

**WARNING: Do Not Operate Before Reading Manual**

# PD Plus OPERATOR'S MANUAL

## Models

3202	3210	4012	5514
3204	4006	5507	5516
3206	4009	5511	5518

Lip-Labyrinth (Air Service)  
Single Envelope Gastight  
Double Envelope Gastight



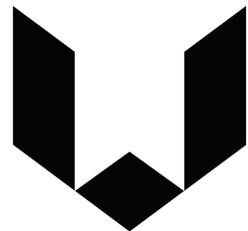
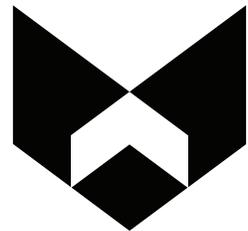
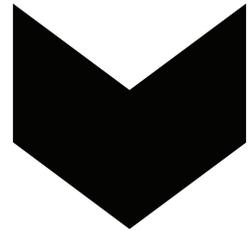
## The employees of Tuthill Vacuum & Blower Systems thank you for your purchase!

Tuthill Vacuum & Blower Systems proudly manufactures Kinney® vacuum pumps and M-D Pneumatics™ blowers and vacuum boosters in Springfield, Missouri, USA. We bring 100+ years of engineering experience and solid, hands-on care to help customers keep their processes running. Your satisfaction is important to us so please take time to provide your Tuthill sales representative with performance feedback. We love to hear from our customers!

Tuthill is a family owned business that was started by James B. Tuthill in 1892. At that time, Tuthill manufactured common brick to Chicago construction companies who were fueling the city's rapid expansion. Fast forward to today and Tuthill now serves sustaining, global markets like agriculture, chemical, construction, energy, food and beverage, pharmaceuticals and medical, transportation, and utilities. While the company has changed in what it manufactures, one thing remains throughout every Tuthill line of business – we are a company with HEART. Our slogan is “Pump Your Heart Into It” and everyday our employees do just that as they represent the Tuthill brand and dare to make better.

Thank you for making Tuthill Vacuum & Blower Systems part of your company's process!

A company with heart right from the start.



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### Disclaimer Statement:

All information, illustrations and specifications in this manual are based on the latest information available at the time of publishing. The illustrations used in this manual are intended as representative reference views only. Products are under a continuous improvement policy. Thus, information, illustrations and/or specifications to explain and or exemplify a product, service or maintenance improvement may be changed at any time without notice.

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## INTRODUCTION

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

**PD PLUS** blowers are built to exacting standards and, if properly installed and maintained, will provide many years of reliable service. Read and follow every step of these instructions when installing and maintaining the blower.

**NOTE:** Record the blower model and serial numbers of the machine in the **OPERATING DATA** form on the inside back cover of this manual. Use this identification on any replacement part orders, or if service or application assistance is required.

### APPLICABLE DOCUMENTATION

The applicable documents associated with this manual are:

- 2006/42/CE – Machinery Directive
- EN 1012-1:1996 - Compressors and vacuum pumps - Safety Requirements - Part 1: Compressors

### SCOPE OF MANUAL

The scope of this manual and the Declaration of Incorporation includes the bare shaft rotary positive displacement blower.

# 02

## CONVENTIONS AND DATA PLATE

### GRAPHIC CONVENTIONS IN THIS MANUAL

This manual is the result of a risk assessment according to the applicable documents referenced in *Applicable Documentation on page 1*. The following are hazard levels are referenced within this manual:

#### **DANGER**

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

#### **WARNING**

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

#### **CAUTION**

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

#### **NOTICE**

*Indicates a situation that can cause damage to the engine, personal property, and/or the environment or cause the equipment to operate improperly.*

**NOTE:** Indicates a procedure, practice, or condition that should be followed in order for the equipment to function in the manner intended.

#### **CAUTION**



Read manual before operation or bodily harm may result. Attention should be given to the safety related sections of this manual.

**DATA PLATE**

MODEL NUMBER <input style="width: 95%;" type="text"/>	SERIAL NUMBER <input style="width: 95%;" type="text"/>	MAWP <input style="width: 95%;" type="text"/>	YEAR <input style="width: 95%;" type="text"/>
		Tuthill Vacuum & Blower Systems 4840 West Kearney Street Springfield, Missouri USA 65803	
READ INSTRUCTION MANUAL BEFORE OPERATION OR BODILY HARM MAY RESULT			
		MAX RPM <input style="width: 95%;" type="text"/>	

 <b>WARNING</b> Keep body & clothing away from machine openings.	 <b>WARNING</b> Do not operate without guards in place.	 <b>CAUTION</b> Hearing protection required.	 <b>CAUTION</b> Do not touch hot surfaces.
<a href="http://www.tuthill.com">http://www.tuthill.com</a>		(800) 825-6937	Made in the USA

Figure 2-1 – General Operation and Symbols on Data Plate

The following information is contained on the data plate:

 <b>WARNING</b>	Keep body & clothing away from machine.  During operation, keep body and clothing away from inlet and outlet of the blower.
 <b>WARNING</b>	Do not operate without guards in place.

 <b>CAUTION</b>	Hearing protection is required while the blower is in operation. Noise levels may reach as high as 81 dBA.
 <b>CAUTION</b>	Do not touch hot surfaces. The upper limit of the blower operation is 400°F (205°C). Do not touch the blower while it is in operation and assure blower is cool when not in operation.

<b>MODEL NUMBER:</b>	The specific model of the blower
<b>SERIAL NUMBER:</b>	Unique to each blower
<b>YEAR:</b>	Year of manufacture
<b>MAWP:</b>	Maximum Allowable Working Pressure  The standard MAWP is per <b>Table 4-2 – Maximum Operating Limits on page 9</b> . The MAWP shall not be exceeded.

# 03

## LIFTING



### WARNING

The blower must be handled using an appropriate device such as a fork truck or appropriate lifting device. See *Table 4-1 on page 8* for approximate weights. Care should be taken to assure blower does not over-turn during handling and installation.

# 04

## DESCRIPTION

### NOTICE

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

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

Tuthill Vacuum & Blower Systems model 4000 and 5500 Series rotary lobe blowers are positive displacement type blowers, whose pumping capacity is determined by size, operating speed, and differential pressure conditions. Blowers employ rotors rotating in opposite directions within a housing closed at the ends by end plates.

The inlet to the discharge is sealed with operating clearances that are very small. Internal lubrication is not needed, as there is no moving contact.

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

discharge port or upstream of the blower inlet port.

**Figure 4-1** illustrates the air movement within the machine. In addition, the machine can operate in either direction.

Never attempt to control capacity by means of a throttle valve in the intake or discharge piping. This will increase the power load on the drive system, will increase operating temperatures, and can overload and/or seriously damage the blower. Likewise, if the possibility exists that flow to the blower inlet may be cut off during normal operation of a process, install an adequate vacuum relief valve. A pressure-type relief valve in the discharge line near the blower is also recommended for protection against cutoff or blocking in this line. Use check valves on each blower when more than one blower is connected to a discharge line.

When a belt drive is used, it is possible to adjust blower speed to obtain the desired capacity by changing the diameter of one or both sheaves, or by using a variable-speed motor pulley. In a direct-coupled arrangement, a variable-speed motor or transmission is required. Gas blowers can use bypasses, but some applications may require additional cooling. If there is a large volume of high-pressure air or gas downstream of the blower, a check valve in the piping downstream of the blower will protect the blower from overspeeding in a backward direction upon shutdown.

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

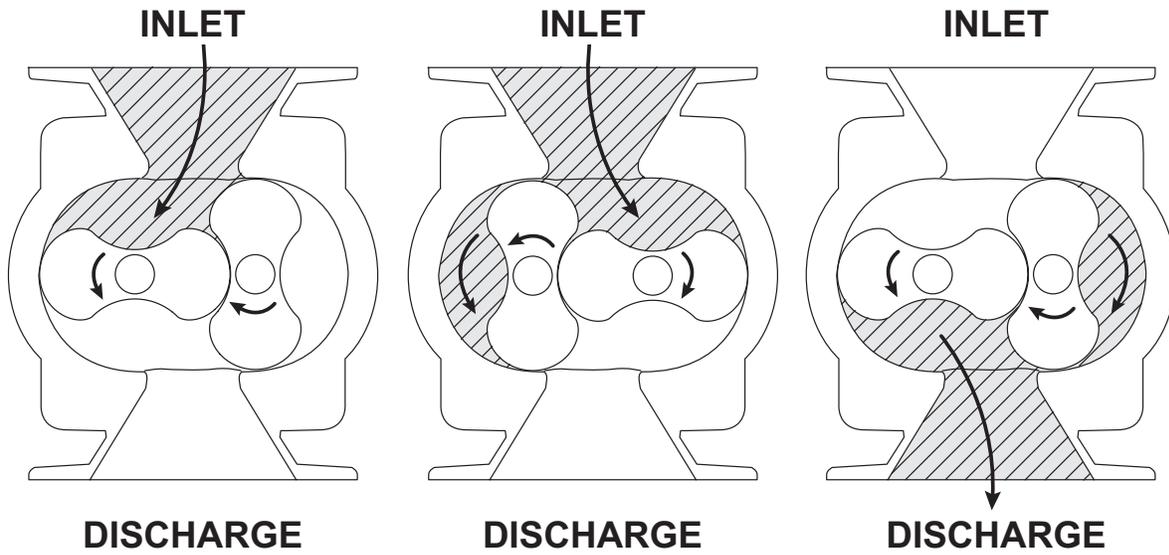


Figure 4-1 – General Operation Principle

## FLOW BY DIRECTION

**! WARNING**

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

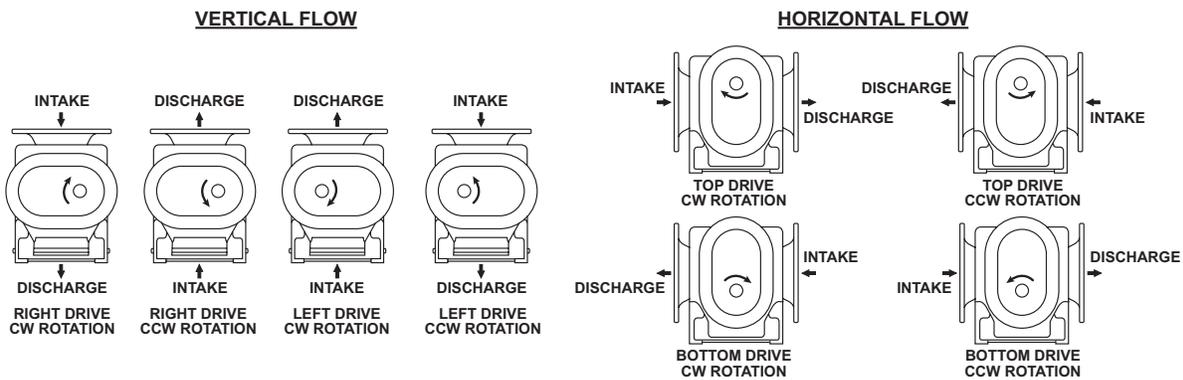


Figure 4-2 – Flow Direction by Rotation

## SPECIFICATIONS

MODEL	APPROXIMATE OIL CAPACITY				APPROXIMATE VERTICAL FLOW WEIGHT		
	VERTICAL FLOW		HORIZONTAL FLOW		STANDARD	SINGLE ENVELOPE	DOUBLE ENVELOPE
	GEAR (DRIVE) END	BACK END	GEAR (DRIVE) END	BACK END			
3202	12 oz (0.35 L)	8 oz (0.24 L)	17 oz (0.50 L)	12 oz (0.35 L)	100 lb (46 kg)	110 lb (50 kg)	115 lb (53 kg)
3204					120 lb (55 kg)	130 lb (59 kg)	135 lb (62 kg)
3206					130 lb (59 kg)	140 lb (64 kg)	145 lb (66 kg)
3210					165 lb (75 kg)	175 lb (80 kg)	180 lb (82 kg)
4006	24 oz (0.71 L)	24 oz (0.71 L)	14 oz (0.42 L)	14 oz (0.42 L)	170 lb (77 kg)	180 lb (82 kg)	185 lb (84 kg)
4009					200 lb (91 kg)	210 lb (96 kg)	215 lb (84 kg)
4012					225 lb (182 kg)	235 lb (107 kg)	240 lb (109 kg)
5507	57 oz (1.7 L)	57 oz (1.7 L)	32 oz (0.95 L)	32 oz (0.95 L)	400 lb (182 kg)	415 lb (189 kg)	420 lb (191 kg)
5511					460 lb (209 kg)	475 lb (216 kg)	480 lb (218 kg)
5514					500 lb (227 kg)	515 lb (234 kg)	520 lb (236 kg)
5516					540 lb (245 kg)	555 lb (252 kg)	560 lb (255 kg)
5518					580 lb (264 kg)	595 lb (270 kg)	600 lb (273 kg)

Table 4-1 – Specifications

MODEL	MAXIMUM RPM	MAXIMUM PRESSURE DIFFERENTIAL	MAXIMUM VACUUM	MAXIMUM TEMPERATURE RISE	MAWP
3202	3600	15 psi (1,035 mbar)	15 inch-Hg (508 mbar)	280°F (156°C)	100 psi (6.9 bar)
3204		15 psi (1,035 mbar)	15 inch-Hg (508 mbar)	280°F (156°C)	
3206		15 psi (1,035 mbar)	15 inch-Hg (508 mbar)	280°F (156°C)	
3210		15 psi (1,035 mbar)	15 inch-Hg (508 mbar)	280°F (156°C)	
4006		15 psi (1,035 mbar)	15 inch-Hg (508 mbar)	300°F (167°C)	
4009		18 psi (1,241 mbar)*	17 inch-Hg (575 mbar)	360°F (200°C)*	
4012		15 psi (1,035 mbar)	15 inch-Hg (508 mbar)	300°F (167°C)*	
5507		18 psi (1,241 mbar)*	17 inch-Hg (575 mbar)	360°F (200°C)*	
5511		17 psi (1,172 mbar)	17 inch-Hg (575 mbar)	360°F (200°C)*	
5514		13 psi (896 mbar)	15 inch-Hg (508 mbar)	300°F (167°C)	
5516		12 psi (827 mbar)	15 inch-Hg (508 mbar)	260°F (144°C)	
5518		10 psi (690 mbar)	15 inch-Hg (508 mbar)	200°F (111°C)	

\* High-pressure option

Table 4-2 – Maximum Operating Limits

**Description**

**WARNING**

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


**WARNING**

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

To permit continued satisfactory performance, a blower must be operated within certain approved limiting conditions. The manufacturer's warranty is, of course, also contingent on such operation.

Maximum limits for pressure, temperature, and speed are specified in **See Table 4-2 on page 9** for various blower sizes when operated under the standard atmospheric conditions. Do not exceed any of these limits.

**NOTICE**

*Specially ordered blowers with nonstandard construction, or with rotor end clearances greater than shown in **Assembly Clearances on page 39**, will not have the operating limits specified here. Contact your Tuthill Vacuum & Blower Systems sales representative for specific information.*

**NOTICE**

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

## INSTALLATION

### GENERAL

#### **DANGER**

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

#### **DANGER**

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

#### **WARNING**



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

#### **WARNING**

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

#### **WARNING**

The standard MAWP is per *Table 4-2*. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the blower has been performed.

#### **WARNING**

*Table 4-2* states the maximum operating speed in RPM (rotations per minute) and maximum temperature. Do not exceed these limits. The installation of the blower shall take these critical operating parameters into account and adequate control features implemented.

 **WARNING**

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

**NOTICE**

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

Carefully check to ensure that no transit damage has been sustained. If damage has occurred from shipment, file a claim with the carrier immediately. Preserve the shipping container for inspection by the carrier.

**NOTICE**

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

Do not remove protective covers and plugs until the connections are complete. Mount the blower on a flat, level surface. Use a baseplate that is rigid, solidly supported, and structurally sound. Shim under the legs where necessary so that each leg of the blower supports an equal share of the blower weight. This is necessary to prevent twisting of the blower. Make sure the feet rest evenly on the mounting surface before fastening down. Twisting or cramping the blower during mounting will cause rotor contact and binding during operation, resulting in a condition called “soft foot.” See **Soft Foot on page 14** for further details and preventative measures.

A blower that is factory-mounted on a base should not require such adjustments. However, since the assembly can become twisted in shipping or installation, check for soft foot after installing the

base. Shims may be needed for alignment. Loosen the foot hold-down screws to check foot contact with the mounting surface. Mount the base on a solid foundation or heavy flooring, using shims as necessary at bolting points to prevent warping the assembly.

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

Make sure piping is accurately squared with the blower and supported independently. Stress imparted from incorrectly aligned piping or mounting will create problems with bearing and seal life, possibly leading to premature internal contact. The blower should sit stress free and evenly on its supporting surface. Take care to evenly tighten the mounting bolts to avoid imparting undue stress into the blower. Stress can be checked in a free state with feeler stock or verified on a previously installed blower with the aid of a dial indicator. Spring or gap should be less than 0.002 in. (0.05 mm).

Use only clean, new pipe and make certain it is free of scale, cuttings, weld beads, dirt, or any other foreign material. To guard against damage to the blower, make sure that an inlet filter is used. Clean the filter of collected debris after 3 hours of operation and periodically thereafter. See **Piping Connections on page 17** for additional details.

**Figure 5-1** shows a typical complete installation of the blower and accessories. Note the absence of throttle or shut-off valves in both discharge and intake piping. If it is possible for airflow to be cut off in either line, add a pressure and/or vacuum relief valve. In some installations, it may be desirable to use only an inlet silencer-cleaner supported directly from the blower connection. Keep the weight of accessories and piping to a minimum to prevent blower casing distortion. If the weight exceeds 10% of blower weight, support the components independently of the blower and connect them with a flexible hose or connectors. The approximate weight of the blower is listed in **Table 4-1 on page 8**.

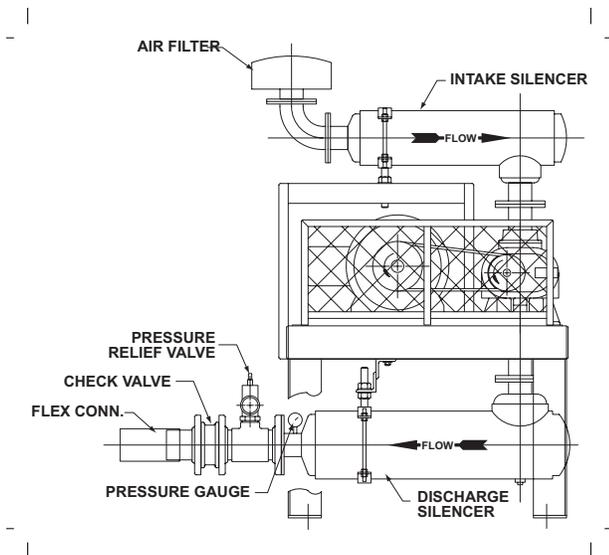


Figure 5-1 – Typical Blower Installation

A blower may be driven by direct-coupling to the driver or by V-belt drive for the purpose of obtaining other speeds within the approved range. **See Motor Drives on page 19** for more information.

Blowers from Tuthill Vacuum & Blower Systems are internally and externally treated after factory assembly and testing to protect against rusting in normal atmospheric conditions prior to installation. The maximum period of internal protection is considered to be 6 months under average conditions, provided closing plugs and seals are not removed. Protection against chemical or salt-water atmosphere is not provided. Avoid opening the blower until ready to begin installation, as protection will be quickly lost due to evaporation. For recommended preparations for long-term storage (longer than 6 months), **see Long-Term Storage on page 30**.

## Location

Install the blower in a room or outdoor area that supplies adequate space and lighting for routine maintenance. Make sure that indoor installation areas are well ventilated and kept as cool as possible, because operating the blower at elevated temperatures can result in nuisance overload or temperature shutdowns. An unprotected outdoor installation is satisfactory only when correct lubrication for the expected temperatures is provided. **See Recommended Lubricants on page 41**.

## Blower Air Intake

To minimize maintenance, supply the blower with the cleanest air possible. The air must not contain any flammable or toxic gases, as the blower will concentrate these gases. This could result in damage to the blower and surrounding property and lead to personal injury or death. Do not block or restrict the opening of the blower, as the motor could overheat and fail.

Do not use blowers on explosive or hazardous gases. Do not exceed the limits described in **Table 4-2** on performance criteria such as pressure differential, running speed, and discharge temperature.

If it is necessary to take air from a remote source, such as in a vacuum application, make sure the diameter of the piping is at least equal to the diameter of the blower inlet. For distances greater than 20 ft (6 m), enlarge the pipe diameter to reduce inlet restriction. Excessive restriction will reduce the efficiency of the blower and elevate its discharge temperature. The piping used should also be corrosion-resistant and free of scale and dirt. Keep the inlet covered to keep out foreign objects and rain. Vacuum kits are available.

## Soft Foot

Soft foot is a condition in which one of the blower feet does not sit flat on the base. Soft foot is usually due to irregularities in the surface to which the blower is mounted. When the bolt on the foot gets tightened, a slight distortion occurs that can affect bearing and seal life as well as internal contact between parts.

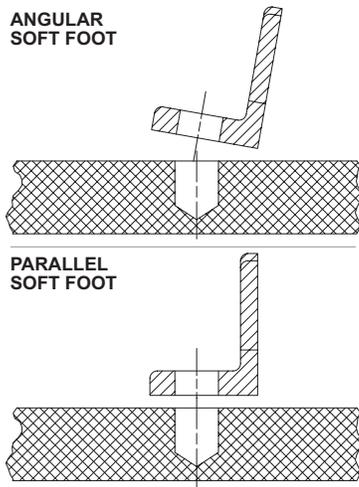


Figure 5-2 – Illustrations of Soft Foot

1. Place the blower on the base.
2. Check each foot for gaps between the foot and base (soft foot). Shim as necessary to fill the gap within 0.002 in. (0.05 mm).  
**Figure 5-2** shows the two most common types of soft foot conditions. If either type is present at a measurement of more than 0.003 in. (0.076 mm), the blower may fail prematurely.
3. Tighten all bolts.
4. Mount a dial indicator on the base contacting one foot at 12 o'clock position.
5. Loosen the bolt on that foot. Observe indicator travel and add shims as needed to reduce "spring" to less than 0.002 in. (0.05 mm). Repeat steps 4 and 5 on the remaining feet.

## SAFETY

Tuthill Vacuum & Blower Systems recommends the use of relief valves to protect against excessive pressure or vacuum conditions. Test these valves at initial start-up to be sure they are properly adjusted to relieve at or below the maximum pressure differential rating of the blower.

### DANGER



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



### DANGER



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



 **DANGER**

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

 **DANGER**


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

 **WARNING**


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

 **WARNING**


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

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

## LUBRICATION

Every blower from Tuthill Vacuum & Blower Systems is factory-tested, oil-drained, and shipped dry to its installation point. Fill both independent oil reservoirs to the proper level before operation. Oil reservoirs are under the vacuum.

Shaft bearings at the gear end of the blower are splash-lubricated by one or both gears dipping into an oil reservoir formed in the gear end plate and cover. Shaft bearings at the drive end of the blower are lubricated by a slinger assembly dipping into an oil reservoir. Before starting the blower, fill the oil sumps as described in *Filling Procedure on page 16*.

Add oil to the blower in the quantity listed in *Table 4-1 on page 8*. Make sure oil level is maintained within the notched area of the sight glass. See *Figure 5-3*. Lower drive blowers have “bull’s eye” type oil level gauges. Maintain oil levels at the center of the glass.

 **WARNING**

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

 **WARNING**

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

 **WARNING**

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

### NOTICE

Assure oil is compatible with copper/yellow metals (if equipped with cooling coils).

### NOTICE

See Table 4-1 for oil capacities.

## Filling Procedure

See **Recommended Lubricants on page 41** for suggested lubricants and grease.

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

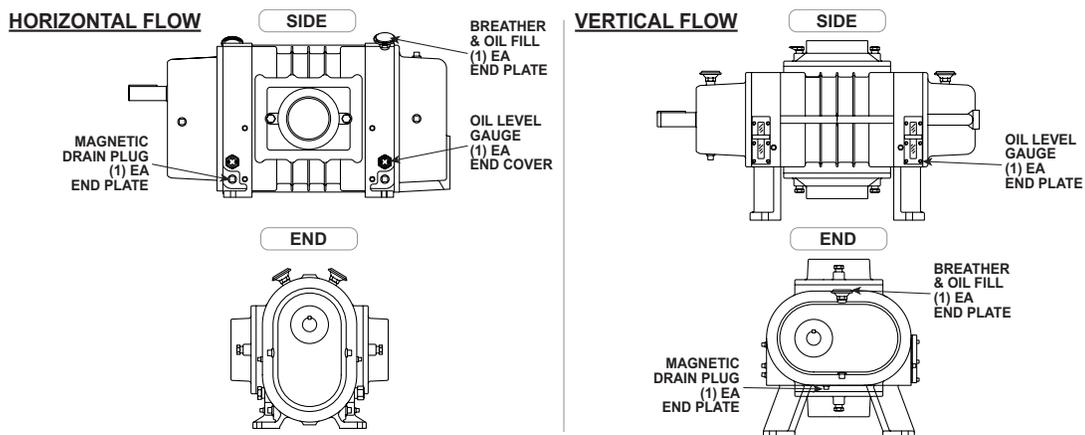


Figure 5-3 – Oil Fill, Drain Connections, and Oil Level Gauges

## Frequently Asked Questions Regarding Lubrication

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

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

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

If the lubricant is not serviced at the proper interval, the shearing action in the bearing and the gears will begin to take its toll and the lubricant will thicken. The blower will run hotter and the wear on moving parts will increase. The lubricant will generally appear dirtier, caused by material rubbing off the components. The lubricant will discolor because of overheating. An indicator of the breakdown of a lubricant is the increase in the Total Acid Number (TAN) and a change of 10 percent in the base viscosity.

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

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

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

## Hazards Associated With Breakdown or Ignition of Lubrication

### DANGER



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

## PIPING CONNECTIONS

### WARNING

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

### NOTICE

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

Inlet and outlet connections on all blowers are large enough to handle maximum volume with minimum friction loss. Maintain same-diameter piping. Do not support silencers by the blower. Avoid stress loads and bending moments.

Be certain all piping is clean internally before connecting to the blower. Place 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. Clean the screen after 3 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 airflow piping configuration is easily achieved by rearranging the mounting feet position.

## Hazards Associated With Hazardous Process Fluids

### DANGER



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

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

## Blockage or Restriction

### WARNING

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

## COOLING COILS (OPTIONAL)

### CAUTION

If the blower is to be located outdoors or in a building where the temperature surrounding the blower or the water supply and return piping can fall below 35°F (2°C), then care must be taken to ensure that the water (or other cooling liquid) does not freeze and cause damage. Cooling coils must be drained of liquid during downtime unless a recirculating unit using a glycol mixture has been installed.

### NOTICE

*Water cooled end plates are discontinued. Consult factory for connection details.*

### NOTICE

*Units are never shipped from the manufacturer with liquid in the end plates or cooling coils.*

Blowers supplied with cooling coils can be identified by the hose that connects the top of the gear (drive) end cover to the bottom of the free (non-drive) end cover. **See Figure 5-4** and **Figure 6-1** for details. Tuthill Vacuum & Blower Systems recommends water cooling for blowers in applications where the blower operates with discharge temperatures of 250°F (120°C) for 4 hours or more per day. Water cooling reduces oil temperature and improves oil viscosity for better lubrication. A water flow of 0.5 – 1.0 GPM (1.9 – 3.8 L/min) is generally sufficient to maintain oil temperatures of 150°F (65°C) or below. Do not allow water pressure to exceed 75 psig (510 kPa g).

## COOLING WATER CONNECTIONS AND SPECIFICATIONS — COOLING COILS (OPTIONAL)

**WARNING**

The cooling water pressure shall not exceed 75 psig (5.17 bar g).

Establish proper gap between coupling halves according to the coupling manufacturer's instructions with the motor armature. Proper gap will minimize the chance of end thrust on the blower shaft. Re-align and grease all direct-coupled base-mounted blowers after field installation.

## MOTOR DRIVES

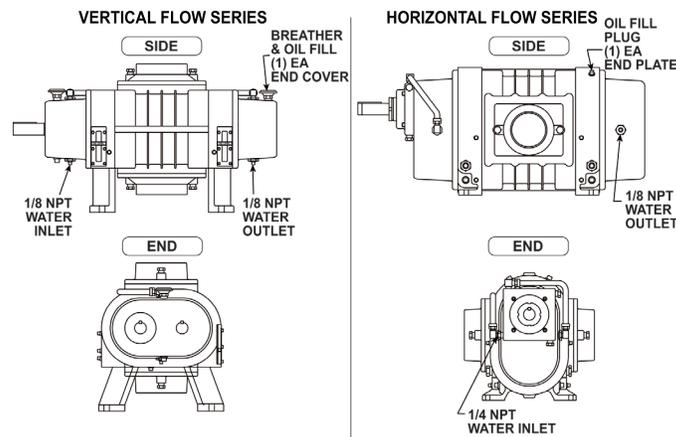


Figure 5-4 – Water Cooling Connections

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

### Direct Coupled

When installing the motor directly to the blower, align the shafts to the coupling according to the coupling manufacturer's instructions. Blowers shipped with the motor directly coupled and mounted on a common base have been aligned prior to shipment. Further alignment is not normally necessary, but be sure to check the alignment and make adjustments if necessary prior to starting the blower.

Coupling halves must correctly fit the blower and drive shafts so that only light tapping is required to install each half. The two shafts must be accurately aligned. A direct-coupled blower and motor must be aligned with the two shafts having no more than 0.005 in. (13 mm) Total Indicator Reading (TIR). Make sure the face is aligned within 0.002 in. (0.05 mm).

Establish proper gap between coupling halves according to the coupling manufacturer's instructions with the motor armature. Proper gap will minimize the chance for end thrust on the blower shaft. Re-align and grease all direct-coupled base-mounted blowers after field installation.

## V-Belts

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

Adjust the belt tension to the manufacturer's specifications using a belt tension tester. Check new belts for proper tension after 24 hours of run time. When manufacturer data is not available, industry guidelines recommend 1/64 in. deflection for each inch of span (0.157 mm deflection per centimeter of span) at 8 – 10 lb (3.6 – 4.5 kg) of force in the center of the belt.

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

A tight or driving fit will force the drive shaft out of its normal position and cause internal damage. A loose fit will result in shaft damage or breaking. Make sure the motor sheave fits correctly and is properly aligned with the blower sheave.

Adjust the motor position on its sliding base so that belt tension is in accordance with drive manufacturer's instructions. Always avoid excessive belt tension. Recheck tension after the first 10 hours of operation and periodically thereafter to avoid slippage and loss of blower speed.

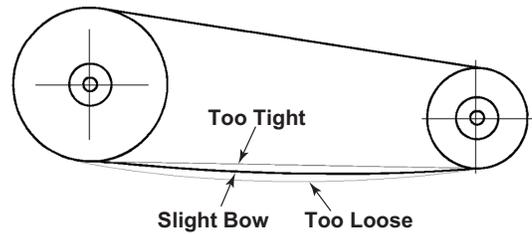


Figure 5-5 – General appearance of a V-belt drive

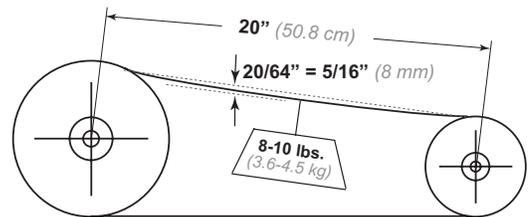


Figure 5-6 – Setting of proper tension for a V-belt drive

Check the blower after installation and before applying power by rotating the drive shaft by hand.

If the drive shaft does not rotate freely:

- Look for uneven mounting, piping strain, excessive belt tension, or coupling misalignment
- Check the blower to make sure oil was added to the reservoirs

## Setting V-Belt Tension

Proper belt tension is essential to long blower life. **Figure 5-5**, **Figure 5-6**, and the following procedure are provided to aid in field-adjusting V-belts (when the blower is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in **Figure 5-5**.

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

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

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

## V-Belt Troubleshooting

PROBLEM	POSSIBLE CAUSES	SOLUTION
Belts slip (sidewalls glazed)	Not enough tension	Replace belts; apply proper tension.
Drive squeals	Shock load	Apply proper tension.
	Not enough arc of contact	Increase center distance.
	Heavy starting load	Increase belt tension.
Belt(s) turned over	Broken cord caused by prying on sheave	Replace set of belts and install correctly.
	Overloaded drive	Redesign drive.
	Impulse loads	Apply proper tension.
	Misalignment of sheave and shaft	Re-align drive.
	Worn sheave grooves	Replace sheaves.
	Excessive belt vibration	Check drive design. Check equipment for solid mounting. Consider use of banded belts.
Mismatched belts	New belts installed with old belts	Replace belts in matched sets only.
Breakage of belt(s)	Shock loads	Apply proper tension; recheck drive.
	Heavy starting loads	Apply proper tension; recheck drive. Use compensator starting.
	Belt pried over sheaves	Replace set of belts correctly.
	Foreign objects in drives	Provide drive guard.

PROBLEM	POSSIBLE CAUSES	SOLUTION
Rapid belt wear	Sheave grooves worn	Replace sheaves.
	Sheave diameter too small	Redesign drive.
	Mismatched belts	Replace with matched belts.
	Drive overloaded	Redesign drive.
	Belt slips	Increase tension.
	Sheaves misaligned	Align sheaves.
	Oil or heat condition	Eliminate oil. Ventilate drive.

## Motor and Electrical Connections

### WARNING

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

### NOTICE

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

Wire the motor and other electrical devices, such as solenoid valves and temperature switch, to the proper voltage and amperage as indicated on the nameplate of the component being wired. Turn the blower by hand after wiring is completed to determine that there are no obstructions and that the blower turns freely. Then, momentarily start the blower to check the direction of rotation.

**Figure 4-2** shows direction of airflow in relation to rotor rotation. The airflow direction can be reversed by reversing the appropriate motor leads.

### GENERAL

#### DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

#### WARNING



Do not operate without guards in place.



#### WARNING

Maximum operating speed: *Table 4-2* states the maximum operating speed in RPM (rotations per minute), the maximum pressure differential, maximum vacuum and maximum temperature rise. Do not exceed these limits.

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

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

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

Assuming all tests are satisfactory, the blower will now be ready for continuous full-load operation. During the first several days, check periodically to make sure all conditions remain acceptable and

steady. These checks may be particularly important if the blower is part of a process system where conditions may vary. At the first opportunity, stop the blower and clean or remove the inlet filter. Also recheck leveling, coupling alignment or belt tension, and mounting bolts for tightness.

## START-UP CHECKLIST

It is recommended that these start-up procedures be followed in sequence and checked off (  ) in the boxes provided in any of the following cases.

<ul style="list-style-type: none"> <li>• During initial installation</li> <li>• After any shutdown period</li> </ul>	<ul style="list-style-type: none"> <li>• After maintenance work has been performed</li> <li>• After blower has been moved to a new location</li> </ul>
<b>DATES CHECKED:</b>	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Check the unit for proper lubrication. Proper oil level is critical. <b>See <i>Lubrication</i> on page 15. See <i>Recommended Lubricants</i> on page 41</b> for information on acceptable lubricants for the product.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Check the V-belt drive for proper belt alignment and tension.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Carefully turn the rotors by hand to be certain they do not bind.



### WARNING

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

<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	“Bump” the unit with the motor to check rotation (counterclockwise when facing the shaft) and to be certain it turns freely and smoothly.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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, <b>see <i>Troubleshooting</i> on page 37.</b>
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Apply the load and observe the operation of the unit for 1 hour.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	If minor malfunctions occur, discontinue operation and <b>see <i>Troubleshooting</i> on page 37.</b>

## OPERATING

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

### DANGER

The blower is not intended to be used with explosive products or in explosive environments. The blower is not intended to be used in applications that include hazardous and toxic gases. Consult the factory for support.

### WARNING

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

### WARNING

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

### CAUTION



Do not touch hot surfaces.  
Do not touch the blower while it is in operation and assure blower is cool when not in operation.

### CAUTION

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

### NOTICE

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

### CAUTION

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

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

## METHANE GAS APPLICATIONS

Some sewage gases will adhere to the rotors in a gas blower. If enough sludge from the gas being pumped builds up on the rotors, it destroys the clearances between the rotors. The build-up can cause the blower to clatter and eventually freeze up when the rotors no longer have clearance to turn. This can be easily prevented by periodically flushing the blower with a mixture of 75% kerosene or fuel oil and 25% lubricating oil. The kerosene or fuel oil dissolves the sludge build-up and the lubricating oil coats the rotors to slow the build-up.

Inject the mixture on the inlet side through a valve set to feed 1 gal (3.8 L) of mixture in 15 – 20 minutes. On blowers that are regularly flushed, flushing once a week is sufficient. If the blower is dirty, flush it daily until the hard build-up is removed and then move to a weekly flushing cycle. In very dirty gas installations, vary the cycle to meet the demand.

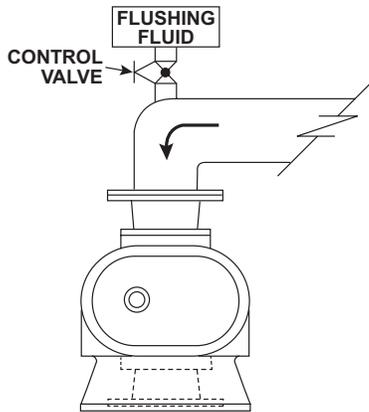


Figure 6-1 – Flushing

## WATER-INJECTED BLOWERS

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

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

## Operation

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

## Shutdown

It is possible to shut down the blower for brief periods by relieving the inlet vacuum, shutting off the water, and then stopping the blower.

To avoid rusting during a slightly longer shutdown period, operate the blower under a partial vacuum without the water injection, allowing the blower to heat within safe limits. The heat will tend to drive off residual moisture.

For extended shutdown, oil may be injected into the inlet of the heated blower just prior to shutting down the blower. The oil will provide a protective coating on the internal components. Make sure the water is completely shut off after shutdown.

Special coatings or platings are available to minimize rusting or corrosion in applications where blowers can remain wet.

Always use vertical-flow blowers with two-lobed, plugged rotors. Always orient the system with the blower intake at the top and discharge at the bottom.

 **CAUTION**

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

**NOTICE**

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

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

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

The following shutdown procedure minimizes the risk of moisture condensation, corrosion, and freezing.

**NOTICE**

*Care must be taken 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, allow the blower to run 3 – 5 minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.
3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such as WD-40® into the inlet of the blower just before shutdown (*3-in-One and WD-40 are registered trademarks of WD-40 Company*). The lubricant will provide an excellent protective coating on the internal surfaces. If using a spray lubricant, take care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, likely to a degree where repair would be required.
4. If the blower is being taken out of commission for an extended period of time, **see Long-Term Storage on page 30**.

# 07

## MAINTENANCE

### GENERAL

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

#### DANGER



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

#### CAUTION

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

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

#### CAUTION

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

Pay special attention to lubrication of timing gears and bearings according to the information in **Lubrication on page 15**.

When a blower is taken out of service, it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of downtime. Under atmospheric conditions producing rapid corrosion, protect the blower immediately. **See Long-Term Storage on page 30**.

### REGULAR MAINTENANCE

A well-designed maintenance program will add years of service to the blower.

Check a newly installed blower frequently during the first month of operation, especially lubrication. With the blower at rest, check the oil level in both the gear (drive) end and free (non-drive) end of the blower and add oil as needed. Complete oil changes are recommended every 1,000 - 1,200 operating hours, or more frequently depending on the type of oil and operating temperature. Also change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
<ol style="list-style-type: none"> <li>1. Check and maintain oil level, and add oil as necessary.</li> <li>2. Check for unusual noise or vibration (<b>See Troubleshooting on page 37</b>).</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage.</li> <li>2. Check the relief valve to make sure it is operating properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inspect the entire system for leaks.</li> <li>2. Inspect the condition of the oil and change if necessary.</li> <li>3. Check drive belt tension and tighten if necessary.</li> </ol>

**NOTICE**

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

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

**SPARE PARTS**

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

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

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

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

**FACTORY SERVICE AND REPAIR**

With proper care, Tuthill Vacuum & Blower Systems blowers will give years of reliable service. The parts are machined to close tolerances and require special tools by mechanics who are skilled at this work. Should major repairs become necessary, contact the factory for the location of the nearest service facility.

**NOTICE**

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

**NOTICE**

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

10. If possible, rotate the drive shaft by hand at least monthly to prevent seals from setting in one position.

## LONG-TERM STORAGE

Any time the blower will be stored for an extended period of time, make sure it is protected from corrosion by following this procedure:

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

## DISASSEMBLY AND REASSEMBLY

### DISASSEMBLY OF BLOWER

**WARNING**

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

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

Remove the oil drain plugs in the bottom of the end covers and drain the oil. Remove eight cap screws 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 prior to disassembly.

- Broken teeth
- Chipped teeth
- Uneven wear
- Excessive wear
- Any other abnormalities

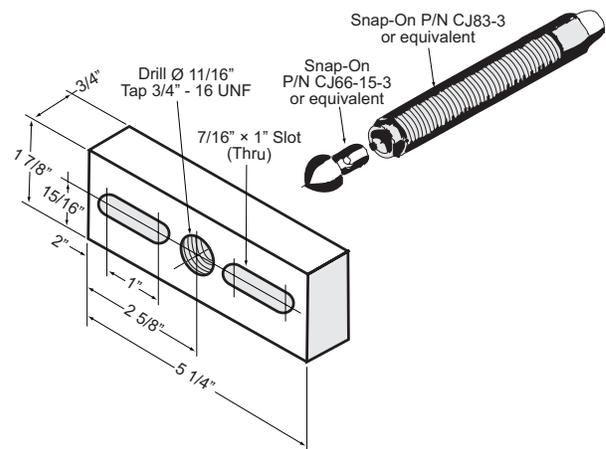


Figure 8-1 – Bar puller

See Figure 13-5 for further details.

1. Make sure that all oil is drained from blower and remove the port fittings.

2. Remove the spanner lock nut, dust washer, screws, and seal adapter housing. Tap out the seal and discard O-rings. Remove the spacers, and discard the O-ring.
3. Remove the cap screws from the gear end cover.
4. Remove the gear end cover using the beveled chisel and hammer, unless jackscrew holes have been provided.
5. Remove the snap ring from drive shaft.
6. Using the gear pullers, remove the drive shaft bearing.
7. Remove the drive shaft.
8. Remove the gear lock nuts and locks.
9. Align the timing marks (**See Figure 8-2** on timing gears).
10. Rotate the drive gear in a clockwise rotation approximately 4 or 5 teeth and mark this location (**see Figure 8-3**). This gear position is necessary so rotors will clear and not jam. Do not allow the reference marks to change location while the driven gear is being removed.
11. Using the gear pullers, pull the driven gear first.
12. After removal of the driven gear, continue with pulling the drive gear.
13. Remove the gear end bearing retainer rings, exposing the bearings.
14. Remove the cap screws and free the end cover, exposing the oil slinger assembly.
15. Remove the flat-head socket screw from the oil slinger and gently pry the oil slinger from the shaft (on some models).
16. Remove the flat-head socket screw and washer from the opposite rotor.
17. Use the bar pullers (**see Figure 8-4**) and attach to free end plate bores. Using the bar pullers, pull the free end plate from rotor shafts.

**NOTE: Using two bar pullers is recommended.**

18. Attach the bar puller to the gear end plate bore and push out the rotors, one at a time.
19. Using the rubber mallet, tap the end plate from the housing.
20. Using a soft metal punch and a mallet, tap out the bearings from the end plate bores.
21. Using a bevel chisel, remove the seals from end plate bores.
22. On blowers with labyrinth seals installed, remove the labyrinth seals with a beveled chisel and hammer, if necessary.
23. Inspect all parts for wear and serviceability.

## ASSEMBLY OF BLOWER

The assembly procedure is generally the same for all series, but notations are made where there are differences.

Gaskets are never used between rotor housing and end plates. Gaskets are used on 16/47 and 17/46 series between the end covers and end plates to seal oil leakage. Dowel pins are used to locate the end plates, housing, and drive end cover in proper location relative to each other. Be sure the dowel pins are in place.

It is recommended that the gear end rotor shaft bearings be purchased from Tuthill Vacuum & Blower Systems, as they are specially ground to locate the rotors with correct end clearance relative to the gear end plate.

## Preparation of End Plates for Assembly

### NOTICE

Make sure all parts are clean and free of any nicks or burrs caused by disassembly. Lip-seal blowers will require all sleeves or seal journals to be polished to remove any nicks or scratches. Failure to polish seal journals will result in seal leakage or damage. See **Special Tool Drawings on page 43** for information and dimensions on seal pressing tools as well as other assembly tools required.

1. In blowers that have labyrinth seals, position the labyrinth seals with the slots pointing up and press one seal into each end plate bore.
2. In blowers that use lip seals as a means of sealing, apply a smooth coating of Permatex #2 or silicone sealer to the outer diameter (OD) edge of the seal shell. Press a lip seal into each end plate bore, making sure the seal “lip” is facing up, or toward the oil. Apply grease to lip seals only.
3. In blowers that require mechanical seals, apply a smooth coating of silicone to the OD of the seal shell as in step 2. Position the mechanical seal with the carbon face up and press the seal into each end plate bore. Wipe the carbon with soft tissue and acetone or similar cleaner. Make sure the seal is fully seated and the shell is not deformed. Make sure the carbon is not scarred or cracked. Mating rings will be seated later in the assembly procedure.

### Gear End Assembly

4. Stand the rotors on the free end in the arbor press. Make sure both keyways are in line and point to the right. Two-lobe rotors include two keyways on each shaft. When positioning the rotors, two keyways (one on each rotor) should point in the same direction, to the right.
5. Place the gear end plate with the seals installed on the rotor shafts. Make sure the threads on the rotor shafts do not damage the seals.
6. Blowers with mechanical face seals must have mating rings installed. Make sure the surface is clean, and gently place a few drops of clean oil on the seal face for lubrication. Install the mating ring (lapped surface) against the carbon face.
7. Lightly coat the rotor shaft with anti-seize compound or equivalent.

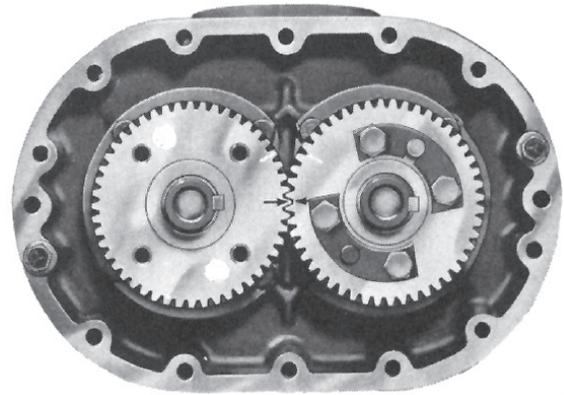


Figure 8-2 – Keyways in line and timing marks matched

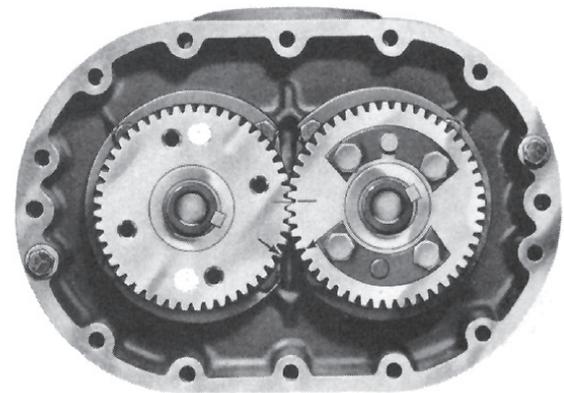


Figure 8-3 – Timing marks advanced 3 teeth (reference marks aligned)

8. Using flush-ground bearings on the gear end only, press the bearings onto the rotor shafts.

### CAUTION

**These bearings have flush ground faces and should be installed with manufacturer numbers up (toward gear). If no numbers appear on either side, look for a black dot (acid mark) on the inner race. Install with dot up. Do not use bearings that have not been flush ground to within a .001" (.025 mm) tolerance.**

9. Install the oil retainer (4000 models only).
10. Install the bearing retainer ring and lock plates on all series blowers.
11. Check the clearance between the gear end plate and rotor lobe ends. Correct clearances are listed in **Assembly Clearances on page 39**.

### NOTICE

*Position of timing marks is for removing or installing the driven gear. To remove the drive gear, advance three teeth in the opposite direction.*

12. Stand the rotors on the arbor press with the gear end shafts up and both keyways facing to the right. The drive rotor should be on the left.
13. Install the gear end plate, making sure the feet are facing in the correct direction, over the rotor shafts and coming to rest on top of the rotor lobes. Be careful not to damage the seals.

14. In blowers that have mechanical face seals, check the lapped surface of the seal mating ring to be sure it is perfectly clean. Use soft tissue and cleaning agent (acetone) if necessary. Place a few drops of lubricating oil on its surface and install on the shaft with the lapped surface coming to rest on top of the carbon. Gently press with fingers to make sure compression is taking place and the ring is not hung up for any reason.
15. Lubricate the shafts and press the double row ball bearings on the rotor shafts and into the end plate bores. Secure with retainer rings and screws.

### NOTICE

*These bearings have been flush ground at the factory. The inner race will have a black dot etched on the surface. This dot must be up and visible when the bearings are installed.*

16. Check clearance between the face of the end plate and the rotor lobes. **See Figure 8-4** for correct gear and clearances. If clearances are not within specifications, recheck the parts to find and correct the cause of improper clearances before proceeding.
17. Install spacer (0.260 in. [6.60 mm] thickness) and oil slinger on the other shaft.

### NOTICE

*Oil slinger and its spacer should always be mounted on either shaft for vertical flow units.*

18. Install the timing shim in the same location as found in disassembly. This does not necessarily ensure the blower will be in proper time. Adjustments can be made later in the assembly process.
19. Insert the gear keys into the rotor shaft keyways. Loose fits are not acceptable.
20. Lubricate the shafts and install the driver gear (right hand helix) on the drive rotor (left side).

To install the driven gear, align the reference marks as shown in **Figure 5-5**. Install the driven gear carefully to avoid mashing any teeth when engaging the opposite gear.

21. Install the washers and flat-head allen screws.
22. Remove the assembly from the press and stand it on the work table with the gears down. Place blocks under the end plate to prevent the assembly from falling over. The drive gear should remain on the left side.
23. Place a small bead of an RTV silicone type sealer around the periphery of the end plate and encircling each bolt hole.
24. Install the rotor housing and secure with four screws evenly spaced.
25. Check clearances between the end of the lobes and the housing using a flat bar and feeler gauges or a depth micrometer. **See Figure 8-4** for free end clearances.

### Free End Assembly

26. On single and double envelope series, put sealer on the free end plate (same as step 15).
27. Install the free end plate and secure it with 4 screws.
28. On single and double envelope series, repeat step 7.
29. In blowers that have mechanical face seals, install the bearing spacers (0.063 in. [0.06 mm] thickness) on each shaft. Lubricate the shafts and tap on the bearings.
30. Install the oil retainer rings with button-head screws.
31. Install the oil slinger on lower rotor (either shaft on vertical-flow blowers), spacer on the opposite shaft, washers, and screws.

### Adjusting Rotor Interlobe Clearance

32. Lay the blower down with the drive gear on the left. Using feeler gauges, take interlobe readings and record on each side of housing as indicated in **Figure 8-4**. 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 0.006 in. (0.16 mm) will change the rotor lobe clearance one-half the amount: 0.003 in. (0.08 mm).

**EXAMPLE:** **See Figure 8-4**, check the clearance at AA (left-hand reading) and BB (right-hand reading). If AA reading is 0.003 in. (0.08 mm) and BB reading is 0.009 in. (0.24 mm), by removing 0.006 in. (0.16 mm) of shim, the readings will change one-half the amount removed or 0.003 in. (0.08 mm). AA should then read 0.006 in. (0.16 mm) and BB should read 0.006 in. (0.16 mm). The final readings should be within 0.002 in. (0.05 mm) of each other.

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

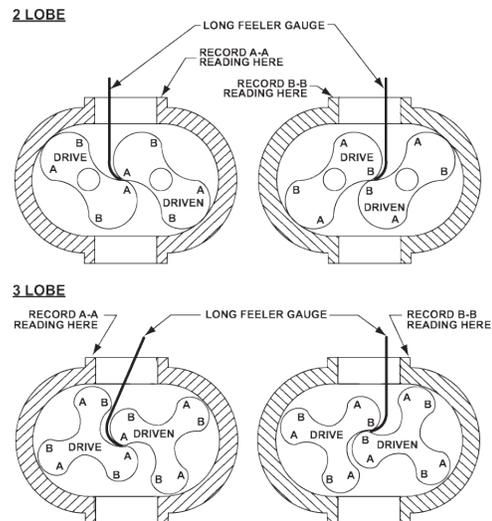


Figure 8-4 – Checking Rotor Interlobe Clearance

33. Install the drive shaft and secure with allen screws. Check drive shaft runout at the seal journal. Do not exceed 0.002 in. (0.05 mm) TIR. Install the lockwire.
34. Install the bearing on the drive shaft and secure with the retaining ring. The shield side of the bearing must face outward.
35. Remove the temporary cap screws from each end plate and install the cover gasket and gear end cover. Make sure the dowel pins are in place. Sealer is not required on factory-supplied gaskets. Secure with cap screws and washers.
36. Coat the OD of the drive shaft seal with sealer, and grease the ID. Install carefully over the keyway and tap into the cover.
37. Install the free end cover with gasket, and secure with cap screws and washers.
38. Install the port fittings, gaskets, and secure with cap screws and washers.

## SPECIAL INSTRUCTIONS – DOUBLE ENVELOPE

Continue assembly:

- A. Prepare the cover. Place the flange side down. Install the first of the two snap rings into the innermost groove. Press in the first of the two mechanical seals. Lightly silicone the outer case of the seal. Press the seal with the carbon side down until seated against the snap ring. Be careful not to distort the snap ring.
- B. Install the second snap ring into the outer groove. Place the mating ring from the first seal into the cover with the lap surface up. Press the second mechanical seal in, with the carbon side groove down until seated against outer snap ring. The carbon will seal against the mating ring when the cover is installed on the drive shaft.

## Drive Shaft Assembly

- A. Install one thin spacer onto the drive shaft so it is next to the bearing with the groove out. Install one O-ring to seat in the groove of the spacer. Lightly oil the face of the mating ring, and install onto the shaft with the lapped surface out. Install the large spacer with the groove side facing the mating ring. Install the thin spacer with the groove out. Install the O-ring so it will seat into the groove.
- B. Remove the temporary hold-down bolts. Place a bead of silicone around the periphery of the end plate encircling each bolt. Install the gear end cover and tighten the bolts. Install the large spacer with the groove out and install the free end spacer. Install the dust cover and lock nut. Install the pipe plug into the bottom nosepiece in the cover silicone plug.
- C. Fill with oil until oil can be seen in the middle hole, and install the pipe plug. Continue to fill to the proper level. Wait 2 minutes before installing the last pipe plug to make sure proper oil level is maintained.

## TROUBLESHOOTING

Although Tuthill Vacuum & Blower Systems blowers are well designed and manufactured, problems may occur due to normal wear and the need for readjustment. The following chart lists symptoms that may occur along with probable causes and remedies.

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil	Gear housing not tightened properly	Tighten gear housing bolts.
	Lip seal failure	Disassemble and replace lip seal.
	Insufficient sealant	Remove gear housing and replace sealant. <b>See <i>Disassembly of Blower on page 31.</i></b>
	Loose drain plug	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication	Correct oil level. Replace dirty oil. <b>See <i>Lubrication on page 15.</i></b>
	Excessive belt tension	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment	Check carefully. Re-align if necessary.
Lack of volume	Slipping belts	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances	Check for proper clearances. <b>See <i>Assembly Clearances on page 39.</i></b>
	Speed too low	Increase blower speed within limits.
	Obstruction in piping	Check system to ensure an open flow path.
Knocking	Blower out of time	Re-time.
	Distortion due to improper mounting or pipe strains	Check mounting alignment and relieve pipe strains.
	Excessive pressure differential	Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary.
	Worn gears	Replace timing gears. <b>See <i>Disassembly of Blower on page 31.</i></b>

SYMPTOM	PROBABLE CAUSE	REMEDIES
Excessive blower temperature	Too much or too little oil in gear reservoir	Check oil level. <b>See <i>Lubrication on page 15.</i></b>
	Too low operating speed	Increase blower speed within limits.
	Clogged filter or silencer	Remove cause of obstruction.
	Excessive pressure differential	Reduce pressure differential across the blower.
	Elevated inlet temperature	Reduce inlet temperature.
	Worn lobe clearances	Check for proper clearances. <b>See <i>Assembly Clearances on page 39.</i></b>
Rotor end or tip drag	Insufficient assembled clearances	Correct clearances. <b>See <i>Assembly Clearances on page 39.</i></b>
	Case or frame distortion	Check mounting and pipe strain.
	Excessive operating pressure	Reduce pressure differential.
	Excessive operating temperature	Reduce pressure differential or reduce inlet temperature.
Vibration	Belt or coupling misalignment	Check carefully. Re-align if necessary.
	Lobes rubbing	Check cylinder for hot spots, and then check for lobe contact at these points. Correct clearances. <b>See <i>Assembly Clearances on page 39.</i></b>
	Worn bearings or gears	Check condition of gears and bearings. Replace if necessary.
	Unbalanced or rubbing lobes	Possible build-up on casing or lobes, or inside lobes. Remove build-up and restore clearances.
	Driver or blower loose	Check mounting and tighten if necessary.
	Piping resonance	Check pipe supports, check resonance of nearby equipment, and check foundation.

## ASSEMBLY CLEARANCES

MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
3202	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.004 – 0.009 in. (0.10 – 0.23 mm)	0.005 – 0.009 in. (0.13 – 0.23 mm)	CENTER TIMED
3204	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.004 – 0.009 in. (0.10 – 0.23 mm)	0.005 – 0.009 in. (0.13 – 0.23 mm)	
3206	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.006 – 0.011 in. (0.15 – 0.28 mm)	0.005 – 0.009 in. (0.13 – 0.23 mm)	
3210	0.003 – 0.006 in. (0.08 – 0.15 mm)	0.010 – 0.015 in. (0.25 – 0.38 mm)	0.005 – 0.009 in. (0.13 – 0.23 mm)	
4006	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.006 – 0.011 in. (0.15 – 0.28 mm)	0.008 – 0.011 in. (0.20 – 0.28 mm)	
4009	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.008 – 0.012 in. (0.20 – 0.30 mm)	0.008 – 0.011 in. (0.20 – 0.28 mm)	
4012	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.010 – 0.014 in. (0.25 – 0.36 mm)	0.008 – 0.011 in. (0.20 – 0.28 mm)	
4014	0.004 – 0.007 in. (0.10 – 0.18 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.008 – 0.011 in. (0.20 – 0.28 mm)	
5507	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.009 – 0.013 in. (0.23 – 0.33 mm)	0.012 – 0.014 in. (0.30 – 0.36 mm)	
5511	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.012 – 0.016 in. (0.30 – 0.41 mm)	0.012 – 0.014 in. (0.30 – 0.36 mm)	
5514	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.014 – 0.018 in. (0.36 – 0.46 mm)	0.012 – 0.014 in. (0.30 – 0.36 mm)	
5516	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.016 – 0.020 in. (0.41 – 0.51 mm)	0.012 – 0.014 in. (0.30 – 0.36 mm)	
5518	0.005 – 0.007 in. (0.13 – 0.18 mm)	0.018 – 0.023 in. (0.46 – 0.58 mm)	0.012 – 0.014 in. (0.30 – 0.36 mm)	

# 11

## TORQUE CHART

Data shown represents “wet” torque values.

PART DESCRIPTION	TORQUE
CAP SCREW 10-32UNF	3 ft-lb (4 N-m)
CAP SCREW 1/4"-20UNC GR5	6 ft-lb (8 N-m)
CAP SCREW 5/16"-18UNC GR5	13 ft-lb (17 N-m)
CAP SCREW 3/8"-16UNC GR5	23 ft-lb (31 N-m)
CAP SCREW 1/2"-13UNC GR5	57 ft-lb (77 N-m)
CAP SCREW 5/8"-14UNC GR5	113 ft-lb (153 N-m)
CAP SCREW 3/4"-10UNC GR5	200 ft-lb (271 N-m)

## RECOMMENDED LUBRICANTS

### RECOMMENDED LUBRICANTS FOR ROTARY BLOWERS AND VACUUM BOOSTERS

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

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

RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	LUBRICANT MEETING U.S. FDA REGULATION 21 CFR 178.3570 GOVERNING PETROLEUM PRODUCTS WHICH MAY HAVE INCIDENTAL CONTACT WITH FOOD, AND USDA H1 REQUIREMENTS	LUBRICANT MEETING U.S. FDA REGULATIONS 21 CFR 172.878 AND 178.3620(A) FOR DIRECT AND INDIRECT FOOD CONTACT
0° to 32°F (-18° to 0°C)	CITGO CLARION® A/W 68 (ISO 68)	CITGO CLARION® 350 FOOD GRADE (ISO 68)
32° to 90°F (0° to 32°C)	CITGO CLARION® A/W 100 (ISO 100)	CONSULT FACTORY
90° to 120°F* (32° to 50°C)	CONSULT FACTORY	CONSULT FACTORY

**Recommended Lubricants**

RECOMMENDED SYNTHETIC BASED, FOOD GRADE LUBRICANTS		
AMBIENT TEMPERATURE	LUBRICANT MEETING U.S. FDA REGULATION 21 CFR 178.3570 GOVERNING PETROLEUM PRODUCTS WHICH MAY HAVE INCIDENTAL CONTACT WITH FOOD, AND USDA H1 REQUIREMENTS	LUBRICANT MEETING U.S. FDA REGULATIONS 21 CFR 172.878 AND 178.3620(A) FOR DIRECT AND INDIRECT FOOD CONTACT
0° to 32°F (-18° to 0°C)	PneuLube™ FG (ISO 100)	CONSULT FACTORY
32° to 90°F (0° to 32°C)		
90° to 120°F* (32° to 50°C)		

RECOMMENDED LUBRICANTS FOR M-D VACUUM BOOSTERS
REQUIREMENTS
<ul style="list-style-type: none"> <li>• Suitable for high vacuum service</li> <li>• 100 cSt @ 40°C</li> <li>• Vapor pressure of 1 micron or less @ 70°F (21°C)</li> <li>• Straight mineral (no additives) or PAO synthetic oil</li> </ul>

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

\* For higher ambient temperatures, please consult the factory.

\*\* Blowers used in oxygen-enriched service should use only Castrol Brayco 1726 Plus non-flammable, PFPE synthetic lubricant. Blowers used in hydrogen service should use only PneuLube synthetic oil. Tuthill Vacuum & Blower Systems cannot accept responsibility for damage to seals, O-rings and gaskets caused by use of synthetic lubricants not recommended by Tuthill Vacuum and Blower Systems.



MATL P/N: CR1018B0-200075 × 5.5 (139.7) LG  
 MATL: COLD ROLLED 1018 BAR  
 2.75 (69.85) × 5.5 (139.7) LONG

**TOLERANCES**

FRACTIONAL = ± .0005 (± 0.0127)  
 CHAMFERS = ± 2°

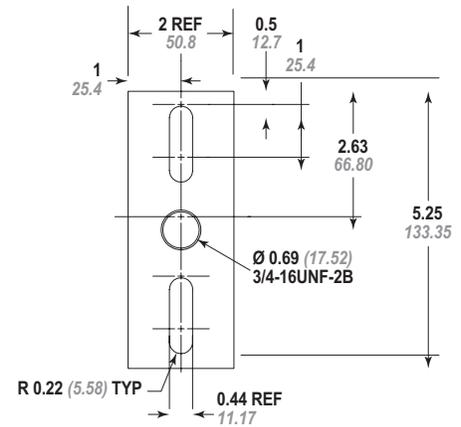
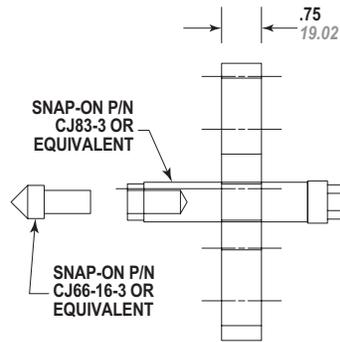


Figure 13-5 – 4000/5500 Gear and EP Tool (T29603)

**NOTE: All dimensions are shown in inches and millimeters.**

## PARTS LIST

### Parts List for Model 3200 Series – Standard Seals

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
12	Lip Seal	4
13	Lip Seal	1
14	Retainer	4
16	Shim	2
16	Shim	6
16	Shim	2
17	Spacer	1
18	Spacer	1
20	Oil Slinger	1
21	Oil Slinger	1
22	Dowel Pin	0
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	4
26	Cap Screw, Hex HD	12
26	Cap Screw, Hex HD	12
27	Lock Washer	24
28	Gasket	2
29	Cap Screw	4
30	Cap Screw	16
31	Magnetic Pipe Plug	2
37	Breather	2
38	Port Fitting	2
39	Port Fitting Gasket	2
40	Cap Screw	24

ITEM NO.	PART DESCRIPTION	QTY
41	Lock Washer	24
42	Nameplate	1
45	Drive Shaft	1
47	Retaining Ring	1
50	Bearing	1
51	Lab Seal	4
57	Spacer	1
66	Cap Screw	2
67	Spacer	2
70	Oil Gauge	2
85	Pipe Plug	6
98	Pipe Plug	6
121	Pipe Plug	3
123	Bearing Spacer	2
129	Spacer	4
174	Pipe Plug	2
234	Oil Level Tag	2
241	Cap Screw	12
242	Sight Gauge Frame	2
243	Sight Gauge Glass Frame	2
244	Window Gasket	2
245	Frame Gasket	2

#### NOTES:

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

**Parts List for Model 3200 Series – Single Envelope**

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
13	Lip Seal	1
14	Retainer	4
16	Shim	2
16	Shim	6
16	Shim	2
17	Spacer	1
18	Spacer	1
20	Oil Slinger	1
21	Oil Slinger	1
22	Dowel Pin	0
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	4
26	Cap Screw, Hex HD	12
26	Cap Screw, Hex HD	12
27	Lock Washer	24
28	Gasket	2
29	Cap Screw	4
30	Cap Screw	16
31	Magnetic Pipe Plug	2
37	Breather	2
38	Port Fitting	2
40	Cap Screw	24
41	Lock Washer	24
42	Nameplate	1
45	Drive Shaft	1

ITEM NO.	PART DESCRIPTION	QTY
47	Retaining Ring	1
50	Bearing	1
51	Lab Seal	4
54	Mechanical Seal	4
57	Spacer	1
66	Cap Screw	2
67	Spacer	2
70	Oil Gauge	0
85	Pipe Plug	6
98	Pipe Plug	10
121	Pipe Plug	2
123	Bearing Spacer	2
174	Pipe Plug	4
234	Oil Level Tag	2
241	Cap Screw	12
242	Sight Gauge Frame	2
243	Sight Gauge Glass Frame	2
244	Window Gasket	2
245	Frame Gasket	2

**NOTES:**

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

## Parts List for Model 3200 Series – Double Envelope

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
14	Retainer	4
16	Shim	2
16	Shim	6
16	Shim	2
17	Spacer	1
18	Spacer	1
20	Oil Slinger	1
21	Oil Slinger	1
22	Dowel Pin	0
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	4
26	Cap Screw, Hex HD	12
26	Cap Screw, Hex HD	12
27	Lock Washer	24
29	Cap Screw	4
30	Cap Screw	16
31	Magnetic Pipe Plug	2
38	Port Fitting	2
40	Cap Screw	24
41	Lock Washer	24
42	Nameplate	1
45	Drive Shaft	1
50	Bearing	1
51	Lab Seal	4
54	Mechanical Seal	4

ITEM NO.	PART DESCRIPTION	QTY
57	Spacer	1
66	Cap Screw	2
67	Spacer	2
70	Oil Gauge	0
74	Spacer	1
75	O-Ring	1
76	Mechanical Seal	1
77	Spacer	1
82	Washer	1
83	Lock Nut	1
85	Pipe Plug	6
91	Drive Shaft Seal Adapter	1
92	O-Ring	1
93	Cap Screw	4
98	Pipe Plug	10
118	Shim	1
118	Shim	1
121	Pipe Plug	4
123	Bearing Spacer	2
140	O-Ring	1
174	Pipe Plug	4
234	Oil Level Tag	2
241	Cap Screw	12
242	Sight Gauge Frame	2
243	Sight Gauge Glass Frame	2
244	Window Gasket	2
245	Frame Gasket	2

## NOTES:

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

**Parts List for Model 4000 Series – Standard Seals**

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
12	Lip Seal	4
13	Lip Seal	1
14	Retainer	2
15	Oil Retainer Ring	4
21	Oil Slinger	1
22	Dowel Pin	6
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	1
26	Cap Screw, Hex HD	28
27	Lock Washer	28
28	Gasket	2
29	Cap Screw	1
30	Cap Screw	4
31	Magnetic Pipe Plug	2
35	Lock Nut	2
36	Washer	2
37	Breather	2
38	Port Fitting	2
39	Port Fitting Gasket	2
40	Cap Screw	28
41	Lock Washer	28
42	Nameplate	1
45	Drive Shaft	1
47	Retaining Ring	1
50	Bearing	1

ITEM NO.	PART DESCRIPTION	QTY
51	Lab Seal	4
61	Bearing Lock Plate	4
62	Cap Screw	8
65	Lock Plate	2
66	Cap Screw	4
68	Dowel Pin	1
69	Cap Screw	1
70	Oil Gauge	2 / -
85	Pipe Plug	4 / 6
98	Pipe Plug	- / 4
121	Pipe Plug	6 / 2
123	Bearing Spacer	2
129	Spacer	4
174	Pipe Plug	2 / -
234	Oil Level Tag	- / 2
241	Cap Screw	- / 12
242	Sight Gauge Frame	- / 2
243	Sight Gauge Glass Frame	- / 2
244	Window Gasket	- / 2
245	Frame Gasket	- / 2

**NOTES:**

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

## Parts List for Model 4000 Series – Single Envelope

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
13	Lip Seal	1
14	Retainer	2
15	Oil Retainer Ring	4
21	Oil Slinger	1
22	Dowel Pin	6
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	1
26	Cap Screw, Hex HD	28
27	Lock Washer	28
28	Gasket	2
29	Cap Screw	1
30	Cap Screw	4
31	Magnetic Pipe Plug	2
35	Lock Nut	2
36	Washer	2
37	Breather	2
38	Port Fitting	2
40	Cap Screw	28
41	Lock Washer	28
42	Nameplate	1
45	Drive Shaft	1
47	Retaining Ring	1
50	Bearing	1
51	Lab Seal	4
54	Mechanical Seal	4

ITEM NO.	PART DESCRIPTION	QTY
61	Bearing Lock Plate	4
62	Cap Screw	8
65	Lock Plate	2
66	Cap Screw	4
68	Dowel Pin	1
69	Cap Screw	1
70	Oil Gauge	2 / 6
85	Pipe Plug	4 / 8
98	Pipe Plug	8 / 2
121	Pipe Plug	6 / 2
123	Bearing Spacer	2 / -
174	Pipe Plug	2 / -
234	Oil Level Tag	- / 2
241	Cap Screw	- / 12
242	Sight Gauge Frame	- / 2
243	Sight Gauge Glass Frame	- / 2
244	Window Gasket	- / 2
245	Frame Gasket	- / 2

## NOTES:

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

**Parts List for Model 4000 Series – Double Envelope**

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
14	Retainer	2
15	Oil Retainer Ring	4
21	Oil Slinger	1
22	Dowel Pin	6
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	1
26	Cap Screw, Hex HD	28
27	Lock Washer	28
28	Gasket	1
29	Cap Screw	4
30	Cap Screw	2 / 3
31	Magnetic Pipe Plug	2
35	Lock Nut	2
36	Washer	2
38	Port Fitting	28
40	Cap Screw	28 / 8
41	Lock Washer	1
42	Nameplate	1
45	Drive Shaft	1
50	Bearing	4
51	Lab Seal	6
54	Mechanical Seal	4
61	Bearing Lock Plate	8
62	Cap Screw	2
65	Lock Plate	4
66	Cap Screw	1
68	Dowel Pin	1
69	Cap Screw	1
70	Oil Gauge	2

ITEM NO.	PART DESCRIPTION	QTY
74	Spacer	2
75	O-Ring, Viton	2
76	Mechanical Seal	1
77	Drive Shaft Face Seal Sleeve	2
78	Retaining Ring	2
82	Washer	1
83	Lock Nut	1
85	Pipe Plug	7 / 8
86	Shim	1
87	Sleeve	1
88	O-Ring, Viton	1
89	Spacer	1
90	Set Screw	2
91	Drive Shaft Adapter Seal	1
92	O-Ring, Viton	1
93	Cap Screw	4
98	Pipe Plug	8
108	Magnetic Pipe Plug	1 / -
121	Pipe Plug	7 / 3
123	Bearing Spacer	2
140	O-Ring, Viton	1
174	Pipe Plug	2 / -
234	Oil Level Tag	- / 2
241	Cap Screw	- / 12
242	Sight Gauge Frame	- / 2
243	Sight Gauge Glass Frame	- / 2
244	Window Gasket	- / 2
245	Frame Gasket	- / 2

**NOTES:**

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

## Parts List for Model 5500 Series – Standard Seals

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
12	Lip Seal	4
13	Lip Seal	1
14	Retainer	2
21	Oil Slinger	1
22	Dowel Pin	6
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	1
26	Cap Screw, Hex HD	28
27	Lock Washer	56
28	Gasket	2
29	Cap Screw	1
30	Cap Screw	6
31	Magnetic Pipe Plug	2
35	Lock Nut	2
36	Washer	2
37	Breather	2
38	Port Fitting	2
39	Port Fitting Gasket	2
40	Cap Screw	28
42	Nameplate	1
45	Drive Shaft	1
46	Ring Adapter	1
47	Retaining Ring	1
50	Bearing	1
51	Lab Seal	4

ITEM NO.	PART DESCRIPTION	QTY
57	Bearing Spacer	1
61	Bearing Lock Plate	6
62	Cap Screw	12
65	Lock Plate	2
66	Cap Screw	4
68	Dowel Pin	1
69	Cap Screw	1
70	Oil Gauge	2 / -
85	Pipe Plug	6 / 4
98	Pipe Plug	- / 4
121	Pipe Plug	2 / -
123	Bearing Spacer	4 / 2
129	Spacer	7 / 4
174	Pipe Plug	- / 5
234	Oil Level Tag	- / 2
241	Cap Screw	- / 12
242	Sight Gauge Frame	- / 2
243	Sight Gauge Glass Frame	- / 2
244	Window Gasket	- / 2
245	Frame Gasket	- / 2

## NOTES:

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

**Parts List for Model 5500 Series – Single Envelope**

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
13	Lip Seal	1
14	Retainer	4 / 2
21	Oil Slinger	1
22	Dowel Pin	6
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	1
26	Cap Screw, Hex HD	28
27	Lock Washer	56
28	Gasket	2
29	Cap Screw	1
30	Cap Screw	6
31	Magnetic Pipe Plug	2
35	Lock Nut	2
36	Washer	2
37	Breather	2
38	Port Fitting	2
40	Cap Screw	28
42	Nameplate	1
45	Drive Shaft	1
46	Adapter Ring	1
47	Retaining Ring	1
50	Bearing	1
51	Lab Seal	4
54	Mechanical Seal	4
57	Bearing Spacer	1

ITEM NO.	PART DESCRIPTION	QTY
61	Bearing Lock Plate	6
62	Cap Screw	12
65	Lock Plate	2
66	Cap Screw	4
68	Dowel Pin	1
69	Cap Screw	1
70	Oil Gauge	2 / -
85	Pipe Plug	10 / 8
98	Pipe Plug	- / 4
123	Bearing Spacer	2 / -
174	Pipe Plug	7 / 5
234	Oil Level Tag	- / 2
241	Cap Screw	- / 12
242	Sight Gauge Frame	- / 2
243	Sight Gauge Glass Frame	- / 2
244	Window Gasket	- / 2
245	Frame Gasket	- / 2

**NOTES:**

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

**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

## Parts List for Model 5500 Series – Double Envelope

ITEM NO.	PART DESCRIPTION	QTY
1	Rotor	2
3	Housing	1
4	End Plate	2
6	Drive End Cover	1
7	Free End Cover	1
8	Timing Gear Set	1
9	Bearing, Drive End	2
10	Bearing, Free End	2
14	Retainer	2
21	Oil Slinger	1
22	Dowel Pin	6
23	Drive Shaft Key	1
24	Gear Key	2
25	Rotor Shaft Washer	1
26	Cap Screw, Hex HD	28
29	Cap Screw	4
30	Cap Screw	2 / 3
31	Magnetic Pipe Plug	2
35	Lock Nut	2
36	Washer	2
38	Port Fitting	28
40	Cap Screw	28 / 8
42	Nameplate	1
45	Drive Shaft	1
50	Bearing	4
51	Lab Seal	6
54	Mechanical Seal	4
57	Bearing Spacer	1
61	Bearing Lock Plate	6
62	Cap Screw	2
65	Lock Plate	4
66	Cap Screw	1
68	Dowel Pin	1
69	Cap Screw	1

ITEM NO.	PART DESCRIPTION	QTY
70	Oil Gauge	2
74	Spacer	2
75	O-Ring, Viton	2
77	Drive Shaft Face Seal Sleeve	2
80	Washer	1 / -
82	Washer	1
83	Lock Nut	1
85	Pipe Plug	7 / 8
86	Shim	1
86	Shim	4
91	Drive Shaft Adapter Seal	1
92	O-Ring, Viton	1
93	Cap Screw	4
98	Pipe Plug	8
123	Bearing Spacer	2
136	Lock Washer	1 / -
140	O-Ring, Viton	1
174	Pipe Plug	2 / -
224	Oil Retainer Plate	4 / 1
225	Cap Screw	4
234	Oil Level Tag	- / 2
241	Cap Screw	- / 12
242	Sight Gauge Frame	- / 2
243	Sight Gauge Glass Frame	- / 2
244	Window Gasket	- / 2
245	Frame Gasket	- / 2
255	Roll Pin	2 / -

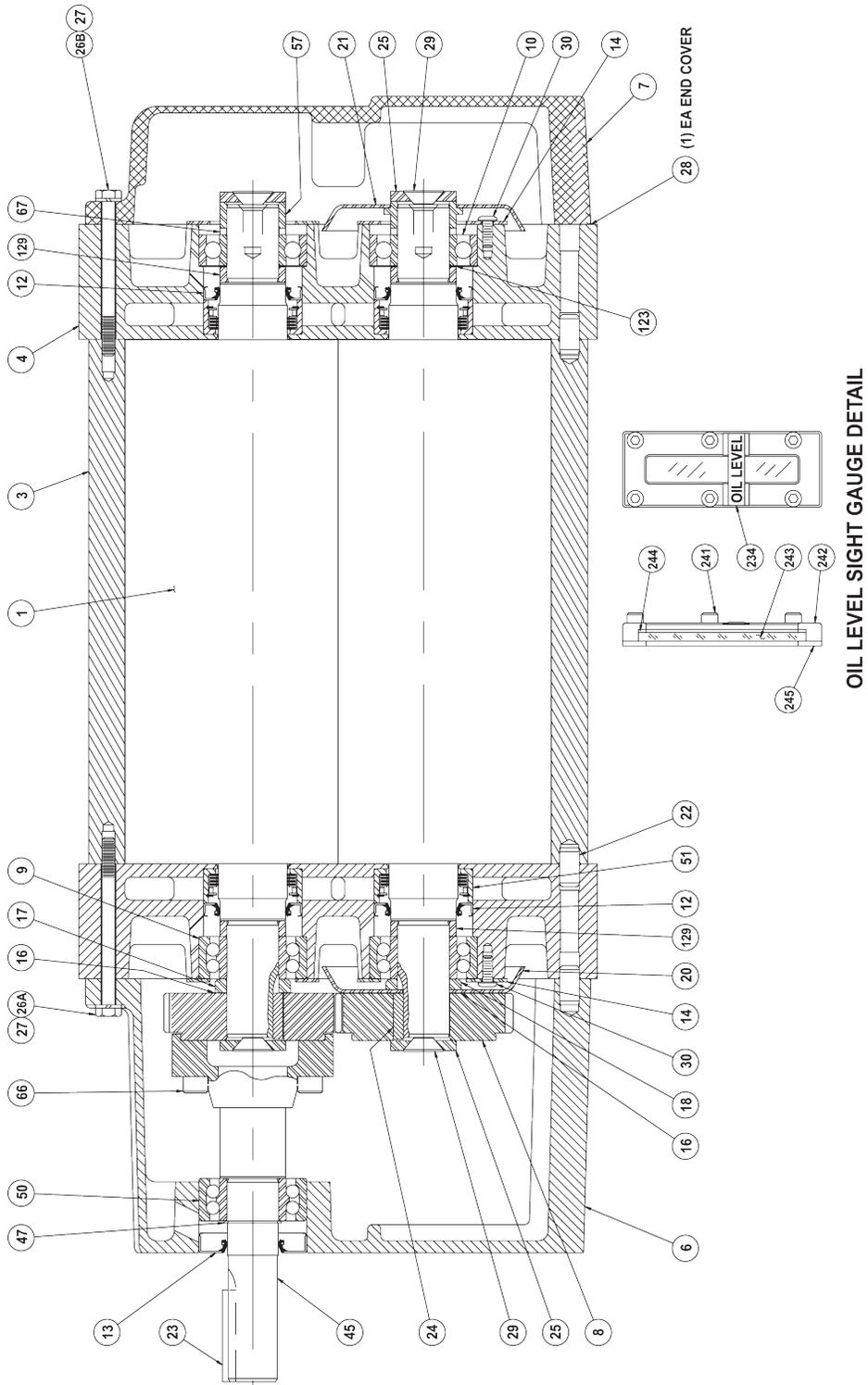
## NOTES:

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

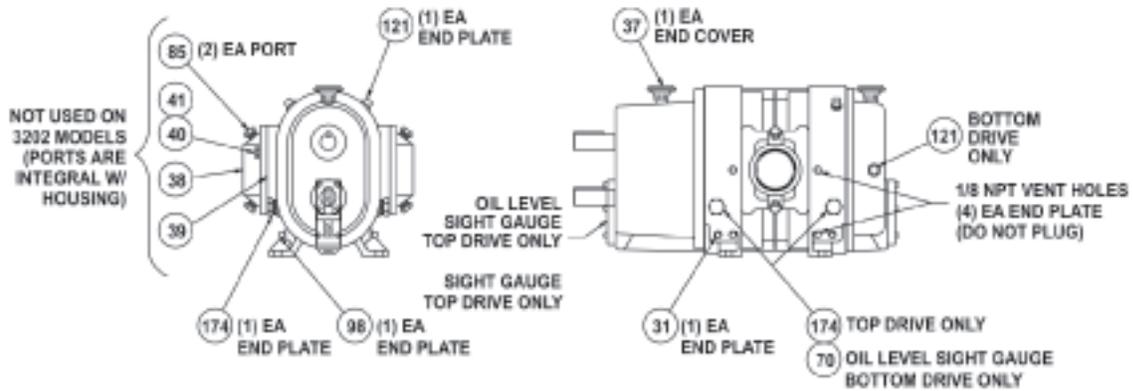
**PARTS KITS ARE AVAILABLE. CONSULT AUTHORIZED REPRESENTATIVE FOR PART NUMBERS.**

# ASSEMBLY DRAWINGS

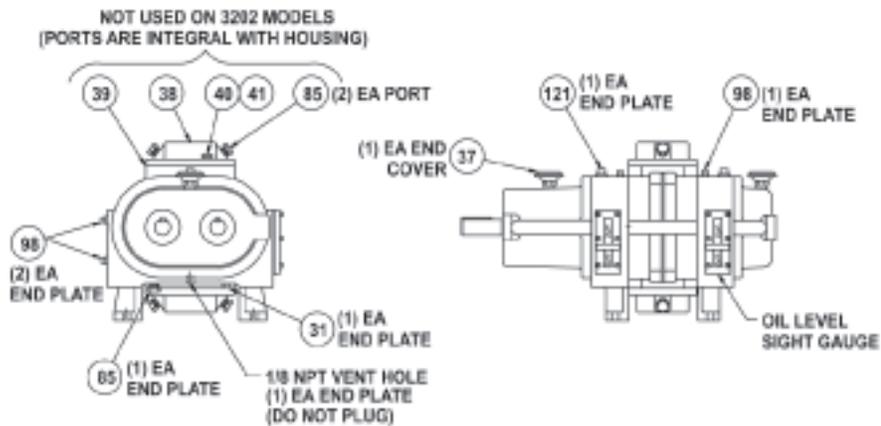
## Model 3200 – Standard Seals – Cutaway View



Model 3200 – Standard Seals – Side and End Views

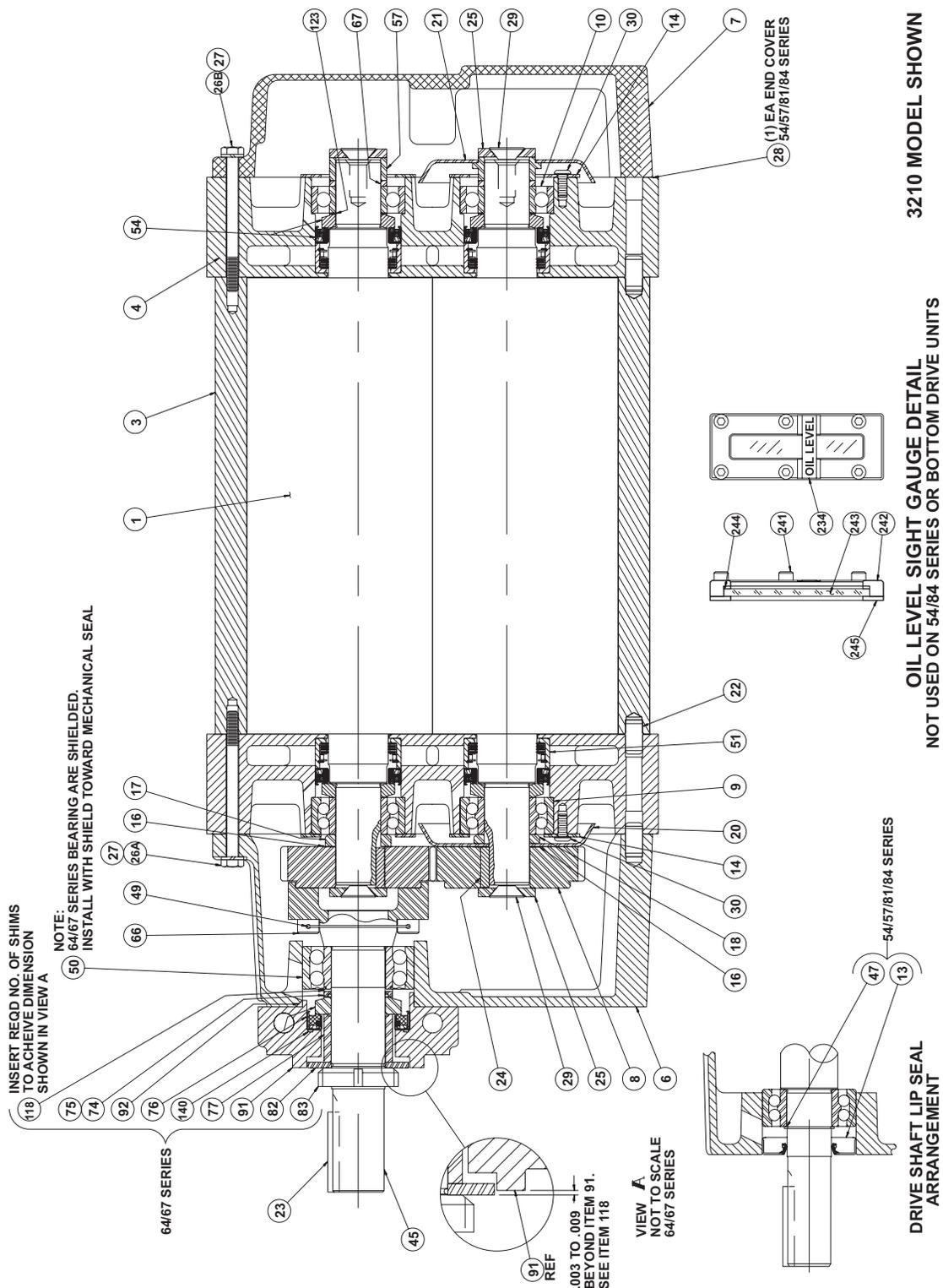


**HORIZONTAL STANDARD SEALS SERIES**

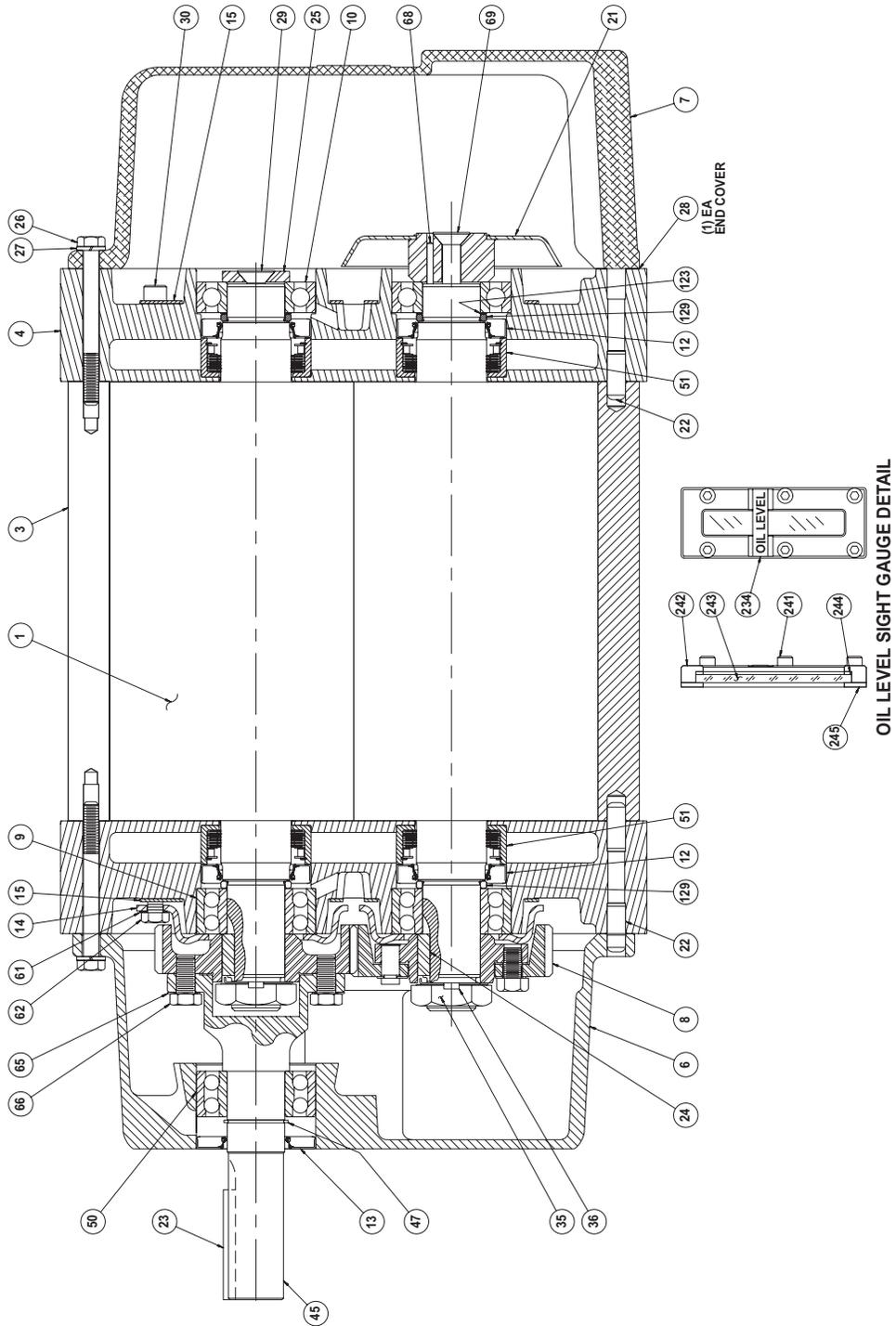


**VERTICAL STANDARD SEALS SERIES**

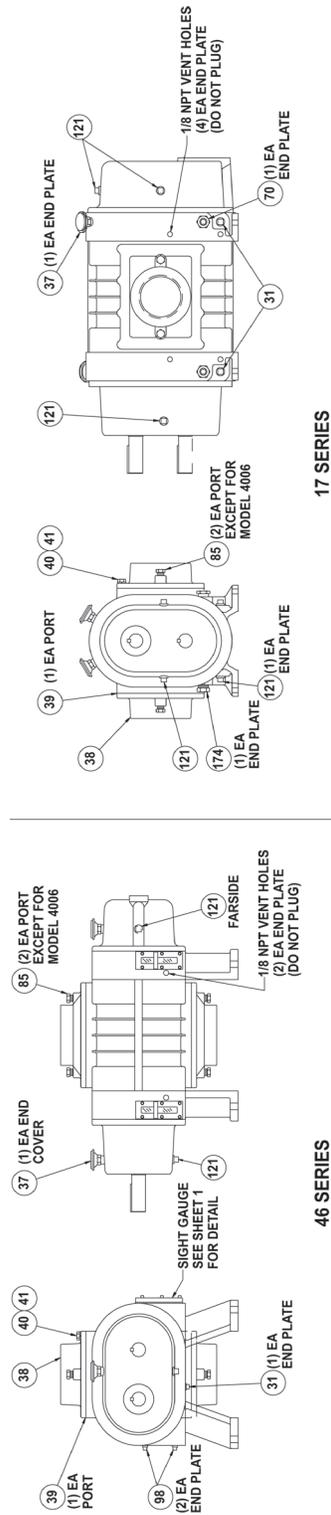
Model 3200 – 54/57/64/67/81/84 – Cutaway View



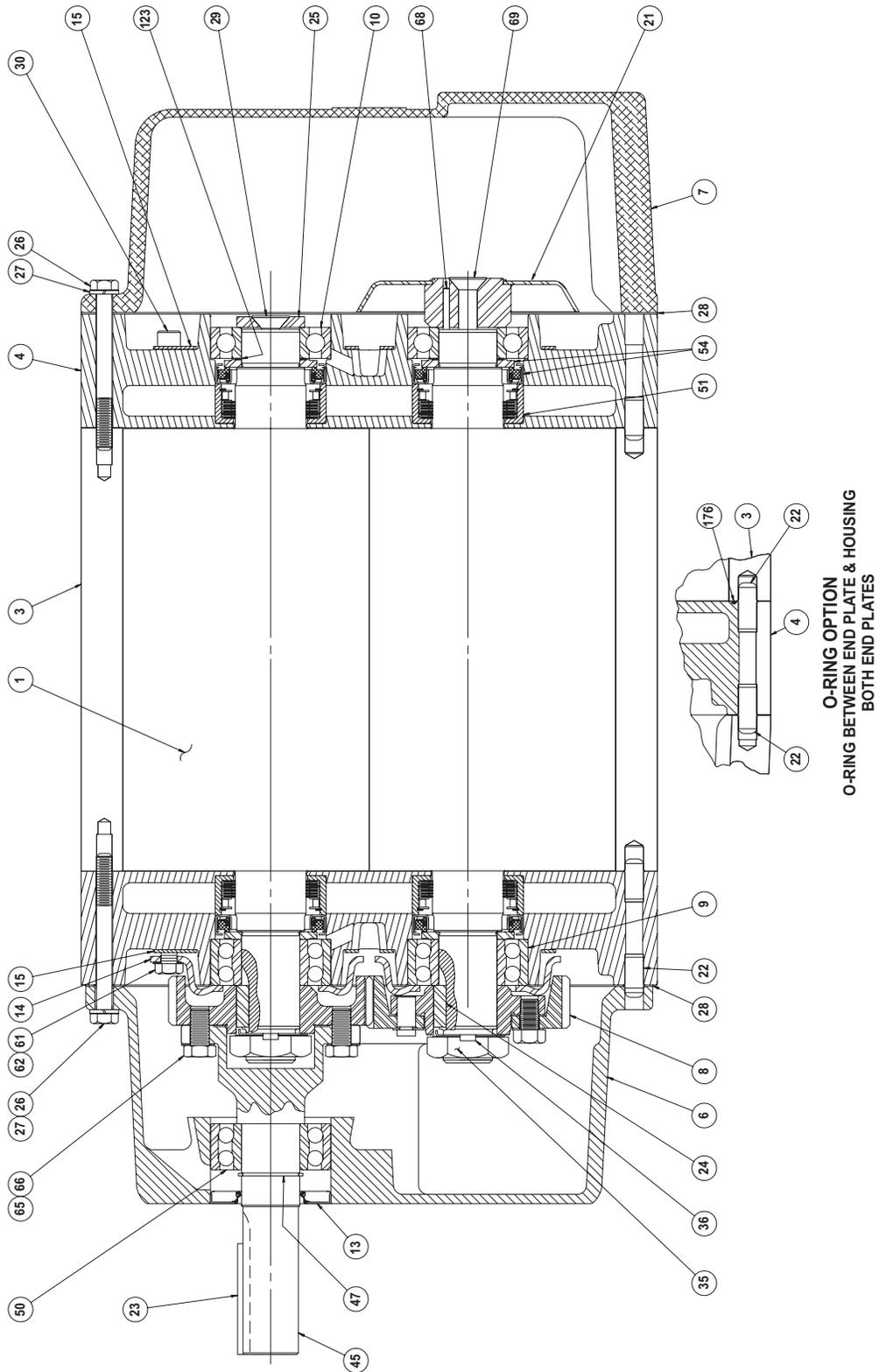
Model 4000 – Standard Seal – Cutaway Views



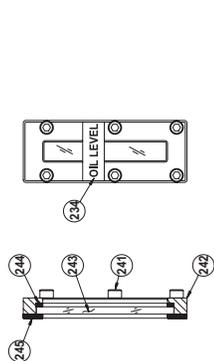
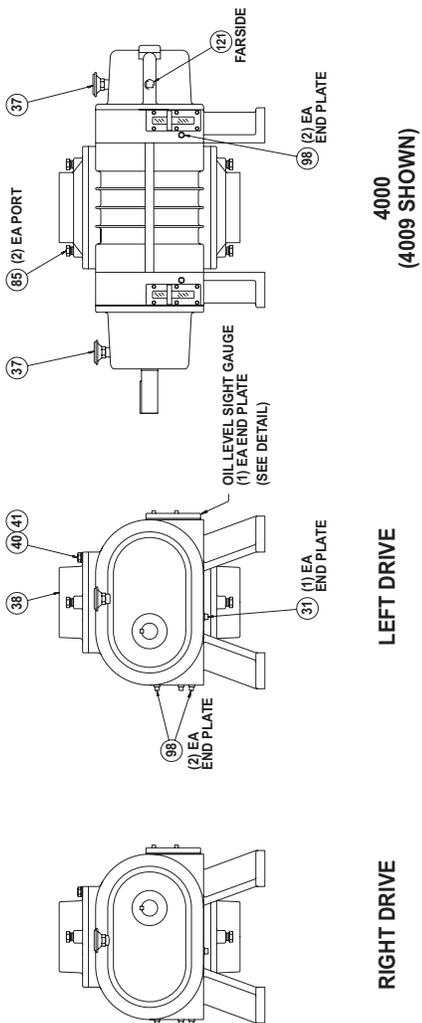
### Model 4000 – Lip-Labyrinth – Side and End Views



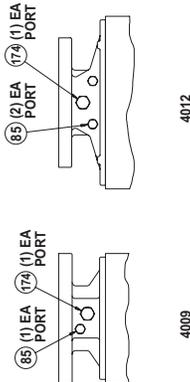
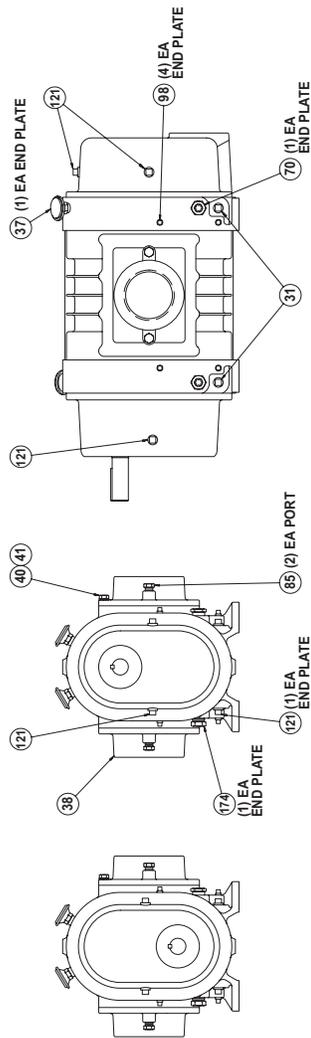
Model 4000 – Single Envelope – Cutaway View



# Model 4000 – Single Envelope – Side and End Views

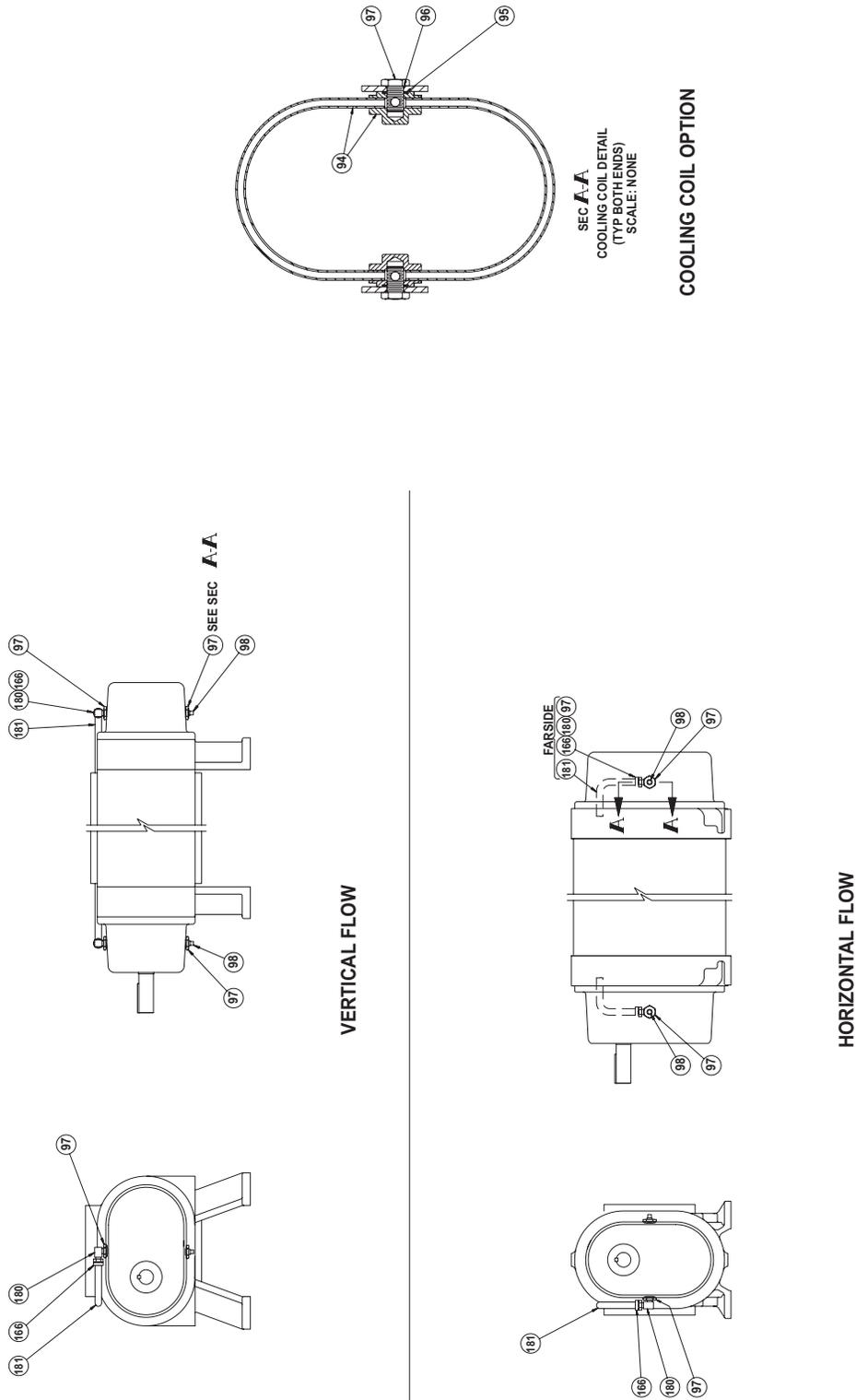


OIL LEVEL SIGHT GAUGE DETAIL

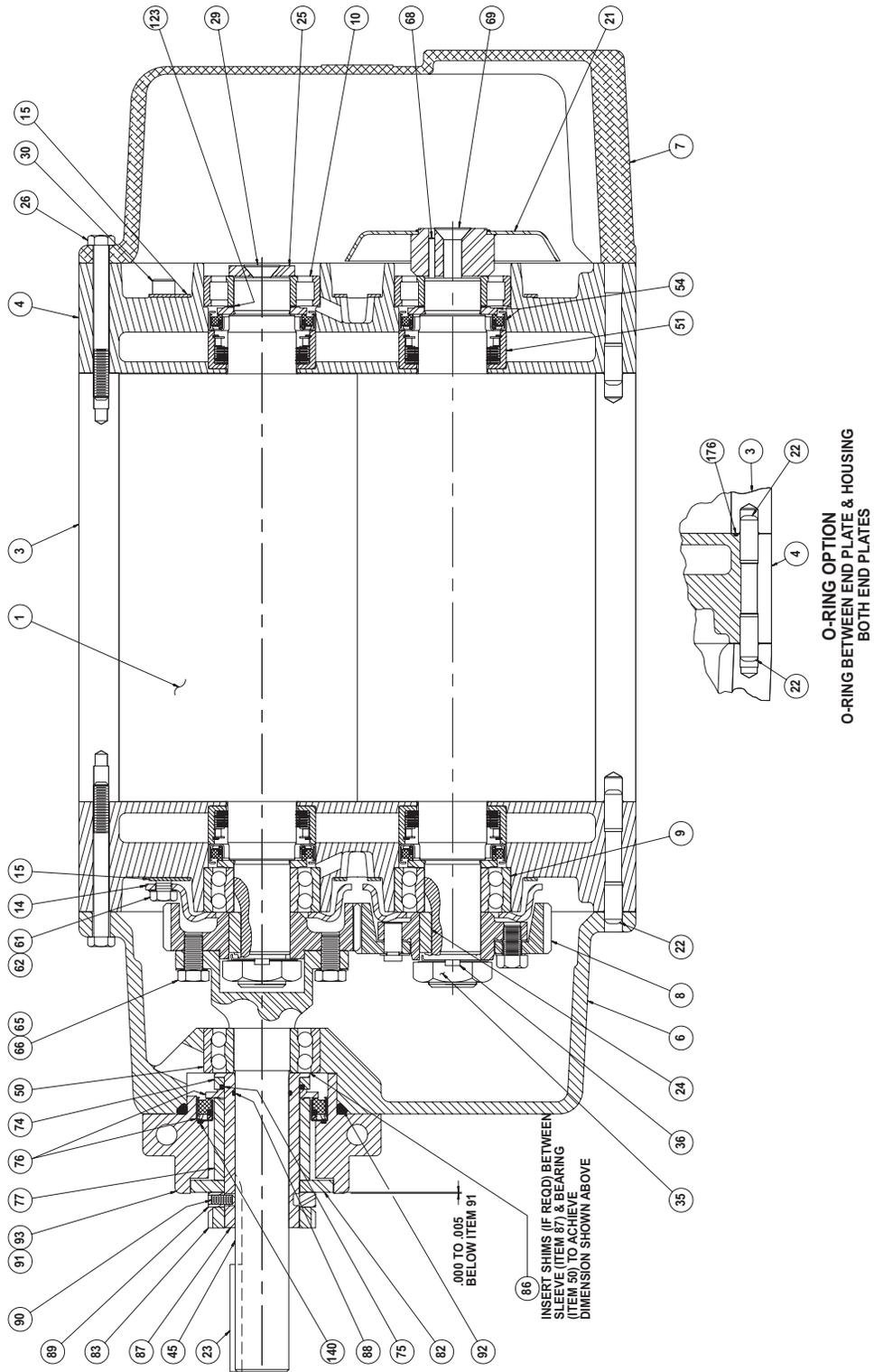


OPTIONAL FLANGED PORT FITTING DETAIL

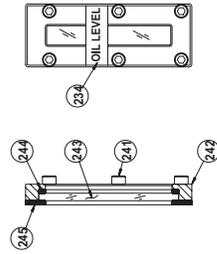
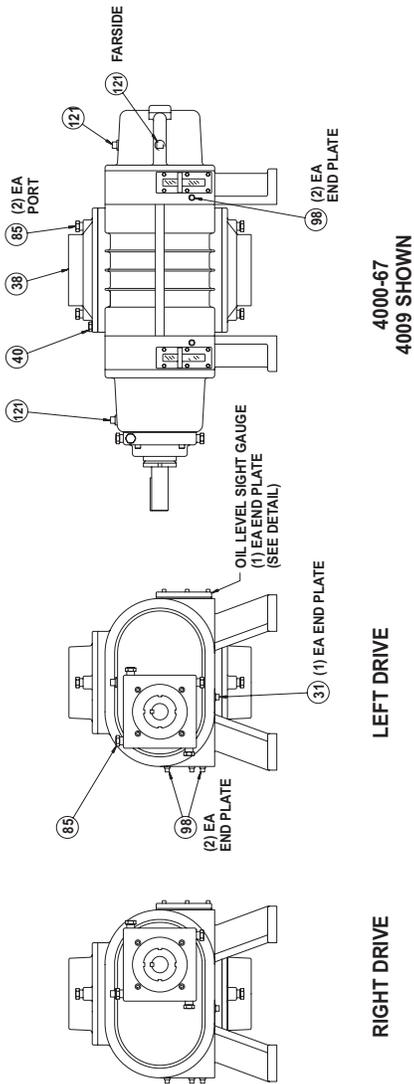
Model 4000 – Single Envelope (Cooling Coil Option) – Side and End Views



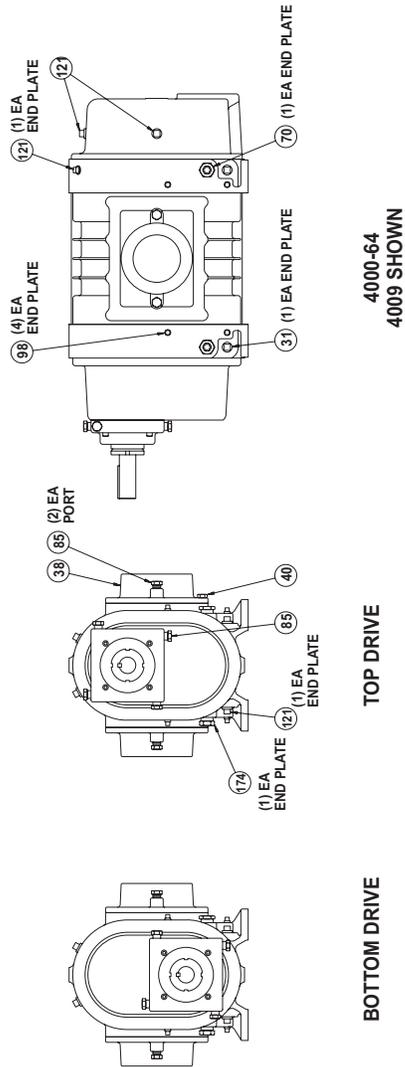
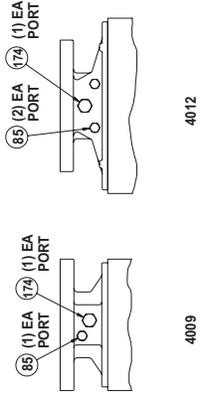
### Model 4000 – Double Envelope – Cutaway View



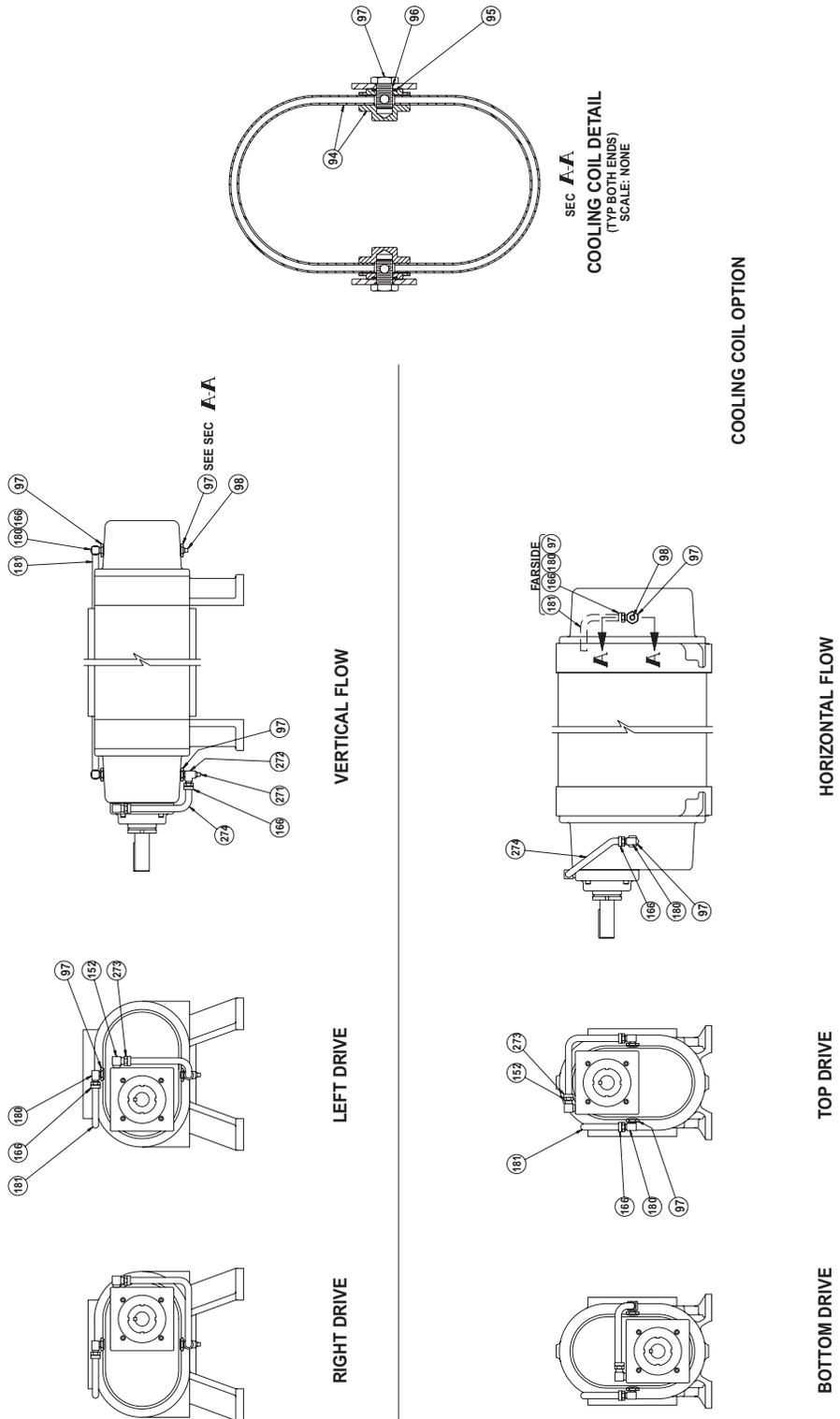
Model 4000 – 64-67-68 – Side and End Views



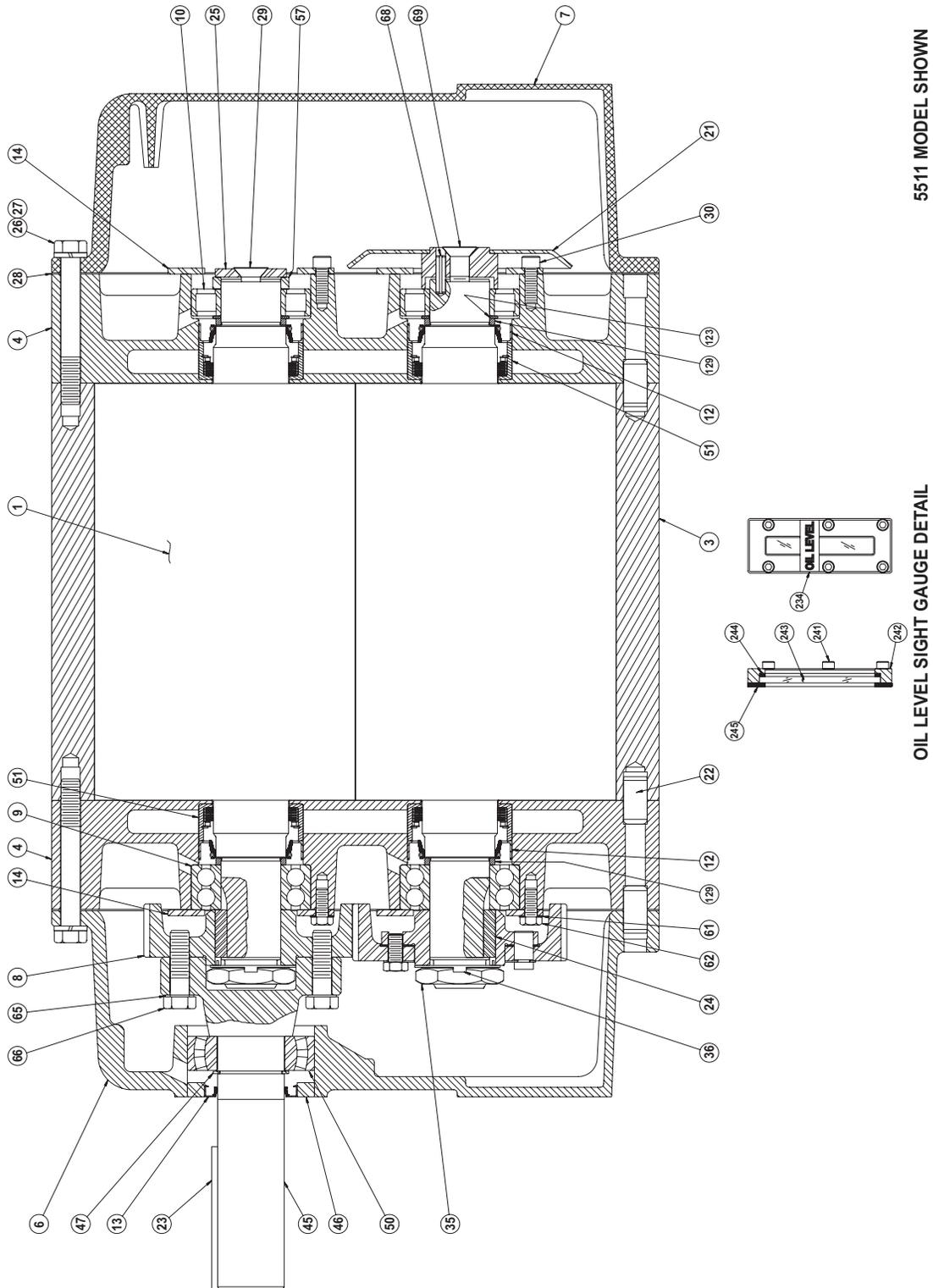
OIL LEVEL SIGHT GAUGE DETAIL



Model 4000 – 64-67-68 (Cooling Coil Option) – Side and End Views



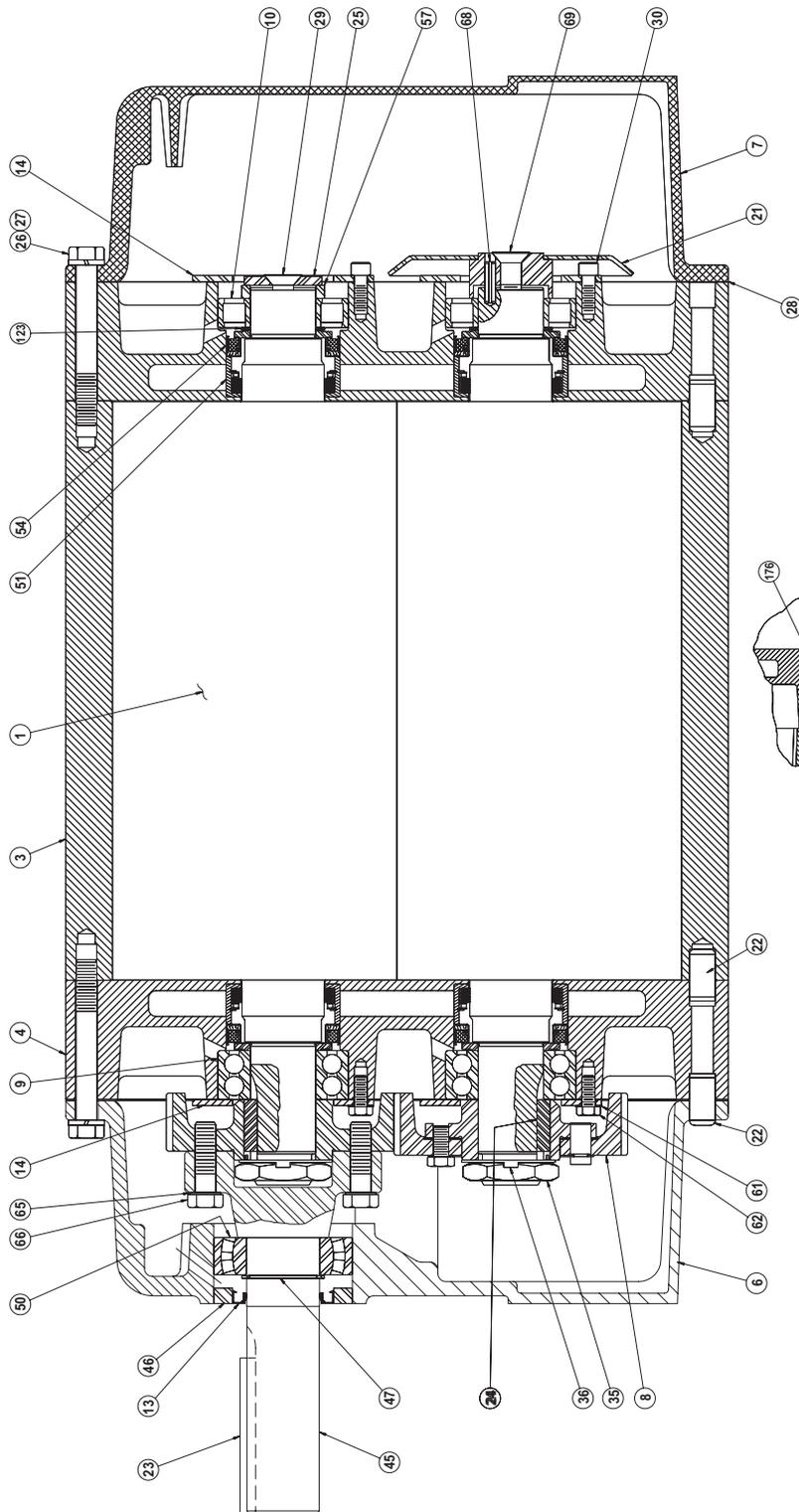
Model 5500 – Standard Seal – Cutaway View



5511 MODEL SHOWN

OIL LEVEL SIGHT GAUGE DETAIL

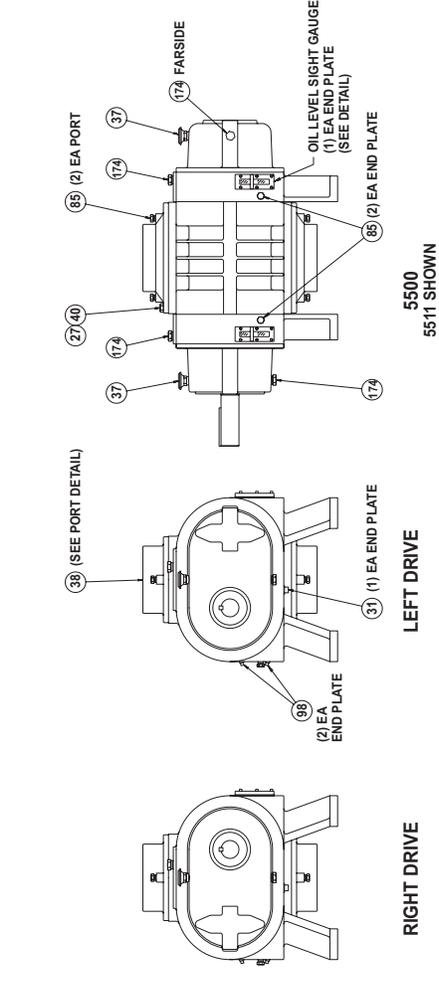
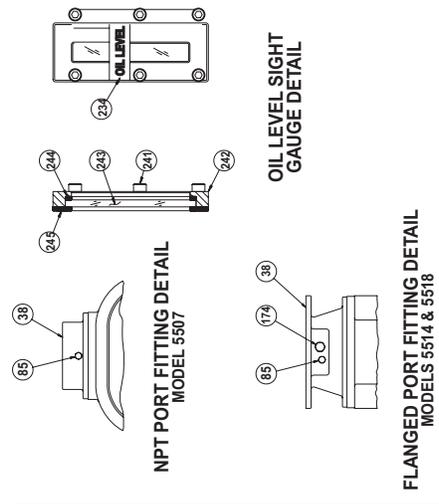
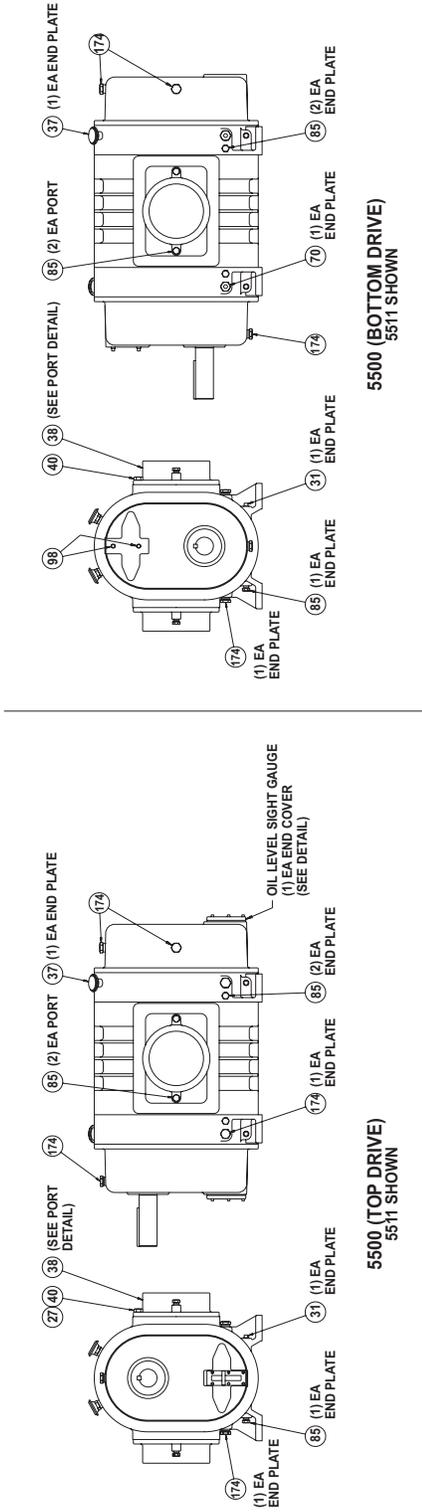
### Model 5500 – Single Envelope – Cutaway View



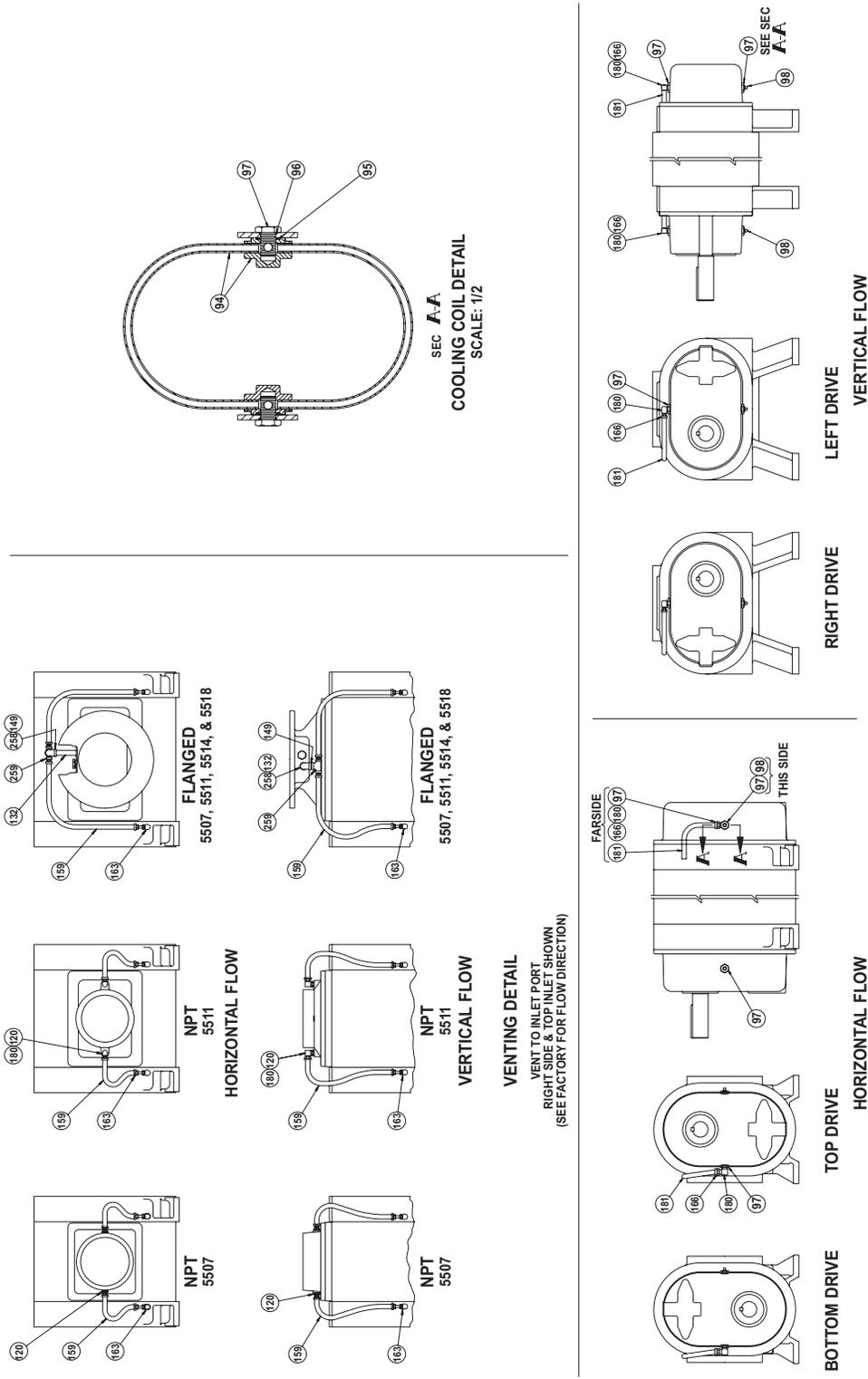
5514 SHOWN

O-RING SEALING ARRANGEMENT OPTION (R)  
TYP FOR BOTH END PLATES  
SCALE: 1/2

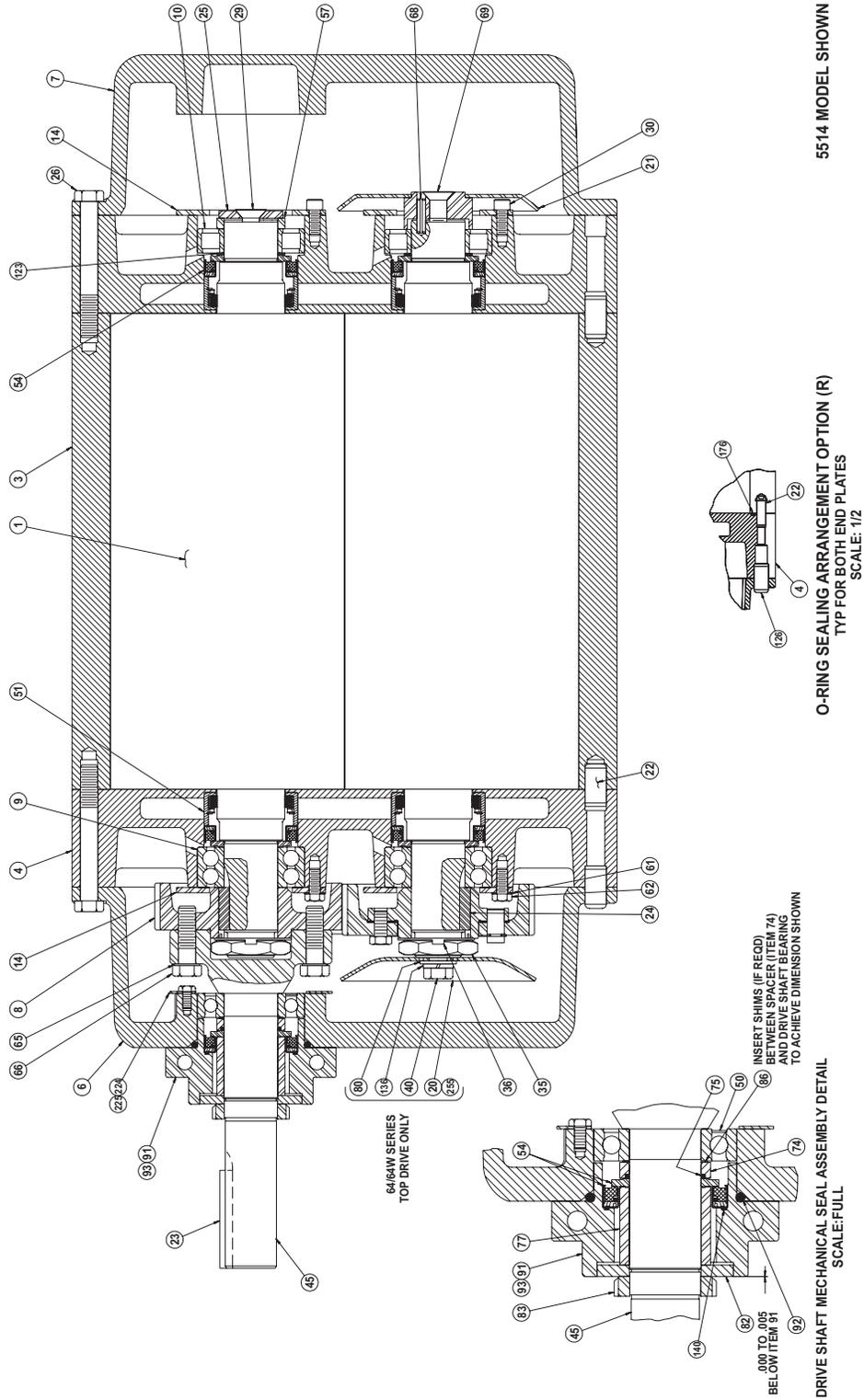
Model 5500 – Single Envelope – Side and End Views



# Model 5500 – Single Envelope (Cooling Coil Option) – Side And End Views



Model 5500 – Double Envelope – Cutaway View



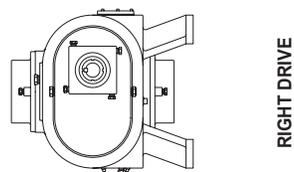
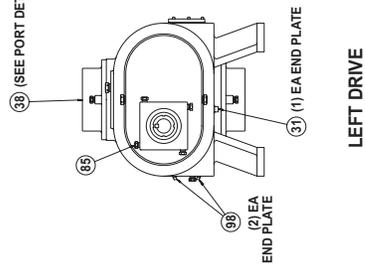
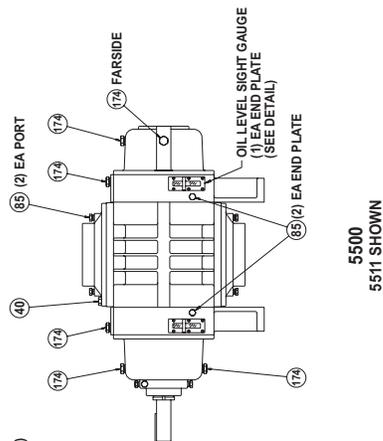
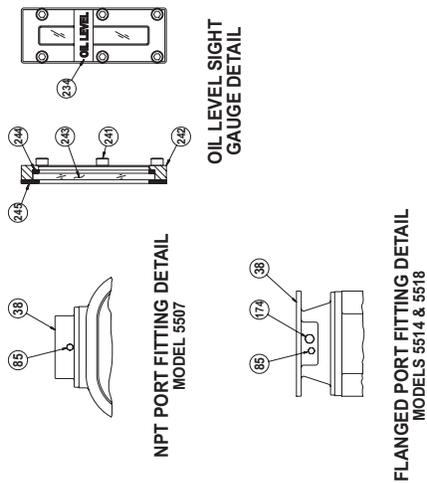
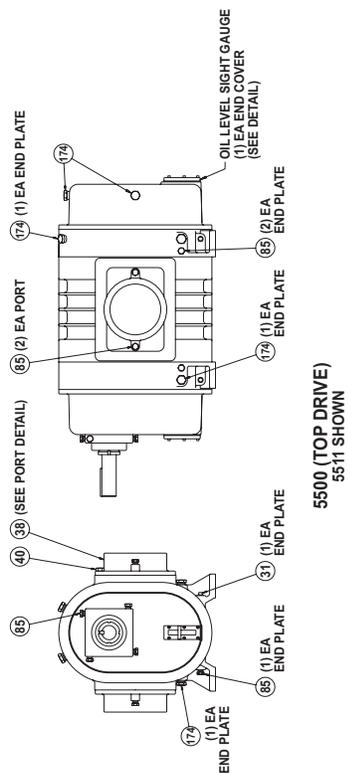
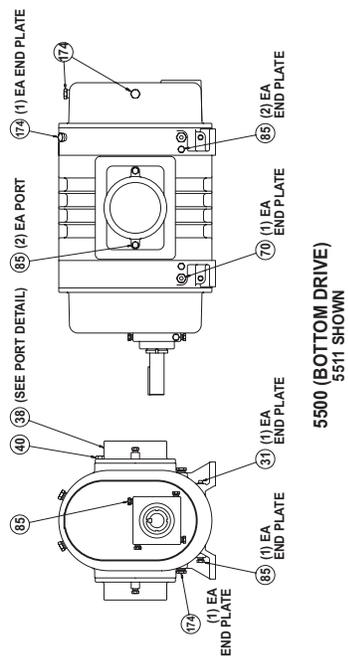
5514 MODEL SHOWN

O-RING SEALING ARRANGEMENT OPTION (R)  
TYP FOR BOTH END PLATES  
SCALE: 1/2

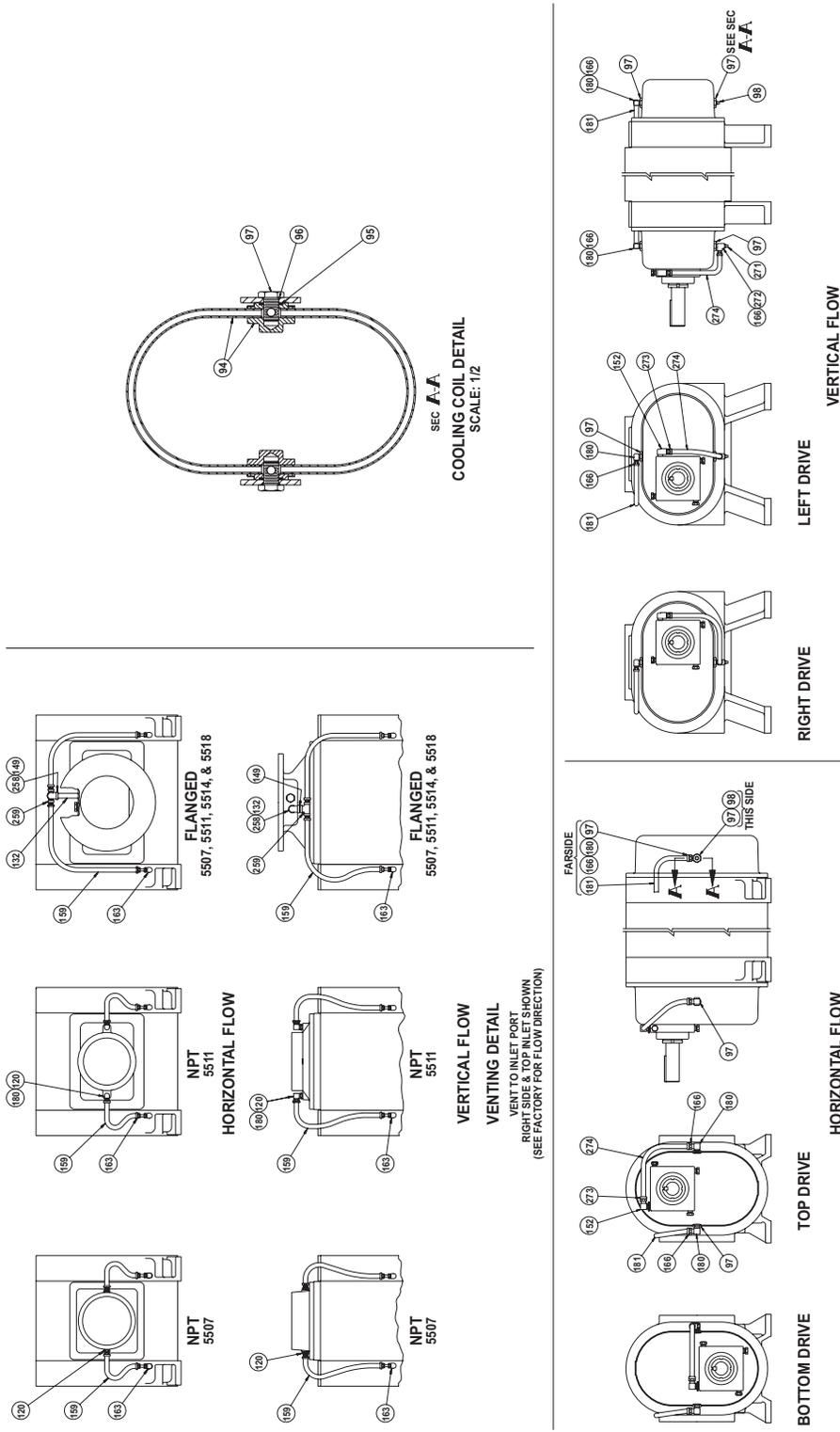
DRIVE SHAFT MECHANICAL SEAL ASSEMBLY DETAIL  
SCALE: FULL

64/64M SERIES  
TOP DRIVE ONLY

### Model 5500 – Double Envelope – Side and End Views



Model 5500 – Double Envelope (Cooling Coil Option) – Side and End Views







## DECLARATION OF INCORPORATION

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

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

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

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

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

The scope of the Declaration of Incorporation is for bare shaft Rotary Positive Displacement (PD Plus) Blowers

Models 3200, 4000, 5500

Lip-Labyrinth (Air Service)

Single Envelope Gastight

Double Envelope Gastight

David Schardt  
Vice President of Engineering, Tuthill Vacuum & Blower Systems



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

## WARRANTY – BLOWER PRODUCTS

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

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

May 2008

## OPERATING DATA FORM / PRODUCT REGISTRATION

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

Model No.	_____	V-Belt Size	_____	Length	_____
Serial No.	_____	Type of Lubrication	_____		
Start-up Date	_____				
Pump RPM	_____	Operating Vacuum	_____		
Pump Sheave Diameter	_____	Any Other Special Accessories Supplied or in Use:			
Motor Sheave Diameter	_____	_____			
Motor RPM	_____	HP	_____		

### NOTES:

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### IMPORTANT

All blowers manufactured by Tuthill Vacuum & Blower Systems are date-coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return the product registration card, or register online at [tuthillvacuumblower.com](http://tuthillvacuumblower.com).



**Technical Support: 1-877-955-TECH** (8324)

**Service & Repair or Product Sales:**

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