

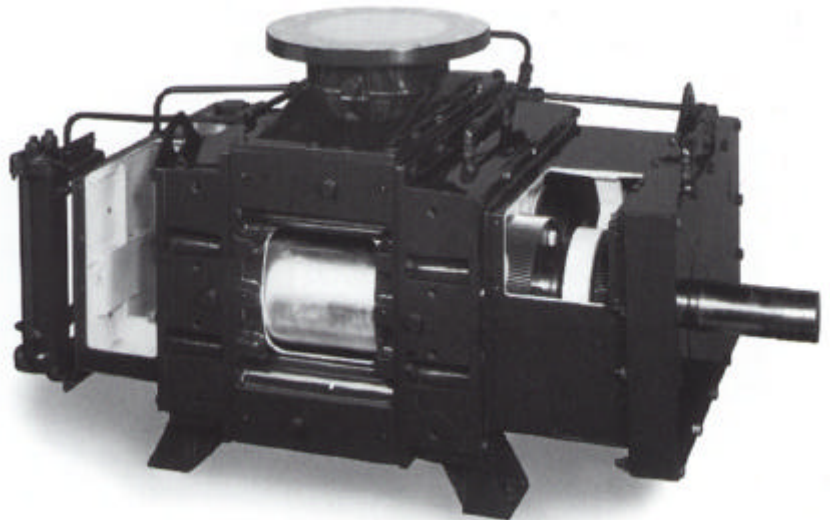
M-D Pneumatics™

PD PLUS®

Rotary Positive Displacement Blower

Models 9012 9016 9020 9027

INSTALLATION
OPERATION
MAINTENANCE
REPAIR
MANUAL



WARNING

DO NOT OPERATE BEFORE
READING MANUAL.



LEADING THE SEARCH FOR INNOVATIVE SOLUTIONS



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Springfield, Missouri USA 65803-8702
Tel 417 865-8715 800 825-6937 Fax 417 865-2950
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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 & 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://pneumatics.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 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.

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.

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.

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. _____ V-Belt Size _____ Length _____

Serial No. _____ Type of Lubrication: _____
(Recorded from nameplate on unit)

Startup Date _____

Blower RPM _____ Pressure _____

Blower Sheave Diameter _____ Vacuum _____

Motor Sheave Diameter _____ Any other special accessories with this unit

Motor RPM _____ HP _____

NOTES: _____

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.

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 7.

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.

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.

Before tightening the bolts, check to see that both mounting feet are resting evenly on the foundation, shim as necessary to eliminate stress on the base when the 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 7.)

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) .002 (.07mm) T I R face run out on coupling.

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.

LUBRICATION

Do not start up the blower until you are positive that it has been properly and fully lubricated. (See Lubrication Section on page 6.)

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

We recommend 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.

LUBRICATION

Every Tuthill Vacuum & Blower Systems 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.

Shaft bearings at the gear end of the blower are lubricated by the method shown below for the specific series of blower. Splash lubricated series utilize one or both gears dipping into an oil reservoir formed in the gear end plate and cover. Shaft bearings at the back end of the blower are lubricated by a slinger assembly dipping into an oil reservoir.

In addition to the splash lubrication, blower series incorporating pressure lubrication with an integral oil pump, pressure relief valve, filter and oil-to-coolant heat exchanger. Before starting the blower, fill oil sumps as shown below under "Filling Procedure." Tuthill Vacuum & Blower Systems approved mineral-based, synthetic and food grade lubricants are listed on page 23.

FILLING PROCEDURE

1. Remove large hex head fill plug from back (non-drive) end cover.
2. SLOWLY pour oil through fill until oil appears in the oil sight glass. Bring oil level to center of sight glass.
3. Verify oil level is at proper level in sight glass.
4. Replace and secure fill plug that was removed in step 1.

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 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.**

SERIES DESCRIPTIONS & APPROXIMATE OIL CAPACITIES

SERIES	Lubrication Type	Oil Capacity	Flow Direction	Sealing
17	Splash	5 gallons (18.9 liters)	Horizontal Flow	Lip-Labyrinth seals internally, lip seal on drive shaft
19	Pressure			
46	Splash	8 gallons (30.3 liters)	Vertical Flow	
86	Pressure			
57	Splash	5 gallons (18.9 liters)	Horizontal Flow	Labyrinth-Mechanical seals internally, lip seal on drive shaft
55	Pressure			
81	Splash	8 gallons (30.3 liters)	Vertical Flow	
82	Pressure			
64	Splash	5 gallons (18.9 liters)	Horizontal Flow	Labyrinth-mechanical seals internally, mechanical seal on drive shaft
66	Pressure			
67	Splash	8 gallons (30.3 liters)	Vertical Flow	
69	Pressure			

RECOMMENDED OIL CHANGE INTERVALS

The following should only be used as an approximate guide. For best results, an oil sampling program is recommended.

The initial oil change should occur after the first 200 hours of operation. Thereafter, frequency of oil changes will depend on the operating conditions. Check for oil contamination periodically. Time between oil changes should never exceed six (6) months.

Operating conditions, PSIG or inches Hg vacuum	Operating hours between oil changes
1-5	1500
6-10	1000
11-15	500

Refer to Page 23 (inside back cover) for approved and recommended lubricants.

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. 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.

The following is recommended as a minimum maintenance program.

DAILY MAINTENANCE

1. Check and maintain oil level, and add oil as necessary.
2. Check for unusual noise or vibration (See Troubleshooting on page 10)

WEEKLY MAINTENANCE

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

MONTHLY MAINTENANCE

1. Inspect the entire system for leaks.
2. Inspect condition of oil and change if necessary (see page 6)
3. Check drive belt tension and tighten if necessary.

START-UP CHECKLIST

We recommend that these startup procedures be followed in sequence and checked (v) 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

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Date Checked

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

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2. Check Alignment.

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

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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.

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

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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 10).

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

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7. If minor malfunctions occur, discontinue operation and refer to the Troubleshooting Section (page 10).

MAXIMUM OPERATING LIMITS				
MODEL	RPM	PRESSURE PSI (mbar)*	VACUUM in. Hg (mbar) †	TEMPERATURE RISE F° (C°)
9012, 9016, 9020, 9027	2400	15 (1035)	15 (508)	280 (156)

PRESSURE LUBRICATED SERIES 19/86, 55/82, 66/69

OIL PRESSURE ADJUSTMENT

The oil pressure on each unit has been preset at the factory during the load testing. Generally the oil pressure should not require adjustment once the unit is installed and in operation. Some adjustment may be required due to the speed and oil temperature.

To adjust the unit to the proper oil pressure remove the hex cap shown in Figure 2 on page 9. Loosen the lock nut and turn the set screw clockwise to increase the pressure or counterclockwise to decrease the pressure. Tighten lock nut, replace cap before reading oil pressure. Always allow unit to reach operating temperature before adjusting the oil pressure to the proper range. Set the oil pressure to 15 PSIG (103 kPa).

OIL COOLER

The supply line to the cooler can be connected to either hole. The fluid flowing through the heat exchanger should be sufficient to keep the oil temperature to the optimum operating range of 150-180° F (65-80° C). This temperature will insure proper lubrication of the bearings and seals.

OIL FILTER

The oil filter is a self-contained, spin-on type. For best protection, Tuthill Vacuum & Blower Systems recommends changing the oil filter at each oil change, using a factory supplied filter. See parts list on page 18 for replacement.

CAUTION: Factory supplied filters are engineered to provide the proper restriction in the oil lubrication system. Using filters other than those available from Tuthill Vacuum & Blower Systems may result in lubrication problems and possibly unwarrantable damage to blower.

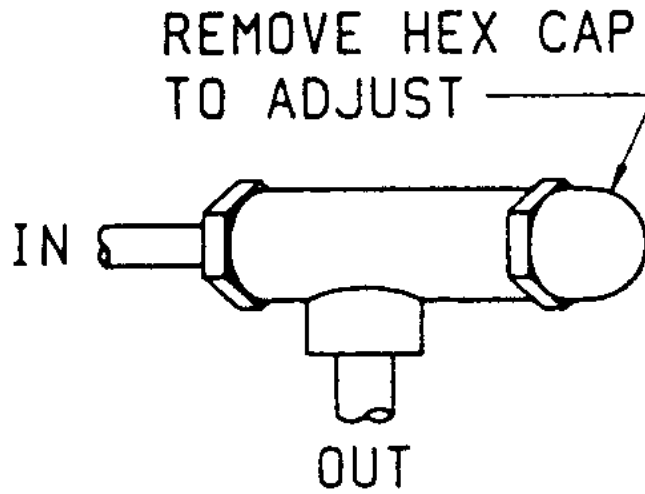
SERVICE & REPAIRS

When ordering parts or question on servicing your blower please have the model and serial number ready when you contact your Tuthill Vacuum & Blower Systems representative. You may contact the factory for assistance.

Tuthill Vacuum & Blower Systems
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Email: mdpneumatics@tuthill.com

Approximate Dry Weight of the Model 9000 Blowers

Model	Weights in LBS.
9012	1600
9016	1720
9020	1970
9027	2200



PRESSURE RELIEF VALVE

Figure 2. Adjustment of Oil Pressure

55 SERIES SHOWN

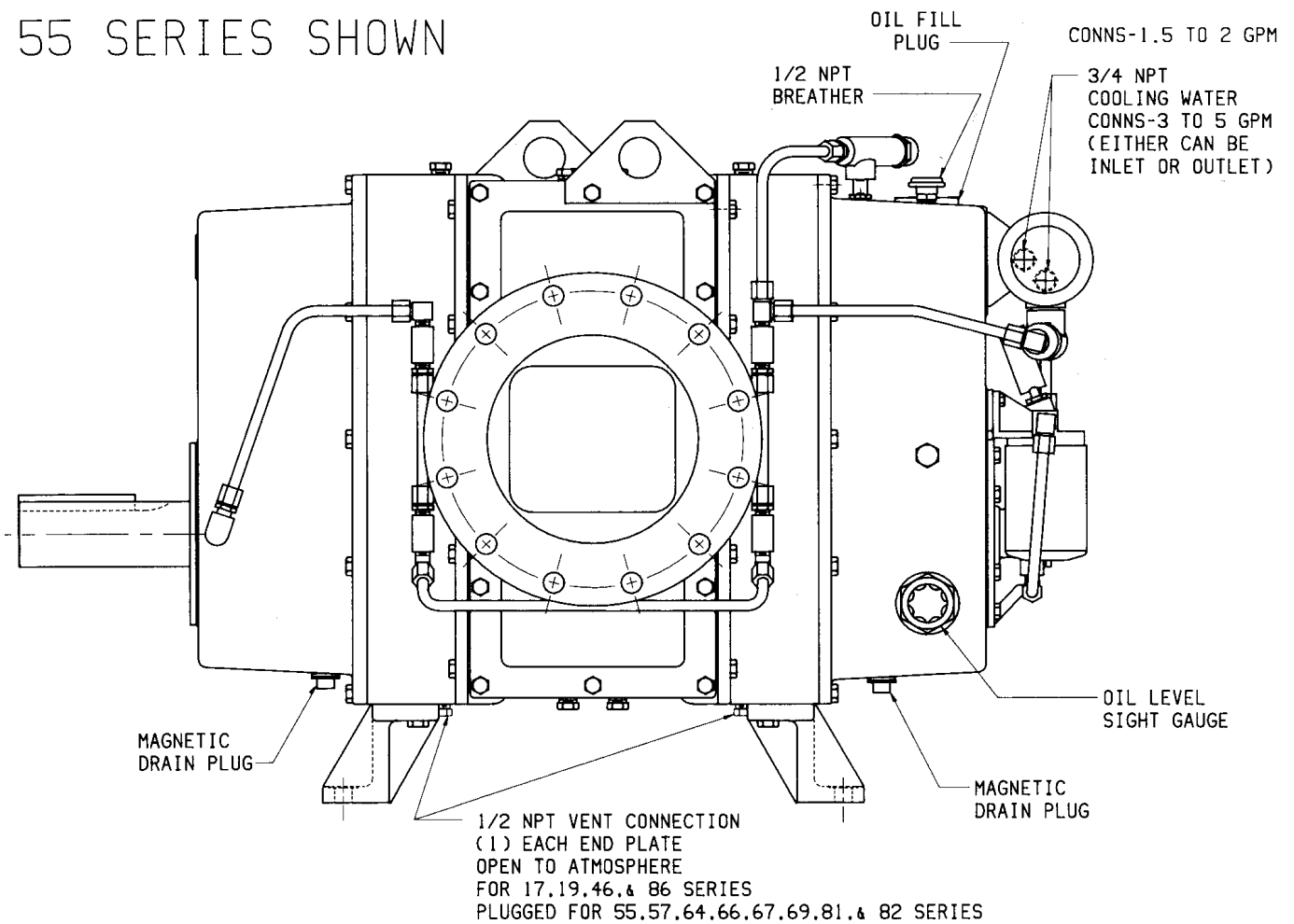


Figure 3. Locations of Key Components for Pressure Lubricated Blowers

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. Lip seal failure. Insufficient sealant. Loose drain plug.	Tighten gear housing bolts. Disassemble and replace lip seal. Remove gear housing and replace sealant. (See Disassembly and Inspection section on page 12) Tighten drain plug.
Excessive bearing or gear wear.	Improper lubrication. Excessive belt tension. Coupling misalignment.	Correct oil level. Replace dirty oil. (See Lubrication section on page 6) Check belt manufacturer's specifications for tension and adjust accordingly. Check carefully, realign if necessary.
Lack of volume.	Slipping belts. Worn lobe clearances. Speed too low. Obstruction in piping.	Check belt manufacturer's specifications for tension and adjust accordingly. Check for proper clearances (See Assembly Clearances on page 18) Increase blower speed within limits. Check system to assure an open flow path.
Knocking.	Unit out of time. Distortion due to improper mounting or pipe strains. Excessive pressure differential. Worn gears.	Re-time. Check mounting alignment and relieve pipe strains. Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary. Replace timing gears (See Disassembly and Inspection section on page 12)
Excessive blower temperature.	Too much or too little oil in gear reservoir. Too low operating speed. Clogged filter or silencer. Excessive pressure differential. Elevated inlet temperature. Worn lobe clearances.	Check oil level. (See Lubrication section on page 6) Increase blower speed within limits. Remove cause of obstruction. Reduce pressure differential across the blower. Reduce inlet temperature. Check for proper clearances (See Assembly Clearances on page 18)
Rotor end or tip drag.	Insufficient assembled clearances. Case or frame distortion. Excessive operating pressure. Excessive operating temperature.	Correct clearances (See Assembly Clearances on page 18) Check mounting and pipe strain. Reduce pressure differential. Reduce pressure differential or reduce inlet temperature.
Vibration.	Belt or coupling misalignment. Lobes rubbing. Worn bearings or gears. Unbalanced or rubbing lobes. Driver or blower loose. Piping resonance.	Check carefully, realign if necessary. Check cylinder for hot spots, then check for lobe contact at these points. Correct clearances (See Assembly Clearances on page 18) Check condition of gears and bearings; replace if necessary. Possible buildup on casing or lobes, or inside lobes. Remove buildup and restore clearances. Check mounting and tighten if necessary. Check pipe supports, check resonance of nearby equipment, check foundation.

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 hose and wand attached. The suction hose and wand will provide enough load to the blower to evaporate the moisture quickly.
3. For extended shutdown, inject a small amount of a light lubricating oil such as 3-in-One® or a spray lubricant such as WD-40® into the inlet of the blower just prior to shutdown. 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.

January, 2001

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

FLOW DIRECTION BY ROTATION

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

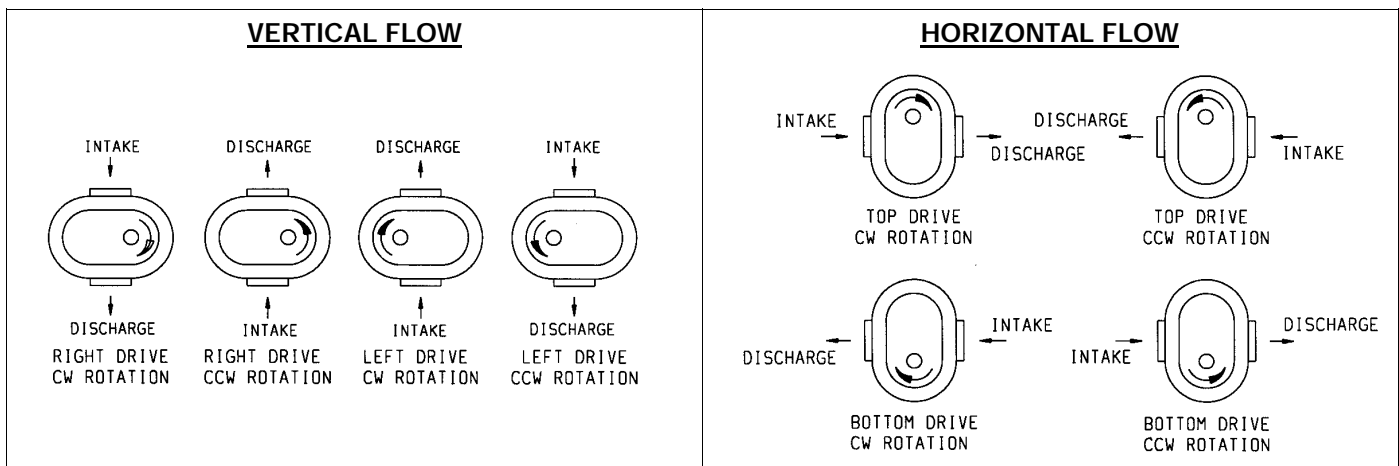


Figure 4. Flow Direction by Rotation

Disassembly Procedure

1. Drain lubrication and disconnect or remove the external oil lines, filter, and cooler if applicable, Port fitting (38) may also be removed. Match mark all parts so that they will be properly installed back to their original position when units are being reassembled.

Free End Disassembly

2. Remove cap screws item (253) and the oil pump mounting plate item (313). It is not necessary to remove oil pump item (144) from plate unless the pump is to be replaced.
3. Support free end cover Item (7) with lifting sling and remove cap screws item (26). Cover flange has two tapped holes for jacking screws to assist in the removal.
4. Remove cap screws item (69), oil pump drive shaft item (267), and Oil Slinger Item (20) or slinger and spacer items (20&197).
5. Remove retainer rings item (220) from both rotor shafts.

Gear End Disassembly Series 17-19-46-55-57-81-82-86

6. Remove flat head socket screws Item (62A). Use two jack screws and remove seal adapter item (46). Tap out lip seal item (12) and discard O-ring item (92).

Series 64-66-67-69

- 6A. Remove cap screws item (93) and water cooling hosing item (278). Discard O-ring item (140&279). Remove cap screws item (62). Use two as jacket screws and remove seal housing item (91). Tap out seal item (76B) and discard O-ring item (92). Remove mating ring portion of seal item (76A).
7. The gear end cover item (6) also as jacking screw holes but it must slide off a spherical bearing and two dowel pins. Use appropriate length screws and a support sling. See figure 9 for on Special Tool Drawings for a bearing alignment tool which can be helpful in cover removal.
8. Remove retainer ring item (47) and pull bearing item (50) from drive shaft.
9. Remove cap screws item (66) and the drive shaft item (45). Jack screw holes are available for easy removal.
10. Remove cap screws item (29) and rotor shaft washer item (25). On the top drive unit only, a slinger item (395) sandwiched between two washer item (25) is used on the lower rotor. Please note the position before removing.
11. Remove the timing gears item (8). Either gear may be used as the drive gear. Normally the solid gear (right hand helix) will be the drive gear. The two piece gear (gear shell and hub) will be the driven gear. Align the match marks and remove the cap screws in the two piece gear. Using a suitable puller, remove the gear shell from the hub. Never use excessive force to remove. A slight rocking motion while pulling the gear will ensure that jamming has not occurred. If jamming does occur, tap gear back on until free moving and recheck location of the timing marks. Using the same puller, remove the gear hub and solid gear.
12. Remove cap screws item (62) and retainer rings item (14).

End Plate and Rotor Disassembly

13. Stand blower its free end on 4x4 blocks and remove mounting feet item (304).
14. Remove the end plate cap screws item (26). The end plate, with the bearing must be pulled from the rotor shafts. Use two fixtures as shown in Figure 9 of the Special Tool Drawings on page 16. Secure each fixture to the bearing retainer bolt holes and apply pressure to the end of the rotor shaft with the center screws or the nuts on the threaded rod. The pressure must be applied equally to each shaft. When end plate is removed, tap out bearing seals. Remove retainer rings item (219) and tap out labyrinth seals item (51).
15. Install the end plate to the housing without bearings, and secure with six cap screws. Turn the blower over and support with blocks under the gear end plate.
16. Remove cap screws item (62), oil retainer ring item (15), and end plate cap screws item (26). Remove the end plate using the same tool as were used on the gear end. Remove the bearings and seals. Discard all O-rings item (233).
17. Lift the rotors out of the housing, Unbolt the gears end plate and lift the housing item (2) off.
18. Clean, deburr, polish, and inspect all parts for wear and serviceability.

NOTE: Check orifice in end plates and gear cover for blockage on units with external oil lines.

Assembly Procedure

The assembly procedure is generally the same in all series. When the procedure differ notations will be made. When sealing the joints between the housing, end plates, end covers, and port fittings an RTV Silicone sealer or equal is required. On some units, O-rings are used to seal between the housing and end plates.

Dowel pins are use for proper location of end plate to the housing, and covers in the proper location relative to each other. We recommend that only factory parts be use when repairing a unit. This will insure the proper operating clearance need for your unit to operate properly.

CAUTION: On lip seal units the seal journals must be properly polish to remove any scratches or burrs. Failure to polish will result in leakage and/or damage to the seals.

Preparation of End Plates

1. Make sure all parts are clean and free of nicks or burrs caused by disassembly. See figure 6&8 for dimension of seal pressing tools.
2. Position end plats with bearing bores up. Press in labyrinth seals item (51) into seal bores of both endplates. Install retainer ring item (219).

Series 17-19-46-86 Lip Seal Installation

3. Apply a thin coat of sealer on the O.D. of the seal. Press into seal bore with lip seal facing toward bearing. Lubricate lip seal only with grease.

Series 55-57-64-66-67-69-81-82

- 3a. Follow instruction for lip seal but do not grease. Install carbon up. On the free end plate be sure the spacer item (55) is in place before installing the seal. If no press is available the bearing pressing plate Figure 9 on Special Tool Drawings can be used. Care must be given taken that no sealer is left on the carbon. Clean with soft tissue and cleaning agent (acetone) if necessary. Failure to remove will result in leakage.

Gear End Assembly

4. Place free end plate item (4) with flat side up on a pair of 4"x 4" block. Endplate must be blocked so rotor shafts will not touch the floor. Do not install O-ring at this time.
5. Set housing item (3) in place, being sure dowel pins are installed. Do not bolt at this time.
6. Lay two pieces of shim 1/8" thick on the end plate at the bottom of the housing.
7. Set each rotor into position in the housing with the gear end (long shaft) up. Face keyways in the direction shown in Figure 5. This will position the rotors so they will match the keyways in the gear.
8. Grease four O-rings item (233) and install in gear end plate. Run a continuous bead of sealer, about 1/8" wide around the perimeter of the housing, encircling each bolt hole and dowel pin. This is not require if O-rings item (176) have been furnished. Mechanical seal units only.
9. Bolt housing to gear end plate and tighten bolts. Use six bolts, equally spaced and secure free end plate against shims at the bottom end of the rotors. Hand tighten only.

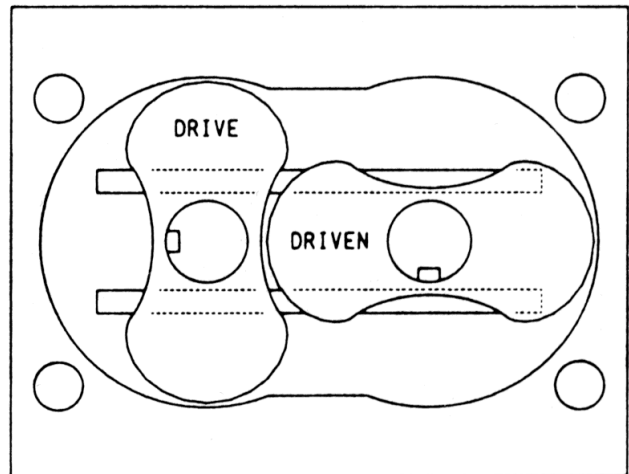


Figure 5. Rotor Alignment for Timing

Install End Plate

Series 55-57-64-66-67-69-81-82

10. Clean the lapped surfaces of the mating rings with soft tissue and acetone being careful not to nick or scratch the surface. Place a few drops of oil on the surface and O-ring. Carefully slide over the rotor shaft and align the slot in the mating ring with the spring pin item (300) in the rotor shaft.

11. Coat the rotors with a light grease and press the bearing item (9) on the shaft. The bearing manufacturer numbers and or the acid dot (inner race) should be toward the gears. Use a bearing press fixture shown in Figure xx on Special Tool Drawings.
12. Loosen bolts holding free end plate to housing then install bearings retainer rings item (14) and secure with cap screws item (62) . At this time to check clearances between rotor lobes and gear end plate. If clearances are not within specification, recheck parts to find the cause of the improper clearances before proceeding.
13. Install key item (24) in rotor shaft. Tight fit required. Coat shaft and the keys with grease.
Note: If gears are being replaced, disassemble the new two piece gear before proceeding.
14. Heat the solid gear and the hub of the two piece gear to 350 degrees F. Install solid gear and hub. Onto rotor shafts. Secure with washers Item (25) and cap screws item (29). Do not install gear shell at this time. Allow the hub and solid gear to cool.

Free End Assembly

15. Retighten the six free end plate screws by hand. Turn the unit over and support it on blocks with the free end up.
16. Remove the six screws and put jack screws in holes provided in the flange of the end plate and remove end plate. take out the 1/8" shims and check clearance between the end of lobes and the housing using a flat bar and feeler gauges or a depth micrometer. Refer to exploded for free end clearances.
17. Install the four O-rings item (233), apply sealant to the housing or O-ring item (176), reinstall end plate and secure with cap screws item (26).

Series 55-57-64-66-67-69-81-82

18. Install seal mating rings using the same procedure as was done on the gear end. #10.
19. Install bearing using the same procedure as done on gear end . #11. Install bearing retainer rings item (220), and oil retainer rings item (15) and cap screws item (62)
20. Install mounting feet item (304 with cap screws item (307) and stand unit on its feet. For horizontal flow units, you may prefer to lay unit on its side with the drive gear to the left. This will make it easier to take inter lobe readings later.
21. Install the gear shell to the hub, making sure the timing shims item (16) is in place, and bolts are tight.
NOTE: As the second gear is installed the helical teeth will cause the rotor to turn , and unless the rotors are in an open position they will jam. To avoid jamming, rotate the installed gear until the timing mark is at the center and the second gear with its timing mark matched to the timing mark on the installed gear.

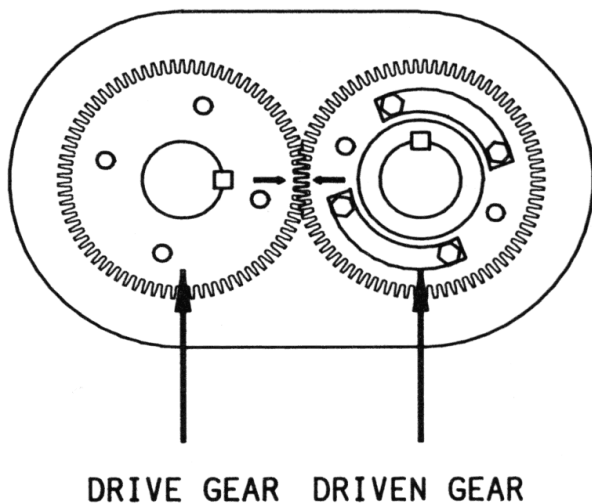


Figure 6A
Timing Marks Matched

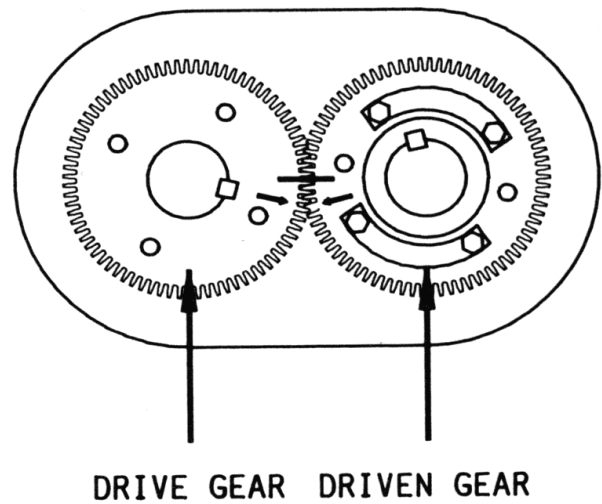


Figure 6B
Timing Marks Advanced 3 Teeth
(Reference Marks Aligned)

Adjusting Interlobe Clearance.

22. The outer gear shell is fasten to the inner hub with four cap screws and located with two dowel pins. Adding and removing shims between the gear shell and the inner hub moves the gear shell axially. The helix causes the the gear to rotate which changes the clearance between the rotor lobes. Adding .030 shims thickness will change the rotor lobe clearance by approximately .009.
- The timing shim is formed from a number of .003 shims which have been laminated together. Tare easily peeled off as necessary.
- Use feeler gauges to check the clearance at AA (right hand reading) and BB (left had reading) see Figure 7. The clearance should be adjusted so they are as equal between all lobes as possible. Usually between .002 to .003. For the results use feeler gauges no larger than .006.
- Example: If AA reading is .020 and BB reading is .008, by removing .021 shims the reading will change .006. AA should read .014 and BB should read .014.**
- Remember to place timing marks on center and match when removing or installing a gear.

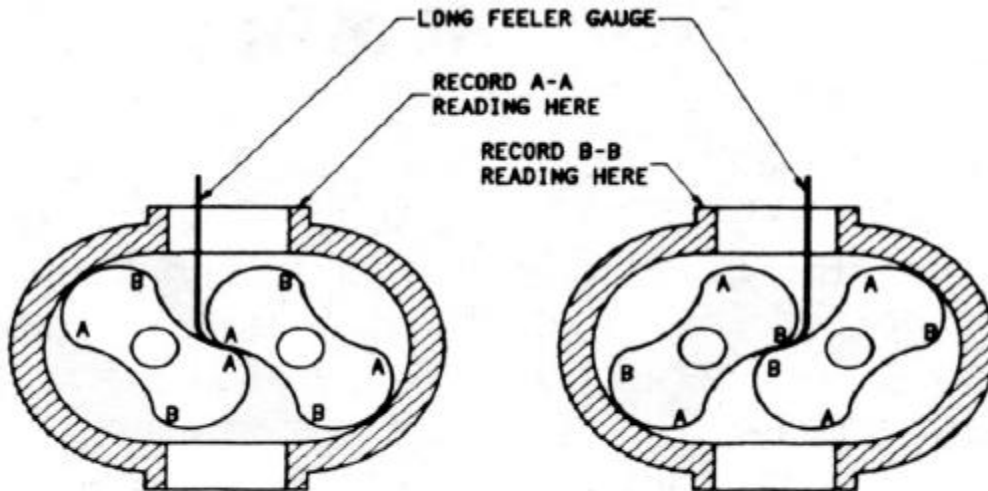


Figure 7.

Complete Drive End Assembly

23. Clean and remove all burrs from mating surfaces of the gear and drive shaft. Install cap screws item (66) . Check drive shaft run out at the seal. **Do not exceed .003 T.I.R.**
24. Install drive shaft bearing item (50) and retainer ring item (47). If top drive unit install oil slinger item (395) and washer item (25) at this time.
25. To aid in the installation of the cover item (6) a tool as shown in Figure 9 of Special Tool Drawing should be made to hold the outer race of the bearing square with the shaft. Put sealer on the end plate and slide the cover over the tool and secure with cap screws Item (26).

Series 17-19-46-55-57-81-82-86

- 26A. Press seal item (12) into adapter item (46). Grease seal and O-ring item (92) and install on shaft. Secure with flat head screws item (62A).

Series 64-66-67-69

- 26B. Seal item (76B) into seal housing item (91) and install O-ring item (92). Clean carbon surface and lapped surface of mating ring with a soft tissue and acetone. Place a few drops of oil on the mating ring and O-ring item (314) and carefully slide over shaft aligning slot with pin item (255). In stall retainer ring item (78). Install seal housing item (91) and secure with cap screws item (62). Grease and install O-ring items (140&279). Install water cooling housing item (278).

Complete Free End Assembly.

Series 17-46-57-64-67-81

27A. Install oil pump drive shaft item (267). Oil slinger item (20) and secure with cap screws item (69). Put sealer on the end plate and install cover item (7).

Series 19-55-66-69-82-86

27B. Install oil pump drive shaft item (267), oil slinger item (20), and secure with cap screws item (69). Put sealer on the end cover item (7). Grease and install O-ring item (361). Align oil pump coupling with slot in drive shaft and install plate item (313). Secure with cap screws item (253). If oil pump is being replaced install new O-ring item (325).

28. Apply sealer to housing and install port fittings item (38). Install cooler, oil filter, and external oil lines on the unit with lube system.

Special Instruction For Gearhead Blowers

Disassembly & Assembly of Gearhead

1. On units furnished with gear head drives (ratio) follow disassembly procedures up to and including # 6, then remove the cover end plate cap screws and nuts item (227 & 116) using jack screws hole provided, remove the drive end cover item (6) and tap out the lip seal item (12).
2. Remove the gear housing cap screws item (26) and gear housing item (201) using jack screw holes.
3. The drive shaft gear, and bearing assembly items (45, 204 & 209) can now be tapped free from the housing, Remove retainer rings item (237) and press shaft from bearing and gear.
4. Tap out mating gear assembly item (200, 204 & 209) and disassemble in the same manner.
5. Remove stub shaft cap screws item (66) and stub shaft, item (207).
6. Continue blower disassembly #10 on page 12.

Use reverse order to reassemble.

Special Tool Drawings

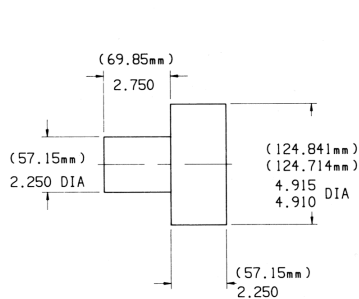


FIGURE 8 LABYRINTH SEAL INSTALLATION TOOL

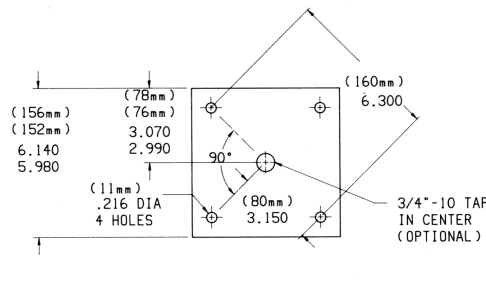


FIGURE 9 BEARING PRESSING FIXTURE

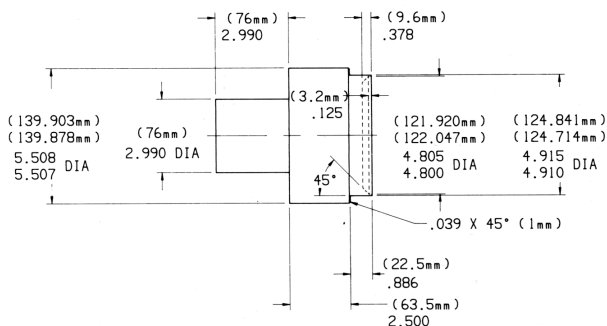
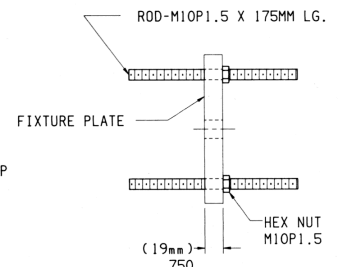


FIGURE 10 SEAL INSTALLATION TOOL

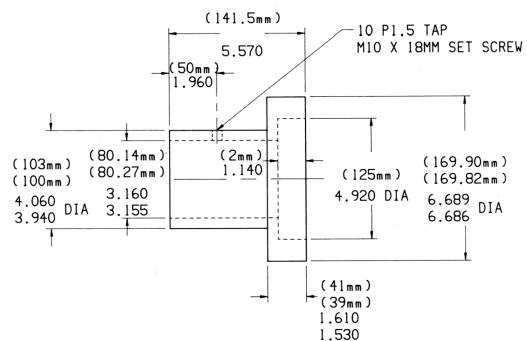
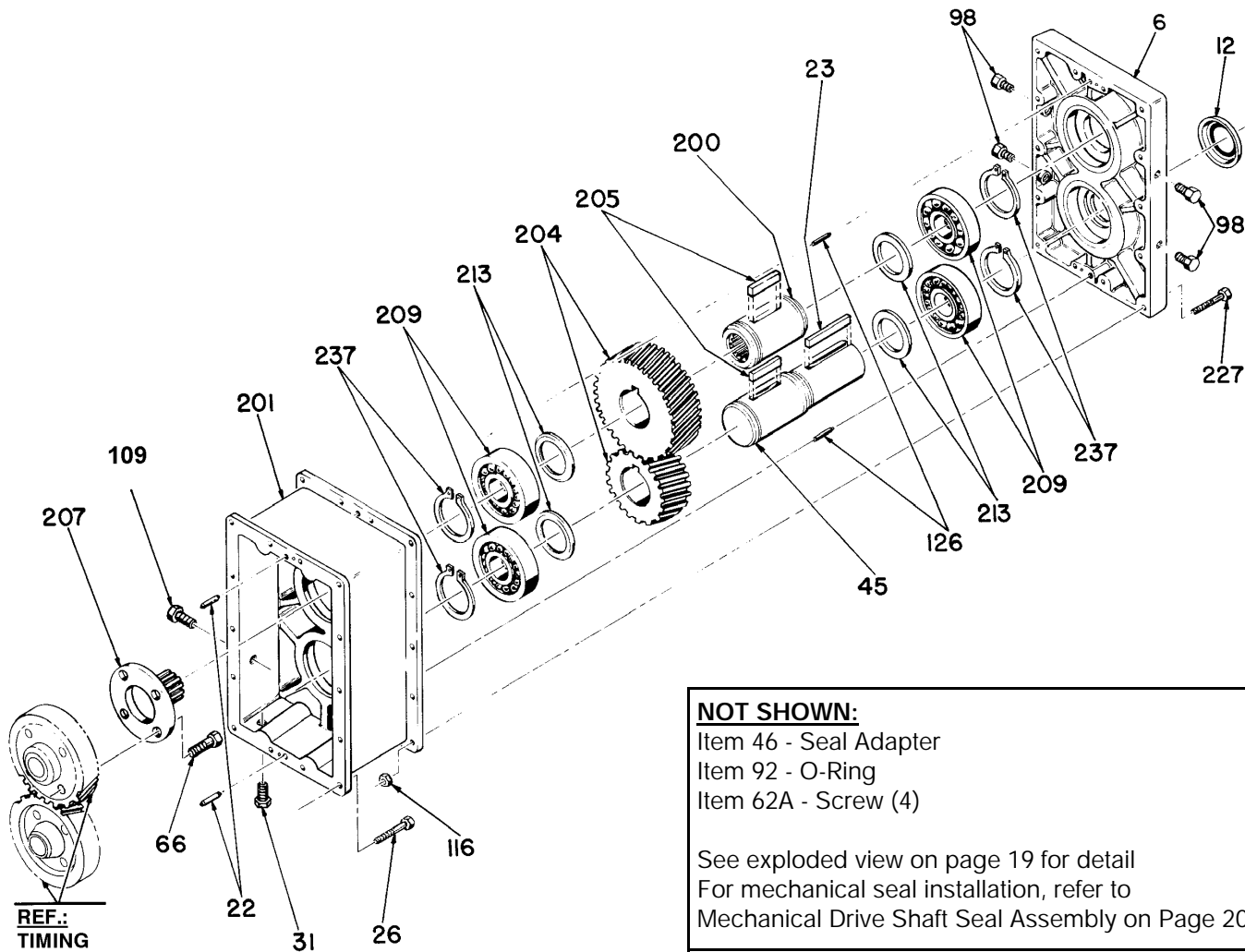


FIGURE 11 ALIGNMENT TOOL FOR DRIVE SHAFT BEARING

MATERIAL MILD STEEL

GEARHEAD ASSEMBLY (HORIZONTAL FLOW SHOWN)



NOT SHOWN:
 Item 46 - Seal Adapter
 Item 92 - O-Ring
 Item 62A - Screw (4)

See exploded view on page 19 for detail
 For mechanical seal installation, refer to
 Mechanical Drive Shaft Seal Assembly on Page 20

**REF.:
 TIMING
 GEAR
 ASSEMBLY**

PARTS LIST					
ITEM NO.	DESCRIPTION	QTY.	ITEM NO.	DESCRIPTION	QTY.
6	COVER, D.E.	1	126	DOWEL PIN	2
12	SEAL, LIP	1	200	SHAFT, PINION GEAR	1
22	DOWEL PIN	2	201	HOUSING, GEAR	1
23	DRIVE SHAFT KEY	1	204	GEAR ASSEMBLY, INCREASER	1
26	HEX HEAD CAP SCREW	14	205	KEY	2
31	HEX HEAD PIPE PLUG, MAGNETIC	1	207	SHAFT, SPLINED	1
45	DRIVE SHAFT	1	209	BALL BEARING	4
66	HEX HEAD CAP SCREW	4	213	BEARING SPACER	4
98	HEX HEAD PIPE PLUG	4	227	HEX HEAD CAP SCREW	14
116	NUT	14	237	RETAINING RING	4
109	HEX HEAD PIPE PLUG	1			

PD PLUS®

PARTS LIST - MODELS 9012, 9016, 9020, 9027

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

Item No.	Description	17/46	19/86	55/82	57/81	64/67	66/69
1	Rotor	2	2	2	2	2	2
3	Housing	1	1	1	1	1	1
4	End Plate	2	2	2	2	2	2
6	Gear End Cover	1	1	1	1	1	1
7	Free End Cover	1	1	1	1	1	1
8	Timing Gear Assembly	1	1	1	1	1	1
9	Bearing	2	2	2	2	2	2
10	Bearing	2	2	2	2	2	2
12	Lip Seal	5	5	1	1	-	-
14	Bearing Retainer Ring	2	2	2	2	2	2
15	Oil Retainer Ring	2	2	2	2	2	2
16	Timing Shim	1	1	1	1	1	1
20	Oil Slinger	1	1	1	1	1	1
22	Dowel Pin	6	8	8	6	6	8
23	Drive Shaft Key	1	1	1	1	1	1
24	Timing Gear Key	2	2	2	2	2	2
25	Rotor Shaft Washer *	2	2	2	2	2	2
26	Cap Screw	AR	AR	AR	AR	AR	AR
29	Cap Screw **	8	8	8	8	8	8
31	Magnetic Plug	2	2	2	2	2	2
37	Breather	1	1	1	1	-	-
38	Port Fitting	2	2	2	2	2	2
45	Drive Shaft	1	1	1	1	1	1
46	Seal Adapter	1	1	1	1	-	-
47	Retaining Ring	1	1	1	1	1	1
50	Bearing	1	1	1	1	1	1
51	Labyrinth Seal	4	4	4	4	4	4
54	Mechanical Seal	-	-	4	4	4	4
55	Seal Spacer	-	-	2	2	2	2

* Top Drive Units require 3

** Top Drive Units require 4

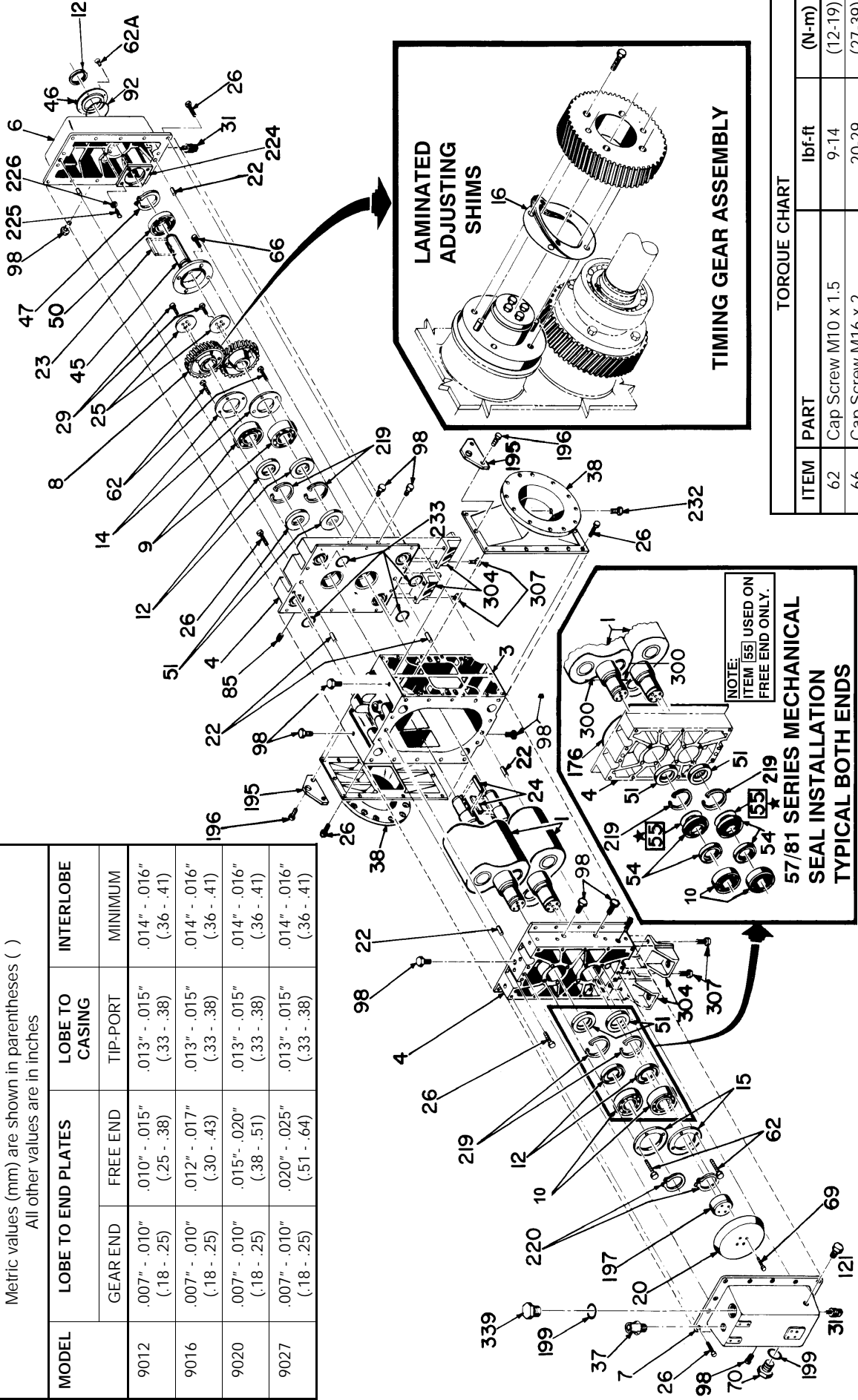
*** Top Drive Units require 8

Item No.	Description	17/46	19/86	55/82	57/81	64/67	66/69
62	Cap Screw	16	16	16	16	20	20
62A	Cap Screw	4	4	4	4	-	-
66	Cap Screw	4	4	4	4	4	4
69	Cap Screw	4	4	4	4	4	4
70	Oil Sight Glass	1	1	1	1	1	1
76	Mechanical Seal	-	-	-	-	1	1
85	Square Head Pipe Plug	2	-	-	2	2	-
92	O-Ring	1	1	1	1	1	1
98	Pipe Plug	AR	AR	AR	AR	AR	AR
121	Pipe Plug	AR	AR	AR	AR	AR	AR
124	Oil Filter	-	1	1	-	-	1
176	O-Ring	-	-	2	2	2	2
195	Lifting Lug	2	2	2	2	2	2
196	Cap Screw ***	4	4	4	4	4	4
197	Oil Slinger Spacer	1	-	-	1	1	-
199	O-Ring	2	2	2	2	2	2
219	Retaining Ring	4	4	4	4	4	4
220	Retaining Ring	2	2	2	2	2	2
224	Oil Retainer	1	1	1	1	1	1
225	Cap Screw	4	4	4	4	4	4
226	Lockwasher	4	4	4	4	4	4
232	Pipe Plug	4	4	4	4	4	4
233	O-Ring	8	8	8	8	8	8
300	Spring Pin	-	-	4	4	4	4
304	Mounting Foot	4	4	4	4	4	4
307	Cap Screw	8	8	8	8	8	8
339	Plug	1	1	1	1	1	1
395	Oil Slinger (top drive only)	1	1	1	1	1	1

ROTARY BLOWER ASSEMBLY

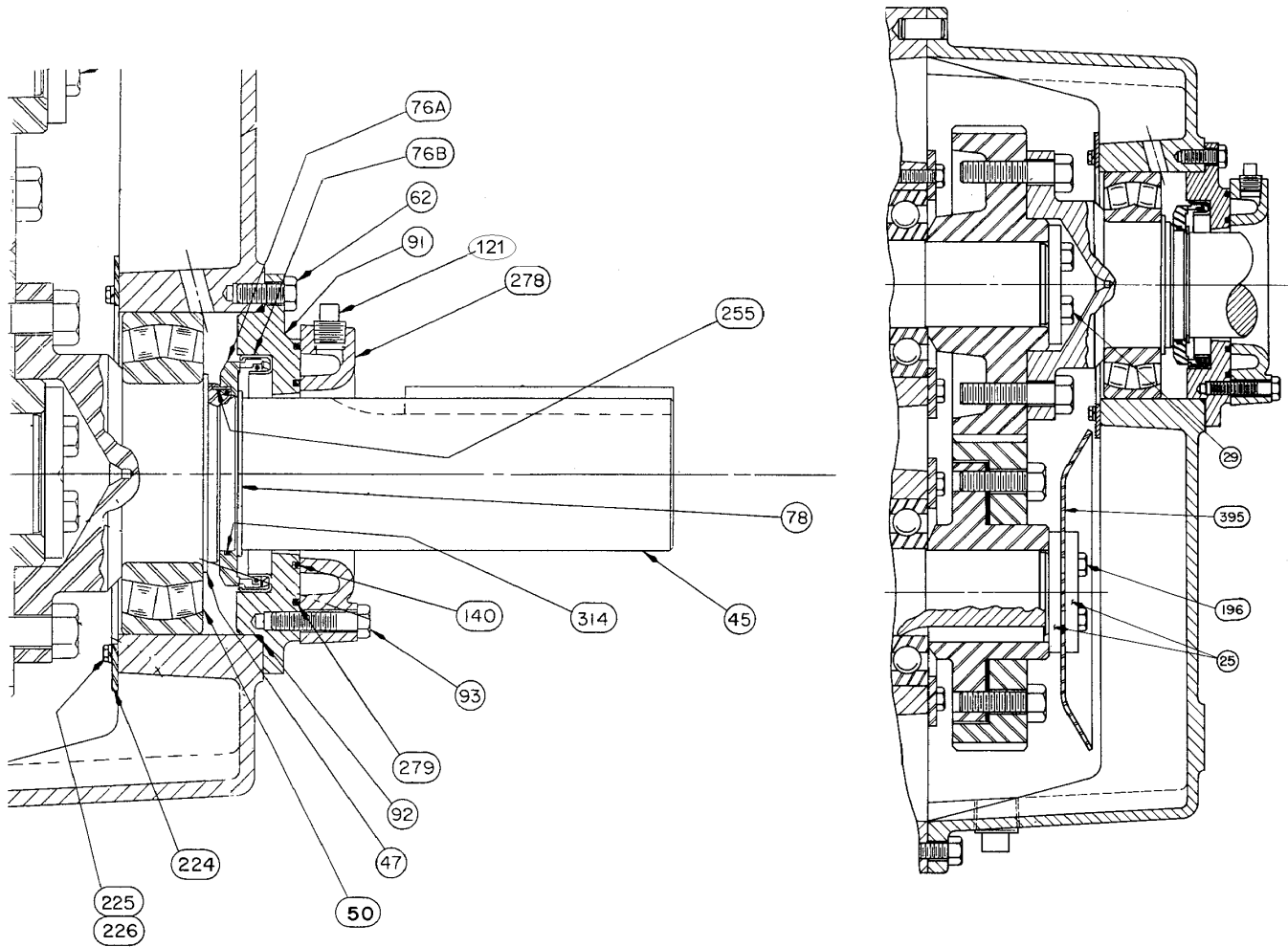
SERIES 17/46 57/81

ASSEMBLY CLEARANCES			
Metric values (mm) are shown in parentheses () All other values are in inches			
MODEL	LOBE TO END PLATES		INTERLOBE
	GEAR END	FREE END	TIP-PORT
9012	.007" - .010" (.18 - .25)	.010" - .015" (.25 - .38)	.013" - .015" (.33 - .38)
9016	.007" - .010" (.18 - .25)	.012" - .017" (.30 - .43)	.013" - .015" (.33 - .38)
9020	.007" - .010" (.18 - .25)	.015" - .020" (.38 - .51)	.013" - .015" (.33 - .38)
9027	.007" - .010" (.18 - .25)	.020" - .025" (.51 - .64)	.013" - .015" (.33 - .38)
			MINIMUM
			.014" - .016" (.36 - .41)
			.014" - .016" (.36 - .41)
			.014" - .016" (.36 - .41)
			.014" - .016" (.36 - .41)



TORQUE CHART			
ITEM	PART	lbf-ft	(N-m)
62	Cap Screw M10 x 1.5	9-14	(12-19)
66	Cap Screw M16 x 2	20-29	(27-39)
69	Cap Screw M8 x 1.25	35-53	(47-71)
26, 29	Cap Screw M12 x 1.75	57-85	(77-115)
307	Cap Screw M14 x 2	90-120	(122-163)

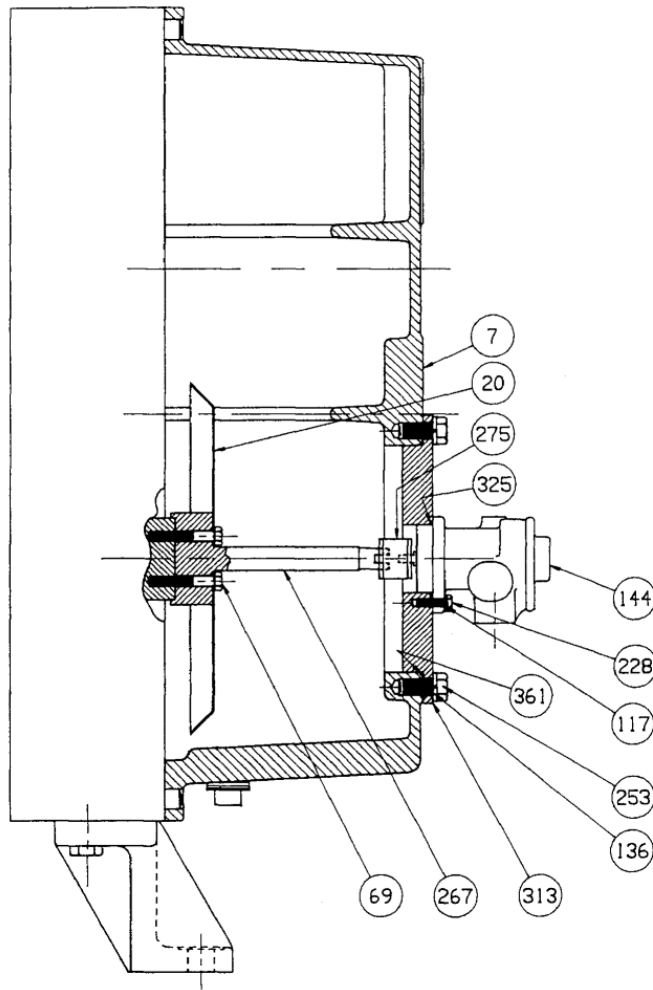
MECHANICAL DRIVE SHAFT SEAL ASSEMBLY (SERIES 64/67/66/69)



PARTS LIST

ITEM NO.	DESCRIPTION	QTY.	ITEM NO.	DESCRIPTION	QTY.
47	RETAINING RING	1	140	O-RING	1
62	HEX HEAD CAP SCREW	4	224	OIL RETAINER RING	1
76A	SEAL MATING RING	1	225	HEX HEAD CAP SCREW	4
76B	SEAL STATOR	1	226	LOCKWASHER	4
78	RETAINING RING	1	255	ROLL PIN	1
121	PLUG	1	278	COOLANT BLOCK	1
91	SEAL HOUSING	1	279	O-RING	1
92	O-RING	1	314	O-RING	1
93	HEX HEAD CAP SCREW	4			

OIL PUMP ASSEMBLY (SERIES 19/86/55/82/66/69)



PARTS LIST					
ITEM NO.	DESCRIPTION	QTY.	ITEM NO.	DESCRIPTION	QTY.
7	FREE END COVER	1	253	HEX HEAD CAP SCREW	6
20	OIL SLINGER	1	267	OIL PUMP DRIVE SHAFT	1
69	HEX HEAD CAP SCREW	4	275	COUPLING ASSEMBLY	1
117	LOCKWASHER	3	313	ADAPTER PLATE	1
136	LOCKWASHER	6	325	O-RING	1
144	OIL PUMP	1	361	O-RING	1
228	HEX HEAD CAP SCREW	3			

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	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.

July, 2002

PD PLUS®

MAINTENANCE AND SERVICE SPECIFICATIONS SHEET MODELS 9012, 9016, 9020, 9027

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)		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 indirect food contact	Lubricant meeting U. S. FDA regulation 21 CFR 178.3570 governing petroleum products which may have incidental contact with food (formerly USDA H1 requirements)
0° F (-18° C) to 32° F (0° C)	CITGO CLARION® 350 FOOD GRADE (ISO 68)	CITGO CLARION® A/W 68 (ISO 68)
32° F (0° C) to 90° F (32° C)	CONSULT FACTORY	CITGO CLARION® A/W 100 (ISO 100)
90° F (32° C) to 120° F (50° C)	CONSULT FACTORY	CONSULT FACTORY

IMPORTANT

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

Company _____

Location _____

City State/Province ZIP/Postal Code Country

Telephone: () _____

PLEASE CHECK ONE

E-mail: _____

Pneumatic Conveying

Model: _____

Food

Serial Number: _____

Vacuum

Date of Purchase: _____

Paper

Wastewater

Date of Startup: _____

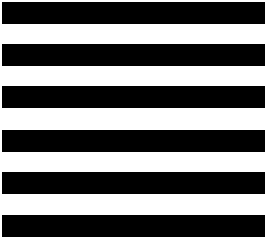
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