

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

# Equalizer

## OPERATOR'S MANUAL

## Models

DF -	4504	4506	4509	4512
RM -	4604	4606	4609	4612
	6012	6016	6024	



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# 1. INTRODUCTION

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

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



## NOTE

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

## 1.1 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

## 1.2 SCOPE OF MANUAL

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

# 2. CONVENTIONS AND DATA PLATE

## 2.1 GRAPHIC CONVENTIONS IN THIS MANUAL

This manual is the result of a risk assessment according the applicable documents referenced in section 1.1. The following are hazard levels are referenced within this manual:

### DANGER

Indicates an immediate hazardous situation which, if not avoided, will result in death or serious injury.

### WARNING

Indicates that a physical injury or damage to health or property, if not avoided, could occur.

### CAUTION

Indicates that a potential hazard may occur which, if not avoided, could result in minor or moderate injury.

## NOTE

Indicates a statement of information which, if not avoided, could cause damage to the product.



## CAUTION

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

## 2.2 DATA PLATE

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

General Operation and Symbols on Data Plate - The following information is contained on the data plate:



### WARNING

Keep body & clothing away from machine.

During operation, keep body and clothing away from inlet and outlet of the blower.



### WARNING

Do not operate without guards in place.



### CAUTION

Hearing protection is required while the blower is in operation. Noise levels may reach as high as 81 dBA.



### CAUTION

Do not touch hot surfaces.

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

- MODEL NUMBER:** This identifies the specific model of the blower.
- SERIAL NUMBER:** Each blower has a unique serial number. This number is to be used with any service issues and with any contact with the manufacturer.
- YEAR:** This states the year that the blower was manufactured.
- MAWP:** This states the maximum allowable working pressure (MAWP) of the blower casing. This is NOT the allowable maximum pressure differential. When determining the pressure differential, the inlet pressure shall be taken into account to assure that the MAWP is not exceeded.

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

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

### 3. LIFTING



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

### 4. DESCRIPTION



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



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

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

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

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

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

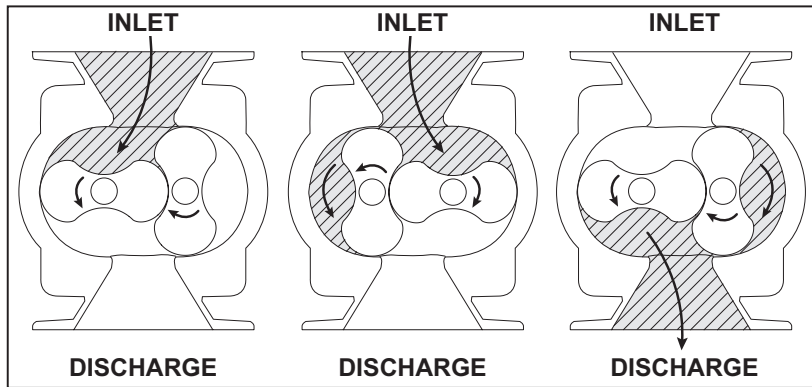


Figure 1 - Illustration of general operation principle

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

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

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

#### 4.1 FLOW BY DIRECTION AND ROTATION



**WARNING**

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

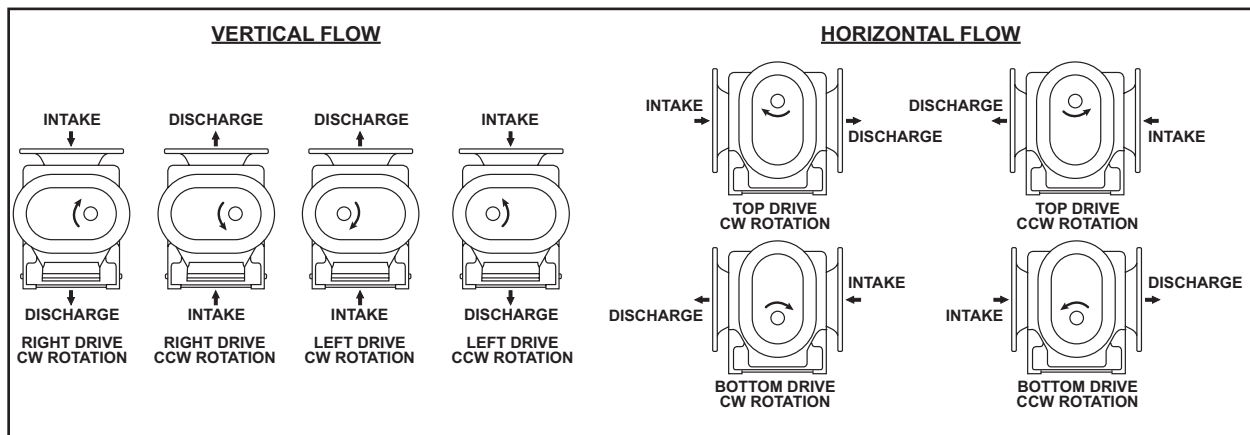


Figure 2 - Flow Direction by Rotation

## 4.2 SPECIFICATIONS

**TABLE 1 — SPECIFICATIONS**

MODEL	APPROXIMATE OIL CAPACITY OUNCES / MILLILITERS				PORT SIZE IN / MM	MAX RPM	APPROXIMATE WEIGHT LBS. / KG
	VERTICAL FLOW		HORIZONTAL FLOW				
	GEAR END	DRIVE END	GEAR END	DRIVE END			
4504	32.0 / 0.95	23.0 / 0.68	16 / 0.47	13.0 / 0.38	SOLD SEPERATELY	4000	270 / 122
4506	32.0 / 0.95	23.0 / 0.68	16 / 0.47	13.0 / 0.38		4000	310 / 141
4509	32.0 / 0.95	23.0 / 0.68	16 / 0.47	13.0 / 0.38		4000	350 / 159
4512	32.0 / 0.95	23.0 / 0.68	16 / 0.47	13.0 / 0.38		4000	390 / 177
4604	32.0 / 0.95	17.0 / 0.50	16 / 0.47	11.0 / 0.33	4 / 102	4000	210 / 95
4606	32.0 / 0.95	17.0 / 0.50	16 / 0.47	11.0 / 0.33	4 / 102	4000	245 / 111
4609	32.0 / 0.95	17.0 / 0.50	16 / 0.47	11.0 / 0.33	4 / 102	4000	280 / 127
4612	32.0 / 0.95	17.0 / 0.50	16 / 0.47	11.0 / 0.33	6 / 152	4000	320 / 145
6012	57.0 / 1.69	41.0 / 1.21	34 / 1.01	22.0 / 0.65	8 / 203	3000	590 / 268
6016	57.0 / 1.69	41.0 / 1.21	34 / 1.01	22.0 / 0.65	8 / 203	3000	650 / 295
6024	57.0 / 1.69	41.0 / 1.21	34 / 1.01	22.0 / 0.65	10 / 254	3000	775 / 352

**TABLE 2 — MAXIMUM OPERATING LIMITS**

MODEL	MAXIMUM RPM	MAXIMUM PRESSURE DIFFERENTIAL psi / mbar	MAXIMUM VACUUM in. Hg / mbar	MAXIMUM TEMPERATURE RISE °F / °C	MAWP psi / bar
4504	4000	18 / 1241	16 / 542	290 / 161	20 / 1379
4506	4000	18 / 1241	16 / 542	265 / 147	20 / 1379
4509	4000	18 / 1241	16 / 542	260 / 144	20 / 1379
4512	4000	15 / 1034	16 / 542	255 / 142	20 / 1379
4604	4000	18 / 1241	16 / 542	290 / 161	20 / 1379
4606	4000	18 / 1241	16 / 542	265 / 147	20 / 1379
4609	4000	18 / 1241	16 / 542	260 / 144	20 / 1379
4612	4000	15 / 1034	16 / 542	255 / 142	20 / 1379
6012	3000	15 / 1034	16 / 542	280 / 156	20 / 1379
6016	3000	15 / 1034	16 / 542	280 / 156	20 / 1379
6024	3000	10 / 690	16 / 542	230 / 128	20 / 1379



### WARNING

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



### WARNING

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

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



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



<b>NOTE</b>
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.

### 4.3 FLOW CONFIGURATIONS

- 17 series EQUALIZER blowers are shipped from the factory in a horizontal flow configuration. Bottom drive with horizontal flow is now available on 4500 EQUALIZER DF and 6000 Equalizer RM models.
- 46 series EQUALIZER blowers are shipped from the factory in either left drive or right drive, vertical flow configuration.
- If flow direction is changed, the oil level sight glasses and breathers must be relocated to proper positions, as shown to the right.
- Failure to change plug location will result in blower failure and void the product warranty.

### 4.4 SPECIAL NOTE REGARDING 4600 & 6000 EQUALIZER RM MODELS

- Vertical flow 4600 & 6000 EQUALIZER RM models with either left or right drive can be converted to top drive. However, a left drive blower cannot be converted to right drive, and vice versa.
- Top drive 4600 & 6000 EQUALIZER RM models can be converted to left drive only. Either left or right drive blowers can be converted to top drive. Unless specifically stated by factory, never arrange the blower so that the flow direction is horizontal with bottom drive. This will result in blower failure and void the product warranty.
- Bottom drive can be changed into right drive only.
- Top drive can be changed into left drive only.

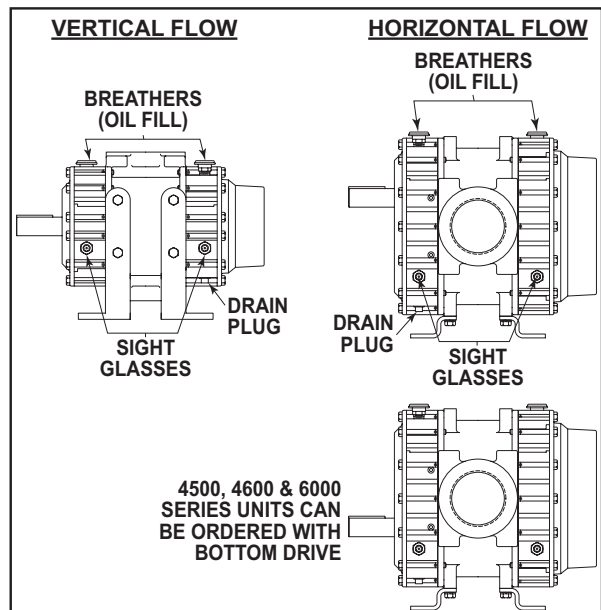


Figure 3 - Flow Configurations



## 5. INSTALLATION

### 5.1 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 issue that proper guarding is in place and compliant with all applicable regulatory requirements.



#### WARNING

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



#### WARNING

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



#### WARNING

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



#### WARNING

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



#### WARNING

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



#### NOTE

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

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



## NOTE

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

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

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

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

Piping should be accurately squared with the blower and supported independently. Stress imparted from incorrectly aligned piping or mounting will create problems with bearing and seal life, possibly leading to premature internal contact. The blower should sit stress free and evenly on its supporting surface. Care should be taken to evenly tighten the mounting bolts to not impart undue stress into the blower. Stress can be checked in a free state with feeler stock or verified on a previously installed blower with the aid of a dial indicator. Less than .002” (.05 mm) spring or gap should be found.

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

Figure 4 shows a typical complete installation of blower and accessories. Note the absence of throttle or shut-off valves in either discharge or intake piping. If it is possible for air flow to be cut off in either of these lines, make provisions to add a pressure and/or vacuum relief valve. In some installations, it may be desirable to use only an inlet silencer-cleaner supported directly from the blower connection. Weight of accessories and piping must be kept to a minimum to prevent blower casing distortion. Weights in excess of 10% of blower weight should be supported independently of blower and connected with a flexible hose or connectors. (The approximate weight of your unit is included within the *Specifications* table.)

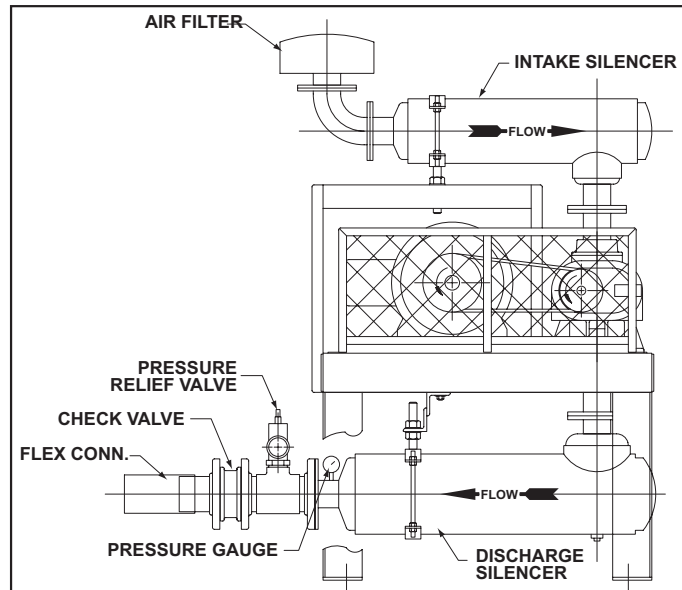


Figure 4 - Typical Blower Installation

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

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

### **5.1.1 LOCATION**

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

### **5.1.2 FOUNDATION**

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

### **5.1.3 BLOWER AIR INTAKE**

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

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

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

### 5.1.4 SOFT FOOT

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

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

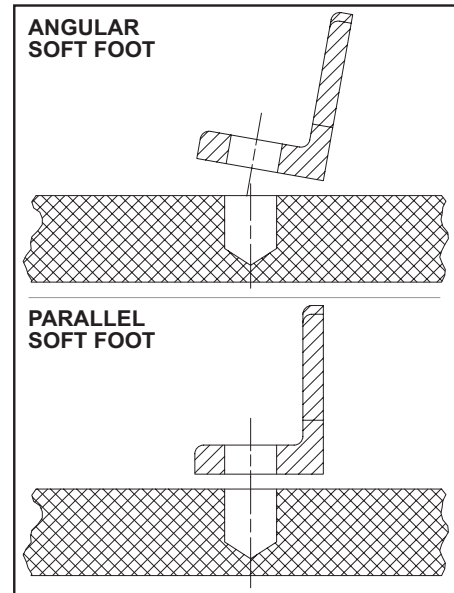


Figure 5 - Illustrations of Soft Foot

### 5.2 SAFETY

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



#### DANGER

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



#### DANGER

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



#### DANGER

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



#### DANGER

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



**WARNING**

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



**WARNING**

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



**NOTE**

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

**5.3 LUBRICATION**

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

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

Add oil to the blower in the quantity shown within the *Specifications* Table. The oil level must be maintained within the notched area of the sight glass. See Figure 6. Lower drive units have “bull’s eye” type oil level gauges. Maintain oil levels at the center of the glass.



**WARNING**

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



**WARNING**

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



**WARNING**

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



**NOTE**

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



**NOTE**

Refer to Table 1 for oil capacities.

### 5.3.1 FILLING PROCEDURE

See Figure 6. Recommended lubricants are shown on page 32.

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

### 5.3.2 FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION

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

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

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

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

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

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

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

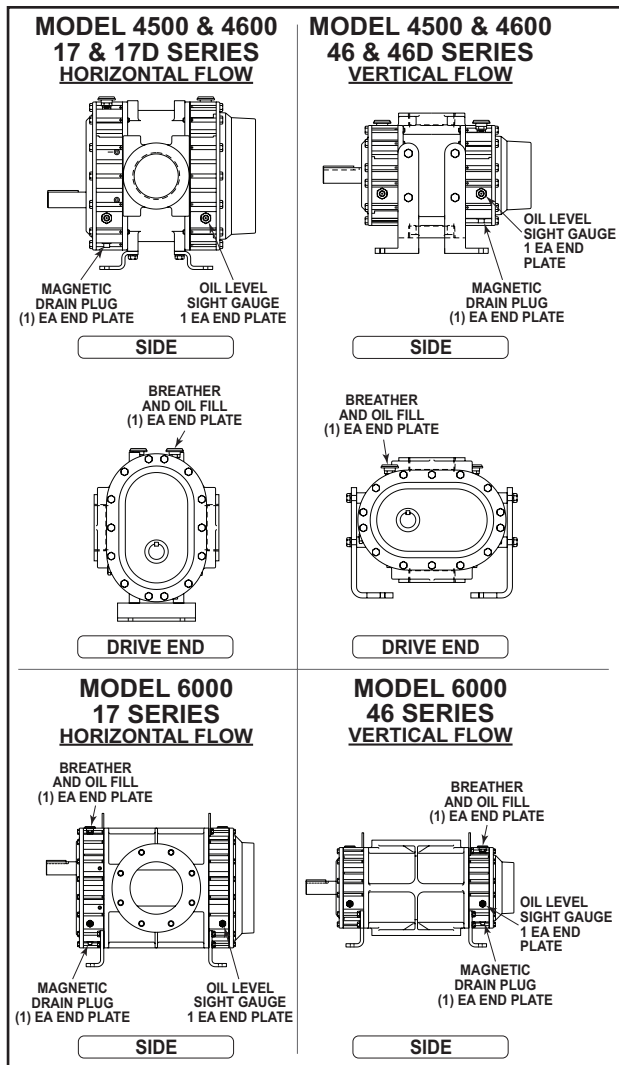


Figure 6 - Location of oil fill, drain, and level gauges

### 5.3.3 HAZARDS ASSOCIATED WITH BREAKDOWN OR IGNITION OF LUBRICATION



#### DANGER

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

### 5.4 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.



#### 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. Heat exchanger and cooling lines must be drained of liquid during downtime unless a recirculating unit using a glycol mixture has been installed.



#### NOTE

Units are never shipped from the manufacturer with liquid in the heat exchanger or cooling lines.



#### NOTE

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. Silencers must not be supported by the blower. Stress loads and bending moments must be avoided.

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

### HAZARDS ASSOCIATED WITH HAZARDOUS PROCESS FLUIDS



#### DANGER

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

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

## 5.4.1 BLOCKAGE OR RESTRICTION



### WARNING

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

## 5.5 MOTOR DRIVES

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

### 5.5.1 DIRECT COUPLED

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

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

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

### 5.5.2 V-BELTS

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

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

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

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

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

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



### 5.5.3 SETTING V-BELT TENSION

Proper belt tension is essential to long blower life. The following diagrams and procedures are provided to aid in field adjusting V-belts (when blower is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in Figure 7.

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

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

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

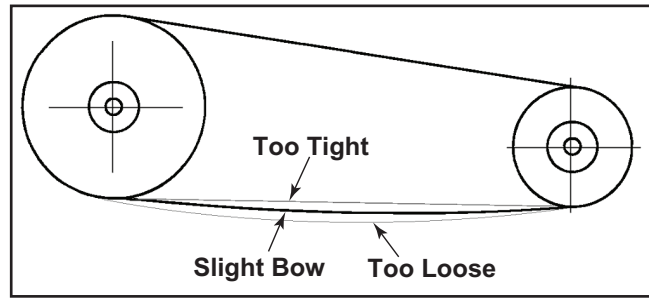


Figure 7 - General appearance of a V-Belt drive

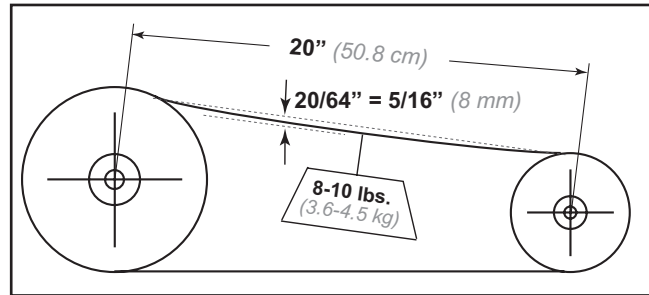


Figure 8 - Setting of proper tension for a V-Belt drive

## 5.5.4 V-BELT TROUBLESHOOTING

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

## 5.6 MOTOR AND ELECTRICAL CONNECTIONS



### WARNING

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



### NOTE

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

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

## 6. OPERATION

### 6.1 GENERAL



#### DANGER

The blower is not intended to be used with explosive products or in explosive environments. 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 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 troubles. Use the following check list as a guide, but also consider any other special conditions in your installation.

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

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

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

## 6.2 START-UP CHECKLIST

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

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

DATES CHECKED:

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

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

Carefully turn the rotors by hand to be certain they do not bind.



### WARNING

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

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

Start the unit and operate it for 30 minutes at no load. During this time, feel the cylinder for hot spots. If minor hot spots occur, refer to the *Troubleshooting* chart.

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

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

## 6.3 OPERATING

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



### DANGER

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



### WARNING

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



### WARNING

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



### WARNING

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



### CAUTION

Do not touch hot surfaces.

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



### CAUTION

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



### NOTE

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

## 6.4 STOPPING



### CAUTION

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

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

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

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

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



### NOTE

Care must be taken so as not to overload or overheat the blower during this procedure.

1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.
2. For carpet cleaning applications, after the work is completed, simply allow the blower to run a few (3-5) minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.

3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such as WD-40® into the inlet of the blower just prior to shutdown. (*3-in-One and WD-40 are registered trademarks of WD-40 Company.*) The lubricant will provide an excellent protective coating on the internal surfaces. If using a spray lubricant, exercise care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, most likely to the point that repair would be required.
4. If the blower is being taken out of commission for an extended period of time, please also refer to the “*Long Term Storage*” section of this manual.

## 7. MAINTENANCE

### 7.1 GENERAL

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



#### DANGER

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



#### CAUTION

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

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



#### CAUTION

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

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

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

## 7.2 REGULAR MAINTENANCE

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

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

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



### NOTE

Oil levels should be checked every 24 hours of operation.

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

## 7.3 SPARE PARTS

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

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

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

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

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

## 7.4 FACTORY SERVICE & REPAIR

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



<b>NOTE</b>
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.



<b>NOTE</b>
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.

## 7.5 LONG TERM STORAGE

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

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



## 8. DISASSEMBLY & ASSEMBLY

### 8.1 DISASSEMBLY & INSPECTION

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

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

Gears are not exposed for visual inspection. Items in brackets [ ] are referenced to item numbers on pages 16, 18, or 20 as applicable to the blower model.

Inspect the gears for the following:

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

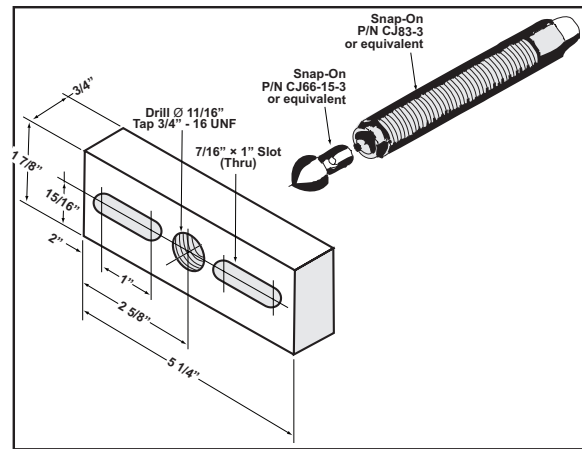


Figure 9 - Bar Puller Illustration

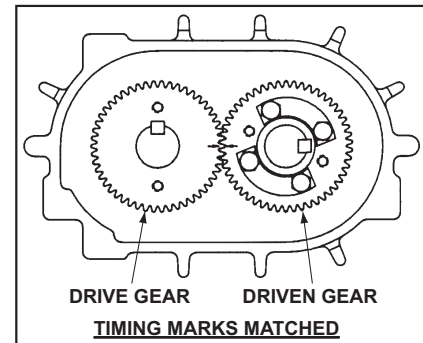


Figure 10 - Timing Marks Aligned

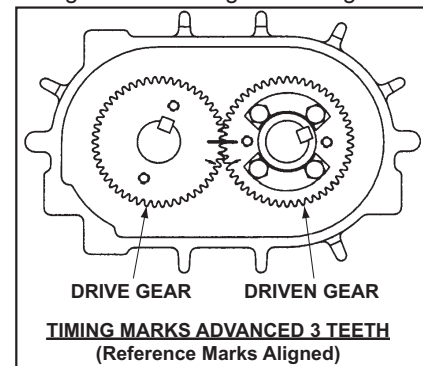


Figure 11 - Timing Marks Advanced Three Teeth



### DANGER

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

### 8.2 DISASSEMBLY OF BLOWER

1. Remove unit from installation and drain lubricant from both ends by removing magnetic drain plugs [31]. Mark end plates, covers and housing so they can be reassembled in their original position.
2. Remove cap screws [26] from drive end cover [6]. Using a beveled chisel and hammer, remove cover,
3. Remove cap screw [307 or 29], washer [27] and oil slinger [20]
4. Remove cap screw [62] and bearing retainer plates [14]. Note location and sequence of wave springs [282] and spacers [281] as they are removed.
5. Attach bar pullers as shown in Figure 3 to each bearing bore and pull end plate [4].
6. Remove cap screws [26] and gear end cover [7].
7. Remove gear lock bolts [29], and washers [25].

8. Align timing marks on gears (Figure 10). Rotate drive gear clockwise approximately three teeth and mark a matching reference line on each gear as shown in Figure 11. This gear position is necessary so rotors will clear and not jam. Do not allow the gears to move from the matched reference line while pulling. Use a light rocking motion to insure that the lobes have not jammed. Remove driven gear first, and then drive gear.



<b>NOTE</b>
Failure to properly pull this gear could result in damage to rotor keyway or a bent rotor shaft. Never use excessive force.

9. Remove cap screws [62] and bearing retainer plates [14].
10. Using bar puller attached to bearing bore, push one rotor [1 & 2] at a time from end plate. Keep rotor lobes in vertical position while removing.
11. Using a mallet, tap end plate from housing.
12. Tap out bearings [9 & 10] or [50], and seals [12 & 13].
13. Remove seal rings [58] from rotor shaft sleeves [239].
14. Inspect all parts for wear.

### 8.3 ASSEMBLY OF BLOWER

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

Dowel pins are used to locate end plates, housing, and end covers in their proper location relative to each other. Be sure they 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.

Make sure all parts are clean and free of any nicks or burrs caused by disassembly. Refer to page 14 for seal pressing tools as well as other assembly tools required.

It is suggested that long feeler gauges (12" [250 mm]) be used to check the interlobe timing, preferably (2) .006" (.15 mm), (1) .005" (.13 mm), (1) .004" (.10 mm), and (1) .003" (.08 mm). This will give you all the combinations from .003" (.08 mm) to .021" (.53 mm) and also .024" (.61 mm), which is the total.



<b>NOTE</b>
All cap screws used on EQUALIZER™ models are metric. The use of anything other than metric cap screws will result in thread damage. All pipe plug and oil breather holes are National Pipe Thread (NPT).

#### 8.3.1 PREPARATION OF END PLATES AND ROTORS FOR ASSEMBLY

1. Apply a thin coat of sealer to O.D. of lip seal [12] and press into seal bores of both end plates [4]. Make sure seals are fully seated without deforming. Seal lip should face up towards the bearing. Lubricate lip with grease.

**All models except 6000:** If the rotor shaft sleeves [239] are being replaced, lubricate shaft and press on new sleeves with inside chamfer facing lobes (O.D. chamfer faces outward). Install seal rings [58] into grooves of rotor shaft sleeves on gear end only and lock in place by compressing ring. Center rings on sleeves. Seal rings for drive end of shafts will be installed later in the assembly.

**Model 6000:** Sleeves are installed in the same manner as above except a silicone sealer must be applied to the two milled indentations in the shafts on the gear side of each rotor. After the sleeve is pressed on, remove any excess sealer that has squeezed out between sleeve and lobe. It is not necessary to seal the shafts on the other end.



### NOTE

All rotor sleeves or seal journals **MUST** be polished to remove any scratches or nicks. Failure to polish seal journals could result in seal leakage.

## 8.3.2 GEAR END ASSEMBLY

- Stand rotors on press with drive rotor [1] on the left, making sure keyways are properly positioned as shown in Figure 11. You may use the drive end plate as a temporary fixture to support the rotor lobes while pressing on the bearings and gears.
- Install gear end plate [4] over the rotor shafts making sure the oil feed holes for the bearing bores are properly located in relation to the drive rotor.

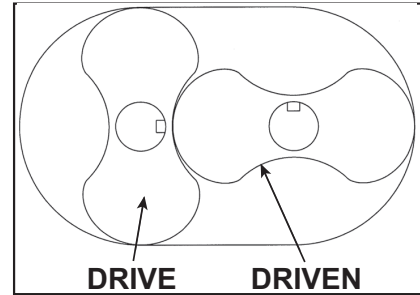


Figure 12 - Keyway Position



### NOTE

Two oil feed holes for each bearing bore must always be at the top when the assembled unit is standing on its feet. Units can only be assembled for top drive, left drive, or right drive.

The seal rings should glide into their respective bores with ease.

- Lubricate shafts and press double row ball bearings [9] onto shafts and into end plate bores. Use bearing pressing tool shown on page 33.



### NOTE

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 within .001" (0.025 mm) tolerance.

- Install bearing retainer rings [14] and secure with cap screws [62]. At this time, using feeler gauges, check the clearance between the face of the end plate and rotor lobes. Refer to assembly drawings for gear end clearance. If clearances are not within specifications, recheck parts to find cause of incorrect clearances before proceeding.
- Install keys [24] in rotor shaft keyways. Tight fits are required.
- Lubricate shafts and keys and press drive gear (right hand helix) on drive rotor. To install driven gear, align reference marks as shown in Figure 11. Tap gear with mallet to start, then press the gear until seated.



### NOTE

All timing gears must be used in sets as they are matched and serially numbered.

8. Install gear washers [25] and secure with cap screws [29] using a few drops of Loctite® #242 (Removable Thread Locker) on each screw.
9. Remove assembly from press and stand it on workbench with gears down. Place blocks under end plate to prevent assembly from falling over. Drive gear should remain on left side.
10. Install rotor housing [3] and secure temporarily with two cap screws evenly spaced.
11. Check clearances between end of lobes and housing using a flat bar and feeler gauges or a depth micrometer. Refer to assembly drawings for drive end clearances.

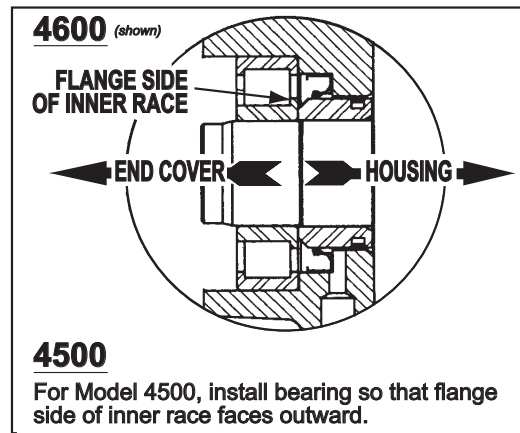


Figure 13 - Bearing Race Illustration

### 8.3.3 DRIVE END ASSEMBLY

12. Repeat instructions given in steps 3 and 4 to assemble drive end plate and temporarily secure with two cap screws evenly spaced.



NOTE
<b>4500 Models:</b> Install Free End Spacers on Shaft (Item 123)

13. Lubricate shafts and install roller bearings [10] on 4600 models. On 6000 models the drive rotor bearing [50] is a larger bearing than the driven rotor bearing [10].



NOTE
The inner races of all roller bearings have a flange on one side only. This flange must face inward, See Fig. 13. For 4500 Models the inner race flange must face outward.

14. **4600 Models:** Install one wave spring [282] on drive rotor and two wave springs with spacer [281] between, on the driven rotor.



NOTE
4500 Models have no wave springs to install.

**Model 6000:** Install two wave springs [282] with spacer [281] between, on both rotors.

Secure with retainer plate [14] and cap screws [62].

15. Install spring pin [68] in driven rotor, oil slinger [20] washer [27] and secure with cap screw [29] or [307].
16. Apply thin coat of sealer to O.D. of drive shaft seal [13] and press into end cover [6] bore. Lip must face inward.
17. Remove temporary screws, then place a bead of silicone sealer around the perimeter of the end plate. Carefully slide cover over drive shaft. Make sure dowels [126] are in place. Secure with cap screws [26]. Lay assembly down with drive gear on the left for timing.

### 8.3.4 ADJUSTING ROTOR INTERLOBE CLEARANCE

18. The driven gear is made of two pieces. The outer gear shell is fastened to the inner hub with four cap screws and located with two dowel pins. A laminated shim, made up of .003" (.076 mm) laminations, separates the hub and the shell. Removing or adding shim laminations moves the gear shell moved axially relative to the inner hub. Being a 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 .014" (.36 mm) on a 6000 model will change the interlobe clearance approximately .005" (.13 mm). On a 4600 model it would take approximately .012" (.30 mm) shims to effect the same change.

**EXAMPLE:** Referring to Figure 14, check the clearance on a 6000 model at AA (right-hand reading) and BB (left-hand reading). If AA reading is .017" (.43 mm) and BB reading is .004" (.10 mm), by removing .018" (.46 mm) of shims, the readings should then read: AA .011" (.28 mm) and BB .010" (.25 mm).

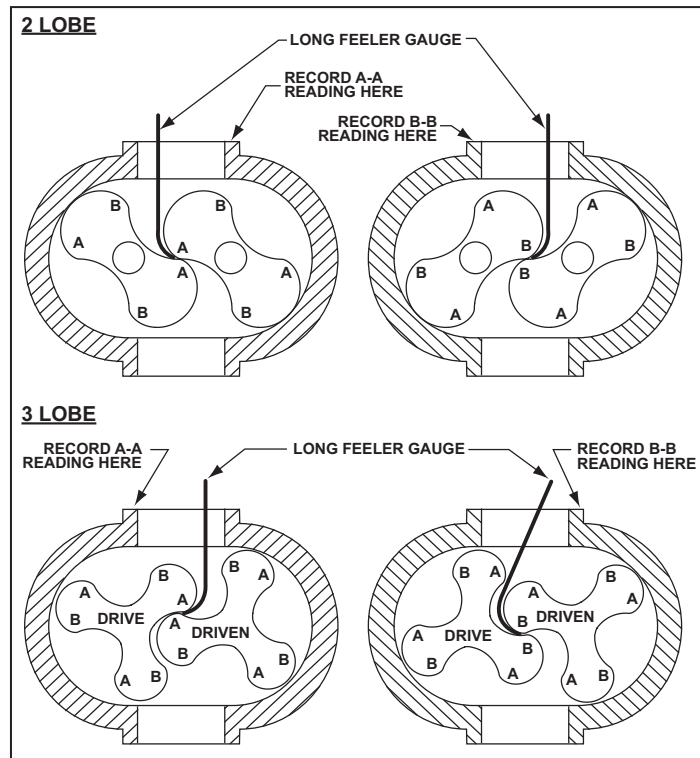


Figure 14 - Checking Rotor Interlobe Clearance

To determine the amount of shim to add or remove, subtract the smaller reading from the larger and multiply the result by:

- 1.2 for Model 4600:**  $.017 - .004 = .013$  (.33 mm)  $\times 1.2 = .0156$  (.396 mm) or  $.015$  (.38 mm)  
**1.4 for Model 6000:**  $.017 - .004 = .013$  (.33 mm)  $\times 1.4 = .0182$  (.462 mm) or  $.018$  (.46 mm)

Round off the amount the closest increment of shims available .006", .009", .012", etc.

To determine whether to add or remove shim: If the right side reading is higher than the left side, remove this amount. If the right side reading is lower, then add this amount. When removing gear shell from driven gear, it is not necessary to remove gear lock bolt. After completing the timing of the lobes, bend over lock tabs on the four gear cap screws.

19. Install gear cover [7] using same method as was used to install drive cover. (Step 18).
20. Install mounting feet [304] and secure with cap screws and washers [307 & 80].
21. Prior to putting blower into operation, follow Installation and Operation instructions. Observe the oil level frequently, during the initial hours of operation. A badly installed or damaged oil seal will result in oil loss.

## 9. TROUBLESHOOTING

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

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

## 10. ASSEMBLY CLEARANCES

Values are shown in inches and *millimeters*.

MODEL	LOBE TO END PLATES		LOBE TO CASING		INTERLOBE
	GEAR END	DRIVE END	TIP-DOWEL	TIP-PORT	MINIMUM
4504	.004" - .008" .10 - .20	.005" - .009" .13 - .23	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4506	.004" - .008" .10 - .20	.006" - .010" .10 - .25	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4509	.004" - .008" .10 - .20	.009" - .013" .23 - .33	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4512	.004" - .008" .10 - .20	.012" - .016" .30 - .41	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4604	.004" - .008" .10 - .20	.005" - .009" .13 - .23	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4606	.004" - .008" .10 - .20	.006" - .010" .10 - .25	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4609	.004" - .008" .10 - .20	.009" - .013" .23 - .33	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
4612	.004" - .008" .10 - .20	.012" - .016" .30 - .41	.007" - .011" .18 - .28	.009" - .013" .23 - .33	.008" - .012 .20 - .30
6012	.005" - .009" .13 - .23	.014" - .020" .36 - .51	.008" - .013" .20 - .33	.011" - .016" .28 - .41	.012" - .016" .30 - .41
6016	.005" - .009" .13 - .23	.018" - .024" .46 - .61	.008" - .013" .20 - .33	.011" - .016" .28 - .41	.012" - .016" .30 - .41
6024	.005" - .009" .13 - .23	.018" - .024" .46 - .61	.011" - .016" .28 - .41	.014" - .019" .36 - .48	.012" - .016" .30 - .41

## 11. TORQUE CHART

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

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

## 12. RECOMMENDED LUBRICANTS

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

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

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

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

RECOMMENDED LUBRICANTS FOR M-D VACUUM BOOSTERS (90/91, 92/93, 96, 31/33 AND 35/37 SERIES)	
REQUIREMENTS	
<ul style="list-style-type: none"> <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.

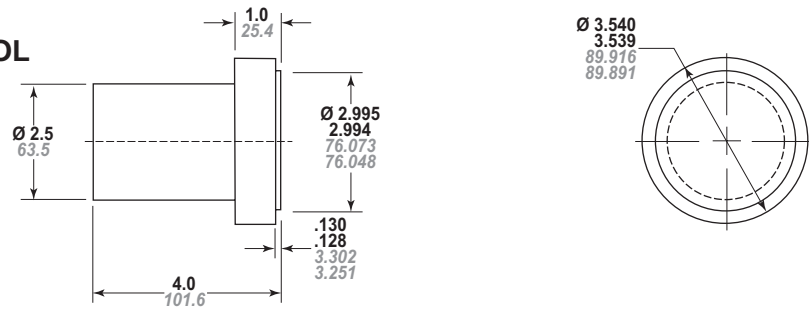
\* For higher ambient temperatures, please consult the factory.

\*\* 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.

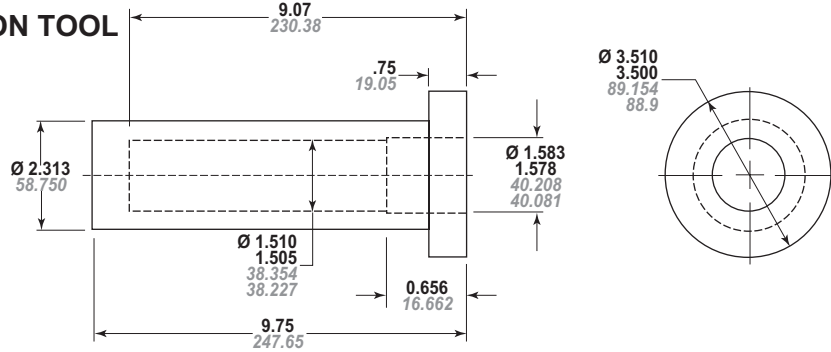


### 13. SPECIAL TOOL DRAWINGS

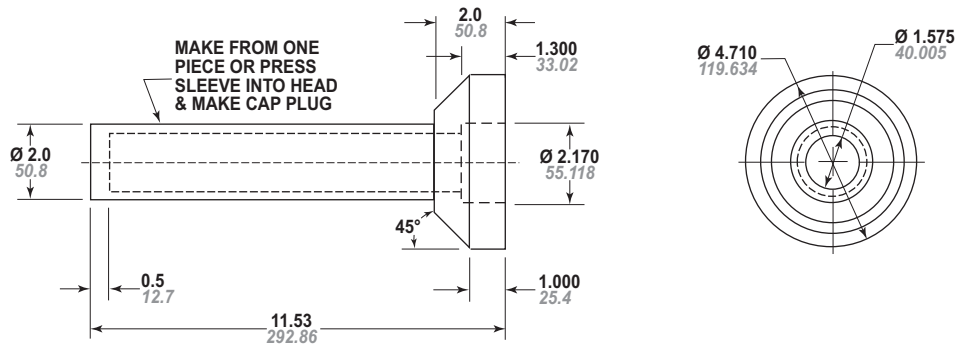
**MODEL 4500/4600  
LIP SEAL PRESSING TOOL**



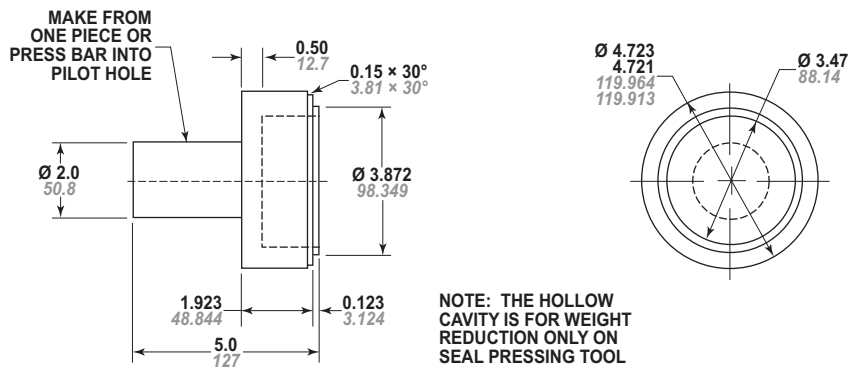
**MODEL 4500/4600  
BEARING INSTALLATION TOOL**



**MODEL 6000  
BEARING PRESSING TOOL**



**MODEL 6000  
SEAL PRESSING TOOL**



**MODEL 6000  
SLEEVE PRESSING RING  
(USE WITH BEARING  
PRESSING TOOL)**



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

**MATERIAL:**  
Mild Steel

**PARTS LIST FOR EQUALIZER DF MODEL 4500 17/46 SERIES BLOWERS**

ITEM NO.	PART DESCRIPTION	17 QTY	46 QTY
1	ROTOR, DRIVE	1	1
2	ROTOR, DRIVEN	1	1
3	HOUSING	1	1
4	END PLATE	2	2
6	END COVER, DE	1	1
7	END COVER, BE	1	1
8	GEAR ASSEMBLY	1	1
9	BEARING, DBL ROW BALL	2	2
10	BEARING,CYLINDRICAL ROLLER	2	2
12	LIP SEAL	4	4
13	LIP SEAL	1	1
14	RETAINER PLATE	2	2
20	OIL SLINGER	1	1
20	OIL SLINGER	1	1
22	DOWEL PIN	4	4
23	KEY, DRIVE SHAFT	1	1
24	KEY, GEAR	2	2
25	WASHER	2	2
26	CAP SCREW	28	28
27	WASHER	1	1
29	CAP SCREW	2	2
31	MAGNETIC DRAIN PLUG	2	2
37	BREATHER	2	2
39	PORT GASKET	2	2
42	NAMEPLATE	1	1
58	SEAL RING	4	4
62	CAP SCREW	14	14
68	SPRING PIN	1	1
70	OIL GAUGE	2	2
80	WASHER	4	4
90	SET SCREW	2	2
123	BEARING SPACER	2	2
126	ROLL PIN	4	4
174	PIPE PLUG	4	4
239	SLEEVE	4	4
304	MOUNTING FOOT	2	2
307	CAP SCREW	5	5

**NOTES:**

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

**PARTS KITS ARE AVAILABLE. AS FOLLOWS:**

17/46 — P/N 46172

**PARTS LIST FOR EQUALIZER RM MODEL 4600 17/46 SERIES BLOWERS**

ITEM NO.	PART DESCRIPTION	17 QTY	46 QTY
1	ROTOR, DRIVE	1	1
2	ROTOR, DRIVEN	1	1
3	HOUSING	1	1
4	END PLATE	2	2
6	END COVER, DE	1	1
7	END COVER, BE	1	1
8	GEAR ASSEMBLY	1	1
9	BEARING, DBL ROW BALL	2	2
10	BEARING,CYLINDRICAL ROLLER	1	1
12	LIP SEAL	4	4
13	LIP SEAL	1	1
14	RETAINER PLATE	4	4
20	OIL SLINGER	1	1
20	SLINGER	1	1
22	DOWEL PIN	4	4
23	KEY, DRIVE SHAFT	1	1
24	KEY, GEAR	2	2
25	WASHER	2	2
26	CAP SCREW	28	28
27	WASHER	1	1
29	CAP SCREW	2	2
31	MAGNETIC DRAIN PLUG	2	2
37	BREATHER	2	2
42	NAMEPLATE	1	1
50	ROLLER BEARING	1	1
58	SEAL RING	4	4
62	CAP SCREW	16	16
68	ROLL PIN	1	1
70	OIL GAUGE	2	2
80	WASHER	8	8
90	SET SCREW	2	2
123	BEARING SPACER	4	4
126	ROLL PIN	4	4
174	PIPE PLUG	4	4
239	SLEEVE	4	4
281	SPACER	3	3
282	SPRING	3	3
304	MOUNTING FOOT	2	2
307	CAP SCREW	9	9

**NOTES:**

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

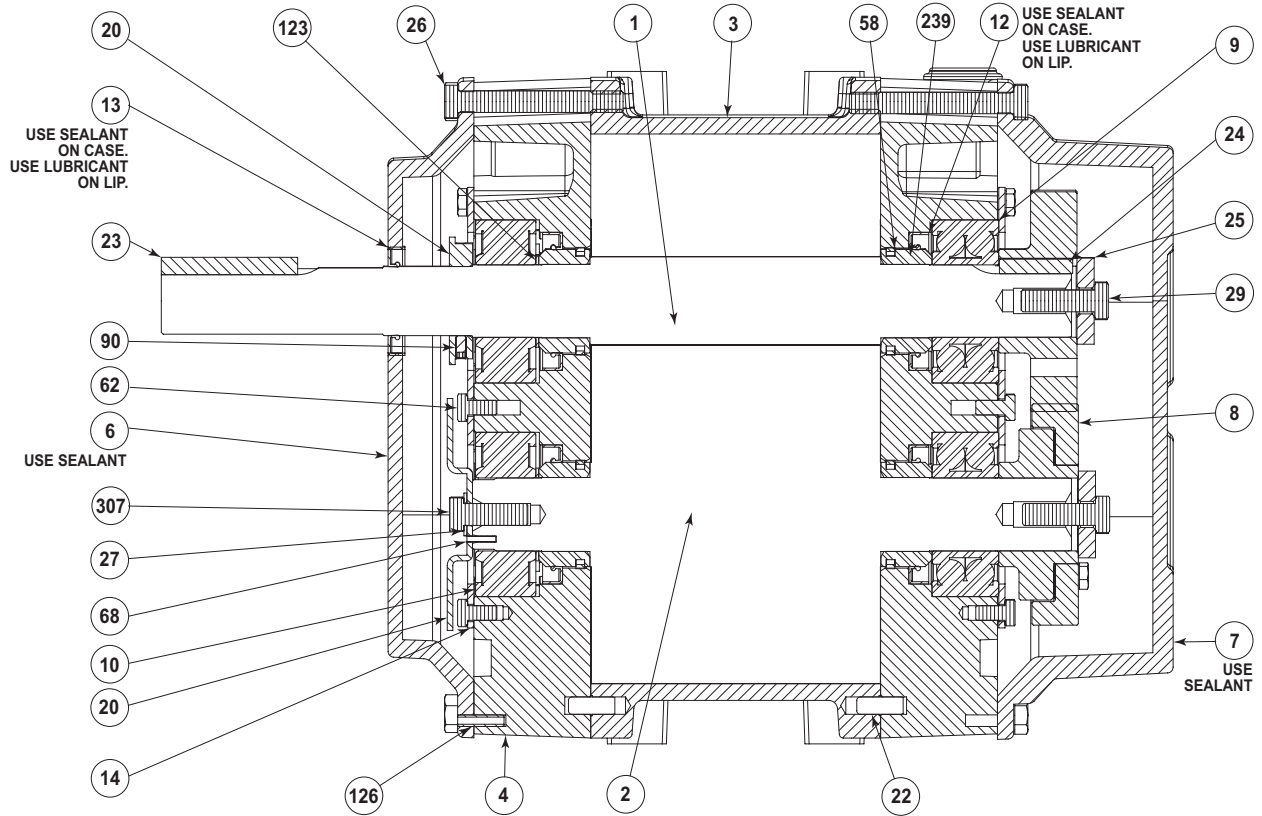
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17/46 — P/N 46044

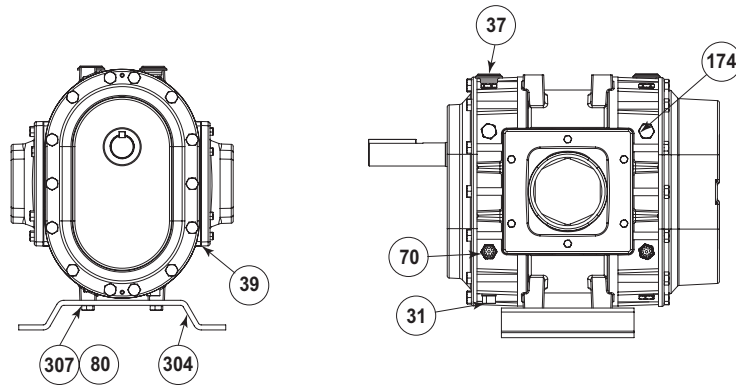
## PARTS LIST FOR EQUALIZER RM MODEL 6000 17/46 SERIES BLOWERS

ITEM NO.	PART DESCRIPTION	17 QTY	46 QTY
1	ROTOR, DRIVE	1	1
2	ROTOR, DRIVEN	1	1
3	HOUSING	1	1
4	END PLATE	2	2
6	END COVER, DE	1	1
7	END COVER, BE	1	1
8	GEAR ASSEMBLY	1	1
9	BALL BEARING	2	2
10	ROLLER BEARING	2	2
12	LIP SEAL	4	4
13	LIP SEAL	1	1
14	RETAINER PLATE	4	4
20	SLINGER	1	1
22	DOWEL PIN	4	4
23	KEY, DRIVE SHAFT	1	1
24	KEY, GEAR	2	2
25	WASHER	2	2
26	CAP SCREW	32	32
29	CAP SCREW	3	3
30	CAP SCREW	2	2
31	MAGNETIC DRAIN PLUG	2	2
37	BREATHER	2	2
42	NAMEPLATE	1	1
58	SEAL RING	4	4
62	CAP SCREW	16	16
68	ROLL PIN	1	1
70	OIL GAUGE	2	2
80	WASHER	10	10
117	WASHER	2	2
123	BEARING SPACER	2	2
126	ROLL PIN	4	4
174	PIPE PLUG	2	2
195	LIFT LUG	2	2
239	SLEEVE	4	4
281	SPACER	2	2
282	SPRING	4	4
304	MOUNTING FOOT	2	2
304	MOUNTING FOOT	2	2
307	CAP SCREW	10	10
<p><b>NOTES:</b></p> <ul style="list-style-type: none"> <li>• QUANTITIES SHOWN ARE MAXIMUM VALUES; QUANTITIES MAY VARY BETWEEN BLOWER</li> </ul> <p><b>PARTS KITS ARE AVAILABLE, AS FOLLOWS:</b> 17/46 — P/N 60035</p>			

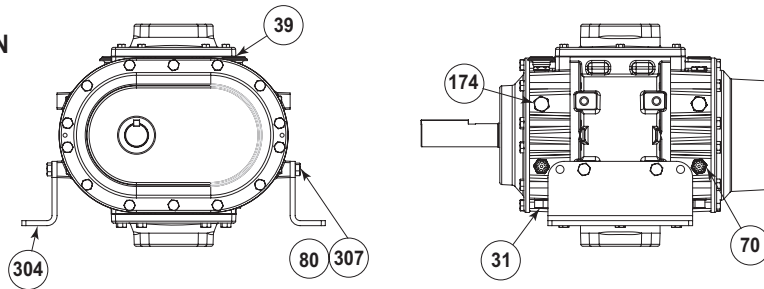
**CUTAWAY DRAWING FOR MODELS 4504, 4506, 4509 AND 4512**



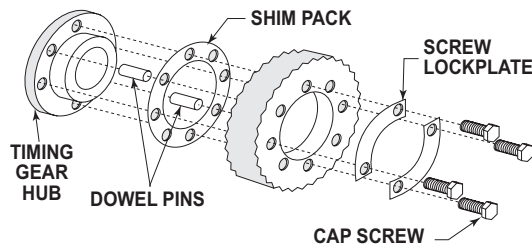
**HORIZONTAL FLOW  
17 SERIES  
TOP DRIVE SHOWN**



**VERTICAL FLOW  
46 SERIES  
LEFT DRIVE SHOWN**

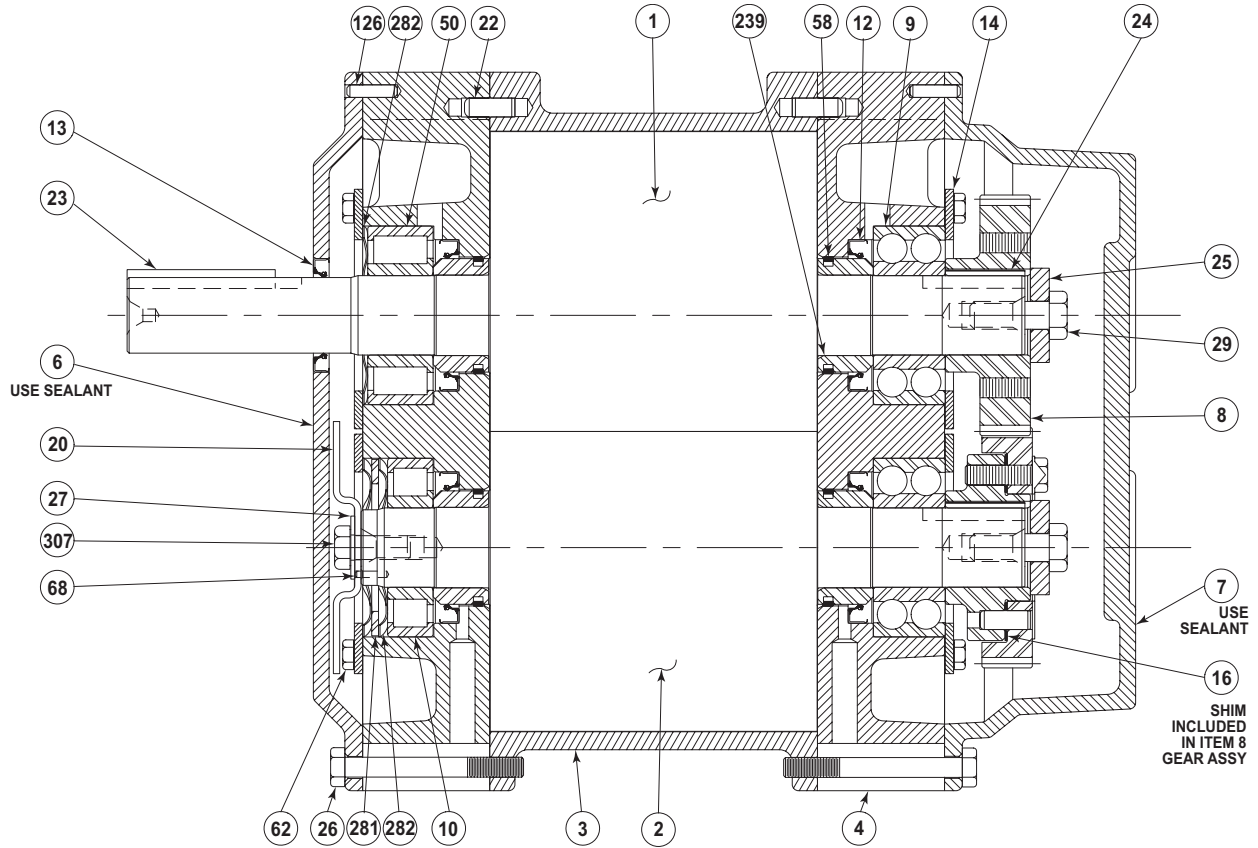


**TIMING GEAR  
ASSEMBLY (ITEM 8)**

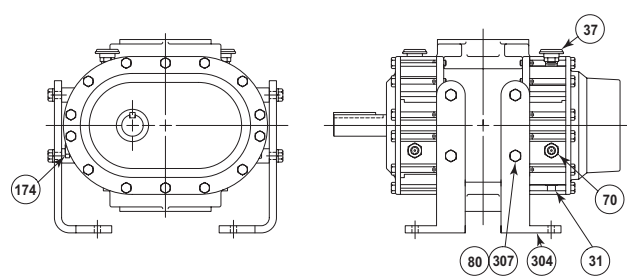


ALL PORTS SHOWN  
ARE OPTIONAL

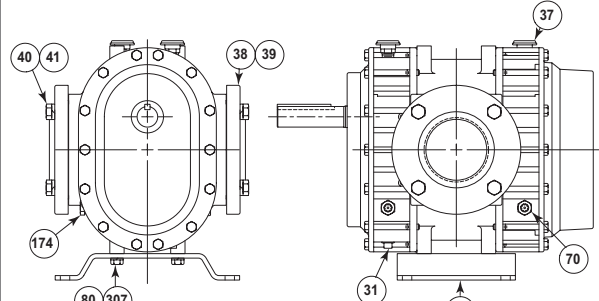
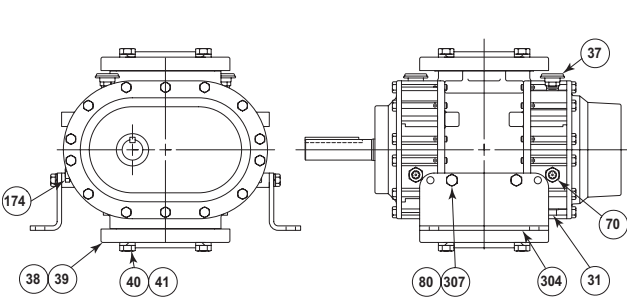
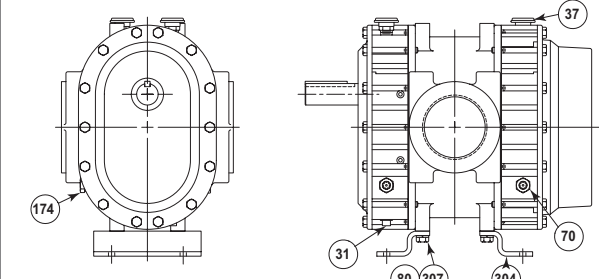
# CUTAWAY DRAWING FOR MODELS 4604, 4606, 4609 AND 4612



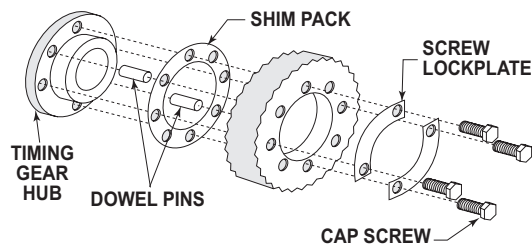
## VERTICAL FLOW LEFT DRIVE SHOWN



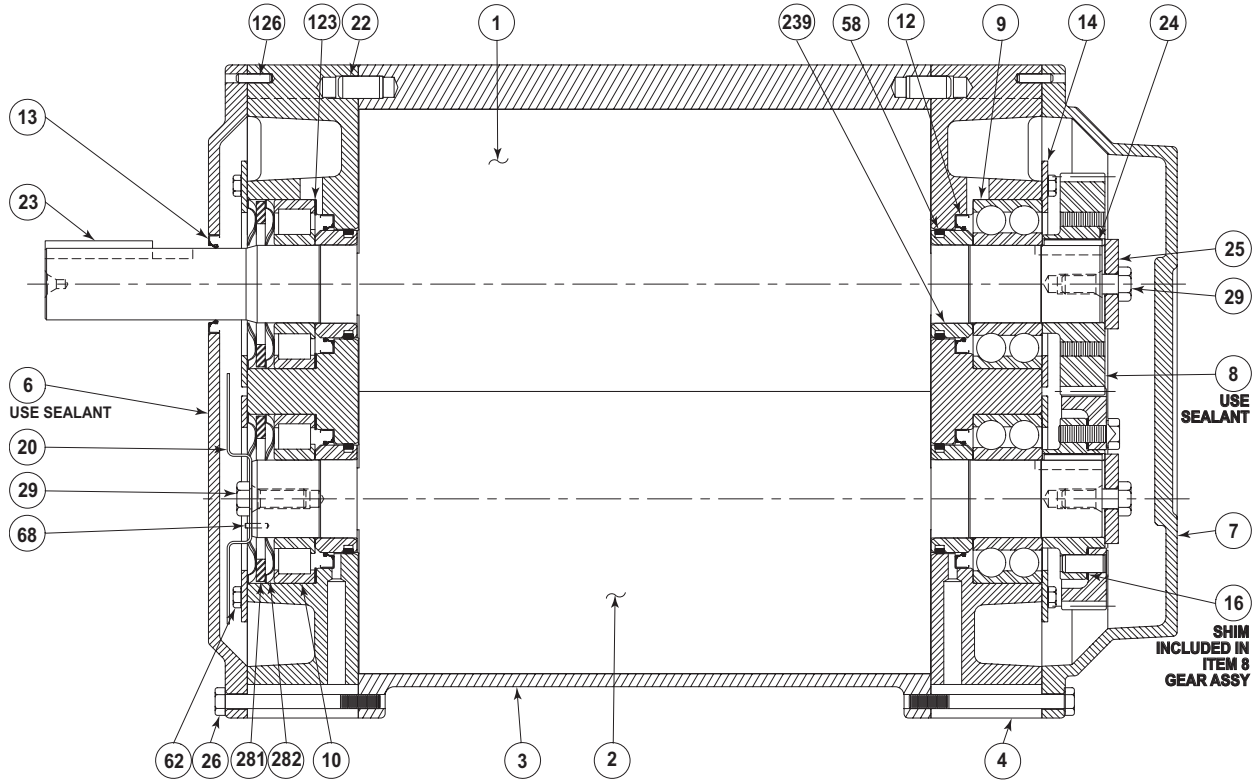
## HORIZONTAL FLOW TOP DRIVE ONLY



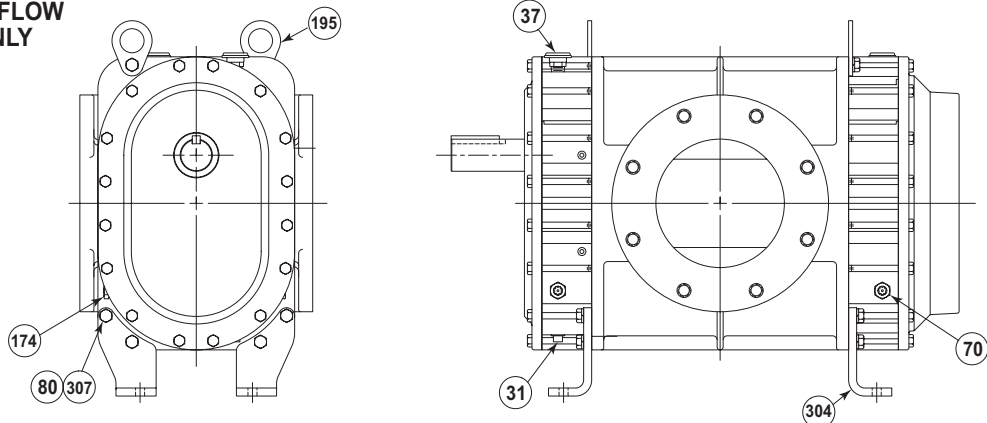
## TIMING GEAR ASSEMBLY (ITEM 8)



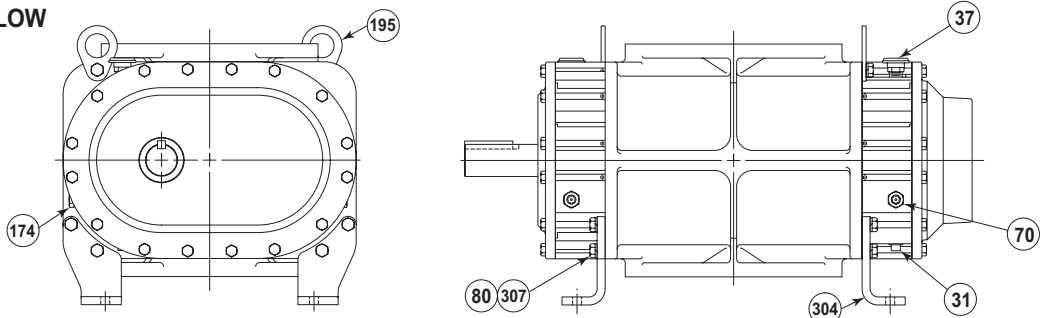
**CUTAWAY DRAWING FOR MODELS 6012, 6016, AND 6024**



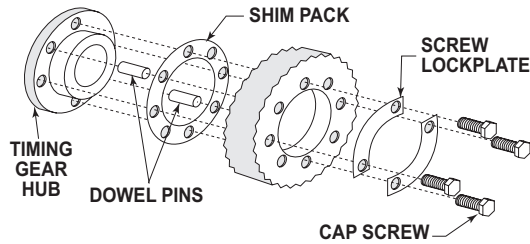
**HORIZONTAL FLOW  
TOP DRIVE ONLY**



**VERTICAL FLOW**



**TIMING GEAR  
ASSEMBLY (ITEM 8)**









## 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 Blowers

Equalizer  
Models DF - 4504, 4506, 4509, 4512  
Models RM - 4604, 4606, 4609, 4612, 6012, 6016, 6024

Horizontal Flow  
Vertical Flow

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



Tuthill Vacuum & Blower Systems  
4840 West Kearney Street  
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> <i>(Qx™ models only)</i>	30 months from date of shipment, or 24 months after initial startup date, whichever occurs first.	Consult Factory
<b>New</b> <i>(all other models)</i>	24 months from date of shipment, or 18 months after initial startup date, whichever occurs first	18 months from date of shipment, or 12 months after initial startup date, whichever occurs first
<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.

# OPERATING DATA FORM / PRODUCT REGISTRATION

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

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

**NOTES:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## IMPORTANT

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



**For Service & Repair, Technical Support,  
or Product Sales contact:**

**Tuthill Vacuum & Blower Systems**

4840 West Kearney Street  
Springfield, Missouri USA 65803-8702  
O 417.865.8715 800.825.6937 F 417.865.2950  
[tuthillvacuumblower.com](http://tuthillvacuumblower.com)



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