Cause	Solution
1.7	The *starter motor* is defective.	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	There is an *engine* problem.	Refer to the engine operation and maintenance manual in your owner's manual or see the local Briggs & Stratton 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	**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 above. However, if there is no gas, see troubleshooting problem number 3 on the following page 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 Briggs & Stratton Engine Maintenance manual included in your owner's manual.
2.4	The *magnetron* is malfunctioning.	Check the magnetron. If it is adjusted properly, all the wires tight, and none of the wires are grounding out, then remove all 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	**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, see troubleshooting problem number 2 on the previous page. However if there is a spark, examine the above troubleshooting guide 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 and 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	**The engine runs poorly or dies after running for awhile.**	
4.1	The *air or gas filter* is clogged.	Inspect both filters and replace the clogged one.
4.2	There is a poor *battery ground* to the fuel pump.	Inspect the electrical grounds and repair any loose ground connections.
4.3	The *fuel pump* is sucking air between the gas tank and the fuel pump.	Inspect for air leaks between the fuel pump and the gas tank. Repair or replace any leaking components.
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 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 12 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 Briggs & Stratton 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 local Briggs & Stratton dealer.

No	Problem / Possible Cause	Solution
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, then remove the copper heat exchanger under the machine and clean the debris.
4.11	**In dual tank Fords**, the engine is pulling through the *'Tank Switching Valve'*.	Do not try to pull gas from both tanks.
4.12	The *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

SpitFire 3.2
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

D-2696 Rev K

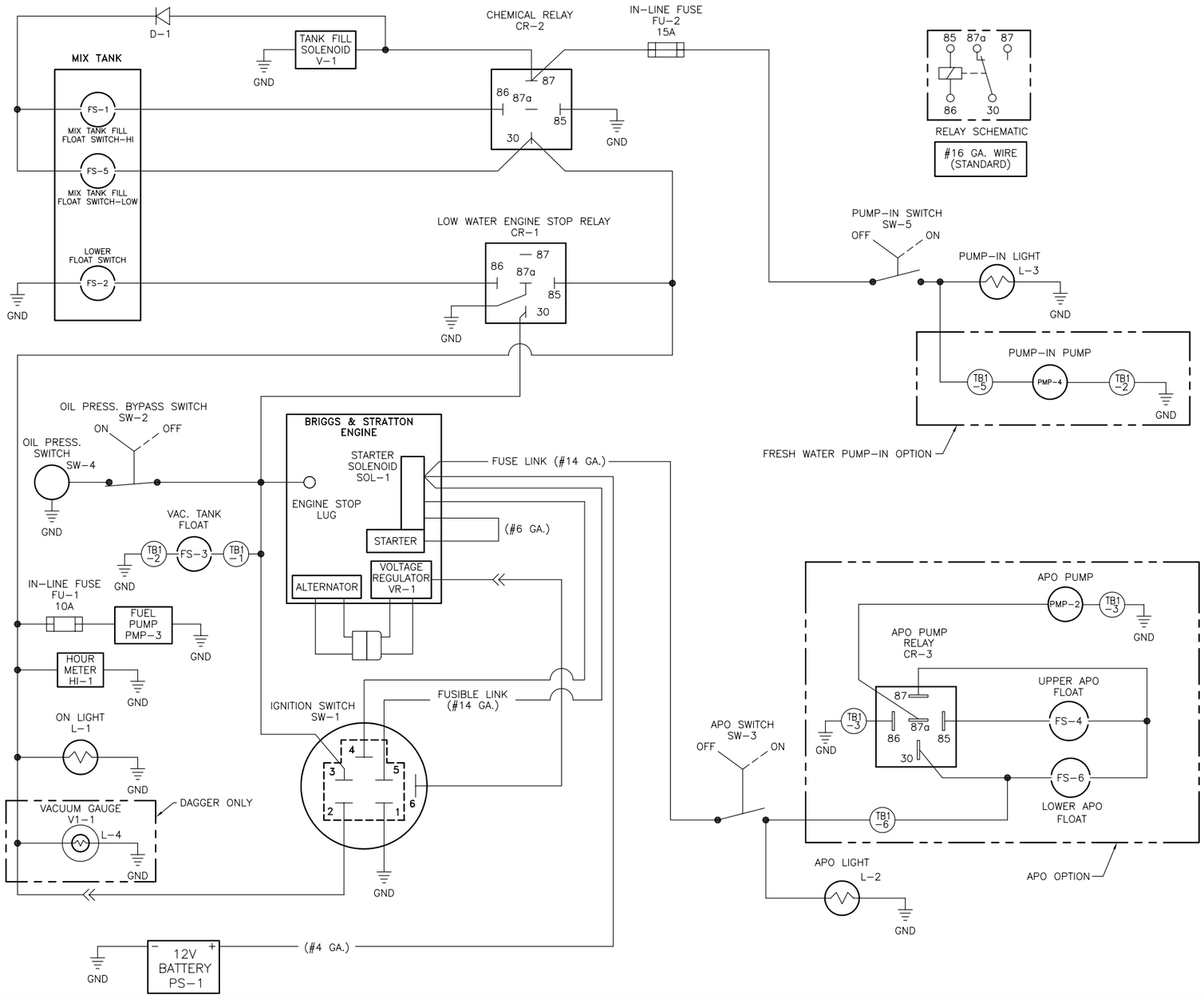


Figure 10 -2 Wiring Diagram

D-2936 Sheet 1 Rev J

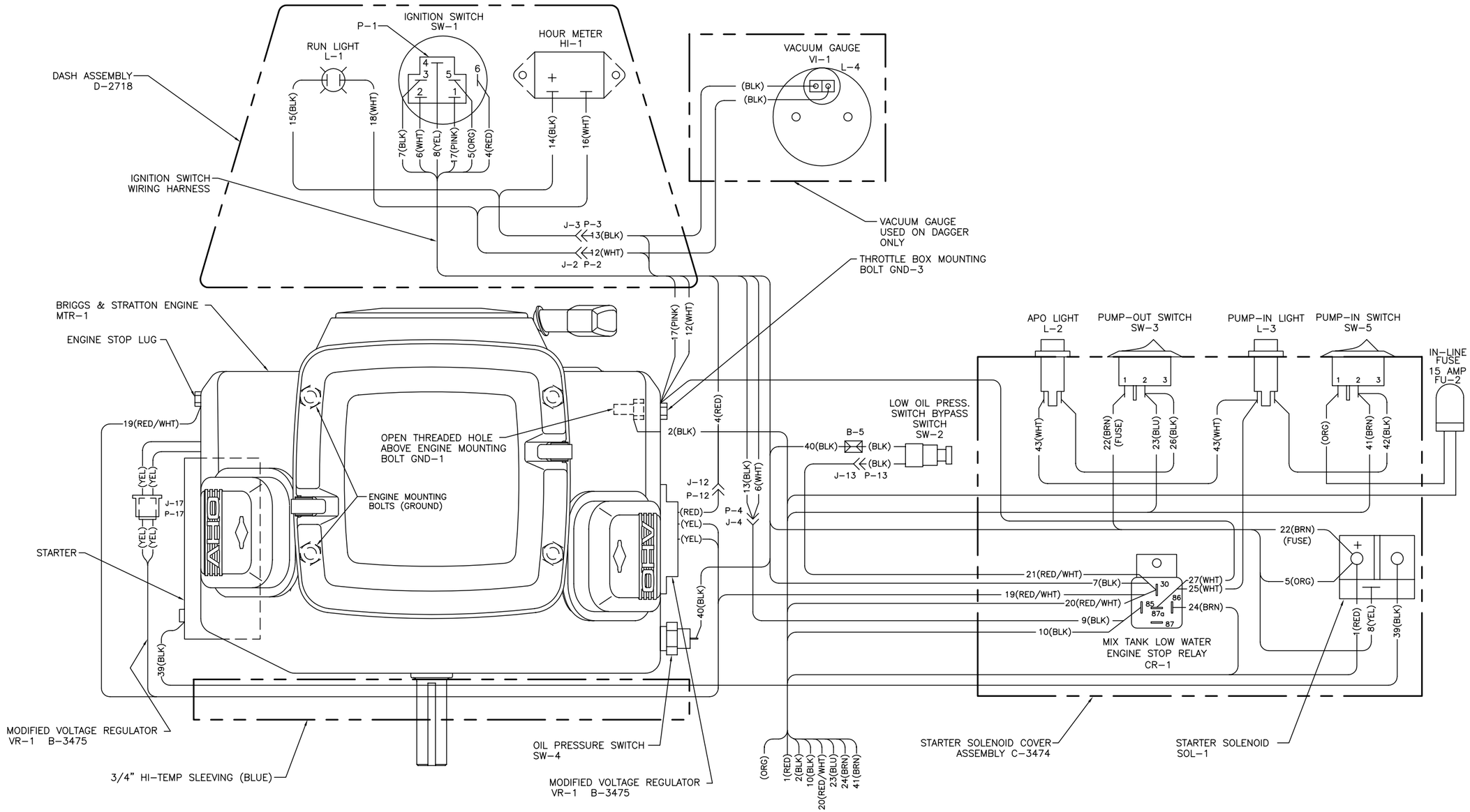
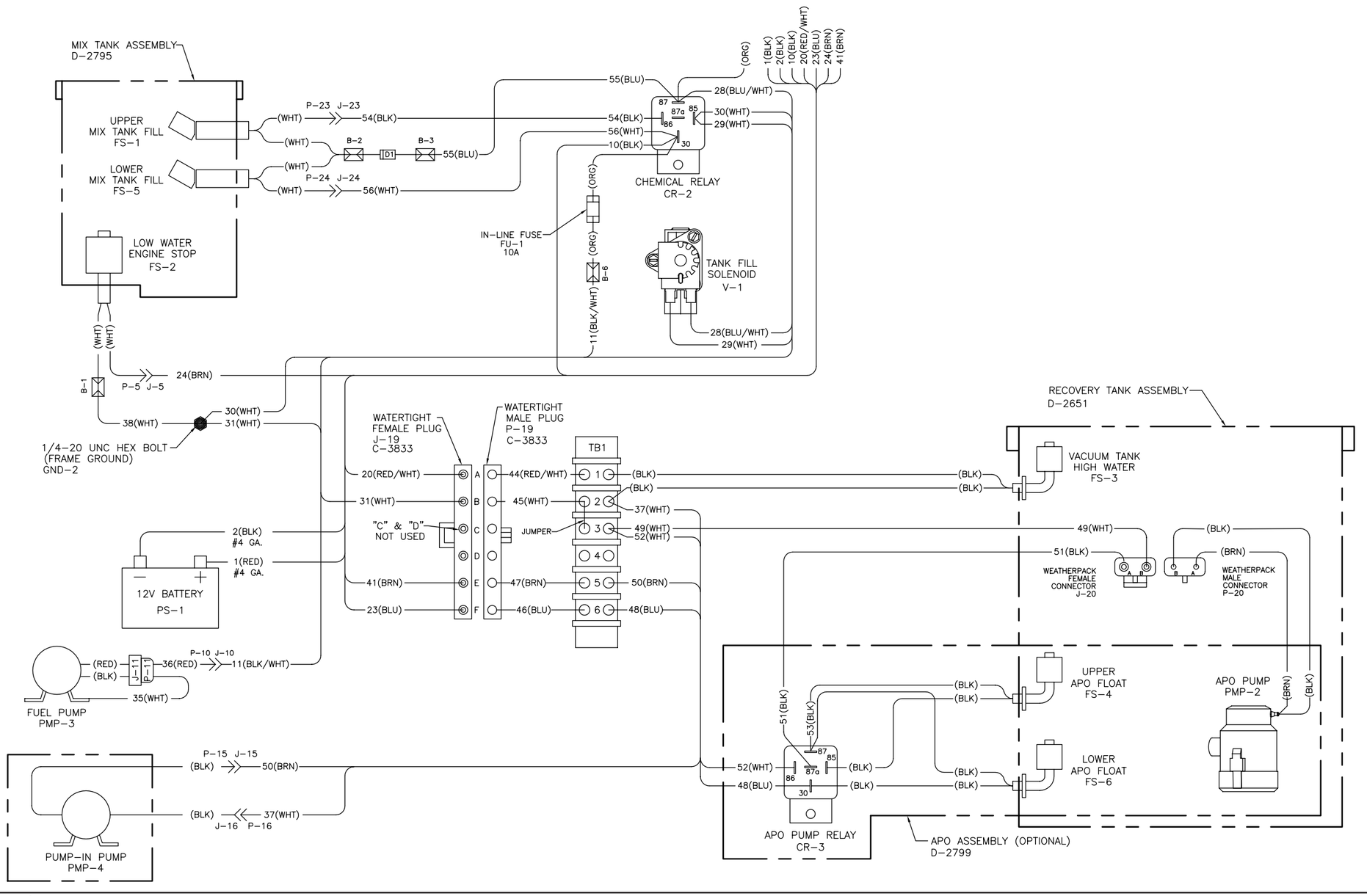


Figure 10-3 Wiring Diagram

D-2936 Sheet 2 Rev J



Electrical Troubleshooting

SpitFire 3.2
Section 10-5

No	Problem / Possible Cause	Solution
1	**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	**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 its 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 3.2
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 date and machine hours in 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.
Inspect vacuum tank s/s filter and filter bag for tears, holes, etc.
Clean, repair or replace as needed.
Lubricate blower with an oil based lubricant through blower inlet.

WEEKLY

One time change of oil and oil filter ***after first 20 hours*** of use.

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.
Check "Y" filter. Clean as necessary.
Inspect orifice.
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.

MONTHLY

Change oil filter.
Check engine air cleaner filter. Clean as necessary.
Remove pressure By-pass 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

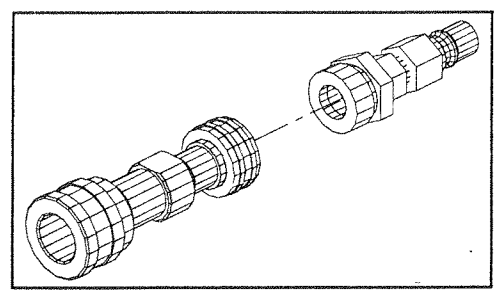
Scale deposits on the interior of the heating system can cause a noticeable loss in heating performance. Deposits of this kind result from hard water deposits,

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, 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 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 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 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.

SPITFIRE 3.2 MAINTENANCE LOG

MAX HRS	DAILY SERVICE	OIL RECOMMENDATIONS							
8	ENGINE OIL check	BLOWER	40 weight non-detergent						
8	PUMP OIL check	PUMP	5 - 30 weight synthetic motor oil						
8	GARDEN HOSE SCREEN clean	ENGINE	30 weight motor oil						
8	MACHINE general inspection		30 weight motor oil						
8	VAC TANK FILTER BAG clean		NOTE: Overhead valve engines can use multi-viscosity oil, but will experience increased oil consumption.						
8	BLOWER INLET spray with lubricant								
	WEEKLY SERVICE	DATE & HOURS							
See Note	OIL change with filter		Note: Break-in period determined by manufacturer. Reference engine manual.						
25	BLOWER check oil level								
25	DRIVE SYSTEM tighten screws								
25	BELTS & PULLEYS check for wear								
25	HIGH PRESSURE LINES check for chafing								
25	NUTS & BOLTS check tightness								
25	"Y" FILTER check and clean								
25	ORIFICE inspect								
25	VACUUM RELIEF VALVE inspect, clean, lube								
25	VACUUM TANK clean								
25	WIRING check for chafing								
25	CHEMICAL SYSTEM flush with vinegar								
25	ENGINE OIL change								
	MONTHLY SERVICE								
100	OIL FILTER change								
100	ENGINE AIR CLEANER clean								
200	BY-PASS VALVE grease piston and o-rings								
200	BATTERY WATER LEVELS check								
	QUARTERLY SERVICE (3 MONTHS)								
300	FUEL LINES check								
300	SPARK PLUGS clean and gap								
300	DRIVE COUPLER check for wear								
400	BLOWER OIL change								
400	PUMP OIL change								
400	BLOWER grease bearing								

How to Order Parts

SpitFire 3.2
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, he either stocks or has access to parts through a regional service center.

EMERGENCIES

If, for any reason, your distributor is unable to supply you with the necessary parts, he 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 Customer Service Department at (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 3.2
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.

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 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 the Warranty/Service Dept. at (425) 775-7275. **No collect calls will be accepted.** When calling, be sure to have machine information and serial number ready for the service representative. **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 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.**

Accessories

SpitFire 3.2
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.

HYDRAMASTER
Corporation
6323 204th Street SW, Lynnwood, WA 98036

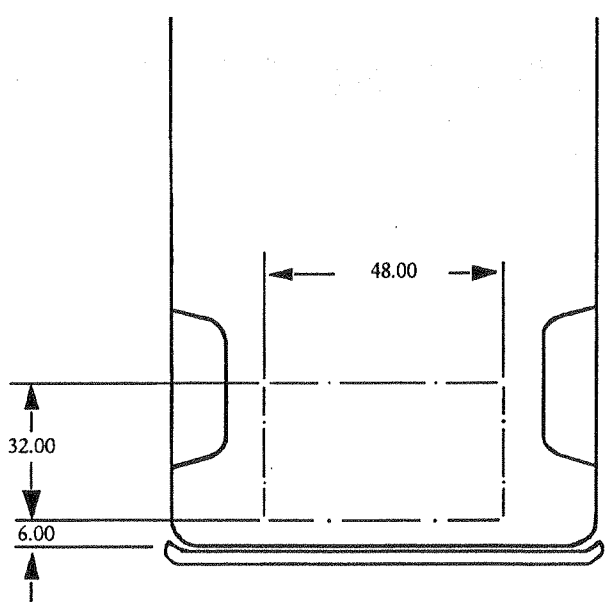
PRODUCT SUPPORT BULLETIN

TO: All HydraMaster Distributors DATE: 14 Jun 1994

RE: '93 Dodge Vans PSB #: 94062
Location of Fuel Tanks

It has come to our attention that the fuel tanks on 1993 and newer Dodge vans are located directly against the floor of the van. Caution must be used when drilling any holes through the floor. The attached illustration indicates the area in the rear of the van where no screws may penetrate the floor.

Anyone who has installed flooring in a 1993 or newer Dodge van may need to check to see that no damage was done to the fuel tank. The fuel tanks are rotationally molded polyethylene plastic. If any holes were made in the tank they can be easily sealed with a hot knife. Please do not use an open flame.



HYDRAMASTER
Corporation
6323 204th Street SW, Lynnwood, WA 98036

PRODUCT SUPPORT BULLETIN

TO: All 1993-94 Truck-Mounts DATE: 1 Sep 1994

RE: Fuel Pumps PSB #: 94091

HydraMaster has available three fuel pumps (Nos. 111-001, 111-045 and 111-002). These pumps have different flow rates and pressure capability. In order to determine which pump is appropriate for a particular application it must be "sized". Each engine has a particular flow and pressure limitation.

The mounting location of the machine and the fuel pump can effect how much fuel flow and pressure the engine sees. Therefore sizing a pump is important. The accompanying chart shows the options available for each machine and fuel pump.

If you are not able to mount the fuel pump within the required ranges shown below, please call HydraMaster Service for other mounting options.

Machine & Engine	Standard Fuel Pump	Required Installation
3.2 Briggs and Stratton	111-001 Square	Mount 12 to 32 inches below the carburetor.
3.7 Briggs and Stratton	111-001 Square	
4.2 Honda	111-045 Round	Mount 32 to 48 inches below the carburetor.
4.2 Kawasaki	111-002 Round	
4.7 Onan	111-045 Round	

HYDRAMASTER

Corporation
6323 204th Street SW, Lynnwood, WA 98036

PRODUCT SUPPORT BULLETIN

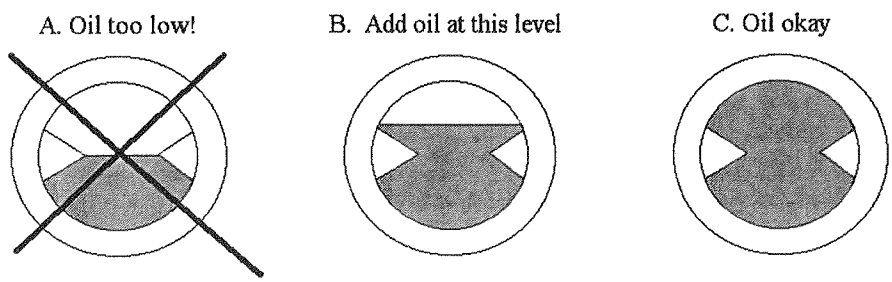
TO: SpitFire 3.2 Owners DATE: 14 Nov 1996

RE: Low Oil in Water Pump PSB #: 96111

The HydraMaster Service Department has noted that almost all pumps coming to the Service Department for repair have low oil levels. If the water pump is run in a low-oil condition it may cause the shaft seals to wear and fail prematurely. The pump then leaks between the water chambers and the crankcase.

Running the pump at low oil levels may be due to monitoring oil levels by the sight glass. The view in the sight glass is in the shape of an hourglass. When the oil level reaches ¼ of the way down the sight glass, add oil. If you wait until the oil level reaches the ½ way point (or the narrowest point in the hourglass), the oil is too low. On the dip stick the oil level should be maintained up to the ring.

The loss of oil may indicate a leak. For this reason future owner's manuals will recommend checking pump oil levels daily.



Use sightglass as a check only - fill using dipstick