

WARNING: Do Not Operate Before Reading Manual

Mechanical Vacuum Boosters OPERATOR'S MANUAL

Models

1215	1236
1224	1248
1230	



31/35 Series - Vertical Flow

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.

Rights Reserved Statement:

No part of this publication may be reproduced or used in any form by any means - graphic, electronic or mechanical, including photocopying, recording, taping or information storage and retrieval systems - without the written permission of Kinney®.

Product information and specifications subject to change.

TABLE OF CONTENTS

SECTION	PAGE
1. INTRODUCTION	1
1.1 APPLICABLE DOCUMENTATION	1
1.2 SCOPE OF MANUAL	1
2. CONVENTIONS AND DATA PLATE	1
2.1 GRAPHIC CONVENTIONS IN THIS MANUAL	1
2.2 DATA PLATE	2
3. LIFTING	3
4. DESCRIPTION	3
4.1 FLOW BY DIRECTION	4
4.2 SPECIFICATIONS	5
5. INSTALLATION	6
5.1 GENERAL	6
5.1.1 LOCATION	8
5.1.2 FOUNDATION	8
5.1.3 VACUUM BOOSTER AIR INTAKE	8
5.1.4 SOFT FOOT	9
5.2 SAFETY	9
5.3 LUBRICATION	10
5.3.1 FILLING PROCEDURE	10
5.3.2 FREQUENTLY ASKED QUESTIONS REGARDING LUBRICATION	12
5.4 RECOMMENDED OIL CHANGE INTERVALS	12
5.4.1 HAZARDS ASSOCIATED WITH BREAKDOWN OR IGNITION OF LUBRICATION	12
5.4.2 LUBRICATION – INTEGRAL PRESSURE	13
5.4.3 OIL FILTER	13
5.4.4 OIL PRESSURE ADJUSTMENT	13
5.4.5 OIL COOLER	13
5.5 PIPING CONNECTIONS	14
5.5.1 BLOCKAGE OR RESTRICTION	14
5.6 MOTOR DRIVES	15
5.6.1 DIRECT COUPLED	15
5.6.2 V-BELTS	15
5.6.3 V-BELT TROUBLESHOOTING	17
5.7 MOTOR AND ELECTRICAL CONNECTIONS	17
6. OPERATION	18
6.1 GENERAL	18
6.2 START-UP CHECKLIST	19
6.3 OPERATING	19
6.4 STOPPING	20
6.5 WATER INJECTED VACUUM BOOSTERS	20
6.5.1 OPERATION	20
6.5.2 SHUTDOWN	21
6.6 RECOMMENDED SHUTDOWN PROCEDURE TO MINIMIZE RISK OF FREEZING OR CORROSION	21
7. MAINTENANCE	22
7.1 GENERAL	22
7.2 REGULAR MAINTENANCE	23
7.3 SPARE PARTS	23
7.4 FACTORY SERVICE & REPAIR	24
7.5 LONG TERM STORAGE	24
8. DISASSEMBLY AND REASSEMBLY	25
8.1 DISASSEMBLY OF VACUUM BOOSTER	25
8.1.1 FREE END DISASSEMBLY	25
8.1.2 GEAR END DISASSEMBLY	25
8.1.3 END PLATE AND ROTOR DISASSEMBLY	25
8.2 ASSEMBLY	26
8.2.1 PREPARATION OF END PLATES	26
8.2.2 GEAR END ASSEMBLY	27
8.2.3 FREE END ASSEMBLY	28
8.2.4 ADJUSTING INTERLOBE CLEARANCE	29
8.2.5 COMPLETING GEAR END ASSEMBLY	30
8.2.6 COMPLETING FREE END ASSEMBLY	30
9. TROUBLESHOOTING	31
10. ASSEMBLY CLEARANCES	32
11. TORQUE CHART	32
12. RECOMMENDED LUBRICANTS	33
13. SPECIAL TOOL DRAWINGS	35
14. PARTS LISTS AND ASSEMBLY DRAWINGS	36
15. WARRANTY — VACUUM BOOSTER PRODUCTS	43
16. OPERATING DATA FORM / PRODUCT REGISTRATION	44

1. INTRODUCTION

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

Kinney mechanical vacuum booster 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 vacuum 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 vacuum booster 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 1012-1:1996 - Compressors and vacuum pumps - Safety Requirements - Part 1: Compressors

1.2 SCOPE OF MANUAL

The scope of this manual includes the bare shaft rotary vacuum booster .

2. CONVENTIONS AND DATA PLATE

2.1 GRAPHIC CONVENTIONS IN THIS MANUAL

This manual is the result of a risk assessment according to the applicable documents referenced in section 1.1. The following 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.

2.2 DATA PLATE

MODEL NUMBER	SERIAL NUMBER	MAWP	YEAR
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
KINNEY®	4840 West Kearney Street Springfield, Missouri USA 65803	MAX RPM <input type="text"/>	
READ INSTRUCTION MANUAL BEFORE OPERATION OR BODILY HARM MAY RESULT			
 WARNING Keep body & clothing away from machine openings.	 WARNING Do not operate without guards in place.	 CAUTION Hearing protection required.	 CAUTION Do not touch hot surfaces.
(800) 825-6937			Made in the USA

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 vacuum booster.



WARNING

Do not operate without guards in place.



CAUTION

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



CAUTION

Do not touch hot surfaces.

The upper limit of the vacuum booster operation is 400° F (205° C). Do not touch the vacuum booster while it is in operation and assure vacuum booster is cool when not in operation.

MODEL NUMBER: This identifies the specific model of the vacuum boost .

SERIAL NUMBER: Each vacuum 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 vacuum booster was manufactured.

MAWP: This states the maximum allowable working pressure (MAWP) of the vacuum booster casing. This is NOT the allowable maximum pressure differential. When determining the pressure differential, the inlet pressure shall be taken into account to assure that the MAWP is not exceeded.

The standard MAWP is per Table 2. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the vacuum booster has been performed.

Contact the factory for testing and documentation if this pressure is to be exceeded.

3. LIFTING



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

4. 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 vacuum booster 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 vacuum 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 vacuum booster, but by the amount of restriction, either downstream of the vacuum booster discharge port, or upstream of the vacuum 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 vacuum booster can make either side the inlet or discharge. See also the Flow Direction by Rotation section below.

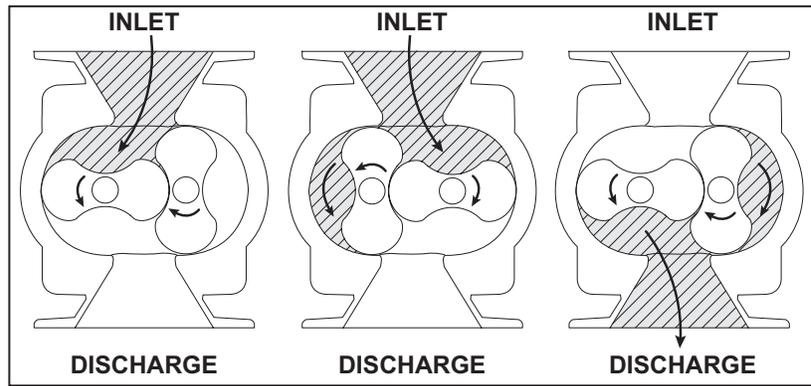


Figure 1 - Illustration of general operation principle

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 vacuum booster. Likewise, if a possibility exists that flow to the vacuum booster inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the vacuum booster. A pressure type relief valve in the discharge line near the vacuum booster is also strongly recommended for protection against cutoff or blocking in this line. Check valves should also be used on every vacuum booster when more than one vacuum booster is connected to a discharge line. This is for both safety and operating conditions.

When a belt drive is employed, vacuum 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 vacuum booster, a check valve in the piping downstream of the vacuum booster will protect the vacuum booster from overspeeding in a backward direction upon shutdown.

Consult your Kinney sales professional if questions arise.

4.1 FLOW BY DIRECTION



WARNING

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

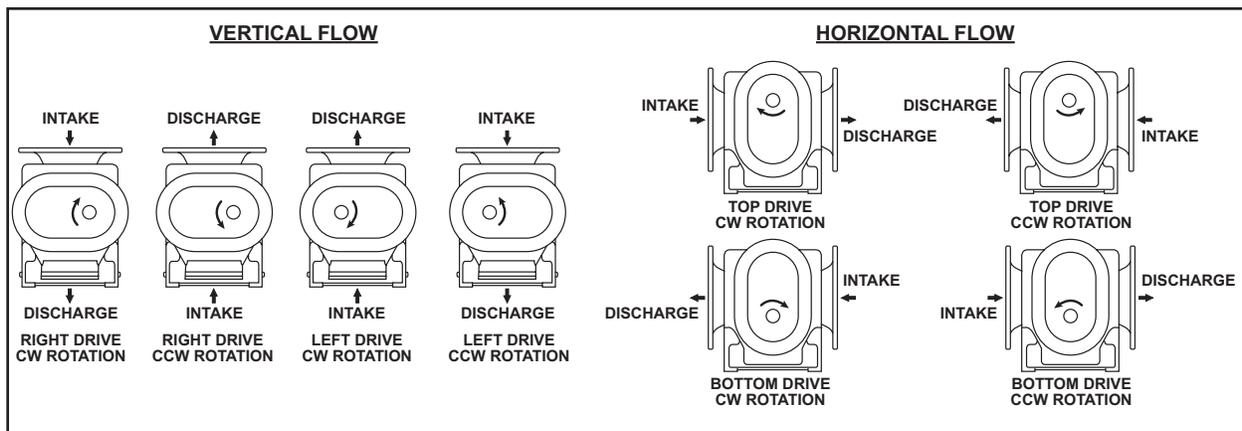


Figure 2 - Flow Direction by Rotation

4.2 SPECIFICATIONS

TABLE 1 — SPECIFICATIONS

MODEL	APPROXIMATE OIL CAPACITY GALLONS / LITERS		PORT SIZE IN / MM	MAX RPM	APPROXIMATE WEIGHT LBS. / KG	
	VERTICAL FLOW 86 / 82 / 69	HORIZONTAL FLOW 19 / 55 / 66			VERTICAL FLOW 86 / 82 / 69	HORIZONTAL FLOW 19 / 55 / 66
1215	10.0 / 37.9	7.0 / 26.5	12 / 305	1800	4200 / 1905	4200 / 1905
1224	10.0 / 37.9	7.0 / 26.5	14 / 356	1800	4900 / 2222	4900 / 2222
1230	10.0 / 37.9	7.0 / 26.5	14 / 356	1800	5400 / 2449	5400 / 2449
1236	10.0 / 37.9	7.0 / 26.5	18 / 457	1800	5900 / 2676	5900 / 2676
1248	10.0 / 37.9	7.0 / 26.5	20 / 508	1400	6850 / 3107	6850 / 3107

TABLE 2 — MAXIMUM OPERATING LIMITS

MODEL	MAXIMUM RPM	MAXIMUM PRESSURE DIFFERENTIAL psi / mbar	MAXIMUM VACUUM in. Hg / mbar	MAXIMUM TEMPERATURE RISE °F / °C	MAWP psi / bar
1215	1800	15 / 1034	15 / 507	280 / 155	100 / 6.8
1224	1800	15 / 1034	15 / 507	280 / 155	100 / 6.8
1230	1800	14 / 965	15 / 507	280 / 155	100 / 6.8
1236	1800	9 / 620	12 / 406	230 / 127	100 / 6.8
1248	1400	6 / 413	10 / 338	190 / 105	100 / 6.8



WARNING

The maximum pressure differential is based on the difference between the inlet pressure and the outlet pressure. The maximum pressure differential shall not be exceeded. Exceeding the maximum pressure differential will cause serious damage to the equipment and could cause bodily injury.



WARNING

The maximum allowable working pressure (MAWP) is based on the absolute pressure of the vacuum booster housing and is NOT the maximum allowable pressure differential. Exceeding the MAWP will cause serious damage to the equipment and could cause bodily injury.

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 vacuum booster sizes when operated under the standard atmospheric conditions. Do not exceed any one of these limits.



NOTE

Specially ordered vacuum 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.

5. INSTALLATION

5.1 GENERAL



DANGER

The vacuum booster is not intended to be used with explosive products or in explosive environments. The vacuum booster 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 vacuum 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

The standard MAWP is per Table 2. The MAWP shall not be exceeded unless specific factory testing of the pressure containing components of the vacuum booster has been performed.



WARNING

Table 2 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 vacuum booster is removed and still does not move freely, check inside the vacuum 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 vacuum 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 vacuum booster supports an equal share of the vacuum booster weight. This is necessary to prevent eventual twisting of the vacuum booster. Make sure feet rest evenly on the mounting surface before fastening down. Twisting or cramping the vacuum 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/vacuum booster base or mounting plate, rather than directly under the feet alone.

Piping should be accurately squared with the vacuum 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 vacuum 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 vacuum booster. Stress can be checked in a free state with feeler stock or verified on a previously installed vacuum booster with the aid of a dial indicator. Less than .002" (.05 mm) spring or gap should be found.

Use only clean new pipe and make certain it is free of scale, cuttings, weld beads, dirt, or any other foreign material. To guard against damage to the vacuum booster, insure that an inlet filter is used. Make provisions to clean the filter of collected debris after a few hours of operation and periodically thereafter. (See the *Piping Connections* section for additional details.)

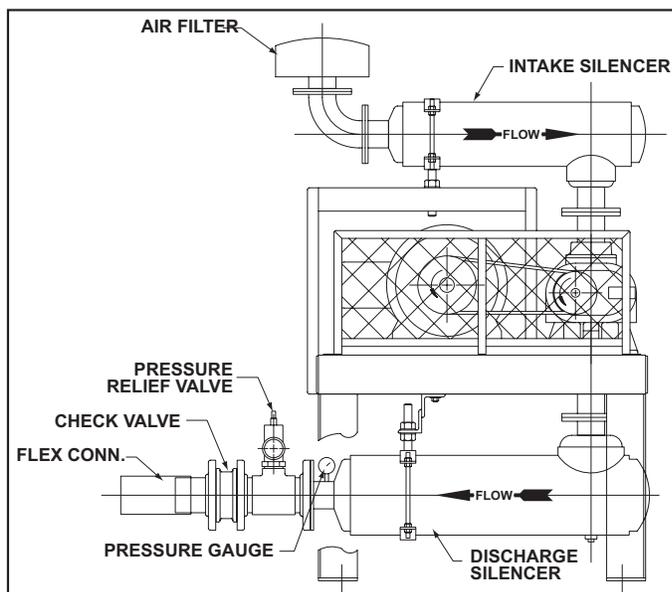


Figure 3 shows a typical complete installation of vacuum booster and accessories. Note the absence of throttle or shut-off valves in either discharge or intake piping. If it is possible for air flow to be cut off in either of these lines, make provisions to add a pressure and/or vacuum relief valve. In some installations, it may be desirable to use only an inlet silencer-cleaner supported directly from the vacuum booster connection. Weight of accessories and piping must be kept to a minimum to prevent vacuum booster casing distortion. Weights in excess of 10% of vacuum booster weight should be supported independently of vacuum booster and connected with a flexible hose or connectors. (The approximate weight of your unit is included within the *Specifications* table.)

Figure 3 - Typical Vacuum booster Installation

A vacuum 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.)

Vacuum 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 vacuum 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.)

5.1.1 LOCATION

Install your vacuum 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.

5.1.2 FOUNDATION

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

5.1.3 VACUUM BOOSTER AIR INTAKE

To minimize maintenance, supply your vacuum booster with the cleanest air possible. It is important that the air does not contain any flammable or toxic gases, as the vacuum 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 vacuum booster and/or motor may overheat and fail.

Do not use vacuum boosters on explosive or hazardous gases. Each size vacuum booster has limits on pressure differential, running speed, and discharge temperature. These limits must not be exceeded. Consult Table 2 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 vacuum 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 vacuum 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.

5.1.4 SOFT FOOT

Soft foot is a condition in which one of the vacuum booster feet does not sit flat on the base. Usually, this is due to irregularities in the surface to which the vacuum booster is mounted. When you tighten the bolt on the foot, the vacuum 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 vacuum 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 vacuum 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.

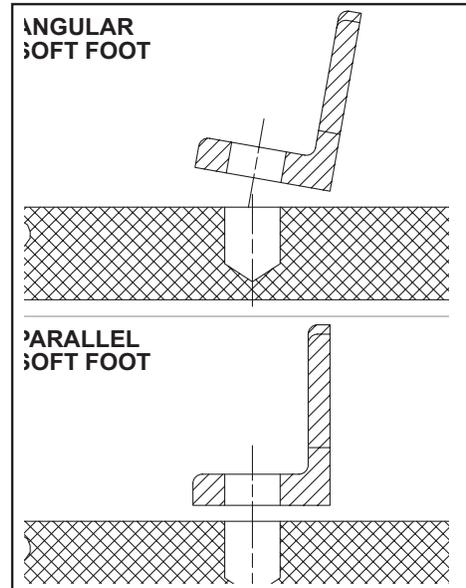


Figure 4 - Illustrations of Soft Foot

5.2 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 vacuum 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 vacuum booster and driving equipment can produce serious physical injuries. The vacuum booster should never be run with the inlet or discharge piping removed. If it becomes necessary to inspect the rotating parts of the vacuum 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 vacuum booster. Also assure that properly sized pressure relief valves are used on the outlet of the vacuum booster. The sizing shall be such to assure that the proper flow can be achieved without exceeding the rated vacuum and pressure ratings.



DANGER

Vacuum 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 vacuum 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.

5.3 LUBRICATION

Every vacuum booster and vacuum booster from Kinney is factory tested; oil drained and shipped dry to its installation point. Both oil reservoirs must be filled to the proper level before operation.

The vacuum booster incorporates pressure lubrication with an integral oil pump, pressure relief valve, filter and oil-to-coolant heat exchanger. Before starting the vacuum booster, fill oil sumps as shown below under “Filling Procedure”. Kinney approved lubricants are listed on page 33.



WARNING

Never attempt to change or add lubrication while the vacuum booster is running. Failure to heed this warning could result in damage to the equipment or personal injury. Oil must be checked when the vacuum 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 vacuum booster until you are sure oil has been put in the gear housing and rear cover. Operation of the vacuum booster without proper lubrication will cause the vacuum booster to fail and void the warranty.

5.3.1 FILLING PROCEDURE

See Figure 5. 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

The end cover oil reservoirs are connected together by passageways external to the rotor housing. To change oil, drain from the one-inch square head plug located in bottom of cover, or the on-half inch plug in the oil pump cover.

Oil levels should be checked frequently. Vacuum booster must be shut down to properly check oil level.

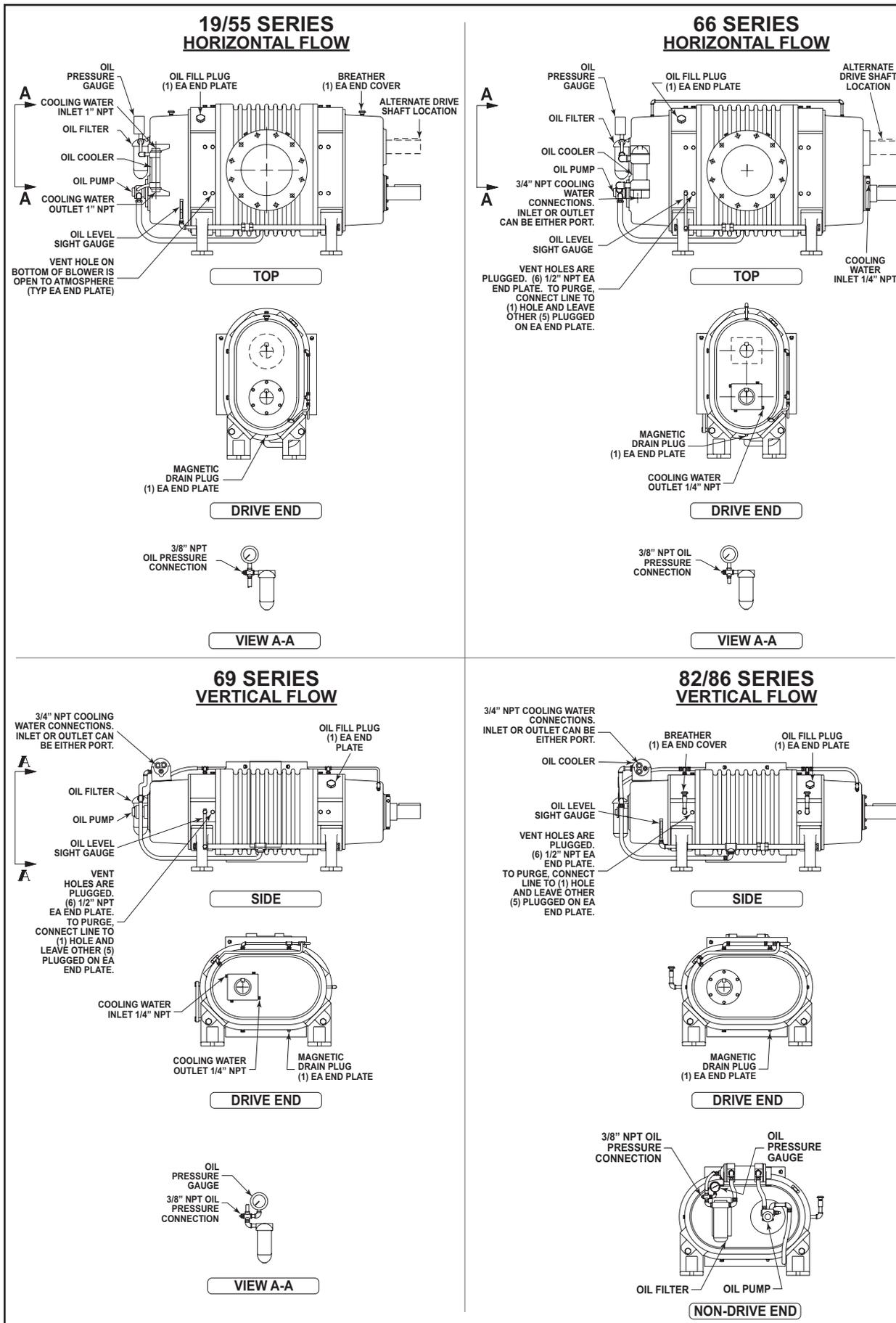


Figure 5 - Location of oil fill, drain, level gauges and cooling connections

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

5.4 RECOMMENDED OIL CHANGE INTERVALS

The *Operating Conditions* table at the right should only be used as an approximate guide. For best results, an oil sampling program is recommended.

The initial oil change should occur after the first 200 hours of operation. Thereafter, frequency of oil changes will depend on the operating conditions. Check for oil contamination periodically.

OPERATING CONDITIONS (PRESSURE/VACUUM)			
PRESSURE RANGE (PSIG) — OR — VACUUM RANGE (Inches Hg)	PRESSURE mbar	VACUUM mbar	OPERATING TIME BETWEEN OIL CHANGES Hours
1-5	70-345	34-170	1500
6-10	410-690	203-339	1000
11-15	760-1035	370-508	500

Time between oil changes should never exceed six (6) months.

Recommended lubricants are shown on page 35.

5.4.1 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.

5.4.2 LUBRICATION – INTEGRAL PRESSURE

5.4.3 OIL FILTER

The oil filter is self-contained. With every oil change, change the oil filter element and its shell gasket, both available from Kinney in Springfield, Missouri, or from any authorized distributor or service center. Oil Filter Element (P/N 91999-1) Shell Gasket (P/N 12102-6)



CAUTION

Factory supplied filters are engineered to provide the proper restriction in the oil lubrication system. Using filters other than those available from Kinney may result in lubrication problems and possibly unwarrantable damage to the booster.

5.4.4 OIL PRESSURE ADJUSTMENT

The oil pressure on each unit has been preset at the factory during the load testing. Generally the oil pressure should not require adjustment once the unit is installed and in operation. Some adjustment may be required due to the speed and oil temperature. The oil pump itself has no adjustment, however, the oil by-pass relief valve located in the oil feed line after the oil filter can be used for the same purpose.

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. Oil pressure may vary between 5 psig and 30 psig. The unit's oil system can operate satisfactorily at 1 psig, if necessary, and still have sufficient flow. 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).

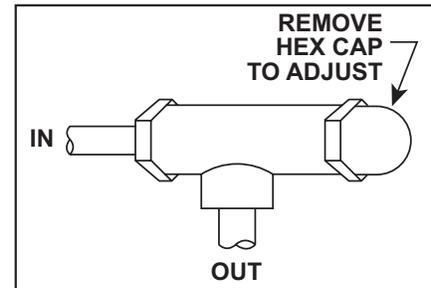


Figure 6 - Pressure Relief Valve

5.4.5 OIL COOLER

All versions are supplied with four-pass coolers. Either hole can be used for water inlet with no effect on performance. For most applications, 2-5 GPM (7.5-20 L/min) of 60° F (15° C) water is generally sufficient. Actual water usage will depend on operating conditions. Ideal oil temperature is 140°F (60° C) to 160° F (72° C).

All standard coolers are designed for use with fresh water only. Do not use brackish or salt water. The liquid to be cooled (oil) flows around the tubes and the cooling liquid (water) flows through the tube.



WARNING

If the unit is to be located outside or in a building where ambient temperatures can fall below freezing, then care must be taken to ensure the water or liquid used for cooling does not freeze and damage the booster. Oil cooler must be drained of liquid during downtime unless a re-circulating unit using a glycol mixture has been installed.

5.5 PIPING CONNECTIONS



WARNING

Pipe loading on the vacuum booster should be negligible as pipe loading can cause distortion of the vacuum 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.



NOTE

If the vacuum booster is to be located outdoors or in a building where the temperature surrounding the vacuum 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. Heat exchanger and cooling lines must be drained of liquid during downtime unless a recirculating unit using a glycol mixture has been installed.



NOTE

Units are never shipped from the manufacturer with liquid in the heat exchanger or cooling lines.

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

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

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.

5.5.1 BLOCKAGE OR RESTRICTION



WARNING

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

5.6 MOTOR DRIVES

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

5.6.1 DIRECT COUPLED

When installing the motor directly to the vacuum booster, align shafts to coupling in accordance with the coupling manufacturer's instructions. Vacuum 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 vacuum 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 vacuum 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 vacuum booster shaft. All direct coupled base mounted units must be re-aligned and greased after field installation.

5.6.2 V-BELTS

If the motor and vacuum booster are V-belt connected, the sheaves on both motor and vacuum booster shafts, should be as close to the shaft bearings as possible. Vacuum booster Sheave is not more than 1/4" (6.5 mm) from the vacuum 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 vacuum 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 vacuum 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 vacuum 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 vacuum booster speed.

Check vacuum 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 vacuum booster at this time to insure oil was added to the reservoirs.

SETTING V-BELT TENSION

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

Factors outside the control of the belt tensioning system used on an individual vacuum 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.

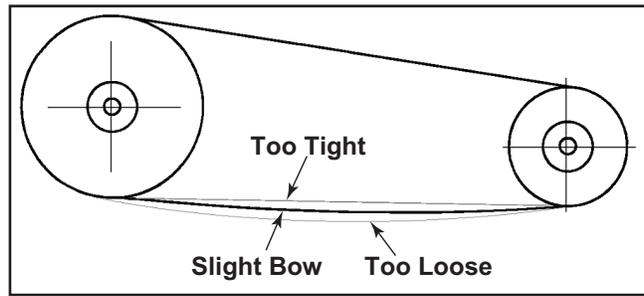


Figure 7 - General appearance of a V-Belt drive

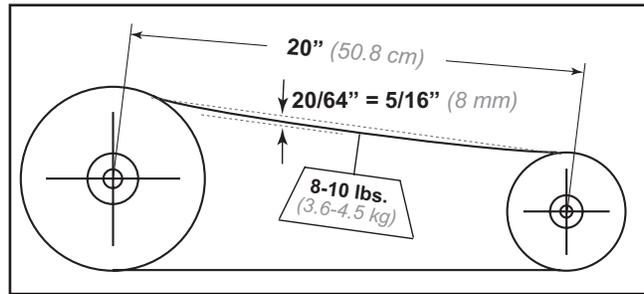


Figure 8 - Setting of proper tension for a V-Belt drive

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 vacuum booster.
8. Resume normal operation.

5.6.3 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.

5.7 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 vacuum booster by hand after wiring is completed to determine that there are no obstructions and if the vacuum booster turns freely; then momentarily start the vacuum 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.

6. OPERATION

6.1 GENERAL



DANGER
The vacuum booster is not intended to be used with explosive products or in explosive environments. The vacuum booster 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 2 states the maximum operating speed in RPM (rotations per minute), the maximum pressure differential, maximum vacuum and maximum temperature rise. Do not exceed these limits.

Before starting the vacuum 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 vacuum 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 vacuum 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 vacuum booster shaft several times by hand to make sure vacuum 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 vacuum 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 vacuum 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 vacuum 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 vacuum booster is part of a process system where conditions may vary. At the first opportunity, stop the vacuum booster and clean or remove inlet filter. Also, recheck leveling, coupling alignment or belt tension, and mounting bolts for tightness.

6.2 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 maintenance work has been performed
- After any shutdown period
- After vacuum 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 vacuum 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.

6.3 OPERATING

The upper temperature limit for vacuum booster operation is 400° F (205° 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 vacuum booster motor will stop and cannot be restarted until the temperature drops below the trip setting of the temperature switch.



DANGER

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



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 vacuum booster and system.



WARNING

The vacuum booster can generate excessive noise, hearing protection is required while the unit is in operation.



CAUTION

Do not touch hot surfaces.

The upper limit of the vacuum booster operation is 400° F (205° C). Do not touch the vacuum booster while it is in operation and assure vacuum 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.



NOTE

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

6.4 STOPPING



CAUTION

Do not stop the vacuum booster if there are high outlet pressures in the outlet piping. Unload the outlet piping prior to shutting down the vacuum booster.

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

6.5 WATER INJECTED VACUUM BOOSTERS

Water injected into the inlet of a vacuum booster operating on vacuum service will cool the vacuum booster. The water absorbs the heat of compression as it passes through the unit along with the air/gas being compressed. A vacuum 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 the factory or sales representative for additional guidance.

6.5.1 OPERATION

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

6.5.2 SHUTDOWN

1. The vacuum booster can be shutdown 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 vacuum booster under a partial vacuum without the water injection, allowing the vacuum booster to heat 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 vacuum booster just prior to shutting the vacuum booster 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.

Vertical flow units with two-lobed, plugged rotors should always be used. Always orient system such that the vacuum booster intake is at the top and discharge at the bottom.



CAUTION

Water injection can cause lime build-up on rotors. Check water supply for hardness. The use of water softeners, other chemicals, or distilled water may be necessary to prevent or remove this build-up. However, due to the wide variations in mineral content, pH, and chemical content of water that can be injected, 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.

6.6 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 vacuum booster is shut down and the vacuum 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 vacuum 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 vacuum booster during this procedure.

1. Isolate the vacuum booster from the moist system piping, allowing the vacuum booster to intake atmospheric air. Operate the vacuum booster under a slight load allowing the vacuum booster to heat within safe limits. The heat generated by the vacuum booster will quickly evaporate residual moisture.
2. For carpet cleaning applications, after the work is completed, simply allow the vacuum 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 vacuum 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 vacuum 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 vacuum booster. The applicator tube will damage the vacuum booster, most likely to the point that repair would be required.
4. If the vacuum 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.

7. MAINTENANCE

7.1 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 vacuum booster operating temperature and pressure remain within allowed limits.



DANGER

The vacuum 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 vacuum 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 vacuum booster should be protected immediately. Refer to the *Long Term Storage* section for more details.

7.2 REGULAR MAINTENANCE

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

A newly installed vacuum booster should be checked frequently during the first month of operation, especially lubrication. With vacuum booster at rest, check oil level in both the gear (drive) end and free (non-drive) end of the vacuum booster and add oil as needed. Complete oil changes are recommended every 1000-1200 operating hours, or more frequently depending on the type of oil and operating temperature. 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 <i>Troubleshooting</i>)	1. Clean all air filters. A clogged air filter can seriously affect the efficiency of the vacuum 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.

7.3 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 vacuum 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 vacuum 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

7.4 FACTORY SERVICE & REPAIR

With proper care, Kinney vacuum 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 65803-870



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 vacuum 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.

7.5 LONG TERM STORAGE

Any time the vacuum booster will be stored for an extended period of time, you should take make sure that 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 vacuum booster does not experience excessive vibration.
8. Attach a desiccant bag to either of the covers to prevent condensation from occurring inside the vacuum booster. Make sure any desiccant bag (or bags) is so attached to the covers that they will be removed before startup of the vacuum booster.
9. Store the vacuum 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.

8. DISASSEMBLY AND REASSEMBLY

8.1 DISASSEMBLY OF VACUUM BOOSTER

1. Drain lubrication from either end and disconnect all external oil lines. Do not attempt to remove oil distribution line bushing in the non-drive end plate until the end cover has been removed and the internal fittings are disconnected. The oil filter and heat exchanger may be removed or left fastened to the cover. Mark piping and other parts so that they can go back in their original position when reassembling.

8.1.1 FREE END DISASSEMBLY

2. Support free end cover (7) using a lifting strap. Remove cap screws (26) and install two of them as jacking screws in the tapped holes next to the dowel pins. It is recommended that two studs 8" (203 mm) long be used to assist in supporting the cover until it has cleared the dowel pins. It is not necessary to remove oil pump (144) and the adapter plate (313) from the cover unless these items are being replaced.
3. Remove large O-ring (302), four slinger cap screws (309) (5/16-12 point socket required), and oil slinger (20). Tap drive shaft (310) lightly with a mallet to remove from rotor shaft. Remove cap screws (30) and the oil retaining rings (15).

8.1.2 GEAR END DISASSEMBLY

4. Remove drive shaft key (23). Remove all burrs and other defacements from the drive shaft.
All series except 66/69. Remove cap screws (30) and place two screws in jackscrew holes provided to remove seal adapter plate (46). Tap out the seal and discard O-ring (314).

Series 66/69: Remove cap screws (30 & 93). Remove seal housing (91) and remove stator portion of the mechanical seal (76B). Using a spanner wrench, remove the adapter sleeve (87) by turning counter clockwise. Remove mating ring (76A) and O-rings (88 & 140).
5. Support drive end cover (6) as done on the non drive end. Remove cap screws (26). The drive end cover also has jacking screw holes, but it must slide off the spherical roller bearing on the drive shaft. To keep the bearing outer race from cocking, it is suggested that the drive shaft bearing pressing tool shown on page 35 be used.
6. Remove cap screws (66) and drive shaft (45). The bearing (50) should be pulled now unless it is to be pressed apart after the drive shaft has been removed.
7. Stand the vacuum booster up on the non drive end on 6" × 6" (152 × 152 mm) blocks remove cap screws (326) from the driven gear and align the match marks on the timing gear teeth (8). Using a suitable puller or extended pry bar, remove the gear shell from their hubs. The shell and hub are matched, do not inter-change. Remark if the original markings are no longer visible.
8. Unlock spanner nut lockwashers (36) and remove spanner nut (35) and lockwashers. Remove gear hubs with puller. Remove gear keys (24).
9. Remove oil sight gauge (70). Remove cap screws (307) and mounting feet (304), Series 66 & 69 have feet (304) and (408). All feet are mounted on 1 1/8" (28.7 mm) hollow locating dowels (306) from which they should easily disengage by tapping lightly with a mallet. Discard O-rings (305).
10. Remove cap screws (30) bearing retainer rings (14) and end plate cap screws.

8.1.3 END PLATE AND ROTOR DISASSEMBLY

11. The end plate, with the bearings, must be pulled from the rotor shafts. Make up two Bearing Pressing Fixture plates shown on page 36 along with eight pieces of 1/2 × 13 all thread, flat washers, and hex nuts. The use of a hydraulic ram is also recommended but some modifications may be necessary depending on the type of equipment available. Install each plate to the bearing retainer ring mounting holes and apply pressure equally to the ends of the rotor shaft by tightening the nuts on the threaded rods. Install spacers under plate after rotor shafts become flush with top of bearing. Use a hoist to pick up the end plate once the bearings have cleared the shaft.

12. After the end plate is removed, tap out the bearings (9). Remove large O-ring (176).

Series 19/86: Tap out lip seals (12).

Series 55/82/66/69: Pull out by hand the stator portion on the mechanical seal (54). Retain the seal adapter (74) for reassembly.



NOTE

If the rotor shaft sleeves (239) were removed with the end plate, pull them out by hand on the 19/86 series. On the other series you must drive them out with the bearings. To avoid damage to the sleeves do not use any hard faced hammers or steel punches to drive the sleeves out. Separate the mating rings from the sleeves.

13. To replace the PTFE washers of the labyrinth seals, remove the retaining ring (219), two wave springs (282), steel spacers (281), and PTFE washers (280).



NOTE

Older units will contain six PTFE and seven steel washers in each bore. The current PTFE washers are thicker, therefore you will only use five PTFE and six steel washers when reassembling.

14. Reinstall the end plate without the bearings and seals and secure with six cap screws equally spaced. Turn the unit over and support with block under the gear end plate.

15. Repeat steps 8, 11, 12 and 13 to remove non-drive end plate.



NOTE

Do not damage bearing spacer (123) when removing bearings. This spacer is only used on the free end.

16. Lift the rotors (1) out of the housing (3). Unbolt the gear end plate and lift the housing off. Clean all parts and inspect for wear. It is not necessary to remove the oil distribution fittings on the end plates and the gear cover but they should be checked with compressed air to be sure the five orifices are not clogged.

8.2 ASSEMBLY

The assembly procedure is generally the same for all series, but where there are differences, notations will be made. All joints between housing, end plate, and covers are O-ring sealed. An RTV silicone sealer or equal is used on the lip seals and mounting feet.

Dowel pins are used to locate end plate, housing, and covers in the proper location relative to each other. It is recommended that the gear end rotor shaft bearings along with all other replacement parts be purchased from Kinney, to insure the rotor location is correct with the proper end clearance relative to the gear end plate.

8.2.1 PREPARATION OF END PLATES

1. Make sure all parts are and free of any nicks or burrs caused by disassembly. See page 36 for dimensions of the seal installation tools.
2. Position end plate with bearing bores up (flange side down) and install components of the labyrinth seals. Starting with a PTFE washer (200) alternately stack five PTFE and five steel spacers in each bore. Add two wave springs, one more steel spacer and a retaining ring. Compress to seat seal.



NOTE

NOTE: Two wave springs are necessary for the proper pressure on the seal, but because of the pressure a tool as shown on page 23 is needed to press the retainer ring into its groove. The tool will center the labyrinth seal as it presses the retainer ring in place.

3. **Series 19/86:** Apply sealer to the O.D. of the lip seal. Install with lip facing upward. Tap in place with installation tool shown on page 36. Apply grease to lip of seal.

Series 55/82/66/69: Install seal adapter (74). The adapter is used to anchor the stator portion of the mechanical seal (54). To install the seal, grease both the O-ring and seal bore, then push the seal, by hand, into the bore and against the seal adapter, making sure the two dimples on the bottom of the seal case are aligned with the holes in the seal adapter. Clean surface with soft tissue and acetone.



NOTE

Never drive mechanical seal or seal tool with any type of hammer. This could result in damage to the carbon or its ability to properly seal.

8.2.2 GEAR END ASSEMBLY

4. Place non-drive end plate on 6" × 6" blocks with the solid side up. The end plate must be blocked up so rotor shafts will not touch floor when they are installed. Grease and install O-ring (176) in end plate groove. Install housing (3) making sure dowel pins are in place. Do not bolt in place at this time.
5. Lay two pieces of steel approximately 2" × 2" × 1/8" thick at the bottom of the housing as shown in Figure 9 with the end (long shafts) up. The rotor lobes will be above the end of the housing which is necessary when assembling this end.
6. Grease and install O-ring (176) in groove of gear end plate. Use sufficient grease to hold it into place when the end plate is turned over .
7. Install the end plate on the rotors and housing. The end plate will rest on the ends of the rotor lobes, and there will be a space between the housing and the plate. Install all cap screws (301) and tighten end plate to housing until tight.
8. Use six cap screws (301) equally spaced and secure non drive end plate against shims at bottom end of rotors. Do not torque these bolts.
9. Grease O-ring (331) and start onto rotor shaft.

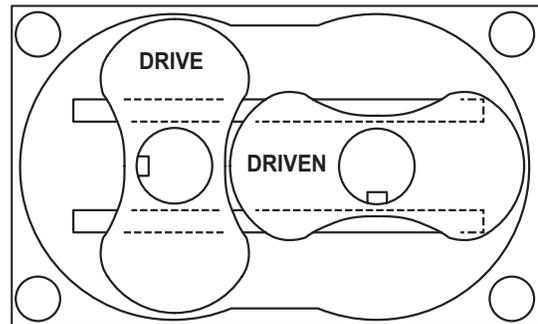


Figure 9 - Rotors in Housing

6. **Series 19/86:** Start sleeve (239) over shaft (larger diameter down) while forcing O-ring into step at the bottom of the sleeve. Slide sleeve down the shaft until seated. You may encounter interference as the sleeve passes through the PTFE rings. Tap sleeve with mallet to seat if necessary.
7. **Series 55/82/66/69:** Grease internal O-ring of mating ring portion of seal (Assemble mating ring over sleeve (236) with lapped surface down. Slot in mating ring must line up with pin in sleeve and be flush with top of sleeve when properly installed. Clean lapped surface of mating ring with soft tissue and acetone. Lubricate surface and start sleeve over rotor shaft while forcing O-ring into step at bottom of sleeve. Carefully slide this assembly down the shaft until seated.
10. Coat the rotor shaft with an anti-seize lubricant and press the bearing (9) on the shaft. The bearing manufacturer numbers and/or an acid dot (inner race) should be up or toward the gears. Use the same plates used to disassembly and a sleeve to press on the inner race of the bearing when installing.
11. Loosen cap screws holding non-drive end plate to housing then install bearing retainer rings (14) and secure with cap screws (30). At this time check clearances between the rotor lobes and gear end plate. See page 34 for the correct gear end clearances. If clearances are not within specifications, recheck parts to find cause of improper clearances before proceeding. Retighten the cap screws on the non-drive end but do not torque at this time.

12. Install keys (24) into rotor shafts. Tight fit required. Coat shafts and key with anti-seize. If new gears are being installed, disassembly gear shell from hub.
13. Heat the gear hubs to 350° F (177° C) At this temperature they should fit easily to the rotor shafts



NOTE
After heating, handle gear hubs with insulated gloves only.

Secure with lockwashers (36) and locknut (35) immediately after hub is installed. Torque to proper specification. Do not install gear shell until hub has been allowed to cool

8.2.3 FREE END ASSEMBLY

14. Turn assembly over and support on blocks. Remove the six cap screws and put jack screws in the holes provided in the flange of the end plate and remove plate. Take out two shims and check free end clearance between end of the lobes and housing using a flat bar and feeler gauges or a depth micrometer. See page 34 for correct clearances.

Series 19/86: Repeat step 9 to install sleeves.

15. **Series 55/82/66/69:** Recheck carbon of seal to be sure it is clean.

All series: Reinstall end plate making sure O-ring is still in its groove and secure with all the cap screws (26).

16. **Series 55/82/66/69:** Repeat step 9 install sleeve and mating ring assemblies.

17. Install bearing spacers (123) then repeat step 10 to install bearings. Secure with lockwashers and locknuts (936 & 35). Bend one lockwasher tap into spanner nut slot to lock all nuts).

18. Install oil retainer rings (15) and cap screws (30) (only six required).

19. To install mounting feet (304) or (304 & 408 on 66/69 series) the hollow dowel (306) should be in the foot. If any of the dowels are in the end plate, remove and transfer to the feet. Grease and install the O-ring over dowel. Run a bead of silicone sealer 1/4" wide, around the dowel holes on the foot mounting pad of the end plate. This acts as a backup O-ring to prevent any oil leakage. Secure with cap screw (307). Reconnect oil pipes then stand unit on its feet.

20. The gear hub should now be cool enough to assemble the gear shells. The dowel pins should be in the hub. Transfer if necessary. Reinstall the timing shim and assemble the shells to their proper hubs (align hubs and shell match marks). Install drive gear first (right hand helix) the align the match marks on the teeth and assemble driven gear (left hand helix).



NOTE
The six cap screws that were in the drive gear are too long without the drive shaft. Temporarily use the six cap screws from the driven gear. Use three in each gear (every other hole).

8.2.4 ADJUSTING INTERLOBE CLEARANCE

21. The timing gears are made up of two pieces. The outer gear shells are fastened to the inner hubs with six cap screws and located with two dowel pins. By adding shims between a gear shell and the inner hub the gear is moved axially relative to the inner hub which is mounted on the rotor shaft. Being a helical gear, it rotates as it is moved out and the rotor turns changing the clearances between rotor lobes. Adding .012" (.30 mm) shim thickness will change the rotor lobe clearance by .003" (.076 mm).

The timing shim is formed from a number of .003 (.075 mm) shims, which have been laminated together. They are easily peeled off as necessary.

Use feeler gauges to check the clearance at AA (right-hand reading) and BB (left-hand reading). See Figure 10. The clearances should be adjusted so they are as equal between all lobes as possible. Usually within .003" to .004" (.076 mm to .10 mm). For best results use feeler gauges no longer than .006" (.15 mm).

EXAMPLE: If AA reading is .030" (.76 mm) and BB reading is .022" (.56 mm), by removing .016" (.40 mm) shim, the readings will change one-quarter of this amount or .004" (.10 mm). AA reading will drop to .026" (.66 mm) and BB reading will increase to .026" (.66 mm).

To determine the amount of shim to add or remove from the driven gear, simply subtract the two readings $.030" (.76 \text{ mm} - .022" (.56 \text{ mm}) = .008" (.21 \text{ mm})$ and double the result $.008 (.21 \text{ mm}) \times 2 = .016 (.42 \text{ mm})$.

22. To determine whether to add or remove this amount the following rule will always apply: If the right reading (AA) is greater than the left side reading (BB), remove this amount.

If the right side reading (AA) is greater than the left side reading (BB), remove this amount. If the right side reading (AA) is less than the left side reading (BB), then add this amount.

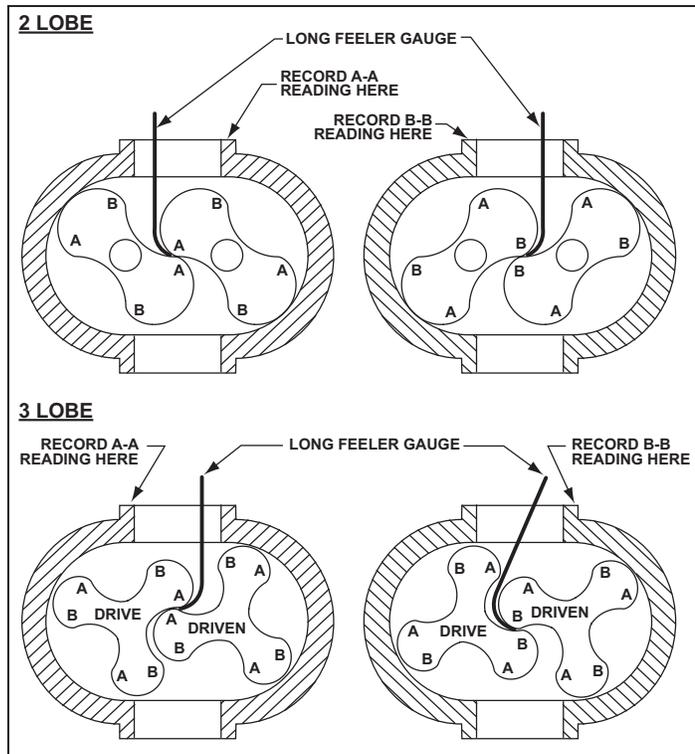


Figure 10 - Checking Rotor Interlobe Clearance



NOTE

If the results require you to remove shim from the driven gear and there are no shims left under this gear, go to the drive gear and add this amount for the same result. When removing or replacing a gear for shimming the timing mark should be matched and on center. Either gear may be pulled in this position.

8.2.5 COMPLETING GEAR END ASSEMBLY

23. Press drive shaft bearing (50) on drive shaft (45). Remove the three cap screws from drive gear and install in the drive gear. Clean and remove all burrs from mating surfaces of the gear and drive shaft flange. Install with cap screws (66)

Torque gear cap screws at this time. Check drive shaft run out at the seal journal. Do not exceed .003" T.I.R. (.13 mm)

Series 19/86/55/82: Secure bearing with Lockwasher (320) and locknut (319). Bend over tab to lock in place.

24. Grease and install O-ring (302). To aid in the installation of the gear cover (6) a tool as shown on page 36 should be made to hold the outer race of the bearing square with the shaft. Slide the cover over the tool and secure with cap screws (26).
25. **Series 19/86/55/82:** Press lip seal (13) into adapter plate (46) with lip facing inward. Grease lip, install O-ring (314) then carefully install assembly over drive shaft.

Series 66/69: Grease and install O-ring (140) on adapter flange and O-ring (88) in the bore of adapter. Clean mating ring (76A) with soft tissue and acetone and install on adapter while aligning pin (300) with slot in mating ring. The larger surface area of the mating ring face inward. Install retaining ring (78), using spanner wrench. Tighten set screws (90).

Lubricate seal O-ring and hand press seal (76B) into the seal housing (91) making sure to align the two dimples on the bottom of the seal with corresponding holes in the seal housing. Clean carbon surface with soft tissue and acetone. Grease and install O-ring (314) around the seal bore. Place a few drops of lubricating oil on the mating ring, then carefully install assembly over the drive shaft on to the cover. Secure with cap screws (30 & 93).

8.2.6 COMPLETING FREE END ASSEMBLY

26. Grease and install O-ring (302) in end plate groove. Install oil pump drive shaft (310) and oil slinger (20) on rotor shaft and secure with cap screws (309).
27. Align drive shaft slot with oil pump tang and carefully slide cover over shaft and onto dowel pins in end plate. Tap cover gently until contact with O-ring is made. If gap remains recheck slot and tang alignment for proper engagement. Secure cover with cap screws (26).



NOTE

If oil pump assembly (144) is being replaced, install cover first, then install O-ring (325) and oil pump.

28. Complete assembly by reinstalling or connecting all remaining oil lines, sight glass, etc. Oil filter element should always be replaced with factory filter when overhauling a unit. Fill with lubricant to proper level on column sight glass.

9. TROUBLESHOOTING

Although Kinney vacuum boosters 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 <i>Disassembly</i> section.
	Loose drain plug.	Tighten drain plug.
Excessive bearing or gear wear	Improper lubrication.	Correct oil level. Replace dirty oil. See the <i>Lubrication</i> 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 <i>Assembly Clearances</i> section.
	Speed too low.	Increase vacuum booster 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 <i>Disassembly</i> section.
Excessive vacuum booster temperature	Too much or too little oil in gear reservoir.	Check oil level. See the <i>Lubrication</i> section.
	Too low operating speed.	Increase vacuum booster speed within limits.
	Clogged filter or silencer.	Remove cause of obstruction.
	Excessive pressure differential.	Reduce pressure differential across the vacuum booster.
	Elevated inlet temperature.	Reduce inlet temperature.
	Worn lobe clearances.	Check for proper clearances. See the <i>Assembly Clearances</i> section.
Rotor end or tip drag	Insufficient assembled clearances.	Correct clearances. See the <i>Assembly Clearances</i> 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 <i>Assembly Clearances</i> 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 vacuum booster loose.	Check mounting and tighten if necessary.
	Piping resonance.	Check pipe supports, check resonance of nearby equipment, check foundation.

10. ASSEMBLY CLEARANCES

Values shown in inches and *millimeters*.

MODEL	GEAR END	FREE END	INTERLOBE	TIP-DOWEL	TIP-PORT
1215	.011 - .014 .28 - .36	.020 - .027 .51 - .69	.025 - .032 .64 - .81	.012 - .019 .30 - .48	.021 - .027 .53 - .69
1224	.011 - .014 .28 - .36	.029 - .036 .74 - .91	.025 - .032 .64 - .81	.012 - .019 .30 - .48	.021 - .027 .53 - .69
1230	.011 - .014 .28 - .36	.035 - .042 .89 - 1.07	.025 - .032 .64 - .81	.012 - .019 .30 - .48	.021 - .027 .53 - .69
1236	.011 - .014 .28 - .36	.041 - .048 1.04 - 1.22	.025 - .032 .64 - .81	.012 - .019 .30 - .48	.021 - .027 .53 - .69
1248	.011 - .014 .28 - .36	.053 - .060 1.35 - 1.52	.025 - .032 .64 - .81	.012 - .019 .30 - .48	.021 - .027 .53 - .69

11. 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)

12. RECOMMENDED LUBRICANTS

RECOMMENDED LUBRICANTS FOR BLOWERS AND VACUUM BOOSTERS

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.

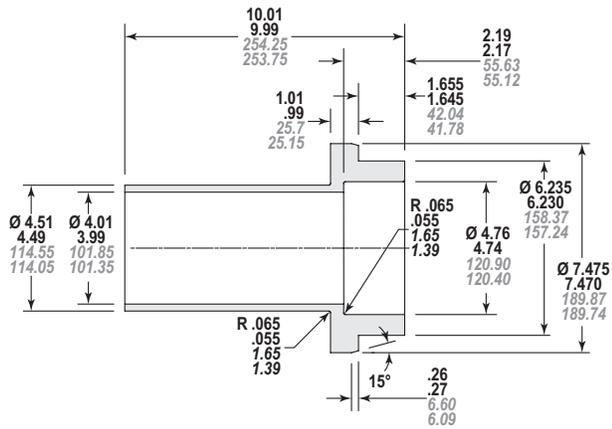
MD BLOWER & BOOSTER LUBRICANTS SPECIFICATIONS				
PRODUCTS	MD ONE	MD PLUS	MD MAX	MD FG
VISCOSITY INDEX	150	154	157	141
@40°C, CST	99.1	231.7	340.9	99.3
@100°C, CST	14.4	27.6	37.2	13.9
FLASH POINT °F (°C)	510 (266)	480 (249)	491 (255)	515 (268)
POUR POINT °F (°C)	- 44 (-43)	-49 (-45)	-54 (-48)	-60 (-51)

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

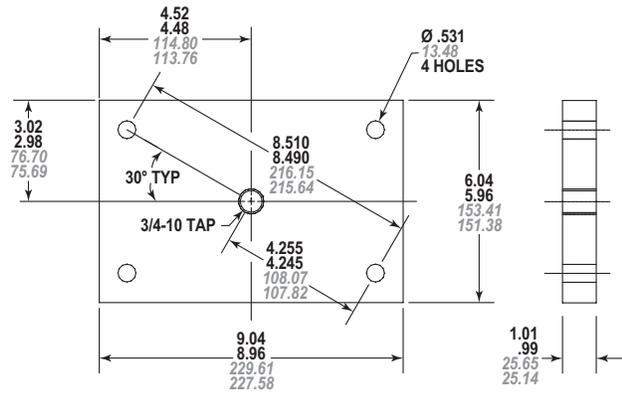
MD BLOWER & BOOSTER LUBRICANTS OPTIONS					
MD OIL TYPE	1 QUART	1 GALLON	5 GALLON	55 GALLON BARREL	CASE 12 QUARTS
MD ONE	16444-MD1-Q	16444-MD1-G	16444-MD1-5G	16444-MD1-B	16444-MD1-Q-C
MD PLUS	16444-MD2-Q	16444-MD2-G	16444-MD2-5G	16444-MD2-B	16444-MD2-Q-C
MD MAX	16444-MD3-Q	16444-MD3-G	16444-MD3-5G	16444-MD3-B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

13. SPECIAL TOOL DRAWINGS

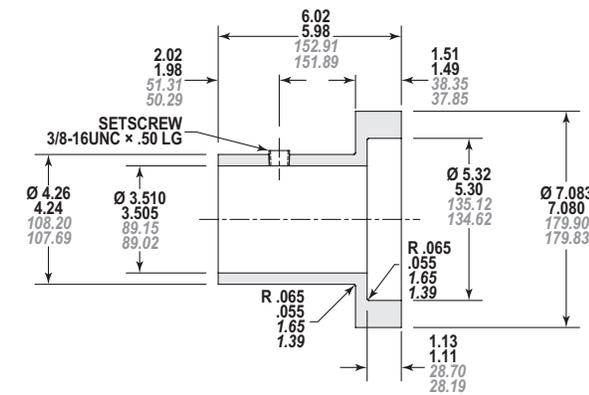
**FIGURE 11 —
LIP SEAL INSTALLATION TOOL**



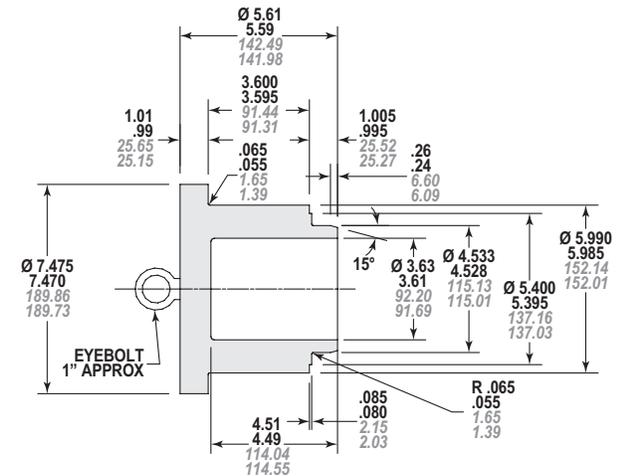
**FIGURE 12 —
BEARING PRESSING FIXTURE TOOL**



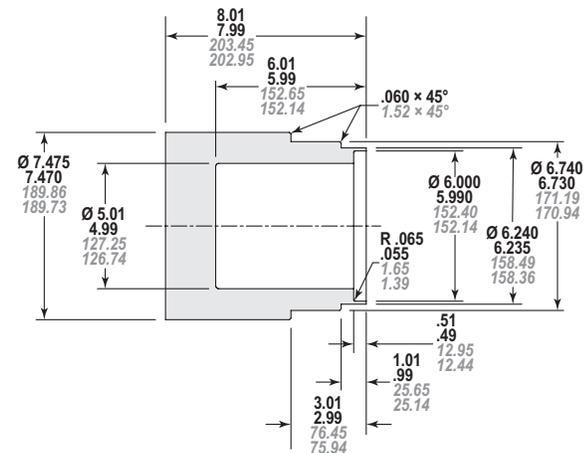
**FIGURE 13 —
DRIVE SHAFT BEARING ALIGNMENT TOOL**



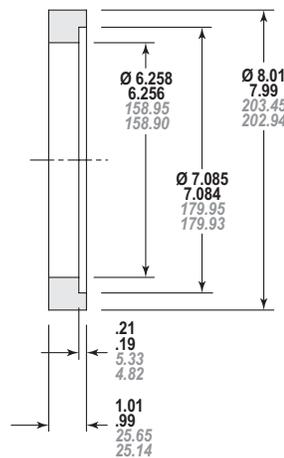
**FIGURE 14 —
LABYRINTH SEAL INSTALLATION TOOL**



**FIGURE 15 —
MECHANICAL SEAL INSTALLATION TOOL
(FOR PRESS FIT SEALS ONLY)**



**FIGURE 16 —
PILOT TOOL FOR MECHANICAL SEAL
(INSTALLATION IN DRIVE SHAFT SEAL HOUSING)**



NOTE:
All dimensions are shown in Inches and millimeters.

MATERIAL:
MILD STEEL

PARTS LIST FOR MODEL 1200 19/86 SERIES Vacuum boosterS

ITEM NO.	PART DESCRIPTION	19 QTY	86 QTY	ITEM NO.	PART DESCRIPTION	19 QTY	86 QTY
1	ROTOR, MECH SEAL	2	2	168	BUSHING REDUCER	1	1
3	HOUSING, CI	1	1	170	STREET ELBOW	—	2
4	END PLATE	2	2	171	ELL, ST	—	1
6	DRIVE END COVER	1	1	172	BUSHING	1	1
7	FREE END COVER	1	1	173	HEAT EXCHANGER, SB701-A4F	1	1
8	TIMING GEAR SET	1	1	174	PIPE PLUG	26	24
9	BEARING, DRIVE END	2	2	176	O-RING	2	2
10	BEARING, FREE END	2	2	181	HOSE, I.D. 1	1	7
12	LIP SEAL	4	4	186	BRACKET	1	1
13	LIP SEAL	1	1	189	HEX NUT	4	4
14	RETAINER	2	2	219	RETAINING RING	4	4
15	RETAINER	2	2	228	CAP SCREW	3	3
16	SHIM, TIMING GEAR	2	2	239	SLEEVE	4	4
20	OIL SLINGER	1	1	257	CROSS NPT	1	1
22	DOWEL PIN	4	4	258	ELBOW, NPT	3	6
23	DRIVE SHAFT KEY	1	1	259	TEE	2	2
24	GEAR KEY	2	2	260	TEE, REDUCING	2	2
26	CAP SCREW	48	48	262	GAUGE	1	1
27	LOCK WASHER	6	6	263	ELBOW, REDUCING	3	3
30	CAP SCREW	36	36	266	HOSE CLAMP	6	6
31	MAGNETIC PLUG	2	2	274	HOSE	1	36
32	HOSE	1	13	280	WASHER, PTFE	20	20
35	LOCK NUT	4	4	281	SPACER	24	24
36	LOCK WASHER	4	4	282	WAVE SPRING, STL	8	8
37	BREATHER	2	2	283	PIPE	—	1
41	LOCK WASHER	4	4	284	PIPE DRESSER	2	2
42	TAG - BOOSTER, CE MARK	1	1	285	PIPE	2	2
44	HOSE	2	9	286	PIPE TUBE	1	1
45	DRIVE SHAFT	1	1	287	PIPE TOE	2	2
46	SEAL ADAPTOR	1	1	289	TEE	1	1
50	BEARING, ROLLER	1	1	290	REDUCER BUSHING	2	2
66	CAP SCREW	6	6	298	REDUCER BUSHING	1	1
70	OIL SIGHT GAUGE	1	1	301	CAP SCREW	48	48
73	HOSE	1	30	302	O-RING	2	2
80	BEVEL WASHER	2	2	304	MOUNTING FOOT	4	4
84	HOSE	1	18	305	O-RING	4	4
103	HOSE CLAMP	10	10	306	SLEEVE	4	4
104	CAP SCREW	4	4	307	CAP SCREW	16	16
105	PIPE	6	6	309	CAP SCREW	4	4
106	PIPE	—	2	310	OIL PUMP ASSEMBLY	1	1
107	HOSE	1	5	313	OIL PUMP ADAPTER	1	1
109	PIPE PLUG	3	3	314	O-RING	2	2
110	CAP SCREW, HEX HD	6	6	319	LOCK NUT	1	1
117	LOCK WASHER	3	3	320	WASHER	1	1
120	BUSH	1	1	325	O-RING	1	1
121	PIPE PLUG	1	1	329	PLUG, STRAIGHT THREAD	2	2
123	BEARING SPACER	2	2	331	O-RING	4	4
124	OIL FILTER, SPIN ON	1	1	336	ORIFICE FITTING	5	5
125	BRACKET	1	1	349	PIPE	1	1
126	DOWEL PIN	4	4	351	PIPE	4	4
132	PIPE	5	5	354	REDUCER BUSHING	5	5
144	OIL PUMP	1	1				
149	PIPE	3	7				
152	ELL, ST	2	3				
166	HOSE CONNECTOR	10	10				
167	PIPE	3	3				

NOTES:
 • QUANTITIES SHOWN ARE MAXIMUM VALUES;
 QUANTITIES MAY VARY BETWEEN VACUUM BOOSTER
PARTS KITS ARE AVAILABLE. AS FOLLOWS:
 19/86 — P/N 29219

PARTS LIST FOR MODEL 1200 55/82 SERIES Vacuum boosterS

ITEM NO.	PART DESCRIPTION	55 QTY	82 QTY
1	ROTOR, MECH SEAL	2	2
3	HOUSING, CI	1	1
4	END PLATE	2	2
6	DRIVE END COVER	1	1
7	FREE END COVER	1	1
8	TIMING GEAR SET	1	1
9	BEARING, DRIVE END	2	2
10	BEARING, FREE END	2	2
13	LIP SEAL	1	1
14	RETAINER	2	2
15	RETAINER	2	2
16	SHIM, TIMING GEAR	2	2
20	OIL SLINGER	1	1
22	DOWEL PIN	4	4
23	DRIVE SHAFT KEY	1	1
24	GEAR KEY	2	2
26	CAP SCREW	48	48
27	LOCK WASHER	2	2
30	CAP SCREW	36	36
31	MAGNETIC PLUG	2	2
32	HOSE	1	1
35	LOCK NUT	4	4
36	LOCK WASHER	4	4
37	BREATHER	2	2
41	LOCK WASHER	4	4
42	TAG - BOOSTER, CE MARK	1	1
44	HOSE	2	2
45	DRIVE SHAFT	1	1
46	SEAL ADAPTOR	1	1
50	BEARING, ROLLER	1	1
54	MECHANICAL SEAL	4	4
66	CAP SCREW	6	6
70	OIL SIGHT GAUGE	1	1
73	HOSE	1	1
80	BEVEL WASHER	2	2
84	HOSE	1	1
103	HOSE CLAMP	10	10
104	CAP SCREW	4	4
105	PIPE	6	6
106	PIPE	0	2
107	HOSE	1	1
109	PIPE PLUG	3	3
110	CAP SCREW, HEX HD	2	2
117	LOCK WASHER	3	3
120	BUSH	1	1
121	PIPE PLUG	1	1
123	BEARING SPACER	2	2
124	OIL FILTER, SPIN ON	1	1
126	DOWEL PIN	4	4
132	PIPE	5	5
144	OIL PUMP	1	1
149	PIPE	2	7
152	STREET ELBOW	2	3
166	HOSE CONNECTOR	10	10
167	PIPE	3	3

ITEM NO.	PART DESCRIPTION	55 QTY	82 QTY
168	BUSHING REDUCER	1	1
170	STREET ELBOW	0	2
171	ELL, ST	0	1
172	BUSHING	1	1
173	HEAT EXCHANGER	1	1
174	PIPE PLUG	28	28
176	O-RING	2	2
181	HOSE, I.D. 1	1	1
219	RETAINING RING	4	4
228	CAP SCREW	3	3
239	SLEEVE	4	4
257	CROSS NPT	1	1
258	ELBOW, NPT	3	6
259	TEE	2	2
260	TEE, REDUCING	2	2
262	GAUGE	1	1
263	ELBOW, REDUCING	3	3
266	HOSE CLAMP	6	6
274	HOSE	1	1
280	WASHER, PTFE	20	20
281	SPACER	24	24
282	WAVE SPRING, STL	8	8
283	PIPE	0	1
284	PIPE DRESSER	2	2
285	PIPE	2	2
286	PIPE TUBE	1	1
287	PIPE TOE	2	2
289	TEE	1	1
290	REDUCER BUSHING	4	4
298	REDUCER BUSHING	1	1
300	ROLL PIN	4	4
301	CAP SCREW	48	48
302	O-RING	2	2
304	MOUNTING FOOT	4	4
305	O-RING	4	4
306	SLEEVE	4	4
307	CAP SCREW	16	16
309	CAP SCREW	4	4
310	OIL PUMP ASSEMBLY	1	1
313	OIL PUMP ADAPTER	1	1
314	O-RING	2	2
325	O-RING	1	1
329	PLUG, TRAIHT THREAD	1	1
331	O-RING	1	1
336	ORIFICE FITTING	2	2
349	PIPE	4	4
351	PIPE	5	5
354	REDUCER BUSHING	1	1
369	TUBE	4	4
408	FOOT ASSEMBLY, MTG VERT	5	5

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES;
QUANTITIES MAY VARY BETWEEN VACUUM BOOSTER

PARTS KITS ARE AVAILABLE. AS FOLLOWS:

55/82 — P/N 29216

PARTS LIST FOR MODEL 1200 66/69 SERIES Vacuum boosterS

ITEM NO.	PART DESCRIPTION	66 QTY	69 QTY
1	ROTOR, MECH SEAL	2	2
3	HOUSING, CI	1	1
4	END PLATE	2	2
6	DRIVE END COVER	1	1
7	FREE END COVER	1	1
8	TIMING GEAR SET	1	1
9	BEARING, DRIVE END	2	2
10	BEARING, FREE END	2	2
14	RETAINER	2	2
15	RETAINER	2	2
16	SHIM, TIMING GEAR	2	2
20	OIL SLINGER	1	1
22	DOWEL PIN	4	4
23	DRIVE SHAFT KEY	1	1
24	GEAR KEY	2	2
26	CAP SCREW	48	48
27	LOCK WASHER	2	2
30	CAP SCREW	32	32
31	MAGNETIC PLUG	2	2
32	HOSE	1	1
35	LOCK NUT	4	4
36	LOCK WASHER	4	4
41	LOCK WASHER	4	4
42	TAG - BOOSTER, CE MARK	1	1
44	HOSE	2	2
45	DRIVE SHAFT	1	1
50	BEARING, ROLLER	1	1
54	MECHANICAL SEAL	4	4
66	CAP SCREW	6	6
70	OIL SIGHT GAUGE	1	1
71	ADAPTER	1	1
72	ADAPTER	1	1
73	HOSE	1	36
76	SEAL ROTOR	1	1
76	SEAL STATOR	1	1
78	RETAINING COLLAR	1	1
80	BEVEL WASHER	2	2
84	HOSE	1	1
85	PIPE PLUG	4	4
87	ADAPTER	1	1
88	O-RING	1	1
90	SET SCREW	2	2
91	SEAL ADAPTER	1	1
93	CAP SCREW	4	4
103	HOSE CLAMP	10	10
104	CAP SCREW	4	4
105	PIPE	6	6
107	HOSE	1	1
109	PIPE PLUG	4	4
110	CAP SCREW, HEX HD	2	2
117	LOCK WASHER	3	3
120	BUSH	1	1
121	PIPE PLUG	1	1
123	BEARING SPACER	2	2
124	OIL FILTER, SPIN ON	1	1
126	DOWEL PIN	4	4
132	PIPE	5	5
140	O-RING	1	1
144	OIL PUMP	1	1
149	PIPE	2	2

ITEM NO.	PART DESCRIPTION	66 QTY	69 QTY
152	STREET ELBOW	2	3
166	HOSE CONNECTOR	10	10
167	PIPE	3	3
170	STREET ELBOW	0	2
171	STREET ELBOW	0	1
172	BUSHING	1	1
173	HEAT EXCHANGER	1	1
174	PIPE PLUG	27	27
176	O-RING	2	2
178	TUBE CONNECTOR	2	2
181	HOSE, I.D.	1	1
219	RETAINING RING	4	4
220	RETAINING RING	1	1
228	CAP SCREW	3	3
239	SLEEVE	4	4
255	ROLL PIN	1	1
257	CROSS NPT	1	1
258	ELBOW, NPT	4	5
259	TEE	2	2
260	TEE, REDUCING	2	2
262	GAUGE	1	1
263	ELBOW, REDUCING	3	3
266	HOSE CLAMP	6	6
274	HOSE	1	41
280	WASHER	20	20
281	SPACER	24	24
282	WAVE SPRING, STL	8	8
283	PIPE	2	3
284	PIPE DRESSER	2	2
285	PIPE	2	2
286	PIPE TUBE	1	1
287	PIPE TOE	2	2
289	TEE	1	1
290	REDUCER BUSHING	3	3
298	REDUCER BUSHING	1	1
300	ROLL PIN	4	4
301	CAP SCREW	48	48
302	O-RING	2	2
304	MOUNTING FOOT	3	3
305	O-RING	4	4
306	SLEEVE	4	4
307	CAP SCREW	16	16
309	CAP SCREW	4	4
310	OIL PUMP ASSEMBLY	1	1
313	OIL PUMP ADAPTER	1	1
314	O-RING	2	2
325	O-RING	1	1
329	PLUG, TRAIHT THREAD	2	2
331	O-RING	4	4
336	ORIFICE FITTING	5	5
349	PIPE	1	1
351	PIPE	4	4
354	REDUCER BUSHING	5	5
369	TUBE	1	1
408	FOOT ASSEMBLY, MTG VERT	1	1

NOTES:

- QUANTITIES SHOWN ARE MAXIMUM VALUES;
QUANTITIES MAY VARY BETWEEN VACUUM BOOSTER

PARTS KITS ARE AVAILABLE, AS FOLLOWS:

66/69 — P/N 29217

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 5803-8702
O 417.865.8715 800.825.6937
F 417.865.2950
www.kinneyvacuum.com



Manual 2002 Rev A p/n 002002 0000
04/21