

CTS 330 Hot Carbonating Truckmount System™

Manufactured Exclusively for
By



Mukilteo, Washington

Machine Serial Number _____

HydraMaster
11015 47th Avenue West
Mukilteo, Washington 98275

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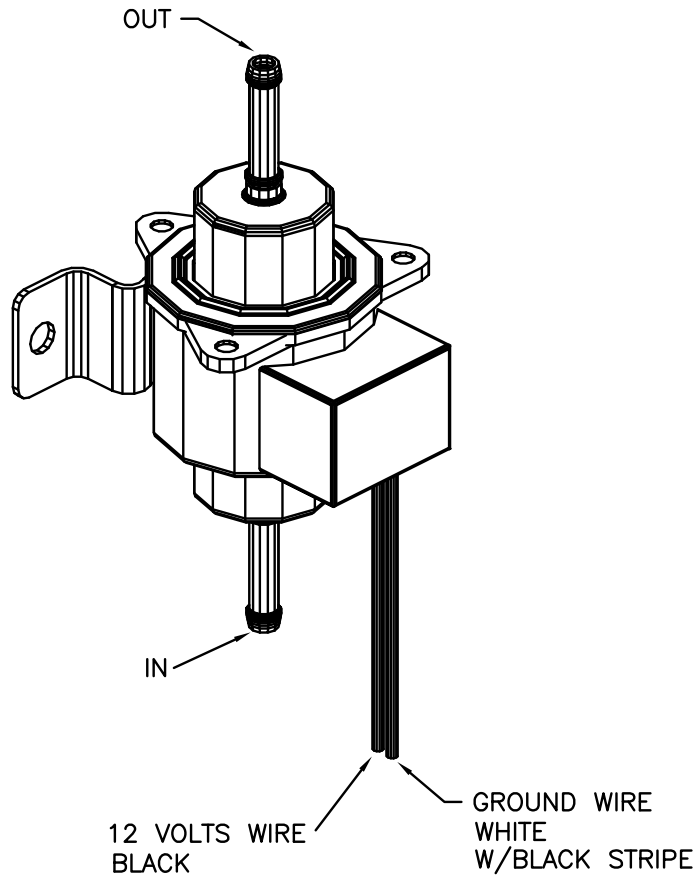
Reference Information

Included with this manual are the following:

- o Blower Owner's Manual
- o Engine Owner's Manual
- o Compressor Owner's Manual

Quick Reference

Fuel Pump Assembly
B4627



General Information

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

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

- The engine has to run at a consistent rpm.
- The vacuum has to pull air and dirty water back from cleaning site.
- The solution system provides stable pressure at proper water flow for cleaning.
- The heating system must maintain proper heat.
- The vacuum tank must store dirty water until drained.

As you can see, this machine is not just a simple turn-key operation where your only worry is “**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.

Telephone Numbers

CTS Installer: _____	_____
HydraMaster/ChemDry Tech Support	(877) 282-2319
HydraMaster Customer Service	(800) 426-1301
Harris Research, Inc. Tech Support	(435) 755-0255

Hours

HydraMaster	Monday-Friday 6:00 am to 5:00 pm Pacific Standard Time
Harris Research, Inc.	Monday-Friday 8:00 am to 5:00 pm Mountain Standard Time

Precautions

 **CAUTION**

1. Engine Cooling

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

 **CAUTION**

2. Level Operation

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

 **WARNING**

3. Moving Parts

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

 **CAUTION**

4. Freeze Protection

There is often little warning before a cold spell. Failure to protect 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.

 **WARNING**

5. Exhaust System

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

 **WARNING**

6. Hot Surfaces

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

WARNING

7. Hearing Protection

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

WARNING

8. Carbon Monoxide

This unit generates toxic fumes. Position the vehicle so that the fumes will be directed away from the job site. Do not park where exhaust fumes can enter a building through open doors, windows, air conditioning units, or kitchen fans.

WARNING

9. Toxic Fumes

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

WARNING

10. Engine Exhaust

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

WARNING

11. Carburetor Drain

Under no circumstances should the drain in the carburetor bowl be used when the machine is hot.

WARNING

12. Portable Gas Tank

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

WARNING

13. 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 Harris Research Inc. and by federal and state regulations.

 **WARNING**

14. Vacuum System

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 over loading and damaging itself, there is a vacuum relief system installed on the vacuum tank. When the vacuum tank inlet is completely sealed off, a maximum of 12 inches 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 this operation is not performed daily the vacuum blower will develop rust deposits from moisture and will decrease the life of the vacuum blower.

 **CAUTION**

15. Vacuum Tank

Foam passing through the blower could lead to equipment malfunction. Therefore, it is important to keep the vacuum tank foam free.

 **WARNING**

16. Vacuum Hose

Do not leave the vacuum hose unattended during operation. This could cause bodily injury.

Responsibilities

The **Purchaser's** responsibilities are:

Reading of Owner's Manual: It is the purchaser's responsibility to read the unit operation manual and to familiarize himself with the information contained therein. *Special attention should be paid to all **Cautions and Warnings**.*

Prior to arrival of unit, install exterior plywood flooring in the vehicle and we suggest sealing with a sealer.

Purchase a heavy duty group 24 - 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.

The **Equipment Installer** responsibilities are:

ACCEPTANCE OF SHIPMENT:

1. If the unit shows any outward signs of damage, do not sign the delivery receipt until you have closely inspected the unit and noted any damage on the delivery receipt.
2. The equipment installer is responsible for the correct installation of the unit in your vehicle and thoroughly training you in its operation, maintenance and precautions.

Correct Installation Includes:

- Installation of through-floor fittings for gasoline fuel lines.
- Placing the unit and recovery tank in your vehicle and securing them with bolts or tie down cleats.
- Install and connect the fuel pump.
- Connecting gasoline lines.
- Connecting the battery.
- Checking the vacuum blower and engine oil levels prior to starting the unit.
- Starting the unit to check engine and see that all systems function normally.
- Checking all hoses, wands, etc. for correct operation.

Note: Under certain circumstances, machines may require modification for optimal performance. Certain environmental conditions may require engine modification or control function calibration.

Training Shall Include:

- A thorough review of the operation manual with purchaser.
- A thorough review of the unit warranty and warranty procedures.
- Instruction and familiarization in:
 1. How to correctly start up and shut down the unit.
 2. How to correctly clean with the unit.
 3. Where and how often to check and change component oil levels.
 4. How the unit's systems work.
 5. How to troubleshoot the unit.
 6. How to do basic repairs.
 7. Safety precautions and their importance.
 8. Freezing damage and how to avoid it.
 9. Cleaning the orifices and how they function in the system.

Vehicle Preparation

When selecting a truck, remember the preferable vehicle for a CTS 330 installation is a cargo van with a heavy-duty suspension package and a half ton capacity. If a fresh water tank is added, a three quarter ton or larger capacity van, with a 2,400 pound payload capacity, is required.

TRUCK PREPARATION

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

CAUTION

Be cautious when drilling any holes through the van floor. Many vans have critical components mounted directly below the van floor that could be damaged by a misplaced drill bit. (See Product Support Bulletins 92101, 94062, and 94063 at the end of this manual.)

This provides 'metal to cushion' mounting rather than 'metal to metal' and makes for an attractive van interior. It is highly recommended to install roof vents in vehicles operated in hot weather locations. Roof vent positions are shown in Figure 1-1.

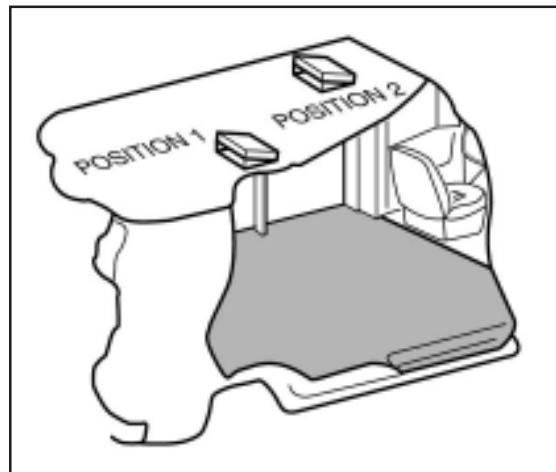


Figure 1-1 Roof Vent

PLACEMENT OF UNIT IN VEHICLE

There are two recommended unit placements:

SIDE DOOR:

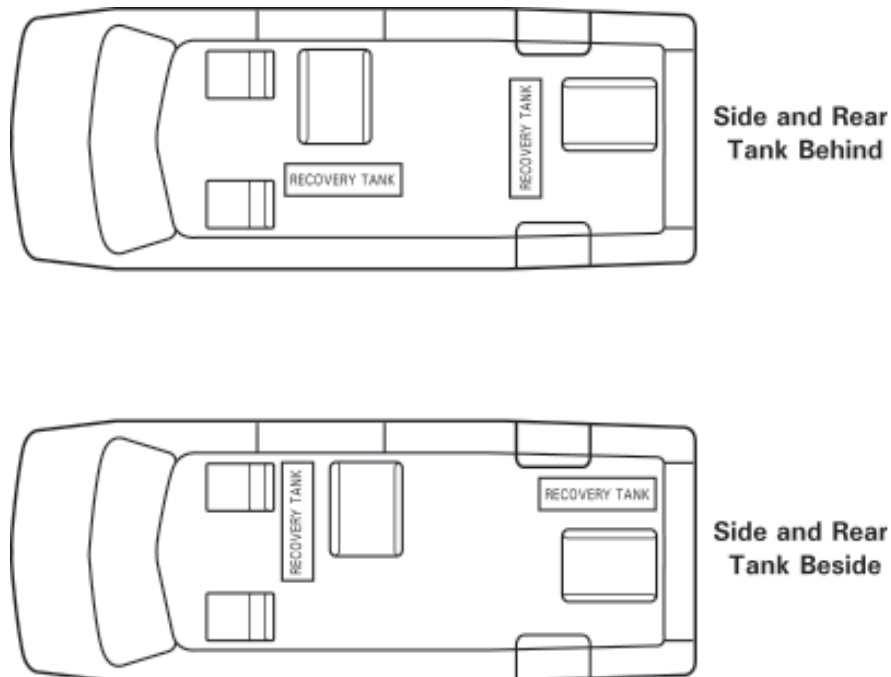
Most installations are side door. This provides rear access for accessories and hoses as well as unobstructed access to the component/working side of the machine, thus making it a bit easier to perform maintenance and/or repair without removing the unit from the truck.

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 (See **Figure 1-4**). This safety measure will ensure that the machine will not slide inside the van. See the following illustration for the correct installation.

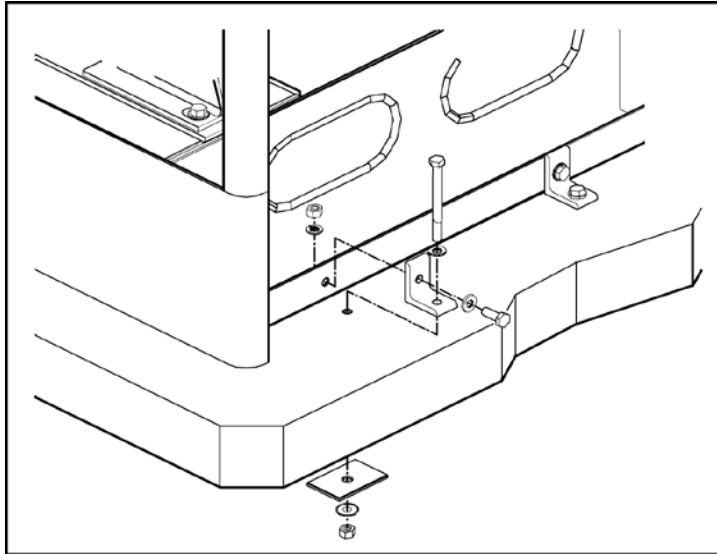


Figure 1-4 Installation Using Tie-down Cleats

WARNING

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

WARNING

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

The manufacturer also recommends the installation of 12 volt powered vents in the truck roof to allow heat to escape.

WARNING

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

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

 **WARNING**

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

 **WARNING**

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

 **WARNING**

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

 **WARNING**

If the battery location is at your option, first make sure it is in an approved battery container and that it is covered and secured to the floor of the vehicle. Make sure the battery is isolated from hot machine components. This will cause the battery to last longer and also prevent the possibility of fire or explosion.

High Altitude Operation Preparation

To have your machine run at it's peak performance; you may have to make adjustments depending on the elevation. Elevation plays a key role in how the machine will operate.

The factory setting of the machine is set for elevations from 0—3,000 feet. Any time the machine is operated above 3,000 feet there are two areas on the machine the *may* need adjustment.

The first area is the carburetor jet. The higher the elevation, the less air is provided to the fuel mixture. This will make the engine run 'rich', and, in turn will result in the loss of power, excessive heat in the exhaust, and carbon buildup in the exhaust and heat exchanger system. The jet sizes vary per engine and elevation. Consult HydraMaster to obtain proper jet size.

The second area that may need adjustment is the heat control system. The heat control system is also optimized to 0-3,000 feet. At higher altitudes the boiling point of water is lowered. In turn, this can cause the water box to boil and the high pressure pump to cavitate. The heat control system settings will have to be adjusted to compensate for the elevation. These settings will vary according to elevation. Contact HydraMaster to obtain the recommended settings.

Local Water Precautions

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.



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 hard water map on page 1-15 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, and the appearance of cleaned carpets enhanced when water softeners are incorporated in hard water areas. The manufacturer strongly urges the use of a water softener units in areas exceeding 32 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.

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.

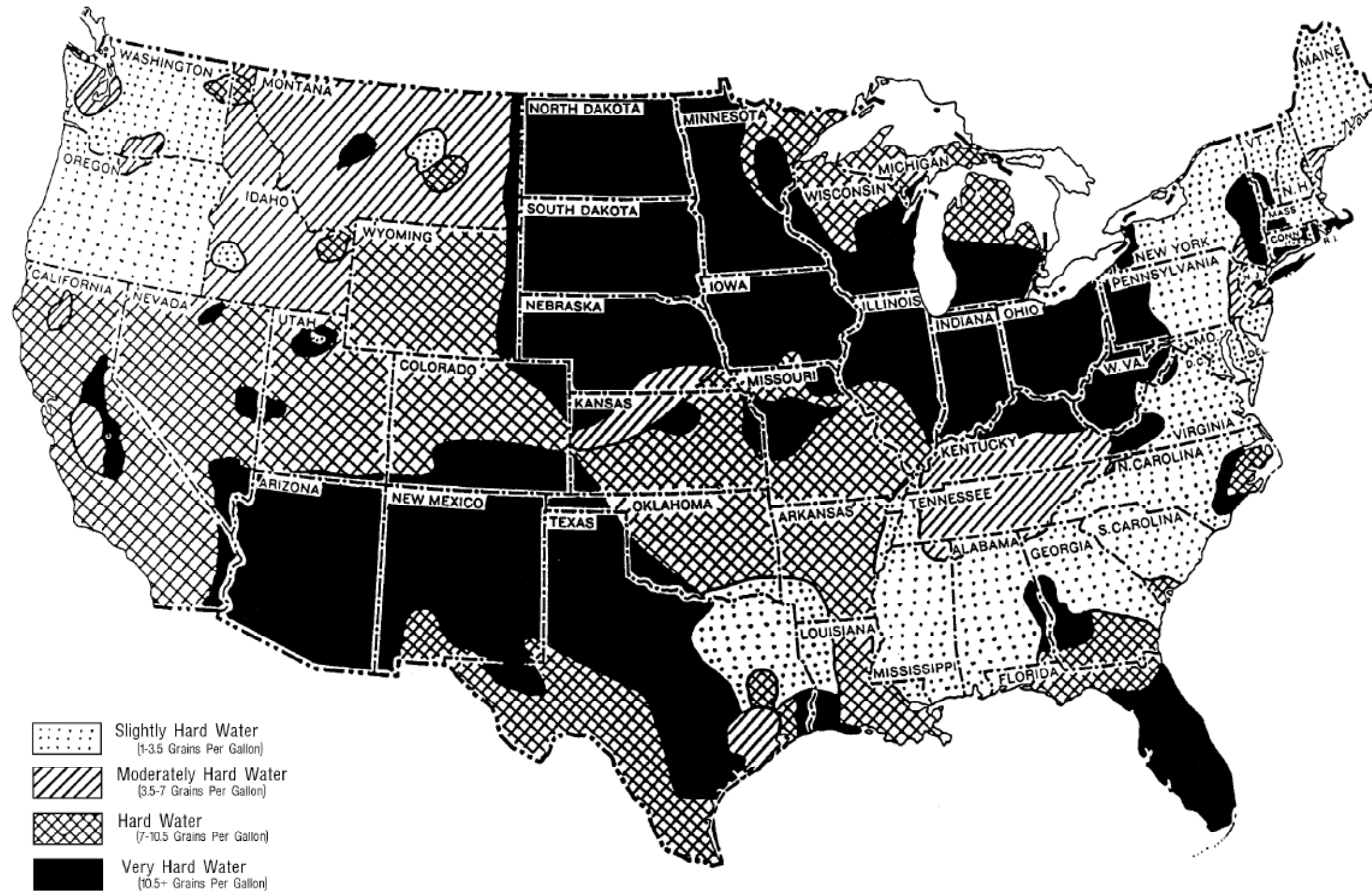
In most cases, an acceptable method of waste water disposal is to discharge into a municipal sewage treatment system after first filtering out solid material such as carpet fiber. Access to the sanitary system can be obtained through a toilet, laundry drain, RV dump, etc. Permission should first be obtained 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 the machine with an Automatic Pump-Out System. These systems are designed to remove waste water from the extractor's recovery system and actively pump the water through hoses to a suitable disposal drain. Properly designed, they will continuously monitor the level of waste water and pump it out simultaneously to the cleaning operation. The hidden benefit of this process is that the technician does not have to stop his cleaning to empty the recovery tank.

HydraMaster makes an A.P.O. System available which can be ordered with new equipment or installed later.

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

Figure 1-4 Hard Water Map



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

Machine Specifications

Frame: 23"W x 31"L x 22"H

Weight: 385 lbs.

Engine: Vanguard 16 HP Briggs & Stratton
Pressurized oil system
Spin-on oil filter
12 v electric starter motor
12 v, 16 amp alternator, regulated

Air Compressor: Thomas clutch driven

Vacuum Blower: Tuthill, 3003 Competitor Plus

Solution System: Dual high pressure tank compressed air fed

Heating System: Stainless steel cross flow exhaust heat exchanger

Drive System: Direct coupling rubber

Instruments and Controls: Vacuum level gauge, 0-30" Hg
Hour meter, machine run time
Keyed ignition
Mechanical throttle
Recovery tank drain valve
Manual engine choke
Blower lubrication port

Recovery Tank: 50 gallon aluminum, epoxy finish

High Pressure Hose: 3/16" high temperature, lined, vinyl covered
Hose rated to 2200 psi, 250° F.

Vacuum Hose: 2" reinforced

Standard Equipment: Machine power console
Full instrumentation
Thomas air compressor
Tuthill Competitor Plus™ Vacuum Blower
Stainless steel water heating package
Vacuum recovery tank
(1) fifteen gallon stainless steel solution tank with holder
100 ft, 2" vacuum hose
100 ft, 3/16" solution line
10 ft, 1½" recovery drain line
Battery box
Van installation kit

Machine Layout

Recovery Tank – Holding tank for solution recovered from the carpet

Throttle Control – Controls the speeds of the engine.

Cleaning Mode Switch – Selects between carpet and extraction modes.

Choke – Pull style cable for cold starts (located behind the dash).

Compressor Valve – Allow compressed air to be purged from the system.

Solution Valve – Allows priming of the high temperature solution to be purged from the system.

Solution Outlet – Hook up for the 3/16" solution hose.

Lube Port – Allows the blower to be lubricated.

Vac. Hose Hook Up – Hook up for the 2" vacuum hose.

Dump Valve – Allows the recovery tank to be dumped manually into a treated sanitary system (i.e. toilet).

Ignition Switch – Main power control to the machine.

Vacuum Gauge – Displays engine temp, solution temp (older versions), and vacuum.

Heat Mode Light – Shows if the diverter is in heat mode.

Exhaust Out – Engine and blower exhaust outlet.



Component Descriptions

The engine produces the power required to operate the vacuum pump and air compressor (**Figure 2-1**).

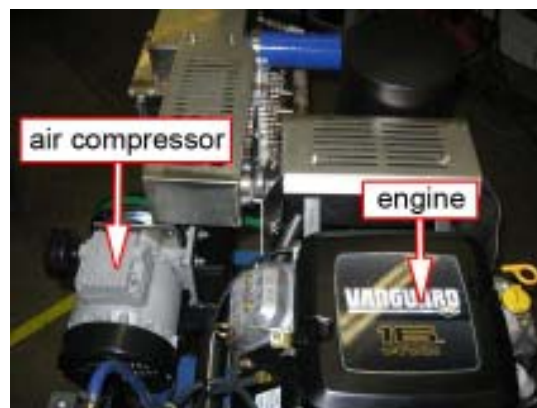


Figure 2-1

The vacuum pump is driven through the direct coupler by the engine (**Figure 2-2**).

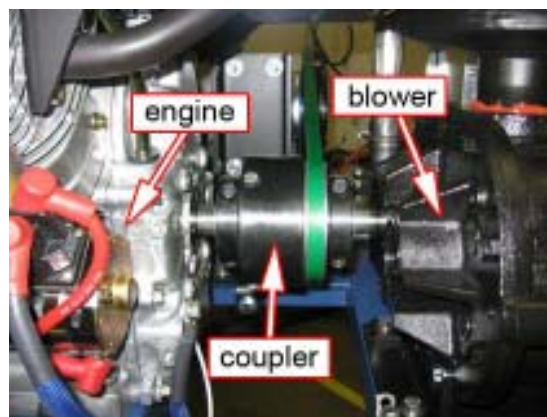


Figure 2-2

The air compressor is driven by a V-belt located between the blower and engine (**Figure 2-3**).

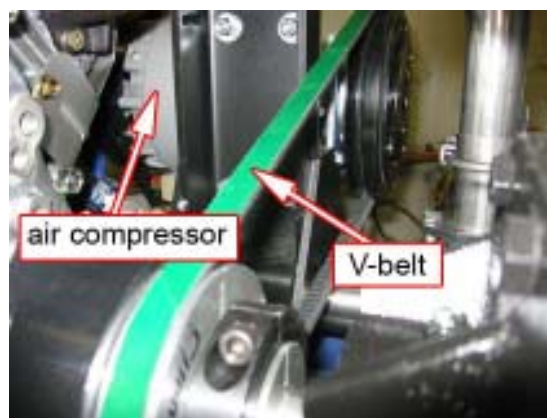


Figure 2-3

Operating Instructions

WARNING

Do not jump start machine! Damage may occur to Electrical System!

Start Up

1. Perform daily and periodic maintenance as specified in this Owner's Manual.
2. Pull out choke knob (located behind the dash).
3. Move throttle lever to IDLE position.
4. Start engine.
5. Push in Choke knob.
6. Allow engine to warm up in the idle position for 3-5 minutes.
7. Move throttle lever to HIGH position (**Figure 3-1**).

Note: For optimal solution temperature, block off vacuum port for 5 minutes prior to cleaning.



Figure 3-1

WARNING

The machine cannot be run in the IDLE position for cleaning upholstery, carpet or flood extraction. This will void the warranty.

Carpet or Upholstery Cleaning

1. Fill solution tank with solution.
2. Position the Compressor Valve to CLEANING MODE.
3. Position the Solution Valve to CLEANING MODE.
4. Change Cleaning Mode switch to CARPET MODE.
This will engage the compressor clutch and put the temperature control on auto.
5. Connect the solution and vacuum hoses to the tool.
6. Commence cleaning.

Notes:

- The machine operates at a pressure of 100 - 120 psi.
- If the Solution Valve is left in the PRIME position, the solution will evacuate from the chemical tanks into the recovery tank.
- If the solution tanks run dry, air will fill the system. After the solution tanks have been filled, with solution, purging the air from the system may require several minutes. This can be expedited by turning the solution valve to prime for 15 seconds, then returning the valve to cleaning mode.

Flood Extraction

1. Position Solution Valve to PRIME mode (**Figure 3-2**).
2. Position Compressor Valve to PRESSURE RELIEF (**Figure 3-2**).
3. Set Cleaning Mode switch to EXTRACT ON mode.
4. Connect vacuum hoses and tool.
5. If equipped, switch Auto Pump Out to ON.
6. Disconnect out-going quick connects on chemical tanks.



Figure 3-2

Notes:

- The Compressor Valve **must be** positioned in the PRESSURE RELIEF during flood extraction. If the valve is left in the CLEANING MODE, this may cause damage to the air compressor and related components.
- The Solution Valve **must be** positioned in the PRIME mode during flood extraction. If the valve is left in the CLEANING MODE, the system may build up excessive pressure, which could cause damage to the machine.

Solution Fill Procedure

1. Position Compressor Valve to PRESSURE RELIEF.
2. Remove the lids from the solution tanks.
3. Disconnect hoses if necessary (**Figure 3-3**).
4. Fill solution tank with solution.
5. Replace the lids on the chemical tanks.
6. Reconnect hoses if necessary.
7. Position the Compressor Valve to CLEANING MODE.



Figure 3-3

Notes:

- Solution tank recharge time will vary depending on the level of the solution.

Shut Down

1. Set Compressor Valve to PRESSURE RELIEF.
2. Lube vacuum blower at blower port. (End of Day)
3. If in use, switch OFF Auto Pump –Out.
4. Disconnect all hoses.
5. Move throttle lever to IDLE mode.
6. Switch OFF ignition.
7. Drain and Flush recovery tank with clean water.
8. Remove and clean filter bag. (End of Day)

Safety Shut Down

This machine is equipped with two safety shutdowns.
This will alert you by shutting down the machine.

The two machine shutdowns are:

- 1. Machine Overheat**

This will activate when the machine solution temperature reaches 300° F.

- 2. Recovery Tank Full**

This will activate once the recovery tank has reached its full capacity.

General Operating Information

1. In accordance with state and local EPA laws, do not dispose of wastewater into gutters, storm drains, streams, reservoirs, etc. Dispose wastewater into a treated sanitary system.

Machine Maintenance

Engine

- Quick Reference List.
- Check air filter.
- Drain oil.
- Change oil filter.
- Fill oil.
- Remove and replace spark plugs.
- Set spark plug gap.
- Change fuel filter
- Visually check compressor belt.
- Tighten belt.
- Loosen belt.
- Check exhaust system (donut gaskets).

Engine Air Filter

1. Unlock the two clamps and remove cover (Figure 4-1).
2. Remove air filter cartridge.
3. Carefully clean out cartridge and foam element.
4. Reinstall air filter cartridge.
5. Install cover and lock clamps.



Figure 4-1

Note: Do not use pressurized air or solvents to clean cartridge and foam ring.

Engine Oil and Filter Change

Tools:

- 11/16 inch wrench
- 5/8 inch wrench
- Oil filter wrench

1. Remove oil drain cap from drain hose located on the right side of the engine (**Figure 4-2**). Do not reinstall cap until you begin filling the engine with oil (refer to step 4)
2. Remove oil filter located on the left side of the engine (**Figure 4-3**).



Figure 4-2



Figure 4-3

3. Apply oil to the new oil filter gasket. Install oil filter (HRI part # 049-014).
4. Remove the oil fill cap located on top of the valve cover.
5. Begin filling engine with 30W. After the oil begins to flow out of the oil drain fitting, re-install the cap. This will allow air to evacuate from the system and give accurate oil level readings. Engine oil capacity is approximately 1.75 quarts with filter.

WARNING

Failure to do this step will result in an insufficient amount of oil in the engine!

6. Check oil dipstick for proper level.
7. Re-install the oil fill cap.

Spark Plug Replacement

The spark plugs are located on each side of the engine.

Tools:

- 5/8 inch spark plug socket
- 0.030" feeler gauge

1. Unplug the wires from the spark plugs (**Figure 4-4**).
2. Remove the spark plugs with a 5/8" Socket.
3. Install the new plugs with a gap of 0.030".
Champion Part # RC12YC
HRI Part # 000-106-016
4. Re-install the spark plug wires.



Figure 4-4

Fuel Filter

The fuel filter is located underneath the van. It is between the fuel filler neck and the fuel through floor assembly (**Figure 4-5**).

Tools:

- 12 mm wrench

1. Loosen the hose clamps on either side of the filter.
2. Pull the hoses off of the filter.
3. Install the new filter. The filter has an arrow on it. The arrow should point towards the hose to the machine. HRI Part # 049-049
4. Tighten the hose clamps.



Figure 4-5

Blower

Quick Reference List:

- Check blower level.
- Drain oil.
- Fill oil.
- Lube blower.

Blower Oil Change

The vacuum blower has grease ports in the front and **one sight glass** for checking the oil level (**Figure 4-6**). The sight glass is located in the rear of the blower and can be viewed by looking at the right side on the rear case of the blower. The oil level should be checked **daily** to ensure that it reaches over half the sight glass.



Figure 4-6

Tools:

- 11/16 wrench
- 5/8 wrench
- Grease gun

1. Remove the oil drain cap, which is located on the oil drain hose on the side of the machine. (**Figure 4-7**).
2. Remove oil fill cap.
3. Fill the blower with 40W non-detergent oil. After oil begins to flow out of the oil drain fitting, re-install the caps. This will allow air to evacuate from the system and give accurate oil level reading.



Figure 4-7

Failure to do this step will result in an insufficient amount of oil in the blower will lead to damage or failure!

4. Re-install the oil fill plug.
5. Attach grease gun to zerks and pump grease into the blower until grease flows out of the weep holes.

Recovery Tank

Quick Reference List

- Remove and Clean Filter Bag
- Remove and Clean S/S Filter
- Remove and Clean APO Filters
- Clean APO Pump
- Remove and Clean S/S Floats
- Clean Vac Relief Box

1. Remove the filter bag and clean (**Figure 4-8**). **Perform this operation after every cleaning job.**

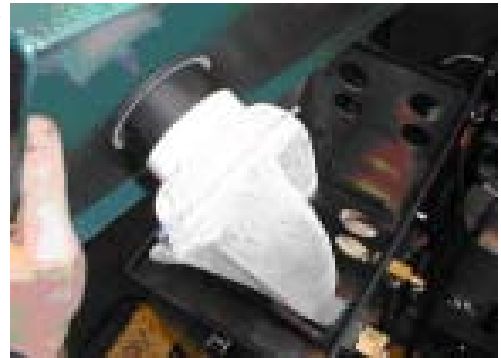


Figure 4-8

2. Remove stainless steel filter (**Figure 4-9**).
3. Clean the stainless steel filter of debris **daily**. This filter is connected to the vacuum blower. Failure to clean the filter daily will result in a loss of vacuum. This loss of vacuum will cause the blower to over heat.



Figure 4-9

4. Remove the stainless steel floats and clean (**Figure 4-10**).

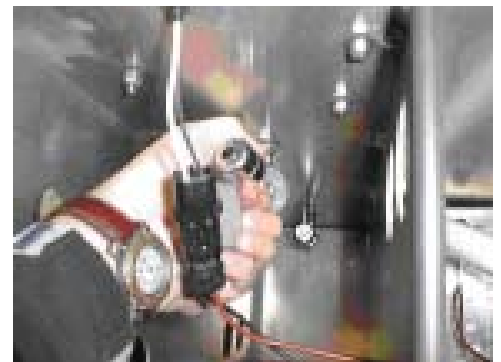


Figure 4-10

Recovery Tank (cont.)

5. Rinse out the recovery tank thoroughly. **Perform this operation daily.**
6. Clean vacuum relief box as necessary (**Figure 4-11**).
7. Replace all parts before starting up machine.

Solution System

Quick Reference List:

- Remove filters
- Clean filters
- Remove orifice
- Clean orifice
- Inspect manifold
- Rinse tanks



Figure 4-11

Orifice Quick Connect Assembly

The orifice assembly is located on the side of the solution tank bracket, in line with the outlet hose. The purpose of the orifice manifold is to control the amount of solution being used and to filter any debris from entering the system.

Tools:

- 3/32 Allen wrench

Orifice and Filter Maintenance

1. Position Compressor Valve to PRESSURE RELIEF.
2. Remove the filter by disconnecting the stainless steel quick connect (**Figure 4-12**).



WARNING

NEVER disconnect under pressure!



Figure 4-12

3. Clean the filters and orifices with fresh water or compressed air. **Perform this operation daily (Figure 4-13).**
4. Re-install filters and orifices (**Figure 4-14**).



Figure 4-13



Figure 4-14

Blower Heat Exchanger

The Blower Heat Exchanger should be inspected on an annual basis or anytime there are indications that it might be clogged. Symptoms could include reduced vacuum, reduced engine power, increased back pressure or overheating.

Inspect fins for debris, hair, carpet fibers, dirt, carbon buildup on the exhaust side. If required, have the heat exchanger core cleaned or professionally descaled.



Excessive exhaust back pressure can result in premature component failure.

General Maintenance

1. Inspect hoses.
2. Inspect wire connections.
3. Check nuts, belts, and hose clamps.

Freeze Guard Information

Your machine should be protected from freezing for any temperature below 35° F.



Water freezes at 32° F

Freeze Guard Procedure

1. Empty solution tank. Once they have been emptied reinstall the lid and all the hoses.
2. Turn the Solution Valve to the “Purge” position.
3. Turn the Air Valve to the “Cleaning Mode” position.
4. Run the machine for approximately 3 to 5 minutes.
5. Empty the recovery tank.

CTS 330 Hot Carbonating Truckmount System™

**CTS 330
GENERAL MAINTENANCE LOG**

MAX HRS	DAILY SERVICE	OIL RECOMMENDATIONS													
8	ENGINE OIL check	BLOWER	40 weight non-detergent												
8	MACHINE general inspection	ENGINE	30 weight motor oil												
8	RECOVERY TANK FILTER BAG clean		NOTE: Overhead valve engines can use multi-viscosity oil, but will experience increased oil consumption.												
8	RECOVERY TANK STAINLESS STEEL FILTER Clean														
8	BLOWER INLET spray with lubricant														
8	Empty Air Tank														
8	Clean ORIFICE FILTER														
8	ORIFICE inspect/clean														
	WEEKLY SERVICE	DATE & HOURS													
See	OIL change with filter									Note: Break-in period determined by manufacturer. Refer to engine					
25	BLOWER check oil level														
25	DRIVE SYSTEM tighten screws														
25	COMPRESSOR BELTS & PULLEYS check for wear <i>HRI Part # 000-010-122</i> <i>Gates Belt # HD9465</i>														
25	HIGH PRESSURE LINES check for chafing														
25	NUTS & BOLTS check tightness														
25	VACUUM RELIEF VALVE inspect, clean, lube														
25	VACUUM TANK clean & flush														
25	WIRING check for chafing														
25	FLOAT SWITCHES check for debris														
	MONTHLY SERVICE														
50	ENGINE OIL change														
100	ENGINE AIR CLEANER clean <i>HRI Part # 000-049-012</i>														
100	BATTERY WATER LEVELS check (if applicable)														
50	OIL FILTER change														
200	COMPRESSOR BELT check tension														
	QUARTERLY SERVICE (3 MONTHS)														
300	FUEL LINES check for wear														
300	SPARK PLUGS clean and gap <i>HRI Part # 000-106-016</i> <i>Champion Part # RC12YC</i>														
300	SOLUTION TANKS clean & flush														
400	BLOWER OIL change														
	YEARLY SERVICE														
1000	BLOWER HEAT EXCHANGER inspect fins for debris (hair, carpet fibers, dirt, carbon) on the exhaust side clean (as required)														
1000	TEMPERATURE CONTROL SENSOR clean														

Machine Assemblies and Parts Lists

Figure 5-1 Machine Assembly - Front Right View
D-6150 Rev C

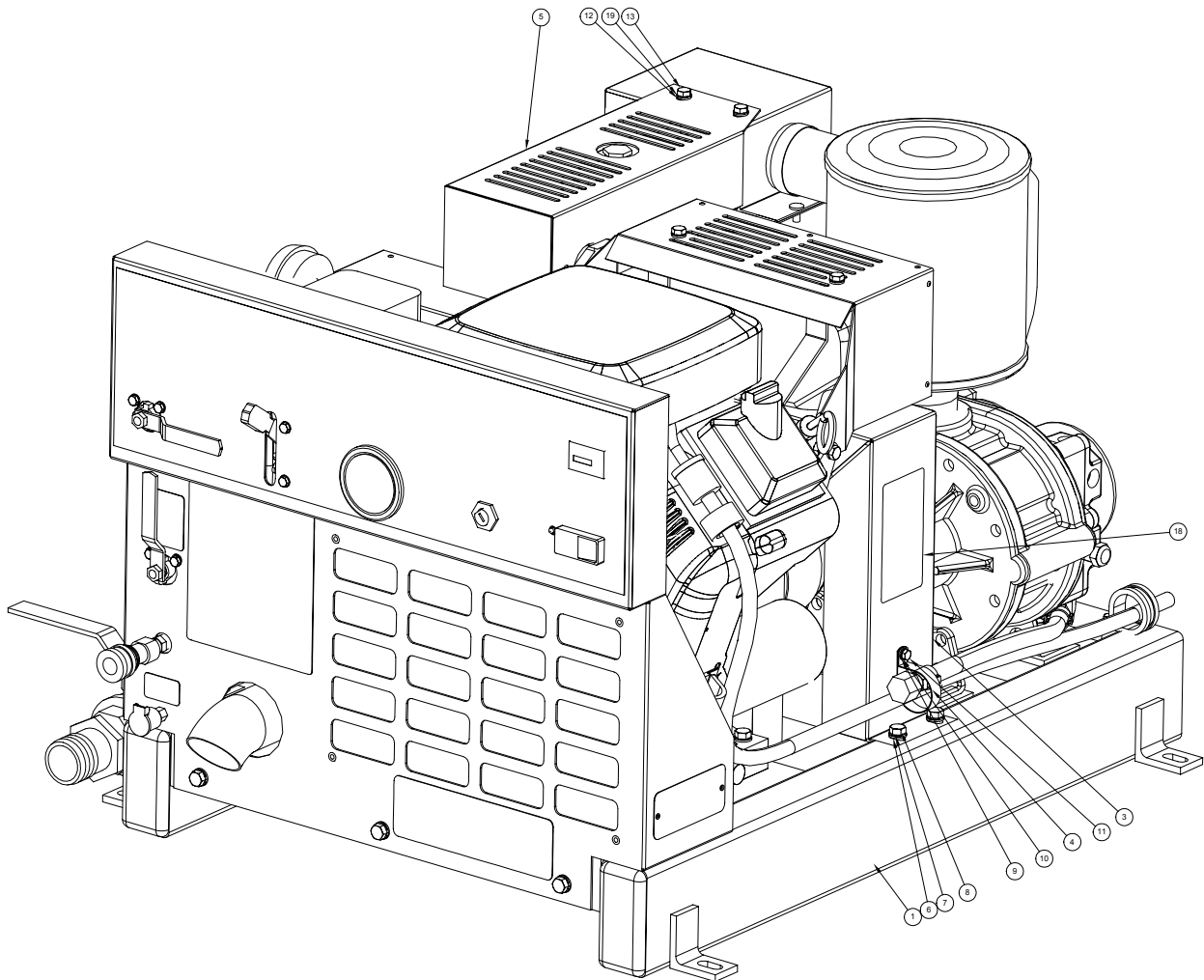


Figure 5-2 Machine Assembly - Front Left View
D-6150 Rev C

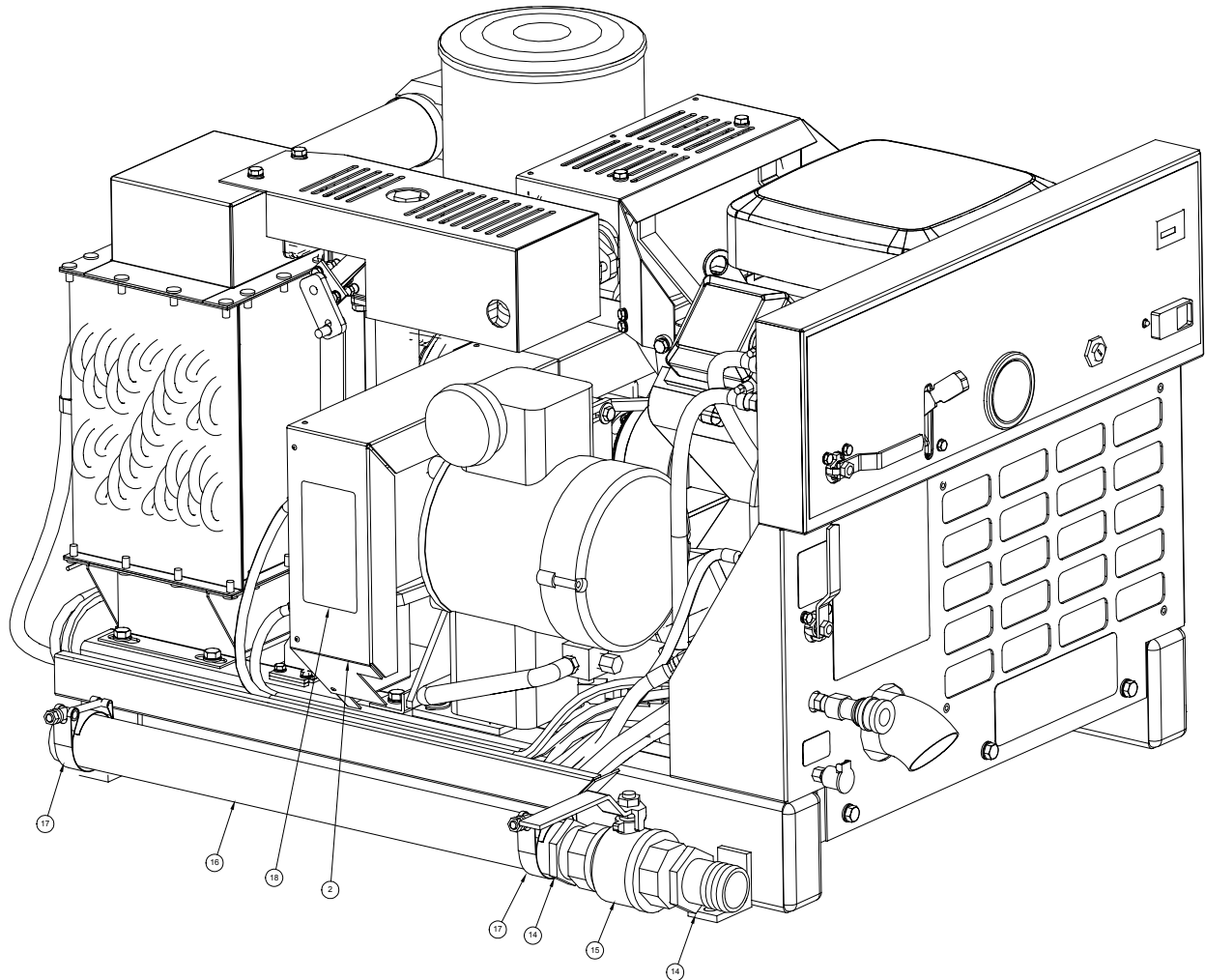
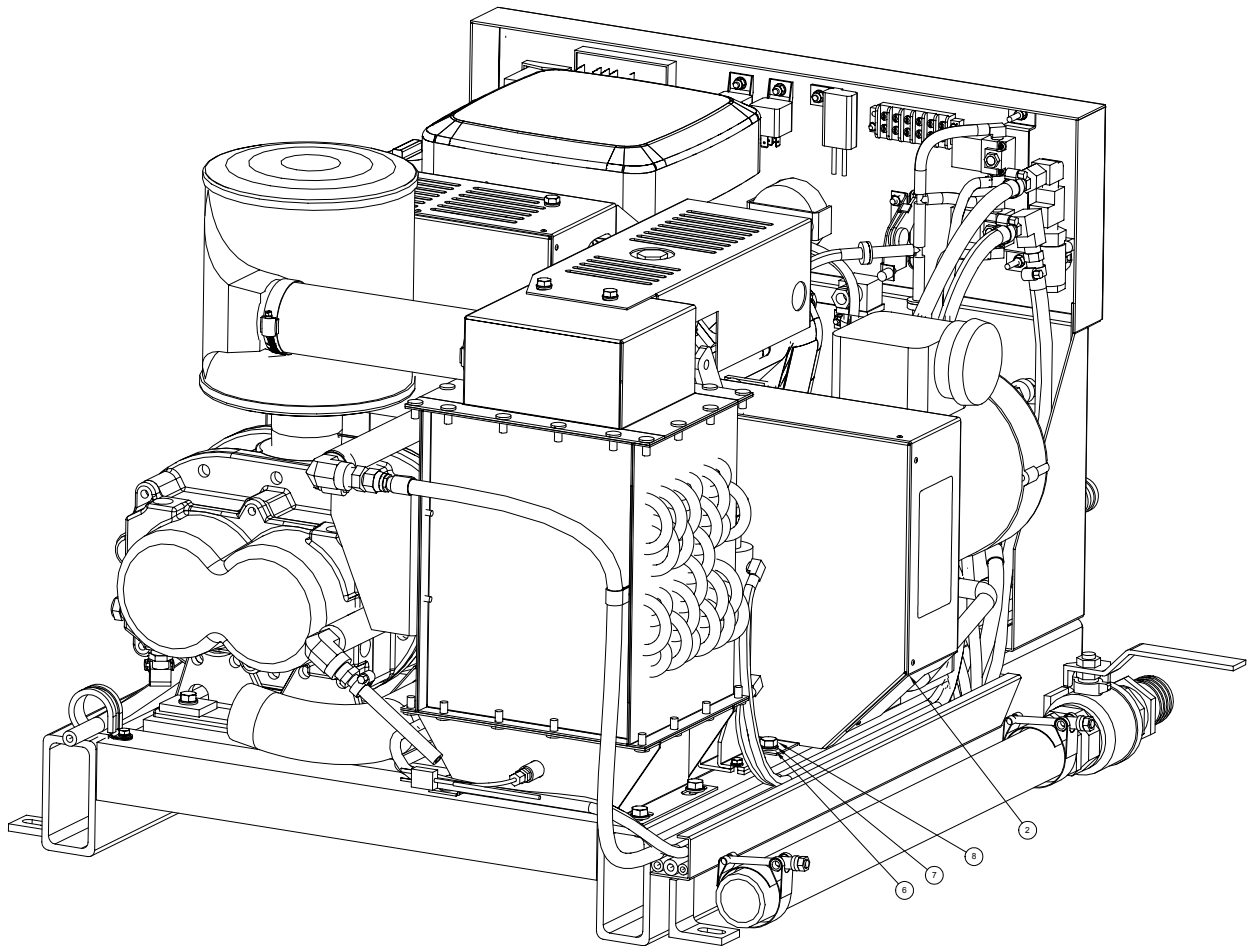


Figure 5-3 Machine Assembly - Rear View
D-6150 Rev C



Machine Assembly Parts List

Item	Part Number	Description	Qty
1	610-001-034	Assembly, Frame (Fig. 5-4 thru 5-6)	1
2	000-108-142	Protector, Belt Guard - Left Assembled	1
3	000-108-143	Protector, Belt Guard - Right	1
4	000-033-053	Clamp, 1-1/2" Cushion Loop	1
5	000-041-437	Cover, Exhaust - Weldment	1
6	000-174-049	Washer, 5/16" Flat	4
7	000-174-018	Washer, 5/16" Lock	4
8	000-143-011	Screw, Hhcs 5/16-18 x 1/2	4
9	000-174-001	Washer, #10 Flat	1
10	000-174-014	Washer, #10 Lock	1
11	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	1
12	000-174-003	Washer, 1/4" Flat	2
13	000-143-333	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head	2
14	000-052-226	Insert, 1-1/2" NPT x 1-1/2" Barb (Grey)	2
15	000-169-022	Valve, 1-1/2" Full Port Ball	1
16	000-068-135	Hose, Ø1.50" I.D. Red Stripe Type 55 - Bulk	1
17	000-033-063	Clamp, 1-1/2" T-Bolt	2
18	000-081-215	Label, Caution Rotating Equipment	2
19	000-174-019	Washer, 1/4" Lock	2

Figure 5-4 Frame Assembly - Front Left View
D-6151 Rev B

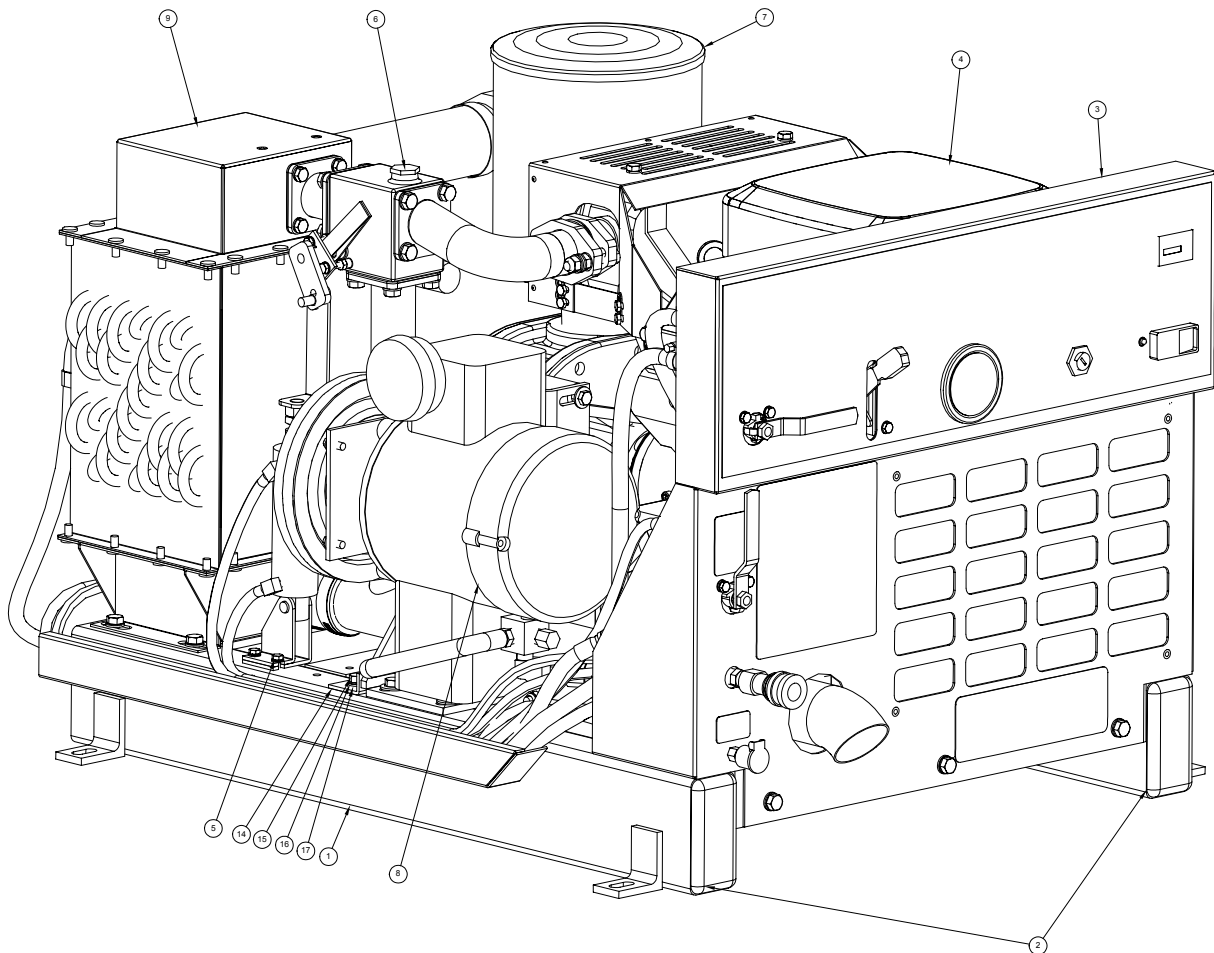


Figure 5-5 Frame Assembly - Front Right View
D-6151 Rev b

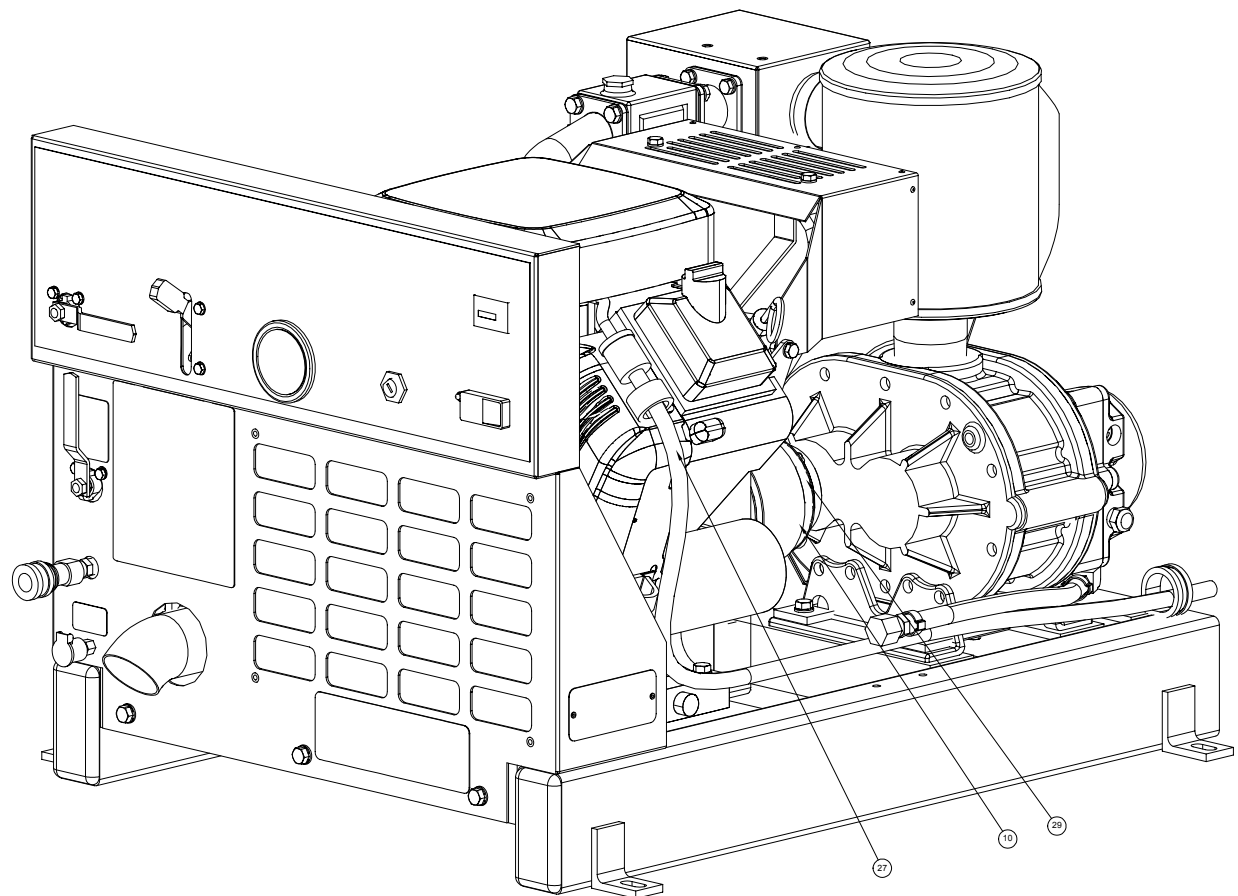
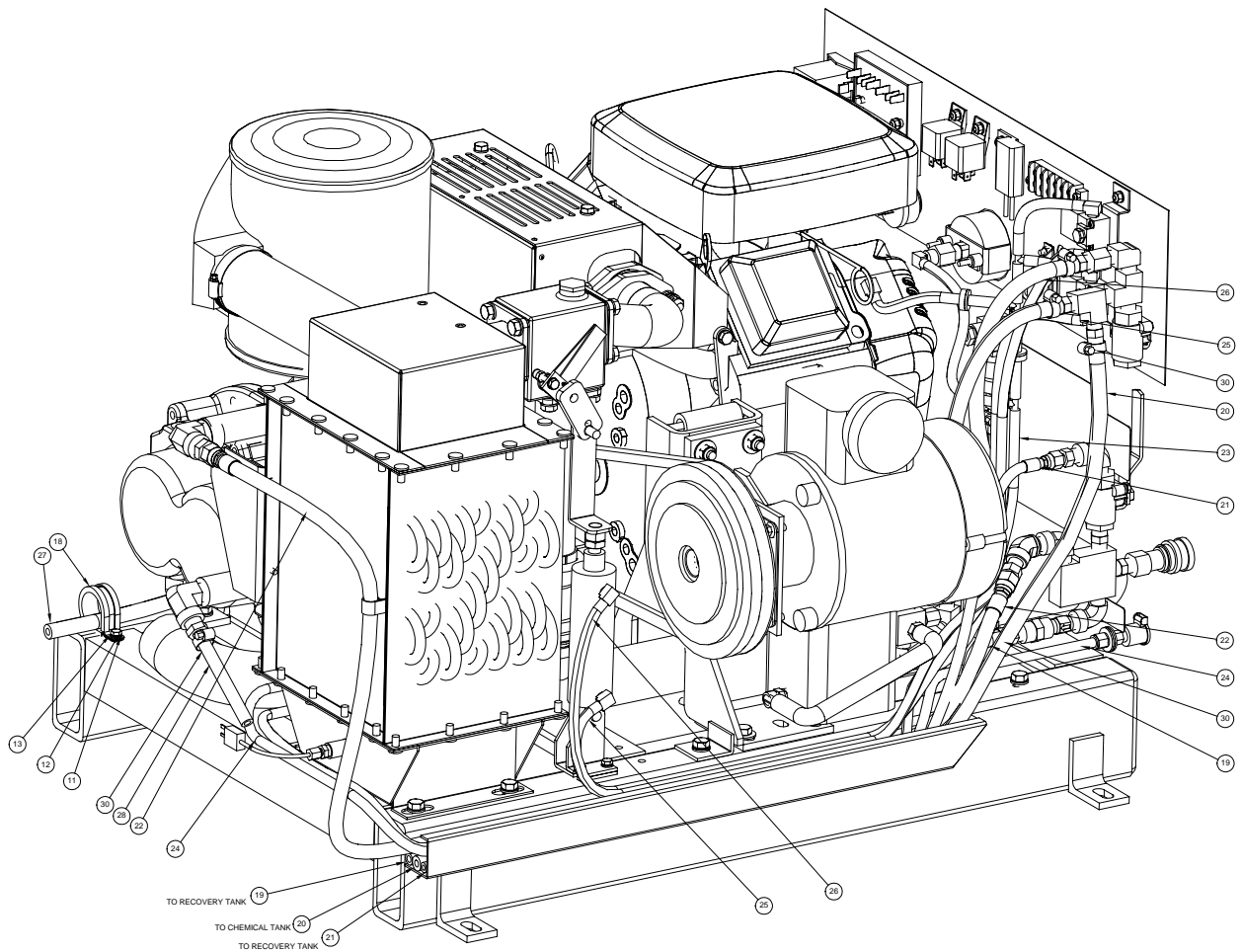


Figure 5-6 Frame Assembly - Rear View
D-6151 Rev B



Frame Assembly Parts List

Item	Part Number	Description	Qty
1	000-055-181	Frame, Welded	1
2	000-027-034	Cap, Frame End - Modified	2
3	610-018-034	Assembly, Dash (Fig. 5-7 thru 5-8)	1
4	610-003-034	Assembly, Engine 16 Hp Vanguard (Fig. 5-12 thru 5-13)	1
5	610-003-034	Assembly, Diverter Valve Actuator (Fig. 5-15)	1
6	610-003-034	Assembly, Exhaust (Fig. 5-14)	1
7	610-002-034	Assembly, Blower (Fig. 5-16 thru 5-17)	1
8	610-007-034	Assembly, Air Compressor (Fig. 5-18)	1
9	610-005-034	Assembly, Blower Heat Exchanger (Fig. 5-19)	1
10	000-039-054	Coupler, 40 Series	1
11	000-174-001	Washer, #10 Flat	1
12	000-174-014	Washer, #10 Lock	1
13	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	1
14	000-015-920	Bracket, Compressor Guide	1
15	000-143-012	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head	1
16	000-174-018	Washer, 5/16" Lock	1
17	000-174-049	Washer, 5/16" Flat	1
18	000-033-052	Clamp, 1-1/4" Cushion Loop	1
19	000-068-015	Hose, 1/4" I.D. Rubber - Bulk	1
20	000-068-131	Hose, 1/4" I.D. Hi Temp - Bulk	1
21	000-068-723	Hose, 3/16" I.D. x 775" Lg. Teflon w/ JIC Ends	1
22	000-068-758	Hose, 3/8" I.D. x 50" Lg. Teflon	1
23	000-068-030	Hose, 5/32" I.D. Vacuum - Bulk	1
24	000-068-030	Hose, 5/32" I.D. Vacuum - Bulk	1
25	000-068-030	Hose, 5/32" I.D. Vacuum - Bulk	1
26	000-068-030	Hose, 5/32" I.D. Vacuum - Bulk	1
27	000-068-660	Hose, 1/4" Fuel - Trident - Bulk	1
28	000-068-015	Hose, 1/4" I.D. Rubber - Bulk	1
29	000-010-122	Belt, Compressor	1
30	000-033-003	Clamp, Size #4 Mini	3

Figure 5-7 Dash Assembly - Front View
D-6152 Rev B

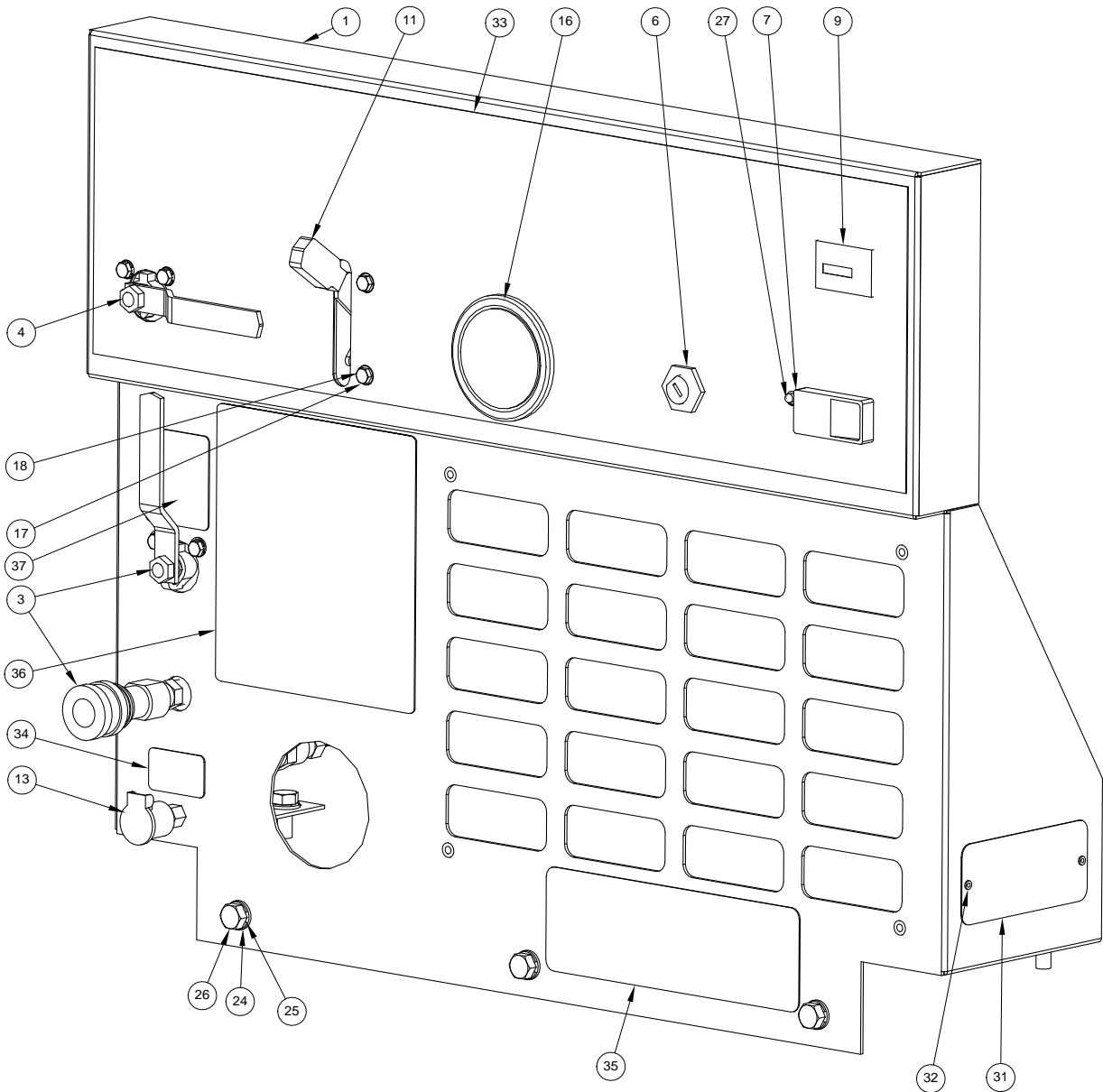
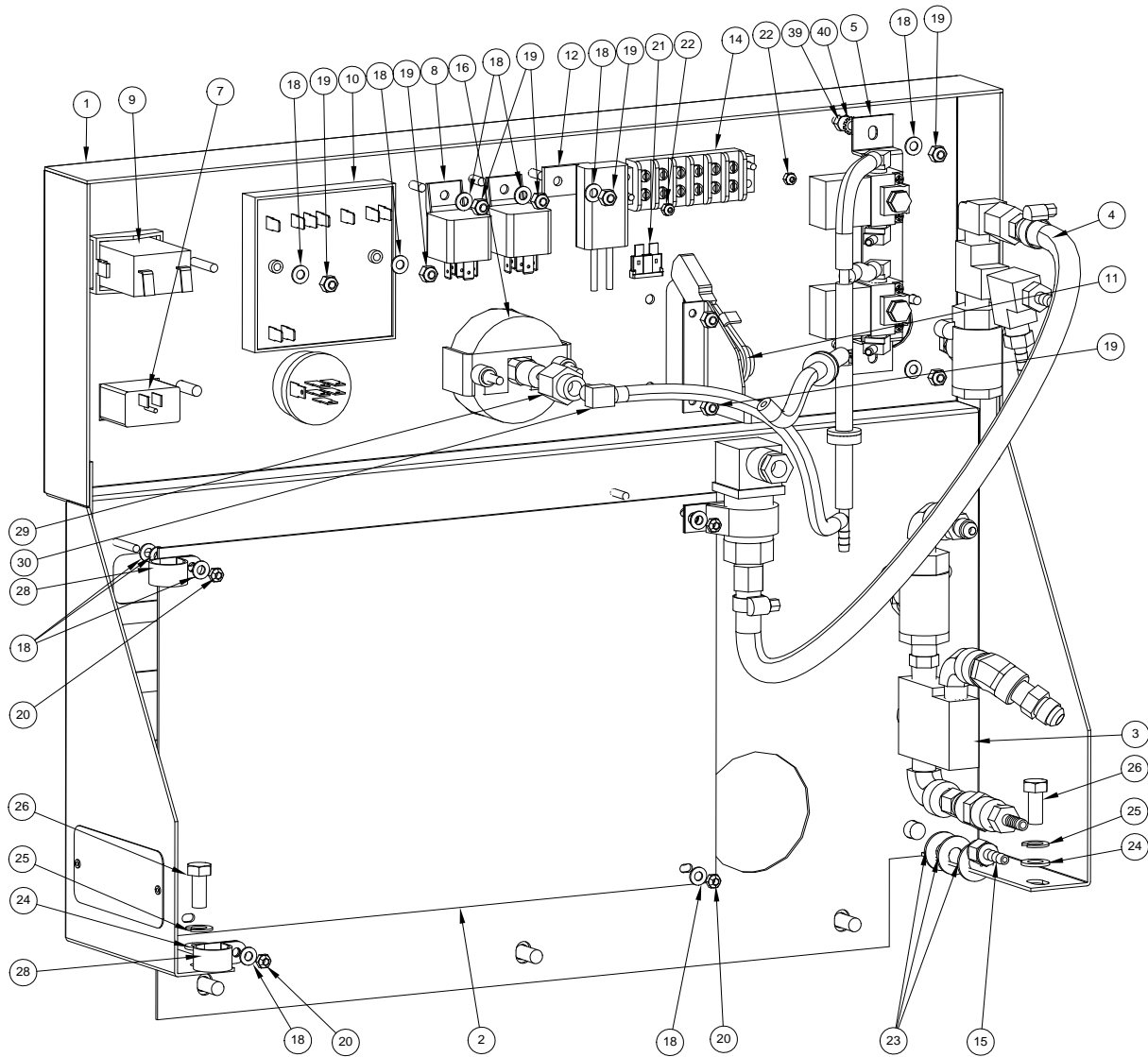


Figure 5-8 Dash Assembly - Rear View
D-6152 Rev B



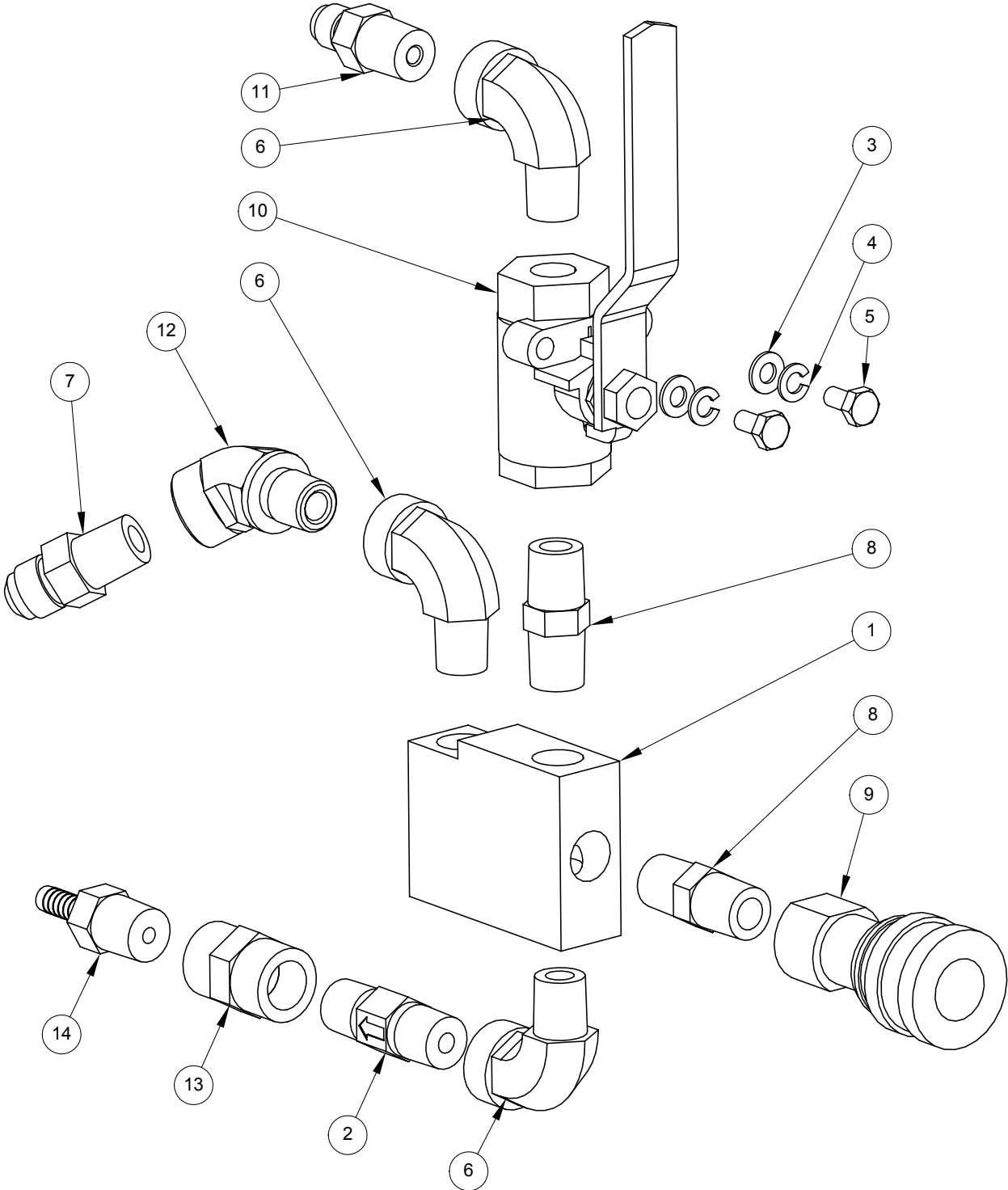
Dash Assembly Parts List

Item	Part Number	Description	Qty
1	000-100-160	Panel, Dash w/ Gussets	1
2	000-100-161	Panel, Perforated Grill	1
3	610-018-034	Assembly, Hi-PSI Manifold (Fig. 5-9)	1
4	610-018-034	Assembly, Purge Valve (Fig. 5-10)	1
5	610-018-034	Assembly, Vacuum Solenoid Valves (Fig. 5-11)	1
6	000-157-017	Switch, Ignition B&S 14 HP	1
7	000-157-040	Switch, 20 AMP Rocker	1
8	000-157-022	Switch, Relay	2
9	000-074-018	Meter, Rectangular w/o Bezel	1
10	000-074-126	Controller, Exhaust Sensing 'TC' Type Temperature	1
11	- - -	Throttle Box Modification	1
12	000-056-006	Fuse Holder, Inline Weather Proof	1
13	000-052-272	Cup, Gravity Feed Oil Blower Lubrication Port	1
14	000-012-002	Block, 6 Post Terminal	1
15	000-052-096	Insert, #F23 (1/8" FPT x 3/16" Barb)	1
16	000-074-025	Gauge, 0-30"Hg Vac. 2 1/2"	1
17	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	2
18	000-174-001	Washer, #10 Flat	21
19	000-094-034	Nut, #10-24UNC Nylock	9
20	000-094-059	Nut, #8-32UNF Nylock	4
21	000-056-011	Fuse, 30 AMP Plug In	1
22	000-094-063	Nut, #6-32UNC Nylock	2
23	000-174-032	Washer, 3/8" Flat	3
24	000-174-049	Washer, 5/16" Flat	5
25	000-174-018	Washer, 5/16" Lock	5
26	000-143-012	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head	5
27	000-084-011	Light, Red LED Indicator Mini	1
28	000-033-023	Clamp, 3/4" Nylon Hose	2
29	000-052-066	Coupler, 1/4" FPT x 1/8" FPT	1
30	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	1
31	000-105-012	Plate, Machine Serial I.D.	1

Dash Assembly Parts List

Item	Part Number	Description	Qty
32	000-140-001	Rivet, 1/8" x 1/4" Aluminum	2
33	000-081-243	Label, Dash	1
34	000-081-243	Label, Blower, Lube Port	1
35	000-081-243	Label, Engine Produces Toxic Gas	1
36	000-081-243	Label, Operating Instructions	1
37	000-081-215	Label, Solution Valve	1
38	000-033-057	Clamp, 1" Cushion Loop	1

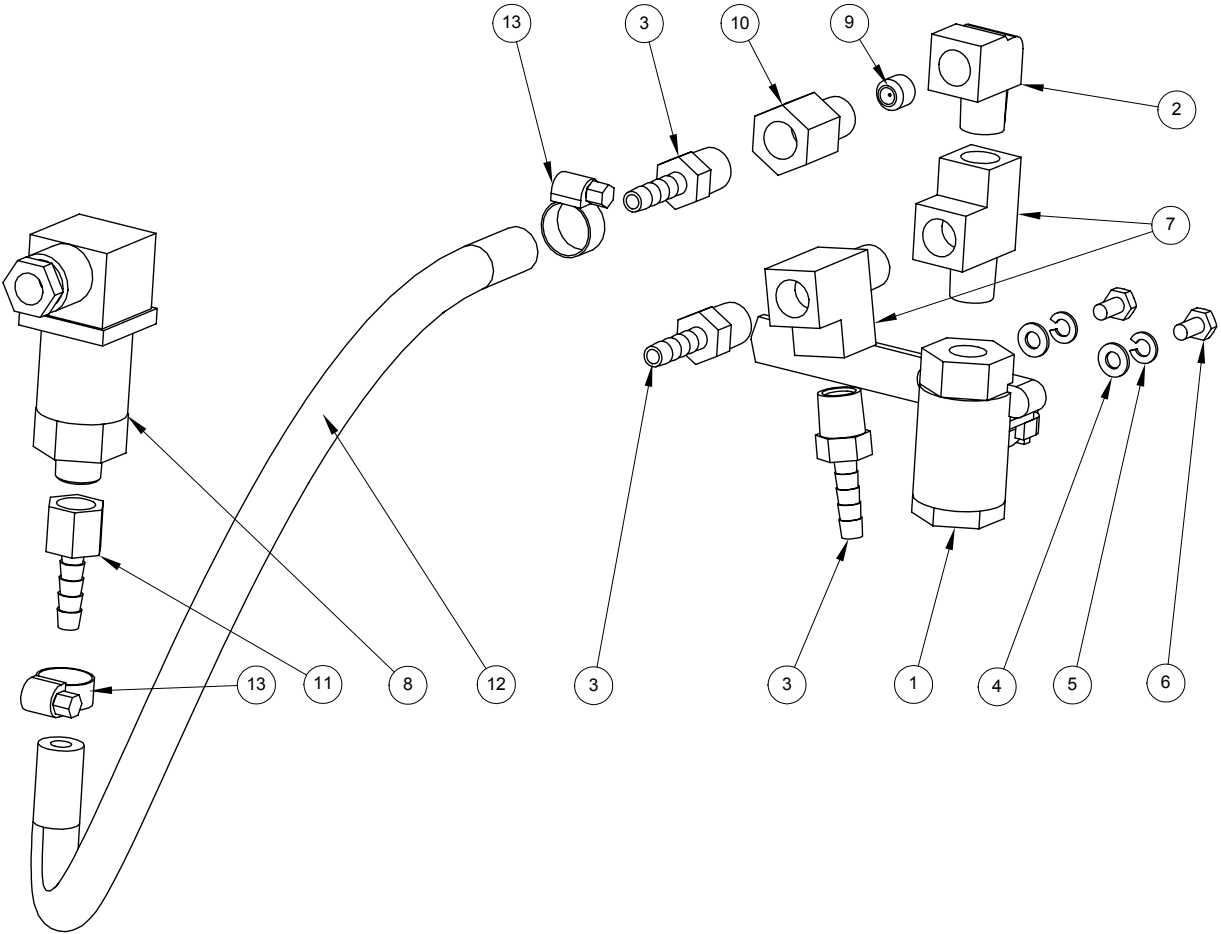
Figure 5-9 HI-PSI Manifold Assembly
C-6158 Rev A



HI-PSI Manifold Assembly Parts List

Item	Part Number	Description	Qty
1	000-090-018	Manifold, HI PSI s/s	1
2	000-169-195	Valve, 200 PSI Pop Off	1
3	000-174-001	Washer, #10 Flat	2
4	000-174-014	Washer, #10 Lock	2
5	000-143-166	Screw, #10-24UNC x 0.38" Lg. Hex Head	2
6	000-052-691	Elbow, 1/4" Street s/s	3
7	000-052-506	Nipple, 1/4" NPT x 9/16"-18UNF x 37° JIC	1
8	000-052-095	Nipple, 1/4" NPT Hex	2
9	000-052-690	Quick Connect, Female - CTS 450	1
10	000-169-095	Valve, 1/4" NPT Panel Mount - Full Port Ball	1
11	000-052-526	Nipple, 1/4" NPT x 1/4" JIC	1
12	000-052-745	Elbow, 1/4" NPT x 45° Street s/s	1
13	000-052-610	Coupler, 1/4" FPT Hex s/s	1
14	000-052-696	Insert, #44 (1/4" NPT x 1/4" Barb) s/s	1

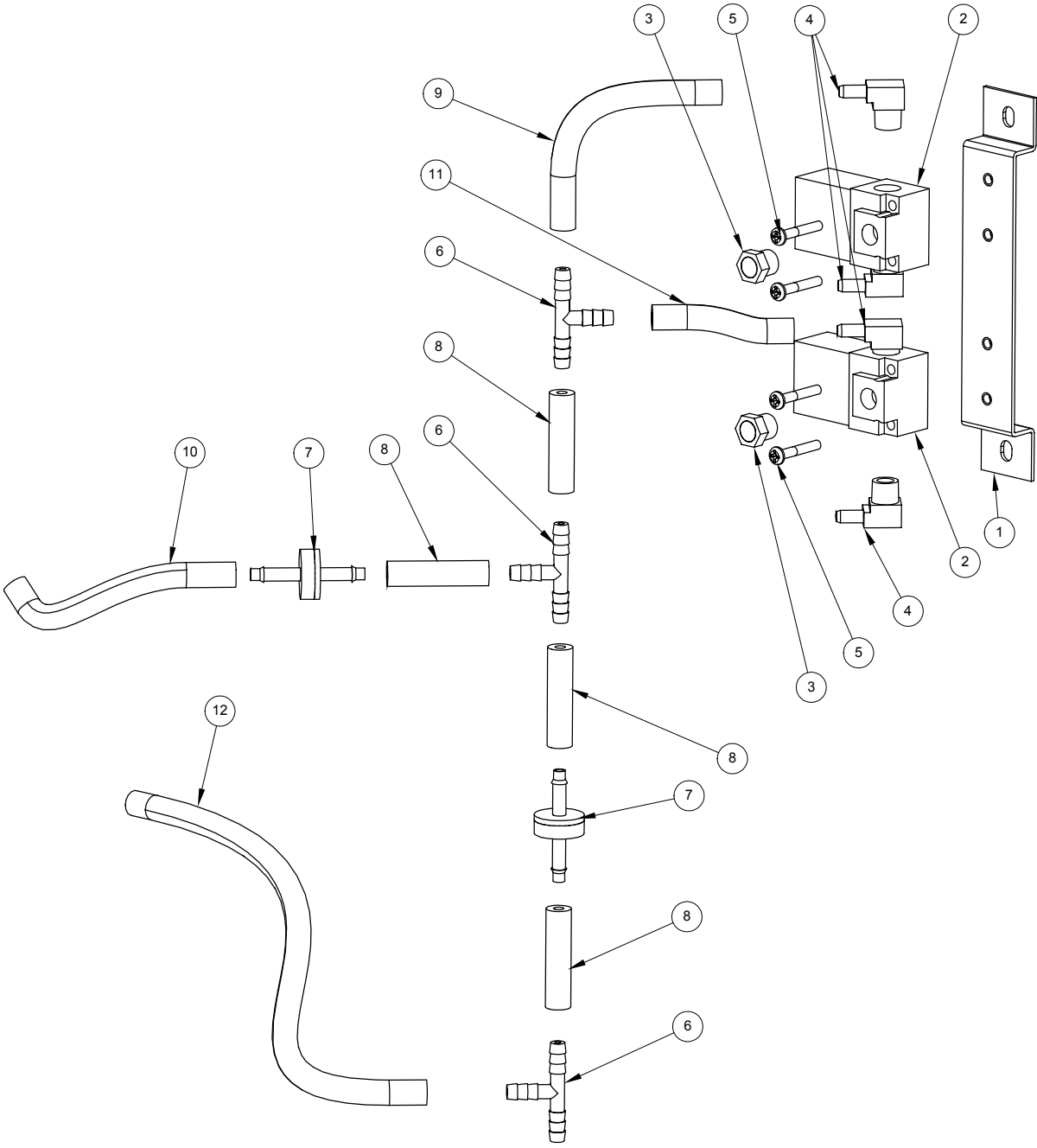
Figure 5-10 Purge Valve Assembly
C-6161 Rev A



Purge Valve Assembly Parts List

Item	Part Number	Description	Qty
1	000-169-090	Valve, 1/4" NPT Panel Mount - Full Port Ball	1
2	000-052-085	Elbow, 1/4" NPT Street	1
3	000-052-100	Insert, #44 (1/4" NPT x 1/4" Barb)	3
4	000-174-001	Washer, #10 Flat	2
5	000-174-014	Washer, #10 Lock	2
6	000-143-166	Screw, #10-24UNC x 0.38" Lg. Hex Head	2
7	000-052-090	Tee, 1/4" NPT Branch M-F-F	2
8	000-157-148	Switch, Pressure 125 PSI	1
9	000-180-004	Orifice, Set Screw 0.033"	1
10	000-052-423	Bushing, Modified Set Screw Orifice	1
11	000-052-110	Insert, #F44 (1/4" FPT x 1/4" Barb)	1
12	000-068-131	Hose, 1/4" I.D. Hi Temp - Bulk	1
13	000-033-003	Clamp, Size #4 Mini	2

Figure 5-11 Vacuum Solenoid Valves Assembly
C-6162 Rev -



Vacuum Solenoid Valves Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-924	Bracket, Vacuum Solenoid Valves Mounting	1
2	000-169-070	Valve, Primary Vac. Solenoid	2
3	000-106-014	Plug, Gearbox Vent	2
4	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	4
5	000-143-047	Screw, #6-32UNC x 7/8" Lg. Pan Head Phillips	4
6	000-052-155	Tee, 3/16" Plastic Vacuum Insert	3
7	000-169-156	Valve, Check - Diverter Control System	2
8	000-068-030	Hose, 5/32" I.D. Vacuum	4
9	000-068-030	Hose, 5/32" I.D. Vacuum	1
10	000-068-030	Hose, 5/32" I.D. Vacuum	1
11	000-068-030	Hose, 5/32" I.D. Vacuum	1
12	000-068-030	Hose, 5/32" I.D. Vacuum	1

Figure 5-12 Engine Assembly - Left View
D-6153 Rev C

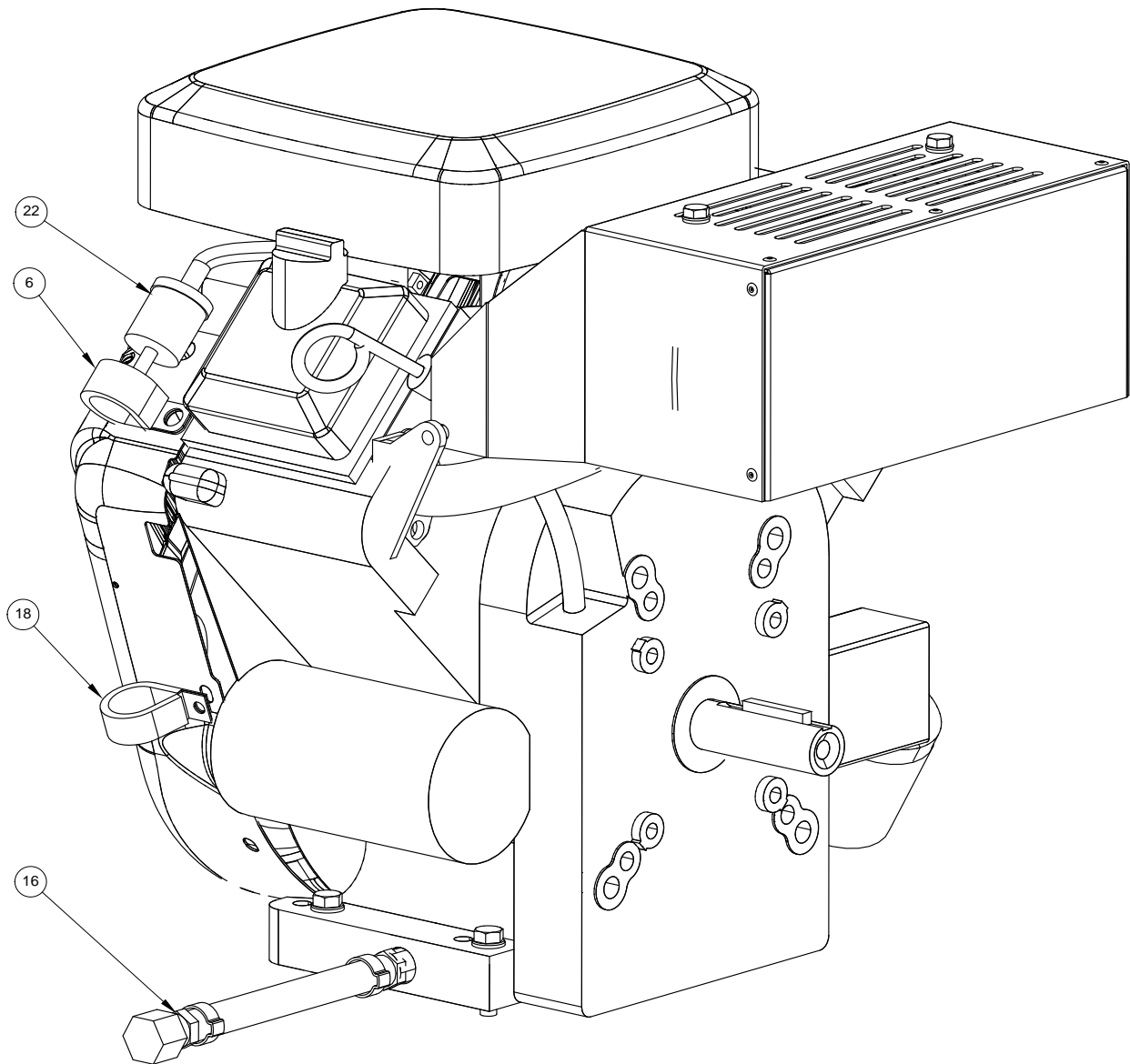
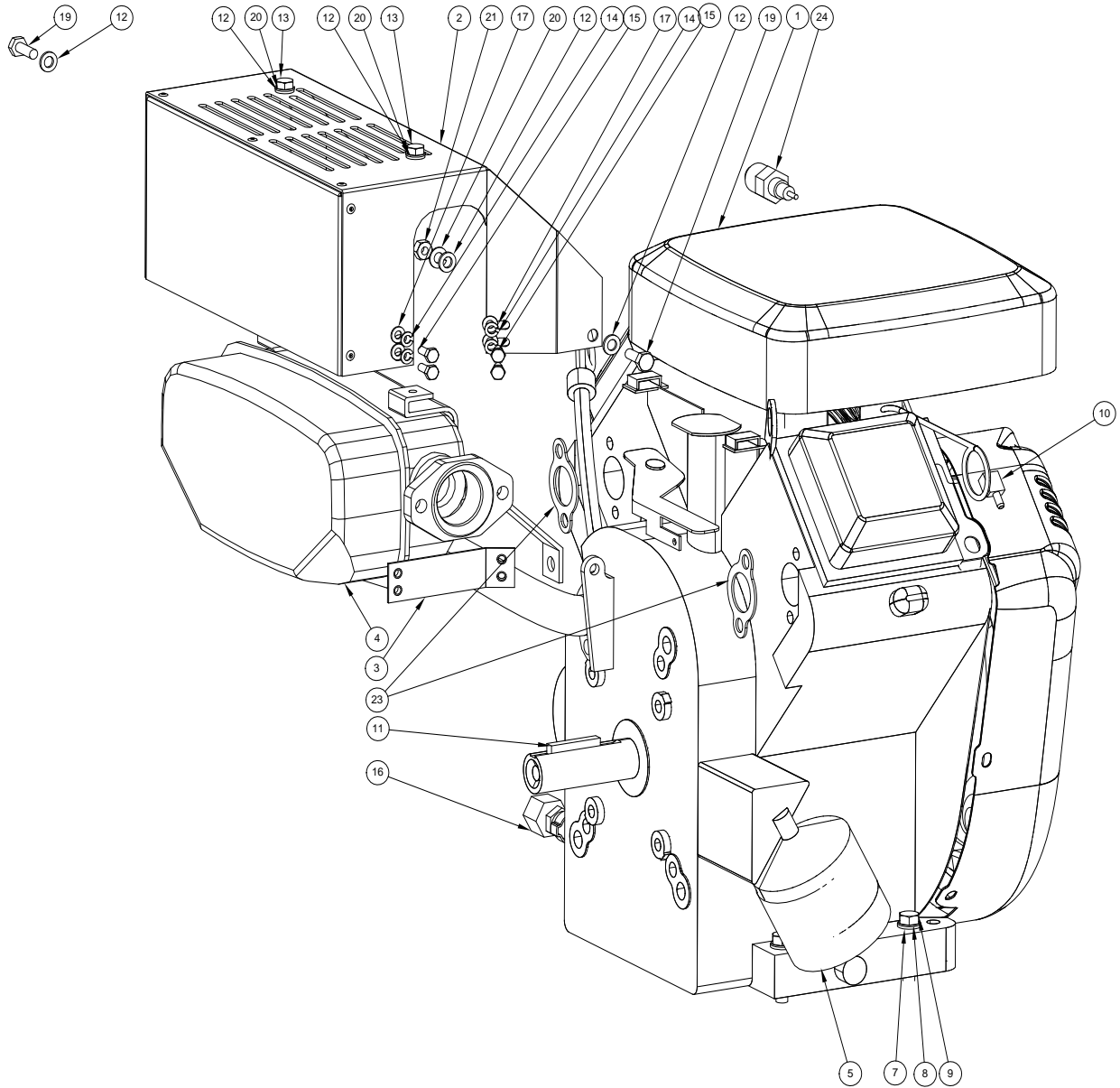


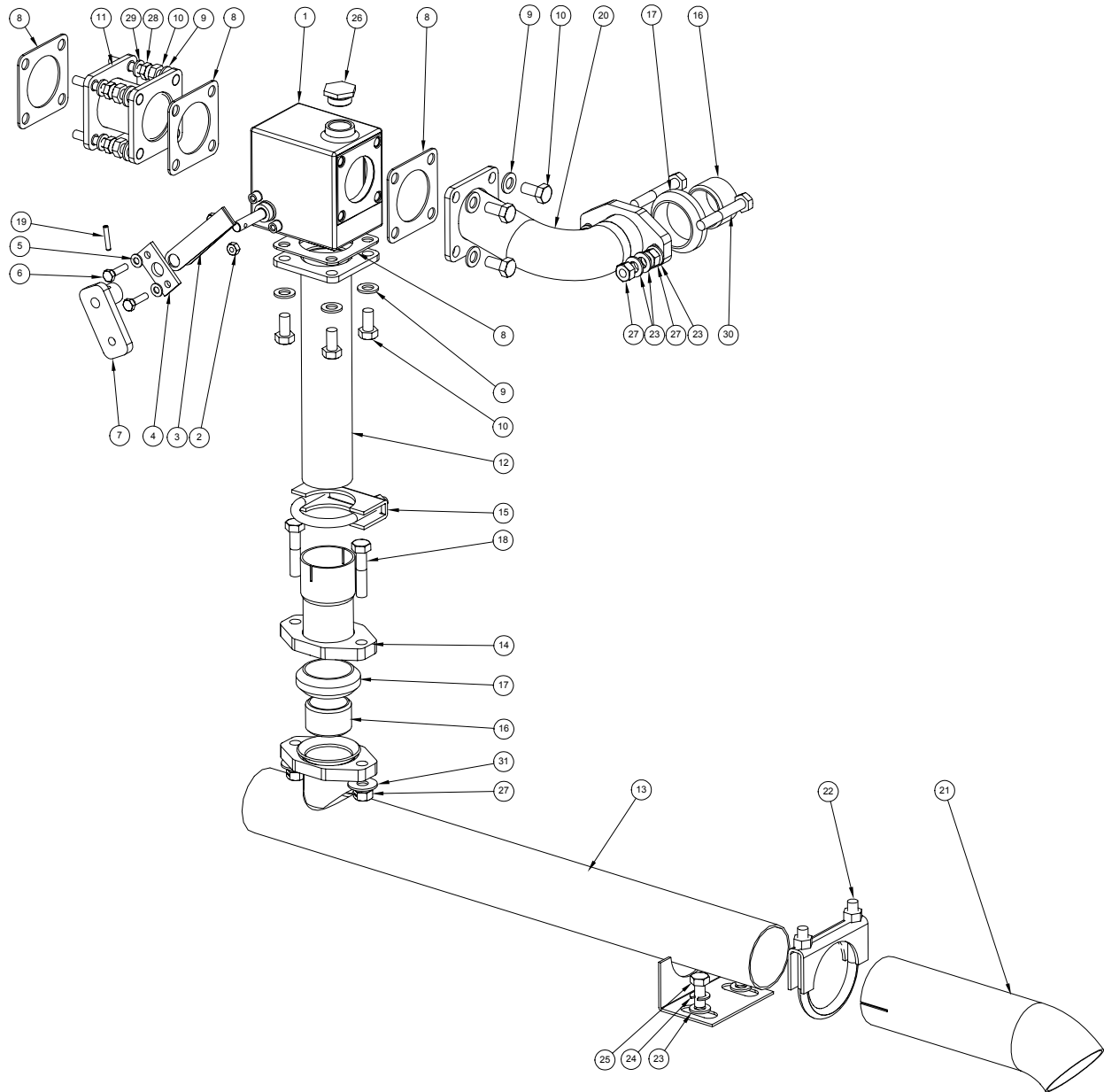
Figure 5-13 Engine Assembly - Right View
D-6153 Rev C



Engine Assembly Parts List

Item	Part Number	Description	Qty
1	000-047-008	Engine, B&S Vanguard 16 HP V-Twin	1
2	000-041-438	Cover, Muffler - Assembly	1
3	000-015-921	Bracket, Muffler Cover Stiffener	1
4	000-093-099	Muffler, 16HP Vanguard - Modified	1
5	000-049-014	Filter, 16HP Oil - All B & S	1
6	000-033-117	Clamp, 1" Cushion Loop w/ 7/16" Mount Hole	1
7	000-174-049	Washer, 5/16" Flat	4
8	000-174-018	Washer, 5/16" Lock	4
9	000-143-015	Screw, 5/16"18UNC x 1.50" Lg. Hex Head	4
10	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	1
11	000-077-010	Key, 1/4" x 1-1/2" Lg. Class 2 Fit	1
12	000-174-003	Washer, 1/4" Flat	6
13	000-143-333	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head	2
14	000-174-014	Washer, #10 Lock	4
15	000-143-327	Screw, #10-32UNF x 0.50" Lg. Hex Head	4
16	000-068-219	Hose, Spitfire Pump Drain	1
17	000-174-001	Washer, #10 Flat	4
18	000-033-057	Clamp, 1" Cushion Loop	1
19	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	2
20	000-174-019	Washer, 1/4" Lock	4
21	000-094-010	Nut, 1/4"-20UNC Hex	2
22	- - -	Filter, B&S Fuel (Comes w/ Engine)	1
23	000-057-010	Gasket, Exhaust Manifold - Vanguard	2

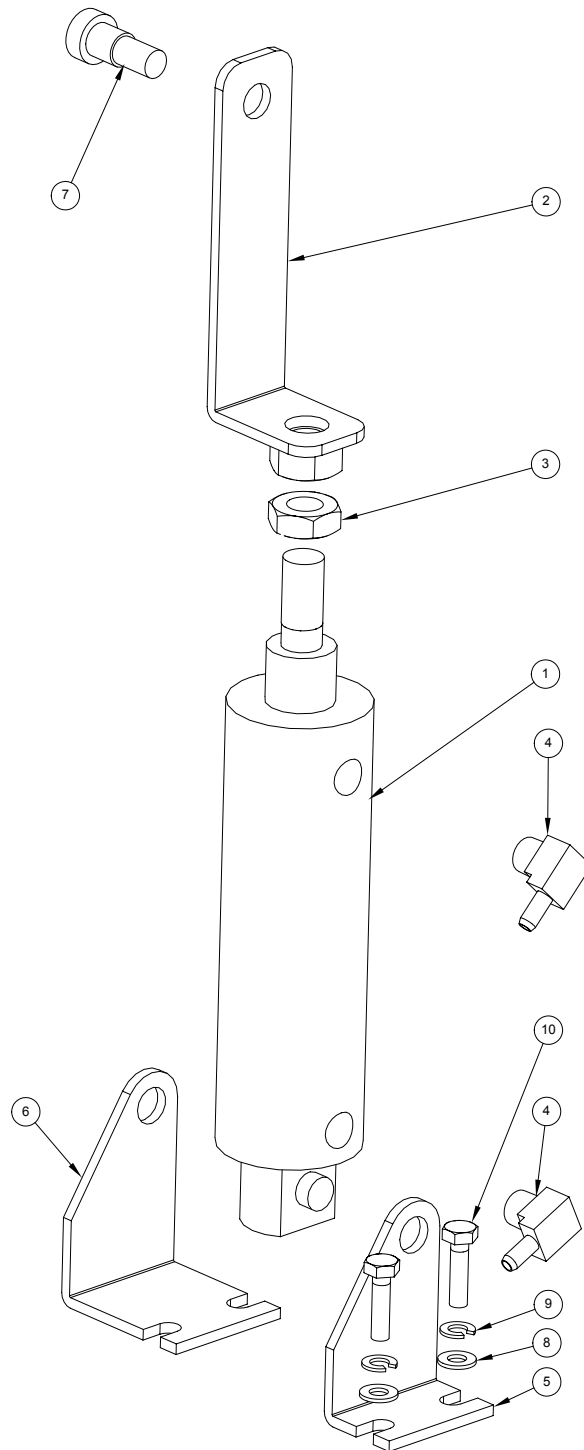
Figure 5-14 Exhaust Assembly
D-6155 Rev B



Exhaust Assembly Parts List

Item	Part Number	Description	Qty
1	000-169-045	Valve, Cast Exhaust Diverter	1
2	000-094-027	Nut, #10-24UNC Hex	2
3	000-155-030	Spring, Leaf	1
4	000-138-010	Retainer, Leaf Spring	1
5	000-174-001	Washer, #10 Flat	2
6	000-143-132	Screw, #10-24UNC x 0.75" Lg. Hex Head	2
7	000-015-631	Bracket, Air Cylinder Actuation	1
8	000-057-146	Gasket, Four Hole Exhaust Diverter	4
9	000-174-069	Washer, 5/16" Inconel Belleville, Diverter Valve	12
10	000-143-572	Screw, 5/16"-18UNC x 5/8" Lg. Hex Grd. 5	12
11	000-125-209	Tube, Inlet To Heat Exchanger	1
12	000-125-210	Tube, Diverter Outlet	1
13	000-125-211	Tube, Heat Exchanger Outlet - Welded	1
14	000-001-116	Adapter, 1.50" F Slip To Flare	1
15	000-033-068	Clamp, 1-1/2" Muffler	1
16	000-125-128	Tube, 1-3/8" OD x 1/8" Wall x 7/8" Long	2
17	000-057-177	Gasket, Exhaust Donut 1.50"	2
18	000-143-501	Screw, 5/16"-18UNC x 1-1/2" Lg.	2
19	000-103-014	Pin, 1/8 x 3/4" Roll	1
20	000-125-208	Tube, Diverter Inlet - Welded	1
21	000-001-130	Adapter, Final Exhaust Turndown - Mod.	1
22	000-033-024	Clamp, 2" Muffler	1
23	000-174-049	Washer, 5/16" Flat	8
24	000-174-018	Washer, 5/16" Lock	2
25	000-143-012	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head	2
26	000-106-120	Plug, M18 x 1.5	1
27	000-094-081	Nut, 5/16"-18UNC Hex 2-Way Locking	6
28	000-143-003	Screw, 1/4"20UNC x 1.25" Lg. Hex Head	4
29	000-174-003	Washer, 1/4" Flat	4
30	000-143-316	Screw, 5/16"-18UNC x 2.00" Lg. Hex Head	2
31	000-174-004	Washer, 5/16" Flat	2

Figure 5-15 Diverter Valve Actuator Assembly
C-6154 Rev A



Diverter Valve Actuator Assembly Parts List

Item	Part Number	Description	Qty
1	000-169-169	Valve, Air Cylinder	1
2	000-015-922	Bracket, Air Cylinder Extension	1
3	000-094-092	Nut, 7/16"-20UNF Hex Jam	1
4	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	2
5	000-015-750	Bracket, Air Cylinder Mount - Inner	1
6	000-015-748	Bracket, Air Cylinder Mount - Outer	1
7	000-143-573	Screw, 5/16-18 Shoulder, 3/8" Dia x 1/2"	1
8	000-174-001	Washer, #10 Flat	2
9	000-174-014	Washer, #10 Lock	2
10	000-143-132	Screw, #10-24UNC x 0.75" Lg. Hex Head	2

Figure 5-16 Blower Assembly - Front View
D-6156 Rev A

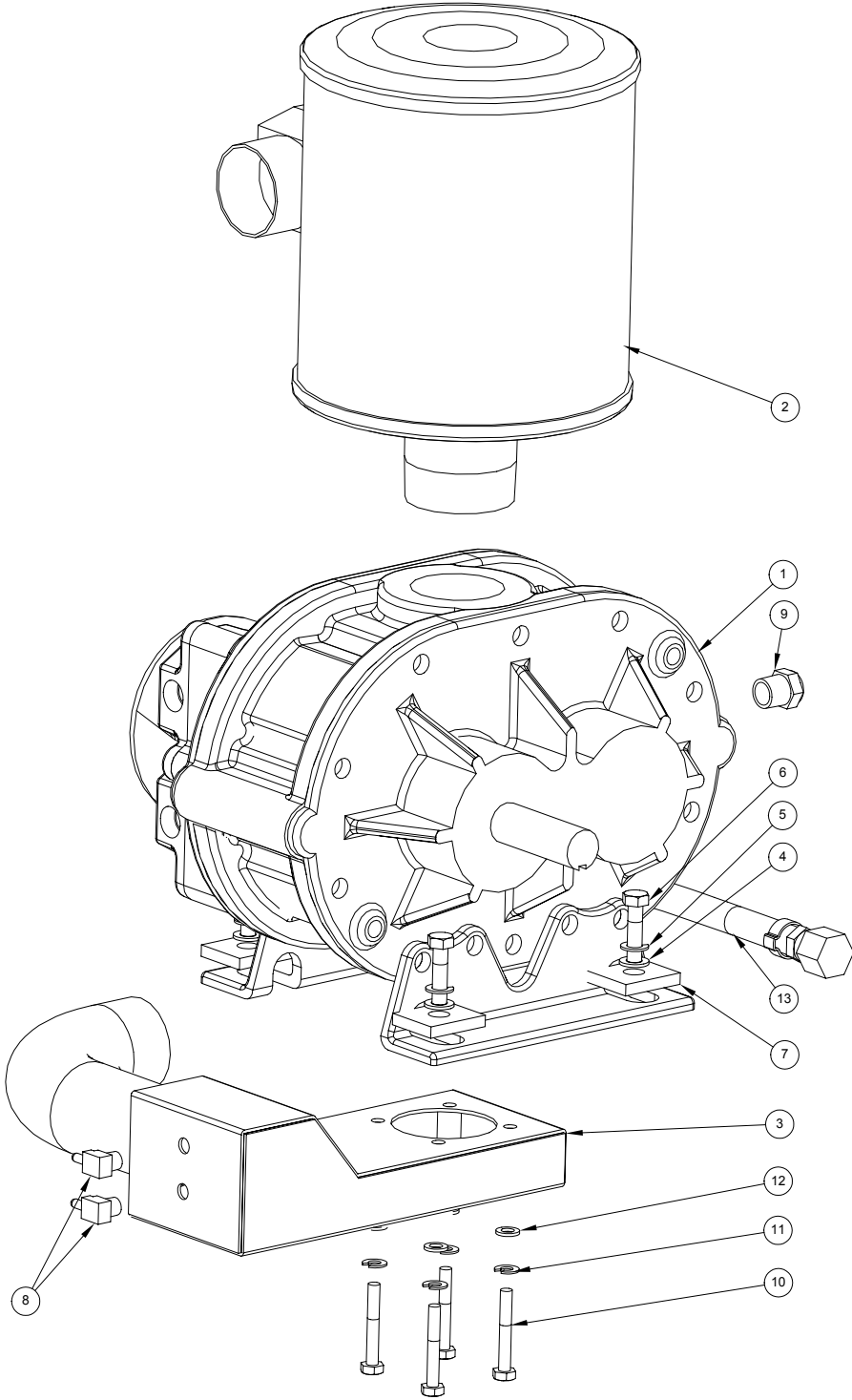
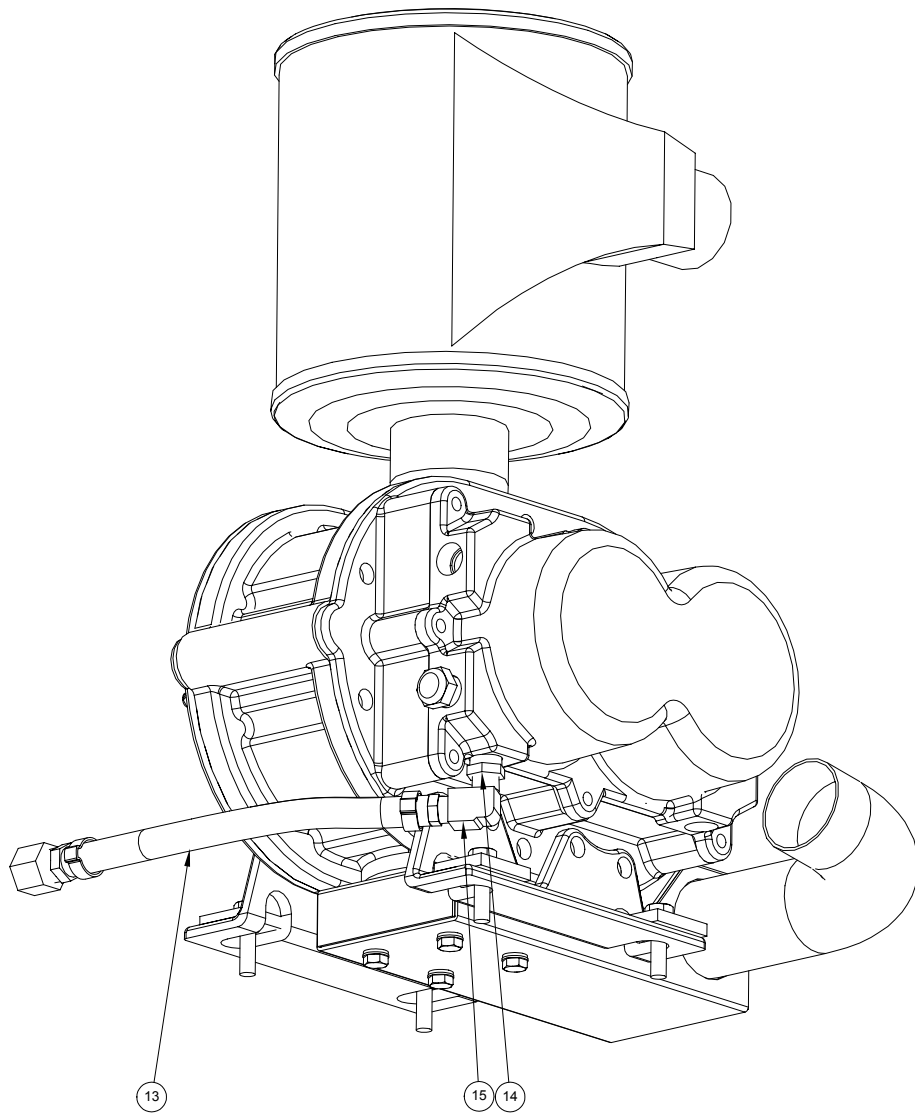


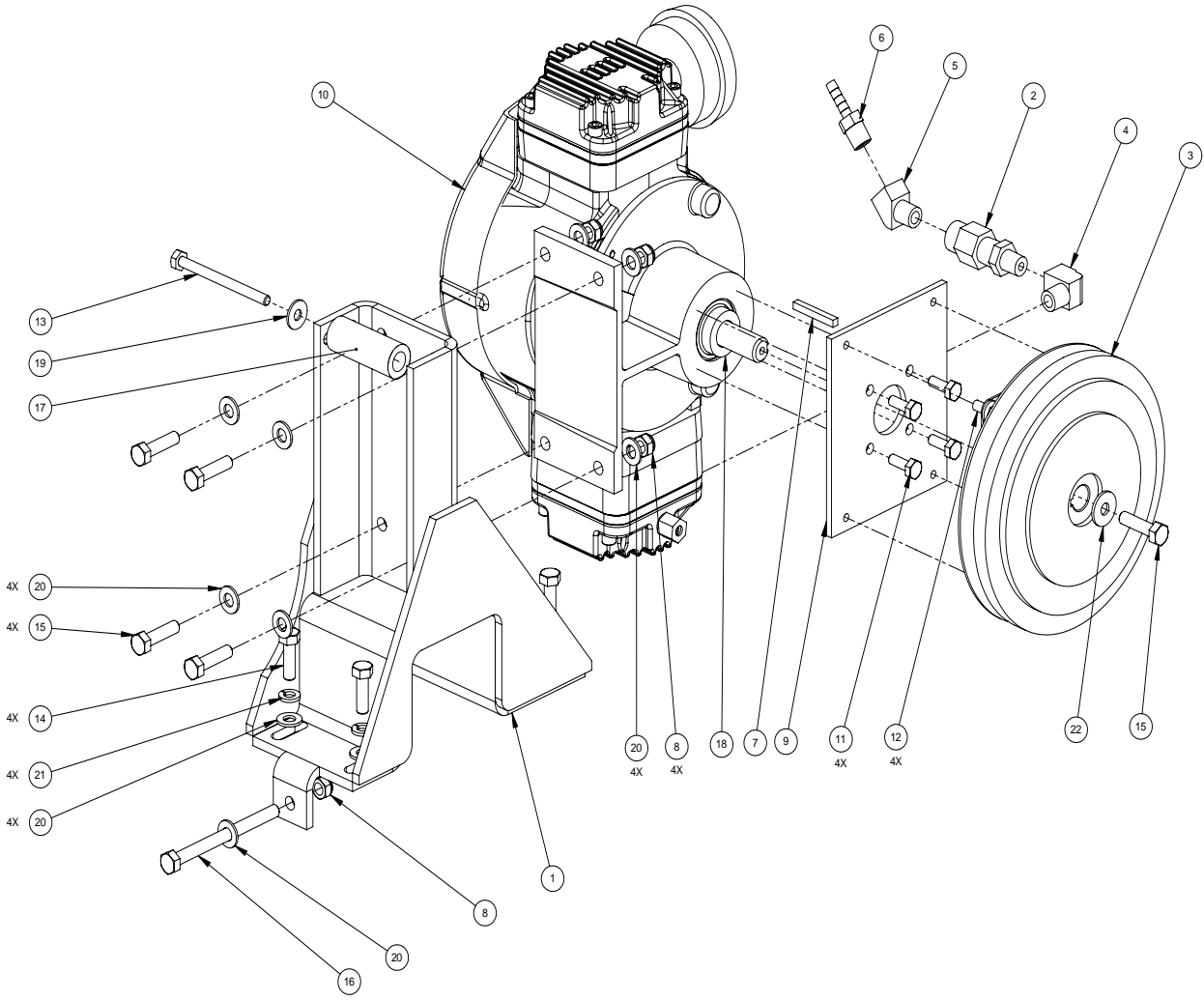
Figure 5-17 Blower Assembly - Rear View
D-6156 Rev A



Blower Assembly Parts List

Item	Part Number	Description	Qty
1	000-111-133	Blower, 3003 Competitor Plus	1
2	000-093-101	Silencer, 2" Cowl	1
3	000-013-066	Box, Blower Outlet Collector	1
4	000-174-049	Washer, 5/16" Flat	4
5	000-174-018	Washer, 5/16" Lock	4
6	000-143-014	Screw, 5/16"-18UNC x 1.25" Lg. Hex Head	4
7	000-174-068	Washer, Blower Feet	4
8	000-052-106	Insert, 1/8" NPT x 5/32" Barb x 90°	2
9	000-027-112	Plug, Oil Sight Glass Tuthill Blower	1
10	000-143-005	Screw, 1/4"-20UNC x 1.75" Lg. Hex Head	4
11	000-174-019	Washer, 1/4" Lock	4
12	000-174-003	Washer, 1/4" Flat	4
13	000-068-221	Hose, 3/8" x 24" Lg. Pump Drain	1
14	000-052-061	Bushing, 3/8" NPT x 1/4" FPT	1
15	000-052-085	Elbow, 1/4" NPT Street	1

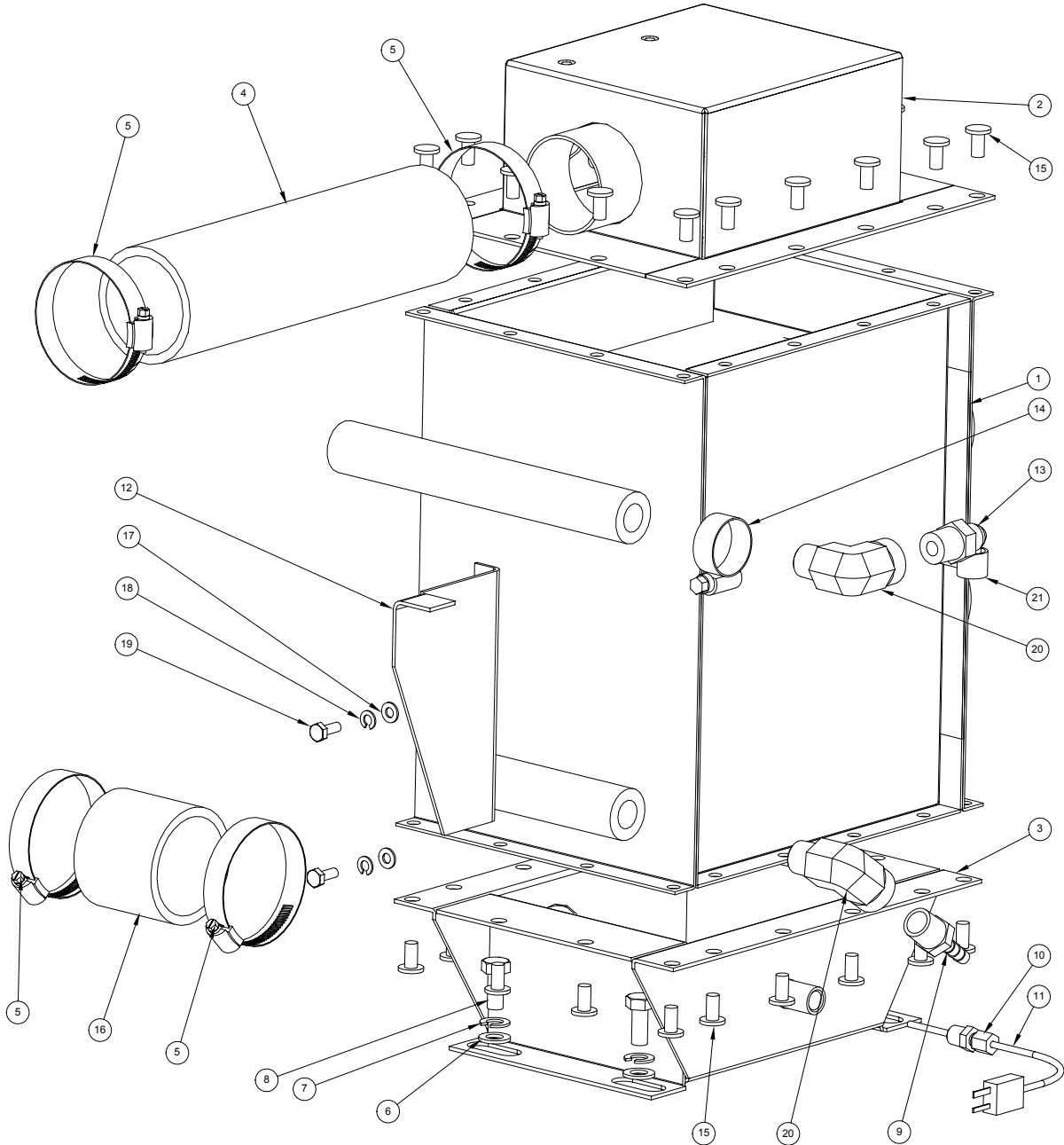
Figure 5-18 Compressor Assembly
D-6157 Rev D



Compressor Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-928	Bracket, Compressor Mounting - Coated	1
2	- - -	Check Valve (Comes w/ Compressor)	1
3	000-036-010	Clutch, 7" O.D. 0.625" Bore Single Groove	1
4	000-052-085	Elbow, 1/4" NPT Street	1
5	000-052-082	Elbow, 1/4" NPT Street X 45°	1
6	000-052-100	Insert,#44	1
7	000-077-015	Key, 3/16" X 1-1/2"	1
8	000-094-038	Nut, 5/16"-18UNC Nylock	5
9	000-105-323	Plate, Compressor Clutch Mount	1
10	000-111-204	Pump, Compressor (Thomas SGH-617b)	1
11	000-143-001	Screw, 1/4"-20UNC X 0.75" Lg. Hex Head	4
12	000-143-141	Screw, 1/4"-20UNC X 1/2" Lg. Whiz Lock	4
13	000-143-372	Screw, 1/4"20UNC X 3.25" Lg. Hex Head Grd 5	1
14	000-143-013	Screw, 5/16"-18UNC X 1.00" Lg. Hex Head Grade 8	4
15	000-143-014	Screw, 5/16"18UNC X 1.25" Lg. Hex Head	5
16	000-143-324	Screw, 5/16"18UNC X 4" Lg Tap Hex Head Grd 5	1
17	000-154-149	Spacer, Belt Guard Stiffening - Coated	1
18	000-020-064	Spacer, Compressor Clutch	1
19	000-174-002	Washer, 1/4" Flat	1
20	000-174-004	Washer, 5/16" Flat	13
21	000-174-018	Washer, 5/16" Lock	4
22	000-174-170	Washer, Hardened, 5/16"	1

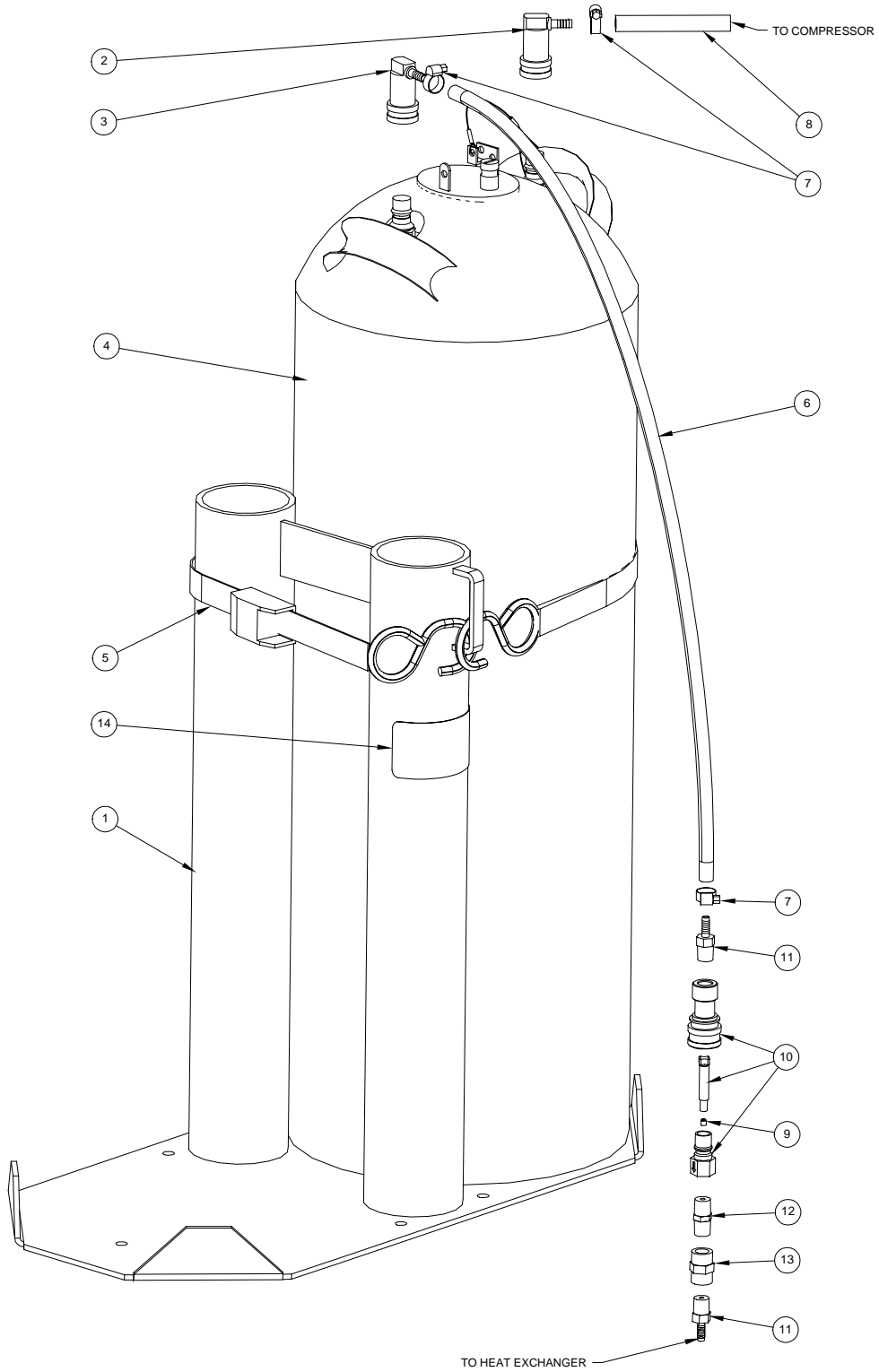
Figure 5-19 Blower Heat Exchanger Assembly
D-6159 Rev A



Blower Heat Exchanger Assembly Parts List

Item	Part Number	Description	Qty
1	000-038-071	Core, Blower Heat Exchanger s/s	1
2	000-013-064	Box, Inlet Plenum - Weldment	1
3	000-013-065	Box, Outlet Plenum - Weldment	1
4	000-068-728	Hose, 2" Silicone	1
5	000-033-010	Clamp, Size # 32 - Hose	4
6	000-174-049	Washer, 5/16" Flat	4
7	000-174-018	Washer, 5/16" Lock	4
8	000-143-012	Screw, 5/16"-18UNC x 0.75" Lg. Hex Head	4
9	000-052-749	Insert, #64 (3/8" NPT x 1/4" Barb)	1
10	000-052-744	Compression, 1/8" NPT x 1/8" Tube - Modified	1
11	000-149-054	Sensor, K Type Thermocouple 1/8" x 6" Lg.	1
12	000-015-923	Bracket, Blower Hx Manifold Support	1
13	000-052-507	Nipple, 3/8" NPT x 9/16"-18 37° JIC	1
14	000-033-026	Clamp, Size #10 Hose	1
15	000-140-021	Rivet, 1/4" Blind x 0.50" Lg.	32
16	000-068-728	Hose, 2" Silicone	1
17	000-174-001	Washer, #10 Flat	2
18	000-174-014	Washer, #10 Lock	2
19	000-143-126	Screw, #10-24UNC x 0.50" Lg. Hex Head	2
20	000-052-747	Elbow, 3/8" NPT Street	2
21	000-033-046	Clamp, 1/2 Wide x 1/2 Tube	1

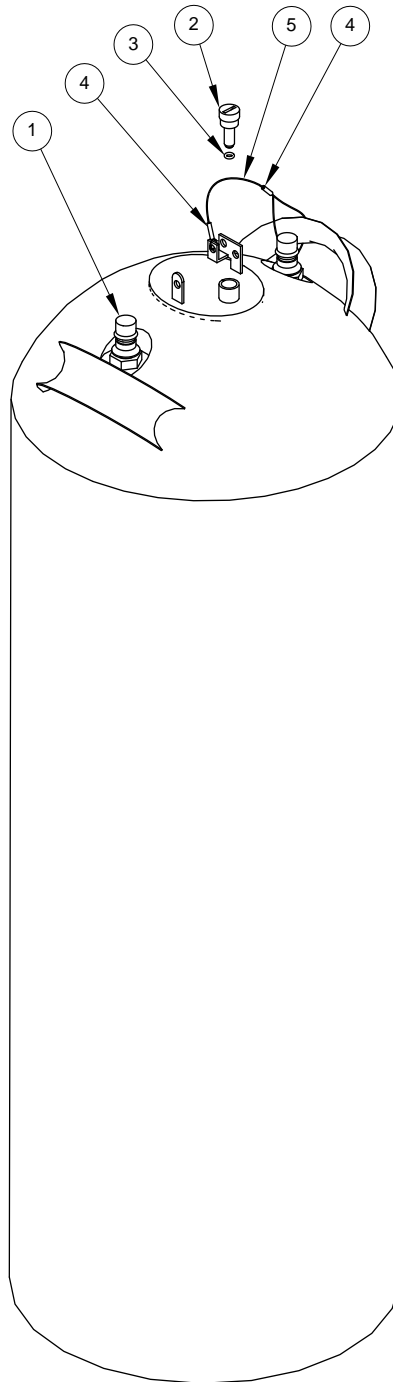
Figure 5-20 **15 Gallon Chemical Jug Assembly**
D-6163 Rev B



15 Gallon Chemical Jug Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-869	Bracket, 15 Gallon Tank	1
2	000-052-697	Socket, In s/s 90° Barb	1
3	000-052-698	Socket, Out s/s 90° Barb	1
4	000-159-127	Tank, 15 Gallon Chemical	1
5	000-108-141	Tie Down Strap	1
6	000-068-015	Hose, 1/4" I.D. - Bulk	1
7	000-033-003	Clamp, Size #4 Mini	3
8	000-068-131	Hose, Ø1/4" Silicone	1
9	000-180-021	Orifice, Set Screw #10-32UNF x Ø0.052"	1
10	000-049-137	Filter, In-Line - Quick Connect	1
11	000-052-696	Insert, #44 (1/4" NPT x 1/4" Barb) s/s	2
12	000-169-157	Valve, 1/4" NPT Check w/ Orifice	1
13	000-052-610	Coupler, 1/4" FPT Hex s/s	1
14	000-081-218	Label, Caution - Tank	1

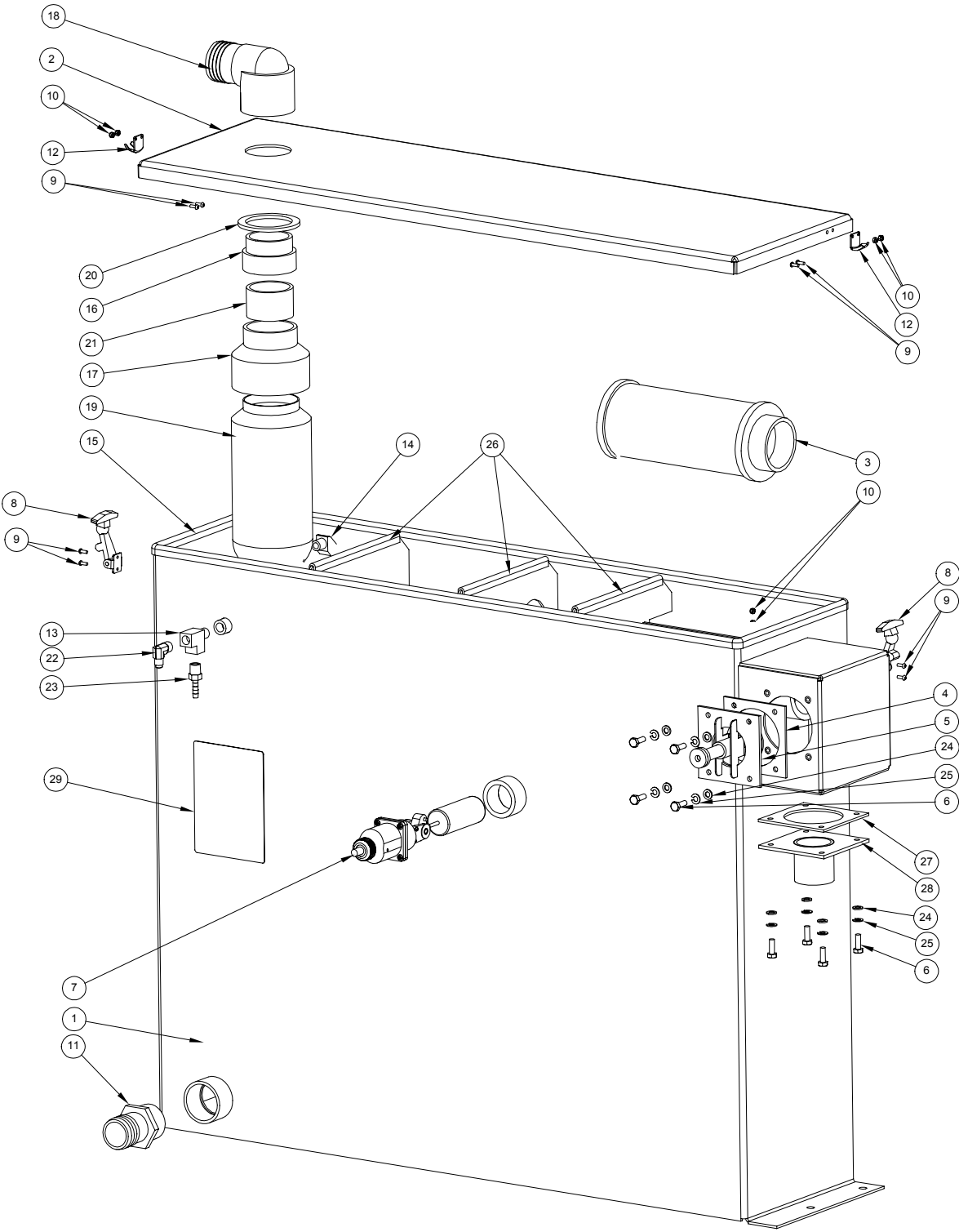
Figure 5-21 **15 Gallon Chemical Tank Assembly**
C-6109 Rev -



15 Gallon Chemical Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-159-126	Tank, 15 Gallon Chemical	1
2	000-106-055	Plug, 1/4 s/s Chemical Container	1
3	000-097-006	O-Ring, #8 Buna	1
4	000-033-032	Clamp, CDS Throttle Cable	2
5	000-025-008	Cable, 150 Lb Test	1

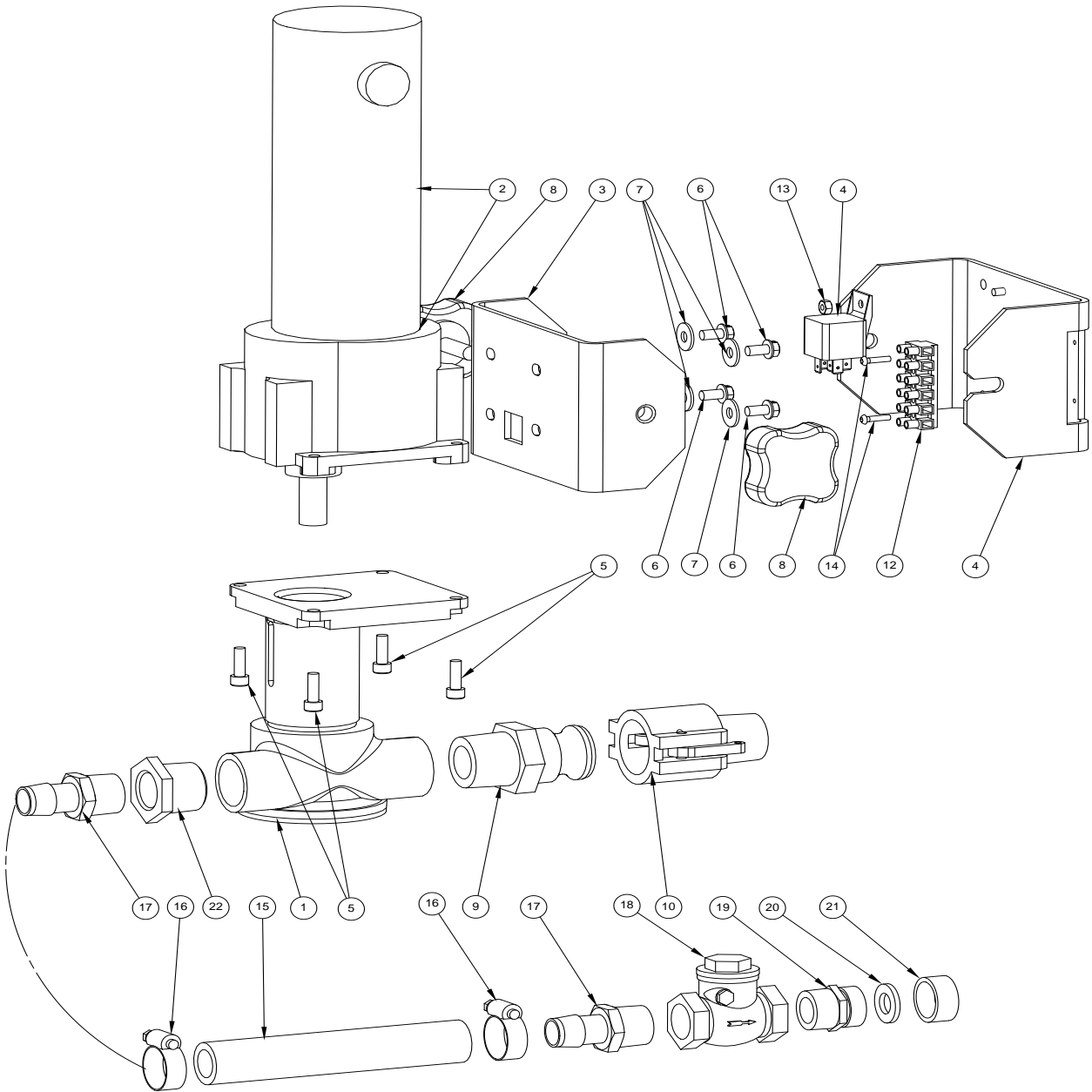
Figure 5-22 Recovery Tank Assembly
D-5530 Rev D



Recovery Tank Assembly Parts List

Item	Part Number	Description	Qty
1	000-159-112	Tank, Recovery - Weldment	1
2	000-041-409	Cover, Recovery Tank - Weldment	1
3	000-049-008	Filter, 2-1/2" Recovery Tank	1
4	000-057-178	Gasket, Vacuum Relief Plate	1
5	Fig. 5-24	Assembly, Vacuum Relief Valve	1
6	000-143-001	Screw, 1/4"-20UNC x 0.75" Lg. Hex Head	8
7	000-157-090	Float, Lever Switch	1
8	000-086-008	Latch, Bungie	2
9	000-143-165	Screw, #6-32UNC x 3/8" Lg. Pan Head	8
10	000-094-063	Nut, #6-32UNC Nylock	8
11	000-052-226	Insert, 1-1/2" NPT x 1-1/2" Barb (Grey)	1
12	000-086-008	Latch, Bungie - Strike	2
13	000-052-090	Tee, 1/4" NPT Branch M-F-F	1
14	000-052-082	Elbow, 1/4" NPT Street x 45°	1
15	000-131-021	Trimlok, 5/8" x 1/8"	1
16	000-052-219	Adapter, 2" NPT x 2" F Slip	1
17	000-052-404	Adapter, 3" F Slip x 2" F Slip	1
18	000-052-222	Elbow, 2" Barb x 2" FPT	1
19	000-049-030	Filter Bag, 92+Truck Mount	1
20	000-057-015	Gasket, 1-1/2" Bulkhead Fitting	1
21	000-125-052	Tube, 2" Pvc x 1.50" Lg. Filter Bag Adapter Sleeve	1
22	000-052-532	Elbow, 1/4" SAE x 1/4" JIC x 90°	1
23	000-052-100	Insert, #44 (1/4" NPT x 1/4" Barb)	1
24	000-174-003	Washer, 1/4" Flat	8
25	000-174-019	Washer, 1/4" Lock	8
26	000-131-021	Trimlok, 5/8" x 1/8"	3
27	000-057-193	Gasket, Recovery Tank Outlet	1
28	000-001-129	Adapter, Recovery Tank Outlet	1
29	000-081-243	Label, Maintenance & Lubrication Schedule	1

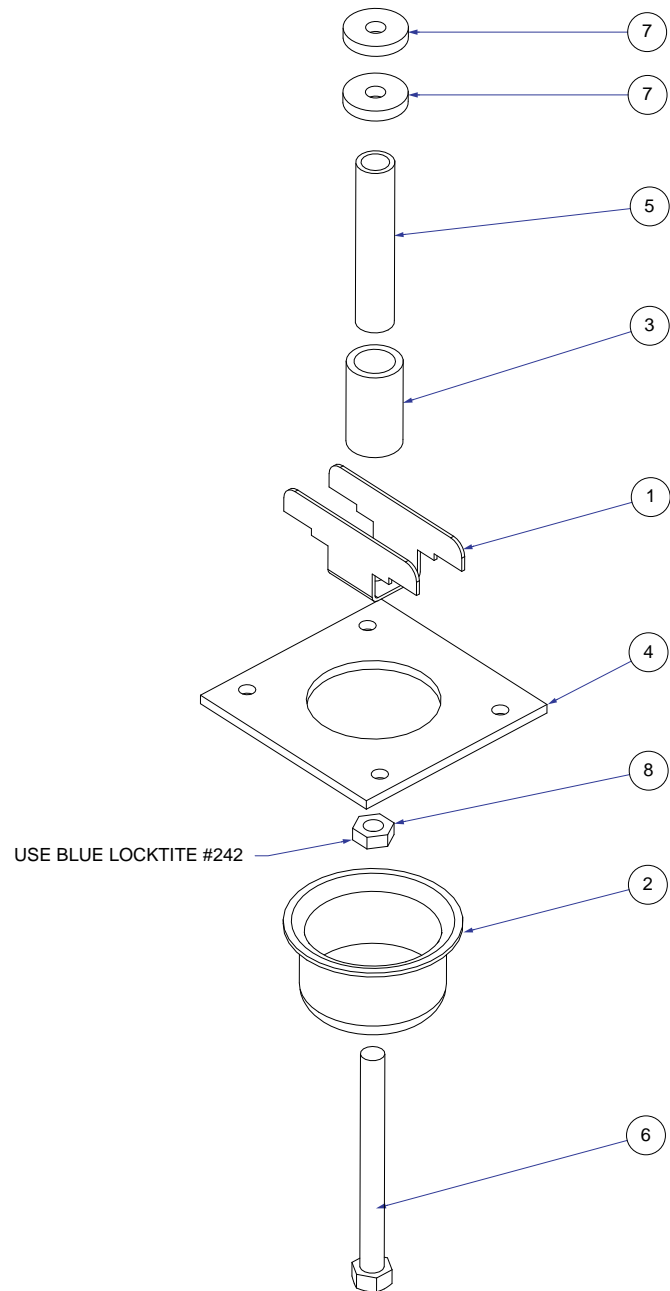
Figure 5-23 Dura-Flow APO Assembly
D-5654 Rev B



Dura-Flow APO Assembly Parts List

Item	Part Number	Description	Qty
1	000-111-169	Assembly, APO Pump - Jabsco	1
2	000-091-042	Motor, Bison 438 Series	1
3	000-015-891	Bracket, APO Clamp	1
4	000-015-890	Bracket, Tank Mounted APO Support	1
5	000-143-566	Screw, 1/4-28UNF x 0.75" Lg. Socket Head	4
6	000-143-074	Screw, 1/4"-20UNC x 0.50" Lg. Hex Head Self-Tapping	4
7	000-174-002	Washer, 1/4" Flat	4
8	000-061-131	Knob, Handle - RDM	2
9	000-052-723	Fitting, 1" NPT Cam Lock - Banjo 100F	1
10	000-052-724	Fitting, 1" NPT Cam Lock - Banjo 100B	1
11	000-157-022	Switch, Relay	1
12	000-012-011	Block, 6 Post	1
13	000-094-027	Nut, #10-24UNC Hex	1
14	000-143-532	Screw,#6-32UNC x 5/8" Lg. Socket Head	2
15	000-094-113	Nut, 1/4"-20UNC Neoprene Wellnut	4
16	000-143-002	Screw, 1/4"-20UNC x 1.00" Lg. Hex Head	4
17	000-174-060	Washer, 1/4" Flat Rubber Backed	4
18	000-052-654	Insert, #1612 (1" NPT x 3/4" Barb)	1
19	000-068-069	Hose, 3/4" I.D. Weatherhead - Blue - Bulk.	1
20	000-033-026	Clamp, Size #10 Hose	2
21	000-052-338	Insert, #1212 (3/4" NPT x 3/4" Barb)	1
22	000-169-009	Valve, 3/4" FPT Swing Check	1
23	000-052-281	Nipple, 3/4" NPT x 3/4" Male Garden Hose	1
24	000-057-055	Gasket, Garden Hose	1
25	000-027-014	Cap, Garden Hose	1

Figure 5-24 Vacuum Relief Valve Assembly
C-4237 Rev B



Vacuum Relief Valve Assembly Parts List

Item	Part Number	Description	Qty
1	000-015-182	Bracket, Vacuum Relief Valve	1
2	000-027-032	Cap, Vacuum Relief Valve	1
3	000-125-111	Pipe, Vacuum Relief Spring Guide	1
4	000-105-067	Plate, Vacuum Relief Valve Mounting	1
5	000-155-026	Spring, Vacuum Relief	1
6	000-143-198	Screw, 3/8"-16UNC x 4" Lg. Hex Head Full Thread	1
7	000-094-077	Nut, 3/8"-16UNC x 1.00" O.D. Knurled	2
8	000-094-101	Nut, 3/8"-16UNC Hex Jam	1

Compressor System

The compressor pump in this machine is also referred to as an oil-less reciprocating piston pump. The performance and life of this unit is greatly dependent on the care and proper maintenance it receives.

The compressor is belt and clutch driven. The clutch is controlled by the pressure switch located on the front panel. The compressor operates as follows:

- With the cleaning mode switch in “Cleaning Mode” and the pressure in the solution tank is below the set point, the pressure switch will activate the clutch. This allows the compressor to turn and pressurize the system.
- With the cleaning mode switch in “Cleaning Mode” and the pressure in the solution tank is above the set point, the pressure switch will deactivate the clutch. This will turn off the compressor.
- With the cleaning mode switch in “Extraction Mode” the clutch will turn off regardless of the pressure in the solution tank.

CAUTION

The compressor should be well ventilated. Objects placed or installed adjacent to the pump will significantly reduce the life of the pump

Filtration: Periodically check the inlet air filter. To clean filter, disassemble filter housing and use compressed air to blow dirt particles from the filter element. Replace filter when element can no longer be cleaned with this method

CAUTION

Do not operate without an inlet air filter. Excessive dirt, foreign particles, moisture, or liquids entering the pump can contribute to poor performance and/or premature failure. Dirty filters reduce pump performance by restricting air flow.

Lubrication: The CTS 330 compressor is a dry, oil-less compressor. The product uses sealed grease packed bearings and does not require additional lubrication

CAUTION

DO NOT LUBRICATE. Adding grease products to this unit will reduce performance and can potentially damage the product.

Vacuum System

The vacuum pump in this machine is commonly referred to as a 'positive displacement lobe' type blower. The performance and life of this unit is greatly dependent on the care and proper maintenance it receives.

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

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

CAUTION

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

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

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

CAUTION

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

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

 **CAUTION**

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

VACUUM TANK FILTER BAGS

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

Vacuum System Troubleshooting

- 1.0. Weak vacuum at wand. Gauge reads normal (10" to 12" with hoses & wand attached)
 - 1.1. **Clogged hoses or wand tube.** Disconnect hoses and check carefully for an obstruction.
 - 1.2. **Excessive length of hoses connected to machine.** Make sure machine is rated for the conditions under which it is being operated.

- 2.0. Vacuum gauge will not come up to 12" hg
 - 2.1. **There is an air leak somewhere in the vacuum system.** Check vacuum relief valve for proper adjustment. Carefully check all vacuum hoses for a cut or break. Check recovery tank lid gasket. Make sure recovery tank drain valve is fully closed.
 - 2.2. **Vacuum blower is turning too slowly.** Check engine RPM. Adjust as necessary to 3000RPM.
 - 2.3. **The vacuum gauge is defective.** Test gauge and replace as necessary.

- 3.0. Vacuum gauge reads too high with no hoses attached
 - 3.1. **Filter in recovery tank is clogged.** Remove and clean or replace as necessary.
 - 3.2. **Hose from vacuum blower to recovery tank is collapsed internally.** Inspect and replace as necessary.

- 4.0. Noisy vacuum blower
 - 4.1. **Vacuum blower is low on oil.** Inspect oil level and replenish as necessary. Note: Running vacuum blower low on oil can cause severe mechanical damage. If this situation occurs, it should be inspected by a qualified service technician.
 - 4.2. **Vacuum blower has internal damage.** Refer to qualified service technician.

- 5.0. *Vacuum blower is locked and will not turn.*
- 5.1. **The machine has been unused for a period on time and the blower was not properly lubricated when it was shut down, causing rust to build up on internal surfaces.** *Spray penetrating oil into blower inlet and let sit for at least one hour. Then very carefully use pipe wrench on outer diameter of pulley on blower shaft and attempt to free up blower. Do not use wrench directly on blower shaft. If unable to free up blower in this manner, refer to qualified service technician.*
- 5.2. **There is internal damage to the blower.** Refer to qualified service technician.
-

Miscellaneous Troubleshooting

- 1.0. Water from exhaust
- 1.1. **The recovery tank has been filled with foam or overfilled with water.** Remove recovery tank lid and inspect. If full, drain tank then inspect high-level shutoff switch for proper operation. Clean or replace switch as necessary.
- 1.1.1. If foam is observed in recovery tank, use defoamer on carpet being cleaned.
- 1.2. **Condensation.** *This will be more pronounced in cool weather and humid climates. Observe how long this condition persists after starting machine. If it is only until the machine warms up, it is normal.*
- 1.3. **A heat exchanger is leaking.** Change the diverter mode switch back and forth between divert and heat exchange mode. Observe which condition causes water to be expelled from exhaust.
- 1.3.1. If water is expelled while switch is in heat exchange mode, the engine exhaust after burner heat exchanger is leaking internally. Remove and test. Replace as necessary.
- 1.3.2. If water is expelled while switch is in divert mode, the blower exhaust heat exchanger is leaking. Remove and test. Replace as necessary.

Electrical System

The CTS 330 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.



When a new battery is installed, check that it is properly charged before installation or damage to the charging system 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:

Table 8-1

Terminal No.	Wire Color	Function
1	Orange	To Solenoid (Battery Post)
2	White	To Main Fuse
3	Black	Engine Kill Lug
4	Yellow	To Solenoid (Start Position)
5	Brown	To Regulator Ground
6	Red	To Regulator / Rectifier

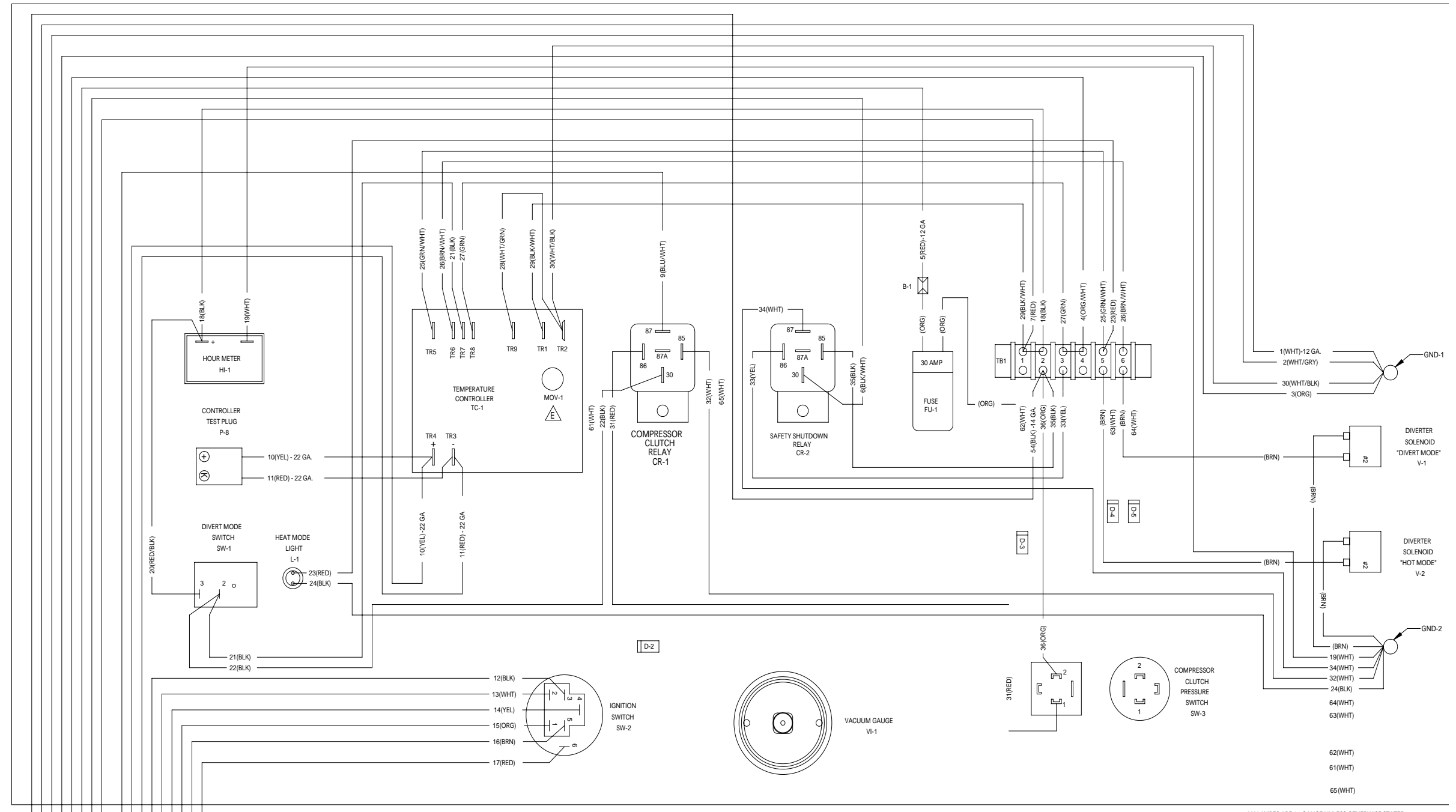
Table 8-2

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

FRONT DASH

Figure 8-1 Wiring Diagram

D-6166 Sht 2, Rev E



- [TO ENGINE CARB SOL - 14 GA] 54(BLK)
- [TO ENGINE GND - 12 GA] 1(WHT)
- [TO FUEL PUMP] 2(WHT/GRY)
- [TO REC TANK P-5 #D] 3(ORG)
- [TO REC TANK P-5 #B] 4(ORG/WHT)
- [TO J-1 - 12 GA] 5(RED)
- [TO ENGINE KILL LUG] 6(BLK/WHT)
- [FUEL PUMP P-3] 7(RED)
- [TO COMPRESSOR CLUTCH] 9(BLU/WHT)
- [TO CONTROLLER SENSOR - 22 GA] 10(YEL)
- [TO CONTROLLER SENSOR - 22 GA] 11(RED)
- [TO ENGINE KILL LUG] 12(BLK)
- [TO ENGINE P-1] 13(WHT)
- [TO START POS ON STARTER SOLENOID] 4(YEL)
- [TO BATT POST ON SOLENOID] 15(ORG)
- [TO GROUND AT REGULATOR] 16(BRN)
- [TO REGULATOR] 17(RED)

TO ENGINE/RECOVERY TANK

*ALL WIRES ARE 18 GAUGE UNLESS OTHERWISE STATED

Figure 8-2 Wiring Diagram

D-6166 Sht 3, Rev E

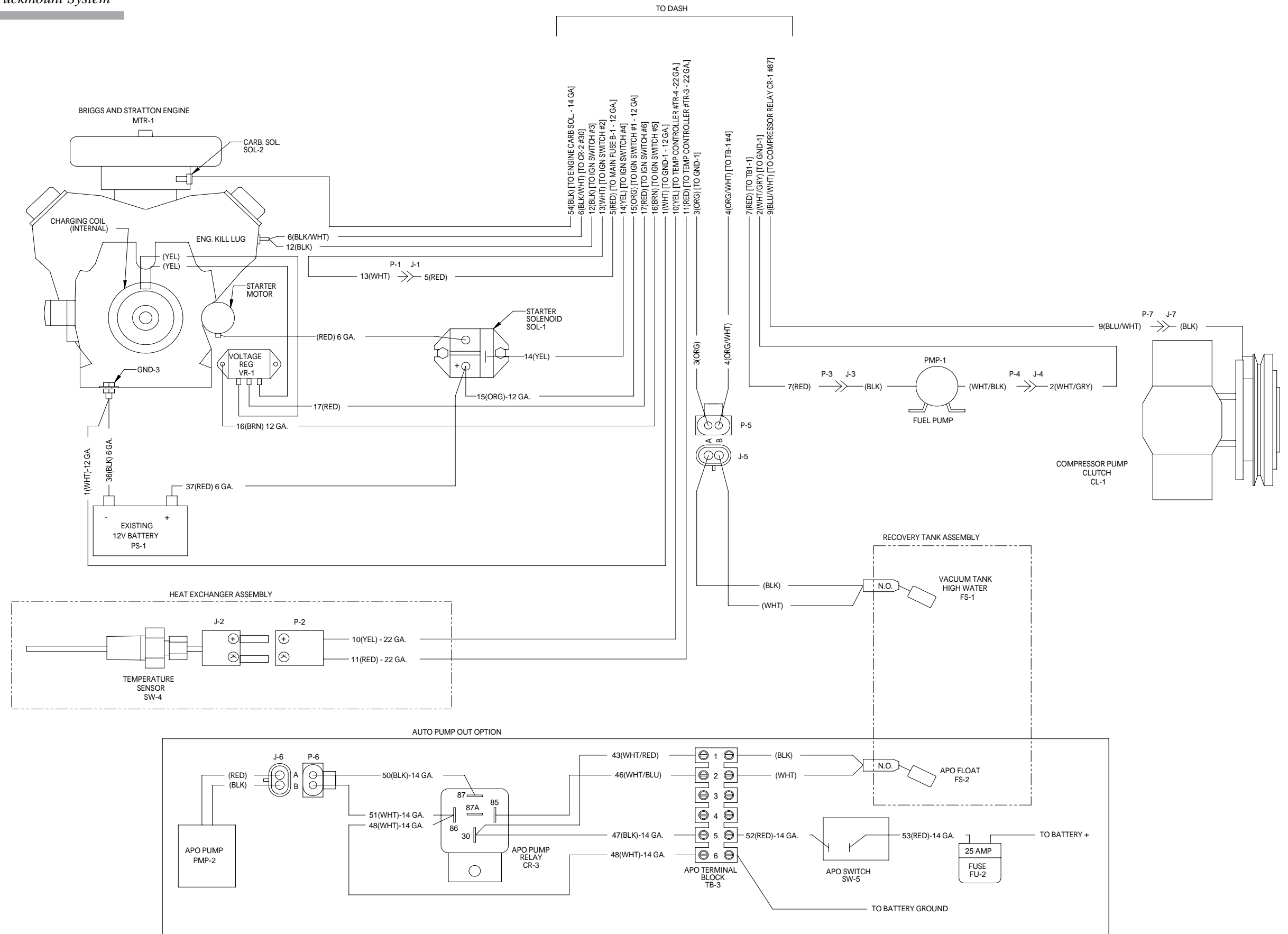
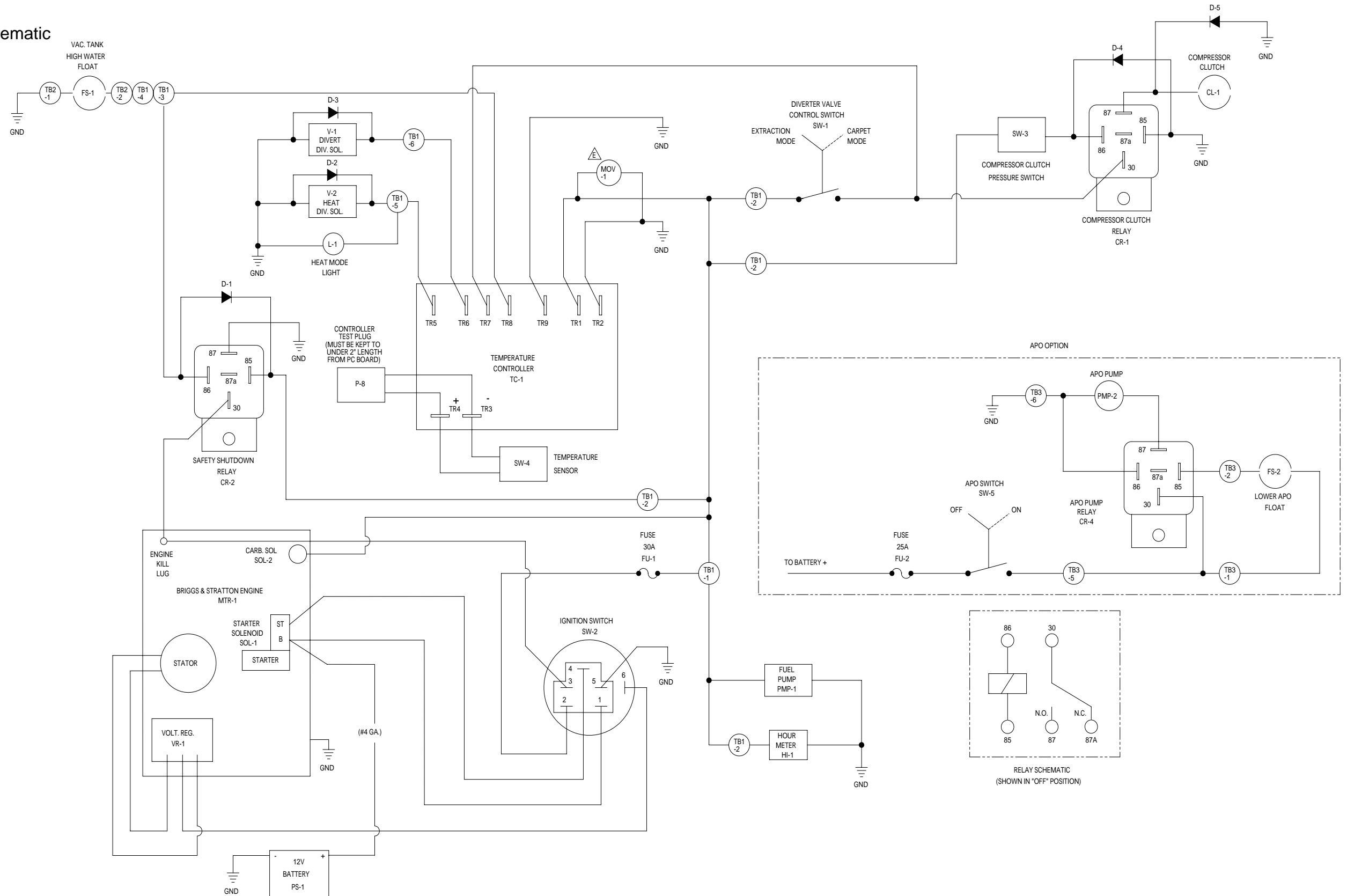


Figure 8-3 Electrical Schematic

D-6167 Rev E



Water and Chemical System

Chemical Flow Operation

The engine, vacuum pump, air compressor, drive system, and heat exchanger are the primary components of the cleaning system. The objective of this system is to move cleaning solution from the solution tank to the surface in need of cleaning, and eventually back to the recovery tank. The first part of this process is to move the cleaning solution out of the solution tanks. This is accomplished by pressurizing the solution tanks with the air compressor. The compressed air pushes the solution out of the tanks and through hoses to the orifice.

The orifice regulates the flow of the cleaning solution. The solution then flows through the heat exchange system into the outlet manifold. The outlet manifold contains a solution valve, pop off valve, and solution outlet. If the wand trigger is in use and the solution is at the desired temperature, the chemical solution will flow through the solution outlet. The solution valve and the pop off valve send the solution to the recovery tank.



Figure 9-1

The heat exchange system (**Figure 5**) elevates the cleaning solution to the desired temperature. This system is comprised of two main components: The components are the engine/blower exhaust heat exchanger and the diverter valve system. The engine/blower exhaust heat exchanger is a cross-flow heat exchanger; solution flows through the stainless steel tubes which flows the mixed exhaust along the outside.

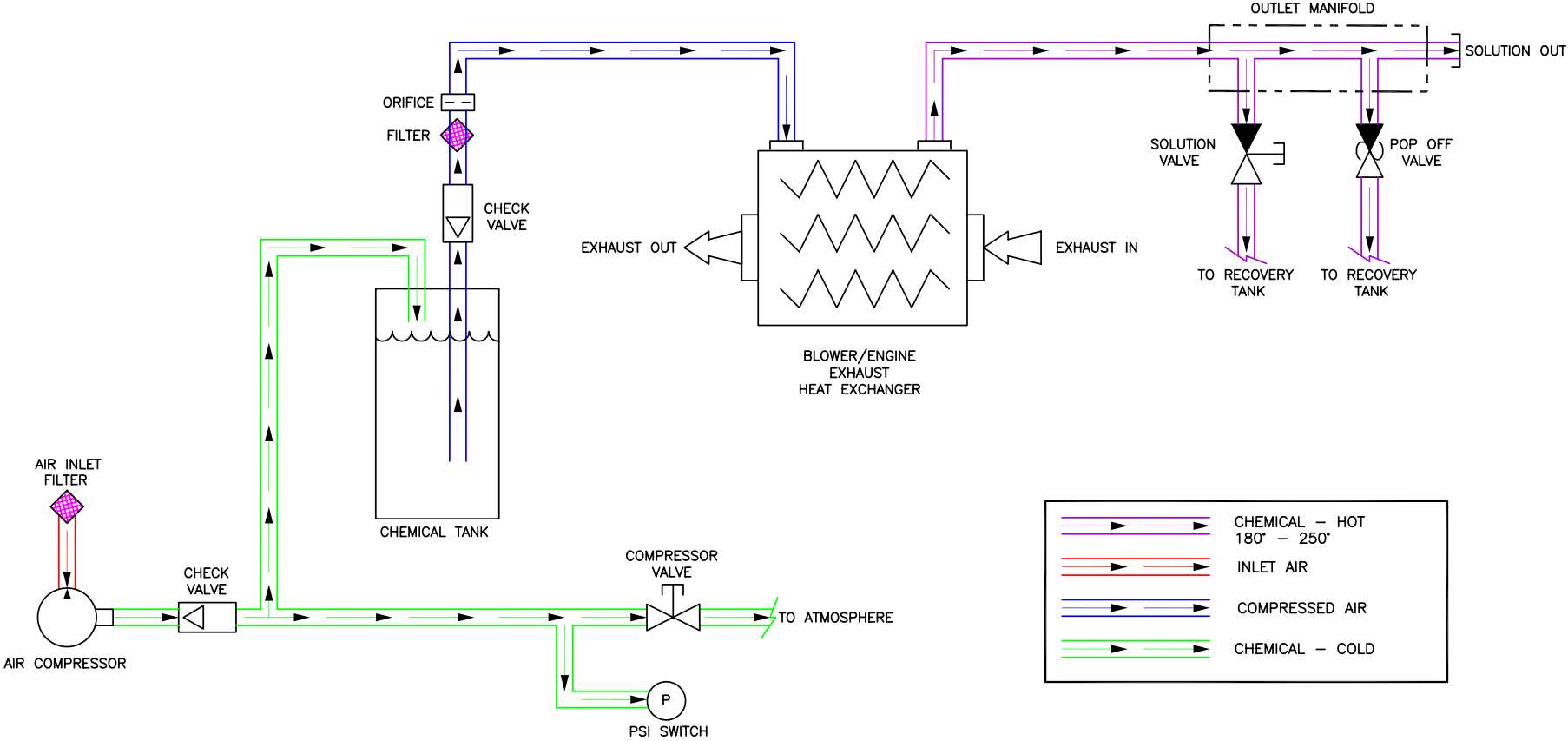
The heating process begins when the mixed exhaust flows through the heat exchanger. The cleaning solution is heated by the mixed exhaust as it flows through the coils of the heat exchanger. Once the cleaning solution has passed through the heat exchanger the flow is directed to the outlet manifold then to the cleaning tool.

The **compressor valve's** purpose is to manually relieve the system of compressed air. This is done in situations such as removing the lids on the solution tanks.

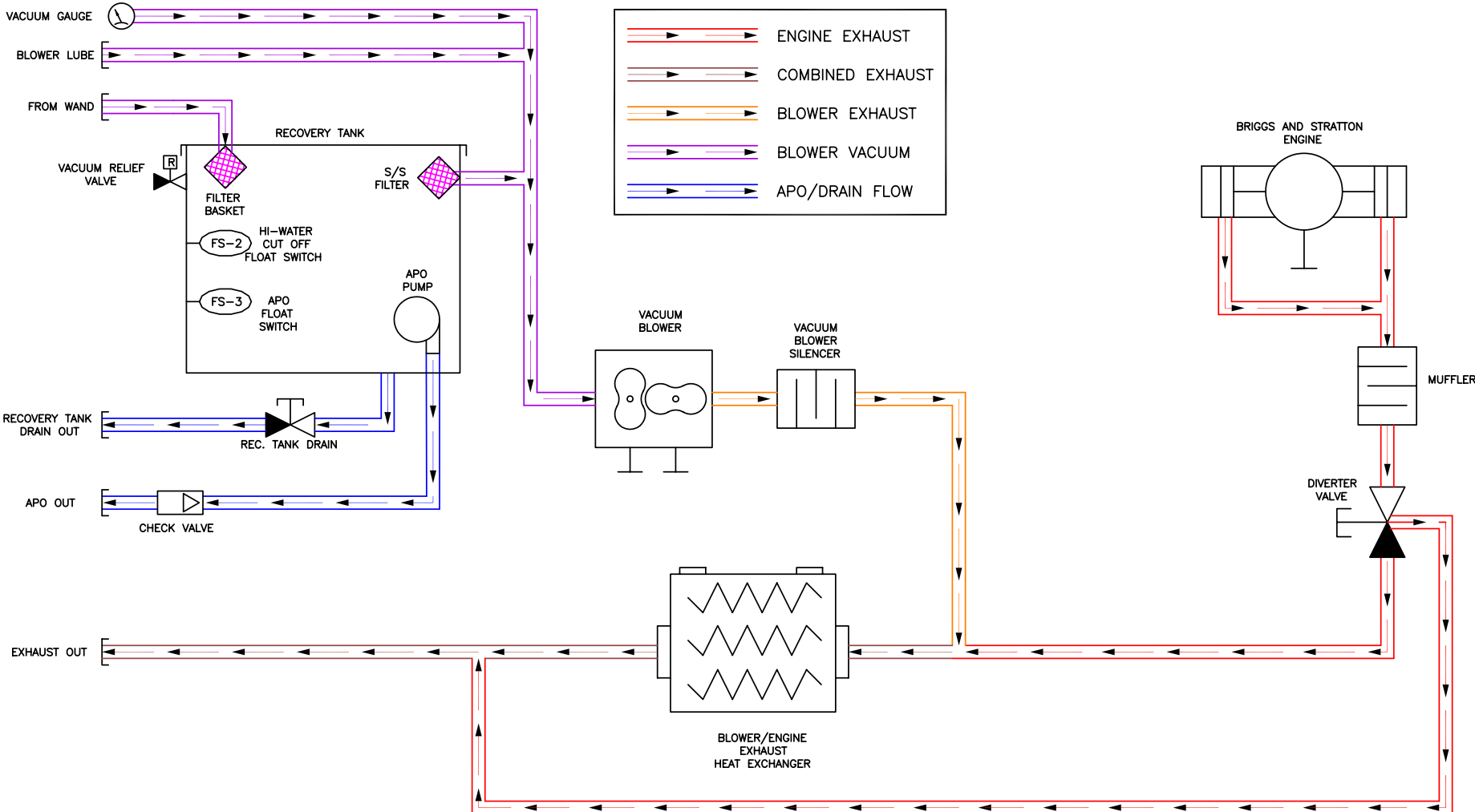
The **solution valve**'s purpose is to relieve the system of excessive pressure on the solution side. This is done in situations such as "Flood Damage Mode" or in a case of the machine running for an extended period of time with no solution hoses hooked up. The pressure build up in the heat exchangers and hoses can be too high for the solution hose to be hooked up. By turning this valve to prime, it will relieve the pressure and allow the solution hose to be connected. The valve can also be used for priming the solution.

CTS 330 *Hot Carbonating Truckmount System*

Figure 9-2 **Solution Flow Diagram**
D-6168 Rev -



CTS 330 Hot Carbonating Truckmount System



Engine Troubleshooting

- 1.0. Will not turn over
- 1.1. **There is a loose or corroded battery terminal.** Clean and tighten the battery terminal connections.
- 1.2. **The battery is dead.** Recharge or replace the battery. Test the charging system. Repair if necessary.

 **WARNING**

Do not attempt to jump-start this machine from a running vehicle. The amperage output from an automobile will damage the charging system of the truckmount.

- 1.3. **The 30 amp main power fuse in the electrical panel has blown.** Inspect the wiring thoroughly to locate shorted or damaged wires.
- 1.4. **The vacuum blower has seized.** Attempt to turn the engine by hand. If it will not turn, refer to Vacuum Troubleshooting in Section 6-3.
- 1.5. **The ignition switch is defective.** Test to see if there is 12 volts to the switch. If there is, but there is not 12 volts going from the switch, replace the switch.
- 1.6. **There is a problem with the starter solenoid.** If there is 12 volts at the battery connection and at the key switch connection with the key in the start position but there is not 12 volts on the starter connection of the solenoid, replace the solenoid.
- 1.7. **The starter motor is defective.** Check to see if the engine can be turned over by hand. If it can and if there is 12 volts from the starter solenoid to the starter, replace the starter.
- 1.8. **There is a mechanical problem with the engine.** If the engine can be turned over by hand and the vacuum blower is not locked, refer the engine to a qualified service technician to determine the cause of the problem.

2.0. Turns over but will not start. There *is no spark*

Note: To check for spark, use the following procedure. Remove a spark plug from the engine. Attach the lead wire back onto the plug. Ground the threaded part of the spark plug to an unpainted engine surface. While holding the plug and wire assembly by the insulated wire, crank the engine over by turning the ignition switch to the "start" position. You should observe a blue spark between the two electrodes of the spark plug.

2.1. **Recovery tank is full.** Empty the tank.

2.2. **Recovery tank float is defective.** Disconnect float. If engine starts, replace the float.

2.3. **Note:** It is important to use only Briggs oil filters. Even though an after-market filter may fit, the internal by-pass system may not be compatible with the Briggs engine resulting in low oil pressure.

2.4. **The high temperature switch has shut the engine down.** Observe the temperature gauge. If it is above the normal operating range, allow the machine to cool down. If it will still not start, disconnect the high temp switch. If the machine then starts, replace the switch.

2.4.1. If the machine starts after it has cooled down, refer to the Heating System section, 1.0.

2.5. **The spark plugs are faulty.** Remove and inspect. Replace as necessary.

2.6. **The engine ignition system is malfunctioning.** Refer to a qualified engine service technician for inspection.

3.0. Turns over but will not start. There *is* spark.

3.1. **Fuel is not reaching the carburetor inlet.** Check the fuel pump. If the pump is working, inspect the fuel lines between the fuel source and the carburetor. Repair or replace any faulty parts as necessary.

3.1.1. If the pump *is not* working, check for 12 volts and a ground at the pump.

3.1.2. If 12 volts *is not* present at the pump, check the wiring to the pump, including the fuse. Repair or replace as necessary. **Note:** If the fuse has blown, carefully inspect the wiring for a shorted or damaged wire. Repair immediately.

- 3.1.3. If 12 volts *is* present at the pump and the ground is good, replace the pump.
- 3.2. **The engine is flooded.** Wait for a few minutes and attempt to start with the choke open.
Note: *If the engine has been flooded, it may be necessary to remove and clean the spark plugs.*
- 3.3. **The spark plugs are dirty or worn.** Inspect and replace as necessary.
- 3.4. **There is a mechanical problem with the engine.** Have engine inspected by a qualified engine service technician.
- 4.0. Will not come up to normal operating rpm
- 4.1. **Throttle linkage is out of adjustment.** Inspect for broken or loose linkage. Repair or replace as necessary and adjust to proper rpm. Note: It is important to use an accurate tachometer to adjust engine speed to 3400 rpm (no load) while it is under a vacuum load of between 10"hg and 12"hg. Too high or too low will cause severe damage to machine components.
- 4.2. **There is excessive load on the engine due to the blower-to-recovery tank hose becoming delaminated.** Remove and inspect the inside of the hose. Replace as necessary.
- 4.3. **There is excessive back-pressure on the engine or blower exhaust.** Check for clogged blower heat exchanger.
- 5.0. Runs rough at medium or high speed
- 5.1. **One or both spark plugs are defective.** Remove and inspect spark plugs. Replace as necessary.
- 5.2. **A spark plug wire is loose at the spark plug or has been damaged.** Inspect wire. Replace wire and coil as necessary.
- 5.3. **Low compression on one or both cylinders.** Check compression. If low, check valve adjustment. If incorrect, adjust to proper specs. This operation should be performed by a qualified service technician.
 - 5.3.1. If adjustment is okay, there is a possibility of burned valves, burned head gasket or worn cylinders. Refer to qualified engine service technician.
- 5.4. **Poor spark on one or both cylinders.** Refer to qualified engine service technician.

- 5.5. **Inadequate fuel supply to the carburetor.** Test the fuel volume at the carburetor by removing the fuel line from the carburetor inlet and placing the line in a metal container with a minimum of 16 oz capacity. Turn on the ignition switch to operate the fuel pump. The fuel flow volume should be 12 oz / minute. Check for clogged filter or obstructed fuel line. Also check to make sure the fuel pump is mounted vertically and is close to the fuel source. Repair as necessary.
- 6.0. Runs rich (Black smoke).
- 6.1. **Dirty air filter.** Inspect and replace as necessary.
- 6.2. **Choke is partially closed.** Inspect and adjust or repair as necessary.
- 6.3. **Excessive fuel to carburetor.** Insure that fuel pump is proper PSI rating. A fuel pump with a psi rating in excess of that of the pump supplied with the machine could overpower the inlet valve in the carburetor, causing excessive fuel to be supplied to the carburetor.
- 7.0. Engine overheats
- 7.1. **Poor ventilation in vehicle.** All cargo area doors must be open for proper ventilation. Roof vents are strongly recommended for machines that are operated in hot climates. Any item that might restrict air flow to the machine such as other equipment or a solid divider should be moved or modified to permit proper air flow.
- 7.2. **Low engine oil level.** Check oil level and replenish as necessary.
- 7.3. **Engine rpm too high.** Check RPM with an accurate tachometer. Adjust as necessary to 3400 rpm (no load).
- 7.4. **Restricted engine or blower exhaust.** Disassemble exhaust components to locate restriction. Repair as necessary.

Warranty Information

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

Blower:

- Failure to lubricate impellers daily with an oil-based lubricant.
- Failure to properly maintain oil levels in the blower.
- Failure to properly grease blower.
- Failure to use the correct oil grade and viscosity as recommended in the blower manual.
- Failure to properly maintain blower safe guard systems such as waste tank filter screen, vacuum safety relief valve and waste tank automatic shut-off system.
- Allowing foam to pass through blower.

Vacuum Tank:

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

Solution System:

- Use of improper chemical
- Operating machine without proper solution filter screen.
- Failure to protect against freezing.

Vacuum and Solution Hose:

- Failure to protect hoses against freezing.
- Failure to protect hoses against burns from engine and 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.

Water Heating System:

- Failure to protect against freezing.

Limited Warranty Plan

HydraMaster warrants all 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 below from date of installation. If repairs or replacements are made by the Purchaser without HydraMaster written consent, HydraMaster 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. Warranties on equipment purchased or used outside of the United States may not carry the same warranty, as per the policy of the individual component manufacturers.

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. To qualify for warranty coverage, defective parts must be returned to HydraMaster within 30 days. No warranty liability whatsoever shall attach to HydraMaster unless and until HydraMaster has received payment in full for the warranted machine or part.

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.

All components not specifically referenced in the schedule below are covered under this warranty for a period of one (1) year, excepting those parts which are considered, by HydraMaster, to be expendable in normal use, including but not limited to paint, labels and other cosmetic parts or features.

SEPARATE DRIVE AIR COMPRESSOR AND VACUUM PUMPS

SGH 'B' MODELS RATED 1/4-1 HP

INSTALLATION, OPERATION, PARTS LIST AND MAINTENANCE

GENERAL

Operation and maintenance instructions as well as parts information presented herein relate to the following models:

SGH-3051B SGH-410B SGH-3V1B
SGH-405B SGH-510B SGH-4VB
SGH-505B SGH-610B SGH-5VB
SGH-605B SGH-610B SGH6VB
SGH-705B
SGH-705B
SGH-617B SGH-E1010B

AMBIENT CONDITIONS

Compressors and vacuum pumps should be located in a well ventilated area where the air is relatively cool, clean, and dry. A 95°F (35°C) maximum temperature is recommend for surrounding and inlet air, while 35°F (2°C) is the minimum temperature recommended. NOTE: UNIT REQUIRES NO LUBRICATION. BEARINGS ARE FACTORY SEALED FOR LIFE.

FILTERS

NEVER OPERATE A COMPRESSOR WITHOUT FILTERS. Intake filters must be kept clean for best performance. To clean filter, lift off top from filter housing, remove filter insert and blow dirt particles from filter using compressed air. DO NOT CLEAN FILTER WITH PETROLEUM BASED PRODUCTS. Replace felt insert after several cleanings.

Establish a periodic time for checking and cleaning all filters to obtain maximum satisfactory service. Filters should be checked for cleaning at least every thirty days as required.

Always use an inlet filter on vacuum pumps to prevent foreign material from entering the pump. Thomas, part number - S62240, inline filter is recommended for this purpose.

WARNING-These Products are suitable for pumping atmospheric air. As defined in Compressed Gas Association Pamphlet G-7, Page 3, atmospheric air is mixture of elements and compounds where nitrogen and oxygen comprise more than 99% with all other trace gases comprising less than 1%. DO NOT USE THIS PRODUCT IN CONTAMINATED ENVIRONMENTS OR FOR PUMPING MIXTURES OTHER THAN ATMOSPHERIC AIR.

 **WARNING**

OSHA SPECIFICATION REQUIRE ALL BREATHING AIR SYSTEMS TO MEET THE STANDARDS AS SPECIFIED FOR "TYPE 1, GROUP D AIR," AS FURTHER DEFINED IN CGA PAMPHLET G-7. THEREFORE, ALL COMPRESSED AIR BREATHING SYSTEMS MUST INCLUDE AIR FILTRATION EQUIPMENT FROM COMPRESSOR INTAKE TO FINAL RESPIRATOR DEVICE.

PISTON & ROD ASSEMBLIES

Consist of assembled piston and rod bearing and eccentric.

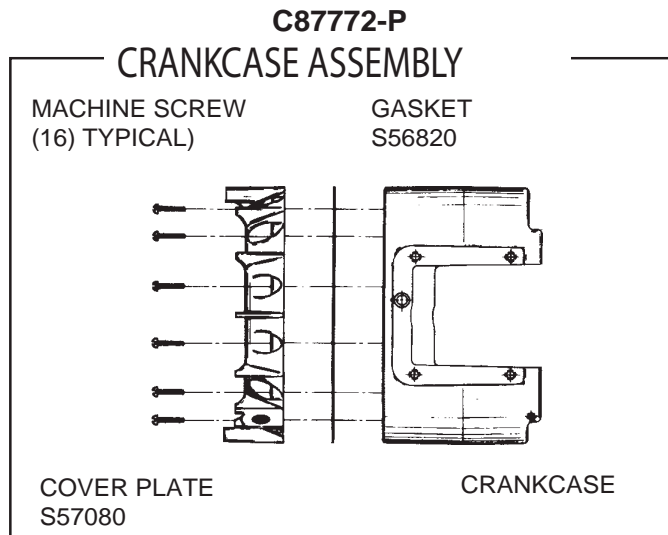
Motor H.P. (Rated)	Number of Cylinders	Vacuum Model	Piston & Rod Assy.	50 PSI Compressor		100 PSI Compressor	
				Model	Piston & Rod Assy.	Model	Piston & Rod Assy.
1/4	1	*SGH-3V1B	C87226-P	*SGH-3051B	C87226-P		
1/3	2	SGH-4VB	C87048-P	SGH-405B	C87050-P	*SGH-401B	C87050-P
1/2	2	SGH-5VB	C87226-P	SGH-505B	C87226-P	SGH-510B	C87050-P
3/4	2	SGH-6VB	C87053-P	SGH-605B	C87226-P	SGH-610B	C87050-P
1	2			SGH-705B	C87053-P	SGH-710B	C87226-P
3 H.P. ENG.	2					SGH-E1010B	C87053-P

*These models use a two cylinder crankcase with one active cylinder. They use C87814-P RH dummy cylinder head assembly listed on page 3. Counter weights are used listed below by model number.

SGH-3V1B & SGH-3051B use counter weight S60780

SGH-410B uses counter weight S60820

H.P.	Cylinders	Model	Pressure	1st Stage Piston/Rod	2nd Stage Piston/Rod
3/4	2	SGH-617B	175 PSI	C87053-P	S70900-P



MODEL NUMBER: This identifies the specific model of the blower.

SERIAL NUMBER: Each blower has a unique serial number. This number is to be used with any service issues and with any contact with the manufacturer.

YEAR: This states the year that the blower was manufactured.

MAWP: This states the maximum allowable working pressure (MAWP) of the blower casing. This is NOT the allowable maximum pressure differential. When determining the pressure differential, the inlet pressure shall be taken into account to assure that the MAWP is not exceeded.

The standard MAWP is per Table 2. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the blower has been performed.

Contact the factory for testing and documentation if this pressure is to be exceeded.

3. LIFTING



WARNING
The blower must be handled using an appropriate device such as a fork truck or appropriate lifting device. See Table 1 for approximate weights. Care should be taken to assure blower does not over-turn during handling and installation.

4. DESCRIPTION



NOTE
Refer to specific data sheets for flow capacities and vacuum capacities.



NOTE
Refer to diagrams in this manual for proper rotation and orientation in inlet and discharge.

Tuthill Vacuum & Blower Systems Competitor model rotary lobe blowers are positive displacement type units, whose pumping capacity is determined by size, operating speed, and differential pressure conditions. Blowers employ rotors rotating in opposite directions within a housing closed at the ends by end plates.

Effective sealing of the inlet to the discharge is accomplished through the use of very small operating clearances. The resulting absence of moving contact eliminates the need for any internal lubrication.

Clearances between the rotors during rotation are maintained by a pair of accurately machined helical timing gears, mounted on the two shafts extended outside the air chamber. The intermeshing rotary lobes are designed to rotate and trap air or gas between each rotor and the housing. As the rotor lobes rotate past the edge of the suction port, the trapped air or gas is essentially at suction pressure and temperature. Since the blower is a constant volume device, the trapped air remains at suction pressure until the leading rotor lobe opens into the discharge port. The close clearances between the rotors inhibit back slippage of the trapped volume from between the rotors and the trapped volume is forced into the discharge piping. Compression occurs not internal to the blower, but by the amount of restriction, either downstream of the blower discharge port, or upstream of the blower inlet port.

Figure 1 illustrates that the air moves not between the rotors but between the rotors and the side of the housing. Also, the machine is bi-directional, meaning that the direction of rotation of the blower can make either side the inlet or discharge. See also the Flow Direction by Rotation section on below.

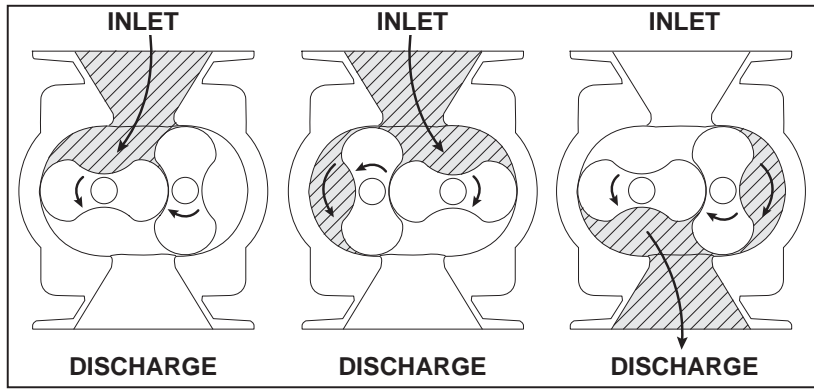


Figure 1 - Illustration of general operation principle

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will increase the power load on the drive system, increase operating temperatures, and can overload and/or seriously damage the blower. Likewise, if a possibility exists that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is also strongly recommended for protection against cutoff or blocking in this line. Check valves should also be used on every blower when more than one blower is connected to a discharge line. This is for both safety and operating conditions.

When a belt drive is employed, blower speed, if necessary, can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves, or by using a vari-speed motor pulley. In a direct coupled arrangement, a variable speed motor or transmission is required, or excess air or gas may be blown off through a manually controlled unloading valve and silencer. Gas units can use bypasses, but some applications may require additional cooling. If there is a large volume of high pressure air or gas downstream of the blower, a check valve in the piping downstream of the blower will protect the blower from overspeeding in a backward direction upon shutdown.

Consult your Tuthill Vacuum & Blower Systems sales professional if questions arise.

4.1 FLOW BY DIRECTION AND ROTATION



WARNING

Refer to diagrams in this manual for proper rotation and orientation in inlet and discharge.

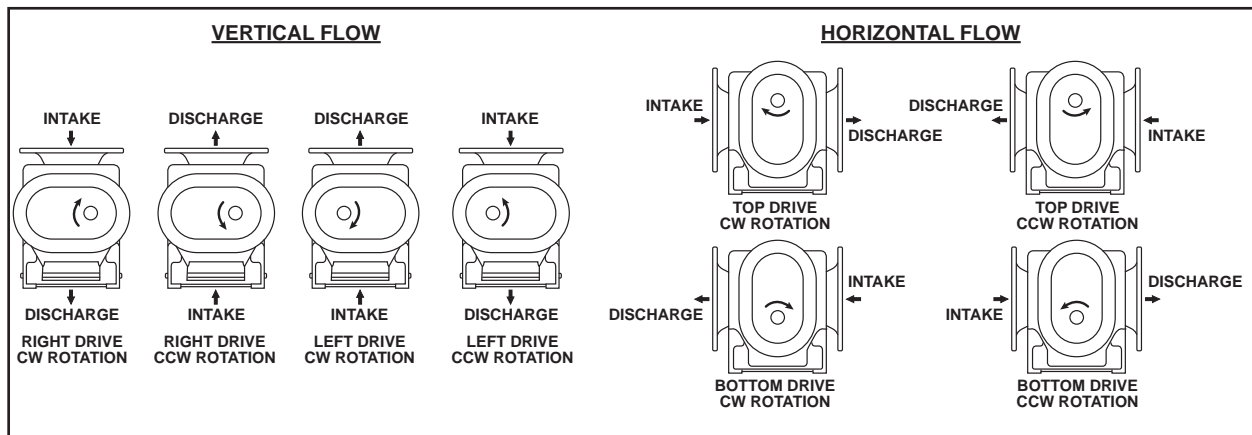


Figure 2 - Flow Direction by Rotation

4.2 SPECIFICATIONS

TABLE 1 — SPECIFICATIONS

MODEL	APPROXIMATE OIL CAPACITY ¹ OUNCES / MILLILITERS				PORT SIZE IN / MM	MAX RPM	APPROXIMATE WEIGHT LBS. / KG
	VERTICAL FLOW		HORIZONTAL FLOW				
	GEAR END ²	DRIVE END ³	GEAR END ²	DRIVE END ³			
2002	3.4 / 101	N/A	1.7 / 50	N/A	1 / 25	5275	41 / 19
2004	3.4 / 101	N/A	1.7 / 50	N/A	2 / 51	5275	53 / 24
3002	6.0 / 177	4.0 / 118	3.4 / 101	2.5 / 74	1.25 / 32	3600	78 / 35
3003	6.0 / 177	4.0 / 118	3.4 / 101	2.5 / 74	2 / 51	3600	83 / 38
3006	6.0 / 177	4.0 / 118	3.4 / 101	2.5 / 74	2.5 / 64	3600	113 / 51
4002	8.5 / 251	6.4 / 189	5.8 / 172	4.7 / 139	1.5 / 38	3600	95 / 43
4005	8.5 / 251	6.4 / 189	5.8 / 172	4.7 / 139	2 / 51	3600	127 / 58
4007	8.5 / 251	6.4 / 189	5.8 / 172	4.7 / 139	3 / 76	3600	146 / 66
5003	18.3 / 541	10.2 / 302	7.1 / 210	5.4 / 160	2.5 / 64	2850	152 / 69
5006	18.3 / 541	10.2 / 302	7.1 / 210	5.4 / 160	4 / 102	2850	185 / 84
5009	18.3 / 541	10.2 / 302	7.1 / 210	5.4 / 160	4 / 102	2850	222 / 101
6005	25.5 / 754	18.0 / 532	16.9 / 500	9.0 / 266	3 / 76	2350	250 / 113
6008	25.5 / 754	18.0 / 532	16.9 / 500	9.0 / 266	5 / 127	2350	310 / 141
6015	25.5 / 754	18.0 / 532	16.9 / 500	9.0 / 266	6 / 152	2350	456 / 207
7006	28.7 / 849	N/A	20.3 / 600	N/A	4 / 102	2050	425 / 193
7011	28.7 / 849	N/A	20.3 / 600	N/A	4 / 102	2050	555 / 252
7018	28.7 / 849	N/A	20.3 / 600	N/A	4 / 102	2050	675 / 306

¹ 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.

² Gear End amounts are applicable to all 21 Series (Competitor Plus) and 22 Series (Competitor SL) Blowers

³ Drive End amounts are only applicable to 22 Series (Competitor SL) and 23 Series (Competitor GT) Blowers

TABLE 2 — MAXIMUM OPERATING LIMITS

MODEL	MAXIMUM RPM	MAXIMUM PRESSURE DIFFERENTIAL psi / mbar	MAXIMUM VACUUM in. Hg / mbar	MAXIMUM TEMPERATURE RISE °F / °C	MAWP psi / bar
2002	5275	12 / 827	16 / 542	225 / 125	15 / 1034
2004	5275	7 / 483	16 / 542	185 / 103	15 / 1034
3002	3600	15 / 1034	16 / 542	210 / 117	15 / 1034
3003	3600	12 / 827	15 / 508	180 / 100	15 / 1034
3006	3600	7 / 483	15 / 508	170 / 94	15 / 1034
4002	3600	15 / 1034	16 / 542	220 / 122	17 / 1172
4005	3600	10 / 690	16 / 542	210 / 117	15 / 1034
4007	3600	7 / 483	15 / 508	170 / 94	15 / 1034
5003	2850	15 / 1034	16 / 542	195 / 108	17 / 1172
5006	2850	13 / 896	16 / 542	195 / 108	15 / 1034
5009	2850	7 / 483	15 / 508	160 / 89	15 / 1034
6005	2350	15 / 1034	16 / 542	250 / 139	17 / 1172
6008	2350	14 / 965	16 / 542	240 / 133	15 / 1034
6015	2350	7 / 483	12 / 406	180 / 100	15 / 1034
7006	2050	15 / 1034	16 / 542	235 / 131	17 / 1172
7011	2050	10 / 690	16 / 542	210 / 117	15 / 1034
7018	2050	6 / 414	12 / 406	120 / 67	15 / 1034



WARNING

The maximum pressure differential is based on the difference between the inlet pressure and the outlet pressure. The maximum pressure differential shall not be exceeded. Exceeding the maximum pressure differential will cause serious damage to the equipment and could cause bodily injury.



WARNING

The maximum allowable working pressure (MAWP) is based on the absolute pressure of the blower housing and is NOT the maximum allowable pressure differential. Exceeding the MAWP will cause serious damage to the equipment and could cause bodily injury.

To permit continued satisfactory performance, a blower must be operated within certain approved limiting conditions. The manufacturer's warranty is, of course, also contingent on such operation. Maximum limits for pressure, temperature and speed are specified here for various blower sizes when operated under the standard atmospheric conditions. Do not exceed any one of these limits.



NOTE

Specially ordered blowers with nonstandard construction, or with rotor end clearances greater than shown within the *Assembly Clearances* table, will not have the operating limits specified here. Contact your Tuthill Vacuum & Blower Systems sales representative for specific information.



NOTE

Special attention must be paid when a blower has a higher than standard ambient suction temperature. Special recommendations for operating parameters and/or additional cooling may be recommended. Consult the factory or local representative for appropriate information.

5. INSTALLATION

5.1 GENERAL



DANGER

The blower is not intended to be used with explosive products or in explosive environments.



DANGER

It is the responsibility of the installer to assure that proper guarding is in place and compliant with all applicable regulatory requirements.



WARNING

The bare shaft blower can generate excessive noise. Methods to reduce the noise levels by installing inlet and outlet silencers will be required. Even with inlet and outlet silencers, hearing protection will be required.



WARNING

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



WARNING

The standard MAWP is per Table 2. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the blower has been performed.



WARNING

Table 2 states the maximum operating speed in RPM (rotations per minute) and maximum temperature. Do not exceed these limits. The installation of the blower shall take these critical operating parameters into account and adequate control features implemented.



WARNING

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 of binding. If blower is removed and still does not move freely, check inside the blower housing for foreign material.



NOTE

Remove the protective covers from the shaft and inspect for damage.

Carefully check to ensure that no transit damage has been sustained. If damage has occurred from shipment a claim must be filed with the carrier immediately; preserve the shipping container for inspection by the carrier.



NOTE

In the event that your unit sustains damage while being shipped to your facility, do not return it to the factory without first obtaining shipping instructions from us.

Protective covers and plugs should not be removed until the connection is being made. Mount the blower on a flat, level surface. We recommend a baseplate that is a rigid, solidly supported, and structurally sound. Shim under the legs where necessary so that each leg of the blower supports an equal share of the blower weight. This is necessary to prevent eventual twisting of the blower. Make sure feet rest evenly on the mounting surface before fastening down. Twisting or cramping the blower in mounting will cause rotor contact and binding during operation, resulting in a condition called “soft foot”. (See the *Soft Foot* section of this manual for further details and preventative measures.)

A unit that is factory mounted on a base, should not require the above adjustments. However, since the assembly can become twisted in shipping or installation, checking for soft foot should be done after installation of the base. Shims may be needed for alignment. Loosen the foot hold-down screws to check foot contact with the mounting surface. The base should be mounted on a solid foundation or heavy flooring, using shims as necessary at bolting points to prevent warping the assembly. (Also refer to the *Foundation* section.)

Transmission of small operating vibrations to a support structure may be objectionable in some cases. Use of vibration isolators or vibration absorbing materials can be effective in overcoming this problem. To avoid casing distortion, the treatment used should be applied under the common motor/blower base or mounting plate, rather than directly under the feet alone.

Piping should be accurately squared with the blower and supported independently. Stress imparted from incorrectly aligned piping or mounting will create problems with bearing and seal life, possibly leading to premature internal contact. The blower should sit stress free and evenly on its supporting surface. Care should be taken to evenly tighten the mounting bolts to not impart undue stress into the blower. Stress can

be checked in a free state with feeler stock or verified on a previously installed blower with the aid of a dial indicator. Less than .002" (.05 mm) spring or gap should be found.

Use only clean new pipe and make certain it is free of scale, cuttings, weld beads, dirt, or any other foreign material. To guard against damage to the blower, insure that an inlet filter is used. Make provisions to clean the filter of collected debris after a few hours of operation and periodically thereafter. (See the *Piping Connections* section for additional details.)

Figure 3 shows a typical complete installation of blower and accessories. Note the absence of throttle or shut-off valves in either discharge or intake piping. If it is possible for air flow to be cut off in either of these lines, make provisions to add a pressure and/or vacuum relief valve. In some installations, it may be desirable to use only an inlet silencer-cleaner supported directly from the blower connection. Weight of accessories and piping must be kept to a minimum to prevent blower casing distortion. Weights in excess of 10% of blower weight should be supported independently of blower and connected with a flexible hose or connectors. (The approximate weight of your unit is included within the *Specifications* table.)

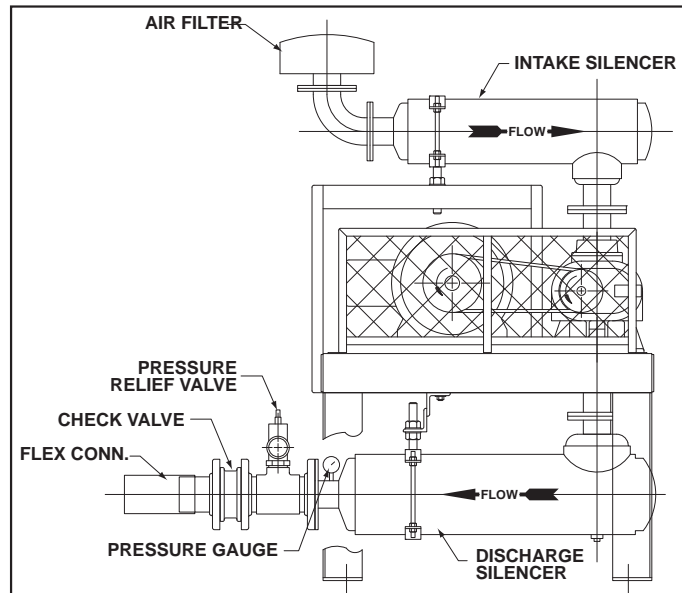


Figure 3 - Typical Blower Installation

A blower may be driven by direct-coupling to the driver or by V-belt drive, to obtain other speeds within approved range. (See the *Motor Drives* section for more information.)

Blowers from Tuthill Vacuum & Blower Systems are internally and externally treated after factory assembly and testing to protect against rusting in normal atmospheric conditions prior to installation. The maximum period of internal protection is considered to be up to 6 months under average conditions, provided closing plugs and seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the blower until ready to begin installation, as protection will be quickly lost due to evaporation. (For recommended preparations for long term storage (longer than 6 months), please see the *Long Term Storage* section in this manual.)

5.1.1 LOCATION

Install your blower in a room or outdoor area that supplies adequate space and lighting for routine maintenance. Indoor installation areas should be well ventilated and kept as cool as possible, because operating the unit at elevated temperatures can result in nuisance overload or temperature shutdowns. An unprotected outdoor installation is only satisfactory when correct lubrication for expected temperatures is provided, as per the *Recommended Lubricants* section in this manual.

5.1.2 FOUNDATION

Your blower does not need a special foundation, however it does require a solid, level floor and adequate frame support. Bolt the blower system to the floor and seal any cracks.

5.1.3 BLOWER AIR INTAKE

To minimize maintenance, supply your blower with the cleanest air possible. It is important that the air does not contain any flammable or toxic gases, as the blower will concentrate these gases. This could result in damage to the unit and surrounding property, lead to personal injury or death. Do not block or restrict the opening or the blower and/or motor may overheat and fail.

Do not use blowers on explosive or hazardous gases. Each size blower has limits on pressure differential, running speed, and discharge temperature. These limits must not be exceeded. Consult Table 2 for details pertaining to the allowable performance criteria.

If it is necessary to take air from a remote source, such as in a vacuum application, the piping should be at least the same diameter of the blower inlet. For distances greater than 20 feet (6 m) the pipe diameter should be enlarged to reduce inlet restriction. Excessive restriction will reduce the efficiency of the blower and elevate its discharge temperature. The piping used should also be corrosion resistant, and free of scale and dirt. The inlet should be covered to keep out precipitation, insects, and small animals. Vacuum kits are available.

5.1.4 SOFT FOOT

Soft foot is a condition in which one of the blower feet does not sit flat on the base. Usually, this is due to irregularities in the surface to which the blower is mounted. When you tighten the bolt on the foot, the blower will distort slightly, but enough to cause problems with bearing and seal life, and premature internal contact between the rotors and the housing.

1. Place blower on base.
2. Check each foot for gaps between foot and base (soft foot), shim as necessary to fill gap within .002" (.05 mm) Below are shown the two most common types of soft foot conditions. If either type is present, and measures more than .003" (.076 mm), the blower may fail prematurely.
3. Tighten all bolts.
4. Mount a dial indicator on base contacting one foot at 12 o'clock position.
5. Loosen bolt on that foot. Observe indicator travel and add shims as needed to reduce "spring" to less than .002" (.05 mm). Repeat steps 4 and 5 on remaining feet.

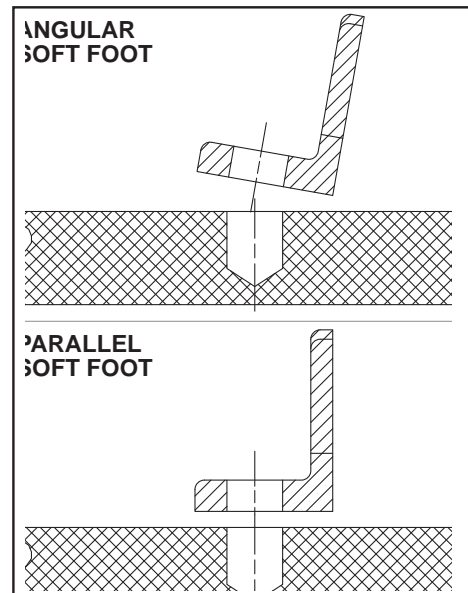


Figure 4 - Illustrations of Soft Foot

5.2 SAFETY

Tuthill Vacuum & Blower Systems recommends 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.



DANGER
It is the responsibility of the installer to assure that proper guarding is in place and compliant with all applicable regulatory requirements.



DANGER
Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. The blower should never be run with the inlet or discharge piping removed. If it becomes necessary to inspect the rotating parts of the blower or to change V-belts, be absolutely sure that all power to the motor controls has been shut off, the motor controls are locked out, and properly tagged before proceeding.



DANGER

Assure that properly sized vacuum breaks/relief valves are used on the inlet side of the blower. Also assure that properly sized pressure relief valves are used on the outlet of the blower. The sizing shall be such to assure that the proper flow can be achieved without exceeding the rated vacuum and pressure ratings.



DANGER

Blower housing and associated piping or accessories may become hot enough to cause major skin burns on contact.



WARNING

Use lock out/tag out procedures to disable the electrical energy source before any service or work is done on the blower.



WARNING

Avoid extended exposure in close proximity to machinery with high intensity noise levels. Wear adequate ear protection.



NOTE

Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.

5.3 LUBRICATION

Every blower from Tuthill Vacuum & Blower Systems 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. Oil reservoirs are under vacuum.

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 within the *Filling Procedure* section.

Add oil to the blower in the quantity shown within the *Specifications* Table. The oil level must be maintained within the notched area of the sight glass. See Figure 5. Lower drive units have “bull’s eye” type oil level gauges. Maintain oil levels at the center of the glass.



WARNING

Never attempt to change or add lubrication while the blower is running. Failure to heed this warning could result in damage to the equipment or personal injury. Oil must be checked when the blower is NOT running.



WARNING

Properly dispose of the spent lubricants. Refer to the manufacturer of the lubricant and any regulations to assure proper and safe disposal.



WARNING

Do not start the blower until you are sure oil has been put in the gear housing and front cover (grease if 21 series). Operation of the blower without proper lubrication will cause the blower to fail and void the warranty.



NOTE

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.

5.3.1 FILLING PROCEDURE

See Figure 5. Recommended lubricants are shown on page 33.

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.

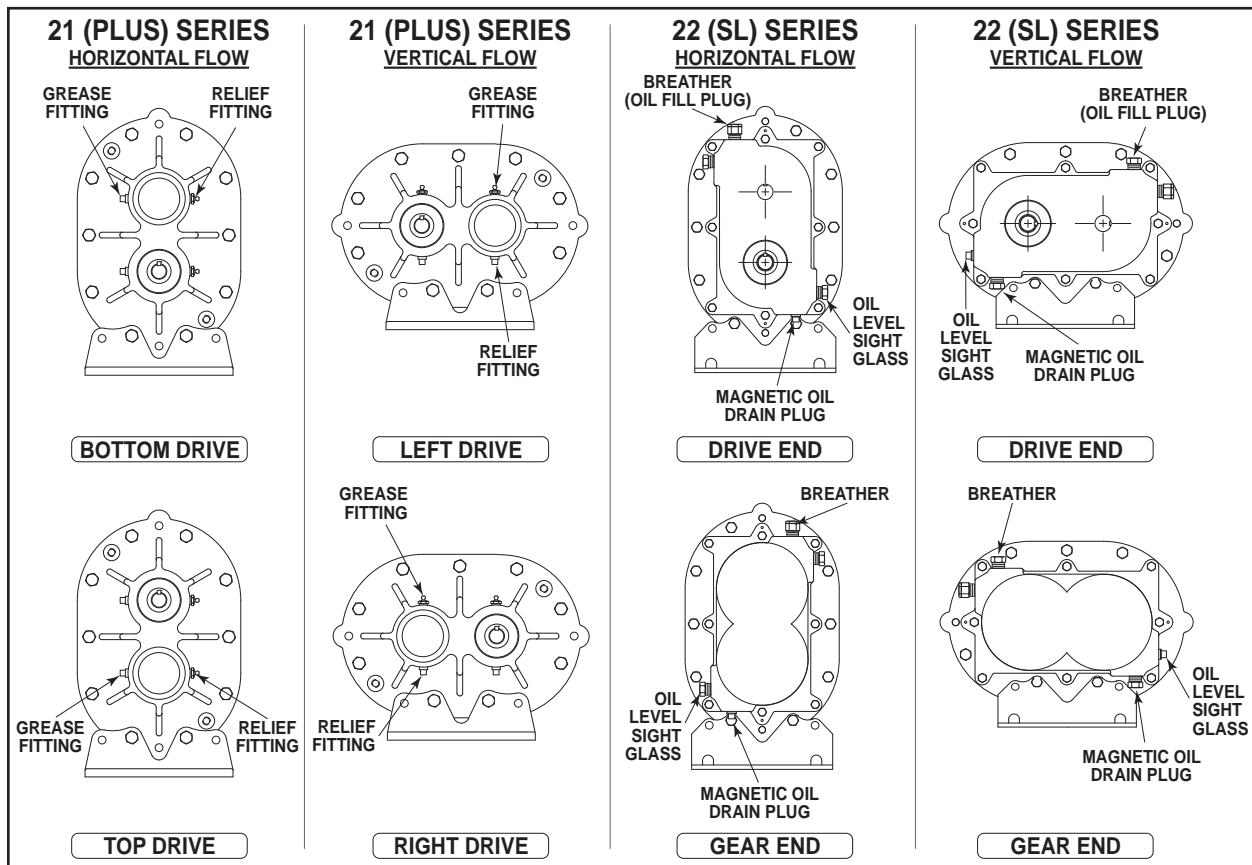


Figure 5 - Location of oil fill, drain, and level gauges on Competitor blowers

5.3.2 FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION

What is the functional detriment if the “wrong oil” is used?

The lubricant is selected based on bearing and gear speed, and operating temperature. Too light of a lubricant increases wear by not separating the sliding surfaces and it will not remove the heat adequately. If the lubricant is too thick, the drag in the bearings is increased causing them to run hotter. Since it is thicker, it will not flow as readily into the gears and it will reduce the available backlash. Lubricants at our conditions are incompressible.

What is the functional detriment if the oil is not serviced?

If the lubricant is not serviced at the proper interval the shearing action in the bearing and the gears will begin to take their toll and the lubricant will thicken, making matters worse. The unit will run hotter and the wear on running surfaces will increase. Generally, the lubricant will appear dirtier, this is actually material rubbed off the unit's components. The discoloration comes from overheating the additive package. An indicator of the breakdown of a lubricant is the increase in the TAN (Total Acid Number), and a change in the base viscosity of ten percent.

Several things are happening as the lubricant goes through the unit. First, it is absorbing frictional energy in the form of heat. This heat has to be dissipated through either surface contact with cooler materials, or in a rest volume of lubricant. While reducing the friction, the lubricant is also going through a shearing process and the molecular structure is broken down.

The result is that the lubricant will begin to thicken because of the shorter molecular chains and the drop out of additive packages. The thickened lubricant will cause more drag, increasing the friction and heat, and further degrading the lubricant.

Operation of the blower (environment, run time, speed, and pressure) has a direct effect on duty cycles. Our published cycles are based on worst-case conditions.

5.3.3 HAZARDS ASSOCIATED WITH BREAKDOWN OR IGNITION OF LUBRICATION



DANGER

There is a risk associated with the lubrication media breaking down and resulting in a hazardous fluid or vapor. There may also be a hazard associated with the ignition of the lubrication media. Refer to the lubrication manufacture's applicable instruction for safety precautions.

5.3.4 GREASE LUBRICATED BEARINGS — 21 (PLUS) SERIES ONLY

Service drive end bearing at regular intervals. (See the *Suggested Lubrication Intervals for Grease Lubricated Bearings* table, to the right.) Use NLGI #2 premium 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.

SUGGESTED LUBRICATION INTERVALS FOR GREASE LUBRICATED BEARINGS			
SPEED IN RPM	OPERATING HOURS PER DAY		
	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 & up	1	1	1



NOTE

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



NOTE

Refer to Figure 5, which shows locations of grease fitting and grease relief for horizontal and vertical flow units (21 series).

5.4 PIPING CONNECTIONS



NOTE

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



WARNING

Pipe loading on the blower should be negligible as pipe loading can cause distortion of the blower. Use proper supports and pipe hangers to assure that there is no loading.

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.

HAZARDS ASSOCIATED WITH HAZARDOUS PROCESS FLUIDS



DANGER

It shall be the responsibility of the installer to ensure that piping is adequate, sealing between pipe joints is adequate for the process fluids and proper process and pressure protection devices are in place. It is also the responsibility of the installer to assure that process gasses are not vented in a manner that would be hazardous.

Refer to the manufacturer of the process media to assure that proper safety precautions are in place.

5.4.1 BLOCKAGE OR RESTRICTION



WARNING

Damage to the blower could occur if there is blockage in the inlet or outlet ports or piping. Care should be taken when installing the blower to assure that there are no foreign objects or restrictions in the ports or piping.

5.5 MOTOR DRIVES

Two drive connections commonly used are direct drive and V-belt drive.

5.5.1 DIRECT COUPLED

When installing the motor directly to the blower, align shafts to coupling in accordance with the coupling manufacturer's instructions. Blowers shipped with motor directly coupled and mounted on a common base have been aligned prior to shipment and normally no further alignment is necessary. However, alignment should be checked and adjustments made if necessary prior to starting the unit.

Coupling halves must correctly fit the blower and drive shafts so that only light tapping is required to install each half. The two shafts must be accurately aligned, A direct coupled blower and motor must be aligned with the two shafts not having more than .005" (13 mm) T.I.R. (Total Indicator Reading). Face must be aligned within .002"(.05 mm) .

Proper gap between coupling halves must be established according to coupling manufacturers instructions with the motor armature. This will minimize the change for end thrust on the blower shaft. All direct coupled base mounted units must be re-aligned and greased after field installation.

5.5.2 V-BELTS

If the motor and blower are V-belt connected, the sheaves on both motor and blower shafts, should be as close to the shaft bearings as possible. Blower Sheave is not more than 1/4" (6.5 mm) from the blower drive end cover. The drive sheave is as close to the driver bearing as possible. Care should be taken when installing sheaves on the blower and motor shafts. The face of the should be accurately in line to minimize belt wear.

Adjust the belt tension to the to the manufactures specifications using a belt tension tester. New belts should be checked for proper tension after 24 hours of run time. When manufacturer data is not available industry guidelines are 1/64 inch deflection for each inch of span at 8 to 10 pounds of force in the center of the belt.

Insufficient tensioning is often indicated by slipping (squealing) at start up. Belt dressing should not be used on V-belts. Sheaves and V-belts should remain free of oil and grease. Tension should be removed from belts if the drive is to be inactive for an extended period of time. For more specific information consult the drive manufacturer. In a v-belt drive, the blower sheave must fit its shaft accurately, run true, and be mounted as close to the bearing housing as possible to minimize bearing loads.

A tight or driving fit will force the drive shaft out of its normal position and cause internal damage. A loose fit will result in shaft damage or breaking. The motor sheave must also fit correctly and be properly aligned with the blower sheave.

Adjust motor position on its sliding base so that belt tension is in accordance with drive manufacturer's instructions. Avoid excessive belt tension at all times. Recheck tension after the first ten hours of operation and periodically thereafter to avoid slippage and loss of blower speed.

Check blower after installation and before applying power by rotating the drive shaft by hand. If it does not rotate freely, look for uneven mounting, piping strain, excessive belt tension, or coupling misalignment. Check blower at this time to insure oil was added to the reservoirs.

5.5.3 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.

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.

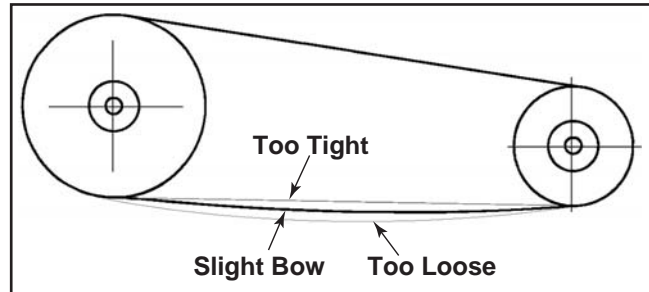


Figure 6 - General appearance of a V-Belt drive

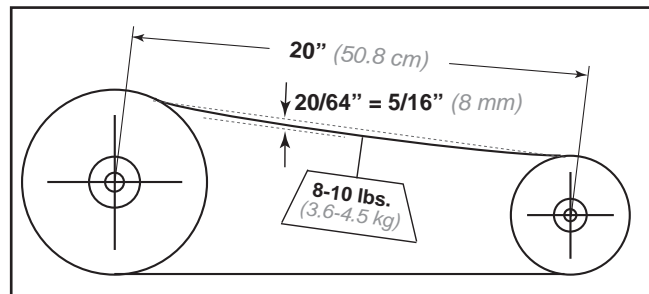


Figure 7 - Setting of proper tension for a V-Belt drive

5.5.4 V-BELT TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	SOLUTION
Belts slip (sidewalls glazed)	Not enough tension	Replace belts; apply proper tension
Drive squeals	Shock load	Apply proper tension
	Not enough arc of contact	Increase center distance
	Heavy starting load	Increase belt tension
Belt(s) turned over	Broken cord caused by prying on sheave	Replace set of belts and install correctly
	Overloaded drive	Redesign drive
	Impulse loads	Apply proper tension
	Misalignment of sheave and shaft	Realign drive
	Worn sheave grooves	Replace sheaves
	Excessive belt vibration	Check drive design Check equipment for solid mounting Consider use of banded belts
Mismatched belts	New belts installed with old belts	Replace belts in matched sets only
Breakage of belt(s)	Shock loads	Apply proper tension; recheck drive
	Heavy starting loads	Apply proper tension; recheck drive Use compensator starting
	Belt pried over sheaves	Replace set of belts correctly
	Foreign objects in drives	Provide drive guard
Rapid belt wear	Sheave grooves worn	Replace sheaves
	Sheave diameter too small	Redesign drive
	Mismatched belts	Replace with matched belts
	Drive overloaded	Redesign drive
	Belt slips	Increase tension
	Sheaves misaligned	Align sheaves
	Oil or heat condition	Eliminate oil. Ventilate drive.

5.6 MOTOR AND ELECTRICAL CONNECTIONS



WARNING

The motor and connections shall be protected to assure that product and environmental condensation does not come in contact with the electrical connections.



NOTE

It is the responsibility of the installer to assure that the motor is in compliance with the latest edition of IEC 60204-1 and all electrical connections performed per IEC 60204-1, this includes over current protection.

Wire the motor and other electrical devices such as solenoid valves and temperature switch to the proper voltage and amperage as indicated on the nameplate of each component being wired. Turn the blower by hand after wiring is completed to determine that there are no obstructions and if the blower turns freely; then momentarily start the blower to check the direction of rotation. Figure 2 shows direction of air flow in relation to rotor rotation. The air flow direction can be reversed by reversing the appropriate motor leads.

6. OPERATION

6.1 GENERAL



DANGER

The blower is not intended to be used with explosive products or in explosive environments.



WARNING

Do not operate without guards in place.



WARNING

Maximum operating speed: Table 2 states the maximum operating speed in RPM (rotations per minute), the maximum pressure differential, maximum vacuum and maximum temperature rise. Do not exceed these limits.



WARNING

The blower can generate excessive noise, hearing protection is required while the unit is in operation.

Before starting the blower for the first time under power, recheck the installation thoroughly to reduce the likelihood of troubles. Use the following check list as a guide, but also consider any other special conditions in your installation.

1. Be certain no bolts, rags, or dirt have been left in blower.
2. Be certain that inlet piping is free of debris. If an open outdoor air intake is used, be sure the opening is clean and protected by an inlet filter. This also applies to indoor use.
3. If installation is not recent, check blower leveling, drive alignment, belt tension, and tightness of all mounting bolts.
4. Be certain the proper volume of oil is in the oil reservoir chambers.
5. Be certain the driving motor is properly lubricated, and that it is connected through suitable electrical overload devices.
6. With electrical power off and locked out to prevent accidental starting, rotate blower shaft several times by hand to make sure blower is rotating freely. Unevenness or tight spots is an indication of a problem that should be corrected before progressing.
7. Check motor rotation by momentarily pushing the start button and check flow direction of the blower. Reverse the motor connections if flow is in the wrong direction.

Initial operation should be carried out under “no load” conditions by opening all valves and venting the discharge to atmosphere, if possible. Then start motor briefly, listen for unusual noises, and check that the blower coasts freely to a stop. If no problem appears, repeat this check, and let the motor run a little longer. If any questions exist, investigate before proceeding further.

Assuming all tests are satisfactory, the blower will now be ready for continuous full load operation. During the first several days, make periodic checks to determine that all conditions remain acceptable and steady. These checks may be particularly important if the blower is part of a process system where conditions may vary. At the first opportunity, stop the blower and clean or remove inlet filter. Also, recheck leveling, coupling alignment or belt tension, and mounting bolts for tightness.

6.2 START-UP CHECKLIST

We recommend that these startup procedures be followed in sequence and checked off (☑) in the boxes provided in any of the following cases:

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

DATES CHECKED:

Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to the *Lubrication* section. Please see *Recommended Lubricants* for information on acceptable lubricants for your product.

Check V-belt drive for proper belt alignment and tension.

Carefully 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.

“Bump” the unit with the motor to check rotation (counter-clockwise [CCW] when facing shaft) and to be certain it turns freely and smoothly.

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* chart.

Apply the load and observe the operation of the unit for one hour.

If minor malfunctions occur, discontinue operation and refer to the *Troubleshooting* chart.

6.3 OPERATING

The upper temperature limit for blower operation is 445° F (229° C) measured in the exhaust gas stream with a low mass thermocouple. When this temperature limit switch is installed, as the temperature exceeds the predetermined temperature, the blower motor will stop and cannot be restarted until the temperature drops below the trip setting of the temperature switch.



DANGER

The blower is not intended to be used with explosive products or in explosive environments.



WARNING

Physical harm may occur if human body parts are in contact or exposed to the process vacuum. Assure that all connections are protected from human contact.



WARNING

If rated vacuum or pressure levels are exceeded, process fluids will migrate to other parts of the blower and system.



CAUTION

Do not touch hot surfaces.

The upper limit of the blower operation is 445° F (229° C) Do not touch the blower while it is in operation and assure blower is cool when not in operation.



CAUTION

Use of a thermowell insulates the thermocouple. Invalid and delayed readings will result. This can result in ineffective protection devices.



NOTE

The upper temperature limits are not intended for continuous operation. Consult with factory for detailed information assistance.

6.4 STOPPING



CAUTION

Do not stop the blower if there are high outlet pressures in the outlet piping. Unload the outlet piping prior to shutting down the blower.

Stop the blower by turning off the motor. Isolate the blower from the vacuum system and vent the blower to atmosphere. Turn off the cooling water, if water cooled. Stop the backing pump. Refer to component instruction manual.

6.5 WATER INJECTED BLOWERS

Water injected into the inlet of a blower operating on vacuum service will cool the blower. The water absorbs the heat of compression as it passes through the unit along with the air/gas being compressed. A blower cooled in this manner can operate safely at higher vacuums or higher inlet temperatures than a normally uncooled unit.

The amount of water required depends on the inlet air/gas temperature, inlet vacuum, water temperature, and the maximum discharge temperature desired. Check with the factory or sales representative for additional guidance.

6.5.1 OPERATION

1. Check oil level in sight glass of blower and assure all fittings are tight.
2. Check the water injection system to assure water is available.
3. Operate the blower dry for a few minutes at no load to check correct rotation and smooth operation.
4. Turn water on and adjust flow as recommended for the individual blower. Assure water discharges freely from the outlet piping.
5. Apply vacuum and observe operation at the desired inlet condition.

6.5.2 SHUTDOWN

1. The blower can be shutdown for brief periods by relieving the inlet vacuum, shutting the water off, and then stopping the unit.
2. Rusting during a slightly longer shutdown period can be avoided by operating the blower under a partial vacuum without the water injection, allowing the blower to heat within safe limits. The heat will tend to drive off residual moisture.

3. For extended shutdown, oil may be injected into the inlet of the heated blower just prior to shutting the blower down. The oil will provide a protective coating on the internals. Insure that the water is completely shut off after shutdown.
4. Special coatings or platings are available to minimize rusting or corrosion in applications where units can remain wet.

Vertical flow units with two-lobed, plugged rotors should always be used. Always orient system such that the blower intake is at the top and discharge at the bottom.



CAUTION
Water injection can cause lime build-up on rotors. Check water supply for hardness. The use of water softeners, other chemicals, or distilled water may be necessary to prevent or remove this build-up. However, due to the wide variations in mineral content, pH, and chemical content of water that can be injected, Tuthill Vacuum & Blower Systems cannot be responsible for damage which may result should this build-up occur. Units should be inspected regularly to determine any problems.



NOTE
For liquid injection other than water, consult the factory.

6.6 RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

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.



NOTE
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 as WD-40® into the inlet of the blower just prior to shutdown. (*3-in-One and WD-40 are registered trademarks of WD-40 Company.*) The lubricant will provide an excellent protective coating on 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.
4. If the blower is being taken out of commission for an extended period of time, please also refer to the "Long Term Storage" section of this manual.

7. MAINTENANCE

7.1 GENERAL

Regular inspection of your blower and its installation, along with complete checks on operating conditions will pay dividends in added life and usefulness. Also, service the drive per manufacturer's instructions and lubricate the coupling or check belt drive tension. By use of thermometers and gauges, make sure that blower operating temperature and pressure remain within allowed limits.



DANGER

The blower and parts may contain hazardous media. Assure that pump and parts are evacuated of hazardous media prior to servicing.



CAUTION

The electrical service must be isolated and de-energized prior to maintenance. Apply appropriate procedures to assure electrical supply is de-energized and cannot be inadvertently energized during maintenance.

Assure piping and product is isolated prior to maintenance of blower. Apply appropriate procedures to assure piping and product is isolated and that inadvertent opening of valves cannot occur during maintenance.



CAUTION

During routine maintenance, inspect and assure that guards are in place and secure.

Particular attention should be paid to lubrication of timing gears and bearings in accordance with comments under the *Lubrication* section.

When a blower is taken out of service, it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of down time. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately. Refer to the *Long Term Storage* section for more details.

7.2 REGULAR 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. With blower at rest, check oil level in both the gear (drive) end and free (non-drive) end of the blower and add oil as needed. Complete oil changes are recommended every 1000-1200 operating hours, or more frequently depending on the type of oil and operating temperature. Also change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
<ol style="list-style-type: none"> 1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (See <i>Troubleshooting</i>) 	<ol style="list-style-type: none"> 1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage. 2. Check relief valve to assure it is operating properly. 	<ol style="list-style-type: none"> 1. Inspect the entire system for leaks. 2. Inspect condition of oil and change if necessary. 3. Check drive belt tension and tighten if necessary.



NOTE
Oil levels should be checked every 24 hours of operation.

Proper oil drain schedules require oil be changed before the contaminant load becomes so great that the lubricating function of the oil is impaired or heavy disposition of suspended contaminants occurs. To check the condition of the oil, drain a sampling into a clean container and check for the presence of water or solids. Slight discoloration of the oil should not necessitate an oil change.

7.3 SPARE PARTS

Should adjustments or replacement eventually be needed, these can often be performed locally as described in this book after obtaining required parts. Personnel should have a good background of mechanical experience and be thoroughly familiar with the procedures outlined in this manual. Major repairs not covered in this book should be referred to the nearest Tuthill Vacuum & Blower Systems service representative.

When ordering parts, give all blower nameplate information, as well as the item number and parts description as per the parts lists and assembly drawings for your particular model. Repair kits are available for all models. These kits contain all of the seals, bearings, O-rings, locks, and special retaining screws necessary for an overhaul. For your convenience when ordering parts, we suggest you complete the *Operating Data Form* included on the inside, back cover of this manual.

In developing a stock of spare parts, consider the following:

- The degree of importance in maintaining the blower in a “ready” condition
- The time lag in parts procurement
- Cost
- Shelf life (seals and O-rings)

Contact Tuthill Vacuum & Blower Systems Service Department for any assistance in selecting spare parts.
Telephone: (417) 865-8715 — Toll Free (48 contiguous states): (800) 825-6937 — Fax: (417) 865-2950

7.4 FACTORY SERVICE & REPAIR

With proper care, Tuthill Vacuum & Blower Systems blowers will give years of reliable service. The parts are machined to very close tolerances and require special tools by mechanics who are skilled at this work. Should major repairs become necessary, contact the factory for the authorized service location nearest you. Units which are still under warranty must be returned to the factory, freight prepaid, for service.

Tuthill Vacuum & Blower Systems
ATTN: Inside Service Manager
4840 West Kearney Street
Springfield, MO 65803-8702



NOTE
Current regulations require Material Safety Data Sheet to be completed and forwarded to Tuthill Corporation on any unit being returned for any reason which has been handling or involved with hazardous gases or materials. This is for the protection of the employees of Tuthill Corporation who are required to perform service on this equipment. Failure to do so will result in service delays.



NOTE
When returning a blower to the factory for repair, under warranty, please note the factory will not accept any unit that arrives without authorization. Contact the Service Department for return authorization.

7.5 LONG TERM STORAGE

Any time the blower will be stored for an extended period of time, you should take make sure that it is protected from corrosion by following these steps:

1. Spray the interior (lobes, housing and end plates) with rust preventative. This should be repeated as conditions dictate and at least on a yearly basis.
2. Fill both end covers completely full of oil.
3. Firmly attach a very prominent tag stating that the end covers are full of oil and must be drained and refilled to proper levels prior to startup.
4. Apply a rust preventative grease to the drive shaft.
5. Spray all exposed surfaces, including the inlet and discharge flanges, with rust preventative.
6. Seal inlet, discharge and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for a prolonged amount of time. If any component is left open to the atmosphere, the rust preventative will escape and lose its effectiveness.
7. During storage, ensure that the blower does not experience excessive vibration.
8. Attach a desiccant bag to either of the covers to prevent condensation from occurring inside the blower. Make sure any desiccant bag (or bags) is so attached to the covers that they will be removed before startup of the blower.
9. Store the blower in an air conditioned and heated building if at all possible. At least insure as dry conditions as possible.
10. If possible, rotate the drive shaft by hand at least monthly in order to prevent seals from setting in one position.

8. DISASSEMBLY AND REASSEMBLY

8.1 DISASSEMBLY OF BLOWER

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.

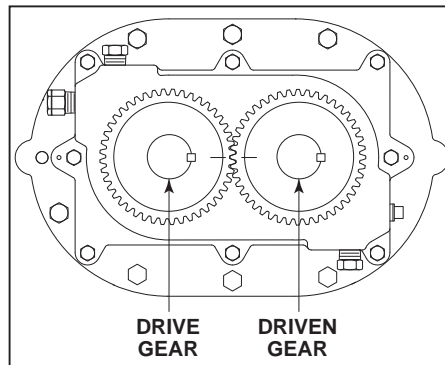


Figure 8 - Timing Marks Matched

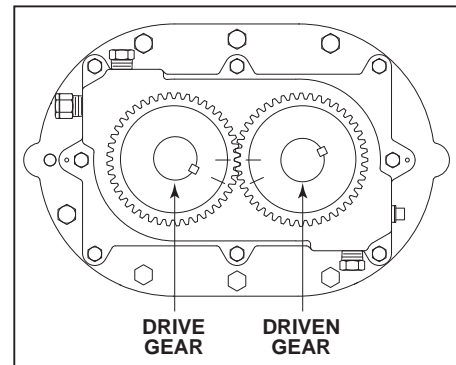


Figure 9 - Timing Marks Advanced 3 Teeth (Reference Marks Aligned)

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 repairs or replacements.



NOTE

Items in brackets [] reference item numbers on pages 37 and 38.

1. Remove the oil drain plugs [18] in the bottom of the end covers [Items 5 & 10] and drain the oil.
2. 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.



NOTE

Gears are not exposed for visual inspection.

Inspect the gears for the following:

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



DANGER

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

3. Position blower with the drive gear on the left when facing the gears. Remove socket head screws and washers. [Items 29 & 26].
4. Align timing marks and count three (3) teeth up and place reference marks on the gears. (Refer to Figure 8)
5. Align reference marks and use puller to pull the driven gear. (Refer to Figure 9)
6. Use puller to remove drive gear. A bar puller (Refer to Figure 11) or jack screws can be used.
7. Remove shim and spacer. [Items 28 & 30], and note from which shaft the shim is removed.
8. Turn blower around and remove eight (8) cap screws securing the drive end cover [10].

9. Remove cover.
10. Loosen the set screws on the oil slingers [Items 45 & 46] and remove the oil slingers from the rotor shafts. (Refer to Figure 12)
11. Remove ten (10) cap screws [15] that secure drive end plate [3] to housing [1].

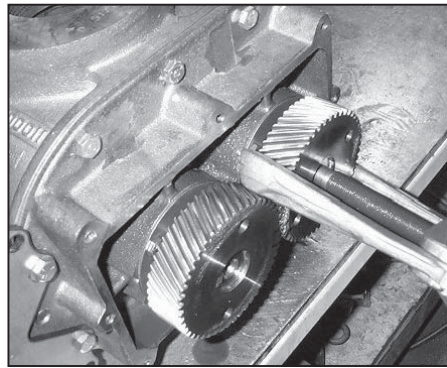


Figure 10 - Pulling Driven Gear with Jaw Puller

12. Use a jaw puller to remove drive end plate. (Refer to Figure 14)
13. 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 15)

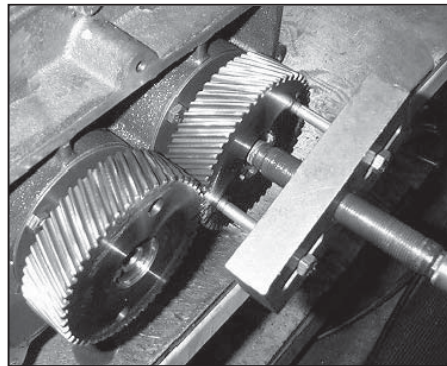


Figure 11 - Pulling Drive Gear with Bar Puller

14. A jaw type puller can also be used. (Refer to Figure 13)

15. 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 16)

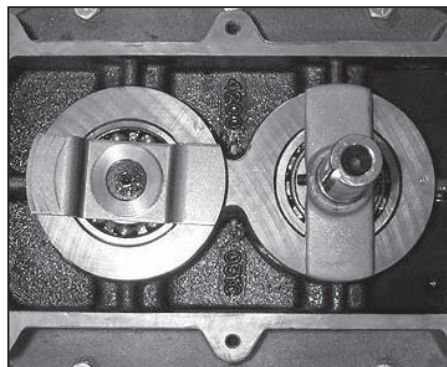


Figure 12 - Pulling Drive End Plate

16. 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.

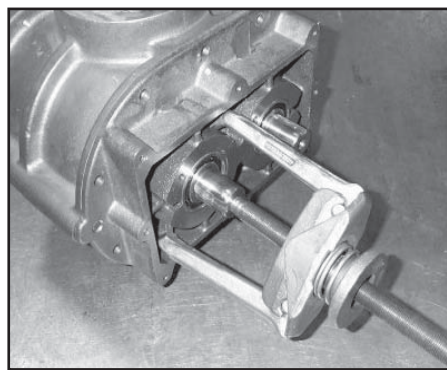


Figure 13 - Driving Rotors Out Using Jaw Puller

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

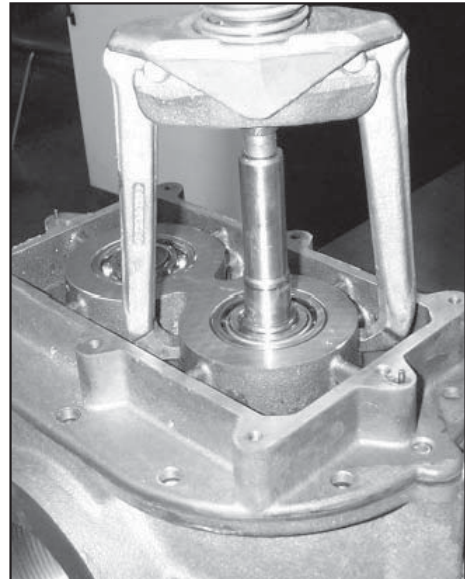


Figure 14 - Pulling Drive End Plate

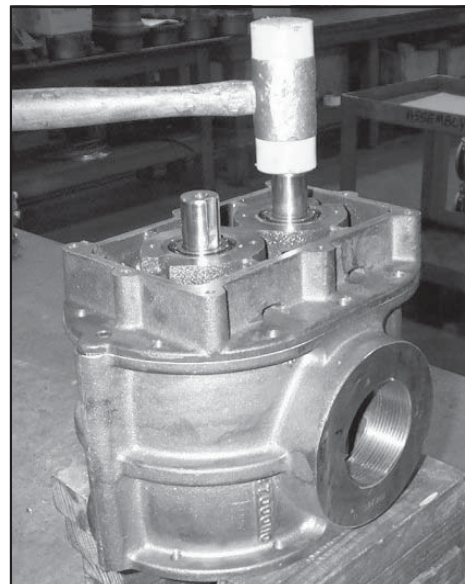


Figure 15 - Driving Rotors Out Using Soft Mallet

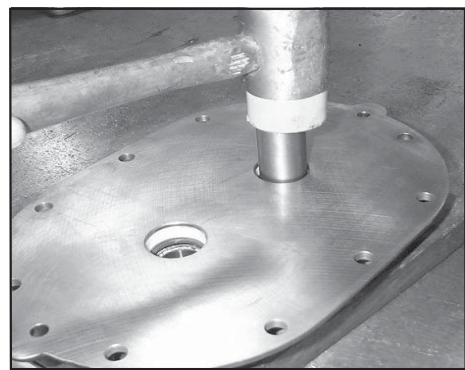


Figure 16 - Tapping Bearings Out of End Plates

8.2 REASSEMBLY OF BLOWER

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 34 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 17). Place rotors in fixture with the drive rotor to the left. (See Figures 17 and 20)

8.2.1 MECHANICAL SEAL INSTALLATION

1. 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.
2. Place end plate [Item 4] on rotors.
3. 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 18).

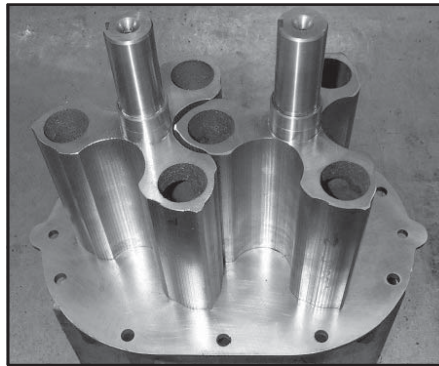


Figure 17 - Rotors Assembled on Drive End Plate (Model 4000 with tri-lobe rotors shown)

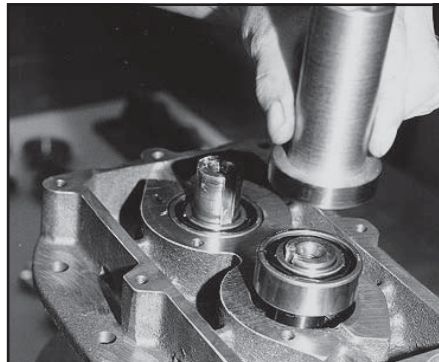


Figure 18 - Tapping Bearings into End Plates

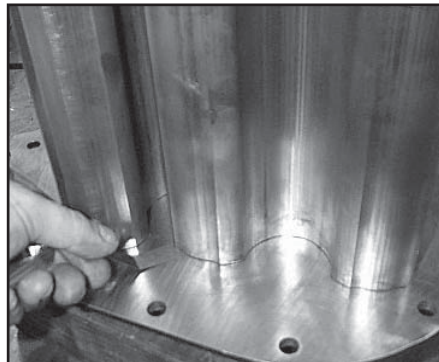


Figure 19 - Checking Gear End Clearances

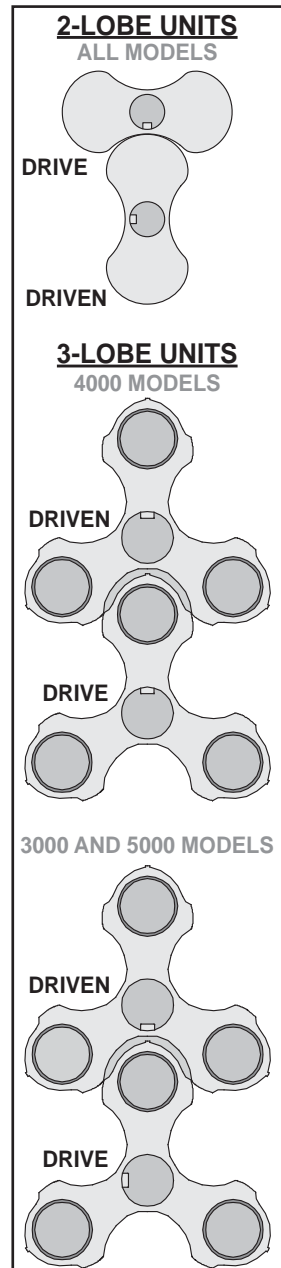


Figure 20 - Checking Gear End Clearances



WARNING

Keep hands and loose clothing away from lobes and gears.

4. Install bearing retainers [Items 22 & 25] to both bearings.
5. Check clearances between the end of the rotors and the face of the end plate. Refer to assembly clearances chart on page 32 for proper clearances for your model blower, and refer to the *Adjusting Rotor Interlobe Clearance* section on page 29 for procedures for checking and adjusting clearances.
6. 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.
7. 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.
8. 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.
9. 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 21) A depth mic can be used.
10. Set on drive end plate [3] and fasten with cap screws [15].



NOTE
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.

11. 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].
12. Install any removed plugs [18], sight glasses [21] and replace breather [27] if required.

8.2.2 LUBRICATION, FINAL ASSEMBLY AND MOUNTING

13. 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.
14. Fill both end covers with oil. Refer to the *Lubrication* section of this manual (page 12) for filling procedure, and page 34 for recommended lubricants.
15. 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.

8.2.3 ADJUSTING ROTOR INTERLOBE CLEARANCE

16. Using feeler gauges take interlobe readings and record on each side of housing as indicated in Figure 21. 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.
17. Changing the shim thickness .006" (.15 mm) will change the rotor lobe clearance .003" (.08 mm) or one-half the amount.
18. **EXAMPLE:** Referring to Figure 21, check the clearance at AA (right hand reading) and BB (left hand reading). If

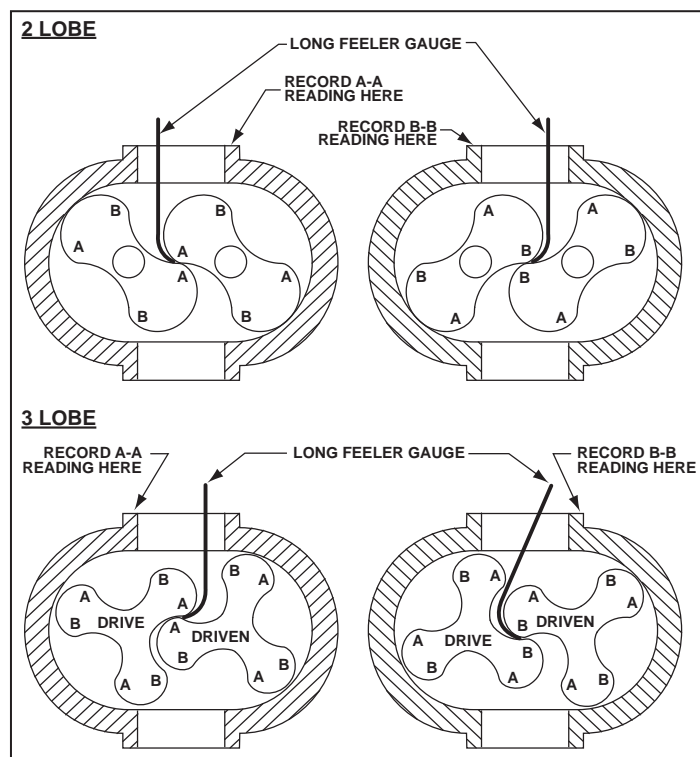


Figure 21 - Checking Rotor Interlobe Clearance

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.

19. 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.

9. TROUBLESHOOTING

Although Tuthill Vacuum & Blower Systems 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.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly.	Tighten gear housing bolts.
	Lip seal failure.	Disassemble and replace lip seal.
	Insufficient sealant.	Remove gear housing and replace sealant. See the <i>Disassembly</i> section.
	Loose drain plug.	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication.	Correct oil level. Replace dirty oil. See the <i>Lubrication</i> section.
	Excessive belt tension.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment.	Check carefully, realign if necessary.
Lack of volume	Slipping belts.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances.	Check for proper clearances. See the <i>Assembly Clearances</i> section.
	Speed too low.	Increase blower speed within limits.
	Obstruction in piping.	Check system to assure an open flow path.
Knocking	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.
	Worn gears.	Replace timing gears. See the <i>Disassembly</i> section.
Excessive blower temperature	Too much or too little oil in gear reservoir.	Check oil level. See the <i>Lubrication</i> section.
	Too low operating speed.	Increase blower speed within limits.
	Clogged filter or silencer.	Remove cause of obstruction.
	Excessive pressure differential.	Reduce pressure differential across the blower.
	Elevated inlet temperature.	Reduce inlet temperature.
	Worn lobe clearances.	Check for proper clearances. See the <i>Assembly Clearances</i> section.
Rotor end or tip drag	Insufficient assembled clearances.	Correct clearances. See the <i>Assembly Clearances</i> section.
	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.
Vibration	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 the <i>Assembly Clearances</i> section.
	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.
	Driver or blower loose.	Check mounting and tighten if necessary.
	Piping resonance.	Check pipe supports, check resonance of nearby equipment, check foundation.

10. ASSEMBLY CLEARANCES

Values are shown in inches and *millimeters*.

MODEL	LOBES TO END PLATES			INTERLOBE	LOBE TO CASING	
	DRIVE END	GEAR END	TOTAL		TIP-DOWEL	TIP-PORT
2002	.004 - .007 .10 - .18	.003 - .005 .08 - .13	.008 - .011 .20 - .28	.005 - .009 .13 - .23	.002 - .004 .05 - .10	.003 - .006 .08 - .15
2004	.004 - .007 .10 - .18	.003 - .005 .08 - .13	.008 - .011 .20 - .28	.005 - .009 .13 - .23	.002 - .004 .05 - .10	.003 - .006 .08 - .15
3002	.004 - .007 .10 - .18	.003 - .005 .08 - .13	.008 - .012 .20 - .30	.006 - .012 .15 - .30	.002 - .005 .05 - .13	.004 - .007 .10 - .18
3003	.005 - .008 .13 - .20	.003 - .005 .08 - .13	.009 - .012 .23 - .30	.010 - .014 .25 - .36	.002 - .005 .05 - .13	.004 - .007 .10 - .18
3006	.006 - .010 .15 - .25	.003 - .005 .08 - .13	.010 - .013 .25 - .33	.010 - .014 .25 - .36	.002 - .005 .05 - .13	.004 - .007 .10 - .18
4002	.004 - .009 .10 - .23	.004 - .006 .10 - .15	.009 - .013 .23 - .33	.012 - .016 .30 - .41	.003 - .006 .08 - .15	.005 - .008 .13 - .20
4005	.005 - .010 .12 - .25	.004 - .006 .10 - .15	.010 - .014 .25 - .36	.012 - .016 .30 - .41	.003 - .006 .08 - .15	.005 - .008 .13 - .20
4007	.005 - .010 .12 - .25	.004 - .006 .10 - .15	.010 - .014 .25 - .36	.012 - .016 .30 - .41	.003 - .006 .08 - .15	.005 - .008 .13 - .20
5003	.004 - .009 .10 - .23	.004 - .006 .10 - .15	.009 - .013 .29 - .33	.014 - .018 .36 - .46	.003 - .006 .08 - .15	.005 - .008 .13 - .20
5006	.005 - .010 .13 - .25	.004 - .006 .10 - .15	.010 - .014 .25 - .36	.014 - .018 .36 - .46	.003 - .006 .08 - .15	.005 - .008 .13 - .20
5009	.005 - .010 .13 - .25	.004 - .006 .10 - .15	.010 - .014 .25 - .36	.014 - .018 .36 - .46	.003 - .006 .08 - .15	.005 - .008 .13 - .20
6005	.008 - .013 .20 - .33	.005 - .007 .12 - .18	.015 - .019 .38 - .48	.010 - .014 .25 - .36	.004 - .007 .10 - .18	.006 - .009 .15 - .23
6008	.008 - .013 .20 - .33	.005 - .007 .12 - .18	.015 - .019 .38 - .48	.010 - .014 .25 - .36	.004 - .007 .10 - .18	.006 - .009 .15 - .23
6015	.009 - .014 .23 - .36	.005 - .007 .13 - .18	.016 - .020 .40 - .50	.010 - .014 .25 - .36	.004 - .007 .10 - .18	.006 - .009 .15 - .23
7006	.008 - .012 .20 - .30	.005 - .007 .13 - .18	.015 - .018 .38 - .46	.012 - .016 .30 - .41	.004 - .007 .10 - .18	.006 - .009 .15 - .23
7011	.010 - .014 .25 - .36	.005 - .007 .13 - .18	.017 - .020 .43 - .51	.012 - .016 .30 - .41	.004 - .007 .10 - .18	.006 - .009 .15 - .23
7018	.010 - .014 .25 - .36	.005 - .007 .13 - .18	.017 - .020 .43 - .51	.012 - .016 .30 - .41	.004 - .007 .10 - .18	.006 - .009 .15 - .23

11. TORQUE CHART

Data shown represents “wet” torque values, in foot-pounds (ft.-lbs) and *Newton-meters (N-m)*.

PART DESCRIPTION	TORQUE
CAP SCREW 10-32UNF	4 5
CAP SCREW 1/4"-20UNC GR5	8 10
CAP SCREW 5/16"-18UNC GR5	15 20
CAP SCREW 3/8"-16UNC GR5	33 45
CAP SCREW 1/2"13UNC GR5	78 106
CAP SCREW 5/8"14UNC GR5	123 167
CAP SCREW 3/4"-10UNC GR5	260 350

12. RECOMMENDED LUBRICANTS

RECOMMENDED MINERAL BASED LUBRICANTS				
AMBIENT TEMPERATURE	SHELL	CITGO	CHEVRON	EXXONMOBIL
0° to 32° F (-18° to 0° C)	TELLUS® S2 M 68 (ISO 68)	A/W 68 (ISO 68)	RANDO HD 68 (ISO 68)	DTE HEAVY MEDIUM (ISO 68)
32° to 90° F (0° to 32° C)	TELLUS® S2 M 100 (ISO 100)	A/W 100 (ISO 100)	RANDO HD 100 (ISO 100)	DTE HEAVY (ISO 100)
90° to 120° F* (32° to 50° C)	—	A/W 150 (ISO 150)	RANDO HD 150 (ISO 150)	DTE EXTRA HEAVY (ISO 150)

RECOMMENDED SYNTHETIC BASED LUBRICANTS**			
AMBIENT TEMPERATURE	TUTHILL	EXXONMOBIL	SHELL
0° to 32° F (-18° to 0° C)	PneuLube™ (ISO 100)	SHC 626 (ISO 68)	MORLINA® S4 B 68 (ISO 68)
32° to 90° F (0° to 32° C)		SHC 627 (ISO 100)	MORLINA® S4 B 100 (ISO 100)
90° to 120° F* (32° to 50° C)		SHC 629 (ISO 150)	MORLINA® S4 B 150 (ISO 150)

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° to 32° F (-18° to 0° C)	CITGO CLARION® A/W 68 (ISO 68)	CITGO CLARION® 350 FOOD GRADE (ISO 68)
32° to 90° F (0° to 32° C)	CITGO CLARION® A/W 100 (ISO 100)	CONSULT FACTORY
90° to 120° F* (32° to 50° C)	CONSULT FACTORY	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° to 32° F (-18° to 0° C)	PneuLube™ FG (ISO 100)	CONSULT FACTORY
32° to 90° F (0° to 32° C)		
90° to 120° F* (32° to 50° C)		

RECOMMENDED LUBRICANTS FOR M-D VACUUM BOOSTERS (90/91, 92/93, 96, 31/33 AND 35/37 SERIES)	
REQUIREMENTS	
<ul style="list-style-type: none"> • Suitable for high vacuum service • 100 cSt @ 40° C • Vapor pressure of 1 micron or less @ 70° F (21° C) • Straight mineral (no additives) or PAO synthetic oil 	

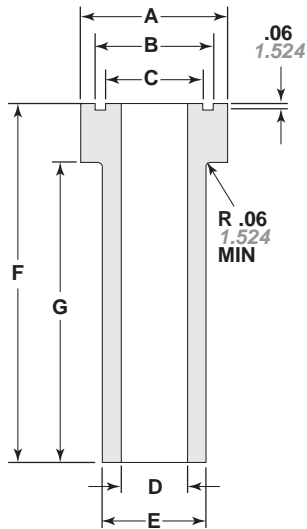
RECOMMENDED GREASE FOR COMPETITOR® PLUS BLOWERS:	
TUTHILL	CITGO
Tuthill PneuLube™ NLGI #2 premium grade, petroleum base lithium grease.	For food grade requirements: Use Citgo Clarion® Food Grade HTEP grease, NLGI No. 2 grade. It meets all requirements of FDA Regulation 21 CFR 178.3570 (the former USDA H-1 approval requirements) for lubricants having incidental contact with food.

* For higher ambient temperatures, please consult the factory.

** Blowers used in oxygen-enriched service should use only Castrol Brayco 1726 Plus non-flammable, PFPE synthetic lubricant. Blowers used in hydrogen service should use only PneuLube synthetic oil. 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.

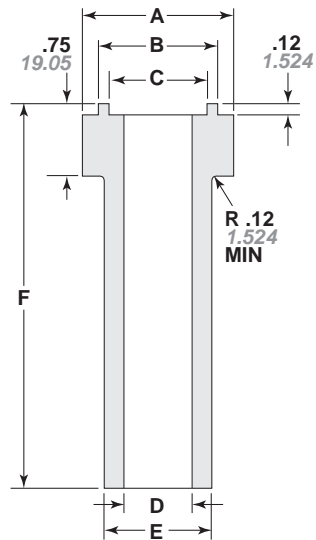
13. SPECIAL TOOL DRAWINGS

BEARING PRESSING TOOL (FOR ALL SERIES)



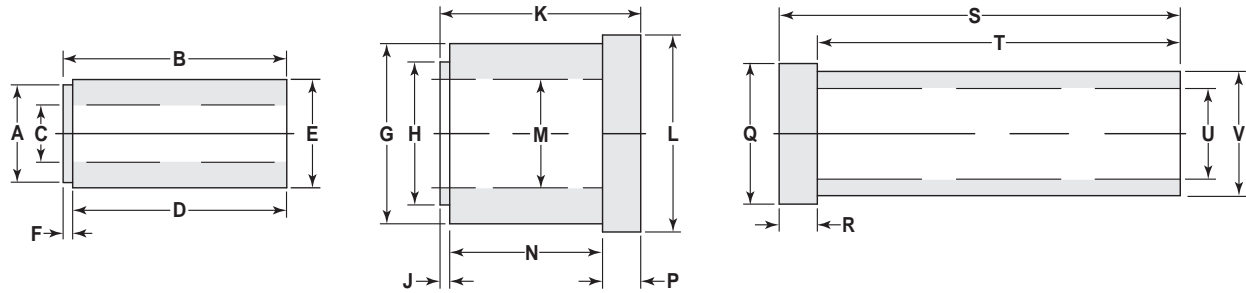
MODEL	A ±.001 ±0.0254	B ±.005 ±0.127	C ±.005 ±0.127	D ±.005 ±0.127	E ±.005 ±0.127	F ±.005 ±0.127	G ±.005 ±0.127
2000	1.560 39.624	1.27 32.258	.98 24.892	.70 17.78	1.10 27.94	3.50 88.9	3.00 76.2
3000	2.035 51.689	1.70 43.18	1.335 33.909	1.015 25.781	1.415 35.941	3.75 95.25	3.00 76.2
4000	2.425 61.595	2.02 51.308	1.61 40.894	1.21 30.734	1.61 40.894	4.50 114.3	3.75 95.25
5000	2.820 71.628	2.42 61.468	1.81 45.974	1.41 35.814	1.81 45.974	5.00 127	4.25 107.95
6000	3.135 79.629	2.73 69.342	2.00 50.8	1.605 40.767	2.00 50.8	6.25 158.75	5.50 139.7
7000	3.525 89.535	2.98 75.692	2.46 62.484	1.605 40.767	2.00 50.8	6.25 158.75	5.50 139.7

SEAL PRESSING TOOL (FOR 21 & 22 SERIES)



MODEL	A ±.001 ±0.0254	B ±.005 ±0.127	C ±.005 ±0.127	D ±.005 ±0.127	E ±.005 ±0.127	F ±.005 ±0.127
2000	1.560 39.624	1.24 31.496	1.04 26.416	.70 17.78	1.10 27.94	4.00 101.6
3000	2.035 51.689	1.74 44.196	1.54 39.116	1.015 25.781	1.415 35.941	4.37 110.99
4000	2.425 61.595	1.865 47.371	1.665 42.291	1.21 30.734	1.61 40.894	5.25 133.35
5000	2.820 71.628	2.427 61.645	2.227 56.565	1.41 35.814	1.81 45.974	5.68 144.272
6000	3.135 79.629	2.74 69.596	2.54 64.516	1.605 40.767	2.00 50.8	7.00 177.8
7000	3.525 89.535	2.99 75.946	2.79 70.866	1.605 40.767	2.00 50.8	7.00 177.8

SEAL INSTALLATION TOOLS (FOR 23 SERIES)



MODEL	A	B	C	D	E	F	G	H	J	K
3000	1.250 31.75	2.819 71.603	0.750 19.05	2.750 69.85	1.248 31.699	0.125 3.175	2.044 51.918	1.749 44.425	0.100 2.54	2.600 66.04
4000	1.397 35.484	2.927 74.346	0.750 19.05	2.802 71.171	1.417 35.992	0.125 3.175	2.438 61.925	1.871 47.523	0.127 3.226	2.627 66.726
5000	1.722 43.739	3.0695 77.965	0.750 19.05	2.8495 72.377	1.735 44.069	0.220 5.588	2.832 71.933	2.434 61.824	0.1745 4.432	2.6745 67.932

MODEL	L	M	N	P	Q	R	S	T	U	V
3000	2.183 55.448	1.253 31.826	2.000 50.8	0.500 12.7	1.749 44.425	0.500 12.7	4.275 108.585	3.775 95.885	0.987 25.070	1.600 40.64
4000	2.578 65.481	1.420 36.068	2.000 50.8	0.500 12.7	1.840 46.736	0.500 12.7	5.250 133.35	4.750 120.65	1.186 30.124	1.700 43.18
5000	2.832 71.933	1.738 44.145	2.000 50.8	0.500 12.7	2.230 56.642	0.500 12.7	5.500 139.7	5.000 127	1.383 35.128	2.090 53.086

NOTE:

All dimensions are shown in Inches and millimeters.

MATERIAL:
MILD STEEL

PARTS LIST FOR MODEL COMPETITOR 21 (PLUS) SERIES

ITEM NO.	PART DESCRIPTION	QTY
1	HOUSING	1
2	MOUNTING FOOT	2
2	MOUNTING FOOT	2
3	DRIVE END PLATE	1
4	GEAR END PLATE	1
5	GEAR COVER	1
6	DRIVE ROTOR	1
7	DRIVEN ROTOR	1
8	GEAR SET	1
9	DOWEL PIN	4
10	COVER GREASE	1
11	BEARING	1
12	BEARING	1
13	BEARING	2
15	SCREW, HEX HEAD	26
16	SCREW, HEX HEAD	8
17	SCREW, HEX HEAD	8
18	PIPE PLUG	6
18	MAGNETIC PLUG	3
19	RELIEF FITTING	2
20	GREASE FITTING	2
22	BEARING RETAINER	2
23	LIP SEAL	1
24	LIP SEAL	4
25	SCREW, HEX HEAD	12
26	WASHER	2
27	BREATHER	1
28	SPACER	2
29	CAP SCREW	2
30	SHIM	6
30	SHIM	6
30	SHIM	4
31	KEY GEAR	2
42	NAMEPLATE	1
45	LIFTING LUG	2
47	VENT HOLE INSERT	8

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES;
QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

P/N 2200638B	3000-21 2 LOBE (WITH 3/4" DRIVE SHAFT)
P/N 3300638C	3000-21 2 LOBE (WITH 7/8" DRIVE SHAFT)
P/N 4500638B	4000-21 2 LOBE
P/N 5600638B	5000-21 2 LOBE
P/N 6800638B	6000-21 2 LOBE
P/N 7600638B	7000-21 2 LOBE
P/N 3300638D	3000-21 3 LOBE
P/N 4500638C	4000-21 3 LOBE
P/N 5600638C	5000-21 3 LOBE

PARTS LIST FOR MODEL COMPETITOR 22 (SL) SERIES

ITEM NO.	PART DESCRIPTION	QTY
1	HOUSING	1
2	MOUNTING FOOT	2
2	MOUNTING FOOT	2
3	DRIVE END PLATE	1
4	GEAR END PLATE	1
5	COVER BE	1
6	DRIVE ROTOR	1
7	DRIVEN ROTOR	1
8	GEAR SET	1
9	DOWEL PIN	4
10	COVER DE	1
11	BEARING	1
12	BEARING	1
13	BEARING BALL	2
15	SCREW, HEX HEAD	26
16	SCREW, HEX HEAD	16
17	SCREW, HEX HEAD	8
18	PIPE PLUG	10
18	MAGNETIC PLUG	2
21	OIL SIGHT GLASS	2
22	BEARING RETAINER	2
23	LIP SEAL	1
24	LIP SEAL	4
25	SCREW, HEX HEAD	12
26	WASHER	3
27	BREATHER	2
28	SPACER	2
29	CAP SCREW	3
30	SHIM	6
30	SHIM	6
30	SHIM	4
31	KEY GEAR	2
42	NAMEPLATE	1
44	ROLL PIN	2
45	LIFTING LUG	2
46	SLINGER	2
47	VENT HOLE INSERT	4
48	ROLL PIN	2
49	VENT HOLE INSERT	8

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES;
QUANTITIES MAY VARY BETWEEN BLOWER

PARTS KITS ARE AVAILABLE. AS FOLLOWS:

3300638G	3000-22 2 LOBE
4500638E	4000-22 2 LOBE
5600638E	5000-22 2 LOBE
3300638E	3000-22 3 LOBE
4500638D	4000-22 3 LOBE
5600638D	5000-22 3 LOBE

PARTS LIST FOR MODEL COMPETITOR 23 (GT) SERIES

ITEM NO.	PART DESCRIPTION	QTY
1	HOUSING	1
2	MOUNTING FOOT	2
3	DRIVE END PLATE	1
4	GEAR END PLATE	1
5	COVER BE	1
6	DRIVE ROTOR	1
7	DRIVEN ROTOR	1
8	GEAR SET	1
9	DOWEL PIN	4
10	COVER DE	1
11	BEARING	1
12	BEARING	1
13	BEARING BALL	2
15	SCREW, HEX HEAD	16
16	SCREW, HEX HEAD	16
17	SCREW, HEX HEAD	4
18	PIPE PLUG	2
18	MAGNETIC PLUG	2
21	OIL SIGHT GLASS	2
22	BEARING RETAINER	2
23	LIP SEAL	1
25	SCREW, HEX HEAD	4
26	WASHER	3
27	BREATHER	2
28	SPACER	2
29	CAP SCREW	3
30	SHIM	6
30	SHIM	2
30	SHIM	2
31	KEY GEAR	2
42	NAMEPLATE	1
44	ROLL PIN	2
45	SLINGER, OIL	1
46	SLINGER	1
47	SCREW, SET	2
48	ROLL PIN	2
50	SEAL, MECHANICAL GE	2
60	SEAL, MECHANICAL DE	2

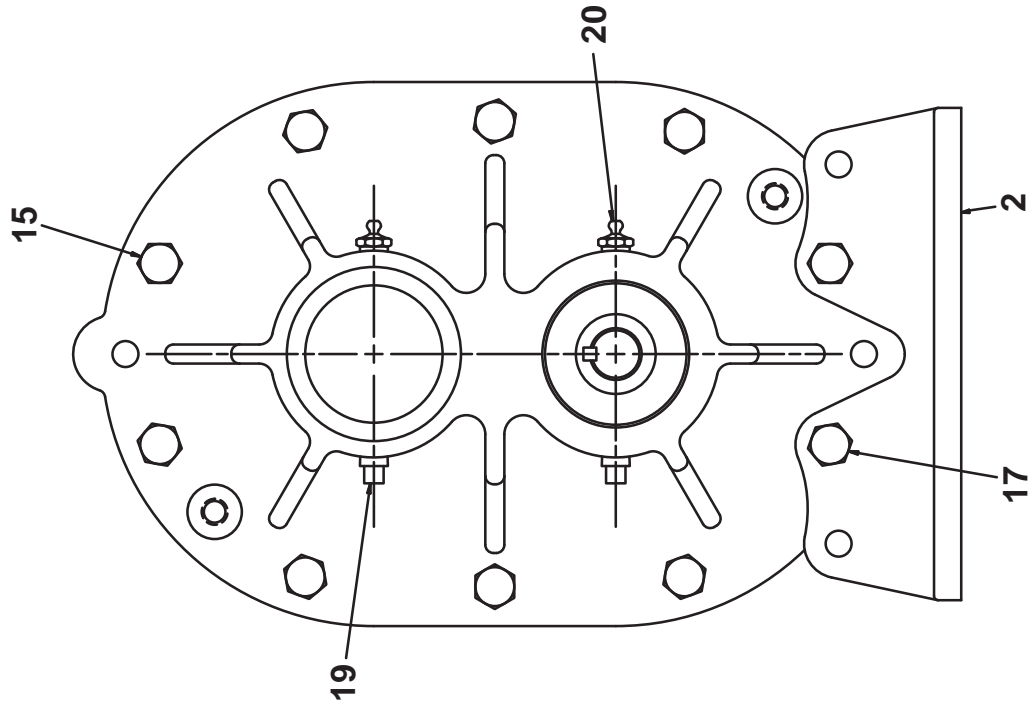
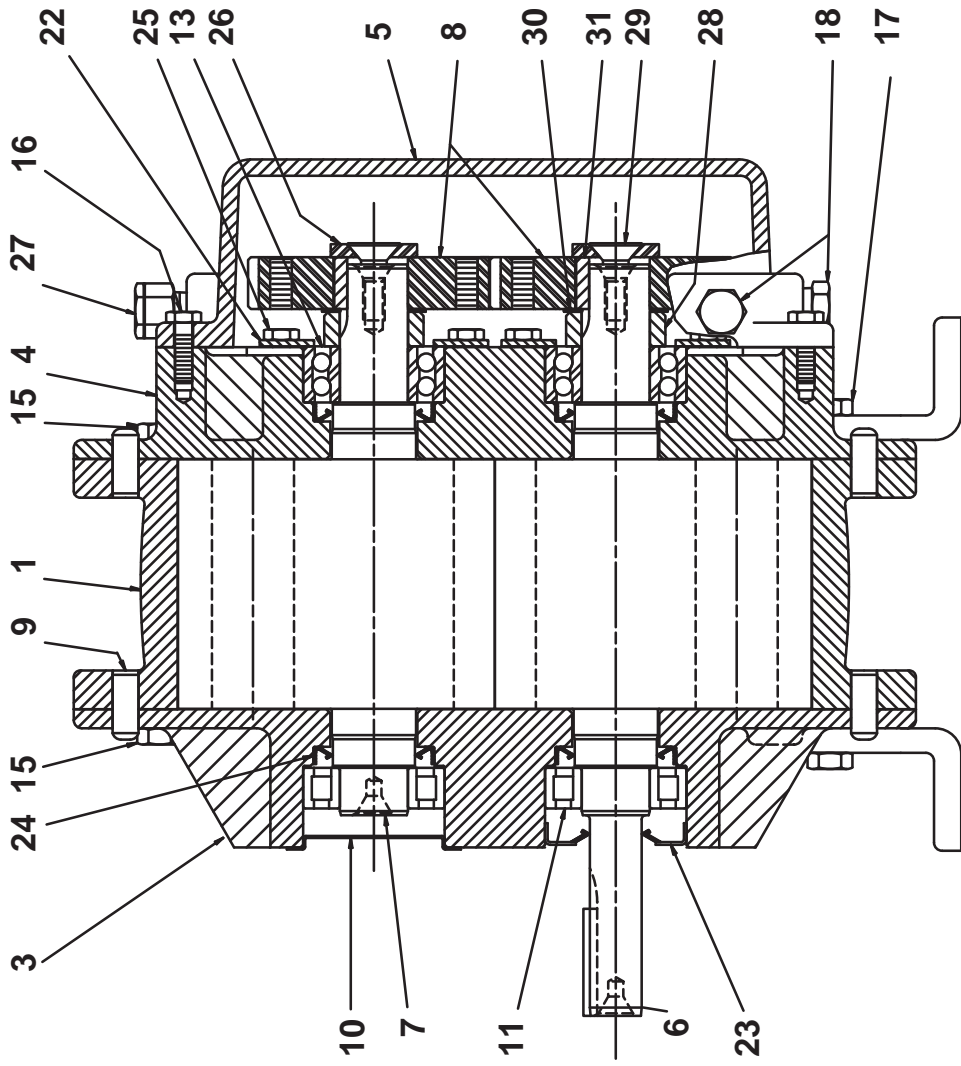
NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES;
QUANTITIES MAY VARY BETWEEN BLOWER

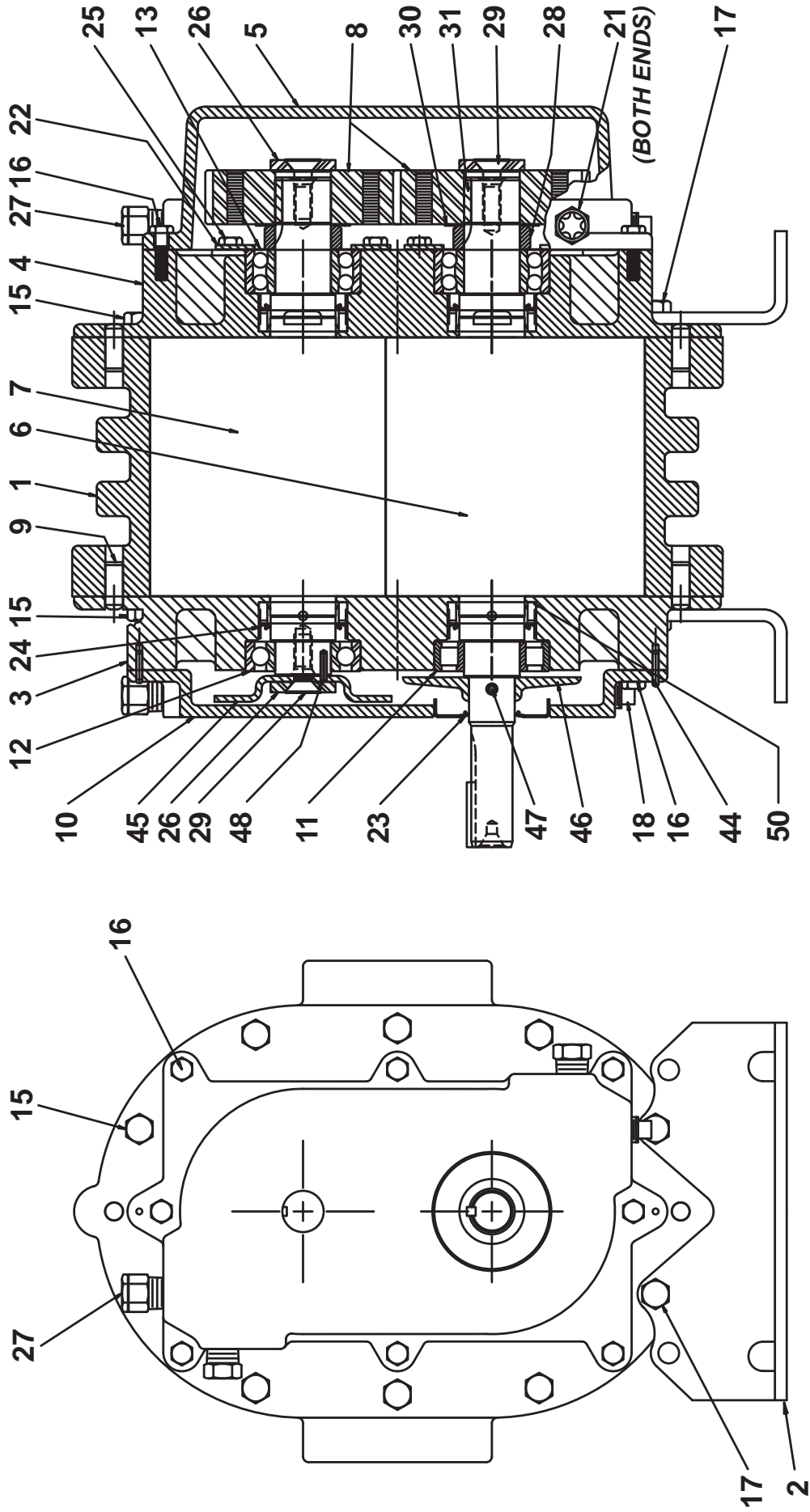
PARTS KITS ARE AVAILABLE. AS FOLLOWS:

3300638F	3000-23
4500638F	4000-23
5600638F	5000-23

CUTAWAY DRAWING FOR 21 (PLUS) SERIES



CUTAWAY DRAWING FOR 22 (SL) AND 23 (GT) SERIES





DECLARATION OF INCORPORATION

Herewith we declare that the items detailed below are in conformity with the provisions of the Machinery Directive 2006/42/EC.

Information on the items detailed are compiled per the Machinery Directive 2006/42/EC, Annex VII, part A and are the responsibility of the person listed below.

The items detailed below must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the relevant directive(s).

Other directives and standards that apply to this Declaration of Incorporation:

EN 1012-1:1996 - Compressors and vacuum pumps - Safety requirements -
Part 1: Compressors

The scope of the Declaration of Incorporation is for bare shaft Rotary Positive Displacement Competitor® Blowers

MODELS 2000, 3000, 4000, 5000, 6000, AND 7000

21 SERIES — GREASE LUBRICATION / AIR SERVICE (PLUS)

22 SERIES — SPLASH LUBRICATION / AIR SERVICE (SL)

23 SERIES — SPLASH LUBRICATION / GAS SERVICE (GT)

The person authorized to compile the technical file is Xavier Lambert, Tuthill Corporation, Parc Industriel Wavre Nord-Avenue Vesale 30, B-1300 Wavre Belgium.

Ron Rinke
Director of Blower Engineering



Tuthill Vacuum & Blower Systems
4840 West Kearney Street
P.O. Box 2877
Springfield, MO USA 65801-0877

WARRANTY – BLOWER PRODUCTS

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 start-up) 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	TYPE OF APPLICATION	
	ATMOSPHERIC AIR OR PROCESS AIR WITHOUT LIQUIDS PRESENT	PROCESS GASES OTHER THAN AIR, OR ANY LIQUID INJECTED APPLICATION
New <i>(Qx™ models only)</i>	30 months from date of shipment, or 24 months after initial startup date, whichever occurs first.	Consult Factory
New <i>(all other models)</i>	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.

OPERATING DATA FORM / PRODUCT REGISTRATION

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

Model No.		V-Belt Size		Length	
Serial No.		Type of Lubrication			
Startup Date					
Pump RPM		Operating Vacuum			
Pump Sheave Diameter		Any other Special Accessories Supplied or in use:			
Motor Sheave Diameter					
Motor RPM		HP			

NOTES:

IMPORTANT

All 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 the product registration card below, or you can visit our product registration web page at:

http://vacuum.tuthill.com/product_registration

IMPORTANT

All 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	
E-mail	
Model	
Serial Number	
Date of Purchase	
Date of Startup	

PLEASE CHECK ONE	
Pnuematic Conveying	<input type="checkbox"/>
Food	<input type="checkbox"/>
Vacuum	<input type="checkbox"/>
Paper	<input type="checkbox"/>
Food/Meat Packing	<input type="checkbox"/>
Wastewater	<input type="checkbox"/>
Gas/Petrochemical	<input type="checkbox"/>
Other	<input type="checkbox"/>

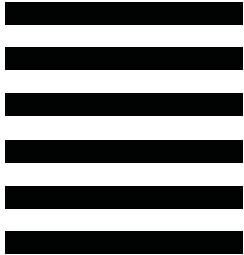


NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 2912 SPRINGFIELD MO

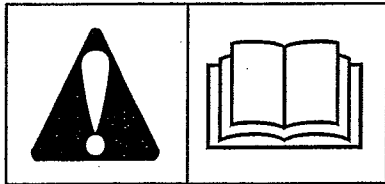
POSTAGE WILL BE PAID BY ADDRESSEE

ATTN. CUSTOMER SERVICE
TUTHILL VACUUM & BLOWER SYSTEMS
PO BOX 2877
SPRINGFIELD MO 65890-2150

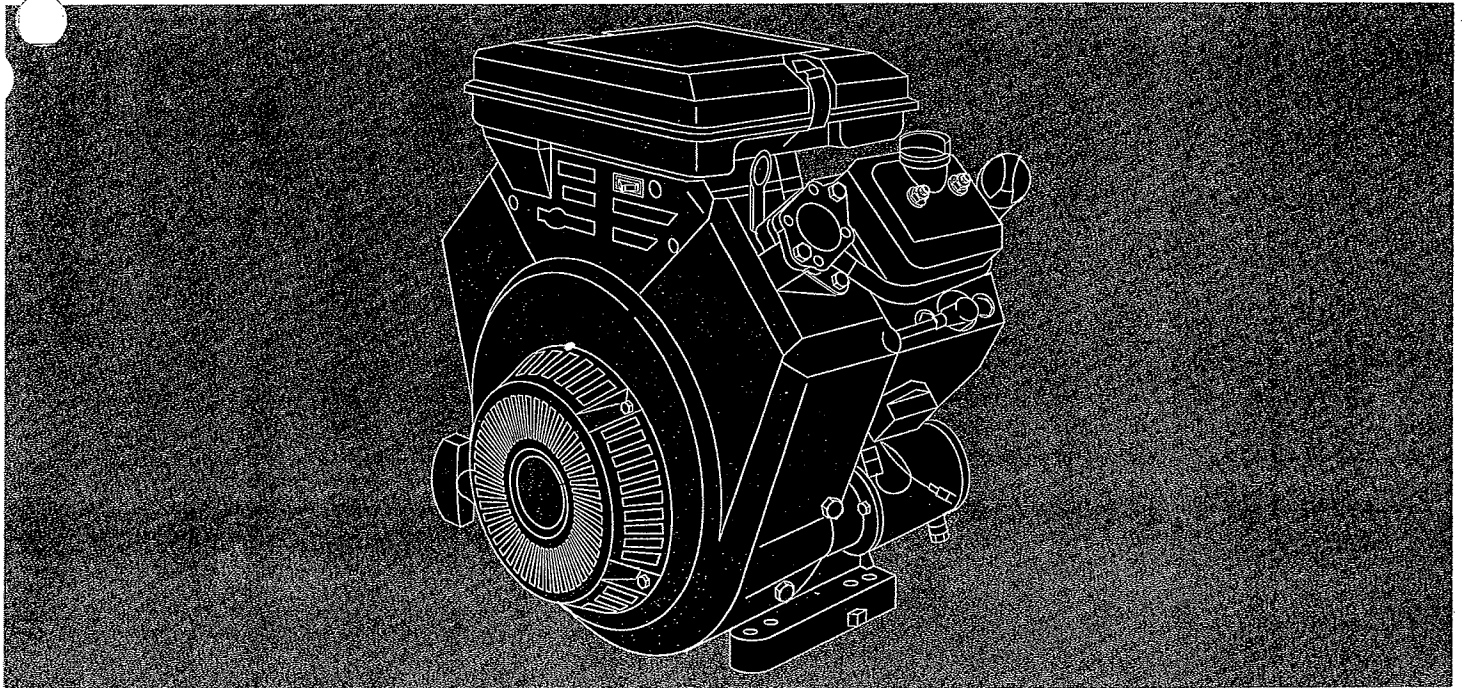
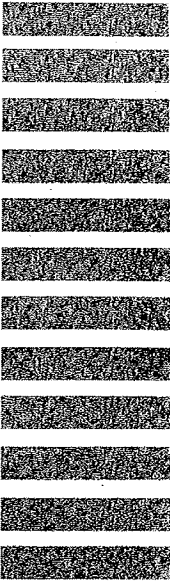




290000, 300000, 350000, 380000



- Ⓒ **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*
- Ⓒ **I** *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.



How To Use Manual Figures

1 - **9** refer to figures inside covers.

1 - **19** refer to engine components in figure **1**.

1 - **9** 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 (All 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. 1)

- 1 Oil fill cap
- 2 Dipstick
- 3 Fuel pump (if equipped)
- 4 Spark plug
- 5 Engine Model Type Code
XXXXXX XXXX XX XXXXXXXX
- 6 12V electric starter (if equipped)
- 7 Oil drain plug
- 8 Blower housing
- 9 Rope handle
- 10 Carburetor or LPG/NG Fuel mixer
- 11 Stop switch (if equipped)
- 12 Air cleaner (without fuel tank)
- 13 Fuel shut-off valve (if equipped)
- 14 Air cleaner (with fuel tank)
- 15 Fuel fill/fuel tank (if equipped)
- 16 Exhaust manifold
- 17 Oil filter (if equipped)

Safety Precautions

BEFORE OPERATING ENGINE...

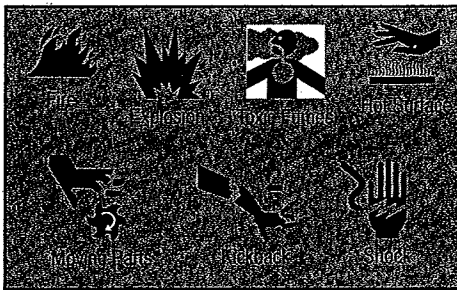
- Read entire Operating & Maintenance Instructions AND the instructions for the equipment this engine powers.*
- Failure to follow instructions could result in serious injury or death.

* 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 hazards, and
- Tell you how to avoid or reduce the risk of injury.

Hazard Symbols and Meanings



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.

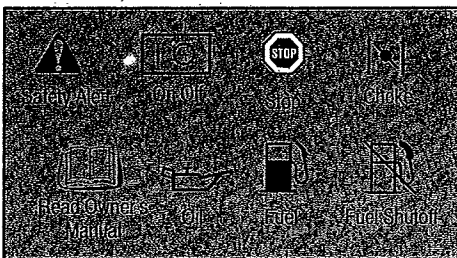
DANGER indicates a hazard which, if not avoided, will result in death or serious injury.

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.

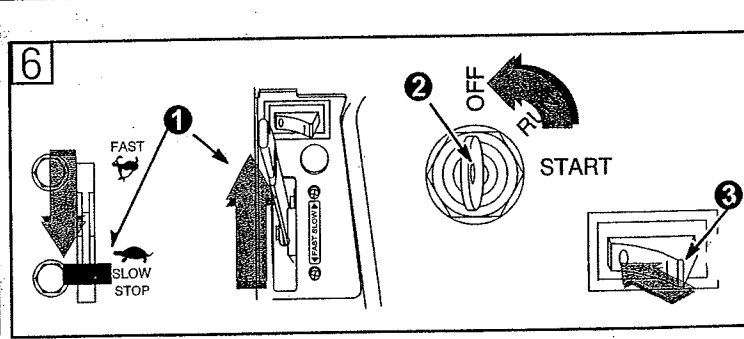
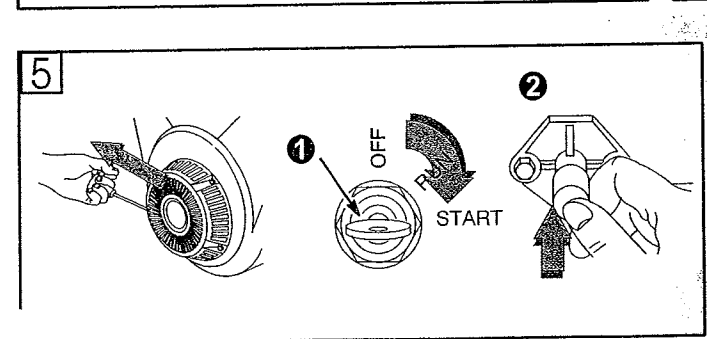
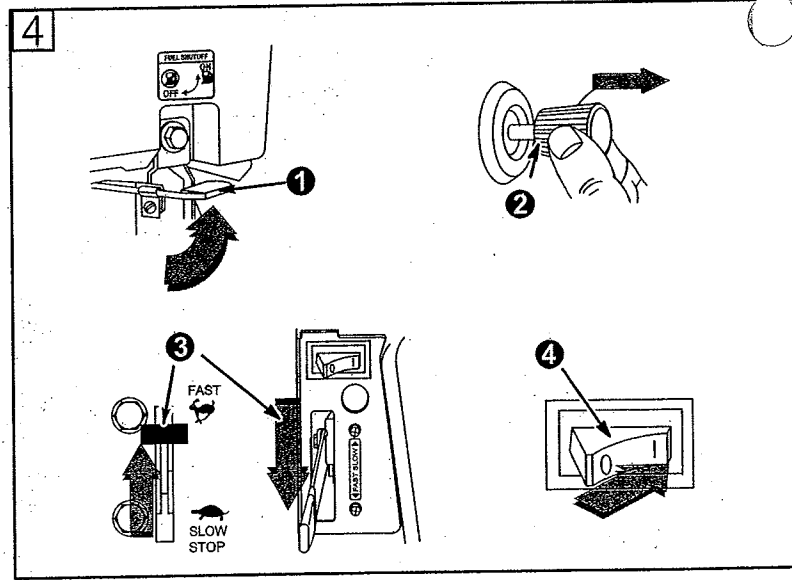
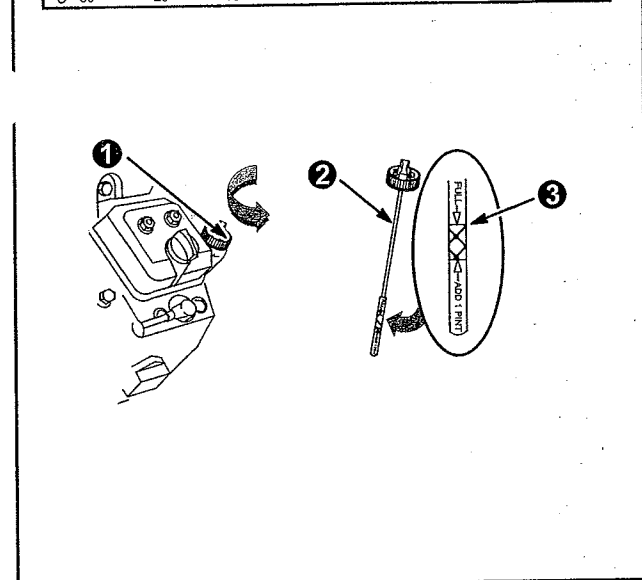
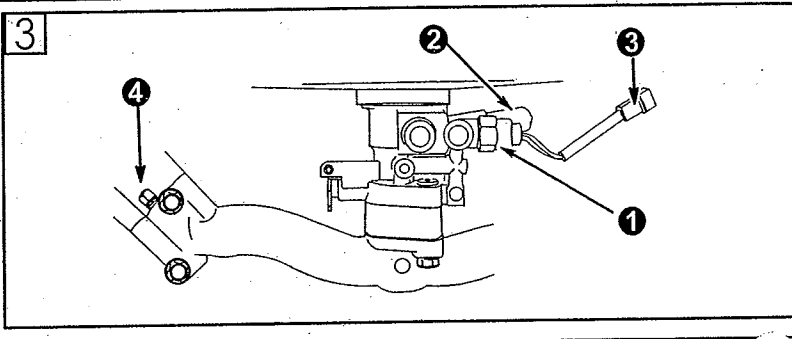
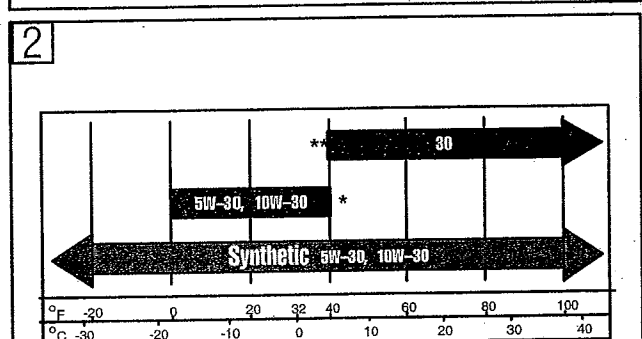
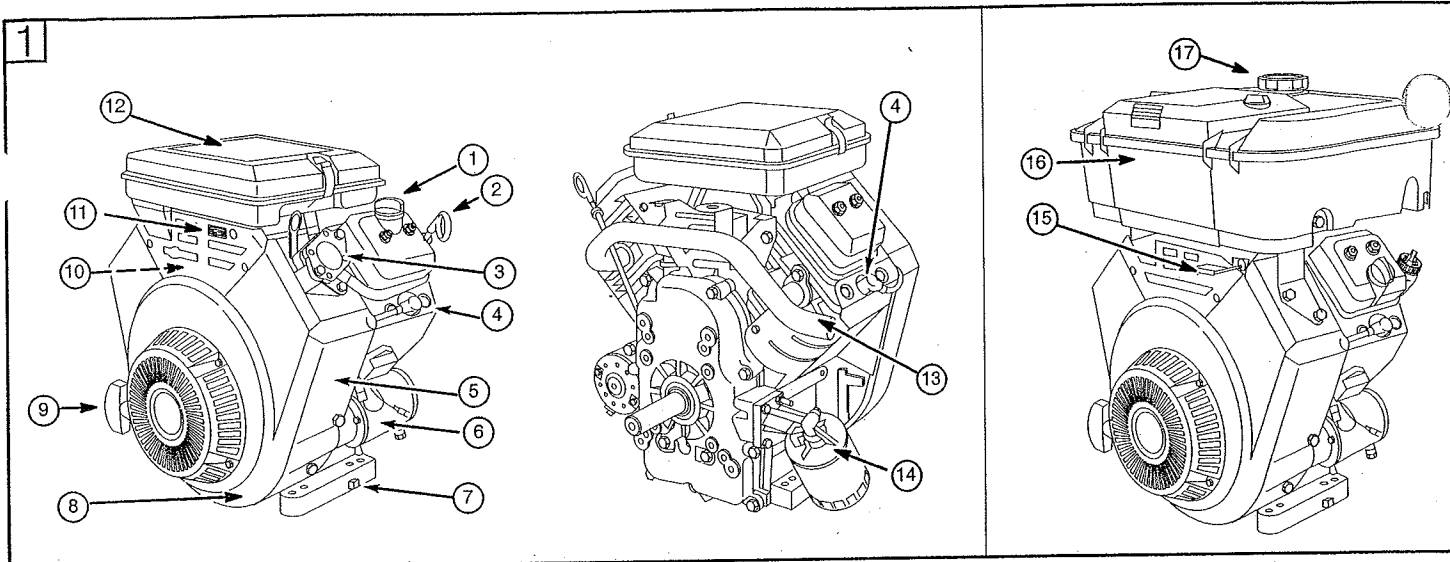
CAUTION, when used without the alert symbol, indicates a situation that could result in damage to the engine.

International Symbols and Meanings



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 engine.
- 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.



WARNING



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.



WARNING



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 tends to collect in low areas. NG vapor is lighter than air and tends to collect in high areas. Both may travel to remote locations.
- 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 engine.
- 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 REPAIRS

- 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 because vapors are flammable.



WARNING



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.

WARNING




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

Traumatic amputation or severe laceration can result.

- 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, impellers, 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])

Note: Synthetic oil meeting ILSAC GF-2, API certification mark and API service symbol (shown at left) with "SJ/CF ENERGY CONSERVING" 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 engine.

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 ①, fuel inlet ②, 12 volt connector ③, and equipped for a fuel lock-off valve ④.

CAUTION:

All LPG / NG fuel mixers are equipped with a solenoid. ① When operating on LPG fuel, 12 volts **MUST** be supplied to connector ③. When operating on NG fuel, 12 volts **MUST NOT** be supplied to connector ③.

1. 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 ① to IDLE or SLOW position, then to STOP or turn key to OFF ② or push rocker switch ③ to 0 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.

Every 1 hour

- Change oil

Every 8 hours or daily

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

Every 25 hours or every season

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

Every 50 hours or every season

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

Every 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

Every season

- 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 ① and ground it before servicing, and disconnect 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 corrected.**

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.
2. 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.

4. 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 ⑤, 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 ⑦ 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 ⑧.

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 accidental starting, remove spark plug wire and ground it before adjusting, and disconnect battery at negative terminal, if equipped.

connect battery at negative terminal, if equipped.

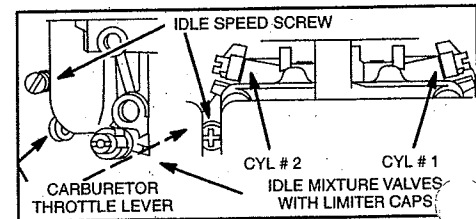
Carburetor adjustments



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 speed.

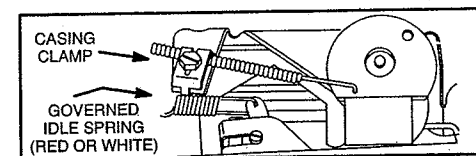
See an Authorized Briggs & Stratton Dealer for carburetor adjustment.

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

Readjust 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)

Air cleaner control adjustments

Remove air cleaner. Move choke control to CHOKE position. Carburetor choke valve ② should be completely closed. If not, loosen casing clamp screw ③ and pull casing and wire ④ in direction of arrow to end of travel. Tighten casing clamp screw. Replace air cleaner.

Throttle control adjustments ⑤

Remove air cleaner. Move throttle control to FAST position. Swivel ⑤ should be against throttle stop ⑥. If not, loosen casing clamp screw ⑦. Move casing and wire ⑧ 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 ⑨ 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])
2. Remove spark plugs and pour about 30 ml (1 oz) of engine oil into cylinders. Replace spark plugs and crank slowly to distribute oil.
3. Clean chaff or debris from cylinders and cylinder head fins and behind muffler.
4. 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

Pages™" directory under "Engines, Gasoline" or "Gasoline Engines," or "Lawn Mowers" or similar category.



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	Part No.
Oil (20 oz.)	100005
Oil (48 oz.)	100028
Oil filter (6 cm long)	492932 (5049)
Oil filter (9 cm long)	491056
Oil pump kit (uses standard electric drill to remove oil from engine quickly)	5056
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)	493629
Fuel filter (with 9 qt. fuel tank on engine)	808116
Air cleaner cartridge (with 9 qt. fuel tank on engine)	393957
Air cleaner pre-cleaner (with 9 qt. fuel tank on engine)	271794
Air cleaner cartridge (all other models except model 380000)	394018
Air cleaner pre-cleaner (all other models except model 380000)	272490
Air cleaner (cartridge and pre-cleaner kit) (all other models except model 380000)	5050
Air cleaner cartridge (model 380000)	692519
Air cleaner pre-cleaner (model 380000)	692520
Resistor spark plug	491055 or 496018
Long life platinum spark plug (used on most OHV engines)	5066
Spark tester	19368
Spark plug wrench	19374
Spark arrester	392390
Resistor spark plug	491055 or 496018

BRIGGS & STRATTON ENGINE OWNER WARRANTY POLICY

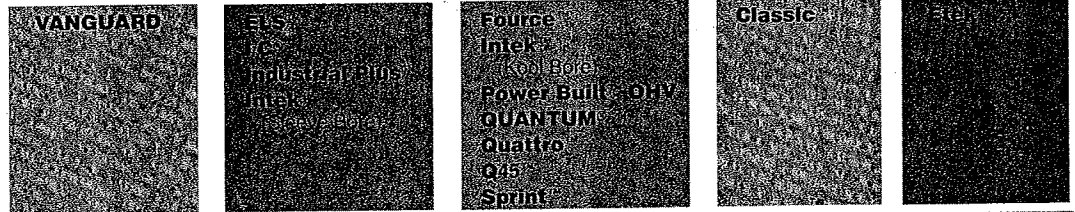
Effective January 1, 2003 replaces all undated Warranties and all Warranties dated before January 1, 2003

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 Pages"™.

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.

OUR PRODUCT



WARRANTY PERIOD

Consumer Use	2 years	2 years	2 years	1 year	1 year
Commercial Use	2 years	2 years	90 days	90 days	90 days

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 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 warranted.

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, if an 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. 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.

ABOUT 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 handled 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 modified.

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:

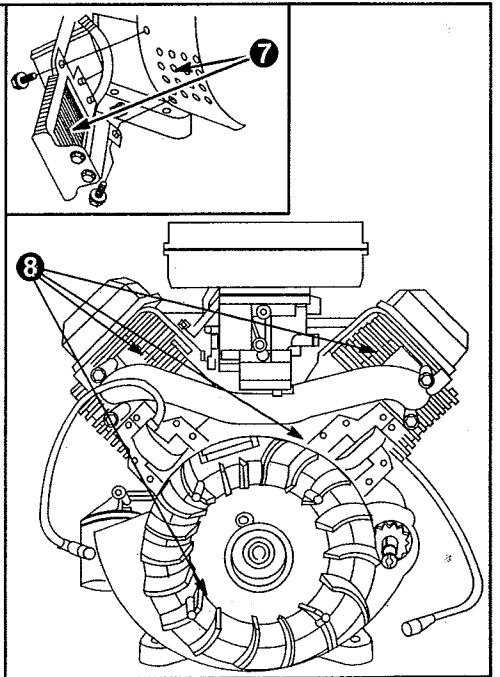
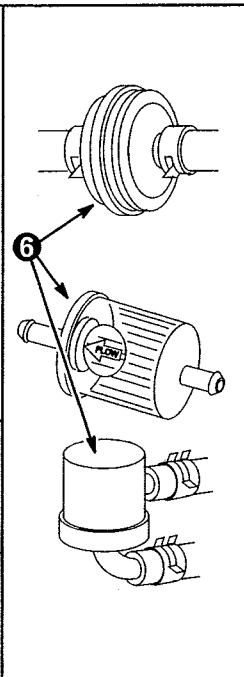
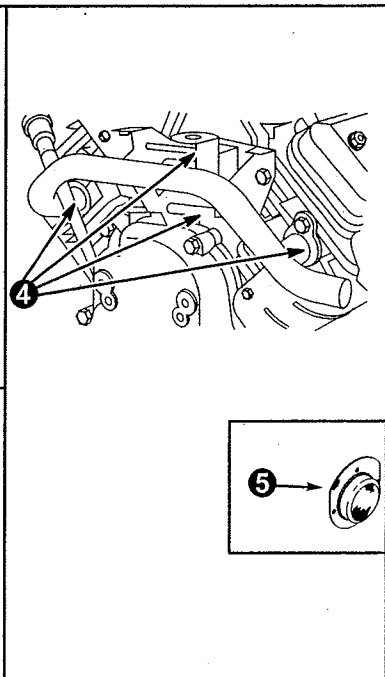
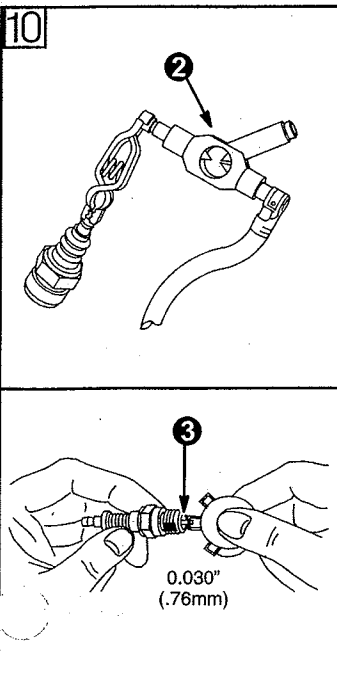
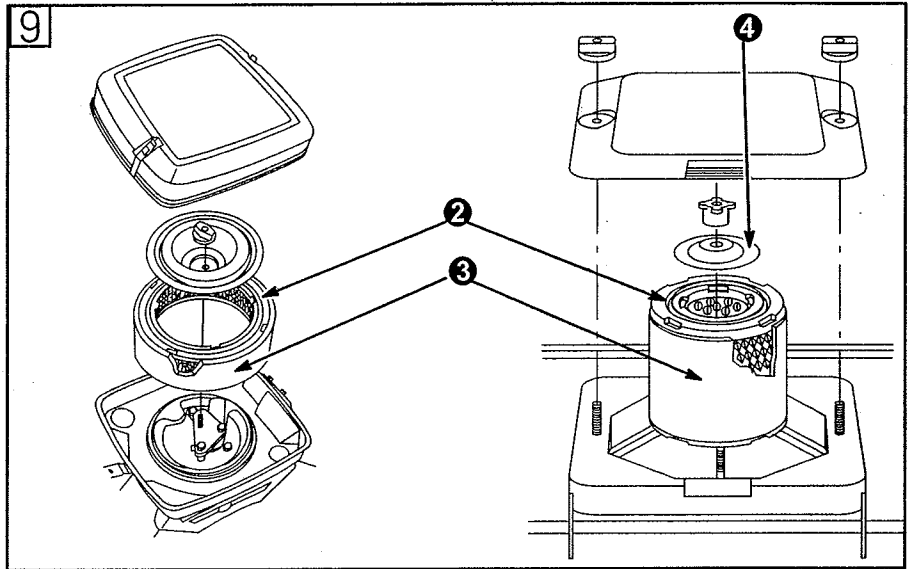
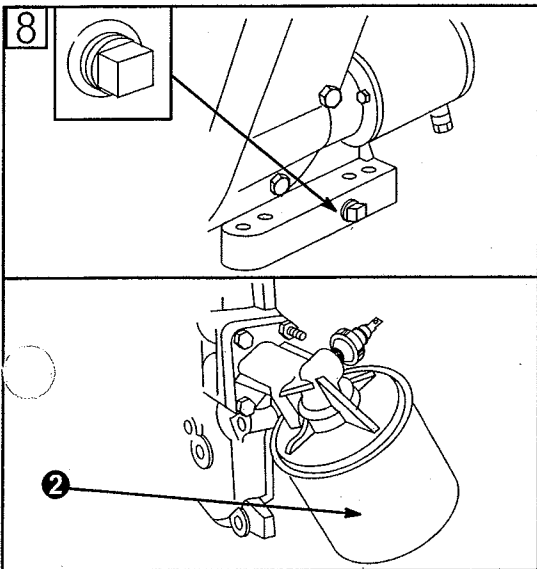
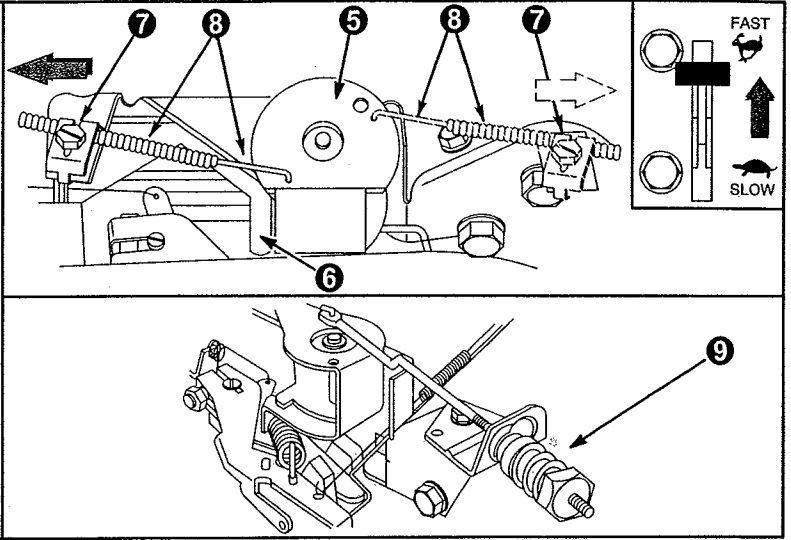
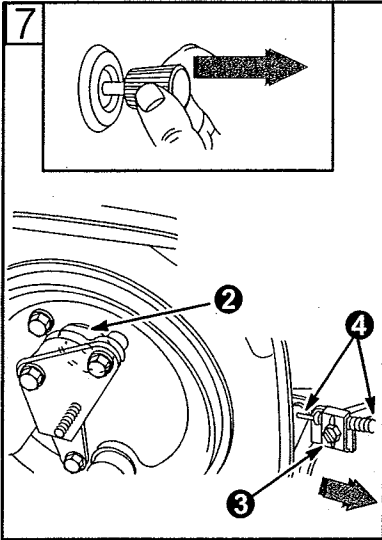
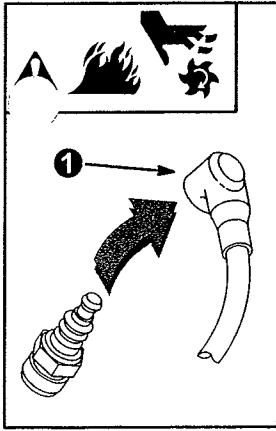
1. PROBLEMS CAUSED BY PARTS THAT ARE NOT ORIGINAL BRIGGS & STRATTON PARTS.
2. Equipment controls or installations that prevent starting, cause unsatisfactory engine performance, or shorten engine life. (Contact equipment manufacturer.)
3. Leaking carburetors, clogged fuel pipes, sticking valves, or other damage, caused by using contaminated or stale fuel. (Use clean, fresh, lead-free gasoline and Briggs & Stratton Fuel Stabilizer, Part No. 5041.)
4. 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. Refill when necessary 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 Operating & Maintenance Instructions.
5. Repair or adjustment of associated parts or assemblies such as clutches, transmissions, remote controls, etc., which are not manufactured by Briggs & Stratton.
6. 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.

7. Parts damaged by over-speeding, or overheating caused by grass, debris, or dirt, which plugs or clogs the cooling 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.
8. 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.
9. 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.
10. Routine tune-up or adjustment of the engine.
11. 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 "Yellow Pages"™ of your telephone directory under "Engines, Gasoline" or "Gasoline Engines," "Lawn Mowers," or similar category.

Briggs & Stratton Engines Are Made Under One Or More Of The Following Patents: Design D-247,177 (Other Patents Pending)										
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	DES. 308
6,284,123	6,064,027	5,813,384	5,606,851	5,320,795	5,197,425	5,086,890	4,977,879	4,630,498		DES. 308, v.
6,260,529	6,014,808	5,765,713	5,548,955	5,271,363	5,197,422	5,070,829	4,971,219	4,522,080		DES. 309,45"
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		DES. 356,9.
6,202,616	5,852,951	5,642,701	5,503,125	5,265,700	5,188,069	5,040,644	4,819,593	4,512,499		DES. 361,77
6,116,212	5,823,153	5,619,845	5,501,203	5,243,878	5,186,142	5,009,208	4,719,682	4,453,507		DES. 375,963



0.030"
(.76mm)

**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 PURCHASED IN CALIFORNIA IN 1995 AND THEREAFTER, WHICH ARE USED IN CALIFORNIA, AND

TO CERTIFIED MODEL YEAR 1997 AND LATER ENGINES WHICH ARE PURCHASED AND ELSEWHERE 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 anti-smog 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 assemblies. 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 maintenance 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 maintenance.

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.

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.

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.

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

2. 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.

3. 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 "Yellow Pages" under "Engines, Gasoline," "Gasoline Engines," "Lawn Mowers," or similar category.

4. 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 normal 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 use of add-on, non-original, or modified parts.

5. Maintenance

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.

6. 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:

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

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

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

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 = 500 hours. For engines of 225 cc or more, Category C = 250 hours, B = 500 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.

