

M-D Pneumatics™

PD PLUS®

Rotary Positive Displacement Blower

Series 17/46 - Lip-Labyrinth (Air Service)

Series 57/81 - Single Envelope Gastight

Series 64/67 - Double Envelope Gastight

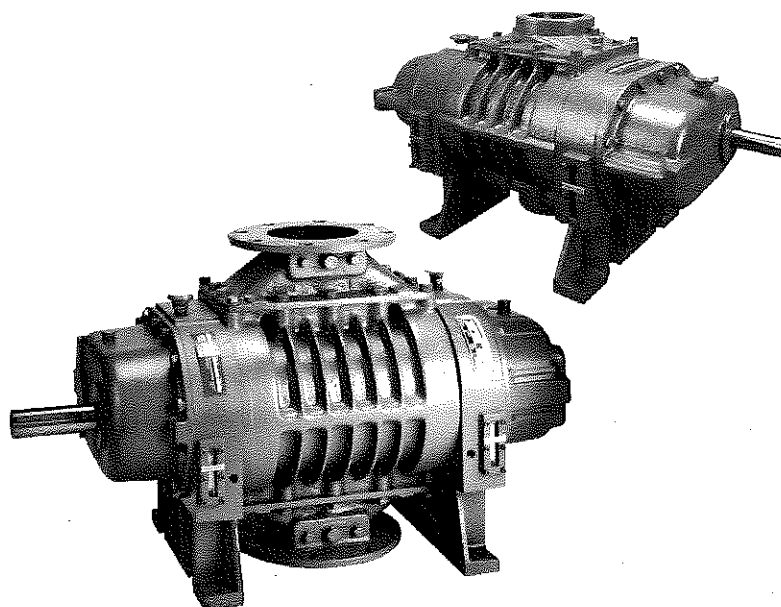
(obsolete 16/47 series also included in this manual)

Models	4006	4009	4012					
	5507	5509	5511	5514	5516	5518	5520	

INSTALLATION OPERATION MAINTENANCE REPAIR MANUAL

WARNING

DO NOT OPERATE BEFORE
READING MANUAL.



LEADING THE SEARCH FOR INNOVATIVE SOLUTIONS



TUTHILL
Vacuum & Blower Systems

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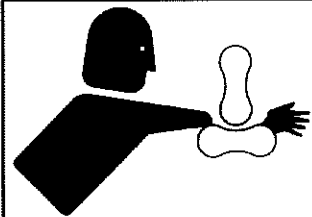
08/2007

<http://vacuum.tuthill.com>

SAFETY INSTRUCTIONS

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

⚠ WARNING



Keep body and clothing away from machine openings

⚠ WARNING



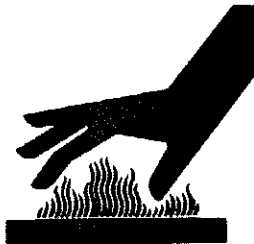
Hearing Protection Required

⚠ WARNING



Do not operate without guards in place

⚠ CAUTION



Do not touch hot surfaces

SAFETY WARNING

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

TUTHILL VACUUM AND BLOWER SYSTEMS

Springfield, MO USA

NOTICE

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

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

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WARRANTY STATEMENT AND REGISTRATION CARD	INSIDE BACK COVER

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 visit our product registration web page at http://vacuum.tuthill.com/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 piping disconnected, place a strong, coarse screen over the inlet and avoid standing in discharge air stream.
- Avoid extended exposure in close proximity to machinery with high intensity noise levels.
- Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.
- Hearing protection may be required depending on silencing capabilities.

INTRODUCTION

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

PD PLUS blowers are built to exacting standards and if properly installed and maintained will provide many years of reliable service. 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.

PD PLUS blowers are internally and externally treated after factory assembly and testing to protect against rusting in normal atmospheric conditions prior to installation. 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 LONG TERM STORAGE on page 10 of this manual.

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

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

GILES ASSET TAG #10201

OPERATING DATA


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

Model No. <u>5511-17T3-4097</u>	V-Belt Size _____ Length _____
Serial No. <u>1405130807</u> (Recorded from nameplate on unit)	Type of Lubrication: _____
Startup Date _____	
Blower RPM _____	Pressure _____
Blower Sheave Diameter _____	Vacuum _____
Motor Sheave Diameter _____	Any other special accessories with this unit _____
Motor RPM _____ HP _____	

NOTES:

Space blower for all three plants

INSTALLATION

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

Do not use air blowers on explosive or hazardous gases. Each size blower has limits on pressure differential, running speed, and discharge temperature, which **must not** be exceeded. These limits are shown on the table "Maximum Operating Limits" on page 17.


LOCATION

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

PROTECTIVE MATERIALS

Remove protective materials from the shaft.

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

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

FOUNDATION

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

Soft foot is a condition that can exist when foundations or mounting bases have uneven mounting surfaces. Soft foot places unequal loads on blower housings and bearings and will result in shortened blower life. To prevent soft foot, check to see that all mounting feet are resting evenly on the foundation, and shim as necessary to eliminate stress on the blower base when the blower mounting bolts are tightened.

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

DRIVE

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

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


For installations where the blower is to be operated by direct drive, selection of the driver should be such as not to exceed the maximum speed ratings of the blower. (See table "Maximum Operating Limits" on page 17.)

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

PIPING


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

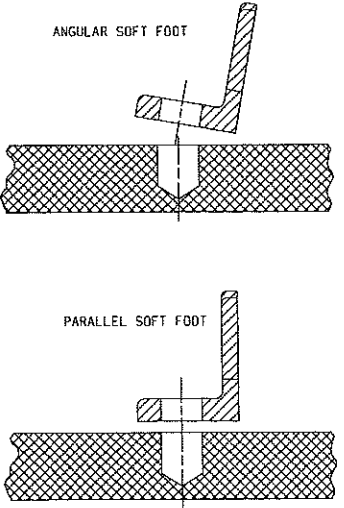
Be certain all piping is clean internally before connecting to the blower. We recommend placing a 16-mesh wire screen backed with hardware cloth at or near the inlet connections for the first 50 hours of use until the system is clean. Make provisions to clean the screen after a few hours of operation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

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

RELIEF VALVES

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.

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



Examples of Soft Foot

LUBRICATION

Every M-D Pneumatics blower 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.

Do not start up the blower until you are positive that it has been properly and fully lubricated. 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 under "Filling Procedure." Tuthill approved mineral-based, synthetic and food grade lubricants are listed on page 17.

FILLING PROCEDURE (SEE ALSO FIGURE 1A BELOW)

- 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 notched area 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 (64/67 series has plugs only - no breathers)

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

WARNING: NEVER ATTEMPT TO CHANGE OR ADD OIL WHILE THE BLOWER IS IN OPERATION. Failure to heed this warning could result in damage to the equipment and/or serious personal injury. **Oil level must be checked while the blower is not running.**

APPROXIMATE OIL CAPACITIES

BLOWER MODEL	Horizontal Flow (series 17/57/64)		Vertical Flow (series 46/81/67)	
	GEAR (DRIVE) END	FREE (BACK) END	GEAR (DRIVE) END	FREE (BACK) END
4000	14 fluid ounces (0.42 liters)	14 fluid ounces (0.42 liters)	24 fluid ounces (0.70 liters)	27 fluid ounces (0.80 liters)
5500	32 fluid ounces (0.95 liters)	32 fluid ounces (0.95 liters)	57 fluid ounces (1.7 liters)	64 fluid ounces (1.9 liters)

RECOMMENDED LUBRICANTS ARE SHOWN ON PAGE 17

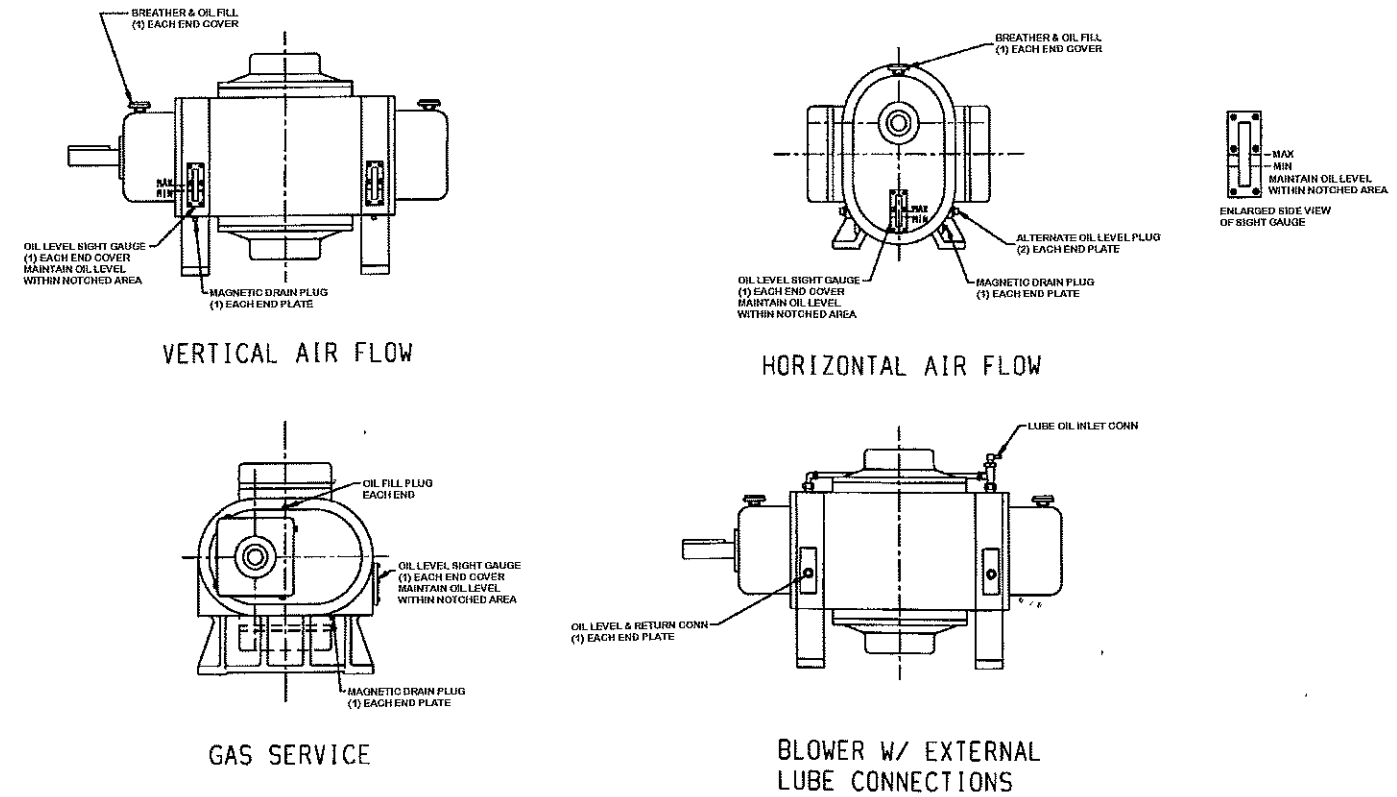


Figure 1A - Oil Fill and Drain Connections and Level Gauges

WATER COOLED END PLATES (OPTIONAL)

Blowers supplied with water cooled end plates (available in vertical flow configuration [series 46/67/81] only) are identified by the letter "E" located in the tenth position of the complete blower model number.

EXAMPLE: 5514-67L3E

Blowers supplied with water cooled end plates can also be identified by the hose that connects the top of the gear (drive) end plate to the bottom of the free (non-drive) end plate. See Figure 2 below for details. Tuthill Vacuum & Blower Systems recommends water cooled end plates for blowers in applications where the blower operates with discharge temperatures of 250° F (120° C) for periods of 4 hours or greater per day. The use of water cooled end plates reduces oil temperature and improves oil viscosity for better lubrication. Generally, a water flow of 0.5-1.0 GPM (1.9-3.8 L/min) is sufficient to maintain oil temperatures of 150° F (65° C) or below. Do not allow water pressure to end plates to exceed 75 PSIG (510 kPa g).

CAUTION: If blower is to be located outdoors or in a building where the temperature surrounding the blower or the water supply and return piping can fall below 35° F (2° C), then care must be taken to ensure that the water (or other cooling liquid) does not freeze inside the end plates and cause damage.

End plates must be drained of liquid during down time unless a recirculation liquid cooling system with a glycol mixture has been installed.

NOTE: Blowers are never shipped from the factory with liquid in the end plates.

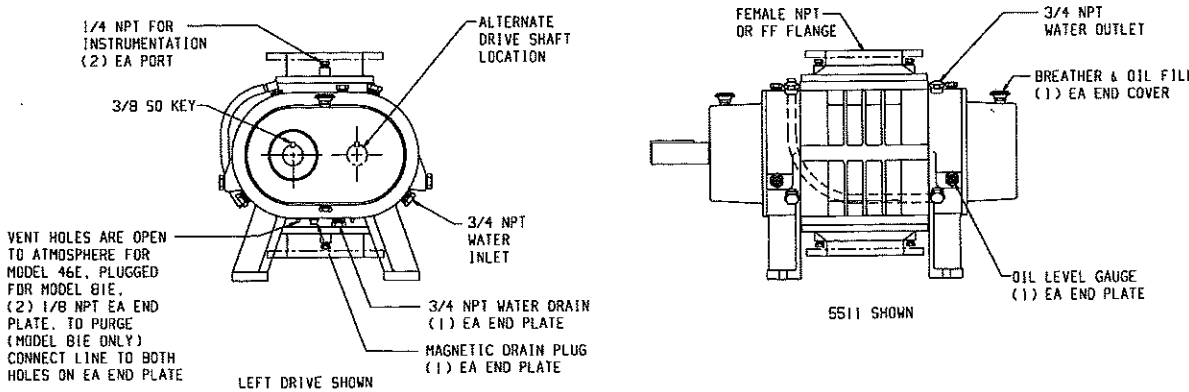


Figure 2 - Oil and Water Connections on Blowers with Water Cooled End Plates

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 the 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. Rotate blower shaft several times by hand to make sure blower is rotating freely. The presence of unevenness or tight spots is an indication of a problem.
- 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.

SPECIAL INSTRUCTIONS FOR BLOWERS WITH EXTERNAL LUBRICATION SYSTEMS

Blowers furnished with external lube tanks are designated with a suffix number after the model number, for example, 4009-84. On older units, it will appear before the model number. There are four variations manufactured:

- 85 - Lip Seal/Vertical Flow *(46)
- 18 - Lip Seal/Horizontal Flow *(17)
- 84 - Mechanical Seal (Single Envelope Gastight)/Vertical Flow *(81)
- 54 - Mechanical Seal (Single Envelope Gastight)/Horizontal Flow *(57)

*Use this corresponding number when following the repair procedure. The blowers are the same except for the end plates which have different drillings for lubrication purposes.

WARNING: Field conversions cannot be made on 46 and 81 series without replacing end plates. Consult factory before making any conversions.

- The external lube tank is equipped with an oil filter which has a replaceable element. The part number for the element is 91999-1.
- Each tank has an oil pressure relief valve which is set at the factory at 12 - 15 PSIG (80 - 100 kPa g) and normally requires no adjustment. If an adjustment becomes necessary, remove the cap and adjust the screw. Clockwise will increase pressure, and counterclockwise will reduce pressure.
- Oil tank should be on a level surface with return connections of tank below the blower return connections at approximately 2 inches drop per foot (16.5 cm drop per meter). Each end of blower shall have separate return hose lines (3/4" [19 mm] I.D. minimum) not over six feet from farthest blower.
- The oil supply hose and connections must be kept free of dirt and foreign material during installation to prevent clogging of blower oil supply restrictors (.055" [1.40 mm] diameter).
- Make sure motor pump wiring connection is for correct rotation as indicated by arrow on motor.
- Tanks equipped with heat exchangers should have water flow direction counter to oil flow. Required water flow rate is approximately 0.25 - 1.0 GPM (0.95 - 3.8 L/min) depending upon blower operating condition (oil sump temperature should not exceed 250° F [120° C] maximum).

CAUTION: Fill both ends of blower with oil to proper level, then operate oil supply system, and be sure oil is returning from both blower return hoses prior to starting blower.

FLOW DIRECTION BY ROTATION

Refer to the illustrations below before installing inlet and discharge piping.

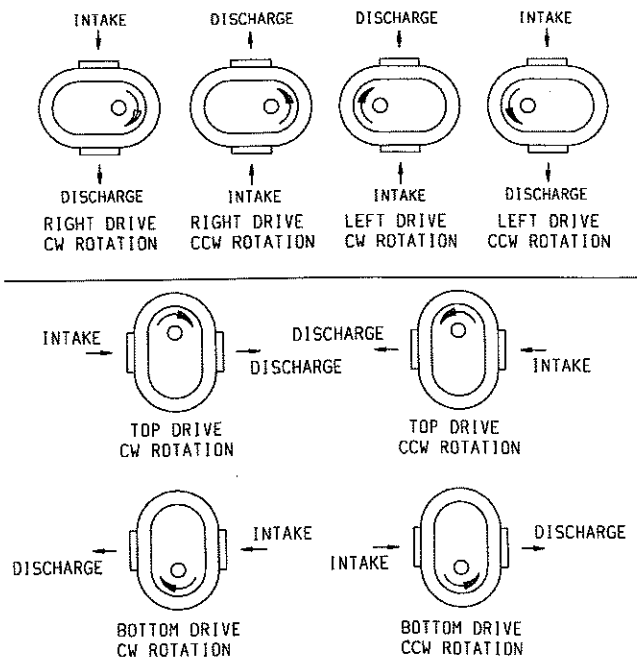


Figure 3 - Flow Direction by Rotation

WATER INJECTED VACUUM OR PRESSURE 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.

OPERATION:

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

SHUTDOWN:

- The blower can be shutdown for brief periods by relieving the inlet vacuum, shutting the water off, and then stopping the unit.
- 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.
- 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.
- Special coatings or platings are available to minimize rusting or corrosion in applications where units can remain wet.

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.

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.

METHANE DIGESTER GAS

There are many M-D Pneumatics blowers utilized in methane digester (or sewage) gas applications. Sewage gas is seldom pure, with much dissolved solid matter entrained in the gas stream. When this gas is compressed by the blower and is subsequently heated by the compression process, any moisture is evaporated, allowing the dissolved solids to "plate out" or adhere to the rotors. If enough of these solids (or "sludge") from the digester gas builds up on the rotors, it reduces the blower operating clearances between the rotors, housing and end plates, resulting in equipment failure.

This can be easily prevented by periodically flushing the blower with a mixture of 75% kerosene or fuel oil and 25% lubricating oil. The kerosene or fuel oil dissolves the sludge buildup and the lubricating oil coats the rotors to slow buildup.

The mixture should be injected on the inlet side through a valve set to feed about 2 quarts (2 liters) of the mixture shown in the table below in a period of 15 to 20 minutes. On units regularly flushed, once a week is sufficient. If the unit is dirty, it should be flushed daily until hard buildup is removed and then put on a weekly cycle. In very dirty gas installations the schedule must be varied to meet the demand.

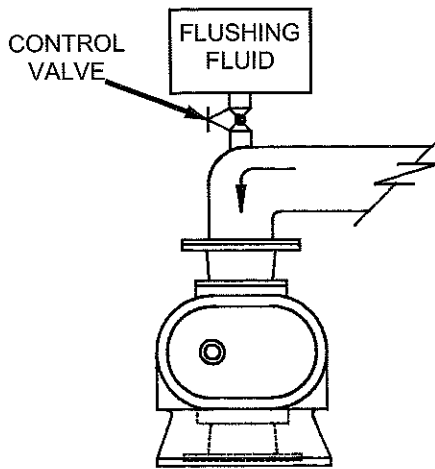


Figure 4 - Flushing Diagram

RECOMMENDED SHUTDOWN PROCEDURE
TO MINIMIZE RISK OF FREEZING OR CORROSION

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

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

1. Isolate the blower from the moist system piping, allowing the blower to intake atmospheric air. Operate the blower under a slight load allowing the blower to heat within safe limits. The heat generated by the blower will quickly evaporate residual moisture.
2. For carpet cleaning applications, after the work is completed, simply allow the blower to run a few (3-5) minutes with the suction 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. 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 a rust preventative.
2. Fill both end bells completely full of oil.
3. Firmly attach a very prominent tag stating that the end bells 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. Attach a dessiccant bag to either of the port fitting caps 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.
6. Store the blower in an air-conditioned and heated building if at all possible. At least insure as dry conditions as possible.
7. If possible, rotate the drive shaft by hand at least monthly in order to prevent the seals from setting in one position.

NOTES:

PREVENTATIVE MAINTENANCE

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

A newly installed blower should be checked frequently during the first month of operation, especially lubrication. 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.

Note: Series 64 & 67 nose block are lubricated at the factory. Lubrication should be changed at recommended lubrication changes. Oil changes our determined by the quality of lubrication used, along with operating conditions and operating hours. Changing procedure 4000 series (page 24)– Nose oil drain (Item 31), drain and replace, fill at top plug (Item 85) wait for air bubbles to clear. 5500 series (page 32) – Nose oil drain (Item 108), drain and replace, fill at top plug (Item 85) wait for air bubbles to clear.

Note: On 64 & 67 Series, change oil in nose block on gear end cover. To drain, remove Item 85 & 108

Fill with oil until oil can be seen in the middle hole, install pipe plug (85). Continue to fill to proper level. Wait 2 minutes before installing the last pipe plug (85) to make sure proper oil level is maintained.

The following is recommended as a minimum maintenance program.

DAILY MAINTENANCE	WEEKLY MAINTENANCE	MONTHLY MAINTENANCE
1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (See Troubleshooting on page 16)	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 (see pages 6 and 17) 3 Check drive belt tension and tighten if necessary.

MAINTENANCE AND REPLACEMENTS

Regular inspection of the 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 comments under LUBRICATION. Also service the driver per the manufacturer's instructions and lubricate the coupling or check belt drive tension. By use of thermometers and gauges, make sure the blower operating temperature and pressure remain within allowed limits.

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 judgement based on existing conditions as well as length of down time. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately.

Should adjustments or replacements 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 authorized service center.

When ordering parts, give all blower nameplate information, plus the item numbers and names as taken from the appropriate assembly drawing in this book. Numbers shown in brackets [] in the disassembly and reassembly procedures correspond to item numbers in the drawing.

Service

Tuthill Vacuum & Blower Systems offers 2 to 3 business day 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
ATTN: Inside Service Manager
4840 West Kearney Street
Springfield, MO 65803-8702

Repair Parts

When ordering repair parts or replacement units, please give the following information:

1. Model Number and Serial Number of unit.
2. Description of part – use item number shown on parts list.

DISASSEMBLY & INSPECTION

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

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

Gears are not exposed for visual inspection. Items in brackets [] are referenced to item numbers on pages referenced in the table below for each particular blower model and series.


Inspect the gears for the following:

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

MODEL-SERIES	PAGE	MODEL-SERIES	PAGE
4000-16/47	19	5500-16/47	27
4000-17/46	21	5500-17/46	29
4000-57/81	23	5500-57/81	31
4000-64/67	25	5500-64/67	33

DISASSEMBLY OF BLOWER

1. Insure that all oil is drained from unit and remove port fittings [38].
2. Remove cap screws [26] from gear end cover.
3. Remove gear end cover [6] using beveled chisel and hammer, unless jackscrew holes have been provided.
4. Remove snap ring [47] from drive shaft.
5. Using gear pullers, remove drive shaft bearing [50].
6. Remove drive shaft [45].
7. Remove gear locknuts [35] and locks [36].
8. Align timing marks, see Fig. 6A on timing gears [8].
9. Rotate drive gear in a clockwise rotation approximately 4 or 5 teeth and mark this location, see Fig. 6B. This gear position is necessary so rotors will clear and not jam. Do not allow the reference marks to change location while the driven gear is being removed.
10. Using gear pullers, pull driven gear first.
11. After removal of the driven gear, continue with pulling the drive gear.
12. Remove gear end bearing retainer rings [14], exposing bearings.
13. Remove cap screws [26] and free end cover [7], exposing oil slinger assembly.
14. Remove flat head socket screw [69] from oil slinger and gently pry oil slinger [21] from shaft. (On some models.)
15. Remove flat head socket screw [29] and washer [25] from opposite rotor.
16. Use bar pullers (see Fig. 5) and attach to free end plate bores. Using bar pullers, pull free end plate [4] from rotor shafts. (Note: The use of two bar pullers is recommended.)
17. Attach bar puller to gear end plate bore and push out rotors [1], one at a time.
18. Using rubber mallet, tap end plate from housing [3].
19. Using a soft metal punch and a mallet, tap out bearings from end plate bores.
20. Using bevel chisel, remove seals (#12 on lip seal units and #54 on mechanical seal units) from end plate bores.
21. Series 17/46, 57/81, 64/67 units have labyrinth seals [51] installed. If necessary, remove labyrinth seals [51] with a beveled chisel and hammer.
22. Inspect all parts for wear and serviceability.

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

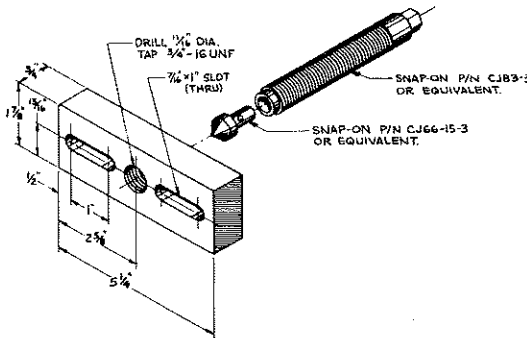


Figure 5 - Illustration of Bar Puller
(See drawing on page 34 for further details)

ASSEMBLY OF BLOWER

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

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


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

A. Preparation of End Plates for Assembly

1. **ATTENTION:** Make sure all parts are clean and free of any nicks or burrs caused by disassembly. Lip seal units will require all sleeves or seal journals to be polished to remove any nicks or scratches. Failure to polish seal journals will result in seal leakage or damage. Refer to page 34-35 for information and dimensions on seal pressing tools as well as other assembly tools required. For 16/47 series, skip step 2 and proceed to step 3.
2. 17/46, 57/81, 64/67 series blowers require labyrinth seals. Position labyrinth seals [51] with slots pointing up and press one seal into each end plate bore.
3. 16/47, 17/46 series blowers utilize lip seals [12]. As means of sealing, apply a smooth coating of Permatex #2 or silicone sealer to the O.D. edge of the seal shell. Press lip seal [12] into each end plate bore, making sure the seal "lip" is facing up, or toward the oil. Apply grease to lip seals only.
4. 57/81, 64/67 series blowers require mechanical seals [54]. Apply smooth coating of silicone to the O.D. of the seal shell as above. Position mechanical seal with the carbon face up and press the seal [54] into each end plate bore, and into end plate bores. Wipe carbon with soft tissue and acetone or similar cleaner, make sure seal is fully seated and shell is not deformed. Insure carbon is not scarred or cracked. Mating rings will be seated later in the assembly procedure.

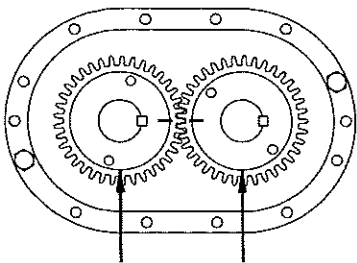
B. Gear End Assembly

1. Stand rotors [1] on free end in arbor press. Both keyways must be in line and point to the right.
- 1A. Two-lobe rotors include two keyways on each shaft. When positioning the rotors, two keyways (one on each rotor) should point in the same direction, to the right.
2. Place gear end plate [4] with seals installed on rotor shafts. Make sure threads on rotor shafts do not damage seals.
3. 57/81, 64/67 series blowers must have mating rings [54] installed. Make sure surface is clean, and gently place a few drops of clean oil on seal face for lubrication. Install mating ring (lapped surface) against carbon face.
4. Lightly coat rotor shaft with anti-seize compound or equivalent.
5. Using flush ground bearings on gear end only, press bearings [9] onto rotor shafts.

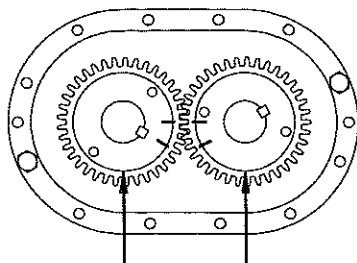
**CAUTION:** These bearings have flush ground faces and should be installed with manufacturer numbers up (toward gear). If no numbers appear on either side, look for a black dot (acid mark) the inner race. Install with dot up. Do not use bearings that have not been flush ground to within a .001" (.025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

6. Install oil retainer [15] (4000 models only).
7. Install bearing retainer ring [14] and lock plates [61] on all series blowers. Bolts are item [62].
8. Check clearance between gear end plate and rotor lobe ends. Correct clearances are shown on pages referenced in the table below for each particular blower model and series.

MODEL-SERIES	PAGE	MODEL-SERIES	PAGE
4000-16/47	19	5500-16/47	27
4000-17/46	21	5500-17/46	29
4000-57/81	23	5500-57/81	31
4000-64/67	25	5500-64/67	33



DRIVE GEAR DRIVEN GEAR
FIGURE 6A
KEYWAYS IN LINE AND TIMING MARKS MATCHED



DRIVE GEAR DRIVEN GEAR
FIGURE 6B
TIMING MARKS ADVANCED AND REFERENCE MARKS ALIGNED

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

Gear End Assembly

5. Stand rotors [1] on arbor press with gear end shafts up and both keyways facing to the right. The drive rotor should be on the left.
6. Install the gear end plate [4], making sure the feet are facing in the right direction, over the rotor shafts and coming to rest on top of the rotor lobes. Be careful not to damage seals.
7. On 57/81/64/67 series, check lapped surface of seal mating ring to be sure it is perfectly clean. Use soft tissue and cleaning agent (acetone) if necessary. Place a few drops of lubricating oil on its surface and install on shaft with lapped surface coming to rest on top of carbon. Gently press with fingers to insure compression is taking place and ring is not hung up for any reason.
8. Lubricate shafts and press the double row ball bearings [9] on rotor shafts and into end plate bores. Secure with retainer rings [14] and screws [30].

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

9. Check clearance between the face of the end plate and the rotor lobes. See exploded view for correct gear and clearances. If clearances are not within specifications, recheck parts to find cause of improper clearances before proceeding.
10. Install spacer [17] (.260" [6.60 mm] thickness) and oil slinger [20] on the other shaft.

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

Install timing shim in same location as found in disassembly. This does not necessarily insure the unit will be in proper time. Adjustments can be made later in the assembly process.

11. Insert gear keys [24] into the rotor shaft keyways. Loose fits are not acceptable.
12. Lubricate shafts and install driver gear (right hand helix) on drive rotor (left side). To install driven gear, align reference marks as shown in Figure 6B on page 13. Install driven gear carefully to avoid mashing any teeth when engaging opposite gear.
13. Install washers [25] and flat head allen screws [29].
14. Remove assembly from press and stand on work table with gears down. Place blocks under end plate to prevent assembly from falling over. Drive gear should remain on left side.
15. On 57/81/64/67 series, use an RTV silicone type sealer. Place a small bead around periphery of the end plate and encircling each bolt hole.
16. Install rotor housing [3] and secure with four screws evenly spaced.
17. Check clearances between end of lobes and housing using a flat bar and feeler gauges or a depth micrometer. Refer to exploded view for free end clearances.

Free End Assembly

18. On 57/81/64/67 series put sealer on free end plate. (Same as step 15 above).
19. Install free end plate and secure with 4 screws.
20. On 57/81/64/67 series, repeat instructions given in step 7.
21. Install bearing spacers [123] (.025" [.06 mm] thickness) on each shaft (57/81/64/67 series only). Lubricate shafts and tap on bearings [10]. Install spacers [67] on 57/81/64/67 series only.
22. Install oil retainer rings [14] with button head screws [30].
23. Install oil slinger [21] on lower rotor, (either shaft on vertical flow units) spacer [57] on opposite shaft, washers [25], and screws [29].

Adjusting Rotor Interlobe Clearance

24. Lay the unit down with the drive gear on the left. Using feeler gauges take interlobe readings and record on each side of housing as indicated in Figure 7. By removing or adding shim behind the helical gear, it rotates as it is moved in or out and the driven rotor turns with it, thus changing the clearance between rotor lobes. Changing the shim thickness .006" (.16 mm) will change the rotor lobe clearance .003" (.08 mm) or one-half the amount.

EXAMPLE: Referring to Figure 7, check the clearance at AA (left hand reading) and BB (right hand reading). If AA reading is .003" (.08 mm) and BB reading is .009" (.24 mm), by removing .006" (.16 mm) of shim, the readings will change one-half the amount removed or .003" (.08 mm). AA should then read .006" (.16 mm) and BB should read .006" (.16 mm). The final reading should be within .002" (.05 mm) of each other.

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

25. Install drive shaft [45] and secure with Allen screws [66]. Check drive shaft runout at seal journal. Do not exceed .002" (.05 mm) T.I.R. Install lockwire [49].

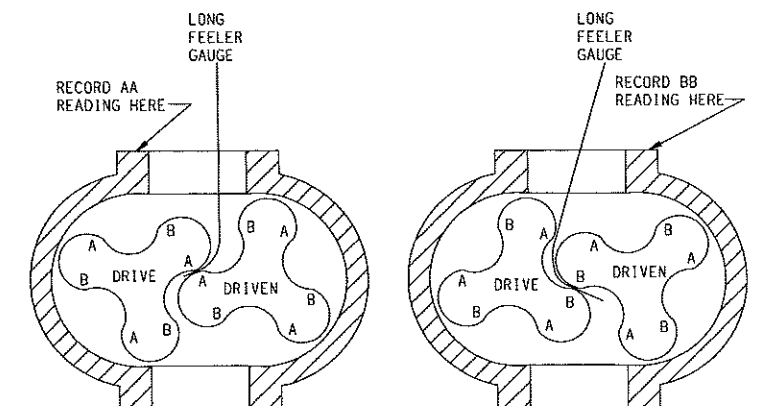


Figure 7 - Measuring Interlobe Clearances

26. Install bearing [9 or 50] on drive shaft and secure with retaining ring [47]. (Item 47 not required on 64/67 series.) Shield side of bearing must face outward (64/67 series only).

NOTE: To continue assembly for series 64/67, see "Special Instructions - 64/67 Series" following this section.

27. Remove temporary cap screws from each end plate and install cover gasket [28] and gear end cover [6]. Make sure dowel pins [22] are in place. Sealer is not required on factory supplied gaskets. Secure with cap screws [26A] and washers [27].
28. Coat O.D. of drive shaft seal [13] with sealer and grease I.D. Install carefully over keyway and tap into cover.
29. Install free end cover [7], with gasket [28] and secure with cap screws [26B] and washers [27].
30. Install port fittings [38], gaskets [39], and secure with cap screws and washers [40 & 41].

Special Instructions - 64/67 Series

Continue assembly:

- A. Prepare cover (6). Place flange side down, install first of two snap rings (78) into innermost groove. Press in first of 2 ea. Mechanical seals (54A) lightly silicone outer case of seal. Press seal with carbon side down until seated against the snap ring. Careful not to distort snap ring.
- B. Install second snap ring (78) into outer groove. Place mating ring from 1st seal into cover with lap surface up. Press second mechanical seal (54) in, carbon side groove down until seated against outer snap ring. Carbon will seal against mating ring when cover is installed on drive shaft.

Drive Shaft Assembly

- A. Install one thin spacer (74) onto drive shaft so it is next to bearing with groove out. Install one o-ring (75) to seat in the groove of the spacer. Lightly oil face of mating ring, install onto shaft with lapped surface out. Install large spacer (77) with groove side facing mating ring. Install thin spacer (74) with groove out, install o-ring (75) so it will seat into groove.
- B. Remove temporary hold down bolts, place bead of silicone around periphery of the end plate (4) encircling each bolt. Install gear end cover and tighten bolts. Install large spacer (77) with groove out, install free end spacer, install dust cover (82) and lock nut. Install pipe plug (85) into bottom nose piece in cover (6) silicone plug.
- C. Fill with oil until oil can be seen in the middle hole, install pipe plug (85). Continue to fill to proper level. Wait 2 minutes before installing the last pipe plug (85) to make sure proper oil level is maintained.

TROUBLESHOOTING

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

SYMPTOM	PROBABLE CAUSE	REMEDIES
Loss of oil.	Gear housing not tightened properly.	Tighten gear housing bolts.
	Lip seal failure.	Disassemble and replace lip seal.
	Insufficient sealant.	Remove gear housing and replace sealant. (See Disassembly and Inspection 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 6)
	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 pages 19-33 as applicable to the blower model)
	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 and Inspection section on page 12)
Excessive blower temperature.	Too much or too little oil in gear reservoir.	Check oil level. (See Lubrication section on page 6)
	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 pages 19-33 as applicable to the blower model)
Rotor end or tip drag.	Insufficient assembled clearances.	Correct clearances (See Assembly Clearances on pages 19-33 as applicable to the blower model)
	Case or frame distortion.	Check mounting and pipe strain.
	Excessive operating pressure.	Reduce pressure differential.
Vibration.	Excessive operating temperature.	Reduce pressure differential or reduce inlet temperature.
	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 pages 19-33 as applicable to the blower model)
	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.

PD PLUS®

MAINTENANCE AND SERVICE SPECIFICATIONS SHEET
 MODELS 4006, 4009, 4012, 5507, 5509, 5511, 5514, 5516, 5518, 5520

RECOMMENDED MINERAL BASED LUBRICANTS

AMBIENT TEMPERATURE	SHELL	CITGO	CHEVRON TEXACO	EXXONMOBIL
0° F (-18°C) to 32° F (0°C)	TELLUS® PLUS 68 (ISO 68)	A/W 68 (ISO 68)	RANDO HD 68 (ISO 68)	DTE HEAVY MEDIUM (ISO 68)
32° F (0° C) to 90° F (32° C)	TELLUS® PLUS 100 (ISO 100)	A/W 100 (ISO 100)	RANDO HD 100 (ISO 100)	DTE HEAVY (ISO 100)
90° F (32° C) to 120° F (50° C)	TELLUS® PLUS 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° F (-18° C) to 32° F (0° C)	PneuLube™ (ISO 100)	SHC 626 (ISO 68)	MADRELA® AS 68 (ISO 68)
32° F (0° C) to 90° F (32° C)		SHC 627 (ISO 100)	MADRELA® P 100 (ISO 100)
90° F (32° C) to 120° F (50° C)	PneuLube™ (ISO 150)	SHC 629 (ISO 150)	MADRELA® P 150 (ISO 150)

NOTE: 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 & Blower Systems.

* 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.

RECOMMENDED MINERAL BASED, FOOD GRADE LUBRICANTS

AMBIENT TEMPERATURE	Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental
0° F (-18° C) to	CITGO CLARION® 350 FOOD GRADE	CITGO CLARION® A/W 68
32° F (0° C) to	CONSULT FACTORY	CITGO CLARION® A/W 100
90° F (32° C) to	CONSULT FACTORY	CONSULT FACTORY

RECOMMENDED SYNTHETIC BASED, FOOD GRADE LUBRICANTS

AMBIENT TEMPERATURE	Lubricant meeting U.S. FDA regulations 21 CFR 172.878 and 178.3620(a) for direct and	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental
0° F (-18° C) to 32° F (0° C)	CONSULT FACTORY	PneuLube™ FG (ISO 100)
32° F (0° C) to		
90° F (32° C) to		PneuLube™ FG

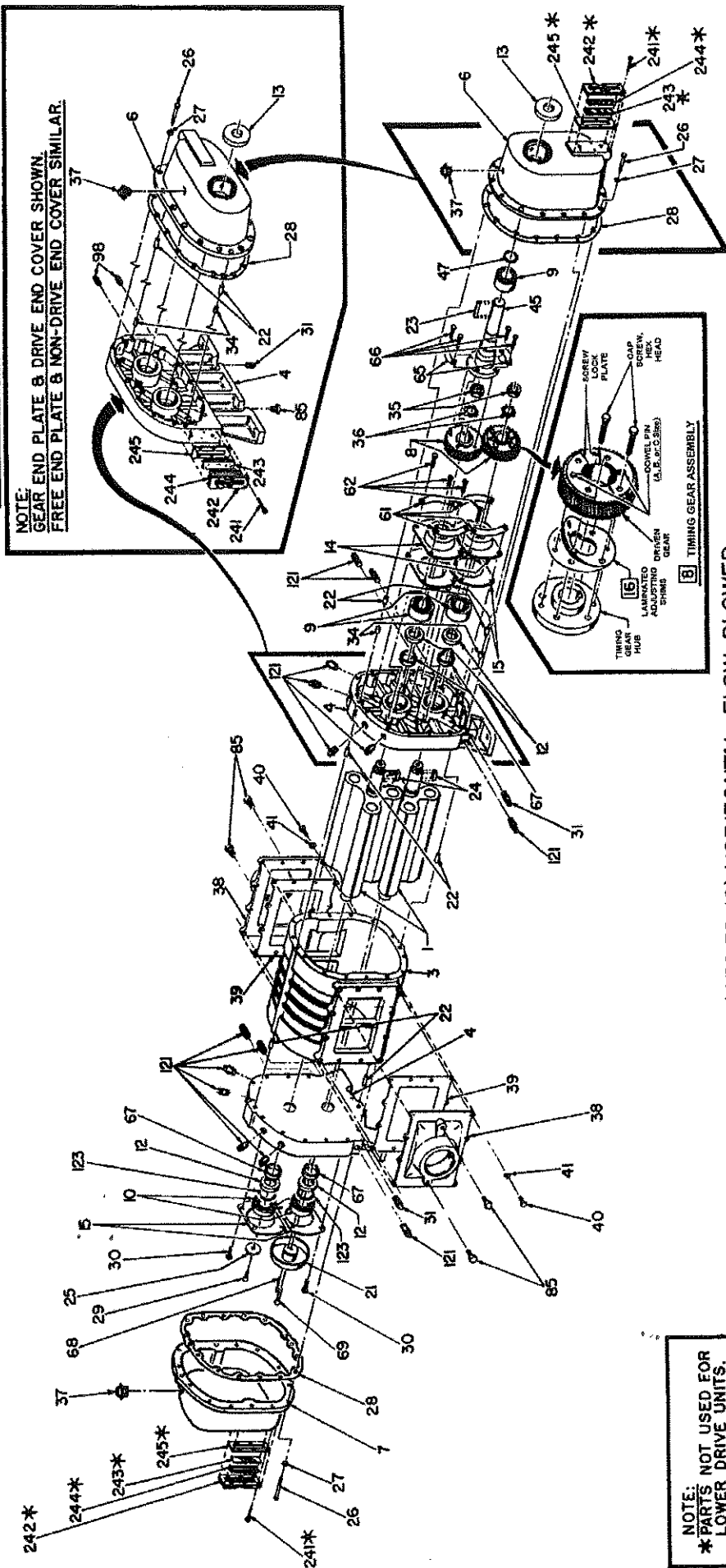
MAXIMUM OPERATING LIMITS				
MODEL	RPM	PRESSURE	VACUUM	TEMPERATURE RISE
4006, 4009, 4012	3600	15 (1035)	15 (508)	280 (156)
5507, 5509, 5511	3600	15 (1035)	15 (508)	280 (156)
4009, 5507, 5509, 5511 (PPO only)	3600	18 (1240)	17 (575)	330 (183)
5514	3600	13 (895)	15 (508)	280 (156)
5516	3600	12 (825)	15 (508)	280 (156)
5518	3600	10 (690)	15 (508)	280 (156)
5520	3600	8 (550)	12 (508)	185 (102)

* Models 4006-5516 in the 16/47 series, (obsolete) are limited to 10 PSI (690 mbar) pressure

† Models 4006-5520 in the 16/47 series, (obsolete) are limited to 10" Hg (340 mbar) vacuum

ROTARY BLOWER ASSEMBLY
MODEL 4000- SERIES 16/47

(SERIES 47) VERTICAL FLOW BLOWER



(SERIES 16) HORIZONTAL FLOW BLOWER

PARTS LIST - MODEL 4006, 4009, 4012, 4014
SERIES 16 (HORIZONTAL FLOW) / 47 (VERTICAL FLOW) - OBSOLETE SERIES
SERIAL NUMBER(S)

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

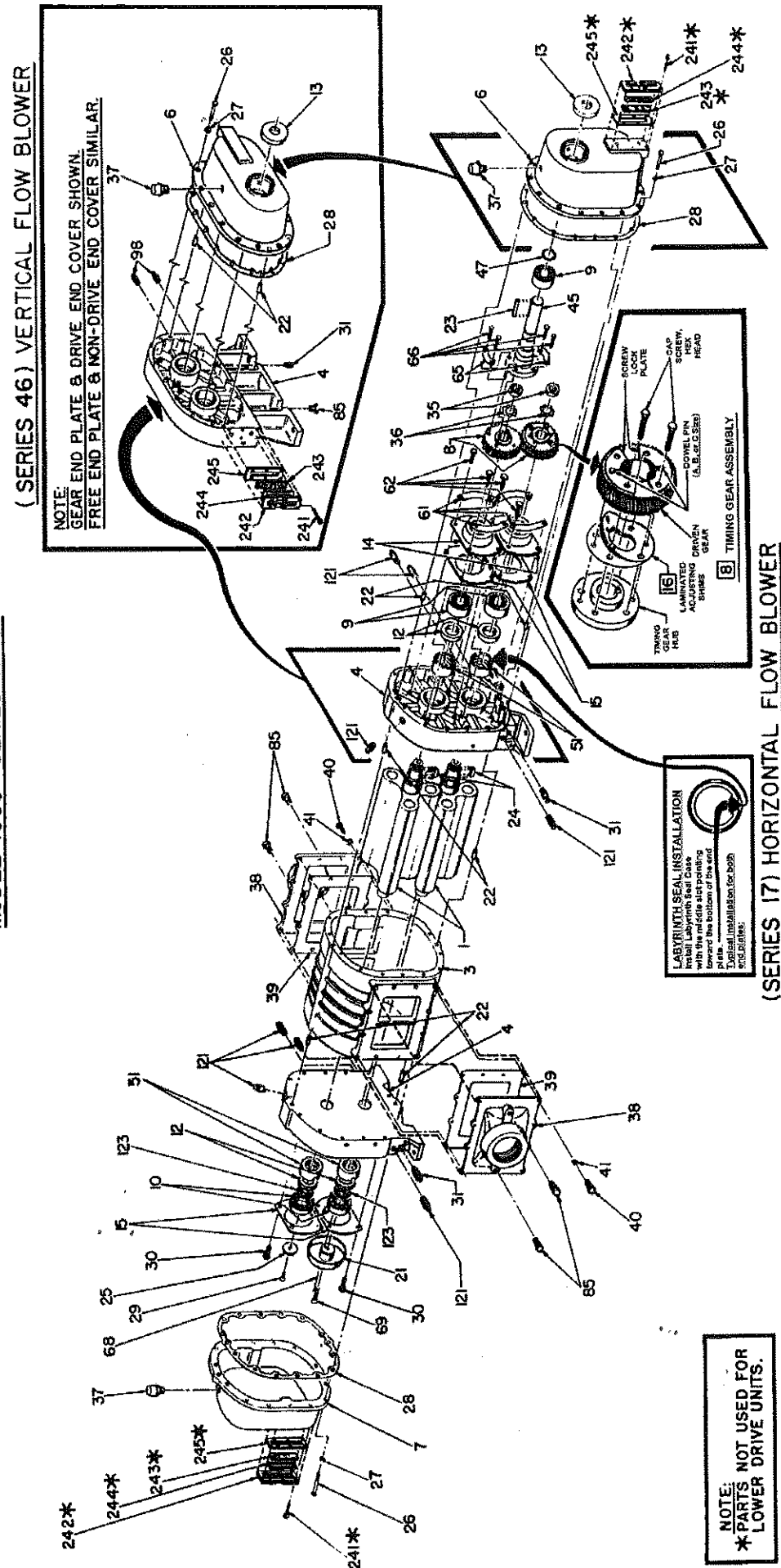
ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	36	GEAR LOCKWASHER	2
3	HOUSING	1	37	BREATHER	2
4	ENDPLATE	2	38	PORT FITTING	2
6	DRIVE END COVER	1	39	PORT FITTING GASKET	2
7	FREE END COVER	1	40	HEX HEAD CAP SCREW	28 *
8	GEAR ASSEMBLY	1	41	LOCKWASHER	28 *
9	BALL BEARING	2	45	DRIVE SHAFT	1
10	BALL BEARING	2	47	RETAINING RING	1
12	LIP SEAL	4	50	BALL BEARING	1
13	LIP SEAL	1	61	CAP SCREW LOCK	4
14	BEARING RETAINER RING	4	62	HEX HEAD CAP SCREW	8
15	OIL RETAINER RING	4	65	CAP SCREW LOCK	2
16	TIMING SHIM KIT	1	67	SPACER	4
21	OIL SLINGER	1	68	DOWEL PIN	1
22	DOWEL PIN	6	69	FLAT HEAD SOCKET SCREW	1
23	DR. SHAFT KEY	1	85	PIPE PLUG	6 *
24	TIMING GEAR KEY	2	98	PIPE PLUG	4 *
25	ROTOR SHFT WASHER	4	121	PIPE PLUG	6 *
26	CAP SCREW	28	123	SPACER	2
27	LOCKWASHER	28 *	234	OIL LEVEL TAG	2
28	GASKET	2	241	SOCKET HEAD CAP SCREW	12
29	FLAT HEAD SOCKET SCREW	1	242	SIGHT GLASS FRAME	2
30	SOCKET HEAD CAP SCREW	4	243	WINDOW	2
31	MAGNETIC PLUG	2	244	WINDOW GASKET	2
34	DOWEL PIN SPACER	2	245	FRAME GASKET	2
35	GEAR LOCKNUT	2	* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER		

ASSEMBLY CLEARANCES

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

MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
4006	.004" - .007" (.10 - .18)	.006" - .011" (.15 - .28)	.008" - .011" (.20 - .28)	CENTER TIMED
4009	.004" - .007" (.10 - .18)	.008" - .012" (.20 - .30)	.008" - .011" (.20 - .28)	
4012	.004" - .007" (.10 - .18)	.010" - .014" (.25 - .36)	.008" - .011" (.20 - .28)	
4014	.004" - .007" (.10 - .18)	.012" - .016" (.30 - .41)	.008" - .011" (.20 - .28)	

ROTARY BLOWER ASSEMBLY
MODEL 4000- SERIES 17/46



(SERIES 46) VERTICAL FLOW BLOWER

NOTE:
GEAR END PLATE & DRIVE END COVER SHOWN
FREE END PLATE & NON-DRIVE END COVER SIMILAR.

(SERIES 17) HORIZONTAL FLOW BLOWER

LABYRINTH SEAL INSTALLATION
Install Labyrinth Seal Case
with the middle and pointing
down to the bottom of the end
plate.
Typical installation for both
rotors.

PD PLUS®

PARTS LIST - MODEL 4006, 4009, 4012
SERIES 17 (HORIZONTAL FLOW) / 46 (VERTICAL FLOW)
SERIAL NUMBER(S) _____

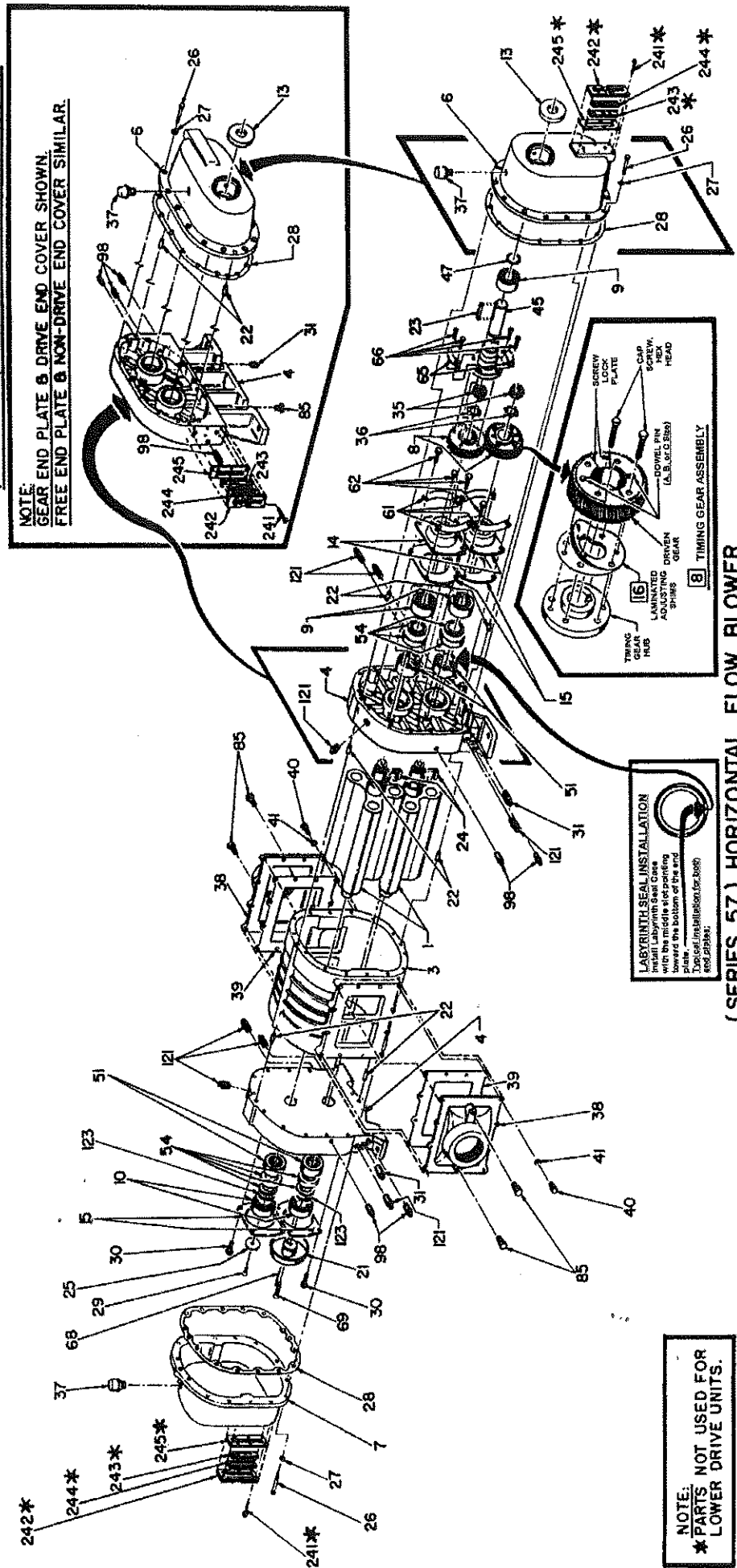
When ordering parts, use the item number shown, plus your model, series and serial number.

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	38	PORT FITTING	2
3	HOUSING	1	39	PORT FITTING GASKET	2
4	END PLATE	2	40	HEX HEAD CAP SCREW	36 *
6	DRIVE END COVER	1	41	LOCKWASHER	36 *
7	FREE END COVER	1	45	DRIVE SHAFT	1
8	GEAR ASSEMBLY	1	47	RETAINING RING	1
9	BALL BEARING	2	50	BALL BEARING	1
10	BALL BEARING	2	51	LABYRINTH SEAL	4
12	LIP SEAL	4	61	CAP SCREW LOCK	4
13	LIP SEAL	1	62	HEX HEAD CAP SCREW	8
14	BEARING RETAINER RING	2	65	CAP SCREW LOCK	2
15	OIL RETAINER RING	4	66	CAP SCREW	4
16	TIMING SHIM KIT	1	68	DOWEL PIN	1
21	OIL SLINGER	1	69	FLAT HEAD SOCKET SCREW	1
22	DOWEL PIN	6	70	OIL GAUGE	2
23	DRIVE SHAFT KEY	1	85	PIPE PLUG	8 *
24	TIMING GEAR KEY	2	98	PIPE PLUG	8 *
25	ROTOR SHAFT WASHER	1	121	PIPE PLUG	8 *
26	CAP SCREW	28	123 174 234 241 242 243 244 245	SPACER	2
27	LOCKWASHER	28		PIPE PLUG	2
28	GASKET	2		OIL LEVEL TAG	2
29	FLAT HEAD SOCKET SCREW	1		SOCKET HEAD CAP SCREW	12
30	SOCKET HEAD CAP SCREW	4		SIGHT GLASS FRAME	2
31	MAGNETIC PLUG	2		WINDOW	2
35	GEAR LOCKNUT	2		WINDOW GASKET	2
36	GEAR LOCKWASHER	2		FRAME GASKET	2
37	BREATHER	2	* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER		

ASSEMBLY CLEARANCES

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

MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
4006	.004" - .007" (.10 - .18)	.006" - .011" (.15 - .28)	.008" - .011" (.20 - .28)	CENTER TIMED
4009	.004" - .007" (.10 - .18)	.008" - .012" (.20 - .30)	.008" - .011" (.20 - .28)	
4012	.004" - .007" (.10 - .18)	.010" - .014" (.25 - .36)	.008" - .011" (.20 - .28)	



ROTARY BLOWER ASSEMBLY
MODEL 4000-SERIES 57/81

(SERIES 81) VERTICAL FLOW BLOWER

(SERIES 57) HORIZONTAL FLOW BLOWER

PD PLUS®

PARTS LIST - MODEL 4006, 4009, 4012
SERIES 57 (HORIZONTAL FLOW) / 81 (VERTICAL FLOW)
SERIAL NUMBER(S)

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

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	38	PORT FITTING	2
3	HOUSING	1	40	CAP SCREW	36*
4	END PLATE	2	41	LOCKWASHER	36*
6	DRIVE END COVER	1	45	DRIVE SHAFT	1
7	FREE END COVER	1	47	RETAINING RING	1
8	GEAR ASSEMBLY	1	50	BALL BEARING	1
9	BALL BEARING	2	51	LAB SEAL	4
10	BALL BEARING	2	54	MECHANICAL SEAL	4
13	LIP SEAL	1	61	LOCK	4
14	BEARING RETAINER	2	62	CAP SCREW	8
15	RETAINER RING	4	65	LOCKPLATE	2
16	TIMING SHIM KIT	1	66	CAP SCREW	4
21	OIL SLINGER	1	68	DOWEL PIN	1
22	DOWEL PIN	6	69	CAP SCREW	1
23	DRIVE SHAFT KEY	1	70	OIL GAUGE	2
24	TIMING GEAR KEY	2	85	PIPE PLUG	8*
25	ROTOR SHAFT WASHER	1	98	PIPE PLUG	8*
26	CAP SCREW	28	121	PIPE PLUG	8*
27	LOCKWASHER	28	123	SPACER	2
28	GASKET	2	174	PIPE PLUG	2
29	CAP SCREW	1	234	OIL LEVEL TAG	2
30	CAP SCREW	4	241	CAP SCREW	2
31	MAGNETIC PLUG	2	242	SIGHT GLASS FRAME	2
35	GEAR LOCKNUT	2	243	WINDOW	2
36	GEAR LOCKWASHER	2	244	WINDOW GASKET	2
37	BREATHER	2	245	FRAME GASKET	2

* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER

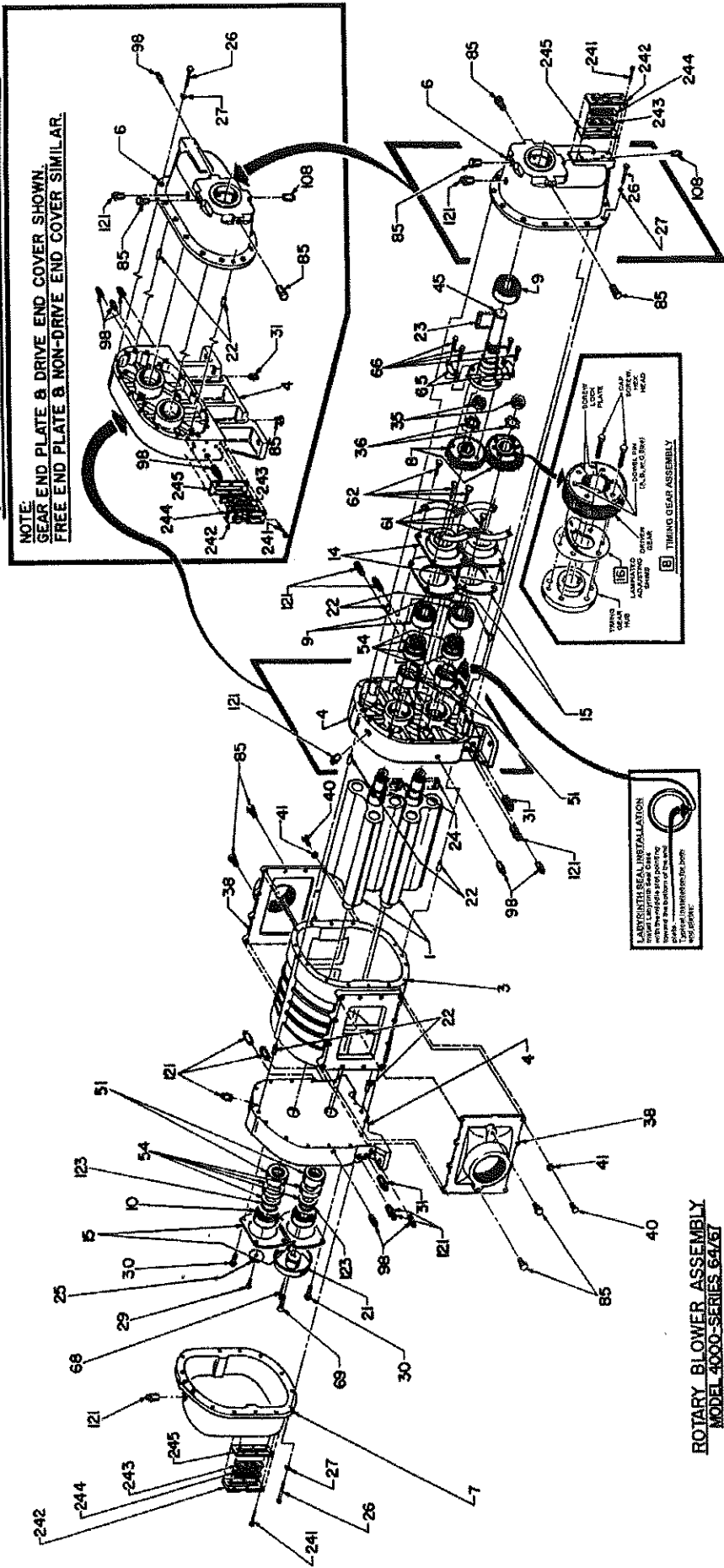
ASSEMBLY CLEARANCES

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

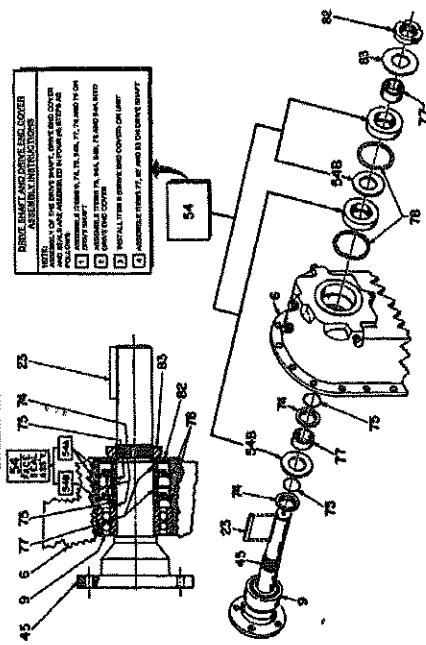
MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
4006	.004" - .007" (.10 - .18)	.006" - .011" (.15 - .28)	.008" - .011" (.20 - .28)	CENTER TIMED
4009	.004" - .007" (.10 - .18)	.008" - .012" (.20 - .30)	.008" - .011" (.20 - .28)	
4012	.004" - .007" (.10 - .18)	.010" - .014" (.25 - .36)	.008" - .011" (.20 - .28)	

ROTARY BLOWER ASSEMBLY
MODEL 4000-SERIES 64/67

(SERIES 67) VERTICAL FLOW BLOWER



(SERIES 64) HORIZONTAL FLOW BLOWER



PD PLUS®

PARTS LIST - MODEL 4006, 4009, 4012
SERIES 64 (HORIZONTAL FLOW) / 67 (VERTICAL FLOW)
SERIAL NUMBER(S) _____

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

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	54	MECHANICAL SEAL	6
3	HOUSING	1	61	LOCK	4
4	END PLATE	2	62	CAP SCREW	8
6	DRIVE END COVER	1	65	LOCKPLATE	2
7	FREE END COVER	1	66	CAP SCREW	4
8	GEAR ASSEMBLY	1	68	DOWEL PIN	1
9	BALL BEARING	2	69	CAP SCREW	1
10	BALL BEARING	2	70	OIL GAUGE	2
14	BEARING RETAINER	2	74	SPACER	2
15	RETAINER RING	4	75	O-RING	2
16	TIMING GEAR SHIM	1	77	SPACER	2
21	OIL SLINGER	1	78	RETAINING RING	2
22	DOWEL PIN	6	82	WASHER	1
23	DRIVE SHFT KEY	1	83	LOCKNUT	1
24	TIMING GEAR KEY	2	85	PIPE PLUG	8*
25	ROTOR SHAFT WASHER	1	98	PIPE PLUG	8*
26	CAP SCREW	28	108	MAGNETIC PLUG	1
27	LOCKWASHER	28	121	PIPE PLUG	8*
29	CAP SCREW	1	123	SPACER	2
30	CAP SCREW	4	174	PIPE PLUG	2
35	GEAR LOCKNUT	2	234	OIL LEVEL TAG	2
36	GEAR LOCKWASHER	2	241	CAP SCREW	12
38	PORT FITTING	2	242	SIGHT GLASS FRAME	2
40	CAP SCREW	36*	243	WINDOW	2
41	LOCKWASHER	36*	244	WINDOW GASKET	2
45	DRIVE SHAFT	1	245	FRAME GASKET	2
50	BALL BEARING	1	244	WINDOW GASKET	2
51	LAB SEAL	4	245	FRAME GASKET	2

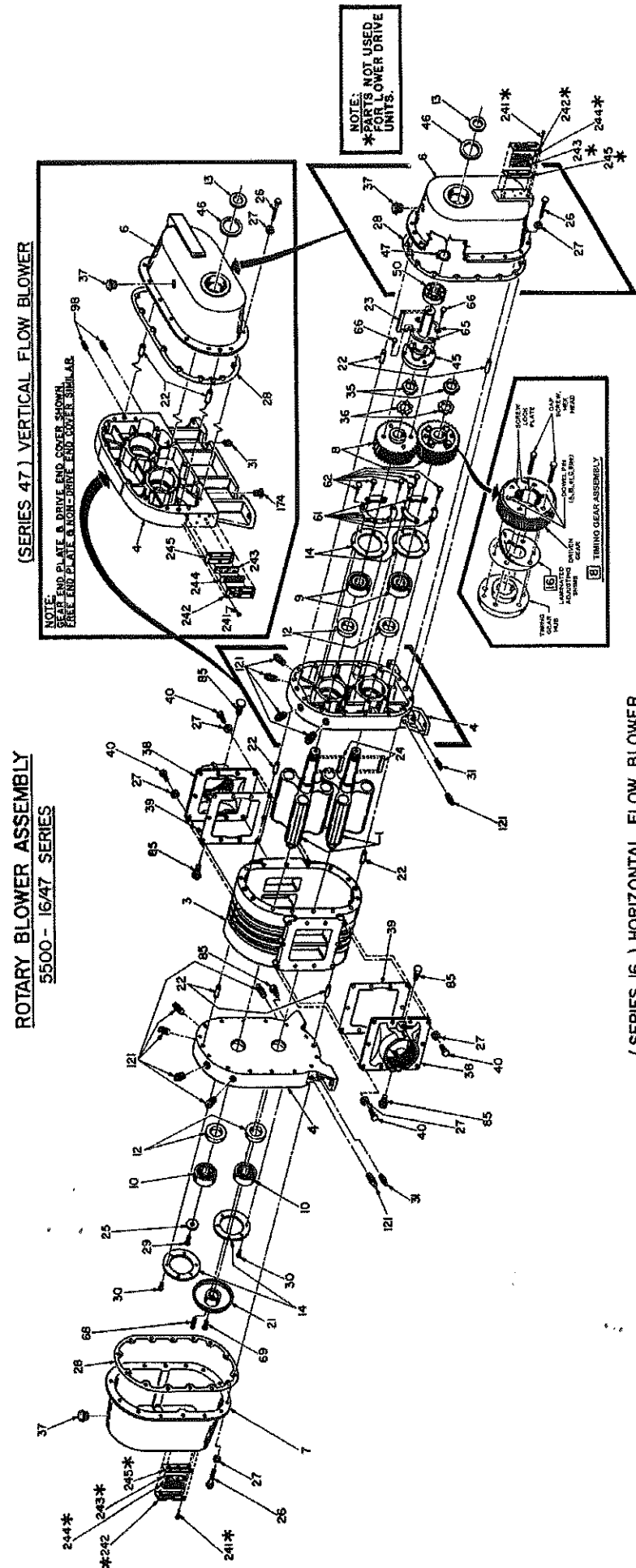
* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER

ASSEMBLY CLEARANCES

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

ASSEMBLY CLEARANCES Metric values (mm) are shown in parentheses () All other values are in inches				
MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
4006	.004" - .007" (.10 - .18)	.006" - .011" (.15 - .28)	.008" - .011" (.20 - .28)	CENTER TIMED
4009	.004" - .007" (.10 - .18)	.008" - .012" (.20 - .30)	.008" - .011" (.20 - .28)	
4012	.004" - .007" (.10 - .18)	.010" - .014" (.25 - .36)	.008" - .011" (.20 - .28)	

ROTARY BLOWER ASSEMBLY
5500 - 16/47 SERIES



PARTS LIST - MODEL 5507, 5509, 5511, 5514, 5516, 5518, 5520
SERIES 16 (HORIZONTAL FLOW) / 47 (VERTICAL FLOW) - OBSOLETE SERIES
SERIAL NUMBER(S) _____

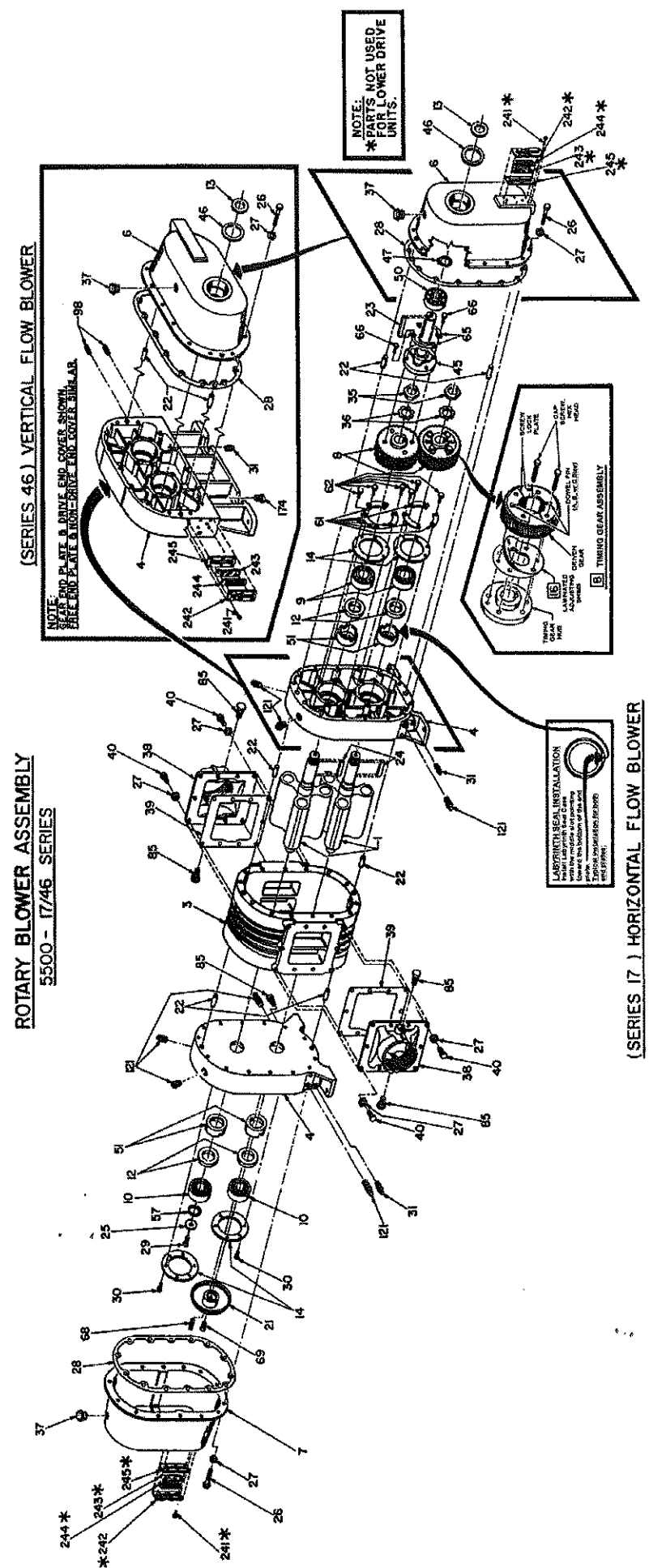
When ordering parts, use the item number shown, plus your model, series and serial number.

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	37	BREATHER	2
3	HOUSING	1	38	PORT FITTING	2
4	END PLATE	2	39	PORT FITTING GASKET	2
6	DRIVE END COVER	1	40	HEX HEAD CAP SCREW	28 *
7	FREE END COVER	1	41	LOCKWASHER	28 *
8	GEAR ASSEMBLY	1	45	DRIVE SHAFT	1
9	BALL BEARING	2	46	ADAPTER RING	1
10	BALL BEARING	2	47	RETAINING RING	1
12	LIP SEAL	4	50	BALL BEARING	1
13	LIP SEAL	1	61	CAP SCREW LOCK	6
14	BEARING RETAINER RING	4	62	HEX HEAD CAP SCREW	12
16	TIMING SHIM KIT	1	65	CAP SCREW LOCK	2
21	OIL SLINGER	1	68	DOWEL PIN	1
22	DOWEL PIN	6	69	FLAT HEAD SOCKET SCREW	1
23	DRIVE SHAFT KEY	1	85	PIPE PLUG	6 *
24	TIMING GEAR KEY	2	98	PIPE PLUG	4 *
25	ROTOR SHFT WASHER	1	121	PIPE PLUG	6 *
26	CAP SCREW	12	123	SPACER	2
27	LOCKWASHER	12	234	OIL LEVEL TAG	2
28	GASKET	2	241	SOCKET HEAD CAP SCREW	12
29	FLAT HEAD SOCKET SCREW	1	242	SIGHT GLASS FRAME	2
30	SOCKET HEAD CAP SCREW	6	243	WINDOW	2
31	MAGNETIC PLUG	2	244	WINDOW GASKET	2
35	GEAR LOCKNUT	2	245	FRAME GASKET	2
36	GEAR LOCKWASHER	2	* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER		

ASSEMBLY CLEARANCES

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

MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
5507	.005"-.007" (.13 - .18)	.009" - .013" (.23 - .33)	.012" - .014" (.30 - .36)	ALL CENTER TIMED
5509		.010" - .014" (.25 - .36)		
5511		.012" - .016" (.30 - .41)		
5514		.014" - .018" (.36 - .46)		
5516		.016" - .020" (.41 - .51)		
5518		.018" - .023" (.46 - .58)		
5520		.020" - .025" (.51 - .64)		



PD PLUS®

PARTS LIST - MODEL 5507, 5509, 5511, 5514, 5516, 5518, 5520 SERIES 17 (HORIZONTAL FLOW) / 46 (VERTICAL FLOW) SERIAL NUMBER(S) _____

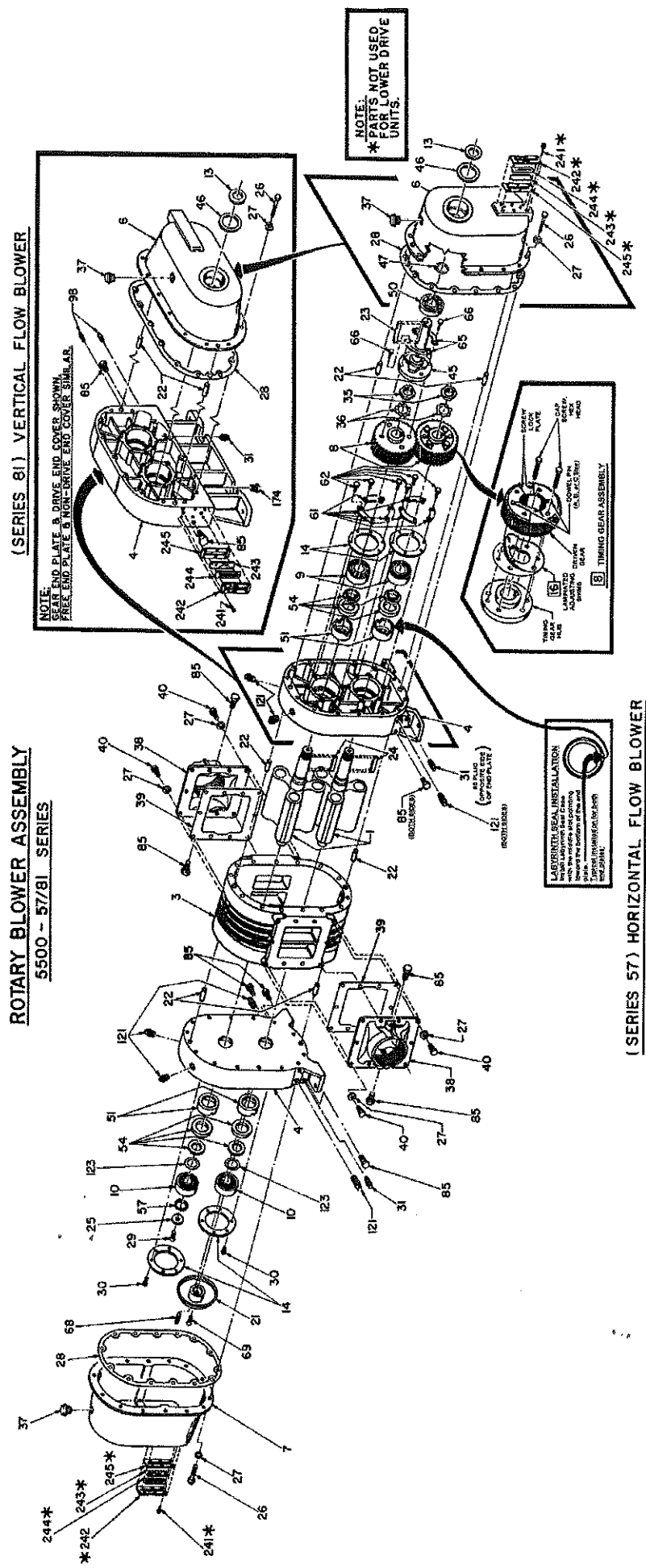
When ordering parts, use the item number shown, plus your model, series and serial number.

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	38	PORT FITTING	2
3	HOUSING	1	39	PORT FITTING GASKET	2
4	END PLATE	2	40	CAP SCREW	28*
6	DRIVE END COVER	1	45	DRIVE SHAFT	1
7	FREE END COVER	1	46	ADAPTER RING	1
8	GEAR ASSEMBLY	1	47	RETAINING RING	1
9	BALL BEARING	2	50	ROLLER BEARING	1
10	ROLLER BEARING	2	51	LAB SEAL	4
12	LIP SEAL	4	57	BEARING SPACER	1
13	LIP SEAL	1	61	LOCKPLATE	6
14	RETAINER RING	4	62	CAP SCREW	12
16	TIMING GEAR SHIIM	1	65	LOCKPLATE	2
21	OIL SLINGER	1	66	CAP SCREW	4
22	DOWEL PIN	6	68	ROLLER BEARING	1
23	DRIVE SHAFT KEY	1	69	CAP SCREW	1
24	TIMING GEAR KEY	2	70	OIL GAUGE	2
25	ROTOR SHAFT WASHER	1	85	PIPE PLUG	8*
26	CAP SCREW	28	98	PIPE PLUG	4
27	LOCKWASHER	56*	174	PIPE PLUG	9*
28	GASKET	2	234	OIL LEVEL TAG	2
29	CAP SCREW	1	241	CAP SCREW	12
30	CAP SCREW	6	242	SIGHT GLASS FRAME	2
31	MAGNETIC PIPE PLUG	2	243	WINDOW	2
35	GEAR LOCKNUT	2	244	WINDOW GASKET	2
36	GEAR LOCKWASHER	2	245	FRAME GASKET	2
37	BREATHER	2	* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER		

ASSEMBLY CLEARANCES

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

MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
5507	.005"-.007" (.13 -.18)	.009" - .013" (.23 - .33)	.012" - .014" (.30 - .36)	ALL CENTER TIMED
5509		.010" - .014" (.25 - .36)		
5511		.012" - .016" (.30 - .41)		
5514		.014" - .018" (.36 - .46)		
5516		.016" - .020" (.41 - .51)		
5518		.018" - .023" (.46 - .58)		
5520		.020" - .025" (.51 - .64)		



PD PLUS®

PARTS LIST - MODEL 5507, 5509, 5511, 5514, 5516, 5518, 5520 SERIES 57 (HORIZONTAL FLOW) / 81 (VERTICAL FLOW) SERIAL NUMBER(S)

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

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	40	CAP SCREW	44*
3	HOUSING	1	45	DRIVE SHAFT	1
4	END PLATE	2	46	ADAPTER RING	1
6	DRIVE END COVER	1	47	RETAINING RING	1
7	FREE END COVER	1	48	PORT FITTING	1
8	GEAR ASSEMBLY	1	50	ROLLER BEARING	1
9	BALL BEARING	2	51	LAB SEAL	4
10	ROLLER BEARING	2	54	MECHANICAL SEAL	4
13	LIP SEAL	1	57	BEARING SPACER	1
14	RETAINER RING	4	61	LOCKPLATE	6
16	TIMING GEAR SHIIM	1	62	CAP SCREW	12
21	OIL SLINGER	1	65	LOCKPLATE	2
22	DOWEL PIN	6	66	CAP SCREW	4
23	DRIVE SHAFT KEY	1	68	ROLLER BEARING	1
24	TIMING GEAR KEY	2	69	CAP SCREW	1
25	ROTOR SHAFT WASHER	1	70	OIL GAUGE	2
26	CAP SCREW	28	85	PIPE PLUG	4*
27	LOCKWASHER	56*	98	PIPE PLUG	4
28	GASKET	2	123	SHIM SEAL	2
29	CAP SCREW	1	174	PIPE PLUG	9*
30	CAP SCREW	6	234	OIL LEVEL TAG	2
31	MAGNETIC PIPE PLUG	2	241	CAP SCREW	12
35	GEAR LOCKNUT	2	242	SIGHT GLASS FRAME	2
36	GEAR LOCKWASHER	2	243	WINDOW	2
37	BREATHER	2	244	WINDOW GASKET	2
38	PORT FITTING	2	245	FRAME GASKET	2

* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER

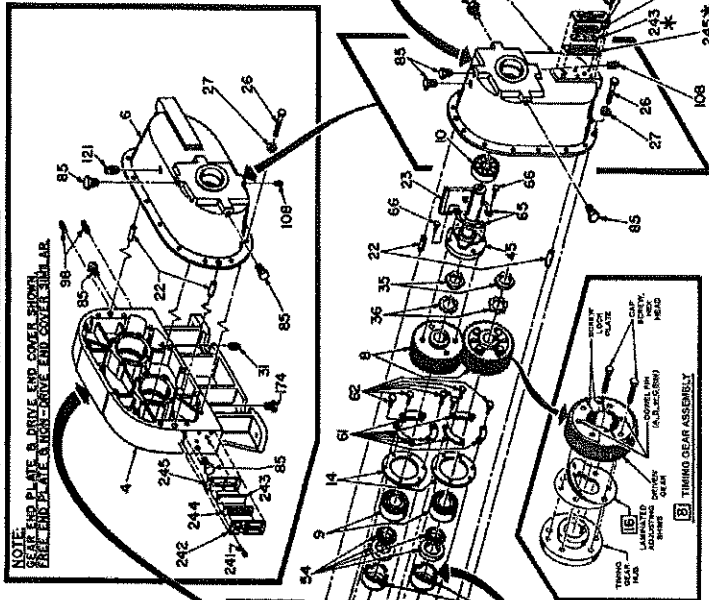
ASSEMBLY CLEARANCES

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

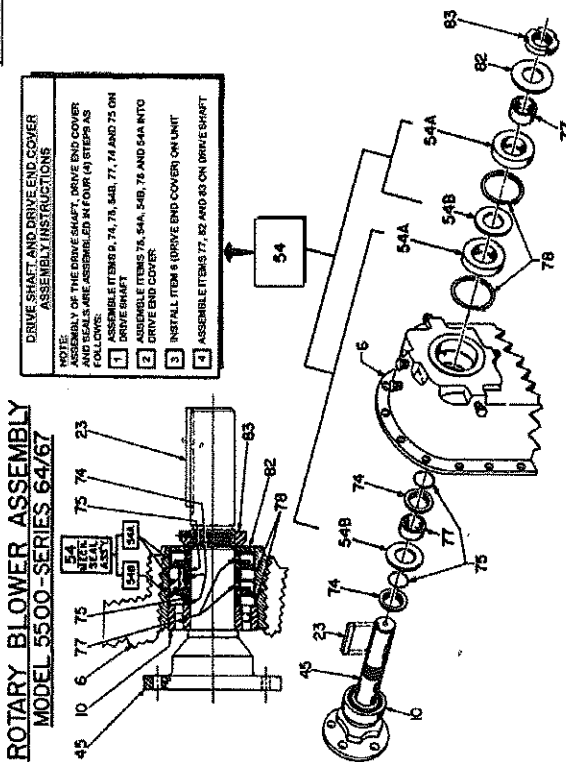
MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
5507	.005"-.007" (.13 -.18)	.009" - .013" (.23 - .33)	.012" - .014" (.30 - .36)	ALL CENTER TIMED
5509		.010" - .014" (.25 - .36)		
5511		.012" - .016" (.30 - .41)		
5514		.014" - .018" (.36 - .46)		
5516		.016" - .020" (.41 - .51)		
5518		.018" - .023" (.46 - .58)		
5520		.020" - .025" (.51 - .64)		

ROTARY BLOWER ASSEMBLY
5500-64/67 SERIES

(SERIES 67) VERTICAL FLOW BLOWER



(SERIES 64) HORIZONTAL FLOW BLOWER



ROTARY BLOWER ASSEMBLY
MODEL 5500-SERIES 64/67

NOTE: SEE DRAWING SHEET 2 OF 2 FOR DRIVE END COVER AND DRIVE SHAFT KEY AND DRIVE END COVER ASSEMBLY INSTRUCTIONS.

NOTE: PARTS NOT USED ON BOTTOM DRIVE UNITS

NOTE: SEE DRAWING SHEET 2 OF 2 FOR DRIVE END COVER AND DRIVE SHAFT KEY AND DRIVE END COVER ASSEMBLY INSTRUCTIONS.

NOTE: PARTS NOT USED ON BOTTOM DRIVE UNITS

PD PLUS®

PARTS LIST - MODEL 5507, 5509, 5511, 5514, 5516, 5518, 5520 SERIES 64 (HORIZONTAL FLOW) / 67 (VERTICAL FLOW) SERIAL NUMBER(S)

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

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	ROTOR	2	51	LAB SEAL	4
3	HOUSING	1	54	MECHANICAL SEAL	6
4	END PLATE	2	57	BEARING SPACER	1
6	DRIVE END COVER	1	61	LOCKPLATE	6
7	FREE END COVER	1	62	CAP SCREW	12
8	GEAR ASSEMBLY	1	65	LOCKPLATE	2
9	BALL BEARING	2	66	CAP SCREW	4
10	ROLLER BEARING	2	68	ROLLER BEARING	1
14	RETAINER RING	4	69	CAP SCREW	1
16	TIMING GEAR SHIM	1	70	OIL SIGHT GAUGE	2
21	OIL SLINGER	1	74	SPACER	2
22	DOWEL PIN	6	75	O-RING	2
23	DRIVE SHAFT KEY	1	77	SLEEVE	2
24	TIMING GEAR KEY	2	78	RETAINER RING	2
25	ROTOR SHAFT WASHER	1	82	WASHER	1
26	CAP SCREW	28	83	LOCKNUT	1
27	LOCKWASHER	56*	85	PIPE PLUG	14*
29	CAP SCREW	1	98	PIPE PLUG	4
30	CAP SCREW	6	108	MAGNETIC PLUG	1
31	MAGNETIC PIPE PLUG	2	123	SHIM SEAL	2
35	GEAR LOCKNUT	2	174	PIPE PLUG	9*
36	GEAR LOCKWASHER	2	234	OIL LEVEL TAG	2
38	PORT FITTING	2	241	CAP SCREW	12
40	CAP SCREW	40*	242	SIGHT GLASS FRAME	2
45	DRIVE SHAFT	1	243	WINDOW	2
48	PORT FITTING	1	244	WINDOW GASKET	2
50	ROLLER BEARING	1	245	FRAME GASKET	2

* MAXIMUM QUANTITY SHOWN; MAY VARY PER BLOWER

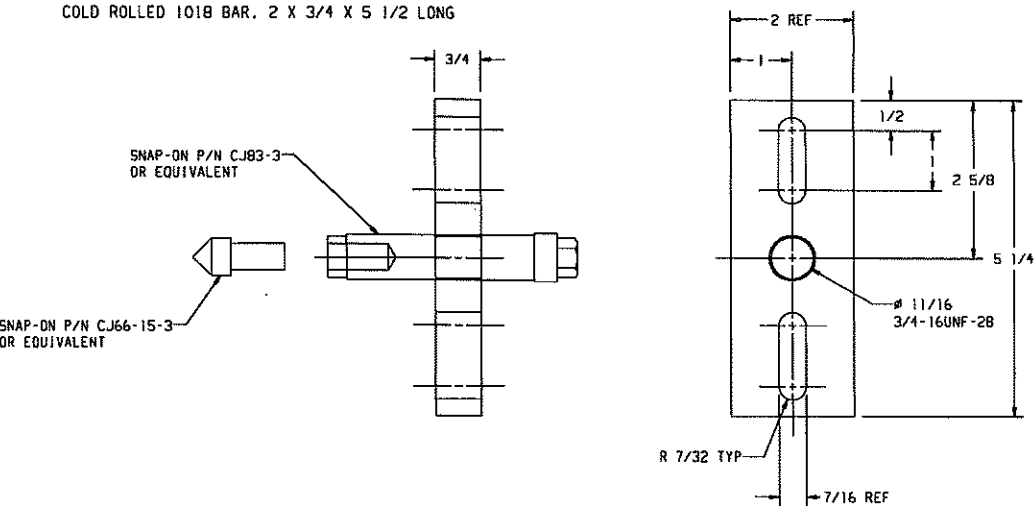
ASSEMBLY CLEARANCES

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

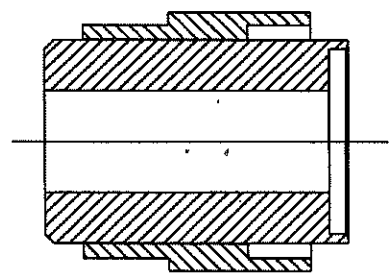
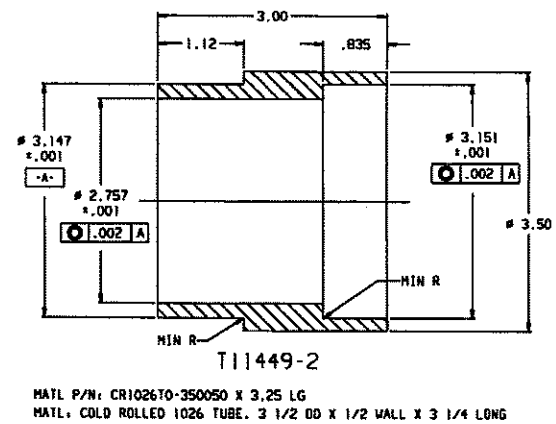
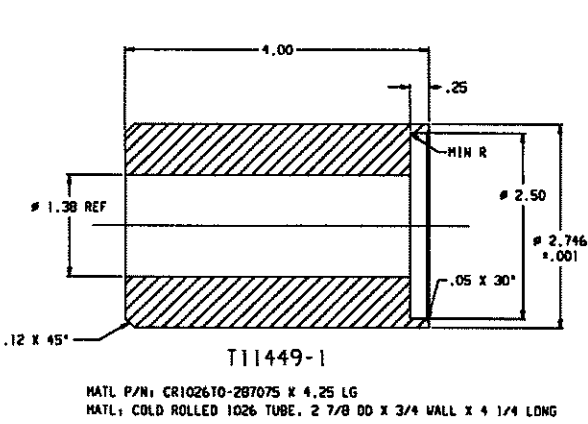
MODEL	LOBES TO END PLATES		LOBE TO HOUSING	INTERLOBE
	GEAR END	FREE END	TIP-PORT	
5507	.005"-.007" (.13 -.18)	.009" - .013" (.23 - .33)	.012" - .014" (.30 - .36)	ALL CENTER TIMED
5509		.010" - .014" (.25 - .36)		
5511		.012" - .016" (.30 - .41)		
5514		.014" - .018" (.36 - .46)		
5516		.016" - .020" (.41 - .51)		
5518		.018" - .023" (.46 - .58)		
5520		.020" - .025" (.51 - .64)		

SPECIAL TOOL DRAWINGS

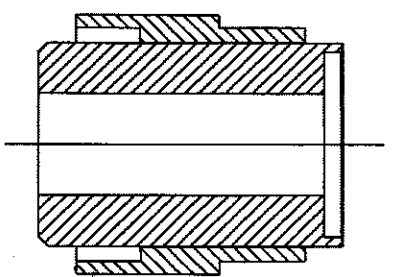
BAR PULLER



PRESSING TOOL FOR MECHANICAL SEALS



TOOL ASSEMBLY FOR DRIVE SHAFT MECHANICAL SEAL INSTALLATION

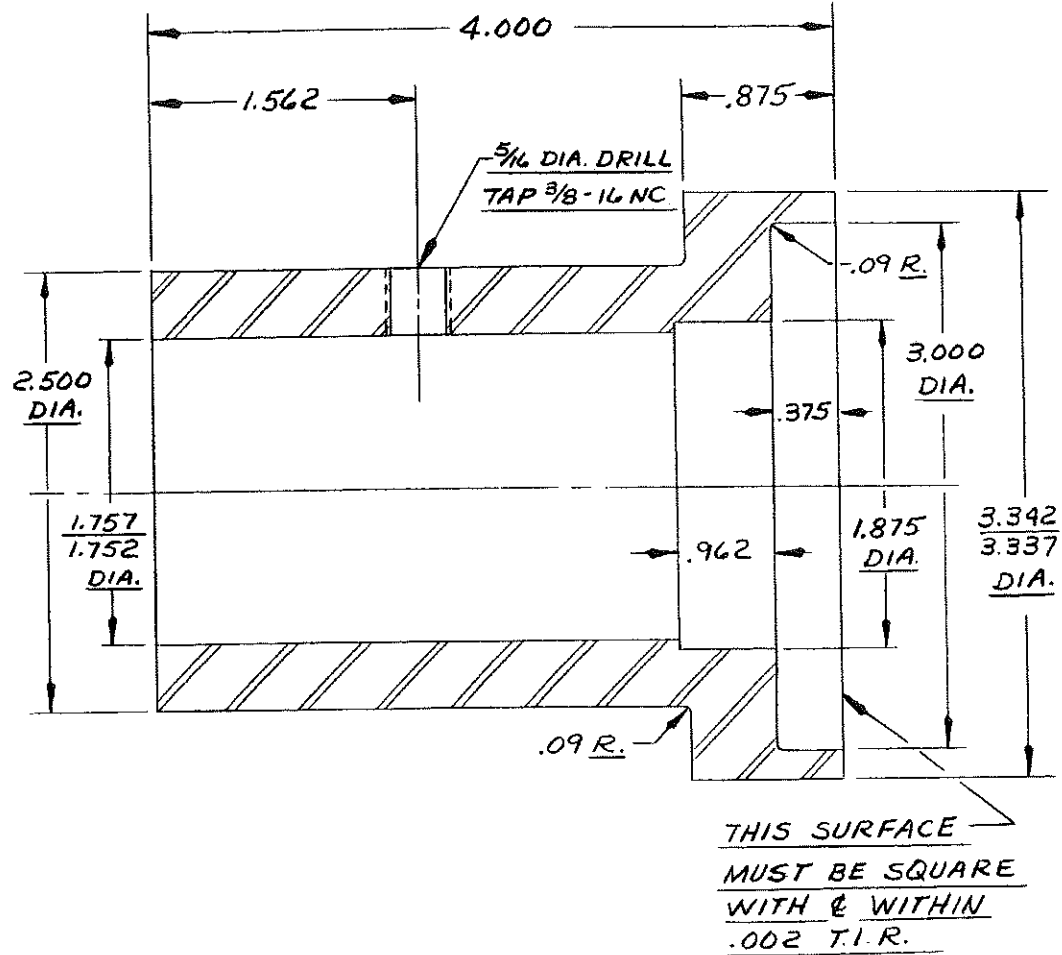


TOOL ASSEMBLY FOR END PLATE LAB SEAL AND END PLATE MECHANICAL SEAL INSTALLATION

NOTE:
TOOLS T11449-1 & T11449-2 ARE USED TO INSTALL MECHANICAL SEAL AND LABYRINTH SEAL USED ON MODEL 5500 ROTOR SHAFTS.
MECHANICAL SEAL USED ON MODEL 5500 DRIVE SHAFT AND MECHANICAL SEAL USED ON MODEL 4000 VACUUM BOOSTER DRIVE SHAFT.

SPECIAL TOOL DRAWINGS

PRESSING TOOL FOR MECHANICAL SEALS



NOTES:

START-UP CHECKLIST

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

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


Date Checked

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

2. Check Alignment.

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

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



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

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

5. Start the unit and operate it for 30 minutes at no load. During this time, feel the cylinder for hot spots. If minor hot spots occur, refer to the Troubleshooting Section (page 16).

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

7. If minor malfunctions occur, discontinue operation and refer to the Troubleshooting Section (page 16).

NOTES:

NOTES:

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	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	3 months from date of shipment, or remaining warranty period, whichever is greater	3 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.

August 2007

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 below, or if you prefer, you can visit our product registration web page at http://vacuum.tuthill.com/product_registration

Company _____

Location _____

City _____ State/Province _____ ZIP/Postal Code _____ Country _____
Telephone: () _____

E-mail: _____ PLEASE CHECK ONE

Model: _____ Pneumatic Conveying ☐

Serial Number: _____ Food ☐

Date of Purchase: _____ Vacuum ☐

Date of Startup: _____ Paper ☐

BY: _____ Wastewater ☐

Gas/Petrochemical ☐

Other ☐

**BUSINESS REPLY MAIL**

FIRST-CLASS MAIL PERMIT NO. 2912 SPRINGFIELD MO

POSTAGE WILL BE PAID BY ADDRESSEE

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

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



SAFETY INSTRUCTIONS

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



SAFETY WARNING

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

TUTHILL VACUUM AND BLOWER SYSTEMS

Springfield, MO USA

NOTICE

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

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

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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 visit our product registration web page at http://vacuum.tuthill.com/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 piping disconnected, place a strong, coarse screen over the inlet and avoid standing in discharge air stream.
- Avoid extended exposure in close proximity to machinery with high intensity noise levels.
- Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.
- Hearing protection may be required depending on silencing capabilities.

INTRODUCTION

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

PD PLUS blowers are built to exacting standards and if properly installed and maintained will provide many years of reliable service. 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.

PD PLUS blowers are internally and externally treated after factory assembly and testing to protect against rusting in normal atmospheric conditions prior to installation. 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 LONG TERM STORAGE on page 10 of this manual.

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

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

GILES ASSET TAG #10201

OPERATING DATA


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

Model No. <u>5511-17T3-4097</u>	V-Belt Size _____ Length _____
Serial No. <u>1405130807</u> (Recorded from nameplate on unit)	Type of Lubrication: _____
Startup Date _____	
Blower RPM _____	Pressure _____
Blower Sheave Diameter _____	Vacuum _____
Motor Sheave Diameter _____	Any other special accessories with this unit _____
Motor RPM _____ HP _____	

NOTES:

Space blower for all three plants

INSTALLATION

 **WARNING:** Customers are warned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in the installation and operation of this equipment in the system or facility.
Do not use air blowers on explosive or hazardous gases. Each size blower has limits on pressure differential, running speed, and discharge temperature, which **must not** be exceeded. These limits are shown on the table "Maximum Operating Limits" on page 17.


LOCATION

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

PROTECTIVE MATERIALS

Remove protective materials from the shaft.

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

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

FOUNDATION

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

Soft foot is a condition that can exist when foundations or mounting bases have uneven mounting surfaces. Soft foot places unequal loads on blower housings and bearings and will result in shortened blower life. To prevent soft foot, check to see that all mounting feet are resting evenly on the foundation, and shim as necessary to eliminate stress on the blower base when the blower mounting bolts are tightened.

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

DRIVE

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

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


For installations where the blower is to be operated by direct drive, selection of the driver should be such as not to exceed the maximum speed ratings of the blower. (See table "Maximum Operating Limits" on page 17.)

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

PIPING


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

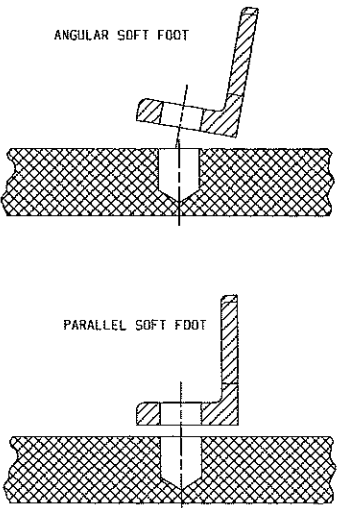
Be certain all piping is clean internally before connecting to the blower. We recommend placing a 16-mesh wire screen backed with hardware cloth at or near the inlet connections for the first 50 hours of use until the system is clean. Make provisions to clean the screen after a few hours of operation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

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

RELIEF VALVES

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.

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



Examples of Soft Foot