

M-D Pneumatics™

COMPETITOR®

Rotary Positive Displacement Blower

21 Series - Grease Lubrication / Air Service (Plus)

22 Series - Splash Lubrication / Air Service (SL)

23 Series - Splash Lubrication / Gas Service (GT)

Models

2002	3002	4002	5003	6005	7006
2004	3003	4005	5006	6008	7011
	3006	4007	5009	6015	7018

INSTALLATION OPERATION MAINTENANCE REPAIR MANUAL



2012 0811 ORIGINAL LANGUAGE - ENGLISH



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1. INTRODUCTION

CONGRATULATIONS on your purchase of a new **Competitor® 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.

Competitor 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
	Tuthill Vacuum & Blower Systems 4840 West Kearney Street Springfield, Missouri USA 65803	MAX RPM ____	
READ INSTRUCTION MANUAL BEFORE OPERATION OR BODILY HARM MAY RESULT			
WARNING  Keep body & clothing away from machine openings.	WARNING  Do not operate without guards in place.	CAUTION  Hearing protection required.	CAUTION  Do not touch hot surfaces.
http://www.tuthill.com		(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 Competitor model rotary lobe blowers are positive displacement type units, whose pumping capacity is determined by size, operating speed, and differential pressure conditions. Blowers employ rotors rotating in opposite directions within a housing closed at the ends by end plates.

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

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

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

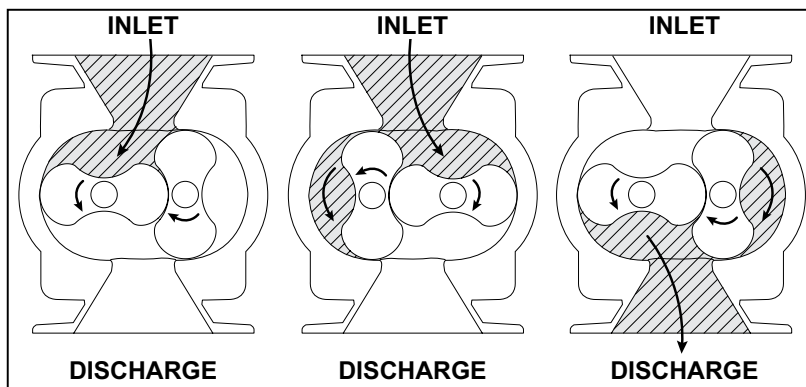


Figure 1 - Illustration of general operation principle

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

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

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

4.1 FLOW BY DIRECTION AND ROTATION



WARNING

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

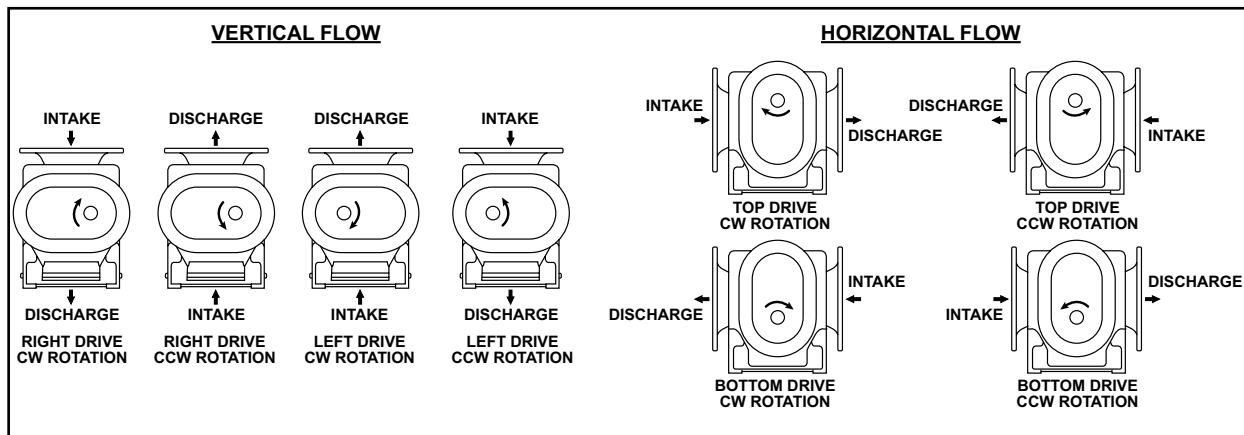


Figure 2 - Flow Direction by Rotation

4.2 SPECIFICATIONS

TABLE 1 — SPECIFICATIONS

MODEL	APPROXIMATE OIL CAPACITY¹ OUNCES / MILLILITERS				PORT SIZE IN / MM	MAX RPM	APPROXIMATE WEIGHT LBS. / KG
	VERTICAL FLOW		HORIZONTAL FLOW				
	GEAR END²	DRIVE END³	GEAR END²	DRIVE END³			
2002	3.4 / 101	N/A	1.7 / 50	N/A	1 / 25	5275	41 / 19
2004	3.4 / 101	N/A	1.7 / 50	N/A	2 / 51	5275	53 / 24
3002	6.0 / 177	4.0 / 118	3.4 / 101	2.5 / 74	1.25 / 32	3600	78 / 35
3003	6.0 / 177	4.0 / 118	3.4 / 101	2.5 / 74	2 / 51	3600	83 / 38
3006	6.0 / 177	4.0 / 118	3.4 / 101	2.5 / 74	2.5 / 64	3600	113 / 51
4002	8.5 / 251	6.4 / 189	5.8 / 172	4.7 / 139	1.5 / 38	3600	95 / 43
4005	8.5 / 251	6.4 / 189	5.8 / 172	4.7 / 139	2 / 51	3600	127 / 58
4007	8.5 / 251	6.4 / 189	5.8 / 172	4.7 / 139	3 / 76	3600	146 / 66
5003	18.3 / 541	10.2 / 302	7.1 / 210	5.4 / 160	2.5 / 64	2850	152 / 69
5006	18.3 / 541	10.2 / 302	7.1 / 210	5.4 / 160	4 / 102	2850	185 / 84
5009	18.3 / 541	10.2 / 302	7.1 / 210	5.4 / 160	4 / 102	2850	222 / 101
6005	25.5 / 754	18.0 / 532	16.9 / 500	9.0 / 266	3 / 76	2350	250 / 113
6008	25.5 / 754	18.0 / 532	16.9 / 500	9.0 / 266	5 / 127	2350	310 / 141
6015	25.5 / 754	18.0 / 532	16.9 / 500	9.0 / 266	6 / 152	2350	456 / 207
7006	28.7 / 849	N/A	20.3 / 600	N/A	4 / 102	2050	425 / 193
7011	28.7 / 849	N/A	20.3 / 600	N/A	6 / 102	2050	555 / 252
7018	28.7 / 849	N/A	20.3 / 600	N/A	8 / 102	2050	675 / 306

¹ Oil capacities are based on filling from dry condition. Less oil may be needed depending on emptiness of oil reservoir(s) after draining. Always fill the gear housing until oil drips out of the oil level hole. Replace plugs in their respective holes. Following this procedure will insure proper oil level.

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

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

TABLE 2 — MAXIMUM OPERATING LIMITS

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



WARNING

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



WARNING

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

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



NOTE

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



NOTE

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

5. INSTALLATION

5.1 GENERAL



DANGER

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



DANGER

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



WARNING

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



WARNING

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



WARNING

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



WARNING

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



WARNING

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



NOTE

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

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



NOTE

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

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

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

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

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

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

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

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

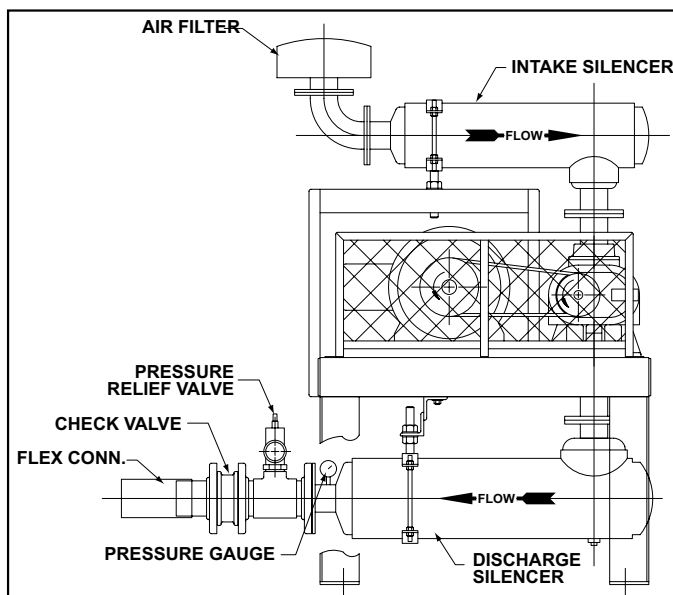


Figure 3 - Typical Blower Installation

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

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

5.1.1 LOCATION

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

5.1.2 FOUNDATION

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

5.1.3 BLOWER AIR INTAKE

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

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

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

5.1.4 SOFT FOOT

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

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

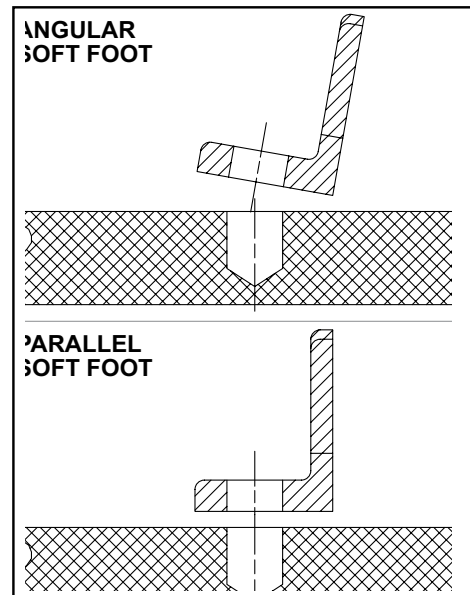


Figure 4 - Illustrations of Soft Foot

5.2 SAFETY

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



DANGER

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



DANGER

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



DANGER

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



DANGER

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



WARNING

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



WARNING

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



NOTE

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

5.3 LUBRICATION

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

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

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



WARNING

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



WARNING

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



WARNING

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



NOTE

Most Competitor blowers are shipped from the factory in a left hand drive, vertical flow configuration. If drive shaft location is changed, the oil level plugs, sight glasses and breathers must be relocated to proper positions, as shown to the right. Failure to change plug location will result in blower failure and void the product warranty.

5.3.1 FILLING PROCEDURE

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

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

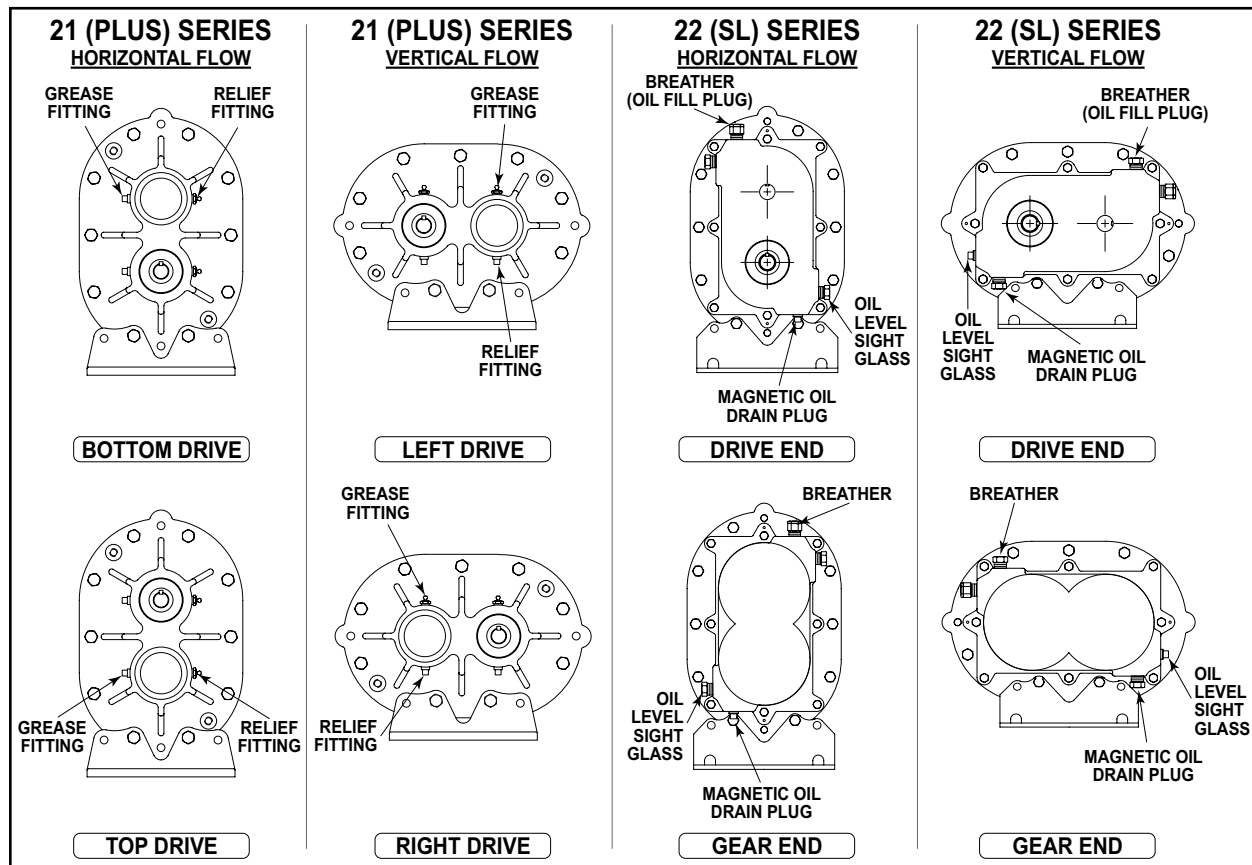


Figure 5 - Location of oil fill, drain, and level gauges on Competitor blowers

5.3.2 FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION

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

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

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

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

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

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

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

5.3.3 HAZARDS ASSOCIATED WITH BREAKDOWN OR IGNITION OF LUBRICATION



DANGER

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

5.3.4 GREASE LUBRICATED BEARINGS — 21 (PLUS) SERIES ONLY

Service drive end bearing at regular intervals. (See the *Suggested Lubrication Intervals for Grease Lubricated Bearings* table, to the right.) Use NLGI #2 premium grade, petroleum base grease with high temperature resistance and good mechanical stability, such as PneuLube grease available from your local Tuthill Vacuum & Blower System Professional. Using a pressure gun, force new grease into each bearing until traces of clean grease comes out of the relief fitting.

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



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



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

5.4 PIPING CONNECTIONS



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



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

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

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

HAZARDS ASSOCIATED WITH HAZARDOUS PROCESS FLUIDS



DANGER

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

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

5.4.1 BLOCKAGE OR RESTRICTION



WARNING

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

5.5 MOTOR DRIVES

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

5.5.1 DIRECT COUPLED

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

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

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

5.5.2 V-BELTS

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

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

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

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

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

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

5.5.3 SETTING V-BELT TENSION

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

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

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

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

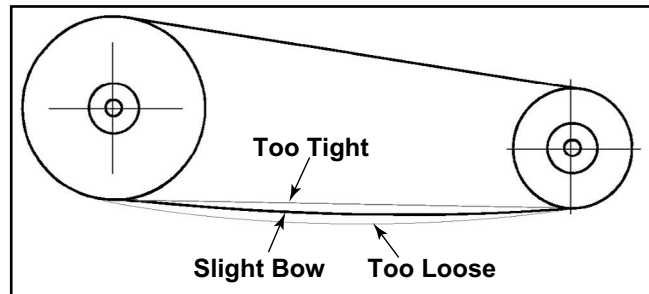


Figure 6 - General appearance of a V-Belt drive

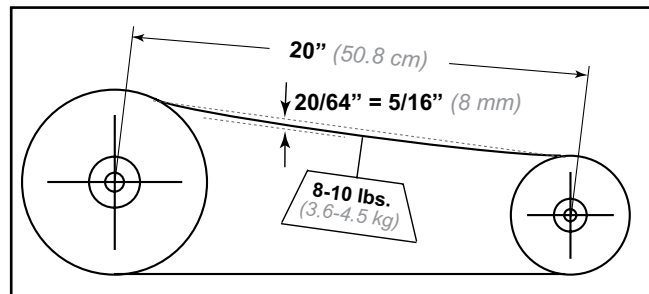


Figure 7 - Setting of proper tension for a V-Belt drive

5.5.4 V-BELT TROUBLESHOOTING

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

5.6 MOTOR AND ELECTRICAL CONNECTIONS



WARNING

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



NOTE

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

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

6. OPERATION

6.1 GENERAL



DANGER

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



WARNING

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

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

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

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

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

6.2 START-UP CHECKLIST

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

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

DATES CHECKED:

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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.

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

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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.

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

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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.

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

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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

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



WARNING

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



CAUTION

Do not touch hot surfaces.

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



CAUTION

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



NOTE

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

6.4 STOPPING



CAUTION

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

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

6.5 WATER INJECTED BLOWERS

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

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

6.5.1 OPERATION

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

6.5.2 SHUTDOWN

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

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

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



CAUTION

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



NOTE

For liquid injection other than water, consult the factory.

6.6 RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

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

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



NOTE

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

1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.
2. For carpet cleaning applications, after the work is completed, simply allow the blower to run a few (3-5) minutes with the suction hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.
3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such as WD-40® into the inlet of the blower just prior to shutdown. (*3-in-One and WD-40 are registered trademarks of WD-40 Company.*) The lubricant will provide an excellent protective coating on the internal surfaces. If using a spray lubricant, exercise care to prevent the applicator tube from getting sucked into the blower. The applicator tube will damage the blower, most likely to the point that repair would be required.
4. If the blower is being taken out of commission for an extended period of time, please also refer to the "Long Term Storage" section of this manual.

7. MAINTENANCE

7.1 GENERAL

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



DANGER

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



CAUTION

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

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



CAUTION

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

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

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

7.2 REGULAR MAINTENANCE

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

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

DAILY	WEEKLY	MONTHLY
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. Units which are still under warranty must be returned to the factory, freight prepaid, for service.

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



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



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

7.5 LONG TERM STORAGE

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

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

8. DISASSEMBLY AND REASSEMBLY

8.1 DISASSEMBLY OF BLOWER

With proper maintenance and lubrication, normal life expectancy for gears, bearings, and seals can be achieved. However, over a period of time these parts must be repaired or replaced to maintain the efficiency of your blower. This section is written in a way that will allow you to completely disassemble your blower.

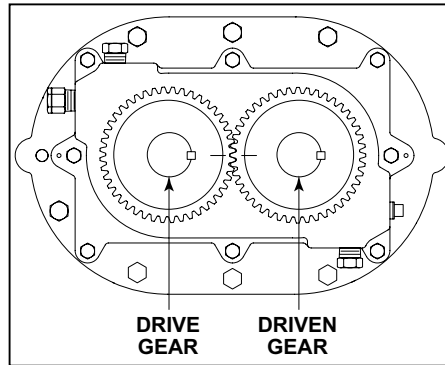


Figure 8 - Timing Marks Matched

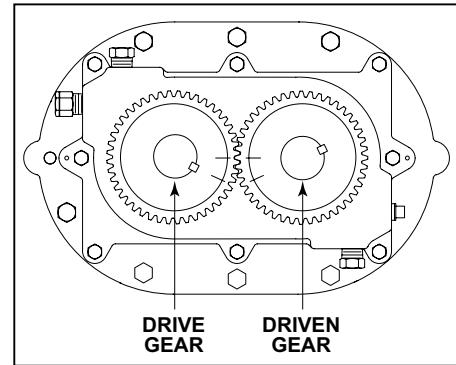


Figure 9 - Timing Marks Advanced 3 Teeth (Reference Marks Aligned)

The inspection of certain repairable or replaceable parts is referred to at the point of disassembly where these parts are exposed. If at any point of inspection, repair or replacement is deemed necessary, appropriate instruction will be given to achieve these repairs or replacements.



NOTE

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

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



NOTE

Gears are not exposed for visual inspection.

Inspect the gears for the following:

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



DANGER

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

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

9. Remove cover.
10. Loosen the set screws on the oil slingers [Items 45 & 46] and remove the oil slingers from the rotor shafts. (Refer to Figure 12)



Figure 10 - Pulling Driven Gear with Jaw Puller or Bar Puller

11. Remove ten (10) cap screws [15] that secure drive end plate [3] to housing [1].

12. Use a jaw puller or jack screws to remove drive end plate. (Refer to Figure 13 and 14).



Figure 11 - Pulling Drive Gear with Bar Puller

13. Press rotors out of end plate in press if available. If press is not available, support end plate and rotors in the housing. Block up housing and use a soft mallet to drive the rotors out. (Refer to Figure 15)

14. A jaw type puller can also be used.

15. Using a tube or round bar of a slightly smaller diameter than the shaft clearance holes in the end plates, tap the bearings out of the end plates. Bearing retainers [22] must be removed before knocking out the bearings. (Refer to Figure 16)

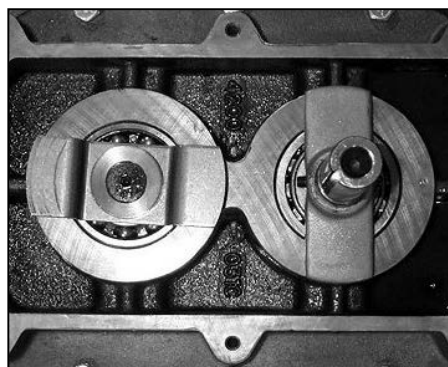


Figure 12 - Set screws for slingers

16. Remove seals from both end plates with a punch or dull chisel. The seals will be damaged during removal and must be replaced. Inspect all parts for wear and or damage.

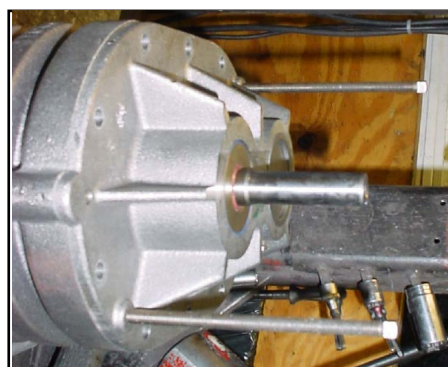


Figure 13 - Removing drive end endplate using Jack Screws (21 series).

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

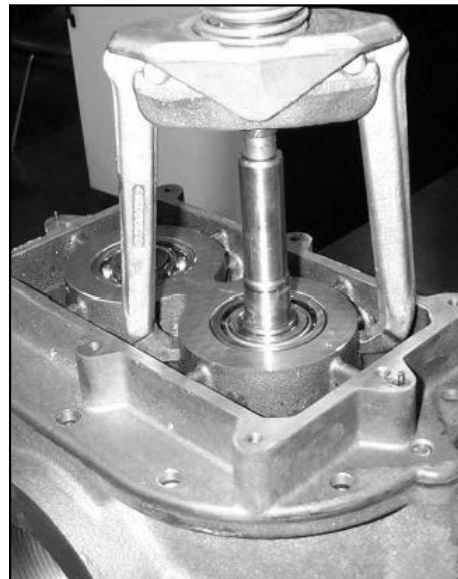


Figure 14 - Pulling drive end plate (22 series)



Figure 15 - Driving Rotors Out Using Soft Mallet



Figure 16 - Tapping Bearings Out of End Plates

8.2 REASSEMBLY OF BLOWER

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

See page 34 for drawings and dimensions of seal and bearing pressing tools.

Using the drive end plate as a fixture, support it high enough so the input shaft of the drive rotor clears the assembly surface. (Refer to Figure 17). Place rotors in fixture with the drive rotor to the left. (See Figures 17 and 20)

8.2.1 MECHANICAL SEAL INSTALLATION

1. Clean and deburr seal bore in endplate. Clean the face of the carbon and mating ring with alcohol etc. Apply a thin layer of silicon to the bottom face of the seal.
2. Place end plate [Item 4] on rotors.
3. Apply a thin coat of lubricant on the rotor shafts and the inner race of the bearings. Tap the bearings [13] into place using a tube with a flanged end that will contact both the inner and outer bearing races. (Refer to Figure 18).



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



Figure 18 - Tapping Bearings into End Plates



Figure 19 - Checking Gear End Clearances

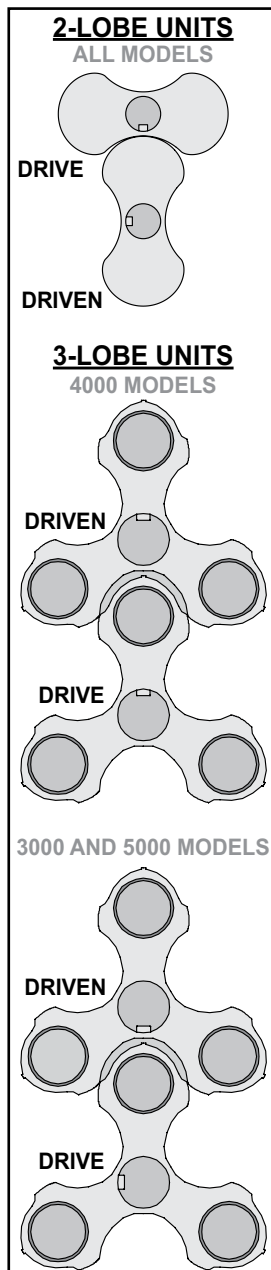


Figure 20 - Checking Gear End Clearances



WARNING

Keep hands and loose clothing away from lobes and gears.

4. Install bearing retainers [Items 22 & 25] to both bearings.
5. Check clearances between the end of the rotors and the face of the end plate. Refer to assembly clearances chart on page 32 for proper clearances for your model blower, and refer to the *Adjusting Rotor Interlobe Clearance* section on page 29 for procedures for checking and adjusting clearances.
6. If clearances check OK, put a spacer [28] and a shim [30] on each shaft. Timing shims that were removed should be put back on the shaft from which they were removed.
7. Lubricate shafts and bores on gears. Begin by pressing on the DRIVE gear. This will be pressed on the drive rotor, which is to the left.
8. Start the driver gear on the shaft and align the reference timing marks and press gear on. Lock gears in place with socket head screw [29] and washer [26]. Turn assembly over and rest the unit on the socket head screws and washers on the gear end.
9. Set dowel pins [9] in housing and position housing over the rotors and fasten with cap screws [15]. Check housing to rotor clearance. (Refer to Figure 21) A depth mic can be used.
10. Set on drive end plate [3] and fasten with cap screws [15].



NOTE

There are four cap screws [17] which are used to attach the feet.

Lubricate shafts and bearings. Install the ball bearing [12] on the driven rotor and the roller bearing [11] on the input shaft.

11. Apply a bead of a good quality RTV silicone sealant to the inner surface of the drive end cover [10] that mates to the drive end plate [3]. Install drive end cover and drive shaft seal [23].
12. Install any removed plugs [18], sight glasses [21] and replace breather [27] if required.

8.2.2 LUBRICATION, FINAL ASSEMBLY AND MOUNTING

13. Apply a bead of a good quality RTV silicone sealant to the inner surface of the gear end cover [5] that mates to the gear end plate [4]. Install the gear end cover with cap screws [16] and tighten evenly.
14. Fill both end covers with oil. Refer to the *Lubrication* section of this manual (page 12) for filling procedure, and page 34 for recommended lubricants.
15. To insure blower has not been distorted during mounting in the installation, turn the lobes by hand to make sure they are not making contact prior to connecting to the driver.

8.2.3 ADJUSTING ROTOR INTERLOBE CLEARANCE

16. Using feeler gauges take interlobe readings and record on each side of housing as indicated in Figure 21. By removing or adding shim behind the helical gear, it rotates as it is moved in or out and the driven rotor turns with it, thus changing the clearance between rotor lobes.
17. Changing the shim thickness .006" (.15 mm) will change the rotor lobe clearance .003" (.08 mm) or one-half the amount.
18. **EXAMPLE:** Referring to Figure 21, check the clearance at AA (right hand reading) and BB (left hand reading). If

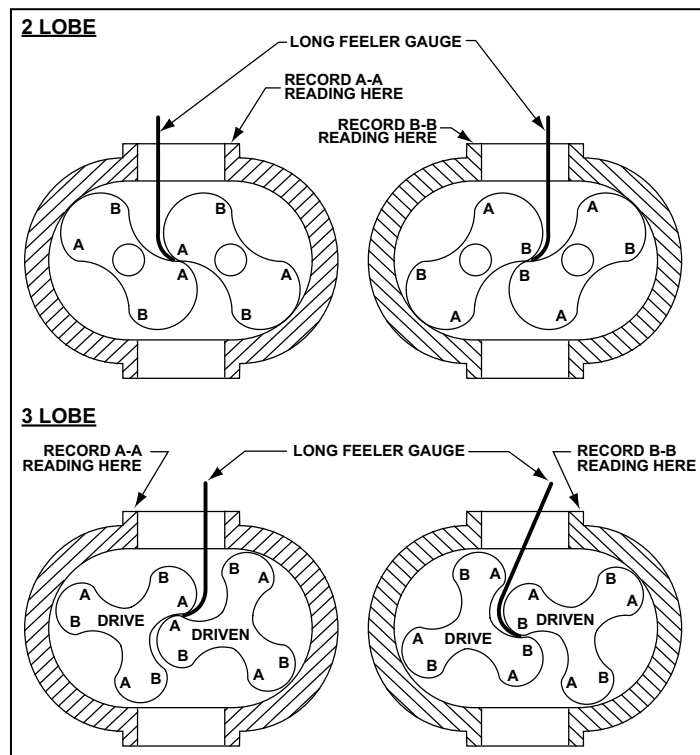


Figure 21 - Checking Rotor Interlobe Clearance

AA reading is .009" (.23 mm) and BB reading .003" (.08 mm) by removing .006" (.15 mm) shims. the readings will change one half the amount removed or .003" (.08 mm). AA should then read .006" (.15 mm) and BB should read .006" (.15 mm). The final reading should be within .002" (.05 mm) of each other.

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

9. TROUBLESHOOTING

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

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

10. ASSEMBLY CLEARANCES

Values are shown in inches and *millimeters*.

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

11. TORQUE CHART

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

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

12. RECOMMENDED LUBRICANTS

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

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

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

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

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

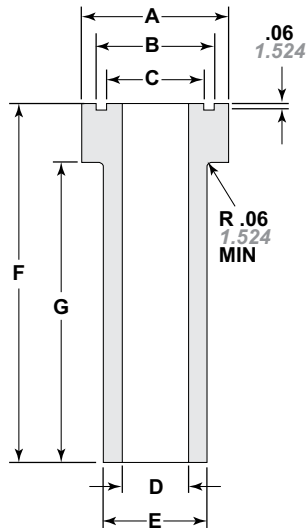
RECOMMENDED GREASE FOR COMPETITOR® PLUS BLOWERS:	
TUTHILL	CITGO
Tuthill PneuLube™ NLGI #2 premium grade, petroleum base lithium grease.	For food grade requirements: Use Citgo Clarion® Food Grade HTEP grease, NLGI No. 2 grade. It meets all requirements of FDA Regulation 21 CFR 178.3570 (the former USDA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

* For higher ambient temperatures, please consult the factory.

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

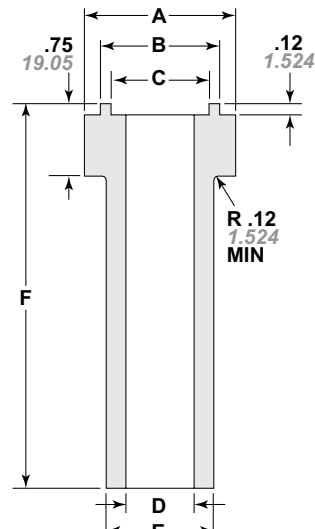
13. SPECIAL TOOL DRAWINGS

BEARING PRESSING TOOL (FOR ALL SERIES)



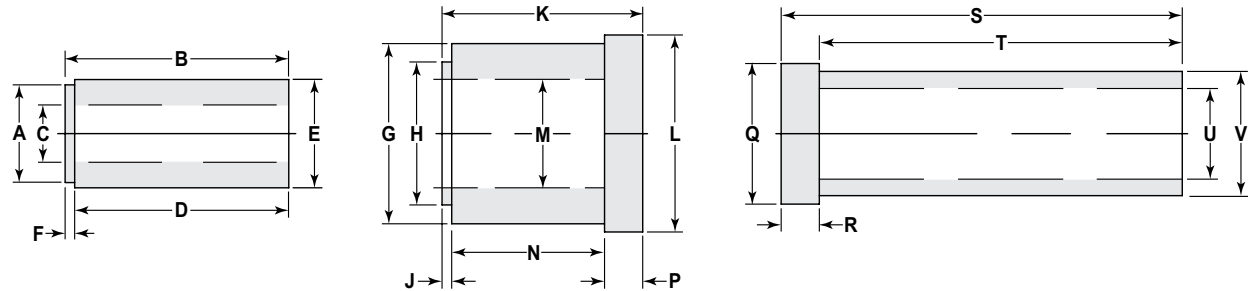
MODEL	A ±.001 ± 0.0254	B ±.005 ± 0.127	C ±.005 ± 0.127	D ±.005 ± 0.127	E ±.005 ± 0.127	F ±.005 ± 0.127	G ±.005 ± 0.127
2000	1.560 39.624	1.27 32.258	.98 24.892	.70 17.78	1.10 27.94	3.50 88.9	3.00 76.2
3000	2.035 51.689	1.70 43.18	1.335 33.909	1.015 25.781	1.415 35.941	3.75 95.25	3.00 76.2
4000	2.425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

SEAL PRESSING TOOL (FOR 21 & 22 SERIES)



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

SEAL INSTALLATION TOOLS (FOR 23 SERIES)



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

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

NOTE:

All dimensions are shown in Inches and millimeters.

MATERIAL:

MILD STEEL

PARTS LIST FOR MODEL COMPETITOR 21 (PLUS) SERIES

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

NOTES:

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

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

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

PARTS LIST FOR MODEL COMPETITOR 22 (SL) SERIES

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

NOTES:

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

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

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

PARTS LIST FOR MODEL COMPETITOR 23 (GT) SERIES

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

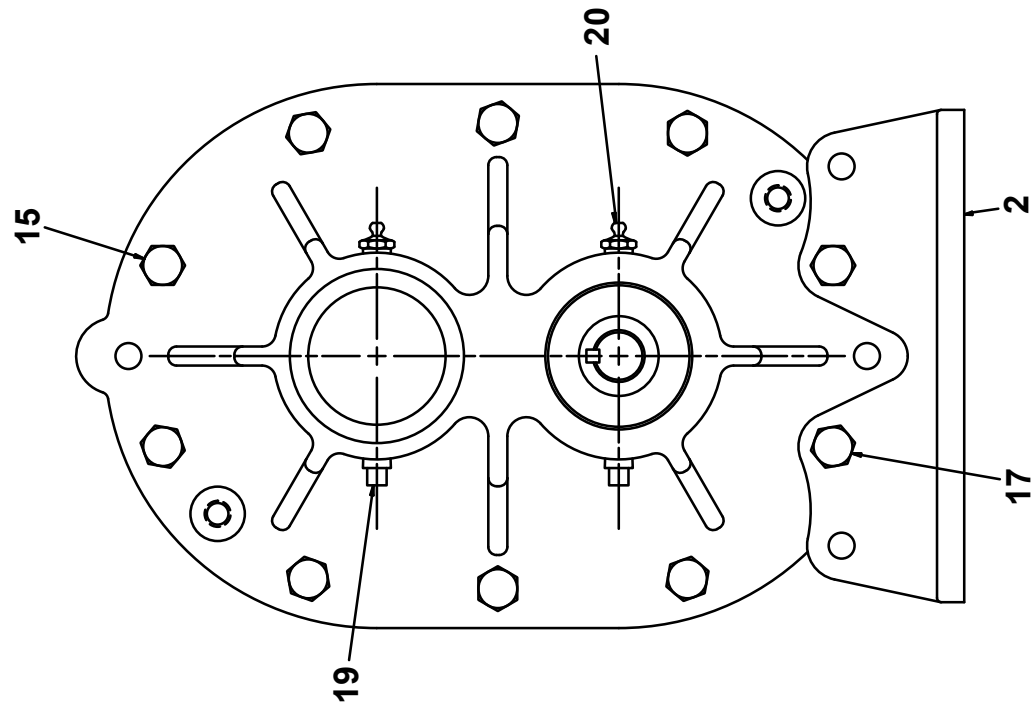
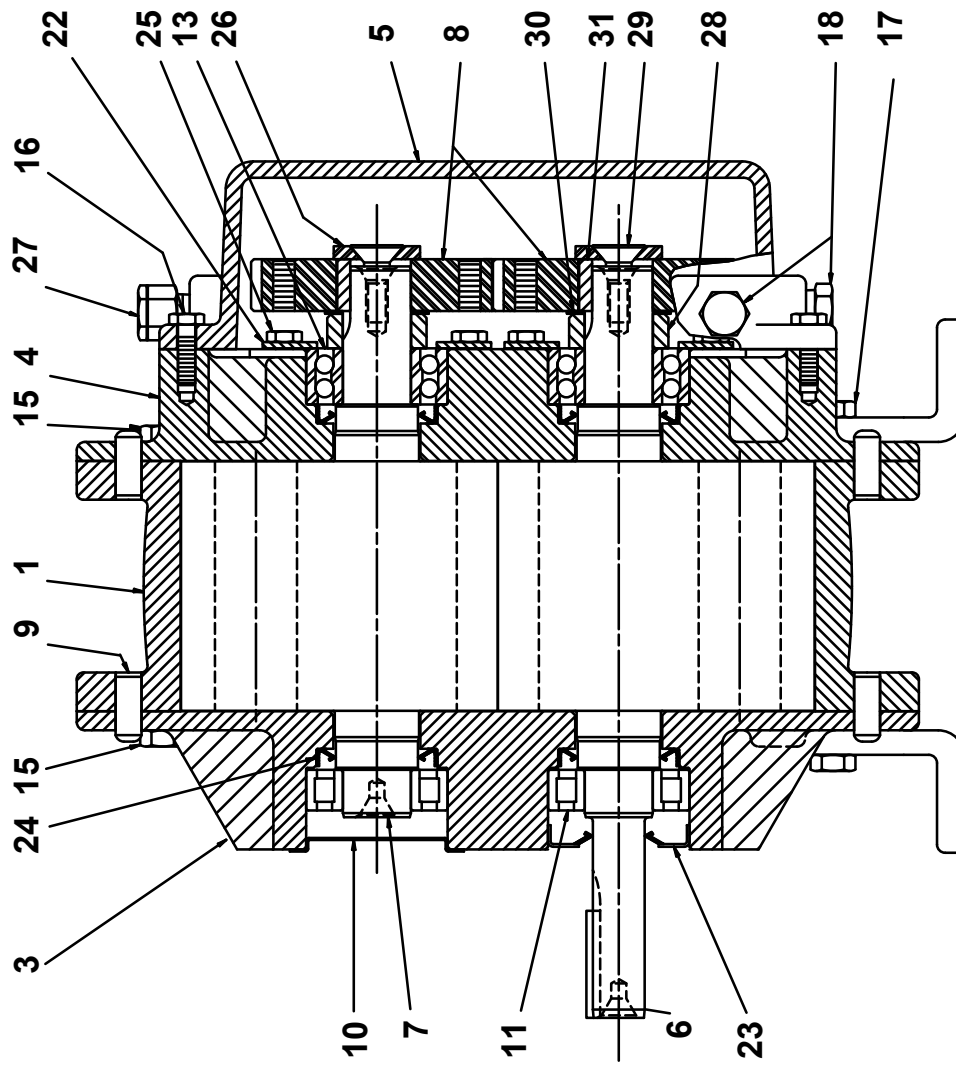
NOTES:

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

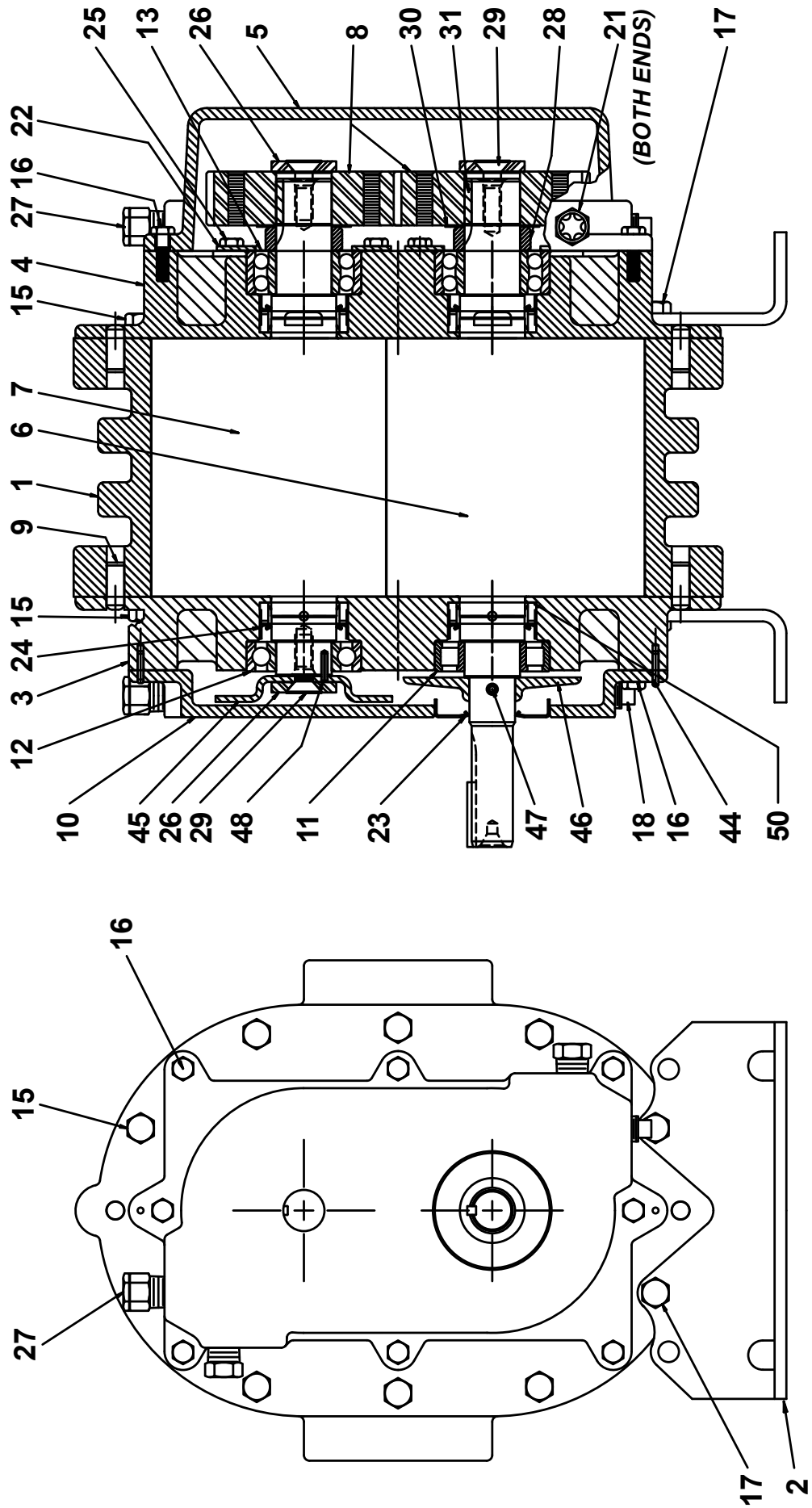
PARTS KITS ARE AVAILABLE. AS FOLLOWS:

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

CUTAWAY DRAWING FOR 21 (PLUS) SERIES



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





DECLARATION OF INCORPORATION

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

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

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

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

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

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

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

21 SERIES — GREASE LUBRICATION / AIR SERVICE (PLUS)

22 SERIES — SPLASH LUBRICATION / AIR SERVICE (SL)

23 SERIES — SPLASH LUBRICATION / GAS SERVICE (GT)

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

Ron Rinke
Director of Blower Engineering



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

WARRANTY – BLOWER PRODUCTS

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

PRODUCT TYPE	TYPE OF APPLICATION	
	ATMOSPHERIC AIR OR PROCESS AIR WITHOUT LIQUIDS PRESENT	PROCESS GASES OTHER THAN AIR, OR ANY LIQUID INJECTED APPLICATION
New (Qx™ models only)	30 months from date of shipment, or 24 months after initial startup date, whichever occurs first.	Consult Factory
New (all other models)	24 months from date of shipment, or 18 months after initial startup date, whichever occurs first	18 months from date of shipment, or 12 months after initial startup date, whichever occurs first
Repair	12 months from date of shipment, or remaining warranty period, whichever is greater	12 months from date of shipment, or remaining warranty period, whichever is greater

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

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

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

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

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

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

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

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

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

OPERATING DATA FORM / PRODUCT REGISTRATION

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

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

NOTES:

IMPORTANT

All blowers manufactured by Tuthill Vacuum & Blower Systems are date coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return the product registration card below, or you can visit our product registration web page at:

http://vacuum.tuthill.com/product_registration

IMPORTANT

All blowers manufactured by Tuthill Vacuum & Blower Systems are date coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return this product registration card.

Company _____

Location _____

City	State/Province	ZIP/Postal Code	Country
------	----------------	-----------------	---------

Telephone _____

E-mail _____

Model _____

Serial Number _____

Date of Purchase _____

Date of Startup _____

PLEASE CHECK ONE

Pneumatic Conveying	<input type="checkbox"/>
Food	<input type="checkbox"/>
Vacuum	<input type="checkbox"/>
Paper	<input type="checkbox"/>
Food/Meat Packing	<input type="checkbox"/>
Wastewater	<input type="checkbox"/>
Gas/Petrochemical	<input type="checkbox"/>
Other	<input type="checkbox"/>



BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 2912 SPRINGFIELD MO

POSTAGE WILL BE PAID BY ADDRESSEE

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

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

