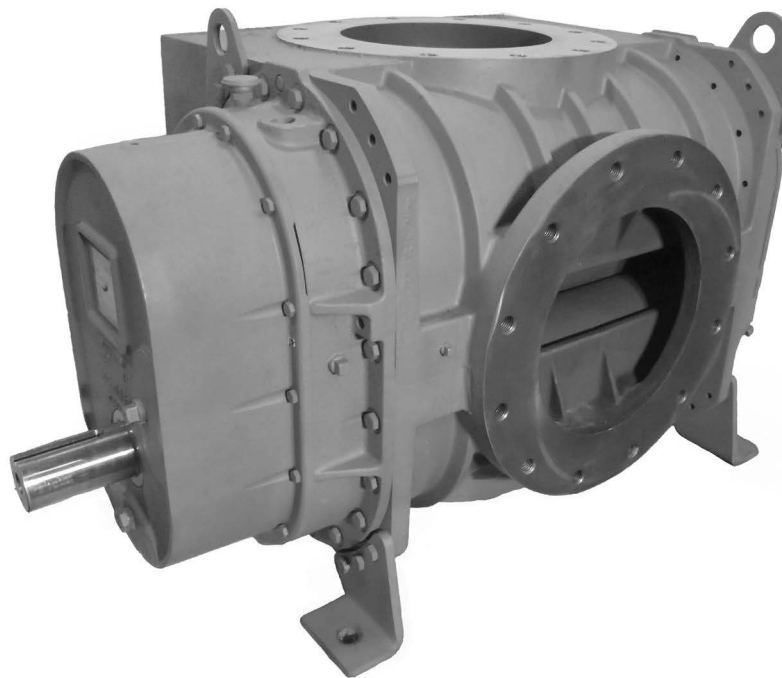




# Roots® 827 DVJ Gear End Drive Blower

Installation Operation & Maintenance Manual



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## Do These Things To Get The Most From Your ROOTS™ Blower

- Check shipment for damage. If found, file claim with carrier and notify Roots.
- Unpack shipment carefully and check contents against packing List. Notify Roots if a shortage appears.
- Store in a clean, dry location until ready for installation. 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.
- Read LIMITATIONS and INSTALLATION sections in this manual and complete the installation.
- Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. SEE SAFETY PRECAUTIONS.
- Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- Make sure both driving and driven equipment is correctly lubricated before start-up. SEE LUBRICATION.
- Read starting checkpoints under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- In event of trouble during installation or operation, do not attempt repairs of Roots equipment. Notify nearest Roots Sales Office giving all nameplate information plus an outline of operating conditions and a description of the trouble.
- Unauthorized attempts at equipment repair may void Manufacturer's warranty. Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operations described this manual, using Factory Parts. Good inspection and maintenance practices should reduce the need for repairs.

**Roots products are sold subject to the current General Terms of Sale and Warranty Policy WP-5020.**

## Foreword

A blower is a precision engineering product with very fine clearances between the twin impellers and between the impellers and the casing. As there is no contact between the moving parts internal lubrication is unnecessary. This ensures that relatively oil free air is delivered at all times.

## Safety Precautions

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

- Do not use V-belt drive.
- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Operate blower only per nameplate ratings and limits listed in this manual.
- 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 per lock out tag out procedure before doing any work and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected,

## Warning

**It is essential that anyone involved in the installation and operation of positive displacement air blowers, must have read and understood these instructions. There is a risk of damage and injury resulting from improper handling and operation.**

place a coarse screen over the inlet, jet port and discharge. Avoid standing in the path of the air streams. Wear appropriate PPE.

- Stay clear of open piping.
- Stay clear of blast from pressure relief valves and the suction area of vacuum relief valves.
- Avoid extended exposure in close proximity to machinery that 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 pressure vented cavities from an external source, nor restrict the vents.
- Do not use air blowers on explosive or hazardous gases or liquids.
- If condensate or water can collect in blower casing, must drain prior to start.
- 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.

## Installation

Do not V-belt drive the 827 DVJ which is Gear End driven. The addition of belt forces could cause undesired and uneven gear contact and damage the blower.

A temporary cover is installed on one jet port along with a permanent cover on the other at the factory. A silencer must be installed in place of the temporary cover before operating the blower; however, the permanent cover and silencer locations may be exchanged if required by the installation.

The permanent cover must be removed, both jet plenums inspected and cleaned for foreign material, then the permanent cover and silencer installed in the desired locations before operating the blower. Full size jet and discharge silencers are desirable, however the jet silencer may be reduced one nominal size providing either the vacuum level less than 18.5 "Hg or if the operating speed is below 60% of maximum blower speed. Both jet and discharge silencers may be reduced one nominal size in applications with vacuum levels is less than 18.5 "Hg and speed is less than 60% of maximum blower speed.

Avoid opening blower protective covers until ready to start installation, as protection will be lost quickly by evaporation.

If internal protection is required due to rust or corrosion, removal of the blower from service, or the internal protection furnished by factory at time of shipment has been removed do not use a liquid preservative of any kind on the coated surfaces. Capsules of vapor inhibitor such as ZeRust VC1-1 may be used internally by sealing all machine openings with vapor barrier paper or tape.

Blowers in long storage should be not subject to excessive vibration and the blower drive shaft should be rotated 3 to 4 revolutions every two weeks. Prior to start-up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust or debris.

This blower has several coats of a fine-grained, natural graphite coating applied to the internal surfaces. The coating is applied after the machine's internal clearances and impeller timing are established. The effect of coating is to close up internal clearances, decrease slip, and increase flow and efficiency at any given speed. Exhaust air may carry some coating particles.

Blowers with internal abrasible coating are for use with clean, dry air only.

After coating, it is not practical to try to measure clearances involving these surfaces before or after

running the blower. After coating and before running some coated surfaces may even be touching. After running the coated surfaces may have abraded areas and scratches, due to run-in contact between the surfaces.

Do not attempt to measure clearances involving coated surfaces as a basis of setting impeller in relation to the cylinder bore, head plates, or each other (fronts and backs). Clearance settings can be made accurately only with uncoated parts.

Where internal inspection indicates a need for cleaning coated surfaces of dirt, dust, etc., wipe clean only with a clean dry rag. Do not use a solvent or cleaner of any kind or allow solvent or cleaner to reach these surfaces while cleaning uncoated surfaces.

### Cleaning, coating & curing procedure for applying abrasible coating

General: These procedures are for coating new uncoated repair parts, spot repair of coating, or renewal. If setting clearances and timing are involved, this should be done before the new parts are coated. Subsequent cleaning and coating may involve at least partial disassembly for proper cleaning without damaging the coating of other original parts still coated, and to apply coating properly.

Normally, for new uncoated surfaces, three coats are applied and each coat must cure properly.

### Cleaning before coating

For new uncoated surfaces, apply cleaner with a clean, "soaked" rag. Apply the cleaner liberally, allow to set for a minute or two and wipe off. Avoid cleaning surfaces not to be coated.

Spot repair to be done only with a clean dry rag.

### Preparation and coating

Please follow the directions on the aerosol graphite lubricant container pertaining to preparation, application, ventilation, and inflammability. Typically, one coat is applied, but when multiple coats are necessary each coat must be completely cured per the procedure described below before the next application.

Each layer of coating should be applied as evenly as possible. The best distance from the spray nozzle to the surface should be 8 to 12 inches. Try to maintain this distance wherever space conditions allow."

### Curing procedure

Note that coated parts may feel dry or "tack free" after few minutes, but the coat will not have the proper cure that is required.

“Two alternative curing methods are acceptable. Let set for 1-1/2 hours minimum at room temperature  $\geq 70^{\circ}\text{F}$  or if coating is applied below  $70^{\circ}\text{F}$ , allow to cure overnight in shop ambient temperatures (not warehouse or outdoors).”

### Check for rotation

Complete blower build if not already assembled. Turn over drive shaft by hand until the rotation is free. Do not try to free up the blower by coupled or belted drive, and do not try to spin the rotors with shop air. Do not attempt to use any kind of solvent or cleaner to partially remove coating, as this could ruin all the coating.

### Complete removal of coating

This is for complete removal (to bare metal) of coating and may require some blower disassembly (depending on blower size and accessibility) for access to the coated parts and any overspray. Apply removal fluid liberally with a clean “soaked” rag. Vigorously rubbing with the rag and scraping of the softened coating is required to clean the surfaces down to bare metal. The amount of effort required will vary depending upon the solvent used. Protect uncoated surfaces from 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 normally give satisfactory service. Important requirements are that the correct grade of lubrication oil be provided for expected temperatures, for expected temperatures, and that the blower be located so that routine checking and servicing can be handled conveniently after installation. The effect of the location on driver and accessory equipment must be also be considered.

Supervision of the installation by a Factory Service Engineer is not usually required for these blowers. Workers 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 with safe practices. Blower mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

For handling the blower alone, use lifting lugs bolted 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.

When blower is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flange is required. Arrange these slings so that no strains are placed on the blower casing, mounting feet, or on any mounted accessory equipment. **DO NOT use the lifting lugs 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 the interior completely for dirt or foreign material. Anti-rust compound on the connection flanges and drive shaft extension may also be removed by this time with solvent. Then cover the flanges again to keep out dirt until ready to connect the air piping. 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 the least satisfactory results. It 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 use. Noise transmission can usually be reduced by use of a cork insulating pad 1 to 2 inches (35 to 50 mm) thick. The pad should be supported by a full steel plate attached to the structure, with a rigid concrete slab on top of the cork to carry the blower and driver.

For a blower without a 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 at least 1 inch (925 mm) thick, with its tip 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. The 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 thickness.

When the 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 tops 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 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.

When the unit is to be directly 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. The standard unit IS NOT DESIGNED for use for V-Belt Drive.

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 endplay exists.

The following requirements of a good installation are recommended. Coupling halves must be fitted to the two shafts with a line to line through .001 inch interference fit. Coupling halves must be warmed up, so that only light tapping is required to install them. Maximum deviation in offset alignment of the shafts should not exceed .005 inches (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001 inches (.03 mm) when checked at six points around the coupling.

### Operating limitations

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

The DVJ cannot be used in pressure applications as the pressure build-up discharges air outward through the cylinder slots resulting in high loss in blower efficiency and reduction in discharge flow.

Any unnecessary restrictions of discharge flow or atmospheric air inlet to the cylinder slots reduces the cooling air flow and limits blower operation, as the maximum temperature rise will occur below the normal limits of vacuum level.

Note: One cylinder jet port must have a full size inlet silencer with no valve or other restrictions. The other port must have the metal cover plate installed.

Jet and discharge flow restrictions result in increased blower temperature rise and should be checked as a possible cause if internal metal-to-metal contact occurs. Back pressure limits on discharge and vacuum limits on jet are shown in Table 1A. No valves should be used in the jet or discharge pipe.

Some type of protection, such as a filter or screen (1/4" mesh) is necessary to stop foreign particle entry through the jet port. Outside installations may also require some weather protection to prevent the entry of rain or snow. An elbow or some other configuration is desirable to assist in keeping the screen clear of foreign particles and the direct entry of rain or snow.

All recheck points in this manual should be followed with the following additions:

1. Be certain no rags, bolts, or dirt have been left in the cylinder slot inlet plenums.
2. No valves should be installed in the jet or discharge silencer pipe.

The blower is suitable for vacuum operation only. A water manometer should be used on the jet and discharge to assure that the maximum pressure drop has not occurred.

Table 1A

% Max speed RPM	Max jet pressure limit - IN H2O	Max discharge pressure limit - IN H2O
50%	6.0	6.0
75%	8.0	8.0
100%	10.0	10.0

**NOTE: 827 DVJ maximum operating speed is 2400 RPM. Maximum vacuum is 27 "Hg and maximum temperature rise is 275°F.**

Before connecting PIPING, remove any remaining anti-rust compound from blower connections. Pipe used should be no smaller than these connection, and clean new piping throughout is strongly recommended. In addition, make sure it is free of dirt, scale, cuttings, weld beads or foreign materials or any kind. To further guard against damage to the blower, especially when an inlet 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 and jet port connections.

Make provisions to clean this screen of collected debris after a few hours operation. It should be removed when nits usefulness has ended, as the wire will eventually deteriorate and small pieces going into the blower may cause serious damage.

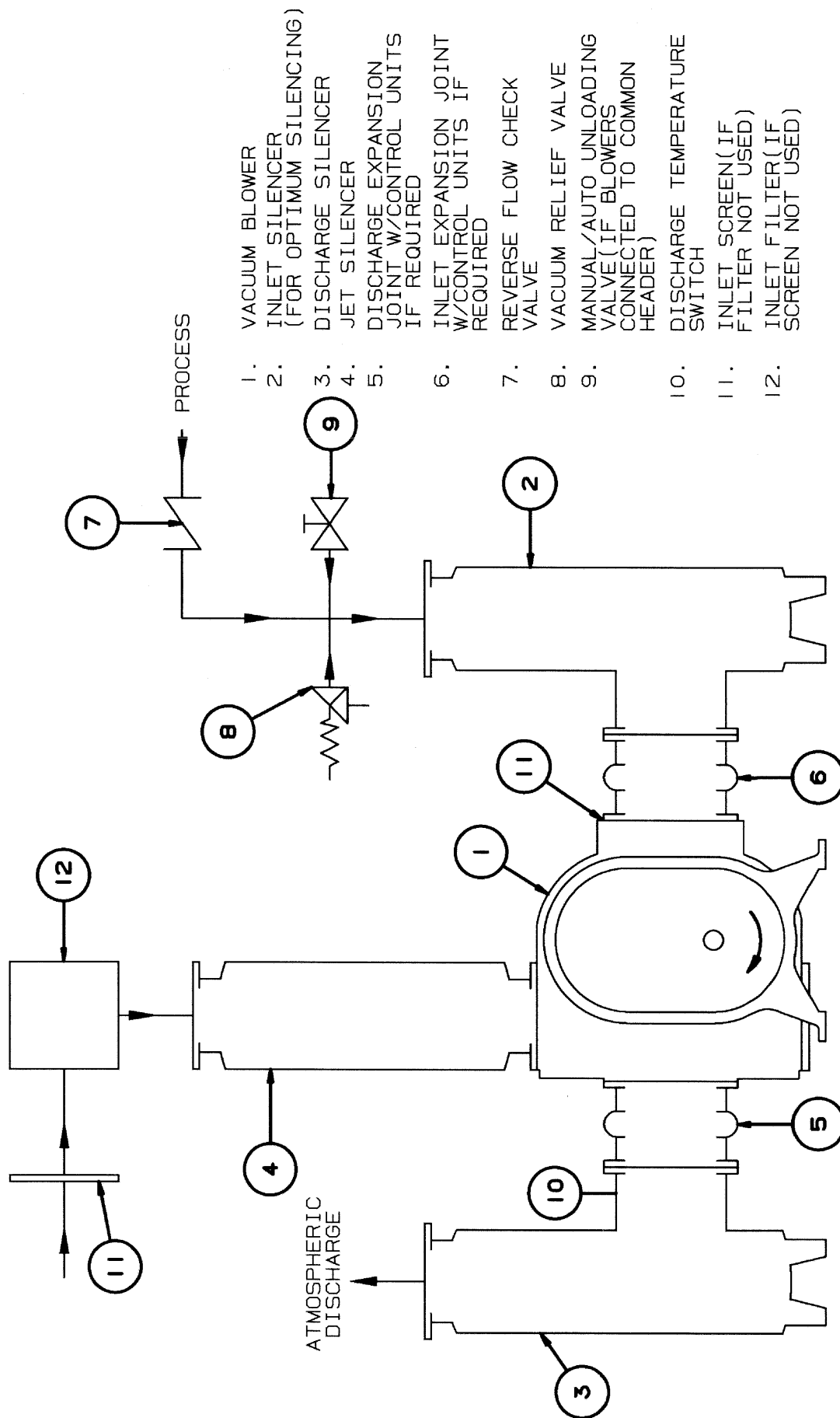
Piping flanges **MUST** meet the blower connections accurately and squarely. **DO NOT** attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the blower casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive 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 1 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.<sup>1</sup>

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, even though WHISPAIR™ blowers operate at generally lower noise levels than conventional lobe-type units. Specific recommendations on silencing can be obtained from Roots.

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, or coupling misalignment. **DO NOT** operate the blower at this time unless it has been lubricated per instructions. Read LUBRICATION section.

<sup>1</sup> For high altitude applications, inlet relief valve may be required to prevent blower from overheating.



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Figure 1 - Schematic Diagram



## Lubrication

A very simple lubrication system is employed in these 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. Entrance of lubricating oil into the blower air chamber is prevented by the use of double shaft sealing. Lip type seal, located inboard of the bearings in each headplate, effectively retain oil within the sumps. 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 into the air chamber and also minimize oil carryover into the air chamber.

Oil sumps on each end of the blower are filled by removing top vent plugs, **Item 37**, filling until oil reaches the middle of the oil level sight gauge, **Item 87** with the **BLOWER NOT OPERATING**, in order to obtain the correct oil level. Approximate oil quantities required are listed in Table 1. Use a good grade of industrial type non-detergent, rust inhibiting, anti-foaming oil and of correct viscosity per Table 2. For heavy duty service, a synthetic lubricant, such as Synfillm GT synthetic oil (Roots p/n 813-106-), is highly recommended. This synthetic oil has a life expectancy of 4 times that of petroleum based oils.

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

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. Thereafter, an occasional check should be sufficient. It is recommended that the oil be changed after initial 100 hours of operation. Frequent oil changing is not required unless the blower is operated in a very dusty location. Normal life expectancy of petroleum based oils is about 2000 hours with an oil temperature of about 200° F.

**Table 1 - Approximate Oil Sump Capacities**

Blower Frame Size	Gearbox		Blind End Cover	
	Quarts	Liters	Quarts	Liters
827V	2.1	1.0	1.0	0.5
827H	4.8	2.3	2.0	1.0

**Table 2 - Lubricant Recommended**

Ambient Temperature	Viscosity Range SSU @ 100°F (38°C)
Above 90°F (32°C)	320
32° to 90°F (0 to 32°C)	220
0° to 32°F (-18 to 0°C)	100
Below 0°F (-18°C)	68

## 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 without 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.
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 drive. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
7. **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 the 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, such as knocking sounds.
- (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 restarted, gradually close inlet valve to apply working vacuum gauge or manometer be connected into the inlet line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether vacuum 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 vacuum 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 TROUBLESHOOTING CHECKLIST.

### Vibration Assessment Criteria

With measurements taken at the bearing locations on the housings, an unfiltered vibration of 1.0 in/sec peak is considered an appropriate assessment guide line for rotary lobe blowers rigidly mounted on stiff foundations.

If the blower is operating above this level then the installation must be fully evaluated to determine the source or cause of the vibration, and the cause corrected.

suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first new days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is connected to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet and jet port protective screens. 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 and mounting bolt tightness.

**Table 3 - Maximum Allowable Operating Conditions**

Frame	Inlet Vacuum		Temperature Rise		Max RPM
	Inches Hg	Mm Hg	°F	°C	
827	27	684	275	152	2400

**Note: Discharge back pressure must not exceed 10" H<sub>2</sub>O**

In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. If such a change occurs, the cause should be determined through spectral analysis.

**Table 4 - Blower Internal Clearances**

Frame Size	Impeller Ends		<sup>1</sup> Impeller Strip to Cylinder			Impeller Lobes		Max. Temp. Rise °F
	Gear End	Opp. G.E.	Inlet	Center	Discharge	Fronts	Backs	
827	.036/.040	.006/.008	.020/.023	.014/.016	.020/.023	.021/.025	.011/.015	275

<sup>1</sup>Impellers have "wear in" strips. Impeller strip to case clearances as shown are expected after running the blower, they will not exist at initial blower assembly. Assembly records need not indicate the strip to case clearance values.

Maximum clearance listed is for reference only.



**Table 4 - 827 DVJ Parts List**

Item Number	Quantity Used	Identification
1	2	Headplate
3	1	Gearbox
4	1 set	Gear
5	1	Cover
7	2	Gasket covers
8	1	Nameplate
9	1	Installation tag
10	1	Shim set
11	1	Cylinder
12 & 13	1	Impeller
14	4	Bearing
16	4	Dowel pin cylinder
17	2	Spring pin
19	1	Key-coupling
20	1	Self-tappign screw
21	2	Breather
22	6	Pipe plug
23	40	Hex head cap screw
26	44	Hex head cap screw
27	4	Oil seal- Inboard
28	4	Piston ring seal
29	2	Wavy washer spring
30	2	Lock nut bearing
33	1	Oil seal- drive shaft
34	2	Brg clamp plate- OGE
35	2	Foot - R/H
36	2	Foot - L/H
38	4	Sleeve - Inboard
40	2	Sight plug
44	18	Hex head cap screw
45	2	Pipe plug
46	1	Slinger
48	2	Washer
49	2	Button head screw
54	2	Brg clamp plate
56	1	Oil leader - R/S
57	1	Oil leader - L/S
58	1	Oil leader - R/S
59	1	Oil leader - L/S
62	1	Hex head cap screw
62A	1	Washer
63	2	Lifting lug
72	4	Pipe plug
74	1	Spring pin
88	4	Steel ball
88A	1	Slinger
90	1	Cover plate
91	12	Hex head cap screw
106	16	Lock washer



## Trouble Shooting Checklist

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with speed on Roots Order Acknowledgement.
	2	Wrong rotation	Compare actual rotation, change driver rotation if wrong.
	3	Obstruction in piping	Check piping valve, silencer, to assure open flow path.
Low Capacity	4	Speed too slow	See Item 1.
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare these figures with specified operation 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	See Item 1.
	9	Excessive pressure rise	See Item 5.
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Look for excessive scale build-up. Correct blower mounting drive alignment.
Overheating of bearings or gears	11	Inadequate lubrication	Check oil sump levels in end covers.
	12	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil or recommended grade
	13	Excessive pressure rise	See Item 5.
	14	Coupling misalignment	Check carefully. Realign if questionable.
Vibration	15	Misalignment	See Item 14.
	16	Impellers rubbing	See Item 10.
	17	Worn bearings/gears	Check gear backlash and condition of bearings and replace as indicated.
	18	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.
	19 20	Driver or blower loose Piping resonance	Tighten mounting bolts accurately. Determine whether standing wave pressure pulsations are present in the piping. Refer to Sales Office.
Driver stops or will not start	21	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See Item 10. Look for defective shaft, bearing and/or gear teeth.
Excessive breather blowby or excessive oil leakage to vent area	22	Broken seal	Replace seals






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