

WARNING: Do Not Operate Before Reading Manual

Qx

OPERATOR'S MANUAL

Models

3200

4600

6000



SAFETY INSTRUCTIONS

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

NOTICE

1. The safety instruction tags shown below were attached to your unit prior to shipment. Do not remove, paint over or obscure in any manner.
2. Failure to heed these warnings could result in serious bodily injury to the personnel operating and maintaining this equipment.



SAFETY WARNINGS

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

IMPORTANT

In order to assure you of the full benefits of our product warranty, please complete, tear out and return the warranty registration card located on the back cover of this manual, or you can register your product online at:

<http://www.tuthillvacuumblower.com/index.cfm/contact-us/product-registration/>

SAFETY PRECAUTIONS

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

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

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INTRODUCTION

CONGRATULATIONS on your purchase of a new Qx® Rotary Positive Displacement Air 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.

Qx 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 realize getting any new piece of equipment up and running in as little time as possible is imperative to production, so we have tried to make these instructions as straightforward as possible.



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

IMPORTANT: Record the blower model and serial number 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.

OPERATING CHARACTERISTICS

QX blowers are rotary positive displacement type units with tri-lobe rotors rotating in opposite directions within a housing closed at the ends by end plates. The pumping capacity is determined by size, operating speed, and differential pressure conditions.

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 two 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.

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 Figure 1, *Flow Direction by Rotation*.

Blowers must be protected by cut-in switches or with bypass valving to limit differential pressure across the blower. This is described in greater detail in the *Operating Limitations* section, below. When a belt drive is employed blower speed 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.

OPERATING LIMITATIONS

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

EXAMPLE: Seldom does the operation of a blower result in pressure differentials large enough to strain the blower drive train (bearings, gears, and seals). Typically, the maximum allowable temperature limit (the limit is a function of the temperature rise as well as the inlet temperature), for any particular blower may occur well before the maximum speed or allowable power rating is reached. Temperature rise then becomes the limiting condition. The operating limit is to be determined by the maximum rating reached first, and it can be any one of the three: temperature, speed, or horsepower.

NOTE: Specially ordered blowers with non-standard construction, or with rotor end clearances greater than shown in this manual, will not have the operating limits specified here. Contact your Tuthill Vacuum & Blower Systems sales representative for specific information.

SPECIFICATIONS TABLE

MODEL	SERIES	PORT SIZE INCHES / mm	APPROX. OIL CAPACITY QUARTS / LITERS		MAX. ALLOWABLE DISCHARGE TEMP. ° F / ° C	MAX. TEMP. RISE ° F / ° C	MAX. PRESSURE PSIG	MAX. VACUUM in. Hg / mbar	MAX. RPM
			VERTICAL FLOW	HORIZONTAL FLOW					
3203 3205 3208 3213	AP	2 / 51 3 / 76 4 / 102 4 / 102	0.68 / 0.64	0.38 / 0.36	445 / 229	325 / 163	18	17 / 576	4800
4606 4610 4616	AP	4 / 102 6 / 152 6 / 152	1.82 / 1.1	1.07 / 1	445 / 229	325 / 163	18	17 / 576	4000
6009 6015 6024	AP	8 / 203 8 / 203 10 / 254	4.68 / 4.4	2.63 / 2.5	445 / 229	325 / 163	18	17 / 576	3200

INSTALLATION



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



WARNING: Do not use air blowers on explosive or hazardous gases. Each size blower has limits on pressure differential, running speed, and discharge temperature, which must not be exceeded. Consult Specifications Table.

PROTECTIVE MATERIALS

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



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

SAFETY

Blower housing and associated piping or accessories may become hot enough to cause major skin burns on contact. Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. 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, and that the motor controls are locked out and have been properly tagged before proceeding.



WARNING: Avoid extended exposure in close proximity to machinery with high intensity noise levels. Always wear adequate ear protection. Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.



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

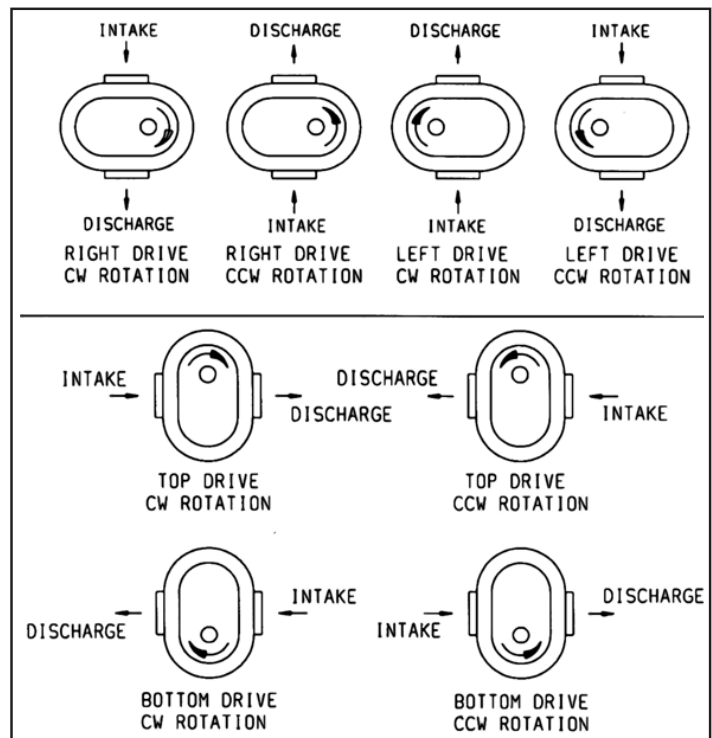


Figure 1 - Flow Direction by Rotation

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.



WARNING: When touching the blower or motor during operation, make certain that loose clothing, long hair, neckties, loose shoelaces, rags, etc. are secured snugly and cannot accidentally dangle into rotating elements such as shafts, belts, and sheaves.

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.

FOUNDATION

Your blower does not need a special foundation, however it does require a solid, level floor and adequate frame support.

LOCATION

Install the unit in a protected indoor location, if possible. However, an unprotected outdoor installation will be satisfactory if correct lubrication for expected temperatures is provided (see recommended lubrication section). Just before starting the installation, remove plugs or covers from inlet and discharge connections. Inspect for dirt or foreign objects inside machine, then turn drive shaft by hand to make sure it rotates freely. Mount in a level position. Use of a rigid, solidly supported, structurally sound baseplate is recommended. Make sure feet rest evenly on the plate before fastening down. Twisting or cramping the blower in mounting will cause rotor contact and binding during operation.

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.

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 motor-blower common mounting plate or base, rather than directly under the feet alone. Piping should be accurately squared with the blower and supported independently. 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.

MOUNTING STRESS

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.

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.



WARNING: Do not use air 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.

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.

MOTOR DRIVES

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

DIRECT COUPLED

When installing the motor directly to the blower, align shafts to the 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.

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 sheave should be accurately in line to minimize belt wear.

Adjust the belt tension to the manufacturer's 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" deflection for each inch of span at 8 to 10 pounds of force in the center of the belt. (Also see Figure 3).

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. (Also see Figure 3)

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. Re-check 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 reservoirs.

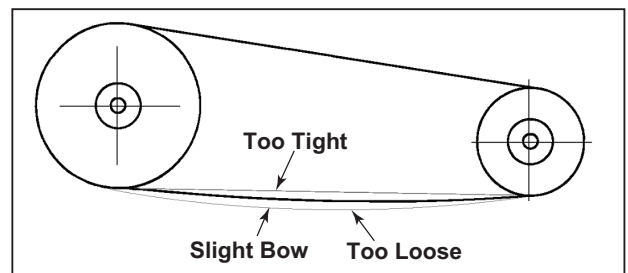


Figure 3. General appearance of V-belt drive

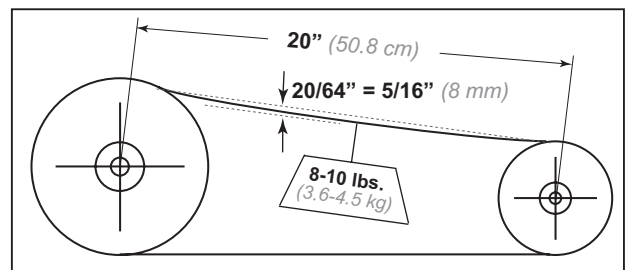


Figure 4. Proper tension for a V-belt drive

ELECTRICAL CONNECTIONS

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 machine by hand after wiring is completed to determine that there are no obstructions, and if the blower turns freely momentarily start the unit to check the direction of rotation. The air flow direction can be reversed by reversing the appropriate motor leads.

RELIEF VALVES

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



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

PIPING

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

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



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

LUBRICATION (SPLASH)

Before starting the unit, fill oil reservoirs as instructed below:

1. Remove fill plugs or breathers from gear (drive) end and free (non-drive) end plates.
2. Pour oil through fill hole until oil appears in sight glass. Slowly bring oil up to center of glass. Repeat for both end plates. Each oil sump must be filled independently.
3. Re-seal plugs and reinstall in end plates.
4. Oil levels should be checked frequently. Unit must be shut down to properly check oil levels.

PLEASE NOTE THE FOLLOWING:

- Time lapse between oil changes will vary depending on operating conditions.
- Higher blower operating temperatures are directly related to higher oil temperatures.
- Every Tuthill Vacuum & Blower Systems blower has been factory tested, oil drained, and shipped dry.
- Oil reservoirs must be filled to proper level before operation.
- Lubricants approved for use in Tuthill blowers are shown on page 15.
- Add oil in the quantity shown in the specifications table on page 5.

FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION

What are the perceived modes of failure when units are run beyond the specified duty cycles?

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.

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.

OPERATION

Before starting the blower for the first time under power, recheck the installation thoroughly to reduce the likelihood of troubles. Use the following 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.

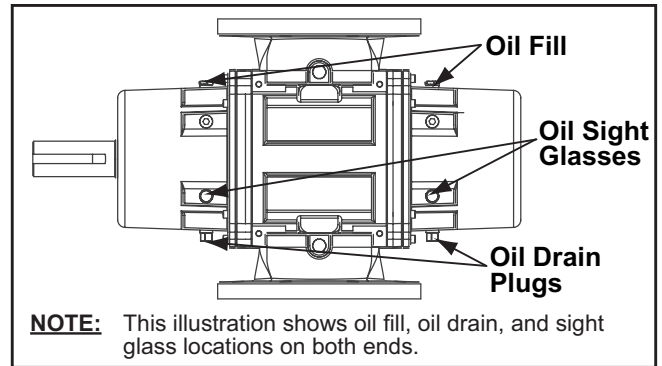


Figure 5. Locations of Oil Fill, Oil Drain Plug, and Oil Sight Glass

RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION

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. 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 shutdown procedure outlined below minimizes the risk of moisture condensation, corrosion, and freezing. Care must be taken to avoid overloading or overheating.

1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air.
2. 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.
3. 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.
4. 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. 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.

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

LONG TERM STORAGE

1. Spray the interior (lobes, housing and end plates) with rust preventative.
2. Apply a rust preventative grease to the drive shaft.
3. Attach a dessiccant bag to either of the covers to prevent condensation from occurring inside the blower. Make sure any dessiccant bag (or bags) is so attached to the covers that they will be removed when dust cover is removed. It is imperative that these be removed before startup of the blower.
4. Store the blower in an air conditioned and heated building if at all possible. At least insure as dry conditions as possible.
5. If possible, rotate the drive shaft by hand at least monthly in order to prevent the seals from setting in one position.

MAINTENANCE

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

PREVENTATIVE MAINTENANCE

The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
<ol style="list-style-type: none"> 1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (See Troubleshooting) 	<ol style="list-style-type: none"> 1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil increased oil usage. Replace if necessary. 	<ol style="list-style-type: none"> 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.

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 Disassembly section on page 12)
	Loose drain plug.	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication.	Correct oil level. Replace dirty oil. (See Lubrication section on page 8)
	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 Assembly Clearances on page 14)
	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 Disassembly section on page 12)
Excessive blower temperature	Too much or too little oil in gear reservoir.	Check oil level. (See Lubrication section on page 8)
	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 Assembly Clearances on page 14)
Rotor end or tip drag	Insufficient assembled clearances.	Correct clearances (See Assembly Clearances on page 14)
	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 Assembly Clearances on page 14)
	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.

REPAIR AND REPLACEMENT PARTS

Regular inspection of your blower and its installation, along with complete checks on operating conditions will pay dividends in added life and usefulness. Particular attention should be paid to lubrication of timing gears and bearings in accordance with the Lubrication section on page 8. Also, the drive should be serviced 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.

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 these instructions. Major repairs not covered in this book should be referred to the nearest Tuthill Vacuum & Blower Systems service representative. When ordering parts, give all nameplate information, plus the item numbers and names as taken from the appropriate assembly drawing in this book.

When ordering repair parts or replacement units, you should provide the model number and serial number of unit as well as the description of the part. Repair kits are available, consult factory.

SERVICE

Tuthill Vacuum & Blower Systems offers service on all repair parts shipments. If any trouble occurs to a unit within the warranty period, we suggest you immediately contact the factory for assistance. When returning units under warranty, transportation charges must be prepaid to:

Tuthill Vacuum & Blower Systems
4840 West Kearney Street
Springfield, Missouri 65803

Additionally, the factory will not accept any unit that arrives without authorization. Contact the Service Department for return authorization.

DISASSEMBLY (3200 AND 4600)

1. Remove all oil drain plugs and vent plugs from both ends of the blower. Before removing any parts, match-mark each component with a punch. This will allow the blower to be reassembled with the components in the same position. Match-mark the covers, endplate, housing, and both rotors.
2. Remove drive key from drive shaft. Remove gear end cover. Remove drive end cover. This is best accomplished by using two small pry bars at the dowel pins. Tap on cover with a mallet while putting pressure on the cover with the pry bar. The cover will slowly move off the dowel pins. Inspect the drive shaft for grooves and burrs. Remove drive shaft seal from drive end cover.
3. Carefully remove the drive seal wear ring from the drive shaft. The simplest method to do so is to use a cut off wheel and a die grinder. The hardened ring will typically snap open once it is cut most of the way through.
4. Remove washer from the rotor shafts on the gear end. Remove oil slinger assemblies.
5. Rotate unit. Remove bolts and washers from rotor shafts on the gear end. Remove the timing gear bolts completely from the driven rotor. Remove the timing gear from the rotor shaft by using a gear puller. See figure 6. Rotate the gear as it is being removed to prevent binding. Inspect gear teeth for wear and pitting. Inspect rotor shaft keyway for wear and damage.
6. Remove bolts from free end endplate.
7. Use 4 jacking screws on the endplate, apply even pressure to the jack screws to push the end plate from the housing. Remove screws. Remove retainer plate. Push rotors out of gear end endplate. Remove bearings and remove bearing shield. Save shims and measure for proper clearance for rebuilding the unit. Remove seal assembly from the endplate. OR Using a large Arbor press, orient the blower drive shaft down, supported by the ports and use a straight bar (such as a puller bar shown in figure 6) to put even pressure on the gear end of the rotors. Once the rotors are pressed to flush with the bearings, insert metric bolts in to the rotor or use a spacer slightly smaller than the shaft diameter to press the rotors through the bearings. Save shims and measure for proper clearance for rebuilding the unit. Remove seal assembly from endplate. Reverse the machine to drive shaft up and press each rotor free from the Drive End endplate.
8. Remove seals from the rotors with a plastic mallet or by tapping towards the end of the rotor shaft.
9. Remove bearings, bearing shield, and seal assembly out of free end endplates.

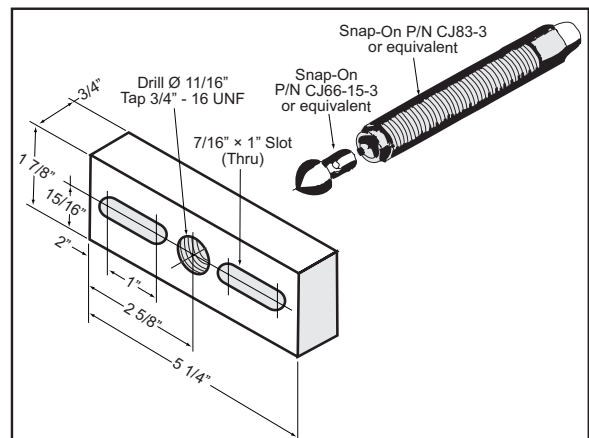


Figure 6. Bar Puller Illustration

- Use a hammer and brass bar to drive bearing and seal housing from endplates. Inspect bearing wear pattern and seal for wear and heat marks. Clean all parts before inspecting. Check the rotors' bearing and seal fits for bearing spinning along with seal housing on the rotor shaft. Check bearing bores and seal bores in the endplate for spinning of bearings and seal housing.

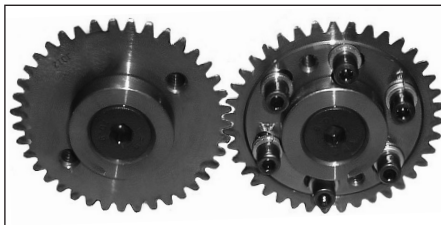


Figure 7. Gear Alignment

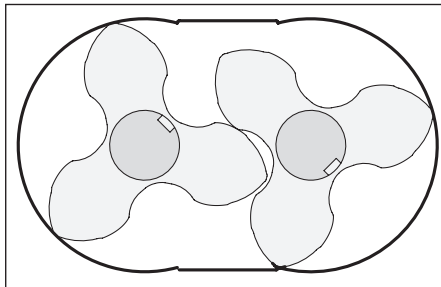


Figure 8. 3 Lobe Keyway Position

ASSEMBLY

A maintenance kit is available from Tuthill Vacuum and Blower Systems. This kit contains all the components that are replaced during a normal blower overhaul. As a minimum, these parts should be on hand prior to assembly. Be certain to have your serial number available when you contact the factory.

Check all parts to insure they are clean and free of burrs or nicks that may have occurred when the blower was being disassembled. Check the repair kit for the correct parts needed to complete the assembly of the unit. Make sure you have the proper tooling and training required to assemble the blower. Take the proper time to read the instruction manual before you begin.

GEAR END ASSEMBLY (3200 AND 4600)

- Seat rotors on a fixture with the gear end of the rotors upward and in the "T" position. Make sure the drive rotor is in the correct location for the proper flow and rotation required for the application.
- Install endplate and housing assembly onto rotors. Using a seal pressing tool, press seal assembly onto rotor shafts and into bores of endplates. Add shims as needed. Install seal slinger. Add shims as needed. Press oil shield onto rotor shafts. The oil shield is part of the seal assembly, but it must be pressed on after the seal assembly is installed.
- Install bearings press until seated. Install retainer and bolts. Install keys into shaft. Install gear assembly. Install solid gear onto long-tail drive rotor and two-piece gear onto the driven rotor. Install locks. Install screws.

DRIVE END (FREE END) ASSEMBLY (3200 AND 4600)

- Turn unit over. Set on face of gears and with feeler gauges check the gear end for proper clearances.
- Consult Figure 10, regarding bearing bore stack up and seal measurement.
- Put depth micrometer on housing and measure the distance to rotor face or use flat block and feeler gauge. Add shims to get proper free end clearances. Install O-ring into groove.
- Install endplate onto unit dowels. Bolt down with screws. With feeler gauge check free end clearance. Adjust with shims appropriately.
- Install seal assembly onto rotor shafts and into endplates. Press slinger onto shaft. Press oil shield onto shaft. Install bearings. Install slingers. Tighten set screws in to shaft. Install washer and install flathead cap screw into end of shaft.

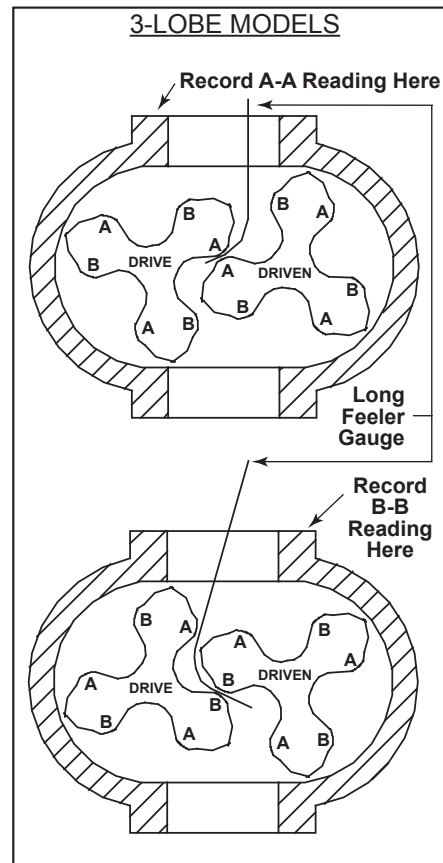


Figure 9.

Checking Rotor Interlobe Clearance

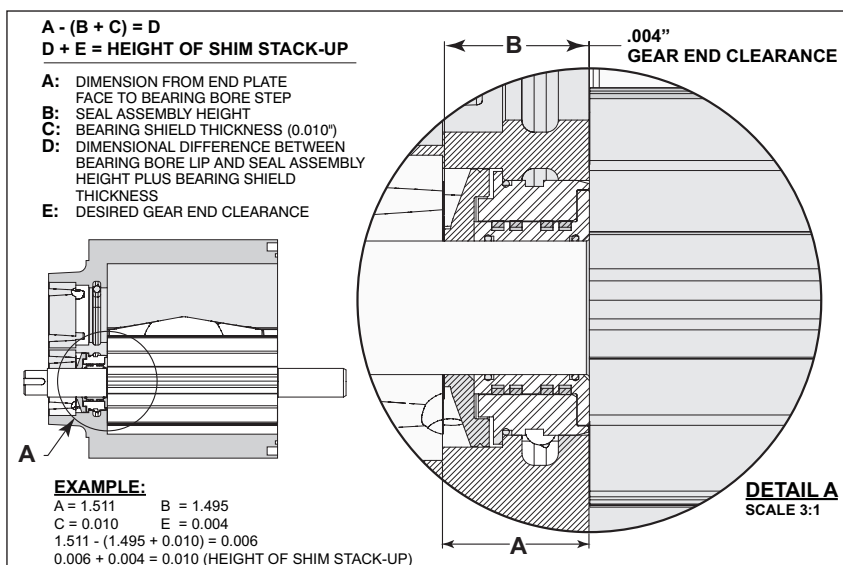


Figure 10. Bearing Bore Stack Up and Seal Measurement

ASSEMBLY CLEARANCES

MODEL	GEAR END	DRIVE END	TOTAL CLEARANCE	INTERLOBE	TIP TO DOWEL	TIP TO PORT
3203	.003 - .006 .08 - .15	.005 - .007 .13 - .18	.008 - .013 .20 - .33	.004 - .008 .10 - .20	.002 - .005 .05 - .13	.005 - .007 .13 - .18
3205	.003 - .006 .08 - .15	.008 - .010 .20 - .25	.011 - .016 .28 - .41	.004 - .008 .10 - .20	.002 - .005 .05 - .13	.005 - .007 .13 - .18
3208	.003 - .006 .08 - .15	.011 - .014 .28 - .36	.014 - .020 .36 - .51	.004 - .008 .10 - .20	.002 - .005 .05 - .13	.005 - .007 .13 - .18
3213	.003 - .006 .08 - .15	.016 - .019 .41 - .48	.019 - .025 .48 - .64	.004 - .008 .10 - .20	.004 - .008 .10 - .20	.009 - .011 .23 - .28
4606	.003 - .006 .08 - .15	.009 - .012 .23 - .30	.012 - .019 .30 - .48	.005 - .011 .13 - .28	.002 - .005 .05 - .13	.006 - .008 .15 - .20
4610	.003 - .006 .08 - .15	.014 - .017 .36 - .43	.017 - .024 .43 - .61	.005 - .011 .13 - .28	.002 - .005 .05 - .13	.006 - .008 .15 - .20
4616	.003 - .006 .08 - .15	.020 - .023 .51 - .58	.023 - .030 .58 - .76	.005 - .011 .13 - .28	.004 - .008 .10 - .20	.009 - .011 .23 - .28
6009	.002 - .005 .05 - .013	.018 - .022 .46 - .56	.022 - .025 .56 - .64	.015 - .016 .38 - .41	.004 - .007 .10 - .18	.007 - .009 .18 - .23
6015	.002 - .005 .05 - .013	.020 - .024 .51 - .61	.024 - .027 .61 - .69	.015 - .016 .38 - .41	.004 - .007 .10 - .18	.007 - .009 .18 - .23
6024	.002 - .005 .05 - .013	.021 - .025 .53 - .64	.025 - .028 .64 - .71	.015 - .016 .38 - .41	.004 - .007 .10 - .18	.009 - .011 .23 - .28

NOTES:

RECOMMENDED LUBRICANTS FOR ROTARY BLOWERS AND VACUUM BOOSTERS

RECOMMENDED MINERAL BASED LUBRICANTS				
AMBIENT TEMPERATURE	SHELL	CITGO	CHEVRON TEXACO	EXXONMOBIL
0° to 32° F (-18° to 0° C)	TELLUS® 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® 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)	TELLUS® 150 (ISO 150)	A/W 150 (ISO 150)	RANDO HD 150 (ISO 150)	DTE EXTRA HEAVY (ISO 150)

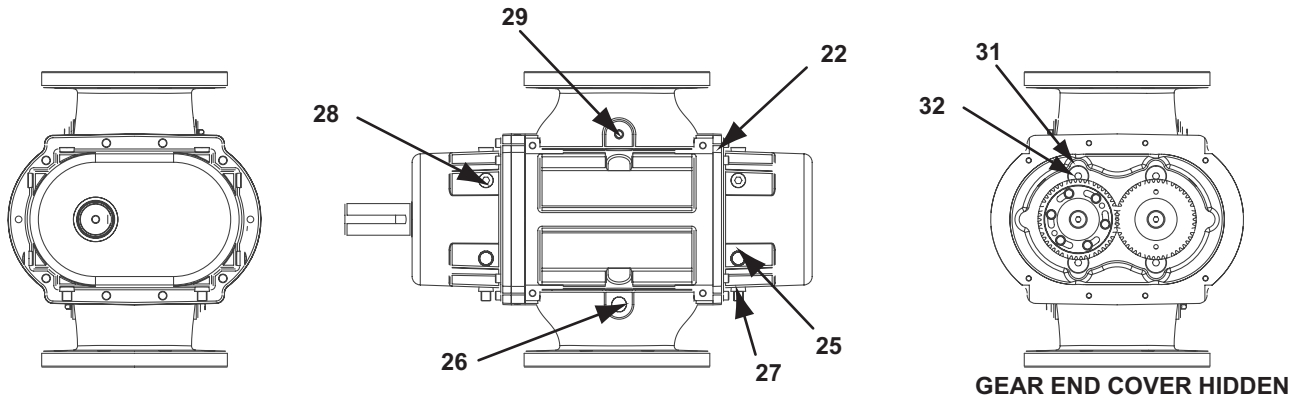
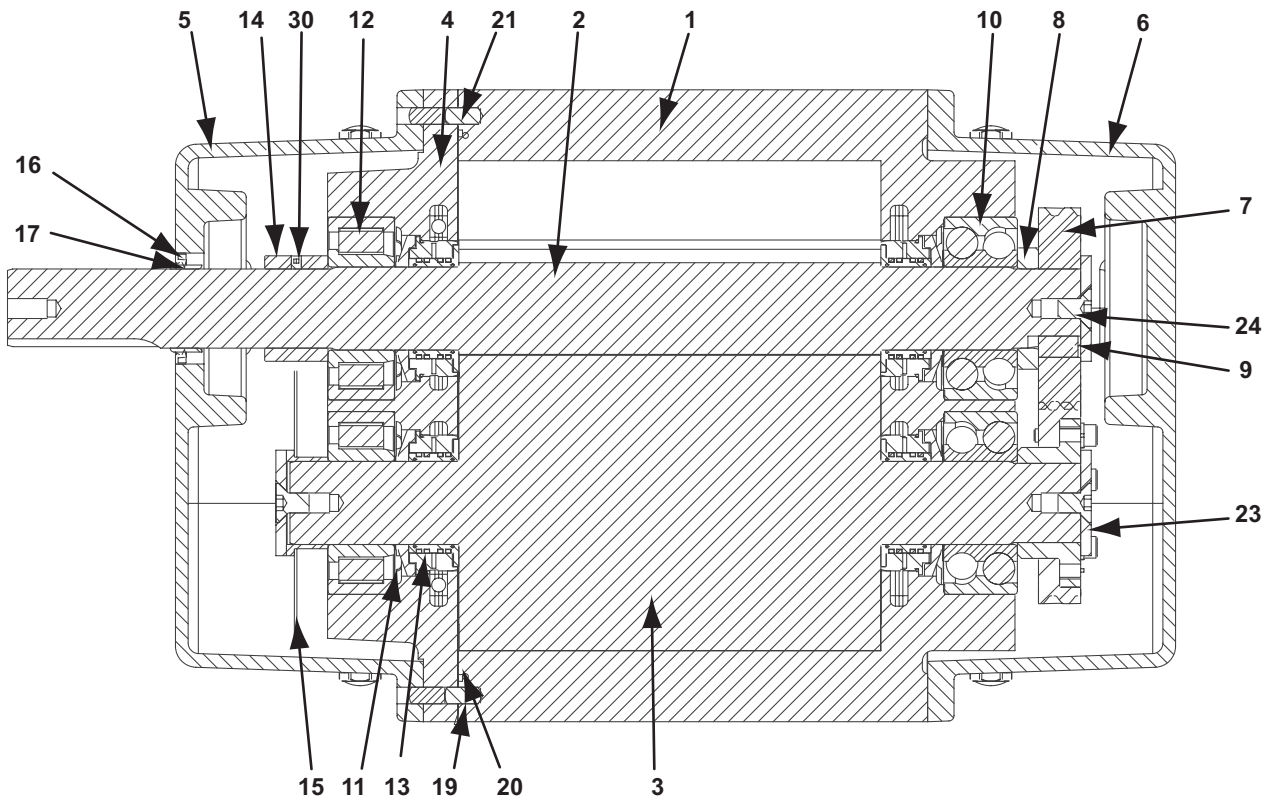
RECOMMENDED SYNTHETIC BASED LUBRICANTS*			
AMBIENT TEMPERATURE	TUTHILL	EXXONMOBIL	SHELL
0° to 32° F (-18° to 0° C)	PneuLube™ (ISO 100)	SHC 626 (ISO 68)	OMALA® RL 68 (ISO 68)
32° to 90° F (0° to 32° C)		SHC 627 (ISO 100)	OMALA® RL 100 (ISO 100)
90° to 120° F (32° to 50° C)		SHC 629 (ISO 150)	OMALA® RL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

* 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.

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

NOTES: _____

CUTAWAY DRAWING FOR Qx-3200 AND Qx-4600 SERIES BLOWERS

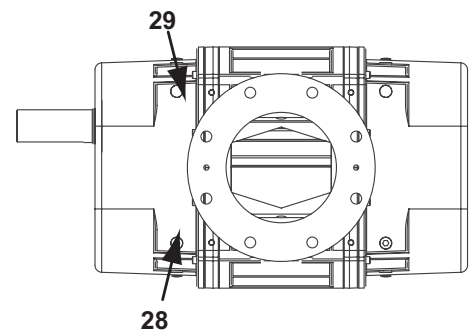
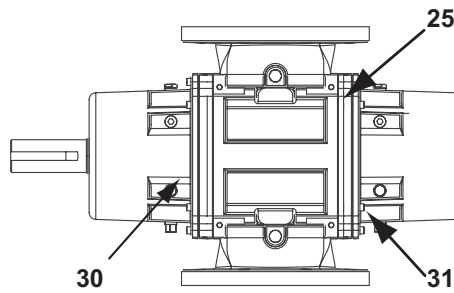
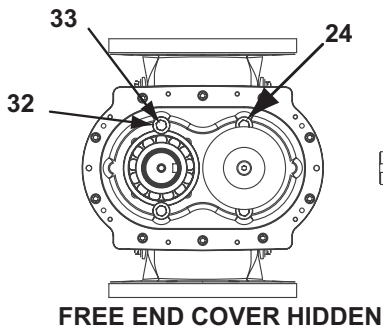
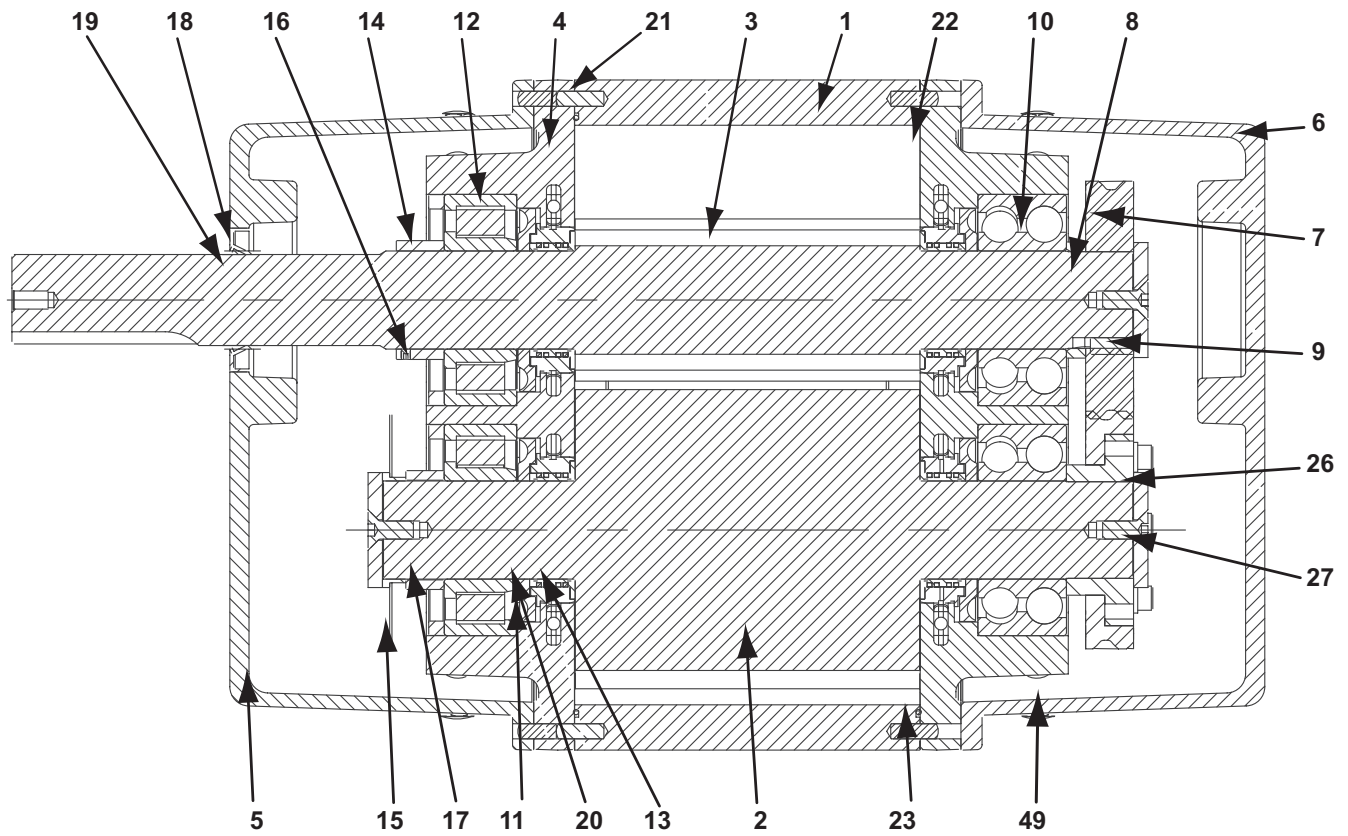


PARTS LIST FOR Qx-3200 AND Qx-4600 SERIES BLOWERS

ITEM NO.	PART DESCRIPTION	QTY
1	HOUSING	1
2	DRIVE ROTOR	1
3	DRIVEN ROTOR	1
4	ENDPLATE	1
5	DRIVE COVER	1
6	GEAR END COVER	1
7	GEAR ASSEMBLY	1
8	GEAR SPACER	1
9	GEAR KEY	2
10	BALL BEARING	2
11	BEARING SHIELD	4
12	CYLINDER BEARING	2
13	SEAL ASSEMBLY	4
14	DRIVE COLLAR	1
15	OIL SLINGER	1
16	LIP SEAL	1

ITEM NO.	PART DESCRIPTION	QTY
17	SEAL WEAR RING	1
18	BEARING SHIM	—
19	HOUSING SHIM	—
20	O-RING	1
21	DOWEL PIN	4
22	CAP SCREW	26
23	ROTOR WASHER	3
24	FLAT CAP SCREW	3
25	OIL SIGHT GLASS	4
26	HEX PIPE PLUG	2
27	OIL DRAIN PLUG	4
28	SOCKET PIPE PLUG	8
29	SQUARE PIPE PLUG	2
30	SET SCREW	2
31	WASHER	4
32	CAP SCREW	4

CUTAWAY DRAWING FOR Qx-6000 SERIES BLOWERS



PARTS LIST FOR Qx-6000 SERIES BLOWERS

ITEM NO.	PART DESCRIPTION	QTY
1	HOUSING	1
2	DRIVEN ROTOR	1
3	DRIVE ROTOR	1
4	ENDPLATE	2
5	DRIVE COVER	1
6	GEAR END COVER	1
7	GEAR ASSEMBLY	1
8	GEAR SPACER	1
9	TIMING GEAR KEY	2
10	BALL BEARING	2
11	BEARING SHIELD	4
12	CYLINDER BEARING	2
13	SEAL ASSEMBLY	4
14	DRIVE COLLAR	1
15	OIL SLINGER	1
16	SET SCREW	2
17	OIL SLINGER SPACER	1

ITEM NO.	PART DESCRIPTION	QTY
18	LIP SEAL	1
19	SEAL WEAR RING	1
20	BEARING SHIM	—
21	HOUSING SHIM	—
22	ORING	2
23	DOWEL PIN	6
24	CAP SCREW	16
25	CAP SCREW	20
26	ROTOR WASHER	3
27	FLAT CAP SCREW	3
28	SOCKET PIPE PLUG	8
29	HEX PIPE PLUG	6
30	OIL SIGHT GLASS	4
31	OIL DRAIN PLUG	2
32	WASHER	8
33	CAP SCREW	8

WARRANTY

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, or register online at 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

