HYDRAMASTER

11015 47th Avenue W, Mukilteo, WA 98275



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SpitFire 3.2

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Introduction

SpitFire 3.2 Section 1-1

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

Unlike a garden tractor, lawn mower or cement mixer, all having one or two functions to perform, the 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

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

TELEPHONE NUMBERS

(425) 775-7276 Parts (425) 775-7275 Service (800) 426-4225 Parts / Service FAX

System Operation

SpitFire 3.2 Section 1-3

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

The water flow is as follows:

Water is fed into the machine under tap pressure. It flows through one preheater and then is automatically combined with a cleaning solution as it enters the mix tank. The solution is then picked up by the high pressure pump and pressurized to the desired level. The water then splits flow, as demanded by the 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

SpitFire 3.2 Section 1-4

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

SpitFire 3.2 Section 1-6

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
eator through our proportion of the control of the		
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	ΩΤΥ
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

SpitFire 3.2 Section 1-8

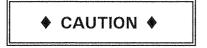
The *Purchaser's* responsibilities, prior to arrival of unit, are:

To install 5/8" exterior plywood flooring in the vehicle and cover it with artificial turf.



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.



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 Preparation

Then selecting a truck, remember the preferable vehicle for a SpitFire 3.2 installation is a cargo van with a heavy-duty suspension package and a three quarter ton capacity, or a larger box truck type vehicle.

VAN PREPARATION

The manufacturer recommends the installation of a spray-on bed liner in the vehicle prior to installation of machine.

A 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.

This provides 'metal to cushion' mounting rather than 'metal to metal', provides insulation and makes an attractive van interior. Astroturf should be color-keyed to the van interior. It is highly recommended to install roof vents in vehicles operated in hot weather conditions. Roof vent positions are shown in Figure 1-1.



Figure 1-1 Roof Vent Locations

PLACEMENT OF UNIT IN VEHICLE

There are two recommended unit placements:

SIDE DOOR:

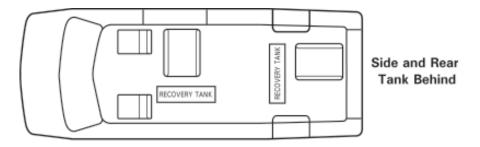
Most installations are side door. This provides rear access for accessories and hoses as well as unobstructed access to the component/working side of the machine, thus making it a bit easier to perform maintenance and/or repair without removing the unit from the truck.

REAR DOOR:

Although this location partly limits working access, it does direct the noise away from the cleaning site. Some cleaners in the colder areas prefer this location because it puts the weight over the rear wheels for better traction in ice and snow. Rear mounting requires the unit to be slid to the right side as far as possible.

This not only provides adequate working space on the component side of the unit but also improves weight distribution inside the van (engine and component weight line up over drive shaft). Also, it is physically easier to load the unit into the rear door due to the height of the van bed.

Figure 1-2 Recommended Placement



Machine Tie Down Cleats

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

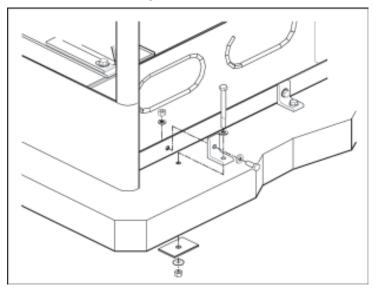


Figure 1-3 Installation Using Tie-down Cleats

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



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.



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

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

! WARNING

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

! WARNING

Transportation in a vehicle of any vented fuel container that presently holds or has ever held a flammable liquid is strictly forbidden by Steamatic, Inc. and by federal and state regulation.

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

Local Water Precautions

SpitFire 3.2 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

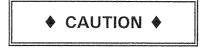
HydraMaster recognizes that any hard water deposits which might occur within the water system of our truckmounts is a serious problem. The precision technology of truckmount heat exchanger systems is intolerant of any foreign material. Hard water deposits will ultimately decrease the performance of the 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 descaler 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 descaling 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.



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.

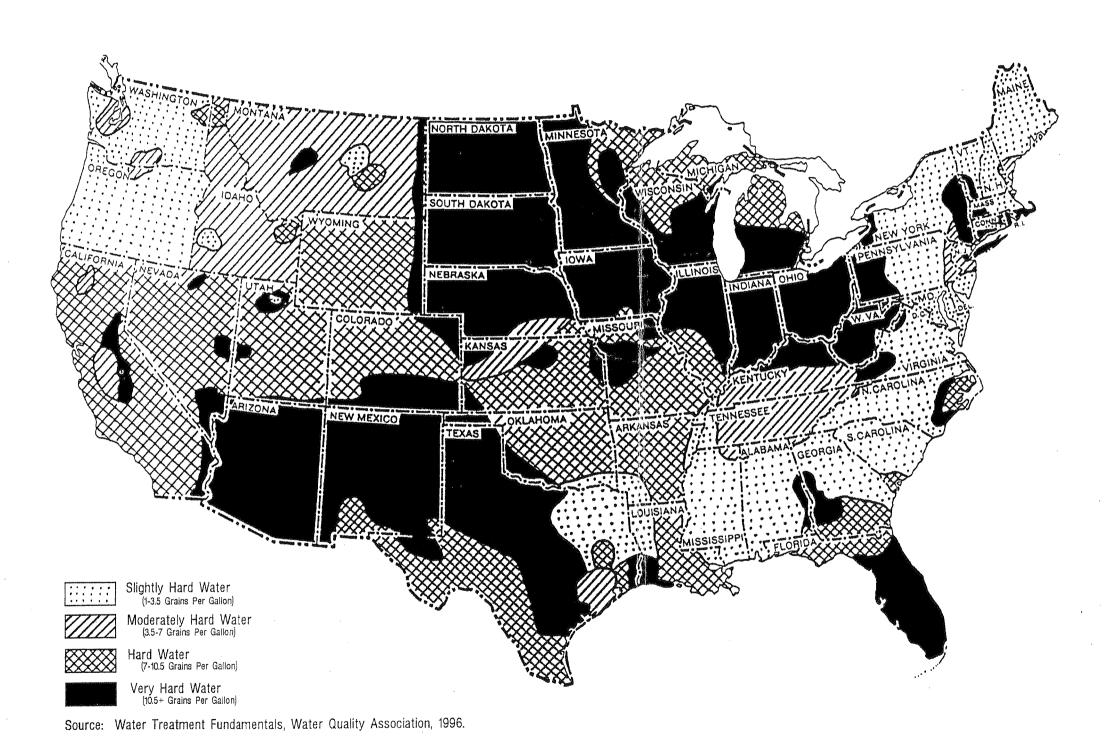
In most cases, an acceptable method of waste water disposal is to discharge into a municipal sewage treatment system after first filtering out solid material such as carpet fiber. Access to the sanitary system can be obtained through a toilet, laundry drain, RV dump, etc. Permission should first be obtained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



Machine Assemblies and Parts Lists

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

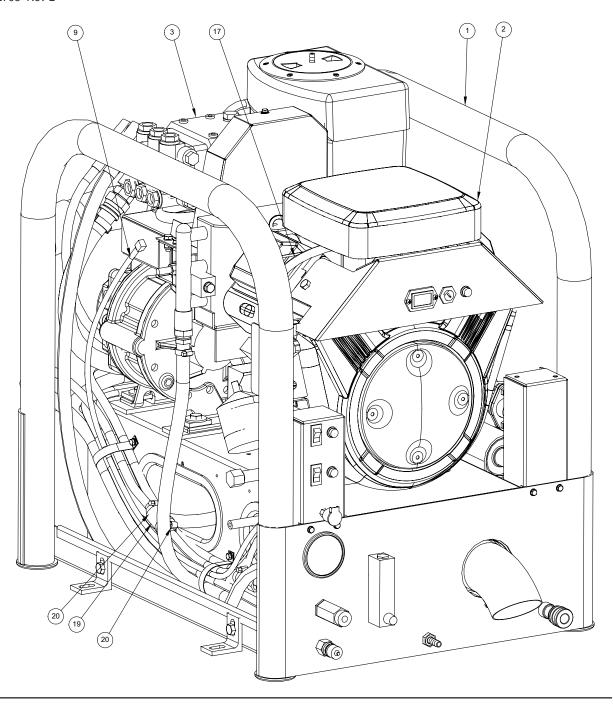


Figure 1-7 Machine Assembly - Front Right View D-2793 Rev L

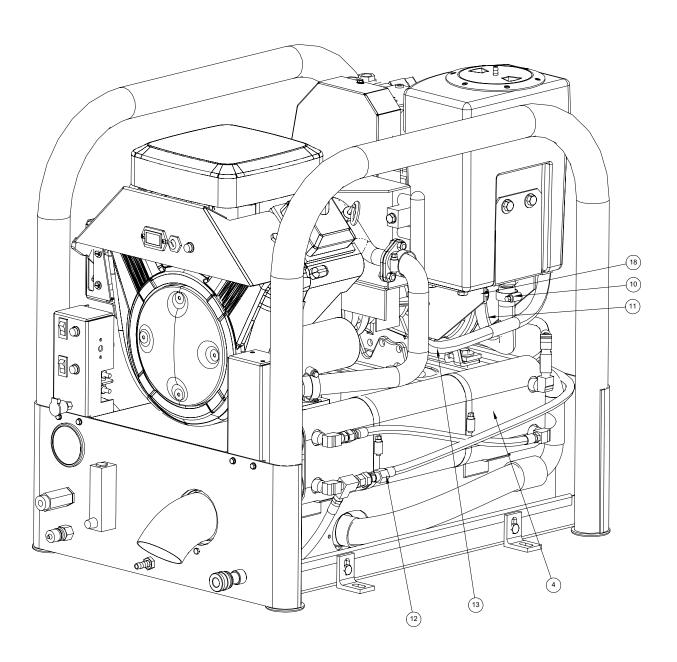


Figure 1-8 Machine Assembly - Rear Left View D-2793 Rev L

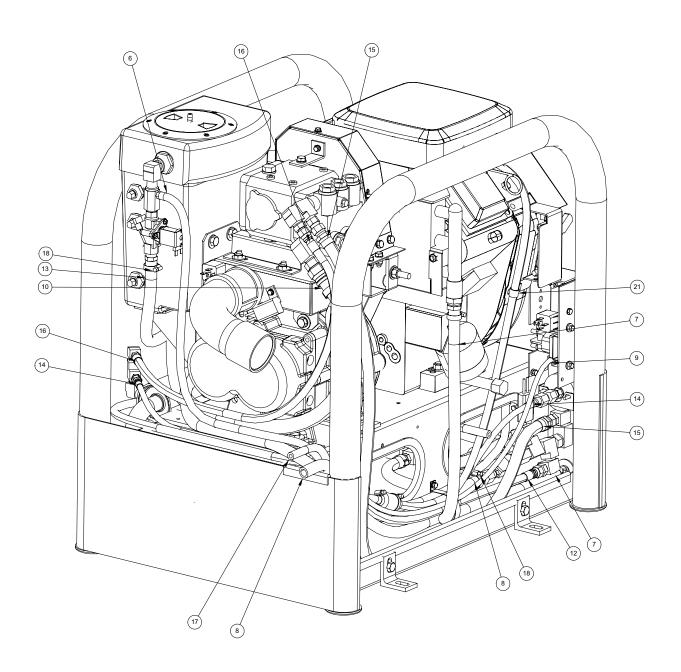
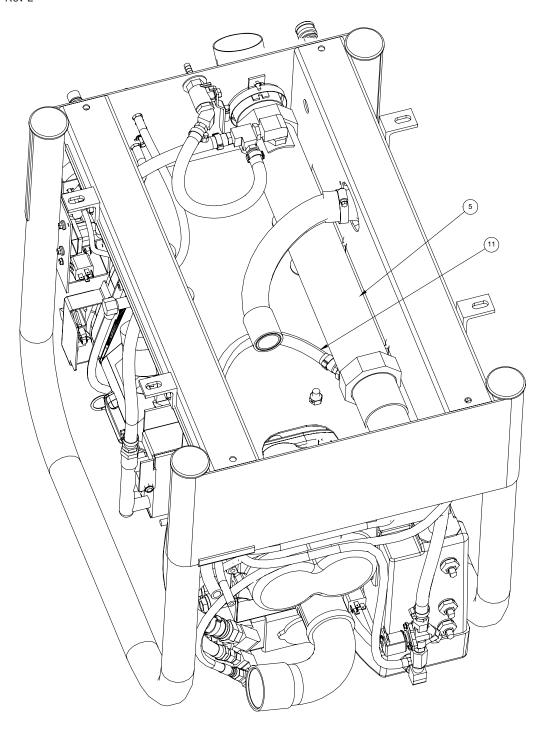


Figure 1-9 Machine Assembly - Bottom View D-2793 Rev L

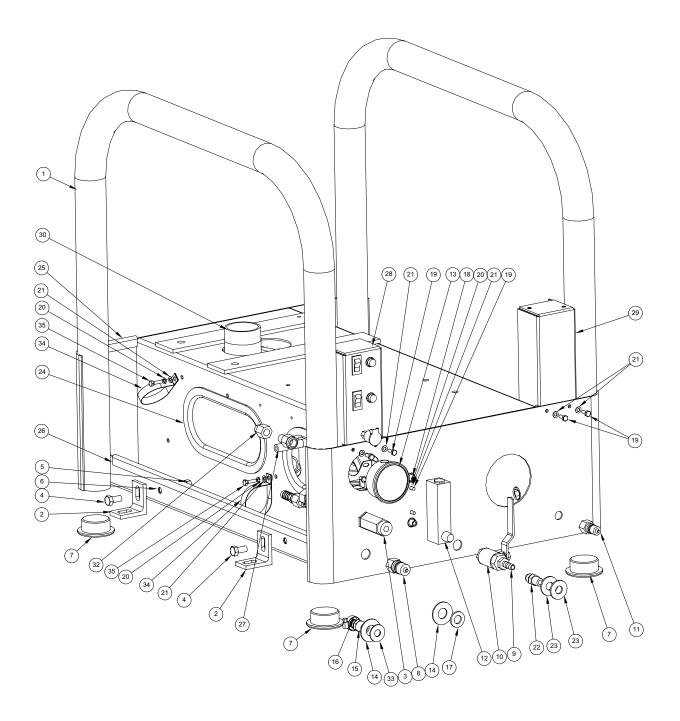


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Machine Assembly Parts List

ltem	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	Dual Heat Exchanger Assembly - Spitfire 3.2	1
5	Fig 1-22	Lower Heat Exchanger Assembly - 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 Femal	1
12	000-068-510	Hose, 3/8" x 56" Lg. Teflon w/ 1/4 NPT x 3/8 JIC Female	1
13	000-068-531	Hose, 1/2" I.D. x 30" Lg. Black 1/2 NPT x 3/8 SAE(1/2"End T $$	1
14	000-068-534	Hose, 3/16" I.D. x 44.50" Lg. Teflon w/ 1/8 NPT x 1/4 JIC Fem	1
15	000-068-588	Hose, Throb	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



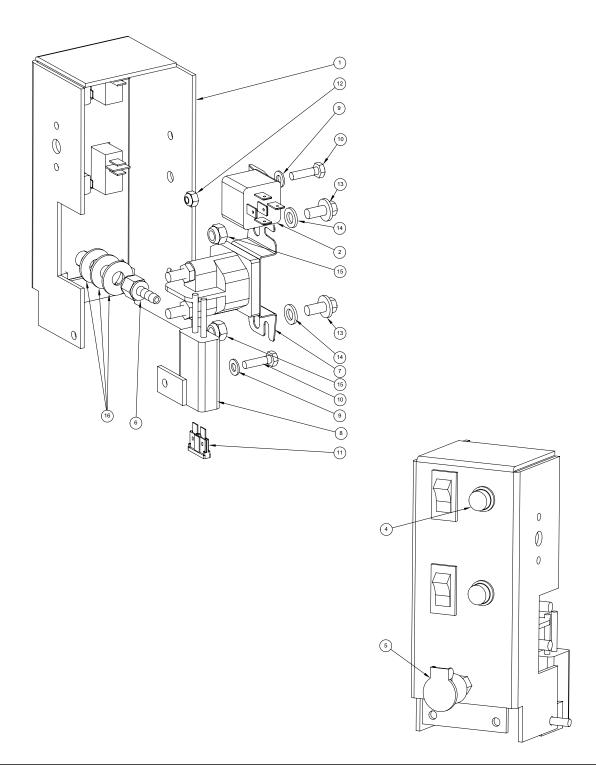
Frame Assembly Parts List

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	000-143-017	Screw, 3/8"-16UNC x 3/4" Lg. Hex Head	4
5	000-094-014	Nut, 3/8"-16UNC Hex Zinc 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	000-052-051	Quick Connect, 440 Female w/ EPDM O-Ring	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

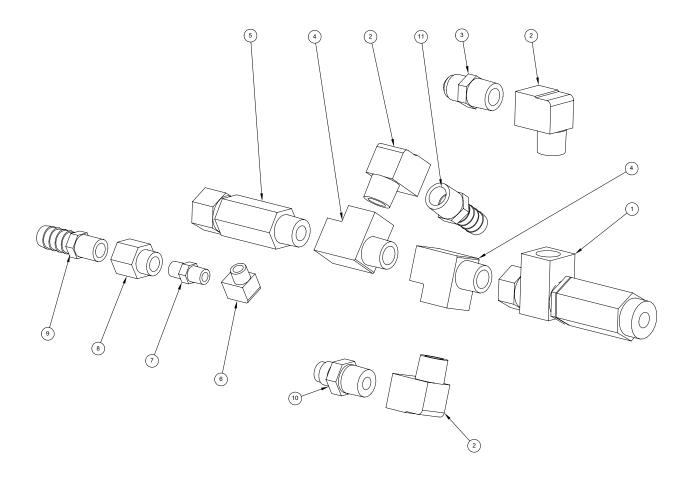
Figure 1-11 Starter Solenoid Cover Assembly D-3474 Rev A



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

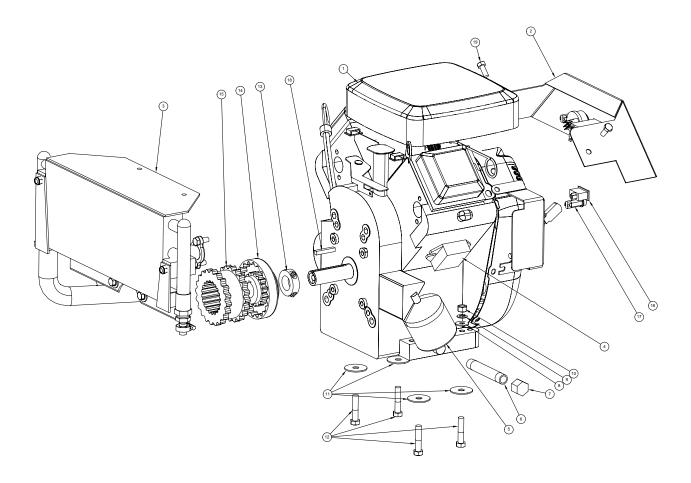
Figure 1-12 **By-Pass Valve Assembly** C-5907 Rev -



By-Pass Valve Assembly Parts List

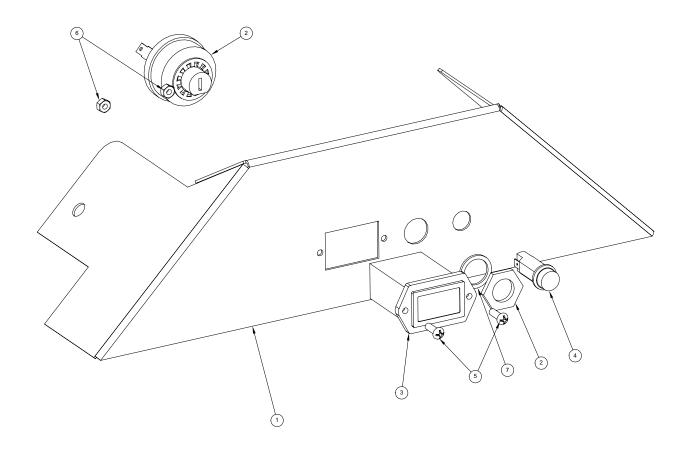
Item	Part Number	Description	Qty
1	000-169-158	Valve, By-Pass w/ Red Spring (0-1000 PSI)	1
2	000-052-086	Elbow, 3/8" NPT Street	3
3	000-052-128	Nipple, 3/8" NPT x 3/8" Male Propane	1
4	000-052-023	Tee, 3/8" NPT Male Street	2
5	000-169-011	Valve, Hi Temp Control 180°	1
6	000-052-084	Elbow, 1/8" NPT Street	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 J



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

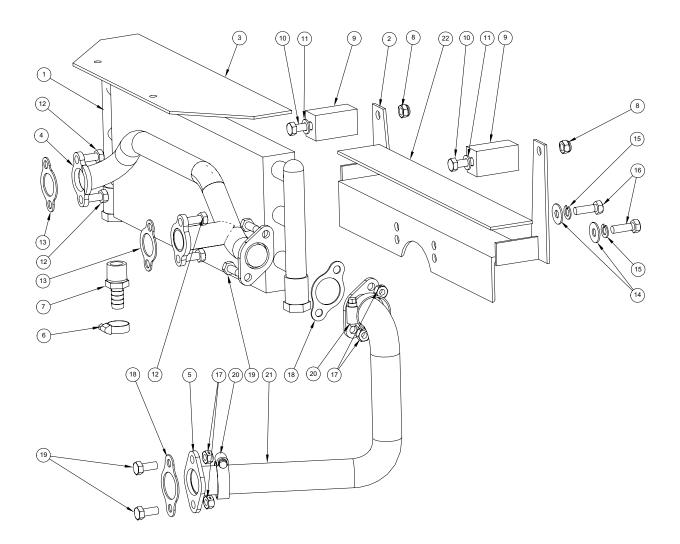
Figure 1-14 Dash Assembly D-2718 Rev B



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

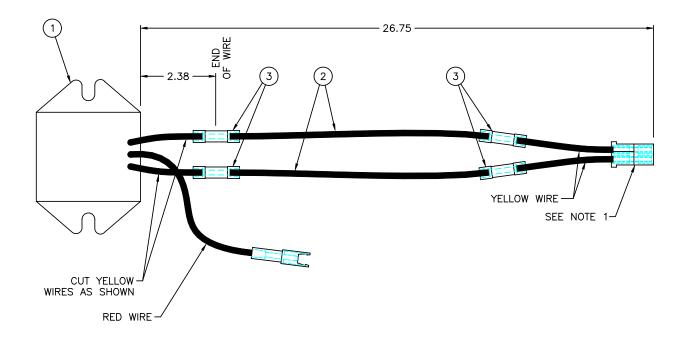
Figure 1-15 Exhaust Assembly D-5909 Rev -



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 Wrap -	1
22	000-131-009	Insulation, 1/8" x 12" - Bulk	1

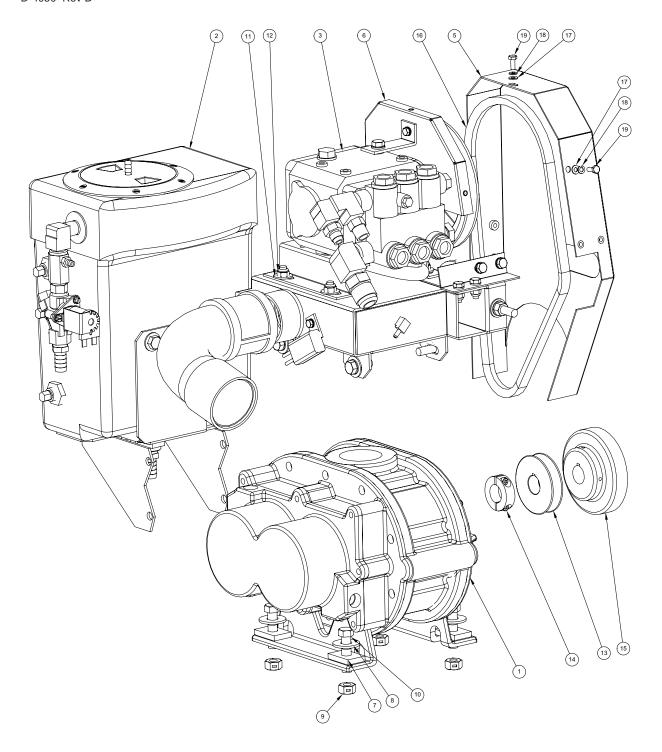
Figure 1-16 Voltage Regulator Modification Assembly B-3475 Rev -



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

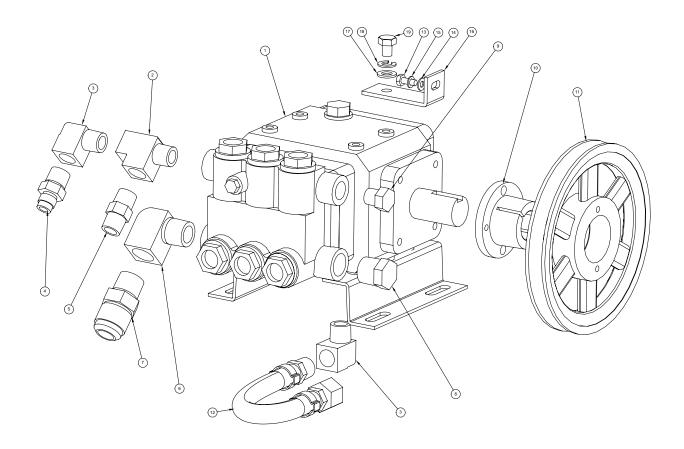
Figure 1-17 Pump & Blower Assembly D-4050 Rev B



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

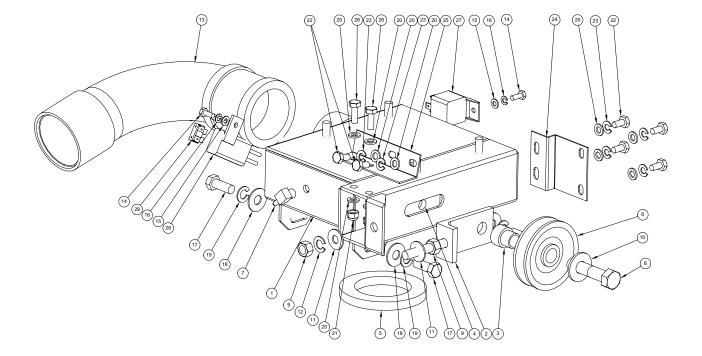
Figure 1-18 **Pump - Hydra II - Assembly** D-5906 Rev -



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

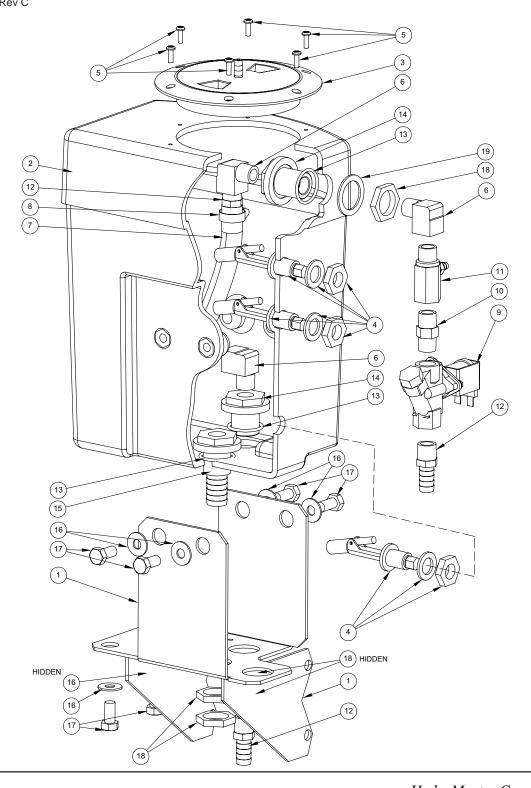
Figure 1-19 Collector Box Assembly D-5908 Rev A



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

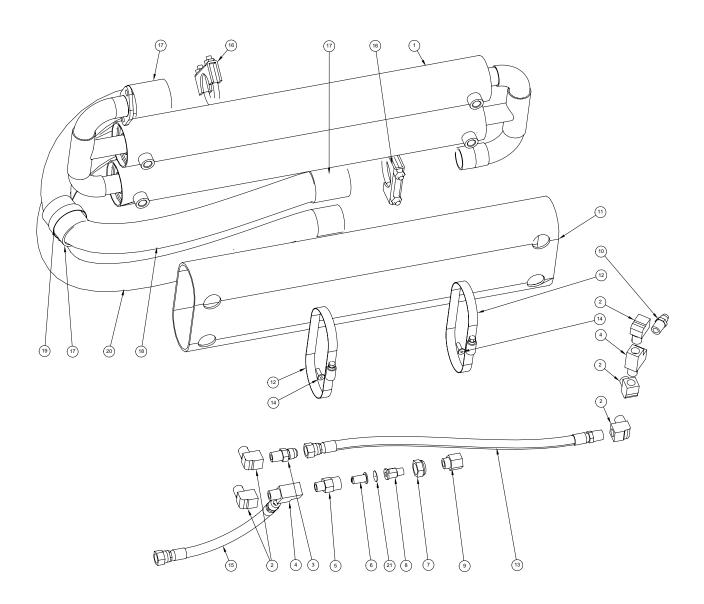
Figure 1-20 Water Box Assembly D-5905 Rev C



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 - Modified	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	000-143-314	Screw, #8 x 1/2" Lg. Pan Head	6
6	000-052-086	Elbow, 3/8" NPT Street	3
7	000-068-327	Hose, 1/2" I.D. Clear Braid - Bulk	1
8	000-033-004	Clamp, Size #6	1
9	000-169-120	Valve, Chemical & Hi-Temp Solenoid - 12 Volt	1
10	000-052-074	Nipple, 3/8" NPT Hex	1
11	000-181-008	Venturi, Low PSI Injector - Modified	1
12	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	3
13	000-097-041	O-Ring, 1/2" Bulkhead	3
14	000-052-660	Bulkhead, 3/8" FPT x 3/8" FPT	2
15	000-052-661	Insert, 3/4" Barb x Straight	1
16	000-174-032	Washer, 3/8" Flat	6
17	000-143-017	Screw, 3/8"-16UNC x 3/4" Lg. Hex Head	6
18	000-094-097	Nut,1-14" Brass Water Box	5
19	000-174-063	Washer, 1.5" O.D. x 1.073" I.D. x 0.075" Thk.	1

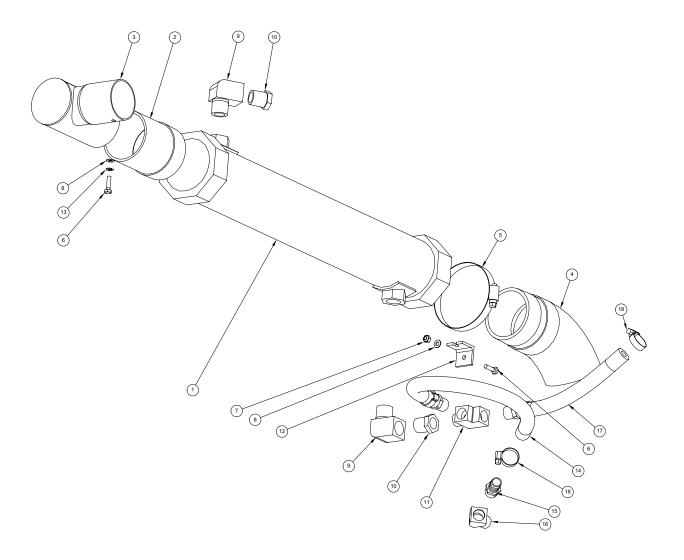
Figure 1-21 **Dual Heat Exchanger Assembly** D-3090 Rev B



Dual Heat Exchanger Assembly Parts List

ltem	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 Ends	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 Ends	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-Silic	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

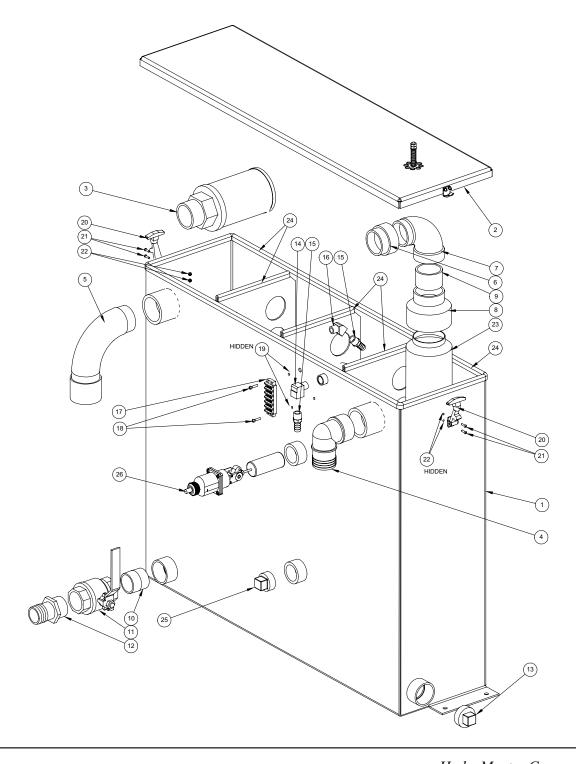
Figure 1-22 Lower Heat Exchanger Assembly D-2665 Rev B



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 Ends	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

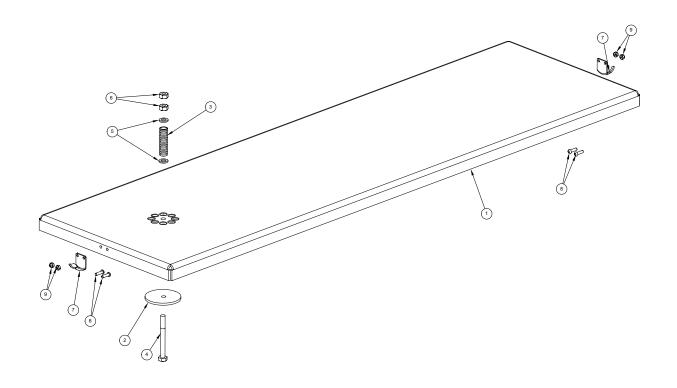
Figure 1-23 Recovery Tank Assembly D-2651 Rev M



Recovery Tank Assembly Parts List

ltem	Part Number	Description	Qty
1	000-159-041	Tank, Recovery - Weldment - Spitfire	1
2	Fig. 1-24	Assembly, Recovery Tank Cover - Spitfire	1
3	000-049-007	Filter, 2" NPT Blower s/s	1
4	000-052-224	Elbow, 2" NPT x 2" Barb	1
5	000-001-036	Adapter, Ø2.75 x 2" NPT Tank Inlet Elbow	1
6	000-052-219	Adapter, 2" NPT x 2" F Slip	1
7	000-052-223	Elbow, 2" F Slip x 2" M Slip	1
8	000-052-404	Adapter, 3" F Slip x 2" F Slip	1
9	000-125-052	Tube, 2" PVC x 1.50" Lg. Filter Bag Adapter Sleeve	1
10	000-052-182	Nipple, 1-1/2" NPT Close Galvanized	1
11	000-169-022	Valve, 1-1/2" Full Port Ball	1
12	000-052-226	Insert,1-1/2" NPT x 1-1/2" Barb (Grey)	1
13	000-106-019	Plug, 1-1/2" NPT	1
14	000-052-086	Elbow, 3/8" NPT Street	1
15	000-052-105	Insert, #68 (3/8" NPT x 1/2" Barb)	2
16	000-052-083	Elbow, 3/8" NPT Street x 45°	1
17	000-012-002	Block, 6 Post Terminal	1
18	000-143-051	Screw, #8-32UNC x 0.75" Lg. Binder Head Phillips	2
19	000-094-059	Nut, #8-32UNF Nylock	2
20	000-086-008	Latch, Bungie	2
21	000-143-539	Screw, #6-32UNC x 0.50" Lg. Button Head Allen	4
22	000-094-063	Nut, #6-32UNC Nylock	4
23	000-049-030	Filter Bag, 92+Truck Mount	1
24	000-131-121	Bumper Materail - Split	1
25	000-106-046	Plug, 1-1/4" NPT	1
26	000-157-090	Float, Lever Switch	1

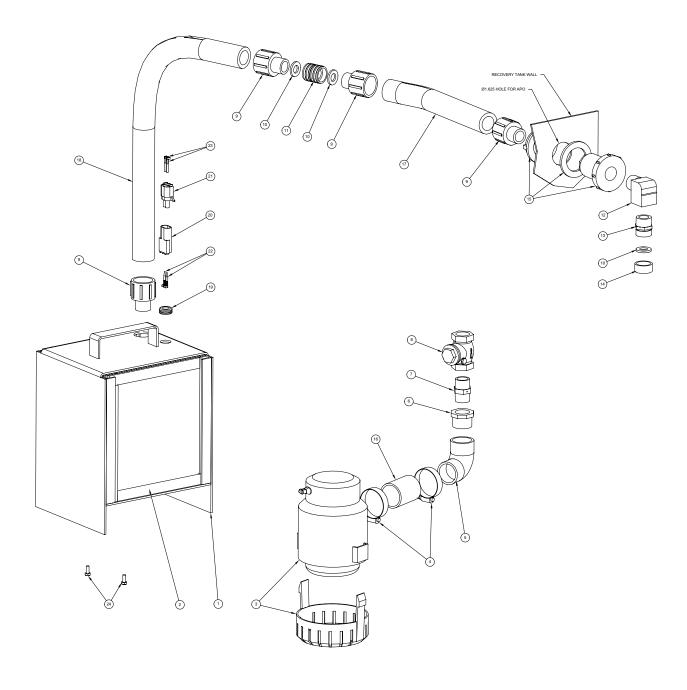
Figure 1-24 Recovery Tank Cover Assembly C-2704 Rev F



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 1-26 APO Assembly D-2799 Rev C



APO Assembly Parts List

ltem	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 B

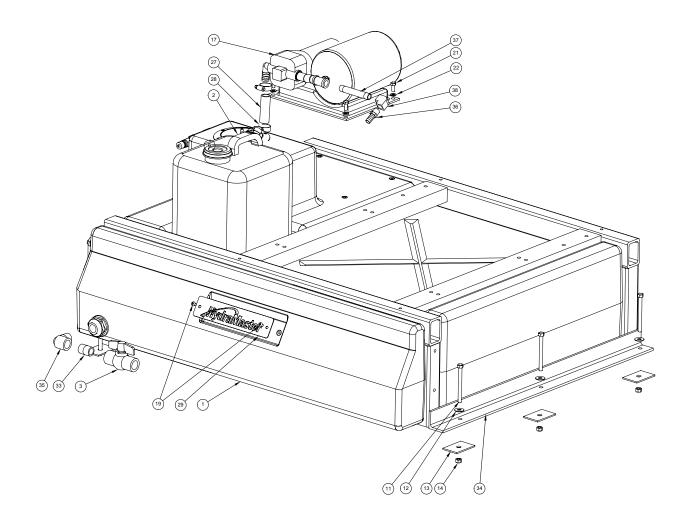
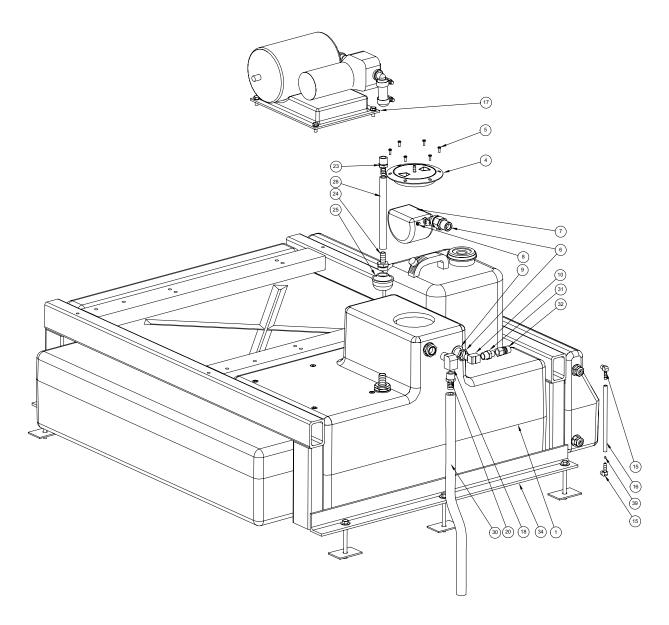


Figure 1-28 **85 Gallon Rotomolded Tank Assembly - Rear View** D-5566 Rev B



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

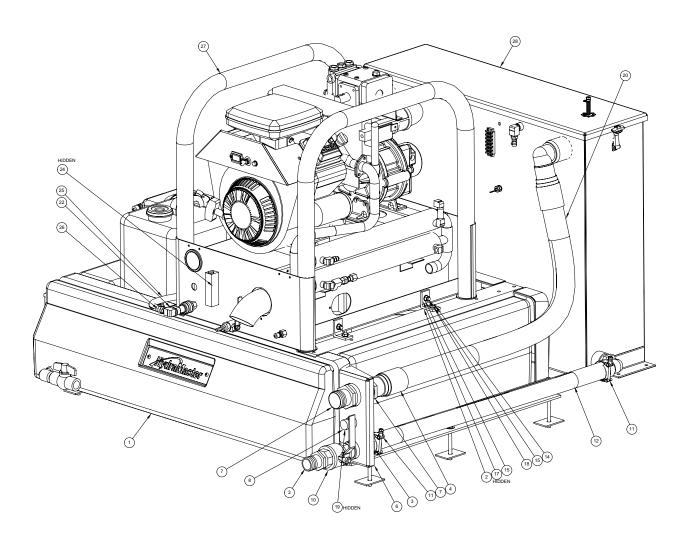
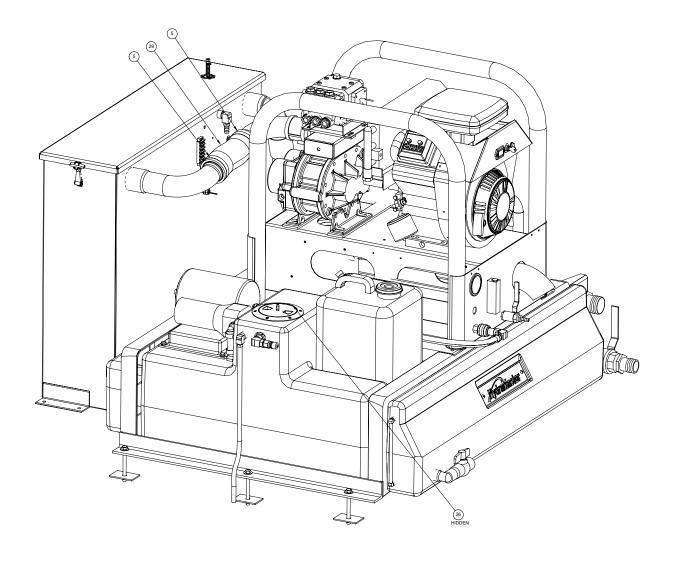


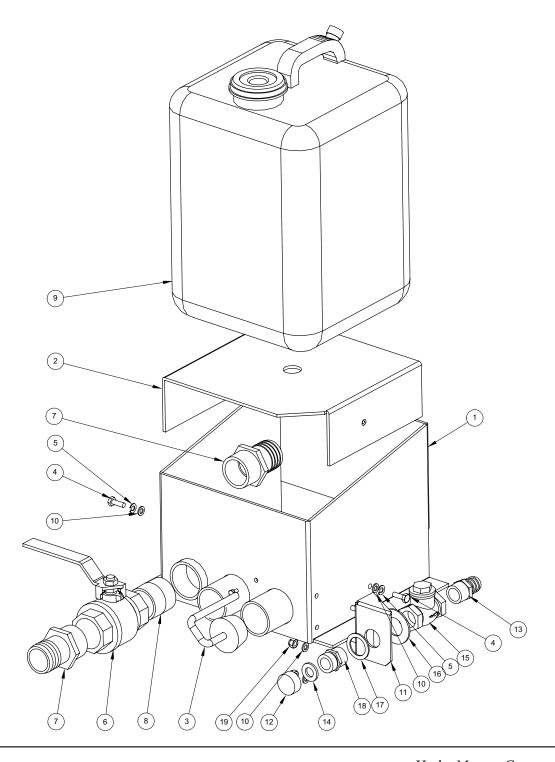
Figure 1-30 **85 Gallon Rotomolded Tank w/ SpitFire 3.2 Assembly - Left View** D-5819 Rev A



85 Gallon Rotomolded Tank w/ SpitFire 3.2 Assembly Parts List

Item	Part Number	Description	Qty
1	Fig. 1-26 & 1-27	' 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	000-143-017-1	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

ltem	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

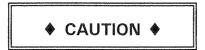
Your mobile carpet cleaning plant has been engineered using the latest and most sophisticated technology available to produce the finest carpet cleaning results possible. Despite this, however, it remains only a tool of the carpet cleaning trade, and it can produce only as good a job as the person operating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



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

<u>Purpose</u>: 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.

<u>Procedure</u>: 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.)

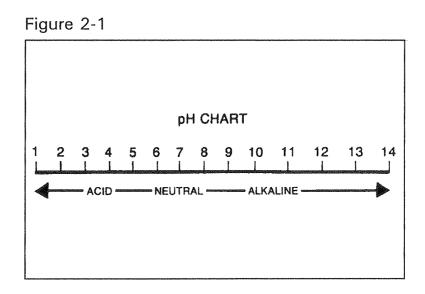
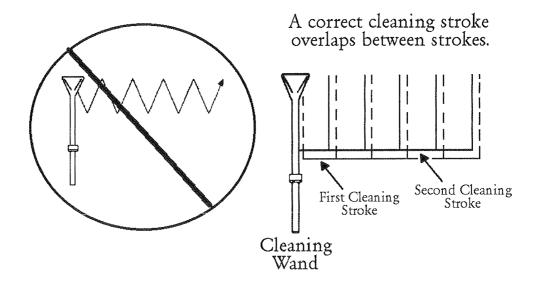


Figure 2-2: CLEANING STROKE PROCEDURE



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

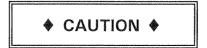


When using equipment for flood damage, you *must* have a fresh water source hooked up at all times to allow a cold water source into the machine. This will prevent overheating during long periods of vacuum recovery.

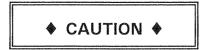
Precautions

SpitFire 3.2 Section 3-3

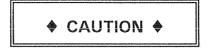
Although this unit has been factory adjusted, it may require additional adjustments to achieve optimum performance, i.e. altitude may require carb adjustment and ambient temperatures may require heat control adjustment. When required, consult an authorized representative.



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.)



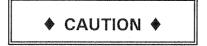
ENGINE COOLING: Units employing air cooled engines must not be enclosed within a van with doors and windows closed. Excessive temperatures within the engine will result in premature engine failure and a compromise of applicable warranty.



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.

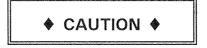


MOVING PARTS: Never touch any part of the machine that is in motion. Severe bodily injury may result.

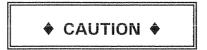


ACID RINSE AGENTS: The increased demand for "clear water" rinsing results in the need for special care when using these acid based chemicals in your equipment. The negative side of these products is the corrosive effects the acid can have on metals, including swivels, pumps, heat exchangers, etc.

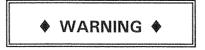
HydraMaster's *ClearWater Rinse* has been formulated to protect vital components. HydraMaster will not warranty parts that have been damaged from using acid products that have obviously caused failures.



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.

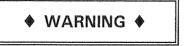


EXHAUST SYSTEM: Do not allow flammable material (i.e. oil, fuel, plastic or wood products) to come in contact with the exhaust system.



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.



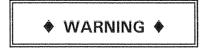
HEARING PROTECTION: The Occupational Safety and Health Administration (OSHA) recommends the use of hearing protection when an operator is exposed to an *average* of 85 decibels (this is an average of exposure over an 8 hour period). This equipment can produce 85 decibels to a distance of 10 feet. Please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



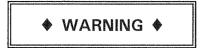
NO SMOKING: It is unsafe to smoke in or around the vehicle.



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.

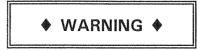


TOXIC FUMES: Do not occupy the vehicle when the cleaning equipment is operating. Toxic fumes may accumulate inside a stationary vehicle.

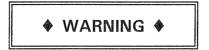


ENGINE EXHAUST: The engine exhaust from this product contains chemicals

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



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.



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



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

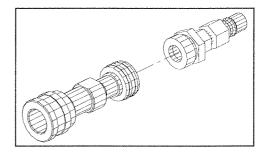
SpitFire 3.2 Section 4-1

- 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

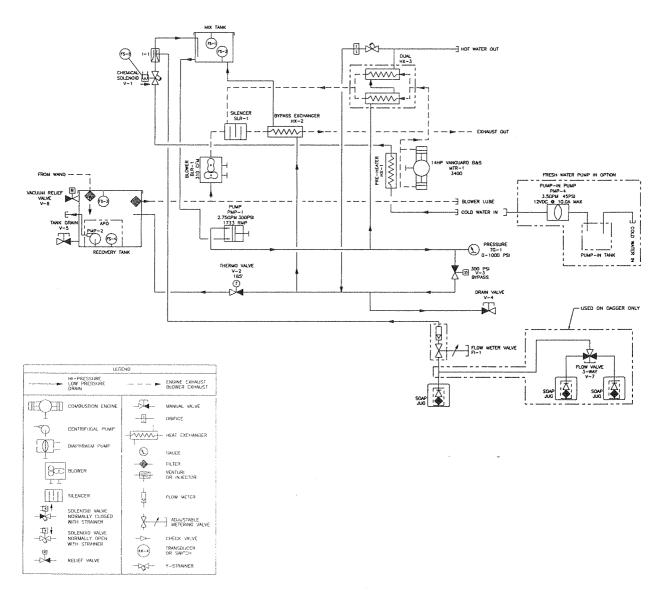


Figure 5-2: **Proportioner Diagram**

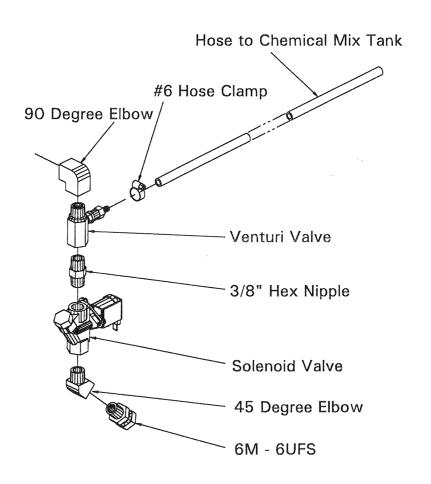
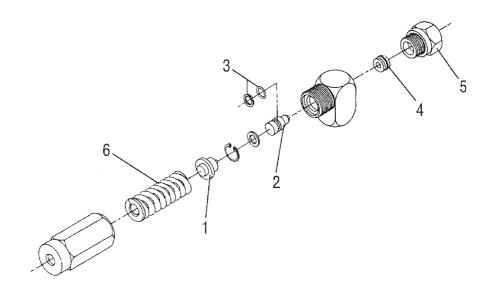


Figure 5-3: By-Pass Valve Assembly



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 Shov	vn:		
	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
	There is a loss of water pressure.	
1.1	The <i>mix tank water supply hose</i> 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 <i>mix tank</i> .	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.
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 <i>mix tank water</i> 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 <i>mix tank supply hose</i> 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 <i>pump</i> .	Inspect the valves and remove any foreign material.
1.10	The controlled <i>orifice</i> 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 <i>by-pass valve</i> 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 <i>glide seals and valves</i> 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 <i>thermo valve</i> is stuck open and water is flowing continually past the valve.	This is a non-serviceable valve. Replace it.
2.2	The <i>orifice</i> (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 <i>exhaust</i> leak.	Inspect the exhaust system for leaks. Tighten any loose clamps. Weld or replace any broken parts.
2.5	There is excessive <i>pressure</i> .	Adjust the pressure regulator for less pressure.
2.6	There is exhaust wrap missing.	Replace any missing wrap.
2.7	The <i>engine</i> speed is low.	Reset the engine speed. Refer to the Engine Operation and Maintenance manual.
2.8	A <i>heat exchanger</i> is scaled.	De-scale the heat exchanger or remove it and take it to a radiator shop to be boiled out.
2.9	A <i>heat exchanger</i> 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 <i>preheater</i> mounted behind the motor is scaled.	Remove the preheater. At a radiator shop, give it a hot tank treatment.

No	Problem / Possible Cause	Solution
S	The water temperature is excessive.	
3.1	The <i>filter</i> in front of the controlled orifice is clogged.	Inspect the filter. Clean it if necessary.
3.2	The controlled <i>orifice</i> is clogged.	Inspect the controlled orifice. Clean it if necessary.
3.3	The <i>thermo valve</i> is not opening and no water is flowing through the valve.	This is a non-serviceable valve. Replace it.
3.4	The <i>engine</i> 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 <i>quick connect</i> on one or more of the high pressure hoses is defective.	Remove and clean or replace the defective quick connect(s).
4.3	The <i>cleaning tool</i> 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 <i>quick connect</i> on the front of the machine is clogged.	Remove and clean or replace the quick connect.
4.5	The inner lining on a <i>hose</i> 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 <i>solenoid valve</i> along side of the mix tank.	Take the valve apart and clean it.
5.2	The <i>upper float</i> 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 <i>mix tank relay</i> 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 <i>pump-in pump</i> .	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 <i>normal</i> ! There is no solution! The water is condensation.
6.2	One of the <i>heat exchangers</i> 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 <i>upper float in the mix tank</i> 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 <i>solenoid valve</i> 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 <i>chemical relay</i> 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 <i>foot valve</i> 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 <i>flowmeter</i> 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 <i>chemical feed hose</i> 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 <i>proportioning venturi</i> 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

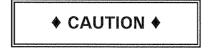
Check the oil level and the condition of the oil. The oil level should be up to the center of the sight glass on the back of the pump.

Use a 30 weight, non-detergent oil.



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.



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

PERIODICALLY

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

♦ CAUTION ♦

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

♦ CAUTION ♦

Protect the pump from freezing.

Service

SpitFire 3.2 Section 6-3

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



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 CAP O'RING VALVE ASSEMBLY VALVE O'RING KIT NO. 078-158 KIT NO, 078-159 HEAD RING HI PRESSURE SEAL LO PRESSURE SEAL O'RING

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.



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.

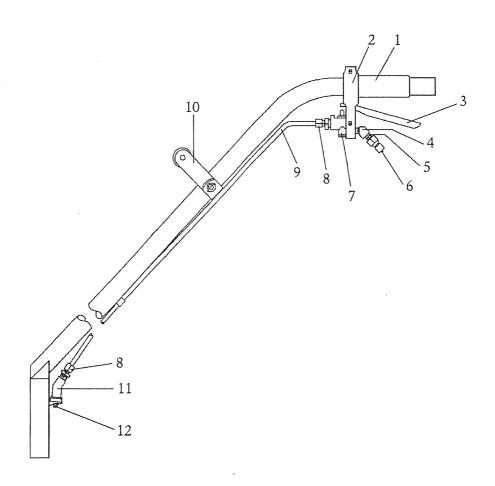
Scored plungers.

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
AN CONTRACTOR OF THE PROPERTY	on the control of the second control of the control		
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 A	ssembly (Item #10):		
	094-035	Nut, 5/16-18 s/s Nylock Half	2
	143-012	Bolt, 5/16-18 x 3/4" 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.



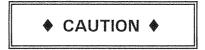
When machine is being run for test purposes and the vacuum inlet on top of the machine is open, caution should be used.

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.



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.



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 <i>filter bag</i> is clogged.	Clean or replace the filter bag.
1.3	The <i>vacuum tank dump valve</i> 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 <i>hose</i> on the live hose reels is collecting water.	Unroll the entire length of the hose each time you use it.
1.5	The <i>vacuum hose</i> 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 <i>vacuum tank seal</i> is defective.	Replace the seal.
1.8	The <i>hose</i> 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 <i>recovery</i> tank.	Inspect the tank for leaks using smoke and weld the tank if it is required.
1.10	There is a hole in the <i>vacuum</i> hose.	Repair or replace the hose.
1.11	The <i>vacuum release</i> is loose.	Readjust the vacuum release.
1.12	The <i>engine speed</i> 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 <i>vacuum leaks</i> 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 <i>exhaust</i> leak between the blower and the silencer.	Inspect the fittings to determine where the air leak is. Repair as necessary.
2.2	The <i>blower</i> 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 <i>silencer</i> is bad.	Inspect it for an external hole. Repair or replace the silencer.
2.4	The <i>lobes</i> are hitting.	Replace the blower.
2.5	The <i>engine</i> 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 <i>bearings</i> 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 <i>lobes</i> 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 <i>gears</i> or shattered <i>lobes</i> .	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 <i>shaft</i> is broken inside the blower.	Replace the blower.

M-D Pneumatics[™]

COMPETITOR

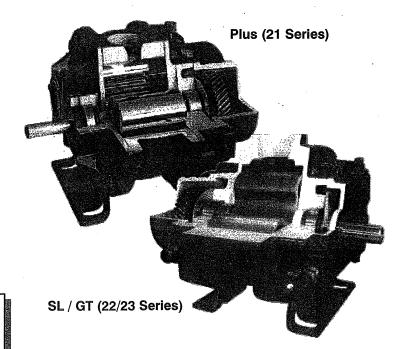
Rotary Positive Displacement Air & Gas Blowers

SERIES: 21 – Grease Lubrication / Air Service (Plus)

22 - Splash Lubrication / Air Service (SL)

23 - Splash Lubrication / Gas Service (GT)

INSTALLATION
OPERATION
MAINTENANCE
REPAIR
MANUAL



WARNING

DO NOT OPERATE BEFORE READING MANUAL.



02/2004

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IMPORTANT

In order to assure you of the full benefits of our product warranty, please complete, tear out and return the warranty registration card located on the back cover of this manual, or you can register your product online at http://pneumatics.tuthill.com/product_registration

SAFETY PRECAUTIONS

For equipment covered specifically or indirectly in this instruction book, it is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should particularly be noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong, coarse screen over the inlet and avoid standing in discharge air stream.
- Avoid extended exposure in close proximity to machinery with high intensity noise levels.
- Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working
 in or passing through the area should be warned by signs and trained to exercise adequate general safety
 precautions.
- Hearing protection may be required depending on silencing capabilities.

INTRODUCTION

CONGRATULATIONS on your purchase of a new COMPETITOR® Rotary Positive Displacement Blower from Tuthill Vacuum & Blower Systems. Please examine the blower for shipping damage, and if any damage is found, report it immediately to the carrier. If the blower is to be installed at a later date make sure it is stored in a clean, dry location and rotated regularly. Make sure covers are kept on all openings. If blower is stored outdoors be sure to protect it from weather and corrosion.

COMPETITOR blowers are built to exacting standards and if properly installed and maintained will provide many years of reliable service. We urge you to take time to read and follow every step of these instructions when installing and maintaining your blower. We have tried to make these instructions as straightforward as possible. We realize getting any new piece of equipment up and running in as little time as possible is imperative to production.

WARNING: Serious injury can result from operating or repairing this machine without first reading the service manual and taking adequate safety precautions.

IMPORTANT: Record the blower model and serial numbers of your machine in the OPERATING DATA form below. You will save time and expense by including this reference identification on any replacement part orders, or if you require service or application assistance.

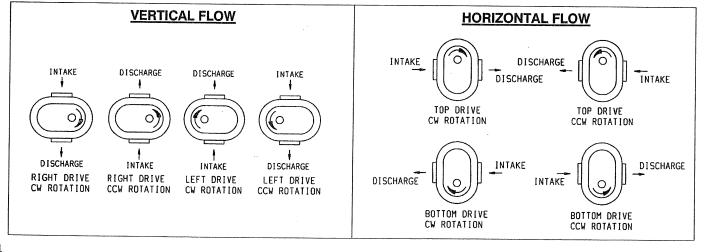
OPERATING DATA

It will be to the user's advantage to have the requested data filled in and available in the event a problem should develop in the booster or the system. This information is also helpful when ordering spare parts.

Model No	V-Belt Size Length
Serial No(Recorded from nameplate on unit)	Type of Lubrication:
Startup Date	
Blower RPM	Pressure
Blower Sheave Diameter	Vacuum
Motor Sheave Diameter	Any other special accessories with this unit
Motor RPM HP	

FLOW DIRECTION BY ROTATION

Refer to the illustrations below before installing inlet and discharge piping.



INSTALLATION

WARNING: Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in the installation and operation of this equipment in the system or facility.

Do not use air blowers on explosive or hazardous gases. Casing pressure must not exceed 25 PSIG (1.72 bar g). Each size blower has limits on pressure differential, running speed, and discharge temperature, which must not be exceeded. These limits are shown on the Specification Sheet "Maximum Operating Limits" on page 14.

LOCATION

Install the blower in a clean, dry, and well lighted area if possible. Leave plenty of room around the blower for inspection and maintenance.

FOUNDATION

We recommend a solid foundation be provided for permanent installation. It is necessary that a suitable base be used, such as a steel combination base under blower and motor, or a separate sole plate under each.

Before tightening the bolts, check to see that both mounting feet are resting evenly on the foundation, shim as necessary to eliminate stress on the base when the bolts are tightened.

Where a solid foundation is not feasible, care must be taken to insure that equipment is firmly anchored to adequate structural members.

DRIVE

When the blower is V-belt driven the sheaves must be positioned so that the hub face of the blower sheave is not more than 1/4" (6.5 mm) from the blower drive end plate and the driver sheave is as close to the driver bearing as possible. Care should be taken when installing sheave onto shaft. The faces of the sheaves should be accurately in line to minimize belt wear.



For installations where the blower is to be operated by direct drive, selection of the driver should be such as not to exceed the maximum speed ratings of the blower. (See Specification Sheet "Maximum Operating Limits" on page 14.)

A flexible type coupling should be used to connect driver and blower shafts. The two shafts must be aligned within .005" (.13 mm) T.I.R. (Total Indicated Runout) Coupling face run out .003 (.8 mm) T.I.R..

PROTECTIVE MATERIALS

Remove protective materials from the shaft.

Remove the protective covers from the inlet and outlet ports and inspect the interior for dirt and foreign material.

WARNING: Keep hands, feet, foreign objects and loose clothes from inlet and outlet openings to avoid injury or damage if lobes are to be rotated at this point.

Do not start up the blower until you are positive that it has been properly and fully lubricated. (See Lubrication Section on page 6.)

PIPING

Inlet and outlet connections on all blowers are large enough to handle maximum volume with minimum friction loss. Maintain same diameter piping. Silencers must not be supported by the blower. Stress loads and bending moments must be avoided.

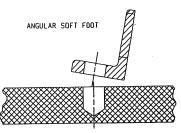
Be certain all piping is clean internally before connecting to the blower. We recommend placing a 16-mesh wire screen backed with hardware cloth at or near the inlet connections for the first 50 hours of use until the system is clean. Make provisions to clean the screen after a few hours of operation and completely discard it once the system is clean, as it will eventually deteriorate and small pieces going into the blower can cause serious damage. A horizontal or vertical air flow piping configuration is easily achieved by rearranging the mounting feet position.

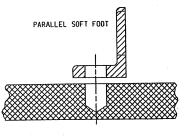
WARNING: Do not operate equipment without adequate silencing devices since high noise level may cause hearing damage. (Reference OSHA Standards.)

RELIEF VALVES

We recommend the use of relief valves to protect against excessive pressure or vacuum conditions. These valves should be tested at initial start-up to be sure they are properly adjusted to relieve at or below the maximum pressure differential rating of the blower.

CAUTION: Upon completion of the installation, and before applying power, rotate the drive shaft by hand. It must move freely. If it does not, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment or any other cause for binding. If blower is removed and still does not rotate freely, check inside the blower housing for foreign material.





Examples of Soft Foot

LUBRICATION

Every Tuthill blower is factory tested, oil drained and shipped dry to its installation point. Both independent oil reservoirs must be filled to the proper level before operation.

Shaft bearings at the gear end of the blower are splash lubricated by one or both gears dipping into an oil reservoir formed in the gear end plate and cover. Shaft bearings at the drive end of the blower are lubricated by a slinger assembly dipping into an oil reservoir. Before starting the blower, fill oil sumps as shown below under "Filling Procedure." Tuthill approved mineral-based, synthetic and food grade lubricants are listed on page 17.

FILLING PROCEDURE

- 1. Remove fill plugs or breathers from both gear end and drive end plates.
- 2. SLOWLY pour oil through fill until oil appears in the oil sight glass. Bring oil level to center of sight glass.
- 3. Verify oil level is at proper level in BOTH gear end and drive end sight glasses.
- 4. Replace fill plugs or breathers that were removed in step 1.

CAUTION: Do not start the blower until you are sure oil has been put in the gear housing. Operation of the blower without proper lubrication will cause the blower to fail and void its warranty.

WARNING: NEVER ATTEMPT TO CHANGE OIL WHILE THE BLOWER IS IN OPERATION. Failure to heed this warning could result in damage to the equipment and/or serious personal injury. Oil level must be checked while the blower is not running.

APPROXIMATE OIL CAPACITIES

Gear end amounts are for all series. Drive end amounts are for SL & GT (22 & 23 series)

MODEL	Horizontal Flow					Vertical	Air Flow	
	GEAR END		DRIVE END		GEAR	END	DRIVE	END
2002 – 2004	1.7 ounces	(50 mL)	N/A :		3.4 ounces	(100 mL)	N/A	
3002 – 3006	3.4 ounces	(100 mL)	2.5 ounces	(75 mL)	6.0 ounces	(180 mL)	4.0 ounces	(120 mL)
4002 - 4007	5.8 ounces	(170 mL)	4.7 ounces	(140 mL)	8.5 ounces	(250 mL)	6.4 ounces	(190 mL)
5003 - 5009	7.1 ounces	(210 mL)	5.4 ounces	(160 mL)	18.3 ounces	(540 mL)	10.2 ounces	(300 mL)
6005 - 6015	16.9 ounces	(500 mL)	N/A		25.5 ounces	(750 mL)	N/A	1
7006 – 7018	20.3 ounces	(600 mL)	N/A	1	28.7 ounces	(850 mL)	N/A	

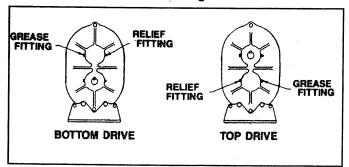
^{*} Oil capacities are based on filling from dry condition. Less oil may be needed depending on emptiness of oil reservoir(s) after draining.

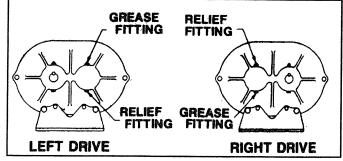
Always fill the gear housing until oil drips out of the oil level hole. Replace plugs in their respective holes. Following this procedure will insure proper oil level.

GREASE LUBRICATED SEARINGS (21 Series Only)

Service drive end bearing at regular intervals. (See "Suggested Lubrication Intervals for Grease Lubricated Bearings" below.) Use NLGI #2premium grade, petroleum base grease with high temperature resistance and good mechanical stability, such as PneuLube grease available from your local Tuthill Vacuum & Blower System Professional. Using a pressure gun, force new grease into each bearing until traces of clean grease comes out of the relief fitting.

CAUTION: To avoid blowing out the drive shaft seal, do not grease too rapidly.





HORIZONTAL FLOW

VERTICAL FLOW

NOTE: Drawings above show location of grease fitting and grease relief for horizontal and vertical flow units (21 series).

START-UP CHECKLIST

We recommend that these startup procedures be followed in sequence and checked ($\sqrt{}$) off in the boxes provided in any of the following cases:

- During initial installation
- After any shutdown period
- After maintenance work has been performed
- After blower has been moved to a new location

Date Checked
 Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to Lubrication Section.
2. Check Alignment.
For Direct Drive: Check coupling and shaft alignment. For Belt Drive: Check for proper belt alignment and tension.
3. Turn the rotors by hand to be certain they do not bind.
WARNING: Disconnect power. Make certain power is off and locked out before touching any rotating element of the blower, motor or drive components.
4. "Bump" the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.
5. Start the unit and operate it for 30 minutes at no load. During this time. feel the cylinder for hot spots. If minor hot spots occur, refer to the Troubleshooting Section (page 8).
6. Apply the load and observe the operation of the unit for one hour. Check the unit frequently during the first day of operation.
7. If minor malfunctions occur, discontinue operation and refer to the Troubleshooting

RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

Section (page 8).

When high humidity or moisture is present in an air piping system, condensation of water can occur after the blower is shut down and the blower begins to cool. This creates an environment favorable to corrosion of the iron internal surfaces, or in cold weather, the formation of ice. Either of these conditions can close the operating clearances, causing the blower to fail upon future start-up.

The following shutdown procedure outlined below minimizes the risk of moisture condensation, corrosion and freezing. Care must be taken so as not to overload or overheat the blower during this procedure.

- 1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.
- 2. For carpet cleaning applications, after the work is completed, simply allow the blower to run a few (3-5) minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.
- 3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such a WD-40® into the inlet of the blower just prior to shutdown. The lubricant will provide an excellent protective coating c the internal surfaces. If using a spray lubricant, exercise care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, most likely to the point that repair would be required.

3-in-One and WD-40 are registered trademarks of WD-40 Company.

CAUTION!

Most Competitor blowers are shipped from the factory in a left hand drive, vertical flow configuration.

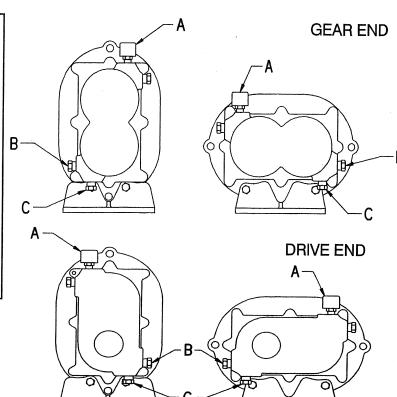
If drive shaft location is changed, the oil level plugs, sight glasses and breathers must be relocated to proper positions. as shown to the right.

Failure to change plug location will result in blower failure and void the product warranty.

A = Breather

B = Oil Level Sight Glass

C = Magnetic Oil Drain Plug



LUBRICATION INSTRUCTIONS FOR OIL LUBRICATED GEARS AND BEARINGS

Add fresh oil as required to maintain proper level. Drain and refill after the first 100 hours of operation and thereafter every 1,000 hours of operation under normal service, more frequently depending on the type of oil and oil operating temperature. Use a good quality oil, such as PneuLube, available through your local Tuthill Pneumatics Sales Professional.

See page 15 for list of recommended lubricants.

FOR GREASE LUBRICATED BEARINGS					
SPEED	OPERAT	ING HOURS F	ER DAY		
IN RPM	8	16	24		
	GREASING INTERVALS IN WEEKS				
750-1000	7	4	2		
1000-1500	5	2	1		
1500-2000	4	2	1		
2000-2500	3	1	1		
2500-3000	2	1	1.		
3000 and up	1	1	1		

CHACECTED LUDDICATION INTERVALO

PREVENTATIVE MAINTENANCE

A good maintenance program will add years of service to your blower.

A newly installed blower should be checked frequently during the first month of operation, especially lubrication. Check oil level in both the drive end and gear end of the blower and add oil as needed. Complete oil changes are recommended every 1000 operating hours, or more frequently depending on the type of oil and oil operating temperature.

The following is recommended as a minimum maintenance program.

DAILY MAINTENANCE

- 1. Check and maintain oil level, and add oil as necessary.
- 2. Check for unusual noise or vibration (See Troubleshooting on page 8)

WEEKLY MAINTENANCE

- 1. Clean all air filters. A clogged air filter 1. Inspect the entire system for leaks. can seriously affect the efficiency of the blower and cause overheating and oil usage.
- 2. Check relief valve to assure it is operating properly

MONTHLY MAINTENANCE

- 2. Inspect condition of oil and change if necessary (see page 6)
- 3 Check drive belt tension and tighten if necessary.

TROUBLESHOOTING

Although Competitor blowers are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The chart below lists symptoms that may occur along with probable causes and remedies.

Gear housing not tightened properly. Lip seal failure.	Tighten gear housing bolts.		
Lin seal failure	l		
Lip scal fallars.	Disassemble and replace lip seal.		
Insufficient sealant.	Remove gear housing and replace sealant. (See Disassembly and Inspection section on page 10)		
Loose drain plug.	Tighten drain plug.		
Improper lubrication.	Correct oil level. Replace dirty oil. (See Lubrication section on page 6)		
Excessive belt tension.	Check belt manufacturer's specifications for tension and adjust accordingly.		
Coupling misalignment.	Check carefully, realign if necessary.		
Slipping belts.	Check belt manufacturer's specifications for tension and adjust accordingly.		
Worn lobe clearances.	Check for proper clearances (See Assembly Clearances on page 14)		
Speed too low.	Increase blower speed within limits.		
Obstruction in piping.	Check system to assure an open flow path.		
Unit out of time.	Re-time.		
Distortion due to improper mounting or pipe strains.	Check mounting alignment and relieve pipe strains.		
Excessive pressure differential.	Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary.		
Too much or too little oil in gear reservoir.	Check oil level. (See Lubrication section on page 6)		
Too low operating speed.	d outside the Books		
	Increase blower speed within limits. Remove cause of obstruction.		
•	Reduce pressure differential across the blower.		
•	Reduce inlet temperature.		
Worn lobe clearances.	Check for proper clearances (See Assembly Clearances on		
	page 14)		
Insufficient assembled clearances.	Correct clearances (See Assembly Clearances on page 14)		
Case or frame distortion.	Check mounting and pipe strain.		
Excessive operating pressure.	Reduce pressure differential.		
Excessive operating temperature.	Reduce pressure differential or reduce inlet temperature.		
Belt or coupling misalignment.	Check carefully, realign if necessary.		
Lobes rubbing.	Check cylinder for hot spots, then check for lobe contact at these points. Correct clearances (See Assembly Clearances on page 14).		
Worn bearings or gears.	Check condition of gears and bearings; replace if necessary.		
Unbalanced or rubbing lobes.	Possible buildup on casing or lobes, or inside lobes. Remove buildup and restore clearances.		
	Check mounting and tighten if necessary.		
	Official moderning and agricult in the deceasing.		
	Loose drain plug. Improper lubrication. Excessive belt tension. Coupling misalignment. Slipping belts. Worn lobe clearances. Speed too low. Obstruction in piping. Unit out of time. Distortion due to improper mounting or pipe strains. Excessive pressure differential. Too much or too little oil in gear reservoir. Too low operating speed. Clogged filter or silencer. Excessive pressure differential. Elevated inlet temperature. Worn lobe clearances. Case or frame distortion. Excessive operating pressure. Excessive operating temperature. Belt or coupling misalignment. Lobes rubbing. Worn bearings or gears.		

DISASSEMBLY & INSPECTION

With proper maintenance and lubrication, normal life expectancy for gears, bearings, and seals can be achieved. However, over a period of time these parts must be repaired or replaced to maintain the efficiency of your blower. This section is written in a way that will allow you to completely disassemble your blower. The inspection of certain repairable or replaceable parts is referred to at the point of disassembly where these parts are exposed. If at any point of inspection, repair or replacement is deemed necessary, appropriate instruction will be given to achieve these repair or replacement is deemed necessary, appropriate instruction will be given to achieve these repairs or replacements.

Remove the oil drain plugs [18] in the bottom of the end covers [Items 5 & 10] and drain the oil. Take out eight cap screws [16] and remove the gear cover. It may be necessary to tap the sides with a mallet or wooden block to break the seal joint.

Gears are not exposed for visual inspection. Items in brackets [] are referenced to item numbers on page 16.

Inspect the gears for the following:

- Broken Teeth
- Chipped Teeth
- Uneven Wear
- Excessive Wear
- Any Other Abnormalities

WARNING: Before performing any repair or replacement, disconnect and lock out power.

Position blower with the drive gear on the left when facing the gears. Remove socket head screws and washers. [items 29 & 26].

Align timing marks and count three (3) teeth up and place reference marks on the gears. (Refer to Figure 1 below)

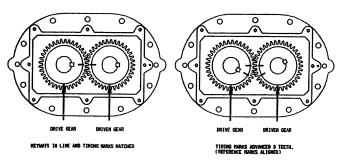


Figure 1. Timing Gear Alignment

Align reference marks and use puller to pull the driven gear. (shown on right side in Figure 2 below)

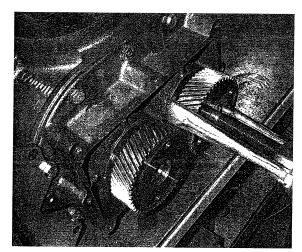


Figure 2. Pulling Driven Gear with Jaw Puller

Use puller to remove drive gear. A bar puller (Refer to Figure 3 below) or jack screws can be used.

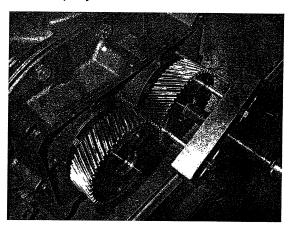


Figure 3. Pulling Drive Gear with Bar Puller

Remove shim and spacer. [Items 28 & 30], and note from which shaft the shim is removed.

Turn blower around and remove eight (8) cap screws securing the drive end cover [10]. Remove cover.

Loosen the set screws on the oil slingers [Items 45 & 46] and remove the oil slingers from the rotor shafts. (Refer to Figure 4 below)

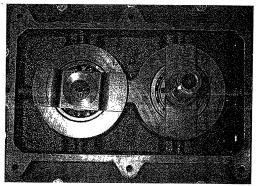


Figure 4. Drive End Oil Slingers

Remove ten (10) cap screws [15] that secure drive end plate [3] to housing [1].

Use a jaw puller to remove drive end plate. (Refer to Figure 5 below)

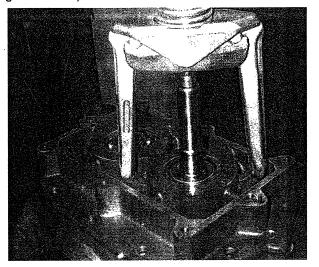


Figure 5. Pulling Drive End Plate

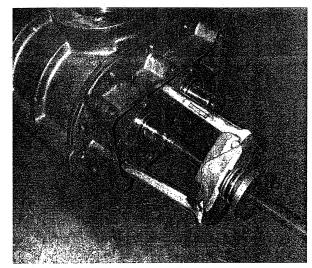


Figure 7. Driving Rotors Out Using Jaw Puller

Using a tube or round bar of a slightly smaller diameter than the shaft clearance holes in the end plates, tap the bearings out of the end plates. Bearing retainers [22] must be removed before knocking out the bearings. (Refer to Figure 8 below)

Press rotors out of end plate in press if available. If press is not available, support end plate and rotors in the housing. Block up housing and use a soft mallet to drive the rotors out. (Refer to Figure 6 below)

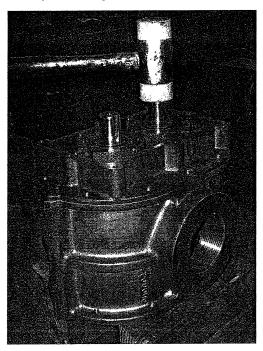


Figure 6. Driving Rotors Out Using Soft

A jaw type puller can also be used. (Refer to Figure 7 above right)

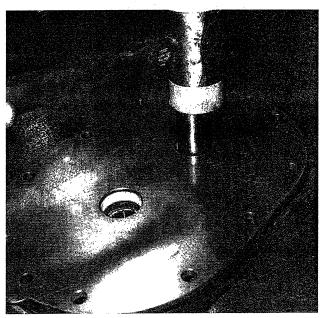


Figure 8. Tapping Bearings Out of End Plates

Remove seals from both end plates with a punch or dull chisel. The seals *will* be damaged during removal and must be replaced.

Inspect all parts for wear and or damage.

Clean and inspect all parts for burrs and polish seal journals with at least 320 grit emery or crocus cloth.

Items in brackets [] are referenced to item numbers on page 16.

BLOWER ASSEMBLY

After thorough cleaning of the seal and bearing bores of both end plates apply a thin coat of sealant on the outside diameter of the new seals and press them into the end plate using a tool that will bear on the outer edge of the seal. Spring side of the seal should be facing you. Apply a thin coat of grease to the seal lip.

See page 15 for drawings and dimensions of seal and bearing pressing tools.

Using the drive end plate as a fixture, support it high enough so the input shaft of the drive rotor clears the assembly surface. (Refer to Figure A1 below). Place rotors in fixture with the drive rotor to the left. (See Figures A1 and A2 below)

MECHANICAL SEAL INSTALLATION

Clean and deburr seal bore in endplate. Clean the face of the carbon and mating ring with alcohol etc. Apply a thin layer of silicon to the bottom face of the seal.

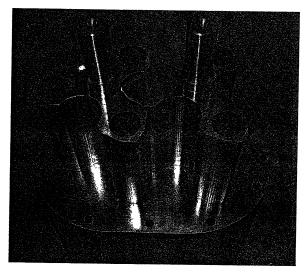


Figure A1. Rotors Assembled on Drive End Plate (Model 4000 with tri-lobe rotors shown)

Place end plate [Item 4] on rotors.

Apply a thin coat of lubricant on the rotor shafts and the inner race of the bearings. Tap the bearings [13] into place using a tube with a flanged end that will contact both the inner and outer bearing races. (Refer to Figure A3 below).

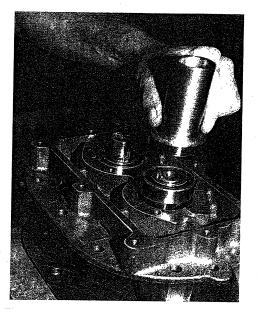
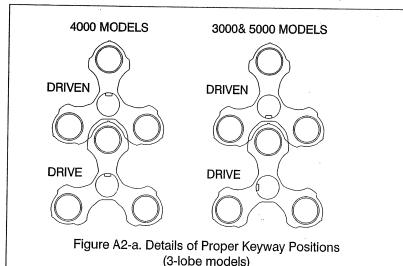


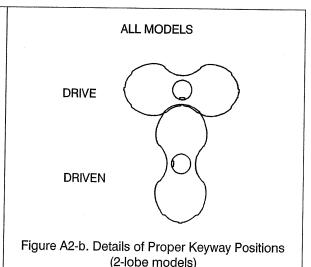
Figure A3. Tapping Bearings into End Plates

WARNING: Keep hands and loose clothing away from lobes and gears.

Install bearing retainers [Items 22 & 25] to both bearings.

Check clearances between the end of the rotors and the face of the end plate. Refer to assembly clearances chart on page 14 for proper clearances for your model blower, and refer to page 13 for procedures for checking and adjusting clearances.





If clearances check OK, put a spacer [28] and a shim [30] on each shaft. Timing shims that were removed should be put back on the shaft from which they were removed.

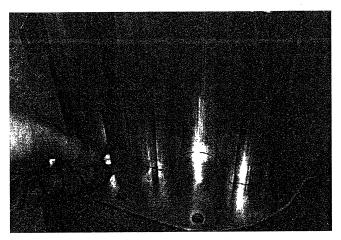


Figure A4. Checking Gear End Clearances

Lubricate shafts and bores on gears. Begin by pressing on the DRIVE gear. This will be pressed on the drive rotor, which is to the left.

Start the driver gear on the shaft and align the reference timing marks and press gear on. Lock gears in place with socket head screw [29] and washer [26]. Turn assembly over and rest the unit on the socket head screws and washers on the gear end.

Set dowel pins [9] in housing and position housing over the rotors and fasten with cap screws [15]. Check housing to rotor clearance. (Refer to Figure A5) A depth mic can be used.

Set on drive end plate [3] and fasten with cap screws [15]. (ATTENTION: There are four cap screws [17] which are used to attach the feet.) Lubricate shafts and bearings. Install the ball bearing [12] on the driven rotor and the roller bearing [11] on the input shaft.

Apply a bead of a good quality RTV silicone sealant to the inner surface of the drive end cover [10] that mates to the drive end plate [3]. Install drive end cover and drive shaft seal [23].

Install any removed plugs [18], sight glasses [21] and replace breather [27] if required.

Items in brackets [] are referenced to item numbers on page 16.

LUBRICATION, FINAL ASSEMBLY AND MOUNTING

Apply a bead of a good quality RTV silicone sealant to the inner surface of the gear end cover [5] that mates to the gear end plate [4]. Install the gear end cover with cap screws [16] and tighten evenly.

Fill both end covers with oil. Refer to the Lubrication Section in this manual (page 6) for filling procedure, and page 17 for recommended lubricants.

To insure blower has not been distorted during mounting in the installation, turn the lobes by hand to make sure they are not making contact prior to connecting to the driver.

ADJUSTING ROTOR INTERLOBE CLEARANCE

Using feeler gauges take interlobe readings and record on each side of housing as indicated in Figure A5 below. By removing or adding shim behind the helical gear, it rotates as it is moved in or out and the driven rotor turns with it, thus changing the clearance between rotor lobes.

Changing the shim thickness .006" (.15 mm) will change the rotor lobe clearance .003" (.08 mm) or one-half the amount.

EXAMPLE: Referring to Figure A5 below, check the clearance at AA (right hand reading) and BB (left hand reading). If AA reading is .009" (.23 mm) and BB reading .003" (.08 mm) by removing .006" (.15 mm) shims. the readings will change one half the amount removed or .003" (.08 mm). AA should then read .006" (.15 mm) and BB should read .006" (.15 mm). The final reading should be within .002" (.05 mm) of each other.

To determine the amount of shim to add or remove, subtract the small figure from the larger. If the right side is higher than the left side, remove shim. If the right side is reading lower, add shim.

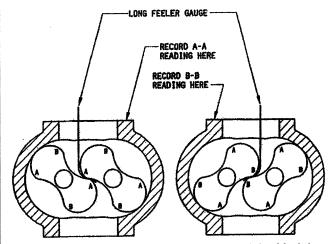


Fig. 5A Checking Interlobe Clearance on 2-lobe Models

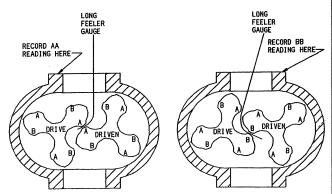


Figure 5B. Checking Interlobe Clearance on 3-lobe Models

COMPETITOR®

MAINTENANCE AND SERVICE SPECIFICATIONS SHEET ASSEMBLY CLEARANCES

Metric values (mm) are shown in parentheses ()
All other values are in inches

	LOBES TO END PLATES			INTERLOBE	LOBE TO	O CASING
MODEL	DRIVE END	GEAR END	TOTAL		TIP-DOWEL	TIP-PORT
2002, 2004	.004"007" (.1018)	.003"005" (.0813)	.008"011" (.2028)	.005"009" (.1323)	.002"004" (.0510)	.003"006" (.0815)
3002	.004"007" (.1018)	.003"005" (.0813)	.008"012"	.006"012" (.1530)	.002"005"	.004"007"
3003	.005"008" (.1320)	.003"005" (.0813)	.009"012" (.2330)	.006"012"	.002"005"	.004"007"
3006	.006"010" (.1525)	.003"005" (.0813)	.010"013" (.2533)	.006"012" (.1530)	.002"005"	.004"007"
4002	.004"009" (.1023)	.004"006" (.1015)	.009"013" (.2333)	.008"012" (.2030)	.003"006" (.0815)	.005"008" (.1320)
4005, 4007	.005"010" (.1325)	.004"006" (.1015)	.010"014" (.1036)	.008"012" (.2030)	.003"006"	.005"008"
5003	.004"009" (.1023)	.004"006" (.1015)	.009"013" (.2333)	.014"018" (.3646)	.003"006" (.0815)	.005"008" (.1320)
5006, 5009	.005"010" (.1325)	.004"006" (.1015)	.010"014" (.1036)	.014"018" (.3646)	.003"006" (.0815)	.005"008" (.1320)
6005, 6008	.008"013" (.2033)	.005"007" (.1318)	.015"019" (.3848)	.010"014" (.1036)	.004"007" (.1018)	.006"009"
6015	.009"014" (.2336)	.005"007" (.1318)	.016"020" (.4151)	.010"014" (.1036)	.004"007"	.006"009" (.1523)
7006	.010"014" (.1036)	.005"007" (.1318)	.017"020" (.4351)	.012"016" (.3041)	.004"007"	.006"009" (.1523)
7011, 7018 	.010"014" (.1036)	.005"007" (.1318)	.017"020" (.4351)	.012"016" (.3041)	.004"007"	.006"009" (.1523)

		(10 .10)	(.5051)	741) (.1018) (
		MAXIMUM O	PERATING LIMITS	
MODEL	RPM	PRESSURE PSI (mbar)	VACUUM in. Hg (mbar)	TEMPERATURE RISE F° (C°)
2002	5275	12 (825)	16 (540)	225 (125)
2004	5275	7 (480)	16 (540)	185 (103)
3002	3600	15 (1035)	16 (540)	210 (116)
3003	3600	12 (825)	15 (508)	180 (100)
3006	3600	7 (480)	15 (508)	170 (94)
4002	3600	15 (1035)	16 (540)	220 (122)
4005	3600	10 (690)	16 (540)	210 (116)
4007	3600	7 (480)	15 (508)	170 (94)
5003	2850	15 (1035)	16 (540)	195 (108)
5006	2850	13 (900)	16 (540)	195 (108)
5009	2850	7 (480)	15 (508)	160 (89)
6005	2350	15 (1035)	16 (540)	250 (139)
6008	2350	14 (965)	16 (540)	240 (133)
6015	2350	7 (485)	12 (410)	180 (100)
7006	2050	15 (1035)	16 (540)	235 (130)
7011	2050	10 (690)	16 (540)	210 (116)
7018	2050	6 (415)	12 (410)	120 (66)



RECOMMENDED LUBRICANTS OIL CAPACITIES ARE SHOWN ON PAGE 6

RECOMMENDED MINERAL BASED LUBRICANTS

AMBIENT TEMPERATURE	SHELL	CITGO	CHEVRON TEXACO	EXXONMOBIL
0° F (-18° C) to	TELLUS® PLUS 68	A/W 68	RANDO HD 68	DTE HEAVY MEDIUM
32° F (0° C)	(ISO 68)	(ISO 68)	(ISO 68)	(ISO 68)
32° F (0° C) to	TELLUS® PLUS 100	A/W 100	RANDO HD 100	DTE HEAVY
90° F (32° C)	(ISO 100)	(ISO 100)	(ISO 100)	(ISO 100)
90° F (32° C) to	TELLUS® PLUS 150	A/W 150	RANDO HD 150	DTE EXTRA HEAVY
120° F (50° C)	(ISO 150)	(ISO 150)	(ISO 150)	(ISO 150)

RECOMMENDED SYNTHETIC BASED LUBRICANTS

AMBIENT TEMPERATURE	TUTHILL	EXXONMOBIL	SHELL
0° F (-18° C) to		SHC 626	MADRELA® AS 68
32° F (0° C)		(ISO 68)	(ISO 68)
32° F (0° C) to	PneuLube™	SHC 627	MADRELA® P 100
90° F (32° C)	(ISO 100)	(ISO 100)	(ISO 100)
90° F (32° C) to		SHC 629	MADRELA® P 150
120° F (50° C)		(ISO 150)	(ISO 150)

NOTE: Tuthill Vacuum & Blower Systems cannot accept responsibility for damage to seals, O-rings and gaskets caused by use of synthetic lubricants not recommended by Tuthill Vacuum and Blower Systems.

Due to its superior viscosity index, Tuthill PneuLube™ provides the greatest ambient temperature flexibility. Contact your local Tuthill Vacuum & Blower Systems Sales Professional for availability of this superior lubricant.

RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS

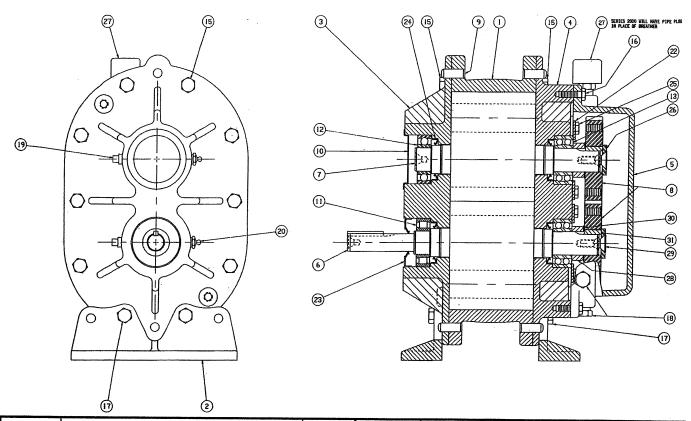
AMBIENT TEMPERATURE	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food, and USDA H1 requirements	Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and indirect food contact
0° F (-18° C) to 32° F (0° C)	CITGO CLARION® A/W 68 (ISO 68)	CITGO CLARION® 350 FOOD GRADE (ISO 68)
32° F (0° C) to 90° F (32° C)	CITGO CLARION® A/W 100 (ISO 100)	CONSULT FACTORY
90° F (32° C) to CONSULT FACTORY 120° F (50° C)		CONSULT FACTORY

RECOMMENDED SYNTHETIC BASED, FOOD GRADE LUBRICANTS

AMBIENT TEMPERATURE	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food, and USDA H1 requirements	Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and indirect food contact
0° F (-18° C) to 32° F (0° C)		
32° F (0° C) to 90° F (32° C)	PneuLube™ FG (ISO 100)	CONSULT FACTORY
90° F (32° C) to 120° F (50° C)		

COMPETITOR®

CUTAWAY VIEW AND PARTS LIST - 21 Series



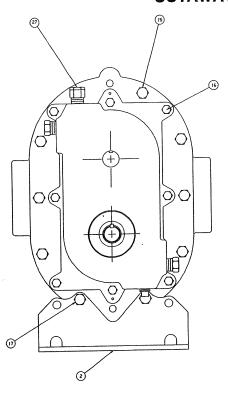
ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	18	Plug, Oil	3
2	Mounting Foot	2 *	19	Relief Fitting	2
3	Drive End Plate	1	20	Grease Fitting	2
4	Gear End Plate	1	22	Bearing Retainer	4
5	Gear Cover	1	23	Lip Seal, Drive Shaft	1
6	Drive Rotor	1	24	Lip Seal	4
7	Driven Rotor	1	25	Screw, Hex Head	4
8	Timing Gear	2	26	Washer	2
9	Dowel Pin	4	27	Breather	1†
10	Bearing Cover Plate	1	28	Spacer	2
11	Roller Bearing, Drive Shaft	1	29	Screw, Hex Head	2
12	Bearing	1	30	Timing Shims	10
13	Bearing	2	31	Gear Timing Key	2
15	Screw, Hex Head	16	42	Alum. Nameplate Kit	1
16	Screw, Hex Head	8 **	43	Dr, Screw	2
17	Screw, Hex Head	4	47	Teflon Vent Insert	8

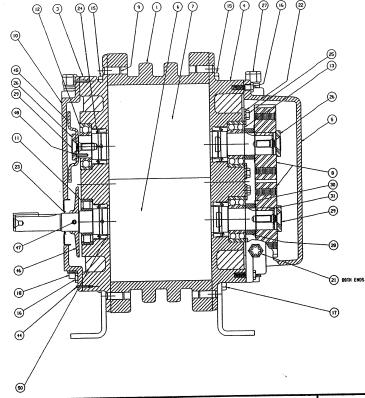
- * Item 2: Models 6005, 6008, 6015, 7006, 7011 and 7018 require (2) each of left and right feet.
- ** Item 16: Models 5003, 5006 and 5009 require (6) each.
- † Item 27: Models 2002 and 2004 requires a pipe plug in lieu of breather.

When ordering parts, use the item number shown, plus your model and serial number.

COMPETITOR®

CUTAWAY VIEW AND PARTS LIST - 22 & 23 Series



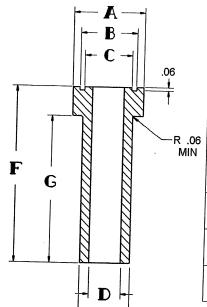


ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	21	Sight Gauge	2
2	Mounting foot	2	22	Bearing Retainer	2
3	Drive End Plate	1	23	Lip Seal	1
4	Gear End Plate	1	24	Lip Seal (Series 22 - SL units)	4
5	Gear Cover	1	24	Mechanical Seal (Series 23 - GT units)	4
6	Drive Rotor	1	25	Screw, Hex Head	4
7	Driven Rotor	1	26	Washer	2
8	Timing Gear	2	27	Breather	2
9	Dowel Pin	4	28	Spacer	2
10	Drive Cover	1	29	Screw, Socket Head	3
11	Roller Bearing	1	30	Timing Shims	1
12	Bearing	1	31	Timing Gear Key	2
13	Bearing	2	44	Dowel Pin	1
15	Screw, Hex Head	16	45	Slinger	1
16	Screw, Hex Head	16	46	Slinger	1
17	Screw, Hex Head	4	47	Set Screw	2
18	Drain Plug	2	48	Roll Pin	2
19	Pipe Plug	2	50	Lab Seal	4

When ordering parts, use the item number shown, plus your model and serial number.

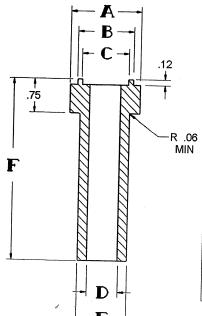
SPECIAL TOOL DRAWINGS

All dimensions shown are in inches.



Bearing Pressing Tool (For All Series)

MOĐEL	PART NUMBER	Α	В	С	D	E	F	G
2000	2200718B	1.560 ±.001	1.27 ±.005	.98 ±.005	.70 ±.005	1.10 ±.005	3.50 ±.005	3.00 ±.005
3000	3300718B	2.035 ±.001	1.70 ±.005	1.335 ±.005	1.015 ±.005	1.415 ±.005	3.75 ±.005	3.00 ±.005
4000	4200718B	2.425 ±.001	2.02 ±.005	1.61 ±.005	1.21 ±.005	1.61 ±.005	4.50 ±.005	3.75 ±.005
5000	5300718B	2.820 ±.001	2.42 ±.005	1.81 ±.005	1.41 ±.005	1.81 ±.005	5.00 ±.005	4.25 ±.005
6000	6500718B	3.135 ±.001	2.73 ±.005	2.00 ±.005	1.605 ±.005	2.00 ±.005	6.25 ±.005	5.50 ±.005
7000	7600718B	3.525 ±.001	2.98 ±.005	2.46 ±.005	1.605 ±.005	2.00 ±.005	6.25 ±.005	5.50 ±.005

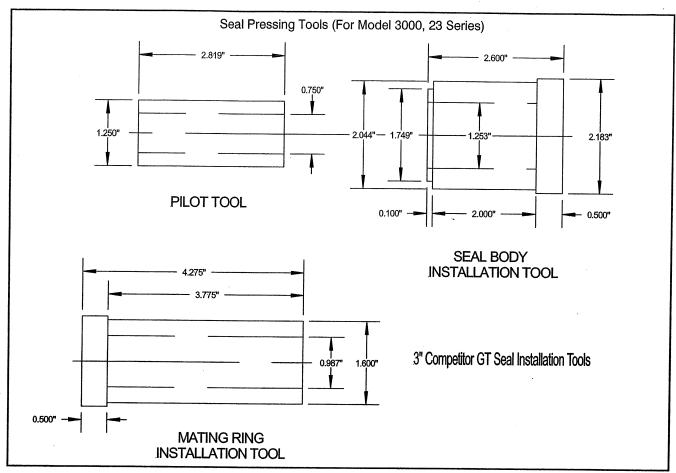


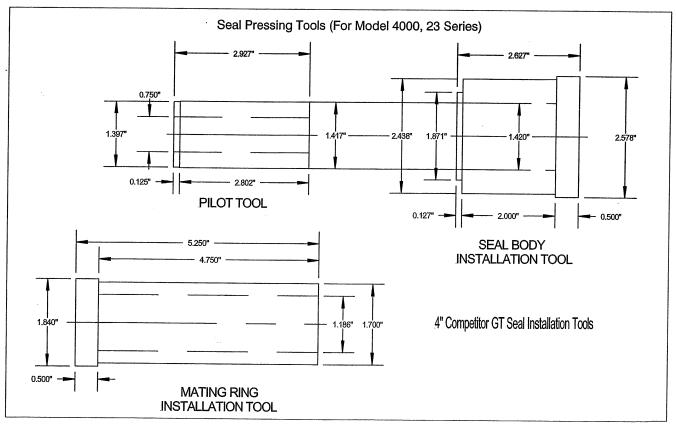
Seal Pressing Tool (For 21 & 22 Series)

MODE	L PART NUMBER	Α	В	С	D	E	F
2000	2200708B	1.560 ±.001	1.24 ±.005	1.04 ±.005	.70 ±.005	1.10 ±.005	4.00 ±.005
3000	3300708B	2.035 ±.001	1.74 ±.005	1.54 ±.005	1.015 ±.005	1.415 ±.005	4.37 ±.005
4000	4200708B	2.425 ±.001	1.865 ±.005	1.665 ±.005	1.21 ±.005	1.61 ±.005	5.25 ±.005
5000	5300708B	2.820 ±.001	2.427 ±.005	2.227 ±.005	1.41 ±.005	1.81 ±.005	5.68 ±.005
6000	6500708B	3.135 ±.001	2.74 ±.005	2.54 ±.005	1.605 ±.005	2.00 ±.005	7.00 ±.005
7000	7600708B	3.525 ±.001	2.99 ±.005	2.79 ±.005	1.605 ±.005	2.00 ±.005	7.00 ±.005

SPECIAL TOOL DRAWINGS

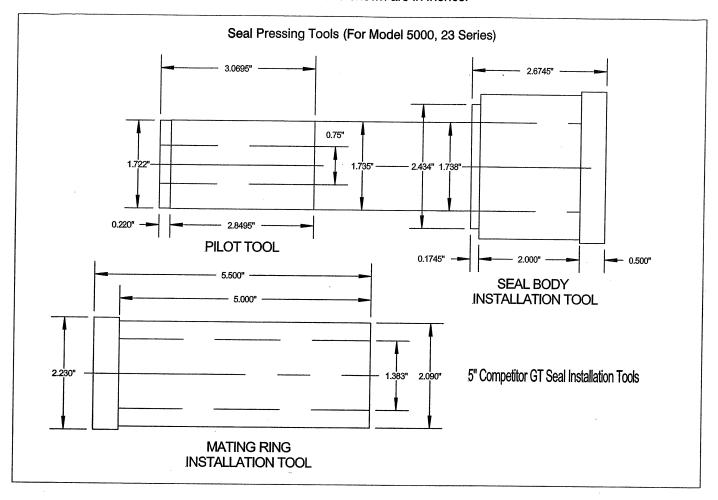
All dimensions shown are in inches.





SPECIAL TOOL DRAWINGS

All dimensions shown are in inches.



SETTING V-BELT TENSION

Proper belt tension is essential to long blower life. The following diagrams and procedures are provided to aid in field adjusting V-belts (when blower is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in Figure 6 below:

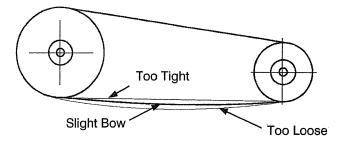


Figure 6. General appearance of a V-belt drive

Factors outside the control of the belt tensioning system used on an individual blower package assembly may contribute to decreased belt life, such as environmental factors, and quality of the belts installed. This can cause wear of the belts beyond the ability of the tensioning system to compensate.

As such, it is recommended to check belt tension monthly and make any manual adjustments found necessary.

- 1. Turn off and lock out power.
- 2. Remove the fasteners from the belt guard (if equipped)
- 3. Remove the belt guard.
- 4. Check and adjust the belt tension as necessary. It should be 1/64" deflection per inch of span (0.157 mm) deflection per centimeter of span) between sheaves, with 8-10 lbs. (3.6-4.5 kg) force applied at center point of the top section of belt.
- 5. Install the belt guard, making sure that all drive components are free of contact with the guard.
- 6. Install belt guard fasteners removed in step 2.
- 7. Unlock the power and start your blower.
- 8. Resume normal operation.

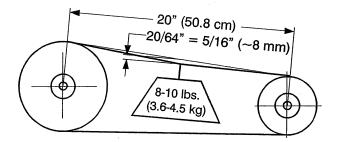


Figure 7. Setting of proper tension for a V-belt drive

WARRANTY

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, Tuthill Vacuum & Blower Systems (the seller) warrants products and parts of its manufacture, when shipped, and its work (including installation and startup) when performed, will be of good quality and will be free from defects in material and workmanship. This warranty applies only to Seller's equipment, under use and service in accordance with seller's written instructions, recommendations and ratings for installation, operating, maintenance and service of products, for a period as stated in the table below. Because of varying conditions of installation and operation, all guarantees of performance are subject to plus or minus 5% variation. (Non-standard materials are subject to a plus or minus 10% variation)

Product Type	Туре	Type of Application				
	Atmospheric Air or Process Air Without Liquids Present	Process Gases Other Than Air, or Any Liquid Injected Application				
New	24 months from date of shipment, or 18 months after initial startup date, whichever occurs first	18 months from date of shipment, or 12 months after initial startup date, whichever occurs first				
Repair	12 months from date of shipment, or remaining warranty period, whichever is greater	12 months from date of shipment, or remaining warranty period, whichever is greater				

THIS WARRANTY EXTENDS ONLY TO BUYER AND/OR ORIGINAL END USER, AND IN NO EVENT SHALL THE SELLER BE LIABLE FOR PROPERTY DAMAGE SUSTAINED BY A PERSON DESIGNATED BY THE LAW OF ANY JURISDICTION AS A THIRD PARTY BENEFICIARY OF THIS WARRANTY OR ANY OTHER WARRANTY HELD TO SURVIVE SELLER'S DISCLAIMER.

All accessories furnished by Seller but manufactured by others bear only that manufacturer's standard warranty.

All claims for defective products, parts, or work under this warranty must be made in writing immediately upon discovery and, in any event within one (1) year from date of shipment of the applicable item and all claims for defective work must be made in writing immediately upon discovery and in any event within one (1) year from date of completion thereof by Seller. Unless done with prior written consent of Seller, any repairs, alterations or disassembly of Seller's equipment shall void warranty. Installation and transportation costs are not included and defective items must be held for Seller's inspection and returned to Seller's Ex-works point upon request.

THERE ARE NO WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS OF PURPOSE.

After Buyer's submission of a claim as provided above and its approval, Seller shall at its option either repair or replace its product, part, or work at the original Ex-works point of shipment, or refund an equitable portion of the purchase price.

The products and parts sold hereunder are not warranted for operation with erosive or corrosive material or those which may lead to build up of material within the product supplied, nor those which are incompatible with the materials of construction. The Buyer shall have no claim whatsoever and no product or part shall be deemed to be defective by reason of failure to resist erosive or corrosive action nor for problems resulting from build-up of material within the unit nor for problems due to incompatibility with the materials of construction.

Any improper use, operation beyond capacity, substitution of parts not approved by Seller, or any alteration or repair by others in such manner as in Seller's judgment affects the product materially and adversely shall void this warranty.

No employee or representative of Seller other than an Officer of the Company is authorized to change this warranty in any way or grant any other warranty. Any such change by an Officer of the Company must be in writing.

The foregoing is Seller's only obligation and Buyer's only remedy for breach of warranty, and except for gross negligence, willful misconduct and remedies permitted under the General Terms of Sale in the sections on CONTRACT PERFORMANCE, INSPECTION AND ACCEPTANCE and the PATENTS Clause hereof, the foregoing is BUYER'S ONLY REMEDY HEREUNDER BY WAY OF BREACH OF CONTRACT, TORT OR OTHERWISE, WITHOUT REGARD TO WHETHER ANY DEFECT WAS DISCOVERED OR LATENT AT THE TIME OF DELIVERY OF THE PRODUCT OR WORK. In no event shall Buyer be entitled to incidental or consequential damages. Any action for breach of this agreement must commence within one (1) year after the cause of action has occurred.

NOTES

IMPORTANT All M-D Pneumatics™ blowers manufactured by Tuthill Vacuum & Blower Systems are date coded at time of shipment. In order to assure you of the full benefits of the product warranty blease complete, tear out and return the product registration card below, or you can visit our product registration web page at http://pneumatics.tuthill.com/product_registration IMPORTANT All M-D Pneumatics™ blowers manufactured by Tuthill Vacuum & Blower Systems are date coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return this product registration card. Company Location City State/Province ZIP/Postal Code Country Telephone: ()			•	
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SAFETY INSTRUCTIONS

- Do not operate before reading the enclosed instruction manual.
- Use adequate protection, warning and safety equipment necessary to protect against hazards involved in installation and operation of this equipment.









SAFETY WARNING

- Keep hands and clothing away from rotating machinery, inlet and discharge openings.
- Blower and drive mounting bolts must be secured.
- Drive belts and coupling guards must be in place.
- Noise level may require ear protection.
- Blower heat can cause burns if touched.

TUTHILL VACUUM & BLOWER SYSTEMS

Springfield, MO USA

NOTICE

The above safety instruction tags were attached to your unit prior to shipment. Do not remove, paint over or obscure in any manner.

Failure to heed these warnings could result in serious bodily injury to the personnel operating and maintaining this equipment.

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 <i>battery cable or</i> corroded battery <i>terminals</i> .	Clean and tighten the battery terminal connections.
1.2	The <i>battery</i> is dead.	Recharge or replace the battery.
1.3	There is a problem with the <i>fuse link</i> .	Check the link. If it is defective, replace it.
1.4	There is a problem with the <i>starter solenoid</i> .	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 <i>ignition switch</i> 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 <i>starter motor</i> 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 <i>engine</i> 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 <i>ground cable</i> underneath the motor has fallen or broken off.	Reattach the cable.

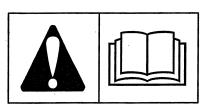
No	Problem / Possible Cause	Solution
2	The starter turns the engine over, however the engine will not start. (There is no spark *.)	* Check for spark at the spark plugs. If there is no spark, examine the troubleshooting guide above. However, if there is no gas, see troubleshooting problem number 3 on the following page for possible fuel problems.
2.1	The recovery tank is full.	Empty the tank.
2.2	The <i>recovery tank float</i> is causing the engine to shut down.	Disconnect the float. If the unit starts, replace the defective float.
2.3	The <i>engine</i> is malfunctioning.	Refer to the Briggs & Stratton Engine Maintenance manual included in your owner's manual.
2.4	The <i>magnetron</i> 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 <i>spark plug</i> 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 <i>engine kill relay</i> 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 <i>oil pressure switch</i> 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 <i>lower float in the chemical mix</i> 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 <i>fuel pump</i> 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 <i>battery ground</i> to the fuel pump.	Repair the loose ground connection.
3.3	The <i>fuel pump</i> 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 <i>fuel filter</i> is clogged.	Inspect the filter and replace if necessary.
3.5	The <i>quick connect</i> in the fuel line is clogged.	Clean or replace the quick connect.

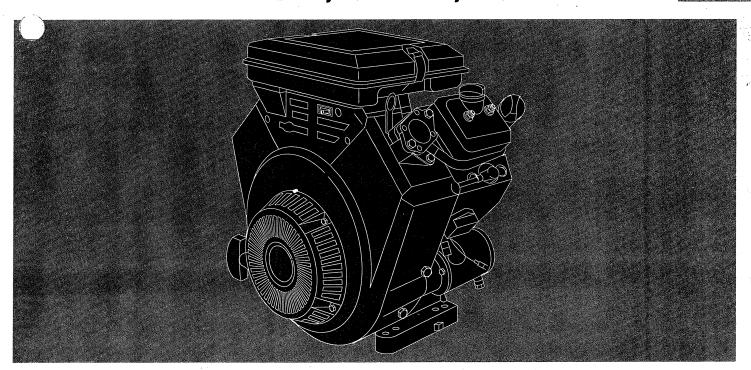
No	Problem / Possible Cause	Solution
4	The engine runs poorly or dies after running for awhile.	
4.1	The <i>air or gas filter</i> is clogged.	Inspect both filters and replace the clogged one.
4.2	There is a poor <i>battery ground</i> to the fuel pump.	Inspect the electrical grounds and repair any loose ground connections.
4.3	The <i>fuel pump</i> 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 <i>fuel pump</i> 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 <i>engine load</i> .	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 <i>combustion</i> chamber.	Refer to a local Briggs & Stratton dealer.
4.8	The engine overheats from too much oil in the <i>crankcase</i> .	Check the oil level and correct if necessary.
4.9	The <i>engine</i> 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 <i>heat exchanger</i> 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 <i>PCV valve</i> is defective.	Remove and check the air cleaner for oil saturation. If it is saturated, replace the PCV valve and air filter.





- **GB** Operating & Maintenance Instructions
- D Betriebsanleitung & Wartungsvorschriften
- **DK** Drifts- og vedligeholdelsesvejledning
- **E** Instrucciones de Mantenimiento & Operación
- F Instructions d'utilisation et de maintenance
- GR Οδηγίες Λειτουργίας & Συντήρησης
- Istruzioni per l'uso e la manutenzione
- N Anvisninger for bruk og vedlikehold
- **NL** Gebruiksaanwijzing
- P Instruções de operação e de manutenção
- S Instruktionsbok
- SF Käyttö & Huolto-ohjeet



Note: (This note applies only to engines used in the U.S.A.) Maintenance, replacement or repair of the emission control devices and systems may be performed (by any nonroad engine repair establishment or individual. However, to obtain no charge repairs under the terms and provisions of the Briggs & Stratton warranty statement, any service or emission control part repair or replacement must be performed by a factory authorized dealer.



...w To Use Manual Figures

refer to figures inside covers.

refer to engine components in figure | 1 |

refer to part/action in figures.

Record your engine Model, Type and Code numbers here for future use.

Record your date of purchase here for future use.

In the state of California, OHV Model Series 290000, 300000, 350000 and 380000 engines are certified by the California Air Resources Board to meet emissions standards for 250 hours. Such certification does not grant the purchaser, owner or operator of this engine any additional warranties with respect to the performance or operational life of this engine. This engine is warranted solely according to the product and emissions warranties stated elsewhere in this manual.

Technical Information

POWER RATINGS: The power ratings for an individual engine model are initially developed by starting with SAE (Society of Automotive Engineers) code J1940

Il Engine Power & Torque Rating Procedure) (Revision 2002-05). Given both the wide array of products on which our engines are placed, and the variety of environmental issues applicable to operating the equipment, it may be that the engine you have purchased will not develop the rated horsepower when used in a piece of power equipment (actual "on-site" power). This difference is due to a variety of factors including, but not limited to, the following: differences in altitude, temperature, barometric pressure, humidity, fuel, engine lubrication, maximum governed engine speed, individual engine to engine variability, design of the particular piece of power equipment, the manner in which the engine is operated, engine run-in to reduce friction and clean out of combustion chambers, adjustments to the valves and carburetor, and other factors. The power ratings may also be adjusted based on comparisons to other similar engines utilized in similar applications. and will therefore not necessarily match the values derived using the foregoing codes.

Engine Components (see fig. 11)

(1) Oil fill cap

2 Dipstick

3 Fuel pump (if equipped)

4 Spark plug

(5) Engine Model Type

Code XXXXXXX XXX XXX XXXXXXXX

6 12V electric starter (if equipped)

(7) Oil drain plug

(8) Blower housing

(9) Rope handle

(0) Carburetor or LPG/NG Fuel mixer

(1) Stop switch (if equipped)

(2) Air cleaner (without fuel tank)

(3) Fuel shut-off valve (if equipped)

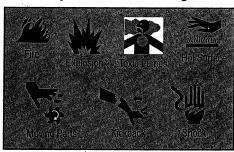
4 Air cleaner (with fuel tank)

(5) Fuel fill/fuel tank (if equipped)

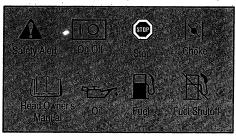
16 Exhaust manifold

(17) Oil filter (if equipped)

Hazard Symbols and Meanings



International Symbols and Meanings



Safety Precautions



BEFORE OPERATING ENGINE

- Read entire Operating & Maintenance Instructions AND the instructions for the equipment this engine
- Failure to follow instructions could result in serious injury or death.
 - Briggs & Stratton does not necessarily know what equipment this engine will power. For that reason, you should carefully read and understand the operating instructions for the equipment on which your engine is placed.

THE OPERATING & MAINTENANCE INSTRUCTIONS CONTAIN SAFETY **INFORMATION TO**

- · Make you aware of hazards associated with engines
- · Inform you of the risk of injury associated with those
- · Tell you how to avoid or reduce the risk of injury.

The safety alert symbol is used to identify safety information about hazards that can result in personal injury.

A signal word (DANGER, WARNING, or CAUTION) is used with the alert symbol to indicate the likelihood and the potential severity of injury. In addition, a hazard symbol may be used to represent the type of hazard.



DANGER indicates a hazard which, if not avoided. will result in death or serious injury.



WARNING indicates a hazard which, if not avoided, could result in death or serious injury.



CAUTION indicates a hazard which, if not avoided, might result in minor or moderate injury.

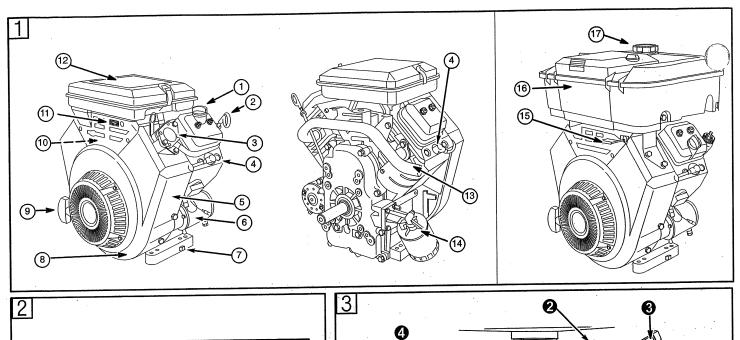
CAUTION, when used without the alert symbol. indicates a situation that could result in damage to the engine.

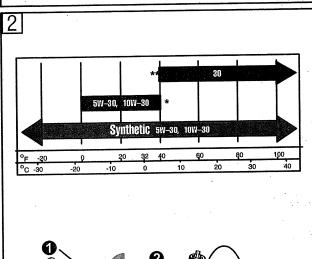


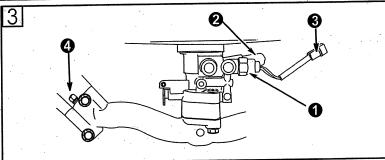
WARNING

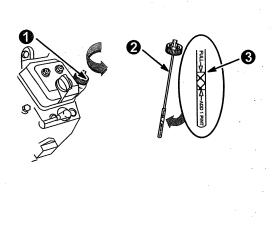


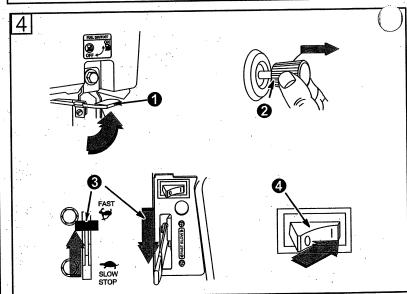
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

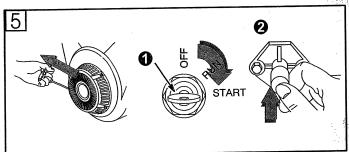


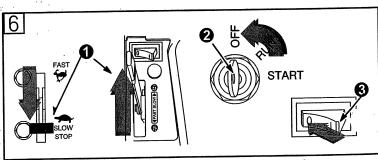














WARNING



Gasoline and its vapors are extremely flammable and explosive.

Fire or explosion can cause severe burns or death.

WHEN FUELING

- Turn engine OFF and let engine cool at least 2 minutes before refueling engine.
- Fill fuel tank outdoors or in well-ventilated area.
- On GASOLINE operated engines, do not overfill fuel tank. Fill tank to approximately 1-1/2 inches below top of neck to allow for fuel expansion.
- Keep fuel away from sparks, open flames, pilot lights, heat, and other ignition sources.
- Check fuel lines, tank, cap, and fittings frequently for cracks or leaks. Replace if necessary.

WHEN STARTING ENGINE

- Make sure spark plug, muffler, fuel cap and air cleaner are in place.
- · Do not crank engine with spark plug removed.
- If fuel spills, wait until it evaporates before starting
- If GASOLINE engine floods, set choke to OPEN/RUN position, place throttle in FAST and crank until engine starts.

WHEN OPERATING EQUIPMENT WITH **GASOLINE ENGINE**

- · Do not tip engine or equipment at angle which causes gasoline to spill.
- Do not choke carburetor to stop engine.

WHEN TRANSPORTING EQUIPMENT

- On gasoline engine, transport with fuel tank EMPTY or with fuel shut-off valve OFF.
- On NATURAL / LIQUID PETROLEUM (LP) GAS engine, transport with fuel cylinder empty, and valve closed, or tank disconnected.

WHEN STORING FUEL OR EQUIPMENT WITH **FUEL IN TANK OR IN FUEL CYLINDER**

 Store away from furnaces, stoves, water heaters or other appliances that have pilot light or other ignition source because they can ignite gasoline vapors.





Engines give off carbon monoxide, an odorless, colorless, poison gas.

Breathing carbon monoxide can cause nausea, fainting or death.

- · Start and run engine outdoors.
- · Do not start or run engine in enclosed area, even if doors or windows are open.





Gaseous fuels are extremely flammable and readily form explosive air-vapor mixtures at ambient temperatures.

IF YOU SMELL GAS:

- . DO NOT start the engine.
- DO NOT actuate any electrical switches.
- DO NOT use the phone in the vicinity.
- · Evacuate the area.
- Contact the gas supplier or fire department.

REMEMBER:

- . LPG vapor is heavier than air and trends to collect in low areas. NG vapor is lighter than air and tends to collect in high areas. Both may travel to remote
- · Keep all flames, sparks, pilot lights, and other ignition sources away from the area where the engine is operated or repaired.
- DO NOT smoke when operating or repairing the
- DO NOT store gasoline or other flammable vapors or liquids in the vicinity of the engine.
- · BEFORE doing any service work to the engine, shut off the gas supply.
- After initial installation or servicing, check for gas leaks. DO NOT use an open flame. Apply very soapy water or leak test solution with a brush and look for bubbles.
- Keep the equipment and the area surrounding the engine free of debris.
- Install the fuel system according to applicable fuel/gas codes.



WARNING



Wear eye protection when doing repair work.

Frostbite can result from skin/eye contact with leaking LP liquid.

- Installation, adjustment and repair work should be done by a qualified technician.
- Flexible supply lines should be checked regularly to make sure they are in good condition. Replace damaged or leaking components.



WARNING



Unintentional sparking can result in fire or electric shock

Unintentional start-up can result in entanglement, traumatic amputation, or laceration.

BEFORE PERFORMING ADJUSTMENTS OR RE-**PAIRS**

- · Disconnect spark plug wire and keep it away from spark plug.
- Disconnect battery at negative terminal (only engines with electric start).

WHEN TESTING FOR SPARK

- Use approved spark plug tester.
- · Do not check for spark with spark plug removed.



WARNING



Starting engine creates sparking. Sparking can ignite nearby flammable gases. Explosion and fire could result.

- If there is natural or LP gas leakage in area, do not start engine.
- Do not use pressurized starting fluids becal vapors are flammable.





Running engines produce heat. Engine parts, especially muffler, become extremely hot.

Severe thermal burns can occur on contact.

Combustible debris, such as leaves, grass, brush, etc. can catch fire.

- Allow muffler, engine cylinder and fins to cool before touching.
- Remove accumulated combustibles from muffler area and cylinder area.
- Install and maintain in working order a spark arrester before using equipment on forest-covered, grass-covered, brush-covered unimproved land. The state of California requires this (Section 4442 of the California Public Resources Code). Other states may have similar laws. Federal laws apply on federal land.





Rotating parts can contact or entangle hands, feet, hair, clothing, or accessories.

Traumatic amputation or severe laceration can

- · Operate equipment with guards in place.
- · Keep hands and feet away from rotating parts.
- · Tie up long hair and remove jewelry.
- · Do not wear loose-fitting clothing, dangling drawstrings or items that could become caught.



WARNING



Rapid retraction of starter cord (kickback) will pull hand and arm toward engine faster than you can let go.

Broken bones, fractures, bruises or sprains could result.

- When starting engine, pull cord slowly until resistance is felt, then pull rapidly.
- Remove all external equipment/engine loads before starting engine.
- · Direct coupled equipment components such as, but not limited to, blades, impellors, pulleys, sprockets, etc., must be securely attached.

Oil Recommendations (see fig. 2)

Engine shipped from Briggs & Stratton without oil. Before starting engine, fill with oil. Do not over-fill.

Use a high quality detergent oil classified "For Service SF, SG, SH, SJ" or higher such as Briggs & Stratton 30W, Part Number 100005 (20 oz.) or 100028 (48 oz.). Use no special additives with recommended oils. Do not mix oil with gasoline.

Choose the SAE viscosity grade of oil from this chart that matches the starting temperature anticipated before the next oil change. (see fig. 2)



Synthetic oil meeting ILSAC GF-2. API certification mark and API service symbol (shown at left) with "SJ/CF ENERGY CON-SERVING" or higher, is an acceptable oil at all temperatures. Use of synthetic oil does not alter required oil change intervals.

Air cooled engines run hotter than automotive engines. The use of non-synthetic multi-viscosity oils (5W-30, 10W-30, etc.) in temperatures above 40° F (4° C) will result in higher than normal oil consumption. When using a multi-viscosity oil, check oil level more frequently.

SAE 30 oil, if used below 40° F (4° C), will result in hard starting and possible engine bore damage due to inadequate lubrication.

Check oil level (see fig. 2)

Oil capacity: approximately 1-1/2 quarts (48 ounces or 1.6 liters) when changing oil and filter. (Oil capacity will be greater if engine is equipped with remote oil filter.)

Oil filling procedure: first add 1 quart (32 ounces or 1 liter). Start and run engine at idle for 30 seconds. Shut engine off and wait 30 seconds. Then add more oil slowly to bring level to Full mark on dipstick. Check for oil leaks. Tighten dipstick firmly before starting engine.

Oil checking procedure: before starting engine, place engine level and clean around oil fill 1. Remove dipstick 2. wipe with clean cloth, insert and tighten down again. Remove dipstick and check oil level. Oil should be at FULL mark 3. If oil is required, add slowly. Tighten dipstick firmly before starting engine.

Fuel Recommendations

Gasoline Powered Engines

Use clean, fresh, lead-free gasoline with a minimum of 85 octane. Leaded gasoline may be used if it is commercially available and if unleaded is unavailable. Purchase fuel in quantity that can be used within 30 days.

Do not use gasoline which contains Methanol. Do not mix oil with gasoline. In U.S.A. leaded gasoline may not be used.

This engine is certified to operate on gasoline. Exhaust Emission Control System: EM (Engine Modifications).

For engine protection, we recommend using Briggs & Stratton Fuel Stabilizer available from an Authorized Briggs & Stratton Service Dealer.

Natural (NG) / Liquid Propane (LPG) **Gas Powered Engines**

Use clean, dry fuel, free of moisture or any particulate material. Using fuels outside the following recommended values may cause performance problems.

In engines set up to run on LPG, commercial grade HD5 LPG is recommended. Recommended fuel composition is fuel with a minimum fuel energy of 2500 BTU's/ft3 with maximum propylene content of 5% and butane and heavier gas content of 2.5% and minimum propane content of 90%.

NG or LPG engines are certified to operate on natural or liquid propane gas.



The equipment on which this engine is mounted is equipped with an automatic safety gas "fuel lock-off" valve. DO

NOT operate the equipment if the "fuel lock-off" valve is missing or inoperative.

Adding Fuel - Gasoline





Before refueling, allow engine to cool 2 minutes.

Clean around fuel fill before removing cap to refuel. Remove cap. Fill tank to approximately 1-1/2 inches below top of neck to allow for fuel expansion. Be careful not to overfill

Adding Fuel - Natural (NG) / Liquid Propane (LPG)

Read the operating instructions supplied by the equipment manufacturer for information on refueling natural or LP gas

Starting (see figs. 3 4)



ALWAYS KEEP HANDS AND FEET CLEAR OF **EQUIPMENT MOVING PARTS.**



Do not use a pressurized starting fluid. Vapors are flammable.

Start, store and fuel equipment in level position. Check oil level.

Open fuel shut-off valve, if equipped.

BEFORE STARTING - LPG / NG Engines (see fig. 3)

The LPG / NG mixer is equipped with solenoid 10, fuel inlet 20, 12 volt connector 3, and equipped for a fuel lock-off valve 3.

CAUTION:

All LPG / NG fuel mixers are equipped with a solenoid. • When operating on LPG fuel, 12 volts MUST be supplied to connector 6.

When operating on NG fuel, 12 volts MUST NOT be supplied to connector .

- Move throttle control to FAST position.
- 2. Push rocker switch to I position.

BEFORE STARTING - Gasoline Engines

(see fig. 4)

If engine runs low on oil, an oil pressure switch (if engine is equipped) will either activate a warning device or stop the engine. (Read the operating instructions supplied by the equipment manufacturer to determine which way your engine is equipped.) See Oil pressure on next page.

- 1. Open fuel shut-off valve 1, if equipped.
- 2. Move choke control 2 to CHOKE position.

Note: If engine does not start, remove air cleaner to check choke. Choke must fully close. If not, see Adjustments.

- 3. Move throttle control 3 to FAST position.
- 4. Push rocker switch 4 to I position.

Rewind starter, if equipped (see fig. 5)



Grasp rope handle and pull slowly until resistance is felt. Then pull cord rapidly to overcome compression, prevent kickback and start engine. Repeat if necessary with choke in RUN

position throttle in FAST. When engine starts, operate in FAST.

Electric starter (see fig. 5)

On engines equipped with 12 volt starting systems, turn key to START position 1 or press button 2. Repeat if necessary with choke off and throttle control in FAST position. Operate engine with choke off and throttle in FAST position.

Note: If equipment manufacturer has supplied battery, charge it before trying to start engine, as equipment manufacturer recommends. Use short starting cycles (15 secs. per min.) to prolong starter life. Extended cranking can damage starter motor.

CAUTION: If engine is equipped with battery for electric starter, do not operate engine with battery disconnected.

Stopping (see fig. 6)

Do not move choke control to CHOKE to stop engine. Backfire or engine damage may occur. Move throttle control 10 to IDLE or SLOW position, then to STOP or turn key to OFF 2 or push rocker switch (3) to (1) position.

Always remove key from switch when equipment is not in use or left unattended.





When engine or equipment is transported, close fuel shut-off valve, if equipped, to prevent fuel leakage.

Maintenance Schedule

Follow the hourly or calendar intervals, whichever occur first. More frequent service is required when operating in adverse conditions noted below.

Change oil

very 8 hours or daily

- Check oil level
- · Clean around muffler, linkage and springs

25 hours or every season

- Change oil if operating under heavy load or high ambient temperature
- Service air cleaner pre-cleaner*

50 hours or every season

- Change oil
- · Clean and inspect spark arrester, if equipped

ery 100 hours or every season

- Service air cleaner cartridge
- Replace oil filter, if equipped
- Clean oil cooler, if equipped*
- Clean cooling system*
- Check valve clearance NG / LPG engines

- Replace spark plugs
- Replace in-line fuel filter
- Check valve clearance
- Clean more often under dusty conditions, or when airborne debris is present or after prolonged operation cutting tall, dry grass.

Maintenance (see figs. 8 9 10)

See any Authorized Briggs & Stratton Dealer for correct replacement parts.



To prevent accidental starting, remove spark plug wire 0 and ground it before servicing, and dis-

connect battery at negative terminal, if equipped.

Oil service (see fig. 8)

Check oil level regularly.

Be sure correct oil level is maintained. Check every 8 hours or daily, before starting engine. See oil filling procedure, Oil Recommendations.

Change oil.

Change oil after first 8 hours of operation. Change oil while engine is warm. Refill with new oil of recommended SAE viscosity grade. (see fig. 2)

Change oil filter **②**, if equipped. *(see fig.* 8)

Replace oil filter after every 100 hours of operation or every season, whichever occurs first. Before installing new filter, lightly oil filter gasket with fresh, clean engine oil. Screw filter on by hand until gasket contacts oil filter adapter. Tighten 1/2 to 3/4 turn more. Start and run engine at IDLE to check for oil leaks. Stop engine. Recheck oil level and add oil if required.

Oil pressure

If oil pressure drops below 1-4 psi (.1-.2 kg/cm²), an oil pressure switch (if engine is equipped) will either activate a warning device or stop the engine. Check oil level with dipstick. If oil level is between ADD and FULL mark on dipstick, do not try to restart engine. Contact an Authorized Briggs & Stratton Service Dealer. Do not operate engine until oil pressure is

If oil level is below ADD mark on dipstick, add oil to bring level to FULL mark. Restart engine and check oil pressure. If pressure is normal, continue to operate engine.

Note: Oil pressure gauge, if engine is equipped, is supplied by manufacturer of equipment.

Maintenance Cont'd

Air cleaner, dual element (see fig. 9)

1. Remove cover.

- Carefully slide pre-cleaner ② off cartridge ③.
- 3. Remove knob and plate. Carefully remove cartridge to prevent debris from entering carburetor.

Replace pre-cleaner, if equipped, or cartridge if very dirty or damaged.

To service cartridge, clean by tapping gently on a flat surface. Do not use petroleum solvents, e.g., kerosene, which will cause cartridge to deteriorate. Do not use pressurized air, which can damage cartridge. Do not oil cartridge.

Reinstall cartridge, plate and knob.

Note: Top side of air cleaner plate 4 is marked "UP" (only on engines equipped with integral fuel tank).

5. Install pre-cleaner on cartridge and replace cover.

Spark plug service (see fig. 10)





DO NOT check for spark with spark plugs removed. Use only Briggs & Stratton Spark Tester 2. to check for spark.

DO NOT crank engine with spark plug removed. If engine is flooded, place throttle in FAST and crank until engine starts.

Spark plug gap 3 should be .76 mm or 0.030 in.

Replace spark plugs every season. Spark tester and spark plug wrench are available from any Authorized Briggs & Stratton Service Dealer.

Note: In some areas, local law requires using a resistor spark plug to suppress ignition signals. If this engine was originally equipped with resistor spark plug, use same type of spark plug for replacement.

Keep engine clean (see fig. 10)

Periodically remove chaff/debris buildup from engine. Do not spray engine with water because water could contaminate fuel. Use a brush or compressed air.



Accumulation of chaff/debris around exhaust manifold/muffler 4 could cause a fire. Inspect and clean before every use.

Keep linkage, springs and controls 4 free of debris.

If muffler is equipped with spark arrester screen 6, remove spark arrester screen for cleaning and inspection every 50 hours or every season. Replace if damaged.





Replace in-line fuel filter 6 every season. Drain fuel tank or close fuel shut-off valve before replacing filter.

Clean oil cooler o every 100 hours or every season, if equipped.

Chaff or debris may clog engine's air cooling system, especially after prolonged service. Every 100 hours or every season, clean internal cooling fins and surfaces to prevent overheating and engine damage. Remove blower housing to clean areas shown 🗿.

Check Valve Clearance

Gasoline Engines -

Check valve clearance yearly (intake and exhaust .10-.15 mm). NG / LPG Engines -

Valve clearance must be checked after every 100 hours of operation. Adjust if necessary.

Adjustments (see fig. 7)



To prevent acc tal starting, re spark plug wire of and ground it before adjusting, and dis-

connect battery at negative terminal, if equipped.

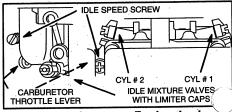
Carburetor adjustments



The manufacturer of the equipment on which this engine is installed specifies top speed at which the engine will be operated. DO NOT EXCEED this

See an Authorized Briggs & Stratton Dealer for carburetor adjustment.

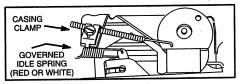
Start engine and warm up approximately 5 minutes before adjusting. With engine running, place throttle control in SLOW position. Rotate carburetor throttle lever against the idle speed screw and hold it. Turn idle speed screw to obtain 1400 rpm (1200 rpm on twin barrel carburetor). While still holding carburetor throttle lever against idle speed screw, turn idle mixture valve with limiter cap screw midway between limits. DO NOT remove limiter cap. DO NOT force beyond limit. On two barrel carburetor, set cylinder #1 idle mixture valve midway between limits. Then set cylinder #2 idle mixture valve midway between limits while holding carburetor throttle lever against idle speed screw.



Single barrel carburetor

Two barrel carburetor

Readiust the idle speed to 1200 rpm, if governed idle spring is red, or 900 rpm, if governed idle spring is white as illustrated below. Release carburetor throttle lever. Move throttle control to FAST position.



Note: Engines operated at approximately 3000 to 5000 feet above sea level may require a high altitude carburetor main jet. See a Briggs & Stratton Dealer.

ON NG / LPG Powered Engines Adjusting Fuel Mixer

If adjustment is needed, see a Briggs & Stratton Authorized Service Dealer who has been licensed by the state or local municipality (if required) in which the service is performed. Mixer adjustment requires special equipment and a qualified technician. DO NOT remove limiter caps. DO NOT force beyond limits.

Adjustments Cont'd (see fig. 7)

'te control adjustments

we air cleaner. Move choke control to CHOKE position. Carburetor choke valve ❷ should be completely closed. If not, loosen casing clamp screw ❸ and pull casing and wire ❹ in direction of arrow to end of travel. Tighten casing clamp screw. Replace air cleaner.

Throttle control adjustments 9

Remove air cleaner. Move throttle control to FAST position. Swivel should be against throttle stop If not, loosen casing clamp screw Move casing and wire in direction shown by arrow until swivel is against throttle stop. Tighten casing clamp screw. Check operation of controls. Readjust if necessary. Replace air cleaner.

Adjustable Governor Control

This control ① was set according to requirements of manufacturer of the equipment on which this engine is installed. If adjustment is required, consult any Briggs & Stratton Authorized Service Dealer.

Storage

Engines stored over 30 days need to be protected or drained of fuel to prevent gum from forming in fuel system or on essential carburetor parts.

For engine protection, we recommend use of Briggs & Stratton Fuel Stabilizer available from an Authorized Briggs & Stratton Service Dealer. Mix stabilizer with fuel in fuel tank or storage container. Run engine for a short time to circulate stabilizer through carburetor. Engine and fuel can be stored up to 24 months.

Note: If stabilizer is not used or if engine is operating on gasoline containing alcohol, e.g. gasohol, remove all fuel from tank and run engine until it stops from lack of fuel.

- 1. Change oil. See Oil service. (see figs. 2 7)
- Remove spark plugs and pour about 30 ml (1 oz) of engine oil into cylinders. Replace spark plugs and crank slowly to distribute oil.
- Clean chaff or debris from cylinders and cylinder head fins and behind muffler.
- Store in a clean and dry area, but NOT near a stove, furnace or water heater which uses a pilot light or any device that can create a spark.

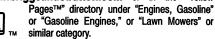
Service

See an Authorized Briggs & Stratton Service Dealer. Each one carries a stock of Genuine Briggs & Stratton Parts and is equipped with special service tools. Trained mechanics assure expert repair service on all Briggs & Stratton engines. Only dealers advertising as "Authorized Briggs & Stratton" are required to meet Briggs & Stratton standards.

When you purchase equipment powered by a Briggs & Stratton engine, you are assured of highly skilled, reliable service at more than 30,000 Authorized Service Dealers worldwide, including more than 5,000 Master Service Technicians. Look for these signs wherever Briggs & Stratton service is offered.



You may locate your nearest Authorized Briggs & Stratton Service Dealer in our dealer locator map on our web site www.briggsandstratton.com or in the "Yellow Page IM" directory under "Engines Gasoline"



Note: Walking fingers logo and "Yellow Pages" are registered trademarks in various jurisdictions.

An illustrated shop manual includes "Theories of Operation," common specifications and detailed information covering adjustment, tune-up and repair of Briggs & Stratton V-Twin cylinder OHV, 4 cycle engines. Order P/N 272144 from an Authorized Briggs & Stratton Service Dealer.

Insist on Genuine Briggs & Stratton replacement parts with our logo on the box and/or part. Non-original parts may not perform as well and may void your warranty.

Partial List of Genuine Briggs & Stratton Parts

Briggs & Stratton (or equivalent)

Part No.
Oil (20 oz.)
Oil (48 oz.)
Oil filter (6 cm long)
Oil filter (9 cm long)
Oil pump kit (uses standard electric drill 5056
to remove oil from engine quickly)
Fuel stabilizer (1 oz., 30 ml single use pouch) 992030
Fuel stabilizer (4.2 oz., 125 ml bottle) 999005E (5041)
Fuel filter (without fuel pump) 298090 (5018)
Fuel filter (with fuel pump)
Fuel filter (with 9 qt. fuel tank on engine) 808116
Air cleaner cartridge
(with 9 at fuel tank on engine)
Air cleaner pre-cleaner
(with 9 qt. fuel tank on engine)
Air cleaner cartridge
(all other models except model 380000)
Air cleaner pre-cleaner
(all other models except model 380000)
Air cleaner (cartridge and pre-cleaner kit) 5050
(all other models except model 380000)
Air cleaner cartridge (model 380000) 692519
Air cleaner pre-cleaner (model 380000) 692520
Resistor spark plug 491055 or 496018
Long life platinum spark plug 5066
(used on most OHV engines)
Spark tester
Spark plug wrench
Spark arrester
Resistor spark plug 491055 or 496018

RIGGS & STRATTON ENGINE OWNER WARRANTY POLICY

Effective January 1, 2003 replaces all undated Warranties and all Warranties dated before January 1, 2003

LIMITED WARRANTY

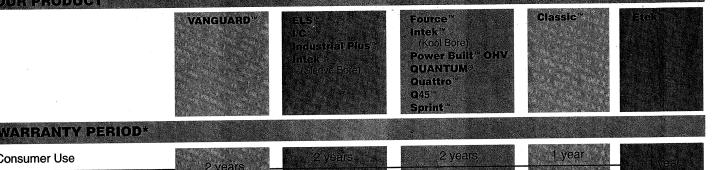
Briggs & Stratton Corporation will repair or replace, free of charge, any part(s) of the engine that is defective in material or workmanship or both. Transportation charges on parts submitted for repair or replacement under this warranty must be borne by purchaser. This warranty is effective for the time periods and subject to the conditions stated below. For warranty service, find the nearest Authorized Service Dealer in our dealer locator map at www.briggsandstratton.com, or by calling 1-800-233-3723, or as listed in the 'Yellow PagesTM'.

THERE IS NO OTHER EXPRESS WARRANTY. IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO ONE YEAR FROM PURCHASE, OR TO THE EXTENT PERMITTED BY LAW ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED. LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARE EXCLUDED TO THE EXTENT EXCLUSION IS PERMITTED BY LAW. Some states or countries do not allow limitations on how long an implied warranty lasts, and some states or countries do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state and country to country.

DUR PRODUCT

Consumer Use

Commercial Use



Note the following special warranty periods: 2 years for Classic™ engines in the European Union and Eastern European countries, for all consumer products in the European Union, and to the the following special warranty periods. ∠ years not classic—engines in the European Chiori and Eastern European Countries, not all consumer products in the European Chiori, and for emission control systems on engines certified by EPA and CARB. 5 years for consumer use, 90 days for commercial use of Touch-N-Mow® starter on Quantum® and Intek™ engines. Engines used in competitive racing or on commercial or rental tracks are not warrantied.

The warranty period begins on the date of purchase by the first retail consumer or commercial end user, and continues for the period of time stated in the table above. "Consumer use" means personal residential household use by a retail consumer. "Commercial use" means all other uses, including use for commercial, income producing or rental purposes. Or engine has experienced commercial use, it shall thereafter be considered as a commercial use engine for purposes of this warranty.

NO WARRANTY REGISTRATION IS NECESSARY TO OBTAIN WARRANTY ON BRIGGS & STRATTON PRODUCTS. SAVE YOUR PROOF OF PURCHASE RECEIPT. IF YOU DO NOT PROVIDE PROOF OF THE INITIAL PURCHASE DATE AT THE TIME WARRANTY SERVICE IS REQUESTED, THE MANUFACTURING DATE OF THE PRODUCT WILL BE USED TO DETERMINE THE WARRANTY PERIOD.

BOUT YOUR ENGINE WARRANTY

Briggs & Stratton welcomes warranty repair and apologizes to you for being inconvenienced. Any Authorized Service Dealer may perform warranty repairs. Most warranty repairs are hanmay perform warranty repairs. Most warranty repairs are nati-dled routinely, but sometimes requests for warranty service may not be appropriate. For example, warranty would not apply if engine damage occurred because of misuse, lack of routine maintenance, shipping, handling, warehousing or improper installation. Similarly, warranty is void if the serial number of the engine has been removed or the engine has been altered or

If a customer differs with the decision of the Service Dealer, an investigation will be made to determine whether the warranty applies. Ask the Service Dealer to submit all supporting facts to his Distributor or the Factory for review. If the Distributor or the Factory decides that the claim is justified, the customer will be fully reimbursed for those items that are defective. To avoid misunderstanding which might occur between the customer and the Dealer, listed below are some of the causes of engine failure that the warranty does not cover.

Normal wear:

Engines, like all mechanical devices, need periodic parts service and replacement to perform well. Warranty will not cover repair when normal use has exhausted the life of a part or an engine.

Improper maintenance:

The life of an engine depends upon the conditions under which it operates, and the care it receives. Some applications, such as tillers, pumps and rotary mowers, are very often used in dusty or dirty conditions, which can cause what appears to be premature wear. Such wear, when caused by dirt, dust, spark plug cleaning grit, or other abrasive material that has entered the engine because of improper maintenance, is not covered by warranty. This warranty covers engine related defective material and/ or workmanship only, and not replacement or refund of the equipment to which the engine may be mounted. Nor does the warranty extend to repairs required because of:

1. PROBLEMS CAUSED BY PARTS THAT ARE NOT

ORIGINAL BRIGGS & STRATTON PARTS.

Equipment controls or installations that prevent starting, cause unsatisfactory engine performance, or shorten en-

cause disabilization of rigid periodical, of other degree disabilization of the control of the c

Parts which are scored or broken because an engine was operated with insufficient or contaminated lubricating oil, or an incorrect grade of lubricating oil (check oil level daily or after every 8 hours of operation. Refil and change at recommended intervals.) OIL GARD® may not shut down running engine. Engine damage may occur if oil level is not properly maintained. Read Operat-

ing & Maintenance Instructions.
Repair or adjustment of associated parts or assemblies such as clutches, transmissions, remote controls, etc., which are not manufactured by Briggs & Stratton.

Damage or wear to parts caused by dirt, which entered the engine because of improper air cleaner maintenance, re-assembly, or use of a non-original air cleaner element or cartridge. (At recommended intervals, clean and re-oil the Oil-Foam® element or the foam pre-cleaner, and replace the cartridge.) Read Operating & Maintenance Instructions.

Parts damaged by over-speeding, or overheating caused by grass, debris, or dirt, which plugs or clogs the cooling by grass, debits, or diff, which plugs or dogs the config-fins, or flywheel area, or damage caused by operating the engine in a confined area without sufficient ventilation. (Clean fins on the cylinder, cylinder head and flywheel at recommended intervals.) Read Operating & Maintenance Instructions.

Engine or equipment parts broken by excessive vibration caused by a loose engine mounting, loose cutter blades, unbalanced blades or loose or unbalanced impellers, improper attachment of equipment to engine crankshaft,

over-speeding or other abuse in operation.

A bent or broken crankshaft, caused by striking a solid object with the cutter blade of a rotary lawn mower, or excessive v-belt tightness.

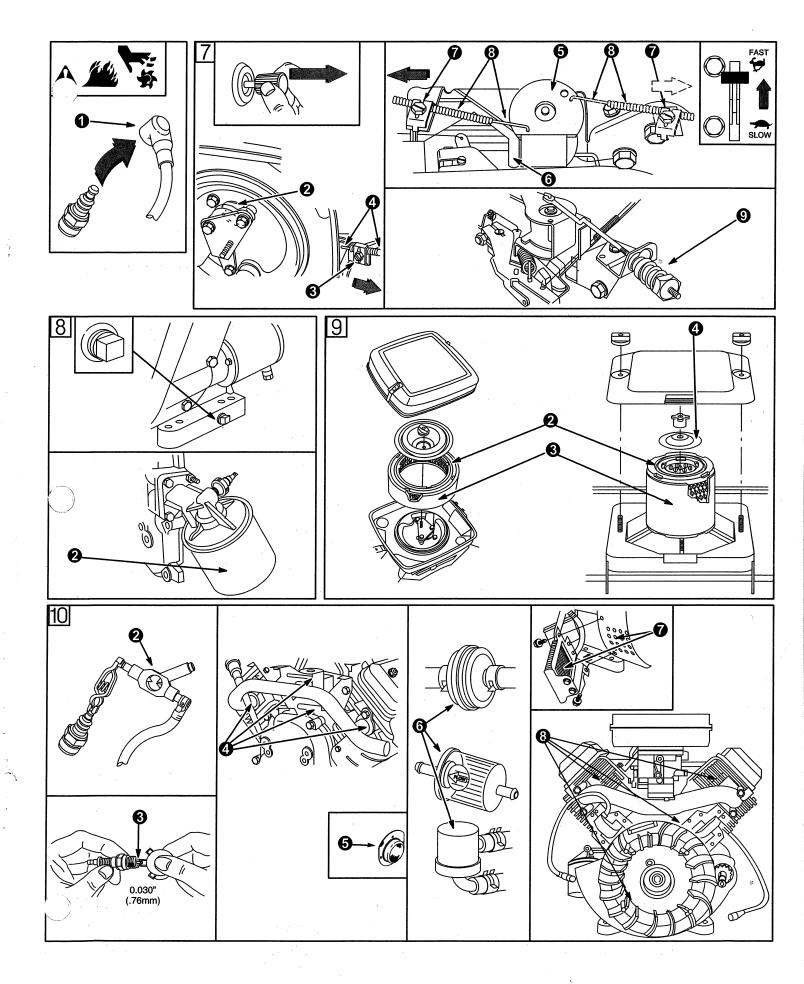
sive v-beit ugritness.

Routine tune-up or adjustment of the engine.

Engine or engine component failure, i.e., combustion chamber, valves, valve seats, valve guides, or burned starter motor windings, caused by the use of alternate fuels such as, liquified petroleum, natural gas, altered gasolines, etc.

Warranty is available only through service dealers which have been authorized by Briggs & Stratton Corporation. your nearest Authorized Service Dealer is listed in the "Yelyour learest authorized Service Sealer in Issue in Figures, Gasoline" or "Gasoline Engines," "Lawn Mowers," or similar category.

Briggs & Stratton	Engines Are Made Und	ier One Or More Of Th	e Following Patents: D	esign D-247,177 (Other	Patents Pending)				4 400 004	DES. 308
6,325,036	6.077.063	5.819,513	5.606.948	5,497,679	5,235,943	5,138,996	4,996,956	4,633,556	4,430,984	
1 ' '	-,,		5,606,851	5.320,795	5.197,425	5.086.890	4.977.879	4,630,498		DES. 308,೬.
6,284,123	6,064,027	5,813,384		-,		5,070,829	4,971,219	4,522,080		DES, 309,457
6.260,529	6,014,808	5,765,713	5,548,955	5,271,363	5,197,422		, ,			DES. 356,951
6.230,678	5,894,715	5,645,025	5.546.901	5,269,713	5,191,864	5,058,544	4,895,119	4,520,288		,
		5,642,701	5.503,125	5,265,700	5.188.069	5.040,644	4,819,593	4,512,499		DES. 361,771
6,202,616	5,852,951		-,,		-,,	5.009.208	4,719,682	4.453.507		DES, 375,963
6 116 212	5.823.153	5.619.845	5,501,203	5,243,878	5,186,142	5,009,206	4,719,002	4,400,007		



Briggs & Stratton Corporation (B&S), the California Air Resources Board (CARB) and the United States Environmental Protection Agency (U.S. EPA)

Emission Control System Warranty Statement (Owner's Defect Warranty Rights and Obligations)

EMISSION CONTROL WARRANTY COVERAGE IS APPLICABLE TO CERTIFIED ENGINES PUR-CHASED IN CALIFORNIA IN 1995 AND THEREAFTER, WHICH ARE USED IN CALIFORNIA, AND

TO CERTIFIED MODEL YEAR 1997 AND LATER ENGINES WHICH ARE PURCHASED AND LELSEWHERE IN THE UNITED STATES (AND AFTER JANUARY 1, 2001 IN CANADA).

California, United States and Canada Emission Control Defects Warranty Statement

The California Air Resources Board (CARB), U.S. EPA and B&S are pleased to explain the Emission Control System Warranty on your model year 2000 and later small off-road engine (SORE). In California, new small off-road engines must be designed, built and equipped to meet the State's stringent antismog standards. Elsewhere in the United States, new non-road, spark-ignition engines certified for model year 1997 and later, must meet similar standards set forth by the U.S. EPA. B&S must warrant the emission control system on your engine for the periods of time listed below, provided there has been

no abuse, neglect or improper maintenance of your small off-road engine.
Your emission control system includes parts such as the carburetor, air cleaner, ignition system, muffler and catalytic converter. Also included may be connectors and other emission related as-

Where a warrantable condition exists, B&S will repair your small off-road engine at no cost to you including diagnosis, parts and labor.

Briggs & Stratton Emission Control Defects Warranty Coverage

Small off-road engines are warranted relative to emission control parts defects for a period of two years, subject to provisions set forth below. If any covered part on your engine is defective, the part will be repaired or replaced by B&S.

Owner's Warranty Responsibilities

As the small off-road engine owner, you are responsible for the performance of the required mainte-nance listed in your Operating and Maintenance Instructions. B&S recommends that you retain all your receipts covering maintenance on your small off-road engine, but B&S cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled mainte-

As the small off-road engine owner, you should however be aware that B&S may deny you warranty coverage if your small off-road engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

You are responsible for presenting your small off-road engine to an Authorized B&S Service Dealer as soon as a problem exists. The undisputed warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

Briggs & Stratton Emission Control Defects Warranty Provisions

The following are specific provisions relative to your Emission Control Defects Warranty Coverage. It is in addition to the B&S engine warranty for non-regulated engines found in the Operating and Maintenance Instructions, 1. Warranted Parts

Coverage under this warranty extends only to the parts listed below (the emission control systems parts) to the extent these parts were present on the engine purchased.

- a. Fuel Metering System
 - · Cold start enrichment system (soft choke)
 - Carburetor and internal parts
 - Fuel Pump
- b. Air Induction System
 - Air cleaner
 - Intake manifold
- c. Ignition System
 - Spark plug(s)
 - Magneto ignition system
- d. Catalyst System
 - Catalytic converter
 - Exhaust manifold
 - Air injection system or pulse valve
- e. Miscellaneous Items Used in Above Systems
 - Vacuum, temperature, position, time sensitive valves and switches
 - · Connectors and assemblies

If you have any questions regarding your warranty rights and responsibilities, you should contact a B&S Service Representative at 1-414-259-5262.

The emission warranty is a defects warranty. Defects are judged on normal engine performance. The warranty is not related to an in-use emission test.

Length of Coverage

B&S warrants to the initial owner and each subsequent purchaser that the Warranted Parts shall be free from defects in materials and workmanship which caused the failure of the Warranted Parts for a period of two years from the date the engine is delivered to a retail purchaser.

No Charge

Repair or replacement of any Warranted Part will be performed at no charge to the owner, including diagnostic labor which leads to the determination that a Warranted Part is defective, if the diagnostic work is performed at an Authorized B&S Service Dealer. For emissions warranty service contact your nearest Authorized B&S Service Dealer as listed in the "Fellow Pages" under "Engines, Gasoline," "Gasoline Engines," "Lawn Mowers," or similar category.

Claims and Coverage Exclusions

Warranty claims shall be filed in accordance with the provisions of the B&S Engine Warranty Policy. Warranty coverage shall be excluded for failures of Warranted Parts which are not nal B&S parts or because of abuse, neglect or improper maintenance as set forth in the Engine Warranty Policy. B&S is not liable to cover failures of Warranted Parts caused by under use of add-on, non-original, or modified parts.

Any Warranted Part which is not scheduled for replacement as required maintenance or which is scheduled only for regular inspection to the effect of "repair or replace as necessary" shall be warranted as to defects for the warranty period. Any Warranted Part which is scheduled for replacement as required maintenance shall be warranted as to defects only for the period of time up to the first scheduled replacement for that part. Any replacement part that is equivalent in performance and durability may be used in the performance of any maintenance or repairs. The owner is responsible for the performance of all required maintenance, as defined in the **B&S** Operating and Maintenance Instructions.

Consequential Coverage

Coverage hereunder shall extend to the failure of any engine components caused by the failure of any Warranted Part still under warranty.

Look For Relevant Emission Durability Period and Air Index Information On Your Engine Emission Label

Engines that are certified to meet the California Air Resources Board (CARB) Tier 2 Emission Standards must display information regarding the Emissions Durability Period and the Air Index, Briggs & Stratton makes this information available to the consumer on our emission labels. The engine label will indicate certification information.

The Emission Durability Period describes the number of hours of actual running time for which the engine is certified to be emission compliant, assuming proper maintenance in accordance with the Operating & Maintenance Instructions. The following categories are used:

Engine is certified to be emission compliant for 125 hours of actual engine running time. Moderate: Intermediate: Engine is certified to be emission compliant for 250 hours of actual engine running time. Engine is certified to be emission compliant for 500 hours of actual engine running time. Extended:

For example, a typical walk-behind lawn mower is used 20 to 25 hours per year. Therefore, the Emission Durability Period of an engine with an intermediate rating would equate to 10 to 12 years. The Air Index is a calculated number describing the relative level of emission for a specific engine family. The lower the Air Index, the cleaner the engine. This information is displayed in graphical form on the emission label.

After July 1, 2000, Look For Emissions Compliance Period On Engine Emissions Compliance Label

After July 1, 2000 certain Briggs & Stratton engines will be certified to meet the United States Environmental Protection Agency (USEPA) Phase 2 emission standards. For Phase 2 certified engines, the Emissions Compliance Period referred to on the Emissions Compliance label indicates the number of operating hours for which the engine has been shown to meet Federal emission requirements. For engines less than 225 cc displacement, Category C = 125 hours, B = 250 hours and A = 1000 hours. The displacement of Model Series 290000 and 300000 engines is 480 cc. The displacement of Model Series 350000 engines is 570 cc. The displacement of Model Series 380000 engines is 627 cc.

This is a generic representation of the emission label typically found on a certified engine.



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	20000	NAME OF	a ligation	Ties etc	1110
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				SMALL NON-	
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ADJUSTME EPA EMISSI					

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 N

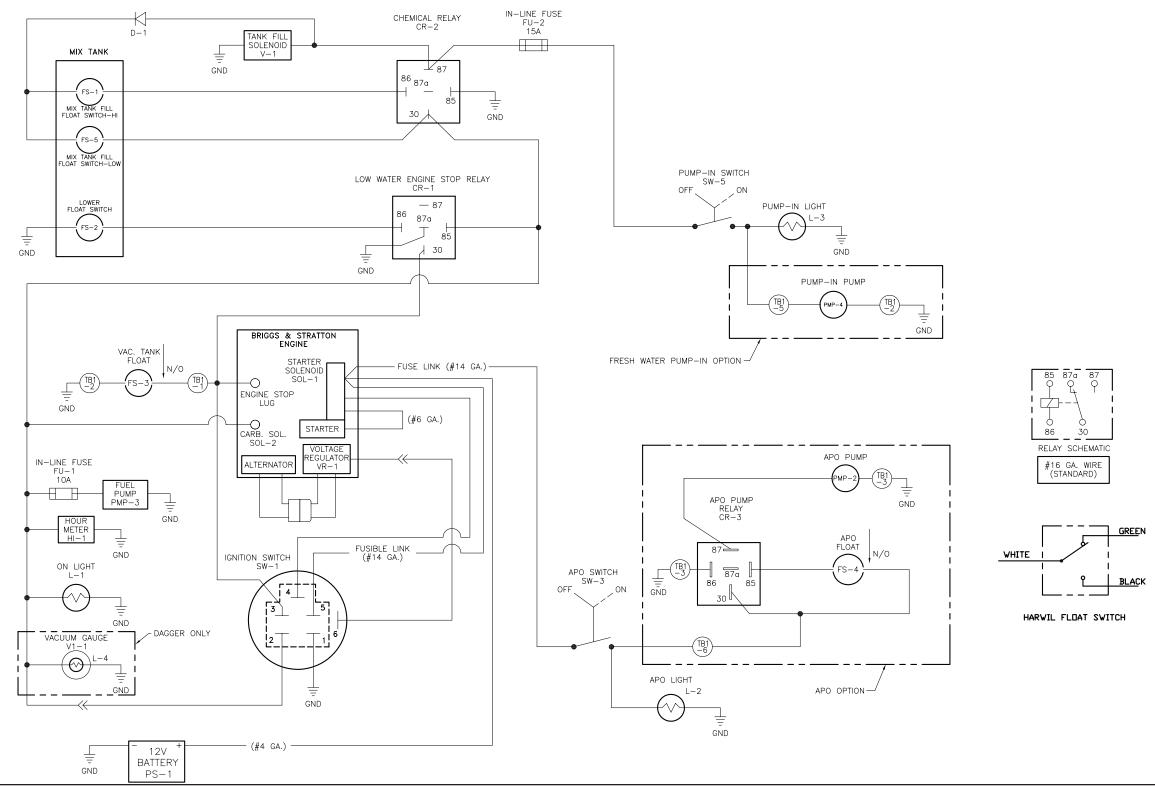


Figure 10 -2 Wiring Diagram

D-2936 Sht 2 Rev O

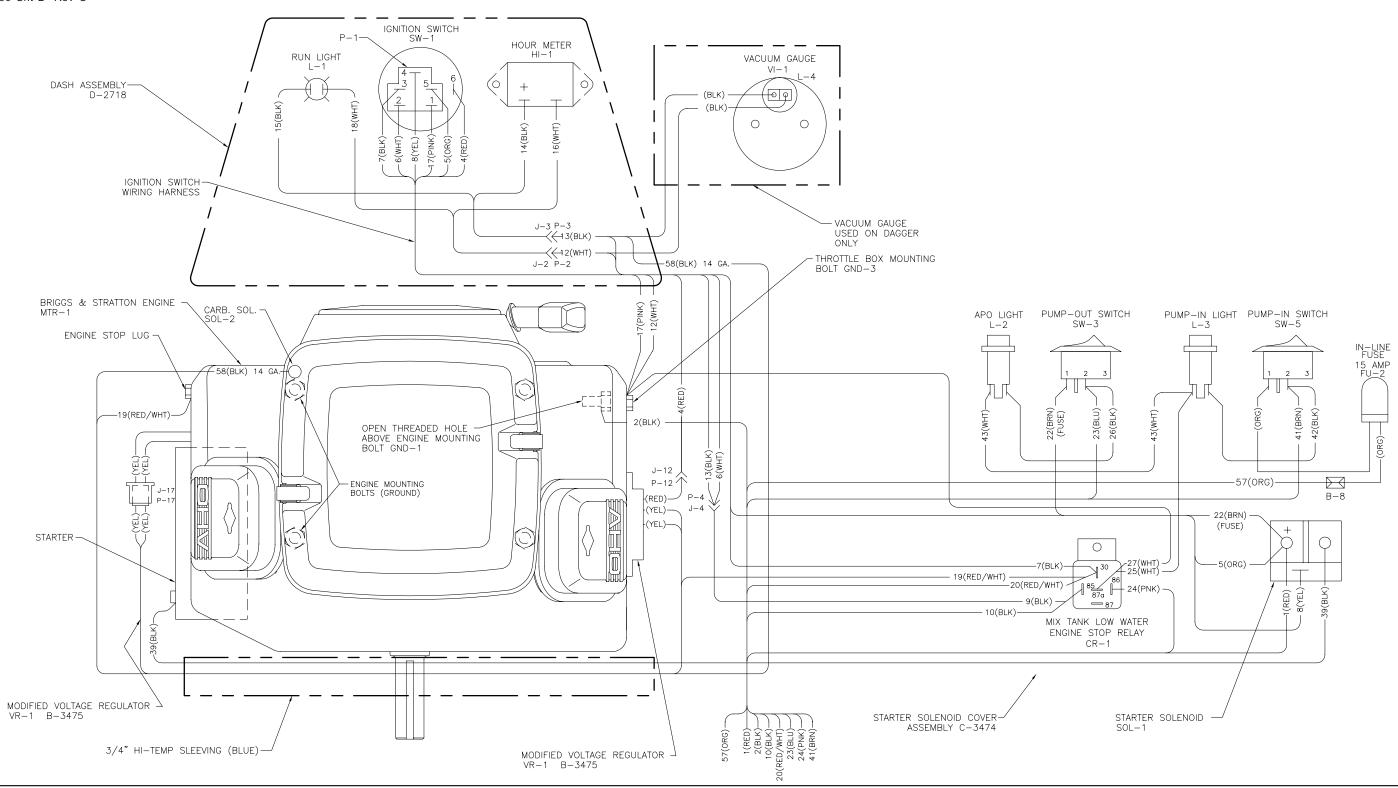
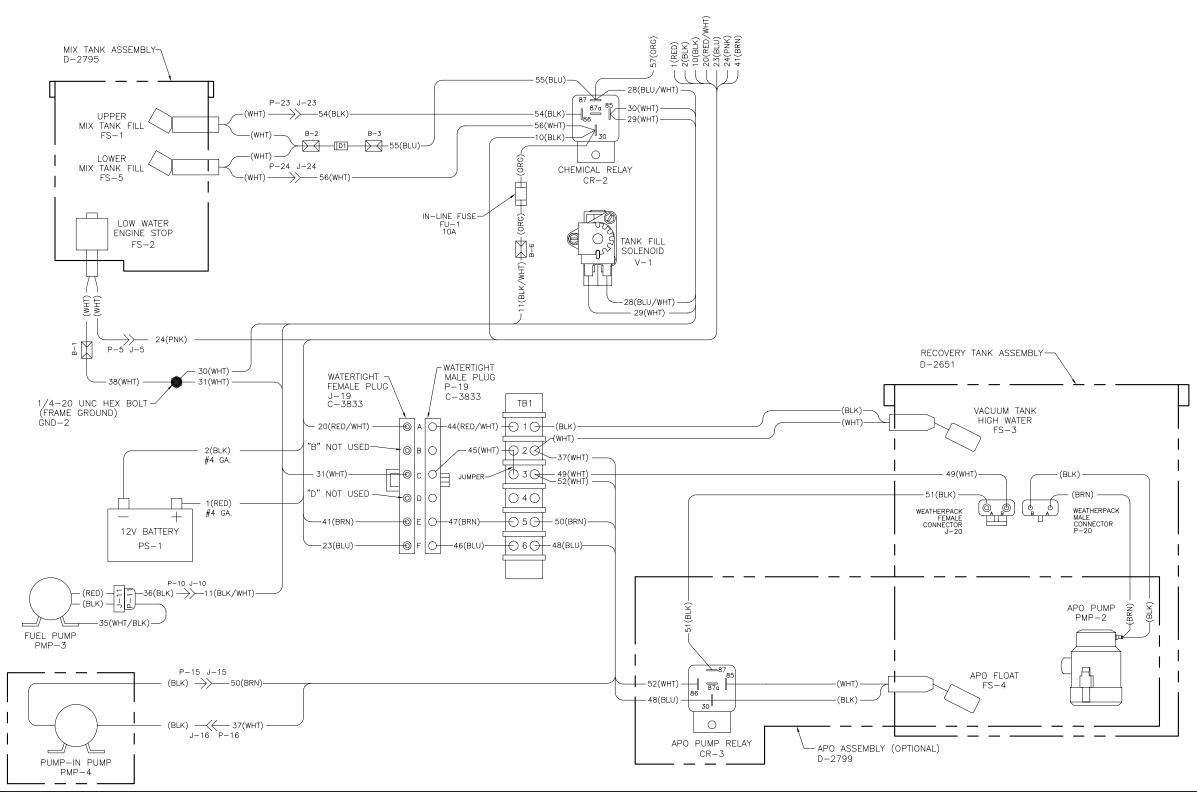


Figure 10-3 Wiring Diagram

D-2936 Sht 3 Rev O



Electrical Troubleshooting

SpitFire 3.2 Section 10-5

No	Problem / Possible Cause	Solution
1	The engine is not charging the battery.	
1.1	The <i>regulator/rectifier</i> 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 <i>stator</i> 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 descaling 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.

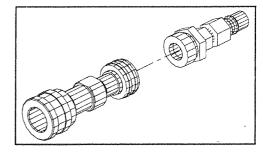
To de-scale your system, add an appropriate de-scaler chemical to your mix tank. Circulate it through the heating system. Let it stand. Flush and repeat as necessary. Clean all screens and strainers, and check them frequently following de-scaling.

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.

	SPITFIRI	E 3.2 N	IAINTEI	NANCE	LOG			
MAX HRS	DAILY SERVICE	OIL RECOMMENDATIONS						
8	ENGINE OIL check	BLOWER 40 weight non-detergent						
8	PUMP OIL check	PUMP	5 - 30 weigh	nt synthetic mo	otor oil			
8	GARDEN HOSE SCREEN clean	ENGINE	30 weight m	notor oil				
8	MACHINE general inspection	30 weight motor oil						
8	VAC TANK FILTER BAG clean		NOTE: Over	rhead valve en	gines can use	multi-viscosity	oil, but will ex	perience
8	BLOWER INLET spray with lubricant		increased oil	consumption.				
	WEEKLY SERVICE			DA	TE & HOU	JRS		
See Note	OIL change with filter		Note: Break	-in period dete	ermined by mar	nufacturer. Re	ference 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

- 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.

GOLDEN GUARANTEE® LIMITED WARRANTY PLAN from HYDRAMASTER

HydraMaster machine owners enjoy the most comprehensive warranty protection available in the truckmount industry. All components, large or small are included in the Warranty Plan, providing the owner with real warranty coverage against any part failure, large or small.

Our machines are designed with a richness of detail and with many labor-saving features. The elegant simplicity of our design will always outperform more complicated equipment in the long haul. While HydraMaster equipment is extremely reliable and we endeavor to use only top quality components, if a malfunction should occur you'll see why they call HydraMaster "Customer Friendly". We look forward to having you as a member of HydraMaster's family of satisfied machine owners.

GOLDEN GUARANTEE® LIMITED WARRANTY PLAN

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

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

HydraMaster agrees, at its option, to repair at the point of shipment, or to replace without charge any parts or parts of products of HydraMaster's manufacture, which within the specified warranty period shall be proved to HydraMaster's satisfaction to have been defective when shipped, provided the purchaser promptly notifies HydraMaster, in writing, of such alleged defect. HydraMaster will pay all freight and transportation charges within the United States, via normal ground shipping means, for replacement of parts covered under this warranty.

This warranty covers parts, as specified, and does not cover labor which may be necessary in completing repairs. HydraMaster's liability to Purchaser, whether in contract or in tort arising out of warranties, representation, instructions, or defects from any cause shall be limited to repairing or replacing the defective part or parts using new or remanufactured parts. To qualify for warranty coverage, defective parts must be returned to HydraMaster within 30 days. No liability whatsoever shall attach to HydraMaster until said products have been paid for.

Except as stated in this section and in the proceeding section and except as to title, there are no guarantees or warranties of merchantability, fitness, performance or otherwise, express, implied or statutory, and HydraMaster shall have no liability for consequential, incidental, or other damages, howsoever caused, including but not limited to; lost business, downtime, and/or lodging. Parts supplied under this warranty will themselves be warranted only for the remaining time left in the original warranty period.

All components not specifically referenced in the schedule below are covered under this warranty for a period of one year, excepting those parts which are considered, by HydraMaster, to be expendable in normal use, including but not limited to; paint, labels and other cosmetic parts or features.

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

Deposits and/or build-up in the water, chemical, recovery or heating systems due to hardness in the water used or chemicals which results in deposits, will VOID all warranties on affected components.

The use or application of any chemical, including but not limited to; acids or solvents, which results in damage to metal, rubber, plastic, or painted parts will VOID all warranties on those parts.

FRAME, COVER ASSEMBLIES	
VACUUM RECOVERY TANK	3 years
ENGINEAs provided by original Manufacture	
VACUUM BLOWER (Uncontested through Tuthill)	2 years
BUCS™ COUPLER SYSTEM (Boxxer 427)	2 years
CHEMICAL SYSTEMS	1 year
CLEANING WAND	1 year
INTERNAL MACHINE HOSES	1 year
HIGH PRESSURE BY-PASS VALVE	1 year
EXTERNAL MACHINE HOSES	1 year
BELTS, FITTINGS, FILTER SCREENS, GAUGES	1 year
WATER HEATING SYSTEM	1 year
WATER PRESSURE PUMP (Through original Manufacturer.)	1 year
ELECTRICAL COMPONENTS	1 year

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

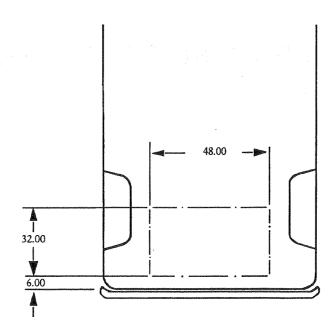
TO: All HydraMaster Distributors DATE: 14 Jun 1994

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
3.7 Briggs and Stratton	111-001 Square	below the carburetor.
4.2 Honda	111-045 Round	
4.2 Kawasaki	111-002 Round	Mount 32 to 48 inches below the carburetor.
4.7 Onan	111-045 Round	

Corporation

6323 204th Street SW, Lynnwood, WA 98036

PRODUCT SUPPORT BULLETIN

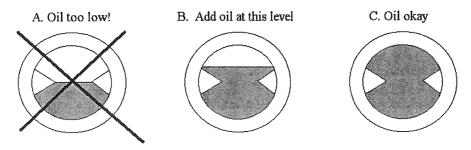
TO: SpitFire 3.2 Owners DATE: 14 Nov 1996

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