



INSTALLATION AND OPERATION MANUAL

R 5 Series

Models 0010, 0012, 0016, 0021, 0160,
0400, 0502, 0630, 1000, 1600
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, RB and RC versions of models 0010, 0012, 0016, 0021, 0160, 0400, 0502, 0630, 1000 and 1600 with a "B" ("A" on 0010 and 0016, "S" on 0021 and no letter designation on 0012) appearing as the seventh character in the model type number. For example, it would appear as follows:

RAXXXX-BXXX-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.

Example: RB0012-1029-XXXX

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. 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 the exhaust port. 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 normal 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 at least one foot (five feet for 0400 and larger pumps) of air space between the pump and any walls or other obstructions to the flow of cooling air.

Also, 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.

CAUTION: On 0400/0502/0630 models, a switch mounted near the exhaust port and on top of the exhaust box is a safety device. This switch is used to shut off the pump in the event the pump oil chamber is overheated. Wire this normally closed switch into the starter control circuit so that when the switch reaches the set point, power to the pump motor is discontinued.

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 must be set consistent with the motor current listed on the motor nameplate.

Note: Soft starting means are required for the motors of models 1000 and 1600. Using an across-the-line type of starter could possibly cause coupling and/or pump failure.

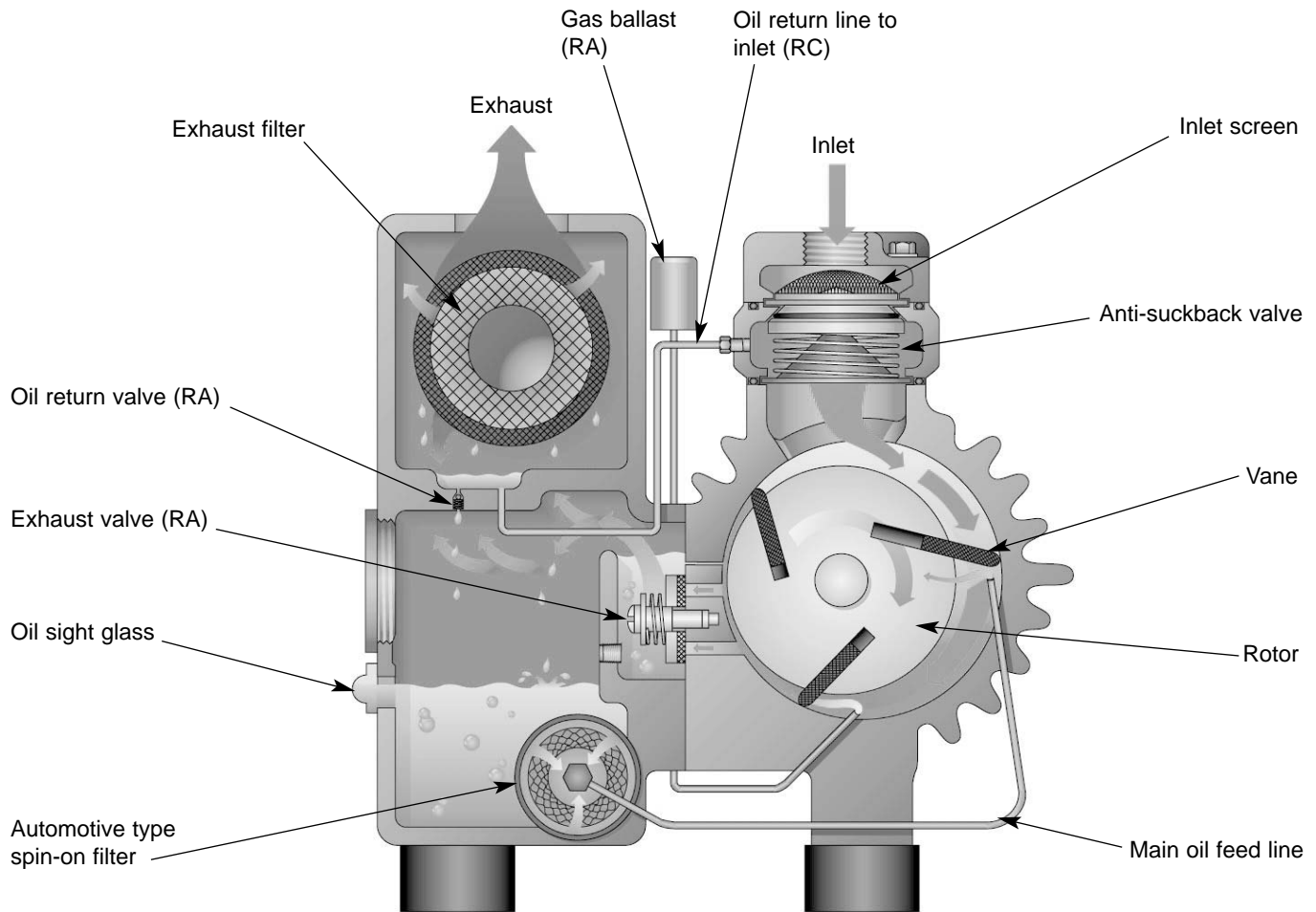


Fig. 1 - Basic R 5 Pump

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.

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.

CAUTION: When using PVC pipe or any static enhancing material for the exhaust piping, make provisions to safeguard against arcing from static electricity. Arcing can ignite oil vapor that may be present.

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: Do not use the anti-suck-back valve 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 26.

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

WARNING: Do not use hydrocarbon oils in pumps on oxygen service. See Section 2.6 - Oxygen Service Pumps.

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!

The pump is shipped without oil. After level installation, and after correct rotation has been established, 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). On pumps with two sight glasses, fill the top glass up to the 3/4 mark. 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, except for the 0021 model, which should use R580. Use R590 or R570 in pumps that are operated in high ambient temperatures (above 90°F) or high operating pressure when the oil carbonizes (turns black) before the change interval. Contact the factory for recommendations when using other oils.

The TECHNICAL DATA chart on page 26 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!

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.

2.0 OPERATION

2.1 Start-up

Check rotation of the motor as described in Section 1.3.

Fill the pump with oil as described in Section 1.5.

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.

On pumps with two sight glasses, with the pump shut off, the oil level should be visible in the upper oil sight glass, 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 return valve (Ref. 275), which opens on R 5 RA/RB model pumps when the pump is shut off. It is necessary to shut off the pump (all RA model pumps and RB0021 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. RA0010 and RA0016 pumps are equipped with a permanent gas ballast which cannot be shut off unless the sintered filter is removed and the orifice plugged. Pumps RA0160 thru RA1600 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 check or shut-off 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.

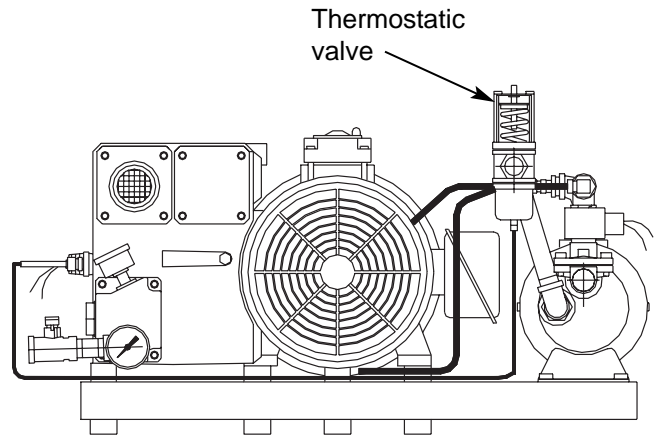


Fig. 2 - Water-cooled Pump

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.

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 or below the 1/4 mark on the upper oil sight glass on pumps with two sight glasses.

On RA/RB 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. Allow sufficient time for the oil to drain back into the sump on RA/RB Series pumps prior to adding oil, or overfilling could result.

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. 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 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.

3.1.2 Oil Type and Quantity

See Section 1.5 for details on oil type and quantity.

3.1.3 Oil and Filter Change

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 or R590 synthetic oils could extend the operating hours between oil changes under ideal conditions. Oil samples should be taken regularly when exceeding the 500-750 hour recommendation.

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.

Excessive Heat

When the pump is subjected to operating conditions that will cause the oil to be heated above 235°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 or R590 synthetic oil should be used to withstand the elevated temperatures. If synthetic oil is used, the pump should be flushed with Busch R568 oil as outlined in the Maintenance and Repair Manual. 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 once-through-sealant or dry-type 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 0160 - 0630 Series pumps are equipped with an automotive-type oil filter (Ref. 100). The 1000/1600 Series has two automotive-type filters. The 0010 thru 0021 are not equipped with an automotive-type oil filter. When replacing the automotive-type oil filter, use only a genuine Busch 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. Pressure within the green field would indicate normal pressure. Pressure in the red field (for a continuous period of time) requires an immediate change of the exhaust filter(s).

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.

In order to replace the filter, remove the screws retaining the exhaust port cover plate. Pull the housing off the exhaust box; set it aside. Use a slotted head screw driver to loosen the exhaust filter retaining spring (Ref. 125), then rotate and remove the spring (see Fig. 3). Pull the filter cartridge (Ref. 120) out of the exhaust box.



Fig. 3 - 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 clean shop rag to seal off the connection between the air hose and the filter. If you can blow through it, the element is not plugged. If plugged, 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 Vacuum Inlet Filter

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.

3.5 Routine Maintenance Schedule

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

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 3.4).

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 (not applicable on the 0010, 0012, 0016 and 0021) 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 filter material as practice determines.

The oil cooling coils (Ref. 240 on models 0012 through 0400), the oil cooler (Ref. 241 on models 0502 through 1600) and any motor or pump grill covers on all models should be inspected regularly for debris. Clean as necessary. Soiling prevents cool air intake or movement and may lead to overheating of the pump.

Drain drips legs on inlet and exhaust piping.

3.6 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 (except 0010, 0012, 0016 and 0021), 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 plugged and/or leaking.

Remedy:

Replace, clean and/or retighten the oil fittings. 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.

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.

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.

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.

4.2 Trouble

Pump will not start.

Possible Cause:

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.

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.

Possible Cause:

The exhaust filter is clogged due to process material.

Remedy:

Contact the factory in Virginia Beach, Va. for recommendations.

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; vanes broken; bearing seizing.

Remedy:

Follow disassembly and assembly steps outlined in the Maintenance and Repair Manual and remove foreign parts, and replace vanes and bearings.

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) 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.

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 recommended Busch oil. 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 (if applicable) 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.

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 (not applicable on 0010, 0012, 0016 or 0021).

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:

Electric motor has failed and seized.

Remedy:

Check and replace motor bearings or replace motor if windings have burned up.

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 operation. 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.

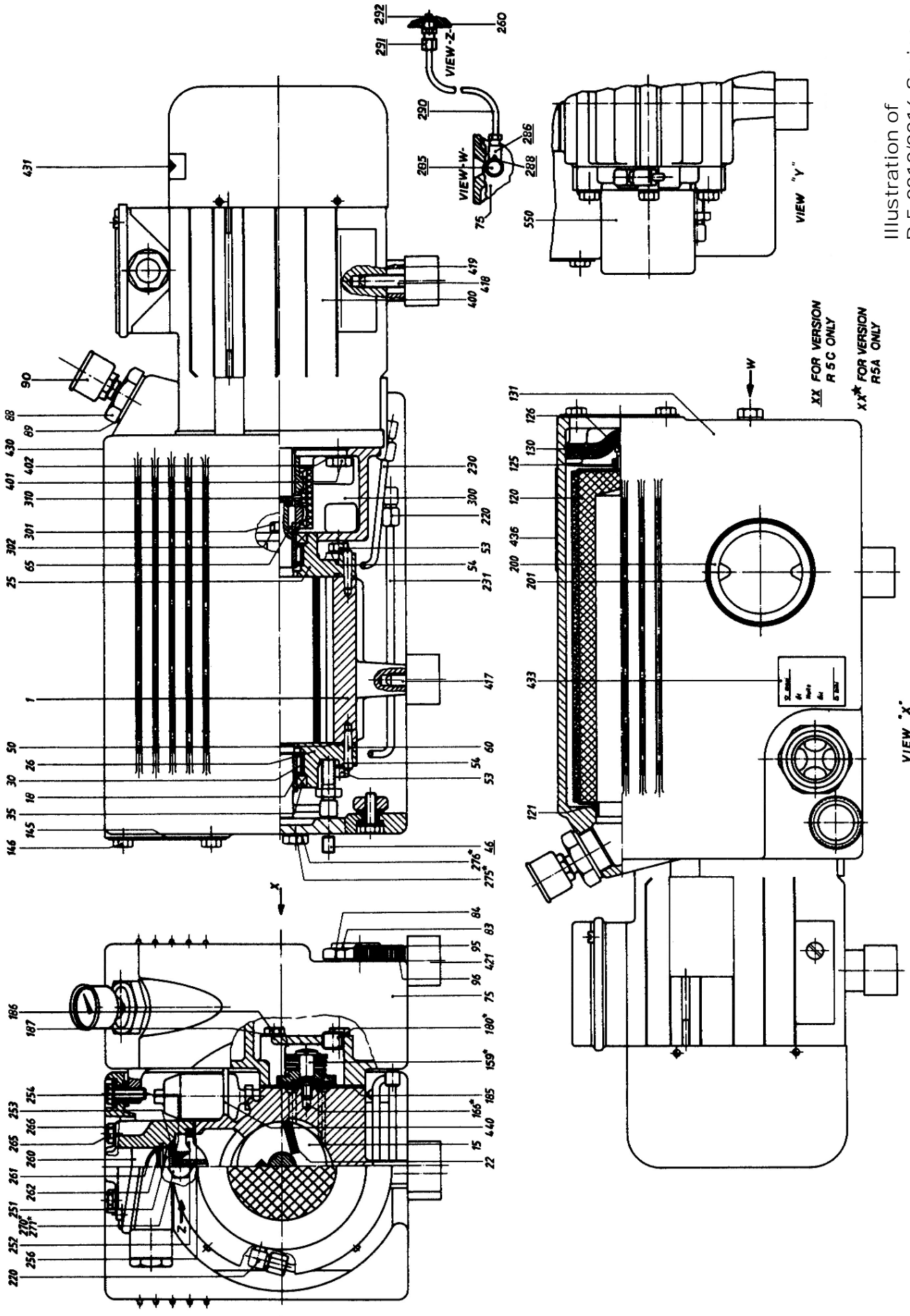
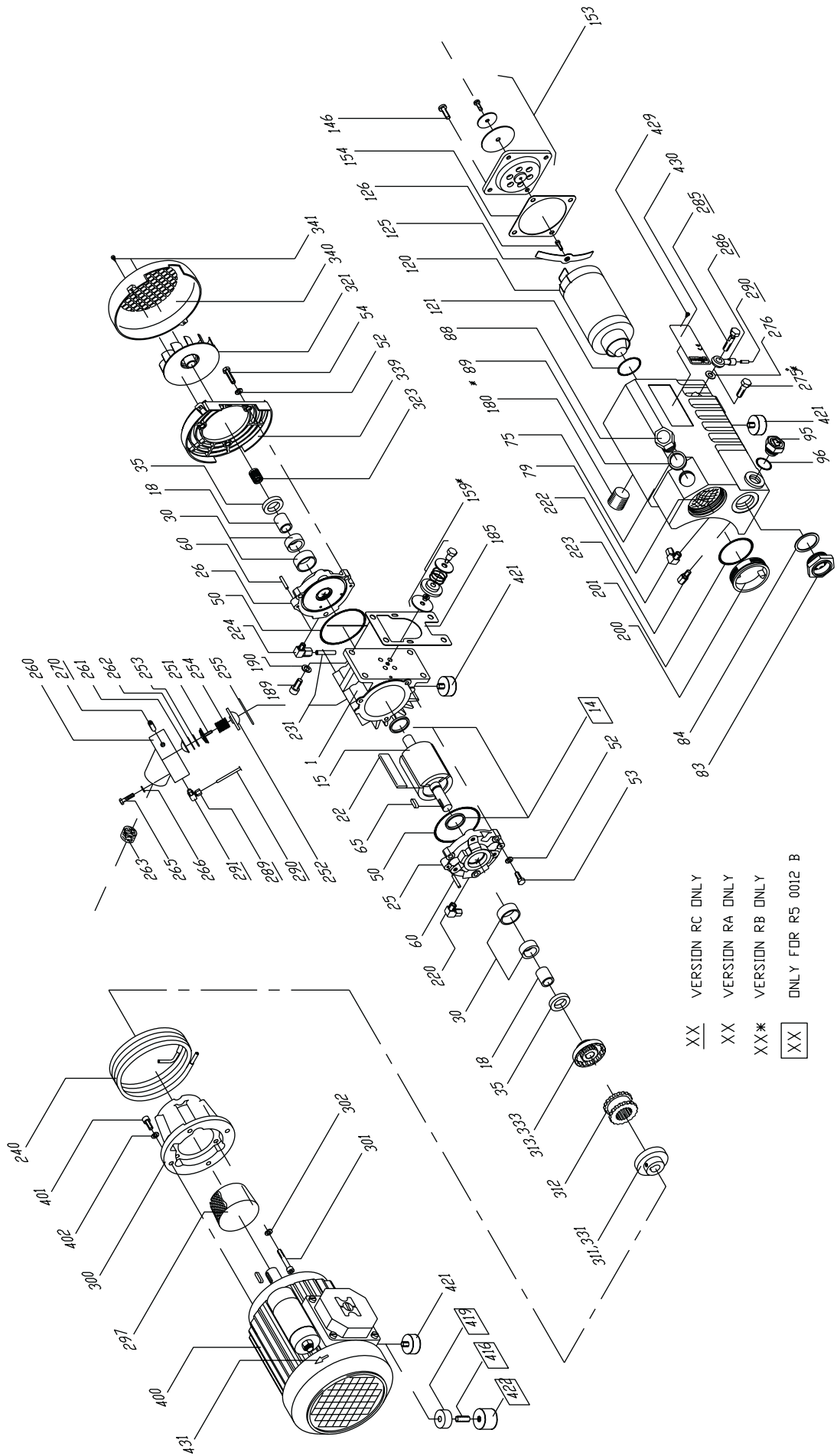


Illustration of
R 5 0010/0016 Series

Parts List for R 5 0010/0016

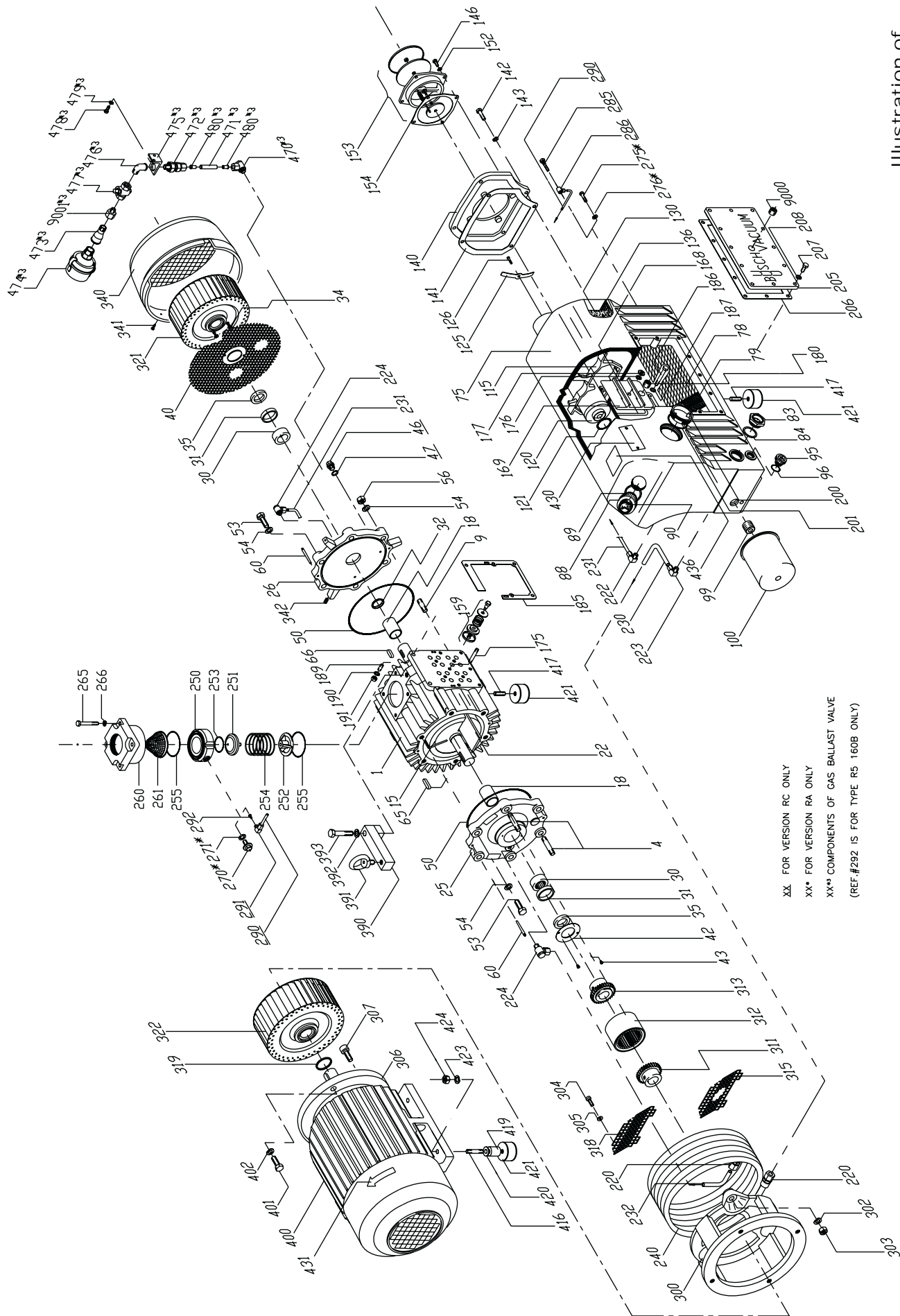
Ref	Description	Ref	Description
001	Cylinder	285	Oil recirc. screw
015	Rotor	286	Banjo hydraulic fitting
018	Bearing sleeve	288	Ring gasket
022	Vane	290	Oil return line
025	Motor side endplate	291	Hydraulic straight fitting
026	Opp. M.S. endplate	300	Motor mounting bracket
030	Needle bearing	301	Socket head cap screw
035	Shaft seal	302	Lockwasher
046	Socket set screw	310	Coupling
047	Lockwasher	400	Motor
050	O-ring	401	Hex head cap screw
053	Hex head cap screw	402	Lockwasher
054	Lockwasher	417	Slotted set screw
056	Hex head cap nut	418	Slotted set screw
060	Tapered pin	419	Washer
065	Shaft key	421	Rubber foot
075	Exhaust box	430	Nameplate
083	Oil sight glass	431	Directional arrow
084	Ring gasket	433	Oil level label
088	Oil fill plug	436	Maintenance label
089	Ring gasket	440	Check valve for gas ballast
090	Pressure gauge	550	Cover guard
095	Oil drain plug		
096	O-ring		
120	Exhaust filter		
121	O-ring		
125	Filter spring assembly		
126	Slot chase head mach. screw		
130	Baffle strainer		
145	Cover plate exhaust screen		
146	Hex head cap screw		
159	Exhaust valve		
166	Cylindrical pin		
180	Plug		
185	Cylinder/exhaust box gasket		
186	Hex head cap screw		
187	Lockwasher		
200	Drum exhaust box plug		
201	O-ring		
220	Hydraulic elbow fitting		
230	Oil tubing		
231	Oil tubing		
251	Valve plate		
252	Valve guide		
253	O-ring		
254	Inlet check valve spring		
256	Cylinder/inlet flange gasket		
260	Inlet flange		
261	Inlet screen		
262	Retaining spring		
265	Hex head cap screw		
266	Lockwasher		
270	Plug		
271	Ring gasket		
275	Oil return valve		
276	Ring gasket		



- XX VERSION RC ONLY
- XX VERSION RA ONLY
- XX* VERSION RB ONLY
- XX ONLY FOR R5 0012 B

Parts List for R 5 0012/0021

Ref	Description	Ref	Description
001	Cylinder	265	Screw
014	Seal	266	Lockwasher
015	Rotor	270	Plug
018	Bearing sleeve	275	Oil return valve
022	Vane	276	Ring gasket
025	Motor side endplate	285	Oil recirc. screw
026	Opp. M.S. endplate	286	Banjo hydraulic fitting
030	Teflon sleeve bearing	289	Fitting nut
035	Shaft seal	290	Oil return line tubing
050	O-ring	291	Hydraulic fitting
052	Lockwasher	297	Screen
053	Hex head cap screw	300	Motor mounting bracket
054	Lock washer	301	Socket head cap screw
060	Tapered pin	302	Lockwasher
065	Shaft key	311	Motor side coupling half
075	Exhaust box	312	Coupling insert
079	Demister pad	313	Pump side coupling half
080	Oil sight glass	321	Pump fan
081	Ring gasket	323	Tolerance ring
083	Oil sight glass	331	Set screw
084	Ring gasket	333	Set screw
088	Oil fill plug w/hole	339	Fan centering ring
089	Ring gasket	340	Pump end cover
090	Pressure gauge	341	Machine screw
095	Oil drain plug	400	Motor
096	O-ring	401	Hex head cap screw
120	Exhaust filter	402	Lockwasher
121	O-ring	416	Stud
125	Filter spring assembly	417	Slotted set screw
126	Slot chs. head mach.screw	419	Foot spacer
146	Hex head cap screw	421	Rubber foot
153	Exhaust cover plate	422	Rubber foot
154	Exhaust cover gasket	429	Screw
159	Exhaust valve assembly	430	Nameplate
180	Plug	431	Directional arrow
185	Gasket		
189	Stud		
190	Lockwasher		
191	Hex head nut		
200	Drum exhaust box plug		
201	O-ring		
220	Hydraulic elbow fitting		
222	Hydraulic straight fitting		
223	Hydraulic straight fitting		
224	Hydraulic elbow fitting		
231	Oil tubing		
240	Cooling coil		
251	Valve plate		
252	Valve guide		
253	O-ring		
254	Inlet check valve spring		
255	O-ring		
260	Inlet flange		
261	Inlet screen		
262	Retaining spring		
263	Baffle strainer		



XX FOR VERSION RC ONLY
 XX* FOR VERSION RA ONLY
 XXX* COMPONENTS OF GAS BALLAST VALVE
 (REF.#292 IS FOR TYPE R5 160B ONLY)

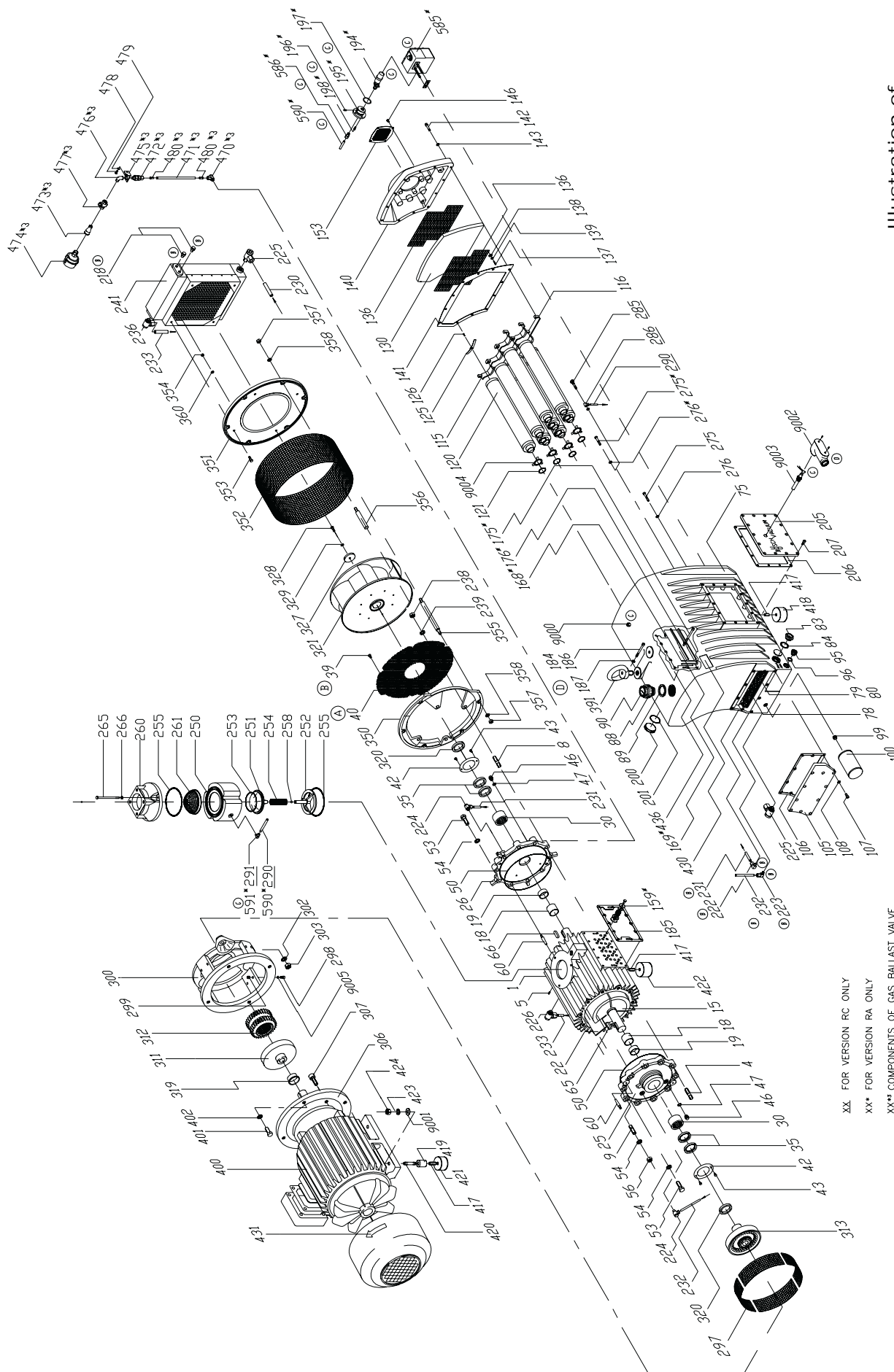
Illustration of
 R 5 0160 Series

Parts List for R 5 0160

Ref	Description	Ref	Description	Ref	Description
001	Cylinder	176	Lockwasher	322	Motor side fan
004	Stud	177	Hex head nut	340	Fan Cover
009	Stud	180	Plug	341	Sheet metal screw
015	Rotor	185	Gasket	342	Plastic insert
018	Bearing sleeve	186	Hex head cap screw	390	Eyebolt adapter
022	Vane	187	Lockwasher	391	Eyebolt
025	Motor side endplate	189	Stud	392	Lockwasher
026	Opp. M.S. endplate	190	Lockwasher	393	Hex head cap screw
030	Needle bearing	191	Hex head nut	400	Motor
031	Endplate spacer	200	Drum exhaust box plug	401	Hex head cap screw
032	Pump spacer	201	O-ring	402	Lockwasher
034	Slotted chs hd cap screw	205	Cover side plate	416	Stud
035	Shaft seal	206	Gasket	417	Slotted set screw
040	Protective screen	207	Hex head cap screw	419	Foot spacer
042	Shaft seal retaining plate	208	Lockwasher	420	Flat washer
043	Hex head cap screw	220	Hydraulic fitting	421	Rubber foot
046	Hex head plug	222	Hydraulic fitting	423	Washer
047	Copper ring gasket	223	Hydraulic fitting	424	Hex head cap nut
050	O-ring	224	Hydraulic fitting	430	Nameplate
053	Hex head cap screw	230	Oil tubing	431	Arrow label
054	Lockwasher	231	Oil tubing	436	Maintenance label
056	Hex head cap nut	232	Oil tubing	470	Hydraulic fitting
060	Tapered pin	240	Cooling coil	471	Teflon tubing
065	Shaft key	250	Inlet flange	472	Check valve
066	Shaft key	251	Valve guide	473	Bell reducer
075	Exhaust box	252	Valve plate	474	Gas ballast filter
078	Sheet metal baffle	253	O-ring	475	Gas ballast valve bracket
079	Demister pad	254	Inlet check valve spring	476	Elbow fitting
083	Oil sight glass	255	O-ring	477	Pet cock valve
084	Ring gasket	260	Inlet flange	478	Hex head cap screw
088	Oil fill plug	261	Inlet screen	479	Lockwasher
089	Oil fill plug gasket	265	Hex head cap screw	480	Oil tube insert
090	Pressure gauge	266	Lockwasher	9000	Steel socket plug
095	Oil drain plug	270	Plug R1/8"	9001	Hydraulic adapter
096	O-ring	271	Ring gasket		
099	Nipple	275	Oil return valve		
100	Auto-type oil filter	276	Ring gasket		
115	Filter bracket	285	Oil recirc. screw		
120	Exhaust filter	286	Banjo hydraulic fitting		
121	O-ring	290	Oil return line tubing		
125	Filter spring assembly	291	Hydraulic fitting		
126	Socket head cap screw	292	Carburetor jet		
130	Baffle strainer	300	Motor mounting bracket		
136	Support for syn. frame	302	Lockwasher		
140	Exhaust cover plate	303	Hex shoulder nut		
141	Cover plate gasket	304	Socket hd machine screw		
142	Hex head cap screw	305	Flat washer		
143	Lockwasher	306	C-face adapter flange		
146	Hex head cap screw	307	Socket head screw		
152	Lockwasher	311	Motor side coupling half		
153	Exhaust silencer	312	Coupling insert		
154	Gasket	313	Pump side coupling half		
159	Exhaust valve	315	Protective screen		
168	O-ring	318	Protective screen		
169	Exh. valve cover plate	319	Spacer		
175	Stud	321	Pump shaft fan		

Parts List for R 5 0400

Ref	Description	Ref	Description	Ref	Description
001	Cylinder	143	Lockwasher	312	Coupling insert
004	Stud	146	Hex head cap screw	313	Pump side coupling half
005	Set screw	153	Cover plate exhaust screen	319	Spacer
009	Stud	159	Exhaust valve	320	Fan and coupling spacer
015	Rotor	168	O-ring	321	Pump shaft fan
018	Bearing sleeve	169	Exh. valve cover plate	322	Motor side fan
019	Shaft seal sleeve	175	Hex head cap screw	327	Locking disk
022	Vane	176	Lockwasher	328	Socket head cap screw
025	Motor side endplate	184	Socket head cap screw	329	Lockwasher
026	Opp. M.S. endplate	185	Cylinder/Exhaust box gasket	340	Fan Cover
030	Needle bearing	186	Hex head cap screw	341	Sheet metal screw
035	Shaft seal	187	Lockwasher	342	Plastic insert
040	Protective screen	200	Drum exhaust box plug	391	Eyebolt
041	Hex head nut	201	O-ring	400	Motor
042	Shaft seal support ring	205	Cover side plate	401	Hex head cap screw
043	Hex head cap screw	206	Gasket	402	Lockwasher
046	Hex head plug	207	Hex head cap screw	417	Slotted set screw
047	Copper ring gasket	215	Reducing nipple	418	Rubber foot
050	O-ring	216	Ring gasket	419	Foot spacer
053	Hex head cap screw	220	Hydraulic fitting	420	Stud
054	Lockwasher	222	Hydraulic elbow fitting	421	Rubber foot
056	Hex head cap nut	223	Hydraulic elbow fitting	422	Rubber foot
060	Tapered pin	224	Hydraulic banjo fitting	423	Lockwasher
065	Shaft key	225	Hydraulic straight fitting	424	Hex head cap nut
066	Shaft key	226	Hydraulic banjo fitting	430	Nameplate
075	Exhaust box	230	Oil tubing	431	Arrow label
078	Sheet metal baffle	231	Oil tubing	436	Maintenance label
079	Demister pad	232	Oil tubing	470	Hydraulic banjo fitting
080	Perforated sheet metal	233	Oil tubing	471	Teflon tubing
083	Oil sight glass	240	Cooling coil	472	Check valve
084	Ring gasket	250	Inlet flange	473	Bell reducer
088	Oil fill plug	251	Valve plate	474	Gas ballast filter
089	Oil fill plug gasket	252	Valve inlet guide	475	Gas ballast valve bracket
090	Pressure gauge	253	O-ring	476	Elbow fitting
095	Oil drain plug	254	Inlet check valve spring	477	Pet cock valve
096	O-ring	255	O-ring	478	Hex head cap screw
099	Nipple	258	Ball, Viton	479	Lockwasher
100	Auto-type oil filter	260	Inlet flange	480	Oil tube insert
105	Cover plate	261	Inlet screen	9000	Steel socket plug
106	Cover plate gasket	265	Hex head cap screw	9001	Flat washer
107	Socket head cap screw	266	Lockwasher	9002	Entrance elbow connector
108	Lockwasher	275	Oil return valve	9003	Fenwal temperature switch
115	Filter bracket	276	Ring gasket	9004	Grounding washer
116	Filter bracket	285	Oil recirc. screw	9005	Plain washer
120	Exhaust filter	286	Banjo hydraulic fitting	9006	Socket head cap screw
121	O-ring	290	Oil return line tubing	9007	Hex head cap screw
125	Filter spring assembly	291	Hydraulic elbow fitting		
126	Socket head cap screw	297	Screen		
130	Baffle strainer	298	Slot chs. head screw		
136	Perf. sheet metal screen	299	Rivet		
137	Hex head cap screw	300	Motor mounting bracket		
138	Flat washer	302	Lockwasher		
139	Lockwasher	303	Hex shoulder nut		
140	Exhaust cover plate	306	C-face adapter flange		
141	Cover plate gasket	307	Socket head screw		
142	Hex head cap screw	311	Motor side coupling half		

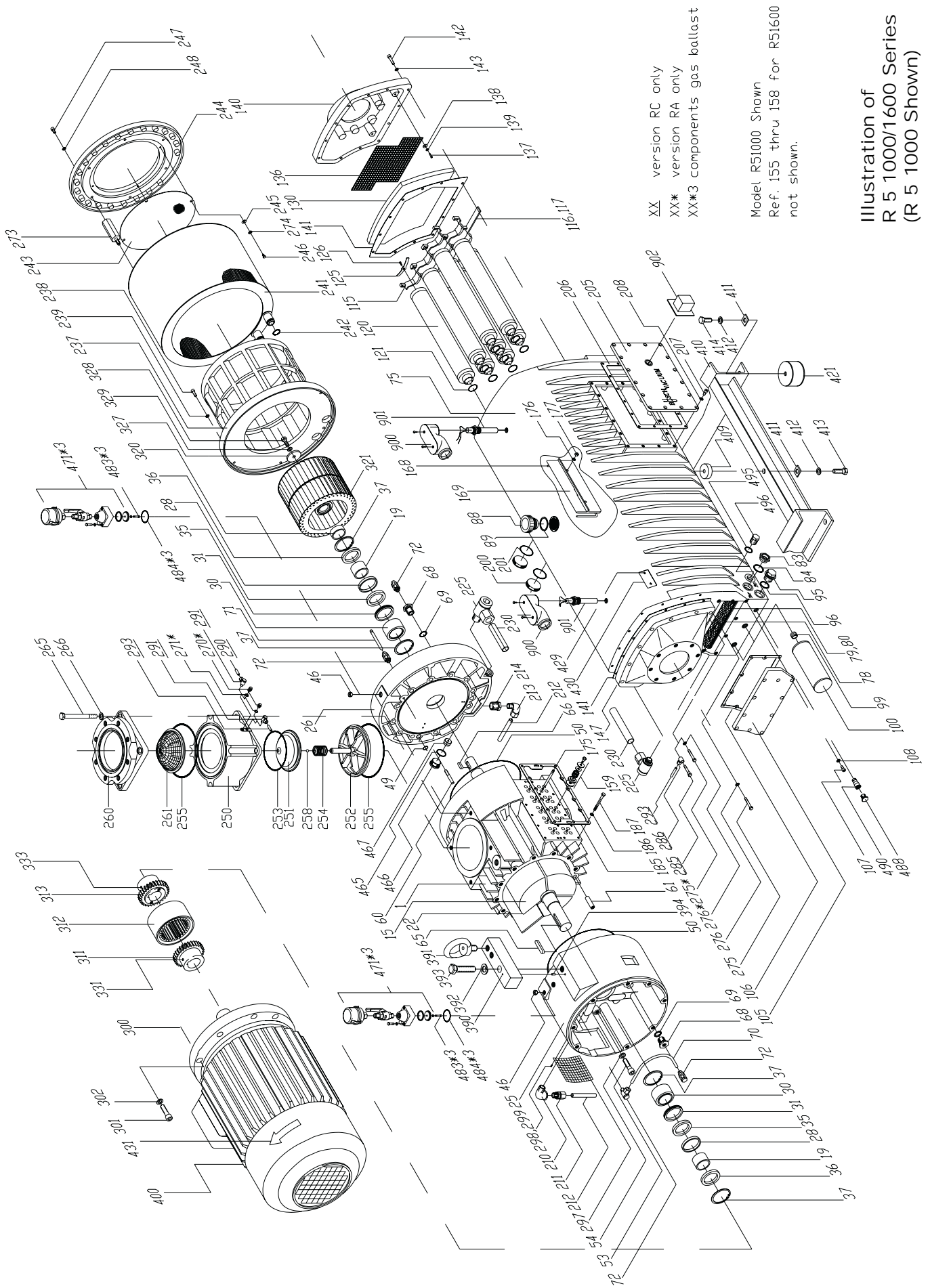


XX FOR VERSION RC ONLY
 XX* FOR VERSION RA ONLY
 XX** COMPONENTS OF GAS BALLAST VALVE

Illustration of
 R 5 0502/0630 Series
 (R 5 0630 Shown)

Parts List for R 5 0502/0630

Ref	Description	Ref	Description	Ref	Description
001	Cylinder	141	Cover plate gasket	313	Pump side coupling half
004	Stud	142	Hex head cap screw	319	Spacer
005	Set screw	143	Lockwasher	320	Fan and coupling spacer
008	Stud	146	Hex head cap screw	321	Pump shaft fan
009	Stud	153	Cover plate exhaust screen	327	Locking disk
015	Rotor	159	Exhaust valve	328	Socket head cap screw
018	Bearing sleeve	168	O-ring	329	Lockwasher
019	Shaft seal sleeve	169	Exh. valve cover plate	350	Centering ring
022	Vane	175	Hex head cap screw	351	Centering ring
025	Motor side endplate	176	Lockwasher	352	Fan guard
026	Opp. M.S. endplate	184	Socket head cap screw	353	Hex head cap screw
030	Needle bearing	185	Cylinder/Exhaust box gasket	354	Hex head nut
035	Shaft seal	186	Hex head cap screw	355	Distance bolt
039	Socket head mach. screw	187	Lockwasher	356	Mounting bolt
040	Protective screen	200	Drum exhaust box plug	357	Hex nut
041	Hex head nut	201	O-ring	358	Lockwasher
042	Shaft seal support ring	205	Cover side plate	360	Lockwasher
043	Hex head cap screw	206	Gasket	391	Eyebolt
046	Hex head plug	207	Hex head cap screw	400	Motor
047	Copper ring gasket	222	Hydraulic elbow fitting	401	Hex head cap screw
050	O-ring	223	Hydraulic elbow fitting	417	Slotted set screw
053	Hex head cap screw	224	Hydraulic banjo fitting	418	Rubber foot
054	Lockwasher	225	Hydraulic straight fitting	419	Foot spacer
056	Hex head cap nut	226	Hydraulic banjo fitting	420	Stud
060	Tapered pin	230	Oil tubing	421	Rubber foot
065	Shaft key	231	Oil tubing	422	Rubber foot
066	Shaft key	232	Oil tubing	423	Lockwasher
075	Exhaust box	233	Oil tubing	424	Hex head cap nut
078	Sheet metal baffle	236	Hydraulic fitting	430	Nameplate
079	Demister pad	238	Hex head nut	431	Arrow label
080	Perforated sheet metal	239	Lockwasher	436	Maintenance label
083	Oil sight glass	241	Oil cooler	470	Hydraulic banjo fitting
084	Ring gasket	250	Inlet flange	471	Teflon tubing
088	Oil fill plug	251	Valve plate	472	Check valve
089	Oil fill plug gasket	252	Valve inlet guide	473	Bell reducer
090	Pressure gauge	253	O-ring	474	Gas ballast filter
095	Oil drain plug	254	Inlet check valve spring	475	Gas ballast valve bracket
096	O-ring	255	O-ring	476	Elbow fitting
099	Nipple	258	Ball, Viton	477	Pet cock valve
100	Auto-type oil filter	260	Inlet flange	478	Hex head cap screw
105	Cover plate	261	Inlet screen	479	Lockwasher
106	Cover plate gasket	265	Hex head cap screw	480	Oil tube insert
107	Socket head cap screw	266	Lockwasher	585	Oil return float valve kit
108	Lockwasher	285	Oil recirc. screw	586	Hydraulic fitting
115	Filter bracket	286	Banjo hydraulic fitting	591	Hydraulic fitting
116	Filter bracket	290	Oil return line tubing	9000	Steel socket plug
120	Exhaust filter	297	Screen	9001	Flat washer
121	O-ring	298	Slot chs head screw	9002	Entrance elbow connector
125	Filter spring assembly	299	Rivet	9003	Fenwal temperature switch
126	Socket head cap screw	300	Motor mounting bracket	9004	Grounding washer
130	Baffle strainer	302	Lockwasher	9005	Plain washer
136	Perf. sheet metal screen	303	Hex shoulder nut	9006	Socket head cap screw
137	Hex head cap screw	306	C-face adapter flange	9007	Hex head cap screw
138	Flat washer	307	Socket head screw		
139	Lockwasher	311	Motor side coupling half		
140	Exhaust cover plate	312	Coupling insert		



XX version RC only
 XX* version RA only
 XX*3 components gas ballast

Model R51000 Shown
 Ref. 155 thru 158 for R51600
 not shown.

Illustration of
 R 5 1000/1600 Series
 (R 5 1000 Shown)

Parts List for R 5 1000/1600

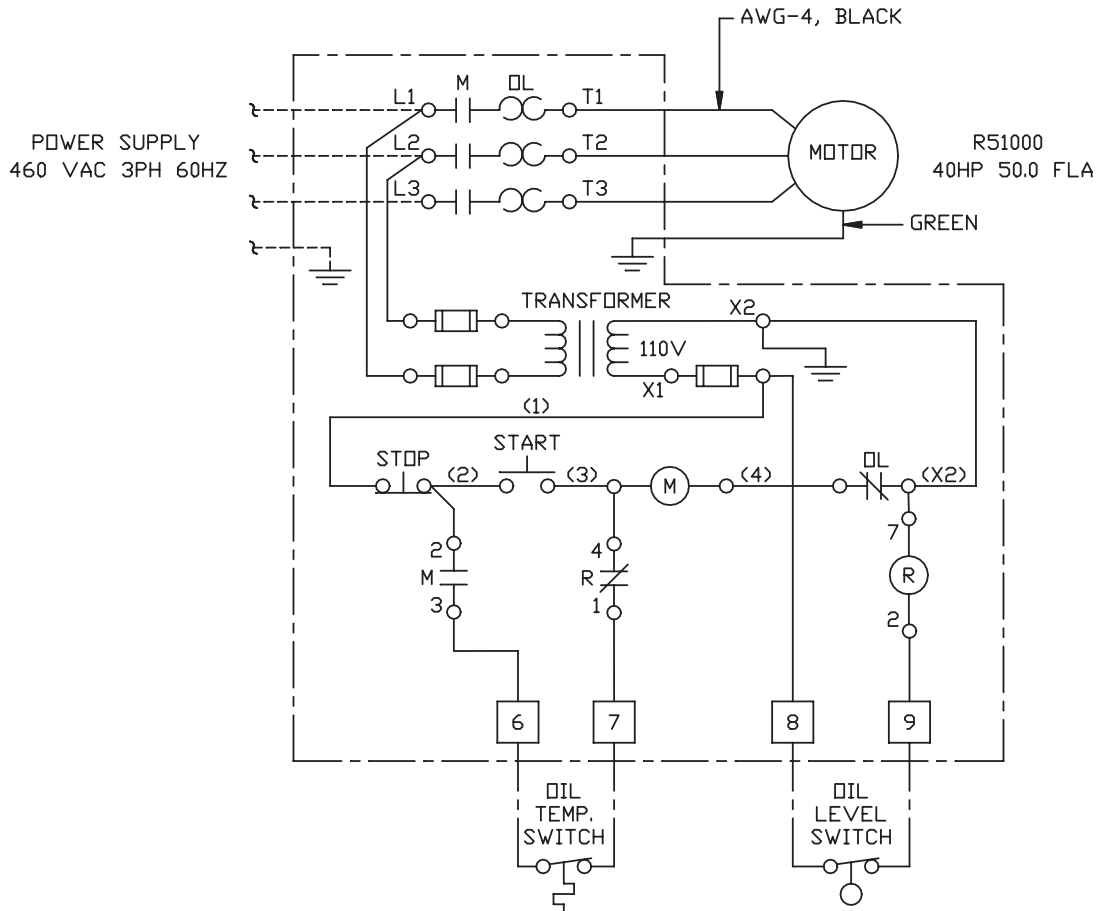
Ref	Description	Ref	Description	Ref	Description
001	Cylinder	147	Exhaust cover plate	299	Sheet metal nut
015	Rotor	159	Exhaust valve	300	Motor mounting adapter
019	Shaft seal sleeve	168	O-ring	301	Socket head cap screw
022	Vane	169	Exh. valve cover plate	302	Lockwasher
025	Motor side endplate	175	Stud	311	Motor side coupling half
026	Opp. M.S. endplate	176	Lockwasher	312	Coupling insert
028	End plate spacer	177	Hex head nut	313	Pump side coupling half
030	Needle bearing	185	Cylinder/exhaust box gasket	320	Distance spacer
031	Endplate spacer	186	Hex head cap screw	321	Cooling fan
035	Shaft seal	187	Lockwasher	327	Retaining disk
036	Shaft seal	200	Drum exhaust box plug	328	Hex head cap screw
037	Retaining ring	201	O-ring	329	Lockwasher
046	Hex head plug	205	Cover plate	331	Socket set screw
049	O-ring	206	Cover plate gasket	333	Socket set screw
050	O-ring	207	Hex head cap screw	390	Eyebolt adapter
053	Hex head cap screw	208	Lockwasher	391	Eyebolt
054	Lockwasher	210	Elbow pipe fitting	392	Lockwasher
060	Tapered pin	211	Hydraulic straight fitting	393	Hex head cap screw
061	Cylindrical pin	212	Oil tubing	394	Alignment pin
065	Shaft key	213	Hydraulic elbow fitting	400	Motor
066	Shaft key	214	Reducer bushing	401	Hex head cap screw
068	Connect piece for hyd. fitting	225	Hydraulic banjo fitting	402	Lockwasher
069	O-ring	230	Oil tubing	409	Spacer
070	Gas ballast line, A-side	237	Cooler guide	410	Frame
071	Gas ballast line, B-side	238	Socket head cap screw	411	Washer
072	Hydraulic fitting	239	Lockwasher	412	Lockwasher
075	Exhaust box	241	Oil cooler	413	Hex head cap screw
078	Sheet metal baffle	242	O-ring	414	Hex head cap screw
079	Demister pad	243	Fan guard	421	Rubber foot
080	Perforated sheet metal	244	Cooler front cover	429	Sheet metal screw
083	Oil sight glass	245	Flat washer	430	Nameplate
084	Ring gasket	246	Hex head cap screw	431	Arrow label
088	Oil fill plug	247	Socket head cap screw	465	Ring gasket
089	Oil fill plug gasket	248	Lockwasher	466	Plug
096	O-ring	250	Inlet flange	467	Bypass plug
099	Nipple	251	Valve plate	471	Gas ballast valve assembly
100	Auto-type oil filter	252	Valve inlet guide	483	Ring gasket
105	Cover plate	253	O-ring	484	O-ring
106	Cover plate gasket	254	Inlet check valve spring	488	Socket head plug
107	Socket head cap screw	255	O-ring	490	Nipple
108	Lockwasher	258	Ball	495	O-ring
115	Filter bracket	260	Inlet flange	496	Float switch
116	Filter bracket	261	Inlet screen	498	Socket head cap screw
117	Filter bracket	265	Hex head cap screw	499	Lockwasher
120	Exhaust filter	266	Lockwasher	900	Elbow connector
121	O-ring	270	Plug	901	Temperature switch
125	Filter spring assembly	271	Ring gasket	902	Temperature switch
126	Socket head cap screw	273	Distance bolt		
129	Baffle strainer, A side	274	Lockwasher		
130	Baffle strainer, B side	275	Oil return valve		
136	Perf. sheet metal screen	276	Ring gasket		
137	Slot chase head screw	285	Oil recirc. screw		
138	Flat washer	286	Hydraulic banjo fitting		
139	Flat washer	290	Oil return tubing		
140	Exhaust cover plate	291	Elbow assembly kit		
141	Cover plate gasket	293	Oil steel tubing		
142	Socket head cap screw	297	Screen		
143	Lockwasher	298	Sheet metal screw		

Technical Data

Model	0010	0012	0016	0021	0160	0400	0502	0630	1000	1600
Nom. pumping speed (ACFM)	6	7	8.6	14	115	305	375	455	670	1030
Free air displacement (CFM)	7.1	8.5	11.2	15	117	330	413	490	704	1130
Maximum sound level (dBa)	69	68	70	72	79	83	84	85	85	86
3 phase motor data (HP) **	3/4	3/4	3/4	1	7.5	15	20	25	40	50
1 phase motor data (HP) **	1	3/4	1	1 1/4	NA	NA	NA	NA	NA	NA
Approx. oil capacity (qts)	0.5	0.5	0.5	0.5	7	14	16	16	42	44
Inlet connection - NPT (inch)	3/4	1" hose	3/4	3/4	2	3	3	3	6 ANSI	6 ANSI
End vacuum (RC)	15	15	15	15	15	15	15	15	15	15
End vacuum (RA)	0.5	2 ***	0.5	2***	0.5	0.5	0.5	0.5	0.5	0.5
Approx. weight of pump (lbs)	49	42	60	42	416	1152	1316	1525	2151	2833

Notes:

- * Maximum oil temperature with 90°F ambient temperature and no supplemental oil cooling.
- ** 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.
- *** RB versions for Model 0012 and 0021.



Typical Wiring Diagram for 1000 and 1600 Pumps Only



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