ROOTS DRESSER

$2.00

RCS

INSTRUCTIONS

ROTARY LOBE BLOWERS

CONTENTS

NUMBERS IN ( ) ARE METRIC EQUIVALENTS

DO THESE THINGS . . . To Get The Most From Your Roots Blower

1 Check shipment for damage in transit. After filing claim with carrier, notify nearest Sales Office or factory.

2 Unpack shipment carefully and check contents against Packing List. Notify Sales Office or factory if a shortage appears.

3 Store in a clean, dry location until ready for installation, if possible. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.

4 Read LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation. If supervision by a Service Engineer is needed, contact the nearest Dresser Parts and Service Center at least two weeks in advance and confirm by your purchase order. Standard charges will be made.

5 Provide for adequate safeguards against accidents to persons working on or near equipment during both installation and operation. See PRECAUTIONS.

6 Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.

7 Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.

8 Read starting check points under OPERATION. Run equipment briefly to check for obvious faults, and make corrections. Follow with a trial run under normal operating conditions.

9 In the event of trouble during installation or operation of a new unit, do not attempt repairs. Notify nearest Sales Office or factory, giving all nameplate information plus an outline of operating conditions and a description of the trouble.

10 Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operations described in this manual, using Factory Parts. Good inspection and maintenance practices should reduce the need for repairs. See Distributor List on last page for parts and service after warranty period.

Bulletin IRB-115-387

OPERATING CHARACTERISTICS

Roots RCS blowers, as covered in this manual, are available in basic frame size of 4½ inch gear diameter. Within this frame size are two case lengths, selected to produce reasonable steps in blower capacity ratings. All units are designated as air blowers, and may be used for handling air in either pressure or vacuum service. They are unsuitable for handling gases because shaft seals are not designed to prevent leakage to atmosphere.

The basic Roots rotary lobe blower is a positive displacement type unit, whose pumping capacity is determined by size, operating speed and pressure conditions. It employs two double-lobe impellers mounted on parallel shafts and rotating in opposite directions within a cylinder closed at the ends by headplates. As the impellers rotate, air is drawn into one side of the cylinder and forced out the opposite side against the pressure existing there. *The pressure developed, therefore, depends on the resistance of the discharge system.*

Effective sealing of the blower inlet area from the discharge area is accomplished by use of very small operating clearances. Resulting absence of moving contacts eliminates the need for any internal lubrication. Clearance between the impellers during rotation are maintained by a pair of accurately machined timing gears, mounted on the two shafts extended outside the blower casing.

Operation of the rotary lobe blower is illustrated in **FIGURE 1**, where air flow is right to left from inlet to discharge with the lower impeller rotating clockwise. In Position 1 it is delivering a known volume **(A)** to the discharge, while space **(B)** between the upper impeller and cylinder wall is being filled. Counterclockwise rotation of this impeller then traps equal volume **(B)** in Position 2, and further rotation delivers it to the discharge in Position 3. At the same time, another similar volume is forming under the lower impeller, and will be discharged when rotation reaches Position 1 again.

One complete revolution of the driving shaft alternately traps four equal and known volumes of air (two by each impeller) and pushes them through to the discharge. The pumping capacity of a lobe blower operating at a constant speed therefore remains relatively independent of reasonable inlet or discharge pressure variations. **To change capacity, it is necessary either to change speed or rotation or vent some of the air.**

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will not only increase the power load on the driver, but can also overload and seriously damage the blower. If a possibility does exist that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve *must* be installed near the blower. A pressure type relief valve in the discharge line near the blower is *required* for protection against cut-off or blocking in this line. See Figure 2.

When a belt drive is employed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. In a direct coupled arrangement a variable speed motor or transmission is required, or excess air may be blown off through a manually controlled unloading valve and silencer. If returned to the blower inlet, the air *must* be cooled to 100 °F (38 °C) through a by-pass arrangement to maintain acceptable blower temperatures.

Before making any change in blower capacity, or operating conditions, contact the nearest Sales Office for specific information applying to your particular blower. In all cases, operating conditions *must* be maintained within the approved range of pressures, temperatures and speeds as stated under LIMITATIONS. Also, the blower *must not be used to handle air containing liquids or solids.* Serious damage to the rotating parts will result.

OPERATING LIMITATIONS

To permit continued satisfactory performance, a Roots RCS blower must be operated within certain approved limiting conditions. The Manufacturer's warranty is, of course, also contingent on such operation.

Maximum limits for pressure, temperatures and speed are specified in Table 1 for RCS blowers. These limits apply to all blowers of normal construction, having operating clearances as listed in Table 5, when operated

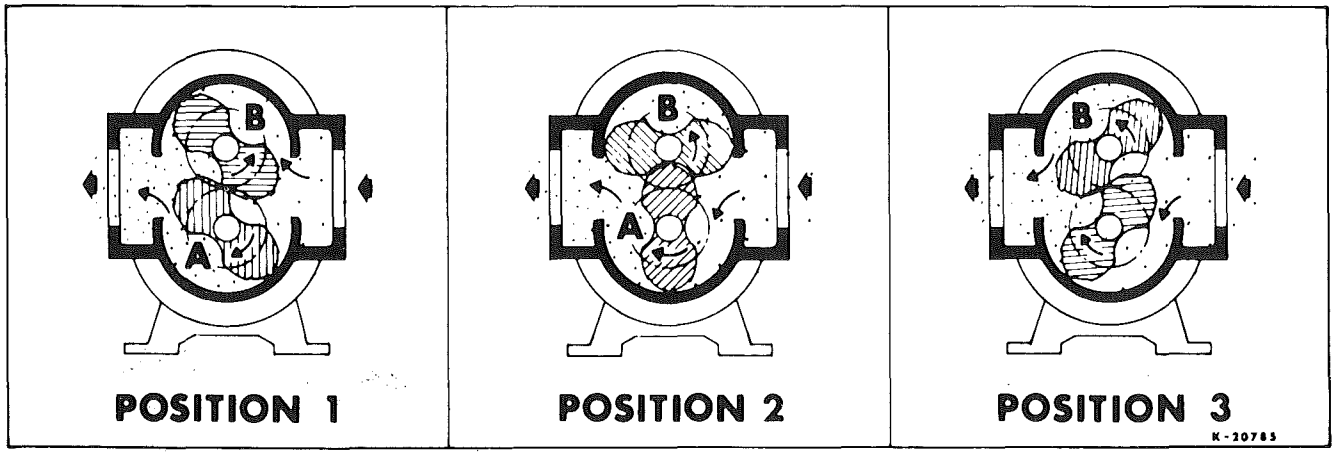


Figure 1 — Flow Through RCS Blower

under standard atmospheric conditions. **Do not exceed any one of these limits.**

Example: The listed maximum allowable temperature rise (increase in air temperature between inlet and discharge) for any particular blower may occur well before its maximum pressure or vacuum rating is reached. This can easily occur at high altitude or at very low speed. *Temperature rise then is the limiting condition.* In other words, the operating limit is always determined by the maximum rating reached first. It can be any one of the three: pressure, temperature or speed.

Be sure to arrange connections or taps for thermometers and mercury type pressure or vacuum gauges at or near the inlet and discharge connections of the blower. These along with a good tachometer, will enable periodic checks of operating conditions to be made easily.

PRESSURE—On pressure service; the pressure rise (between blower inlet and discharge) must not exceed the figure listed for the specific blower frame size concerned. Also, in any system where the blower inlet is at a positive pressure above atmosphere, the discharge pressure must never exceed 25 PSI (172 kPa) gauge regardless of blower size.

On vacuum service, with the discharge going to atmospheric pressure, the inlet suction or vacuum must not be greater than values listed for the specific frame size.

TEMPERATURE—RCS blower frame sizes are approved only for installations where the following temperature limitations can be maintained in service.

A. Measured temperature rise must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the blower. This is not outdoor temperature unless the blower is installed outdoors.
B. If inlet temperature is higher than ambient, the listed allowable temperature rise values must be reduced by ⅔ of the difference between the actual measured inlet temperature and the ambient temperature.
C. An average temperature between inlet and discharge up to 250°F. (121°C).

SPEED RANGE—RCS blowers may be operated at speeds up to the maximum listed for the sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be the limiting factor as noted in the preceding example.

Table 1—Maximum Allowable Operating Conditions

Frame Size	Speed RPM	Press. Rise		Inlet Vac.		Temp. Rise	
		PSI	(kPa)	In. Hg.	(kPa)	F°	C°
404	3820	15	(104)	15	(50)	275	(153)
406	3820	15	(104)	15	(50)	275	(153)
409	3820	15	(104)	15	(50)	275	(153)
412	3820	15	(104)	15	(50)	275	(153)
418	3820	15	(104)	15	(50)	275	(153)
616	2860	10	(69)	15	(50)	230	(128)
624	2820	10	(69)	15	(50)	230	(128)

INSTALLATION

Roots RCS blowers are internally and externally treated after factory assembly to protect against normal atmospheric corrosion before installation. The maximum period of internal protection is considered to be one year under average conditions, if closing plugs or seals are not removed. *Protection against chemical or salt water atmosphere is not provided.* Avoid opening the blower until ready to start installation, as protection will be lost quickly by evaporation.

If there is to be an extended period between installation and start up, the following steps should be taken to insure corrosion protection:

1. Coat internals of cylinder, gearbox and drive end bearing reservoir with Motorstor or equivalent. Repeat once a year or as conditions may require. Motorstor is oil soluble and does not have to be removed before lubricating. If desired, Motorstor may be removed from within the cylinder shortly before start up by spraying a fine mist of petroleum solvent through the blower while it is running at a slow speed with open inlet and discharge, or it can remain in the blower if it is not harmful to the operation of the connected system. Motorstor is a product of Daubert Chemical Co., 2000 Spring Rd., Oak Brook, Ill. 60521.
2. Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-145 or equivalent.
3. Seal inlet, discharge, and vent openings. It is **not** recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Motorstor vapor will escape and lose its effectiveness.
4. Units are not to be subjected to excessive vibration during storage. If stored outdoors, provide coverage such as a tarpaulin or lean-to.
5. Rotate drive shaft three or four revolutions every two weeks.
6. Prior to start up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and drive end bearing cover and inspect gear teeth and bearings for rust.

Because of the completely enclosed blower design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred. However, an outdoor or wet location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected temperatures, and that the blower be located so that routine checking and servicing can be handled conveniently after installation. Effect of the location on driver and accessory equipment must also be considered.

Supervision of the installation by a Factory Service Engineer is not usually required for these blowers. Workmen with experience in installing light-medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance and safe practices. Blower mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

Two methods may be used to handle a blower *without base.* One is to use eyebolts screwed into the top of the headplates. Test them first for tightness and fractures by tapping with a hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If eyebolts are not available, lifting slings may be passed under the cylinder adjacent to the headplates. Either method prevents strain being placed on the extended drive shaft.

When blower is furnished *mounted on a baseplate,* with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the blower casing or mounting feet, or on any mounted accessory equipment. **DO NOT** use the eyebolts in the top of the headplates.

Before starting the installation, remove plugs, covers or seals from blower inlet and discharge connections and inspect the interior completely for dirt or foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent such as DuPont Triclene D. After this, turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the connection flanges and drive shaft extension may also be removed at this time with the same solvent. Then cover the flanges again to keep out dirt until ready to connect the air piping. Washing out is not required if the interior is found to be clean. The corrosion inhibitor used will vaporize and disappear during operation.

Care, plus consideration of all possible problems, will pay dividends when arranging the blower mounting. This is especially true when the blower is a "bare" unit, furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces least satisfactory results. It definitely causes the most problems in leveling and alignment.

Direct use of structural framing members is also not a recommended mounting. If unavoidable, the members must be rigidly reinforced when part of a building, and spring type mountings should not be used. Noise transmission can usually be reduced by use of a cork insulating pad 1 to 2 inches (25 to 50 mm) thick. The pad should be supported by a full steel plate attached to the structure, with a rigid concrete slab laid on top of the cork to carry the blower and driver.

For a blower without base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided at the installation point. The plate should be about 1 inch (25 mm) thick, with its top surface machined flat, and large enough to provide leveling areas at one side and one end after the blower is mounted. It should have properly sized studs or tapped holes located to match the blower foot drilling. As an alternative, smaller plates at each end of the blower may be used. This is more complicated usually makes leveling more difficult, and can produce twist or strains in the blower. Use of a high quality machinist's level is important.

With the mounting plate in place and leveled, set the blower on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop the rocking. Place half of this under each of the diagonally-opposite short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers still turn freely. If the blower is to be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the blower shaft. Best arrangement is for the blower to be bolted directly to the mounting plate while the driver is on shims of at least 1/8 inch (3 mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thicknesses.

When blower and driver have been factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. Satisfactory installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and partly inside the base, after it has been carefully leveled by shimming, is recommended.

It is possible for a base-mounted assembly to become twisted during shipment, thus disturbing the original alignment. For this reason, *make the following checks after the base has been leveled and bolted down.* Disconnect the drive and rotate the blower shaft by hand. It should turn freely at all points. Loosen the blower foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if blower is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections.

In planning the installation, and before setting the blower, consider how piping arrangements are dictated by the blower design and assembly. RCS blowers have reversible rotation.

Standard arrangement on vertical units has the drive shaft at the top. Horizontal units' standard arrangement has the drive shaft at the left.

When a blower is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the blower. Refer to LIMITATIONS for allowable speeds for various blower sizes. A *flexible* type coupling should always be used to connect the driver and blower shafts.

Coupling halves must be accurately aligned, and a sufficient gap between shaft ends provided so that side strains and end thrust on either shaft are avoided or minimized. This will require considerable care in the mounting of the driver. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end play exists.

The following requirements for a good installation are recommended. Coupling halves must be fitted to the two shafts so that only light tapping is required to install them. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum devia-

tion from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around the coupling.

When a blower is BELT DRIVEN, the proper selection of sheave diameters will result in the required blower speed. This flexibility can lead to operating temperature problems caused by blower speed being too low. Make sure the drive speed selected is within the allowable range for the specific blower size, as specified under LIMITATIONS.

Belt drive arrangements usually employ two or more V-belts running in grooved sheaves. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the blower shaft. The driver should be mounted on the inlet side of a vertical blower (horizontal piping) and on the side nearest to the shaft on a horizontal blower. The driver must also be mounted on an adjustable base to permit installig, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

Install the blower sheave so that its inner hub face is not more than ⅛ inch (.3 mm) from the drive end cover. The shaft fit should be such that the sheave can be worked into place by hand or by very light tapping. A tight or driving fit can damage a bearing, and may cause internal blower damage by forcing the impeller out of its normal operating position. A loose fit or wobbly sheave will cause vibration, and may result in shaft breakage.

The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that ⅔ of the total movement is available in the direction away from the blower, and mount the assembly so that the face of the sheave is accurately in line with the blower sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the blower is operating under load. *Excessive tightening* can lead to early bearing failures.

In the absence of belt manufacturer's instructions for tensioning, the following procedure may be used.

1. With the belts loose, pull the slack on all of them to the bottom side of the drive.
2. Adjust motor position to tighten belts until they appear to be seating in the sheave grooves.
3. Thump the belts with your fist. If they feel dead, tighten them more until they vibrate and feel springy when struck.
4. Run-in the drive for a short period, after preparing the blower as instructed in a following paragraph. While running adjust until only a very slight bow appears in the slack side of the belts.
5. Stop the motor and compare the tensions of the individual belts by pressing down firmly with one hand on the top surface. It should be possible to deflect each belt only to the point where its top surface is even with the bottom of the other underdeflected belts.
6. A new set of belts should be first tensioned about ⅓ greater than normal to allow for stretch and wear-in. Before putting the drive into normal operation, increase the tension as obtained above by a small amount. Recheck after each 8 hour operating period during the first 50 hours and, adjust as necessary.

Before operating the drive under power to check initial belt tension, first remove covers from the blower connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a coarse screen over the inlet connection to prevent anything being sucked into the blower while it is operating, and avoid standing in line with the discharge opening. Put oil in the sumps per instructions under LUBRICATION.

Before connecting PIPING, remove any remaining anti-rust compound from blower connections. Pipe used should be no smaller than these connections, and clean, new piping throughout is strongly recommended. In addition, make sure it is free of dirt, scale, cuttings, weld beads, or foreign materials of any kind. To further guard against damage to the blower, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours' operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the blower may cause serious damage.

Pipe flanges or male threads *must* meet the blower connections accurately and squarely. **DO NOT** attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the blower casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the blower to eliminate dead weight strains. Also, if pipe expansion is likely to occur from temperature change, installation of flexible connectors or expansion joints is advisable.

Figure 2 represents in diagram form a blower installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or restrictions. When a shut-off valve (not shown) cannot be avoided, make sure a full size vacuum relief is installed near the blower inlet. This will protect against blower overload caused by accidental closing.

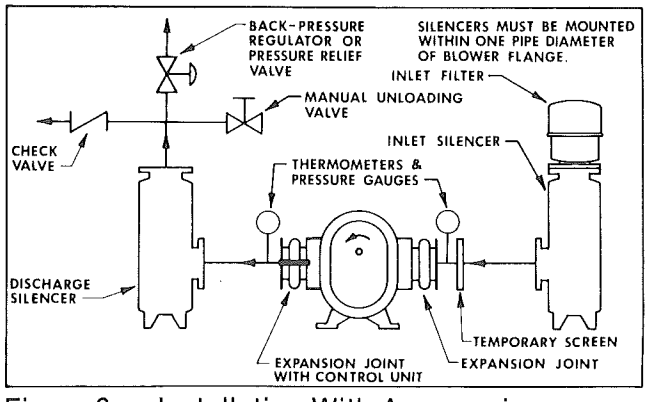


Figure 2 — Installation With Accessories

Need for an inlet silencer will depend on blower speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is normally *recommended*, especially in dusty or sandy locations, for blower protection. A discharge silencer is also normally *suggested* for RCS blowers. Specific recommendations on silencing can be obtained from the nearest Sales Office.

Discharge piping *requires*, a pressure relief valve, and should include a manual unloading valve to permit starting the blower under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are *recommended* to allow making the important checks on blower operating conditions. The back-pressure regulator shown in Figure 2 is useful mainly when volume demands vary while the blower operates at constant output. If demand is constant, but somewhat lower than the blower output, excess may be blown off through the manual unloading valve.

In multiple blower installations where two or more units operate with a common header, use of check valve is *necessary*. These should be of a direct acting or free swinging type, with one valve located in each line between the blower and header. Properly installed, they will protect against damage from reverse rotation caused by air and material back-flow through an idle blower.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment. **DO NOT** operate the blower at this time unless it has been lubricated per instructions. Read LUBRICATION section.

LUBRICATION

A very simple lubrication system is employed in RCS blowers. All friction parts — gears, bearings and oil seals — are lubricated by the action of oil slingers which dip into the main oil sumps causing oil to splash directly on gears and bearings and also to fill the small reservoirs above the bearings. From these, oil flows, by gravity, through the bearings and to the oil seals. A drain port is provided below each bearing to prevent an excessive amount of oil in the bearings. Refer to assembly drawings, Figures 6 & 7. Entrance of lubricating oil into the blower air chamber is prevented by the use of double shaft sealing. Lip type seals, located inboard of the bearings in each headplate, effectively retain oil within the sumps. Any small leakage that may occur, should the seals wear, passes into a cavity in each headplate that is vented and drained downward. In addition, sealing rings are provided on both shafts where they pass through the inner walls of the headplates. These serve to reduce air leakage from or into the air chamber and also minimize oil carryover into the air chamber. They are not sufficiently effective to enable the blower to handle gases, however.

Oil sumps on each *each* end of the blower are filled by removing top plugs, Item (22), and filling until oil reaches the *middle* of the oil level gauge, Item (45). See Figure 3.

Filling the sumps should be accomplished with the *blower not operating*, in order to obtain the correct oil

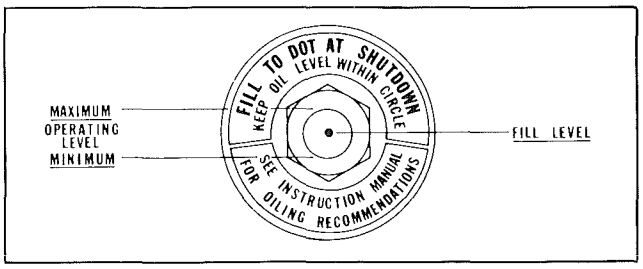


Figure 3 — Oil Level Gauge

level. Approximate oil quantities required for blowers of the various configurations are listed in Table 3. **Do not overfill.** A good grade of industrial type non-detergent, anti-foaming, rust inhibiting oil should be used.

The level should *never* be allowed to fall below the oil level gauge ring when the blower is not operating. It may rise on the gauge during operation, to an extent depending somewhat on oil temperture and blower speed, but it should not be permitted to rise above the oil level gauge ring.

During the first week of operation, check the oil levels in the oil sumps about once a day, and watch for leaks. Replenish as necessary. *Oil should be changed after initial 100 hours of operation. Thereafter, change periods of about 500 hours may be considered normal.* In draining the sumps, remove plugs (22) at the bottom.

Ambient Series	Viscosity SSU At 100°F. (37.8°C)	Approximate SAE No.
Above 90°F. (32°C)	1000-1200	50
32-90°F. (0-32°C)	700-1000	40
0-32°F. (-18-0°C)	500-700	30

Table 2 — Recommended Oil Grades

Gearbox		Drive End	
Fl. Oz.	(Liters)	Fl. Oz.	(Liters)
50	(1.48)	30	(.089)
30	(.089)	18	(0.53)
96	(2.84)	64	(1.89)
64	(1.89)	32	(0.95)

Table 3 — Oil Sump Capacities

OPERATION

Before operating a blower under power for the first time, recheck the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure list as a guide, but consider any other special conditions in the installation.

1. **Be certain** that no bolts, tools, rags or dirt have been left in the blower air chamber.
2. **Be certain** that inlet piping is free of any debris. If an outdoor intake witout filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the *temporary* protective screen at the blower as described under INSTALLATION is strongly recommended.
3. **Recheck** blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.

4. Turn drive shaft **by hand** to make sure impellers still rotate without bumping or rubbing at any point.
5. **Make sure** oil levels in the main oil sumps are correct.
6. Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
7. Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, **be sure** it is open.
8. Bump blower a *few revolutions* with driver to check that direction of rotation agrees with arrow near blower shaft, and that both units coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions as set up under Item 7. The following procedure is suggested to cover this initial operation test period.

a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.
b. Repeat above, but let blower run 2 or 3 minutes. Check for noises, and vibrations of .005 in. (.13 mm) or greater.
c. Operate blower for about 10 minutes unloaded. Check oil levels. Feel cylinder and headplate surfaces for development of spots too hot to touch, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is

TROUBLE SHOOTING CHECKLIST

TROUBLE	ITEM	POSSIBLE CAUSE	REMEDY
No Air Flow	1	Speed too low	Check by tachometer and compare with speed shown on Roots Order Acknowledgement.
	2	Wrong rotation	Compare actual rotation with Figure 1 and arrow on blower. Compare driver if wrong.
	3	Obstruction in piping	Check piping, screen, valves, silencer, to assure an open flow path.
Low capacity	4	Speed too low	See item 1. If belt drive, check for slippage and readjust tension.
	5	Excessive pressure	Check inlet vacuum and discharge pressure, and compare these figures with specified operating conditions on Order.
	6	Obstruction in piping	See item 3.
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances.
Excessive Power	8	Speed too high	Check speed and compare with Roots Order Acknowledgement.
	9	Pressure too high	See item 5.
	10	Impellers rubbing	Inspect outside of cylinder and headplates for high temperatures areas, then check for impeller contacts at these points. Correct blower mounting, drive alignment.
Overheating of Bearings or Gears	11	Inadequate lubrication	Restore correct oil levels in main oil sumps.
	12	Excessive lubrication	Check oil level. If incorrect, drain and refill with clean oil of recommended grade.
	13	Excessive pressure	See item 5.
	14	Coupling misalignment	Check carefully. Realign if questionable.
	15	Excessive belt tension	Readjust for correct tension.
Vibration	16	Misalignment	See item 14.
	17	Impellers rubbing	See item 10.
	18	Worn bearings/gears	Check gear backlash and condition of bearings. If lateral rotor play exceeds .010 in. (.25 mm) replace gears and bearings.
	19	Unbalanced or rubbing impellers	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance.
	20	Driver or blower loose	Tighten mounting bolts securely.
	21	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping. Refer to Sales Office.

restarted, gradually close the discharge unloading valve to apply working pressure. At this point it is recommended that a good pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower *exceeds the limit specified in this manual,* shut down and investigate conditions in the piping system or in the process to which air is being supplied. Refer to the TROUBLE SHOOTING CHECKLIST for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under INSTALLATION. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a *small* excess may be blown off continuously through the manual unloading or vent valve. **Never rely on the pressure relief valve as an automatic vent.** Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If blower capacity appears to be too low, refer to the TROUBLE SHOOTING CHECKLIST first. If no help is found there it may be possible to increase the blower speed. Before attempting this change, contact the nearest Sales Office for recommendations. Be prepared to furnish data on actual air requirements and operating pressure/temperature conditions.

SAFETY PRECAUTIONS

For equipment covered specifically or indirectly in this instruction book, it is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should particularly be noted:

- **Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.**
- **Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.**
- **Disconnect power before doing any work, and avoid by-passing or rendering inoperative any safety or protective devices.**
- **If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream.**
- **Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.**
- **Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.**
- **Avoid extended exposure in close proximity to machinery which exceeds safe noise levels.**
- **Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.**
- **Casing pressure must not exceed 25 PSI (172 kPa) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents.**
- **Do not use air blowers on explosive or hazardous gases.**
- **Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.**

MAINTENANCE & REPLACEMENTS

A good program of inspection and maintenance servicing followed consistently, is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on regular schedule. Basic service needs are lubrication, checking for hot spots or increase in vibration and noise, and the recording of operating pressures and temperatures. Above all, **a blower must be operated within its specified rating limits** to obtain satisfactory service life.

A newly installed blower should be checked frequently during the first month of full-time operation. Attention thereafter may be less frequent, depending on what the early checks have shown. Lubrication is normally the most important consideration. Unless operating conditions are unusually severe, a weekly check of oil levels in the gearbox and bearing reservoirs, with addition of oil as required, should be sufficient. Complete oil changes should be made at intervals of 250 operating hours, or more frequently if oil condition becomes poor.

Driver lubrication practices should be in accordance with the manufacturers' instructions. If direct connected to blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent it from causing vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts. Refer to tensioning instructions under INSTALLATION.

In a new and properly installed blower there are no moving contacts between the two impellers, or between the impellers and cylinder or headplates. Wear is then confined to the bearings which support and locate the shafts,

the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil *of the correct grade* is always used. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Sealing rings are designed to operate with no rubbing contact, once temperature and thermal growth have stabilized. The rings, which are stationary, do rub the rotating sleeves briefly during temperature cycles which result from starting and stopping the blower. However, the hardened sleeves and the sealing rings are treated with a dry lubricant coating which provides initial lubrication during break-in wear.

If the sealing rings become excessively worn, greater leakage from the vents will occur. Seal rings should be replaced if vent leakage becomes excessive, or if inspection at the time of blower disassembly shows more than .010" (.25 mm) axial clearance between ring and groove.

Shaft bearings have been selected to have optimum life under average conditions with proper lubrication. They are critical in the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and cylinder headplate. This will cause spot heating, which can be detected by feeling these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller is no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive, or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal, and is also affected to surprising degree by shaft smoothness and freedom from scratches under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating a need for replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers.

However, a high oil level will cause churning and excessive heating indicated by an unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth clearance or backlash, and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Operating problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting, or from changes in piping support. Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and **make sure** that all piping meets blower connections accurately and squarely before reconnecting it.

A wide range of causes for operating troubles are covered in the TROUBLE SHOOTING CHECKLIST. The remedies suggested there in some cases need to be performed by qualified mechanics with a good background of general experience, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to the nearest Distributor listed on the last page.

Warranty failures should not be repaired at all, unless specific approval has been obtained through a Sales Office before starting work. Unauthorized disassembly within the warranty period may void the warranty.

When a blower is taken out of service it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgment based on existing conditions as well as length of downtime. Under favorable conditions, protection will probably not be needed if shutdown is not longer than a month. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately. See long term storage suggestions on page 3.

It is *recommended* that major repairs, if needed, be performed by a factory authorized distributor listed on the last page. However, it is recognized that this may not always be practical especially when a spare blower is not available. If a blower is out of the warranty period, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that Factory Parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give Item Numbers and their work descriptions from Figures 6 or 7 and Table 6. Also specify quantities wanted, and the blower size and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care and patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that a high percentage of bearing failures is caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following outlines of repair procedures, numbers shown in brackets ( ) correspond to the Item Numbers used in assembly drawings, Figure 6 and 7 and parts list, Table 6. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawing, before starting work. This will

produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances are to be checked or re-set, a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a high pressure hydraulic pump and a suitable hydraulic puller, and heat must be used during bearing and sleeve installation.

Design of the RCS blowers is basically simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a perferred order of work and to call out points to be observed. Where special operations are required, detailed coverage is given.

DISASSEMBLY OF GEAR END

1. Drain oil completely from the gearbox sump by removing plugs (22) in bottom of the headplate (1).
2. Loosen all flange screws (23) in the gearbox and remove all but two upper screws. Install two (one on top, one on bottom) short capscrews from the headplate to the cylinder to keep the headplate in place. Bump the gearbox to break the joint if it cannot be pulled free by hand, then remove the last two screws and lift off the gearbox. Remove gasket (7).

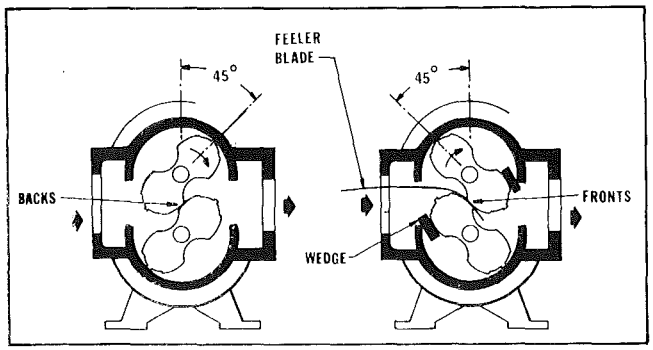


Figure 4 — Impeller Timing Viewed From Gear End

3. Removing gears: Be sure that each gear is marked for return to the same shaft in the same angular position and that the gears have match marks for the teeth. For this operation, the impellers should be wedged as shown in Figure 4. Remove the locknuts (31), slinger (46) and gear mounting washers (30). The timing gears (4) have two ½"-13 holes for pulling purposes. Use a puller of the type shown in Figure 5. The two ½"-13 screws should be turned into the gear full depth, but make sure the puller is square with the shaft. If a shouldered plug as shown in Figure 5 is not used, the gear may spring away from the shaft when it releases. Stand to one side and provide rags or cushioning material under the gear.

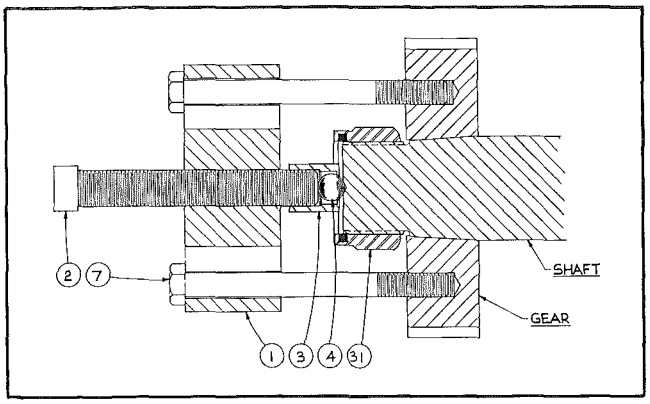


Figure 5 — Gear Removal

4. Remove bearing clamp plates (54) by unscrewing capscrews (32) and removing lockwashers (35). Group the shims (10) and the wavy spring washers (29) with each clamp plate and tag for ease of reassembly.
5. Remove the headplate — remove all capscrews holding the headplate to the cylinder. Insert jacking screws into the four (4) threaded flange hole and turn them in evenly. The headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.
6. Remove the bearing inner race and sleeve (38) from the shaft with the aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.
7. Remove the sealing rings (28) by inserting a thin, pointed tool at the gap to lift one end over the other so its springs free.

DISASSEMBLY OF DRIVE END

1. Remove the sheave or coupling and key from the drive shaft. File off any burrs or sharp edges along the keyway.
2. Drain oil by removing drain plugs (22).
3. Remove the flange screws (23). Tap the drive end cover to loosen it, then slide it along the shaft carefully to avoid damaging the lip seal (33) on the drive shaft keyway. Remove the gasket (7). Remove oil slinger capscrew (60), oil slinger (40) and lockwasher (36).
4. Remove bearing clamp plates (34) by unscrewing capscrews (32) and removing lockwashers (35). Keep shim halves (10) together exactly as removed by tagging them with each clamping plate.
5. Remove the headplate — remove all capscrews holding headplate to the cylinder. Insert jacking screws into the four threaded flange holes and turn them in evenly. The headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.
6. Remove the bearing inner race and sleeve (38 or 39) from the shaft with the aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and

applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

7. Remove the sealing ring by inserting a thin, pointed tool at the gap to lift one end over the other so it springs free.

ASSEMBLY

Prior to any assembly operation, it is essential that all parts are completely clean and free from nicks and scratches.

1. Assembly of sealing rings (28) - To avoid scratching the lip seal surface, install the sealing rings (28) in the sleeves (38 and 39) from the end nearest the groove before assembling the sleeve on the shaft.
   Unhook the gap joint and expand the ring while sliding it to the groove, then compress it so one end of the hook joint slides over the other. Move the ring in the groove to be sure it is free.
2. Installation of sleeves (38 and 39) - Heat the sleeve to 300 °F. (149 °C) then quickly slide it on the shaft tightly against the impeller. **Note!** The drive shaft end sleeve (39) is shorter than the other sleeves (38). If the sleeve hangs up during assembly, it can be pressed into place using a tubular pressing tool with square, clean ends.
3. Assembly of seals (27) in headplate (1) - Place headplate flat with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Lubricate the seal lips and outer diameter. Place seal over the bore with lip facing up, then press the seal evenly until it seats against the stop.
4. Assembly of impellers (12 and 13) to headplate (1) -Place gear end headplate flat on 3 in. (76 mm) blocks with the smallest bores facing up. Inspect entering bevels to be sure they are smooth and clean. Locate the drive impeller correctly (top for vertical units and toward the driver for horizontal units). Place the seal ring gaps toward the inlet. Insert the impeller shafts in the headplate so the impellers rest on the headplate. Use care to avoid damaging the lip seals.
5. Assembly of cylinder (11) to gear end headplate (1) -Install dowel pins (16) and secure cylinder to headplate with four short capscrews. Then, install drive end headplate (1) and dowel pins (16) and secure with four capscrews.
6. Installation of drive end bearings (14 and 52) - Heat bearing inner race to 300 °F. (149 °C) in an oven or hot oil, then slide it into the shaft so the bearing shoulder is snuggly against the sleeve. **Note!** Drive bearing (52) is longer than other bearings. Insert the bearing outer race and rollers in each bore and tap lightly into place.
7. Measure and record the end clearance between the impellers and drive headplate using long feeler gauges. Then, subtract the allowed average drive end clearance. See Table 5. The result is the space required between clamping plates (34) and bearing outer race. Place shims (10) as required to get this clearance. Then, fasten the clamping plates to the headplate with capscrews (32) and lockwashers (35). **Note!** The 400 drive end drive bearing has a bearing clamp spacer (53) included in the clamping arrangement. Be sure the bearing clamping plates are located so the oil feed groove will be up and toward the bearing, when the unit is turned to its normal position.
8. Installation of gear end bearings (14) - Turn the blower so that the gear end headplate is up. Heat bearing inner race to 300 °F. (149 °C) in an oven or hot oil then slide it onto the shaft so that the bearing shoulder is snuggly against the sleeve. Insert the bearing outer race and rollers in each bore and tap lightly into place.
9. Measure and record the end clearance between the impellers and gear end headplate, then subtract the allowed average gear end clearance. See Table 5. The result is the space required between clamping plate (54) and bearing outer race. Place shims (10) as required to get this clearance. Then fasten the clamping plates (54) to the headplate using capscrews (32) and lockwashers (35). **Do not** install wavy spring washers (29) at this time as a final check of clearances is required first.
10. Final check of end clearances - Using long feeler gauges, check the clearance between the impellers and drive end headplate. See Table 5. Place the blower assembly on its feet and correct shimming as required. Then, force the impellers as close to the gear end headplate as possible, and check the clearance between impellers and gear end headplate for agreement with Table 5. Adjust shimming on the gear end as required.
    Check the total end float of each impeller. Install indicator on gear face. Push the impeller all the way toward the drive end. Measure the axial movement as the impeller is pulled all the way toward the gear end. The measured float must be per Table 5. If minimum required float cannot be obtained with end clearance set at a minimum value, contact factory.
    Finally, after clearances have been corrected and checked, remove the gear end clamping plates (54) and install wavy spring washers (29) and re-install shims (10) and clamping plate (54). Be sure oil feed grooves are up and toward bearings.
11. Installing drive gear (4) - Be sure shafts and gear bores are clean and free of scratches. Clean the tapered fits in the shafts, and coat them with a light oil or WD-40 then wipe off with a clean rag or paper towel. Oil capscrew threads lightly. Place hardwood wedges as shown in Figure 4. Install gear (4), washer (30) and capscrew (31) so match mark at tooth is at the line of engagement. Tighten the drive gear to the torque given in Table 4. Blower assembly *must* be fastened down for torquing operation.

Table 4 — Locknut Torque

Gear Size (in.)	Torque	
	lb - ft	(kg - m)
4.5	400	(55)
6	630	(88)

Table 4A — Slinger Screw Torque

Gear Size (in)	Torque	
	lb - ft.	(kg - m)
4.5	75	(10)
6	140	(19)

Table 5 lists the ranges of impeller clearances used in factory assembly of normal RCS blowers. It should be kept in mind that clearances may change slightly in service, but should never be less than the minimum values listed. Only *well-qualified* personnel should attempt to measure clearances for direct comparison with this data.

Table 5 — Normal RCS Internal Clearances - Inches (mm)

Blower Frame Size	Impeller Lobes at 45° (Fig. 4) Fronts & Backs	Impeller End to Headplate		Impeller Tips to Cyclinder		Minimum Required Float
		Drive End and Gear End	Gear End with Springs Installed	Inlet & Discharge	Center	
404	.011-.017	.004-.006	.005-.010	.007-.009	.005-.007	0.004
	(.28-.43)	(.10-.15)	(.13-.25)	(.18-.21)	(.13-.25)	(.10)
406	.011-.017	.004-.006	.009-.014	.008-.010	.006-.008	0.007
	(.28-.43)	(.10-.15)	(.21-.36)	(.20-.25)	(.15-.20)	(.18)
409	.011-.017	.004-.006	.016-.021	.0085-.0105	.0065-.0085	0.01
	(.28-.43)	(.10-.15)	(.40-.53)	(.22-.27)	(.17-.22)	(.25)
412	.011-.017	.004-.006	.019-.024	.010-.012	.008-.010	0.013
	(.28-.43)	(.10-.15)	(.48-.60)	(.25-.31)	(.20-.25)	(.33)
418	.011-.017	.004-.006	.026-.031	.014-.016	.010-.012	0.02
	(.28-.43)	(.10-.15)	(.66-.79)	(.36-.40)	(.25-.30)	(.53)
616	.012-.019	.005-.007	.021-.026	.012-.014	.008-.010	0.014
	(.30-.48)	(.13-.18)	(.53-.66)	(.30-.36)	(.20-.25)	(.36)
624	.012-.019	.005-.007	.029-.034	.016-.018	.011-.013	0.022
	(.30-.48)	(.13-.18)	(.74-.86)	(.40-.46)	(.28-.33)	(.56)

12. Installing driven gear (4) - Insert a long, metal feeler gauge between the impeller's lobes at the fronts or backs as shown in Figure 4. Feeler gauge thickness to be a middle value from Table 5 for fronts and backs. Align the gear so the tooth match marks agree with the drive gear, then install washer (30), slinger (46) and locknuts (31). Tighten lightly with a small wrench, then check front and back clearances against Table 5 for each 45° position. Both fronts and backs should be about the same and within the specified range in Table 5. Adjust gear position, if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear capscrew to the torque specified in Table 4. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts.

    Caution! Keep fingers away from impellers and gears.
13. Install gearbox (3) with gasket (7) and tighten capscrews (23) evenly. **Note!** Replace short capscrews used during assembly under point 5.
14. Apply Locktite to the screw threads, the washer faces an both sides of the slinger then install drive end oil slinger (40), flatwasher (36) and tighten capscrew (60) to torque value in Table 4A.
15. Install drive end cover (5) and gasket (7) with drive lock pins (17) in place. Tighten capscrews (23) evenly. **Note!** Replace short capscrews used during assembly under point 5. Check seal bore for concentricity with shaft using an indicator; re-position drive lock pins, if necessary. Install seal (33) with lip facing inward using care to avoid tearing or scratching seal on shaft keyway. Use a pressing tool with clean, square ends to insure correct positioning of the seal against its stop.
16. Install breather air filter (55), and breather plug (21) in each headplate.
17. Replace oil drain plugs (22) and refill drive end and gear sumps with proper grade of oil as discussed under LUBRICATION.
18. Install drive sheave or coupling half and install blower, refer to INSTALLATION instructions.

Table 6 — Parts Identification List for Figures 6, 7, and 10

Item Number	Quantity Used	Identification	Item Number	Quantity Used	Identification
1	2	Headplate	28	4	Seal Ring
3	1	Gearbox	29	2	Washer - Wavy Spring
4	2	Gear	30	2	Washer - Gear Mounting
5	1	Drive End Cover	31	2	Locknuts
7	2	Gasket	32	16	Capscrew
8	1	Nameplate	33	1	Seal - Lip, D.E. Cover
9	2	Lubrication Label	34	2	Clamp Plate, Drive End
10	4	Shim	35	16	Lockwasher
11	1	Cylinder	36	1	Flatwasher
12	1	Impeller & Shaft - Drive	37	2	Oil Level Gauge
13	1	Impeller & Shaft - Driven	38	3	Sleeve
14	3	Bearing, Non - Drive	40	1	Slinger, D.E.
16	4	Dowel Pin	45	2	Pipe Plug
17	2	Driv-Lok Pin	46	1	Slinger, G.E.
19	1	Key	52	1	Bearing, D.E. Drive
20	4	Drive Screw	53	1	Spacer, Drive Bearing
21	2	Breather	54	2	Clamp Plate, Gear End
22	6	Drain - Filler Plug	55	2	Air Filter
23	36	Capscrew	60	1	Slinger Capscrew
27	4	Seal-Lip, Headplate	61	2	Filler Plug

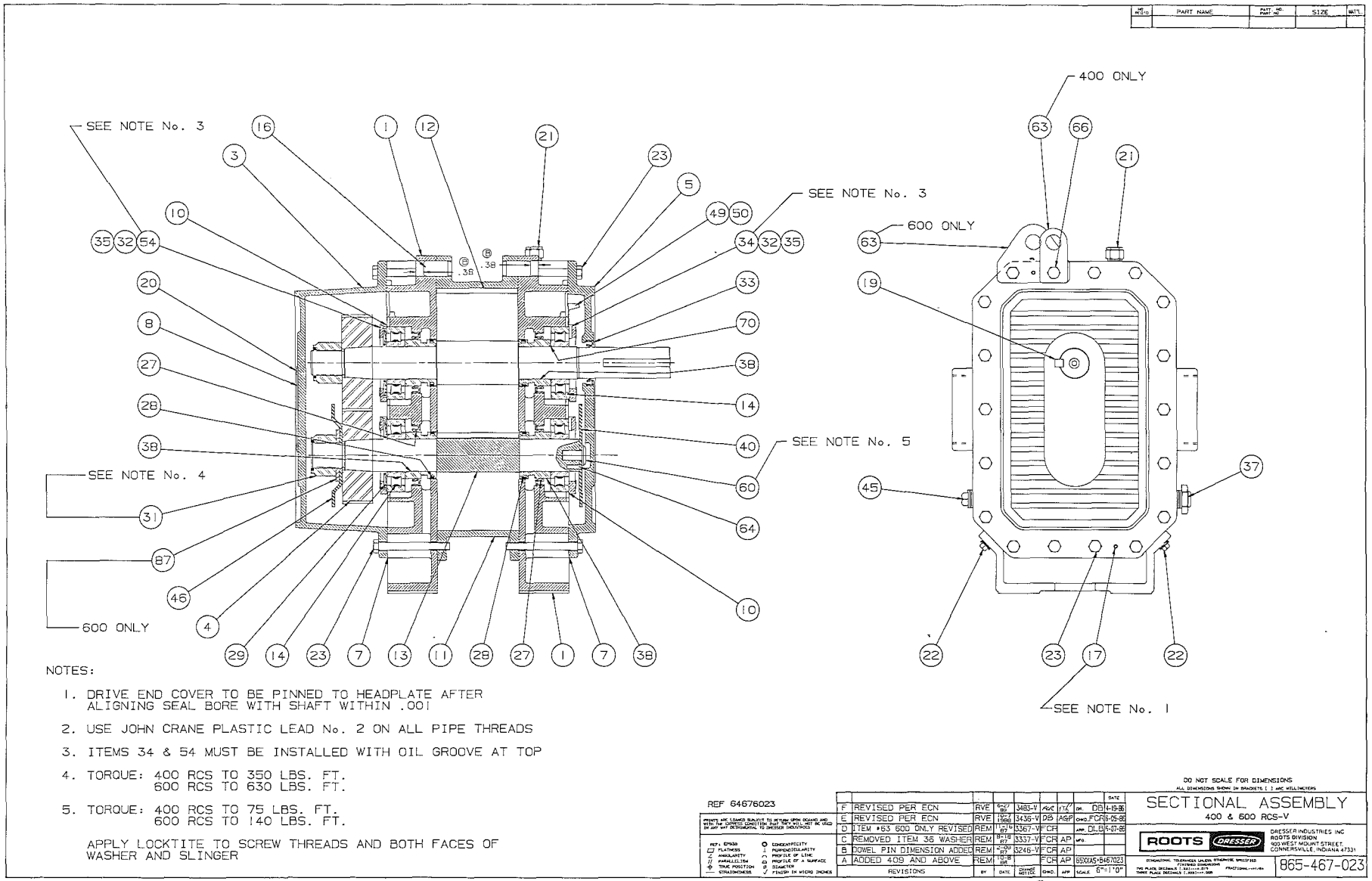


Figure 6 — Assembly of RCS Vertical Style Blowers

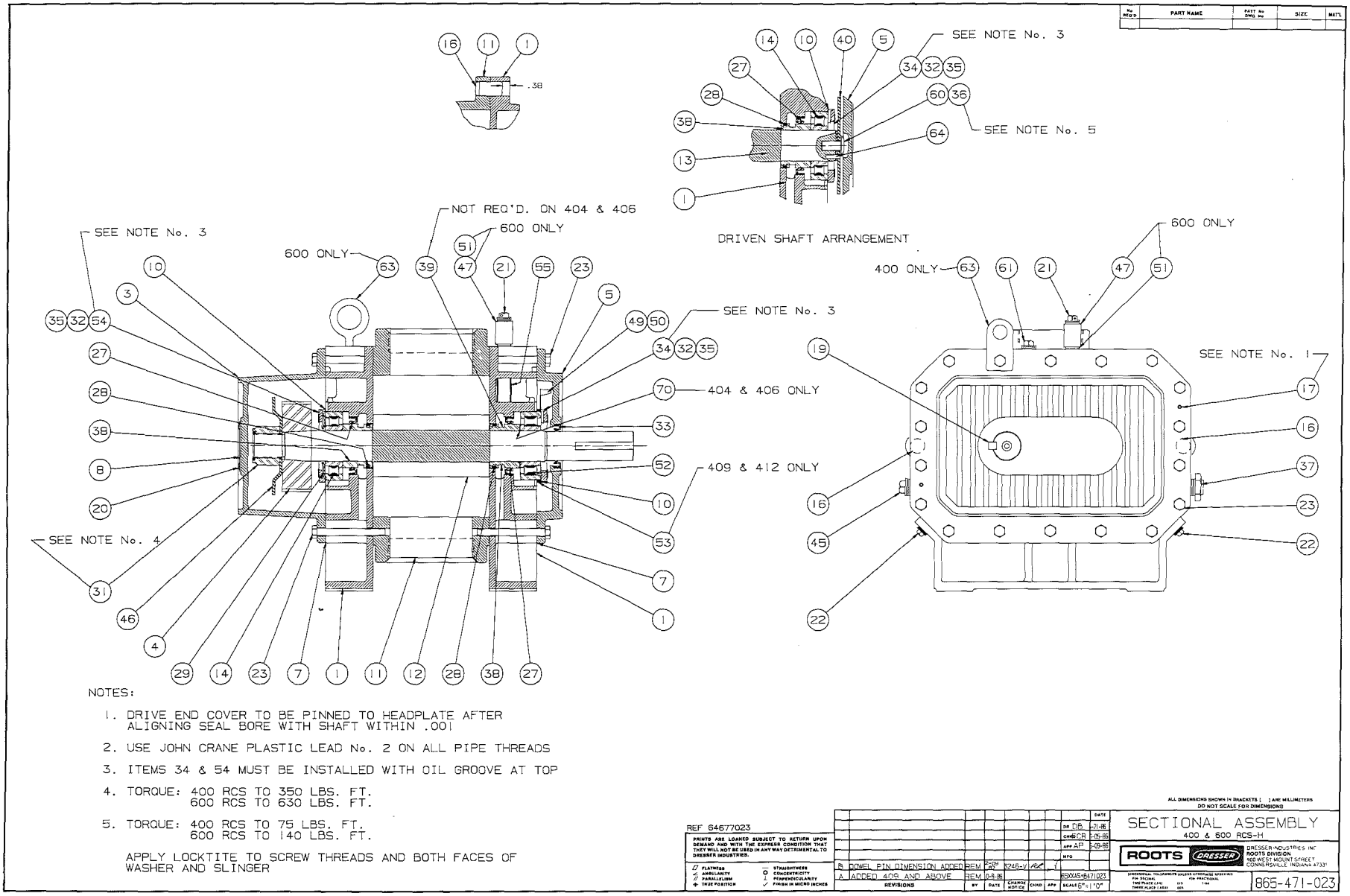
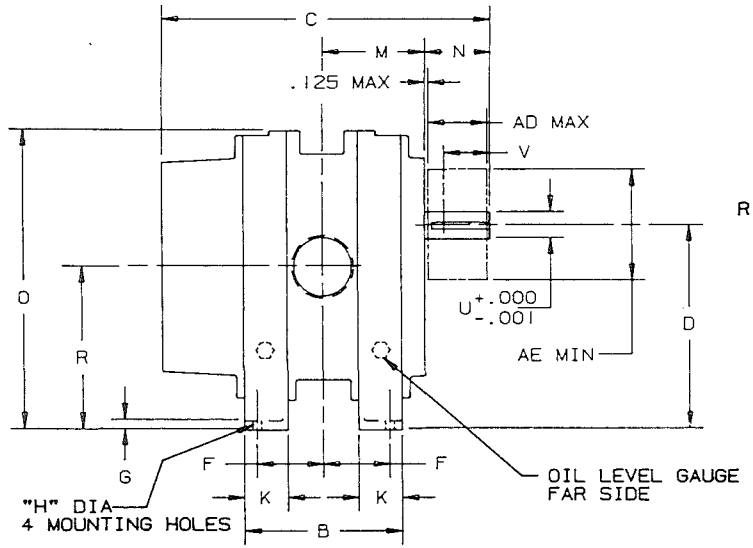
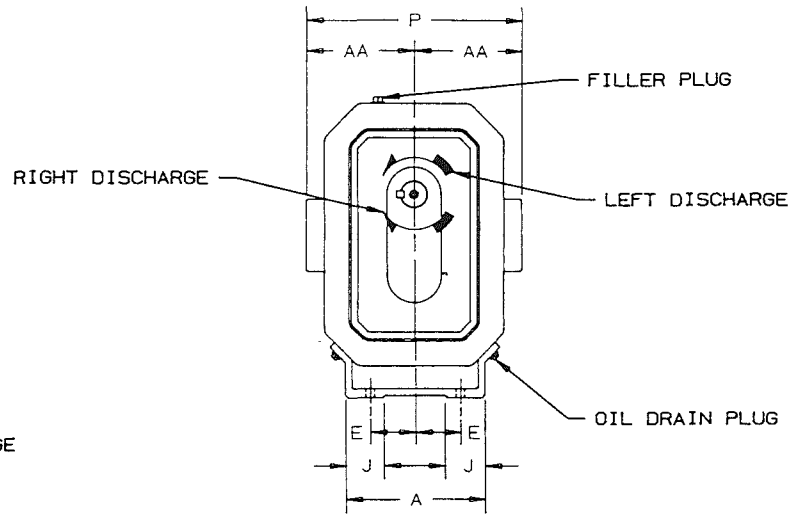


Figure 7 — Assembly of RCS Horizontal Style Blowers





INLET AND DISCHARGE FLANGES TO MATE FLUSH AND SQUARE WITH FLAT FACE FLANGES ONLY. USE FULL FACE GASKETS

FOR V-BELT DRIVEN UNITS MOTOR TO BE LOCATED ON INLET SIDE OF BLOWER

	6"FLG	8"FLG	10"FLG
OPENING	6.00	8.00	10.00
BOLT CIRCLE	9.50	11.75	14.25
FLANGE O.D.	11.00	13.50	16.00
No. TAPPED HOLES	8	8	12
SIZE HOLES	3/4-10	3/4-10	7/8-9
TAP DEPTH	1.13	1.13	1.31

W -INLET

WI -DISCHARGE

AD -SHEAVE WIDTH

AE -SHEAVE DIAMETER

ALL DIMENSIONS IN INCHES

RCS-V BLOWER

FRAME SIZE	A	B	C	D	E	F	G	H	J	K	M	N	O	P	R	U	V	KEYWAY	W	WI	AA	AD	AE	OIL CAPACITY	APPROX WEIGHT
404	7.50	8.88	18.38	11.25	2.50	3.75	.50	.44	2.00	2.44	5.75	3.69	16.50	12.00	9.00	1.50	2.75	.375x.188	3"NPT	3"NPT	6.00	3.53	6.50	32.5 FL. OZ.	230
406	"	10.88	20.38	"	"	4.75	"	"	"	"	6.75	"	"	"	"	"	"	"	4"NPT	4"NPT	"	"	"	"	"	260
409	"	13.88	23.38	"	"	6.25	"	"	"	"	8.25	"	"	11.00	"	"	"	"	4"NPT	4"NPT	5.50	"	"	"	"	300
412	"	16.88	26.38	"	"	7.75	"	"	"	"	9.75	"	"	"	"	"	"	"	6"FLG	6"FLG	"	"	"	"	"	360
418	"	22.88	32.38	"	"	10.75	"	"	"	"	12.75	"	"	"	"	"	"	"	8"FLG	8"FLG	"	"	"	"	"	440
616	10.00	21.44	32.44	15.00	3.50	9.75	.63	.56	2.50	2.75	12.19	4.56	22.00	14.50	12.00	2.00	3.63	.500x.250	8"FLG	8"FLG	7.25	4.44	8.50	70 FL. OZ.	650
624	"	29.44	40.44	"	"	13.75	"	"	"	"	16.19	"	"	"	"	"	"	"	10"FLG	10"FLG	"	"	"	"	"	775

CERTIFIED CORRECT FOR

CUSTOMER ORDER No.

ROOTS ORDER No.

DATE

V-BELT DRIVE DATA

BELTS

DRIVE SHEAVE

DRIVEN SHEAVE

CENTER DISTANCE

REM 10/27/82

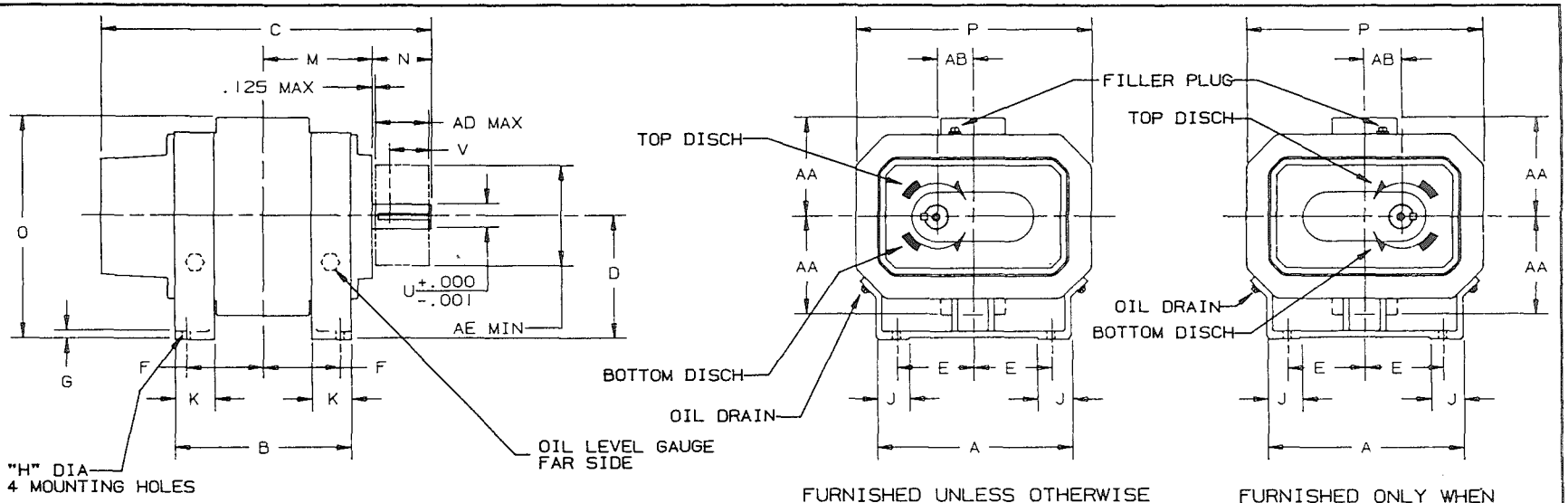
ROOTS DRESSER

DRESSER INDUSTRIES, INC.
ROOTS DIVISION
900 WEST MOUNT STREET
CONNERSVILLE, INDIANA 47331

861-893-021

PRINTED IN U.S.A. 61XXAD-B893021 D ADDED 418 & 616 REM 8/3/87 RR C. AA CORRECTED REM 11/19/85 B. WI CORRECTED-FRAME 624 DB 10/30/84 A. ADDED FRAME 624 REM 11/10/83 REDRAWN DB 4/23/86

Figure 8 — Vertical Unit



FURNISHED UNLESS OTHERWISE SPECIFIED

FURNISHED ONLY WHEN SPECIFIED

INLET AND DISCHARGE FLANGES TO MATE FLUSH AND SQUARE WITH FLAT FACE FLANGES ONLY. USE FULL FACE GASKETS

FOR V-BELT DRIVEN UNITS MOTOR TO BE LOCATED ON DRIVE SHAFT SIDE OF BLOWER

RCS-H BLOWER

	6"FLG	8"FLG	10"FLG
OPENING	6.00	8.00	10.00
BOLT CIRCLE	9.50	11.75	14.25
FLANGE O.D.	11.00	13.50	16.00
No TAPPED HOLES	8	8	12
SIZE HOLES	3/4-10	3/4-10	7/8-9
TAP DEPTH	1.13	1.13	1.31

W -INLET

WI -DISCHARGE

AD -SHEAVE WIDTH

AE -SHEAVE DIAMETER

ALL DIMENSIONS IN INCHES

FRAME SIZE	A	B	C	D	E	F	G	H	J	K	M	N	O	P	U	V	KEYWAY	W	WI	AA	AB	AD	AE	OIL CAPACITY	APPROX WEIGHT
404	12.00	8.88	18.38	7.50	4.75	3.75	.50	.44	2.00	2.44	5.75	3.69	13.50	15.00	1.50	2.75	.375x.188	3"NPT	3"NPT	6.00	2.25	3.53	6.90	56 FL. OZ.	240
406	"	10.88	20.38	"	"	4.75	"	"	"	"	6.75	"	"	"	"	"	"	4"NPT	4"NPT	"	"	"	"	"	270
409	"	13.88	23.38	"	"	6.25	"	"	"	"	8.25	"	13.00	"	"	"	"	4"NPT	4"NPT	5.50	"	"	"	"	310
412	"	16.88	26.38	"	"	7.75	"	"	"	"	9.75	"	"	"	"	"	"	6"FLG	6"FLG	"	"	"	"	"	370
418	"	22.88	32.38	"	"	10.75	"	"	"	"	12.75	"	"	"	"	"	"	8"FLG	8"FLG	"	"	"	"	"	450
616	16.00	21.44	32.44	9.00	6.50	9.75	.63	.56	2.50	2.75	12.19	4.56	16.25	20.00	2.00	3.63	.500x.250	8"FLG	8"FLG	7.25	3.00	4.44	8.50	118 FL. OZ.	675
624	"	29.44	40.44	"	"	13.75	"	"	"	"	16.19	"	"	"	"	"	"	10"FLG	10"FLG	"	"	"	"	"	800

CERTIFIED CORRECT FOR

CUSTOMER ORDER No.

ROOTS ORDER No.

DATE

V-BELT DRIVE DATA

BELTS

DRIVE SHEAVE

DRIVEN SHEAVE

CENTER DISTANCE

REM 10/27/82

DRESSER INDUSTRIES, INC.
ROOTS DIVISION
900 WEST MOUNT STREET
CONNERSVILLE, INDIANA 47331

861-891-021

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C ADDED 418 & 616 REM 8/3/87 RR B. O DIM. REVISED REM 11/5/86 FOR A. ADDED FRAME 624 REM 11/10/83 REDRAWN DB 4/23/86 FC

Figure 9 — Horizontal Unit

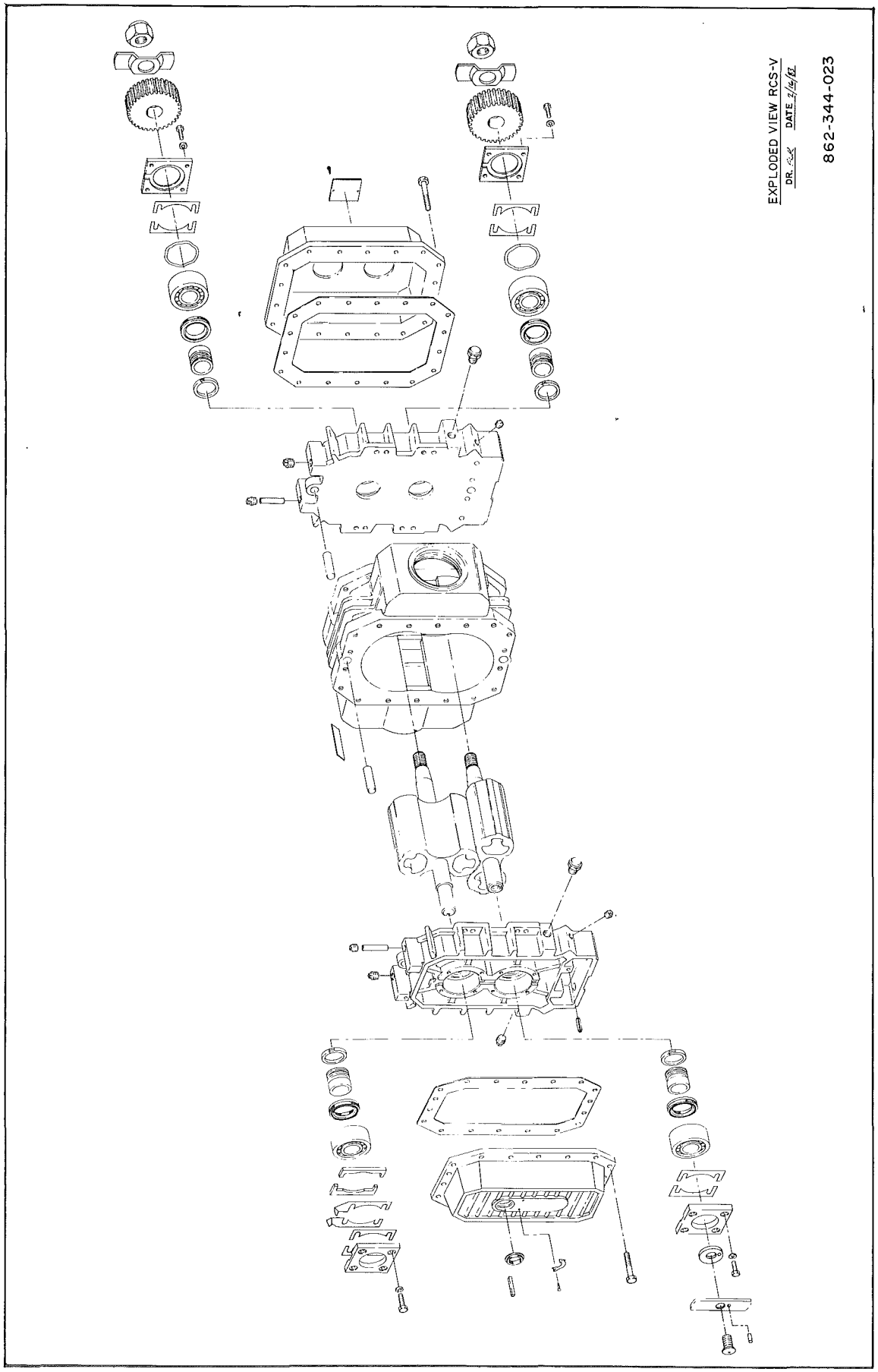

Figure 10 — Exploded View

SERVICE RECORD

Date	Service	Notes

RCS BLOWER — FRAMES 400 THRU 600

REF. NO.	QTY.	PART DESCRIPTION	FRAME SIZE 400	600
7	2	Gasket	—	—
10	1	Shim Set	—	—
14	3	Bearings	—	—
27	4	Seals—Headplate	—	—
28	4	Sealing Ring	—	—
33	1	Seal—Dr. Shaft	—	—
37	2	Oil Level Gauge	—	—
38	3	Sleeve	—	—
39	1	Sleeve	—	—
52	1	Bearing	—	—
55	2	Air Filters	—	—

NOTES: See pages 13 & 14 for reference number.