VORTEX 777

Mobile Cleaning Unit

Operation and Service Manual

VORTEX 777

Mobile Cleaning Unit

Operation and Service Manual

Call Vortex Cleaning Systems
For Service: 1-801-523-9111

TABLE OF CONTENTS

SECTION 8 PART MANUALS

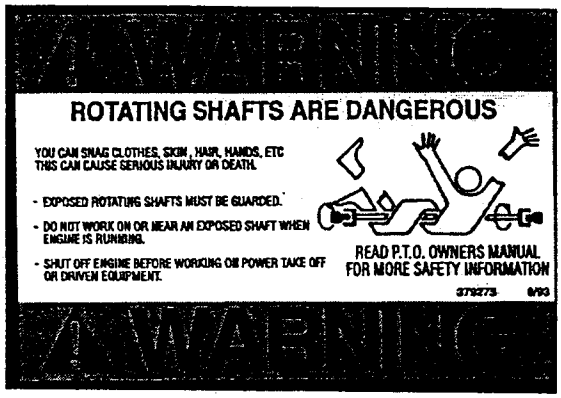
SECTION 9 TECH BULLETIN

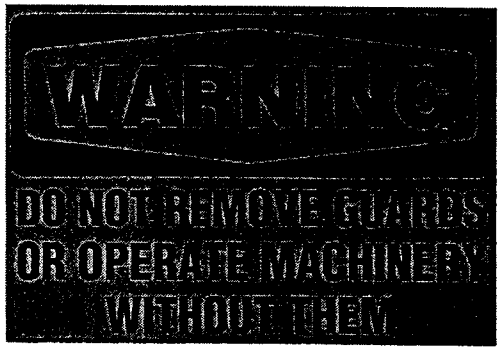
SECTION 1 – GENERAL INFORMATION

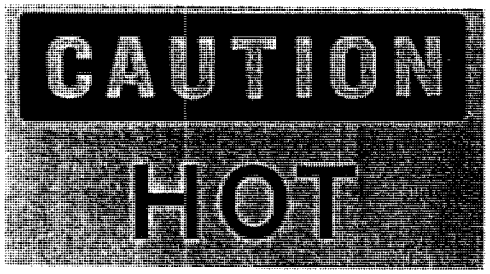
1.1 SAFETY

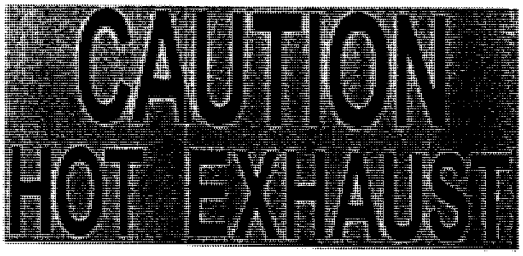
! WARNING: For Your Safety!

The following **WARNING LABELS** are found on your truck. These labels point out important **Warnings** and **Cautions** which should be followed at all times. Failure to follow warnings and cautions could result in a fatality, personal injury to yourself and/or others, or property damage. Follow these instructions carefully! **DO NOT** remove these labels.









! This symbol means WARNING or CAUTION. Failure to follow warnings and cautions could result in fatality, personal injury to yourself and/or others, or personal damage. Follow instructions carefully.

! WARNING!

1.1.1 Read the operator's manual before starting this unit. Failure to adhere to instructions can result in severe personal injury or could be fatal.

1.1.2 Operate this unit only in a well-ventilated area. Exhaust fumes contain carbon monoxide which is an odorless and deadly poison that can cause severe injury or fatality. **DO NOT** run this unit in an enclosed area. **DO NOT** operate this unit where the exhaust may enter any building doorway, window, vent or opening of any type.

1.1.3 DO NOT place hands, feet, hair, and clothing near rotating or moving parts. Avoid any contact with moving parts! Rotating machinery can cause injury or fatality.

1.1.4 Never operate this unit without belt guards. The high speed moving parts, such as belts and pulleys, should be avoided while this unit is running. Severe injury, damage, or fatality may result.

1.1.5 DO NOT service this unit while it is running. The high-speed mechanical parts as well as high temperature components may result in severe injury.

1.1.6 Never touch electrical wires or components while the engine is running. They can be sources of electrical shock.

1.1.7 Engine components can get extremely hot from operation. To prevent severe burns, **DO NOT** touch these areas while the engine is running – or immediately after the engine is turned off.

1.1.8 DO NOT touch the exhaust diverter valve, heat transfer pump, or heat exhangers. Severe burns may result.

1.1.9 Before servicing this unit, allow it to "cool down". This will prevent burns from occurring.

1.1.10 Water under high pressure at high temperature can cause burns, severe personal injury, or fatality. Shut down machine, allow to cool down, and relief system pressure before removing valves, caps, plugs fittings, filters, and misc. equipment.

1.1.11 Do not exceed truck weight limit. GVW allowable 14250 lb.

1.1.12 Keep your truck work area clean. Wands, stair tools, and other accessories must be securely fastened before driving the truck. This will prevent damage to yourselves or your equipment in event of a sudden stop.

1.1.13 All high pressure hoses must be rated for 3000psi at 300°F. Do not use hoses with lower rating. Severe burns and injury may result if the hoses do not meet these requirements.

1.1.14 Make certain that you receive complete training before using this truck.

1.1.15 This Truck uses high pressure and temperature. Improper or irresponsible use may result in serious injury.

1.1.16 Do not modify this unit in any manner. Improper modification can cause severe personal injury or fatality and void any warranty.

1.2 SYSTEM SPECIFICATION.

Truck		**Nissan UD1400**
Truck Idle Speed		**600-700 RPM**
Truck in Cleaning Mode		
	Engine RPM	**1100 to 1500 RPM**
Radiator Remote Thermostat		**195°F**
Water Tank		
Max. Operating Capacity		**260 US gal**
Waste Tank Capacity		
Max. Operating Capacity		**260 US gal**
Max. Outlet Water Pressure		**1500 psi**
Max. Outlet Water Temp.		**280°F**
Blower Flow		**700 ICFM @ 2650 RPM**
Max. System Design Vacuum		**15" Hg. Limited by Blower**
Water Pump Max Flow		**4.5 GPM**
Max. Truck Operating Weight		**12440 lbs ****

Weight include all truck equipment, 300gal of water 1/2 full fuel tank and one driver.

Engine RPM	Blower RPM/ICFM		Pump RPM/GPM	
1100	2300	570	1420	3.45
1500	2880	700	1700	4.50

**** Allowable Truck Gross weight** **14250 lbs**

1.3 WATER REQUIREMENTS

Hard water deposits will adversely affect the plumbing and heat exchange system on the truck

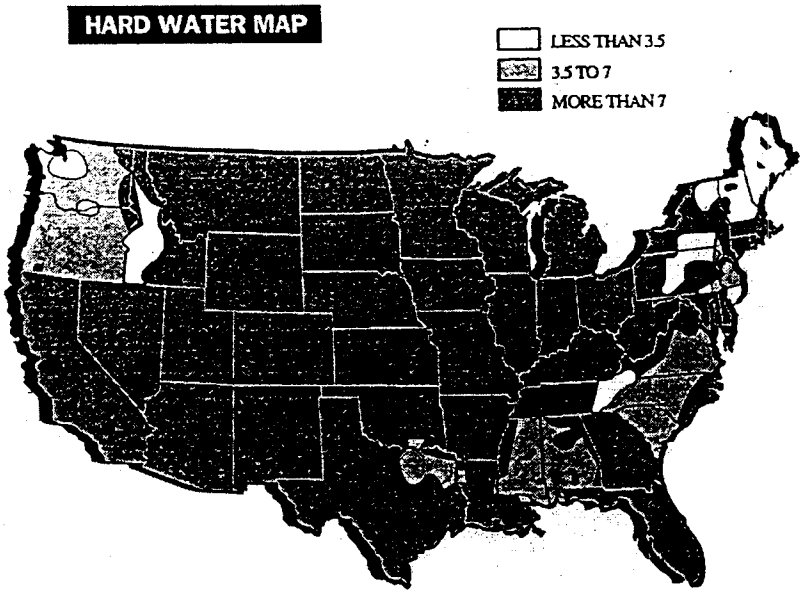
The map below will give you an idea of where areas of high water hardness may occur. Though any water supply obtained from a well is almost always hard water and a water softener will be needed to protect truck equipment.

! NOTE:

Equipment malfunction or component failure caused by hard water scaling is not covered under warranty.

If you are operating this truck in an area where the unit will be using water in which the hardness exceeds 3-1/2 grains, we highly recommend a suitable water softener be installed.

Using a water softener will reduce maintenance and decrease down time caused by hard water scaling. It will also allow cleaning chemical to be more effective in lower concentrations.



SECTION 2 SYSTEMS

This chapter of the operators manual divides the unit up into systems and explains how each system works. Before proceeding into the operational and maintenance section of this manual, we recommend acquiring a basic knowledge of how this unit functions. Read this section of the manual carefully and completely.

2.1 WATER PUMPING SYSTEM

See System Flow Diagram on page 8.

Note.

Fresh water tank has to be filled with water. Max Operating Water level in the tank is 260USgal, Minimum water level is 3" from tank bottom.

Water flows through a strainer into the water pump where it is pressurized. This pressurized water is pumped to the pressure regulator which provides and maintains the desired pressure setting.

Pump discharge manifold is also equipped with a nitrogen-charged accumulator which helps reduce pressure fluctuations.

Water from the pressure regulator flows through the coil within E-1 heat exchanger, then through the tubes within the secondary oil heat exchanger (E-2) and finally to the distributor manifold which contains the user outlets.

2.2 HEAT TRANSFER SYSTEM

See System Flow Diagram on page 8.

Temperature is adjusted primarily using the thermostatic temperature control. This control will de-energize solenoid valve and shut down exhaust gas flow through exhaust heat exchanger.

Water is heated by means of a three stage heat exchange system which utilizes the engines radiator hot water and the engines exhaust heat.

Stage one heating.

The hot water from the engines radiator is circulated between the inside coil and enclosing shell of the exchanger E-1, and is regulated at 195°F by a thermostat. Since E-1 is immersed in the Fresh Water tank, the water in the tank is warmed by the outside surface of the shell of E-1. This constitutes stage 1 heating.

Stage two heating.

In this stage, the pressurized water flowing through the coil in exchanger E-1 is heated by the hot radiator water flowing on the outside of the coil and within the shell of E-1.

Stage three heating.
Here the exhaust heat from the engine is utilized to raise the temperature of the pressurized water leading to the wand. This is done by circulating oil in a secondary loop between exhaust heat exchanger E-3 and secondary exchanger E-2. Oil heated in E-3 is circulated in a closed loop by the oil pump to E-2 (the secondary heat exchanger) where the hot oil transfers its heat to the pressurized water, thus further raising the water temperature from E-1. At this point the water temperature is limited to 280°F by action of the diverter valve.

Exhaust diverter by-pass valve.
Diverter valve located just beyond the engine muffler, the diverter valve is a 3-way by-pass valve that either diverts hot exhaust gases through heat exchanger E-3 or by-passes E-3 to direct the exhaust gas to the atmosphere. For the diverter valve to direct the exhaust gas through exchanger E-3 the water pump must be operating and the oil temperature must be below the set point on the temperature controller.

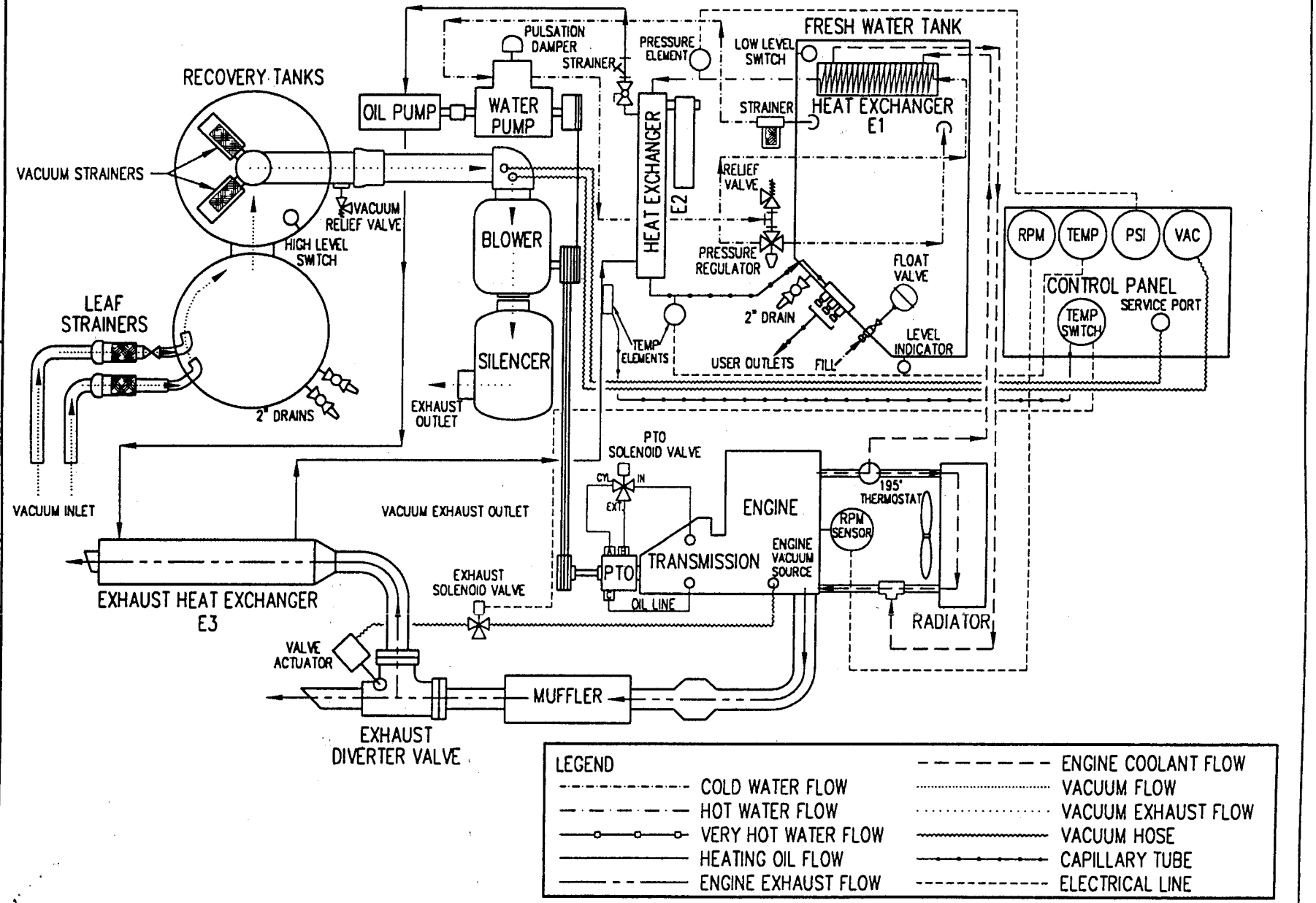
2.3 VACUUM SYSTEM

Vacuum flow begins at the cleaning tool, with air and some chemicals being drawn into the vacuum inlets at the Recovery Tank.
The mixture then flows through leaf strainers prior to the Recovery Tank. Two 100 mesh stainless steel strainers, located inside one Recovery Tank and a relief valve have been provided for vacuum blower protection.

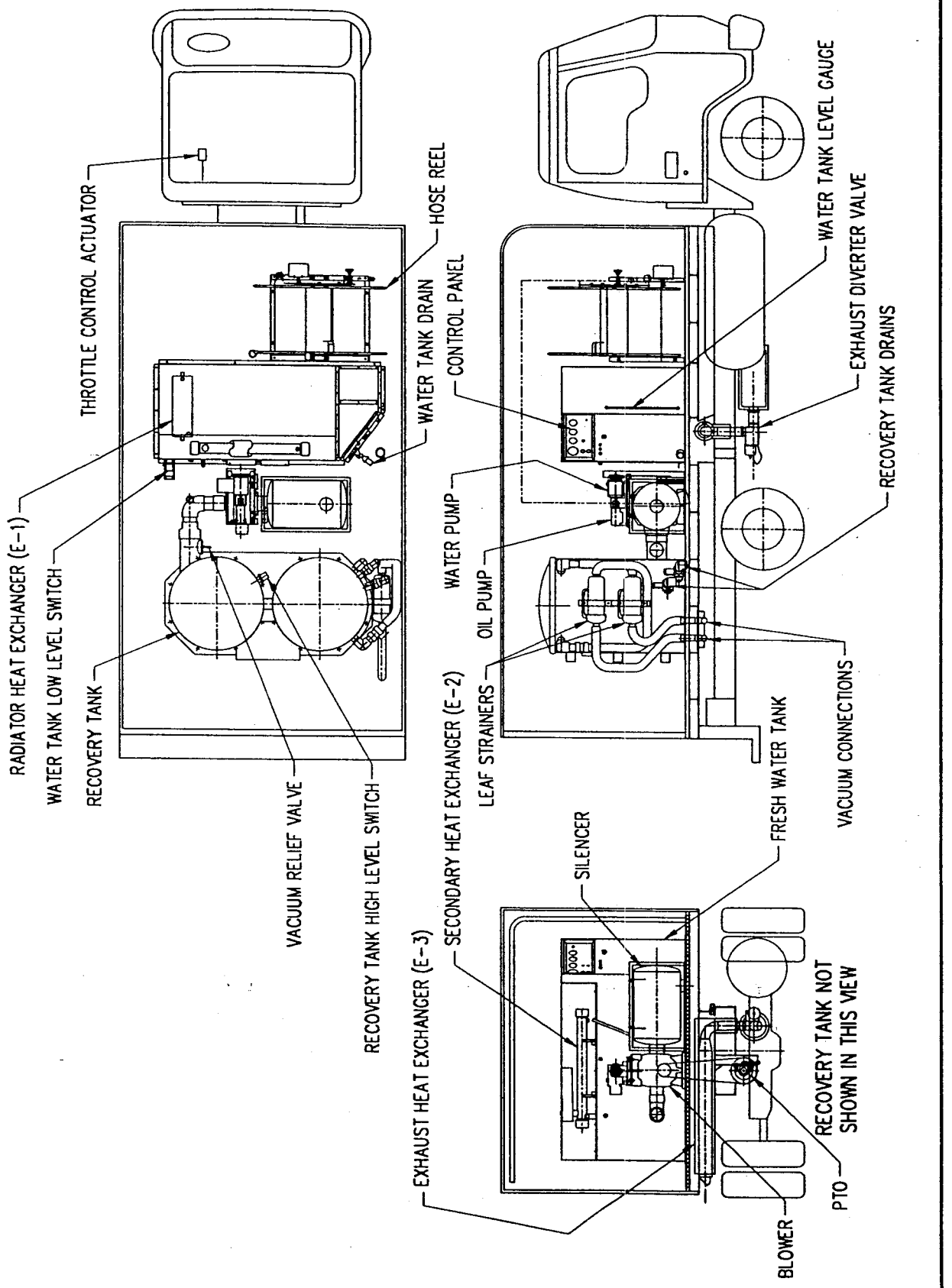
The air then flows into the vacuum blower which is driven by the truck engine through a truck transmission mounted PTO.

The air discharged from vacuum blower exits through the silencer directly into the atmosphere.
A level sensor switch located near the top of the Recovery Tank will shut down the water pump and drop engine RPM to the idle position before the Recovery Tank reaches its full capacity. This protects the vacuum blower from water damage.

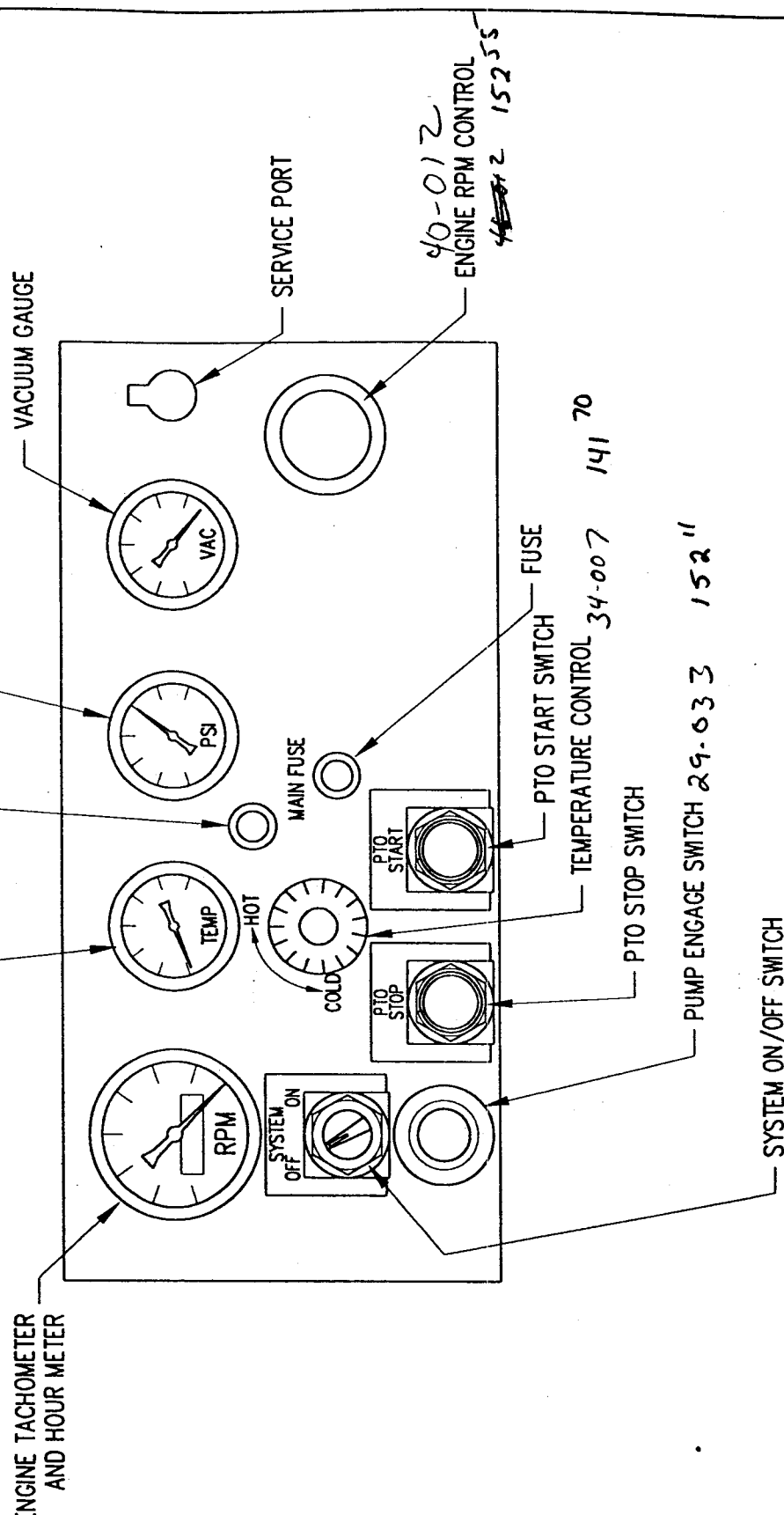
SYSTEM DIAGRAM



GENERAL LAYOUT



CONTROL PANEL



SECTION 3 OPERATION

This chapter of the operators manual explains how to prepare, startup, shut down, and daily maintain the Carpet cleaning unit. Operation of the unit is simple. However, read the following instruction carefully and fully understand the interaction of the various components.

CAUTION:
Operate this unit only in a well-ventilated area. Exhaust fumes contain carbon monoxide which is an odorless and deadly poison that can cause severe injury or fatality. DO NOT operate this unit where the exhaust may enter any building doorway, window, vent, or opening of any type.

3.1. CHECK FOR ADEQUATE FUEL.

Check the fuel tank to be certain there is adequate fuel to complete the job. This unit use approximately 2 gallons per hour, depending on speed setting.

3.2. CHECK OIL LEVEL IN WATER PUMP DRIVEN BY VACUUM BLOWER

Check water pump oil daily before starting system. Oil level should be in the center of level gauge. If the oil level below level gauge center line add oil. Avoid overfilling or damage may occur to pump. Use only oil specified by water pump manufacturer.

3.3 CHECK HEAT TRANSFER FLUID LEVEL IN E-2 HEAT EXCHANGER.

Check level in E-2 heat exchanger. Oil level to be checked with system off and heat exchanger temperature between 60 and 80°F. Normal oil level should be in center of level gauge.

Avoid overfilling heat transfer fluid otherwise damage to the system may occur.

3.4 CHECK STRAINERS IN RECOVERY TANK.

Check vacuum strainers daily. Clean and replace as required.

3.5. CHECK RADIATOR ANTIFREEZE LEVEL.

Check antifreeze level in the beginning of the shift. Add if necessary.

3.6 FILL FRESH WATER TANK WITH CLEAN WATER.

Start the truck and proceed to the first job location.
Running truck for 20 minutes will preheat Fresh water Tank to approximately 80 to 100°F. Do not turn truck off at the job location.

3.8 AT THE JOB LOCATION.

3.8.1 Remove tools from vehicle.

3.8.2 Connect the water pressure hose(s) to the outlet connection(s) at the Fresh Water tank Connect the cleaning tool to the pressure hose(s).

3.8.3 Connect the vacuum hose(s) to the vacuum inlet connection(s) at the vacuum ports. Connect the other end of the vacuum hose(s) to the cleaning tool(s).

3.8.4 Turn PTO switch to "Engage " position this will energize PTO solenoid and engage PTO. Engine will run at idle speed approximately 700 RPM. Blower pulley will start turning. Allow 30 second for the system get to the idle speed.

3.8.5 Set the **temperature control** on the control panel to the desired cleaning temperature. The thermostatic temperature control will allow an increase or decrease in the solution temperature automatically. Simply turn the **control knob** to the desired temperature setting.

3.8.6 Pull **Pump Switch.** This action will energize water pump clutch and both water pump and oil (heat transfer fluid) pump will be on. Allow 30 second for both pumps get to the idle speed.

Water pump will recirculate water through water bypass valve back to the Fresh Water tank. Oil pump will circulate oil from E-3 exhaust heat exchanger to E-2 water/oil heat exchanger.

Note: If your unit fails to build water pressure after 15 second, check for adequate water supply. If necessary, see **Loss of Water Pump pressure** in Water Pump section troubleshooting of this manual.

Do not engage pumps at high engine RPM damage may occur to pump clutch.

Complete system is now ready for high speed operation.

3.8.7 **Turn PTO switch to desired speed selection.**

3.8.8 **Allow adequate time for the engine to get to desired speed.**

Allow adequate time for the truck engine to worm up before engaging PTO.

! CAUTION

WATER UNDER HIGH PRESSURE AND HIGH TEMPERATURE CAN CAUSE BURNS, SEVERE PERSONAL INJURY, OR COULD BE FATAL. SHUT DOWN EQUIPMENT, ALLOW TO COOL DOWN, AND RELEASE SYSTEM OF ALL PRESSURE BEFORE ANY WORK.

! CAUTION

DO NOT MODIFY UNIT WITHOUT WRITTEN PERMISSION FROM MANUFACTURER.

! WARNING!

NEVER dispose of waste in storm drains, water ways, or on ground areas. Always dispose of waste in accordance with Local, State , or Federal laws.

3.9 CLEANING/EXTRACTION.

Once you have completed item 3.8 (starting the unit) proceed with the cleaning operation. PTO should be in speed 1 or speed 2 position (on electrical panel) when cleaning or extracting. A water high level switch located inside the Recovery Tank will automatically shut down PTO when it reaches its full capacity. When this occurs, empty the Recovery Tank before continuing.

3.10 CLEANING

Observe the following guidelines, while cleaning.

3.10.1 Before proceeding make sure the wand spray nozzles are functioning properly.
   a. To check, hold the wand one foot above the surface to be cleaned and open the wand valve. A full spray should be observed from the spray nozzles .
   b. If any nozzle is not showing a full spray pattern, adjust for proper pattern, clean, or replace nozzle, if required.

3.10.2 When cleaning, keep the working opening (mouth) flat on the surface being cleaned. Keep the wand moving when the valve is open.

3.10.3 Truck will automatically return to the idle speed and shutdown water pump when the Recovery Tank is full. This will prevent water being drawing into the vacuum blower. If this occurs, empty the Recovery Tank before proceeding.

> **! WARNING!**
> **DO NOT dispose of waste in any manner which, in so doing, would violate any Local, State, or Federal laws.**

3.11 UPHOLSTERY CLEANING.

Since the upholstery tool has a lower flow rate and smaller spray nozzle orifice, operate the unit with reduced temperature and reduced pressure. Turn temperature control thermostat CCW to reduce temperature setting. This will prevent excessive heat build up in the water system.

3.12 FLOOD RESTORATION.

During flood restoration, do not engage pump switch. The water pumping system and exhaust heat transfer system is now OFF. 3-way valve is in the off position with exhaust gases going directly from the muffler to the atmosphere.

3.13 SHUTDOWN AND DAILY MAINTENANCE.

3.13.1 Remove as much moisture from the vacuum hoses as is reasonable. This will prevent spillage of solution in your vehicle when replacing hoses. Turn sped control nub CCW to reduce engine RPM to idle, Disconnect vacuum hose from the system.

3.13.2 Shutdown water pump and continue running engine in idle position for one minute in order to remove all moisture from the blower.

NOTE: If finished for the day:

Run vacuum blower at full speed, plug the vacuum inlets and spray WD-40 (or equivalent) into the vacuum service port (located at front panel). This will lubricate the blower and prevent internal rusting.

! WARNING !

Do not turn system off at high engine RPM. Lower engine RPM and only then shut down blower.

3.13.4 Push PTO "STOP" Push Button switch this action will shut down blower.

3.13.5 Relieve pressure from the cleaning tools and pressure hoses by activating the valve on the tool. Disconnect the tools and pressure hoses from the unit and store all equipment.

3.13.6 Drain the Recovery Tank and dispose of waste in proper manner.

! **WARNING!**

NEVER dispose of waste in storm drains, water ways, or on ground areas. Always dispose of waste in accordance with Local, State, or Federal law.

3.13.7 Clean the leaf strainers and reinstall. Inspect the vacuum inlet strainer inside the Recovery Tank. If any lint or debris exists, remove and clean strainer.

NOTE: When removing the vacuum inlet strainer, grip the plastic hexagonal section of filter. Grasping strainer by screen may collapse or ruin the strainer. Re-install the strainer hand-tight. **Never operate this unit with this strainer removed, damage or improperly installed.**

NOTE: When replacing this strainer, use only the recommended stainless steel element. This will prevent rust and corrosion from entering the vacuum system.

3.13.8 At the end of the day, rinse out the waste tank with fresh water. Add special Deodorizer to the waste tank to inhibit the growth of bacteria.

3.13.9 Clean the unit, tools, hoses, truck interior, etc., as needed. Inspect All equipment for any damage, wear, leaks, etc.

3.14 FREEZING PROTECTION

! **WARNING:**

If the unit is exposed to freezing weather, the water in the unit may freeze causing SERIOUS DAMAGE to the unit. To avoid this, the following is recommended during the cold weather season:

When the unit is not in use, always park it in a heated building or drain completely.

While in operation, avoid long shutdowns as unit provides heat while running. Shut it down just prior to leaving for the next job.

MAINTENANCE CHART DAILY CHECKS

Truck Engine			Check engine oil level. Fill to proper level.
			Check engine coolant level
			Check transmission level.
			Check power Steering level
			Check Brakes and Washer fluid level.
			Check speed Actuator Linkage.
Water Pump			Check oil level.
Heating System	**		Check oil level, E-2 exchanger
Vacuum Blower			Spray WD-40 into lubrication port at front panel
Vacuum inlet strainer			Clean strainers, inspect, replace if damaged.
Vacuum hoses			Wash out with clean water.

Note: Start at driver door and walk around the truck checking tires, Lug nuts and damage to the truck.
Also check under truck for any fluid leakage on the ground.
Check truck lighting: headlights, turn signals, brake lights, etc.

! WARNING !

**** Do not overfill heating system (Normal liquid level must be in the middle of glass at temperature 70°F. See Tech Bulletin-001 for instruction.**

With Truck Running

1. Engage PTO and pumps and check for water pressure. If system does not develop water pressure in 15 sec. Shutdown water pump and verify if pump is properly primed.

! WARNING !

Always check for water pressure before going to Cleaning Speed. Running Water Pump dry will Damage Pump!

2. Check that unit will come up to desired speed. Also check that 1000 psi water pressure Can be obtained.

3. Check system vacuum at the speed.

MAINTENANCE CHART - WEEKLY CHECKS

Vacuum Blower		Check oil level. Fill to proper level.
Water pump inlet Strainer		Check for debris and clean
3-way exhaust diverter valve		Lubricate weekly
Secondary Exchanger		Vent E-2 heat exchanger (note 1).

MAINTENANCE CHART

High Pressure Water Hoses	25 HR *	Inspect for damage or impending failure
Vacuum Blower	80 HR	Lubricate bearing
Pressure Regulator	100 HR	Lubricate O-rings
Engine Oil and Oil Filter	**	Change engine oil and oil filter monthly.
Radiator & E-1 Hoses	200 HR	Check Radiator hoses for leaks and clamp tightness.
Exhaust Heat exchanger Tubes	200 HR	Clean tubes or every 6 month
Drive shaft	100 HR	Lubricate universal Joints (note 3)
Lower pulley shaft bearing	100 HR	Lubricate bearing (note 3)
Pump belt	200 HR***	Inspect, clean, check belt tension and sheave alignment
Heating fluid replacement	300 HR	Replace Heat Transfer Fluid (note1 and 2).
Transmission Oil	400 HR**	Change transmission oil. (note 2)
Blower Drive belt	500 HR***	Inspect, clean, check belt tension and sheave alignment
Water Pump Oil	500 HR	Change oil
Blower oil	500 HR	Change oil

* Or as often as required.

** See Truck manual for more information.

*** Perform drive belt, sheave, and bushing maintenance after first 25 hours of operation, and then again at 100 hours.

Note 1. See Tech Bulletin – 001

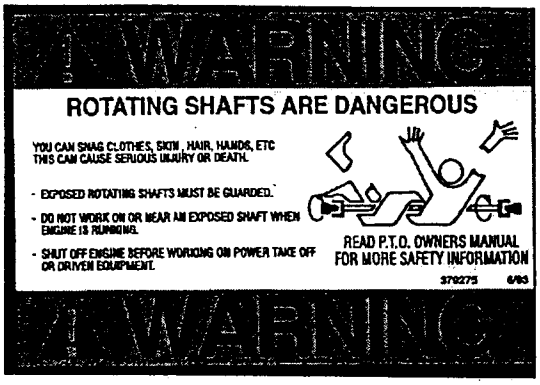
2. Or every 6 month.

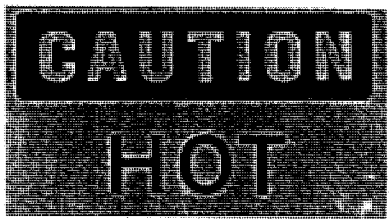
3. See Tech Bulletin –002

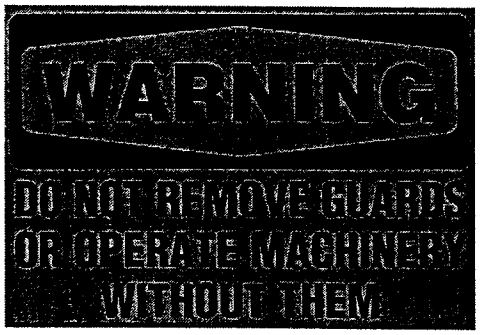
SECTION 4 MAINTENANCE

This chapter of the operator's manual contains the maintenance information for this unit.

Initiation of the planned PREVENTATIVE MAINTENANCE PROGRAM will assure that your Truck unit has optimal performance, a long operating life, and a minimal amount of "down" time.







! WARNING:

DO NOT service this unit while it is running. The high speed mechanical parts as well as high temperature of the components may result in severe injury, severed limbs, or fatality.

4.1 TRUCK ENGINE, TRANSMISSION and PTO.

Refer to Truck Owner's manual for specific instructions.

4.1.1 Check the engine and transmission oil levels **daily**, when in use. MAKE CERTAIN THAT PROPER OIL LEVEL IS MAINTAINED. **NEVER** overfill.

4.1.2 Check transmission/PTO hoses for leaks daily.

4.1.3 Change the break-in engine oil after the **first 100 hours** of operation. Thereafter, change engine oil **every 200 hours** of operation.

4.1.4 The Power Take-Off, being an integral part of the transmission, should be serviced at the same intervals as the transmission.
The Power Take-Off is also part of a system. The PTO includes a drive shaft. PTO requires periodic check and service. Every time the chassis is lubricated or a mechanic is under the vehicle the PTO system should be checked and serviced. Within the first week of use, recheck the installation of the PTO. Check for leaks and loose mounting hardware (studs, huts, cap screws).

4.2 VACUUM BLOWER:

Refer to Vacuum Blower section in the manual for specific instructions.
Lubrication: Recommended mineral based lubricants

32°F to 90°F Ambient temperature	Shell Tellus100 (SAE 30)	AMOCO American ind.100 (SAE 30)	TEXACO Rando HD 100 (SAE 30)	MOBIL DTE Heavy SAE 30

Or Use CPI 4601-68 (SAE-30) Synthetic Based lubricant oil in the gear end of the vacuum blower.

4.2.1 Check oil level weekly to assure the proper level. PROPER LEVEL cannot be overemphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating.

4.2.2 To prevent rust from building up inside the vacuum blower (if moisture exist) each truck is supplied with a lubrication port on the front of the panel. First, run the unit at least 1 minute to remove any moisture from the vacuum blower. Next, fill the lubrication port with WD-40 or a similar lubricant while the unit is running and the vacuum inlet at the Recovery Tank is sealed. Do this at the end of **each working day.**

4.2.3 Drain, flush and replace oil every 1000 hours or yearly, whichever comes first. Change oil more frequently if inspection so indicates.

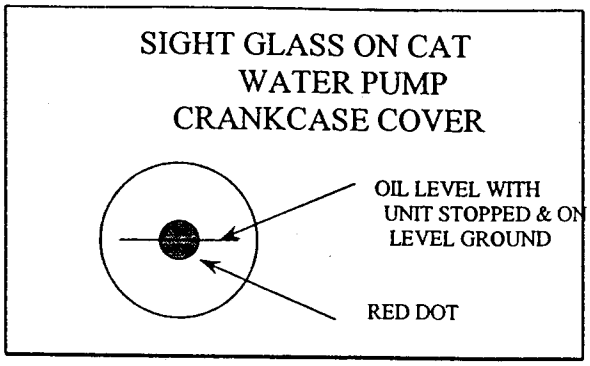
4.2.4 The bearings on pulley end of the vacuum blower require grease lubrication every 2 to 3 weeks or every 80 hours. Using a pressure gun, force new grease into each bearing until trace of clean grease comes out of the relief fitting. Use NLGI #2 premium grade, petroleum base grease with high temperature resistance and good mechanical stability.

CAUTION: Do not inject grease too fast to avoid damaging the drive shaft seal.

4.3 WATER PUMP:

Refer to the Water Pump Operation and Service Manual for specific instructions.

4.3.1 Check the crankcase oil level daily to assure the proper level. If the level has dropped, check for the source of leakage and repair.



4.3.2 Refill the oil to the proper level, if required, with Cat Pump Crankcase Oil, SPECIAL FORMULA PREMIUM 10W30 GRADE NON-DETERGENT HYDRAULIC Oil. Other Cat approved oil equivalents are:

Mobil DTE 16, Amoco Rycow 68, Shell Tellus T68.

4.3.2 Change the crankcase oil with Cat Pump Crankcase Oil after the **first 50 hours** of operation. Drain and refill the crankcase oil with Cat Pump Crankcase Oil every 500 hours thereafter.

4.4 VACUUM INLET STRAINERS.

Inspect the vacuum inlet strainers inside Recovery Tank. If there is any lint or debries, remove and clean strainer. Re-install the strainer **hand-tight.**

The vacuum strainers in Recovery Tank should be removed and cleaned **daily**. If this is done, the strainer will last for long time.

> **! CAUTION:**
> **When removing the vacuum inlet filter, grip the plastic hexagonal section of filter. Grasping filter by screen may collapse or ruin the filter.**

Replace this strainer if damaged or as needed. Replace strainer with new all stainless steel element 100mesh screen.

4.5 DRIVE SHAFT, BELTS, SHEAVES, & BUSHINGS.

4.5.1 Check pulley bushing cap screws after the first 25 hours and then again at 100 hours. Re-torque these screws with a wrench as required.

4.5.2 Grease drive shaft joint every 200 hours. Use Penzoil ULTRA EPI tacky lithium or Penzoil SPL2 grease.

4.5.3 Check for sheave groove wear, clean the belts and sheave grooves, check for worn belts, proper belt tension, and sheave alignment after the first 25 hours and then again at 100 hours.

Check for belt ride in the groove. In multiple groove drives, belt ride should be uniform, not more than 1/16" above or below top of sheave groove.

Check groove wear area for wear. Side wall of groove should be straight, not dished out. Bottom of groove should show no signs of belt contact.

Inspect belts for contaminates, such as oil or grease. Wipe belts clean with detergent and water. Inspect sheaves for buildup of such material and remove, if necessary.

Check wear surface of belt for excessive wear. If it has a slick, glazed look, belts are slipping. Check belt tension. Never replace one belt in a used set. Replace entire set if replacement is necessary.

Place a straight-edge across the top of belt. There should be no more than ½" deflection in the center of the belt with 10lbs push, halfway between the sheaves. If there is to much slack, tighten belt, making sure that it stays properly aligned.

Check alignment with straight-edge or string across faces of the pulleys, Correct alignment to as near perfect as possible.

4.6 INLET STRAINER TO WATER PUMP.

The strainer is located of the outside fresh water tank. Flush screen regularly and reinstall into body. Check gasket for cuts or wear and replace if necessary to assure proper seal. Thread body and cap hand tight for proper seal.

4.7 RECOVERY TANK INLET LEAF STRAINER.

The leaf strainers are located outside of the Recovery Tank. Strainer bag should be removed and cleaned whenever it is full of debris. This should be done on at least a **daily** basis.

4.8 PRESSURE REGULATOR.

Lubricate the o-rings every 100 hours. Use O-ring lubricant.

For procedure, see "General Service Adjustment Section" in this manual for details.

4.9 VACUUM HOSES.

To assure maximum hose life, ATMI recommends that the hose be washed out with clean water at the end of **each working day.**

4.10 ENGINE EXHAUST HEAT EXCHANGER E-3.

If the truck engine is not properly maintained, the exhaust gases will deposit carbon on the inside tubes of the heat exchanger and continuous running will effect the cleaning solution temperature and may cause damage to the catalytic converter. If this condition exist exchanger tubes can be cleaned by a wire brush. Proper maintenance of the truck engine, such as regular tune-ups and proper fuel will help prevent carbon build-up on the heat exchanger tubes and increase the life of the unit.

4.11 3-WAY EXHAUST DIVERTER VALVE.

If the truck engine is not properly maintained, the exhaust gases will deposit carbon on inside walls of the 3-way diverter valve.

Lubrication: Use LUBICON series I/M lubricant provided in an aerosol can. Spray into brass tube located on top of the 3-way valve.

LUBICON is formulated especially for 3-way valve high temperature service. LUBICON will dissolve carbon build up and will lubricate valve shaft surface. Lubricate 3-way valve weekly with the exhaust system at 120°F or less.

Do not use any other type of lubricant.

4.12 HEAT TRANSFER FLUID/WATER HEAT EXCHANGER E-2.

Vent E-2 heat exchanger **weekly or every 40 hours of operation.**

Replace heat transfer fluid **every 6 months** of operation.

See Tech Bulletin 001 for detailed instructions.

4.13 HIGH PRESSURE HOSES.

Inspect high pressure water and oil hoses for wear after the **first 100 hours** of use. Inspect **every 25 hours thereafter**. If hoses show any signs of damage or impending rupture, replace the hose.

! CAUTION:

DO NOT attempt to repair high pressure hoses! Repairing high pressure hoses may result in severe burns and serious injury!

All high pressure hoses must be rated for 3000psi at 250°F. Thermoplastic hoses do not meet these specifications and should not be used. Severe burns and injury may result if the hoses do not meet these requirements.

4.14 RADIATOR HOSES.

Inspect all radiator hoses for leaks after the **first 25 hours** of use. Inspect **every 100 hours thereafter**. If hoses show any signs of damage or impeding rupture, replace the hose.

SECTION 5. GENERAL SERVICE ADJUSTMENTS.

! WARNING:
DO NOT service this unit while it is running. The high-speed mechanical parts as well as high temperature components may result in severe injury, severed limbs, or fatality.

! WARNING:
DO NOT set the engine speed above 1900 RPM. Under no circumstance should vacuum blower operate over 2900 RPM. Permanent damage may occur. DO NOT attempt to adjust RPM without a tachometer.

5.1 VACUUM BLOWER DRIVE BELTS.

To tighten the vacuum blower belts:

5.1.1 Remove belt cover from lower pulley assembly.

5.1.2 Loosen the 2 nuts which hold each pillow block.

5.1.3 Turn each adjustment bolt an equal amount until the proper belt tension is achieved (1/2" deflection in the center of the belt) halfway between the sheaves with about 10lb load on a belt

CAUTION: When adjusting belt tension, make certain that the lower shaft and vacuum blower shaft remain parallel, and the belt tension is equal on all thee belts.

5.1.4 After adjusting, re-tighten the 4 nuts which hold the pillow blocks in position. Check pulley alignment with a straight edge.

5.2 WATER PUMP DRIVE BELT.

To tighten the water pump belt:

5.2.1 Remove belt guard.

5.2.2 Loosen the 2 nuts from front and rear of pump base.

5.2.3 Adjust the belt tension adjusting bolt until the proper belt tension is achieved. (1/2" deflection in the center of the belt halfway between the sheaves).

5.2.4 Tighten the pump mount hold-down nuts.

5.2.5 Reinstall belt guard.

5.3 VACUUM RELIEF VALVE.

While unit is running at full RPM, Block the air flow at the vacuum inlet connections and read the vacuum gauge. If adjustment is required, shut the unit down and adjust the locking nut tension. Start your unit and read the vacuum gauge. Repeat this process until the relief valve opens at 15"Hg.

5.4 PRESSURE REGULATOR.

The pressure regulator serves to maintain water pressure at a preset point and to bypass this water back to the water tank. Adjust as follows:

5.4.1 With system running, close the cleaning tool water valve. Check the pressure gauge. Open the water valve. Set pressure regulator so that the pressure gauge reads 1000 PSI with water valve open.
When the water valve is open, there is an approximate drop of 100 PSI in pressure. If there is a pressure drop greater than 100 PSI it may be necessary to lubricate the o-rings in the pressure regulator.

5.4.2 If the pressure regulator requires adjustment, turn the adjustment knob (while observing the pressure gauge on the control panel) until the desired pressure is obtained.

5.5 ADDING/DRAINING ENGINE COOLANT.

Use 50/50 ethylene glycol-water ratio in the truck cooling system. Change the coolant every 1000 hours or every year.

5.5.1 To drain the coolant, remove the radiator cap and vent plug from E-1 heat exchanger (exchanger located inside fresh water tank) and open the lower engine radiator drain cock.

5.5.2 To add coolant, first close drain cock, add coolant to E-1 heat exchanger (it will take appr. 2gal) and add liquid to the radiator untill it is full. Close radiator cap and add more coolant to E-1 heat exchanger. Reinstall E-1 exchanger vent plug. Then add to overflow container (fill only halfway between the add and full marks). After running truck add more coolant, if necessary, into overflow container only. Check complete coolant system for air pockets.

5.6 SECONDARY WATER HEATING SYSTEM VENTING AND FILLING PROCEDURE.

See Tech Bulletin No. 001 for detail instructions.

SECTION 6. TROUBLESHOOTING

! WARNING:
DO NOT service this system while it is running. The high-speed mechanical parts as well as high temperature components may result in severe injury, severed limbs, or fatality.

This chapter of the operation manual explains how to look for and fix malfunctions which may occur.

Intelligent, accurate troubleshooting is based on a complete and thorough understanding of the WATER, VACUUM, HEAT TRANSFER, SAFETY and WIRING systems of the truck.

If there is a malfunction occurring in a system which you do not fully understand, turn to the "OPERATION" section 3 of this manual and REVIEW "SYSTEMS".

In addition, prior to proceeding, time can be saved by checking that:

1. The truck engine is running at the normal speed (1400 to 1500 RPM per RPM meter), with the diverter valve in heat exchanger position. (check by observing if exhaust is coming out of E-3 exchanger).

SPECIFIC PROBLEMS

6.1 PTO WILL NOT ENGAGE.

Truck engine running at idle speed.

PROBABLE CAUSE	CORRECTIVE ACTION
Main fuse on control panel has been burned out.	After inspecting the system determine the cause of the failed fuse. Replace fuse and start system.
Loose or corroded battery terminals.	Clean, tighten, or replace the battery terminals.
Defective 2 position panel switch.	Test switch for power going into switch. If there is power going in but NO power going out, replace switch.
Defective PTO solenoid.	Check if there is a power going to the solenoid coil. Check solenoid ground wire. Inspect solenoid for proper operation, replace if necessary.
Defective PTO relay.	Check PTO relay for proper operation, replace if necessary.
Engine not at idle position.	Check System RPM cable and limit switch
Recovery Tank full with water.	Drain Recovery Tank

6.2 PTO WILL NOT RUN AT SPEED

PROBABLE CAUSE	CORRECTIVE ACTION
Defective Throttle Actuator.	Check throttle Actuator for proper function and replace if necessary.

6.3 LOSS OF WATER PUMP PRESSURE.

PROBABLE CAUSE	CORRECTIVE ACTION
Improper pump speed.	Using a tachometer, check the engine speed. Engine should run at 1200 to 1500
Pressure regulator O-rings are dry.	Lubricate O-rings with special lubricant.
Pressure regulator has worn O-rings	Check O-rings. If necessary, replace.
Pressure regulator is dirty, stuck open, or improperly adjusted.	Clean or repair pressure regulator. Adjust to working pressure. Lubricate O-rings.
Low pump volume. (Measure the amount of water being produced by the pump. With discharge hose disconnected from pressure regulator. It should fill a gallon container every 17 seconds with pump running @ 1300 RPM.	Examine the check valves, plunger cups, and cylinder head on the water pump. Repair as required. (Refer to the water pump section).
Defective water pressure sensor or pressure gauge.	Replace pressure gauge sensor or pressure gauge.
Orifice (spray nozzle) in the cleaning tool is worn, defective, or the wrong size.	Replace nozzle.
Debris or calcium built up clogging water lines.	Clean or replace as needed.

6.4 LOSS OF WATER VOLUME AT CLEANING TOOL ORIFICE.

Water pressure gauge reads normal.

PROBABLE CAUSE	CORRECTIVE ACTION
Plugged orifice in the cleaning tool.	Unplug or replace spray nozzle.
Defective quick-connect on one of the high pressure hoses	Replace defective quick-connect(s) on high pressure hose(s).
Cleaning tool valve is malfunctioning.	Repair or replace valve.
Hose inner lining is constricted.	Remove restriction or replace hose.
Heat exchanger is scaled.	De-scale coil, and install a water softener, if necessary, to protect the equipment. If water contains 5 grains or more of water hardness, a water softener is needed.

6.5 LOSS OF VACUUM.

While cleaning, the vacuum is not up to specification. Engine RPM is normal.

PROBABLE CAUSE	CORRECTIVE ACTION
Vacuum hose is damaged, causing a suction leak.	Inspect the vacuum hose(s). Repair any damage or replace.
Recovery Tank gasket not sealing properly, not positioned properly.	Inspect the gasket. Repair seal or replace. Reposition lid.
Debris and lint is trapped in vacuum line between cleaning tool and waste tank.	Locate obstruction and remove.
Plugged vacuum line leading to vacuum gauge.	Unplug or replace the vacuum line.
Recovery Tank filter or leaf strainer is plugged.	Clean or replace strainer.
Loose vacuum blower drive belts.	Tighten the drive belts
Recovery Tank drain valve is damaged or left open, causing a vacuum leak.	Drain the waste tank. Close drain valve, if open. Remove the drain valve and after inspecting, replace the defective components.
Vacuum relief requires adjustment.	Re-adjust the vacuum relief valve. If the vacuum does not increase, remove and inspect the relief valve. If damaged, replace.
Vacuum blower is worn out.	Replace the vacuum blower.

6.6 PUMP DOES NOT ENGAGE.

PROBABLE CAUSE	CORRECTIVE ACTION
Recovery tank is at high level.	Check recovery tank level. Drain tank if necessary. Check Hi. Level switch in recovery tank for loose wires or defective level switch. Replace switch if necessary.
Fresh Water tank is at low level.	Check water level in Fresh Water Tank. Low level switch will trip at appr. 3-4" water level. Check level switch for proper operation and for any loose wires. Replace switch if necessary.
Defective water pump clutch.	Check power at the clutch. If there is power at the clutch but does not operate, replace the defective clutch
Defective electrical connection in the control panel wiring or defective switch.	Examine switch, electrical connections, and wiring. Repair any defective connections. If there is power going to the switch but not going out, replace the defective switch.

6.7 EXCESSIVE WATER OUTLET TEMPERATURE

PROBABLE CAUSE	CORRECTIVE ACTION
Instrument settings:	Check Temperature controller setting. Lower setting if required.
Diverter Valve in the Heat Exchanger position	Check position of the diverter valve by noting E-3 exhaust.
Temperature control is set at a high temperature.	Turning temperature controller nub CCW will lower temperature setting and should divert exhaust flow to normal exhaust.
Defective temperature controller	Inspect temperature control for proper operation, repair or replace, if necessary
Flow restriction caused by hard water scaling.	Descale unit, repair or replace damaged plumbing components as necessary. Install water softener.

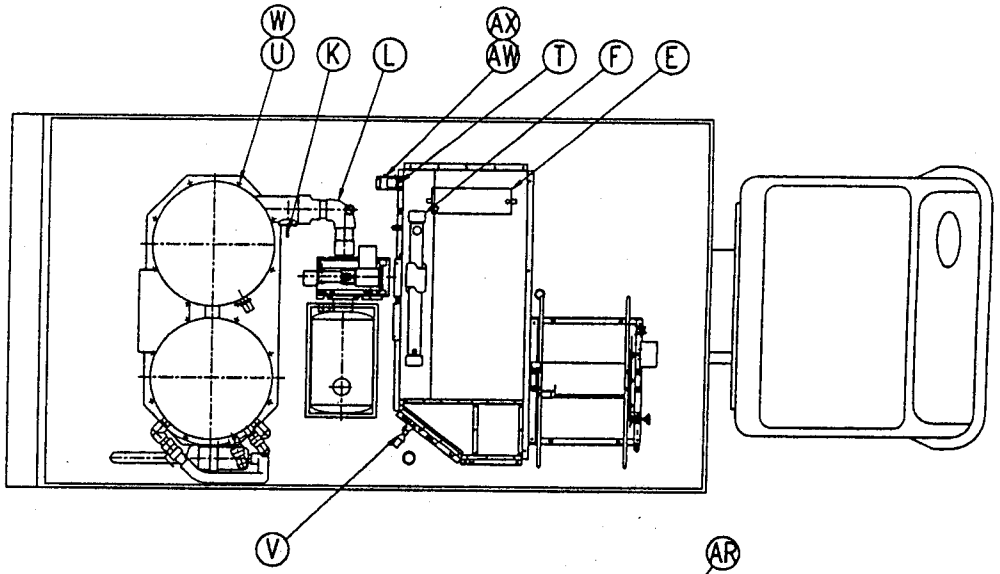
6.8 LOSS OF WATER TEMPERATURE.

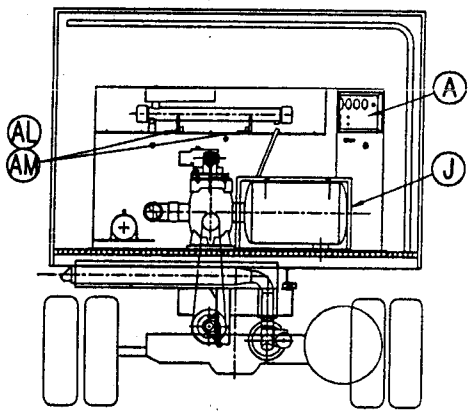
The heat output of the unit is LESS than normal.

PROBABLE CAUSE	CORRECTIVE ACTION
Diverter valve is in the Normal Exhaust position.	Check the diverter valve for proper operation.
Temperature control is set at a low temperature.	Set temperature control to a higher setting
Vacuum relief valve is set too low.	Reset vacuum relief valve to 15"Hg.
Low Heat Transfer fluid level.	Normal level of Heat Transfer fluid should be in the middle of the level eye of E-2 at ambient temperature or below upper tube if looking from the fill opening. Check heat transfer system for leaks. Add oil if so required. (See Tech Bulletin 001)
Defective Heat Transfer oil pump.	Inspect pump for proper operation and replace, if necessary.
Defective temperature controller.	Test. If necessary, replace.
Engine RPM is low.	Check engine RPM. See system specification of this manual.
Defective temperature sensor.	Inspect sensor for proper operation and replace, if necessary.
Defective temperature gauge.	Test gauge. If necessary, replace.
E-3 heat exchanger is coated on inside of the tubes.	Clean exhaust heat exchanger tubes.
E-2 heat exchanger is coated with hard water deposits	Soak complete heat exchanger at radiator shop. Rinse exchanger with clean water and completely dry before reinstalling.

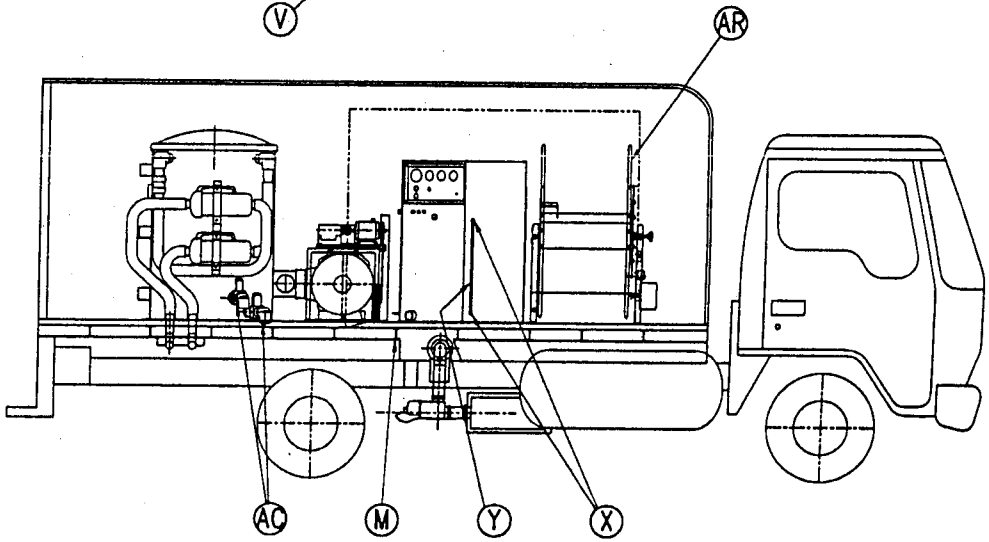
TRUCK MAIN ASSEMBLY

	Parts Listing	Part Number
A.	Electrical System	045003
E.	E-1 Heat Exchanger	045101
F.	E-2 Heat Exchanger	045102
J.	Silencer Cover	045118
K.	Vacuum Relief Valve	045143
L.	Vacuum Piping	045119
M.	Backing PLate	045120
T.	Level Switch	ELSW-0596
U.	3/8-16 Lock Nut	HWNT-0210
V.	2" Drain Valve	PLBV-0041
W.	3/8-16 x 2-1/2" long Bolts	HWBL-0221
X.	Nylon Elbow } Level Gauge	TFML-0001
Y.	Clear Tubing } Level Gauge	TRLP-0009
AL.	3/8-16 x 3/4" long Bolts	HWBL-0111
AM.	3/8-16 Hex Nut	HWNT-0208
AR.	Hose Reel Assembly	045008
AW.	Level Switch Cover	045192
AX.	#10 Self Tapping Screw	-

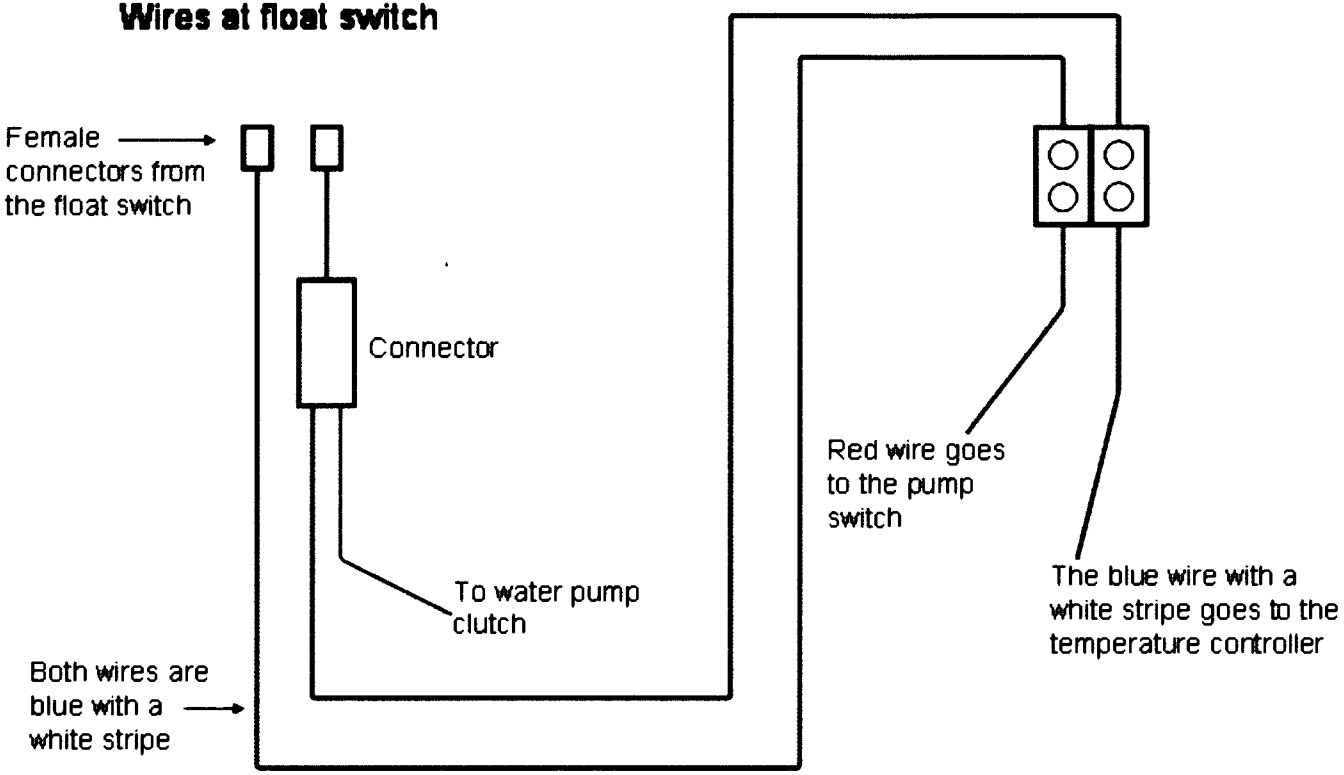




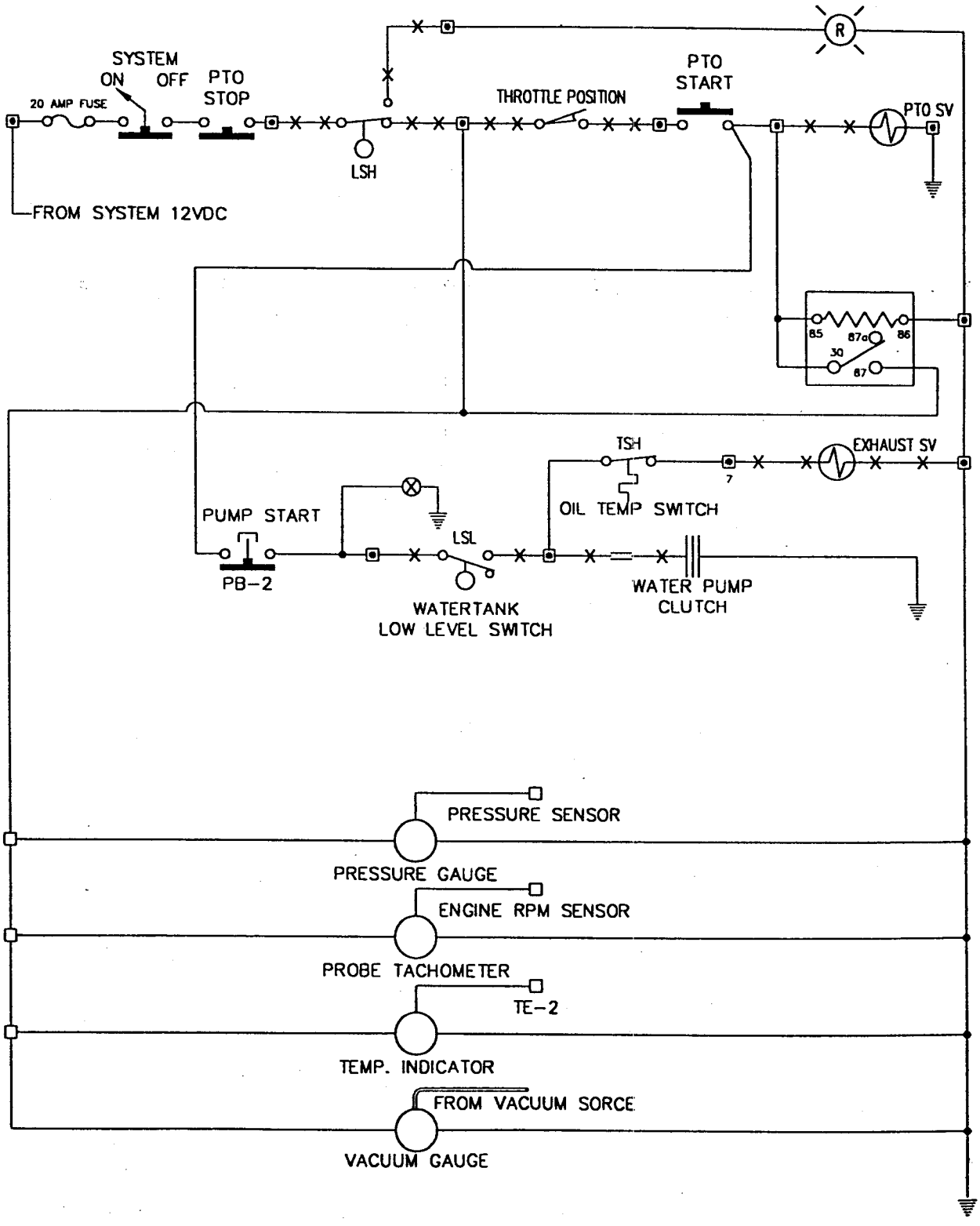
RECOVERY TANK NOT SHOWN IN THIS VIEW



Wires at float switch



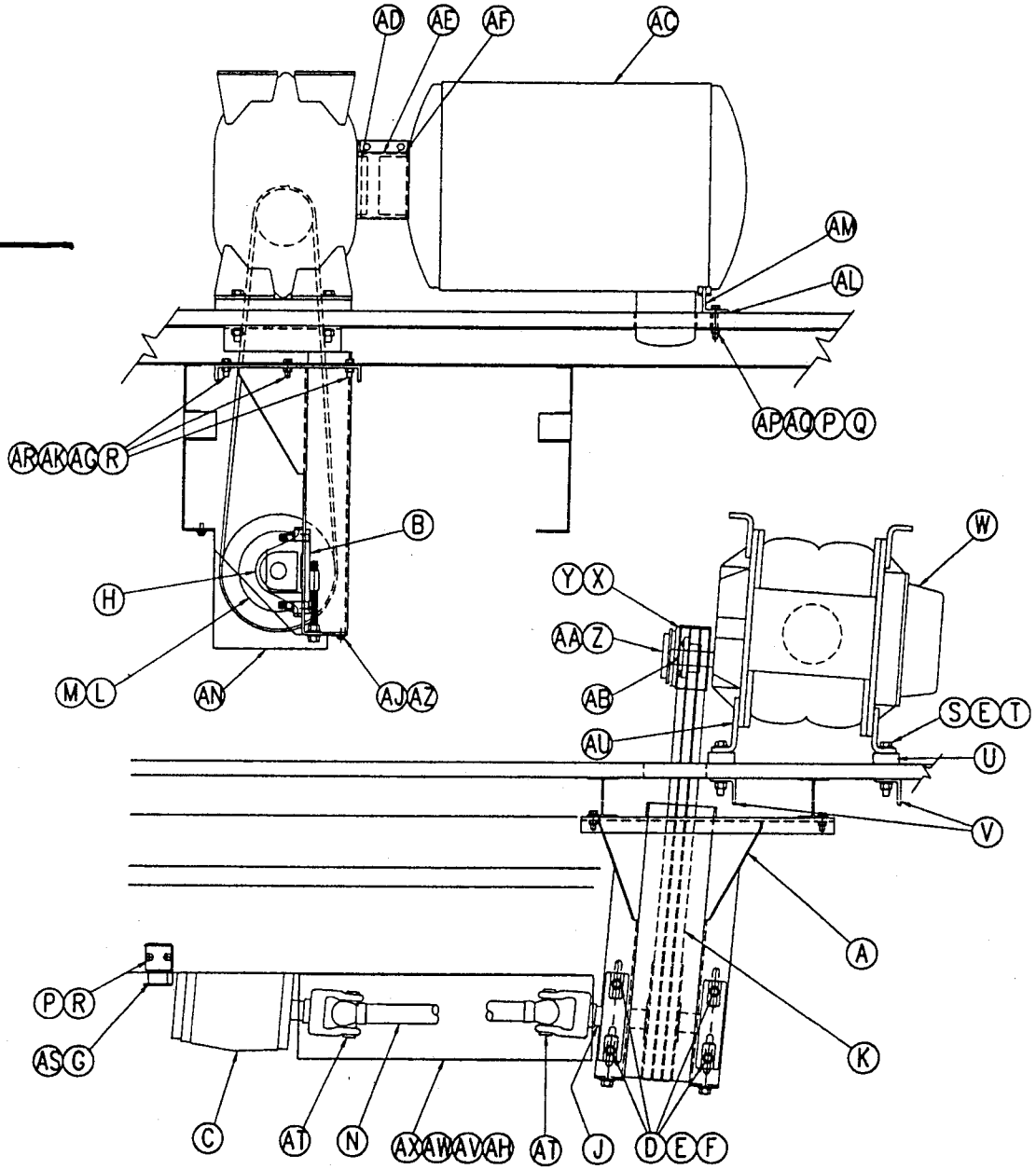
ELECTRICAL LOGIC DIAGRAM



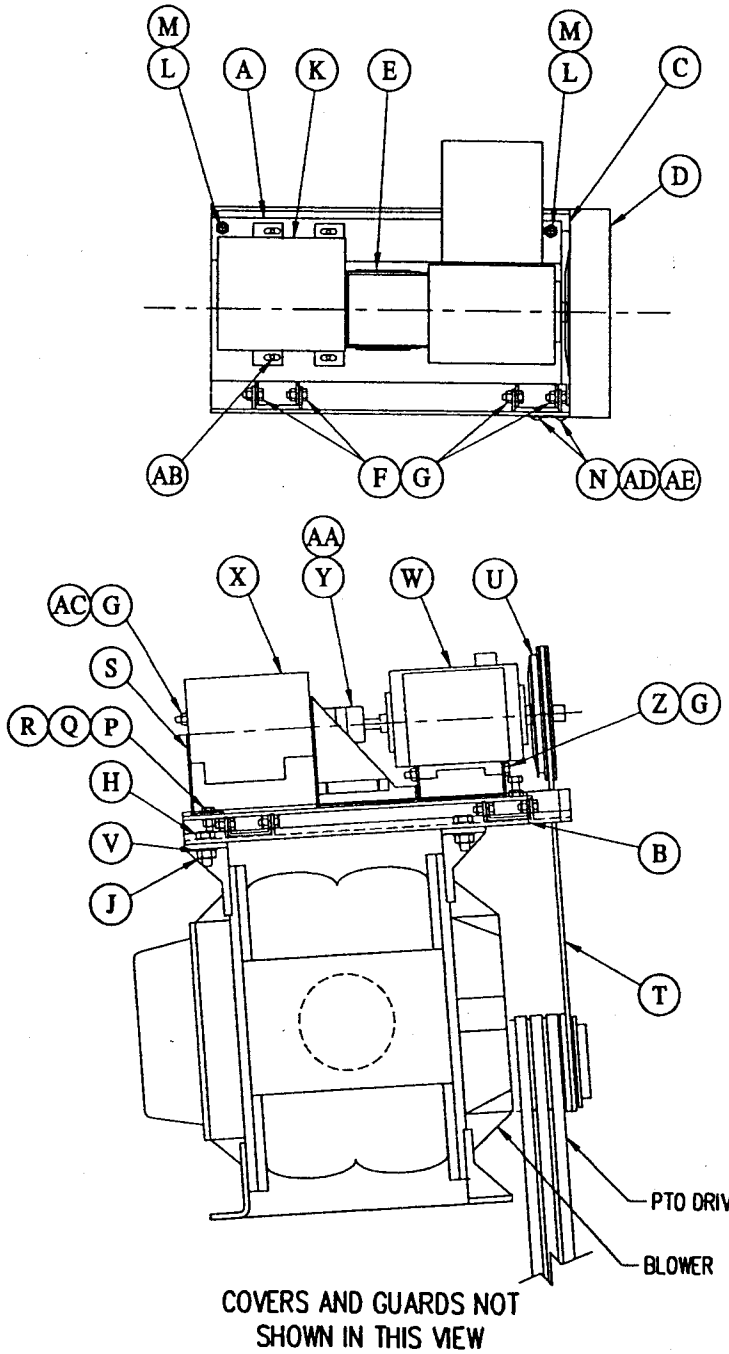
B7-049 5VX800

PTO/BLOWER ASSEMBLY

	Parts Listing	Part Number
A.	Sheave Bracket	045164
B.	Backing Plate Bracket	045167
C.	PTO (Chelsea)	HWPT-0001
	PTO (Muncie)	HWPT-0004
D.	1/2-13 Hex Nut	HWNT-0216
E.	1/2 Flat Washer	HWWA-0167
F.	1/2 Lock Washer	HWWA-0166
G.	Solenoid Bracket	045180
H.	Pillow Block Bearings	HWBR-0093
J.	Shaft	045173
K.	Drive Belt	HWBT-0027
L.	Sheave	HWSV-0009
M.	Bushing	HWBS-0038
N.	Drive Shaft	045139
P.	3/8-16 Hex Nut	HWNT-0219
Q.	3/8 Flat Washer	HWWA-0146
R.	3/8-16 x 1-1/4" Long Bolts	HWBL-0109
S.	1/2-13 x 3-1/2" Long Bolts	HWBL-0218
T.	1/2-13 Hex Lock Nut	HWNT-0216
U.	Blower Mount	045168-A
V.	Blower Mounting Angle	045169
W.	Blower	HWBW-0001
X.	Sheave	HWSV-0010
Y.	Bushing	HWBS-0039
Z.	Bushing	HWBS-0040
AA.	Pump Sheave	HWSV-0011
AB.	1/4" Key Stock	BSKS-0002
AC.	Silencer	045176
AD.	4" x 2" Long Pipe Nipple	PLNP-0180
AE.	1/4" Rubber Coupling	HWGS-0161
AF.	Strap Clamp	CLMP-0024
AG.	3/8 Flat washer	HWWA-0165
AH.	Drive Shaft Guard	045178
AJ.	1/4-20 x 3/8" Long Screw	HWSC-0560
AK.	3/8-16 Hex Nut	HWNT-0165
AL.	Rubber Gasket	FMRS-0013
AM.	Silencer Mounting Saddle	045181
AN.	Sheave Guard	045179
AP.	3/8-16 x 2-1/2" Long Bolt	HWBL-0221
AQ.	Backing Plate	045120
AR.	3/8 Lock Washer	HWWA-0001
AS.	#10-32 x 1/2" Long Screw	HWSC-0375
AT.	Safety Wire	WRCS-0001
AU.	Blower Front Leg	045126
AV.	5/16-18 x1" Long Bolt	HWBL-0094
AW.	5/16-18 Hex Lock Nut	HWNT-0204
AX.	5/16 Flat Washer	HWWA-0110
AZ.	1/4 Flat Washer	HWWA-0086

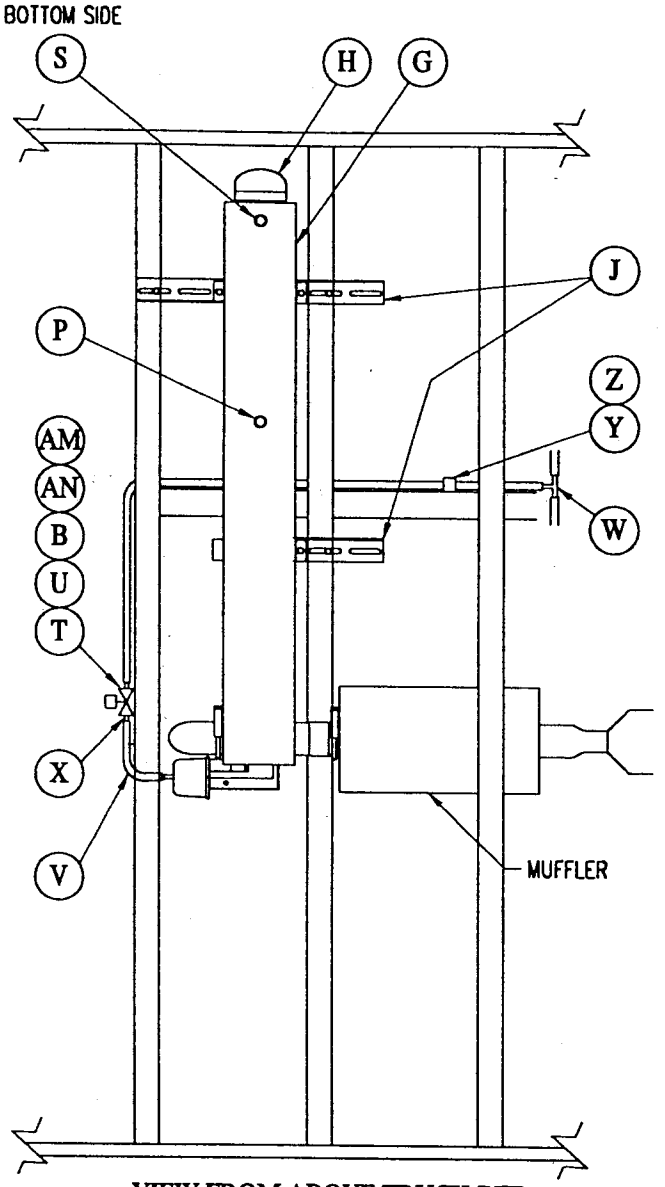


WATER/OIL PUMP ASSEMBLY

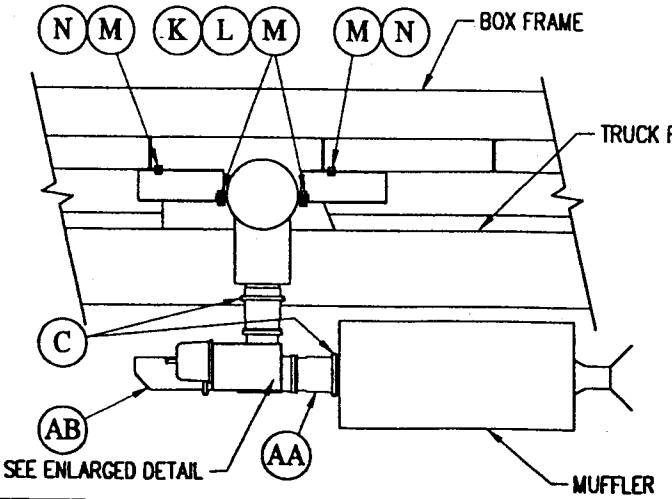


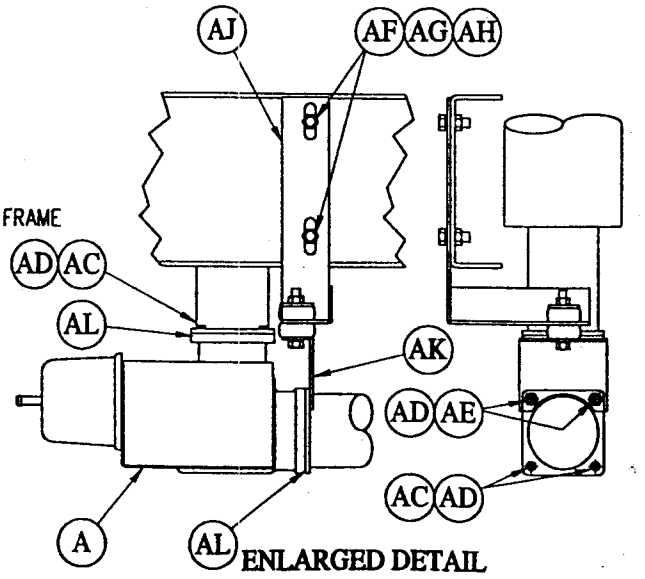
	Parts Listing	Part Number
A.	Pump Mounting Plate	045112
B.	Hinge Assembly	045148
C.	Adjustment Bracket	045146
D.	Belt Guard	045125
E.	Coupling Guard	045117
F.	5/16-18 x 3/4" Long Bolts	HWBL-0069
G.	5/16-18 Locking Nut	HWNT-0205
H.	1/2-13 x 1-1/4" Long Bolt	HWBL-0108
J.	1/2-13 Locking Nut	HWNT-0216
K.	Oil Pump Cover	045115
L.	3/8-16 x 2" Long Bolt	HWBL-0098
M.	3/8-16 Hex Nut	HWNT-0054
N.	1/4-20 x 3/4" Long Screw	HWSC-0547
P.	5/16-18 x 1" Long Bolt	HWBL-0094
Q.	5/16-18 Hex Nut	HWNT-0069
R.	5/16 Lock Washer	HWWA-0162
S.	Oil Pump Bracket	045147
T.	Drive Belt	HWBT-0026
U.	Water Pump Clutch	PLPC-0001
V.	1/2 Flat Washer	HWWA-0060
W.	Water Pump	PLPP-0039
X.	Oil Pump	PLPP-0034
Y.	Shaft Coupling	HWCP-0018
Z.	5/16-18 x 1/2" Long Bolt	HWBL-0100
AA.	Key Stock	BSKS-0005
AB.	#10-32 x 1/2" Long Screw	HWSC-0375
AC.	5/16 Flat Washer	HWWA-0110
AD.	1/4 Lock Washer	HWWA-0014
AE.	1/4 Flat Washer	HWWA-0086

EXHAUST HEAT SYSTEM



VIEW FROM ABOVE TRUCK BED

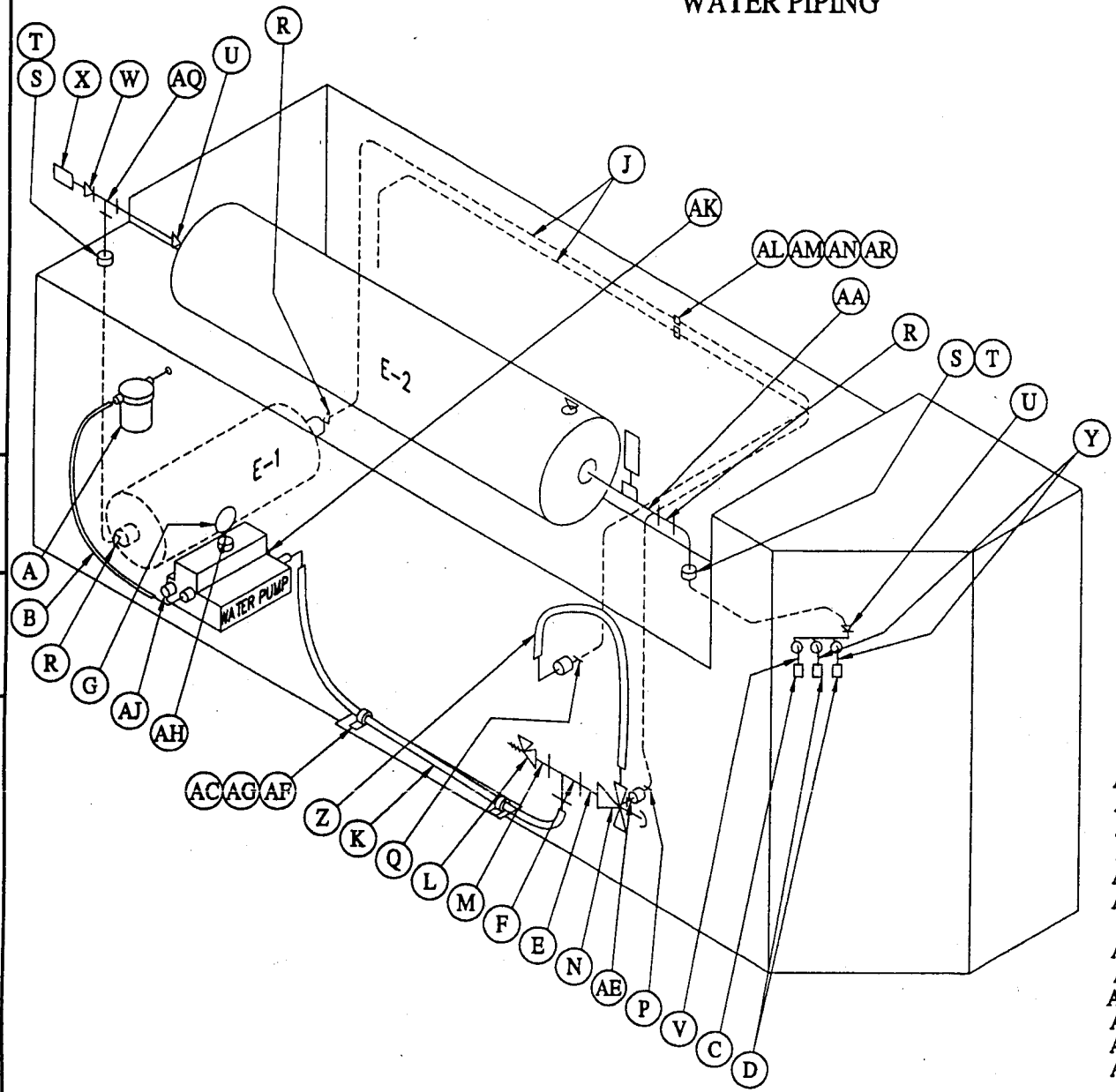




ENLARGED DETAIL

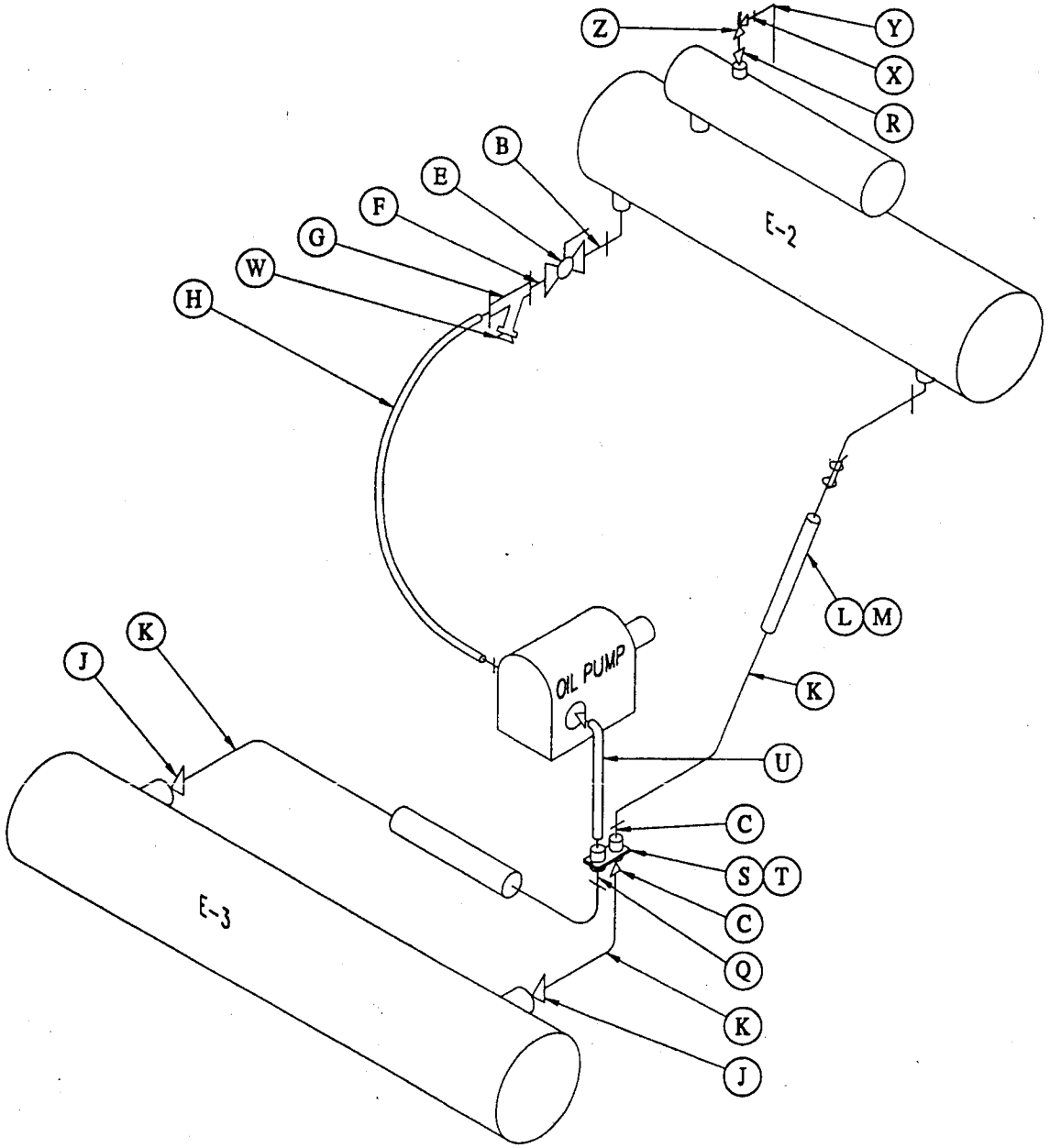
	Parts Listing	Part Number
A.	Exhaust Diverter Valve	045110
B.	Solenoid Valve Filter	PLFL-0024
C.	3" Exhaust Clamp	CLMP-0021
G.	E-3 Exchanger	045103
H.	Outlet Hood	045141
J.	Exchanger Mounting Bracket	045107
K.	Vibration isolator	045142
L.	3/8-16 x 2" Long Bolts	HWBL-0110
M.	3/8-16 Hex Nut/Washer	HWNT-0208
N.	3/8-16 x 3/4" Long Bolts	HWBL-0111
P.	1/2" Hex Head Plug	PLPL-0032
S.	3/8 Hex Head Plug	PFPL-0015
T.	Exhaust Solenoid	ELSO-0056
U.	#10-32 x 1/2" Long Bolts	-
V.	1/4" Vacuum Hose	HWHS-0050
W.	3/8 x 1/4 Hose Tee	HWHB-0047
X.	Hose Barb Fitting	HWHB-0050
Y.	Hose Clamps	-
Z.	#10-32 Self Tapping Screw	HWSC-0565
AA.	Tail Pipe Connector	045138
AB.	Tail Pipe	045135
AC.	5/16-18 x 3/4" Long Bolts	HWBL-0112
AD.	Tab Washer	045196
AE.	5/16-18 x 1" Long Bolts	HWBL-0094
AF.	3/8-16 x 1" Long Bolts	HWBL-0223
AG.	3/8 Flat Washer	HWWA-0146
AH.	3/8-16 Hex Locking Nut	HWNT-0210
AJ.	Truck Frame Support Bracket	045190
AK.	Exhaust Valve Support Bracket	045191
AL.	Exhaust Valve Gasket	045134
AM.	#10 Split Lock Washer	HWWA-0013
AN.	#10 Flat Washer	HWWA-0012

WATER PIPING



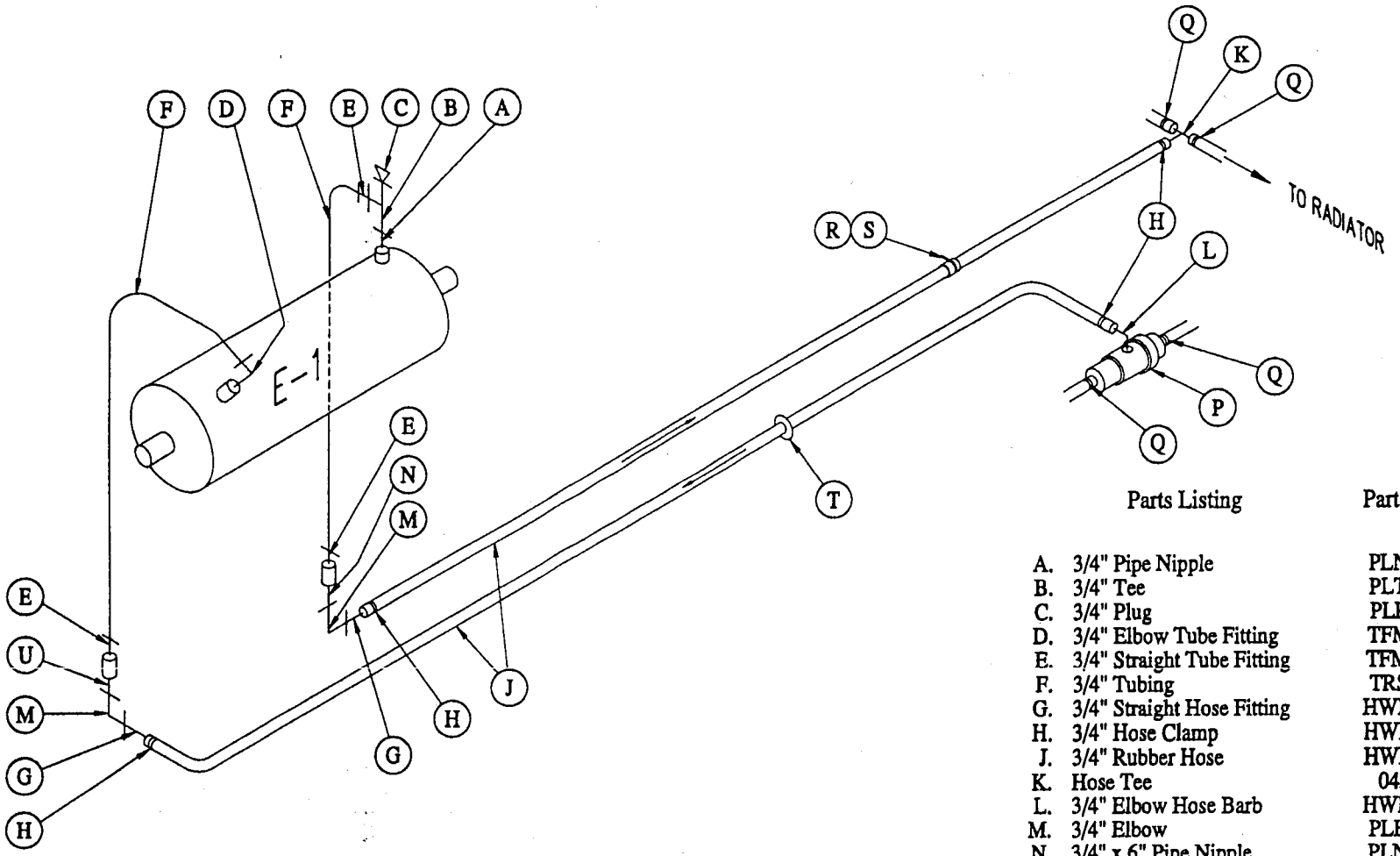
	Parts Listing	Part Number
A.	Water Strainer	PLFL-0022
B.	Water Pump Suction Hose	045004-6
C.	3/8" Hose Connect	PLCN-0028
D.	1/4" Hose Connect	PLCN-0029
E.	Reducing Nipple	PLNP-0159
F.	1/2" Tee	PLTE-0102
G.	Pulsation Damper	PLPD-0001
J.	1/2" Tubing	TRSS-0008
K.	Water Pump Discharge Hose	045004-6
L.	Relief Valve	PLVA-0070
M.	Reducing Bushing	PLRD-0003
N.	Pressure Regulator	PLRG-0004
P.	3/8" Straight Tube Fitting	TFMC-0113
Q.	1/2" Straight Tube Fitting	TFMC-0045
R.	3/4" Straight Tube Fitting	TFFC-0023
S.	Bulkhead Union	PLBH-0008
T.	Teflon Washer	HWWA-0154
U.	3/4" Straight Tube Fitting	TFMC-0044
V.	3/8" Elbow Tube Fitting	PLEL-0095
W.	Bushing	PLRD-0102
X.	Pressure Element	HWGA-0038
Y.	1/4" Elbow Tube Fitting	PLEL-0094
Z.	Water By-Pass Hose	045004-6
AA.	3/4" x 2-1/2" Pipe Nipple	PLNP-0131
AC.	1/4-20 Hex Nut	HWNT-0214
AE.	3/8" Pipe Nipple	PLNP-0006
AF.	Loop Clamp	HWHC-0041
AG.	1/4-20 x 3/4" Long Screw	HWBL-0073
AH.	3/8" Adapter	PLRD-0098
AJ.	1/2" Plug	PLPL-0033
AK.	3/8" Plug	PLPL-0028
AL.	Tubing Clip	-
AM.	#10-32 X 1/2" Long Screw	HWSC-0375
AN.	#10-32 Hex Nut	HWNT-0018
AQ.	1/2" Tubing Tee Fitting	TFTE-0002
AR.	#10 Lock Washer	HWWA-0117

TRANSFER OIL PIPING SYSTEM



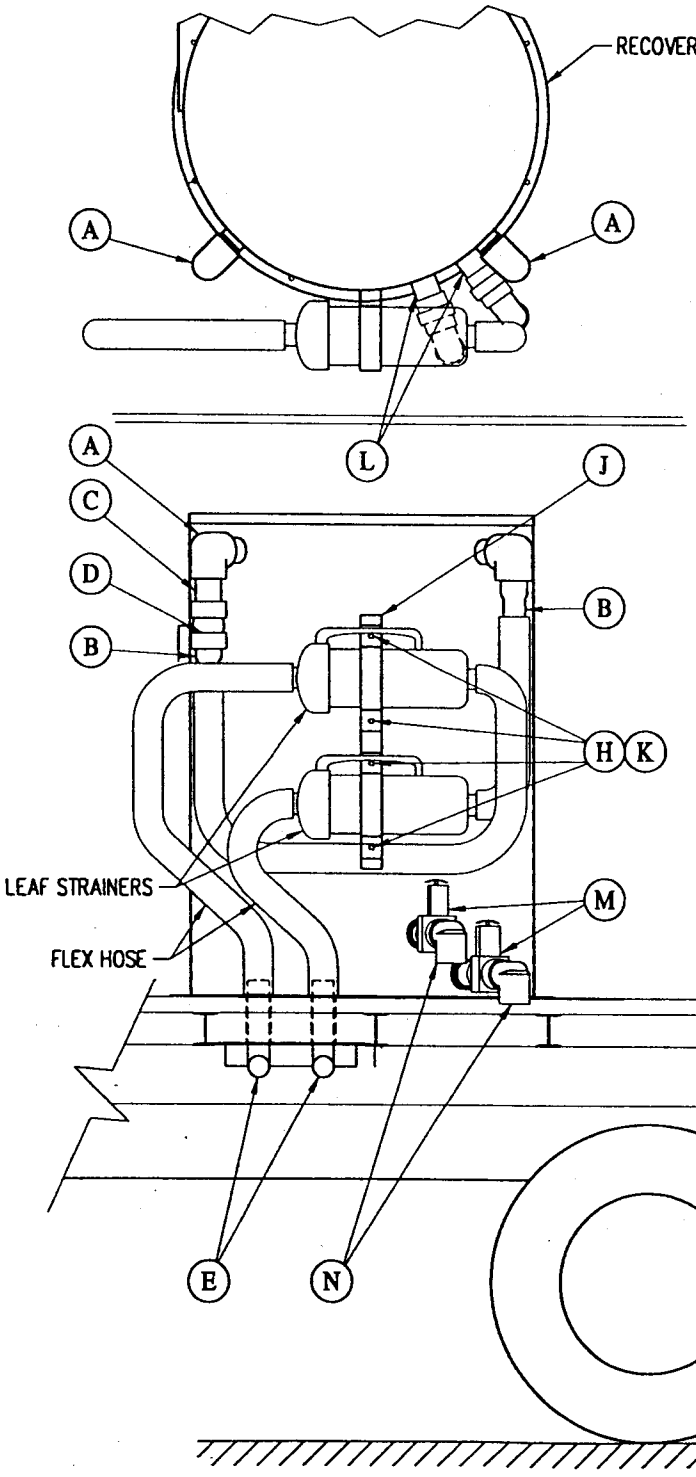
	Parts Listing	Part Number
B.	3/4" x 4" Pipe Nipple	PLNP-0164
C.	1/2" Straight Tube Fitting	TFMC-0114
E.	3/4" Ball Valve	PLBV-0042
F.	3/4" Pipe Nipple	PLNP-0094
G.	3/4" Strainer	PLST-0003
H.	Oil Pump Suction Hose	045004-6
J.	3/4" Straight Tube Fitting	TFMC-0112
K.	1/2" Tubing	TRSS-0008
L.	Insulation	ISPD-0022
M.	Insulation Cover	ISCV-0001
Q.	1/2" Elbow Tube Fitting	TFML-0007
R.	Reducing Bushing	PLRD-0108
S.	Coupling Plate	045004-5
T.	#10-32 x 1" Screw	HWSC-0565
U.	Oil Pump Discharge Hose	045004-6
W.	3/8" Plug	PLPL-0028
X.	3/8" Elbow Tube Fitting	TFML-0011
Y.	3/8" Tubing	TRSS-0010
Z.	Relief Valve	PLVA-0076

RADIATOR FLUID SYSTEM



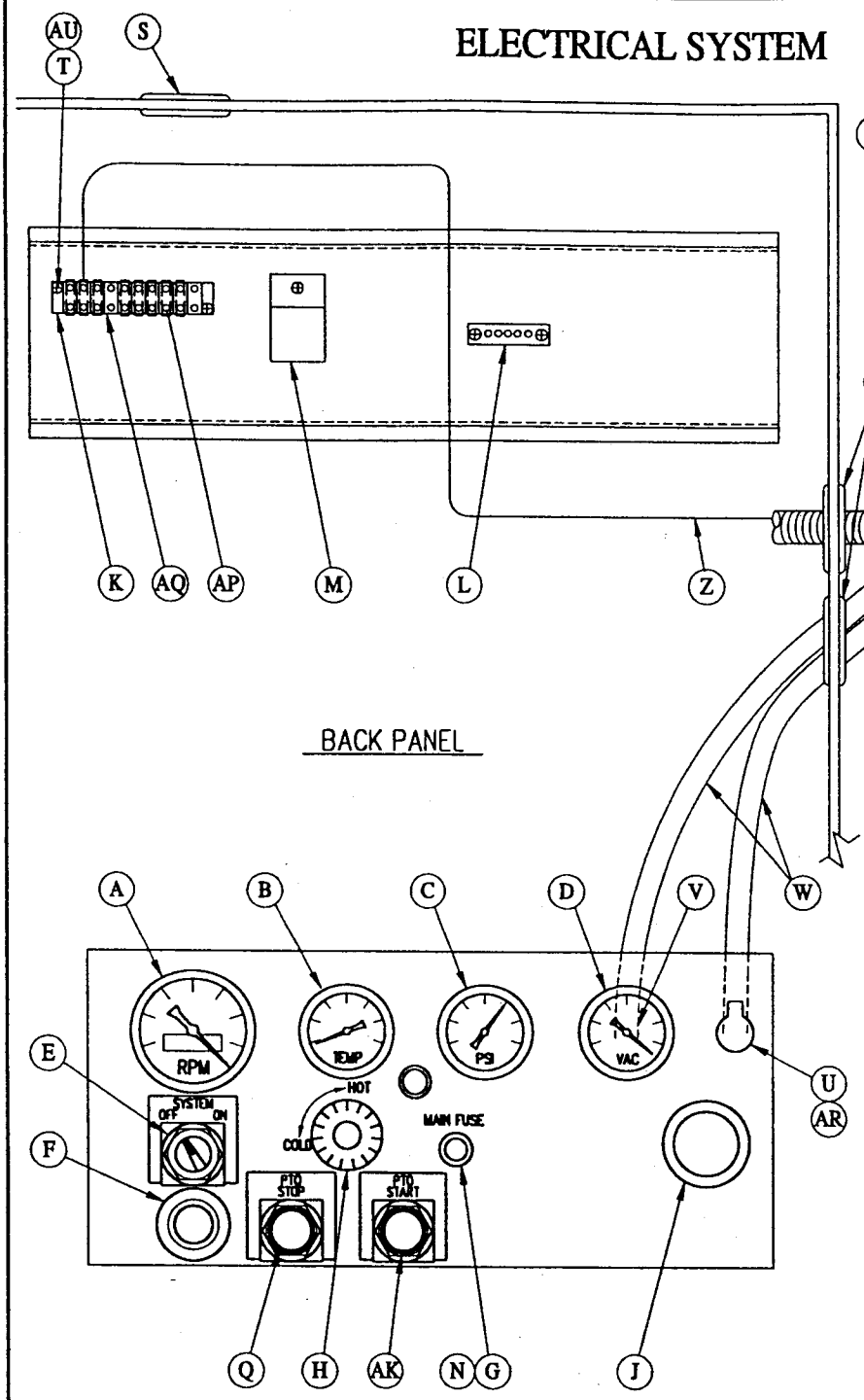
	Parts Listing	Part Number
A.	3/4" Pipe Nipple	PLNP-0094
B.	3/4" Tee	PLTE-0100
C.	3/4" Plug	PLPL-0029
D.	3/4" Elbow Tube Fitting	TFML-0011
E.	3/4" Straight Tube Fitting	TFMC-0110
F.	3/4" Tubing	TRSS-0034
G.	3/4" Straight Hose Fitting	HWHB-0040
H.	3/4" Hose Clamp	HWHC-0011
J.	3/4" Rubber Hose	HWHS-0040
K.	Hose Tee	045004-4
L.	3/4" Elbow Hose Barb	HWHB-0041
M.	3/4" Elbow	PLEL-0075
N.	3/4" x 6" Pipe Nipple	PLNP-0169
P.	Thermostat	045150
Q.	1" Hose Clamp	HWHC-0012
R.	Tie Wraps	ELWW-0013
S.	Gasket	HWGS-0149
T.	Gromet	-
U.	3/4" X 2-1/2" Pipe Nipple	-

VACUUM RECOVERY SYSTEM



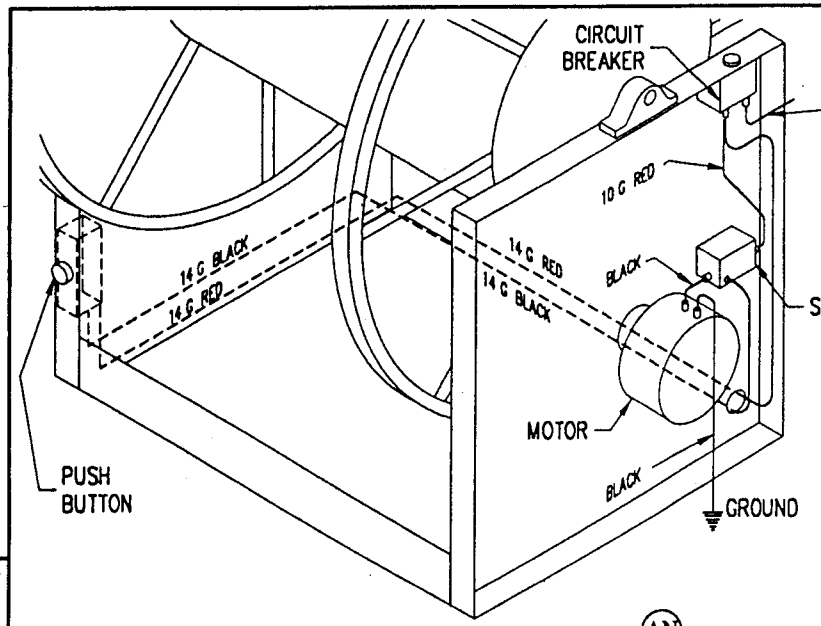
	Parts Listing	Part Number
A.	2" PVC Elbow	PLEL-0105
B.	2" Hose Adapter	PLNP-0174
C.	2" Galvanized Pipe Nipple	PLNP-0181
D.	2" Ball Valve	PLBV-0041
E.	Inlet Tubing	045162
H.	1/4-20 x 3/4" Long Bolts	HWBL-0113
J.	Filter Support	045155
K.	1/4-20 Hex Locking Nut	HWNT-0213
L.	2" PVC Pipe Nipple	PLNP-0172
M.	2" Gate Valve	PLVA-0071
N.	2" PVC Elbow	PLEL-0100

ELECTRICAL SYSTEM

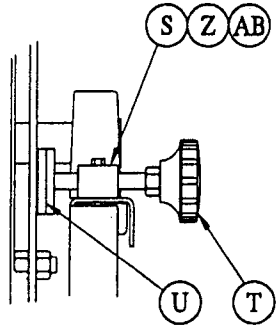


	Parts Listing	Part Number
A.	Tachometer	HWGA-0035
B.	Temperature Gauge	HWGA-0039
C.	Pressure Gauge	HWGA-0036
D.	Vacuum Gauge	HWGA-0037
E.	System On Off Switch	ELSW-0017
F.	Pump Start Switch	ELSW-0575
G.	20 Amp Fuse	ELFS-0294
H.	Temperatue Controller	ELTC-0017
J.	Push Pull Control	HWCL-0125
K.	Terminal Strip	ELTL-0225
L.	Ground Bar	ELGL-0020
M.	Relay	ELRL-0352
N.	Fuse Holder	ELFH-0003
P.	Engine RPM Sensor	ELSN-0001
Q.	PTO Stop Push Button	ELSW-0021
R.	1-1/2" Wire Grommet	HWGR-0024
S.	1" Wire Grommet	HWGR-0023
T.	#8-32 x 3/8" Screw	HWSC-0156
U.	MPT Hose Barb	HWHB-0500
V.	FPT Hose Barb	HWHB-0049
W.	Vacuum Hose	HWHS-0042
X.	3/4" Wire Wrap	TRPL-0010
Y.	1/4" Wire Wrap	TRPL-0011
Z.	Beldin Cable	ELWR-0200
AN.	Engine RPM Sensor Gasket	HWGS-0146
AP.	#8-32 x 3/4" Long Screw	-
AQ.	Jumper Bar	ELJB-0057
AR.	Lubrication Port	HWOC-0001
AU.	#8 Lock Washer	HWWA-0004
AK.	PTO Start Push Button	ELSW-0019

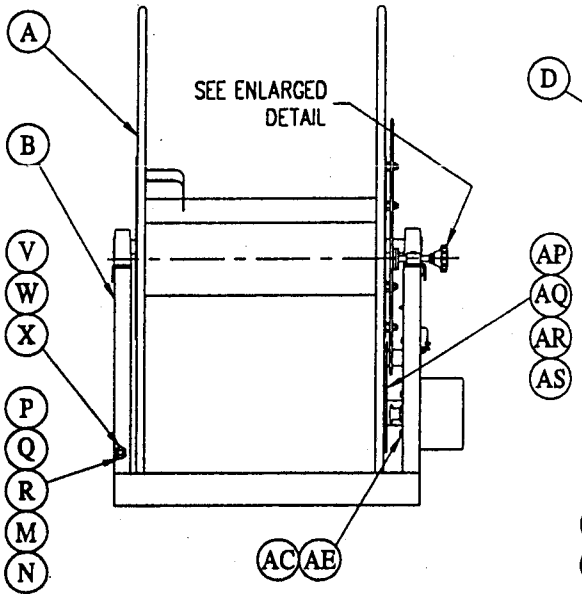
HOSE REEL

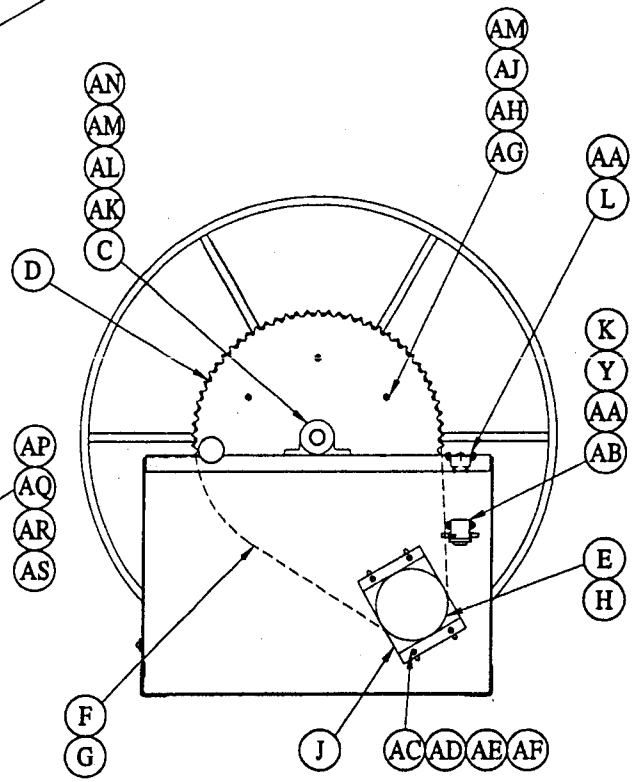


WIRING DETAIL



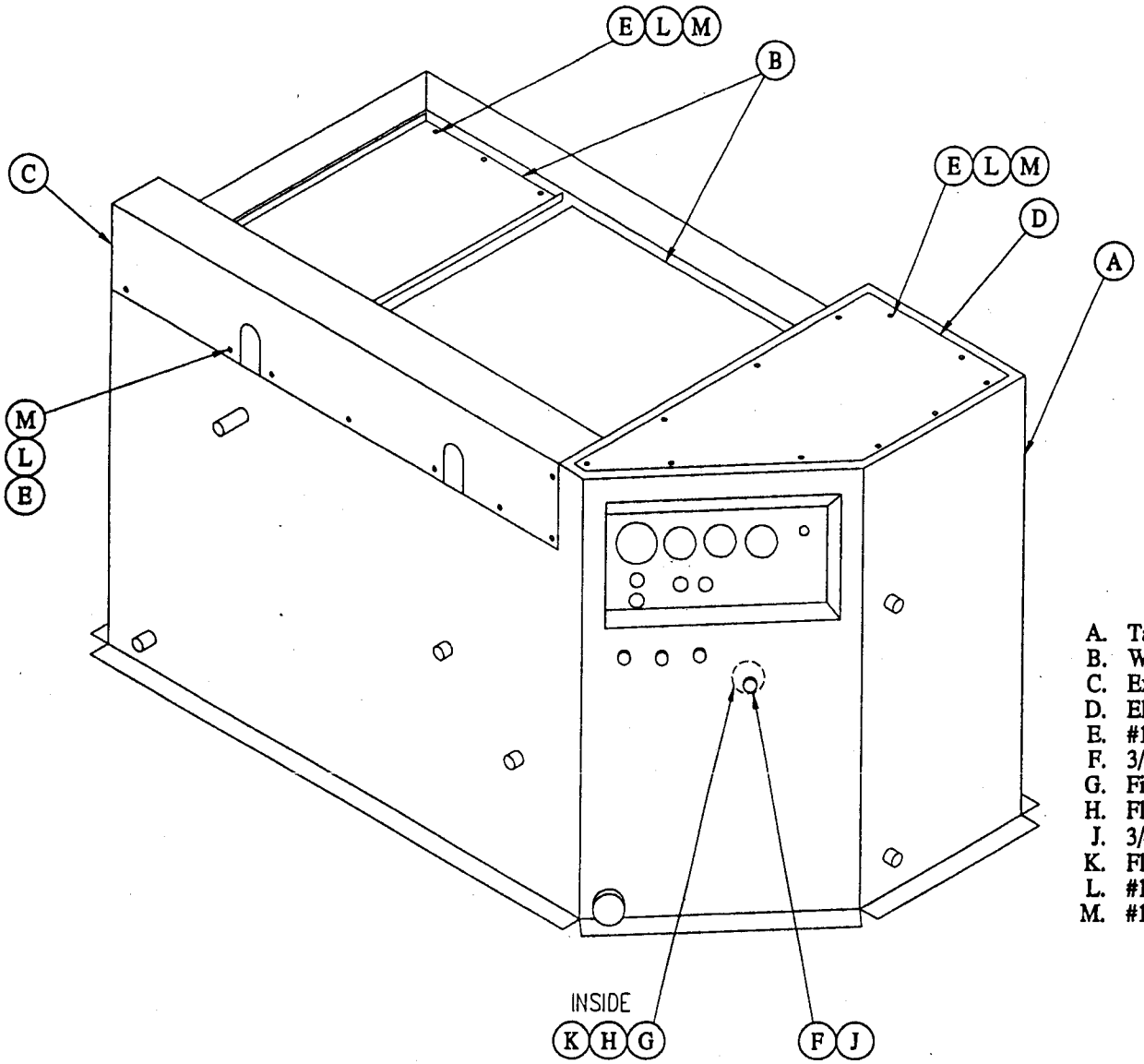
ENLARGED DETAIL





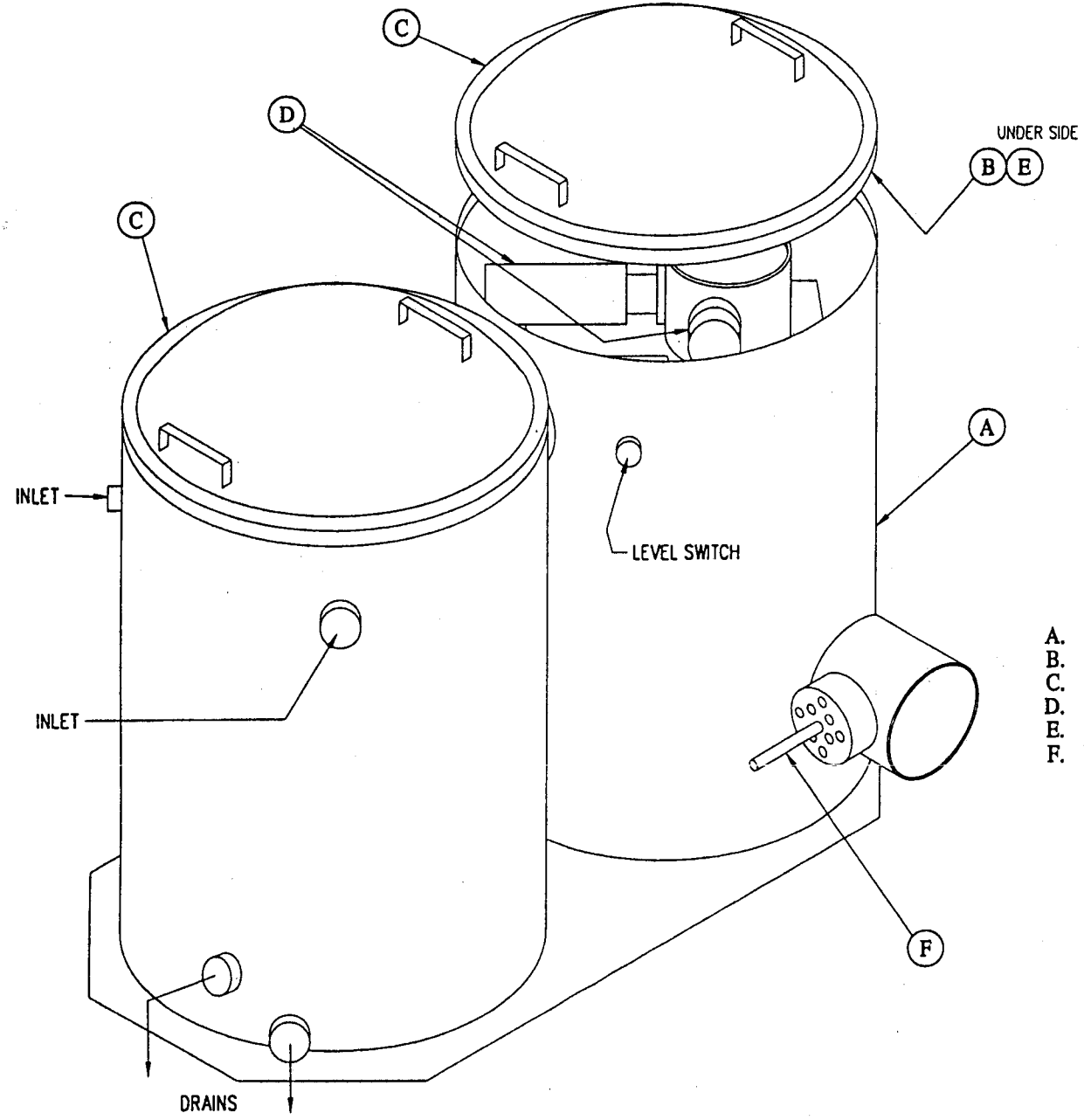
	Parts Listing	Part Number
A.	Reel Section	045805
B.	Frame Section	045801
C.	Pillow Block	HWBR-0094
D.	Reel Sprocket	045813
E.	Motor Sprocket 39-027	HWSK-0045
F.	Chain 50-006	HWRC-0009
G.	Chain Link Connector 50-007	-
H.	Motor	ELMT-0028
J.	Motor Mounting Bracket	045819
K.	Solenoid Valve	ELSL-0054
L.	Curcuit Breaker	ELCB-0249
M.	Pushbutton	ELSW-0597
N.	Pushbutton Boot	ELBT-0006
P.	Coduit Body	ELBD-0010
Q.	Reducer Bushing	PLRD-0101
R.	Cord Grip Fitting	ELCN-0167
S.	Lock Block	045818
T.	2-1/2" Knob	HWKB-0005
U.	Adjustable Leveling Guide	HWLV-0015
V.	#8-32 x 1/2" Long Screw	HWSC-0021
W.	#8 lock Washer	HWWA-0053
X.	#8-32 Hex Nut	HWNT-0221
Y.	1/4-20 x 1/2" Long Bolt	HWBL-0219
Z.	1/4-20 x 1-1/2" Long Bolt	HWBL-0093
AA.	1/4 Flat Washer	HWWA-0086
AB.	1/4-20 Hex Nut/Washer	HWNT-0214
AC.	5/16-18 x 1/2" Long Bolt	HWBL-0114
AD.	5/16 Flat Washer	HWWA-0110
AE.	5/16 Lock Washer	HWWA-0162
AF.	5/16-18 Hex Nut	HWNT-0069
AG.	3/8-16 x 1-1/4" Long Bolts	HWBL-0109
AH.	3/8 Lock Washer	HWWA-0001
AJ.	3/8-16 Hex Nut	HWNT-0017
AK.	1/2-13 x 1-1/2" Long Bolts	HWBL-0097
AL.	1/2 Lock Washer	HWWA-0166
AM.	1/2-13 Hex Nut	HWNT-0218
AN.	1/2 Flat Washer	HWWA-0060
AP.	Chain Guard	045821
AQ.	#10-32 x 1/2" Long Screw	HWSC-0375
AR.	#10 Lock Washer	HWWA-0013
AS.	#10 Flat Washer	HWWA-0012

WATER TANK ASSEMBLY



	Parts Listing	Part Number
A.	Tank Body	045109-0
B.	Water Chamber Cover Plate	045109-9
C.	Exchanger Cover	045109-13
D.	Electrical Box Cover	045109-22
E.	#10-32 x 1/2" Long Screw	HWSC-0375
F.	3/4" Hose Adapter	PLAD-0035
G.	Fill Valve	PLFV-0007
H.	Float Ball	PLFB-0001
J.	3/4" Pipe Nipple	PLNP-0150
K.	Float Stem	HWFS-0002
L.	#10 Lock Washer	HWWA-0117
M.	#10 Flat Washer	HWWA-0022

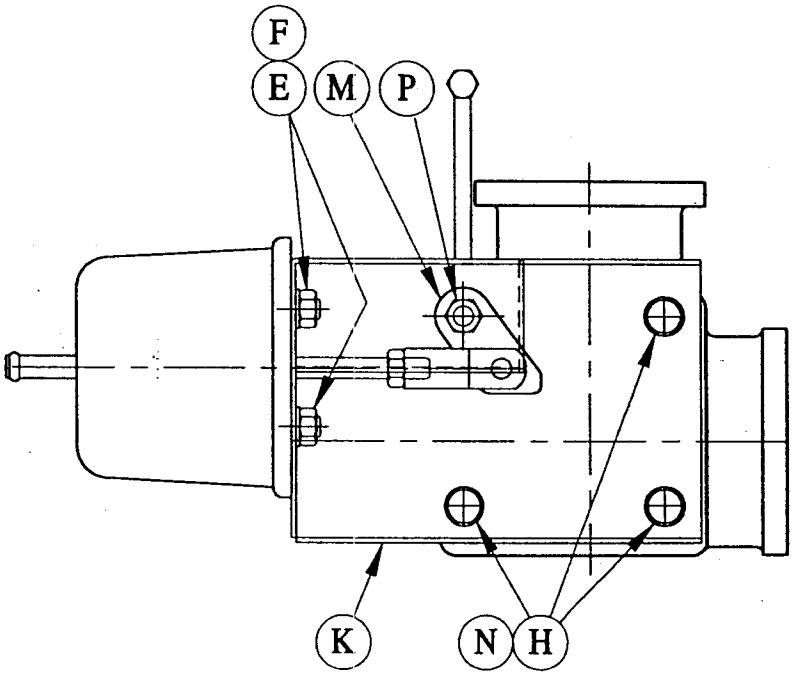
RECOVERY TANK ASSEMBLY (TRUCK SERIAL NUMBER 9941 AND ABOVE)

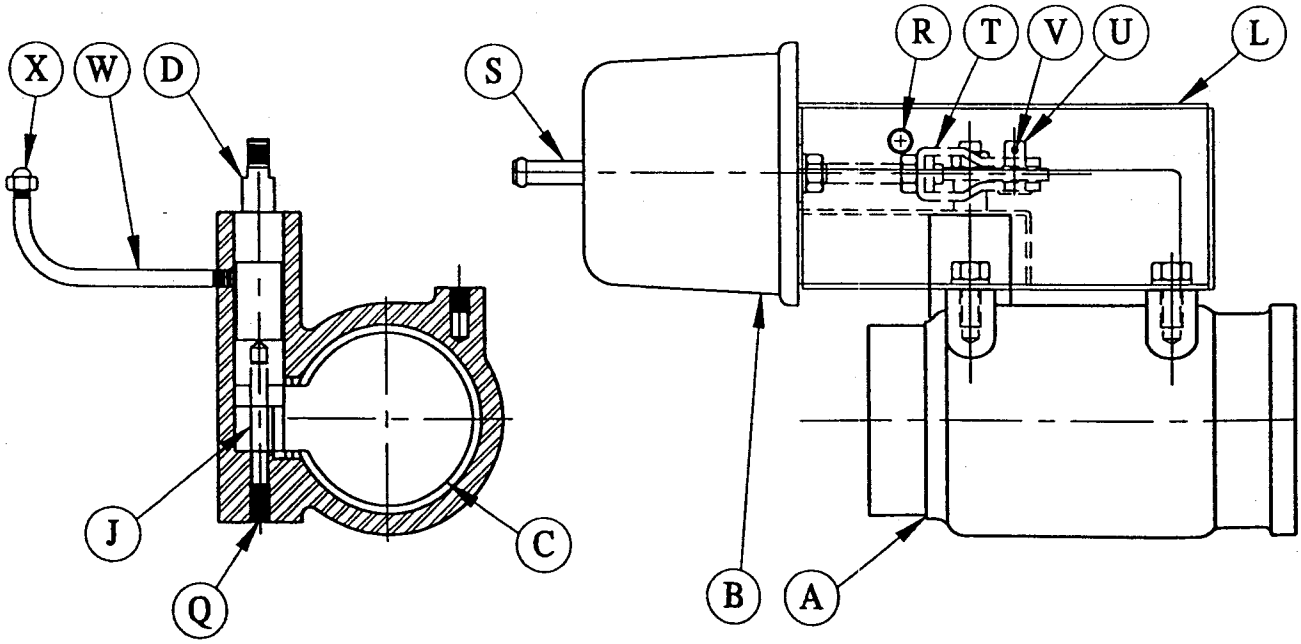


Parts Listing	Part Number
A. Tank Body	045007-2
B. Gasket	HWGS-0171
C. Tank Cover	045007-3
D. Strainer	PLST-0008
E. Gasket Adhesive	RMRO-380
F. Vacuum Relief Valve	045143

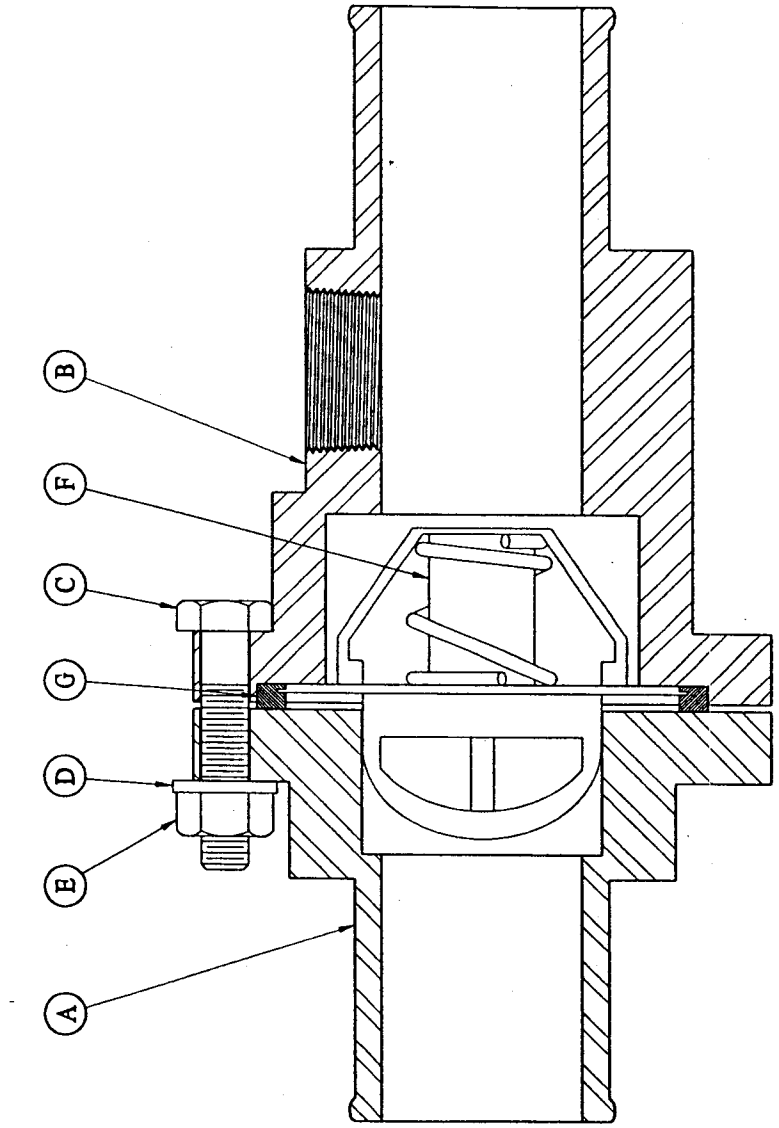
3 WAY EXHAUST DIVERTER VALVE

	Parts Listing	Part Number
A.	Valve Body	045110-2
B.	Actuator	PLVA-0068
C.	Flapper PLate	045110-3
D.	Shaft	045110-4
E.	8mm Hex Nut	HWNT-0173
F.	8mm Lock Washer	HWWA-0163
H.	5/16 Lock Washer	HWWA-0006
J.	Dowel pin	HWPN-0033
K.	Valve Bracket	045110-7
L.	Valve Cover	045110-8
M.	Pivot Plate	045110-9
N.	5/16-18 x 3/8" Long Bolts	HWBL-0228
P.	5/16-18 Hex Nut	HWNT-0209
Q.	Set Screw	HWSC-0568
R.	#10-32 x 3/8" Long Screw	HWSC-0542
S.	Acuator Connection	HWHB-0048
T.	Clevis	HWCV-0011
U.	Clevis Pin	HWPN-0011
V.	Cotter Pin	HWPN-0042
W.	1/4" Tube Elbow	PLEL-0111
X.	1/4-28 Acorn Nut	HWNT-0229





THERMOSTAT ASSEMBLY



Parts Listing	Part Number
A. Thermostat Cover	045151
B. Thermostat Housing	045152
C. 1/4-20 x 1-1/4" Bolts	HWBL-0103
D. 1/4 Flat Washer	HWWA-0086
E. 1/4-20 Hex Nut	HWNT-0030
F. Thermostat	HWTS-0001
G. Gasket	HWGS-0141

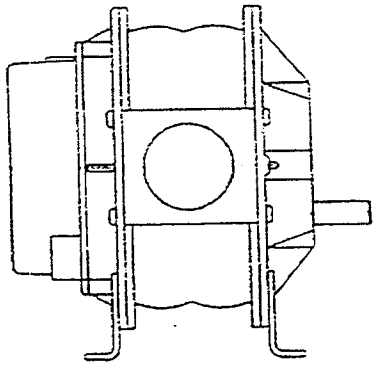
Part Manuals

M-D Pneumatics

COMPETITOR PLUS™

positive displacement rotary air blower

Model 5009 & 6008



INSTALLATION
OPERATION
MAINTENANCE
REPAIR

MANUAL

WARNING

DO NOT OPERATE BEFORE READING MANUAL.

Safety Precaution

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

- **Blower casing, oil pump, water pump and all associated piping and tubing or accessories will become hot enough to cause major skin burns on contact.**
- **Internal and external rotating parts of the equipment can produce serious physical injuries.**
- **All truck equipment have to be shout down before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.**
- **Avoid extended exposure in close proximity to machinery with high intensity noise level.**
- **Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.**
- **Hearing protection are required to operate this equipment.**

PREVENTATIVE MAINTENANCE

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

Blower should be checked frequently during operation, especially lubrication. Check oil level in the gear housing and add oil as needed. Complete oil changes are recommended every 500 operating hours.

Daily Maintenance
Check and maintain oil level and add oil as necessary.

Check for unusual noise or vibration.
Clean filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage.

Weekly Maintenance
Check relief valve to make sure it is operating properly.
Check drive belt tension and tighten if necessary

Monthly Maintenance
Inspect condition of oil and change if necessary.

LUBRICATION

The bearings at the drive shaft end of the blower are grease lubricated. The timing gears and bearings at the other end are lubricated by the lower timing gear (when in the horizontal flow configuration) acting as a oil slinger, carrying oil to the upper timing gear and providing splash lubrication for the bearings. Both timing gears act as slingers when the blower is in the vertical flow configuration.

Use a good grade industrial type anti-rust, oxidation and foam inhibited, non-detergent oil.

FILLING PROCEDURE

To fill the gear housing, remove the oil breather* (A) and oil level plug (B) on the gear end. Fill the gear housing until oil drips out of the oil level hole. Replace plugs in their respective holes.

*Some units may not have an oil breather, in this case remove plug to fill.

WARNING
Do not start the blower until you are sure oil has been put in the gear housing.

GREASE LUBRICATED BEARINGS

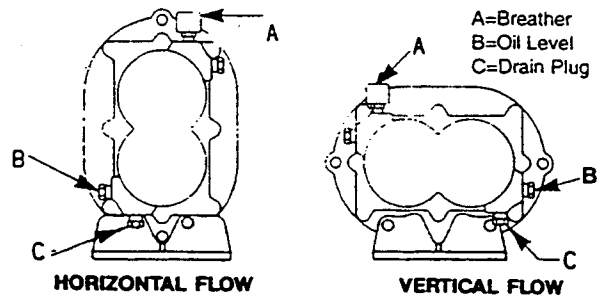
Service drive end bearings at regular intervals. (See "Suggested Lubrication Intervals For Grease Lubricated Bearings".) Use NLGI #2 premium grade, petroleum base grease with high temperature resistance and good mechanical stability. Using a pressure gun, force new grease into each bearing until traces of clean grease come out of the relief fitting.

CAUTION:
Do not inject grease too fast to avoid blowing out the drive shaft seal.

LUBRICATION INSTRUCTIONS FOR OIL LUBRICATED GEARS AND BEARINGS

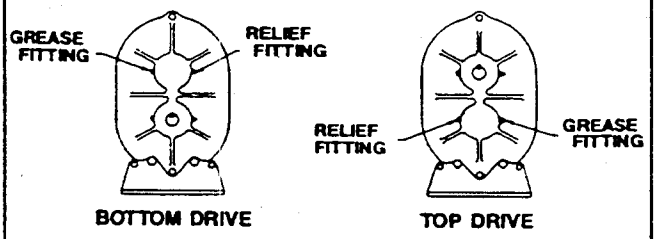
Add fresh oil as required to maintain proper level. Drain and refill after the first 100 hours of operation and thereafter every 1,000 hours of operation under normal service, more frequently depending on the type of oil and oil operating temperature. Use a good quality oil.

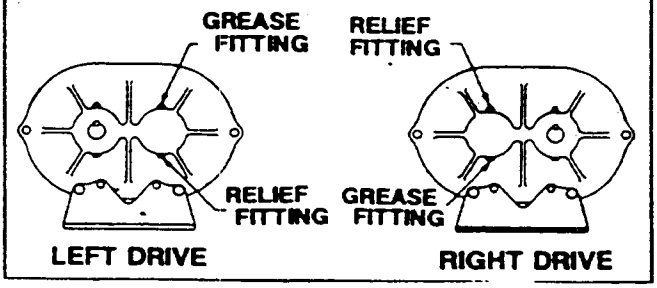
AMBIENT TEMPERATURE	OIL GRADE	OIL VISCOSITY, RANGE SSU AT 100° F.
Above 90° F	SAE 50	1000-1200
32° F to 90° F	SAE 40	700-1000
0° F to 32° F	SAE 30	500-700
Below 0° F	SAE 20	300-500



SUGGESTED LUBRICATION INTERVALS FOR GREASE LUBRICATED BEARINGS

SPEED IN RPM	OPERATING HOURS PER DAY		
	8	16	24
	GREASING INTERVALS IN WKS		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 And Up	1	1	1





TROUBLESHOOTING

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

SYMPTOMS	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly. Lip seal failure. Insufficient sealant	Tighten gear housing bolts Disassembly and replace lip seal. Remove gear housing and replace sealant.
Excessive Bearing or Gear Wear	Improper lubrication. Excessive belt tension.	Correct oil level. Replace dirty oil. Check belt for tension and adjust accordingly.
Lack of Volume	Slipping Belts. Worn lobe clearances. Speed to low. Obstruction in piping.	Check belt for tension and adjustment. Check for proper clearances. Increase blower speed within limits. Check system to assure an open flow path
Knocking	Unit out-of-time. Worn gears.	Retime. Replace timing gears.
Excessive Blower Temperature	Too much or too little oil in gear reservoir. Too low operating speed. Clogged filer or silencer. Excessive pressure differential. Elevated inlet temperature. Worn lobe clearances.	Check oil level. Increase blower speed within limits. Remove cause of obstruction. Check relief valve. Reduce inlet temperature. Check for proper clearances.
Rotor End or Tip Drag	Insufficient assembly clearances. Excessive operating pressure. Excessive operating temperature	Correct clearances. Adjust relief valve. Reduce pressure differential or reduce inlet temp.
Vibration	Belt misalignment. Lobes rubbing. Worn bearings/ gears. Unbalanced or rubbing lobes. Blower loose.	Check carefully, realign if necessary. Check cylinder for hot spots. Check conditions of gears and bearings. Check mounting and tighten if necessary.

DISASSEMBLY & INSPECTION

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

Remove the oil drain plug (18) in the bottom of the gear cover (5) and drain the oil. Take out eight capscrews (16) and remove the gear cover. It may be necessary to tap the sides with a mallet or wooden block to break the seal joint.

Gears are not exposed for visual inspection

Referenced item numbers on page

Inspect the gears for the following:

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

BLOWER DISASSEMBLY

Position blower with the drive gear on the left when facing the gears. Remove socket head screws and washers. (Items 29 & 26)

Align timing marks and count four (4) teeth down and place reference marks on the gears. (Refer to figure 1)

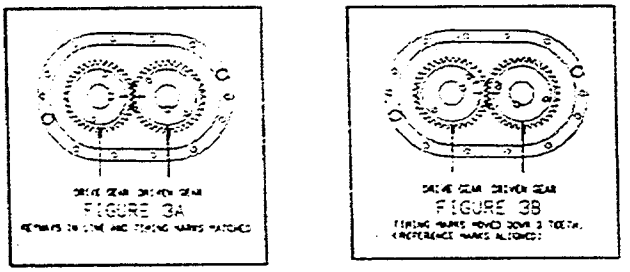


FIGURE 1

Align reference marks and use puller to pull the driven gear. (Gear on right side). (Refer to Figure 2)

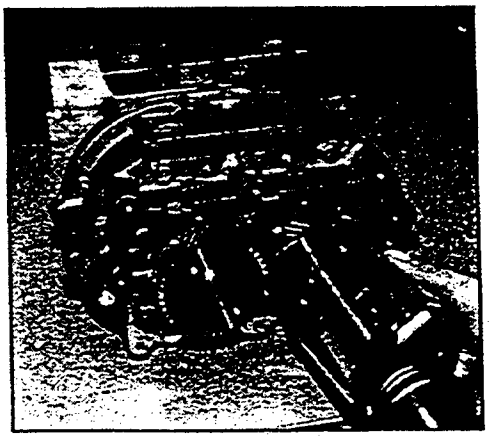


FIGURE 2

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

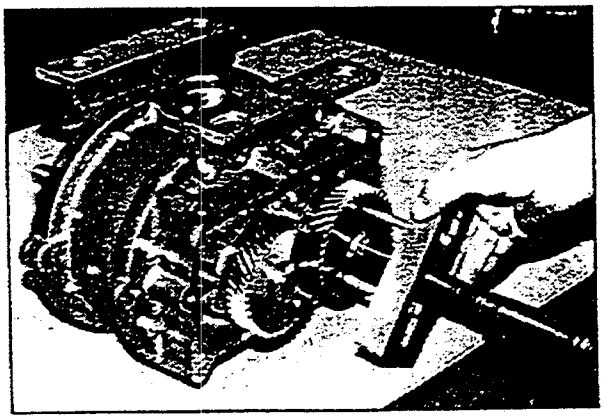


FIGURE 3

Remove shim and spacer. (Items 28&30)

Turn blower around and remove grease cover (Item 10)

Remove eight (8) cap screws. (Item 15)

Use jack screws to remove end plate. (Refer to Figure 4)

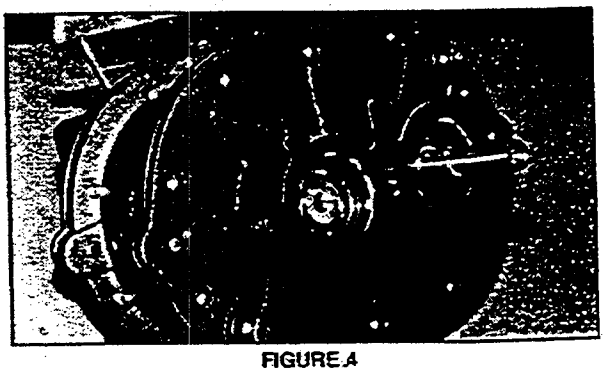


FIGURE 4

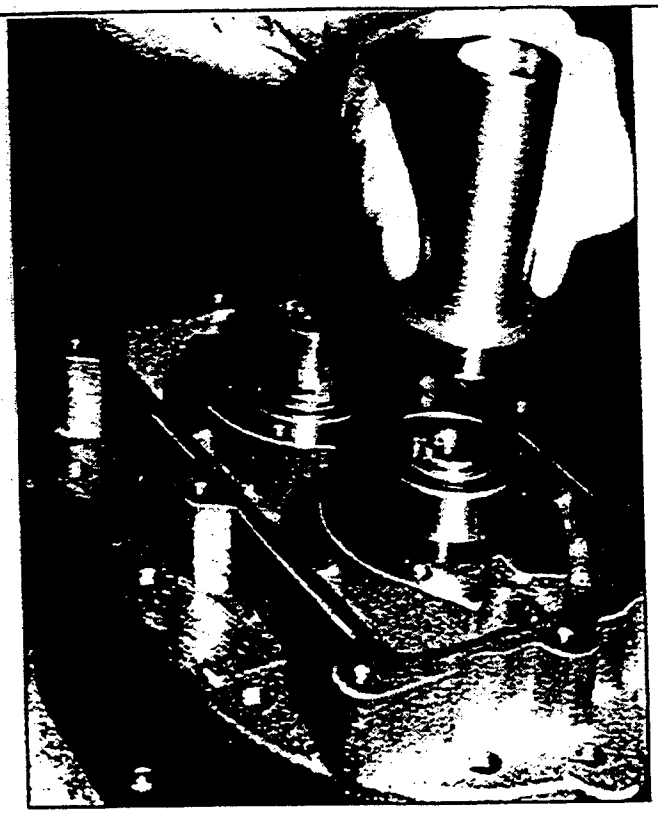


FIGURE A3

Install bearing retainers (Items 22 & 25) to both bearings.

Check clearances between the end of the rotors and the face of the end plate. (check internal clearances chart on page 12 for proper clearances for your model blower. (Refer to Figure A4)

FIGURE A4

Clearances okay, put a spacer (Item 28) and a shim (Item 30) on each shaft. Timing shims that were removed should be put back on the shaft they were removed from.

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

Start the driver gear on the shaft and align the reference timing marks and press gear on. Lock gears in place with cap screw (Item 29) and washer (Item 26).

Turn assembly over and rest the unit on the cap screws and washers on the gear end.

Set dowel pins (Item 9) in housing and position housing over the rotors and fasten with cap screws (Item 15).

Check housing to rotor clearance. (Refer to Figure A5) Depth mic can be used.

Set on drive end plate (Item 3) and fasten with cap screws (Item 15). (ATTENTION: There are four cap screws (Item 17) which are used to fasten the feet on.)

Lubricate shafts and bearings. Install the ball bearing (Item 12) on the driven rotor and the roller bearing (Item 11) on the input shaft.

Install grease cover (Item 10) and drive shaft seal. (Item 23)

Install any removed plugs (Item 18) and replace breather if required. (Item 27)

Referenced item numbers on page 11.

ADJUSTING ROTOR INTERLOBE CLEARANCE

Using feeler gauges take interlobe readings and record on each side of housing as indicated in Figure 5.

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.

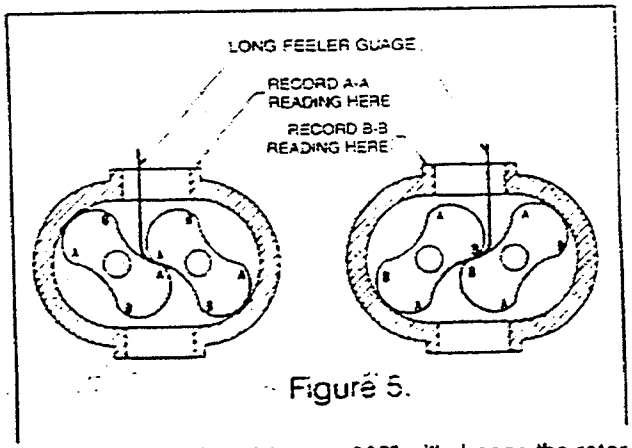


Figure 5.

Changing the shim thickness .006" will change the rotor lobe clearance .003" or one half the amount.

EXAMPLE: Referring to Figure 5 check the clearance at AA (right hand reading) and BB (left hand reading). If AA reading is .009" and BB reading .003" by removing .006" shims, the readings will change one half the amount removed or .003". AA should then read .006" and BB should read .006". The final reading should be within .002" of each other.

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

BLOWER ASSEMBLY

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

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

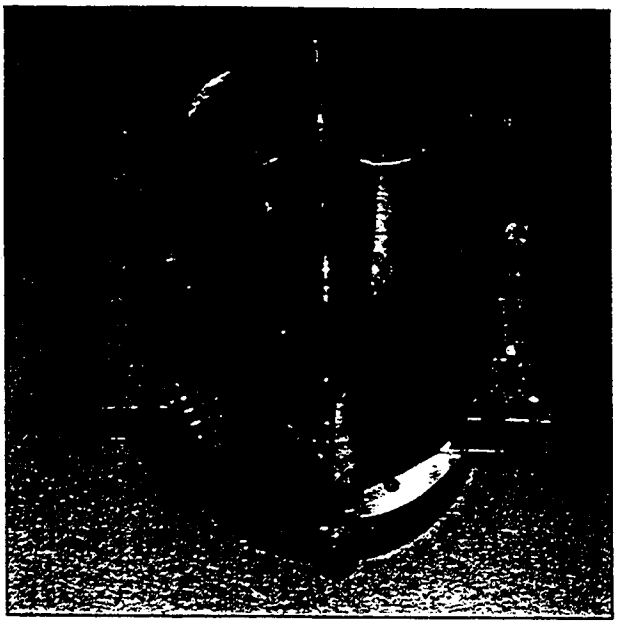


FIGURE A1

Place end plate (Item 4) on rotors.

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

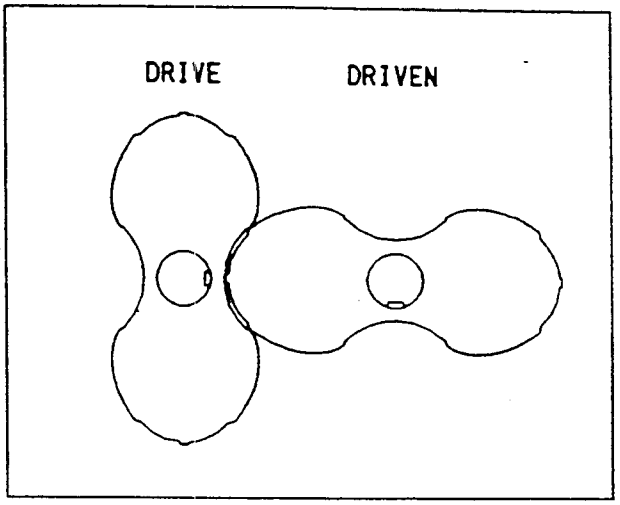


FIGURE A2

Rotor alignment will be opposite that of Figure A2 on all 6" units (keyway on drive rotor will be up and driven to the right).

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

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 5)

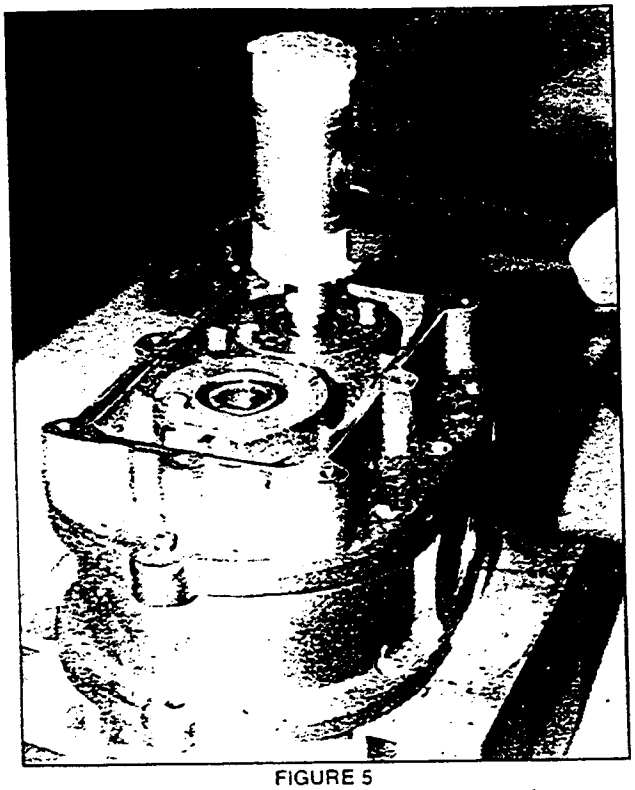


FIGURE 5

A jaw type puller can also be used. (Refer to figure 6)

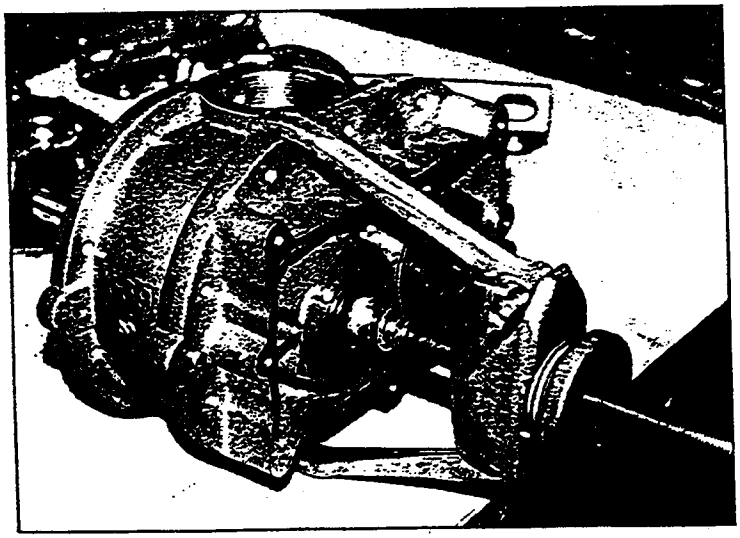


FIGURE 6

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 (Item 22) must be removed before knocking out the bearings.) (Refer to Figure 7)

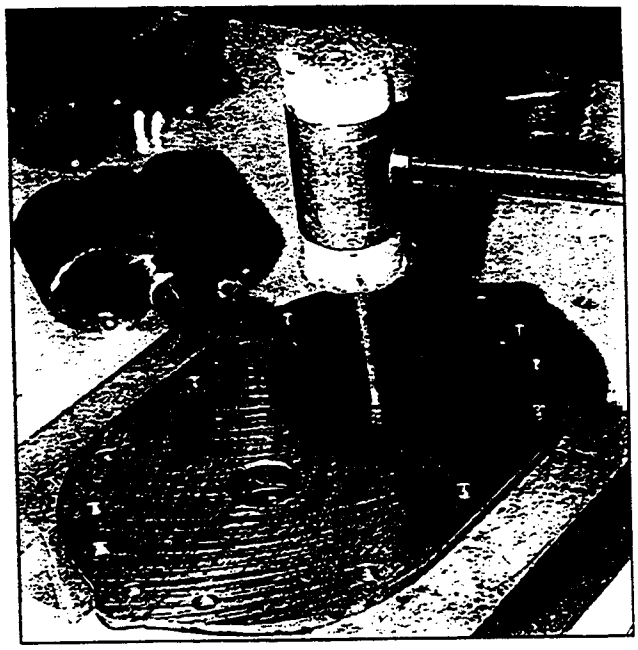


FIGURE 7

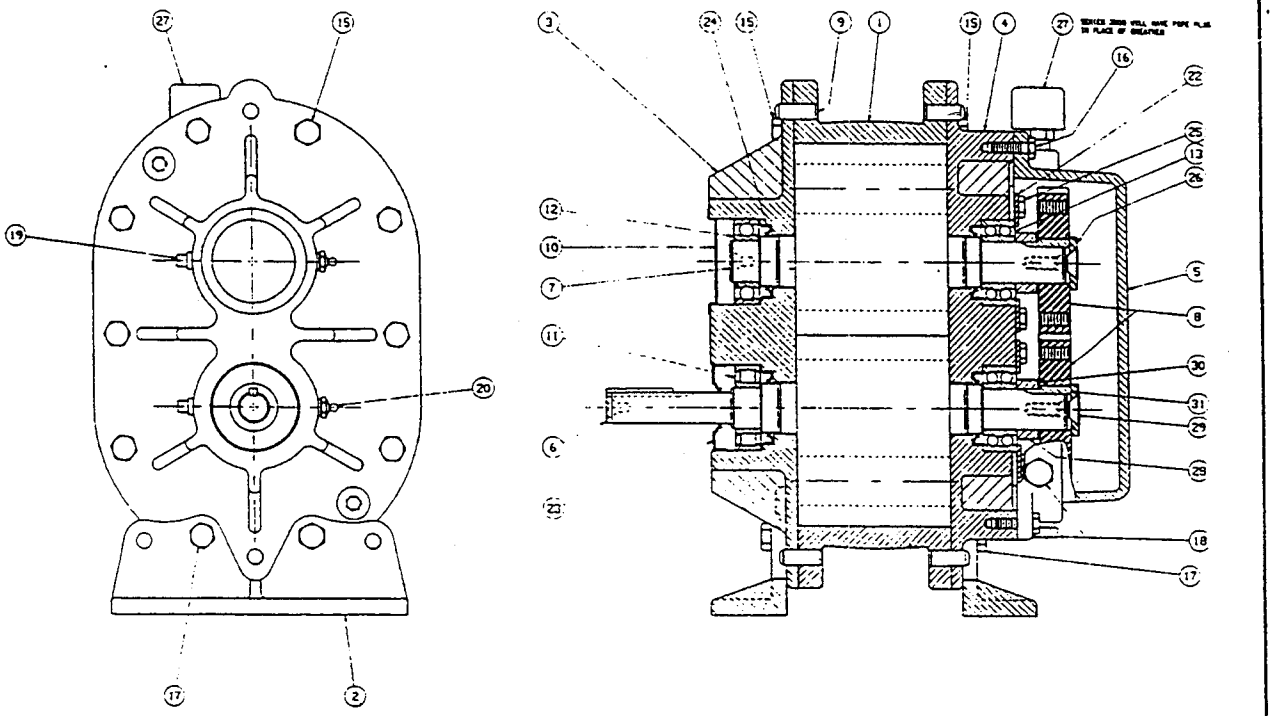
Remove seals from both end plates with a punch or dull chisel. The seals ***will*** be damaged during removal and must be replaced.

Inspect all parts for wear and or damage.

Clean and inspect all parts for burrs and polish seal journals with at least a 320 grit.

Referenced item numbers on page

COMPETITOR™ PARTS LIST



ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	15	Screw, Hex Hd.	16
2	Mounting Feet	2*	16	Screw, Hex Hd.	8**
3	End Plate / Drive End	1	17	Screw, Hex Hd.	4
4	End Plate / Gear End	1	18	Plug, Oil	3
5	Gear Cover	1	19	Relief Fitting	2
6	Drive Rotor	1	20	Grease Fitting	2
7	Driven Rotor	1	22	Bearing Retainer	4
8	Timing Gear	2	23	Lip Seal, Drive Shaft	1
9	Dowel Pin	4	24	Lip Seal	4
10	Bearing Cover Plate	1	25	Screw, Hex Hd.	4
11	Roller Bearing, Drive Shaft	1	26	Washer	2
12	Bearing	1	27	Breather	1
13	Bearing	2			

*Item 2 larger models require 2 left and 2 right feet
**Quantity (6) for 5" Gear

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

M-D BLOWER MAINTENANCE & SERVICE SPECIFICATIONS

Model	Assembly Clearance					
	Lobes - End Plares			Lobe - Casing		Between Lobes
	Total	Drive End Min	Gear End Min	Min.	Max.	Min.
5009	.007/.012	0.004	0.003	0.005	0.009	0.012
6008	.011/.015	0.008	0.003	0.006	0.01	0.01

Oil Reservoir Capacity

Model	Fluid Ounces Horiz. Flow
5009	16.0
6008	28.0

Maximum Operating limits

Model	R.P.M.	Pressure PSI	Inlet Vacuum	Temp. Rise Deg. F
5009	2850	7	14	115
6008	2350	12	16	240

Lubrication, Final Assembly and Mounting

Pack the bearing cavities with suitable grease. Install bearing cover plate (10). Replace front lip seal (23) taking care not to damage the lip as it passes over the keyway. Lip must point inward toward the bearing. Apply a good quality RTV silicon sealant to the inner surface of the gear cover (5). Install the gear cover with cap screws (16) and tighten evenly. Fill gear cover with oil and grease front end bearings. Refer to the Lubrication Section for oil and grease specification and filling procedures.
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 start.

Model	Total	End Clearance drive end (minimum)	Gear end (minimum)	Rotor tip to housing		Interlobe	
				Min	Max	Min	Max
5009	10-14	4	4	5	9	12	21
6008	15-19	8	5	6	10	10	14

BLOWER ASSEMBLY

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

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

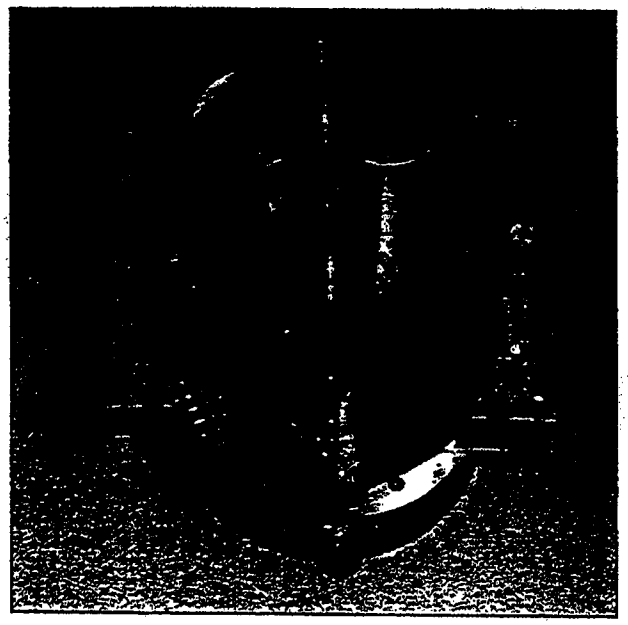


FIGURE A1

Place end plate (Item 4) on rotors.

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

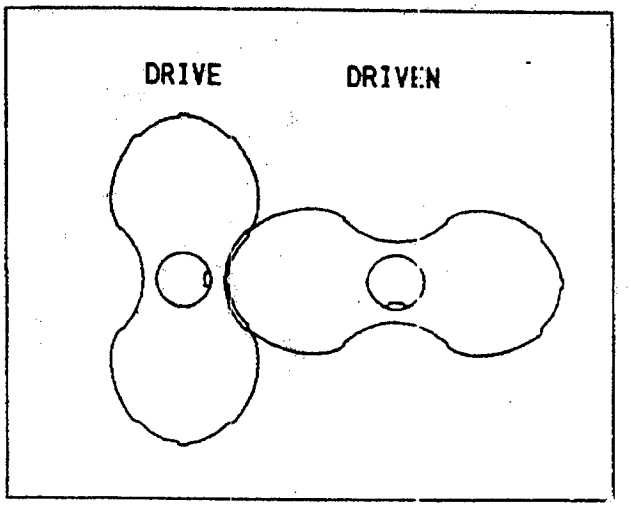


FIGURE A2

Rotor alignment will be opposite that of Figure A2 on all 6" units (keyway on drive rotor will be up and driven to the right).

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

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 5)

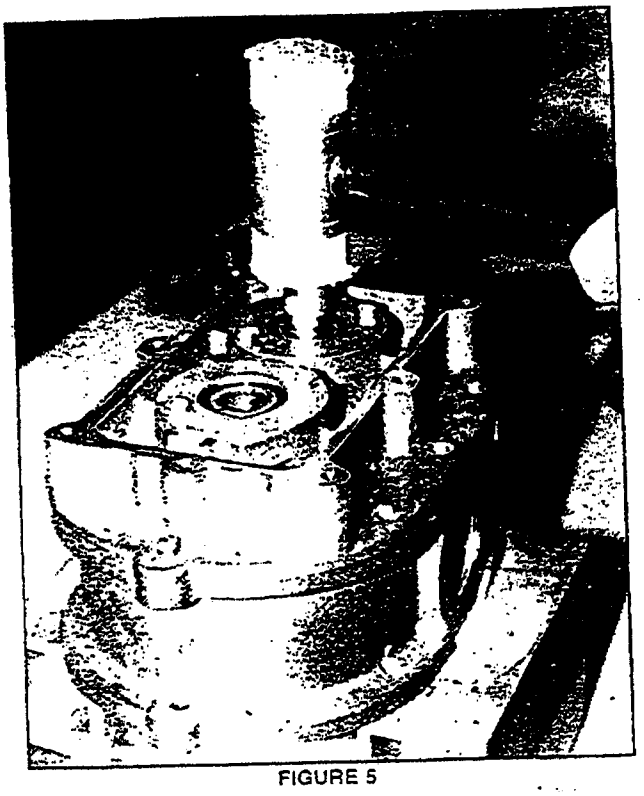


FIGURE 5

A jaw type puller can also be used. (Refer to figure 6)

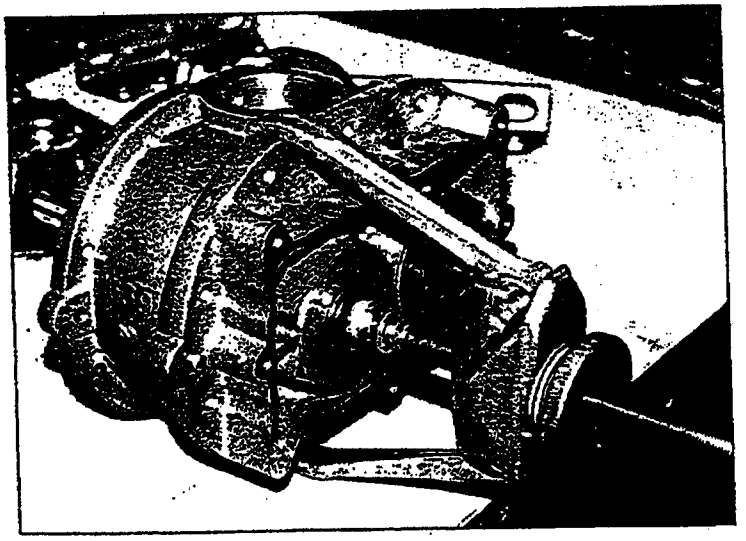


FIGURE 6

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 (Item 22) must be removed before knocking out the bearings.) (Refer to Figure 7)

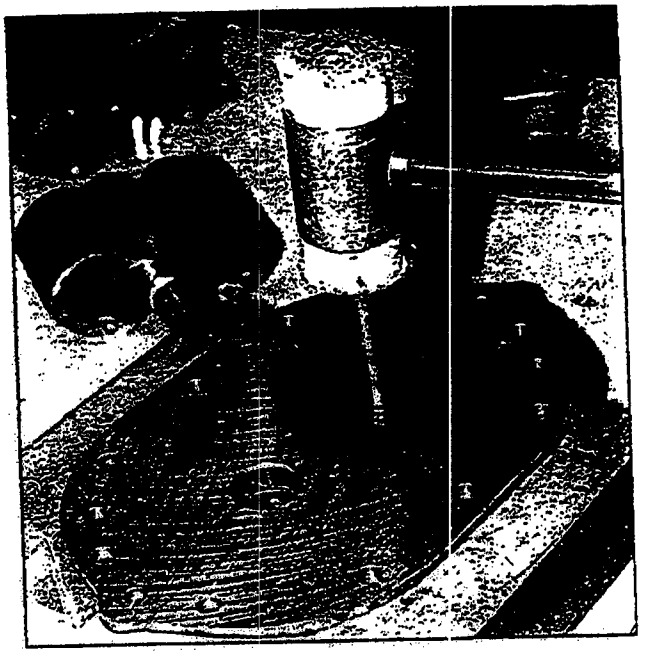


FIGURE 7

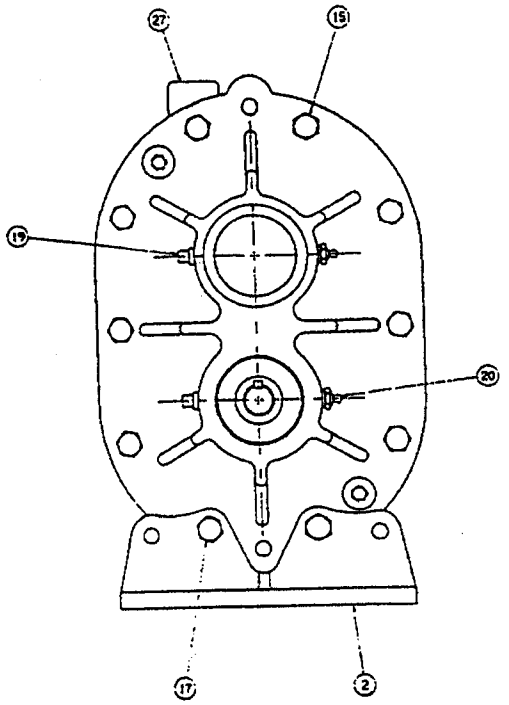
Remove seals from both end plates w th a punch or dull chisel. The seals ***will*** be damaged during removal and must be replaced.

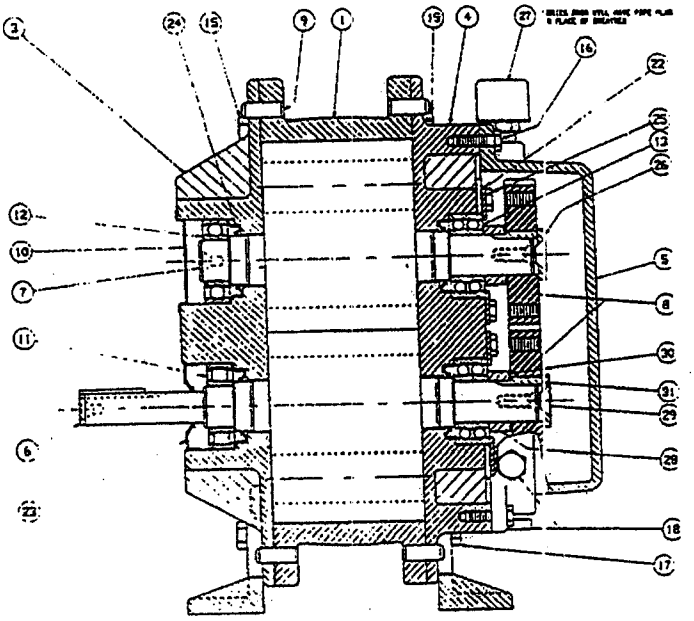
Inspect all parts for wear and or damage.

Clean and inspect all parts for burrs and polish seal journals with at least a 320 grit.

Referenced item numbers on page

COMPETITOR™ PARTS LIST





ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	15	Screw, Hex Hd.	16
2	Mounting Feet	2*	16	Screw, Hex Hd.	8**
3	End Plate / Drive End	1	17	Screw, Hex Hd.	4
4	End Plate / Gear End	1	18	Plug, Oil	3
5	Gear Cover	1	19	Relief Fitting	2
6	Drive Rotor	1	20	Grease Fitting	2
7	Driven Rotor	1	22	Bearing Retainer	4
8	Timing Gear	2	23	Lip Seal, Drive Shaft	1
9	Dowel Pin	4	24	Lip Seal	4
10	Bearing Cover Plate	1	25	Screw, Hex Hd.	4
11	Roller Bearing, Drive Shaft	1	26	Washer	2
12	Bearing	1	27	Breather	1
13	Bearing	2			

*Item 2 larger models require 2 left and 2 right feet
**Quantity (6) for 5" Gear

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

M-D BLOWER MAINTENANCE & SERVICE SPECIFICATIONS

Model	Assembly Clearance					
	Lobes - End Plares			Lobe - Casing		Between Lobes
	Total	Drive End Min	Gear End Min	Min.	Max.	Min.
5009	.007/.012	0.004	0.003	0.005	0.009	0.012
6008	.011/.015	0.008	0.003	0.006	0.01	0.01

Oil Reservoir Capacity

Model	Fluid Ounces Horiz. Flow
5009	16.0
6008	28.0

Maximum Operating limits

Model	R.P.M.	Pressure PSI	Inlet Vacuum	Temp. Rise Deg. F
5009	2850	7	14	115
6008	2350	12	16	240

Lubrication, Final Assembly and Mounting

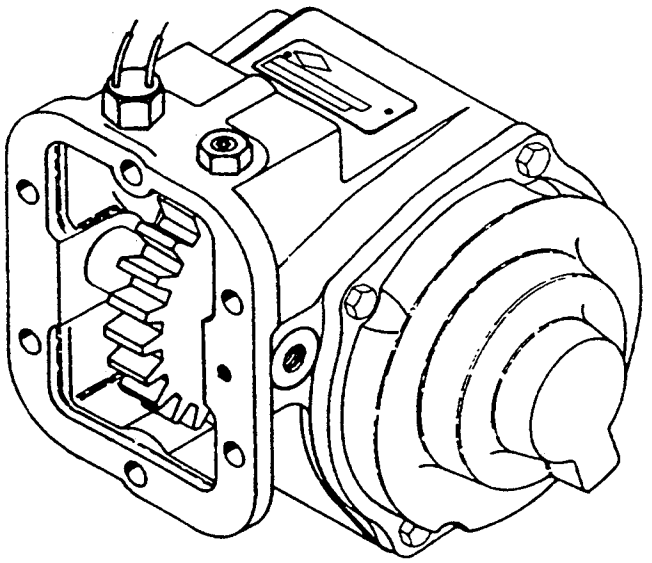
Pack the bearing cavities with suitable grease. Install bearing cover plate (10). Replace front lip seal (23) taking care not to damage the lip as it passes over the keyway. Lip must point inward toward the bearing. Apply a good quality RTV silicon sealant to the inner surface of the gear cover (5). Install the gear cover with cap screws (16) and tighten evenly. Fill gear cover with oil and grease front end bearings. Refer to the Lubrication Section for oil and grease specification and filling procedures.
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 start.

Model	Total	End Clearance drive end (minimum)	Gear end (minimum)	Rotor tip to housing		Interlobe	
				Min	Max	Min	Max
5009	10-14	4	4	5	9	12	21
6008	15-19	8	5	6	10	10	14

Series Power Take-Off

270

Side Mounted, S.A.E. Six Hole, Hydraulic Shift, Two Gear



COLD WEATHER OPERATION OF POWER SHIFT P.T.O.'s

WARNING: During extreme cold weather operation [32°F (0°C) and lower], a disengaged Power Shift Power Take-Off can momentarily transmit high torque that will cause unexpected output shaft rotation. This is caused by the high viscosity of the transmission oil when it is extremely cold. As slippage occurs between the Power Take-Off clutch plates, the oil will rapidly heat up and the viscous drag will quickly decrease.

The power take-off output shaft rotation could cause unexpected movement of the driven equipment resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

- The driven equipment must be left in the disengaged position when not in operation.
- Do not operate the driven equipment until the vehicle is allowed to warm up.

MOUNTING P.T.O. TO TRANSMISSION

1. Remove the P.T.O. aperture cover plate. (See Fig. 1.)

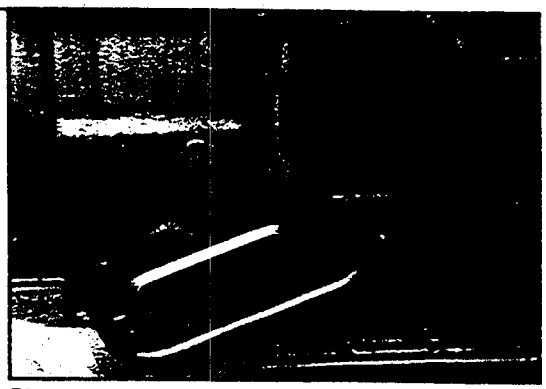


Fig. 1

2. Discard the cover plate and cover plate gasket, and then clean the aperture pad using a putty knife or wire brush. (See Fig. 2.)

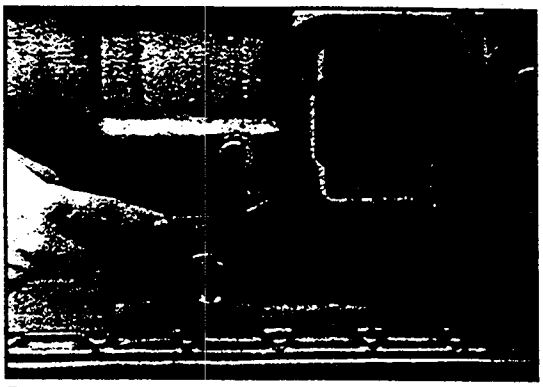


Fig. 2

3. Install the proper studs in the P.T.O. aperture pad using a stud driver or wrench. (See Fig. 3.)

   NOTE: Avoid contact of Permatex with automatic transmission fluid in automatics. Always check to be sure that the studs do not interfere with transmission gears.

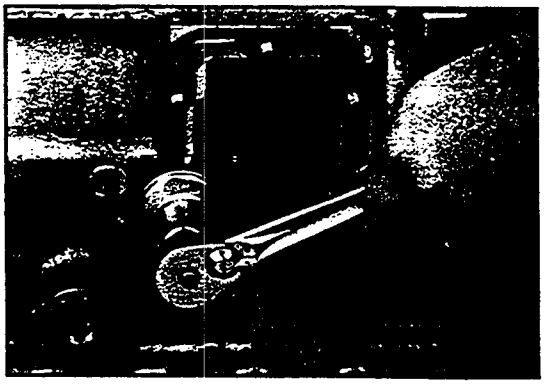


Fig. 3

4. Tighten the studs to 17 - 19 lbs. ft. (2.38 - 2.66 kg. meters) and then torque the capscrews to 32 - 37 lbs. ft. (4.43 - 5.12 kg. meters) for the 6 or 8 bolts. (See Fig. 4.)

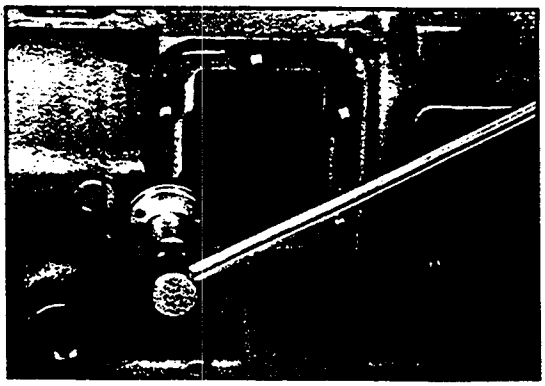


Fig. 4

MOUNTING P.T.O. TO TRANSMISSION

5. For the 230, 800, and 852 series, place one thick gasket .020" (.50 mm) and one thin gasket .010" (.25 mm) over the studs. For the 270 series with the AJ gear pitch designation (i.e.: 270XBAJP-B3XD), use the special 35-P-41 gasket that comes with the P.T.O. When the 35-P-41 gasket is installed with the 270 series, the need for backlash adjustment is greatly reduced. (See Fig. 5.)

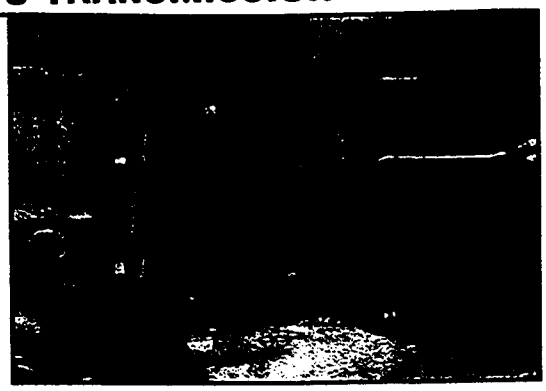


Fig. 5

- When mounting a P.T.O. use gaskets between all mounting surfaces.
- Do not stack more than 3 gaskets together.
- Usually, one thick gasket .020" (.50 mm) will be required.
- Remember the lubricant in the transmission also lubricates the P.T.O. Therefore, a gasket must always be used.

6. Fasten the P.T.O. to the transmission and tighten the 6 or 8 bolts. (See Fig. 6.)

Fig. 6

7. Torque the 6 or 8 bolts to 32 - 37 lbs. ft. (4.43 - 5.12 kg. meters). (See Fig. 7.)
8. Bend the tabs to lock the nuts.

Fig. 7

MOUNTING P.T.O. TO TRANSMISSION

9. There are two (2) large drilled and tapped holes on the 230, 270, 800, and 852 series P.T.O. housing. (See Fig 8.) These two holes come with plugs installed.

Fig. 8

10. One of the plugs will be used for the dump line from the solenoid to the housing of the 270, 800, and 852 series. The 230 series is air shifted and does not require the dump line.

    The second plug, which is positioned over the input gear, must be removed and replaced with a transducer if you are using the Chelsea Electronic Over Speed Control. If you are not using an Electronic Over Speed Control, the plug will remain in the housing. (See Fig. 9.) After checking backlash, continue with the plumbing and wiring of the controls.

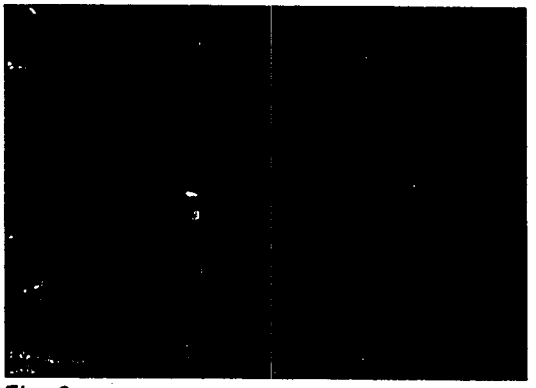


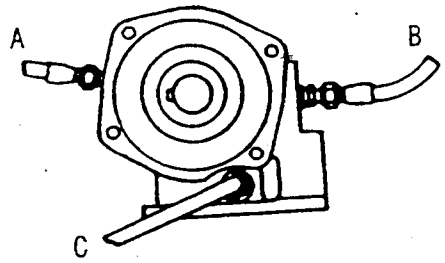
Fig. 9

POWER SHIFTS
P.T.O. HOSE CONNECTION ILLUSTRATIONS

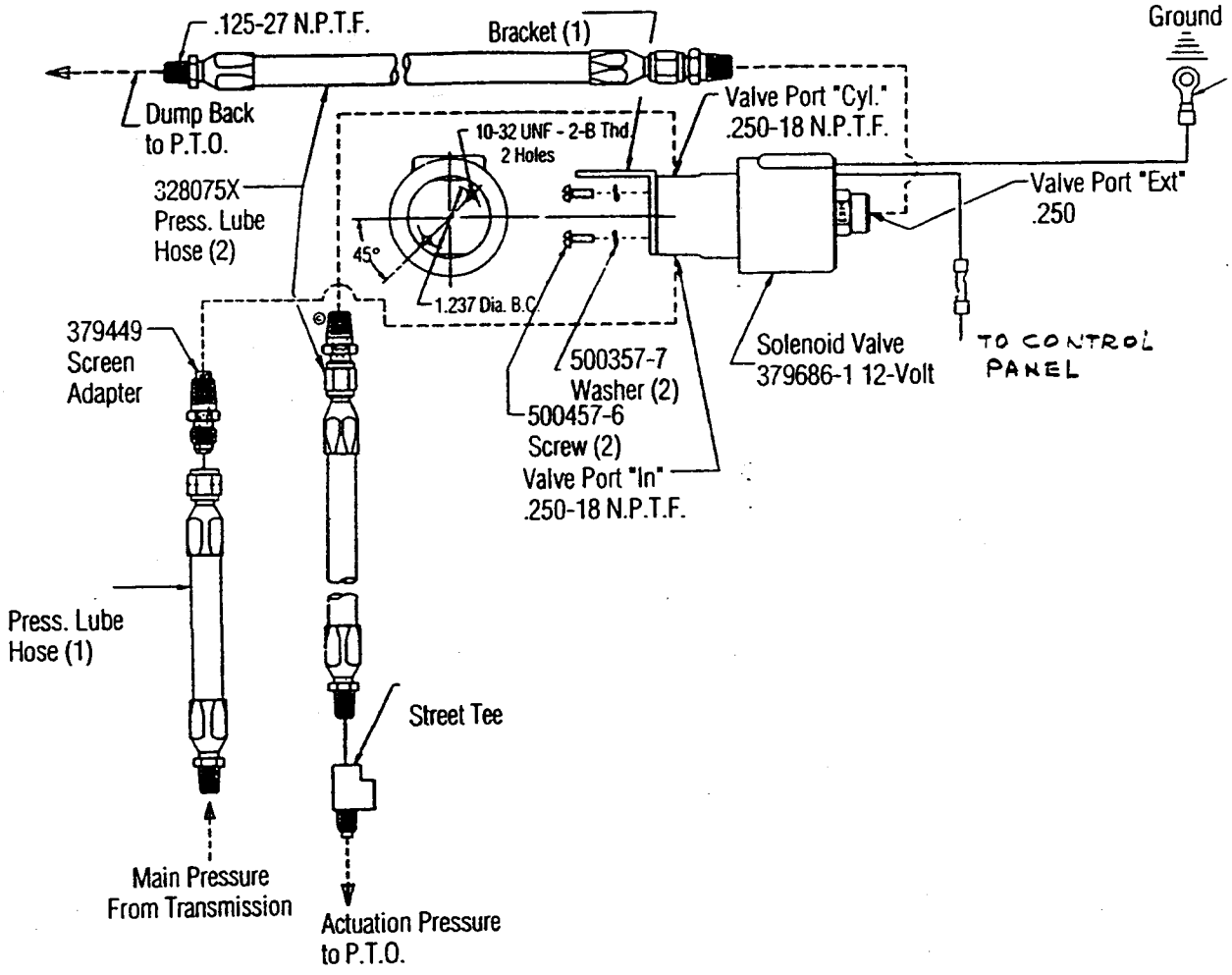
A.. High Pressure Line From Valve.

B. Dump Line to P.T.O. From 3 Way Valve.

C. Lubrication Line From Transmission. Attach to Either End of IDLER Shaft.



SHIFTER COMPONENT INSTALLATION SKETCH



P.T.O. SHIFTING PROCEDURE & PRECAUTIONS

CAUTION: This vehicle is equipped with a Power Take-Off. Shut the engine off before working on the Power Take-Off or getting below the vehicle.

POWER TAKE-OFF OPERATION—VEHICLE STATIONARY.

1. Automatic Transmission with Power Shift P.T.O.'s

Engage P.T.O. with the engine at idle speed.

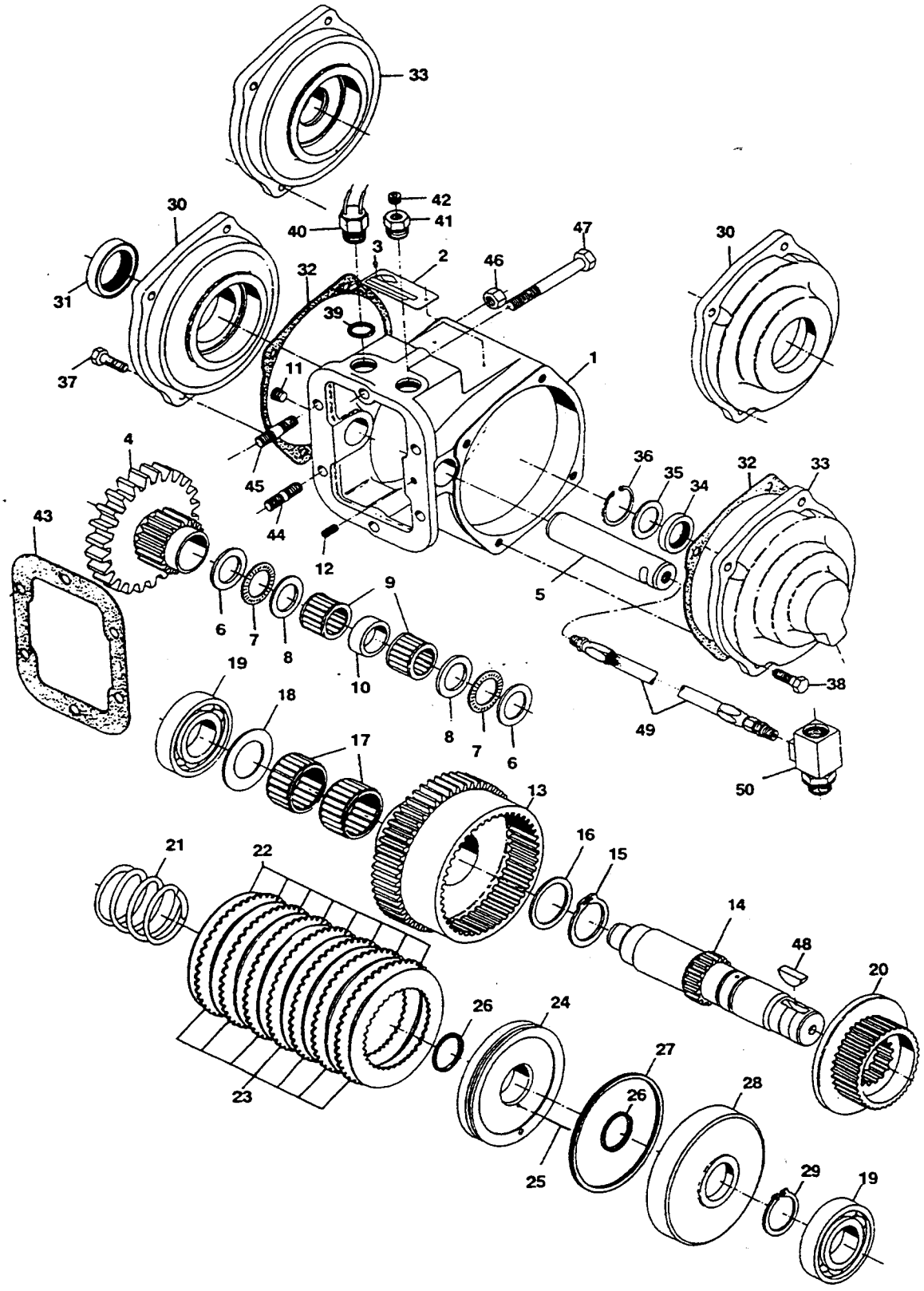
NOTE: Power Shift P.T.O.'s: The engine must be at idle or below 1,000 rpm when the P.T.O. is initially engaged. See the transmission manufacturer's instructions for special procedures.

IMPORTANT: Failure to follow proper shifting or operating sequences will result in premature P.T.O. failure with possible damage to other equipment.

ROTATING AUXILIARY DRIVESHAFTS

WARNING: 

- Rotating auxiliary driveshafts are dangerous. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.
- Do not go under the vehicle when the engine is running.
- Do not work on or near an exposed shaft when the engine is running.
- Shut off the engine before working on the power take-off or driven equipment.
- Exposed rotating driveshafts must be guarded.


33
30
42
41
40
47
3
2
46
30
31
32
39
37
11
1
4
45
36
35
34
32
33
43
44
12
5
6
7
8
9
10
19
18
17
8
7
6
38
49
50
13
16
15
21
22
14
48
20
26
24
27
26
28
23
25
29
19

270 SERIES

PARTS LIST & SPECIFICATIONS

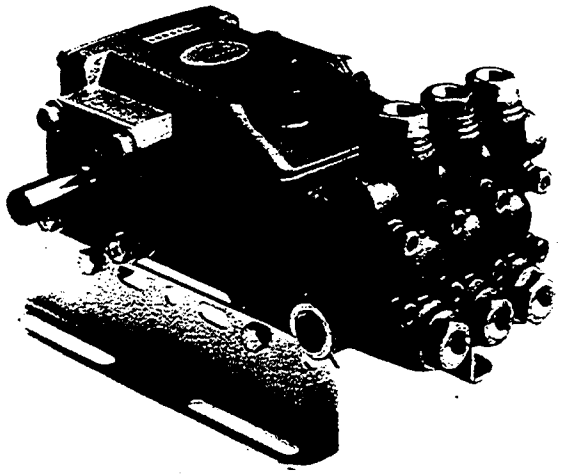
Item	Part Number	Description	Quantity
1	1-P-437	HOUSING, Standard Mount	1
	1-P-460	HOUSING, Special Mount for Jatco	1
2	68-P-2	NAME PLATE	1
3	378422	DRIVE SCREW	2
4	See Chart Pg. 5	GEAR, Input	1
5	9-P-54	SHAFT, Input Idler (Pressure Lube)	1
	9-P-55	SHAFT, Input Idler (No Pressure Lube)	1
6	31-P-61	THRUST RACE (1/32" Thick)	2
7	560920	BEARING, Needle Thrust	2
8	31-P-62	THRUST RACE (1/8" Thick)	2
9	550886	BEARING, Needle Assembly	2
10	14-P-54	SPACER, Idler Shaft	1
11	379231	PIPE PLUG (1/8"-27 N.P.T.F.)	1
12	378452-7	SETSCREW (1/4"-20 x 5/16")	1
13	See Chart Pg. 5	GEAR, Output	1
14	3-P-679	SHAFT, Standard Output 1-1/4" Rd. (Assemblies 3 & 5)	1
	3-P-677	SHAFT, Standard Output 1-1/4" Rd. (Assemblies 4 & 6)	1
15	378608	SNAP RING	1
16	14-P-49	SPACER	1
17	560918	ROLLER BEARING	2
18	31-P-57	THRUST WASHER	1
19	550010	BALL BEARING	2
20	2-P-458	INNER CLUTCH GEAR	1
21	37-P-39	CLUTCH SPRING	1
22	379485	FRICTION DISC	8
23	378684	CLUTCH PLATE	7
	328676X	CLUTCH PISTON & BALL ASSEMBLY	1
24	379133	PISTON	1
25	378856	WIGGLER WIRE (.012" Diameter)	1
26	28-P-244	O-RING	2
27	28-P-121	BLOCK VEE RING	1
28	378760	CLUTCH BACK-UP CYLINDER	1
29	378576	SNAP RING	1
30	21-P-451	BEARING COVER, Open End (Assemblies 3 & 5)	1
	21-P-297	BEARING COVER, Open End (Assemblies 4 & 6)	1
31	28-P-225	OIL SEAL	1
32	22-P-53	GASKET, Bearing Cover	2
	328806X	BEARING COVER ASSEMBLY, Closed End (Assemblies 3 & 5)	1
	328988X	BEARING COVER ASSEMBLY, Closed End (Assemblies 4 & 6) (Includes items 33 thru 36)	1
33	21-P-295	BEARING COVER, Closed End (Assemblies 3 & 5)	1
	21-P-449	BEARING COVER, Closed End (Assemblies 4 & 6)	1
34	28-P-119	OIL SEAL	1
35	378811	BACK-UP PLATE	1
36	378849	SNAP RING	1
37	378430-10	CAPSCREW, Hex Head (5/16"-18 x 1") Assemblies 4 & 6, Open End	4
	378430-12	CAPSCREW, Hex Head (5/16"-18 x 1 1/4") Assemblies 3 & 5, Open End	4

270 SERIES

PARTS LIST & SPECIFICATIONS

Item	Part Number	Description	Quantity
38	378430-10	CAPSCREW, Hex Head (5/16"-18 x 1") Assemblies 3 & 5, Closed End	4
	378430-12	CAPSCREW, Hex Head (5/16"-18 x 1 1/4") Assemblies 4 & 6, Closed End	4
39	28-P-171	O-RING, Speed Sensor	1
40	379243	SPEED SENSOR (Transducer) Included w/Electronic Overspeed Control	1
41	379242	ADAPTER PLUG, with E.O.C.	1
		ADAPTER PLUG, without E.O.C.	2
42	379231	PIPE PLUG (1/8"-27 N.P.T.F.), with E.O.C.	1
		PIPE PLUG (1/8"-27 N.P.T.F.), without E.O.C.	2
43	328951-6X	MOUNTING GASKET & INSTALLATION INSTRUCTIONS	1
		Use To Mount Gear Pitch Models 270XAAJ, 270XBAJ, 270XDAJ	
	35-P-41	GASKET, Mounting	1
N.S.	328948-12X	MOUNTING GASKET & INSTALLATION INSTRUCTIONS, JATCO	1
	35-P-79-1	GASKET, Mounting .010"	1
	35-P-79-2	GASKET, Mounting .020"	1
		LOOSE PARTS	
	328170-101X	MOUNTING PARTS KIT (Items 44 thru 47)	1
44	379457-13	SHOULDER STUD (3/8"-16 & 3/8"-24 — 1 3/4")	1
N.S.	379423-14	STUD (3/8"-16 & 3/8"-24 — 1 3/4")	2
45	379423-16	STUD (3/8"-16 & 3/8"-24 — 1 7/8")	2
N.S.	379224	TAB-LOCKWASHER	1
N.S.	378774	TAB-LOCKWASHER	5
46	501146-3	HEX NUT (3/8"-24)	5
47	378935	CAPSCREW (3/8"-16 x 3 1/4")	1
	7170-87X	MOUNTING PARTS KIT, Jatco 270J	1
48	500007-29	WOODRUFF KEY	1
49	328075X	PRESSURE LUBE HOSE, Allison	1
	329087X	PRESSURE LUBE HOSE, Jatco 270J	1
50	378840	STREET TEE, Allison AT Series	1
	378970	STREET TEE, Allison MT Series 1975 & After	1
	378880	STREET TEE, Allison MT Series 1974 & Before	1
	378897	STREET TEE, Allison CLT, CLBT & HT Series	1
N.S.	329049X	FITTING KIT, Jatco	1
		For Item 50, see application pages for correct fittings	
		SERVICE KITS	
N.S.	328356-21X	GASKET & SEAL KIT	1
N.S.	328970X	SERVICE KIT, Clutch Pack	1
N.S.	328971X	SERVICE KIT, Clutch Pack & Back-Up Piston	1
N.S.	328992X	HOSE KIT, For Solenoid Valve Plumbing	1

N.S. — Not Shown

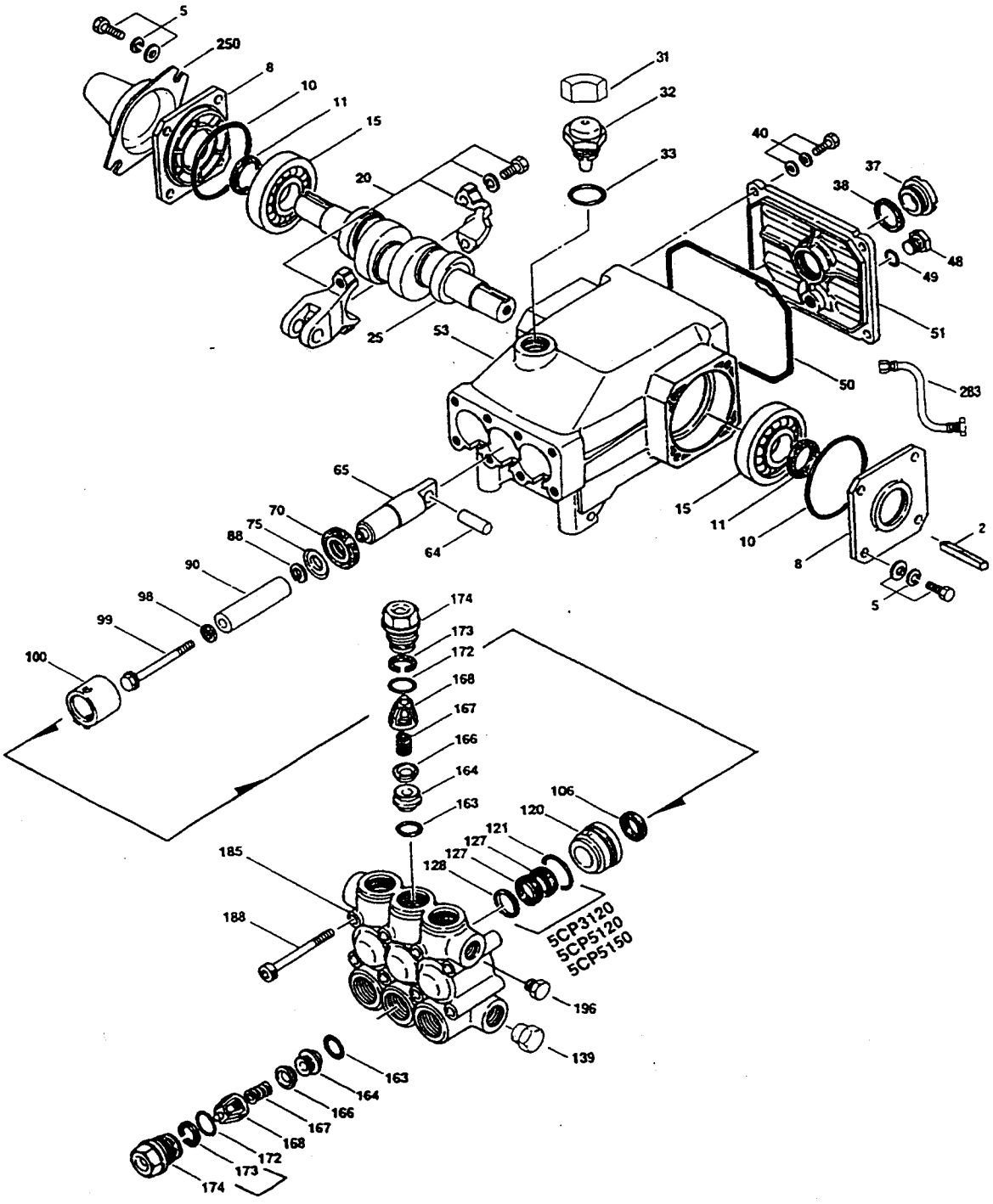


5CP Plunger Pump Models

5CP3120

SPECIFICATIONS

Volume	4.5 GPM	(17 L/M)
Discharge Pressure	100-3500 PSI	(7-245 BAR)
RPM	1645 RPM	(1645 RPM)
Bore.	**0.630"**	**(16 mm)**
Stroke	0.709"	(18 mm)
Weight	20.02 lbs.	(9.1 kg)


5
250
8
10
11
15
20
25
31
32
33
40
37
38
48
49
51
53
50
283
65
64
70
75
88
90
98
99
100
15
11
10
8
2
5
174
173
172
168
167
166
164
163
106
120
121
127
127
128
185
188
5CP3120
5CP5120
5CP5150
196
139
163
164
166
167
168
172
173
174

PARTS LIST

ITEM	PART NUMBER		DESCRIPTION	QTY
	5CP3120	**MATL**		
2	*30057*	*STL*	*Key (M6)*	*1*
5	96031	STZP	Screw, Sems HHC (M8x16)	8
8	46910	AL	Cover, Bearing	2/1
10	14028	NBR	O-Ring, Bearing Cover	2
11	43222	NBR	Seal, Oil, Crankshaft	2
15	14480	STL	Bearing	2
20	46743	ZZ	Rod, Connecting Assy	3
25	46928	FCM	Crankshaft, Dual End - 2120W, 3120, 5120, 6120	1
	—		Crankshaft, Single End - 2140W	1
	—		Crankshaft, Dual End - 2150W	1
	48233	**FCM**	Crankshaft, Single End - 3120G1, 5120G1	1
30	**48224**	**AL**	Cover, Bearing Blind	1
31	*82871Q*		*Protector, Oil Cap*	*1*
32	46798		Cap, Oil Filler, Domed	1
33	14179	NBR	O-Ring, Oil Filler Cap	1
37	43987		Gauge, Oil, Bubble	1
38	44428	NBR	Gasket, Flat, Oil Gauge	1
40	92519	STZP	Screw, Sems HHC (M6x16)	4
48	25625	BBCP	Plug, Drain	1
49	23170	NBR	O-Ring, Drain Plug	1
50	46940	AL	Cover, Crankcase	1
51	14044	NBR	O-Ring, Crankcase Cover	1
53	46912	AL	Crankcase	1
64	46746	S	Pin, Rist	3
65	46747		Rod, Plunger	3
70	46838	NBR	Seal, Oil, Crankcase	3
75	**43900**	**S**	Slinger, Barrier	3
88	45697	S	Washer, Keyhole (M18)	3
90	**46884**	**CC**	Plunger (M50)	3
98	46730	S	Washer, Seal	3
	48394	FPM	Washer, Seal	3
99	***46729***	***S***	*Retainer, Plunger w/Stud (M7)*	*3*
100	46749	PVDF	Retainer, Seal	3
106	**43316**	**NBR**	Seal, LPS w/S-Spg	3
	106660	***FPM***	*Seal, LPS w/S-Spg*	*3*
120	**46888**	**BB**	Case, Seal, Press-in-style	3
121	13978	NBR	O-Ring, Seal Case	3
	14329	*FPM*	*O-Ring, Seal Case*	*3*
125	—		Seal, HPS w/S	3
	—		*Seal, HPS w/S*	*3*
	—		*Seal, HPS w/S*	*3*
127	**43319**	**PTFE**	V-Packing	6
	46287	**HT**	V-Packing	6
	—		V-Packing	6
128	**46618**	**NY**	Adapter, Male	3
139	22179	BBCP	Plug, Inlet (1/2")	1
	—		Back-up-Ring, Seat	6
163	**17547**	**NBR**	O-Ring, Seat	6
	11685	***FPM***	*O-Ring, Seat*	*6*
164	**46658**	**S**	Seat	6
166	**46429**	**S**	Valve	6
167	**43750**	**S**	Spring	6
168	**46583**	**PVDF**	Retainer, Spring	6
172	**17549**	**NBR**	O-Ring, Valve Plug	6
	26996	***FPM***	*O-Ring, Valve Plug*	*6*
173	**48365**	**D**	Back-up-Ring, Valve Plug	6
174	**45900**	**BBCP**	Plug, Valve	6
		—	Plug, Valve	6
185	**46886**	**FBB**	Manifold, Head	1
	—		Manifold, Head - W770	1
188	87872	STZP	Bolt, HSH (M8x70), Manifold Head	8
196	*22187*	*BBCP*	*Plug, Discharge (3/8")*	*1*
250	*118672*	*STCP*	*Protector, Shaft*	*1*
255	*30243*	*STZP*	*Mount, Direct*	*1*

	30611	STZP	Assembly, Angle Rail - B (28499, 30900, 30910, 30920) (Belt Drive Only)	1	
	30637	STZP	Mount, Angle Assy-Retro fit	1	
265	30659		Kit, Complete Mounting (Incids: 30611,30944,30633,118672) (Belt Drive Only)	1	
275	30944	STL	Hub & Key Assy (M20 w/M6 Keyway) [See complete Accessory Drive Packages, Tech Bulletin 03]	1	
283	34334		Kit, Oil Drain	1	
● 299	814843	FBB	Head, Complete	1	●
300	—		Kit, Seal (Incids: 98, 106, 121,125)	1	
	—		Kit, Seal (Incids: 98,106,121,125)	1	
	33629	NBR	Kit, Seal (Incids: 98,106,121,127)	1	
310	—		Kit, Valve (Incids: 162,163,164,166,167,168,172)	2	
	33060	NBR	Kit, Valve (Incids: 163,164,166,167,168,172)	2	
	—		Kit, Valve (Incids: 162,163,164,166,167,168,172)	2	
350	30696	STZP	Tool, Valve Seat Removal	1	
400	7655	BB	Modular Unloader (See Individual Data Sheet)	1	
	7659	BB	Modular Unloader (With Quick Start, Thermo Valve)	1	

● Industrial discount. **Bold print part numbers are unique to a particular pump model.** *Italics are optional items.*
See Tech Bulletins 03, 24, 36, 43, 53, 60, 61, 64, 74, 77 and 78 for additional information. ✧ Effective with 897 production. Add .3000 for the Hi-Temp model.
MATERIAL CODES (Not Part of Part Number): AL=Aluminum BB=Brass CC=Ceramic CP=Chromeplated CPST=Chromeplated Steel D=Delrin® EPDM=Ethylene Propylene Diene Monomer FBB=Forged Brass FPM=Fluorocarbon (Viton®) HT=Hi-Temp (EPDM Alternative) NBR=Medium Nitrile (Buna-N) NY=Nylon PTFE=Polytetrafluoroethylene (Teflon®) PVDF=Fluoroplastic (High Strength) S=304SS STL=Steel W770=W-770 ZP=Zinc Plated ZPST=Zinc Plated Steel ZZ=Zamack

CP PLUNGER PUMP SERVICE MANUAL

STORING: For extended storing or between use in cold climates, drain all pumped fluids from pump and **flush with antifreeze solution to prevent freezing and damage** to the pump. DO NOT RUN PUMP WITH FROZEN FLUID.

LUBRICATION: Fill crankcase with special CAT PUMP oil per pump specifications [5CP-17 oz.]. DO NOT RUN PUMP WITHOUT OIL IN CRANKCASE. Change initial fill after 50 hours running period. Thereafter, change oil every **3 months or 500 hour intervals.**

Fig. A

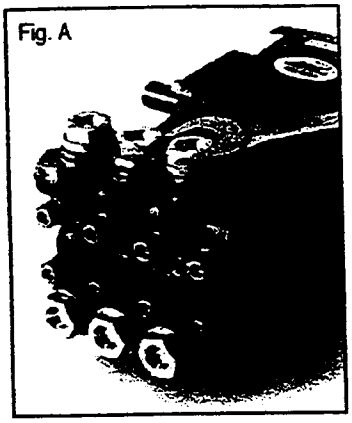


Fig. C

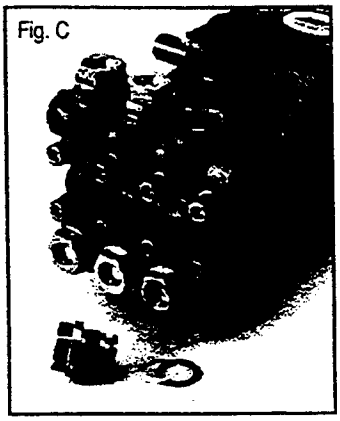


Fig. D

Models 5CP3120 and 5CP5120

Fig. E

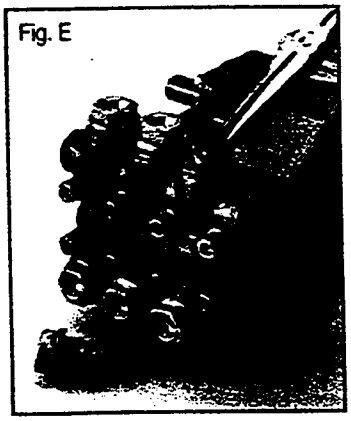


Fig. F

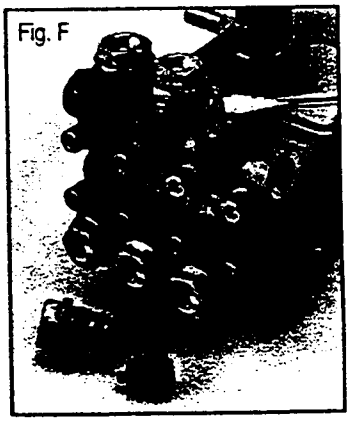
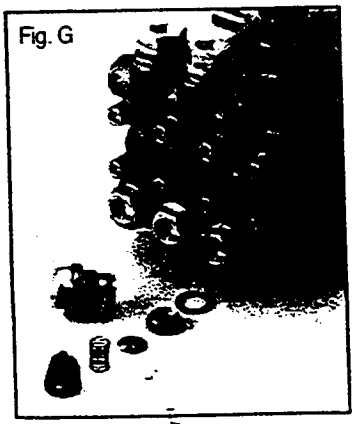


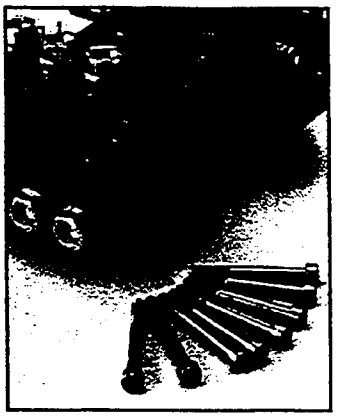
Fig. G



SERVICING THE VALVES

1. Remove the hex Valve Plugs (top discharge, bottom inlet). (Fig. A, C)
2. Unthread the Valve Plug and examine the O-Ring under the plug for cuts or distortion. Replace if worn. Lubricate new O-Rings before installing.
   NOTE: The 5CP3120 and 5CP5120 have both an O-Ring and Back-up Ring on the Valve Plug.
3. Grasp Valve Retainer by the tab at the top with a pliers and remove from the valve chamber (Fig. D, E). Usually the valve assembly will remain together while being removed. To separate the valve assembly, insert a screwdriver into the side of the Retainer and press on the back side of the Valve to begin separation, then between the Retainer and Valve Seat to separate completely. If the valve assembly separates during removal, remove the Spring and Valve with a needle nose pliers. With a reverse pliers, remove the Valve Seat from the manifold chamber. Then, with a small screwdriver, carefully remove the O-Ring at the bottom of the valve chamber. (Fig. F)
4. Examine all valve parts for pitting, gouges or wear and replace with preassembled Valve Assembly in service kit containing Retainer, Spring, Valve, Valve Seat and O-Ring. (Fig. G,)
   NOTE: Inlet and discharge valve parts are interchangeable. **Two Valve Kits** are needed for complete valve change.
5. Grasp new Valve Assembly by the tab at the top with a pliers, immerse in oil and push into valve chamber. (Fig. D) Be certain valve assembly is completely seated in valve chamber.

   NOTE: For certain applications apply liquid gasket to the o-ring crevices and seal surfaces. See Tech Bulletin 53 for model identification.
6. Apply Loctite 242 to the threads of the Valve Plug, thread into manifold port and torque per chart.



SERVICING THE PUMPING SECTION

Disassembly

1. Using an M6 allen wrench, remove the eight (8) Socket Head Bolts. (Fig. I)
2. Rotate Crankshaft by hand to start separation of Manifold Head from Crankcase.
3. Insert two flat head screwdrivers on opposite sides to further separate Manifold Head from Crankcase or support the underside of the Manifold Head and tap lightly with a mallet on the backside of the Manifold Head. CAUTION: KEEP MANIFOLD PROPERLY ALIGNED WITH CERAMIC PLUNGERS WHEN REMOVING TO AVOID DAMAGE TO EITHER PLUNGERS OR SEALS.
4. Remove the Seal Retainer and examine for wear.
5. Examine Ceramic Plunger for cracks or scoring and refer to Servicing Plungers if replacement is needed.

Reassembly

1. Generally Plungers do not need to be replaced. Clean plungers and remove any foreign material with a non-abrasive cleaner.
2. Slip the Seal Retainer over the Ceramic **Plungers with the holes to the top and bottom and forward.** (Fig. L)
3. Turn Crankshaft by hand to line up Plungers so end Plungers are parallel.
4. Lightly lubricate the Plungers and carefully slide the Manifold Head onto the Plungers supporting from the underside to avoid damaging the Plungers. On the high pressure V-Packing models or larger manifolds, it may be necessary to gently tap with a soft mallet until the Manifold Head is flush with the Crankcase.
5. Replace eight (8) Socket Head Bolts and torque per chart.

SERVICING THE PLUNGERS

Disassembly

1. Remove the Manifold Head as described in the Servicing the Pumping Section.
2. To service the Plungers, remove the Seal Retainers.
3. Using a hex tool, and unthread the Plunger Retainer with sealing washer.
5. Remove the Ceramic Plunger, Keyhole Washer and Barrier Slinger from Plunger Rod. (Fig. L)

Reassembly

1. Visually inspect Crankcase Seal for deterioration or leaks and contact factory for assistance with replacement. Replace Barrier Slinger if damaged and slide onto Plunger Rod **with concave side away from Crankcase.**
2. Examine Ceramic Plunger for scoring or cracks and replace if worn.
3. Examine Sealing Washer on the Plunger Retainer and replace if cut or worn. Lubricate new Sealing Washer for ease of installation and to avoid damage. (Fig. L)
4. Apply Loctite 242 to the threads of Plunger Retainer and insert into Ceramic Plunger. Thread hand tight, then torque per chart.
5. Install the Seal Retainer with **holes to top and bottom and forward.** (Fig. L)
6. Proceed with servicing the seals or remounting of Manifold Head as described.

SERVICING THE SEAL AND V-PACKINGS

Disassembly

1. Remove the Manifold Head as described in Servicing the Pumping Section.
2. Using a reverse pliers, remove the Lo-Pressure Seal from the Seal Case. (Fig. J)
3. Place the **Crankcase side of manifold facing up** and with a reverse pliers, remove the press-in style Seal Case from the Manifold Head.
4. Remove the O-Ring from O.D. of Seal Case.

5. **Hi-Pressure Seal Models:** The Hi-Pressure Seal is generally easily removed from the manifold without any tools. If extremely worn a reverse pliers may be used. (Fig. J)
6. **V-Packing Models:** The V-Packings and Male Adapter are easily removed from the manifold without any tools. If extremely worn a reverse pliers may be used. (Fig. K)

Reassembly
V-Packing Models:

1. Lubricate seal chamber in the manifold.
   NOTE: For certain applications apply liquid gasket to the o-ring crevices and seal surfaces. See Tech Bulletin 53 for model identification.
2. Insert Male Adapter **with notches down** and **"v" side up** and press completely into chamber by hand.
3. Lubricate V-Packings and install one at a time with **grooved side down.**
4. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Rings before installing.
5. Press Seal Case into manifold until completely seated.

Hi-Pressure Seal Models:

1. Lubricate seal chamber in manifold.
   NOTE: For certain applications apply liquid gasket to the o-ring crevices and seal surfaces. See Tech Bulletin 53 for model identification.
2. Carefully square Hi-Pressure Seal into position by hand with the **grooved side down** (metal back facing out).
3. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Ring before installing.
4. Next press the Seal Case into manifold until completely seated.

Lo-Pressure Seal-All Models:

1. Examine Lo-Pressure Seal for wear or broken spring and replace if necessary.
2. Install Lo-Pressure Seal into Seal Case with **garter spring down.**
3. All Models: Install Seal Retainer over Plungers with **hole down.**
4. Replace Manifold Head onto pump as described under Servicing the Pumping Section and torque per chart.

SERVICING THE CRANKCASE SECTION

1. While Manifold Head, Plungers and Seal Retainers are removed, examine Crankcase Seals for wear.
2. Check oil level and for evidence of water in oil.
3. Rotate Crankshaft by hand to feel for smooth bearing movement.
4. Examine Crankshaft Oil Seal externally for drying, cracking or leaking.
5. Consult factory or your local distributor if crankcase service is evidenced.

PREVENTATIVE MAINTENANCE CHECK-LIST

Check	Daily	Weekly	50 hrs.	500 hrs.*	1500 hrs.**
Clean Filters	x				
Oil Level/Quality	x				
Oil Leaks	x				
Water Leaks	x				
Belts, Pulley		x			
Plumbing		x			
Initial Oil Change			x		
Oil Change				x	
Seal Change					x
Valve Change					x
Accessories					x

*If other than CAT PUMPS special multi-viscosity ISO68 oil is used, change cycle should be every 300 hours.

**Each system's maintenance cycle will be exclusive. If system performance decreases, check immediately. If no wear at 1500 hours, check again at 2000 hours and each 500 hours until wear is observed.

**Remember to service the regulator/unloader at each seal servicing and check all system accessories and connections before resuming operation.

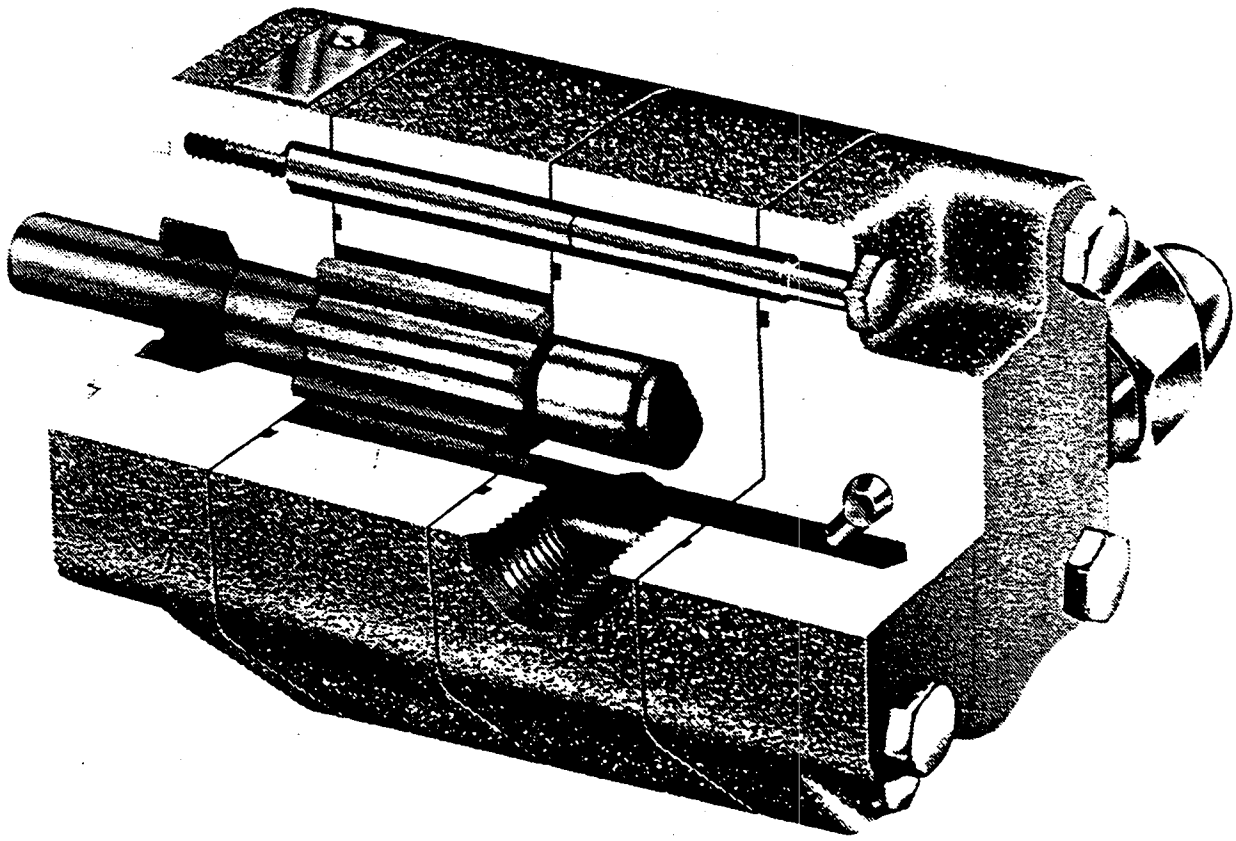
TORQUE CHART

Pump Item	Thread	Tool Size [Part No.]	Torque in.lbs.	ft.lbs.	Nm
Plunger Retainer	M6	M10 Hex [25082]	55	4.4	6.2
Manifold Bolt	M8	M6 Allen [30941]	115	9.4	13
Valve Plugs	M22	M24 Hex [44046]	870	72.3	100
Bearing Cover Screws					
3CP	M6	M10 Hex./Phil. [25082]	50	4.0	6
5CP	M8	M13 Hex M5 Hex [25324]	115	9.4	13
Crankcase Cover	M6	M10 Hex./Phil. [25082]	50	4.0	6
Bubble Oil Gauge	M28	Oil Gauge Tool [44050]	45	3.6	5
Mounting Bolts	M8	M13 Hex [25324]	115	9.4	13

DIAGNOSIS AND MAINTENANCE

PROBLEM	PROBABLE CAUSE	SOLUTION
• Low Pressure	• Worn nozzle	• Replace nozzle of proper size.
	• Belt slippage	• Tighten or replace; use correct belt.
	• Air leak in inlet plumbing	• Use PTFE liquid or tape.
	• Pressure gauge inoperative or not registering accurately	• Check pressure with new gauge and replace as needed.
	• Relief valve stuck partially plugged or improperly adjusted	• Clean and reset relief valve to system pressure and correct by-pass. Check supply tank for contamination.
	• Worn seat or valves	• Clean or replace with valve kit.
	• Inlet suction strainer clogged or improperly sized	• Use adequate size for inlet pump connection and fluid being pumped. Clean frequently.
	• Worn seals. Abrasives in pumped fluid, severe cavitation; inadequate water supply, stressful inlet conditions	• Install and maintain proper filter, check line size and flow available to pump. Install a C.A.T.
	• Fouled or dirty inlet or discharge valves	• Clean inlet and discharge valve assemblies.
	• Worn inlet or discharge valves	• Replace with valve kit.
	• Leaky discharge hose	• Replace hose. Check connections.
• Pulsation, pump runs extremely rough, pressure low	• Faulty Pulsation Dampener	• Check precharge (should be 30-50%) of system pressure or replace as needed.
	• Restricted inlet or air entering inlet plumbing	• Check filters and clean as needed. Check fittings and use PTFE liquid or tape for airtight connection.
	• Stuck inlet or discharge valve	• Clean or replace valve. Check supply tank for contamination.
• Water leakage from under the manifold *Slight leakage	• Worn Lo-Pressure, Hi-Pressure seals or V-packings	• Replace with seal kit. • Check inlet pressure and system temperature. • Use Thermo Valve in by-pass line. • Use inlet pressure regulator in inlet line.
• Oil leak between crankcase and pumping section	• Worn crankcase seals	• Replace crankcase seals.
• Oil leaking in the area of crankshaft	• Worn crankshaft seal • Bad bearing	• Replace damaged seals. • Replace bearing.
• Excessive play in the end of the crankshaft	• Worn bearing	• Replace bearing.
• Water in crankcase	• Humid air condensing into water inside of the crankcase	• Change oil every 3 months or 500 hour intervals using special CAT PUMP Premium Grade Oil, PN 06100 (Case) 6107 (Bottle), (other approved oil every month or 300 hours).
	• Leaking of crankcase seals or seals installed backward	• Replace seals. Follow proper installation procedure. Contact Cat Pumps supplier for crankcase servicing.
• Oil leaking at the rear portion of the crankcase	• Damaged or improperly installed oil gauge, crankcase cover or drain plug O-ring	• Replace oil gauge, crankcase cover or drain plug O-ring. Thread in oil gauge and drain plug hand tight to avoid extruding o-ring.
• Loud knocking noise in pump	• Pulley loose on crankshaft	• Check key and tighten set screw.
	• Worn bearing, connecting rod or crankshaft	• Consult Cat Pumps supplier for crankcase servicing.
	• Stressful inlet conditions	• Install C.A.T.
• Frequent or premature failure of the packing	• Scored plungers	• Replace plungers.
	• Over pressure to inlet manifold	• Reduce inlet pressure per instructions.
	• Abrasive material in the fluid being pumped	• Install proper filtration on pump inlet plumbing.
	• Excessive pressure and/or temperature of fluid being pumped	• Check pressure and inlet fluid temperature. Be sure they are within specified range.
	• Running pump dry	• DO NOT RUN PUMP WITHOUT WATER.
• Strong surging at the inlet and low pressure	• Foreign particles in the inlet or discharge valve or worn inlet and/or discharge valves	• Check for smooth surfaces on inlet and discharge valve seats. Replace with kit if pitted or worn. • Check supply tank for contamination. Install and regularly clean filter. Do not pump abrasive fluids.

OIL PUMP



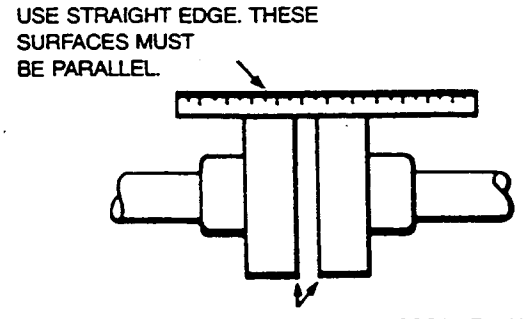
Mounting

1. Surfaces pump mounts against must be clean and flat.
2. Use only SAE Grade 5 capscrews for mounting pump.
3. The 4 mounting capscrews for SG-04 and SG-05 pumps must have a minimum of ½ inch thread engagement and must be torqued evenly to 12-15 ft. lbs.
4. Standard SG Series pumps are designed to be used with jaw type couplings that do not induce axial thrust on the pump shaft. If an improper type of coupling is used, internal damage may result.
5. Do not strike or press pump drive coupling to install. Internal pump damage will result. If coupling does not slide on shaft, inspect coupling, shaft and key for nicks or burrs and remove.
6. Once pump has been mounted and coupling installed, pump must be primed. Squirt oil in suction port and turn pump by hand to make sure it turns freely.

Alignment

Check alignment after mounting

1. If the pump is driven by a flexible coupling, remove any coupling guards or covers and check alignment of coupling halves. A straight-edge (piece of key stock works good) across coupling must rest evenly on both rims at top, bottom, and sides. Refer to Figure 3.



CHECK WIDTH BETWEEN THESE SURFACES WITH INSIDE CALIPERS OR FEELER GAUGE TO BE CERTAIN THE FACES ARE EQUAL DISTANCE APART AND PARALLEL.

FIGURE 3

2. Make final check on alignment after piping is hooked up.

DANGER

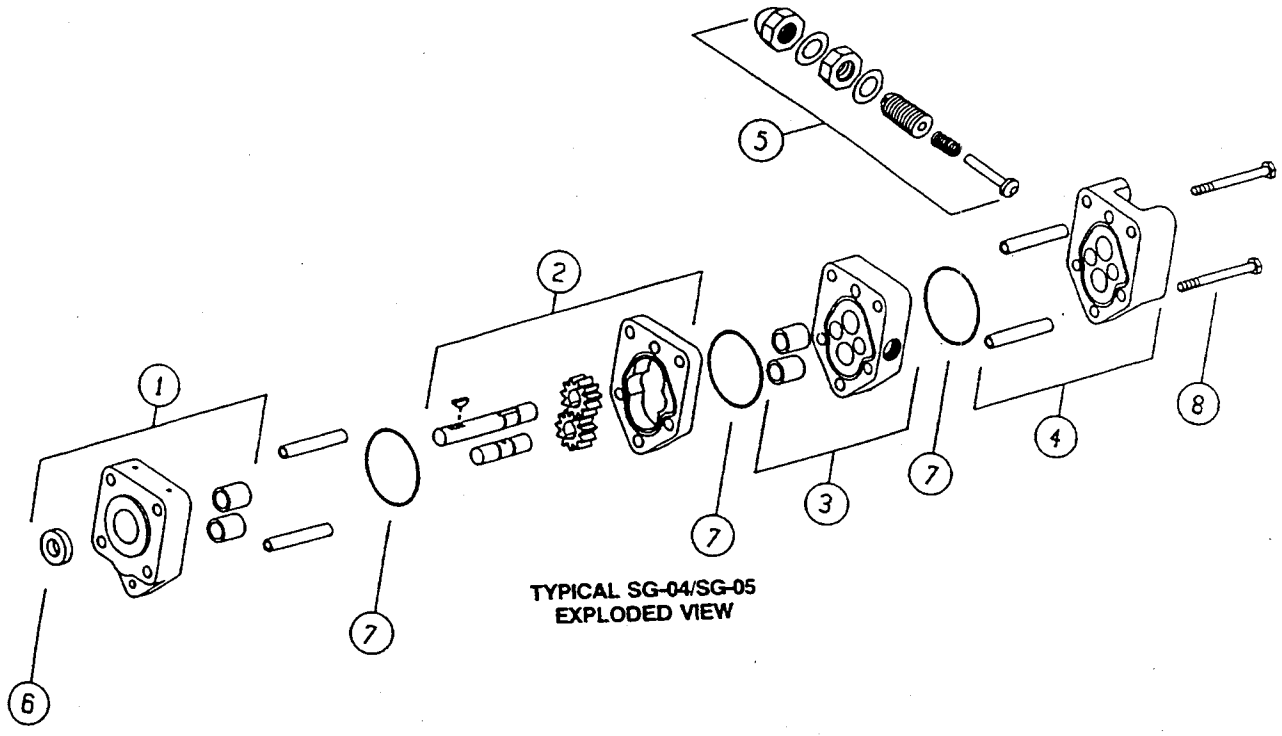
Before starting pump, be sure all drive equipment guards are in place. Failure to properly mount guards may result in serious injury or death.

DANGER

Before opening any pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc). be sure:

1. **That any pressure in chamber has been completely vented through suction or discharge lines or other appropriate openings or connections.**
2. **That the PTO has been "locked out" or made non operational so that it cannot be started while work is been done on pump.**

Failure to follow above listed precautionary measures may result in serious injury or death.



TYPICAL SG-04/SG-05
EXPLODED VIEW

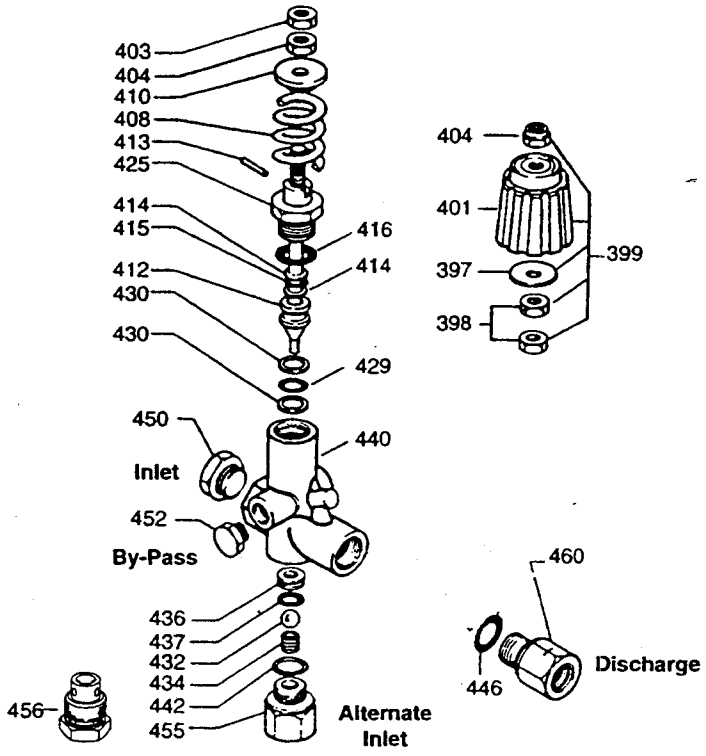
ITEM	DESCRIPTION
1	Bracket, lipseal & bearing section
2	Match ground casing & (2) gears, driver & driven shafts
3	Separation plate & bearing assy.
4	Head and alignment sleeve assy.

ITEM	DESCRIPTION
5	Relief valve kit
6	Lipseal
7	O-ring
8	Assembly capscrews

PRESSURE REGULATOR

MODE 7570

EXPLODED VIEW



ITEM	DESCRIPTION	7570	MATL	QTY
397	Washer, Flat	33633	STZP	1
398	Nut, Jam (M8)	32116	STZP	2
399	Assembly, Complete Handle (Incldes: 397,398,401,404)	32087	NY	1
401	Handle, Black	33782	NY	1
403	Nut, Adjusting (M8)	—		1
404	Nut, Adjusting w/Nylon Insert	32811	STZP	1
408	Spring, **White** 1450 PSI	32090	STL	1
	Spring, **Blue** 3450 PSI	—		1
410	Washer, Retaining	—	BB	1
412	Stem, Piston (Prior to 6/88)	32119	S	1
	Stem-2, Piston	33219	S	1
413	Pin, Locking, Piston	32818	S	1
414	Back-up-Ring, Stem	32873	PTFE	2
415	O-Ring, Stem	33533	NBR	1
	O-Ring, Stem	*33572*	*FPM*	*1*
416	O-Ring, Fitting	32113	NBR	1
	O-Ring, Fitting	*33567*	*FPM*	*1*
425	Retainer, Piston	33318	BB	1
429	O-Ring, Piston	32919	NBR	1
	O-Ring, Piston	*33575*	*FPM*	*1*
430	Back-up-Ring, Piston	33303	PTFE	2
432	Ball	32289	S	1
434	* Spring	33781	STZP	1
436	Seat	33640	S	1
437	O-Ring, Seat	32008	FPM	1
	O-Ring, Seat	*33562*	*FPM*	*1*
440	Body	—	BB	1
442	O-Ring, Fitting	32113	NBR	1
450	Plug, Hex, Inlet (3/8" NPT)	—	BB	1
452	Plug, Hex, By-Pass (3/8" NPT)	—	BB	1
455	* Fitting, Inlet (3/8" NPT)	32111	BB	1
460	Fitting, Discharge (3/8" NPT)	32112	BB	1
468	*Kit, O-Ring (Incldes: 414,415,416,429,430,437,441,442,446) (Prior to 6/88)*	*33146*	*NBR*	*1*
—	*Kit-2, O-Ring (Incldes: 414,415,416,429,430,437,441,442,446) (After 6/88)*	*33246*	*NBR*	*1*
—	*Kit-2, O-Ring (Incldes: 414,415,416,429,430,437,441,442,446) (After 6/88)*	*32878*	*FPM*	*1*
—	*Kit, Valve (Incldes: 432,434,436,437,442)*	*33147*	*S*	*1*

Italics are optional items. MATERIAL CODES (Not Part of Part Number): BB=Brass FPM=Fluorocarbon (Viton®) NBR=Medium Nitrile (Buna-N) NY=Nylon PTFE=Polytetrafluoroethylene (Teflon®) S=304SS STL=Steel STZP=Steel/Zinc Plated

PRESSURE ADJUSTMENT: Setting and adjusting the regulator pressure must be done with the system "on". Start the system with the regulator backed off to the **lowest pressure** setting. Squeeze the trigger and read the pressure on the gauge at the pump. If more pressure is desired, release the trigger, turn adjustment knob/bolt one quarter turn, squeeze the trigger and read the pressure. Repeat this process until desired pressure is attained. Pressure fluctuation from this established system pressure is minimal with the opening of each additional gun.

Monitor the by-pass flow at each adjustment. If the by-pass flow, with all guns or valves open, drops below 10% of rated regulator flow, STOP ADJUSTMENT. The nozzle(s) selection is improperly sized to achieve the desired system pressure.

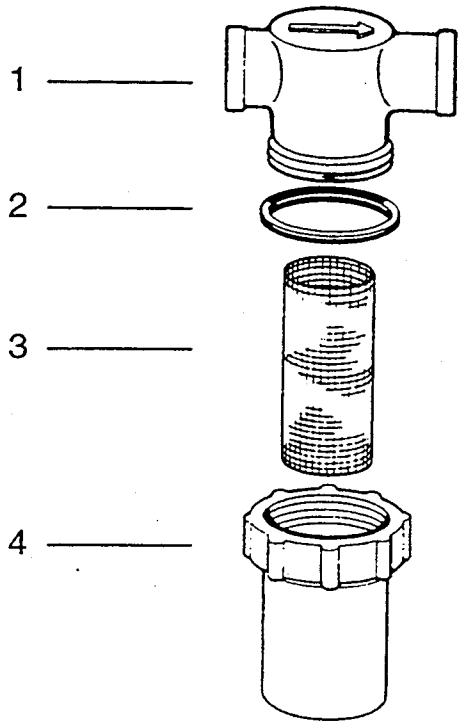
Proceed by accepting the attained pressure OR selecting a smaller or fewer nozzles OR increasing the pump RPM providing you stay within specifications OR selecting a larger pump or dual pumps.

Once the desired system pressure is reached, stop adjusting and set the top locking knob to hold the system pressure. **Do not read the pressure at the gun or nozzle for setting system pressure.** Check the nozzle(s) as part of regular maintenance and replace if worn. **Do not adjust regulator pressure setting to compensate for worn nozzle(s).**

TROUBLESHOOTING

Cycling	• Too little flow for valve specifications. • Air in system, poor connections. • Inlet seals in pump worn. • O-ring in gun worn.
System will not build up to pressure	• Nozzle worn. • Improper nozzle size for system specs. • Foreign material trapped in seat.
Pressure drop	• Nozzles worn. • Piston and seat in regulator worn. • Air in system, poor connections. • Insufficient flow to pump. • Filter clogged. Check and clean regularly.
Pressure spikes while in by-pass	• Minimum by-pass of 10% not present. • Excessive pressure adjustment made for worn nozzle. REPLACE NOZZLE. Reset system pressure.
Leakage from regulator vent hole	• O-ring around piston worn. Replace. • Piston Retainer scored. Replace as needed.

EXPLODED VIEW



PARTS LIST

ITEM	PART NO.	MATL	DESCRIPTION
• 1	—		Cap
2	33071	NBR	Gasket, 1/2", 3/4"
2	33073	NBR	Gasket, 1", 1-1/4", 1-1/2"
• 2	33082	FPM	Gasket, 1/2", 3/4"
2	33083	FPM	Gasket, 1", 1-1/4", 1-1/2"
• 3	33072	SS	Screen, 1/2", 3/4" 80 mesh
3	33074	SS	Screen, 1" 80 mesh
3	33075	SS	Screen, 1-1/4" 80 mesh
3	33076	SS	Screen, 1-1/2" 80 mesh
4	33077	NY	Bowl, clear, 1/2", 3/4"
• 4	33078	NY	Bowl, white, 1/2", 3/4"
4	33079	NY	Bowl, clear, 1", 1-1/4", 1-1/2'
4	33080	NY	Bowl, white, 1", 1-1/4", 1-1/2

MATERIAL CODES (Not Part of Part Number): FPM=Flourocarbon (V
NBR=Medium Nitrile (Buna-N) NY=Nylon SS=316SS

MAINTENANCE: Flush screen regularly and reinstall into body. Check gasket for cuts or wear and replace if necessary to assure proper seal. Thread body and cap hand tight for proper seal.

TECH BULLETIN 001

Carpet Cleaning Truck secondary heating system

! WARNING:
DO NOT service heating system while truck is running. The high-speed mechanical parts as well as high temperature components may result in severe injury or fatality.

DO NOT smoke or use open flame while servicing secondary water heating system.

1. Carpet Cleaning Truck is equipped with a secondary water heating system consisting of the following parts (see attached schematic diagram):

a. **3-way diverter valve.**
b. **Exhaust heat exchanger E-3**
c. **Secondary oil/water heat exchanger E-2.**
d. **Oil Pump. (Heat transfer Pump).**

2. SECONDARY HEAT TRANSFER OPERATING CONDITIONS.

a. **Engine Exhaust temperature 500 to 530°F (max. operating exhaust temperature should not exceed 550°F).**
b. **Oil (heat transfer fluid) normal operating temperature 280 to 350°F.**
c. **System charged with Dynalene SF heat transfer fluid. Total charge 14 lbs (The equivalent 1.9 gal or 243 oz @70°F).**

3. HEAT TRANSFER SYSTEM MAINTENANCE.

Every 1 week or 40 hours of operation the heat transfer system must be vented to remove any gases from the oil and to normalize the pressure in E-2

SYSTEM VENT PROCEDURE

a. **With all system Of and truck at ambient temperature. Slowly remove E-2 relief valve. (Relief valve located on top of the E-2 heat exchanger expansion tank). Allow air and gas to escape.**
b. **Start truck and engage PTO.**
c. **Run truck for 3 min and engage water/oil pumps.**
d. **Switch PTO to the 1st speed.**

e. **Preheat water to approximately 180°F on water temperature gauge. (do not overheat).**
f. **Switch PTO to the idle position.**
g. **Shut down water/oil pumps and blower.**

! **WARNING:**
DO NOT service heating system while truck is running. The high-speed mechanical parts as well as high temperature components may result in severe injury or fatality.

DO NOT smoke or use open flame while servicing secondary water heating system.

SYSTEM OIL CHECK PROCEDURE.

a. **Cool system to ambient temperature. (90°F max)**
b. **Check heat transfer fluid level in level eye of E-2. Normal level should be at the middle of the level eye at ambient temperature or slightly below upper tube in E-2 heat exchanger.**
c. **Add heat transfer fluid if so required.**
DO NOT Overfill System. Overfilling system will create high pressure in the heating system.
d. **Reinstall system relief valve.**

Every 300 hours heat transfer fluid must be replaced.

HEAT TRANSFER FLUID REPLACEMENT PROCEDURE.

DO NOT drain heat transfer fluid if system is hot. (Greater than 120°F).
a. **Slowly remove System relief valve. (Relief valve located on top of the E-2 heat exchanger expansion chamber). Allow air and gas to escape.**
b. **Remove drain plug from E-3 exchanger. (E-3 exchanger located below truck floor).**
c. **Drain all liquid in to a suitable container. (approximately. 1.9 gal charge) It will take approximately. 1 hr to drain all of the oil.**
d. **Remove vent plug from E-3 heat exchanger.**

Carpet Cleaning Truck drive shaft.

! WARNING:
DO NOT service truck mechanical components while truck engine is running. The high-speed mechanical parts as well as high temperature components may result in severe injury or fatality.

Carpet Cleaning Truck is equipped with a transmission PTO, universal joint shaft and main pulley shaft. All shafts assemblies located below truck frame on the driver side. (see attached schematic diagram).

Both universal joint shaft and main pulley shaft covered with shaft covers for safety protection.

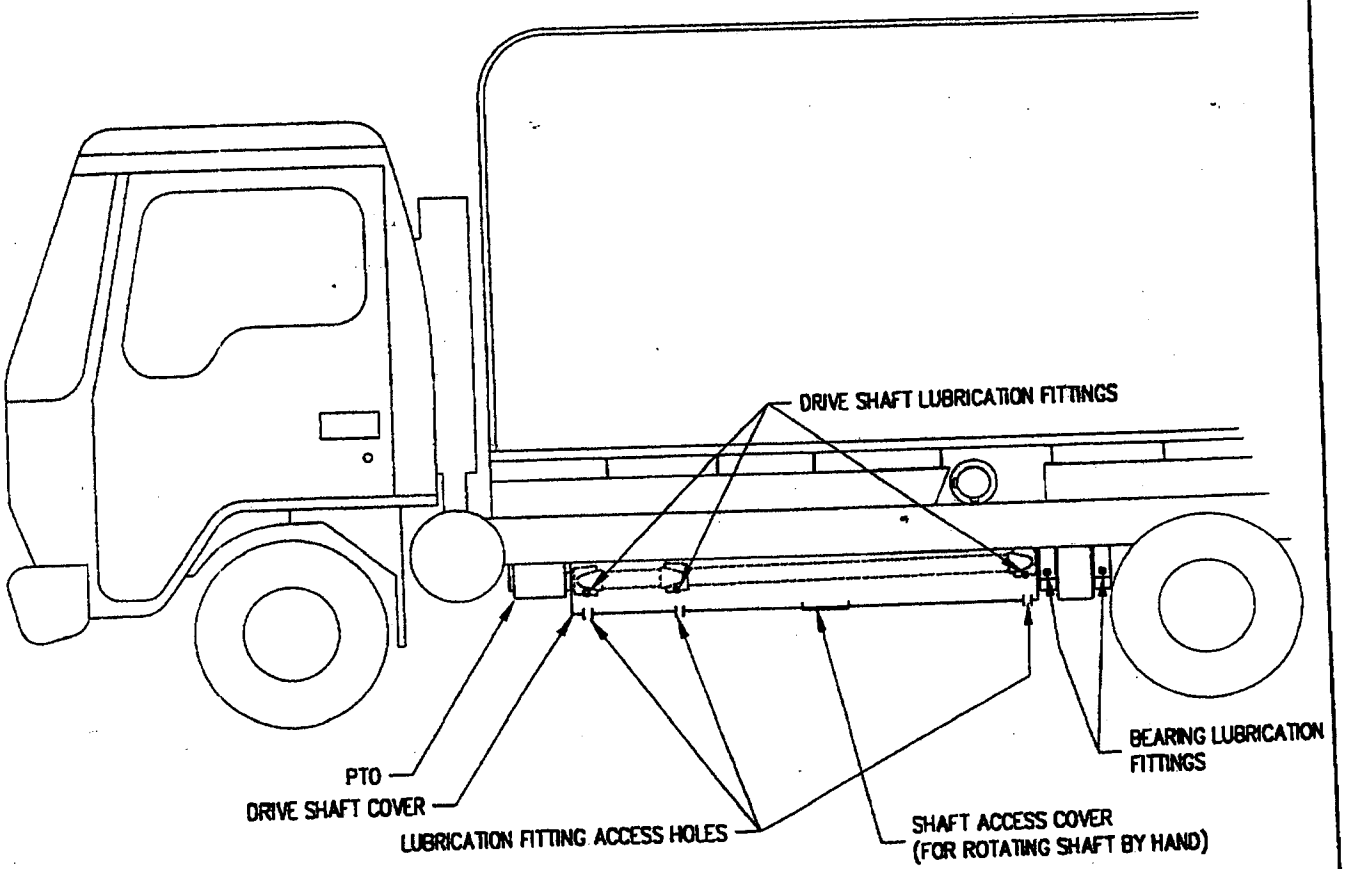
Universal joint shaft equipped with three lubrication fittings accessible from the bottom of the shaft cover.

All universal joint shaft and main pulley shaft bearings must be lubricated every week.

TECHNICAL BULLETIN

002

MAY 3, 2000



CARPET CLEANING TRUCK

PTO DRIVE SHAFT LUBRICATION SYSTEM

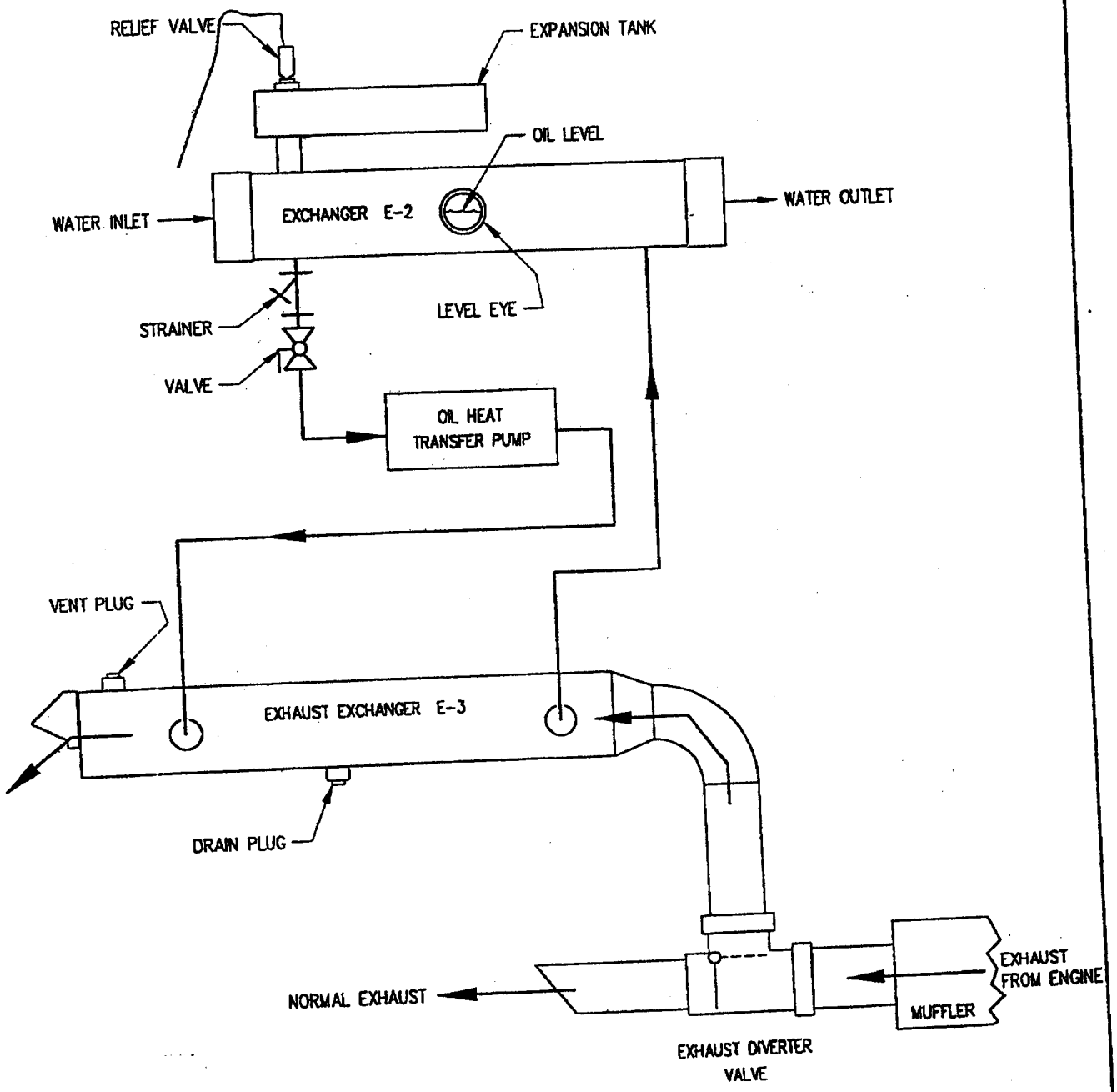
! WARNING:
When disposing of used heat transfer fluid, observe local laws and regulation. Do not drain on to the ground or into storm drainage systems.

e. **Re-install drain plug. Use Hi. Temperature Teflon threaded sealant tape.**
f. **Fill system through relief valve threaded port. Heat Transfer liquid is very viscous at ambient temperature. Allow some time for liquid to go through.**
g. **It will take approximately 1.2 gal to fill E-3 heat exchanger. Re-install vent plug. Use Hi. Temperature Teflon threaded sealant tape.**
h. **Continue with charging (approximately charge will be 1.5 gal. Assuming that some old liquid is left inside heat exchangers).**
i. **Run water/oil pump for approximately. 3min. DO NOT HEAT THE SYSTEM. Running oil pump will transfer oil from E-2 upper exchanger to E-3 lower heat exchanger and eliminate any air pockets in the system.**
j. **Re-install the relief valve. Use Hi. Temperature Teflon threaded sealant tape.**
k. **Check oil level.**

DO NOT Overfill System. Overfilling system will create high pressure in the heating system.

TECHNICAL BULLETIN

FEBRUARY 16, 2000



CARPET CLEANING TRUCK

SECONDARY HEATING SYSTEM SCHEMATIC