



# INSTALLATION AND OPERATION MANUAL

## R 5 Series

Models 0025, 0040, 0063, 0100, 0101 and 0250 C/E  
Single Stage Rotary Vane Vacuum Pumps



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## GENERAL

### Identification

For model identification, see the nameplate mounted on the side of the exhaust box.

This manual is written to cover RA and RC versions of models 0025, 0040, 0063, 0100, 0101 and 0250 with a "C" or "E" appearing as the seventh character in the model type number stamped into the nameplate. For example, it would appear as follows:

RAXXXX-CXXX-XXXX

When ordering parts, it is helpful to include the identification code stamped into the side of the cylinder as well as the serial number from the nameplate.

### Operating Principles

All reference (Ref. XXX) numbers listed in the text and on illustrations throughout this manual are related to the drawings and parts list shown later in this publication.

All R 5 Series, Single Stage, Rotary Vacuum Pumps are direct-driven, air-cooled, oil-sealed, rotary vane pumps that operate as positive displacement pumps. They consist of a rotor positioned eccentrically in a cylindrical stator (see Fig. 1). The rotor has three radially sliding vanes which divide the pump chamber into three segments. When the rotor spins, centrifugal force pushes the vanes, which glide in the slots, towards the wall of the cylinder. The rotor has three vanes which divide the pump chamber into three segments. The gas to be pumped enters at the inlet port, passes through the inlet screen and the open anti-suck-back valve into the pump chamber. As the rotor rotates, the inlet aperture is closed, the gas is compressed and forced out through one-way valves between the pump cylinder and the exhaust box. This operation is repeated three times each revolution.

All R 5 series pumps are designed to handle air. Vapor in the air stream can be tolerated when the pump is operated within certain operating parameters as defined by Busch, Inc. Engineering (see Section 2.2 - Gas Ballast). When you desire to use the pump on an air stream that contains vapors, contact Busch, Inc. Engineering for operating recommendations; otherwise, the warranty could be void.

## 1.0 INSTALLATION

### 1.1 Unpacking

Inspect the box and pump carefully for any signs of damage incurred in transit. Since all pumps are ordinarily shipped FOB our factory, such damage is the nor-

mal responsibility of the carrier and should be reported to them.

Remove the nuts from the bottom of the box/crate and pull the pump out of the container, then unscrew the studs from the bottom of the rubber feet.

The inlet port of the pump is covered with a plastic cap prior to shipment to prevent dirt and other foreign material from entering the pump. Do not remove this cover until the pump is actually ready for connection to your system.

### 1.2 Location

The pump must be installed in a horizontal position on a level surface so that the pump is evenly supported on its rubber feet. Allow sufficient air space between the pump and any walls or other obstructions; adequate ventilation must be provided for the fans on the pump and motor (i.e., do not locate the pump in a stagnant air location).

Whenever the pump is transported, be sure to drain the oil prior to shipping to avoid vane breakage when restarting the pump.

Do not tip the pump over if it is filled with oil.

Locate the pump for easy access to the oil sight glass (Ref. 83) in order to inspect and control the oil level properly. Allow clearance at the exhaust flange area to provide service access to the exhaust filters.

### 1.3 Power Requirements

The schematic diagram for the electrical connection is located in the junction box or on the nameplate of the pump motor.

The motor must be connected according to the electrical codes governing the installation. The power supply must be routed through a fused switch to protect the motor against electrical or mechanical overloads. The motor starter has to be set consistent with the motor current listed on the motor nameplate.

If the pump is supplied with a manual motor starter, it is preset at the factory in accordance with the customer's specification. For other voltage requirements, contact the factory for motor and/or starter information.

Note: See the motor manufacturer's manual for start-up maintenance of the motor.

Correct direction of rotation is marked by an arrow on the motor fan housing and is counterclockwise when looking at the motor from the motor's fan side.

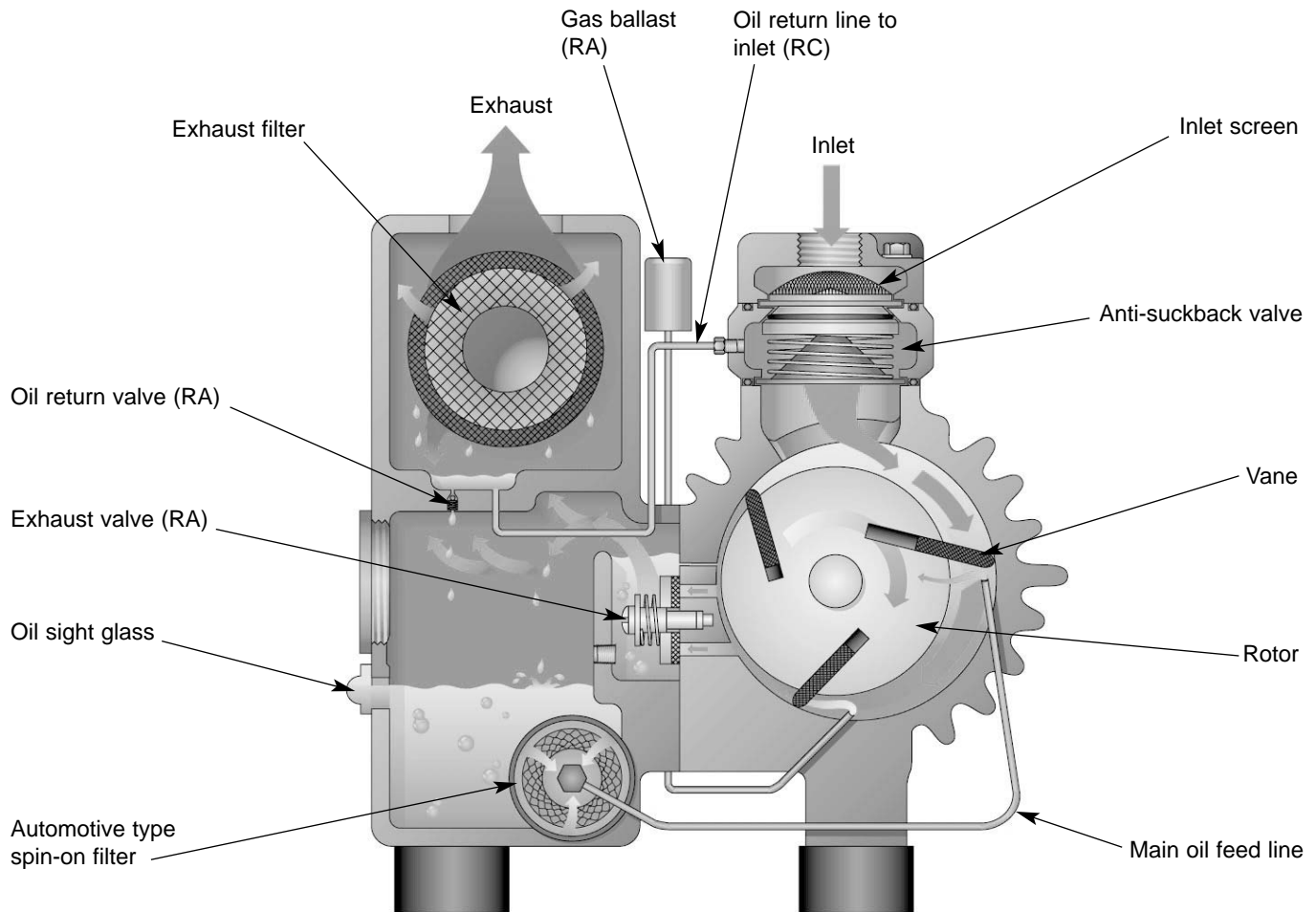


Fig. 1 - Basic R 5 Pump

**CAUTION:** After the electrical connection has been made, but before the pump is filled with oil, the rotation of the motor must be checked. Open the inlet port and jog the motor briefly to make sure rotation is correct. If it runs backwards and if it is wired three phase power, reverse any two leads of the three at the power connection.

#### 1.4 Vacuum Connections and Drip Legs

Use a line size to the vacuum system that is at least as large as that of the pump inlet. Smaller lines will result in lower pumping speeds than the rated values.

Install a drip leg and drain on the vertical pipe near the pump inlet. Also, when installing discharge piping, a drip leg should be installed. Drain the drip legs often to remove any condensation which may have collected.

If more than one vacuum pump or a receiver tank is connected to a common main line, each pump should have its own manual or automatic operated shut-off valve or positive action check valve. The built-in, anti-suck-back valve should not be used as a shut-off valve for the vacuum system.

**CAUTION:** The built-in, anti-suck-back valve is not positive action; do not use it as a system check valve.

Remove the plastic protective cap from the inlet port prior to connection of the pump to the system. Vertical connection of the vacuum line can be made directly to the pump inlet (Ref. 260).

Type and size of the inlet connections of the R 5 Series pumps are shown in the TECHNICAL DATA page 14.

If the gas that is pumped contains dust or other foreign solid particles, a suitable inlet filter (10 micron rating or less) should be connected to the inlet port. Consult the factory for recommendations.

#### 1.5 Oil Filling

The pump is shipped without oil. After level installation, and after correct rotation has been established and with the pump switched "off" and secured against accidental start-up, fill the pump with the recommended vacuum oil through the oil filling port (Ref. 88), observing the "MAX" and "MIN" position at the oil sight glass (Ref. 83).

Non-detergent oil should be used. Do not use detergent motor oil as additives in detergent oil will plug exhaust filter elements and shorten their life.

It is recommended that Busch R500 Series oil be used to receive the best performance from your vacuum equipment. R500 Series oil is a high quality vacuum oil that will give longer running time between oil changes, will provide better lubrication at high operating temperatures, and will prolong the life of exhaust filter elements. This oil can be obtained directly from Busch, Inc. in Virginia Beach, Virginia.

The strict use of Busch oils and parts from the day of purchase can extend the Limited Standard Warranty to three years. Contact Busch, Inc. in Virginia Beach, Virginia for details.

For general applications, use R530 in all models covered by this manual. Use R590 or R570 in pumps that are operated in high ambient temperatures (above 90°F) or when the oil carbonizes (turns black) before the change interval. Use R590 or R570 on 0250 pumps. Contact the factory for recommendations when using other oils.

The TECHNICAL DATA chart on page 14 gives the approximate quantities of oil required for each pump. The oil capacity chart should only be used as a guide, since oil capacity may be slightly lower, depending on whether the pump was filled previously, and whether all components such as oil filter, oil lines, etc., were allowed to completely drain. Use only the sight glass reading for proper level. Never overfill!

**WARNING: Keep the oil fill plug tight as pressure in the exhaust box could cause bodily injury if the plug is blown out. Do not fill/add the pump with oil through the exhaust/inlet ports as there is danger of breaking the vanes!**

For ambient operating temperatures lower than 41°F, use Busch R580 synthetic oil. If this does not help (where the pump has difficulty starting due to high oil viscosity), contact the factory in Virginia Beach, Virginia.

Replace the oil fill plug (Ref. 88), making sure that the gasket (Ref. 89) is in place and properly seated and secured. Some pumps are equipped with an exhaust pressure gauge as an integral part of the oil fill plug. Switch the power back into the "on" position.

## 2.0 OPERATION

### 2.1 Start-up

Check rotation of the motor as described in Section 1.3

### - Power Requirements.

Fill the pump with oil as described in Section 1.5 - Oil Filling.

Start the pump and immediately close the inlet. Run the pump for a few minutes before checking the oil level again. With the pump shut off, the oil level should be visible in the oil sight glass (Ref. 83), between the "MIN" and "MAX" mark.

Add oil, if necessary, but only add it when the pump has been shut off and the circulating oil has had sufficient time to return to the oil sump.

Note: The oil separated by the exhaust filter element forms droplets on the outside of the exhaust filter that collect at a low point in the upper half of the exhaust box. From there the collected oil is drained back to the oil sump via an oil check valve (Ref. 275) which opens on R 5 RA model pumps when the pump is shut off. It is necessary to shut off the RA model pumps after every 8 hours of operation to allow the check valve to open. If the pump is not shut off after this time period, it is possible to starve the pump of oil since the oil is not allowed to drain back into the oil sump and/or oil droplets may be blown out of the exhaust. If the pump is operating at high pressure it may be necessary to shut it down sooner than 8 hours.

On R 5 (Standard) RC model pumps, the collected oil is drawn continuously during operation of the vacuum pump to the inlet flange (Ref. 260) via the oil return line (Ref. 290). The oil return line is connected directly to the area of the exhaust box, downstream of the exhaust filter, which is at atmospheric pressure. Therefore, a constant amount of air is sucked into the pump, which is an additional reason that the R 5 Standard Series Pumps do not achieve as low a vacuum as the R 5 Series Super Vacuum Pumps. RC model pumps can run continuously without having to shut them off for the oil to drain back.

### 2.2 Gas Ballast

All RA Series pumps are equipped with a gas ballast valve. The gas ballast valve (Ref. 440) is located between the inlet port and the exhaust box. RA series pumps are equipped with a permanent gas ballast which cannot be shut off unless the sintered filter is removed and the orifice plugged. Larger pumps are equipped with an adjustable gas ballast valve.

The adjustable gas ballast valve should normally be left open. Its primary function is to prevent water vapor from condensing in the pump. Condensation causes emulsification of the oil, loss of lubricity, and possible rotor seizure.

## 2.3 Process Gas

The R 5 series pumps are designed to pump air and are not intended for use when water vapor is being pumped. In some applications, when the quantity of the water vapor is moderate, R 5 pumps have been used with good results. On these occasions, the pump is run until it is up to operating temperature before it is allowed to pump the process gas. The pump is also operated for a period of time off process and on air (to clear it of process gas) before it is shut down. This operating technique prevents the vapor from condensing in the pump. Before attempting to pump a gas laden with water vapor, contact Busch Engineering for advice.

## 2.4 Stopping Pump

To stop the pump, turn off the power. The pump has a built-in, anti-suck-back valve (Ref. 251 thru 255) to prevent the pump from rotating backwards when it is shut off.

**CAUTION:** Do not use the anti-suck-back valve as a system check valve for your vacuum system. Do not depend on the anti-suck-back valve to prevent pump oil from migrating through the inlet into the system when the pump is shut down.

Install an automatic operated valve (such as a check valve) in front of the pump, if more than one pump is pumping on the same line or if there is a sufficient volume of vacuum in the system to cause the pump oil to be drawn into the piping when that pump is shut down.

All R 5 Series pumps are vented internally to atmospheric pressure through venting holes that are next to the exhaust valve assembly.

## 2.5 Water-Cooled Pumps (optional)

Water-cooled pumps are cooled by circulating the oil through a shell-and-tube type heat exchanger. The circulation of the pump oil through the shell is created by vacuum in the pump, but the circulation of the cooling water through the tubes is thermostatically controlled. The flow rate of the cooling water is controlled by a thermostatically activated valve (see Fig. 2) that senses, through a capillary bulb mounted in the exhaust box, the pump's oil temperature as it is discharged from the compression chamber. The valve will open at its set point and close at approximately 3°F to 5°F below the set point. The valve set point is adjustable as follows:

(a) Rotate the valve adjustment screw counterclockwise to cause the valve to open at a higher temperature. This makes the pump run hotter.

(b) Rotate the valve adjustment screw clockwise to make the valve open at a lower temperature. This

makes the pump run cooler.

The thermostatic valve can be manually opened by inserting a screwdriver under each side of the spring guide and prying the spring and guide upward away from the valve body.

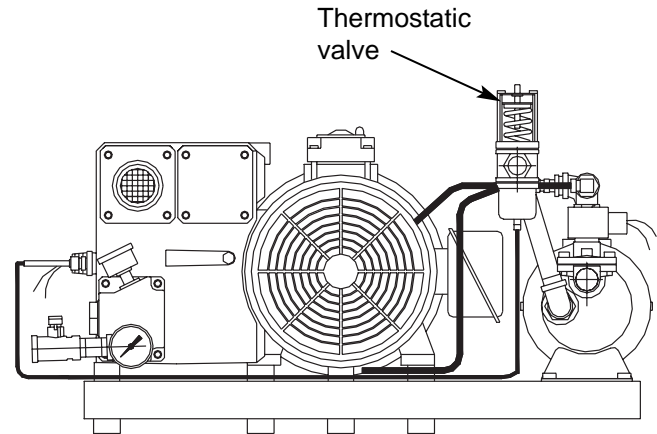


Fig. 2 - Water-cooled Pump

The water cooling option can be used to cool pumps operating in high ambient temperatures, or it can be used to maintain a pump at elevated temperatures to prevent condensation inside the pump in wet applications. Contact Busch Engineering in for details.

## 2.6 Oxygen Service Pumps

Oxygen service pumps must be used in oxygen enriched applications that are defined as any application which has a process gas that is 25% or more oxygen. If this pump is contaminated by organic compounds, do not attempt to use it on oxygen service until it has been decontaminated.

These pumps have been manufactured, solvent washed (to remove organic contaminants) and assembled according to the latest technical standards and safety regulations. If this pump is not installed properly or not used as directed, a dangerous situation or damage might occur. It is mandatory that these operating instructions be read and understood prior to vacuum pump installation and start-up!

**WARNING:** This pump is filled with a special operating fluid. Do not use any other type of fluid, oil and/or grease. Use one of the following:

- Fomblin LC 250
- Tyreno Fluid 12/25V (perfluorinated polyether)
- KRYTOX ® Vacuum pump fluid by Du Pont Company

If you have any questions, please phone our Customer Service Department for more information.

For overhaul/repair of oxygen service pumps, Busch Inc. strongly recommends that all major repair operations be conducted at the factory. Improper handling of repairs could result in extreme danger to personnel operating the pump.

### 3.0 ROUTINE MAINTENANCE

R 5 Series pumps require very little maintenance; however, to insure optimum pump performance, the following steps are recommended.

#### 3.1 Pump Oil

##### 3.1.1 Oil Level

**CAUTION:** Do not add oil while the pump is running since hot oil vapor may escape through the oil fill port.

**CAUTION:** Insufficient oil quantity in the pump has the potential, under certain conditions, to lead to self-ignition of the remaining oil in the pump.

With the pump installed relatively level, make sure that there is sufficient clean oil in the pump. The oil level should be observed on a daily basis and/or after 8 hours of operation and should be replenished if it drops below the 1/4 mark on the oil sight glass on pumps with one sight glass.

On RA Series pumps, you must first shut the pump off in order to let the oil flow back into the oil sump prior to checking the sight glass. Allowing insufficient time for the oil to drain back into the sump on RA Series pumps prior to adding oil could result in overfilling.

Oil level readings should be done only when the pump is turned off. Oil can be added to the oil fill port (Ref. 88) if the pump is shut off and the circulating oil has sufficient time to return to the oil sump. The oil might appear to be foamy, which is a normal phenomenon with aerated oil.

Under normal circumstances, it should not be necessary to add or drain oil from the pump between recommended oil changes.

A significant drop in oil level means there is an oil leak or that an exhaust filter is broken, and the pump should be smoking excessively. It is normal for the oil to be foamy and light in color in an operating pump. However, if the oil is milky colored, it is an indication that water is present in the oil. Normally, by operating the pump for an extended period, with the inlet suction blanked off and the gas ballast (Ref. 440) open on RA pumps, the water will be purged from the oil. If the oil is dark colored, it is contaminated or carbonized and must be changed. Depending on the severity of the

contamination, a thorough flushing may be needed. Contact the factory for flushing oil (Busch R568) and refer to Section 3.1.4 for the flushing procedure.

##### 3.1.2 Oil Type and Quantity

See Section 1.5 - Oil Filling for details on oil type and quantity.

##### 3.1.3 Oil and Filter Change

**CAUTION:** When changing the oil and filters, it may be necessary to flush the pump to remove any build-up of degraded oil from the sumps, oil lines, radiators, etc., to ensure proper oil flow through the pump. Reduced oil flow, especially through radiators and cooling coils, can cause mechanical damage or extreme overheating, which could cause the oil vapors to ignite.

**WARNING:** Always take the necessary precautions concerning personal protective equipment when changing oil and make sure the pump is switched to "off" so that accidental starting will not occur. Oil temperature can reach 212°F and may pose a danger of scalding.

See Section 1.5 and the Technical Data on page 14 for details on oil type and quantity.

Check the oil for contamination on a weekly basis by shutting the pump off and draining some of the oil into a small glass or a similar transparent container through the oil drain port (Ref. 95).

Oil life is dependent upon the conditions to which it is exposed. A clean, dry air stream and an oil operating temperature under 210°F are ideal conditions. When using R530 (hydrocarbon oil), it is recommended that oil changes are made every three (3) to four (4) months or 500 to 750 hours of operation, or as necessary if high heat is contaminating the oil. The use of Busch R570 (synthetic) or R590 (semi-synthetic) oil may significantly extend the operating hours between oil changes under ideal conditions. However, you may need to flush out the pump before changing. Contact the factory Service Department for advice. Oil samples should be taken regularly when exceeding the 500-750 hour recommendation.

##### Excessive Heat

When the pump is subjected to operating conditions that will cause the oil to be heated above 210°F, the oil will carbonize and become contaminated after a relatively low number of operating hours. The higher the temperature, the quicker the oil becomes contaminated.



If the oil temperature is too severe, Busch R570 (synthetic) or R590 (semi-synthetic) oil should be used to withstand the elevated temperatures. If synthetic oil is used, the pump should be flushed with Busch R568 oil. Contact the factory for instructions on the flushing procedure. Auxiliary oil cooling is the most practical approach to a severe heating problem.

### Contaminated Air Stream

When the air stream contains a solid and/or liquid that can contaminate the oil, it must be changed more often. If the air stream contains a small percentage of contaminants and/or they are slightly aggressive\* (mild acids, etc.), synthetic oil, such as Busch R570, will resist breakdown better than the standard Busch R530. The solution is to install a filter or knock-out pot to keep the contaminants out of the pump.

\*Process air streams with a large percentage of contaminants and/or more than slightly aggressive contaminants must use a chemical duty pump.

Oil change intervals can only be established by experience with the pump operating in the actual conditions (see previous paragraph for some of the conditions). Develop the oil change interval by periodically checking an oil sample removed from the pump. When the oil sample has become dark in color (from solids and carbonized particles) or is milky looking (from water), it is time to discard it. As mentioned before, a thorough flushing may be required.

#### 3.1.4 Oil Flushing Procedure

Flushing is needed under certain conditions. Some pumps will be beyond flushing and will need to be overhauled.

To help determine if flushing is needed, observe the condition of the oil as it is drained from the pump. Is it black and tar like or contaminated in any way? Was the pump noisy, overheating, or was the motor overload shutting the pump off? How old is the pump and when was the last time the oil was changed?

If the above conditions exist or you don't know when the last oil change was performed further investigation is needed. Also, when changing from one oil type such as R530 to another type such as R590 or R570 it will be beneficial to flush. Although the oils are compatible, mixing a lesser grade oil such as R530 with a synthetic oil like R570 will reduce the effectiveness of the synthetic oil.

All of the oil will be removed and replaced with the flushing oil (Busch R-568), and eventually that will be replaced by whatever Busch oil is needed for your particular application. Have enough oil and oil filters on hand for a couple of flushes. The following describes

the steps in the flushing procedure:

Shut the pump off and drain all the oil from the pump and remove the access plates (Ref. 205) from the exhaust box (Ref. 075). Remove the metal baffle (Ref. 078) and take a good look at the internal walls of the oil sump. If the walls are discolored but have no build up of any kind one can proceed with the flushing. If gelled or burnt oil is clinging to the walls this material must be scraped and removed prior to flushing. Proceed by scraping and cleaning as much of the exhaust box as possible. The more debris that is removed now the more effective the flushing will be later. Re-install the metal baffle, cover and proceed with the flushing. At this point one must remember that the oil lines and oil cooler might also be plugged to a point where no amount of flushing will make a difference and a complete overhaul will be the only option. Depending on the severity of the oil contamination flushing may be a last ditch effort.

Drain all of the oil from the pump. The more contaminated oil you remove now the more effective the oil flushing will be.

Remove the oil filter (Ref. 100) and install a new one. It is recommended that you do not change the exhaust filter or filters until after the flushing to prevent contamination of any new filters.

Fill the exhaust box with the proper amount of flushing oil (Busch R-568).

If possible run the pump with the inlet closed and off of the process. Run the pump for approximately six hours, shut the pump off and drain a small sample of oil into a clear container.

Examine it. If it is clear to amber run the pump for another six hours and examine it again. If after the first six hours it is black drain it and fill again using another new oil filter.

If after the second flushing the oil still remains black the pump may have too much contaminated oil in it to flush out properly. There may be residue remaining in the lines and cooler that will not flush out. An overhaul will be necessary.

If after the second six hour period the oil still remains clear to amber in color drain it, change the oil filter and fill with the regular oil. At this point also change the exhaust filters.

Run the pump with a fresh charge of the oil to be used in your application (not R-568), and monitor the operating conditions closely. Check for noise, overheating and oil condition until a regular oil change schedule can be established.

Do not let the oil turn black. Change it before it fails. If the oil is kept in good condition the pump will last for years. If the oil starts to turn black do not hesitate to flush again. Keeping on top of the oil changes will prevent costly overhauls.

If you are just switching from one type of oil to another a single six hour flush is all that is necessary (follow the above instructions). Remember to change to a new exhaust filter or filters after the flushing and not before.

### 3.2 Automotive-Type Oil Filter

The pump is equipped with an automotive-type oil filter (Ref. 100). When replacing the automotive-type oil filter, use only a Busch genuine filter.

Note: Make sure to tighten the Busch oil filter securely against the aluminum sealing surface so that leaks will not occur.

### 3.3 Exhaust Filter

**WARNING:** If the gas entering this pump is a health hazard, use rubber gloves and all necessary personal protection equipment when performing the exhaust filter replacement operation.

Every nine (9) to twelve (12) months, or as necessary, replace the exhaust filter elements. The service life of the exhaust filters varies widely with pump application. It is only necessary to change the filters when the elements become clogged with foreign material or burned oil. Indications of clogged filters are smoke and oil mist coming from the pump exhaust, higher than normal motor current or oil leaking from the gas ballast valve on RA models.

A pressure gauge (Ref. 90) is supplied with your R 5 vacuum pump as part of the oil fill plug. This gauge has a green field and a red field. A pressure within the green field would indicate normal pressure. Any pressure in the red field (for a continuous period of time) requires an immediate change of the exhaust filter(s).

In order to replace the filter, remove the four socket head cap screws (Ref. 146 on 0025 through 0101 / Ref. 142 On 0250) and lockwashers (Ref. 143) retaining the exhaust port housing (see Fig. 3). Pull the housing off the exhaust box and set it aside. Use a slotted head screw driver to loosen the exhaust filter retaining spring, then rotate and remove the spring (see Fig. 4). Pull the filter cartridge (Ref. 120) out of the exhaust box.

**WARNING:** Wear safety glasses when installing or removing the spring retainers. The retainers can, if not secured correctly, slip off and fly out of the exhaust box.



Fig. 3 - Removing the Exhaust Housing



Fig. 4 - Removing the Filter Spring

To field test an exhaust filter element, remove it from the pump, allow it to cool, clean the sealing end (or O-ring end), and use compressed air to blow through the element. Apply approximately 3 to 6 psi (maximum allowable operating pressure across the filter).

**WARNING:** Do not inhale through the filter or allow your mouth to come in direct contact with the filter.

Use a shop rag to seal off the connection between the air hose and the filter. If you can blow through it, the element is good. If not, discard it and install a new one. The filter cannot be cleaned successfully. Visually inspect the filter element for cracks.

Reinstall the filter elements. Make sure the open end of the element is properly seated down in its recess in the exhaust box with the O-ring (Ref. 121) correctly positioned. Retain the filter with the spring clip, tighten the

tension screw until the filter is secure. Place the exhaust port gasket and cover in position on the exhaust box and retain with the cap screws.

### 3.4 Inlet Flange

The standard inlet flange assembly contains an inlet screen (Ref. 261) which may require occasional cleaning. The frequency of cleaning can only be determined by experience and is affected by hours of operation and particle size being trapped. An optional vacuum inlet filter is offered and can help minimize the need or frequency of cleaning the inlet screen.

To clean the screen, disconnect the flange from the process piping. Remove the four screws and lockwashers (Ref. 265/266). Remove the inlet flange (Ref. 260). Remove the screen (Ref. 261) and clean with compressed air. After cleaning, install the screen and inlet securing them with the screws and lockwashers. Make sure the O-ring (Ref. 265) is in place prior to securing the screws. Reattach the process piping to the inlet.

### 3.5 Vacuum Inlet Filter (optional)

If the pump is equipped with a special vacuum inlet filter in applications where powder, dust or grit is present, the filter cartridge should be cleaned on a weekly basis, or as required, depending on the amount of foreign particles to which the pump is exposed.

### 3.6 Routine Maintenance Schedule

See the motor manufacturer's manual for the periodic motor maintenance.

Note: Lack of proper maintenance can result in blocked filters, radiators, oil lines, etc. This condition can lead to excessive heat causing mechanical failure or ignition of the oil vapors.

Daily: Visually check oil level (see 3.1.1 and 3.1.2).

Weekly: Check oil for contamination (see 3.1.3). Inspect inlet filter (see 3.5).

Every three (3) or four (4) months, 500 to 750 hours of operation, or as necessary: See 3.1.3 and 1.5. Drain and discard oil from the hot pump. Replace the automotive-type oil filter and refill with fresh oil through the fill plug (see 3.1.2 through 3.1.3 and 3.2).

Every nine (9) to twelve (12) months, or as necessary: Replace exhaust filter elements (see 3.3).

As necessary: Check and/or clean the standard inlet screen. If the optional inlet filter is used, replace the fil-

ter material as practice determines.

The radiator (Ref. 241) on model 0250, the fan cover (Ref. 340) on the 0025 through 0101 models and (Ref. 244) on the 0250 model should be inspected regularly for debris. Soiling prevents cool air intake and may lead to overheating of the pump.

Drain drip legs on inlet and exhaust piping.

### 3.7 Overhaul Kit/Filter

An overhaul kit containing a set of gaskets and O-rings, vanes, bearings and bearing sleeves, shaft seals and taper pins, is available from the factory.

Also, a filter kit containing oil drain plug, gaskets, automotive-type oil filter (where applicable), exhaust filter, and synthetic baffle strainer (where applicable), is available from the factory.

When ordering, please specify pump size and model (a 4-digit suffix after size), and serial number.

## 4.0 TROUBLESHOOTING

### 4.1 Trouble

Pump does not reach "blank-off" pressure, which is the lowest absolute pressure (best vacuum) when running with the inlet closed via a blank flange or a valve; or the pump takes too long to evacuate the system. Blank-off pressure can be measured by using a good quality capsule gauge.

Possible Cause:

Contaminated oil is the most common cause of not reaching the ultimate pressure.

Remedy:

Shut off pump, after operating temperature has been reached, drain the warm oil from pump and exchange automotive-type oil filter (where applicable), if necessary. Flush and fill pump with new oil and take new blank-off measurement after operating temperature is reached (at least 20-30 minutes).

Possible Cause:

Vacuum system or vacuum piping not leak-tight.

Remedy:

Check hose and pipe connections for possible leak.

Possible Cause:

Wire mesh inlet screen plugged (Ref. 261).

Remedy:

Clean wire mesh inlet screen. Install inlet filter if problem repeats frequently.

Possible Cause:

No oil or not enough oil in oil reservoir.

Remedy:

Shut off the pump, add the necessary oil, or if oil seems contaminated, drain balance of oil from pump, exchange automotive oil filter, and refill with fresh oil. Flush if necessary.

Possible Cause:

Automotive-type oil filter is dirty or clogged (where applicable).

Remedy:

Replace automotive-type oil filter, exchange oil, if necessary, and refill with fresh oil.

Possible Cause:

Inlet valve plate (Ref. 251) stuck in closed or partially open position due to contamination.

Remedy:

Disassemble inlet valve and screen. Clean as required.

Possible Cause:

Oil tubing fittings are loose and leaking. Oil return line broken on RC model.

Remedy:

Replace or retighten the oil fittings or oil tubing. Replace only with same size tubing.

Possible Cause:

Shaft seal leaking.

Remedy:

Replace the shaft seal following disassembly and assembly steps outlined in the Maintenance and Repair Manual. Check the shaft seal. It should have a spring installed inside and around the shaft sealing lip.

Possible Cause:

Exhaust valve (Ref. 159) is not properly seated or it is partially stuck open (RA models only).

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual or contact the nearest Busch Factory Service Center.

Possible Cause:

Vanes are blocked in the rotor or they are damaged.

Remedy:

Free vanes or replace with new ones following disassembly and assembly steps outlined in the Maintenance and Repair Manual or contact the nearest Busch Factory Service Center.

Possible Cause:

Radial clearance between the rotor and cylinder is no longer adequate.

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual on resetting the radial clearance correctly or contact the nearest Busch Factory Service Center.

Possible Cause:

Internal parts worn or damaged.

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual and replace worn or damaged parts or contact the nearest Busch Factory Service Center.

Possible Cause:

Radial clearance between the rotor and cylinder is no longer adequate.

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual on resetting the radial clearance correctly or contact the nearest Busch Factory Service Center.

Possible Cause:

Internal parts worn or damaged.

#### Possible Cause on RC Models Only:

The oil return line (Ref. 290) is connected directly to atmospheric pressure in the exhaust area. On small model pumps, a fairly large amount of air is sucked through the oil return line, and it may not be possible to reach 15 torr or 29.4 inches Hg. blank-off on the inlet of the pump under these conditions.

Blank-off of 29.4 inches Hg or 15 torr can be reached by temporarily disconnecting and closing the oil return line; also by squirting oil through the exhaust opening into the exhaust filter area. Oil will be sucked into the oil return line, and no air will reach the inlet, thus affecting the "blank-off" pressure.

#### 4.2 Trouble

Pump will not start.

##### Possible Cause:

The motor does not have proper supply voltage or is overloaded; motor starter overload settings are too low or wrong setting; fuses are burned; or wire is too small or too long, causing a voltage drop to the motor.

##### Remedy:

Check correct supply voltage; check overload settings in motor starter for size and setting according to motor nameplate data; check fuses; and install proper size wire. If ambient temperature is high, use larger size overloads or adjust setting 5% above nominal motor nameplate value.

##### Possible Cause:

Pump or motor is blocked.

##### Remedy:

Remove fan cover and try to turn pump and motor by hand. If frozen, remove motor from pump and check motor and pump separately. If pump is frozen, disassemble completely per the Maintenance and Repair Manual and remove foreign objects in the pump or replace broken vanes.

#### 4.3 Trouble

Pump starts, but labors and draws a very high current.

##### Possible Cause:

Oil too heavy (viscosity too high) or ambient temperature below 5 degrees C (41°F).

##### Remedy:

Change to R580 vacuum oil if very cold, or warm up oil before starting the pump.

##### Possible Cause:

Pump runs in the wrong direction.

##### Remedy:

Check for correct rotation which is counterclockwise when looking at the motor from the motor's fan side. Reverse any two leads on the motor to change the direction of rotation.

##### Possible Cause:

Pump is overfilled with oil or wrong kind of oil is used.

##### Remedy:

Correct the oil level and quality per Section 1.5 and use recommended motor oil.

##### Possible Cause:

Exhaust filters in exhaust chamber are clogged and appear burned black with pump oil.

##### Remedy:

Replace exhaust filters, maintain proper oil condition, oil level, and use only Busch recommended vacuum oil and filters.

##### Possible Cause:

The exhaust filter is clogged due to process material.

##### Remedy:

Contact the factory in Virginia Beach, Va. for recommendations or proper filter cartridge.

##### Possible Cause:

Loose connection in motor terminal box; not all motor coils are properly connected. Motor operates on two phases only.

##### Remedy:

Check motor wiring diagram for proper hookup, especially on motors with six internal motor windings, tighten and/or replace loose connections.

##### Possible Cause:

Foreign particle in pump; the vanes broken; the bearing

is seizing.

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual and remove foreign parts, and replace vanes and bearings or contact the nearest Busch Factory Service Center..

#### 4.4 Trouble

Pump discharges smoke at the exhaust port or expels oil droplets from the exhaust.

Possible Cause:

Exhaust filter is not properly seated with O-ring (Ref. 121) in filter base or filter material is cracked.

Remedy:

Check condition and check for proper seating of exhaust filters. Replace if necessary. Also, check filter spring clips for tightness.

Possible Cause:

Exhaust filter is clogged with foreign particles.

Remedy:

Replace exhaust filter.

Possible Cause:

The oil return valve (Ref. 275) is stuck open on RA/RB pumps. Proper function is that when blowing into check valve, it should close. When applying vacuum on it, check valve should open.

**WARNING: Do not apply pressure or vacuum by mouth.**

Remedy:

Free or replace the oil return check valve.

Possible Cause:

If RA/RB Series vacuum pumps run continuously over 8 hours without ever being shut down, it may be possible that oil accumulates behind the exhaust box cover to the extent that oil is blown out of the exhaust with the exhaust gas.

Remedy:

Shut pump down during break periods or install an additional oil return line assembly. Check that oil return valve (Ref. 275) is free and drains oil back into the

pump when the RA/RB Series pump is stopped.

Possible Cause:

Oil return line (Ref. 290) on RC Standard pump is clogged or broken.

Remedy:

Free clogged line or replace. Check that oil is being drawn out of the exhaust filter area while the vacuum pump is operating.

Note: An oil filling plug with pressure gauge is provided on all R 5 Series pumps, so that the pressure in front of the exhaust filters can be monitored. The green field indicates that the filters are still effective. Back pressure that causes a continuous reading in the red field requires immediate change of exhaust filters (Ref. 120).

#### 4.5 Trouble

Pump runs very noisily.

Possible Cause:

Coupling insert worn.

Remedy:

Replace coupling insert in motor/pump coupling.

Possible Cause:

Bearing noise.

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual and replace bearings.

Possible Cause:

Vanes stuck.

Remedy:

Follow disassembly and assembly instructions outlined in the Maintenance and Repair Manual and replace vanes. Use only recommended Busch oil and change oil more frequently.

#### 4.6 Trouble

The pump runs very hot. See Technical Data for typical oil sump temperature.

Note: The oil temperature with a closed inlet should be approximately 185-225°F depending on pump type. At 24 in. Hg, the oil in the pump can go above 225°F.

These values are taken at an ambient temperature of 68°F. The maximum recommended ambient operating temperature for an R 5 is 100°F on a continuous basis. When it is necessary to operate a pump in ambient temperatures above this limit, careful oil monitoring and/or optional water cooling is necessary. Contact the factory for details.

Possible Cause:

Not enough air ventilation to the pump.

Remedy:

Clean motor and pump air grills. Do not install the pump in an enclosed cabinet unless a sufficient amount of cool air is supplied to the pump. On pumps with oil cooling coils, clean outside fin assembly. Bring ambient air temperature down.

Possible Cause:

Automotive-type oil filter clogged and pump does not receive enough oil.

Remedy:

Change automotive oil filter.

Possible Cause:

Not enough oil in oil reservoir, or badly burned oil is used for pump lubrication.

Remedy:

Drain and refill only with Busch recommended oil. Increase oil change intervals.

Note: On some high temperature applications, it may be necessary to change to a high temperature oil such as R590 or R570. Contact the factory for recommendations.

#### 4.7 Trouble

Pump is seized.

Possible Cause:

Pump operated without oil and vanes are broken.

Remedy:

Disassemble and exchange vanes as outlined in the Maintenance and Repair Manual or contact the nearest Busch Factory Service Center..

Possible Cause:

Pump was operated for an extended period of time in the wrong rotation.

Remedy:

Inspect vanes and replace.

Possible Cause:

Liquid carryover into the pump cylinder broke vanes while pump was running, or oil broke vanes on start-up.

Remedy:

(a) Install condensate trap on the inlet of the pump.

(b) Pump was overfilled with oil in oil reservoir. Follow oil filling procedure (see Section 1.5) and do not overfill.

(c) Built-in, anti-suck-back valve (Ref. 250 through 255) leaking while pump was shut down and vacuum was left in manifold. Clean valve seat and check that anti-suck-back valve holds vacuum on inlet when pump is shut down.

(d) Two pumps or a receiver is on the same main line. Install a manual or automatic operated valve in front of each pump.

#### 4.8 Trouble

Automotive-type oil filter (Ref. 100) does not get warm within two to five minutes when cold pump is started.

Possible Cause:

Automotive-type oil filter is clogged.

Remedy:

Replace automotive-type filter per Section 3.2 and exchange oil per Section 1.5.

Possible Cause:

Wrong automotive-type filter is used and/or oil lines and oil coolers leading to pump are clogged.

Remedy:

Use only automotive filter as listed in Section 3.2 and blow lines free. Flush oil cooler.

Possible Cause:

The oil cooler (Ref. 241) is plugged internally with burnt

oil (0250 models).

Remedy:

Remove the oil cooler and flush. Pump may have to be disassembled completely to correct a severely contaminated condition.

## 5.0 LIMITED STANDARD WARRANTY

Busch, Inc. warrants that all products furnished by it are free from defects in material and workmanship at the time of shipment for a period of 18 months from the date of shipment, or 12 months from the date of installation, whichever occurs first. Claims must be made during that period and are limited to the replacement or repair of parts claimed to be defective.

In the case of components purchased by Busch, Inc., such as starters, controls, mechanical seals, motors, couplings, etc., the warranty of that manufacturer will be extended to the purchaser in lieu of any warranty by Busch, Inc. The replacement of wear items including, but not limited to, seals, bearings, couplings, exhaust cover gaskets, oil drain plugs, oil fill plugs etc., made in connection with normal service are not covered by this Warranty.

The Limited Standard Warranty is valid only when the product has been properly installed, used in a normal manner, and serviced according to the operating manual. This warranty shall not extend to products that have been misused, neglected, altered, or repaired without factory authorization during the warranty period. We highly recommend the use of Busch oils and parts to achieve documented performance and efficient oper-

ation. The use of oils or parts other than Busch could limit the life expectancy of the equipment and could void any warranties if they are the cause of any damage. Operating conditions beyond our control such as improper voltage or water pressure, excessive ambient temperatures, or other conditions that would affect the performance or life of the product will also cause the warranty to become void.

Permission to return parts for warranty repair must be obtained, and all returns must be prepaid to the factory. If, after examination, the product or part is found to be defective, it will be repaired or replaced on a no-charge basis and returned, FOB the factory. If it is determined that the Warranty has not been breached by Busch, Inc., then the usual charges for repair or replacement will be made, FOB the factory. Parts or products that are obsolete or those made to special order are not returnable.

This Limited Standard Warranty applies only to the above and is for the period set forth. Busch, Inc.'s maximum liability shall not, in any case, exceed the contract price for the product, part, or component claimed to be defective; and Busch, Inc. assumes no liability for any special, indirect, or consequential damages arising from defective equipment.

THERE ARE NO WARRANTIES IMPLIED OR EXPRESSED THAT EXTEND BEYOND THOSE CONTAINED IN THIS LIMITED STANDARD WARRANTY.

Note: For extended warranties on your new equipment contact Busch, Inc. Headquarters at 1-800-USA-PUMP.

## Technical Data

Model	0025	0040	0063	0100	0101	0250
Nom. pumping speed (ACFM)	18	26	36	56	71	170
Free air displacement (CFM)	20	28	41	63	77	180
Maximum sound level (dBa)	70	70	70	71	71	81
3 phase motor data (HP*)	1 1/2	2	3	5	5	10
1 phase motor data (HP*)	1 1/2	2	3	5	5	N/A
Approx. oil capacity (qts)	1.4	1.4	2.5	2.7	2.7	7
Inlet connection - NPT (inch)	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	2
End vacuum - RC (Torr)	15	15	15	15	15	15
End vacuum - RA (Torr)	0.5	0.5	0.5	0.5	0.5	0.5
Approx. weight (lbs)	106	120	172	198	198	460

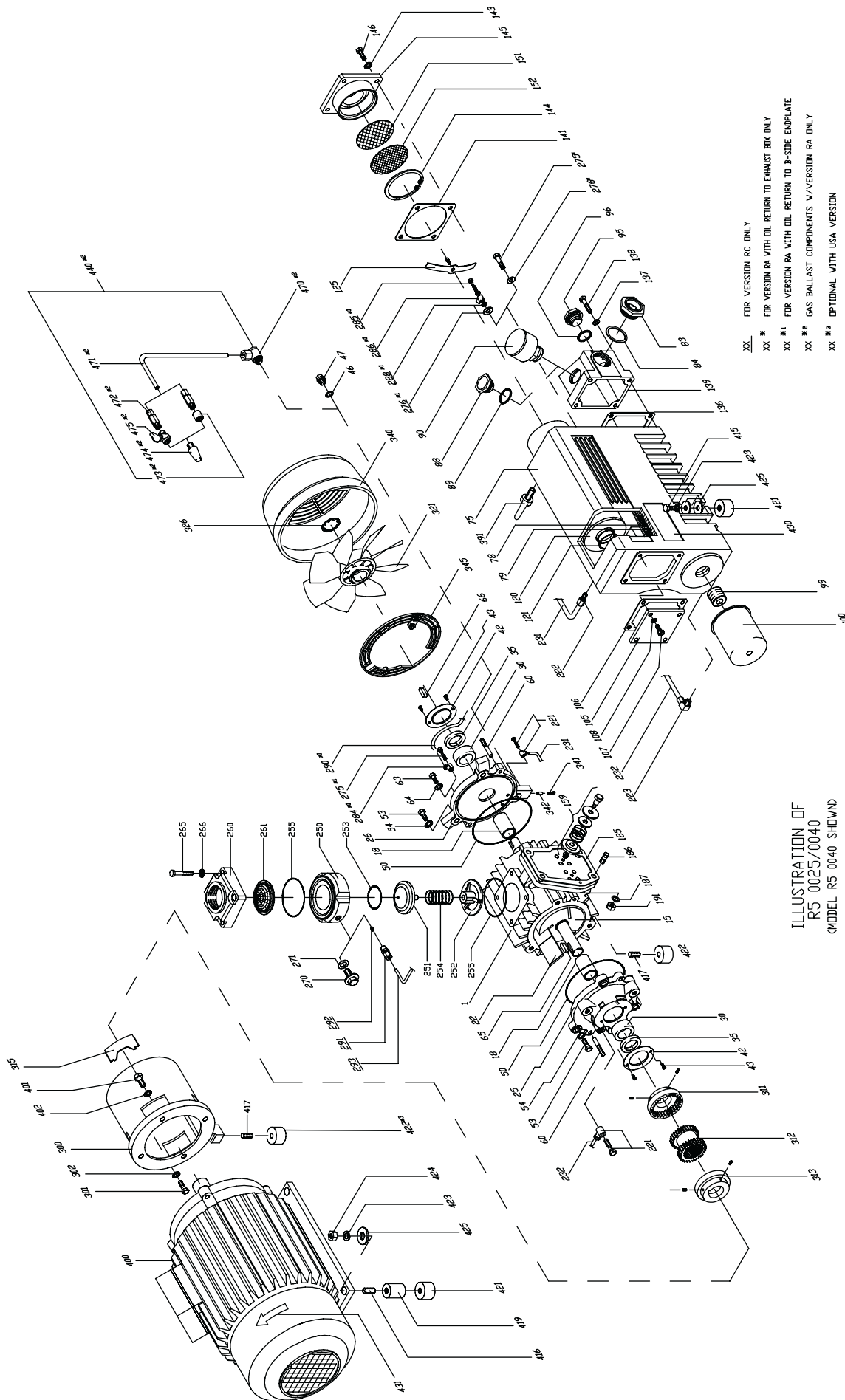
Notes: \*Because various motor types might be available and/or used on your specific pump, you should always refer to the motor nameplate to verify HP, volts, amps, frame size, etc. or consult the factory.



0025 - 0250 "C" & "E" Parts List

Ref	Description	Ref	Description	Ref	Description
1	Cylinder	151	Exh. Screen, coarse	301	Screw hex head cap
5	Socket set screw	152	Exh. Screen, fine	302	Lockwasher
15	Rotor	159	Valve assembly, exhaust	306	Motor adapter flange
18	Bearing sleeve	161	Oil service block	307	Lockwasher
22	Vane	162	Oil service block gasket	311	Coupling half, pump side
25	Endplate, motor side	163	Hex head cap screw	312	Coupling insert
26	Endplate, fan side	164	Lockwasher	313	Coupling half, motor side
30	Bearing	165	Socket head cap screw	315	Plastic clip
31	Spacer, bearing to Seal	166	Lockwasher	320	Spacer
35	Shaft seal	168	O-ring	321	Fan
42	Retainer ring	169	Exhaust valve cover plate	322	Axial fan
43	Screw, hex head	175	Socket head cap screw	323	Socket set screw
46	Gasket-ring	176	Lockwasher	326	Retainer ring
47	Plug	185	Gasket, cylinder/exhaust box	331	Set screw
49	O-ring	186	Stud	333	Set screw
50	O-ring	187	Lockwasher	340	Fan guard
53	Screw, hex head	189	Stud	341	Screw, self tapping
54	Lockwasher	190	Lockwasher	342	Sleeve, plastic
57	Hex head screw	191	Nut	345	Fan cover shield
58	Lockwasher	205	Exhaust cover side plate	353	Socket head cap screw
60	Taper pin	206	Cover plate gasket	360	Lockwasher
63	Plug	207	Socket head cap screw	390	Eye bolt adapter
64	Gasket-ring	208	Lockwasher	391	Eye bolt
65	Shaft key	221	Hydraulic fitting banjo	392	Lockwasher
66	Shaft key	222	Hydraulic fitting, straight	393	Hex head screw
75	Exhaust box	223	Hydraulic fitting, elbow/banjo	400	Motor
78	Baffle, expanded metal	224	Pipe adapter	401	Screw, hex head cap
79	Demister pad	225	Hydraulic fitting	402	Lockwasher
80	Sheet metal baffle	230	Oil tubing	409	Motor foot spacer
83	Oil sight glass	231	Oil tubing	411	Flat Washer
84	Gasket ring, sight glass	232	Oil tubing	413	Slotted set screw
88	Oil fill plug	238	Socket head cap screw	415	Screw, hex. head cap
89	Gasket ring, fill plug	239	Lockwasher	416	Stud, motor foot
90	Exhaust pressure gauge	241	Oil cooler	417	Set screw
95	Oil drain plug	242	O-ring	419	Spacer, motor foot
96	O-ring	244	Fan cover	421	Foot, rubber
99	Pipe nipple	247	Socket head cap screw	422	Foot, rubber
100	Oil filter	250	Housing, lower, inlet	423	Lockwasher
105	Cover, exhaust box	251	Valve plate, inlet	424	Hex nut
106	Gasket, exhaust box cover	252	Valve plate guide	425	Stud
107	Screw, exhaust box	253	O-ring	430	Name plate
108	Lockwasher	254	Spring, valve plate	431	Label "arrow"
115	Exhaust filter bracket	255	O-ring	436	Maintenance label
120	Exhaust filter	260	Inlet flange, upper	440	Gas Ballast Assembly
121	O-ring	261	Inlet screen	470	Hyd. fitting banjo
125	Filter spring assembly	265	Screw, hex head cap	471	Tubing, gas ballast
126	Filter spring screw	266	Lockwasher	472	Valve, check gas ballast
130	Strainer	270	Plug	473	Coupling
136	Gasket, exh. box service block	271	Gasket ring	474	Filter, gas ballast
137	Lockwasher	275	Oil return valve	475	Valve, pet cock
138	Screw	276	Gasket ring	476	Gas ballast elbow
139	Service block	284	Hydraulic, fitting banjo	477	Pet cock valve
140	Exhaust cover plate	285	Screw, oil recirculation	478	Hex head cap screw
141	Exhaust cover gasket	286	Banjo fitting housing	479	Lockwasher
142	Socket head cap screw	288	Gasket ring		
143	Lockwasher	289	Screw		
144	Retaining ring	290	Oil return line, RA version		
145	Housing, exhaust port	291	Hyd. fitting, straight		
146	Screw, exhaust housing	292	Carburetor jet		
148	Service block oil baffle	293	Oil return line, RC version		
149	Socket head cap screw	297	Screen fan guard		
150	Lockwasher	300	Motor mounting bracket		

Note: This parts list includes parts for all the pumps covered by this manual. Your specific model might not necessarily have all the parts indicated in this list. Refer to the illustration for your specific model pump when comparing part numbers or consult the factory.



XX FOR VERSION RC ONLY  
 XX \* FOR VERSION RA WITH OIL RETURN TO EXHAUST BOY ONLY  
 XX \*1 FOR VERSION RA WITH OIL RETURN TO P-SIDE ENDOPLATE  
 XX \*2 GAS BALLAST COMPONENTS W/VERSION RA ONLY  
 XX \*3 OPTIONAL WITH USA VERSION

ILLUSTRATION OF  
 R5 0025/0040  
 (MODEL R5 0040 SHOWN)

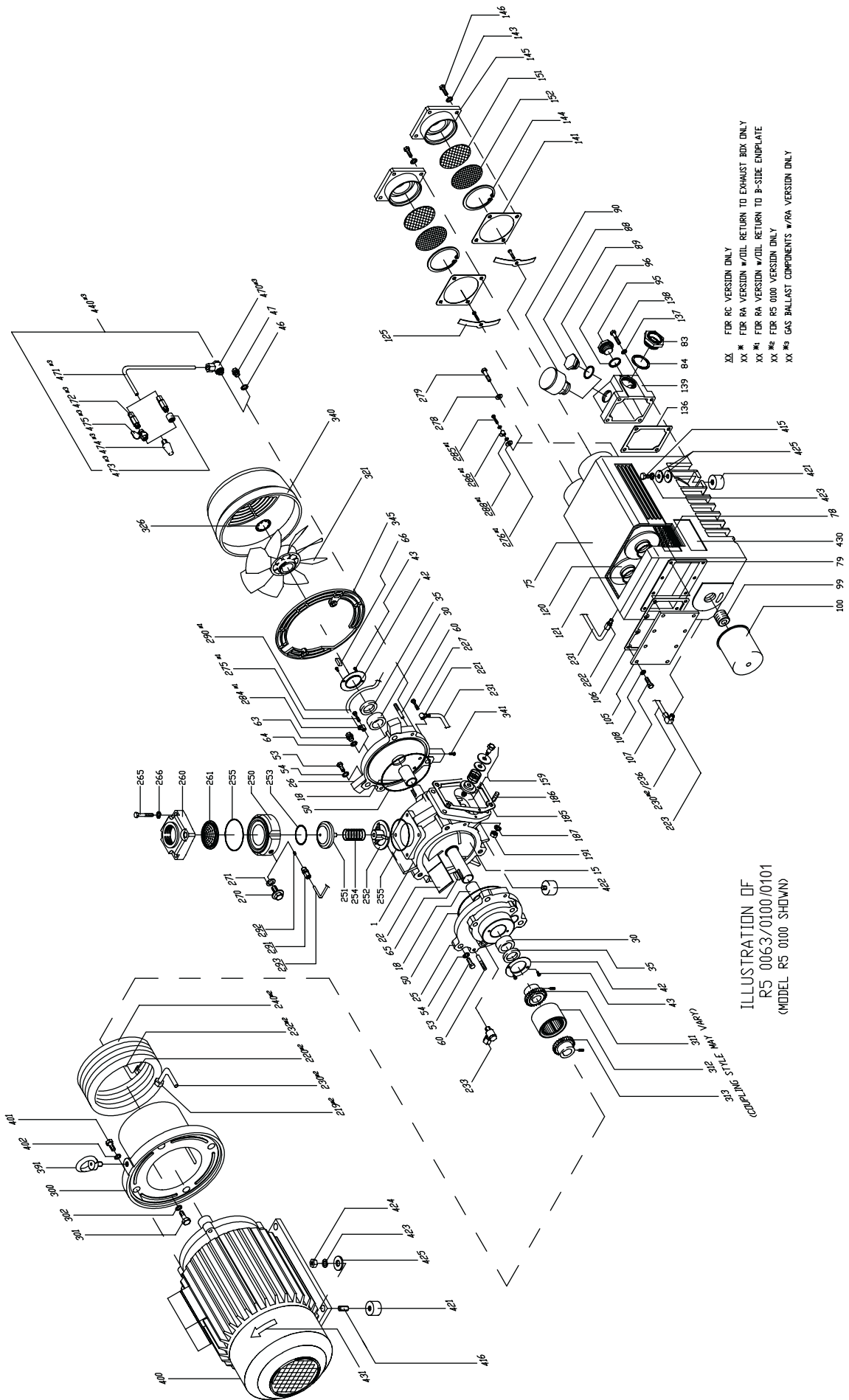


ILLUSTRATION OF  
 R5 0063/0100/0101  
 (MODEL R5 0100 SHOWN)

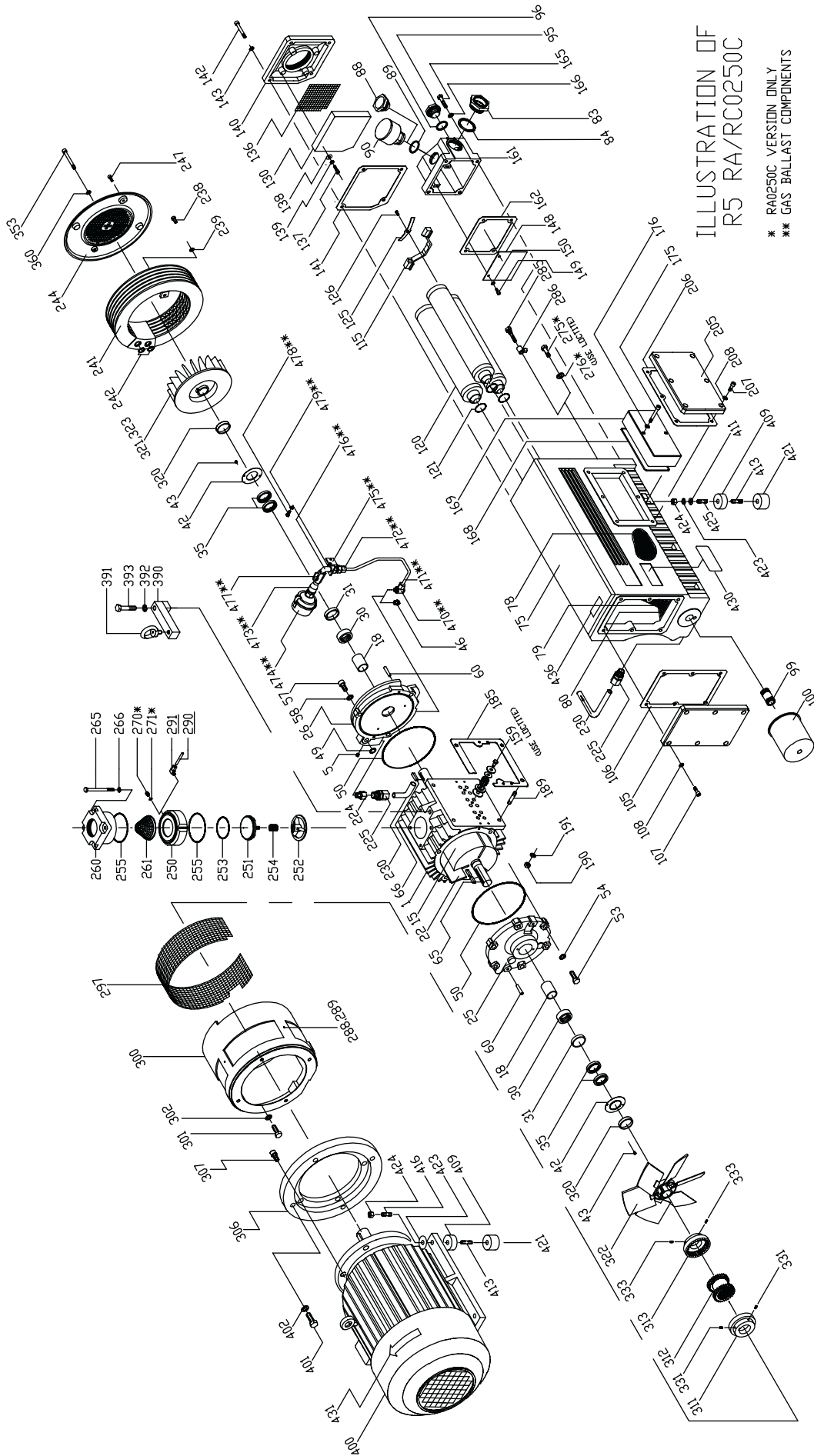


ILLUSTRATION OF  
R5 RA/RC0250C

\* RA0250C VERSION ONLY  
\*\* GAS BALLAST COMPONENTS



## Busch Inc. Factory Service Centers

### California

13826 Struikman Road  
Cerritos, CA 90703  
Phone (562) 926-8422  
Fax (562) 926-7262  
service.ca@buschinc.com

### Illinois

430 Windy Point Drive  
Glendale Heights, IL 60139  
Phone (630) 545-1310  
Fax (630) 545-1384  
service.il@buschinc.com

### New Jersey

39 Davis Street  
South Plainfield, NJ 07080  
Phone (908) 561-3233  
Fax (908) 561-3909  
service.nj@buschinc.com

### Puerto Rico

420 E Street, Suite 4  
Minillas Industrial Park  
Bayamon, PR 00959-1901  
Phone (787) 798-5045  
Fax (787) 798-5033  
service.pr@buschinc.com

### Texas

15411 Vantage Pkwy W., Suite 216  
Houston, TX 77032  
Phone (281) 449-2381  
Fax (281) 449-2383  
service.tx@buschinc.com

### Virginia

516 Viking Drive  
Virginia Beach, VA 23452  
Phone (757) 463-7800  
Fax (757) 463-7407  
service.va@buschinc.com





P/N 0872.900.823  
Revision 03/05



Busch, Inc.  
516 Viking Drive  
Virginia Beach, Virginia 23452  
Phone: (757) 463-7800  
FAX: (757) 463-7407