

## **Vortex 720 Mobile Cleaning Unit**



**VORTEX™**

*The World's Most Powerful Cleaning Machine<sup>SM</sup>*

Rev 62303

**Operation And Service Manual**



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*The World's Most Powerful Cleaning Machine™*

**Vortex 720 Mobile Cleaning Unit  
Operation And Service Manual**

877.262.6500 [www.vortexinfo.com](http://www.vortexinfo.com)

# I M P O R T A N T

**This instruction manual has been designed as a guide for operating and servicing your Vortex Mobile Cleaning Unit. Read this manual completely before operating your Vortex machine.**

The headings: CAUTION, WARNING or NOTE are used to warn you that steps must be taken to prevent damage to the truck and/or personal injury including a fatality. Make certain you read all instruction entirely before proceeding with the operation of the truck.

## **DISCLAIMER OF WARRANTY**

Vortex Cleaning Systems, LLC has made every effort to ensure that the information in this document, which may include information supplied by others, is accurate and complete.

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## If you have a problem with your Vortex machine:

Our commitment is to get you back up and running as fast as possible. To effectively assist you please prepare the following information **before you call technical support during business hours:**

1. Machine hours
2. Vortex model number (example: "720")
3. The month and year you purchased your machine.
4. Truck miles
5. This owner's manual (We cannot assist you effectively if you have not read the owners manual. Familiarity with the basic function and terminology of the Vortex is essential to effective troubleshooting. Please have the owner's manual open to the section that best pertains to the difficulty you are experiencing. If you have not read the owners manual please do so now so that we may assist you properly.)

Vortex Technical Assistance during business hours: 1 877 262 6500

Our commitment is to get you back up and running as fast as possible. To effectively assist you please prepare the following items **before you call technical support after hours:**

1. Your SOM Certification number. (This is the number given to you on-line when you take a test to determine your aptitude and knowledge of safety, operation and maintenance of the Vortex machine.) You will not need an SOM Certification number for after hours support if you have owned your Vortex machine for less than 30 days.
2. Vortex model number (example: "720")
3. Machine hours
4. Truck Miles
5. The month and year you purchased your machine.
6. This Owners Manual (Please have the owner's manual available and open to the section that best pertains to the difficulty you are experiencing.)

Vortex After Hours Technical Assistance: 1 800 256 1442

We recommend that you keep this manual with your Vortex machine at all times.  
You can purchase additional manuals by calling 877 262 6500

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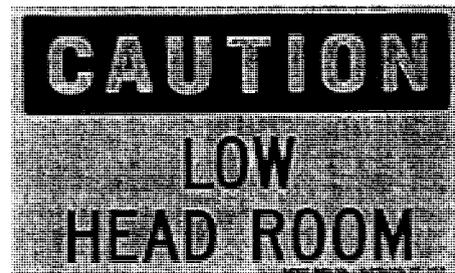
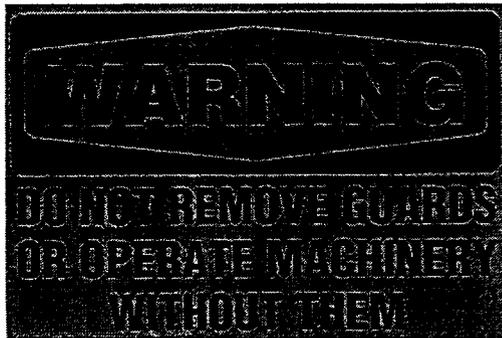
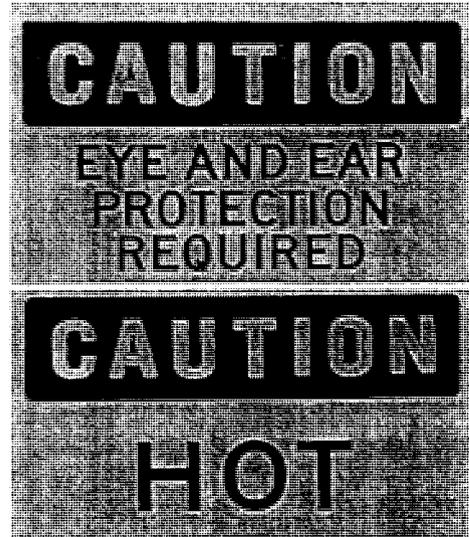
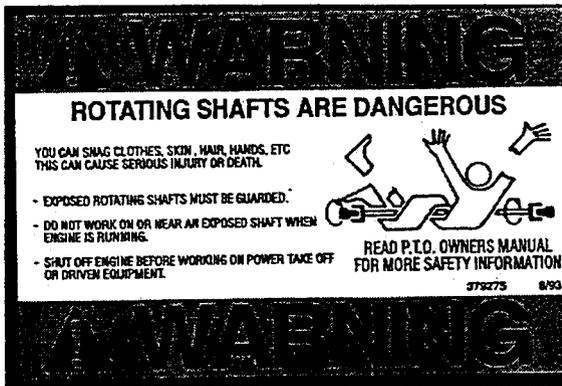
- PTO series 270
- MD vacuum blower
- Water pump CAT
- Heat transfer oil pump
- Water pressure regulator
- System temperature controller

# SECTION 1 – GENERAL INFORMATION

## 1.1 SAFETY

### ! WARNING: For Your Safety!

The following **WARNING LABELS** are found on your Mobile Cleaning Unit. These labels point out important **Warnings** and **Cautions** which must 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.



**Hot Surfaces.  
Do not touch.**

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

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

**1.1.2 Operate this Mobile Cleaning 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 a 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, or clothing near rotating or moving parts. Avoid any contact with moving parts. Rotating machinery can cause injury or a fatality.**

**1.1.4 Never operate this Mobile Cleaning Unit without belt guards properly installed. The high speed moving parts, such as belts and pulleys, must be avoided while the Mobile Cleaning Unit is running. Severe injury or a fatality may result.**

**1.1.5 DO NOT service this Mobile Cleaning Unit while it is running. The high-speed mechanical parts as well as high temperature components may result in severe injury or fatality.**

**1.1.6 Never touch electrical wires or components while the Mobile Cleaning Unit is running. They can be sources of electrical shock and may result in severe injury or a fatality.**

**1.1.7 Mobile Cleaning Unit components get extremely hot from operation. To prevent severe burns, DO NOT touch these areas while the Mobile Cleaning Unit is running – or until the Mobile Cleaning Unit has cooled.**

**1.1.8 Before servicing this Mobile Cleaning Unit, allow it to “cool down”. This will prevent burns from occurring.**

**1.1.9 Water under high pressure at high temperature can cause burns, severe personal injury, or a fatality. Shut down the Mobile Cleaning Unit, allow it to cool down and relieve system pressure before removing valves, caps, plugs, fittings, filters, and misc. equipment.**

**1.1.10 Do not exceed truck weight limit. GVW allowable 14250 lb. (UD-1400)  
GVW allowable 12000 lb. (UD-1200)**

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

**1.1.12 Make certain that you receive complete training before using this Mobile Cleaning Unit.**

**1.1.13 This Mobile Cleaning Unit produces high pressures, high temperatures and high vacuum. Improper or irresponsible use may result in serious injury or a fatality.**

**1.1.14 Do not modify this Mobile Cleaning Unit in any manner. Improper modification can cause severe personal injury or a fatality and void any warranty.**

## 1.2 SYSTEM SPECIFICATION

Truck	Nissan UD1200C or UD1400C	
Truck Engine Idle Speed		600-700 RPM
Engine Operating Speed in Cleaning Mode	Manual Control	700-1650 RPM

Fresh Water Tank	Max. Operating Capacity	140 US gal
Waste Water Tank	Max. Operating Capacity	110 US gal
Max. Outlet Water Pressure		1500psi
System Design Outlet Water	Temperature	260 °F Maximum
Blower Airflow	6008	600 ICFM @ 2000 RPM
	5009	770 ICFM @ 2850 RPM
	5006	500 ICFM @ 2800 RPM
Max. System Design Vacuum	6008	16" Hg
	5009	14" Hg
	5006	16" Hg
Water Pump Max. Flow		4.5 GPM

Allowable Truck Gross weight	UD 1400C	14250lbs
	UD 1200C	12000lbs

Allowable GAWR-Front	UD 1400C	5360lbs
	UD 1200C	4670lbs

Allowable GAWR-Rear	UD 1400C	9880lbs
	UD 1200C	8600lbs

NEVER LOAD YOUR VEHICLE IN EXCESS OF THE GROSS VEHICLE WEIGHT RATING (GVWR) AND THE GROSS AXLE WEIGHT RATINGS OF THE FRONT AND REAR AXLE (GAWR)

## 1.3 WATER REQUIREMENTS

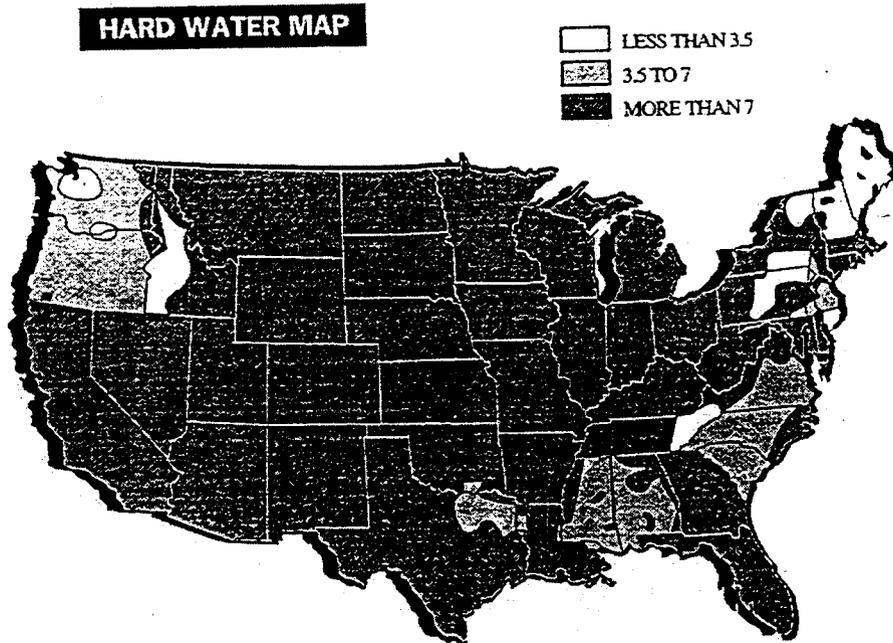
Hard water deposits will adversely affect the plumbing and heat exchange system on the Mobile Cleaning Unit.

The map below will give you an idea of where areas of hard water hardness may occur. Water supply obtained from a well is almost always hard water. In all cases, using softened water will protect the equipment and help ensure maximum performance and service life.

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

If you are operating in an area where the water in which the hardness exceeds 3-1/2 grains, ATMI highly recommends soft water to be used.

Using a soft water 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

### 2.1 WATER PUMPING SYSTEM

*See System Flow Diagram on page 12.*

Maximum operating water level in the fresh water tank is 27" (140USgal), minimum water level is 2" from tank bottom (approximately 10 gallons).

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.

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

Water from the pressure regulator flows through the tubes of 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 Heat Transfer System on page 7.*

Temperature is adjusted using the thermostatic temperature control. This control will de-energize the solenoid valve and shut down exhaust gas flow through the exhaust heat exchanger E-3 when the temperature is beyond the set point and energize when heat is required.

Water is heated by means of a three stage heat exchange system which utilizes the engines radiator fluid for the first and second stages and the engines exhaust heat for the final stage.

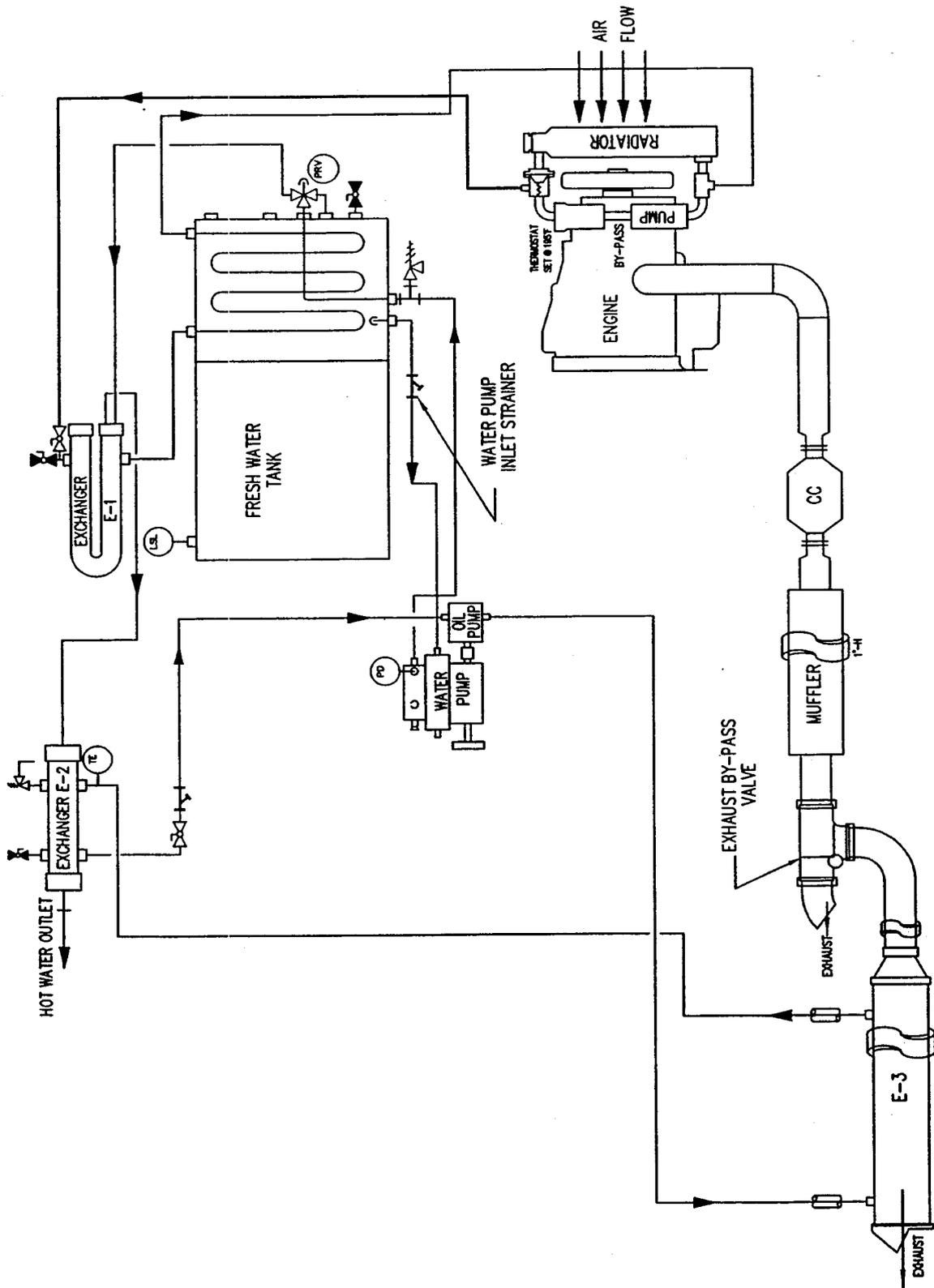
#### **Stage one heating.**

The hot fluid from the engines radiator passes through E-1 heat exchanger to the coil inside of the fresh water tank. Hot radiator fluid is regulated at 195°F by the engine thermostat. Since the coil is immersed in the fresh water tank, the water in the tank is warmed by the outside surface of the coil.

#### **Stage two heating.**

In this stage, the pressurized and pre-heated water coming from the fresh water tank flows through the tubes inside of heat exchanger E-1. Heat exchanger E-1 is heated by the hot radiator fluid flowing on the outside of the tubes and within the shell of E-1.

# HEAT TRANSFER SYSTEM



### **Stage three heating.**

Here the exhaust heat from the truck engine is utilized to raise the temperature of the pressurized water. This is done by circulating oil, in a secondary loop, between exhaust heat exchanger E-3 and secondary heat 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 260<sup>0</sup>F by thermostatic control of the exhaust by-pass valve.

### **Exhaust By-pass Valve**

The exhaust by-pass valve is located just beyond the engine muffler. The exhaust by-pass 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 exhaust by-pass 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**

*See Vacuum System on page 9.*

Vacuum flow begins at the cleaning tool, with air, water and possibly some chemicals being drawn into the vacuum inlets at the recovery tank.

The mixture then flows through a stainless steel basket strainer prior to entering the waste water recovery tank. Beyond the stainless steel inlet basket strainer, two additional 100 mesh stainless steel vacuum strainers, located inside the recovery tank and a relief valve have been provided for maximum vacuum blower protection.

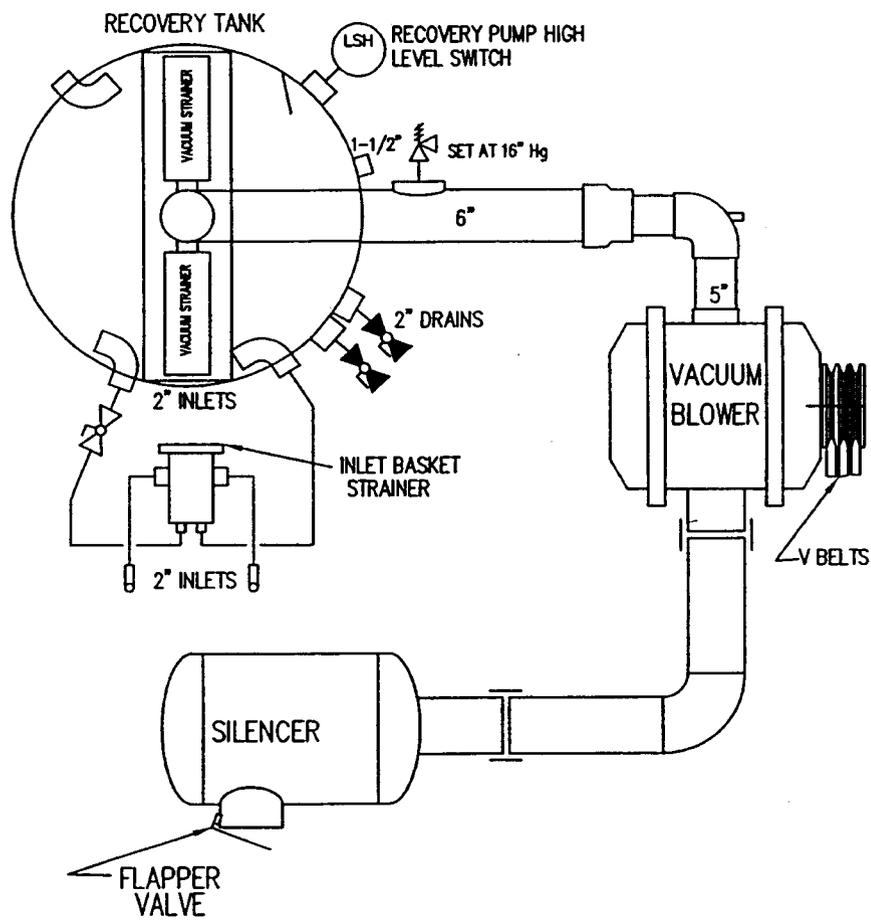
The air then flows into the vacuum blower, which is driven by the truck engine through a transmission mounted PTO (power take-off unit) and specially designed drive system.

The air discharged from the vacuum blower exits through the silencer directly into the atmosphere through a flapper valve. The flapper valve must operate freely to prevent back flow through the blower.

A high water level sensor switch located near the top of the waste water recovery tank will shut down the blower and water pump when the waste water recovery tank reaches its full capacity. This protects the vacuum blower from damage.

Note: The high water level sensor switch must be maintained properly protect the vacuum blower. Water entering the blower can destroy it.

# VACUUM SYSTEM



Section 2

SYSTEM

## **2.4 CHEMICAL PUMPING SYSTEM**

*See Chemical System Diagram on 11*

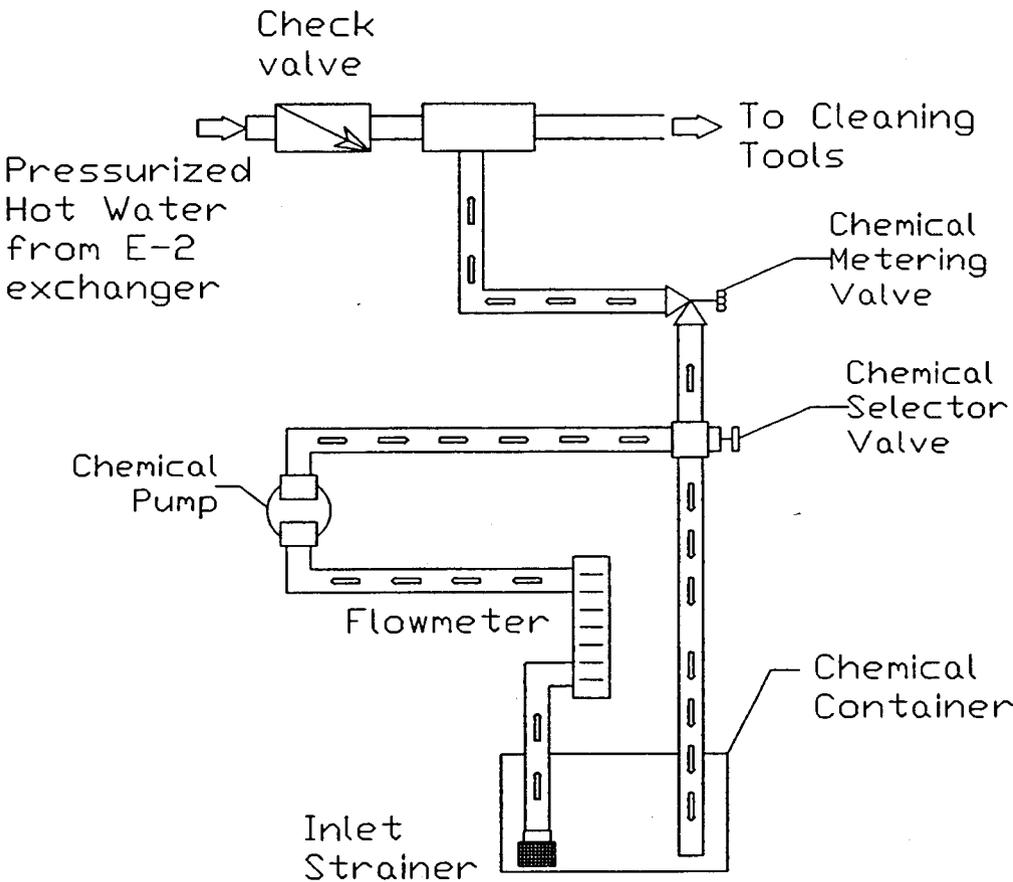
The chemical is drawn from the chemical tank through a strainer into the flow meter. The flow meter indicates the rate of chemical flow.

The chemical then flows through a check valve into a pulse-powered chemical pump.

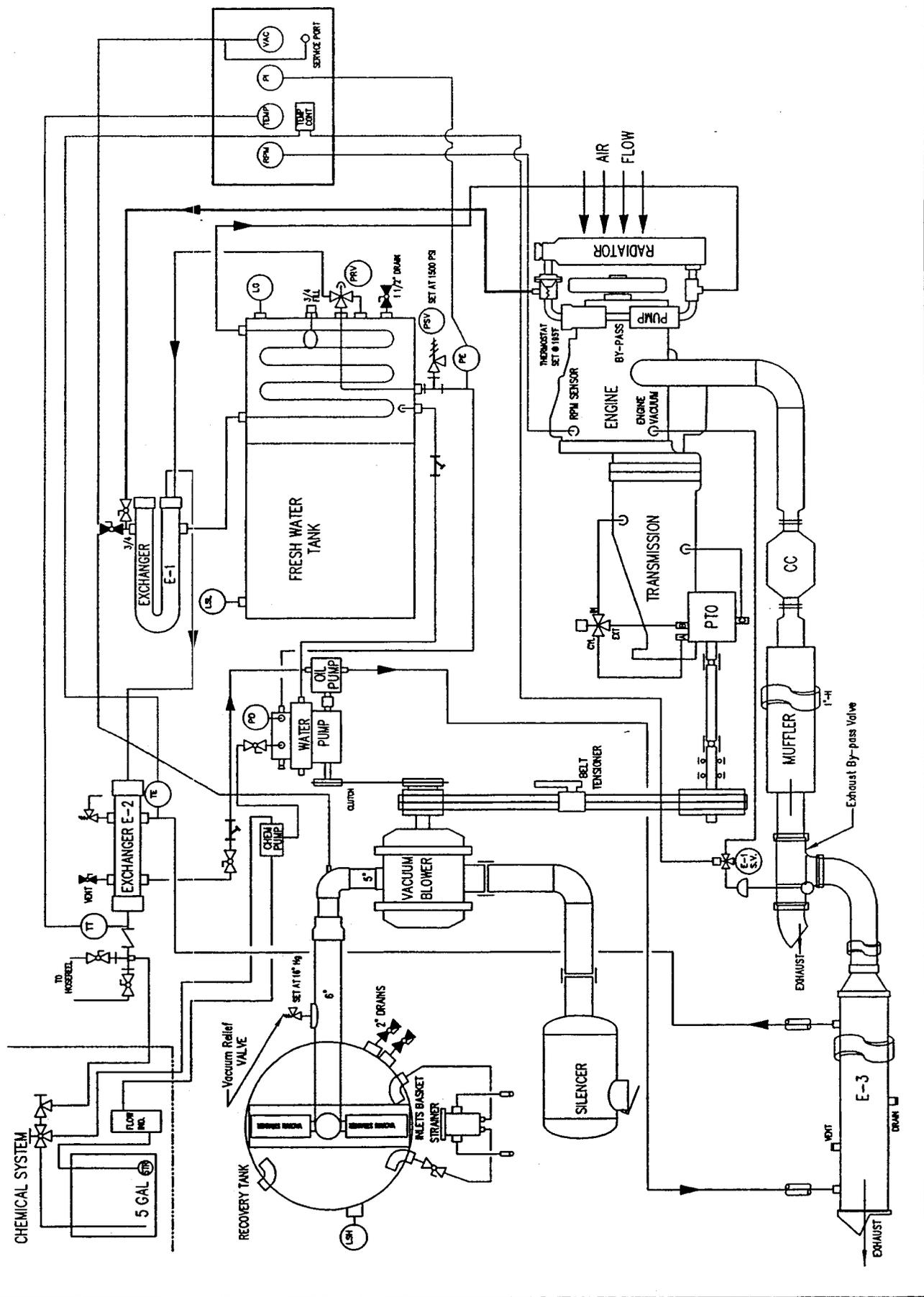
The chemical pump injects the chemical through a check valve to the 3-way selector valve on the control panel. This valve will turn the chemical flow ON – OFF or prime the chemical pump.

The chemical then flows through a metering valve to the solution outlet. This valve controls the rate of flow of chemical injection into the cleaning solution which is indicated on the flow meter.

# CHEMICAL SYSTEM



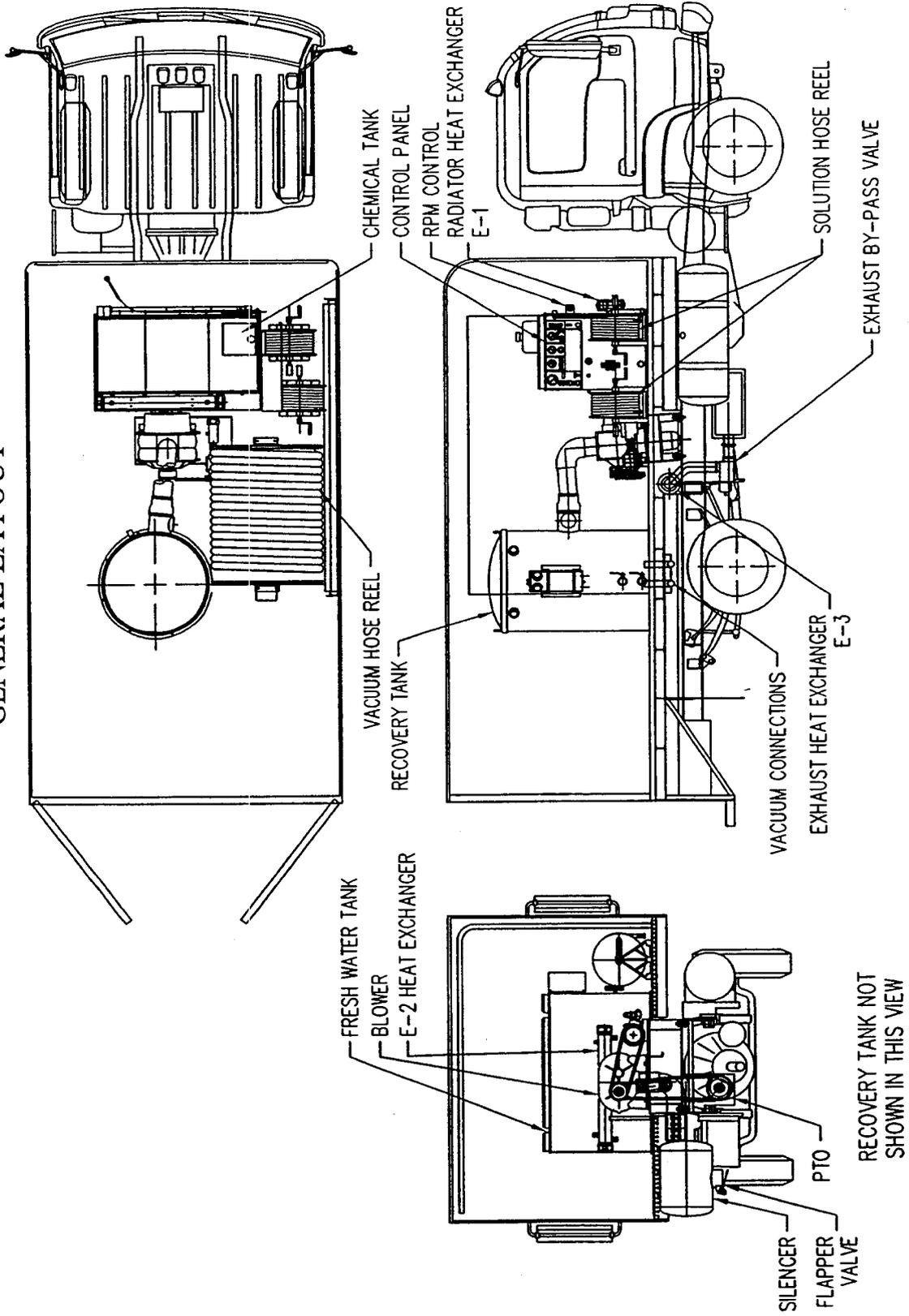
# SYSTEM DIAGRAM



Section 2

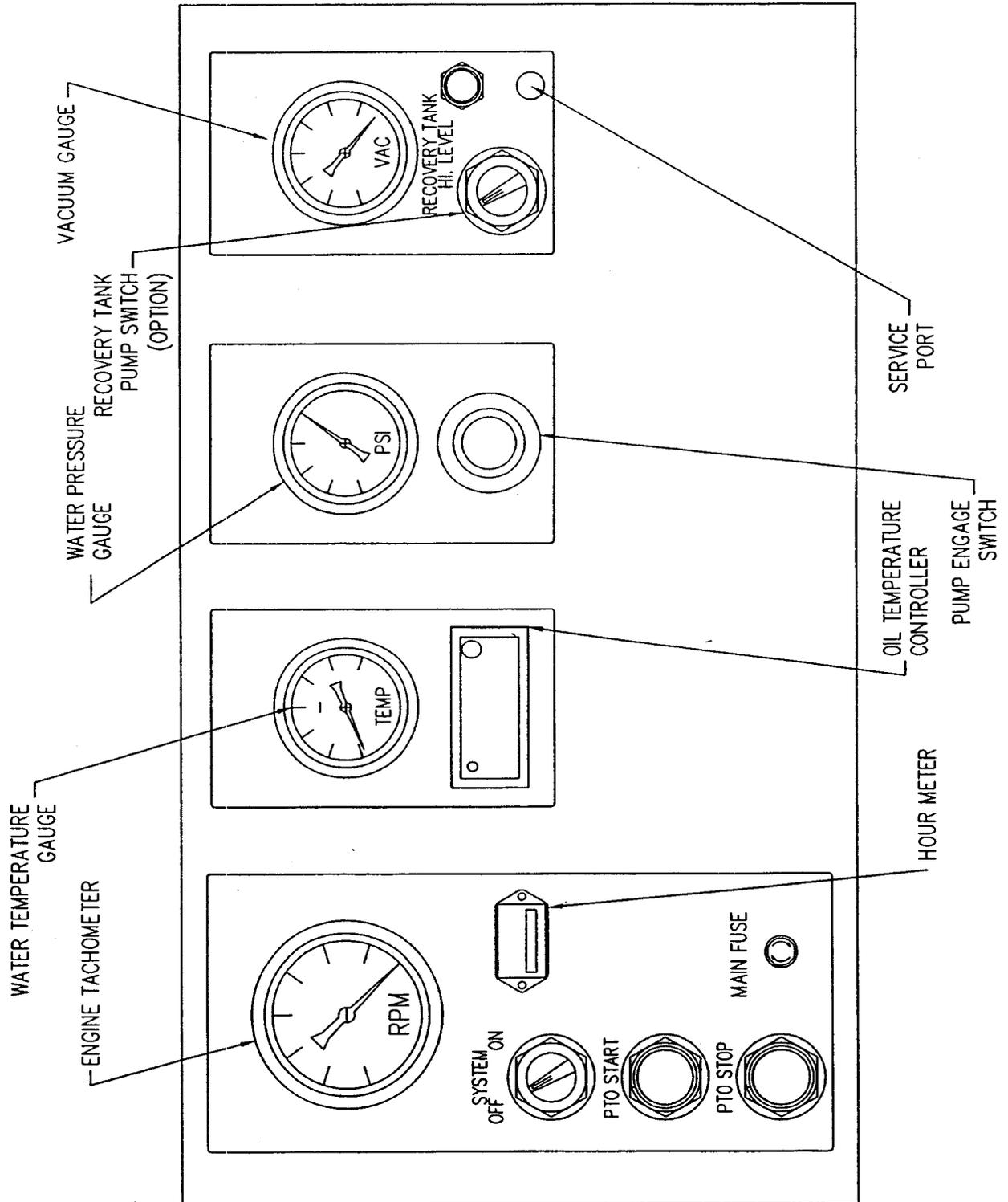
General Information

# GENERAL LAYOUT



Section 2 General Information

# CONTROL PANEL



## SECTION **3** OPERATION

This chapter of the operators manual explains how to prepare, start-up, shut-down, and provide the Mobile Cleaning Unit with daily maintenance. Safe and proper operation of the Mobile Cleaning Unit is critical. In order to provide for safe and proper operation of the Mobile Cleaning Unit, it is imperative that you read the following instructions carefully and fully understand the interaction of the various components.

**!**                    **CAUTION:**  
**Operate this Mobile Cleaning 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 a fatality. DO NOT operate this Mobile Cleaning 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. The truck engine will burn approximately 2 gallons of diesel fuel per hour when operating the engine in the proper RPM range.

### 3.2. CHECK WATER PUMP OIL LEVEL.

Check water pump oil level daily prior to starting the system. Oil level should be in the center of the level gauge. If the oil level is below the level gauge center line, add oil and check for leaks. Avoid overfilling or damage may occur to the pump. Only use oil that is specified by the water pump manufacturer.

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

The Mobile Cleaning Unit must be on level ground prior to checking the heat transfer oil level. The oil level must be checked with the system off and the heat exchanger temperature in the 60 to 90<sup>0</sup> F range. Failure to do so will not provide for an accurate level reading. Normal oil level, is in the center of the level gauge.

**! WARNING. Do not overfill heat transfer fluid. The heat transfer fluid will expand as it heats up. Failure to follow these procedures could result in a fatality, personal injury to yourself and / or others or property damage.**

### 3.4 CHECK STRAINERS IN RECOVERY TANK.

Check vacuum strainers daily. Clean and replace as required.

### 3.5. CHECK TRUCK ENGINE RADIATOR ANTIFREEZE LEVEL.

Check antifreeze level at the beginning of each day. Add if necessary.

### 3.6 FILL FRESH WATER TANK WITH CLEAN, SOFT WATER.

Running the truck over the road under normal conditions for 20 minutes will preheat the water in the fresh water tank from 80 to 120°F.

### 3.7 AT THE JOB LOCATION.

- 3.7.1 Once the necessary tools are properly set up, the following start up procedures should be followed with the truck engine running at idle (approximately 600 RPM).
- 3.7.2 Turn system switch to the "ON" position. This will energize the Mobile Cleaning Unit control panel. Push the PTO start switch in. This will energize the PTO solenoid and engage the PTO. The blower pulley will start turning. Allow approximately 30 second for the Mobile Cleaning Unit to stabilize at idle speed.
- 3.7.3 Set the oil temperature control on the control panel to the desired cleaning temperature. The thermostatic temperature control is designed to maintain the solution temperature automatically. When the button on the lower left of the unit is pushed in and held, the set point is displayed. When the button is out, the oil temperature is displayed. The knob on the lower right is used to change the set point. Turn the knob clockwise to increase the set point. Turn the knob counter clockwise to decrease the set point.

**! CAUTION: The set point can be changed without displaying the set point. Do Not turn the set point knob unless you want the set point changed.**

- 3.7.4 To engage the water pump and the oil pump, pull out the pump engage switch. This action will energize the water pump clutch, which will in turn starts the water and oil pump. Allow approximately 30 second for the truck engine to once again stabilize. The water pump will circulate water through the pressure regulator back to the fresh water tank. The oil pump will circulate the heat transfer fluid between heat exchanger E-2 and heat exchanger E-3.

**Note:** If your Mobile Cleaning Unit fails to build water pressure after 15 seconds, disengage the water pump and check for adequate water supply. If necessary, see loss of water pump pressure in the troubleshooting section of this manual.

**Note:** Do not engage the pump switch at high engine RPM. Damage may occur to the water pump clutch.

The Mobile Cleaning Unit is now ready to run at operating speeds.

Turn the micro-adjusting knob to the desired speed.

Allow adequate time for the engine to achieve the desired operating speed.

**! WARNING**

**Water under high pressure and high temperature can cause burns, severe personal injury or could be fatal. Shut down the Mobile Cleaning Unit, allow it to cool down and release system of all pressure before attempting any work.**

**! WARNING**

**Do not modify the Mobile Cleaning Unit without written permission from the manufacturer.**

**! WARNING!**

**Always dispose of waste water in accordance with Local, State, and Federal laws.**

### 3.8 CLEANING / EXTRACTION

Observe the following guidelines, while cleaning.

- 3.8.1 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.
- 3.8.2 When cleaning, keep the working opening (mouth) flat on the surface being cleaned. Keep the wand moving when the valve is open.

### 3.9 UPHOLSTERY CLEANING.

Since the upholstery tool has a lower flow rate and a smaller spray nozzle orifice, operate the unit with a reduced temperature and reduced vacuum.

### 3.10 FLOOD RESTORATION.

During flood restoration, **do not engage the pump switch**. The water pumping system should remain in the **OFF** position.

### 3.11 SHUTDOWN AND DAILY MAINTENANCE.

- 3.11.1 Remove as much moisture from the vacuum hoses as possible. This will prevent spillage of solution in your vehicle when the hoses are not in use.
- 3.11.2 Turn the micro adjustment knob counter clockwise to reduce engine RPM to its normal idle speed of 600 RPM.
- 3.11.3 Disengage the water pump and continue running the engine at the idle position for one minute in order to remove all moisture from the blower.

**NOTE: If you are finished for the day:**

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

**! WARNING !**

**Do not turn the Mobile Cleaning Unit off while running high vacuum. Reduce the RPM's as described above prior to disengaging the blower.**

- 3.11.4 Press the PTO "STOP" button to disengage the PTO.
- 3.11.5 Relieve pressure from the cleaning tools and pressure hoses by activating the valve on the cleaning tool prior to disconnecting the tools and pressure hoses.
- 3.11.6 Drain the recovery tank and properly dispose of the waste.
- 3.11.7 Clean the inlet basket strainer and reinstall. Inspect the vacuum strainers 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 the strainer. Grasping the screen portion may collapse and ruin the strainer. Re-install the strainer hand-tight.**

**NOTE:** Never operate this unit without the strainers in place, with a damaged strainer or an improperly installed strainer. Serious blower damage may occur.

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

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

3.11.9 Clean the tools, hoses, truck interior, etc., as needed. Inspect all equipment for any damage, wear, leaks, etc.

### 3.12 FREEZE PROTECTION

#### **! WARNING:**

**If the Mobile Cleaning Unit is exposed to freezing weather, the water in the Mobile Cleaning Unit may freeze causing SERIOUS DAMAGE to the Mobile Cleaning Unit.**

When the Mobile Cleaning Unit is not in use, always park it in a heated building or drain and flush all water completely.

While in operation, avoid long shutdowns as the Mobile Cleaning Unit provides heat while running.

### 3.13 PRIMING THE CHEMICAL PUMP.

**NOTE: Chemical pump must be primed whenever the water pump is ON. This will eliminate possible pressure fluctuations and water pump pulsations related to a dry chemical pump.**

1. Place the chemical inlet tube and the chemical prime tube into the chemical container.

**NOTE:** When placing the chemical inlet tube into the chemical container, make sure that it stays fully submerged since the chemical pump will not function if air is allowed to enter inlet line.

2. Turn the chemical selector valve on the control panel to the PRIME position. The chemical will then flow from the chemical container returning through the chemical prime tube.

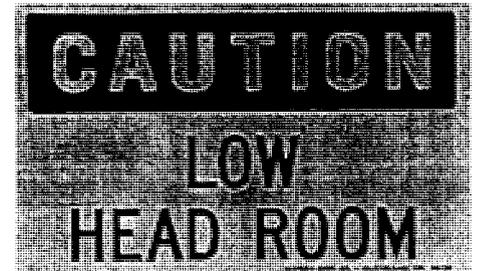
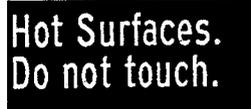
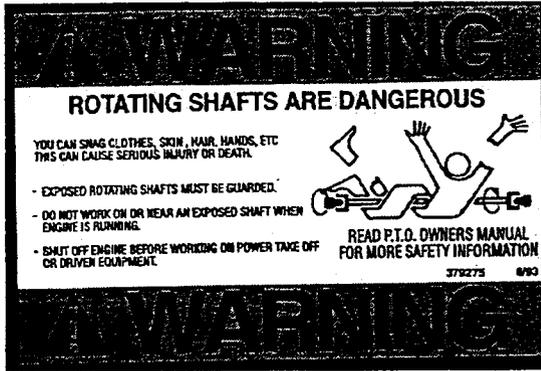
If the chemical does not flow, then:

- a. Connect the chemical prime tubing with system vacuum, vacuum will quickly pull chemical from the chemical container. When the chemical starts to flow, place the chemical prime tubing back into the container.
- b. Once continuous chemical flow without air bubbles has been achieved, turn the chemical selector valve from Prime to ON. With the cleaning tool valve open, observe the flow meter and adjust the chemical metering valve until the desired rate of chemical flow is obtained.

## SECTION 4 MAINTENANCE

This chapter of the operator's manual contains the maintenance information for the Mobile Cleaning Unit.

Initiation of the planned PREVENTATIVE MAINTENANCE PROGRAM will help ensure that your Mobile Cleaning Unit provides you with optimal performance, a long operating life, and a minimal amount of "down" time.



**! WARNING:**  
**DO NOT service this Mobile Cleaning Unit while it is running or if it is hot. The high speed mechanical parts as well as high temperatures of the components may result in fatality, severe personal injury to yourself and / or others or property damage.**

## MAINTENANCE CHART DAILY CHECKS

Truck Engine		Check engine oil level. Fill to proper level
		Check engine coolant level.
		Check transmission oil level.
		Check power Steering level.
		Check Brakes and Washer fluid level.
		Check Throttle cable
Water Pump		Check oil level
Heating System		Check oil level E-2 exchanger
Vacuum Blower		Spray WD-40 into lubrication port (panel)
Vacuum strainer		Clean strainers, inspect, replace if damaged.
Vacuum Hoses		Wash out with clean water.

Starting at driver's door, walk around the entire truck making a thorough visual inspection at the truck its equipment.

Check under the truck for any fluid leakage on the ground.

## MAINTENANCE CHART - WEEKLY CHECKS

Vacuum Blower		Check oil level. Fill to proper level
Water pump inlet strainer		Check for debris and clean
Exhaust by-pass valve		Squirt Exhaust valve conditioner on shaft thru tube port
Secondary Exchanger E-2		Vent E-2 heat exchanger weekly. See page.....

## MAINTENANCE CHART SCHEDULE

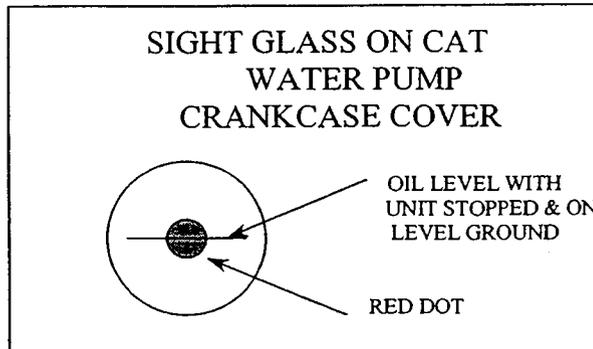
High Pressure Water Hose	25 HR	Inspect for damage or impending failure. Or as often as required.
Vacuum Blower	80 HR	Lubricate bearings.
Engine Oil and Oil Filter		Refer to UD owners manual. See section 4.1.1
Radiator and E-1 Hoses	100 HR	Check Radiator hoses for leaks and clamp tightness
Exhaust Heat Exchanger Tubes	200 HR	Clean Tubes every r months or as needed
Universal Drive Shaft	50 HR	Lubricate universal joints. See page....
Lower Sheave Bearing and Belt Tensioner	50 HR	Lubricate universal joints. See page....
Pump Belt	200 HR	Inspect, clean, check belt tension and sheave alignment. Initially at 25 hours.
Heat Transfer Fluid	300 HR	Replace Heat transfer fluid every 6 months, whichever came first.
Transmission Oil	150 HR	Refer to UD owners manual . See section 4.1.1
Blower Drive Belt	100 HR	Inspect, clean, check belt tension and sheave alignment. Initially at 25 hours.
Water Pump Oil	500 HR	Change oil.
Blower Oil	500 HR	Change oil.



### 4.3 WATER PUMP:

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

- 4.3.1 Check the crankcase oil level (on level ground) daily to ensure the proper level. If the level has dropped, check for the source of the leak and repair.



- 4.3.2 Refill the oil to the proper level, if required, with Cat Pump Crankcase Oil. Refer to Cat Pump service manual for specific instructions.
- 4.3.3 Change the crankcase oil with Cat Pump Crankcase Oil after the first 50 hours of operation. Drain and refill oil with Cat Pump Crankcase Oil every 3 months 500 hours intervals thereafter.

### 4.4 VACUUM STRAINERS.

Inspect the vacuum strainers inside the waste water recovery tank. If there is any lint or debris, remove and clean strainer. Re-install the strainer hand-tight.

The vacuum strainers in the waste water recovery tank should be removed and cleaned daily. Failure to do so will shorten the life of the strainers.

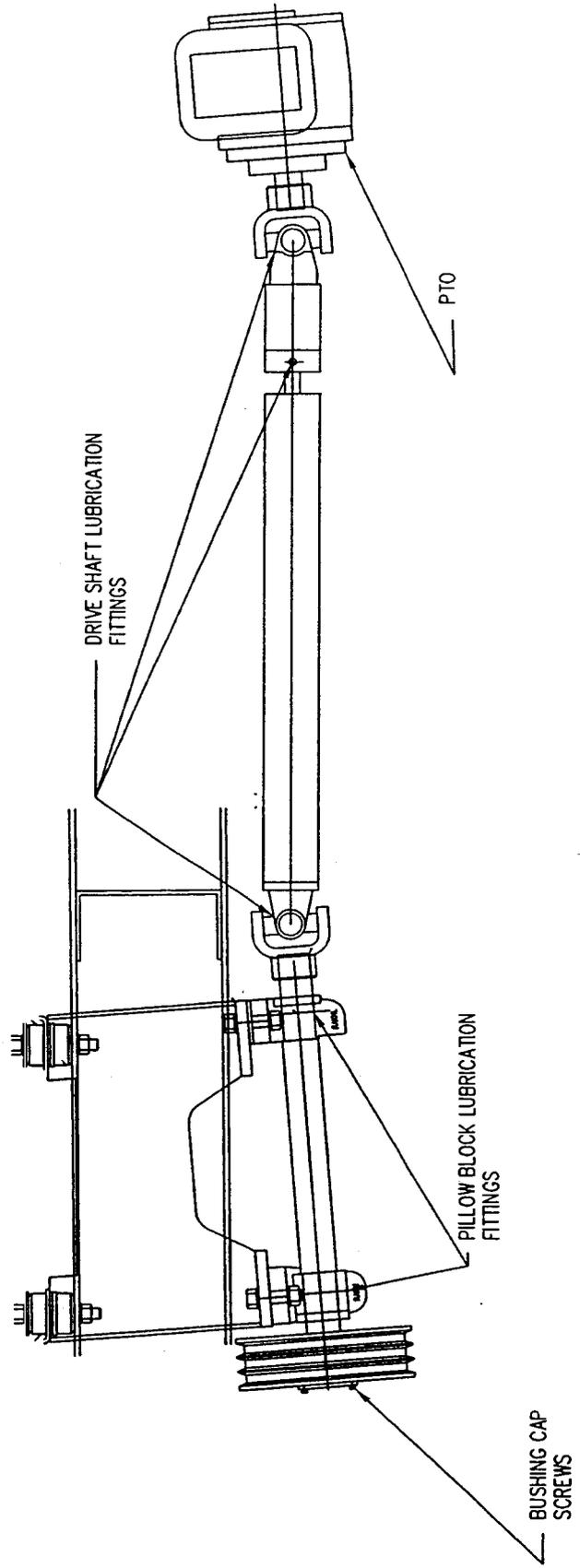
**NOTE:** When removing the vacuum strainer, grip the plastic hexagonal section of the strainer. Grasping the screen may collapse and ruin the strainer.

Replace this vacuum strainer if damaged or as needed. When replacing the vacuum strainer, use an all stainless steel element with 100mesh screen.

### 4.5 DRIVE SHAFT, BELTS, SHEAVES, & BUSHINGS.

- 4.5.1 Check sheave bushing cap screws after the first 25 hours and then again at 100 hours. Re-torque these screws as required.
- 4.5.2 Grease drive shaft U-joints every 50 hours. Use Penzoil ULTRA EPI tacky lithium or Penzoil SPL2 grease. Note that some drive shafts have greaseless U-joints. Grease must be pumped until it completely fills the caps. The U-joints each have 4 caps. Fill grease until you visually see grease come out of all 4 caps.

# DRIVE SHAFT



Section 4

MAINTENANCE

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 only one belt. Replace entire set if replacement is necessary.

For belt alignment or tension adjustment, see section 5.2 of the Mobile Cleaning Unit operators manual.

#### **4.6 INLET WATER PUMP STRAINER.**

The strainer is located on the outside of the fresh water tank. Flush screen regularly with water and reinstall into body. Check gasket for cuts or wear and replace if necessary to insure proper seal.

#### **4.7 RECOVERY TANK INLET BASKET STRAINER.**

The basket strainer is located outside of the waste water recovery tank. The basket strainer should be removed and cleaned on an as needed basis.

**NOTE:** Do not operate the Mobile Cleaning Unit without the basket strainer in place. This will clog the VACUUM STRAINER strainers inside of the waste water recovery tank

#### **4.8 VACUUM HOSES.**

To ensure maximum hose life, ATMI recommends that the vacuum hoses are washed out with clean water at the end of each working day.

#### **4.9 ENGINE EXHAUST HEAT EXCHANGER E-3.**

If the truck engine is not properly maintained, the exhaust gases will deposit carbon on the inside of the E-3 heat exchanger tubes. In turn E-3 will lose efficiency and the Mobile Cleaning Unit will not produce the heat as designed. If this condition exists, the tubes can be manually cleaned with a wire brush. Proper maintenance of the truck engine, such as regular tune-up and proper fuel will help prevent excessive carbon build-up on the heat exchanger tubes and increase the performance of the Mobile Cleaning Unit.

#### 4.10 EXHAUST BY-PASS VALVE.

The purpose of the exhaust by-pass valve is to regulate the oil temperature in exchanger E-3 thereby regulating the temperature of the water used in the cleaning process. The by-pass valve diverts the hot engine gases through exchanger E-3 as called for by the temperature controller. Proper maintenance of the exhaust by-pass valve is critical to maximize the performance of the Mobile Cleaning Unit.

If the truck engine is not properly maintained, the exhaust gases will deposit carbon on the inside walls of the 3-way exhaust by-pass valve inhibiting its ability to regulate temperature.

**Lubrication:** Use LUBICON series I/M lubricant provided by ATMI in an aerosol can. Spray into the lubrication port located on top of the exhaust by-pass valve.

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

**Do not use any other type of lubricant.**

#### 4.11 HEAT TRANSFER FLUID/WATER HEAT EXCHANGER E-2.

E-2 heat exchanger must be vented **weekly or every 40 hours of operation**. For procedure see section 5.6 in the Mobile Cleaning Unit operators manual.

Replace heat transfer fluid **every 6 months or 300 hrs** of operation. Failure to do so will result in reduced heating capacity and will eventually coat the inside of exchangers E-2 and E-3 with a lacquer substance that will make it inefficient and eventually un-repairable.

#### 4.12 HIGH PRESSURE HOSES.

Visually inspect high pressure water hoses for wear after the **first 100 hours** of use. Inspect **every 25 hours thereafter**. Check for evidence of cracks, crushed areas, blisters, bulging, cuts, leaks, and chafing. If a hose shows any sign 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 300°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.**

#### 4.13 RADIATOR HOSES.

During the manufacturing process of the Mobile Cleaning Unit, ATMI "taps" into the UD truck's radiator cooling system. The purpose is to utilize the heat produced by the engine to pre-heat the water with in the system of the Mobile Cleaning Unit.

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 impending rupture, replace the hose.

#### 4.14 QUICK DISCONNECTS

Quick disconnects allow for easy connection of hoses, wand assemblies, and nozzles. The female portion of the quick disconnect is made of brass and is called a coupler. The male portion of the assembly is also made from brass and is called the plug.

The coupler has an outer race, which moves forward and back. This race must be pulled back to allow the plug to be removed from or inserted into the coupler and then pushed forward to lock the plug into the coupler.

Separate the assembly to inspect the mating surfaces and the o-ring seal in the coupler. If the assembly cannot be easily separated by hand, replace it.

Inspect the ridge on the male plug that contacts the stainless steel balls held in the brass body of the coupler. If the ridge has been deformed by the stainless steel balls, replace the male plug. Also check the end of the plug that engages the O-ring held in the brass section of the coupler. If defects are observed, replace.

Inspect the interior of the brass body for cracks or abrasions. Check the O-ring in the interior of the female coupler for signs of wear. The O-ring can be removed with a pin. Replace if required

**! WARNING: When changing nozzles using quick disconnect, check to see that the ring has snapped into the lock position. If the ring has not properly locked into position, the nozzle will be ejected out of the lance as soon as the trigger is depressed, possibly causing property damage and / or bodily injury.**

## SECTION 5. GENERAL SERVICE ADJUSTMENTS.

**! WARNING: DO NOT service this Mobile Cleaning Unit while it is running. The high-speed mechanical parts as well as high temperature components may result in a fatality, personal injury to yourself and / or others or property damage.**

**NOTE: DO NOT set the engine speed above 1650 RPM. Permanent damage may occur.**

### 5.1 VACUUM BLOWER / TENSIONER / LOWER SHEAVE ALIGNMENT.

The alignment of the blower, belt tensioner and the lower sheave is very important to the life of the drive belts. The alignment should be checked everytime the belts are changed. The alignment is a two step process. This must be done with the belts removed from the Mobile Cleaning Unit.

The first step is the alignment of the blower sheave to the belt tensioner and the second step is the alignment of the lower sheave to the belt tensioner.

To align the blower to the belt tensioner:

1. Tighten the two bolts on the belt tensioner. These are the two bolts of the blower side of the tensioner.
2. Position a straight edge on the left side of the blower sheave and also on the left side of the belt tensioner sheave. The straight edge should be flush on both sheaves the full length of each sheave. Follow the same procedure on the right side of the blower sheave and the right side of the belt tensioner sheave. The straight edge should be flush on both sheaves.
3. It may be necessary to loosen the bolts on the blower and move it forward, back or twist the blower in order to achieve the proper alignment.
4. After proper alignment, tighten the blower bolts. Recheck the alignment then lock the tabs on the tab washers. Bolts should be torqued to 200 – 220 LB-FT.

To align the lower sheave to the belt tensioner:

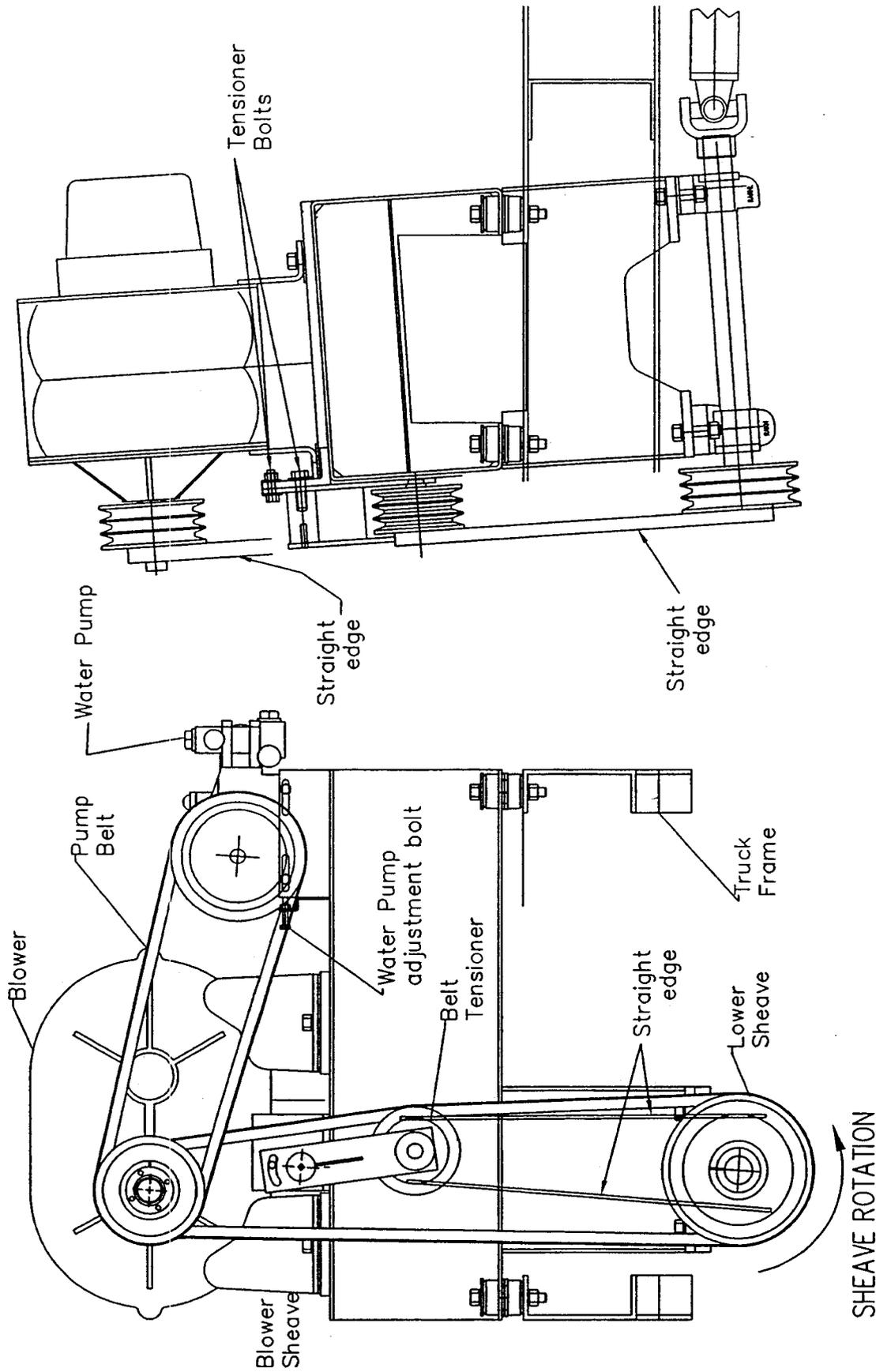
1. Follow step one and two (above) using the straight edge from the lower sheave to the belt tensioner.
2. If a small amount of adjustment is required, loosen the two bolts on each of the two pillow block bearings. You can move the entire assembly forward, backward or twist it in order to achieve the proper alignment.
3. Tighten the four bolts on the pillow block and recheck the alignment.

Loosen the two bolts on the belt tensioner and install the three belts.

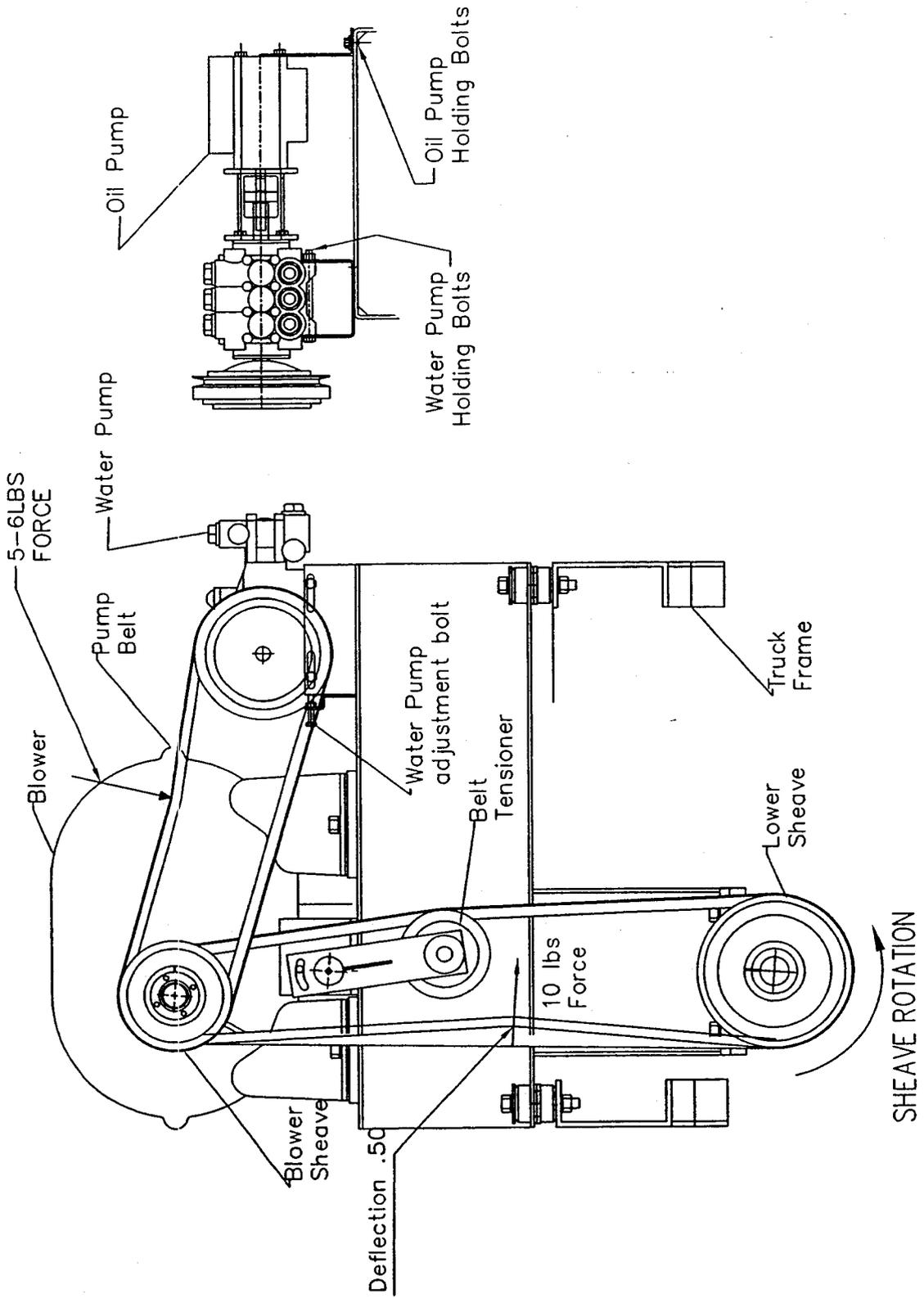
Tighten the belt tensioner against the belts on the passenger side of the truck.

**Tighten the belts until there is ½" of deflection in the center of the belt halfway between the sheaves with a 10 pound load. All three belts must have the same tension.**

# SHEAVES ALIGNMENT



# BELTS ADJUSTMENT



## 5.2 WATER PUMP DRIVE BELT.

To tighten the water pump belt:

- a. Remove the belt guard.
- b. Loosen the two bolts holding the water pump in place and the two bolts holding the oil pump in place.
- c. Adjust the belt tension adjusting bolt until the proper belt tension is achieved – ½” deflection in the center of the belt halfway between the sheaves with a 5-6 lb load.
- d. Tighten all of the hold-down bolts.
- e. Reinstall belt guard.

### **Belt adjustment notes:**

1. The proper tension for a belt drive is the lowest tension at which the belt will not slip under its highest load condition.
2. Check the tension on a new machine – or a new set of belts - frequently during the first 25 hours of operation.
3. Check the drive tension periodically, thereafter.
4. Too much or too little tension shortens belt and bearing life.
5. Keep belts and sheaves free from any foreign material that may cause slip.

## 5.4 VACUUM RELIEF VALVE.

The Mobile Cleaning Unit comes with a specially designed relief valve that is located on the waste water recovery tank vacuum blower suction line. The purpose of the relief valve is to control the amount of vacuum (measured in inches Hg). Too much vacuum will cause excessive wear on all drive components including the vacuum blower itself shortening the useful lifespan of the Mobile Cleaning Unit. Too little vacuum will not provide for enough lift to properly clean surfaces.

While the unit is running at operating RPM, block the airflow at the vacuum inlet connections and read the vacuum gauge which should read 16” Hg. If adjustment is required, shut the unit down and adjust the locking nut tension. Start your Mobile Cleaning Unit and run to operating RPM. Now read the vacuum gauge. Repeat this process until the relief valve opens at 16” Hg.

## 5.5 PRESSURE REGULATOR.

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

- 5.5.1 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 the desired PSI (0 – 1400) with water valve open.  
When the water valve is open and the Mobile Cleaning Unit is at operating speed, there is an approximate drop of 100 PSI in pressure (one wand with flow appr. 1.5GPM).
- 5.5.2 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. Turn the regulator adjustment knob valve clockwise to increase the pressure and counter clockwise to decrease the pressure.

## 5.6 ADDING / DRAINING ENGINE COOLANT.

Refer to the UD 1200 / 1400 owners manual for frequency and type of coolant to be used in the cooling system. Note that your Mobile Cleaning Unit will normally operate at 1400 – 1650 RPM's making each hour of use the equivalent of 50 – 55 miles of highway use. Aero Tech Manufacturing Inc. recommends you factor these hours / miles into the recommendations provided for in your UD 1200 / 1400 owners manual.

- 5.6.1 To drain the coolant, remove the radiator cap and open vent valve on E-1 heat exchanger.
- 5.6.2 Remove the plug from the vent valve on E-1 heat exchanger and open vent valve slowly.
- 5.6.3 Open radiator drain cock.
- 5.6.4 Drain into a suitable container and dispose of properly.
- 5.6.5 Close radiator drain cock.
- 5.6.6 Add coolant to vent valve on E-1 heat exchanger until coolant flows from radiator cap.
- 5.6.7 Start the engine and run for approximately 5 minutes.
- 5.6.8 Shut down engine.
- 5.6.9 Add more coolant to E-1 heat exchanger vent valve. Close valve.
- 5.6.10 Add more coolant to the radiator. Install radiator cap.
- 5.6.11 Add coolant to the engine overflow bottle. Fill halfway between the minimum and maximum marks on the bottle.

## 5.7 SECONDARY HEAT TRANSFER SYSTEM VENTING AND FILLING PROCEDURE.

!

### **WARNING:**

**DO NOT service the heating system while the Mobile Cleaning Unit is running or is still hot. The high-speed mechanical parts as well as high temperature components may result in a fatality, personal injury to yourself and / or others or property damage.**

**DO NOT smoke or use open flame while servicing secondary heat transfer system.**

The Mobile Cleaning Unit is equipped with a secondary heat transfer system consisting of the following parts (see attached schematic diagram)

- a. Exhaust by-pass valve.
- b. Exhaust Heat exchanger E-3.
- c. Secondary oil / water heat exchanger E-2.
- d. Oil Pump. (heat transfer pump).

### **Secondary Heat Transfer Operating Conditions.**

- a. The engine exhaust temperature is 400 to 530<sup>0</sup>F.
- b. The normal operating temperature for the heat transfer fluid is 280 to 350<sup>0</sup>F.
- c. The system is charged with Dynalene SF heat transfer fluid. Total charge is 15 lbs or the equivalent of 2.1 gal @ 70<sup>0</sup>F. No substitutions.

## Heat Transfer System Maintenance.

### **! WARNING**

Every week or 40 hours of operation the secondary heat transfer system must be vented to remove any gases generated from the heat transfer fluid and to normalize the pressure in the system. Failure to do so may result in a fatality, personal injury to yourself and / or others or property damage.

### System vent procedure.

With all systems OFF and the Mobile Cleaning Unit at ambient temperature (60 – 100<sup>0</sup> F) turn the vent cap counter clockwise to the vent position. Open the ball valve on the top of E-2 exchanger slowly to allow gases to escape. Once gases have escaped close vent valve and vent cap.

### **! WARNING**

These gases are highly flammable. No open flames within 50 feet.

### Secondary Heat Transfer System Fluid Check Procedure.

- a. Cool system to ambient temperature (60 - 100<sup>0</sup>F).
- 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.
- c. Note this is a closed loop system and the need for additional fluid indicates a leak that must be repaired.
- d. Close vent valve and reinstall vent cap.

**! WARNING: Do not overfill the system. The system is designed for expansion of the heat transfer fluid as the temperature rises. Overfilling the system will result in high pressure within the system and cause the excess heat transfer fluid to be vented through the relief valve. This vented oil will be extremely hot and may result in a fatality, personal injury to yourself and / or others or property damage.**

### **Every 300 hours heat transfer fluid must be replaced.**

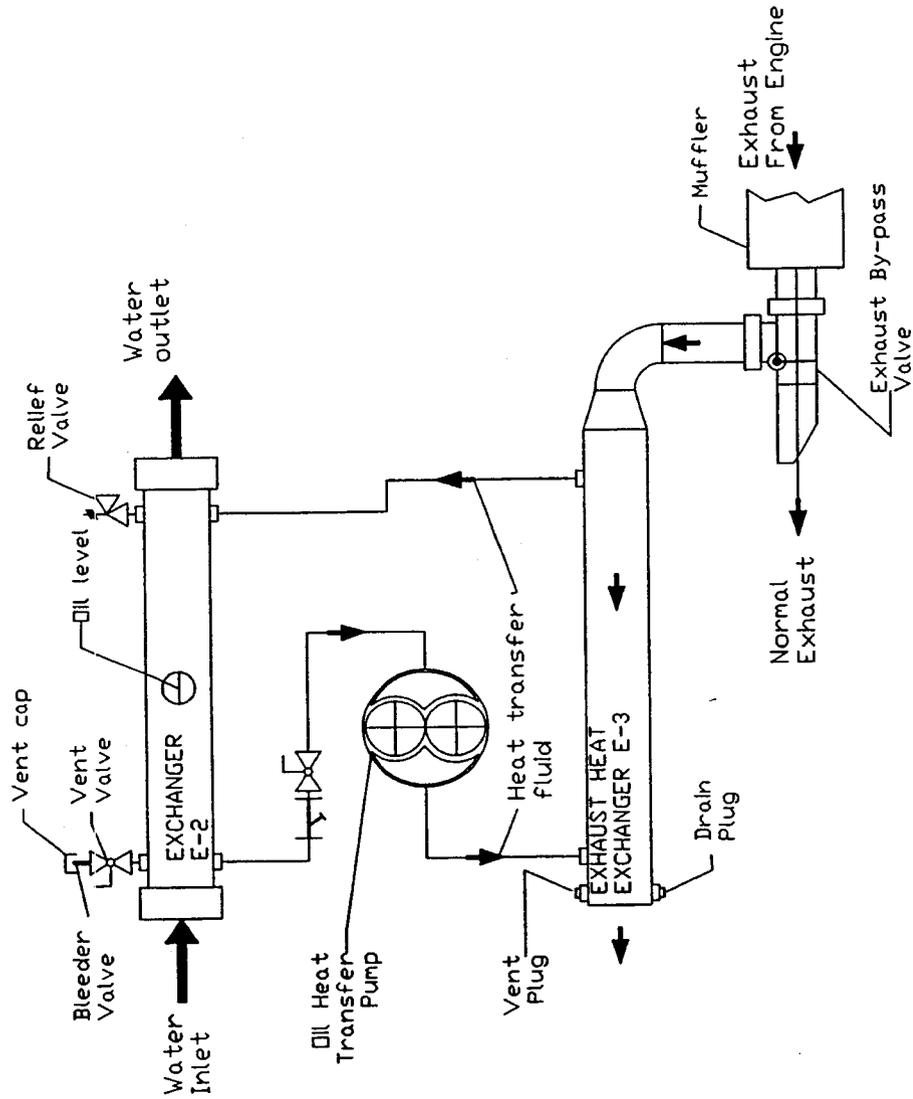
**Do Not** drain heat transfer fluid if system is hot. (Greater than 90<sup>0</sup>F).

- a. Open the vent valve on E-2 exchanger. Allow air and gas to escape.
- b. Remove the drain plug from E-3 exchanger.
- c. Drain all liquid to a suitable container.
- d. Remove vent plug from E-3 Heat Exchanger.
- e. Re-install the drain plug. Use Hi Temperature Teflon tape or special threaded sealant.
- f. Fill system through E-2 vent valve. 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 exchanger. Re-install E-3 vent plug. Use Hi. Temperature sealant.

- h. Continue with charging (approximately charge will be 2.0 gal. Assuming that some old liquid is left inside heat exchangers.
- i. Run the water / oil pump for approximately 3 min. DO NOT HEAT THE SYSTEM. Running the oil pump will transfer oil from E-2 exchanger to E-3 heat exchanger and eliminate any air pockets in the system.
- j. Close the vent valve and reinstall vent plug.
- k. Check oil level.

**DO NOT OVERFILL SYSTEM Overfilling will create high pressure in the heating system.**

# HEAT TRANSFER SYSTEM VENTING & FILLING



This chapter of the operation and service 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 that you do not fully understand, turn to the "OPERATION" section 3 of this manual and REVIEW "SYSTEMS".

## SPECIFIC PROBLEMS

### 6.1 PTO WILL NOT ENGAGE. Truck engine running at idle speed.

PROBABLE CAUSE	CORRECTIVE ACTION
Truck not at idle position.	Check that throttle control cable pulled all the way out. Check throttle control limit switch
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 Start or Stop Push Buttons.	Test Pushbuttons for power going into. If there is power going in but NO power going out, replace Pushbuttons.
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.
Recovery Tank full	Drain recovery Tank
Defective Recovery Tank Level Switch	Check level switch for proper operation, replace if necessary.

### 6.2 PTO WILL NOT RUN AT SPEED

PROBABLE CAUSE	CORRECTIVE ACTION
Defective Throttle cable.	Check throttle cable 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 1400 to 1650 RPM.
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 gauge.	Replace 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 and water inlet strainer.	Clean or replace as needed.

### 6.4 LOSS OF SOLUTION 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 tubes, 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 inletbasket 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 valve 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
Fresh Water tank is at low level.	Check water level in Fresh Water Tank. Low level switch will trip at appr. 2-3" 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

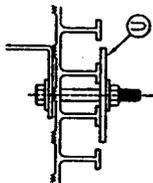
PROBABLE CAUSE	CORRECTIVE ACTION
Instrument settings:	Check Temperature controller setting. Lower setting if required.
Temperature control is set at a high temperature.	Turning temperature controller knob CCW will lower temperature setting.
Temperature controller not responding.	Inspect temperature control 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.

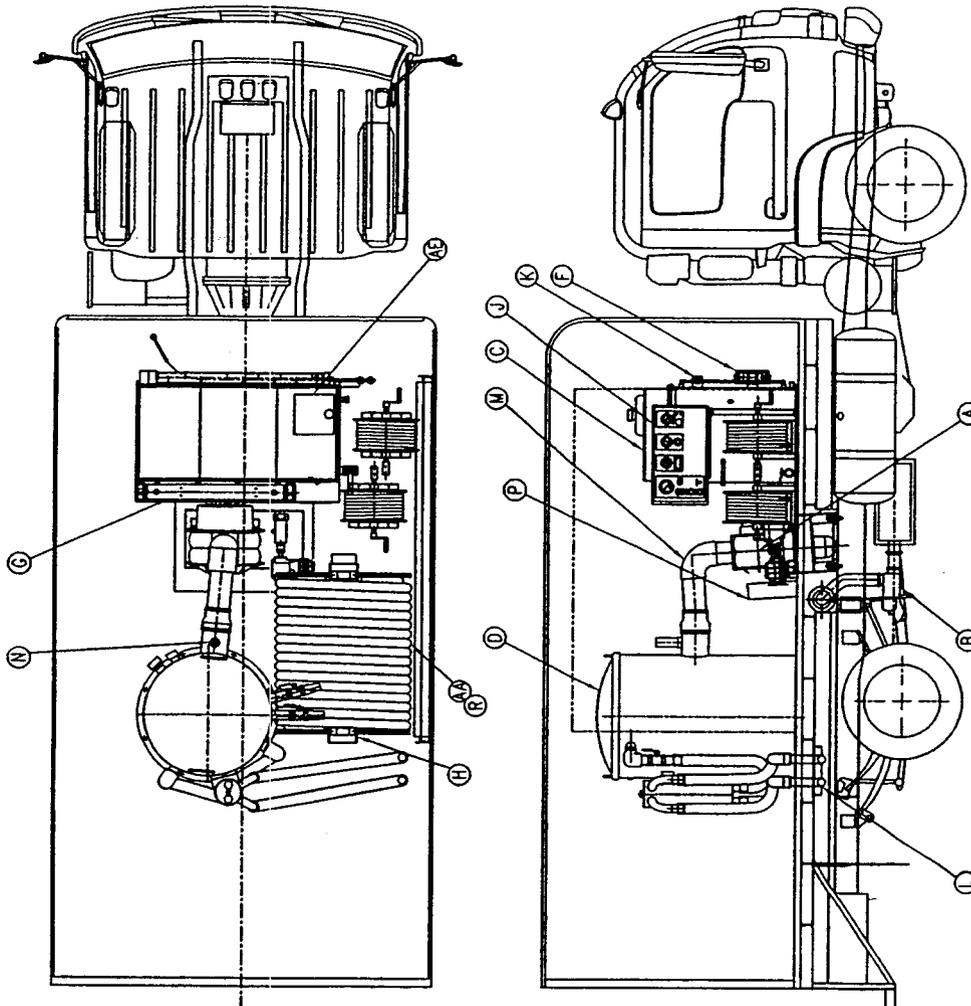
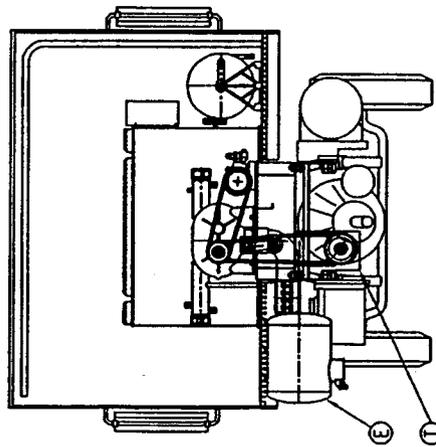
The heat output of the unit is LESS than normal.

PROBABLE CAUSE	CORRECTIVE ACTION
Exhaust by-pass Valve is in the Normal Exhaust Position	Check the exhaust by-pass valve for proper operation.
Temperature control is set at a low temperature.	Set temperature control to a higher setting
Vacuum relief valve set to 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. Add liquid if so required (See section 5.6).
Temperature controller not responding.	Test. If necessary, replace.
Engine RPM is low.	Check engine RPM. See system specification of this manual.
Temperature sensor not responding.	Inspect sensor for proper operation and replace, if necessary.
Temperature gauge not responding.	Test gauge. In necessary, replace.
E-3 exchanger is coated on inside of the tubes.	Clean exhaust heat exchanger tubes.
E-2 heat exchanger tubes are coated with hard water deposit.	Flash complete system.

# MOBILE CLEANING UNIT MAIN ASSEMBLY

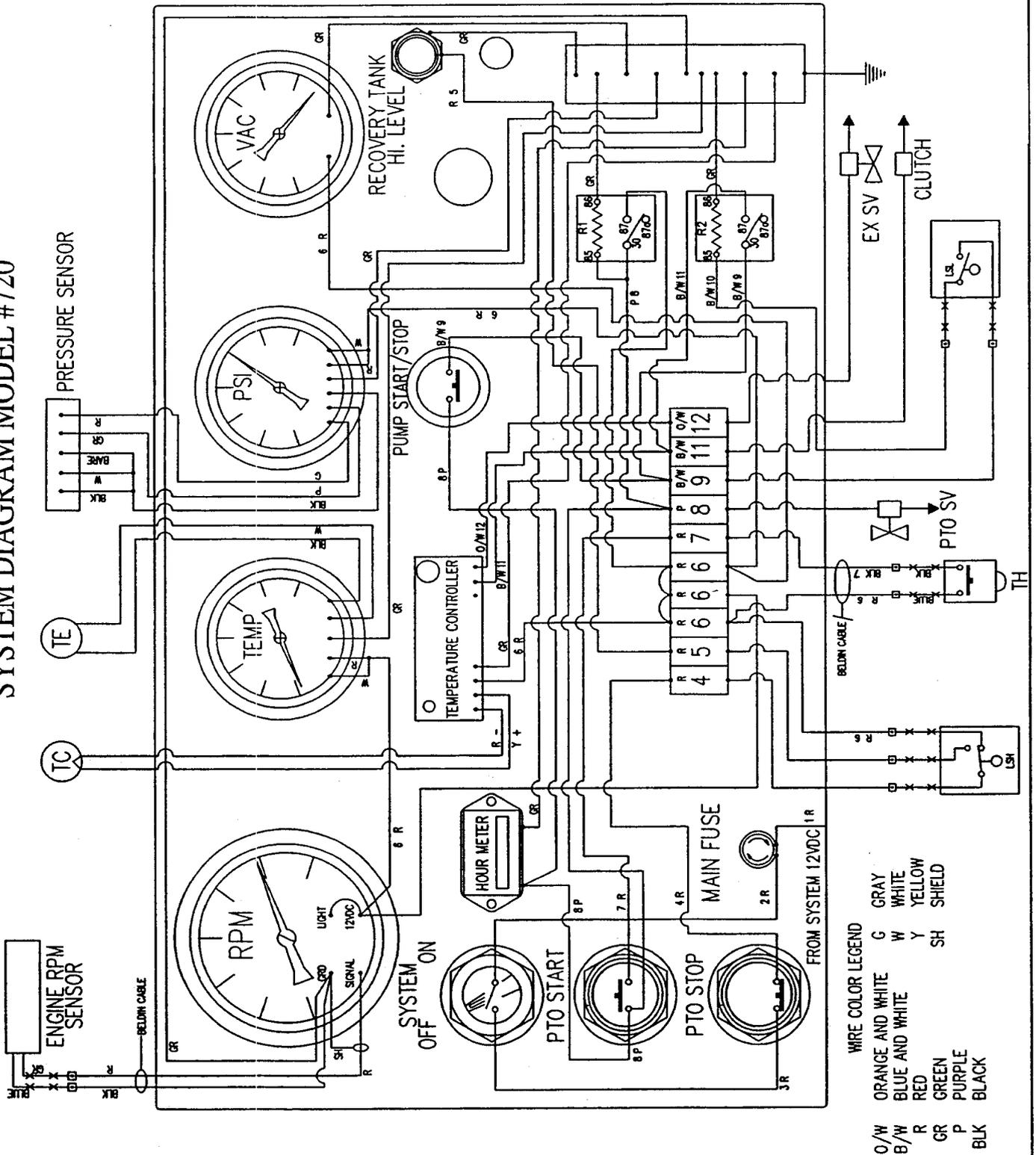


TYP FOR MOUNTING EQUIPMENT TO FLOOR

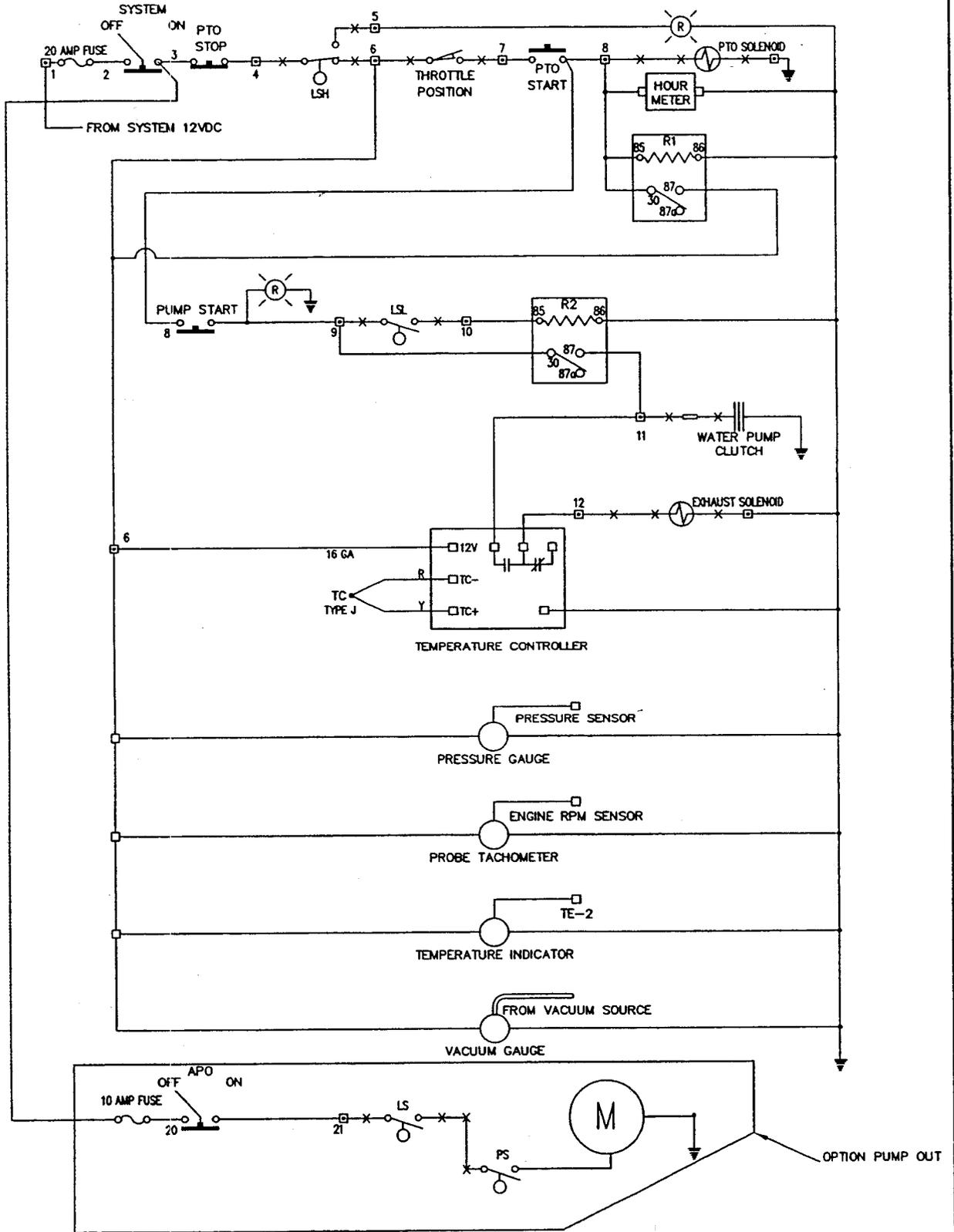


U	30	BACKING PLATE	060196	F	1	WELD DETAIL, E-1 EXCHANGER	060006W
T	1	ASSEMBLY, SHAFT GUARD	060038A	E	1	ASSEMBLY, SILENCER SYSTEM	060003A
P	1	ASSEMBLY, BELT GUARD, CARGO AREA	060277A	D	1	ASSEMBLY, RECOVERY TANK	060004A
N	1	VACUUM RELIEF VALVE SET AT 18" Hg	060301A	C	1	ASSEMBLY, FRESH WATER TANK	060003A
M	1	ASSEMBLY, BLOWER PIPING	060012A	B	1	ASSEMBLY, EXHAUST SYSTEM	060002A
L	1	ASSEMBLY, INLET PIPING	060011A	A	1	ASSEMBLY, PTO/BLOWER DRIVE SYSTEM	060001A
K	1	ASSEMBLY, RPM CONTROL	060010A				
J	1	ASSEMBLY, CONTROL PANEL	060009A				
H	1	ASSEMBLY, VACUUM HOSE REEL	060008A				
G	1	ASSEMBLY, E-2 EXCHANGER	060007A				

# SYSTEM DIAGRAM MODEL #720

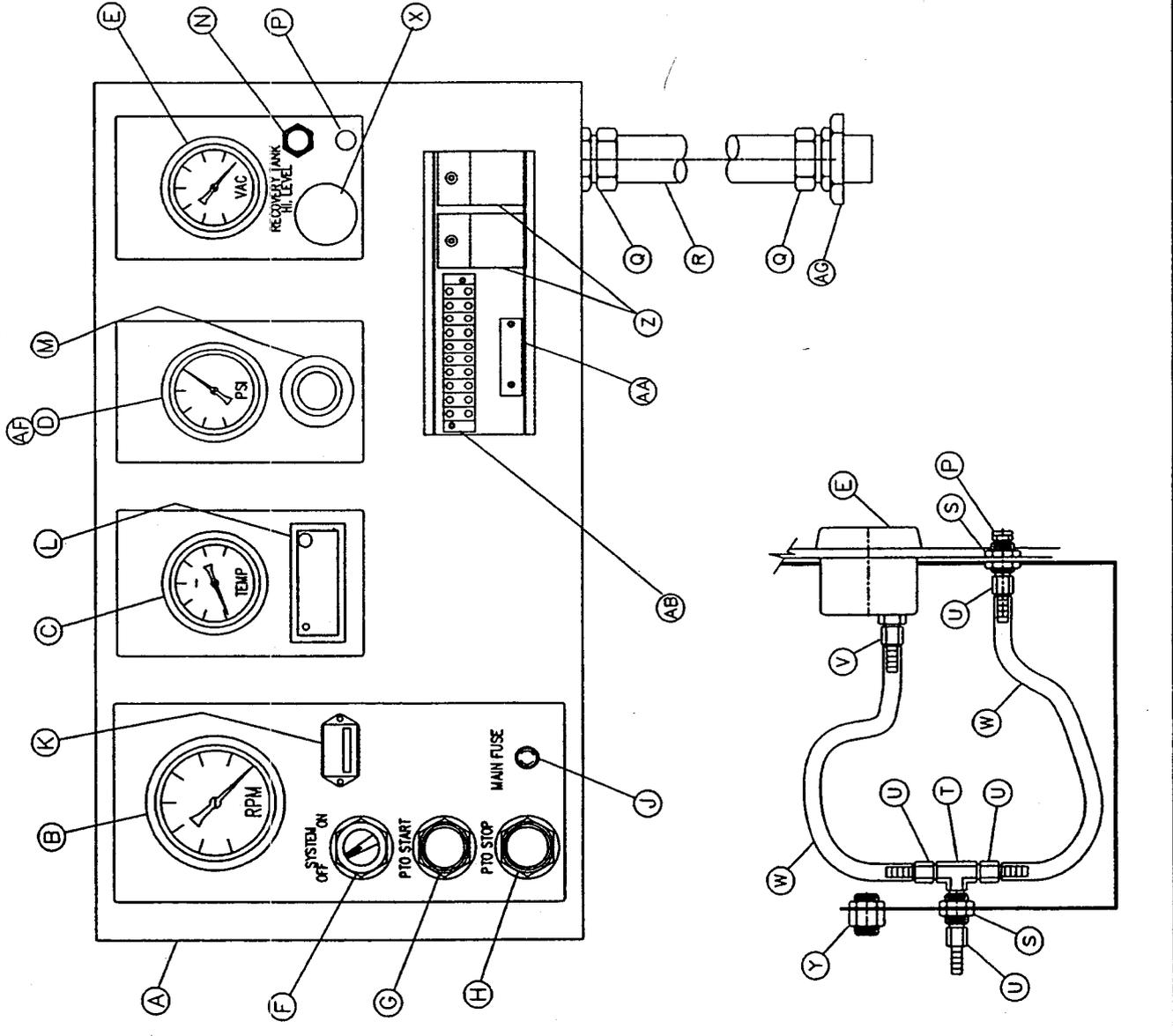


# ELECTRICAL LOGIC DIAGRAM

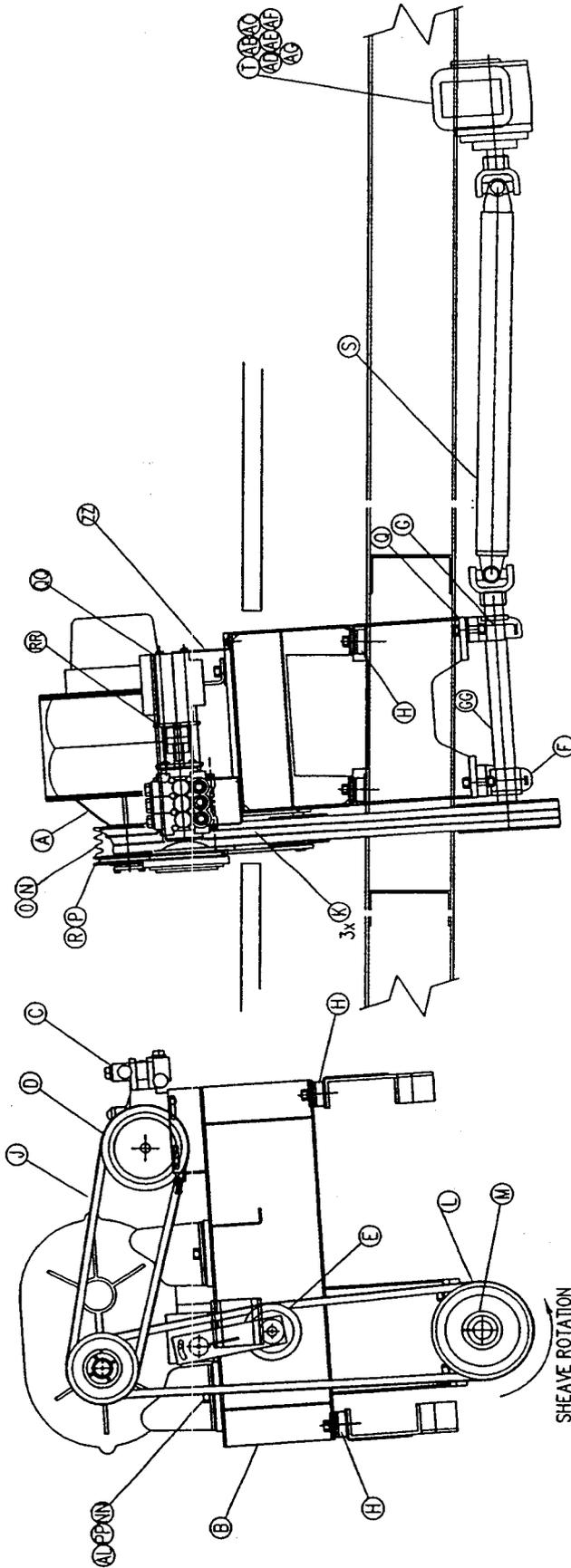


# CONTROL PANEL

AG	1	BULKHEAD FITTING, 3/4"	PLBH-0015
AF	1	PRESSURE TRANSDUCER	HWCA-0038
AB	1	TERMINAL STRIP 10 PLACE	ELTL-0225
AA	1	GROUND BAR 6 LUG	ELGL-0020
Z	2	RELAY 12VDC	ELRL-0352
Y	1	ELECTRICAL CORD FITTING	ELON-0190
X	1	PANEL PLUG	PLPL-0043
W	1	HOSE, 1/4 ID RED	HMHS-0045
V	1	HOSE ADAPTER, 1/8 FPT X 1/4 HOSE	HMHB-0049
U	4	HOSE ADAPTER, 1/8 FPT X 1/4 HOSE	HMHB-0050
T	1	TEE, 1/8 FPT X 1/8 FPT	PLTE-0113
S	2	ANCHOR CONNECTION, 1/8 FPT	PLAC-0002
R	1	1" SEAL TIGHT FLEX	ELON-0040
Q	2	1" STRAIGHT CONNECTION	ELON-0047
P	1	OIL HOLE COVER 1/8 FPT	HMOC-0006
N	1	LEVEL INDICATOR LIGHT, 12VDC	
M	1	PUSH/PULL ILLUMINATED SWITCH, 12VDC	ELSW-0575
L	1	OIL TEMPERATURE CONTROLLER FOR TYPE "K" THERMOCOUPLE	ELTC-0023
K	1	HOUR METER, 12VDC	ELMR-0075
J	1	FUSE HOLDER, WITH 20 AMP FUSE	ELFH-0003
H	1	PUSH BUTTON	ELSW-0631
G	1	PUSH BUTTON	ELSW-0630
F	1	SELECTOR SWITCH	ELSW-0628
E	1	VACUUM GAUGE	HWCA-0037
D	1	PRESSURE GAUGE	HWCA-0036
C	1	WATER TEMPERATURE GAUGE	HWCA-0039
B	1	TACHOMETER	HWCA-0035
A	1	CONTROL PANEL BOX	A-060272

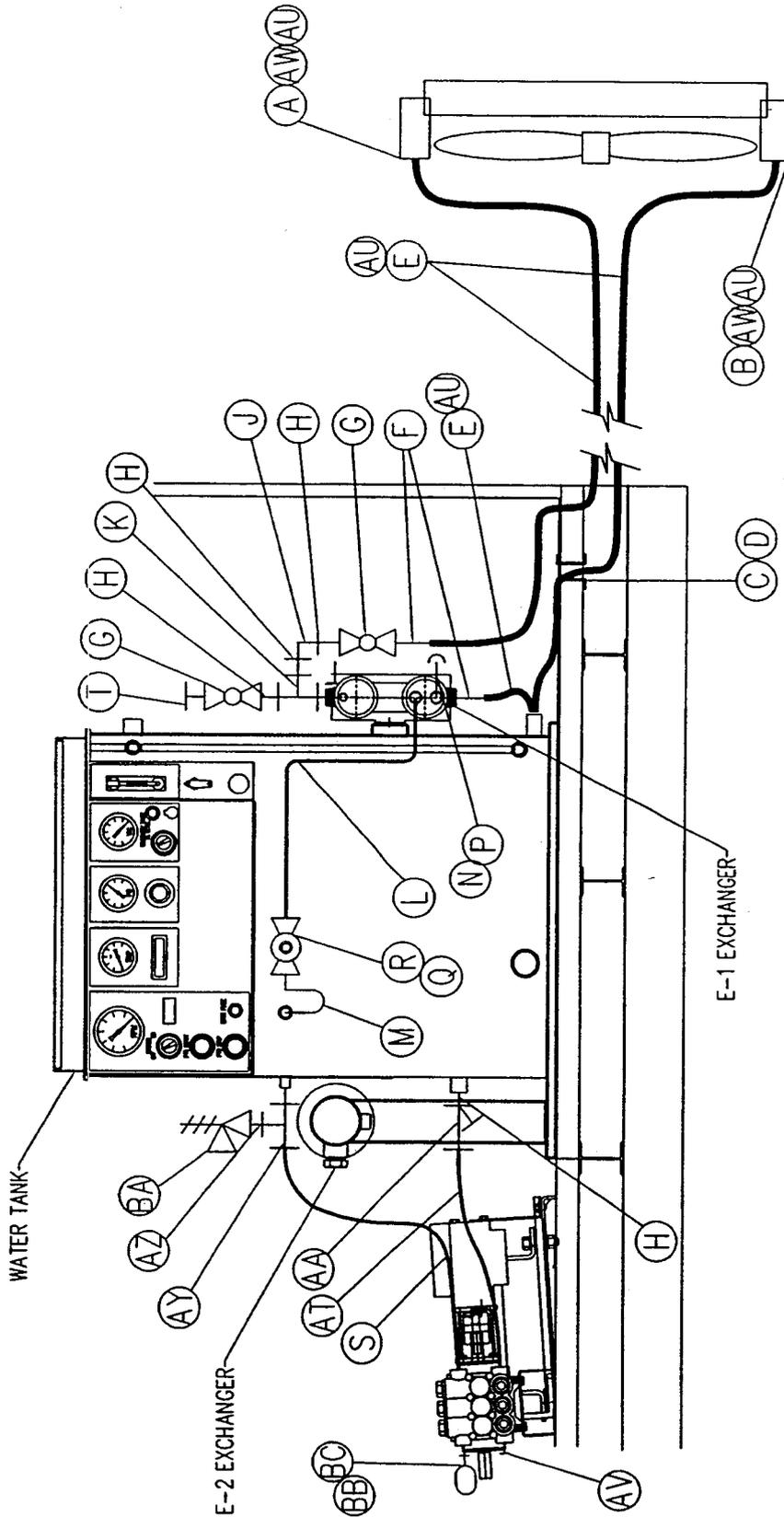


# ASSEMBLY PTO/BLOWER & DRIVE SYSTEM



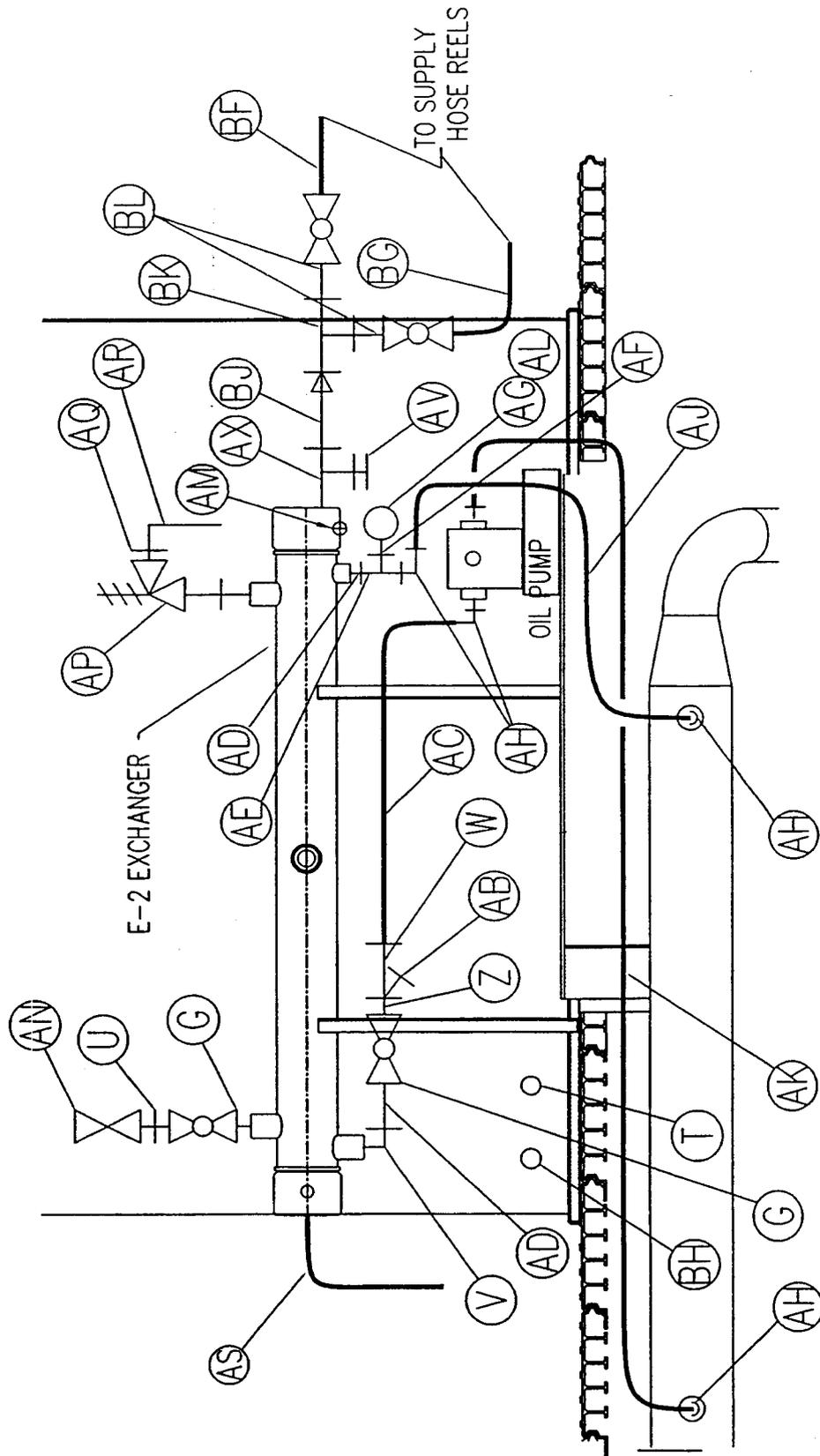
AL	4	LOCK WASHER	060306	CG	1	SHAFT, BLOWER DRIVE	060139	G	1	PILOW BLOCK, 1 7/16"	HMPB-0002
AG	1	BRACKET, PTO SOLENOID	045180	T	1	PTO, FOR A1SN AUTO TRANS SUPPLIED WITH SET OF STUDS AND PLUS	HMP1-0001	F	1	PILOW BLOCK, 1 1/2"	HMPB-0001
AF	2	ELBOW, 1/4 JC X 1/8 MPT	PLE1-0142	S	1	UNIVERSAL DRIVE SHAFT	060273	E	1	ASSEMBLY TENSIONER	060044A
AE	3	ELBOW, 1/4 JC X 1/4 MPT	PLE1-0141	R	1	BUSHING, TYPE "H" 1 3/8 BORE, 5/16 KEYWAY	HMS-0053	D	1	WATER PUMP CLUTCH	PLPC-0001
AD	2	HOSE ASSEMBLY	HWA-0013	Q	1	BEARING SHIM	060138	C	1	WATER PUMP	PLPP-0039
AC	1	HOSE ASSEMBLY	HWA-0012	P	1	SHEAVE, SINGLE GROOVE #AK56H	HMSV-0018	B	1	BLOWER MOUNTING BRACKET, WELD DETAIL	060023W
AB	1	HOSE ASSEMBLY	HWA-0011	O	1	BUSHING 5/16" X 5/32" KEYWAY	HMS-0050	A	1	BLOWER AD PNEUMATICS #6008	HMBW-0004
ZZ	1	OIL PUMP SUPPORT	060173	N	1	SHEAVE, DODGE #45272, 5.5-S05	HMSV-0026				
TT	1	OIL PUMP STANDOFF	060248	M	1	BUSHING SK-1.5, DODGE #120429 1 1/2" BORE, 3/8" KEY	HMSV-0059				
RR	1	SHAFT COUPLING	HMP-0018	L	1	SHEAVE, 3/516, J-SK	HMSV-0024				
OQ	1	LOVE JOY #A-075	PLPP-0043	K	3	BELT, GATES SV6800	HMBT-0045				
PP	4	OIL PUMP (CW ROTATION) 3/4 FLAT WASHER	HWA-0108	J	1	BELT, GATES HIGH POWER V BELT #A-54	HMBT-0037				
NN	4	BOLT, 3/4-10 X 1 3/4 LONG HEX HEAD	HMBL-0251	H	4	BLOWER SUPPORT BRACKET	060317W				

# SYSTEM TUBING & HOSES



FRONT

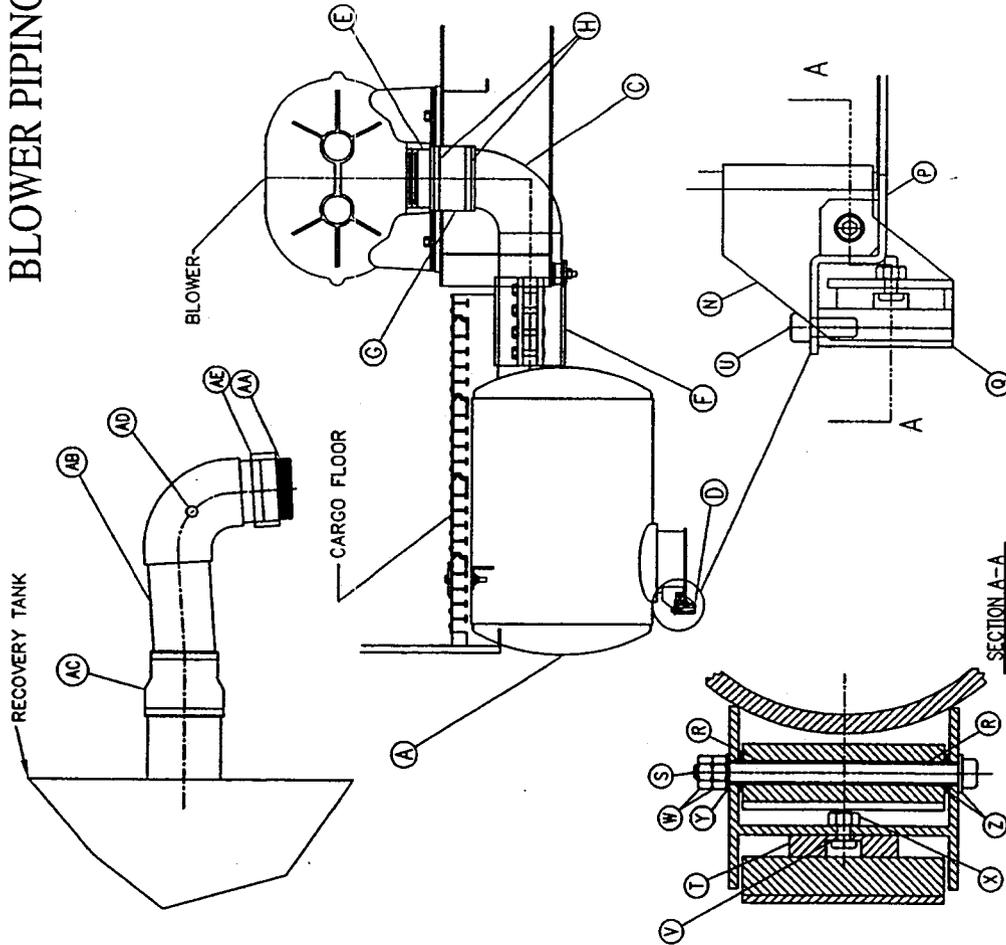
# SYSTEM TUBING & HOSES



SIDE VIEW



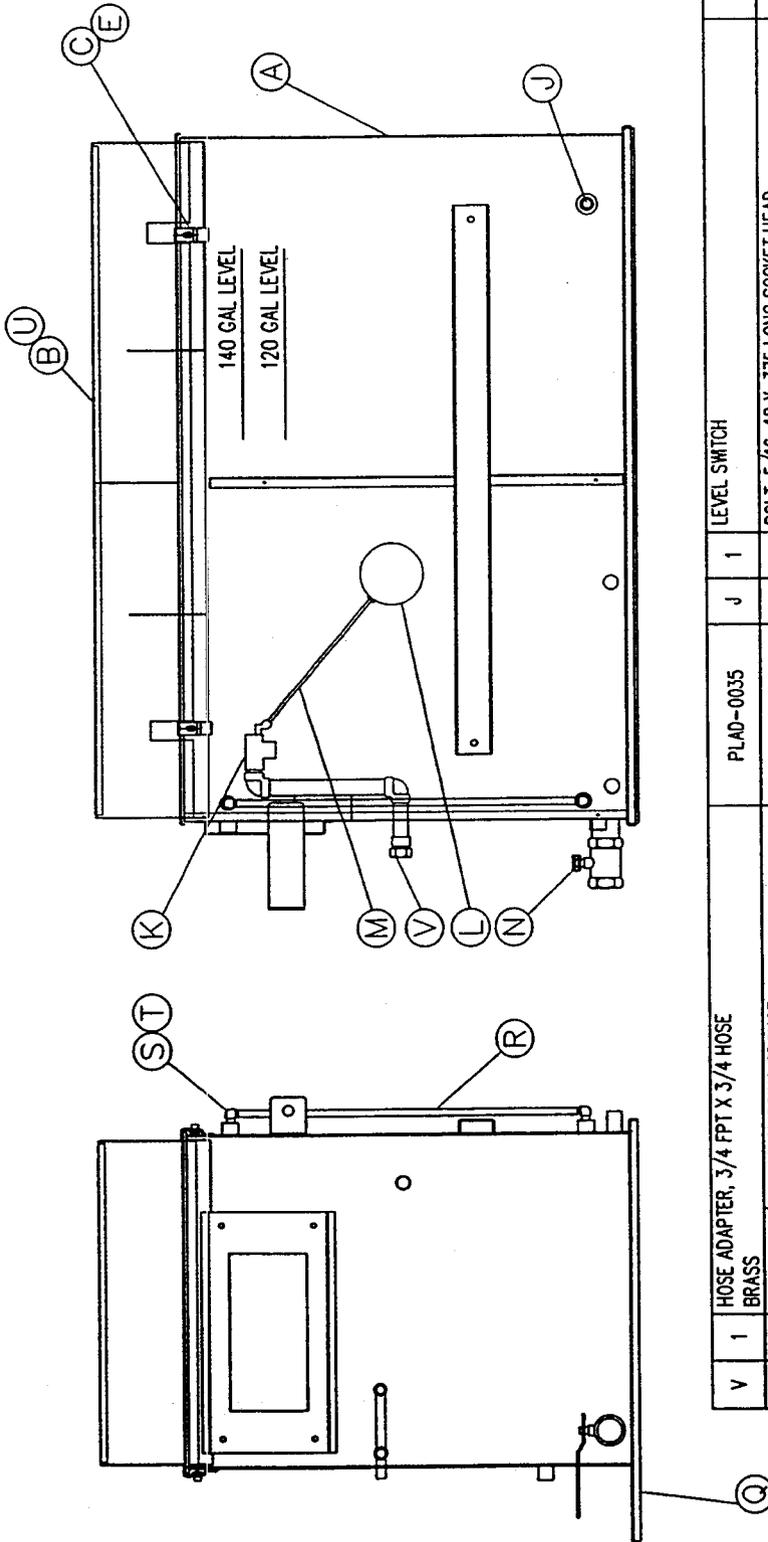
# BLOWER PIPING, SILENCER & FLAPPER



Z	2	WASHER, 1/4 FLAT STAINLESS STEEL	HWHA-0023
Y	1	WASHER, #10 FLAT STAINLESS STEEL	HWHA-0002
X	1	HEX NUT, #8-32 STAINLESS STEEL	HWNT-0009
W	2	HEX NUT, #10-24 STAINLESS STEEL	HWNT-0018
V	1	SCREW, #8-32 X .50 LONG PAN HEAD STAINLESS STEEL	HWSC-0023
U	2	SCREW, 1/4-20 X .50 LONG SOCKET HEAD STAINLESS STEEL	HWSC-0574
T	1	MAGNET, CERAMIC POT #13	HWMG-0004
S	1	SHOULDER SCREW, 1/4 X 3.00 LONG SOCKET HEAD 18-8 STAINLESS STEEL	HWSC-0632
R	2	BUSHING, FLANGED	HWBS-0051
Q	1	COUNTER WEIGHT	060144
P	1	FLAPPER PLATE	060027W
N	1	FLAPPER BRACKET	060026W
H	1	BLOWER/SILENCER CPLG	060311
G	1	1/8" THK SILICON RUBBER	
F	1	FULL BAND PIPE COUPLING, 5"	PFCL-0084
E	1	5" DISCHARGE CONNECTION C.S.	PLNP-0206
D	1	ASSEMBLY, SILENCER FLAPPER	060016A
C	1	SILENCER INLET ELBOW	060143
A	1	SILENCER	060276

AE	1	5" FLEXIBLE COUPLING	HWCP-0027
AD	1	HOSE BARB, 1/4" NPT X 1/4" HOSE BRASS	HWHB-0048
AC	1	6" X 5" FLEXIBLE REDUCING COUPLING	PLRD-0110
AB	1	5" PVC BLOWER INLET PIPING	
AA	1	5" BLOWER INLET PIPE	PLNP-0184

# GENERAL LAYOUT



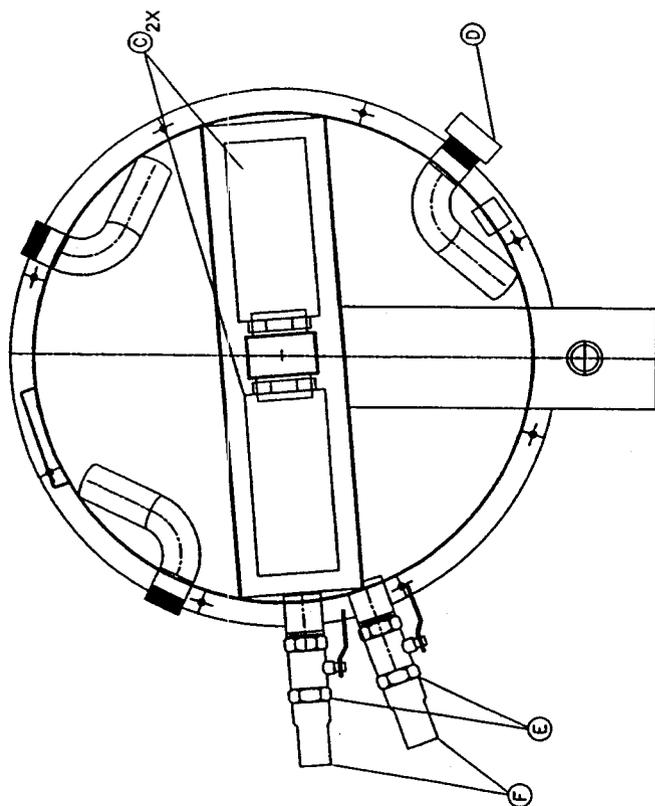
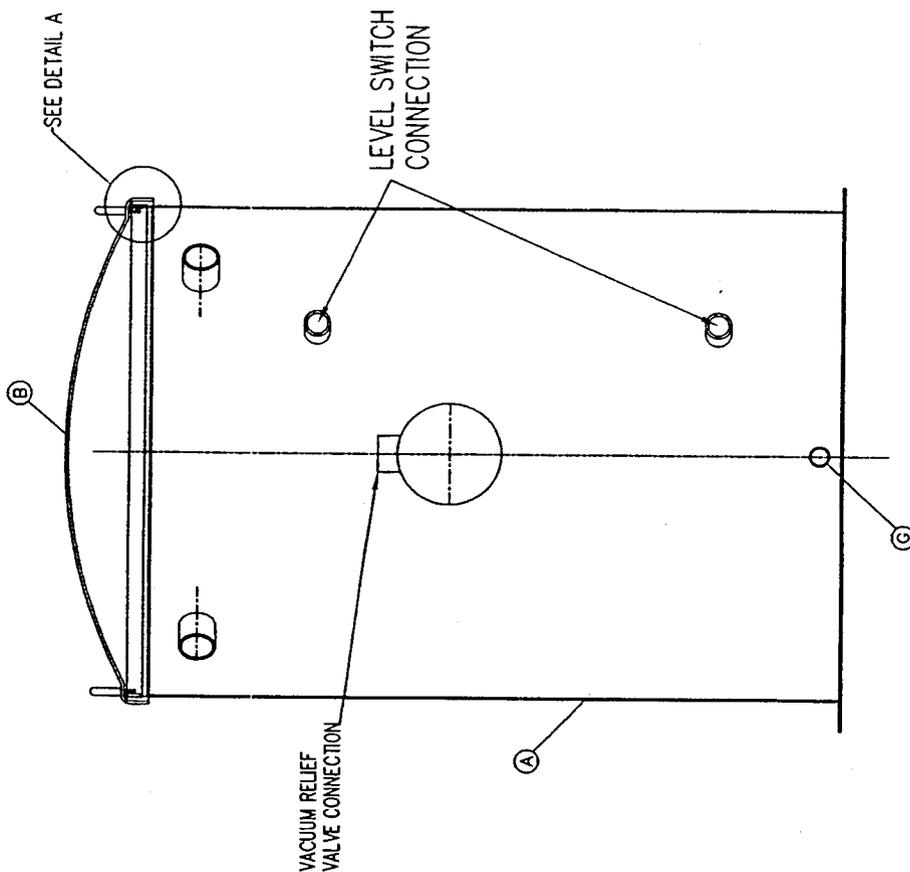
V	1	HOSE ADAPTER, 3/4 FPT X 3/4 HOSE BRASS	PLAD-0035	J	1	LEVEL SWITCH	ELSW-0596
U		GASKET, 21/64 SELF GRIPPING SPONGE	HWGS-0177	E	4	BOLT, 5/16-18 X .375 LONG SOCKET HEAD ZINC PLATED	HWBL-0263
T	2	HOSE CLAMP, 316 STAINLESS STEEL	HWHC-0049	C	4	LOCK CLAMP, FRESH WATER TANK	060118
S	2	ELBOW, 3/8 NPT X 3/8 HOSE, 90° BRASS	PPEL-0010	B	1	COVER, FRESH WATER TANK	060021W
R	1	LEVEL TUBE, 1/2" OD X 3/8" ID X 26" LONG	PLTB-0027	A	1	FRESH WATER TANK	060020W
Q	2	INSULATION SHEET, 1/2" THK	SHPL-0077				
N	1	BALL VALVE, 1-1/2" FPT BRASS	PLBV-0047				
M	1	FLOAT STEM	HWFS-0002				
L	1	FLOAT BALL	PLFB-0001				
K	1	FILL CONNECTION VALVE	PLFV-0007				

Section

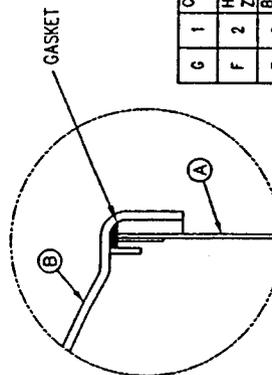
7

Design Documentation

# RECOVERY TANK



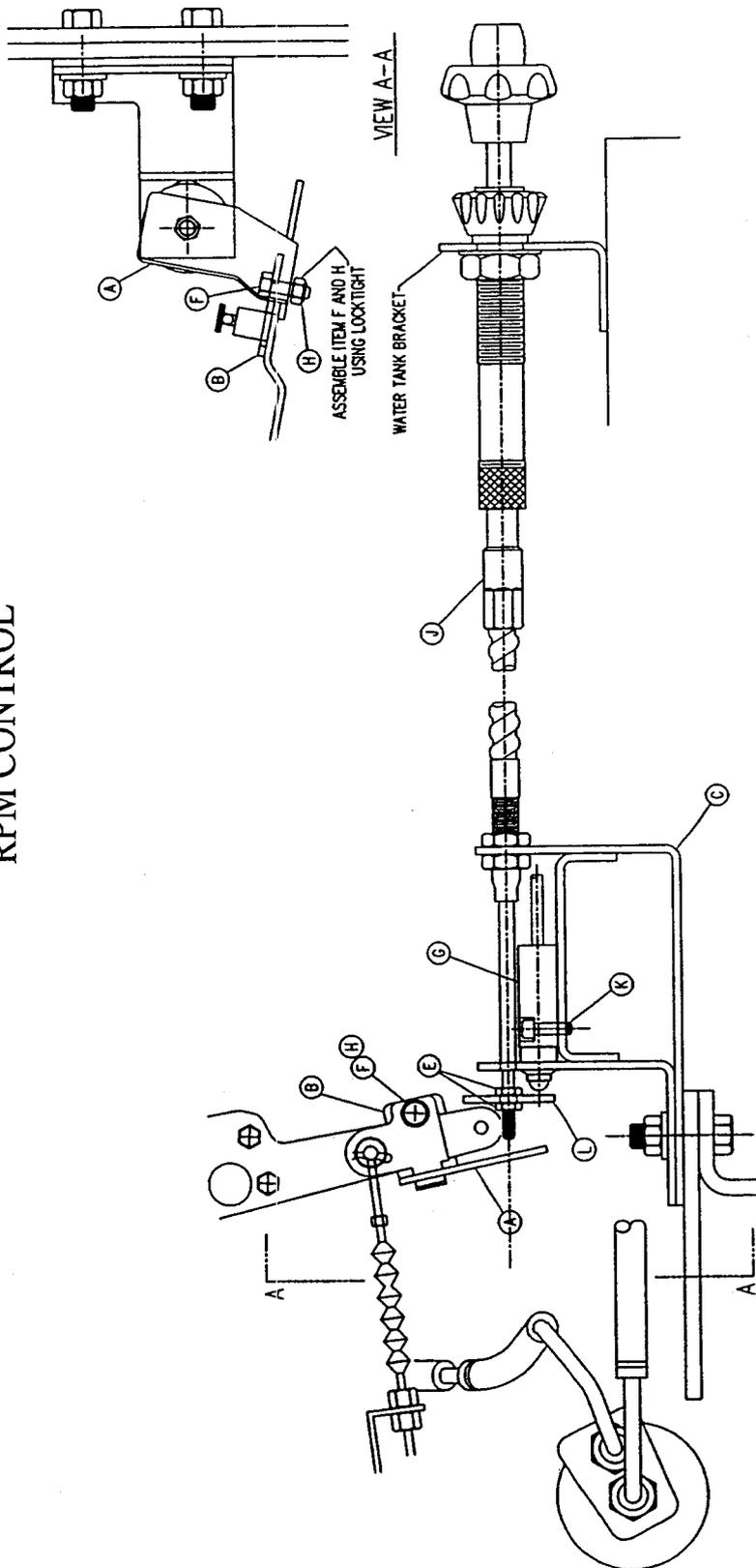
TOP VIEW  
COVER REMOVED FOR CLARITY



DETAIL A

G	1	CAP, 1" SCH 40 PVC		
F	2	HOSE BARB, 2" IPT X 2" HOSE	PLNP-0174	
E	2	ZINC PLATED BALL VALVE, 2" FPT	PLBY-0041	
D	1	CAP, 2" SCH 40 PVC	PLCP-0029	
C	2	STRAINER, 100 GPM, 3" FPT	PLST-0008	
B	1	TANK COVER	06003JW	
A	1	RECOVERY TANK	06003JW	

# RPM CONTROL



L	2	WASHER, 9/32 ID X 1 1/2 OD X 1/8 THK	HWHA-0194
K	2	SCREW, #10-32 X .625 LONG SOCKET HEAD SS	HWSC-0633
J	1	PUSH/PULL CONTROL TUTHILL #26V02DF-2-112	HWCL-0226
H	1	#10-32 HEX NUT W/NYLON LOCK INSERT SS	HWNT-0588
G	1	MICRO LIMIT SWITCH #914CE66-3	ELSW-0629
F	1	SCREW, #10-32 X .75 LONG HEX WASHER HEAD SS	HWSC-0587
E	2	HEX NUT, #10-32 SS	HWNT-0018
C	1	WELD DETAIL, CABLE BRACKET	060041W
B	1	BRACKET, THROTTLE ARM, TOP	060207
A	1	BRACKET, THROTTLE ARM, BOTTOM	060206

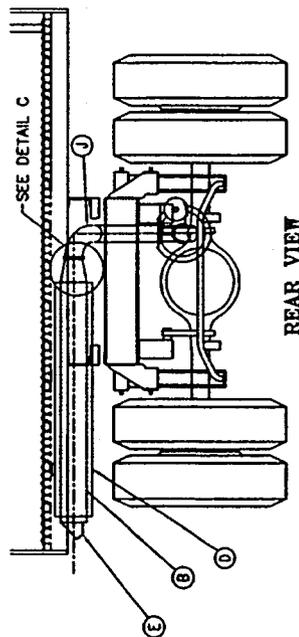
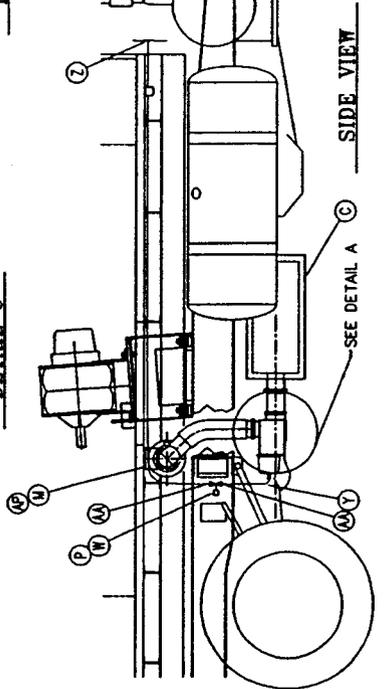
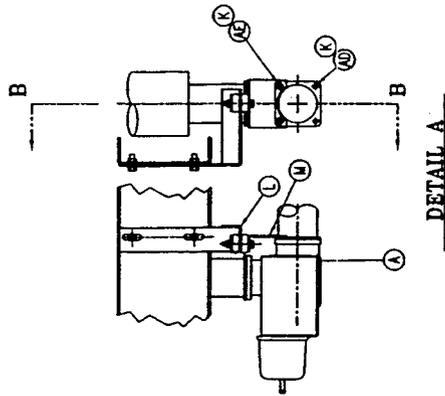
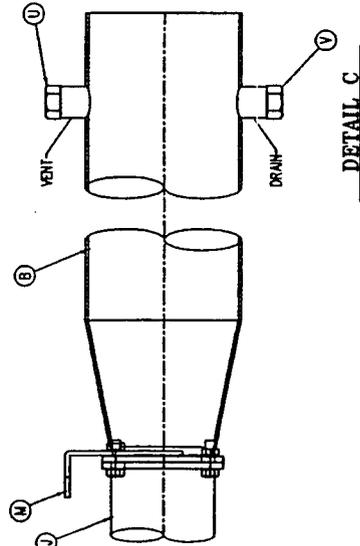
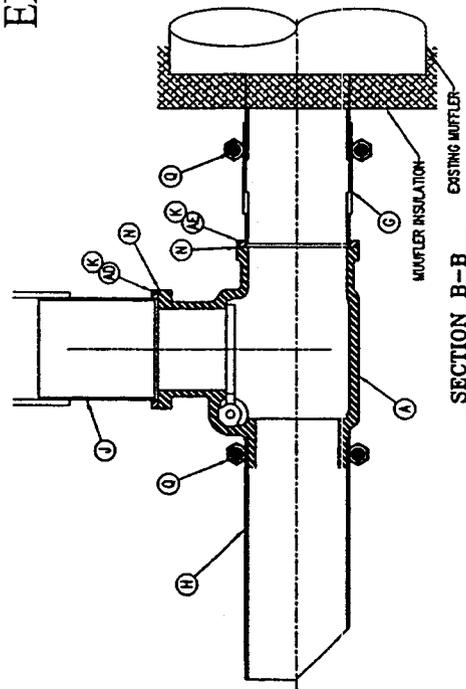
Section

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Design Documentation



# EXHAUST HEAT SYSTEM

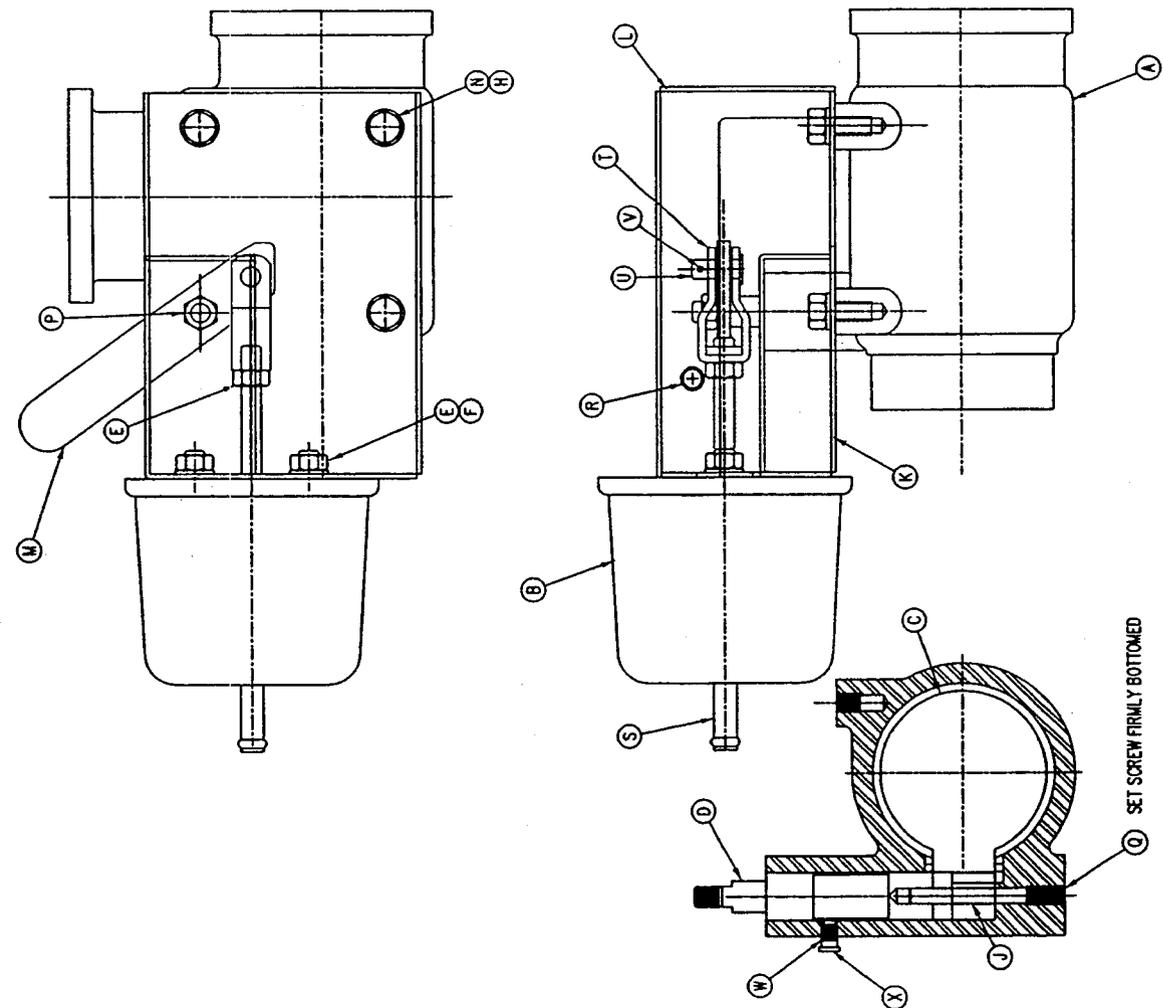


AP	1	BACKING PLATE	060196	S	2	BOLT, 3/8-18 X 2.00 LONG HEX HEAD ZINC PLATED	HWB-0110	E	1	OUTLET HOOD, EXHAUST	060156
AM	4	5/16 SPLIT LOCK WASHER ZINC PLATED	HWMA-0224	Q	3	CLAMP, FULL ORCLE 3" U-BOLT EXHAUST CLAMP ZINC PLATED	CLMP-0021	D	1	ASSEMBLY, EXHAUST EXCHANGER INSULATION COVER	060018A
AH	1	FLANGE, EXHAUST VALVE MATING	060160	P	1	FILTER, SOLENOID VALVE	PFL-0024	C	1	MUFFLER, INSULATION COVER	060157
AE	6	BOLT, 5/16-18 X 1.00 LONG FULLY THREADED ZINC PLATED	HWB-0064	N	3	GASKET, EXHAUST BY-PASS VALVE	060172	B	1	WELD DETAIL, E-3 EXCHANGER	060024W
AD	6	BOLT, 5/16-18 X .75 LONG FULLY THREADED ZINC PLATED	HWB-0112	M	2	SUPPORT BRACKET, EXHAUST VALVE, VALVE SIDE	060171	A	1	ASSEMBLY, EXHAUST BY-PASS VALVE	060017A
AA	2	HOSE BARB, 1/8 MPT X 1/4 HOSE	HWB-0050	L	1	SUPPORT BRACKET, EXHAUST VALVE, FRAME SIDE	060170				
Z	1	HOSE TEE, 3/8 X 3/8 X 1/4 PVC	HWB-0047	K	8	TAB WASHER	060169				
Y		VACUUM HOSE, 1/4"	HWMS-0050	J	1	EXHAUST PIPE	060168				
W	1	EXHAUST SOLENOID	ELSL-0056	H	1	TAIL PIPE	060167				
V	1	PLUG, 3/8-150I THREADED HEX HEAD C.S.	PFPL-1015	G	1	WELD DETAIL, TAIL PIPE CONNECTOR	060030W				
U	1	PLUG, 1/2-150I THREADED HEX HEAD C.S.	PULP-0032								

NOT SHOWN 1A-036 CLAMP, USE WITH 1A-30M

12-036  
10-307

# 3 WAY EXHAUST DIVERTER VALVE



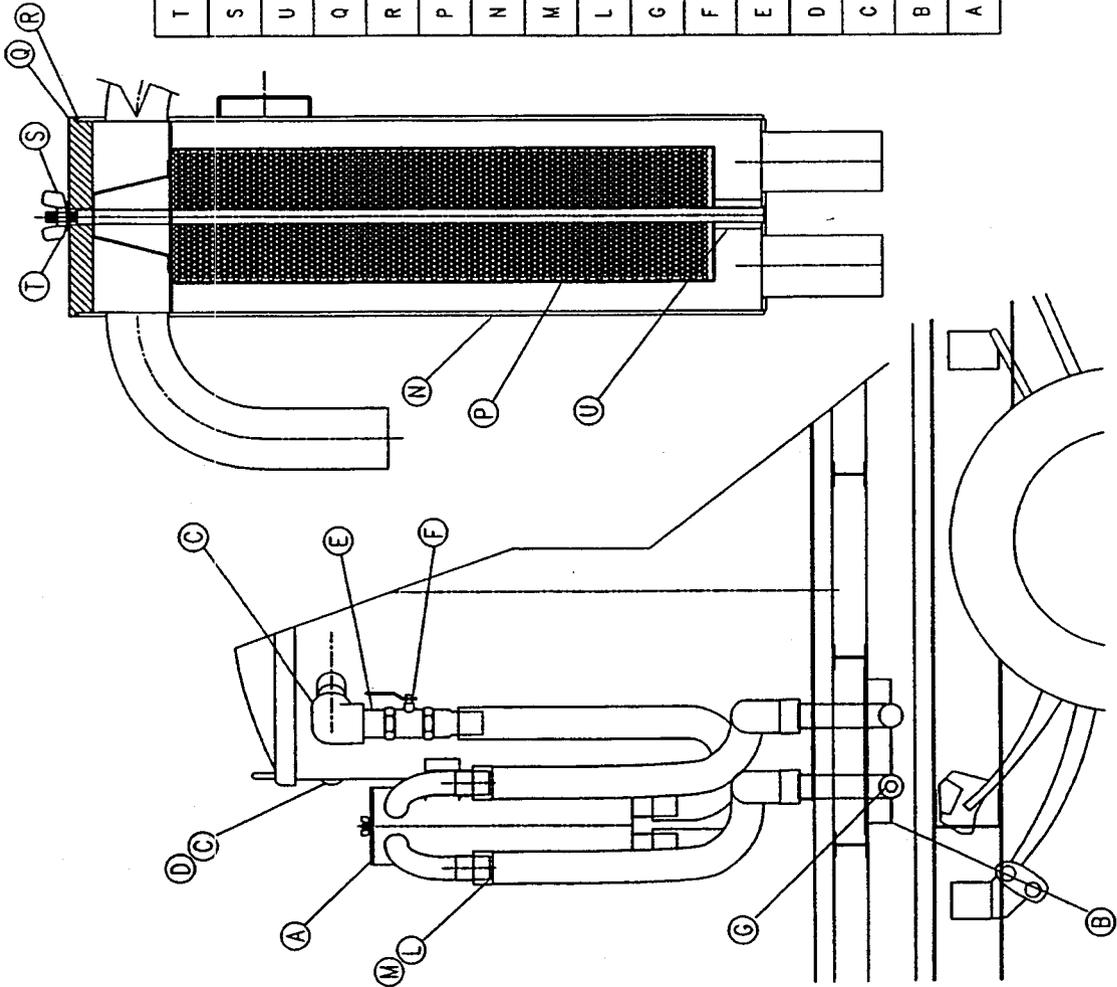
X	1	ADAPTER FITTING, 5/16-24 X 1/4-28	HWAD-0006
W	1	OIL HOLE FITTING, 5/16-32 UNF	HWOC-0002
V	1	COTTER PIN, 1/8" X 1.00 LONG	HWPV-0042
U	1	CLEVIS PIN, 5/16" X 3/4	HWPV-0035
T	1	CLEVIS UD #20309T9000	HWCV-0011
S	1	ACTUATOR CONNECTION 1/4" STRAIGHT HOSE CONNECTION	HWHB-0048
R	2	MACHINE SCREW, #10-32 X 3/8" LONG, ZINC PLATED WITH CAPTIVE EXTERNAL WASHER	HWSC-0542
Q	1	SOCKET SET SCREW, 5/16-18 X .25 LONG	HWSC-0568
P	1	NUT, 5/16-18 UNC WITH TOOTH WASHER ZINC PLATED	HWNT-0209
N	3	CAP SCREW, 5/16-18 UNC X .375 LONG FULLY THREADED HEX HEAD S.S.	HWBL-0228
M	1	PIVOT PLATE,	060156
L	1	COVER, VALVE ACTUATOR BRACKET	060155
K	1	BRACKET, VALVE ACTUATOR	060154
J	1	PIN, 1/4" X 2.00" LONG DOWEL PIN	HWPV-0033
H	3	5/16 SPLIT LOCK WASHER	HWVA-0006
F	2	8mm SPLIT LOCK WASHER	HWVA-0163
E	3	HEX NUT, 8mm 304 S.S.	HWNT-0173
D	1	SHAFT, FORK	060153
C	1	WELDMENT, FLAPPER PLATE	060029W
B	1	VALVE ACTUATOR PART #20308T9002	PLVA-0068
A	1	BODY, EXHAUST BY-PASS VALVE	060150

Section

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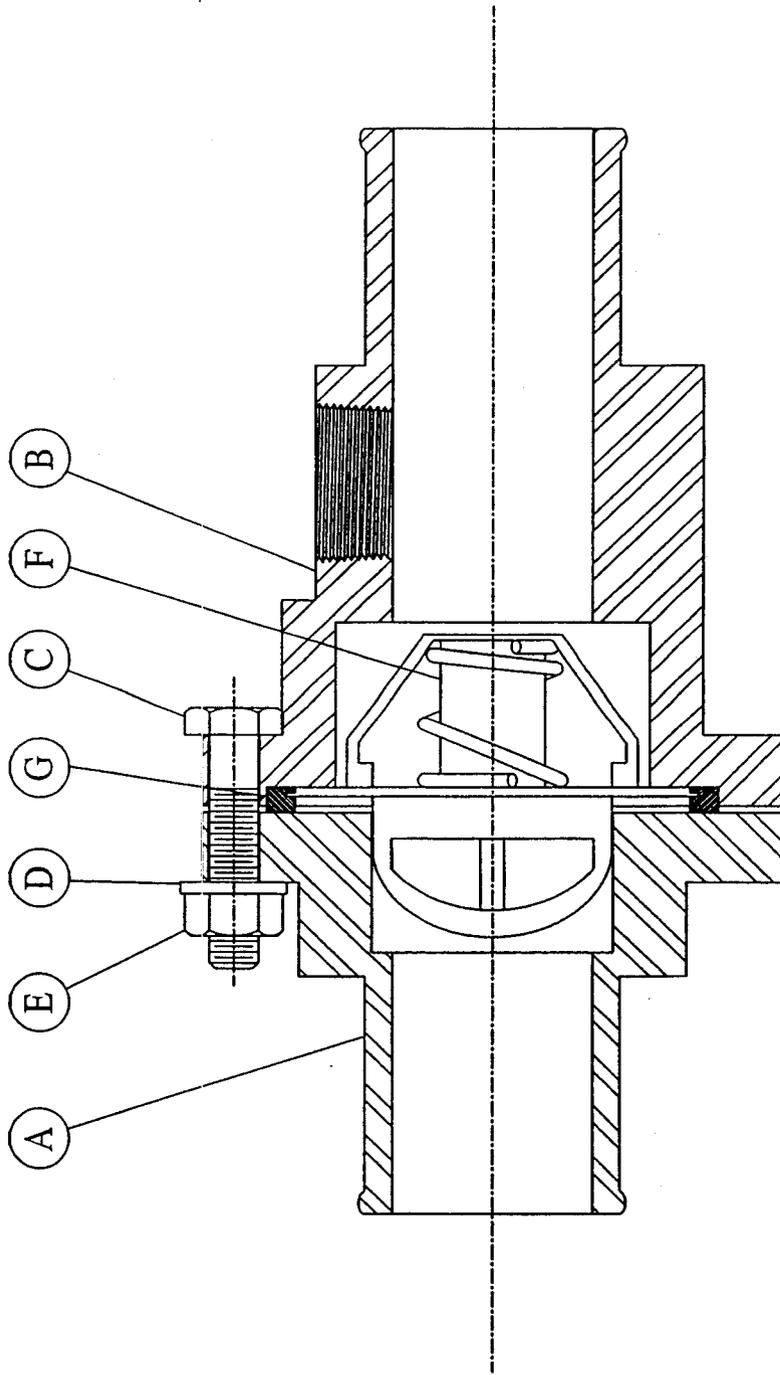
Design Documentation

# VACUUM INLET STRAINER & PIPING



T	1	3/8 FLAT WASHER ZINC PLATED	HWWA-0019
S	1	WING NUT, 3/8-16 ZINC PLATED	HWNT-0633
U	1	PLASTIC STANDOFF FOR 1/2" SCREW, 1" OD X 1-1/2" LONG McMCARR #92510A367	HWSO-0220
Q	1	STRAINER CAP	060199
R	1	O-RING, 1/8 THK X 6-1/4" ID X 6-1/2" OD McM CARR #9452K359	
P	1	WELD DETAIL, STRAINER BASKET	060039W
N	1	STRAINER PIPE	060263
M	1	HOSE CUFF, 2"	HWHS-0071
L	1	VACUUM HOSE, 2" ID PLASTIFLEX	HWHS-0041
G	1	MECHANICAL TEST PLUG	PLPL-0042
F	1	BALL VALVE, 2" FPT BRONZ #9302	PLBY-0041
E	1	2" SCH-40 CLOSE PIPE NIPPLE GALVANIZED	PLNP-0181
D	1	HOSE BARB, 2" MPT X 2" HOSE ZINC PLATED	PLNP-0174
C	1	ELBOW, 2" - SCH 80 90° FPT X FPT PVC	PLEL-0105
B	1	WELD DETAIL, DUAL TUBE	060040W
A	1	ASSEMBLY, INLET STRAINER	060260A

# THERMOSTAT ASSEMBLY



Parts Listing	Part Number
A. Thermostat Cover	045151
B. Thermostat Housing	045152
C. 1/4-20 x 1-1/4" Long 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



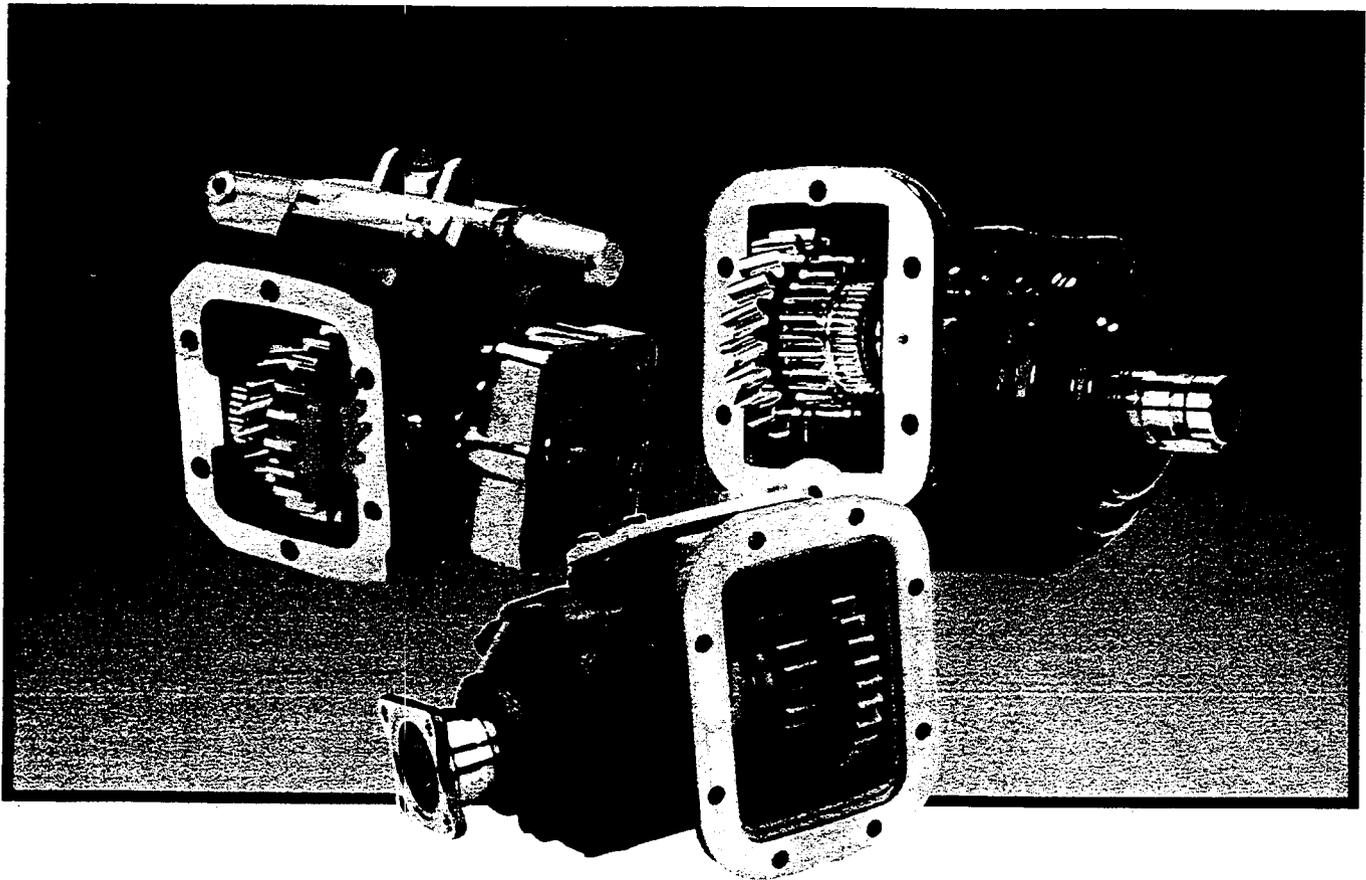
**CHELSEA®**

Bulletin HY25-1240-M1/US

# Owner's Manual Power Take-Offs

Effective: October 2001  
Supersedes: 379240 December 2000

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230 Series  
231 Series  
236 Series

250 Series  
270 Series  
271 Series

800 Series  
852 Series  
885 Series

**Parker**  
Hydraulics

## Safety Information

These instructions are for your safety and the safety of the end user. Read them carefully until you understand them.

### General Safety Information

#### To prevent injury to yourself and/or damage to the equipment:

- Read carefully all owner's manuals, service manuals, and/or other instructions.
- Always follow proper procedures, and use proper tools and safety equipment.
- Be sure to receive proper training.
- Never work alone while under a vehicle or while repairing or maintaining equipment.
- Always use proper components in applications for which they are approved.
- Be sure to assemble components properly.
- Never use worn-out or damaged components.
- Always block any raised or moving device that may injure a person working on or under a vehicle.
- Never operate the controls of the Power Take-Off or other driven equipment from any position that could result in getting caught in the moving machinery.

#### Proper Matching of P.T.O.

 **WARNING:** A Power Take-Off must be properly matched to the vehicle transmission and to the auxiliary equipment being powered. An improperly matched Power Take-Off could cause severe damage to the vehicle transmission, the auxiliary driveshaft, and/or to the auxiliary equipment being powered. **Damaged components or equipment could malfunction causing serious personal injury to the vehicle operator or to others nearby.**

#### To avoid personal injury and/or equipment damage:

- Always refer to Chelsea catalogs, literature, and owner's manuals and follow Chelsea recommendations when selecting, installing, repairing, or operating a Power Take-Off.
- Never attempt to use a Power Take-Off not specifically recommended by Chelsea for the vehicle transmission.
- Always match the Power Take-Off's specified output capabilities to the requirements of the equipment to be powered.
- Never use a Power Take-Off whose range of speed could exceed the maximum.

#### Cold Weather Operation of Powershift P.T.O.

 **WARNING:** During extreme cold weather operation [32°F (0°C) and lower], a disengaged Powershift 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:

- Driven equipment must have separate controls.
- 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.

 This symbol warns of possible personal injury.

## Safety Information (Continued)

### 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.

### Guarding Auxiliary Driveshafts



**WARNING:** We strongly recommend that a Power Take-Off and a directly mounted pump be used to eliminate the auxiliary driveshaft whenever possible. If an auxiliary driveshaft is used and remains exposed after installation, it is the responsibility of the vehicle designer and P.T.O. installer to install a guard.

### Using Set Screws



**WARNING:** Auxiliary driveshafts may be installed with either recessed or protruding set screws. If you choose a square head set screw, you should be aware that it will protrude above the hub of the yoke and may be a point where clothes, skin, hair, hands, etc. could be snagged. A socket head set screw, which may not protrude above the hub of the yoke, does not permit the same amount of torquing as does a square head set screw. Also, a square head set screw, if used with a lock wire, will prevent loosening of the screw caused by vibration. Regardless of the choice made with respect to a set screw, an exposed rotating auxiliary driveshaft must be guarded.

### Important: Safety Information and Owner's Manual

Chelsea Power Take-Offs are packaged with safety information decals, instructions, and an owner's manual. These items are located in the envelope with the P.T.O. mounting gaskets. Also, safety information and installation instructions are packaged with some individual parts and kits. **Be sure to read the owner's manual before installing or operating the P.T.O.** Always install the safety information decals according to the instructions provided. Place the owner's manual in the vehicle glove compartment.



### Warning: Operating the P.T.O. with the Vehicle in Motion

Some Power Take-Offs may be operated when the vehicle is in motion. To do so, the P.T.O. must have been properly selected to operate at highway speeds and correctly matched to the vehicle transmission and the requirements of the driven equipment.

If in doubt about the P.T.O. specifications and capabilities, avoid operating the P.T.O. when the vehicle is in motion. Improper application and/or operation can cause serious personal injury or premature failure of the vehicle, the driven equipment, and/or the P.T.O.

Always remember to disengage the P.T.O. when the driven equipment is not in operation.

### Pump Installation Precautions

Use a bracket to support the pump to the transmission if:

- The pump weighs **40 pounds [18.14 kg]** or more.
- The combined length of the P.T.O. and pump is **18 inches [45.72 cm]** or more from the P.T.O. centerline to the end of the pump.



This symbol warns of possible personal injury.

## Foreword

This booklet will provide you with information on correct installation of Chelsea® Power Take-Offs (P.T.O.'s). Proper installation and set up procedures will help you get additional and more profitable miles from your truck equipment and components.

It is important that you be sure that you are getting the right transmission/P.T.O. combination when you order a new truck. An inadequate transmission will overwork any P.T.O. in a short period of time. In addition, a mismatched transmission and P.T.O. combination can result in unsatisfactory performance of your auxiliary power system from the start.

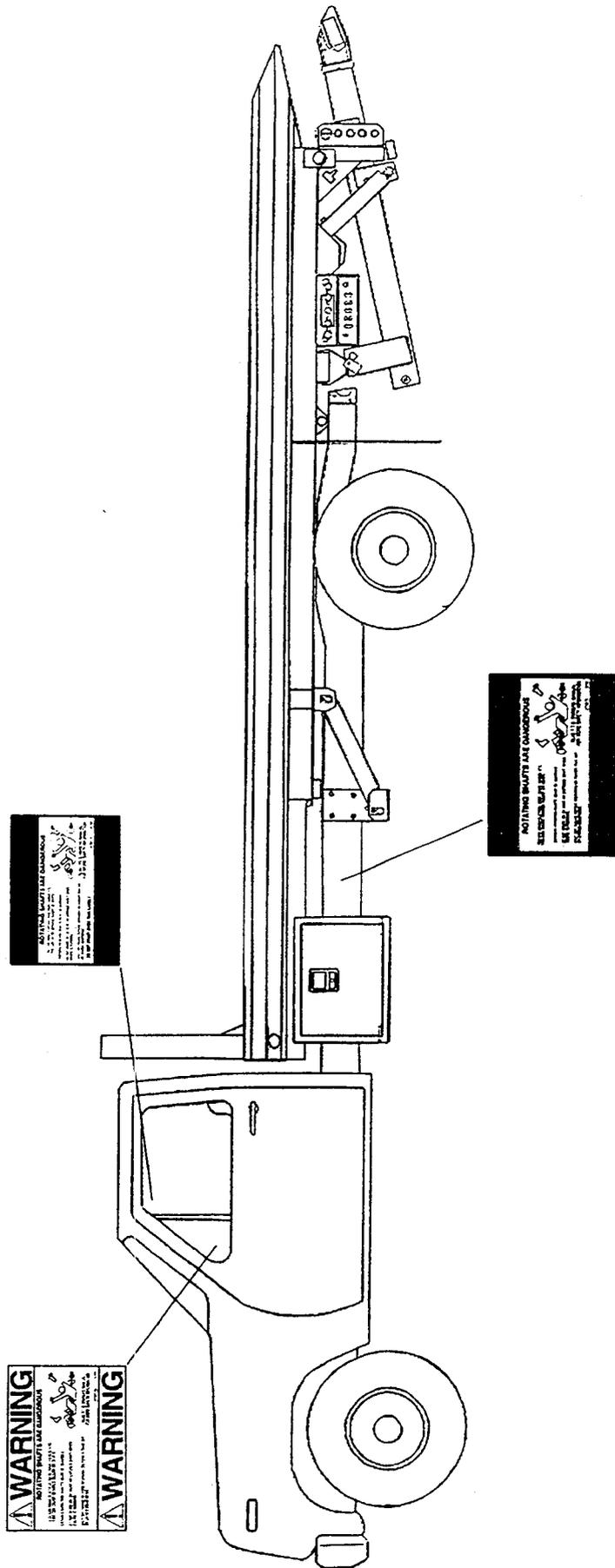
If you have questions regarding correct P.T.O. and transmission combination, please contact your local Chelsea® Auxiliary Power Specialist. They can help you select the properly matched components to insure correct and efficient applications.

## Chelsea P.T.O. Safety Label Instructions

1. The two black and orange on white 5" x 7" pressure sensitive vinyl labels, part number 379274; must be placed on the vehicle frame rails (one (1) on each side), in a position that would be **HIGHLY** visible to anyone that would go under the truck near the P.T.O. rotating shaft. If the vehicle is to be painted after these labels are installed, cover them with two (2) blank masking covers. Remove the masking covers after painting.
2. Place the one (1) black and orange on white 3.5" x 5" pressure sensitive vinyl label, part number 379275, on the visor nearest the operator of the vehicle, this must be placed near the P.T.O. visor label.
3. Place the one (1) white and black heavy duty card, part number 379276, in the vehicle glove box. Again in a position highly visible to the operator, for example: try to place this card on top of whatever may be in the glove box.

If you require labels, please order part number 328946X at no charge from your local Chelsea Warehouse or send request direct to:

**Parker Hannifin Corporation  
Chelsea Products Division  
8225 Hacks Cross Road  
Olive Branch, MS 38654  
Customer Service: (662) 895-1040**



## Function of Auxiliary Power Shafts

An auxiliary power shaft transmits torque from the power source to the driven accessory. The shaft must be capable of transmitting the maximum torque and R.P.M. required of the accessory, plus any shock loads that develop.

An auxiliary power shaft operates through constantly relative angles between the power source and the driven accessory, therefore, the length of the auxiliary power shaft must be capable of changing while transmitting torque. This length change, commonly called "slip movement", is caused by movement of the power train due to torque reactions and chassis deflections.

Joint operating angles are very important in an auxiliary power joint application. In many cases, the longevity of a joint is dependent on the operating angles. (See chart below)

This information is limited to 1000 through 1310 series applications. For applications requiring a series larger than 1310, contact your local Chelsea distributor.

## Determining Shaft Type

- 1) Solid or tubular?
  - a) In applications requiring more than 1000 R.P.M. or where the application necessitates a highly balanced auxiliary power shaft, a tubular shaft should be used.
  - b) Spicer's solid shafting auxiliary power joints are designed for 1000 or less R.P.M. intermittent service such as:
    - Driving small hydraulic pumps
    - Driving winches
    - Driving low speed product pumps
- 2) Joint Series should be determined using the chart on the following page.

Spicer® Universal Joint Operating Angles			
Prop. Shaft R.P.M.	Max. Normal Operating Angle	Prop. Shaft R.P.M.	Max. Normal Operating Angle
3000	5° 50'	1500	11° 30'
2500	7° 00'	1000	11° 30'
2000	8° 40'	500	11° 30'

Above based on angular acceleration of 100 RAD/SEC<sup>2</sup>

**Spicer® Universal Joint Engineering Data**

Joint Series	1000	1100	1280	1310
<b>Torque Rating</b> Automotive (Gas or Diesel Engine) lbs. ft. Continuous	50	54	95	130
<b>Tubing</b> Diameter	1.750	1.250	2.500	3.00
Wall Thickness	.065	.095	.083	.083
W = Welded S = Seamless	W	S	W	W
<b>Flange Diameter (Swing Diameter)</b> Rectangular Type	3.500	3.500	3.875	3.875
<b>Bolt Holes - Flange Yoke</b> Circle	2.750	2.750	3.125	3.125
Diameter	.312	.312	.375	.375
Number	4	4	4	4
Male Pilot Dia.	2.250	2.250	2.375	2.375
<b>Distance Across Lugs</b> Snap Ring Construction	2.188	2.656	3.469	3.469
<b>Bearing Diameter</b>	.938	.938	1.062	1.062

<b>Maximum Operating Speed * By Tube Size, Solid Shaft Size, and Length</b> *(For speed below 500 R.P.M. or over 2500 R.P.M., contact your Chelsea Distributor)					
Tubing Dia. & Wall Thickness Joint & Shaft (W=Welded S=Seamless)	Max. Installed Length in Inches for Given R.P.M. Centerline to Centerline of Joints for a Two Joint Assembly or Centerline of Joint to Centerline of Center Bearing for a Joint & Shaft R.P.M. - Revolutions per Minute				
	500	1000	1500	2000	2500
1.750" X .065" W	117"	82"	67"	58"	52"
1.250" X .095" S	91"	64"	52"	45"	40"
2.500" X .083" W	122"	87"	70"	62"	55"
3.000" X .083" W	-	-	-	85"	76"
<b>Solid Shaft Diameter</b>					
.750"	60"	42"	35"	30"	27"
.812"	62"	44"	36"	31"	28"
.875"	65"	46"	37"	32"	29"
1.000"	69"	49"	40"	35"	31"
1.250"	77"	55"	45"	39"	35"

## Mounting P.T.O. to Transmission for 230, 236, 250, 270, 800, 852 and 885 Series

1. Remove the P.T.O. aperture cover plate (Fig 1).
2. Discard the cover plate and cover plate gasket, then clean the aperture pad using a putty knife or wire brush (Fig 2).



Figure 1

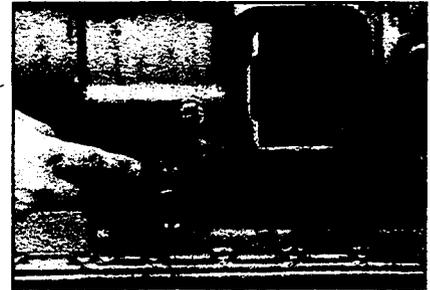


Figure 2

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

4. Tighten the studs to 17 - 19 ft. lbs. (2.38 - 2.66 kg. meters) and then torque the capscrews to 32 - 37 ft. lbs. (4.43 - 5.12 kg. meters) for the 6 or 8 bolts (Fig 4).
5. For the 230, 236, 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.

The 250 Series requires (1) 35-P-41 gasket for installation and no backlash to check ( 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. Secure P.T.O. to the transmission.
  - Use self locking nuts provided with P.T.O. (Fig 6).

NOTE: Self locking nuts do not require lock washers (Fig 7).

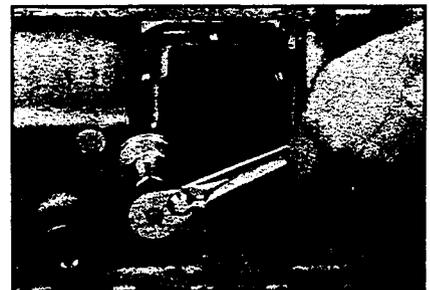


Figure 3

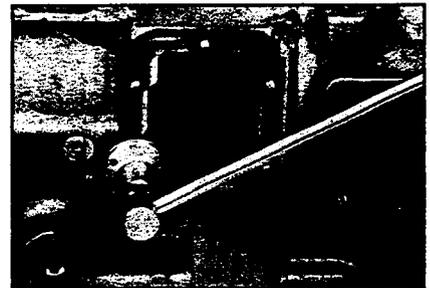


Figure 4



Figure 5



Figure 6

7. Fasten the P.T.O. to the transmission. Torque the self locking nuts to their proper specifications (Fig 8).
- 379744: 3/8"-24 for six bolt applications 35-40 ft. lbs. (4.83-5.52 kg.m)
  - 379745: 7/16"-20 for eight bolt applications 55-60 ft. lbs. (7.59-5.52 kg.m)

Torque capscrews to their proper specifications.

- 7a. The 236 Series has an inspection plate that can be removed to check for proper backlash. Refer to page 12 for checking backlash procedure.
8. There are two (2) large drilled and tapped holes on the 230, 270, 800, and 852 Series P.T.O. housing (See Fig 9). These two holes come with plugs installed. (Fig 9)
9. 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 and 885 Series are 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 Overspeed Control. If you are not using an Electronic Overspeed Control, the plug will remain in the housing (Fig 10). After checking backlash, continue with the plumbing and wiring of the controls.

10. There is a hole drilled and tapped on the 250 Series on the P.T.O. housing. This hole comes with a plug installed and is used for the high pressure line from the transmission (Fig 10-A).

See Page 26 for complete installation drawing.

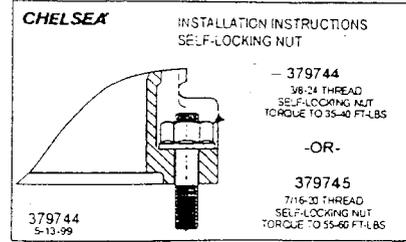


Figure 7



Figure 8



Figure 9



Figure 10

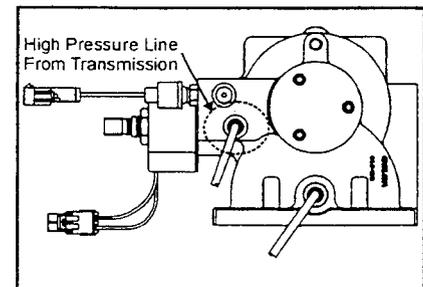


Figure 10-A

## Mounting P.T.O. to Transmission for 231 and 271 Series

1. Remove the 6 bolt cover and gasket from the 6 bolt aperture. Clean the 6 bolt aperture as in step 2 on page 3 (Fig 1).
2. Place the 6 bolt rubber coated gasket on the transmission. The beaded (raised) surface should be facing the special mounting plate. (Fig 2).
3. Next, fasten the special mounting plate onto the opening with the three (3) socket head bolts. The three socket head bolts always go in the three holes closest to the two (2) welded-on nuts. Figure 3 shows the plate position for a P.T.O. with a "5" assembly arrangement. Torque the three socket head bolts to 300 in. lbs. (3.5 kg. meters) using an inch pound torque wrench.
4. Place the special gasket on the plate (Fig 4). Again, the gasket and plate can be mounted in two (2) positions depending on your assembly arrangement. See step 3.
5. Place the 231 or 271 on the plate (Fig 5). There are 5 (five) capscrews that hold the 271 to the transmission and plate. Make sure all 5 capscrews that go through the plate and into the transmission have copper gasket washers under them.
6. All 5 capscrews can be tightened and torqued with a 3/8" drive socket wrench (Fig 5). Torque all capscrews to 32 - 37 ft. lbs. (4.43 - 5.12 kg. meters).



Figure 1

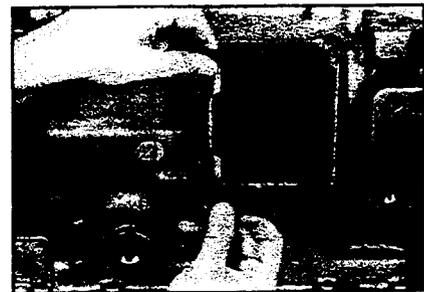


Figure 2



Figure 3

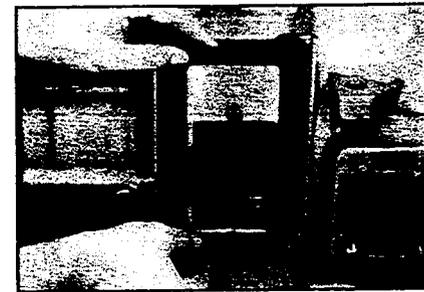


Figure 4

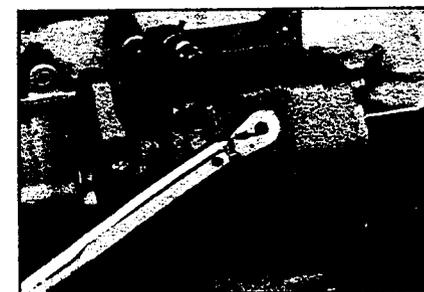


Figure 5

7. Bend the tabs to lock the nuts (Fig 6).
8. There are two (2) large drilled and tapped holes on the 231 and 271 series P.T.O. housing (Fig 7). These two holes come with plugs installed.
9. One of the plugs will be used for the dump line from the solenoid to the housing of the 231 and 271 series. The 231 series does not require the dump line.

The second plug, which is positioned over the input gear, must be removed and replaced with a transducer when using the Chelsea Electronic Overspeed Control. If you are not using an Electronic Overspeed Control, the plug will remain in the housing (Fig 8). After checking backlash, continue with the plumbing and wiring of the controls.



Figure 6



Figure 7



Figure 8

## Checking Backlash

To check for proper backlash on P.T.O.s with shift cover

1. Remove the P.T.O. shift housing and/or inspection plate.
2. Mount the dial indicator so that it registers movement of the input gear (driven gear) of the P.T.O. (Fig. 9).

NOTE: See Figure 10 for proper location of dial indicator contact point. (Two common type dial indicators shown).

3. Hold the P.T.O. driver gear in transmission with a screwdriver or bar and rock the P.T.O. input gear (driven gear) back and forth with your hand. Note the total movement on the dial indicator.
4. Establish backlash at .006" - .012" [.15mm - .30mm] by adding or subtracting gaskets.

**General rule: A Chelsea .010" gasket will change backlash approx. .006". A .020" gasket changes backlash approx. .012".**

5. Replace the shift housing and/or inspection plate and retorque (4) four capscrews to 16-20 ft. lbs. (2.21-2.76 kg meters).

NOTE: Apply a drop of Loctite 290 on each capscrew before reinstalling. Capscrews that are furnished with a conversion kit and are being installed for the first time do not require the drop of Loctite.



Fig. 9

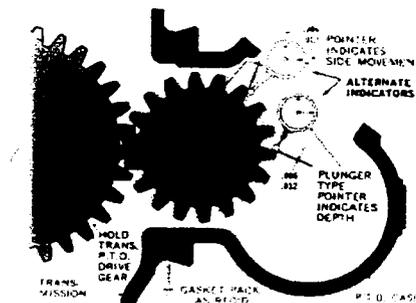
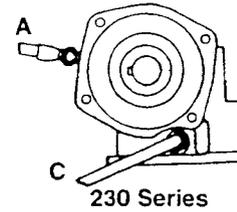


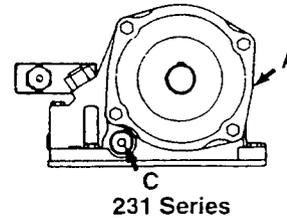
Fig. 10

### Powershifts P.T.O. Hose Connection Illustrations

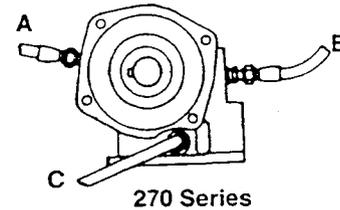
- A. Air Pressure Line From Valve.
- C. Lubrication Line From Transmission. Attach to Either End of IDLER Shaft.



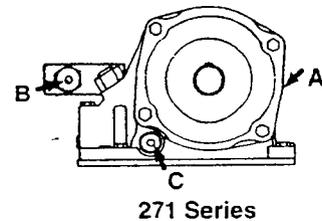
- A. Air Pressure Line From Valve.
- C. Lubrication Line From Transmission. Attach to Either End of IDLER Shaft.



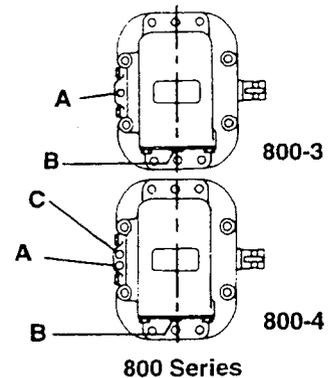
- A. High Pressure Line From Valve.
- B. Dump Line to P.T.O. From 3 Way Valve.
- C. Lubrication Line From Transmission. Attach to Either End of IDLER Shaft.



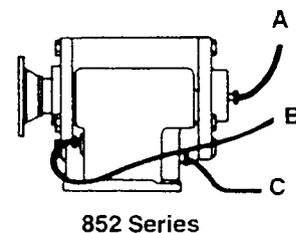
- A. High Pressure Line From Valve.
- B. Dump Line to P.T.O. From 3 Way Valve.
- C. Lubrication Line From Transmission. Attach to Either End of IDLER Shaft.



- A. High Pressure Line From Valve.
- B. Dump Line to P.T.O. From 3 Way Valve.
- C. Lubrication Line From Transmission.



- 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.

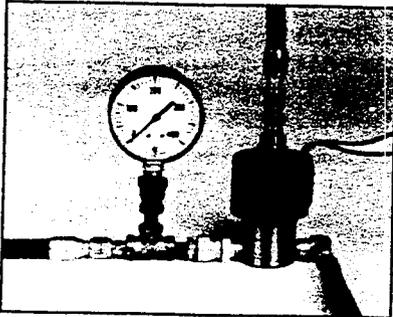




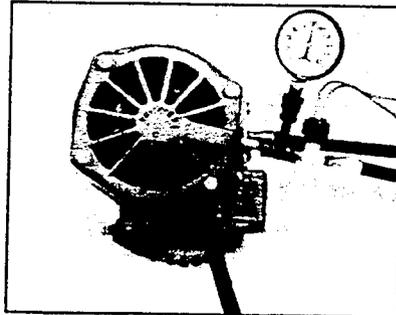
### Circuit Check for Powershift P.T.O. for 270, 271, 800 and 852 Series on Automatic Transmissions

Perform the following steps. Record the results when installing the P.T.O. originally, as a replacement, or while troubleshooting.

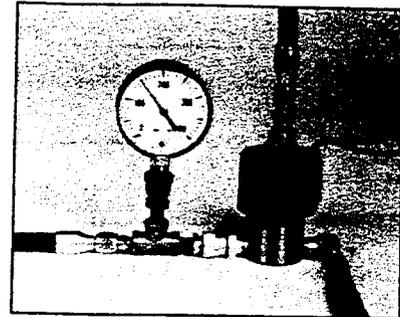
1. Install 2 Pressure Gauges in the circuit as shown: 300 - 400 PSI Gauges for Allison's.
2. With the Solenoid Valve "Off," record the pressures at inlet to Solenoid Valve for the transmission both cold (ambient) and at the operating temperature for engine idle R.P.M. and engine maximum R.P.M.



Before 378965 Screen Adapter @ "In" Port of Solenoid Valve.



Between 378966 Screen Adapter and P.T.O. Port.



For Allison's should be 90-270 PSI.

Rpm	Transmission Cold (Ambient)	Transmission At Operating Temperature
Engine Idle	PSI	PSI
Engine Maximum	PSI	PSI

### Circuit Check For Powershift P.T.O. For 270, 271, 800 and 852 Series on Automatic Transmissions

3. With the Solenoid Valve "On," record the corresponding pressures at the 2 gauges with the transmission both cold (ambient) and at the operating temperature for engine idle R.P.M. and engine maximum rpm.

Engine R.P.M.	Transmission Cold (ambient)		Transmission At Operating Temperature	
	Into Solenoid	Into PTO	Into Solenoid	Into PTO
Idle	PSI	PSI	PSI	PSI

If at any time the above pressures are below 90 PSI or there is a 50 PSI or more difference in two of the corresponding readings in Part 3:

- (a) Check the circuit for correct installation.
  - (b) Check hoses and screens for obstruction.
4. Remove the "B" line from the P.T.O. with the Solenoid Valve "On." No oil should appear from the line. Then turning the Solenoid Valve to "Off" should dump the oil from the P.T.O. Clutch Pack through this line.
  5. Remove the "C" line from the P.T.O. Idler Shaft end, and confirm that oil is running to this shaft for lubrication.

Retain the findings of these tests for future comparison. Re-check the oil level in the transmission after testing is complete. This concludes your installation and circuit checks. Make sure all lines are reconnected (lube lines and pressure solenoid lines).

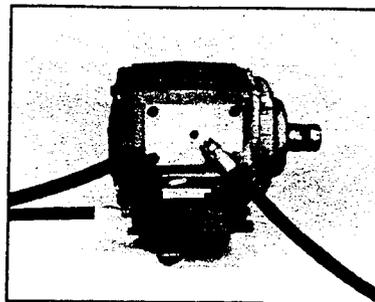


Fig. 1

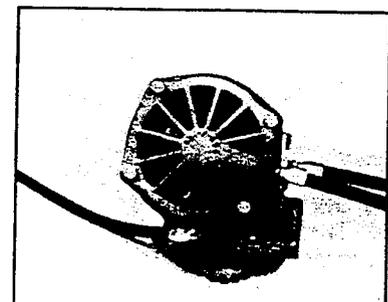


Fig. 2

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## **P.T.O. Shifting Procedure & Precautions for 1000, 2000/2400, AT, MT & HT Series Transmissions**

**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.

Consult operating instructions before using. (See Sun Visor)

POWER TAKE-OFF OPERATION VEHICLE STATIONARY.

**1. Automatic Transmission with Powershift P.T.O.**

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

**2. Manually Shifted Transmission with Powershift P.T.O.**

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

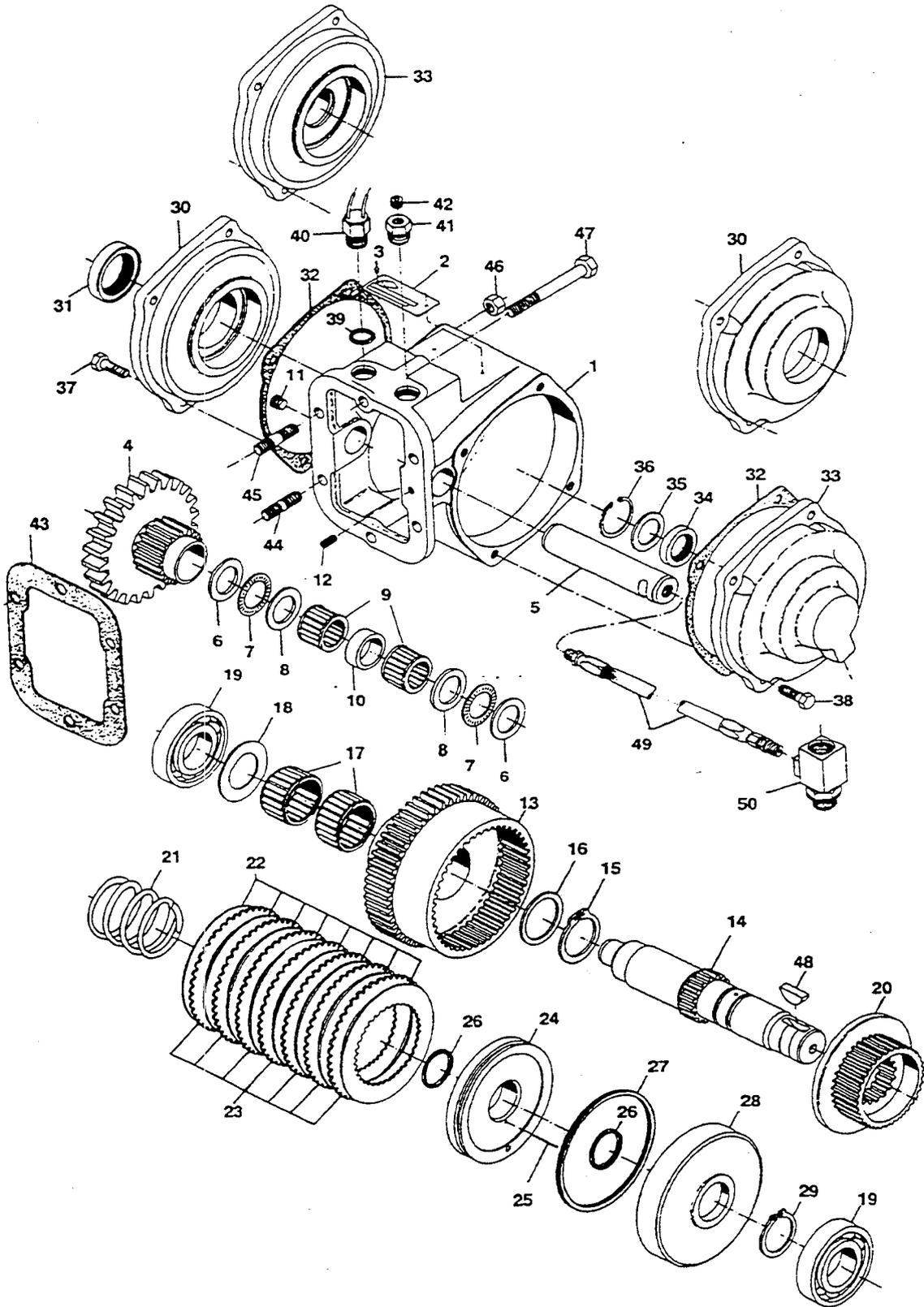
**NOTE:** Powershift P.T.O.: The engine must be at idle or below 1,000 R.P.M. when the P.T.O. is initially engaged. See the transmission manufacturer's instructions for special procedures.

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

**NOTE:** There is a torque converter lock up feature available with the 1000/2000/2400 Series transmissions. The torque converter lock up feature comes on and is controlled by the Transmission Control Module (TCM) at 1100 engine RPM when a signal is provided to the "P.T.O. Enable" circuit of the TCM by the P.T.O. switch. Lock up will only come on in the "NEUTRAL" and "PARK" positions. The lock up clutch does not come on automatically in "DRIVE" at 1100 R.P.M.

# 270 SERIES

## PARTS LIST & SPECIFICATIONS



**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	FRICITION 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)	1
		(Includes items 33 thru 36)	
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 Use To Mount Gear Pitch Models 270XAAJ, 270XBAJ, 270XDAJ	1
	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
<b>LOOSE PARTS</b>			
	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			
<b>SERVICE KITS</b>			
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

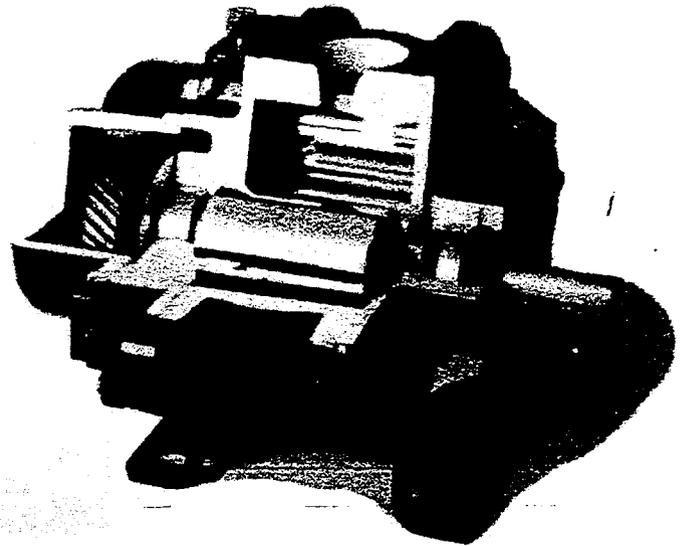
Tuthill Pneumatics

# COMPETITOR<sup>PLUS</sup>™

## Rotary Positive Displacement Air Blower

<b>Models</b>	2002	3002	4002	5003	6005	7006
	2004	3003	4005	<u>5006</u>	<u>6008</u>	7011
		3006	4007	<u>5009</u>	6015	7018

INSTALLATION  
OPERATION  
MAINTENANCE  
REPAIR  
MANUAL



### **WARNING**

DO NOT OPERATE BEFORE  
READING MANUAL.



**LEADING THE SEARCH FOR NEW SOLUTIONS**



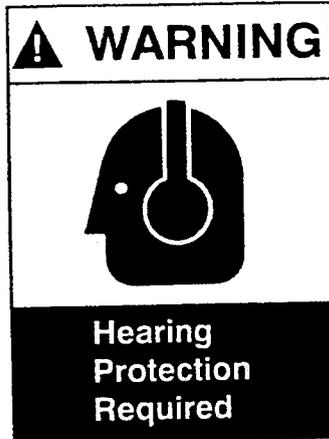
**TUTHILL**  
**Vacuum and Blower Systems**

4840 West Kearney Street, P. O. Box 2877  
Springfield, Missouri USA 65801-2877  
Tel 417 865-8715 800 825-6937 Fax 417 865-2950  
E-mail: [mdpneumatics@tuthill.com](mailto:mdpneumatics@tuthill.com)

<http://pneumatics.tuthill.com>

### SAFETY INSTRUCTIONS

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



#### SAFETY WARNING

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

TUTHILL PNEUMATICS GROUP

Springfield, MO USA

#### NOTICE

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

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

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## SAFETY PRECAUTIONS

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

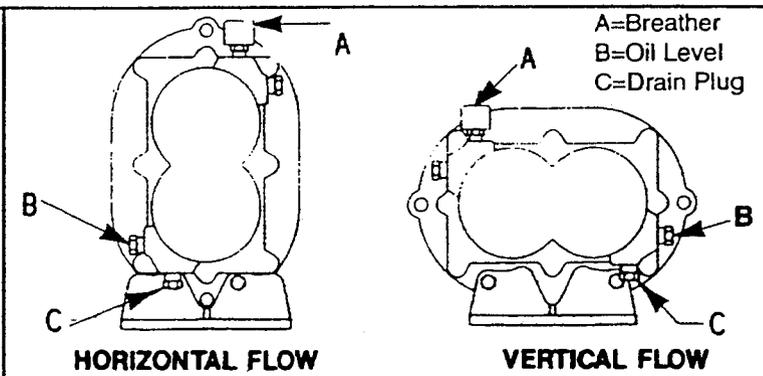
- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while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

### CAUTION!

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

If drive shaft location is changed, the oil level plug and breather must be relocated to proper positions, as shown to the right.

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



# INTRODUCTION

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

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

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

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

## OPERATING DATA

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

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

**NOTES:** \_\_\_\_\_  
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## INSTALLATION

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

Do not use air blowers on explosive or hazardous gases. Each size blower has limits on pressure differential, running speed, and discharge temperature, which *must not* be exceeded. These limits are shown on the table "Maximum Operating Limits" on page 14.

### LOCATION

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

### FOUNDATION

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

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

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

### DRIVE

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

Adjust the belt tension to the belt manufacturer's specifications.

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

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

### PROTECTIVE MATERIALS

Remove protective materials from the shaft.

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

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

### LUBRICATION

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

### PIPING

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

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

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

### RELIEF VALVES

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

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

# 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 oil. Recommended lubricants are shown on page 15.

## 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.

\*Models 2002 and 2004 do not have oil breathers. 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" below.) Use NLGI #2 premium grade, petroleum base grease with high temperature resistance and good mechanical stability, such as PneuLube grease available from your local Tuthill Pneumatics Sales Professional. Using a pressure gun, force new grease into each bearing until traces of clean grease come out of the relief fitting.

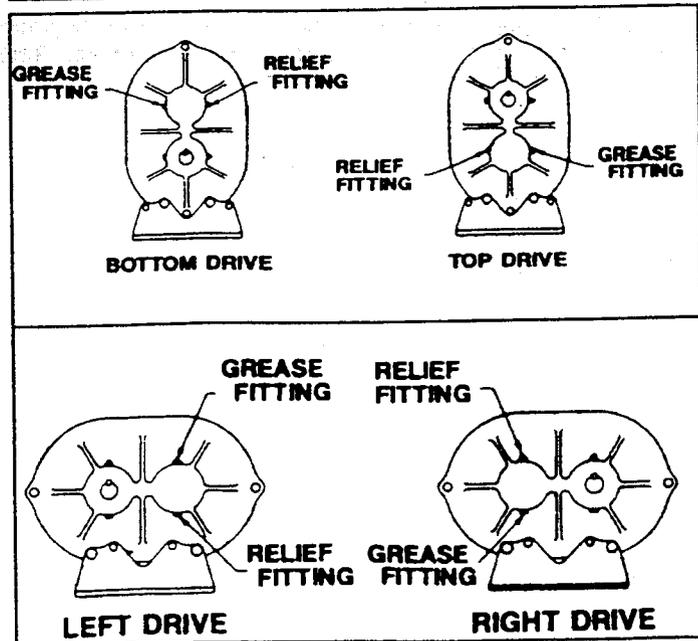
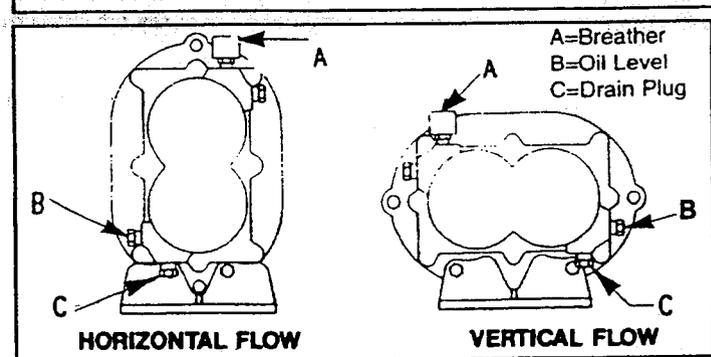
**CAUTION:** To avoid blowing out the drive shaft seal, do not inject grease too rapidly.

### LUBRICATION INSTRUCTIONS FOR OIL LUBRICATED GEARS AND BEARINGS

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

**See page 15 for list of recommended lubricants.**

SUGGESTED LUBRICATION INTERVALS FOR GREASE LUBRICATED BEARINGS			
SPEED IN RPM	OPERATING HOURS PER DAY		
	8	16	24
	GREASING INTERVALS IN WEEKS		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 and up	1	1	1



# PREVENTATIVE MAINTENANCE

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

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

The following is recommended as a minimum maintenance program.

DAILY MAINTENANCE	WEEKLY MAINTENANCE	MONTHLY MAINTENANCE
1. Check and maintain oil level, and add oil as necessary.	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage.	1. Inspect the entire system for leaks.
2. Check for unusual noise or vibration (See Troubleshooting on page 8)	2. Check relief valve to assure it is operating properly	2. Inspect condition of oil and change if necessary (see page 6)
		3. Check drive belt tension and tighten if necessary.

## START-UP CHECKLIST

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

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

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Date Checked

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1. Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to Lubrication Section.

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2. Check Alignment.

For Direct Drive: Check coupling and shaft alignment.  
For Belt Drive: Check for proper belt alignment and tension.

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3. Turn the rotors by hand to be certain they do not bind.

**WARNING:** Disconnect power. Make certain power is off and locked out before touching any rotating element of the blower, motor or drive components.

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4. "Bump" the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.

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5. Start the unit and operate it for 30 minutes at no load. During this time, feel the cylinder for hot spots. If minor hot spots occur, refer to the Troubleshooting Section (page 8).

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6. Apply the load and observe the operation of the unit for one hour. Check the unit frequently during the first day of operation.

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7. If minor malfunctions occur, discontinue operation and refer to the Troubleshooting Section (page 8).

## TROUBLESHOOTING

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

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

## RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

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

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

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

January, 2001

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

## 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 repairs or replacements.

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

Gears are not exposed for visual inspection. Items in brackets [ ] are referenced to item numbers on page 17.

Inspect the gears for the following:

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

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

## 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 below)

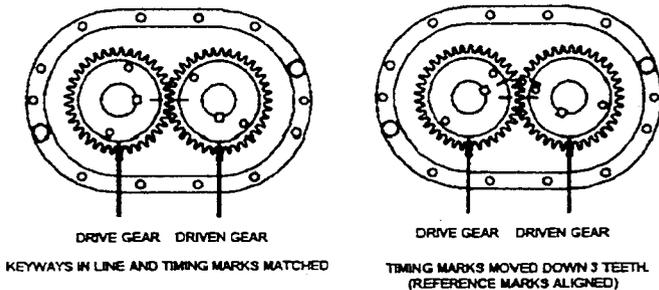


Figure 1. Timing Gear Alignment

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

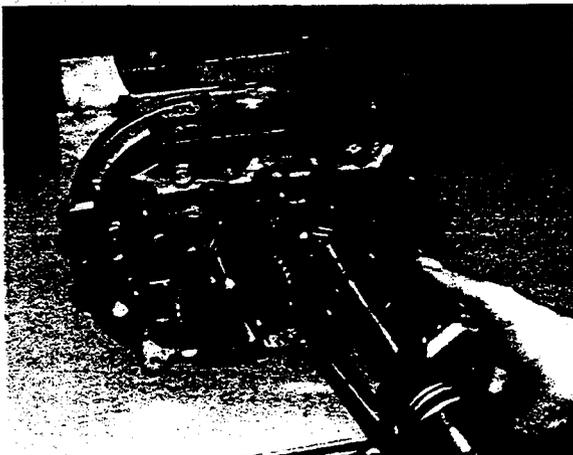


Figure 2. Pulling Driven Gear with Jaw Puller

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

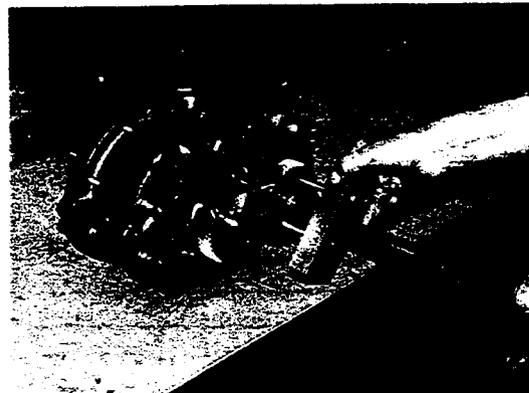


Figure 3. Pulling Drive Gear with Bar Puller

Remove shim and spacer. [Items 28 & 30]

Turn blower around and remove grease cover [Item 10]

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

Use jackscrews to remove end plate. (Refer to Figure 4 below)

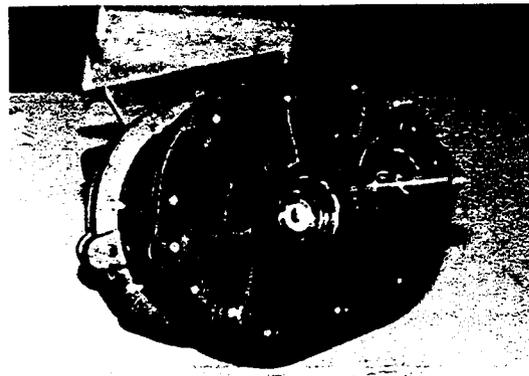


Figure 4. Pulling Drive End Plate

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 below)

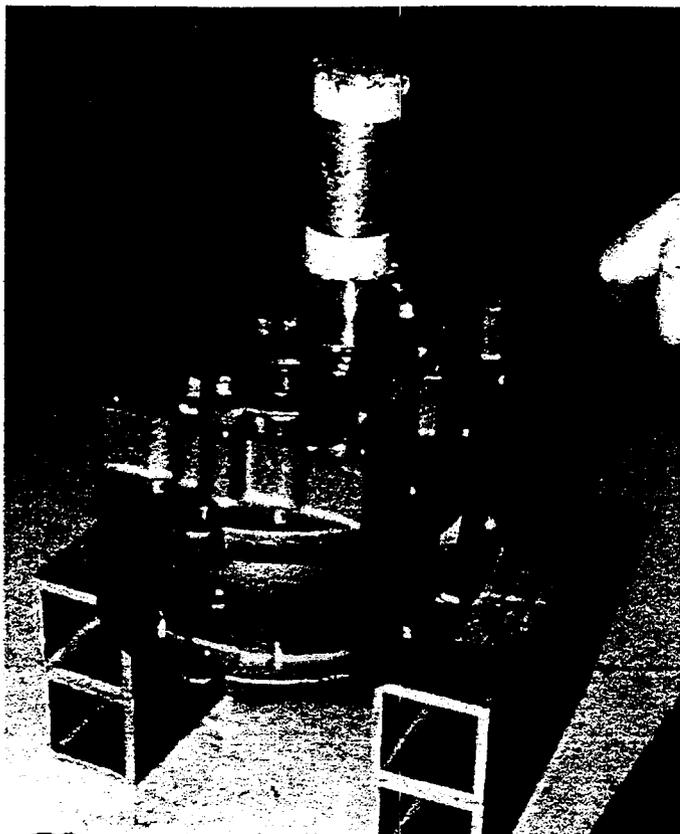


Figure 5. Driving Rotors Out Using Soft Mallet

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

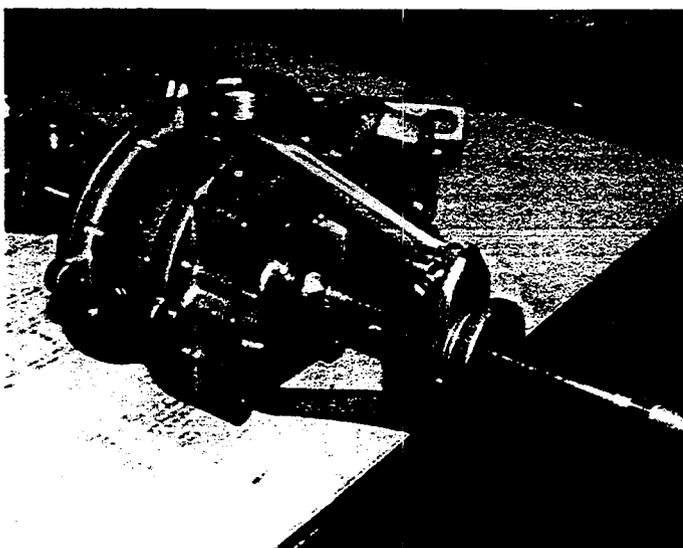


Figure 6. Driving Rotors Out Using Jaw Puller

Using a tube or round bar of a slightly smaller diameter than the shaft clearance holes in the end plates, tap the bearings out of the end plates. Bearing retainers [Item 22] must be removed before knocking out the bearings. (Refer to Figure 7 below)

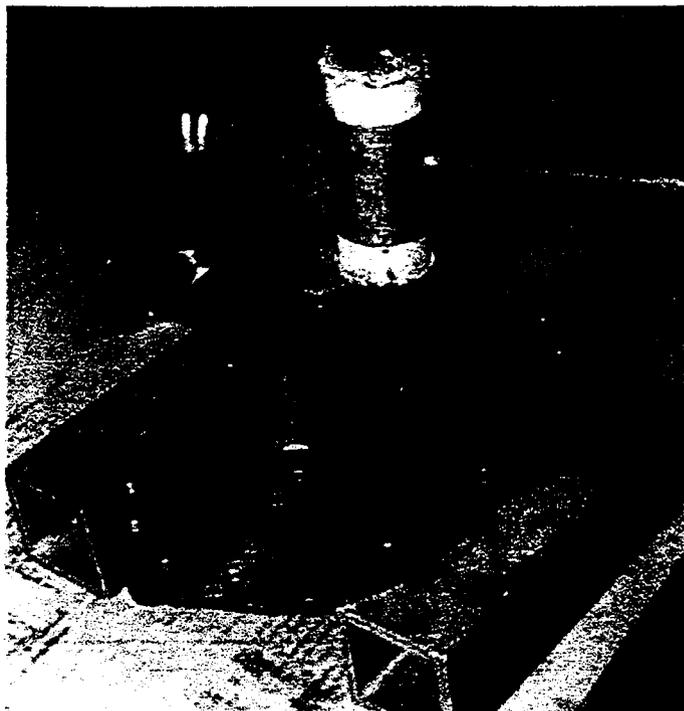


Figure 7. Tapping Bearings Out of End Plates

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

Inspect all parts for wear and or damage.

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

Items in brackets [ ] are referenced to item numbers on page 17.

## 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 below). Place rotors in fixture with the drive rotor to the left. (See Figures A1 and A2 below)

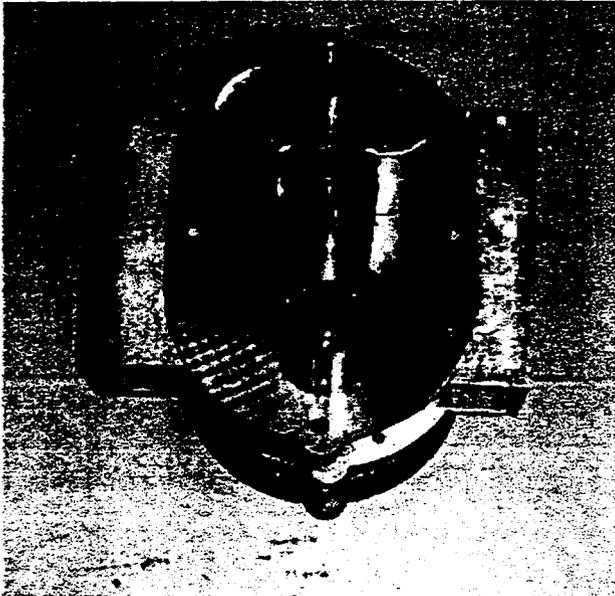


Figure A1. Rotors Assembled on Drive End Plate

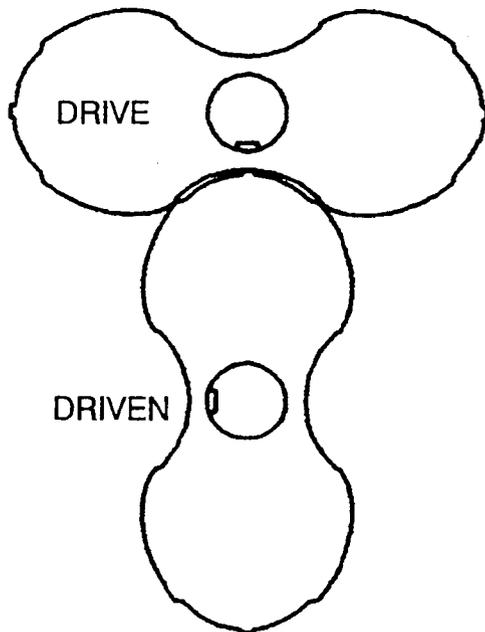


Figure A2. Detail of Proper Keyway Positions  
(NOTE: Keyway positions are exactly opposite for models 6005, 6008 and 6015)

Place end plate [Item 4] on rotors.

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

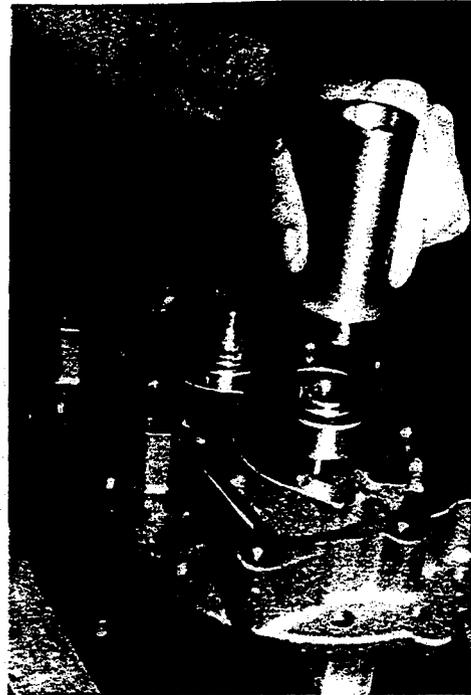


Figure A3. Tapping Bearings into End Plates

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.

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

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

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

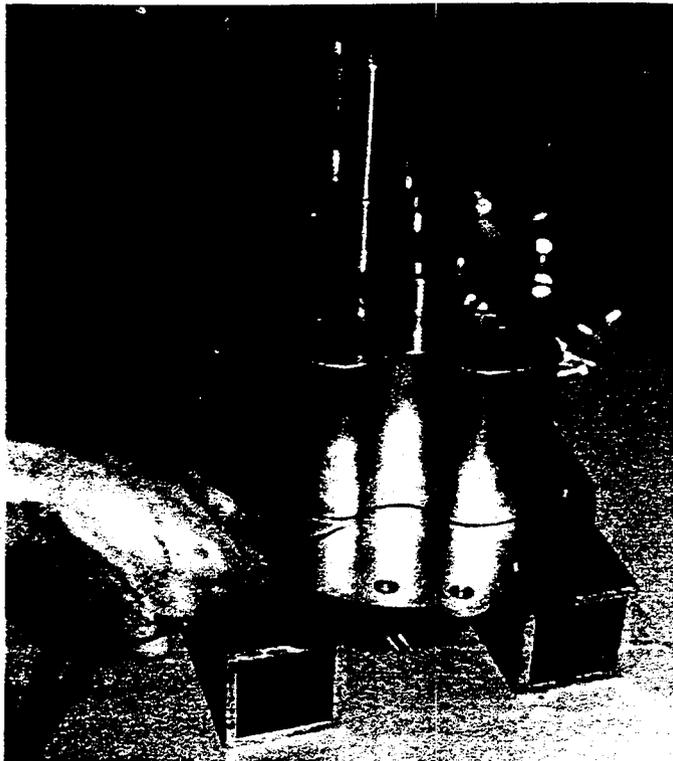


Figure A4. Checking Gear End Clearances

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

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

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

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

Install grease cover [Item 10] and drive shaft seal [23].

Install any removed plugs [18] and replace breather [27] if required.

Items in brackets [ ] are referenced to item numbers on page 17.

## ADJUSTING ROTOR INTERLOBE CLEARANCE

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

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

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

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

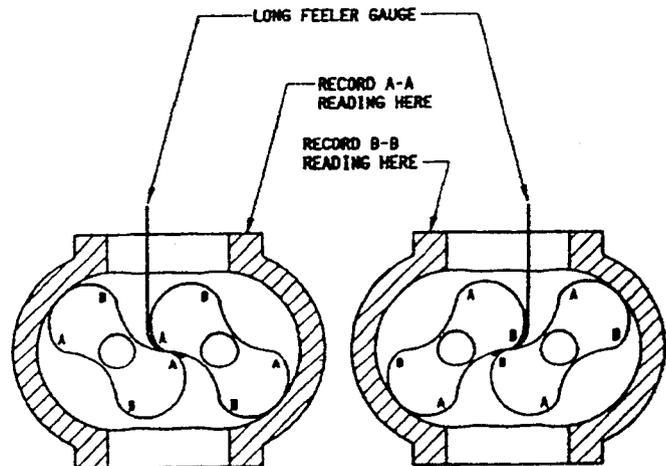


Figure A5. Checking Gear End Clearances

## 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 silicone 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 in this manual 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 connecting to the driver.

# COMPETITOR<sup>PLUS</sup>™

## MAINTENANCE AND SERVICE SPECIFICATIONS SHEET ASSEMBLY CLEARANCES

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

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

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

# COMPETITOR<sup>PLUS</sup>™

## MAINTENANCE AND SERVICE SPECIFICATIONS SHEET RECOMMENDED LUBRICANTS AND CAPACITIES

### RECOMMENDED MINERAL BASED LUBRICANTS

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

### RECOMMENDED SYNTHETIC BASED LUBRICANTS FOR TUTHILL PNEUMATICS ROTARY BLOWERS \*

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

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

### RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS FOR TUTHILL PNEUMATICS ROTARY BLOWERS

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

### OIL RESERVOIR CAPACITIES \*

MODEL	FLUID OUNCES (mL)	
	HORIZONTAL FLOW	VERTICAL FLOW
2002, 2004	1.7 (50)	3.4 (100)
3002, 3003, 3006	3.0 (90)	5.1 (150)
4002, 4005, 4007	5.1 (150)	6.8 (200)
5003, 5006, 5009	6.8 (200)	16.9 (500)
6005, 6008, 6015	16.9 (500)	25.4 (750)
7006, 7011, 7018	20.3 (600)	28.7 (850)

\* Oil capacities are based on filling from dry condition. Less oil may be needed depending on emptiness of oil reservoir (gear housing) after draining.

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

### RECOMMENDED GREASE FOR DRIVE END:

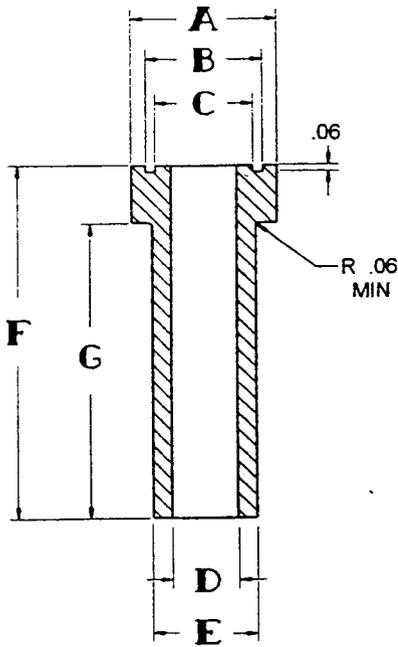
Use NLGI #2 premium grade, petroleum base grease with high temperature resistance and good mechanical stability, such as PneuLube grease available from your local Tuthill Pneumatics Sales Professional. Using a pressure gun, force new grease into each bearing until traces of clean grease come out of the relief fitting.

### FOR FOOD GRADE APPLICATIONS:

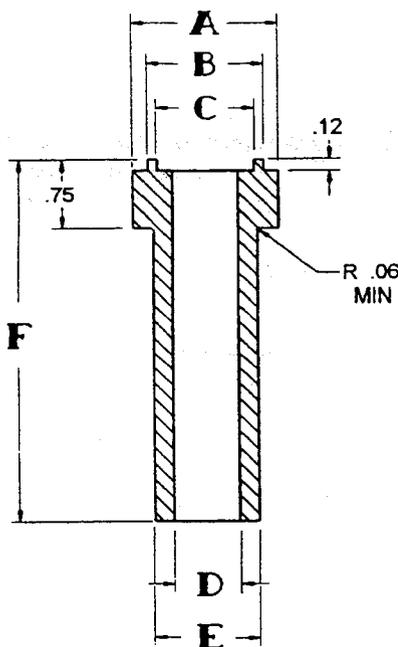
CITGO CLARION<sup>®</sup> Food Grade HTEP NLGI #2 premium grade grease with high temperature resistance and good mechanical stability that is USDA authorized for use as an H1 lubricant in meat and poultry plants under the federal inspection program. It meets FDA Regulation 21 CFR 178.3570 for lubricants having incidental contact with food.

# SPECIAL TOOL DRAWINGS

All dimensions shown are in inches.



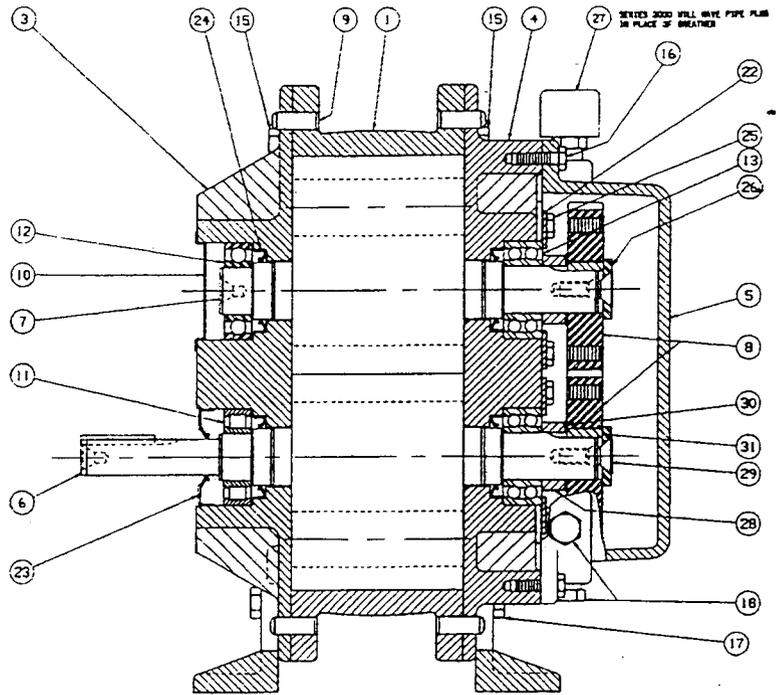
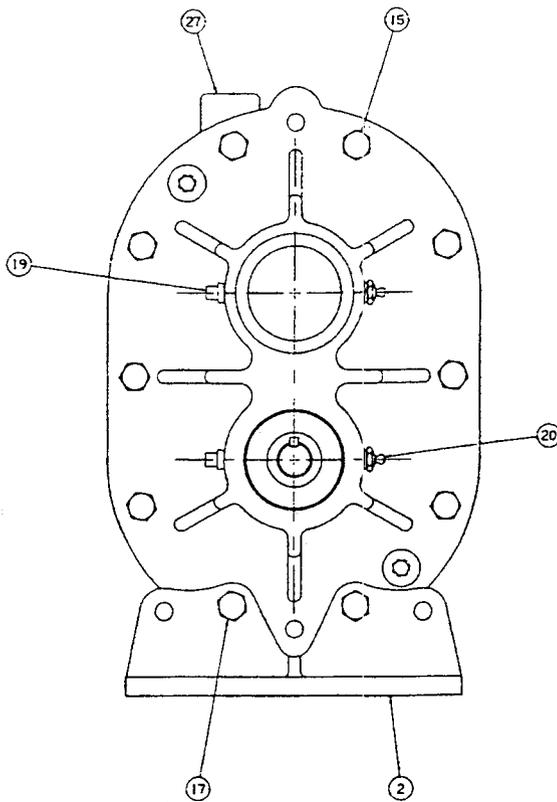
MODEL	PART NUMBER	A	B	C	D	E	F	G
2000	2200718B	1.560 ±.001	1.27 ±.005	.98 ±.005	.70 ±.005	1.10 ±.005	3.50 ±.005	3.00 ±.005
3000	3300718B	2.035 ±.001	1.70 ±.005	1.335 ±.005	1.015 ±.005	1.415 ±.005	3.75 ±.005	3.00 ±.005
4000	4200718B	2.425 ±.001	2.02 ±.005	1.61 ±.005	1.21 ±.005	1.61 ±.005	4.50 ±.005	3.75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



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

# COMPETITOR<sup>PLUS</sup>™

## CUTAWAY VIEW AND PARTS LIST



ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Housing	1	15	Screw, Hex Head	16
2	Mounting Foot	2 *	16	Screw, Hex Head	8 **
3	Drive End Plate	1	17	Screw, Hex Head	4
4	Gear End Plate	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 Head	4
11	Roller Bearing, Drive Shaft	1	26	Washer	2
12	Bearing	1	27	Breather †	1
13	Bearing	2			

\* Item 2: Models 6005, 6008, 6015, 7006, 7011 and 7018 require (2) each of left and right feet.

\*\* Item 16: Models 5003, 5006 and 5009 require (6) each.

† Item 27: Models 2002 and 2004 requires a pipe plug in lieu of breather.

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

## WARRANTY

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

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

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

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

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

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

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

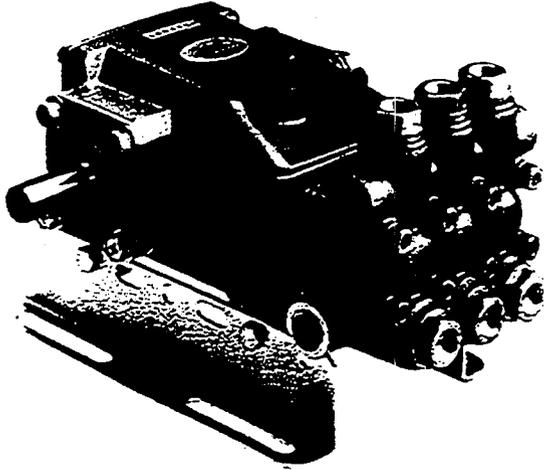
The products and parts sold hereunder are not warranted for operation with erosive or corrosive material or those which may lead to build up of material within the product supplied, nor those which are incompatible with the materials of construction. The Buyer shall have no claim whatsoever and no product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

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

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

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

March, 2002

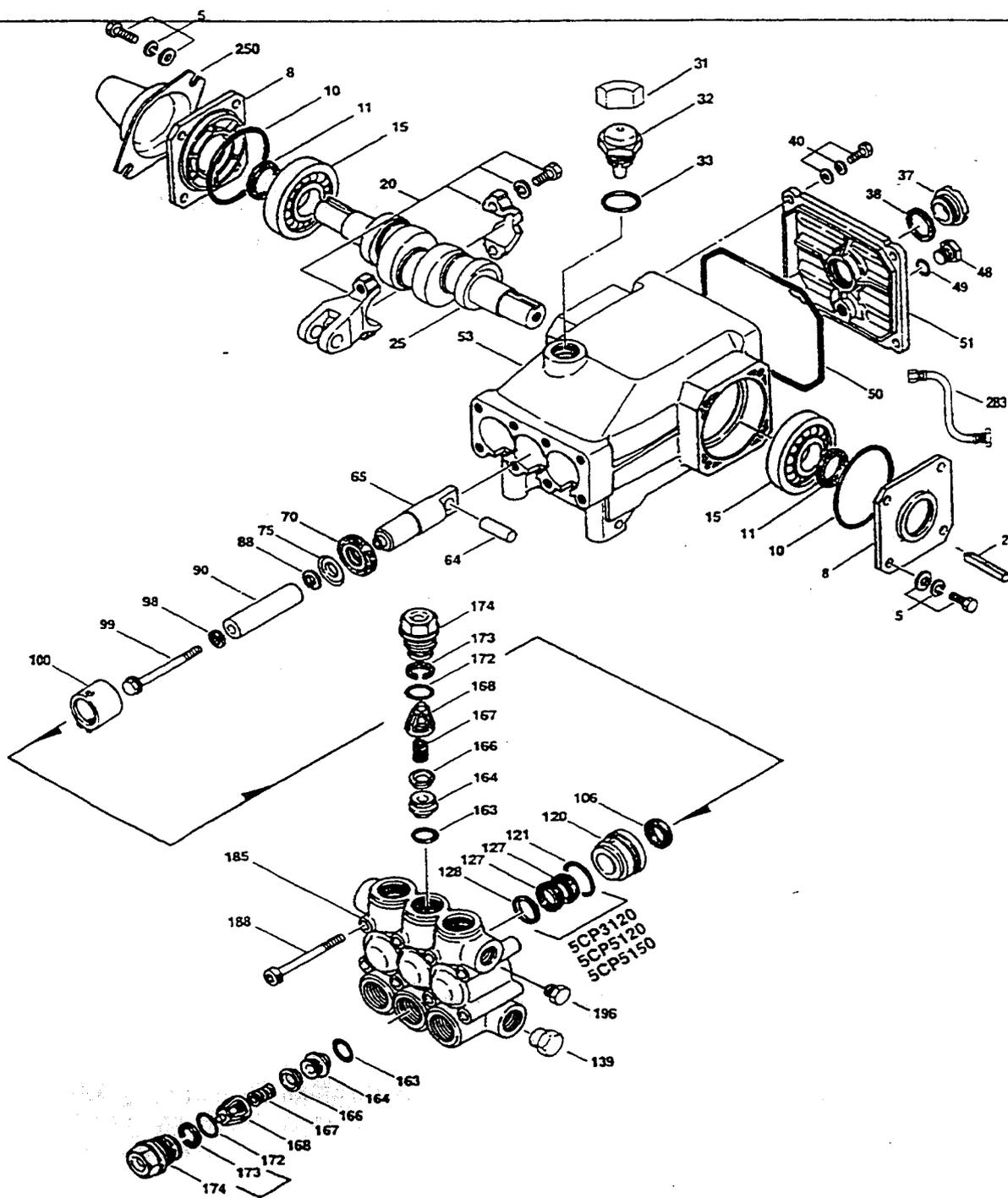


## 5CP Plunger Pump Models

**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)



# PARTS LIST

ITEM	PART NUMBER	DESCRIPTION	QTY
	SCP3120	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	43749	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
265	30637	STZP	Mount, Angle Assy-Retro fit	1
	30659		Kit, Complete Mounting (Incls: 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 (Incls: 98, 106, 121,125)	1
	—		Kit, Seal (Incls: 98,106,121,125)	1
	33629	NBR	Kit, Seal (Incls: 98,106,121,127)	1
310	—		Kit, Valve (Incls: 162,163,164,166,167,168,172)	2
	33060	NBR	Kit, Valve (Incls: 163,164,166,167,168,172)	2
	—		Kit, Valve (Incls: 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.

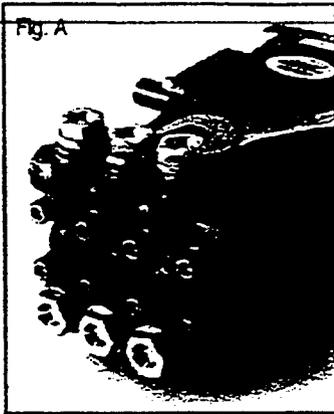
**MATERIAL CODES (Not Part of Part Number):** AL=Aluminum BB=Brass CC=Ceramic CP=Chromeplated CPST=Chromeplated Steel  
D=Delryn<sup>®</sup> EPDM=Ethylene Propylene Diene Monomer FBB=Forged Brass FPM=Fluorocarbon (Viton<sup>®</sup>) HT=Hi-Temp (EPDM Alternative)  
NBR=Medium Nitrile (Buna-N) NY=Nylon PTFE=Polytetrafluoroethylene (Teflon<sup>®</sup>) 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

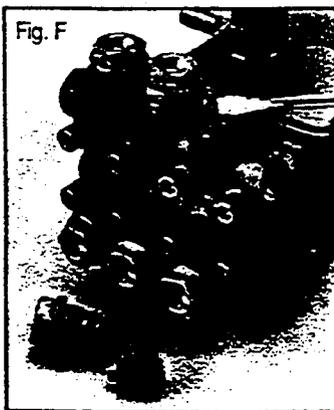


**STORING:** For extended storing or between use in cold climates, drain all pumped fluids from pump and **flush with antifreeze solution to prevent freezing and damage to the pump. DO NOT RUN PUMP WITH FROZEN FLUID.**

**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.



Models 5CP3120 and 5CP5120



### 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.

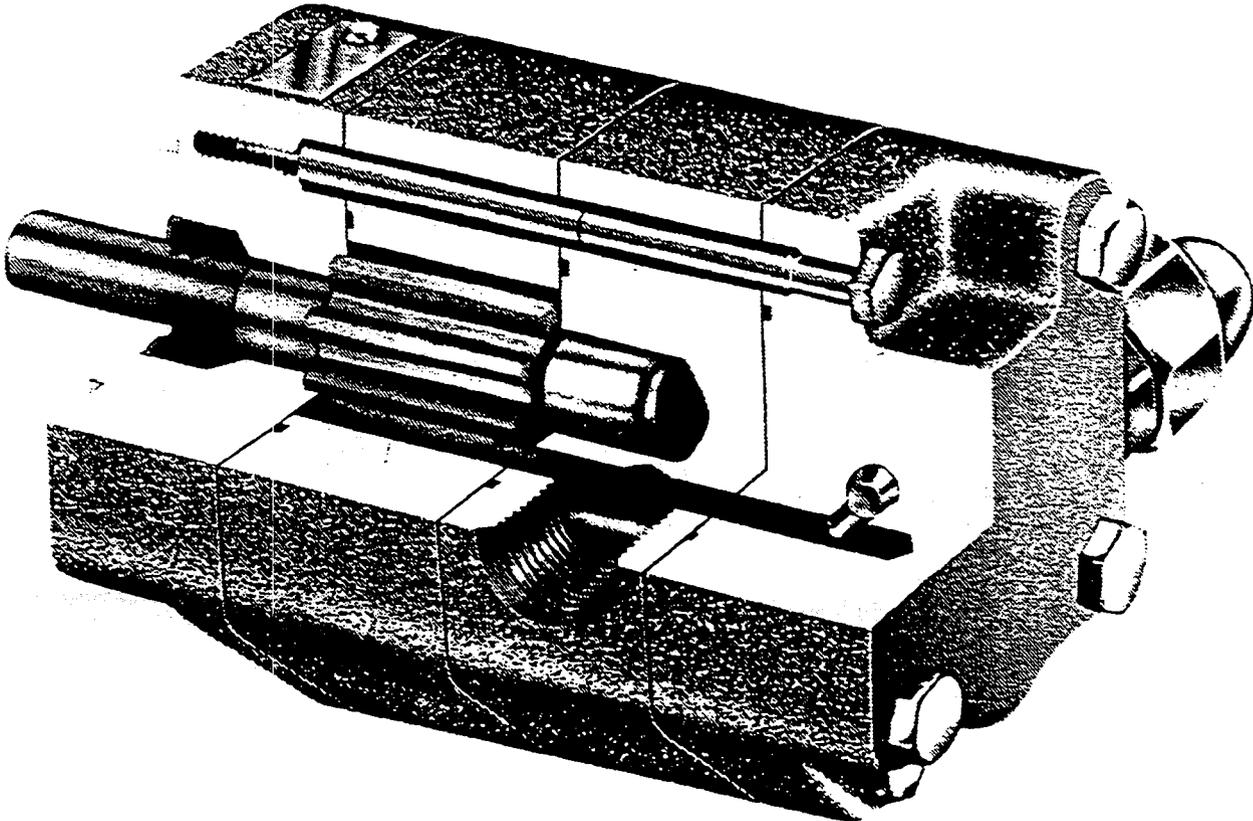
## TORQUE CHART

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
<b>Bearing Cover Screws</b>					
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
<ul style="list-style-type: none"> <li>• Low Pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Worn nozzle</li> <li>• Belt slippage</li> <li>• Air leak in inlet plumbing</li> <li>• Pressure gauge inoperative or not registering accurately</li> <li>• Relief valve stuck partially plugged or improperly adjusted</li> <li>• Worn seat or valves</li> <li>• Inlet suction strainer clogged or improperly sized</li> <li>• Worn seals. Abrasives in pumped fluid, severe cavitation; inadequate water supply, stressful inlet conditions</li> <li>• Fouled or dirty inlet or discharge valves</li> <li>• Worn inlet or discharge valves</li> <li>• Leaky discharge hose</li> </ul>	<ul style="list-style-type: none"> <li>• Replace nozzle of proper size.</li> <li>• Tighten or replace; use correct belt.</li> <li>• Use PTFE liquid or tape.</li> <li>• Check pressure with new gauge and replace as needed.</li> <li>• Clean and reset relief valve to system pressure and correct by-pass. Check supply tank for contamination.</li> <li>• Clean or replace with valve kit.</li> <li>• Use adequate size for inlet pump connection and fluid being pumped. Clean frequently.</li> <li>• Install and maintain proper filter, check line size and flow available to pump. Install a C.A.T.</li> <li>• Clean inlet and discharge valve assemblies.</li> <li>• Replace with valve kit.</li> <li>• Replace hose. Check connections.</li> </ul>
<ul style="list-style-type: none"> <li>• Pulsation, pump runs extremely rough, pressure low</li> </ul>	<ul style="list-style-type: none"> <li>• Faulty Pulsation Dampener</li> <li>• Restricted inlet or air entering inlet plumbing</li> <li>• Stuck inlet or discharge valve</li> </ul>	<ul style="list-style-type: none"> <li>• Check precharge (should be 30-50%) of system pressure or replace as needed.</li> <li>• Check filters and clean as needed. Check fittings and use PTFE liquid or tape for airtight connection.</li> <li>• Clean or replace valve. Check supply tank for contamination.</li> </ul>
<ul style="list-style-type: none"> <li>• Water leakage from under the manifold *Slight leakage</li> </ul>	<ul style="list-style-type: none"> <li>• Worn Lo-Pressure, Hi-Pressure seals or V-packings</li> </ul>	<ul style="list-style-type: none"> <li>• Replace with seal kit.</li> <li>• Check inlet pressure and system temperature.</li> <li>• Use Thermo Valve in by-pass line.</li> <li>• Use inlet pressure regulator in inlet line.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil leak between crankcase and pumping section</li> </ul>	<ul style="list-style-type: none"> <li>• Worn crankcase seals</li> </ul>	<ul style="list-style-type: none"> <li>• Replace crankcase seals.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil leaking in the area of crankshaft</li> </ul>	<ul style="list-style-type: none"> <li>• Worn crankshaft seal</li> <li>• Bad bearing</li> </ul>	<ul style="list-style-type: none"> <li>• Replace damaged seals.</li> <li>• Replace bearing.</li> </ul>
<ul style="list-style-type: none"> <li>• Excessive play in the end of the crankshaft</li> </ul>	<ul style="list-style-type: none"> <li>• Worn bearing</li> </ul>	<ul style="list-style-type: none"> <li>• Replace bearing.</li> </ul>
<ul style="list-style-type: none"> <li>• Water in crankcase</li> </ul>	<ul style="list-style-type: none"> <li>• Humid air condensing into water inside of the crankcase</li> <li>• Leaking of crankcase seals or seals installed backward</li> </ul>	<ul style="list-style-type: none"> <li>• 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).</li> <li>• Replace seals. Follow proper installation procedure. Contact Cat Pumps supplier for crankcase servicing.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil leaking at the rear portion of the crankcase</li> </ul>	<ul style="list-style-type: none"> <li>• Damaged or improperly installed oil gauge, crankcase cover or drain plug O-ring</li> </ul>	<ul style="list-style-type: none"> <li>• Replace oil gauge, crankcase cover or drain plug O-ring. Thread in oil gauge and drain plug hand tight to avoid extruding o-ring.</li> </ul>
<ul style="list-style-type: none"> <li>• Loud knocking noise in pump</li> </ul>	<ul style="list-style-type: none"> <li>• Pulley loose on crankshaft</li> <li>• Worn bearing, connecting rod or crankshaft</li> <li>• Stressful inlet conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Check key and tighten set screw.</li> <li>• Consult Cat Pumps supplier for crankcase servicing.</li> <li>• Install C.A.T.</li> </ul>
<ul style="list-style-type: none"> <li>• Frequent or premature failure of the packing</li> </ul>	<ul style="list-style-type: none"> <li>• Scored plungers</li> <li>• Over pressure to inlet manifold</li> <li>• Abrasive material in the fluid being pumped</li> <li>• Excessive pressure and/or temperature of fluid being pumped</li> <li>• Running pump dry</li> </ul>	<ul style="list-style-type: none"> <li>• Replace plungers.</li> <li>• Reduce inlet pressure per instructions.</li> <li>• Install proper filtration on pump inlet plumbing.</li> <li>• Check pressure and inlet fluid temperature. Be sure they are within specified range.</li> <li>• DO NOT RUN PUMP WITHOUT WATER.</li> </ul>
<ul style="list-style-type: none"> <li>• Strong surging at the inlet and low pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Foreign particles in the inlet or discharge valve or worn inlet and/or discharge valves</li> </ul>	<ul style="list-style-type: none"> <li>• Check for smooth surfaces on inlet and discharge valve seats. Replace with kit if pitted or worn.</li> <li>• Check supply tank for contamination. Install and regularly clean filter. Do not pump abrasive fluids.</li> </ul>

OIL PUMP



## Mounting

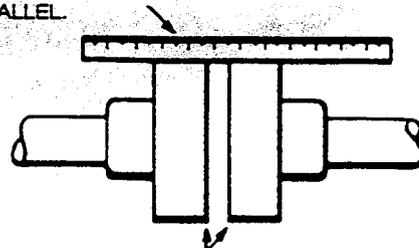
1. Surfaces pump mounts against must be clean and flat.
2. Use only SAE Grade 5 capscrews for mounting pump.
3. The 4 mounting capscrews for SG-04 and SG-05 pumps must have a minimum of ½ inch thread engagement and must be torqued evenly to 12-15 ft. lbs.
4. Standard SG Series pumps are designed to be 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.

USE STRAIGHT EDGE. THESE SURFACES MUST BE PARALLEL.



CHECK WIDTH BETWEEN THESE SURFACES WITH INSIDE CALPERS 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

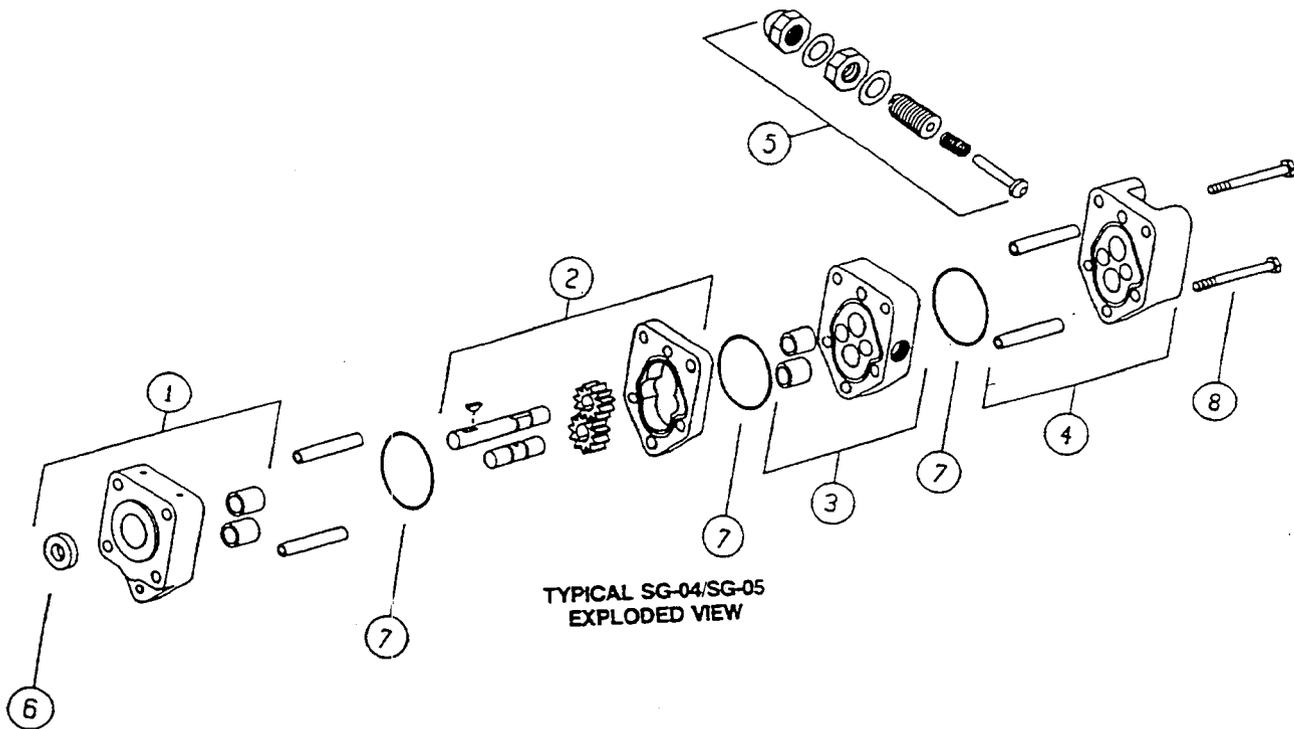
Before starting pump, be sure all drive equipment guards are in place. Failure to properly mount guards may result in serious injury or death.

## 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.



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 cap screws



## **Regulating Unloader Models**

**With  
Handle**

**7570**

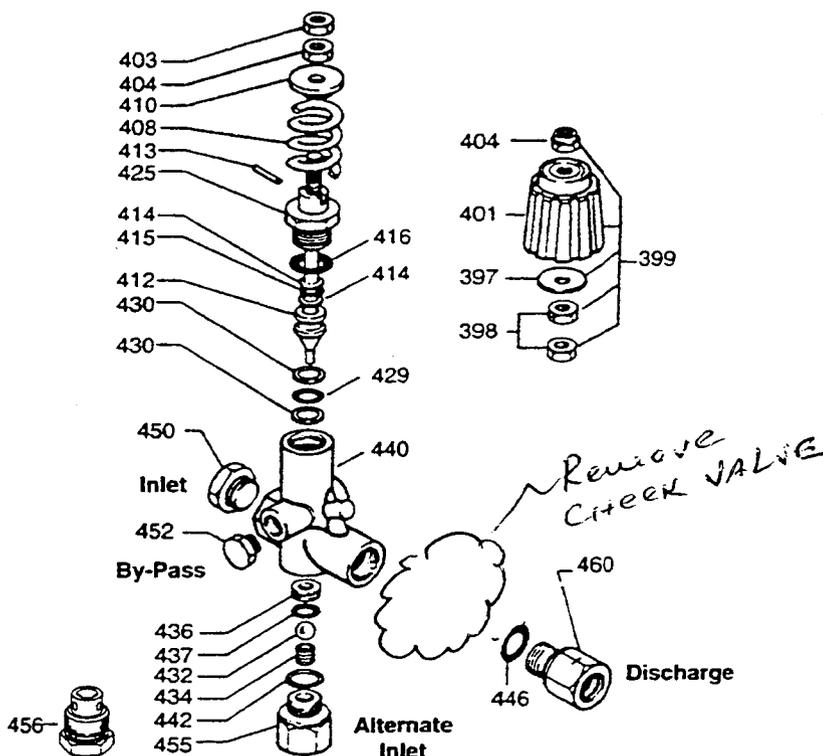
Section  
ATMI

8

Part Manuals Water Pressure Regulator  
Operation & Service Manual

1

# EXPLODED VIEW



ITEM	DESCRIPTION	7570	MATL	QTY
397	Washer, Flat	33633	STZP	1
398	Nut, Jam (M8)	32116	STZP	2
399	Assembly, Complete Handle (Incls: 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 (Incls: 414,415,416,429,430,437,441,442,446) (Prior to 6/88)	33146	NBR	1
—	Kit-2, O-Ring (Incls: 414,415,416,429,430,437,441,442,446) (After 6/88)	33246	NBR	1
—	Kit-2, O-Ring (Incls: 414,415,416,429,430,437,441,442,446) (After 6/88)	32878	FPM	1
—	Kit, Valve (Incls: 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.

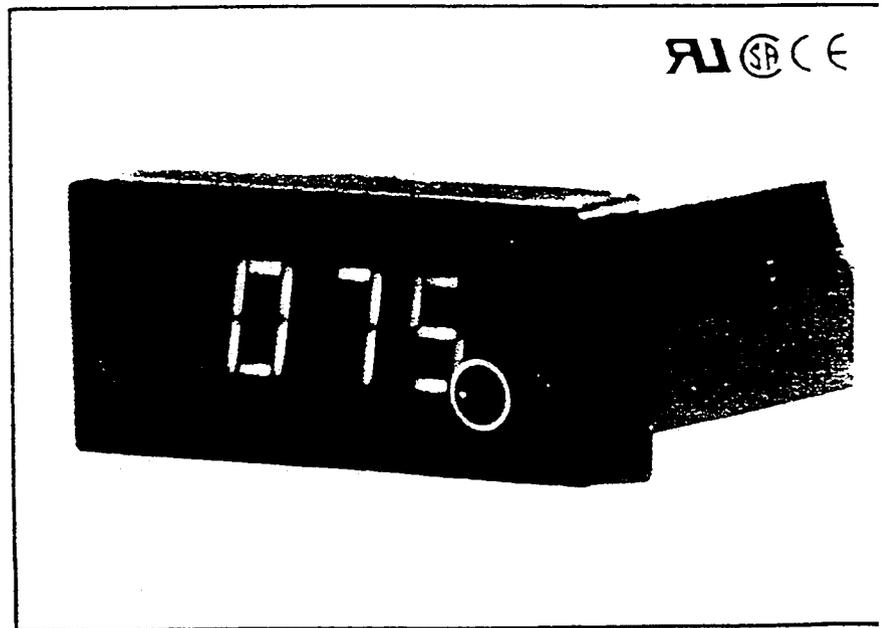
Once the desired system pressure is reached, stop adjusting and set the top locking knob to hold the system pressure. **Do not read the pressure at the gun or nozzle for setting system pressure.** Check the nozzle(s) as part of regular maintenance and replace if worn. **Do not adjust regulator pressure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

### TROUBLESHOOTING

Cycling	<ul style="list-style-type: none"> <li>● Too little flow for valve specifications.</li> <li>● Air in system, poor connections.</li> <li>● Inlet seals in pump worn.</li> <li>● O-ring in gun worn.</li> </ul>
System will not build up to pressure	<ul style="list-style-type: none"> <li>● Nozzle worn.</li> <li>● Improper nozzle size for system specs.</li> <li>● Foreign material trapped in seat.</li> </ul>
Pressure drop	<ul style="list-style-type: none"> <li>● Nozzles worn.</li> <li>● Piston and seat in regulator worn.</li> <li>● Air in system, poor connections.</li> <li>● Insufficient flow to pump.</li> <li>● Filter clogged. Check and clean regularly.</li> </ul>
Pressure spikes while in by-pass	<ul style="list-style-type: none"> <li>● Minimum by-pass of 10% not present.</li> <li>● Excessive pressure adjustment made for worn nozzle. REPLACE NOZZLE. Reset system pressure.</li> </ul>
Leakage from regulator vent hole	<ul style="list-style-type: none"> <li>● O-ring around piston worn. Replace.</li> <li>● Piston Retainer scored. Replace as needed.</li> </ul>

# TEMPERATURE CONTROLLERS WITH DIGITAL DISPLAY MODEL-TTC

## INSTALLATION INFORMATION



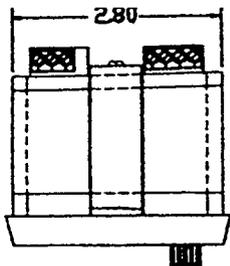


FIGURE 1  
DIMENSIONS IN INCHES

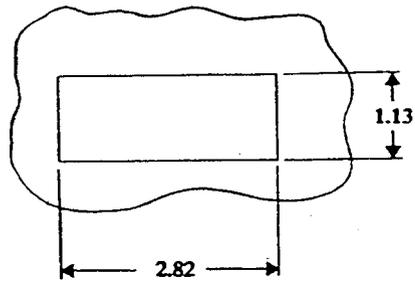
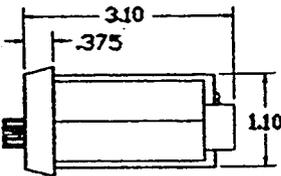
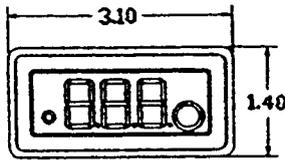


FIGURE 2  
PANEL CUT-OUT

Figure 1 above shows the unit dimensions (in inches). Figure 2 shows the panel cut-out required to mount the unit. The unit is inserted into the panel from the front and

locked into place with the bracket and screw provided with the unit (see Figures 3, 4 and 8).

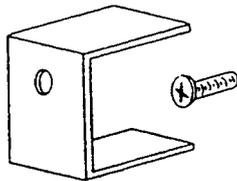


FIGURE 3  
MOUNTING BRACKET  
AND SCREW

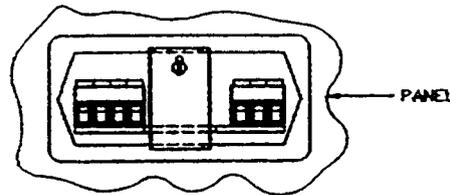


FIGURE 4  
MOUNTING BRACKET  
AND SCREW POSITIONS

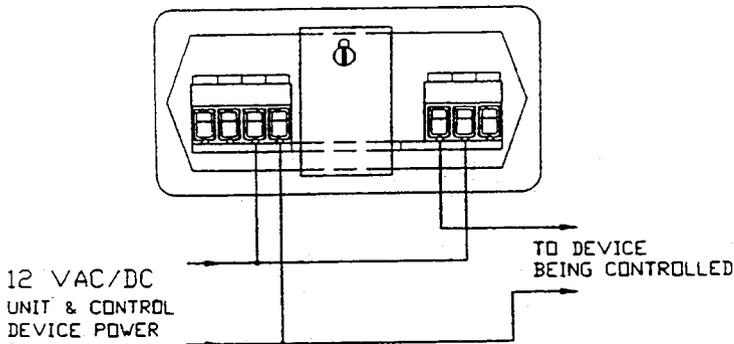


FIGURE 5

Figures 5 and 6 illustrate how to wire the relays for the different power requirements. The relay must have an external power source for you to be able to control your device.

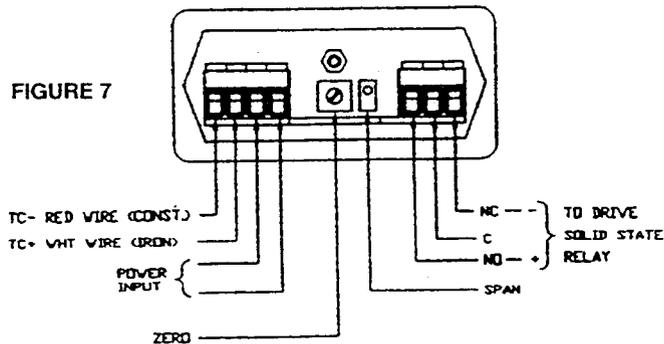


FIGURE 7

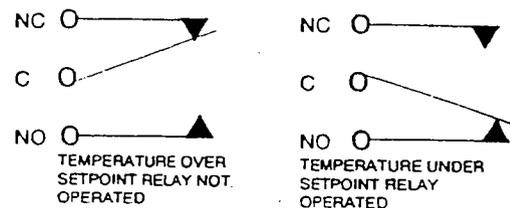
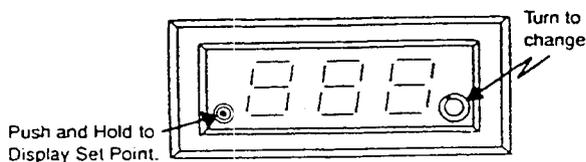
**WIRING INFORMATION**

Figure 7 provides required wiring information. 12 Vac/DC @ 250 mA must be supplied to the unit's "power input". Connect unit as indicated in Figure 7.

observed, the unit may not meet specifications.

Power and thermocouple wire should not be placed in the same conduit or wiring trough. However, wires from several thermocouples may be in the same conduit or wiring trough. If shielded thermocouples are used, the shields should be insulated electrically from the thermocouple wires and terminated to earth ground.

Figure 7 also shows the type J or K thermocouple wire terminals. For long thermocouple runs the proper thermocouple extension wire must be used, and the proper polarity must be maintained. If these precautions are not



**FIGURE 10**  
**SET POINT CALIBRATION AND OUTPUT STATES**

When the button on the lower left of the unit is pushed in and held, the setpoint is displayed. As long as the button is held in, the setpoint is displayed. When the button is out, the temperature at the thermocouple is displayed.

The knob on the lower right is used to change the setpoint. Turn the knob clockwise to increase the setpoint. Turn the knob counter clockwise to decrease the set point.

**CAUTION:** The setpoint can be changed without

displaying the setpoint. Do not turn the setpoint knob unless you want the setpoint changed.

Figure 10 shows the output states of the controller internal relay when the temperature as seen by the thermocouple is above and below the setpoint. Make connection accordingly observing the power rating of the contacts. The unit will read "EEE" for over range inputs.

If the thermocouple "opens" the internal relay will go to its "not operated" stated.

**SOLID STATE RELAY OUTPUT**

When the temperature seen by the thermocouple is above the set point, there will not be any voltage between - and + terminals. If the temperature seen by the thermocouple is below the setpoint, there will be

12-16 VDC output. This output is capable of providing 30 mA. If an "open" thermocouple condition occurs, the voltages between - and + terminals will be zero.

**LIMITATION OF LIABILITY.** It is understood and agreed that seller's liability whether in contract, in tort, under any warranty, in negligence or otherwise shall not exceed the return of the amount of the purchase price paid by purchaser and under no circumstances shall seller be

liable for special, indirect or consequential damages. The price stated for the equipment is a consideration in limiting seller's liability. No action regardless of form, arising out of the transactions may be brought by purchaser more than one year after the cause of action has accrued.