KINNEY®

Kinney®
Mechanical Vacuum Boosters

Manual 2004 Rev B p/n 002004 0000

WARNING: Do Not Operate Before Reading Manual

Mechanical Vacuum Boosters
OPERATOR'S MANUAL

Models

7010	7021
7013	7026
7017	

33/91 Series - Horizontal Flow
31/90 Series - Vertical Flow

800.825.6937 | www.kinneyvacuum.com

Original Instructions

Disclaimer Statement:
All information, illustrations and specifications in this manual are based on the latest information available at the time of publishing. The illustrations used in this manual are intended as representative reference views only. Products are under a continuous improvement policy. Thus, information, illustrations and/or specifications to explain and or exemplify a product, service or maintenance improvement may be changed at any time without notice.

Product information and specifications subject to change.

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1. INTRODUCTION

CONGRATULATIONS on your purchase of a new **Mechanical Vacuum Booster** from **Kinney®**. Please examine the booster for shipping damage, and if any damage is found, report it immediately to the carrier. If the booster 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 booster is stored outdoors be sure to protect it from weather and corrosion.

This manual covers the installation, operation and maintenance of model 7000 mechanical vacuum boosters. The boosters are manufactured for either a vertical flow or a horizontal flow. Most in-field drive conversions can be readily accomplished by changing the location of a few external parts.

Mechanical Vacuum Boosters 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 booster. We have tried to make these instructions as straightforward as possible. We realize getting any new piece of equipment up and running in as little time as possible is imperative to production.

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

1.1 APPLICABLE DOCUMENTATION

The applicable documents associated with this manual are:
- 2006/42/CE – Machinery Directive
- EN 1012-2:1996 - Compressors and vacuum pumps - Safety Requirements - Part 2: Vacuum Pumps

1.2 SCOPE OF MANUAL

The scope of this manual ncludes the bare shaft booster.

1.3 GRAPHIC CONVENTIONS IN MANUAL

This manual is the result of a risk assessment according to the applicable documents referenced in section 1.1. The following are hazard levels are referenced within this manual:

DANGER
Indicates an immediate hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Indicates that a physical injury or damage to health or property, if not avoided, could occur.

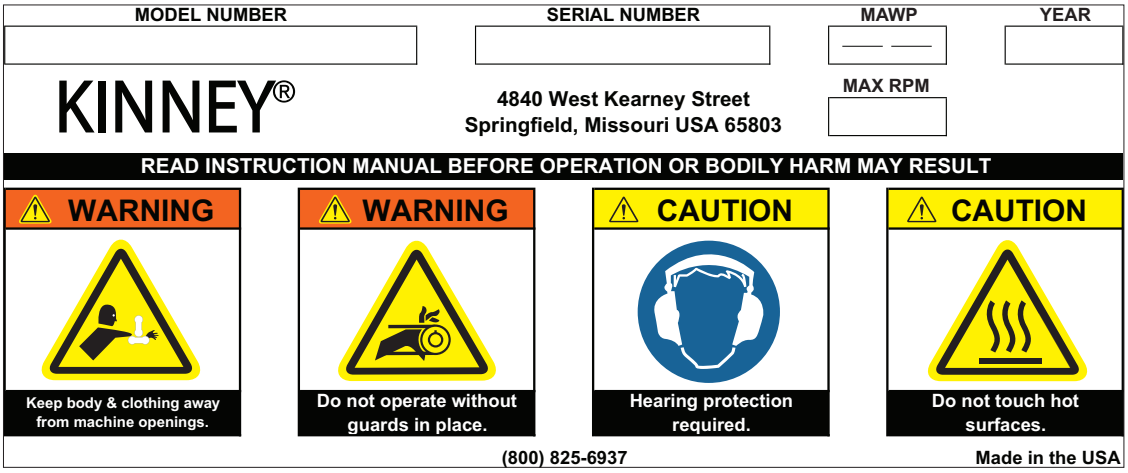
CAUTION
Indicates that a potential hazard may occur which, if not avoided, could result in minor or moderate injury.

NOTE
Indicates a statement of information which, if not avoided, could cause damage to the product.

CAUTION

Read manual before operation or bodily harm may result. Attention should be given to the safety related sections of this manual.

1.4 DATA PLATE



General Operation and Symbols on Data Plate - The following information is contained on the data plate:

WARNING

Keep body & clothing away from machine.

During operation, keep body and clothing away from inlet and outlet of the booster.

WARNING

Do not operate without guards in place.

CAUTION

Hearing protection is required while the booster is in operation. Noise levels may reach as high as 81 dBA.

CAUTION

Do not touch hot surfaces.

The upper limit of the booster operation is 190° C (375 °F). Do not touch the booster while it is in operation and assure booster is cool when not in operation.

MODEL NUMBER: This identifies the specific model of the booster.

SERIAL NUMBER: Each booster has a unique serial number. This number is to be used with any service issues and with any contact with the manufacturer.

YEAR: This states the year that the booster was manufactured.

RPM: This states the maximum RPM that the booster can be operated.

2. LIFTING

WARNING

Booster must be handled using appropriate device such as fork truck or appropriate lifting device. See Table 1 for approximate weights. Care should be taken to assure booster does not over-turn during handling and installation.

3. DESCRIPTION

NOTE

Refer to specific data sheets for flow capacities and vacuum capacities.

NOTE

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

Kinney model 7000 mechanical vacuum boosters are positive displacement type units, whose pumping capacity is determined by size, operating speed, and differential pressure conditions. Vacuum boosters employ rotors rotating in opposite directions within a housing closed at the ends by end plates.

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

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

Figure 1 illustrates that the air moves not between the rotors but between the rotors and the side of the housing. Also, the machine is bi-directional, meaning that the direction of rotation of the booster can make either side the inlet or discharge. See also the *Flow Direction by Rotation* section on page 6.

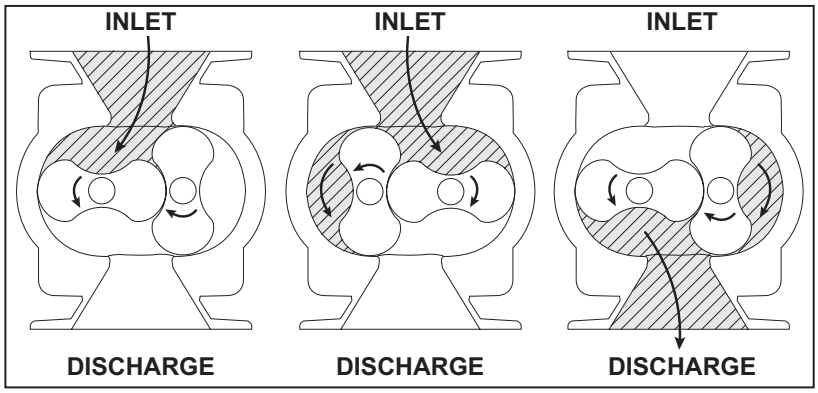


Figure 1 - Illustration of general operation principle

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

blocking in this line. Check valves should also be used on every booster when more than one booster is connected to a discharge line. This is for both safety and operating conditions.

Vacuum boosters must be protected by cut-in switches or with bypass valving to limit differential pressure across the booster.

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

Consult your Kinney sales professional if questions arise.

3.1 FLOW BY DIRECTION AND ROTATION

WARNING

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

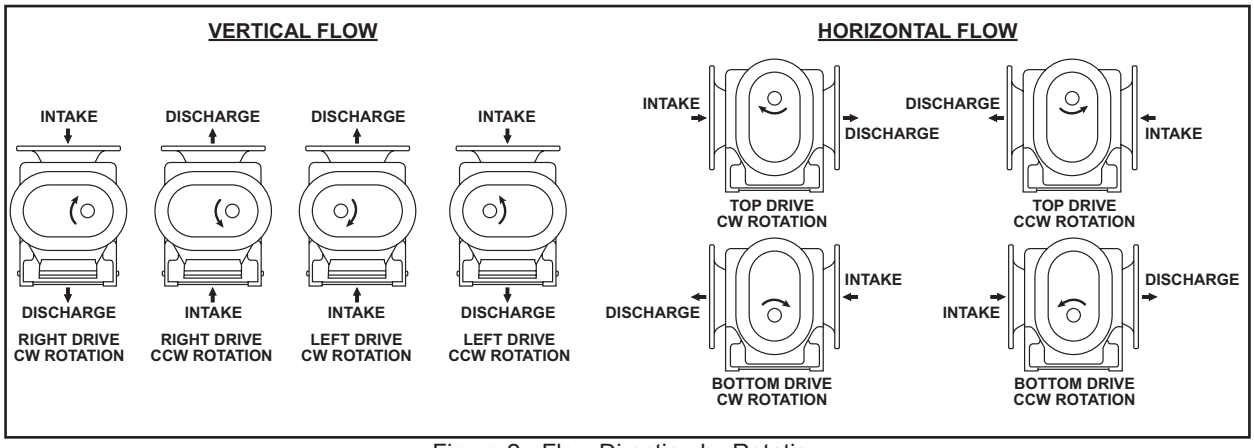


Figure 2 - Flow Direction by Rotation

3.2 SPECIFICATIONS

TABLE 1 — SPECIFICATIONS

MODEL	SERIES	APPROXIMATE OIL CAPACITY QUARTS / *LITERS*		PORT SIZE IN / *MM*	MAX RPM	APPROXIMATE WEIGHT LBS. / *KG*	
		VERTICAL FLOW 90 / 31	HORIZONTAL FLOW 91 / 33			VERTICAL FLOW 90 / 31	HORIZONTAL FLOW 91 / 33
7010	90 / 91	8 / *7.5*	5.0 / *4.75*	6 / *150*	3000	—	1120 / *510*
7013				8 / *200*		1255 / *570*	—
7017				10 / *250*		—	1390 / *635*
7021				12 / *300*		1530 / *695*	1530 / *695*
7026				12 / *300*		1695 / *770*	1695 / *770*
7010	31 / 33	15 / *14.2*	12 / *11.4*	6 / *150*	3000	—	1120 / *510*
7013				8 / *200*		1255 / *570*	—
7017				10 / *250*		—	1390 / *635*
7021				12 / *300*		1530 / *695*	1530 / *695*
7026				12 / *300*		1695 / *770*	1695 / *770*

Maximum discharge temperature is 375° F (190° C). Maximum temperature is based on a 70° F (21° C) inlet temperature. For inlet temperatures below 70° F (21° C), maximum allowable temperature rise across the vacuum booster should also never exceed 305° F (170° C).

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

EXAMPLE: Seldom does the operation of a vacuum booster result in pressure differentials large enough to strain the booster drive train (bearings, gears and seals). Typically in vacuum boosting, the maximum allowable temperature limit (the limit is a function of the temperature rise as well as the inlet temperature) for any particular booster may occur well before the maximum speed or allowable power 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 any one of the three: temperature, speed, or horsepower.

NOTE

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

NOTE

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

Deep vacuum requires instrumentation much more sensitive than standard thermometers and mercury type pressure or vacuum gauges. At operation pressures less than 100 Torr (mmHg), low-deadband cut-in switches and low-mass thermocouples should be utilized and positioned such that the sensor is connected to the inlet and discharge connections of the vacuum booster. NPT connections are provided at each of the inlet and discharge ports for this purpose. Standard temperature switches, because of their higher mass, do not have reaction times fast enough to adequately protect the vacuum booster. Likewise, standard vacuum switches are not recommended for cut-in switches as vacuum boosting typically requires a very accurate cut-in point. A tachometer will enable periodic checks of operating speed.

4. INSTALLATION

4.1 GENERAL

DANGER

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

DANGER

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

WARNING

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

WARNING

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

WARNING

Table 1 states the maximum operating speed in RPM (rotations per minute) and maximum temperature. Do not exceed these limits. The installation of the booster shall take these critical operating parameters into account and adequate control features implemented.

WARNING

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

NOTE

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

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

NOTE

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

Protective covers and plugs should not be removed until the connection is being made. Mount the booster on a flat, level surface. We recommend a baseplate that is a rigid, solidly supported, and structurally sound. Shim under the legs where necessary so that each leg of the booster supports an equal share of the

booster weight. This is necessary to prevent eventual twisting of the booster. Make sure feet rest evenly on the mounting surface before fastening down. Twisting or cramping the booster in mounting will cause rotor contact and binding during operation, resulting in a condition called “soft foot”. (See the *Soft Foot* section of this manual for further details and preventative measures.)

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

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

Piping should be accurately squared with the booster and supported independently. Stress imparted from incorrectly aligned piping or mounting will create problems with bearing and seal life, possibly leading to premature internal contact. The booster should sit stress free and evenly on its supporting surface. Care should be taken to evenly tighten the mounting bolts to not impart undue stress into the booster. Stress can be checked in a free state with feeler stock or verified on a previously installed blower with the aid of a dial indicator. Less than .002” (.05 mm) spring or gap should be found.

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

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

4.1.1 LOCATION

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

4.1.2 FOUNDATION

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

4.1.3 BOOSTER AIR INTAKE

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

Do not use boosters on explosive or hazardous gases. Each size booster has limits on pressure differential, running speed, and discharge temperature. These limits must not be exceeded. Consult Table 1 for details pertaining to the allowable performance criteria.

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

4.1.4 SOFT FOOT

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

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

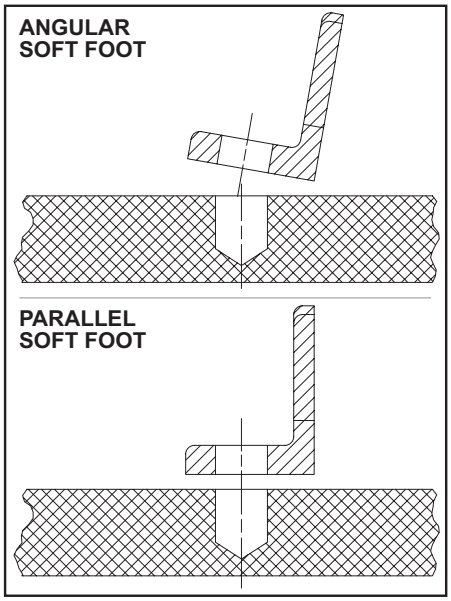


Figure 3 - Illustrations of Soft Foot

4.2 SAFETY

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

DANGER

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

DANGER

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

DANGER

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

DANGER

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

WARNING

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

WARNING

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

NOTE

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

4.3 LUBRICATION

Every booster from Kinney 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. Oil reservoirs are under vacuum.

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

Add oil to the booster in the quantity shown within the *Specifications* Table. The oil level must be maintained within the notched area of the sight glass. See Figure 4. Lower drive units have “bull’s eye” type oil level gauges. Maintain oil levels at the center of the glass.

WARNING

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

WARNING

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

WARNING

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

NOTE

Assure oil is compatible with copper/yellow metals (if equipped with cooling coils).

NOTE
Refer to Table 1 for oil capacities.

4.3.1 FILLING PROCEDURE

See Figure 4. Recommended lubricants are shown on page 33.

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

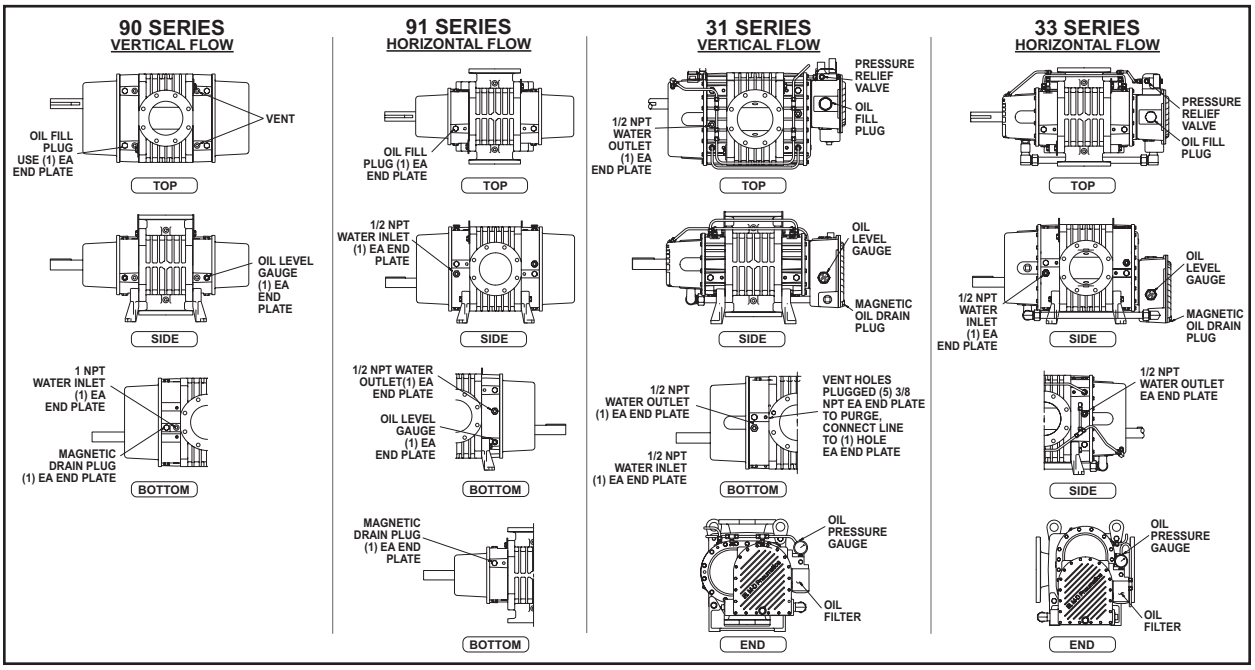


Figure 4 - Location of oil fill, drain, level gauges and cooling connections

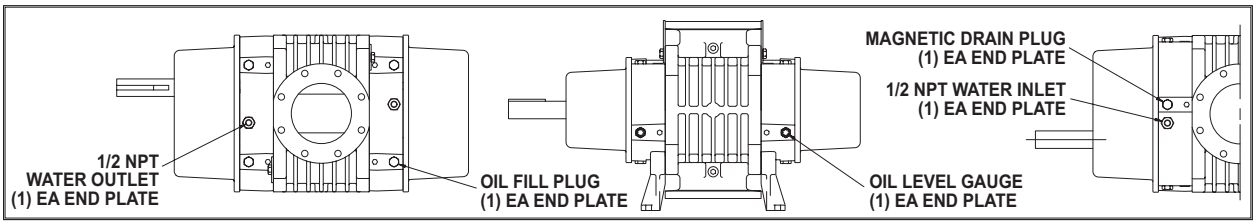


Figure 5 - Location of oil fill, drain, level gauges and cooling connections on boosters with water cooled endplates

(Please note: Water cooled end plates have been discontinued.
This diagram is for reference only to identify if the unit has water jacketed end plates.)

4.3.2 FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION

What is the functional detriment if the "wrong oil" is used?

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

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

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

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

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

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

4.3.3 HAZARDS ASSOCIATED WITH BREAKDOWN OR IGNITION OF LUBRICATION

DANGER

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

4.3.4 LUBRICATION (SPLASH - 90/91 SERIES)

WARNING

For connecting water, remove only the 1" NPT plugs with the 5/8" allen heads. Use of any other connection for water will cause serious damage to unit.

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

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

Oil levels should be checked frequently. Unit must be shut down to properly check oil levels.

4.3.5 LUBRICATION (INTEGRAL PRESSURE - 31/33 SERIES)

1. Before starting the unit, fill reservoirs as instructed below:
2. Remove oil fill plug.
3. Pour oil through fill hole until oil appears in sight glass.
4. The front and back oil reservoirs are connected together; however, it will take some time for the oil to travel to the front of the machine. Allow several minutes for this to occur.
5. Bring oil level up to the center of the sight glass. Again, allow time for equalization of oil level between the back and the front of the machine.
6. Reinstall fill plug.

4.3.6 OIL FILTER

Change the oil filter element with every oil change. Filters (P/N 70248) are available from Kinney in Springfield, Missouri, or from any authorized distributor or service center.

4.3.7 OIL PRESSURE ADJUSTMENT

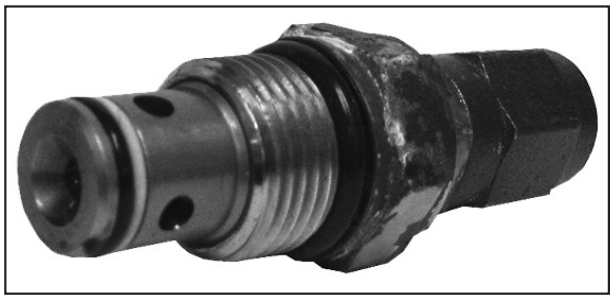


Figure 6 - Oil Pressure Adjustment Hex Cap

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 require due to the speed and oil temperature.

To adjust the unit to the proper oil pressure remove the hex cap shown in the image to the right. Loosen the lock nut and turn the set screw clockwise to increase the pressure or counterclockwise to decrease the pressure. Tighten lock nut and 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).

4.4 PIPING CONNECTIONS

WARNING

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

NOTE

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

Manifolding should be no smaller than the pump connections in order to minimize restrictions to gas flow. Accurately align the mating flanges to the inlet and discharge manifolding to prevent distortion of the booster housing. Temporarily fit a fine wire mesh filter at the suction port if solid particles are likely to be entrained into the air stream and remove the filter when particles no longer appear. This is especially desirable on new installations and when manifolds have been welded. The manifolding to and from the booster should be fitted with flexible connections to isolate vibrations, absorb expansion and contraction due to thermal change, and to absorb misalignment differences. If the booster is to be water cooled, connect a clean supply to the ¼" NPT connection on the seal adapter housing adjacent to the drive shaft. The drain line will be connected on the bottom of the non-drive end reservoir, see Figure 4 for connection locations. Care should be taken to not over tighten or loosen the bushing for the cooling coil connection. The bushing should be held in place as additional fitting and plumbing is performed.

4.4.1 HAZARDS ASSOCIATED WITH HAZARDOUS PROCESS FLUIDS

DANGER

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

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

4.4.2 BLOCKAGE OR RESTRICTION

WARNING

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

4.5 WATER COOLING INSTRUCTIONS

Units with water cooled endplates can be identified by the connecting hose which runs from the top of the drive end plate to the bottom of the rear end plate. See Figure 5.

CAUTION

If the booster is to be located outdoors or in a building where the temperature surrounding the booster or the water supply and return piping can fall below 35°F (2°C), then care must be taken to ensure that the water (or other cooling liquid) does not freeze and cause damage. Cooling coils must be drained of liquid during downtime unless a recirculating unit using a glycol mixture has been installed.

NOTE

Water cooled endplates are discontinued. Consult factory for connection details.

NOTE

Units are never shipped from the manufacturer with liquid in the end plates or cooling coils.

4.6 COOLING WATER CONNECTIONS

(Refer to Figure 4 for cooling connections)

An on-off valve should be provided on the incoming line and a regulating valve located in the drain line. The drain line should terminate at an open drain to enable the operator to better regulate the water flow.

4.7 COOLING WATER SPECIFICATIONS

Units that will operate with continuous discharge gas temperatures of 250° F (121° C) or more must be connected to a water (liquid) supply in order to maintain reasonable oil temperatures. Generally a water flow of ½ to 1 GPM (1.9 - 3.8 L/min) is sufficient to maintain oil temperatures below 150° F (65° C).

WARNING

The cooling water pressure shall not exceed 75 psig (5.17 bar g)

4.8 MOTOR DRIVES

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

4.8.1 DIRECT COUPLED

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

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

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

4.8.2 V-BELTS

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

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

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

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

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

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

4.8.3 SETTING V-BELT TENSION

Proper belt tension is essential to long booster life. The following diagrams and procedures are provided to aid in field adjusting V-belts (when booster is so equipped) for maximum performance. A visual inspection of the V-belt drive should yield the appearance shown in Figure 7.

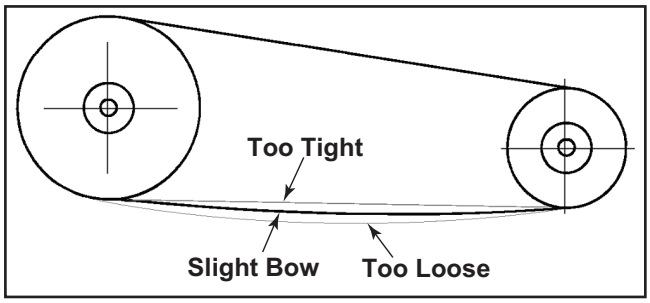


Figure 7 - General appearance of a V-Belt drive

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

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

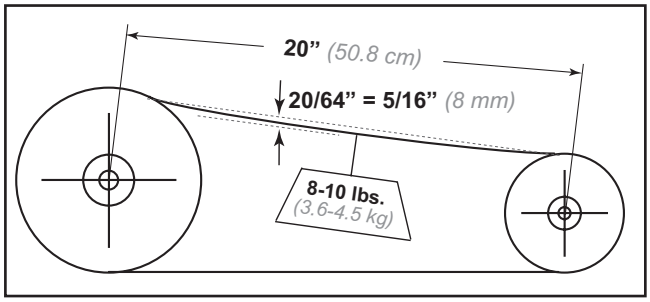


Figure 8 - Setting of proper tension for a V-Belt drive

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

4.8.4 V-BELT TROUBLESHOOTING

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

4.9 MOTOR AND ELECTRICAL CONNECTIONS

WARNING

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

NOTE

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

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

5. OPERATION

5.1 GENERAL

DANGER

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

WARNING

Do not operate without guards in place.

WARNING

Maximum operating speed: Table 1 states the maximum operating speed in RPM (rotations per minute) and maximum temperature. Do not exceed these limits.

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

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

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

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

5.2 START-UP CHECKLIST

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

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

DATES CHECKED:				

☐☐☐☐ Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Refer to the *Lubrication* section. Please see *Recommended Lubricants* for information on acceptable lubricants for your product.

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

☐☐☐☐ Carefully turn the rotors by hand to be certain they do not bind.

WARNING

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

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

☐☐☐☐ Start the unit and operate it for 30 minutes at no load. During this time, feel the cylinder for hot spots. If minor hot spots occur, refer to the *Troubleshooting* chart.

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

☐☐☐☐ If minor malfunctions occur, discontinue operation and refer to the *Troubleshooting* chart.

5.3 STARTING

Check the oil for proper level at both ends of the booster. Add or drain oil as necessary to bring the oil to the correct level. See Figure 4. Too much oil, particularly on the gear end, can result in excessive heat generation. Too little oil will possibly result in failure of the timing gears, bearings, and mechanical seals.

Start the backing pump. When pressure is reduced sufficiently, start booster pump. A pressure switch can be installed to start the booster at a predetermined pressure. If the booster is water cooled turn on the cooling water when the booster is started. Adjust the water flow so that the discharge water temperature is no more than lukewarm (70° to 80° F [21° to 26° C]).

5.4 OPERATING

The upper temperature limits for booster pump operation are between 350° to 375° F (175° to 190° C) measured in the exhaust gas stream with a low mass thermocouple. When this temperature limit switch is installed, as the temperature exceeds the predetermined temperature, the booster motor will stop and cannot be restarted until the temperature drops below the trip setting of the temperature switch.

NOTE

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

CAUTION

Do not touch hot surfaces.

The upper limit of the booster operation is 375º F (190º C). Do not touch the booster while it is in operation and assure booster is cool when not in operation.

CAUTION

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

WARNING

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

WARNING

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

5.5 STOPPING

CAUTION

Venting the booster to pressures above cut-in while running can damage the pump.

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

5.6 METHANE GAS APPLICATIONS

Instructions for injecting fuel oil, kerosene, and lube oil into boosters sludged by methane digester (sewage) gas: Some sewage gases will adhere to the rotors in a gas booster. If enough sludge from the gas being pumped builds up on the rotors, it destroys the clearances between the rotors. The build-up can cause the booster to clatter and eventually freeze up when the rotors no longer have clearance to turn. This can be easily prevented by periodically flushing the booster with a mixture of 75% kerosene or fuel oil and 25% lubricating oil. The kerosene or fuel oil dissolves the sludge buildup and the lubricating oil coats the rotors to slow the build-up. The mixture should be injected on the inlet side through a valve set to feed a gallon of mixture in 15-20 minutes. On units regularly flushed, once a week is sufficient. If the unit is dirty, it should be flushed daily until the hard build-up is removed then put on a weekly cycle. In very dirty gas installations, the cycle must be varied to meet the demand.

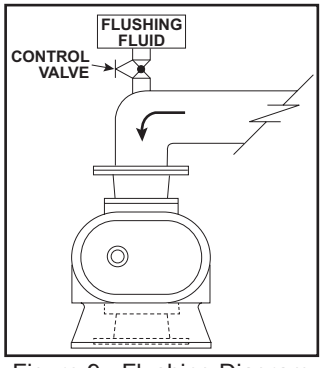


Figure 9 - Flushing Diagram

5.7 WATER INJECTED VACUUM BOOSTERS

Water injected into the inlet of a booster operating on vacuum service will cool the booster. The water absorbs the heat of compression as it passes through the unit along with the air/gas being compressed. A booster cooled in this manner can operate safely at higher vacuums or higher inlet temperatures than a normally uncooled unit. The amount of water required depends on the inlet air/gas temperature, inlet vacuum, water temperature, and the maximum discharge temperature desired. Check with factory or sales representative for additional guidance.

1. Vertical flow units should always be used with suction at top and discharge at bottom. If your booster or vacuum booster is not in this configuration, consult factory before proceeding.
2. Check oil level in sight glass of booster and assure all fittings are tight.
3. Check the water injection system to assure water is available.
4. Operate the booster dry for a few minutes at no load to check correct rotation and smooth operation.
5. Turn water on and adjust flow as recommended for the individual booster. Assure water discharges freely from the outlet piping.
6. Apply vacuum and observe operation at the desired inlet condition.

CAUTION

Water injection into vacuum boosters with inlet vacuum of 28” Hg (950 mbar g) or deeper, regardless of inlet temperature must be performed carefully to prevent reducing inlet temperature to temperatures below freezing. Operation of boosters with water injection below the freezing point will damage the booster.

CAUTION

Water injection can cause lime or other mineral buildup on rotors. Check water supply for hardness. The use of water softeners, other chemicals, or distilled water may be necessary to prevent or remove this build-up. Kinney cannot be responsible for damage which may result should this build-up occur. Units should be inspected regularly to determine any problems.

NOTE

For liquid injection other than water, consult the factory.

5.7.1 SHUTDOWN

1. The booster can be shut down for brief periods by relieving the inlet vacuum, shutting the water off, and then stopping the unit.
2. Rusting during a slightly longer shutdown period can be avoided by operating the booster under a partial vacuum without the water injection, allowing the booster to heat to within safe limits. The heat will tend to drive off residual moisture.
3. For extended shutdown, oil may be injected into the inlet of the heated booster just prior to shutting the unit down. The oil will provide a protective coating on the internals. Insure that the water is completely shut off after shutdown.
4. Special coatings or platings are available to minimize rusting or corrosion in applications where units can remain wet.

5.8 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 booster is shut down and the booster 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 booster to fail upon future start-up.

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

NOTE

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

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

6. MAINTENANCE

6.1 GENERAL

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

DANGER

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

CAUTION

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

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

CAUTION

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

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

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

6.2 REGULAR MAINTENANCE

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

A newly installed booster should be checked frequently during the first month of operation, especially lubrication. With booster at rest, check oil level in both the gear (drive) end and free (non-drive) end of the booster and add oil as needed. Scheduled maintenance consists of changing lubricating oil every 250 to 1500 hours of operation, or more frequently depending on the type of oil and operating temperature. Boosters with mechanical seals on the rotors can generally run the full 1500 hours before an oil change is required. Also change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. The following is recommended as a minimum maintenance program.

DAILY	WEEKLY	MONTHLY
1. Check and maintain oil level, and add oil as necessary. 2. Check for unusual noise or vibration (See *Troubleshooting*)	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the booster and cause overheating and oil usage. 2. Check relief valve to assure it is operating properly.	1. Inspect the entire system for leaks. 2. Inspect condition of oil and change if necessary. 3. Check drive belt tension and tighten if necessary.

NOTE

Oil levels should be checked every 24 hours of operation.

Proper oil drain schedules require oil be changed before the contaminant load becomes so great that the lubricating function of the oil is impaired or heavy disposition of suspended contaminants occurs. To check the condition of the oil, drain a sampling into a clean container and check for the presence of water or solids. Slight discoloration of the oil should not necessitate an oil change.

6.3 SPARE PARTS

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

When ordering parts, give all booster nameplate information, as well as the item number and parts description as per the parts lists and assembly drawings for your particular model. Repair kits are available for all models. These kits contain all of the seals, bearings, O-rings, locks, and special retaining screws necessary for an overhaul. For your convenience when ordering parts, we suggest you complete the *Operating Data Form* included on the inside, back cover of this manual.
In developing a stock of spare parts, consider the following:

- The degree of importance in maintaining the booster in a “ready” condition
- The time lag in parts procurement
- Cost
- Shelf life (seals and O-rings)

Contact Kinney Service Department for any assistance in selecting spare parts.
Telephone: (417) 865-8715 — Toll Free (48 contiguous states): (800) 825-6937 — Fax: (417) 865-2950

6.4 FACTORY SERVICE & REPAIR

With proper care, Kinney boosters will give years of reliable service. The parts are machined to very close tolerances and require special tools by mechanics who are skilled at this work. Should major repairs become necessary, contact the factory for the authorized service location nearest you. Units which are still under warranty must be returned to the factory, freight prepaid, for service.

Kinney
ATTN: Customer Service Manager
4840 West Kearney Street
Springfield, MO 65803-8702

NOTE

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

NOTE

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

6.5 LONG TERM STORAGE

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

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

7. DISASSEMBLY AND ASSEMBLY

7.1 DISASSEMBLY

1. Remove unit from installation and drain lubricant from both ends by removing magnetic drain plugs (31). Mark end plates, covers and housing so they can be reassembled in their original position.

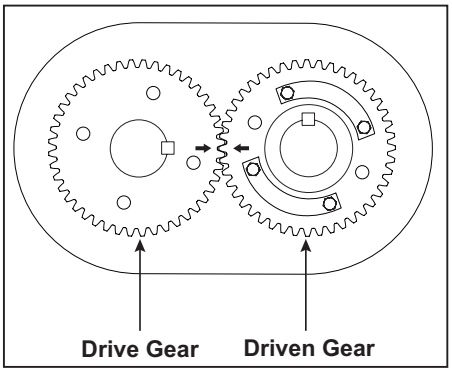


Figure 10 - Timing Marks Matched

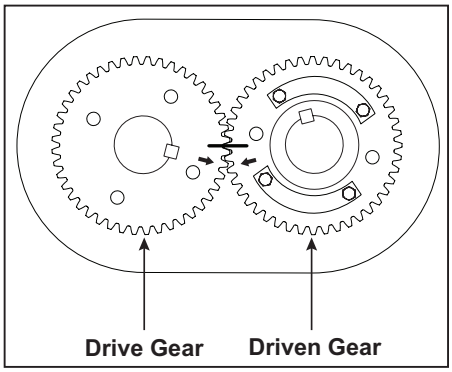


Figure 11 - Timing Marks Advanced 3 Teeth (Reference Marks Aligned)

2. On 90/91 series only, remove three socket head screws (111) and dust plate (82). Requires 1/8" hex head (Allen) wrench. Using same wrench, loosen three set screws (90) and remove seal retainer (89).
3. Remove four socket head screws (93). Requires 5/32" hex head (Allen) wrench. Place two of the screws in tapped jacking holes and remove seal housing (91). Tap out seal and discard O-rings.
4. Remove gear cover cap screws (26) and gear cover (6) by placing two of the screws in the tapped jacking holes provided on the cover flange. Support cover with lift straps or other suitable means while removing. The jackscrews will provide the force necessary to break the seal between cover and end plate.
5. Temporarily secure end plate to housing with two screws (26) and some flat washers. Remove four nylok screws (66) from drive shaft (45). A light tap with a mallet will break it loose from the drive gear.
6. On 90/91 series only, remove mating ring of mechanical seal (54).
7. Remove inner bearing race with gear puller or press.
8. Bend back lock tabs and remove cap screws (29), lock (59), washers (25) and spring pins (68).
9. Position timing gears (8) so both timing marks are matched. See Figure 10. Rotate drive gear clockwise approximately three teeth and mark a matching reference line on each gear as shown in Figure 11. This gear position is necessary so rotors will clear and not jam. Using a gear puller with a live center or a centering adapter, large enough so it will not jam into threaded hole, pull driven gear, while keeping matched reference line marks aligned. Use a slight rocking motion to insure rotors have not jammed. Should jamming occur, release pressure and tap gear back on until it rotates freely. Pull mating gear.

CAUTION

Never attempt to pull gear when rotors are jammed. Rotor keyway damage will result.

10. Repeat procedure used in No. 4 to remove free end cover (7). Remove rotor shaft screws as was done in No. 6 and also oil slinger (20). Remove cap screws (30) and oil retainer rings (14). Place ½" eye bolt into top of end plate on 91 series, or both sides of end plate on 90 series, in holes provided for lifting.
11. Make up four pieces of thr eaded rod ½"-13 UNC approximately 9" long with double nuts or a single welded nut to turn rods. On the opposite ends remove about ½" of threads as this end will mushroom slightly when jacking end plate. This will prevent threads from jamming when removing rods. Run in equally to remove end plate. Tap out roller bearings (10). Note that each bearing on this end has two identical spacers (57), one on each side of bearing. Tap out seals (54) or (12). Also remove the labyrinth seals (51), as they should be replaced with each overhaul. On 90/91 series, discard O-ring (75) and retain O-ring spacers (74) for reassembly.
12. Remove cap screws (30) and bearing retainer rings (14) from drive end of unit. Remove rotors (1). To remove the rotors from the end plate will require either a two-jaw gear puller with jaws inserted in the oil feed slots of the bearing bore, or a bar-type puller using the tapped holes around the bearing bore.

CAUTION

If rotors are side by side, position the lobes vertically when removing. If they are one on top of the other, remove top rotor first in a vertical position. Then position bottom rotor vertically and remove.

13. Support end plate with eyebolts and lift strap. Remove temporary cap screws and tap end plate from housing (3). Remove bearings and seals.
14. Clean and inspect parts for damage and wear. Replace all O-rings, seals and bearings at each overhaul.

NOTE
If end plates, housing or end covers are not being reassembled in their original position or some new parts are being used, it will be necessary to clean all paint or rust build-up from the mating surfaces to insure a good seal. Failure to do so could result in excessive end clearances and air or oil leaks.

7.2 ASSEMBLY

The assembly procedure is generally the same for all series, but where there are differences, notations are made. Dowel pins are used to locate end plates, housing and end covers in their proper locations relative to each other. Be sure they are in place. An O-ring lubricant should be used on all O-rings.

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

NOTE
Make sure all parts are clean and free of any nicks or burrs caused by disassembly. Boosters incorporating lip seals will require all sleeves or seal journals to be polished to remove any nicks and scratches. Failure to polish seal journals will result in seal leakage or damage. Refer to page 33 for seal pressing tools as well as other assembly tools required.

NOTE
When rebuilding the model 7000 boosters and vacuum boosters and depending on the series designation, it may be necessary to reseal the joints between the rotor housing, end plates, and end covers. The following sealers are recommended and are available for purchase from Kinney: Dow Corning - RTV 737 General Electric - N-SIL

7.2.1 PREPARATION OF END PLATES FOR ASSEMBLY

1. Press the labyrinth seals (51) into seal bores with the lips toward the oil side.

NOTE
For lip seal units put a light coat of silicon in the seal bore of end plate. Install lip seal open side facing up.

7.2.2 MECHANICAL SEAL UNITS

2. Install O-ring spacers (74) with grooves up. Install O-rings (75) making sure they are fully seated in their grooves. Apply a thin coat of sealer to O. D. of seal (54) and press into seal bore. Make sure seals are fully seated without deforming. Clean seal carbon with soft tissue and cleaning agent (acetone).

7.2.3 GEAR END ASSEMBLY

3. Place free end plate on suitable blocking with rotor side up. Stand rotors (1) into each bore with gear end shafts up and keyways facing in the direction shown in Figure 12.
4. Install the gear end plate (4) over the rotor shafts and coming to rest on top of the rotor lobes, being careful not to damage the seals. Recheck the location of the oil sight glass in relation to the drive rotor before proceeding with the assembly.
5. **90/91 series only:** Inspect lapped surface of seal mating ring to be sure it is perfectly clean. Use a soft tissue and cleaning agent if necessary. Place a few drops of lubricating oil on its surface and lubricate the O-ring. Install on rotor shaft with lapped surface down. Slot must line up with pin (300) in rotor shaft. Gently press with fingers to insure compression is taking place and mating ring is not hung up for any reason. Top of mating ring should sit flush with rotor shoulder when fully seated.

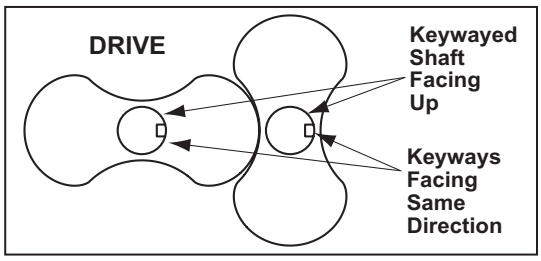


Figure 12 - Keyways

CAUTION

Gear end 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 (toward gear). Do not use bearings that have not been flush ground to within .001" (.025 mm) Coat the rotor shafts with an anti-seize lubricant and press the bearings (9) on the shafts. The bearing manufacturer numbers and/or an acid dot (inner race) should be up or toward the gears. Use the tool shown on page 33 along with a length of 3/4- 10 × 6" threaded rod, washer (25) and nut. The use of a hydraulic ram with a hollow center is also recommended. In this case the threaded rod will have to be made longer.

6. Install bearing retainer plates (14) and secure with cap screws (30).
7. Check clearance between the face of the end plate and rotor lobes. Refer to the Assembly Clearances table on page 31 for correct gear end clearances. If clearances are not within specifications, recheck parts to find cause of improper clearances before proceeding. Install keys (24) in rotor shaft keyways.
8. Lubricate shafts and keys and press drive gear (right hand helix) on drive rotor. To install driven gear, align reference marks as shown in Fig. 11 on page 26. Tap gear with mallet to start then press the gear until seated.

NOTE

All timing gears must be used in sets as they are matched and serially numbered.

9. Install roll pins (68), washers (25), lock tabs (59) and shaft bolts (29). Bend over lock tabs.

NOTE

These bolts are structural bolts, not standard cap screws. Therefore they have a larger body diameter and this centers the washers and slinger. Do not replace with standard cap screws.

10. Remove the gear end assembly from the free end plate and turn over so the gears are facing down on a solid surface. Place some wood blocking on each side for support.
11. **90/91 series:** Place a small bead of an RTV silicone type sealer around the periphery of the housing (3) bores, but inside the bolt pattern. Encircle the dowel pins. Install rotor housing and temporarily secure to end plate with two cap screws (26) and some flat washers. Check clearances between end of lobes and housing using a flat bar and feeler gauges or a depth micrometer. Refer to exploded view for free end clearances.
12. **90/91 series:** Put sealer on rotor housing, same as above.
    All series: Install free end plate and secure in same manner.
13. **90/91 series:** Install seal mating rings as was done in Step 4.
    All series: Install one bearing spacer (57) on each shaft. Lubricate shafts and install roller bearings with inner race flange outward. See Figure 13

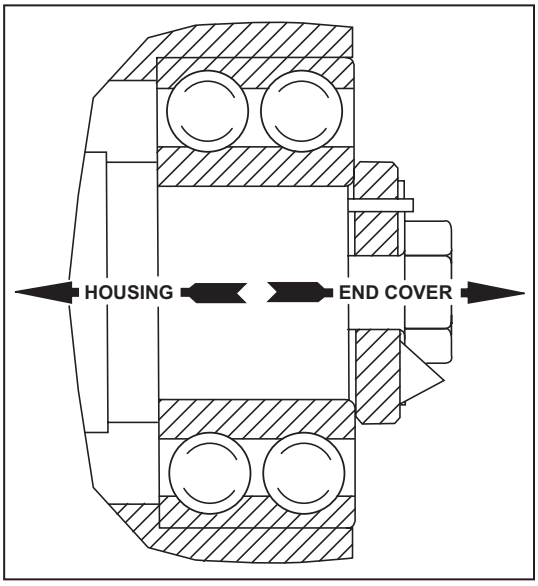


Figure 13 - Roller Bearings Illustration

14. Install oil retainer rings (14) and cap screws (30). Install roll pin (68) washers (25), oil slinger (20) (on drive rotor), lock tabs (59) and bolts (29). Bend over tabs.
15. Install mounting feet (304) with machined surface against housing and secure with lockwashers (80) and cap screws (307). Install lifting lugs (195) with cap screws (196).

7.2.4 ADJUSTING ROTOR INTERLOBE CLEARANCE

16. The driven gear is made of two pieces. The outer gear shell is fastened to the inner hub with four cap screws and located with two dowel pins. A laminated shim, made up of .003" (.076 mm) laminations, separates the hub and the shell. By removing or adding shim laminations, the gear shell is moved axially relative to the inner hub. Being a 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 .014" (.36 mm) will change the rotor lobe clearance .005" (.13 mm).

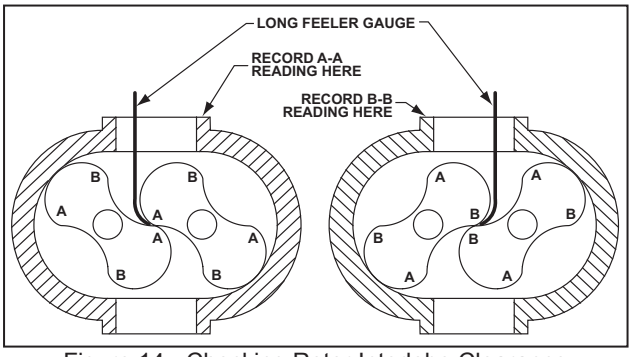


Figure 14 - Checking Rotor Interlobe Clearance

EXAMPLE: Referring to Figure 14, check the clearance at AA (right hand reading) and BB (left hand reading). If AA reading is .017" (.43 mm) and BB reading is .004" (.10 mm), by removing.018" (.46 mm) shims, the readings should then read AA .011" (.28 mm) and BB .010" (.25).

To determine the amount of shim to add or remove, subtract the smaller reading from the larger and multiply the result by 1.4. (.017" [.43 mm] -.004" [.10 mm] = .013" [.33 mm] × 1.4 = .018" [.46 mm]) If the right side reading is higher than the left side, remove shim. If the right side reading is lower, add shim. The final readings should be within .002" (.05 mm) of each other.

17. When removing gear shell from driven gear, it is not necessary to remove gear lock bolt. Make sure bolt locks are in place because the dowel pins must come off with the gear shell.
18. Install inner race of drive shaft roller bearing (50) onto drive shaft. Flange side must be inboard. See special tool drawings. Install outer race with rollers into cover bore flush with inside boss. Install oil slingers (395) back to back on drive shaft flange. Make sure both mating surfaces are clean and free of burrs-then mount drive shaft to gear and secure with-nylok cap screws (29). Check drive shaft runout at seal journal. Do not exceed .003" (.08 mm) T.I.R.

19. Remove temporary cap screws from gear end of housing and place bead of silicone around the periphery of the end plate. Encircle the dowel pins. Install cover (6) and cap screws (26). The use of two ½"-13 threaded rods as guide screws is recommended.

7.2.5 DRIVE SHAFT SEAL ASSEMBLY

20. **90/91 series:**
    a. Install O-ring (75) into seal housing (91) and press in stator portion of mechanical seal (54). See special tool drawing. Clean face of carbon and mating ring with soft tissue and acetone. Install O-ring (92).
    b. Lubricate O-ring in ID of mating ring and carefully slide onto drive shaft with slot up and seat against shoulder. Do not use any tools. Lapped surface should be facing outward.
    c. Install seal housing (91) into cover bore and secure with four hex head screws (93).
    d. With set screws (90) in place install mating ring retainer (89) (flange facing outward) while aligning pin (300) with slot in mating ring. Secure to shaft with set screws.
21. Install free end cover (7) same as gear end.

8. TROUBLESHOOTING

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

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

9. ASSEMBLY CLEARANCES

Values shown in inches and *millimeters*.

MODEL	GEAR END	FREE END	INTERLOBE	TIP-DOWEL	TIP-PORT
7010	.006 - .009 *.15 - .23*	.013 - .019 *.33 - .48*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7013	.006 - .009 *.15 - .23*	.016 - .022 *.41 - .56*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7017	.006 - .009 *.15 - .23*	.021 - .027 *.53 - .69*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7021	.006 - .009 *.15 - .23*	.026 - .032 *.68 - .81*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*
7026	.006 - .009 *.15 - .23*	.031 - .037 *.79 - .94*	.010 - .014 *.25 - .36*	.008 - .012 *.20 - .30*	.015 - .019 *.38 - .48*

10. TORQUE CHART

Data shown represents “wet” torque values.

PART DESCRIPTION	TORQUE
CAP SCREW 10-32UNF	3 ft-lb (4 N-m)
CAP SCREW 1/4”-20UNC GR5	6 ft-lb (8 N-m)
CAP SCREW 5/16”-18UNC GR5	13 ft-lb (17 N-m)
CAP SCREW 3/8”-16UNC GR5	23 ft-lb (31 N-m)
CAP SCREW 1/2”-13UNC GR5	57 ft-lb (77 N-m)
CAP SCREW 5/8”-14UNC GR5	113 ft-lb (153 N-m)
CAP SCREW 3/4”-10UNC GR5	200 ft-lb (271 N-m)

11. RECOMMENDED LUBRICANTS

Positive displacement blowers and vacuum boosters require proper lubrication for bearings, seals and gears to operate effectively and efficiently. Oil is distributed from the oil reservoir to the critical components by means of oil slingers that are attached to the rotor shaft. In certain models of CP Series blowers, a high-performance grease rated for high temperatures is used on the drive-end bearings.

MD full synthetic lubricants are recommended for blowers and vacuum boosters. MD lubricants are specifically formulated using unique additives that provide maximum protection and extend the life of your product over mineral oils or semi-synthetic lubricants.

⚠ WARNING

Do not overfill the oil sumps. Overfilling can result in gear damage or oil leaks.

⚠ CAUTION

Units are shipped without oil in the sumps. Ensure adequate oil has been added before operating.

MD oils are suitable for a wide range of operating temperatures that are based on model, operating speed and discharge temperature of the product.

FOR OXYGEN-ENRICHED SERVICE

Blowers and vacuum boosters operated in oxygen enriched applications should only use non flammable, PFPE full synthetic lubricants. Blowers and vacuum boosters used in hydrogen service should only MD full synthetic oil

NOTE: Oxygen-enriched service only applicable for PD Plus blowers and vacuum boosters.

⚠ CAUTION

M-D Pneumatics and Kinney does not accept responsibility for damage caused by use of lubricants that are not recommended by M-D Pneumatics and Kinney.

MD BLOWER & BOOSTER LUBRICANTS SPECIFICATIONS				
PRODUCTS	**MD ONE**	**MD PLUS**	**MD MAX**	**MD FG**
VISCOSITY INDEX	150	154	157	141
@40°C, CST	99.1	231.7	340.9	99.3
@100°C, CST	14.4	27.6	37.2	13.9
FLASH POINT °F (°C)	510 (266)	480 (249)	491 (255)	515 (268)
POUR POINT °F (°C)	- 44 (-43)	-49 (-45)	-54 (-48)	-60 (-51)

NOTE: MD One Vapor Pressure: (mm Hg) 100ºF <0.00004; 200ºF <0.00018

MD BLOWER & BOOSTER LUBRICANTS OPTIONS					
MD OIL TYPE	**1 QUART**	**1 GALLON**	**5 GALLON**	**55 GALLON BARREL**	**CASE 12 QUARTS**
MD ONE	16444-MD1-Q	16444-MD1-G	16444-MD1-5G	16444-MD1-B	16444-MD1-Q-C
MD PLUS	16444-MD2-Q	16444-MD2-G	16444-MD2-5G	16444-MD2-B	16444-MD2-Q-C
MD MAX	16444-MD3-Q	16444-MD3-G	16444-MD3-5G	16444-MD3-B	16444-MD3-Q-C
MD FG	16444-MD1-Q-FG	16444-MD1-G-FG	16444-MD1-5G-FG	16444-MD1-B-FG	16444-MD1-Q-C-FG

12. BEARING AND SEAL PRESSING TOOLS

FIGURE 15 —
LAB SEAL PRESSING TOOL

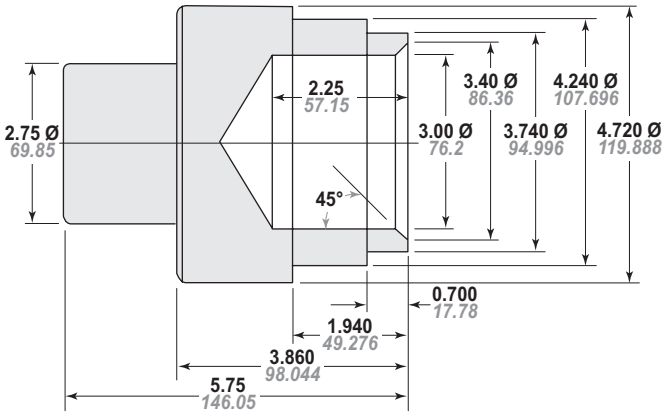


FIGURE 16 —
MECHANICAL & LIP SEAL TOOL

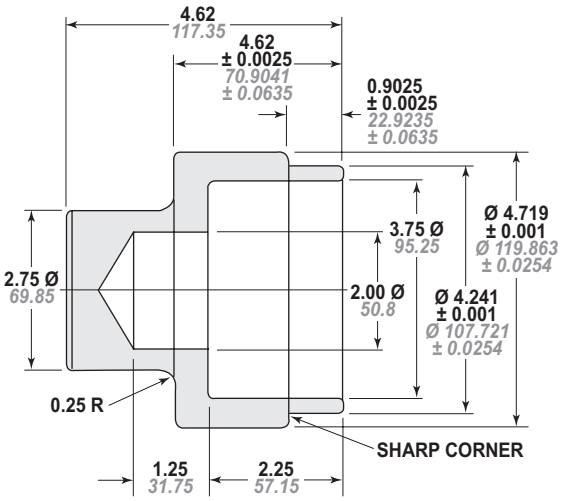


FIGURE 17 —
SEAL INSTALLATION TOOL

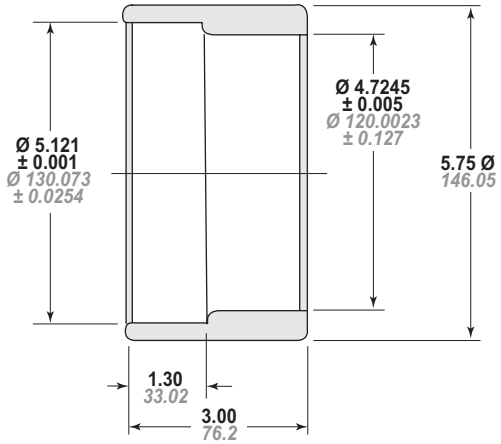


FIGURE 18 —
BEARING PRESSING TOOL

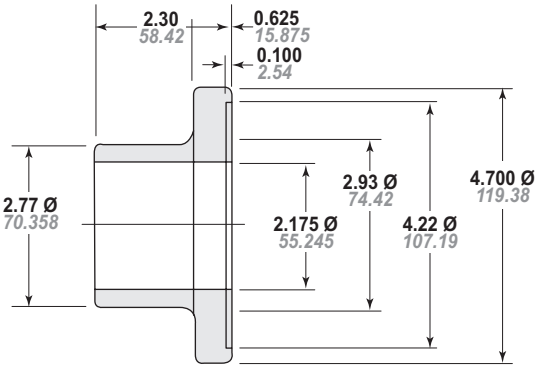
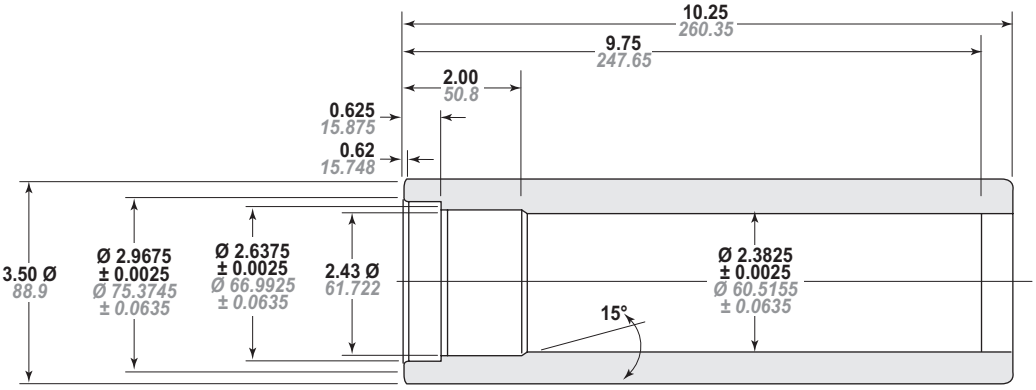


FIGURE 19 —
DRIVE SHAFT BEARING INNER RACE PRESSING TOOL



NOTE:
All dimensions are shown in Inches and *millimeters*.

TOLERANCES (Unless otherwise noted)
.XX = ± 0.01 .XXX = ± 0.003
.XX = ± 0.254 .XXX = ± 0.0762

MATERIAL:
MILD STEEL

PARTS LIST FOR MODEL 7000-31/33

ITEM NO.	PART DESCRIPTION	31 / 33 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	1
10	BEARING	1
13	LIP SEAL, VITON	1
14	RETAINER	3
15	RETAINER	1
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	3
26	CAP SCREW, HEX HD 1/2	36
29	BOLT, 3/4-10	3
30	CAP SCREW, SOC HD 3/8	16
31	MAGNETIC PIPE PLUG, 1-1/16	1
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
54	MECHANICAL SEAL, WITH VITON & HE-11	5
57	ROTOR SPACER	1
59	ROTOR LOCKING TAB	3
66	CAP SCREW, SOC HD, 1/2-13 NYLOK	4
67	BEARING SPACER	1
68	DOWEL PIN	3
69	CAP SCREW, HEX HD 1/4	4
74	SEALING RING	4
75	O-RING, VITON	5
80	LOCK WASHER, 3/4	4
89	MECHANICAL SEAL LOCK RING	1
90	SET SCREW, 1/4-20 UNC	3
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW, SOC HD 1/4	4
94	COOLING COILS	2 / —
95	O-RING, VITON	4 / —
96	O-RING, VITON	4 / —
97	MANIFOLD BUSHING	4 / —
101	ST ELBOW, 1-1/2 X 90	1
102	PIPE TBE, 1-1/2 STL	1
103	HOSE CLAMP, WORM DRIVE	— / 2
106	PIPE COUPLING, 1-1/2 STL	1
109	PIPE PLUG, 1 SOC HD	14
110	CAP SCREW, SOC HD 10-32 UNC	3
121	PIPE PLUG, 3/8 SQ STL	4
122	SET SCREW, #5-40	2
124	OIL FILTER, SPIN ON	1
125	PUMP MOUNTING BRACKET	1
135	UNION, TEE, TUBE, STL	4
136	LOCK WASHER, 5/16	4
144	OIL PUMP	1
147	TUBE, ALUMINUM, 1/2 O.D.	— / 1
150	HOSE, 3/8 I.D.	— / 1

ITEM NO.	PART DESCRIPTION	31 / 33 QTY
155	TUBE ELBOW, 1-1/2 X 1-1/2 M	2
161	TUBE, ALUMINUM, 1/2 O.D.	2
162	TUBE, ALUMINUM, 1/2 O.D.	1
163	TUBE ELBOW, 1/2 X 1/2 MPT	1 / —
165	TUBE CONNECTOR, 1/2 X 1/2 MPT	1 / —
166	HOSE CONNECTOR, 3/8 X 3/8 MPT	— / 1
172	REDUCING BUSHING, 1/2 X 1/4	1
174	PIPE PLUG, 1/2 HEX, STL	1
178	TUBE ADAPTOR	2
179	TUBE, ALUMINUM, 1/2 O.D.	— / 1
187	TUBE, 1-1/2 O.D., STL	1
188	TUBE ELBOW, UNION 1/2	2 / —
195	LIFTING LUG	2
196	CAP SCREW, HEX HD 3/4-10 UNC	2
212	CAP SCREW, 5/8-11 UNC	2
226	FLAT WASHER, 5/8	2
235	MALE TUBE ADAPTOR, 1/2 STL	5
236	TUBE, ALUMINUM, 1/2 X 1-1/2 FORMED	— / 2
262	GAUGE, 30 HG - 30 PIS, LIQUID FILLED	1
265	BY-PASS RELIEF VALVE	1
270	OIL FILTER ADAPTER	1
271	PIPE PLUG, 1/-1/2 SQ, IRON	2
273	ELBOW, HOSE, 3/8 X 1/2 MPT	— / 1
294	MALE TUBE ADAPTOR, 1/2 STL	1
300	ROLL PIN	5
302	O-RING, VITON	2
304	MOUNTING FOOT	2
306	SLEEVE	1
307	CAP SCREW, HEX HD 3/4-10 UNC	4
322	CAP SCREW, HEX HD 5/16	4
325	O-RING, VITON	1
329	PLUG, STRAIGHT THRD, 2-1/4 STL	1
330	SWIVEL ADAPTER	— / 1
336	ORIFICE FITTING	5
337	KEY, 3/16 SQ X 7/8	2
339	PLUG, STRAIGHT THRD, 1-1/16 STL	8
349	PIPE, 1/8 STL	1
350	CAP SCREW, HEX, HD, 5/16	36
351	PIPE, 1/8 STL	4
354	REDUCER BUSHING 1/2 X 1/4	5
355	TUBE, ALUMINUM, 1/2 O.D.	— / 1
360	OIL FILTER THREADED TUBE	1
369	TUBE, PFA PTFE, 1/2 O.D. X 7-1/2	1 / —
395	OIL SLINGER	2
446	OIL PUMP COVER	1
449	ROTOR SPROCKET ADAPTER	1
450A	CHAIN, ROLLER, 60 LENGHTS	1
450B	CHAIN LINK CONNECTOR, NO. 35	1
451	SPROCKET, NO. 35, 16 TEETH	1
452	SPROCKET, NO. 35, 32 TEETH	1
458	PUMP HOUSING	1
459	OIL GAUGE, BULLSEYE	1
479	TUBE, ALUMINUM, 1/2 O.D.	1 / —
499	REDUCING BUSHING, 1 X 1/2	1
500	THERMOSWITCH, **35 FT-LB TORQUE**	1

NOTES:

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

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

31/33 — P/N 77101

PARTS LIST FOR MODEL 7000-90/91

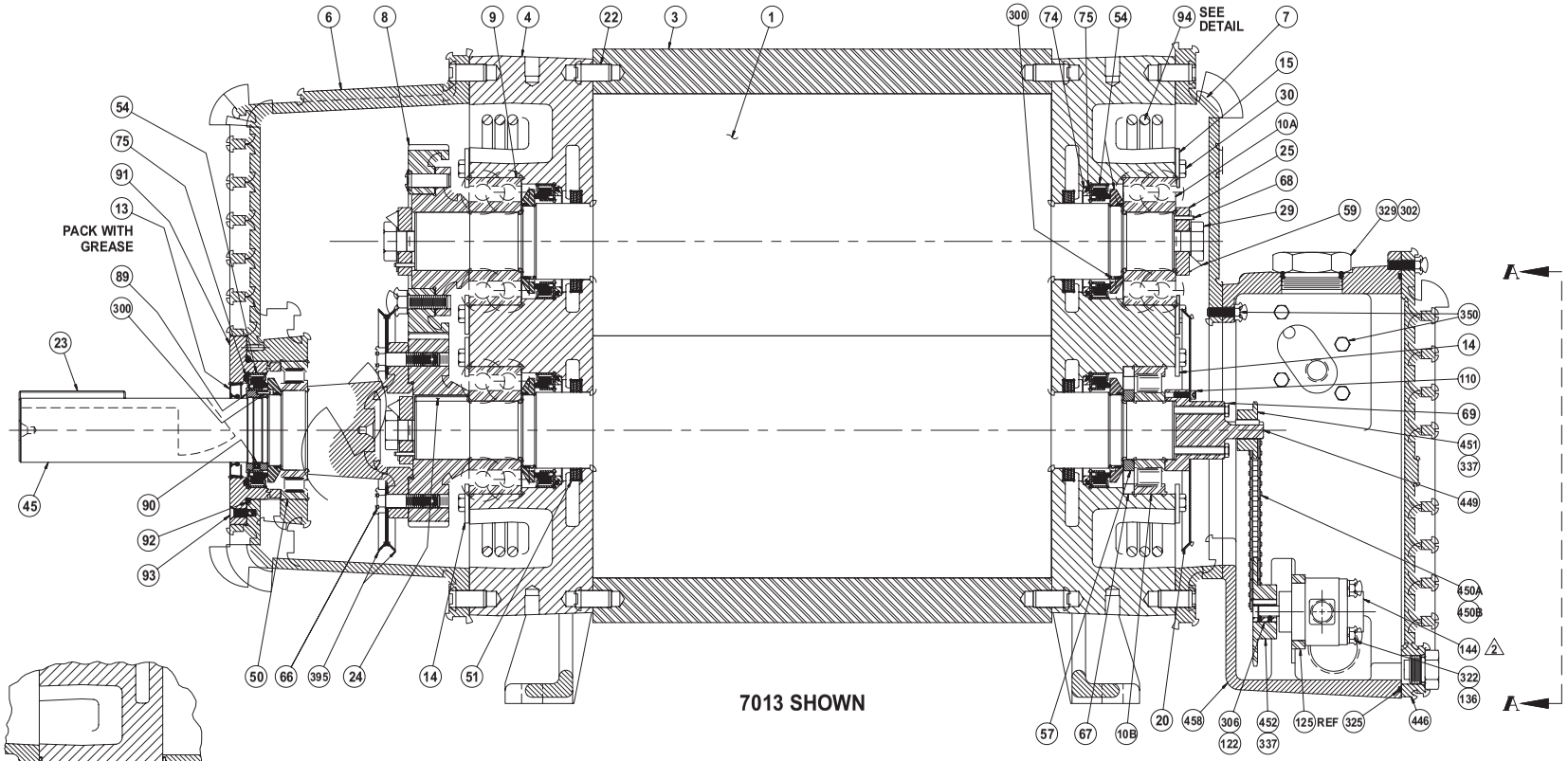
ITEM NO.	PART DESCRIPTION	90 / 91 QTY
1	ROTOR	2
3	HOUSING	1
4	END PLATE	2
6	DRIVE END COVER	1
7	FREE END COVER	1
8	TIMING GEAR SET	1
9	BEARING, DRIVE END	2
10	BEARING, FREE END	2
13	LIP SEAL, VITON	1
14	RETAINER	2
15	RETAINER	2
20	OIL SLINGER	1
22	DOWEL PIN	8
23	DRIVE SHAFT KEY	1
24	GEAR KEY	2
25	ROTOR SHAFT WASHER	4
26	CAP SCREW, HEX HD 1/2	36
29	BOLT, 3/4-10	4
30	CAP SCREW, SOC HD 3/8	16
31	MAGNETIC PIPE PLUG, 1-1/16	2
42	NAMEPLATE	1
45	DRIVE SHAFT	1
50	BEARING	1
51	LAB SEAL	4
54	MECHANICAL SEAL, WITH VITON & HE-11	5
59	ROTOR LOCKING TAB	4
66	CAP SCREW, SOC HD, 1/2-13 NYLOK	4
68	DOWEL PIN	4
70	SIGHT GAUGE WINDOW	2
74	SEALING RING	4
75	O-RING, VITON	5

ITEM NO.	PART DESCRIPTION	90 / 91 QTY
80	LOCK WASHER, 3/4	4
85	PIPE PLUG, SOC 1	14
89	MECHANICAL SEAL LOCK RING	1
90	SET SCREW, 1/4-20 UNC	3
91	NOSE PIECE LIP SEAL	1
92	O-RING, VITON	1
93	CAP SCREW, SOC HD 1/4	4
94	COOLING COILS	2
95	O-RING, VITON	4
96	O-RING, VITON	4
97	MANIFOLD BUSHING	4
98	PIPE PLUG, 3/8 SQ STL	4
109	PIPE PLUG, 1 SOC HD	14 / —
121	PIPE PLUG, 3/8 SQ STL	10 / —
174	PIPE PLUG, 1/2 HEX, STL	4
195	LIFTING LUG	2
196	CAP SCREW, HEX HD 3/4-10 UNC	2
199	O-RING, VITON	2
300	ROLL PIN	5
304	MOUNTING FOOT	2
307	CAP SCREW, HEX HD 3/4-10 UNC	4
339	PLUG, STRAIGHT THRD, 1-1/16 STL	6
395	OIL SLINGER	2
499	REDUCING BUSHING, 1 X 1/2	1
500	THERMOSWITCH, **35 FT-LB TORQUE**	1

NOTES:
- QUANTITIES SHOWN ARE MAXIMUM VALUES
- QUANTITIES MAY VARY BETWEEN BLOWER

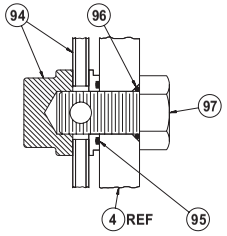
PARTS KITS ARE AVAILABLE, AS FOLLOWS:
90/91 — P/N 77052

ASSEMBLY DRAWINGS FOR MODEL 7000-31/33 — CUTAWAY VIEW



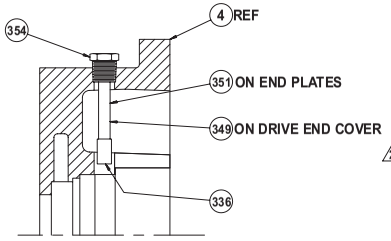
OPTIONAL O-RING ARRANGEMENT

FOR UNITS WITH O-RING SEALING TYP FOR BOTH ENDS



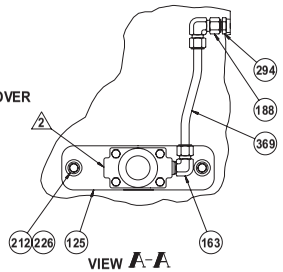
COOLING COIL DETAIL

EACH END PLATE
SCALE: 3/4

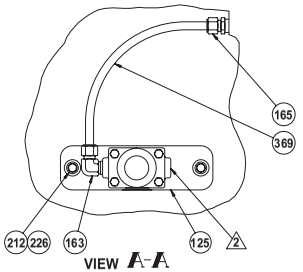


ORIFICE ASSY

4 PLACES ON EACH END PLATE
1 PLACE ON DRIVE END COVER



VIEW A-A
(COVER REMOVED)
31 SERIES
SCALE: NONE

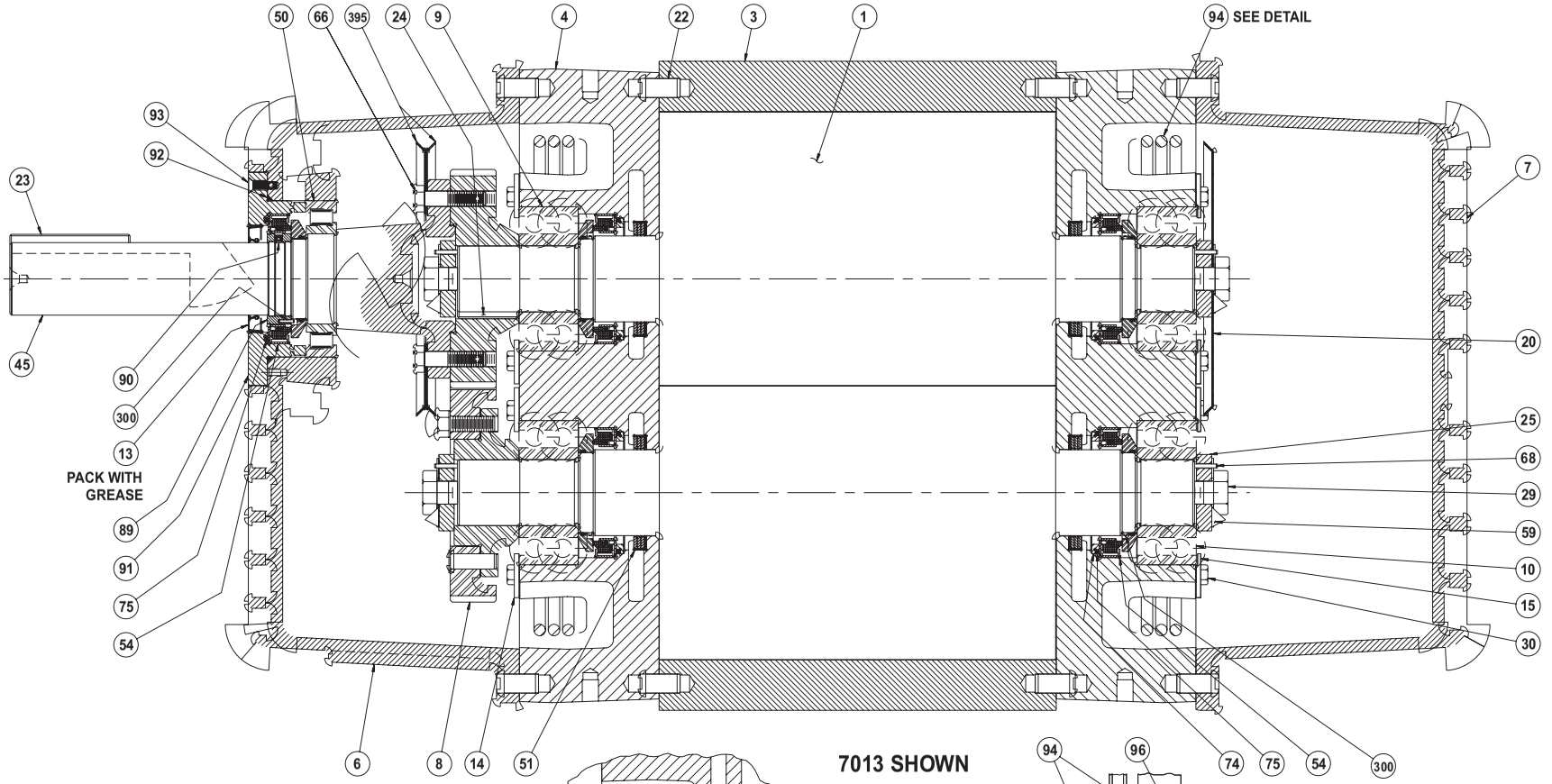


VIEW A-A
(COVER REMOVED)
33 SERIES
SCALE: NONE

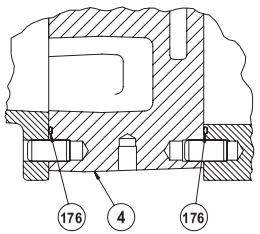
NOTES:

1. USE SEALANT BETWEEN END COVERS, END PLATES, HOUSING, PUMP HOUSING & OIL FILTER ADAPTER.
2. INSTALL ITEM 144 OIL PUMP WITH SUCTION SIDE OF PUMP (MARKED WITH "S") ON SIDE OF BLOWER OPPOSITE ITEM 187 OIL DRAIN LINE.

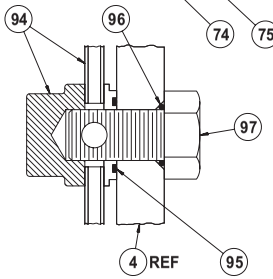
ASSEMBLY DRAWINGS FOR MODEL 7000-90/91 — CUTAWAY VIEW



NOTE:
USE SEALANT BETWEEN END COVERS, END PLATES & HOUSING

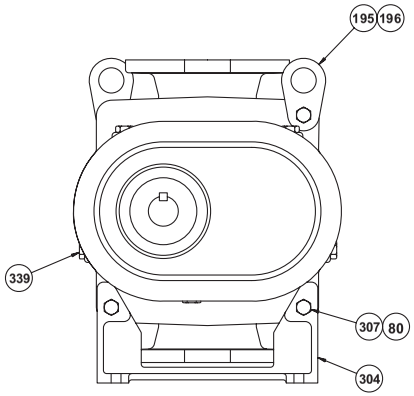


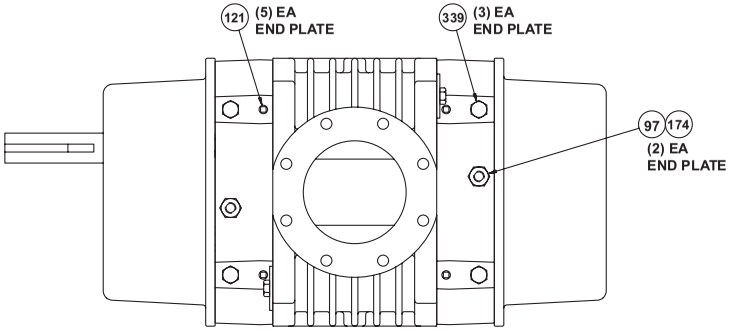
OPTIONAL O-RING ARRANGEMENT
FOR UNITS WITH O-RING SEALING
TYP FOR BOTH ENDS

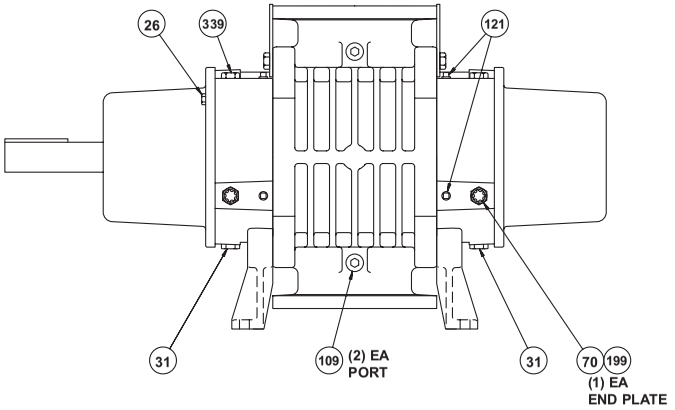


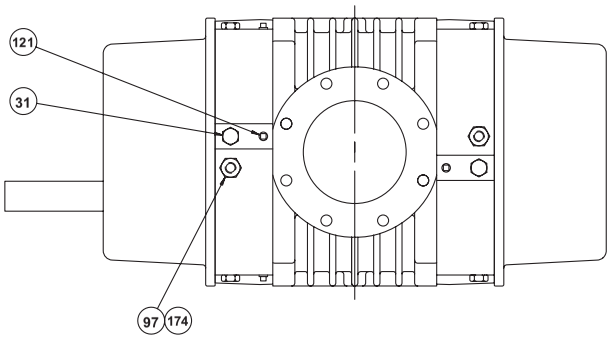
COOLING COIL DETAIL
EACH END PLATE
SCALE: 3/4

ASSEMBLY DRAWINGS FOR MODEL 7000-90/91 — SIDE AND END VIEWS



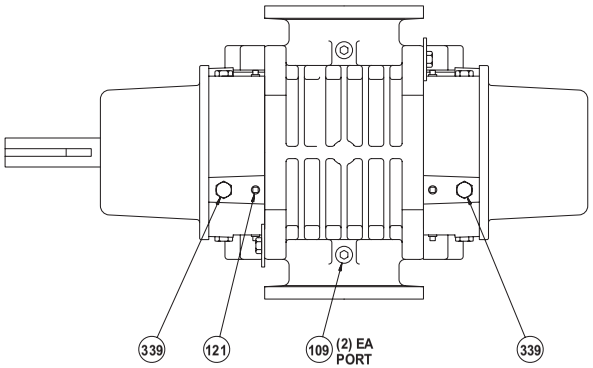


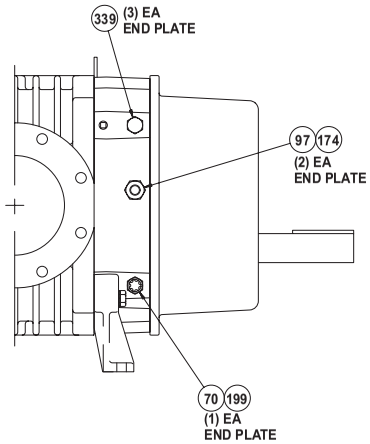


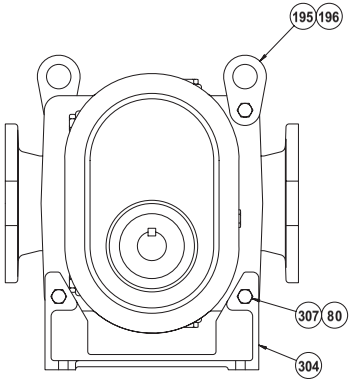


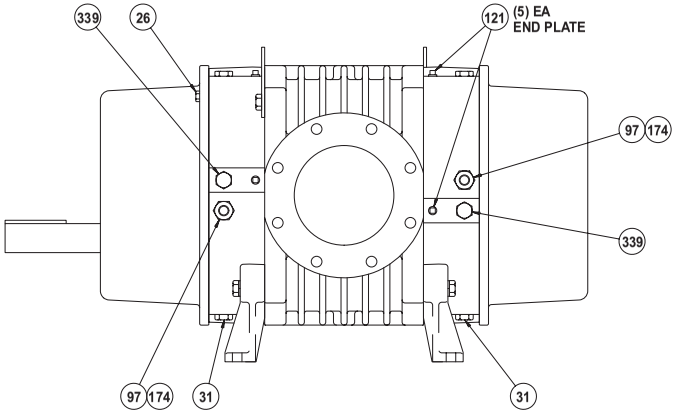
7000-90
7013 SHOWN

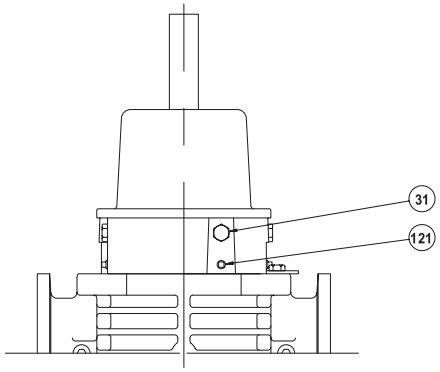
ASSEMBLY DRAWINGS FOR MODEL 7000-90/91 — SIDE AND END VIEWS











7000-91
7013 SHOWN

WARRANTY – VACUUM PRODUCTS

Subject to the terms and conditions hereinafter set forth and set forth in General Terms of Sale, Kinney (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	WARRANTY DURATION
New (Non-Piston Pumps)	15 months after date of shipment or 12 months after initial startup date, whichever occurs first
New (Piston Pumps)	30 months after date of shipment, on all units sold after June 1, 2014.
Repair	6 months after date of shipment or remaining warranty period, whichever is greater
Remanufactured	9 months after date of shipment or 6 months after initial startup date, whichever occurs first

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.

June, 2014

OPERATING DATA FORM / PRODUCT REGISTRATION

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

Model No. _____ V-Belt Size _____ Length _____

Serial No. _____ Type of Lubrication _____

Startup Date _____ _____

Pump RPM _____ Operating Vacuum _____

Pump Sheave Diameter _____ Any other Special Accessories Supplied or in use:

Motor Sheave Diameter _____ _____

Motor RPM _____ HP _____ _____

NOTES: _____

_____

_____

_____

IMPORTANT

All vacuum boosters and vacuum pumps manufactured by Kinney are date coded at time of shipment. In order to assure you of the full benefits of the product warranty, please complete, tear out and return the product registration card. You may also register your product online at www.kinneyvacuum.com or contact Customer Service.

KINNEY®

For Service & Repair, Technical Support, or Product Sales contact:

Kinney
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
O 417.865.8715 800.825.6937
F 417.865.2950
www.kinneyvacuum.com

MEMBER OF CAGI Compressed Air & Gas Institute

AVEM Association of Vacuum Equipment Manufacturers

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