

## Kice PD Blower

### Operators Manual

# 1. INTRODUCTION

When you purchased your new Kice equipment, you bought a dependable and quality-built product. The range of equipment manufactured by Kice should satisfy nearly every conceivable industrial air-handling need.

We are proud of our products and the people at Kice who build them. At Kice, we start in our own foundry and follow the design and manufacturing standards that have proven superior for more than 60 years.

This owner's manual is intended as a guide for proper installation, operation and maintenance to keep your Kice equipment operating safely and efficiently on the job. Service and factory reconditioning information is also included for your benefit.

Sincerely,

Drew Kice  
President  
Kice Industries, Inc.

## Warranty

The Company (Kice Industries, Inc.) warrants the equipment manufactured by the Company to be free of defects in material and workmanship for a period of one year from the date of shipment. Company agrees to repair or replace, at its option, any parts found to be defective in the opinion of the Company. Company is not liable for any costs in connection with the removal, shipment or reinstallation of said parts. This warranty does not apply to abrasion, corrosion, or erosion.

Purchaser agrees to look to the warranty, if any, of the manufacturer or supplier of equipment manufactured by others and supplied to the Company for any alleged defects in such equipment and for any damages or injuries caused thereby or as a result thereof.

### **PURCHASER SHALL BE RESPONSIBLE FOR COMPLIANCE WITH ELECTRICAL COMPONENT MANUFACTURER'S RECOMMENDATIONS, UNDERWRITERS CODE AND ALL SAFETY PRECAUTIONS.**

The only warranty extended under this agreement is the above express warranty and there are no other warranties, express or implied, including warranties of merchantability, fitness for a particular purpose or otherwise which extends beyond the face hereof. The Company and its dealers shall not in any event be liable for consequential or incidental damages and this agreement provides purchaser's sole and exclusive remedy. Any actions for breach of this agreement or warranty must be commenced within one year after the cause of action has occurred.

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# 2. IMPORTANT KICE AIR POWER UNIT INFORMATION

## Important Kice Air Power Unit Information

Write down the MODEL and SERIAL NUMBER of the Kice Air Power Unit, along with the same information for the auxiliary equipment. (Airlock valves, fans, speed reducers, motors, and sheaves size, type and any special modifications to standard).

For additional information, application assistance or special service, please contact us by phone at 316-744-7151 or email at sales@kice.com. We'll need to know the MODEL and SERIAL NUMBER of your Kice Air Power Unit. For ready reference, please record this information and the date of delivery or installation on the lines below. See the General Information section for the location of model and serial number.

Model \_\_\_\_\_

Serial Number \_\_\_\_\_

Date of Delivery or Installation \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Additional Notes:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### 3. GENERAL INFORMATION

#### To The Owner

The purpose of this manual is to assist owners and operators with installing, maintaining and operating the Kice Air Power Unit. Please read it carefully; information and instructions furnished can help you achieve years of dependable performance. Separate manuals may be required for the auxiliary equipment. They contain additional information that may not be repeated in this manual. Please contact the Kice Customer Service Department if additional manuals are needed.

#### Using This Manual

General operation and maintenance guidelines are outlined for owners and operators of Kice Air Power Units. Operating conditions vary considerably and cannot be addressed individually. Through experience however, operators should have no difficulty in developing good operating, safety and monitoring skills.

The terms **“disconnect and lockout”** or **“lockout/tagout”** as used in this manual means that power to the Kice Air Power Unit has been disconnected through the use of a padlockable, manual power cutoff or power lockout switch pursuant to 29CFR1910.147.

Photographs and illustrations were current at the time of printing but subsequent production changes may cause your Kice Air Power Unit to vary slightly in detail. Kice Industries, Inc. reserves the right to redesign and change the air power unit as deemed necessary, without notification. If a change has been made to your Kice Air Power Unit that is not reflected in this owner’s manual or the Illustrated Parts Lists, write or call Kice Industries, Inc. for current information and parts.

#### Model and Serial Number

The model of the Kice Air Power Unit, serial number and date of manufacture can be found stamped on the metal identification plate (see Figure 1) located on the frame structure (see Figure 2).



Figure 1

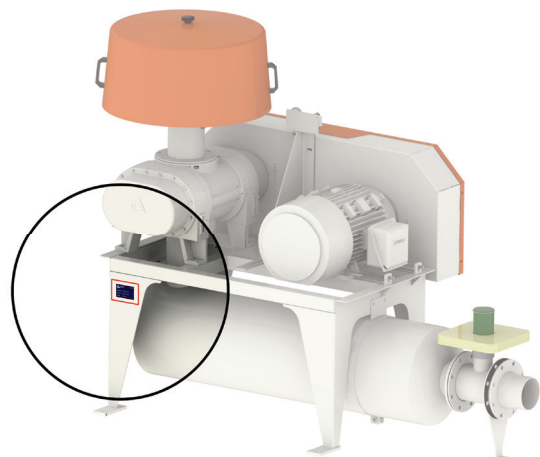


Figure 2

## GENERAL INFORMATION CONTINUED

### Kice Air Power Unit Parts and Service

Use original Kice Air Power Unit replacement parts only. These parts are available from Kice Industries, Inc. only. To obtain prompt, efficient service always provide the correct model and serial number when ordering parts:

For service or assistance ordering parts, contact the Customer Service Department or Quick Ship Department.

**Kice Industries, Inc.  
5500 Mill Heights Drive  
Wichita, Kansas 67219-2358  
Toll Free: (877) 289-5423  
Main Phone: (316) 744-7151  
Fax: (316) 744-7355**

**IMPORTANT:** Any unauthorized modification, alteration or use of non-approved attachments or drive units voids the warranty and releases Kice Industries, Inc. from any liability arising from subsequent use of this equipment. Each Kice Air Power Unit is configured to be used in a specific type of system, handling particular types of material. Using a Kice Air Power Unit for any purpose other than that for which it was designed could result in personal injury as well as product or property damage.

Kice equipment is designed and built to provide years of operation. As with any equipment, the following rules are essential for trouble-free operation:

- Proper installation.
- Regular maintenance.
- Correct operation within original design parameters.
- Proper application within a process.

Failure to properly install, maintain or operate Kice equipment can result in a variety of problems, including but not limited to: poor equipment performance, decreased equipment life, equipment failure, or dangerous operating conditions.

**NOTICE:** Purchased items (such as speed sensors, motors, and positive pressure pumps other than Kice branded) are covered by the manufacturer's warranty. If there is a problem with a purchased item, check with the local supplier or service representative.

## 4. SAFETY PRECAUTIONS

### Safety Symbols



This safety alert symbol is used to call your attention to an important safety message on equipment, safety decals and in manuals, to warn you of possible danger to your personal safety. When you see this symbol, be alert. Your personal safety or the safety of others may be affected. Follow the instructions in the safety message.

### Hazard Levels

The following definitions are used to identify hazard levels:



**DANGER (RED)** – Danger is used to indicate the presence of a hazard that **WILL** cause **SEVERE** personal injury, death or substantial property damage if the warning is ignored.



**WARNING (ORANGE)** – Warning is used to indicate the presence of a hazard that **CAN** cause **SEVERE** personal injury, death or substantial property damage if the warning is ignored.

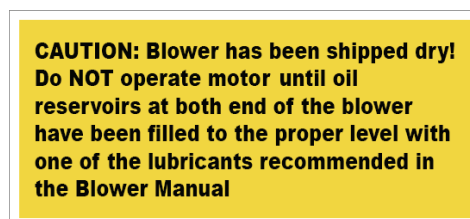


**CAUTION (YELLOW)** – Caution is used to indicate the presence of a hazard that **WILL** or **CAN** cause **MINOR** personal injury or property damage if the warning is ignored.

### Safety Decals

The Kice Air Power Unit decals should not be removed, covered, painted or otherwise become illegible. If this occurs they should be replaced immediately. Contact Kice Industries, Inc. Customer Service Department for replacements.

The following safety decals will be located on the Kice Air Power Unit. Look for them!



## SAFETY PRECAUTIONS CONTINUED



**WARNING:** All owners and operators should read this manual and be instructed in safe operating and maintenance procedures before attempting to uncrate, install, operate, adjust or service this equipment.

## SAFETY PRECAUTIONS

### WORK SAFELY AT ALL TIMES

- All energy sources associated with the air power unit must be locked and tagged out in compliance with 29CFR1910.147, local enforcement authorities, OSHA, and facility safety practices, before removing any protective cover, guard, grate or maintenance gate.
- Do not attempt to install, connect power, operate or service an air power unit without proper instruction and until you have been thoroughly trained in its use by your employer.
- It is the owner's and employer's responsibility to adequately train each operator in the proper and safe use of the air power unit. Written safety programs and formal instruction are essential. All new employees must be made aware of company policies, standard operating procedures (SOPs) and established health and safety procedures. Experienced employees should receive refresher training for potential hazards and up to date training records should be maintained at the job site.
- Assume at all times that power is "on". Treat all conditions as live. This practice ensures a cautious approach that may prevent an accident or injury.
- Before applying power to any equipment, make certain that all personnel are clear of the machine.
- Operate safely at all times. Use personal protective equipment (PPE) when and where appropriate, such as hard hats, helmets, gloves, earplugs, dust masks and eye protection devices. Keep personal protective equipment in good repair and convenient to the operator.
- The air power unit may also have factory supplied guards for rotating components. Do not connect power to or operate the air power unit unless all moving parts are completely enclosed and all guards, grates and maintenance panels are in place and securely fastened.
- All protective covers, guards, grates, maintenance panels, switches and warning decals must be kept in place and in good repair. Any equipment with a damaged, malfunctioning, defective, or missing protective device must be taken out of service until the protective device can be repaired or replaced.
- Do not abuse, overload, mistreat or misuse the air power unit or attempt to operate the Kice air power unit if it is in need of service, lubrication, maintenance or repair.
- The air power unit may be installed and programmed to start automatically or be controlled from a remote location. Keep clear of all moving parts on industrial equipment and on the air power unit at all times, until the POWER IS TURNED OFF AND LOCKED OUT.
- Do not attempt to work on, clean or service the air power unit, open or remove any protective cover, guard, grate, connection or maintenance panel until the POWER IS TURNED OFF AND LOCKED OUT. A main disconnect device must be installed to achieve this.
- The compressed air supply must be disconnected from the system before service and repair work is carried out. The switch-off devices for the compressed air supply, as with the electrical supply, are the responsibility of the distributing company (operator) of the overall system.
- During installation, the motor and frame of each piece of equipment including the air power unit, must be effectively and separately grounded in accordance with OSHA safety and health standards, the National Electrical Code, local codes and DIN EN 60204-1 or DIN EN 60439-1 as required for the classified area.
- High voltage and rotating parts can cause serious or fatal injury. Only qualified, trained, and experienced personnel should perform installation, operation, and maintenance of electrical machinery.
- All air power unit discharge openings must be completely connected to the piping system to prevent human access while the equipment is operating, and must remain connected until POWER IS TURNED OFF AND LOCKED OUT. Keep away from the moving parts of the air power unit during operation.



## SAFETY PRECAUTIONS CONTINUED

- If an air power unit is equipped with a maintenance panel incorporating any Protective Interlocking Limit Switch (PLS), the PLS must be interlocked with all electrical controls so that all motors or powered devices on the unit will be de-energized if any protected cover, guard, grate, or maintenance panel is open or removed. Never attempt to manually override or electrically bypass the PLS safety device. Interlock function of the PLS must be tested and logged daily by supervisory personnel.
- Air power units must be equipped with a properly functioning Protective Interlocking Electrical Control Switch (PCS), a Pad-lockable Manual Power Lockout Switch, along with the other basic safety equipment listed above. On-Off, interlock and padlock functions of the PCS must be tested and logged periodically by supervisory personnel.
- Any device powered by air or hydraulic pressure must be equipped with a properly functioning Padlockable Manual Pressure Lockout and Internal Pressure Relief Valve (PLV) capable of safely relieving motive pressure between the isolation valve and device.
- Any air power unit used in the processing of combustible materials or in hazardous environments require evaluation by the owner and regulatory bodies to determine appropriate air power unit monitoring equipment, dust control, explosion protection and electrical equipment enclosures. Do not use an air power unit in hazardous environments unless properly equipped for the hazard.
- Keep the workplace clean and free of dirt and dust at all times. Do not attempt to work on slippery or unsafe surfaces, ladders or work platforms when maintenance or repair work is being performed on an air power unit.
- The Operator must ensure that all piping and connections are laid away from access routes, ladders and steps.
- Adequate and proper lighting must be provided at the equipment location.
- Do not use a ladder or work platform unless it is in good repair and rated for the load required to complete required air power unit service.
- Never stand under any kind of hoists or lifting mechanisms whether or not it is loaded or in operation. Never stand under or near an air power unit or component when it is being lifted.
- The unit must be lifted by a means with sufficient lifting capacity.
- Never allow any kind of metal or other foreign objects to enter an air power unit while in operation.
- Special attention must be devoted to outside contractors engaged to enter and perform work on an air power unit in the workplace. Special care must be exercised to ensure all such personnel are fully informed of potential hazards and plant safety procedures. Special emphasis should be placed on the use of explosion proof electrical, cutting, or welding tools where required.
- Free outlet of product must be guaranteed at all times. Otherwise, blockage and severe damage may result, or a dangerous situation may occur.
- Actuation components must be inspected and adjusted after transportation and periodically as required by operating conditions. Check clevis pins, lock nuts, bolts holding the mounting bracket to the valve, lever arm on the position switch, air hoses to the high pressure 4-way valve, coupling alignment, set screws and keys, as appropriate to job conditions.
- It is ultimately the operator's responsibility to apply the above listed precautions and ensure proper air power unit use, maintenance and lubrication. Keep these instructions and list of warnings with your machine at all times.
- It cannot be assumed that every acceptable safety procedure is contained herein or that abnormal or unusual circumstances may not warrant or require additional procedures.
- Air power unit casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the air power unit and driving equipment can produce serious physical injuries. Do not reach into any opening in the air power unit 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 in operative any safety or protective devices.
- If air power unit is operated with piping disconnected, place a strong, coarse screen over the inlet and avoid standing in discharge air stream.
- Stay clear of the blast from pressure relief valves and suction area of the vacuum relief valves.
- Avoid extended exposure in close proximity to machinery with high intensity noise levels.
- Hearing protection may be required depending on silencing capabilities.

**WORK SAFELY AT ALL TIMES**

## 5. DELIVERY INSPECTION

The Kice Air Power Unit has been inspected at Kice and should be in excellent condition upon delivery. A thorough customer inspection of the Kice Air Power Unit should be completed upon receipt to verify its condition.

The Kice Air Power Unit and accessories should be inspected upon receipt for any shipping damage. Check for free operation of all moving parts before signing off on the receiver.

**NOTICE:** Delivery inspection should be completed before signing carrier's release.

When a carrier signs the Kice Industries, Inc. bill of lading, the carrier accepts responsibility for any subsequent shortages or damage, evident or concealed. Therefore any resulting claim must be made against the carrier by the purchaser. Evident shortage or damage should be noted on the carrier's delivery document before signature of acceptance. Inspection by the carrier for damage, evident or concealed, must be requested.

Complete a visual inspection paying particular attention to guards, overall external condition, protrusions (i.e. mating flanges, attachment points, valves, etc.) and safety decals while the Kice Air Power Unit is still secured to the freight platform.

## 6. STORAGE

Kice Air Power Units are shipped in many different configurations. Some units are completely assembled and skidded when size permits. These units may be handled and moved using good rigging techniques, being careful to avoid concentrated stresses that will distort any of the parts. Items or parts of the air power unit that are shipped knocked down will be clearly labeled for reassemble. If the air power unit is not to be installed promptly, store it in a clean, dry location to prevent rust and corrosion of steel components. If outdoor storage is necessary, protection should be provided. Cover the inlet and outlets to prevent the accumulation of dirt and moisture inside the body.

### Long Term Storage

1. Spray the interior (lobes, housing and end plates) with a rust preventative.
2. Fill both end reservoirs with the recommended level of oil.
3. Firmly attach a very prominent tag stating that the end reservoirs contain oil and must be drained and refilled to proper levels prior to startup.
4. Apply rust preventative grease to the drive shaft.
5. Attach a desiccant bag to either of the port fitting caps to prevent condensation from occurring inside the air power unit. Make sure any desiccant 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 air power unit.

## **STORAGE CONTINUED**

6. Store the air power unit in an air-conditioned and heated building if at all possible. At least insure as dry conditions as possible.
7. The pump should be stored with the shaft accessible, so that it can be rotated once or twice every two or three weeks.

## 7. INSTALLATION

The following instructions are intended to assist the installer with the assembly and installation of their Kice Air Power Unit but should not be considered a step-by-step instruction due to variations in the supplied product and site location. These variations could be due to application, customer specifications, orientations, etc. Any questions arising before or during installation should be directed to your Kice sales representative for clarification and recommendations.



**WARNING:** Use appropriate equipment when lifting or moving the Kice Air Power Unit. Make sure all persons and obstructions are clear from the path and installation area.

Figure 3 shows a typical complete installation of the air power unit and accessories. Note the absence of throttle or shut-off valves in either the inlet or the outlet line.

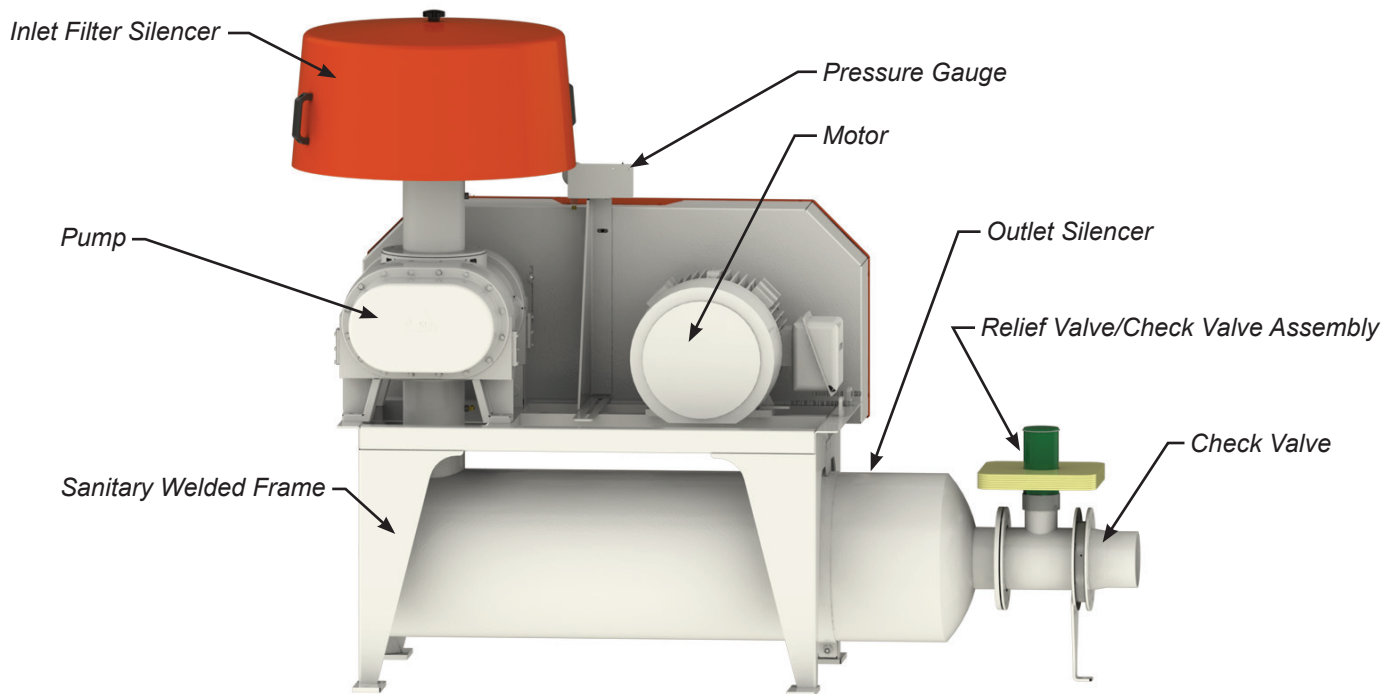


FIGURE 3

The Kice Air Power Unit should be installed in a protected indoor location, if possible. However, an unprotected outdoor installation will be satisfactory if correct lubrication for expected temperatures is provided (see lubrication section). Before starting the installation, remove plugs or covers (shipping seals) from the inlet and discharge connections. Inspect for dirt or foreign objects inside the tubing. Install the inlet filter; rotate the air power unit by hand to insure it will rotate freely. Before connecting the discharge to the conveying line, bump the motor and check for proper rotation. For best results, and long life, run the motor and air power unit for 10 to 20 minutes with no load, as a break-in period.

## INSTALLATION CONTINUED

For proper operation the pressure gauge must be vented. To do this, cut the top of the nipple off as is shown in Figure 4.

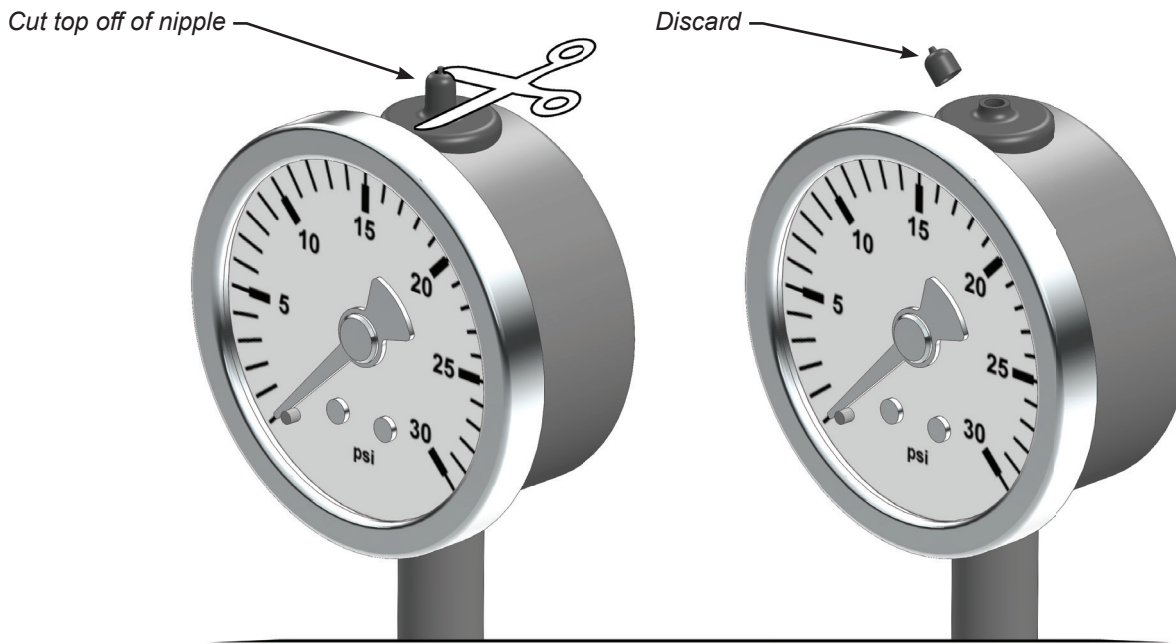


FIGURE 4

**IMPORTANT:** The air power unit has been factory mounted on the base, and the base should be leveled to insure proper lubrication, and even weight distribution. The floor may be uneven; therefore shims may be needed to prevent twisting the base, which may cause the air power unit to be twisted. If the air power unit is twisted or cramped, the lobes may contact the end plates, or the body. Rotating the shaft by hand will confirm if this has happened.

## INSTALLATION CONTINUED

### Slab-Mounted Units

A qualified engineer should design the foundation for the air power unit. The mass of the base must maintain the air power unit/driver alignment, absorb normal vibration, and resist lateral loads. The overall dimensions of the concrete base should extend at least six inches beyond the equipment. The weight of the slab should be two to three times the weight of the rotating assembly, including the motor. The foundation requires firmly anchored fasteners such as the anchor bolts shown in Figure 5. Refer to the drawings provided of your equipment for foot pad locations and equipment weight. Hammer drilled expansion fasteners can be used in less demanding applications.

Move the air power unit to the mounting location and lower it over the anchor bolts, leveling the air power unit with shims around the bolts. Fasten the air power unit securely, if grouting is used, shim the air power unit at least 3/4 inch from the concrete base (see Figure 5). **NOTE:** This includes anchor leg under the discharge (if supplied). When isolation is used, check the Kice drawing for installation instructions.

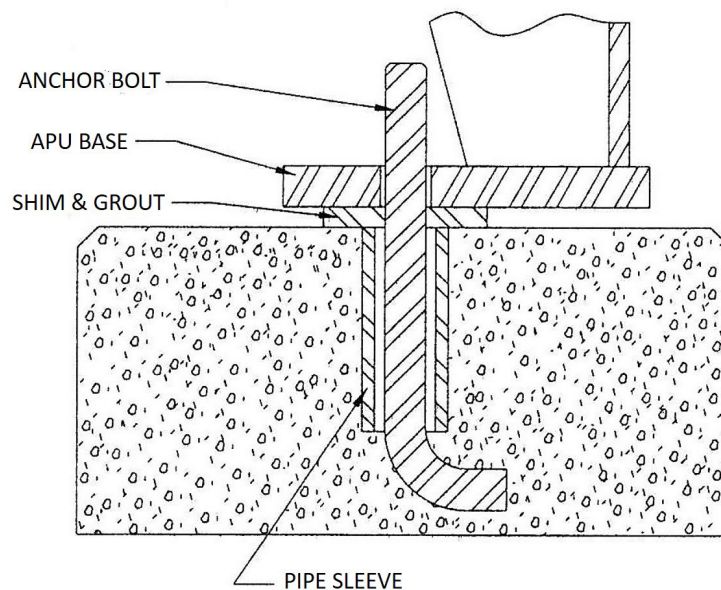


FIGURE 5

**IMPORTANT:** Check each foot for gaps between the foot and base and shim as necessary before tightening anchor bolts. A slight distortion to the frame when tightening anchor bolts can affect bearing and seal life as well as internal contact between parts.

## INSTALLATION CONTINUED

### Structural Steel-Mounted Units

When an elevated or suspended structural steel platform is used, it must have sufficient bracing to support the unit load and prevent side sway. The platform should be of welded construction to maintain permanent alignment of all members.

### V-Belt Drive

The V-Belt Drives are factory installed. In some cases the drives are removed to facilitate the installation of the air power unit, or the customer provides the drives. The following procedure should be used to mount the V-Belt Drives.

1. Remove all foreign material from the air power unit and motor shafts. Coat both shafts with machine oil for easier mounting. Mount the belt guard back plate at this time if partial installation is required prior to sheave mounting.
2. Mount sheaves on the shafts, checking Sheave bores and bushings for nicks or burrs. Avoid using force. If resistance is encountered, lightly polish the shaft with crocus cloth until the sheave slides on freely. Tighten tapered bushing bolts sequentially so that equal torque is applied to each.
3. Adjust the motor on its base to a position closest to the air power unit shaft. Install belts by working each one over the sheave grooves until all are in position. Never pry the belts into place. On Kice air power units, sufficient motor adjustment is provided for easy installation of the proper size belts.
4. Adjust sheaves and the motor shaft angle so that the sheave faces are in the same plane. Check this by placing a straightedge across the faces of the sheaves. Any gap between the edge and sheave faces indicates misalignment. Important: This method is only valid when the width of the surface between the belt edge and the sheave face is the same for both sheaves. When they are not equal, or when using adjustable pitch sheaves, adjust so that all belts have approximately equal tension. Both shafts should be at right angles to the center belt.

### Belt Tensioning

1. Check belt tension with a tensioning gauge and adjust using the motor slide base (see Figure 6). Excess tension shortens bearing life while insufficient tension shortens belt and bearing life, and can have adverse affects on air power unit performance and may cause vibration. The lowest allowable tension is that which prevents slippage under full load. Belts may slip during start up, but slippage should stop as soon as the air power unit reaches full speed. For more precise tensioning methods, consult the drive manufacturer's literature.
2. Recheck set screws, rotate the drive by hand and check for rubbing, then complete the installation of the belt guard.
3. Belts tend to stretch somewhat after installation. Recheck tension after several days of operation. Check sheave alignment as well as setscrew and/or bushing bolt tightness.

## INSTALLATION CONTINUED

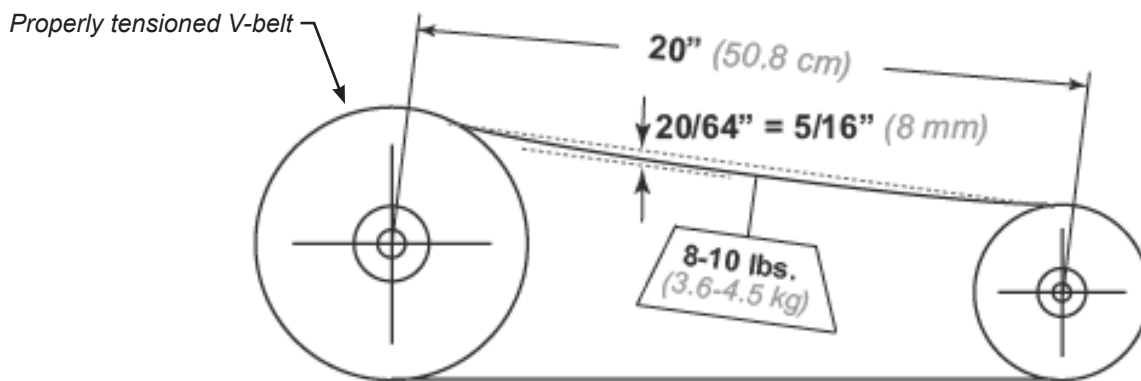


FIGURE 6

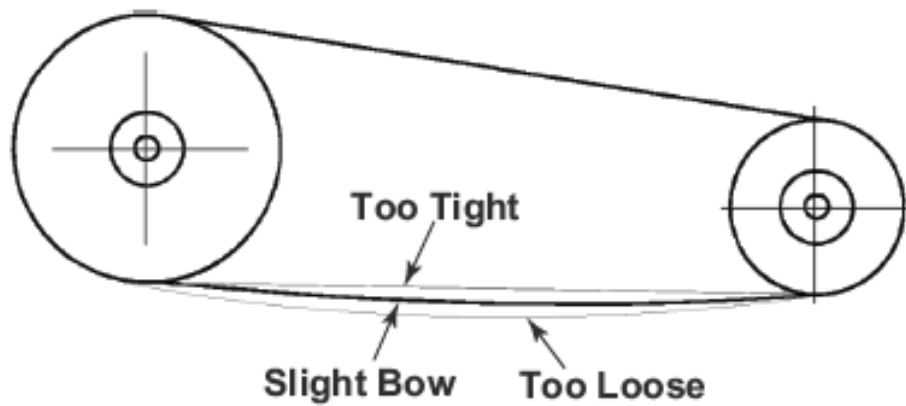


FIGURE 7



## INSTALLATION CONTINUED

### V-Belt Troubleshooting

If problems occur with V-belt installation, use and wear refer to the table below for potential solutions.

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

INSTALLATION CONTINUED



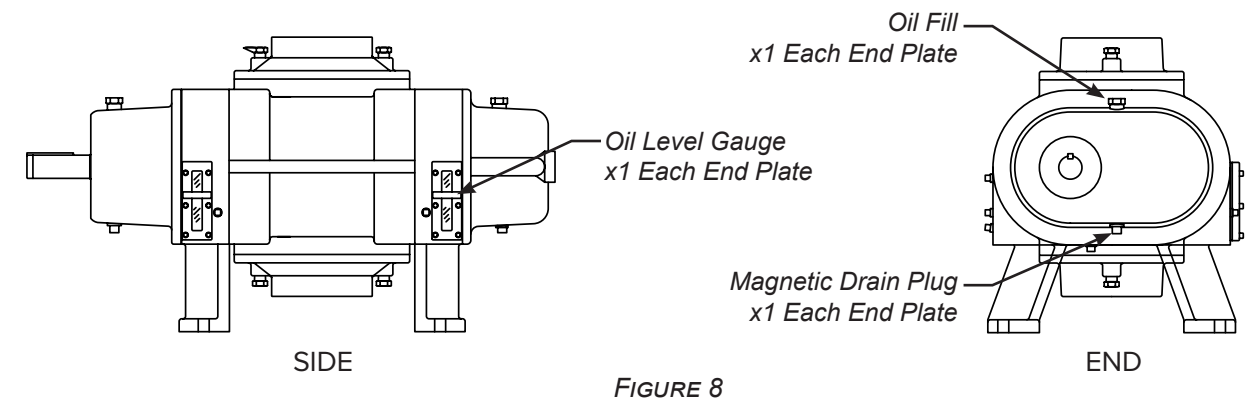
**WARNING:** High voltage and rotating parts can cause serious or fatal injury. Only qualified personnel should perform installation, operation and maintenance of electrical machinery. Make sure that any electric motor and the frame of the filter is effectively grounded in accordance with OSHA standards, the National Electrical Code and local codes.

Lubrication

Every Kice Air Power Unit is factory tested, oil drained, and shipped dry to its installation point. Both independent oil reservoirs (one on each end of the air power unit) must be filled to proper level before operation.

Shaft bearings at the gear end of the air power unit are splash lubricated by one or both gears dipping into the oil reservoir formed in the end plate and cover. A slinger assembly dipping into the oil reservoir lubricates shaft bearings at the free end of the air power unit. Before starting the air power unit, fill sumps as instructed below:

- 1. Remove fill plugs from gear end and free end covers.
- 2. Pour oil through fill hole slowly until oil appears in oil sight glass. Slowly bring oil up to proper level (see Figure 8).
- 3. Replace plugs in end covers.



**NOTICE:** Kice recommends the use of MD full synthetic food grade oil.

Approximate Oil Capacities - Total Per Unit			
Model	Capacity	Model	Capacity
PD-2000	3/4 Qt.	PD-2500	3/4 Qt.
PD-3000	1-3/4 Qt.	PD-4000	1-3/4 Qt.
PD-5000	2-3/4 Qt.	PD-6000	2-3/4 Qt.

## INSTALLATION CONTINUED

**NOTICE:** Lubrication should be checked regularly during operation. Time lapse between oil changes will have to be determined for each individual installation and normally will be between 800-1200 operating hours.



**WARNING:** Never attempt to change or add oil while air power unit is running. Failure to heed this warning could result in damage to the equipment or personal injury.

Blower Model Kice PD	Kice Lube Kit Part Number	Fill Points	Gear End (oz)	Free End (oz)	Total (oz)	Filter Replacement Part Number (Typical)
PD2000, PD2500	BlowerLubeKit1	2	12	12	24	1-1156-03
PD3000, PD4000	BlowerLubeKit2	2	28	28	56	1-1156-03
PD5000, PD6000	BlowerLubeKit3	2	44	44	88	1-1156-04

## 8. OPERATION & START-UP PROCEDURE

### Operation Characteristics

The Kice Air Power Unit is a positive displacement type unit, whose pumping capacity is determined by size, operating speed, and pressure conditions. It employs dual lobe rotors rotating in opposite directions within a housing closed at the ends by end plates.

Effective sealing of the air power unit inlet area to the discharge area is accomplished by use of very close operating clearances. Resulting absence of moving contacts eliminates the need for any internal lubrication. Clearances between the rotors during rotation are maintained by a pair of accurately machined helical timing gears, mounted on the two shafts extended outside the air chamber. The two intermeshing rotary lobes are designed to rotate and trap air or gas between each rotor and the housing. As the rotor lobes rotate past the edge of the suction port the trapped air or gas is essentially at suction pressure and temperature since the air power unit is a constant volume device, the trapped air remains at suction pressure until the leading rotor lobe opens into the discharge port. Immediately, the high-pressure air in the discharge line compresses the low-pressure air to discharge pressure. The rotors continue to rotate and force the air from the air power unit into the discharge line.

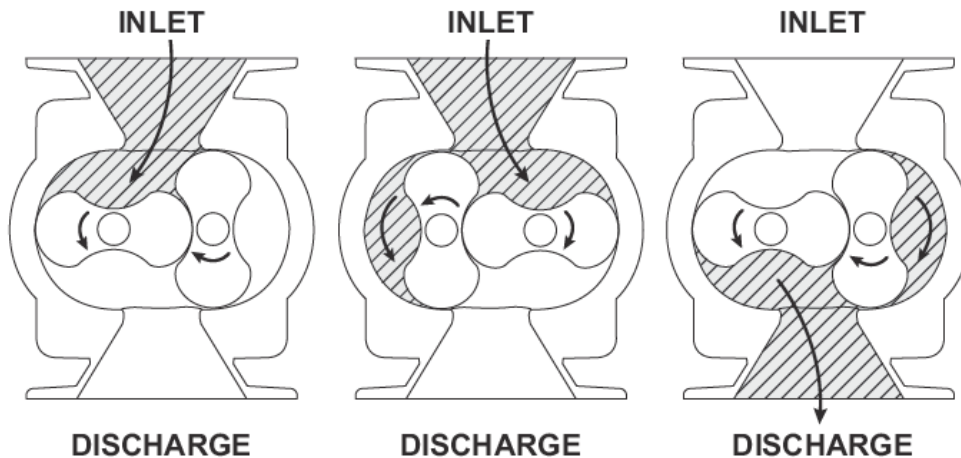


FIGURE 9

It can be seen by the illustration that the air moves not between the rotors but between the rotors and the side of the housings. Also, the rotation of the air power unit can make either side the inlet or discharge.

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

## OPERATION & START-UP PROCEDURE CONTINUED

A V-belt drive is employed to obtain the correct air power unit speed. If conditions change from the design criteria, field changes can be made to the drive by changing the diameter of one or both sheaves to obtain the desired capacity and speed. To protect the air power unit from back flushing of material, a check valve in the piping on the air power unit discharge is installed on all applications.

Consult your Kice sales representative if questions arise.

### Operation Limitations

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

Example: The listed maximum allowable temperature limit (the limit is a function of the temperature rise as well as the inlet temperature) for any particular air power unit may occur well before the maximum speed or maximum pressure rating is reached. Temperature rise then becomes the limiting condition. In other words, the operating limit is always to be determined by the maximum rating reached first, and it can be anyone of the four:

1. Pressure Differential
2. Discharge Temperature
3. Horsepower
4. Blower Speed

Kice Air Power Units that are for pressure/vacuum service have been selected to provide proper volume within the pressure, temperature and horsepower range of the machine, to perform as required. The above factors are listed in the following table for Kice Air Power Units.

Blower Model Number	Maximum Pressure/ Vacuum	Maximum Discharge Temperature	Maximum Break Horsepower	Maximum Blower Speed
PD-2000	15 psig/15" h.g. 1 bar/0.5 bar	280° F 128° C	10 hp 7.5 kW	3600 RPM
PD-2500	15 psig/15" h.g. 1 bar/0.5 bar	280° F 128° C	20 hp 15 kW	3600 RPM
PD-3000	15 psig/15" h.g. 1 bar/0.5 bar	320° F 160° C	40 hp 30 kW	3600 RPM
PD-4000	15 psig/15" h.g. 1 bar/0.5 bar	320° F 160° C	65 hp 48.5 kW	3000 RPM
PD-5000	15 psig/15" h.g. 1 bar/0.5 bar	280° F 138° C	80 hp 59.7 kW	3000 RPM
PD-6000	15 psig/15" h.g. 1 bar/0.5 bar	280° F 138° C	120 hp 89.5 kW	3000 RPM

## OPERATION & START-UP PROCEDURE CONTINUED

### Flow Direction by Rotation

Kice Air Power Units are standardized top inlet, bottom discharge with left hand shaft location, counter clockwise rotation.

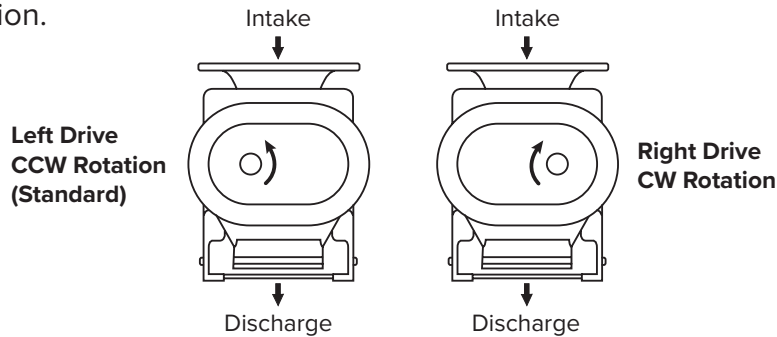


FIGURE 10

### Operation / Start Up

Before starting the air power unit for the first time under power, recheck the installation thoroughly to reduce the possibility of problems. Use the following checklist as a guide, but also consider any other special conditions in your installation.

1. Be certain the air power unit has been installed level, using shims if needed so that the frame is not distorted.
2. Be certain no bolts, rags or dirt have been left in the air power unit.
3. Be certain that inlet piping is free of debris. Inlet must be protected with an inlet filter.
4. Check drive alignment, belt tension and tightness of all mounting bolts.
5. Be certain that the oil is at the proper level in both ends of the air power unit, when not operating.
6. Be certain that the electrical motor is properly lubricated, and that the starter is set for the proper amperage and voltage.
7. Rotate the air power unit shaft several times by hand to make sure air power unit is rotating freely. Unevenness or tight spots is an indication of a problem.
8. Check motor rotation by momentarily pushing the start button (BUMPING) and check flow direction of the air power unit. Reverse the motor connections if flow is in the wrong direction.

Initial operation should be carried out under “no load” conditions by not starting the airlock valves to feed material into the conveying line, or by disconnecting the discharge of the air power unit from the conveying line and venting the discharge to atmosphere. Start the motor briefly, listen for unusual noises, and check that the air power unit coasts freely to a stop. If any questions exist, investigate before proceeding further.

Assuming all tests are satisfactory, the air power unit 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 air power unit is part of a process system where conditions will vary. At the first opportunity, stop the air power unit and clean or remove inlet filter. Also, recheck leveling, belt alignment, tension, and mounting bolts for tightness.

## 9. MAINTENANCE AND SERVICE



**WARNING:** When performing maintenance, all energy sources associated with the air power unit must be locked and tagged out in compliance with 29CFR1910.147, local enforcement authorities, OSHA, and facility safety practices, before removing any protective cover, guard, grate or maintenance gate. Removal of transitions which expose hazards such as nip points of an air power unit also require lockout and tagout precautions be employed.



**WARNING:** Review all Safety Precautions noted in the manual before performing maintenance on equipment.

The key to long and trouble free air power unit operation is good maintenance practices. Periodically inspect the air power unit for damage from foreign materials or wear. Particular attention should be paid to lubrication of timing gears and bearings in accordance with comments under the Lubrication Section of this manual (see Section 7). Also service the drive per manufacture instructions and lubricate the coupling or check belt drive tension. By use of thermometers and gauges, make sure the air power unit operating temperature and pressure remain within allowed limits.

A majority of the operating problems that occur with an air power unit can be traced to improper adjustments and delayed, or neglected, maintenance. A consistently applied maintenance program will prevent many problems.

A thorough understanding of the air power unit is a must if the operating problems are to be corrected satisfactorily. A good rule to follow when troubleshooting a problem is to never make more than one adjustment at a time, thereby isolating the problem by a process of elimination. The cause of a problem is usually simple and is easy to pinpoint if you systematically check each system and function.

When an air power unit 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 air power unit should be protected immediately.

Should adjustments or replacements eventually be needed, these can often be performed locally as described in this manual after obtaining required parts. Personnel should have a good background with mechanical experience and be thoroughly familiar with these instructions. Major repairs not covered in this manual should be referred to the nearest Kice service representative.

MAINTENANCE AND SERVICE CONTINUED

Maintenance Schedule

Daily	Weekly	Monthly
<div>1. Check and maintain oil level, and add oil as necessary.</div> <div>2. Check for unusual noise or vibration.</div>	<div>1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the blower and cause overheating and oil usage.</div> <div>2. Check the relief valve to make sure it is operating properly.</div>	<div>1. Inspect the entire system for leaks.</div> <div>2. Inspect the condition of the oil and change if necessary.</div> <div>3. Check drive belt tension and tighten if necessary.</div>

**Note:** Over lubrication can be an issue as well as under lubrication.

Replacement Parts

It is recommended that only Kice supplied replacement parts be used. Kice parts are built to be fully compatible with the original air power unit using specific alloys and tolerances. These parts carry a standard Kice warranty.

When ordering replacement parts, specify the part name, the Kice serial number and the air power unit model and size. Most of this information is on the metal nameplate attached to the air power unit.



## 10. TROUBLESHOOTING - COMMON AIR POWER UNIT PROBLEMS



**WARNING:** Review all Safety Precautions noted in the manual before performing maintenance on equipment.

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.
	Loose drain plug	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication	Correct oil level. Replace dirty oil.
	Excessive belt tension	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment	Check carefully. Re-align if necessary.
Lack of volume	Slipping belts	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances	Check for proper clearances.
	Speed too low	Increase blower speed within limits.
	Obstruction in piping	Check system to ensure an open flow path.
Knocking	Blower 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.
Oil coming out of breather caps	Breather caps not installed	Install breather caps.
	Improper lubrication	Correct oil level. Replace dirty oil.
Oil coming out of vent ports	Improper lubrication	Correct oil level. Replace dirty oil.

## TROUBLESHOOTING CONTINUED



**WARNING:** Review all Safety Precautions noted in the manual before performing maintenance on equipment.

Symptom	Probable Cause	Remedies
Excessive blower temperature	Too much or too little oil in gear reservoir	Check oil level.
	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, clean filter.
	Worn lobe clearances	Check for proper clearances.
Rotor end or tip drag	Insufficient assembled clearances	Correct clearances.
	Case or frame distortion	Check mounting and pipe strain.
	Excessive operating pressure	Reduce pressure differential.
	Excessive operating temperature	Reduce pressure differential or reduce inlet temperature.
Vibration	Belt or coupling misalignment	Check carefully. Re-align if necessary.
	Lobes rubbing	Check cylinder for hot spots, and then check for lobe contact at these points. Correct clearances.
	Worn bearings or gears	Check condition of gears and bearings. Replace if necessary.
	Unbalanced or rubbing lobes	Possible build-up on casing or lobes, or inside lobes. Remove build-up and restore clearances.
	Driver or blower loose	Check mounting and tighten if necessary.
	Piping resonance	Check pipe supports, check resonance of nearby equipment, and check foundation.

## 11. DISASSEMBLY OF AIR POWER UNIT



**WARNING:** When performing maintenance, all energy sources associated with the air power unit must be locked and tagged out in compliance with 29CFR1910.147, local enforcement authorities, OSHA, and facility safety practices, before removing any protective cover, guard, grate or maintenance gate. Removal of transitions which expose hazards such as nip points of an air power unit also require lockout and tagout precautions be employed.



**WARNING:** Review all Safety Precautions noted in the manual before performing maintenance on equipment.

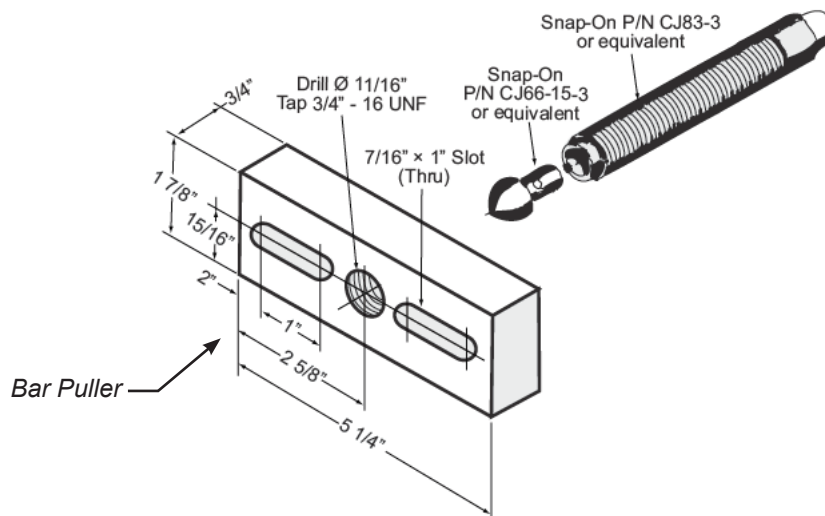


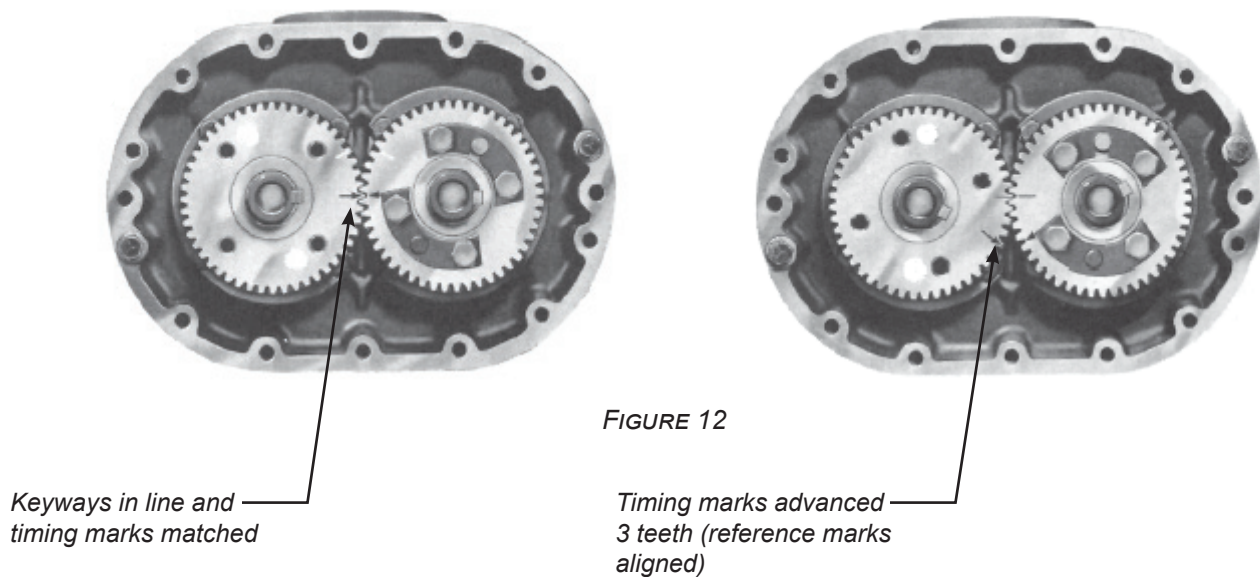
FIGURE 11

### Disassembly of Air Power Unit

1. Make sure that all oil is drained from air power unit and remove the port fittings.
2. Remove the spanner lock nut, dust washer, screws, and seal adapter housing. Tap out the seal and discard O-rings. Remove the spacers, and discard the O-ring.
3. Remove the cap screws from the gear end cover.
4. Remove the gear end cover using the beveled chisel and hammer, unless jackscrew holes have been provided.
5. Remove the snap ring from drive shaft.
6. Using the gear pullers, remove the drive shaft bearing.
7. Remove the drive shaft.
8. Remove the gear lock nuts and locks.
9. Align the timing marks (See Figure 12 on timing gears).
10. Rotate the drive gear in a clockwise rotation approximately 4 or 5 teeth and mark this location (see Figure 12). 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
11. Using the gear pullers, pull the driven gear first.

## DISASSEMBLY OF AIR POWER UNIT CONTINUED

12. After removal of the driven gear, continue with pulling the drive gear.
13. Remove the gear end bearing retainer rings, exposing the bearings.
14. Remove the cap screws and free the end cover, exposing the oil slinger assembly.
15. Remove the flat-head socket screw from the oil slinger and gently pry the oil slinger from the shaft (on some models).
16. Remove the flat-head socket screw and washer from the opposite rotor.
17. Use the bar pullers (see Figure 11) and attach to free end plate bores. Using the bar pullers, pull the free end plate from rotor shafts.
18. Attach the bar puller to the gear end plate bore and push out the rotors, one at a time.
19. Using a rubber mallet, tap the end plate from the housing.
20. Using a soft metal punch and a mallet, tap out the bearings from the end plate bores.
21. Using a bevel chisel, remove the seals from end plate bores.
22. On air power units with labyrinth seals installed, remove the labyrinth seals with a beveled chisel and hammer, if necessary.
23. Inspect all parts for wear and serviceability.



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

## 12. ASSEMBLY OF AIR POWER UNIT

### Assembly of Air Power Unit

The assembly procedure is generally the same for all models. Dowel pins are used to locate end plates, housing and end covers in their proper location relative to each other. Be sure they are in place.

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

Make sure all parts are clean and free of any nicks or buns caused by disassembly. Refer to Special Tools section of this manual (Section 13) for pressing tools as well as other assembly tools required.

It is suggested that long feeler gauges (12") be used to check the interlobe timing. Preferably (2) .006, (1) .005, (1) .004, and (1) .003. This will give you all the combinations from .003 to .024.



**CAUTION** – All Hex head cap screws used on Kice Air Power Units are metric. The use of anything other than metric cap screws will result in thread damage. All pipe plug holes are American Standard Pipe Thread.

### Preparation of End Plate and Rotors for Assembly

1. In air power units that have labyrinth seals, position the labyrinth seals with the slots pointing up and press one seal into each end plate bore.
2. In air power units that use lip seals as a means of sealing, apply a smooth coating of Permatex #2 or silicone sealer to the outer diameter (OD) edge of the seal shell. Press a lip seal into each end plate bore, making sure the seal "lip" is facing up, or toward the oil. Apply grease to lip seals only.
3. In air power units that require mechanical seals, apply a smooth coating of silicone to the OD of the seal shell as in step 2. Position the mechanical seal with the carbon face up and press the seal into each end plate bore. Wipe the carbon with soft tissue and acetone or similar cleaner. Make sure the seal is fully seated and the shell is not deformed. Make sure the carbon is not scarred or cracked. Mating rings will be seated later in the assembly procedure.

### Gear End Assembly

4. Stand the rotors on the free end in the arbor press. Make sure both keyways are in line and point to the right. 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.
5. Place the gear end plate with the seals installed on the rotor shafts. Make sure the threads on the rotor shafts do not damage the seals.
6. Air power units with mechanical face seals must have mating rings installed. Make sure the surface is clean, and gently place a few drops of clean oil on the seal face for lubrication. Install the mating ring (lapped surface) against the carbon face.

## ASSEMBLY OF AIR POWER UNIT CONTINUED

7. Lightly coat the rotor shaft with anti-seize compound or equivalent.
8. Using flush-ground bearings on the gear end only, press the bearings onto the 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) on the inner race. Install with dot up. Do not use bearings that have not been flush ground to within a .001" (.025 mm) tolerance.

9. Install the oil retainer (4000 models only).
10. Install the bearing retainer ring and lock plates on all series air power units.
11. Check the clearance between the gear end plate and rotor lobe ends. Correct clearances are listed in Assembly Clearances on page 33.

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

12. Stand the rotors on the arbor press with the gear end shafts up and both keyways facing to the right. The drive rotor should be on the left.
13. Install the gear end plate, making sure the feet are facing in the correct direction, over the rotor shafts and coming to rest on top of the rotor lobes. Be careful not to damage the seals.
14. In air power units that have mechanical face seals, check the lapped surface of the 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 the shaft with the lapped surface coming to rest on top of the carbon. Gently press with fingers to make sure compression is taking place and the ring is not hung up for any reason.
15. Lubricate the shafts and press the double row ball bearings on the rotor shafts and into the end plate bores. Secure with retainer rings and screws.

**NOTICE:** 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 the bearings are installed.

16. Check clearance between the face of the end plate and the rotor lobes. See Figure 13 for correct gear and clearances. If clearances are not within specifications, recheck the parts to find and correct the cause of improper clearances before proceeding.
17. Install spacer (0.260 in. [6.60 mm] thickness) and oil slinger on the other shaft.

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

18. Install the timing shim in the same location as found in disassembly. This does not necessarily ensure the air power unit will be in proper time. Adjustments can be made later in the assembly process.
19. Insert the gear keys into the rotor shaft keyways. Loose fits are not acceptable.

## ASSEMBLY OF AIR POWER UNIT CONTINUED

20. Lubricate the shafts and install the drive gear (right hand helix) on the drive rotor (left side). To install the driven gear, align the reference marks as shown in Figure 12. Install the driven gear carefully to avoid mashing any teeth when engaging the opposite gear.
21. Install the washers and flat-head allen screws.
22. Remove the assembly from the press and stand it on the work table with the gears down. Place blocks under the end plate to prevent the assembly from falling over. The drive gear should remain on the left side.
23. Place a small bead of an RTV silicone type sealer around the periphery of the end plate and encircling each bolt hole.
24. Install the rotor housing and secure with four screws evenly spaced.
25. Check clearances between the end of the lobes and the housing using a flat bar and feeler gauges or a depth micrometer. See Figure 14 for free end clearances.

## Free End Assembly

26. On single and double envelope series, put sealer on the free end plate (same as step 15).
27. Install the free end plate and secure it with 4 screws.
28. On single and double envelope series, repeat step 7.
29. In air power units that have mechanical face seals, install the bearing spacers (0.063 in. [0.06 mm] thickness) on each shaft. Lubricate the shafts and tap on the bearings.
30. Install the oil retainer rings with button-head screws.
31. Install the oil slinger on lower rotor (either shaft on vertical-flow air power units), spacer on the opposite shaft, washers, and screws.

## Adjusting Rotor Interlobe Clearance

32. Lay the air power 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 13. 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 0.006 in. (0.16 mm) will change the rotor lobe clearance one-half the amount: 0.003 in. (0.08 mm).

**EXAMPLE:** See Figure 13, check the clearance at AA (left-hand reading) and BB (right-hand reading). If AA reading is 0.003 in. (0.08 mm) and BB reading is 0.009 in. (0.24 mm), by removing 0.006 in. (0.16 mm) of shim, the readings will change one-half the amount removed or 0.003 in. (0.08 mm). AA should then read 0.006 in. (0.16 mm) and BB should read 0.006 in. (0.16 mm). The final readings should be within 0.002 in. (0.05 mm) of each other.

To determine the amount of shim to add or remove, subtract the smaller 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.



## ASSEMBLY OF AIR POWER UNIT CONTINUED

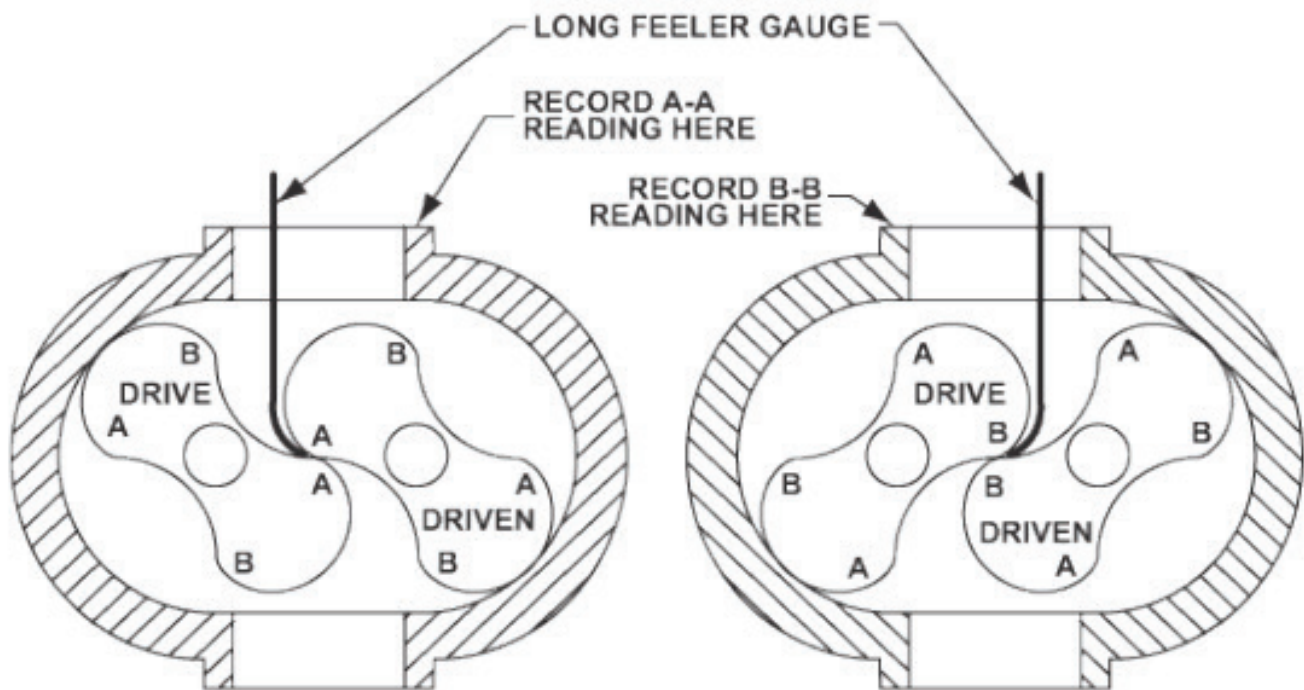


FIGURE 13

33. Install the drive shaft and secure with allen screws. Check drive shaft runout at the seal journal. Do not exceed 0.002 in. (0.05 mm) TIR. Install the lockwire.
34. Install the bearing on the drive shaft and secure with the retaining ring. The shield side of the bearing must face outward.
35. Remove the temporary cap screws from each end plate and install the cover gasket and gear end cover. Make sure the dowel pins are in place. Sealer is not required on factory supplied gaskets. Secure with cap screws and washers.
36. Coat the OD of the drive shaft seal with sealer, and grease the ID. Install carefully over the keyway and tap into the cover.
37. Install the free end cover with gasket, and secure with cap screws and washers.
38. Install the port fittings, gaskets, and secure with cap screws and washers.



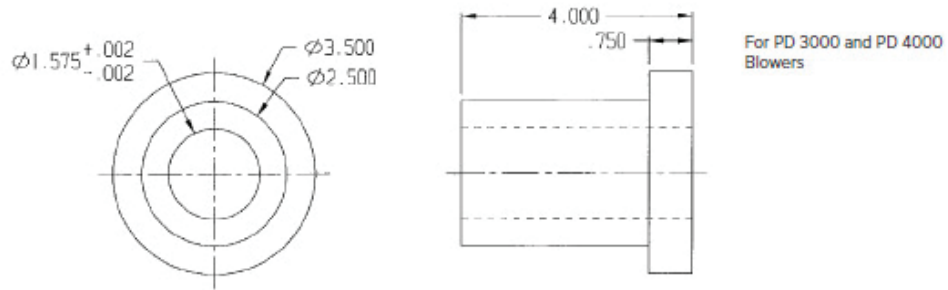
## ASSEMBLY OF AIR POWER UNIT CONTINUED

### Assembly Clearances

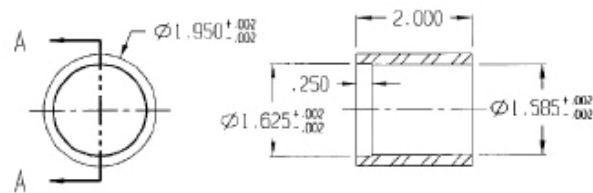
	Gear End	Free End	Total End	Tip-Port	Tip-Dowel	Interlobe
	Min/Max	Min/Max	Min/Max	Min/Max	Min/Max	Min/Max
<b>PD-2000</b>	0.003	0.005	0.011	0.003	0.006	0.006
	0.006	0.011	0.014	0.007	0.010	0.010
<b>PD-2500</b>	0.003	0.007	0.013	0.003	0.006	0.006
	0.006	0.013	0.016	0.007	0.010	0.010
<b>PD-3000</b>	0.004	0.005	0.013	0.003	0.007	0.008
	0.008	0.014	0.018	0.009	0.009	0.012
<b>PD-4000</b>	0.004	0.007	0.015	0.003	0.007	0.008
	0.008	0.014	0.018	0.009	0.009	0.012
<b>PD-5000</b>	0.004	0.010	0.018	0.003	0.007	0.010
	0.008	0.017	0.021	0.009	0.009	0.014
<b>PD-6000</b>	0.004	0.011	0.019	0.003	0.007	0.010
	0.008	0.018	0.022	0.009	0.009	0.014

FIGURE 14

# 13. SPECIALS TOOLS

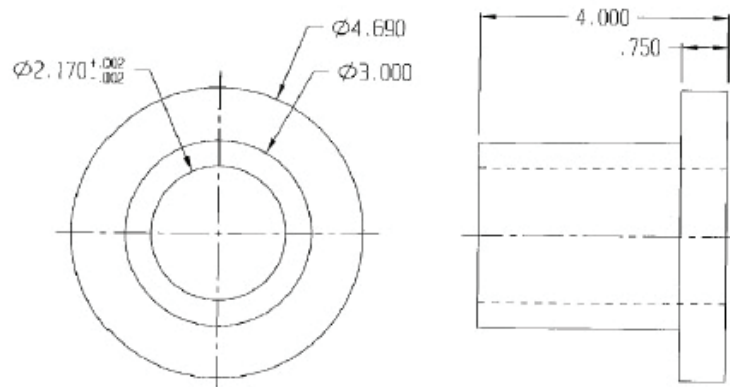


LIP SEAL AND BEARING PRESSING TOOL

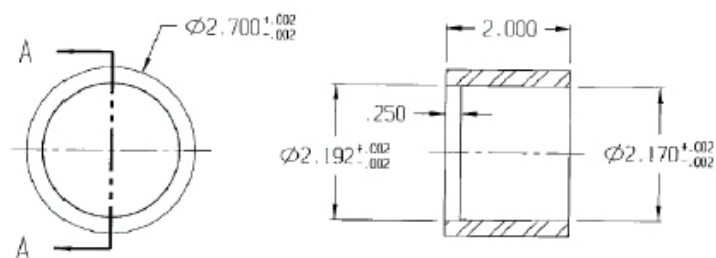


SLEEVE PRESSING TOOL  
(USE WITH BEARING PRESSING TOOLS)

For PD 5000 and PD 6000 Blowers



LIP SEAL AND BEARING PRESSING TOOL



SLEEVE PRESSING TOOL  
(USE WITH BEARING PRESSING TOOLS)

## 14. TORQUE VALUES FOR MAINTENANCE AND INSTALLATION

Recommended U.S. BOLT TORQUE* Coarse thread only							
		SAE Grade 5	SAE Grade 5	SAE Grade 8	SAE Grade 8	Socket head cap screw	Socket head cap screw
Bolt Dia.	Thread Size	lb – ft	N – m	lb – ft	N – m	lb – ft	N – m
1/4	20	8.4	11	12	16	11	15
5/16	18	17	24	25	33	23	31
3/8	16	31	42	44	59	41	55
7/16	14	49	67	70	95	65	89
1/2	13	74	100	110	140	100	140
9/16	12	100	140	150	210	140	200
5/8	11	140	190	210	290	200	270
3/4	10	240	330	380	510	350	480
7/8	9	390	520	610	820	570	770
1	8	570	780	910	1100	850	1200
1-1/8	7	790	1100	1300	1700		
1-1/4	7	1100	1500	1800	2500		
1-3/8	6	1500	2000	2400	3200		
1-1/2	6	1900	2600	3200	4300		
1-5/8	5.5	2400	3300	4300	5900		
1-3/4	5	3000	4100	5000	6800		
2	4.5	4500	6100	7500	10000		

\*Values above are approximations; consult with the manufacturer for torque data.  
Significant variation may exist within the same grade and size between manufacturers.

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