Gardner Denver

PARTS LIST OPERATING AND SERVICE MANUAL

BLOWERS/VACUUM PUMPS

9CDL - -R SERIES

37-1-615
Version 05
August 30, 2018

MAINTAIN BLOWER RELIABILITY AND PERFORMANCE WITH GENUINE GARDNER DENVER PARTS AND SUPPORT SERVICES

Factory genuine parts, manufactured to design tolerances, are developed for optimum dependability - - - specifically for your blower. Design and material innovations are born from years of experience with hundreds of different blower applications. When you specify factory genuine parts you are assured of receiving parts that incorporate the most current design advancements .manufactured in our state-of-the-art blower factory under exacting quality standards.

Your AUTHORIZED DISTRIBUTOR offers all the backup you require. A worldwide network of authorized distributors provides the finest product support in the blower industry.

1. Trained parts technical representatives to assist you in selecting the correct replacement parts.

2. Complete inventory of new machines and new, genuine factory parts.

3. A full line of factory tested AEONÊ PD blower lubricants specifically formulated for optimum performance in all blowers.

4. Authorized distributor service technicians are factory-trained and skilled in blower maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair service.

For the location of your local authorized Gardner Denver blower distributor refer to the yellow pages of your phone directory, check the Web site at www.gardnerdenver.com or contact:

Gardner Denver Compressor Division
1800 Gardner Expressway
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Phone: (217) 222-5400
Fax: (217) 221-8780

FOREWORD

CycloBlower® blowers are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine, the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

⚠ DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenance information which is important but not hazard-related.

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SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards and be cautious. Some general safety precautions are given below:

⚠ DANGER

Failure to observe these notices could result in injury to or death of personnel.

- **Keep fingers and clothing away from revolving fan, drive coupling, etc.**
- **Do not use the air discharge from this unit for breathing – not suitable for human consumption.**
- **Do not loosen or remove the oil filler plug, drain plugs, covers the thermostatic mixing valve or break any connections, etc., in the compressor air or oil system until the unit is shut down and the air pressure has been relieved.**
- **Electrical shock can and may be fatal.**
- **Blower unit must be grounded in accordance with the National Electrical Code. A ground jumper equal to the size of the equipment ground conductor must be used to connect the blower motor base to the unit base.**
- **Open main disconnect switch, tag and lockout before working on the control.**
- **Disconnect the blower from its power source, tag and lockout before working on the unit – this machine is automatically controlled and may start at any time.**

⚠ WARNING

Failure to observe these notices could result in damage to equipment.

- **Stop the unit if any repairs or adjustments on or around the compressor are required.**
- **Disconnect the blower from its power source, tag and lockout before working on the unit – this machine is automatically controlled and may start at any time.**
- **Do not exceed the rated maximum pressure values shown on the nameplate.**
- **Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.**

INTRODUCTION
YOUR KEY TO TROUBLE FREE SERVICE

Although Gardner Denver blowers are sturdy, precision-engineered machines, there are several relatively simple but basic installation and maintenance procedures that must be observed to assure optimum performance. As there is no guesswork in the manufacture of these highly advanced units, there must be none in preparing them to get the job done in the field. It is the purpose of this manual to help you properly install, maintain and service your Gardner Denver blower. It is important that no section be overlooked when preparing to install your blower.

Follow the instructions carefully and you will be rewarded with years of trouble-free operation.

SECTION 1
EQUIPMENT CHECK

Before uncrating, check the packing slip carefully to be sure all the parts have been received. All accessories are listed as separate items on the packing slip, and small important accessories such as relief valves can be overlooked or lost. After every item on the packing slip has been checked off, uncrate carefully. Register a claim with the carrier for lost or damaged equipment.

⚠WARNING

Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in installation and operation of this equipment in the system or facility.

STORAGE

Your Gardner Denver Blower was packaged at the factory with adequate protection to permit normal storage for up to six (6) months.

If the unit is to be stored under adverse conditions or for extended periods of time, the following additional measures should be taken to prevent damage.

1. Store the blower in a clean, dry, heated (if possible) area.
2. Make certain inlet and discharge air ports are tightly covered to prevent foreign material from entering the air box.
3. All exposed, non-painted surfaces should be protected against rust and corrosion.
4. Provide adequate protection to avoid accidental mechanical damage.
5. In high humidity or corrosive environments, additional measures may be required to prevent rusting of the blower internal surfaces.
6. To prevent rusting of gears, bearings, etc., the oil reservoirs may be filled with normal operating oil.

⚠CAUTION

Before running the blower, drain the oil and replace to the proper operating level with clean, fresh lubricant.

7. Rotate the blower shaft (10 to 25 turns) monthly during storage. Inspect the blower shaft (near the shaft seal area) monthly and spray with rust inhibitor if needed.
8. For long term storage (over six (6) months), contact Gardner Denver Compressor Division Customer Service for recommendations.

SECTION 2
INSTALLATION

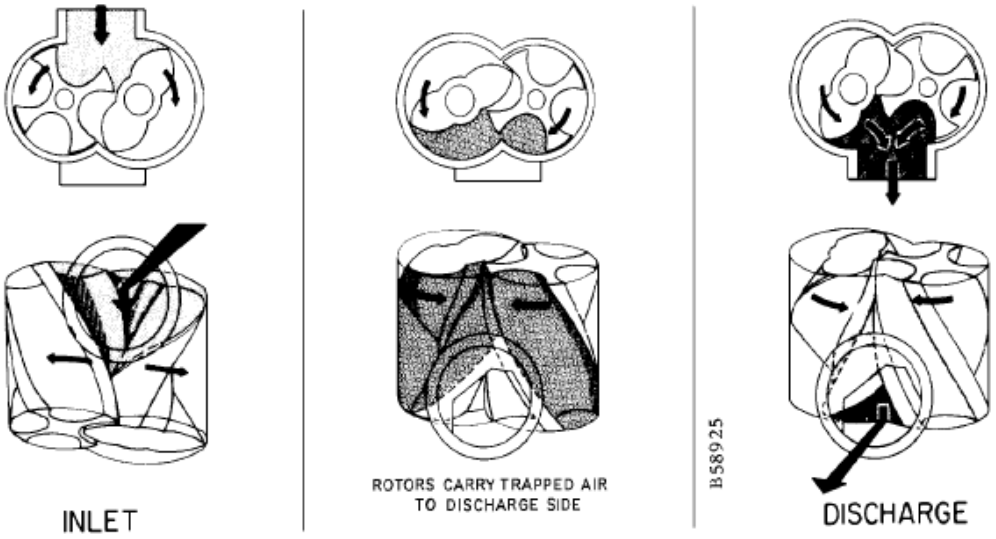


FIGURE 2-1 – OPERATING PRINCIPLE

GENERAL ï The CycloBlower® is a compact, rotary lobe type axial flow blower/compressor. The meshing of two screw type rotors synchronized by timing gears provides controlled compression of the air for maximum efficiency and pulsation-free discharge.

OPERATING PRINCIPLE ï Compression is effected by the main (2 lobe) and gate (4 flute) rotors meshing enclosed in the housing. The timing gears maintain close rotor clearances. The rotors do not touch each other, the housing, or the bearing carries. Although clearances are small, lubrication in the compression chamber is not required, insuring oil-free air delivery.

The compression cycle (FIGURE 2-1) begins as the rotors unmesh at the inlet port. Air is drawn into the rotor cavities, trapped, and compressed by the reducing cavities as rotation continues. When proper compression is made, the cavities cross the discharge port, completing the cycle. The cycle occurs twice each revolution of the main bearing rotor and is continuous.

CONSTRUCTION ï All models of the 9CDL Series CycloBlower are of similar design and construction except for rotor length. The housing is a oneð piece casting with flanged inlet and discharge openings.

The rotors are ductile iron with integral shaft. Rotors are dynamically balanced for vibration--free operation. Helical timing gears are of alloy steel, hobbed and shaved for quiet operation.

Two heavy--duty duplex mounted angular contact ball bearings are used on each rotor shaft, at the discharge end, as fixed bearings to maintain rotor end clearance.

A radial bearing is used on each rotor shaft at the gear end as a floating bearing.

All gears and bearings are oil splash lubricated.

Standard construction is top inlet, bottom discharge, with drive shaft extension from main rotor at the discharge end. Rotation is clockwise facing the drive shaft. Blowers may be mounted for either V--belt or direct--coupled drive. The gate rotor speed is half (1/2) the main rotor or drive speed.

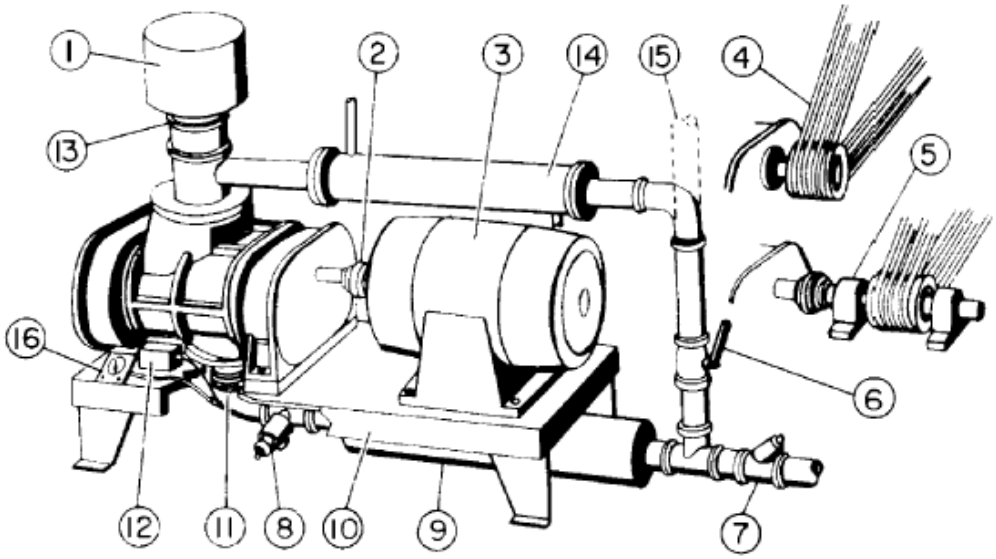


FIGURE 2-2 – ACCESSORIES AND SAFETY DEVICES

LOCATION – Select a clean, dry, well-ventilated area for installing blower and allow ample room for normal maintenance. Proper ventilation is necessary for blower cooling and cool air intake.

⚠WARNING
Do not electric weld on the blower or base; bearings can be damaged by the passage of current.

FOUNDATIONS – Correct supporting is important. Distortion by incorrect supporting will affect internal operating clearances. The foundation or base must provide a level, rigid, nonworking support for the blower. It must be on uniform and solid footing. Complete foundation design cannot be given because of varying conditions. If necessary, use shims under feet for leveling to prevent distortion when foundation bolts are tightened. After installation on the foundation is complete, check alignment of the coupling or drive before starting blower.

ACCESSORIES (FIGURE 2-2) ï The type of service determines the accessory group required. The typical items are listed as follows:

1. Inlet Filter or Filter-silencer.
2. Flexible Coupling
3. Driver.
4. Simple V-Belt Drive.
5. Jackshaft V-Belt Drive.
6. Bypass Valve.
7. Check Valve.
8. Relief Valve, Vacuum or Pressure.
9. Discharge Silencer.
10. Base Plate.
11. Expansion Joint(s) ï Inlet and/or Discharge.
12. Temperature or Pressure Shutdown Switch.
13. Check Valve (Inlet Bypass).
14. Heat Exchanger.
15. Bypass to atmosphere (alternate).
16. Pressure Gauge or Vacuum Gauge.

Inlet Filter or Filter-Silencer ï For pressure service handling air, the blower inlet must be protected by a filter or suitable size to allow full flow of air to the blower inlet. The filter must be of adequate efficiency to trap any foreign materials which may be in the general area of the air inlet. If noise is a factor, filter-silencers are available.

⚠WARNING
Rotating components will cause severe injury in case of personal contact. Keep hands away from the blower inlet and discharge ports.

In choosing a location for the filter, consideration should be given to a source of cool, clean air, and most important, access for maintenance.

Filters generally used for blower service fall under three types:

Oil-wetted Screen Type

Oil Bath

Dry Type

Filter-silencers are also available in the above types.

For vacuum service, the type of system used and materials being handled will determine the necessity for an in-line filter.

Couplings ï For direct-coupled units, a flexible type coupling, accurately aligned, should be used between the blower and power unit. Misaligned couplings may cause vibration, additional bearing loads and stresses which will affect life of parts involved. DO NOT drive the couplings on shaft. Check shaft and coupling bore for burrs. Polish the shaft and bore if necessary for proper fit. Fit keys to keyways. Check coupling alignment. Exact alignment will vary with the type of couplings; however, it is not uncommon to hold alignment within .003ö in all directions. With lubricated or special couplings, follow the manufacturerøs instructions for installation and maintenance.

DRIVE INSTALLATION

V-Belt Drive ï Follow normal specifications recommended by the belt manufacturers for installation of belt drive on blowers. To provide the most compact drive, it is suggested the high capacity V-belt drives be used. Blower shaft and power unit shaft should be parallel, with sheaves aligned on shafts so belts run true. Use only matched belt sets and replace belts in complete sets only. Belt tension should be according to manufacturerøs recommendations. Slippage can be detected by belt squeal, overheating or loss of speed. A few hours after initial starting with new belts, it is advisable to recheck belt tension and provide tension adjustment as necessary.

⚠WARNING
Over tightening belts lead to heavy bearing loads and premature failure.

When selecting a V-belt drive, check to be sure the maximum allowable moment limitation is not exceeded. Refer to FIGURE 2-3, for belt drive overhung load calculations.

NOTICE
When a simple V-belt drive is not available, to stay within the maximum allowable moment, a jackshaft V-belt drive is required.

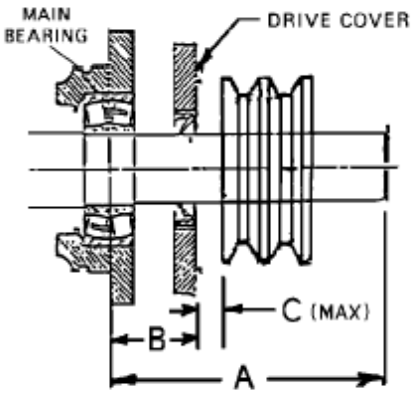
Belt drives must be carefully aligned. Motor and blower pulleys must be parallel to each other and in the same plane within 1/16 inch. Belt tension should be carefully adjusted and belts tightened only enough to prevent slippage and per the belt manufacturer's recommendations.

NOTICE
The sheave should be positioned as close as possible to the drive cover. This will reduce the overhung load and extend the bearing life.

On direct connected units, alignment and lubrication of the couplings to specifications of the coupling manufacturer are very important. When mounted drives are supplied from the factory, proper alignment has been established before shipment. However, during shipping, handling and installation, it is likely that the alignment has been disturbed and final adjustment must be made before startup.

9CDL Drive Shaft Location	Dimensions (Inches)			Maximum Allowable Moment
	A	B	C (Max)	(LB-IN)
Discharge End (Standard)	9.84	4.32	0.5	11,265
Gear End (Optional)	10.92	5.51	0.5	11,265

MAXIMUM ALLOWABLE MOMENT



DRIVE SHAFT ILLUSTRATION

Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac
0.000	1.000	0.250	0.966	0.500	0.926	0.750	0.879	1.000	0.823	1.250	0.751
0.025	0.997	0.275	0.962	0.525	0.922	0.775	0.874	1.025	0.816	1.275	0.742
0.050	0.994	0.300	0.958	0.550	0.917	0.800	0.869	1.050	0.810	1.300	0.734
0.075	0.990	0.325	0.954	0.575	0.913	0.825	0.864	1.075	0.803	1.325	0.725
0.100	0.987	0.350	0.951	0.600	0.908	0.850	0.858	1.100	0.796	1.350	0.716
0.125	0.983	0.375	0.947	0.625	0.904	0.875	0.852	1.125	0.789	1.375	0.706
0.150	0.980	0.400	0.943	0.650	0.899	0.900	0.847	1.150	0.782	1.400	0.697
0.175	0.977	0.425	0.939	0.675	0.894	0.925	0.841	1.175	0.774	1.425	0.687
0.200	0.973	0.450	0.935	0.700	0.889	0.950	0.835	1.200	0.767		
0.225	0.969	0.475	0.930	0.725	0.884	0.975	0.829	1.225	0.759		

ARC OF CONTACT FACTORS

$$\text{Belt Pull} = \left[\frac{2.5 - Ac}{Ac}\right]\left[\frac{125954 \times Hp \times S.F.}{D \times RPM}\right]$$

Key:
- Ac = Arc of Contact Factor (Refer to Arc of Contact Factors Chart above)
- Hp = Blower Horsepower for Operating Conditions
- S.F. = Actual Drive Service Factor
- D = Blower Sheave Pitch Diameter in Inches
- RPM = Blower Sheave Speed
- Z = $\frac{\text{Large Sheave Pitch Diameter (in) - Small Sheave Pitch Diameter (in)}}{\text{Sheave Center Distance (in)}}$

CALCULATION OF BELT PULL

$$\text{Shaft Moment (LB-IN)} = \text{Belt Pull} \times \left[B + C + \left(\frac{\text{Sheave Width}}{2}\right)\right]$$

CALCULATION OF SHAFT MOMENT

FIGURE 2-3 – BELT DRIVE OVERHUNG LOAD CALCULATIONS

Bypass Valve ï Installation of a bypass valve at the blower discharge (FIGURE 2-2) will allow the blower to be started under no-load. Bypass line may be discharged at atmosphere or to blower inlet depending on local requirements or material being handled.

Heat Exchanger ï When the bypass line discharges to blower inlet, a heat exchanger must be included in the line between blower discharge and blower inlet, to remove the heat of compression before the gas is reintroduced into the blower inlet. A check valve (FIGURE 2-2) should also be placed in the inlet line between the bypass line and the inlet filter or silencer, to prevent discharging backwards through the filter or silencer.

SAFETY DEVICES – For all installations the following safety devices are a requirement for safe blower operation. Numbers shown are reference numbers used in FIGURE 2-2.

7. Check Valve, Blower Discharge Line
8. Relief Valve, Vacuum or Pressure
12. High Discharge Air Temperature Switch

Check Valve (FIGURE 2-2) ï When the blower is used in a pneumatic conveying system, a check valve must be used to prevent backflow of material into the blower. In any system it is a safety device preventing the down stream pressure from motoring the blower through shutdown periods. A check valve must be provided for each blower when several blowers are manifold into a common system.

Relief Valve (FIGURE 2-2) ï The relief valve must be installed as close to blower ports as possible. There should be no accessories such as valves, check valves, silencers, etc. between the relief valve and blower ports. It should be set 2 to 3 PSI above normal blower operating pressure (1/2òto 1òHg. In vacuum service), but not to exceed 2 PSI above maximum differential pressure rating of the blower for pressure service.

NOTICE
Relief valves should be placed as close as possible to the blower inlet port (vacuum operation) or discharge port (pressure operation).

High Temperature and High Pressure Shutdown ï All blower installations should be protected with a high temperature shutdown switch. The controls should be set to stop the blower when the discharge temperature reaches 355°F or temperature rise reaches 255°F. In some installations a high pressure shutdown switch may also be advisable. The sensing element of these controls should be installed as close to the blower discharge as possible. See FIGURE 2-2. On remote or unattended installations these controls are normally mandatory.

INLET PIPING ï During the installation of piping make sure dirt and other foreign materials do not enter blower openings. When inlet piping is used IT MUST BE CLEAN, AND FREE OF SCALE AND OTHER FOREIGN MATERIALS WHICH COULD ENTER THE BLOWER. It is suggested that an expansion joint be installed near blower openings to prevent stressing of the blower housing. Support the pipe to relieve weight on the expansion joint and the blower. Make sure the pipe size is adequate and as straight as possible to prevent pressure drop at the blower inlet. Where bends are necessary use long radius fittings. All connections must be air tight.

For vacuum service, an accurate vacuum gauge must be used near the blower inlet to indicate operating vacuum and a suitable vacuum relief valve must be used. A vacuum blower in pneumatic conveying service requires pre-inlet separation and filtering to prevent material carry-over into the blower.

Inlet pipe size is determined as follows:

0 to 10 feet long, use pipe size equal to blower inlet flange size.

10 to 17 feet long, use pipe size larger than blower inlet.

17 to 33 feet long, two pipe sizes larger than blower inlet.

DISCHARGE PIPING ï In general, the type system used will govern the piping arrangement. However, the following suggestions should be followed for blower protection and efficiency.

An expansion joint should be installed as close to the blower opening as possible to protect the blower housing from stresses. All pipe connections should be square and even to prevent distortion from misalignment.

An accurate pressure gauge must be provided near the blower discharge to indicate operation pressure. If noise level is a factor, a discharge silencer should be used. The discharge line should be as straight as possible. Where bends are necessary, use long radius fittings. Provision for condensate drainage at the lowest point in the piping may be required.

VENTILATION – If the blower is to operate in a housing or enclosure, proper ventilation must be provided for adequate blower cooling. Cooling air should be taken from outside the enclosure.

OUTLINE DRAWINGS ï Certified outline drawings are available upon request. All important dimensions are shown in FIGURE 2-4 & FIGURE 2-5.

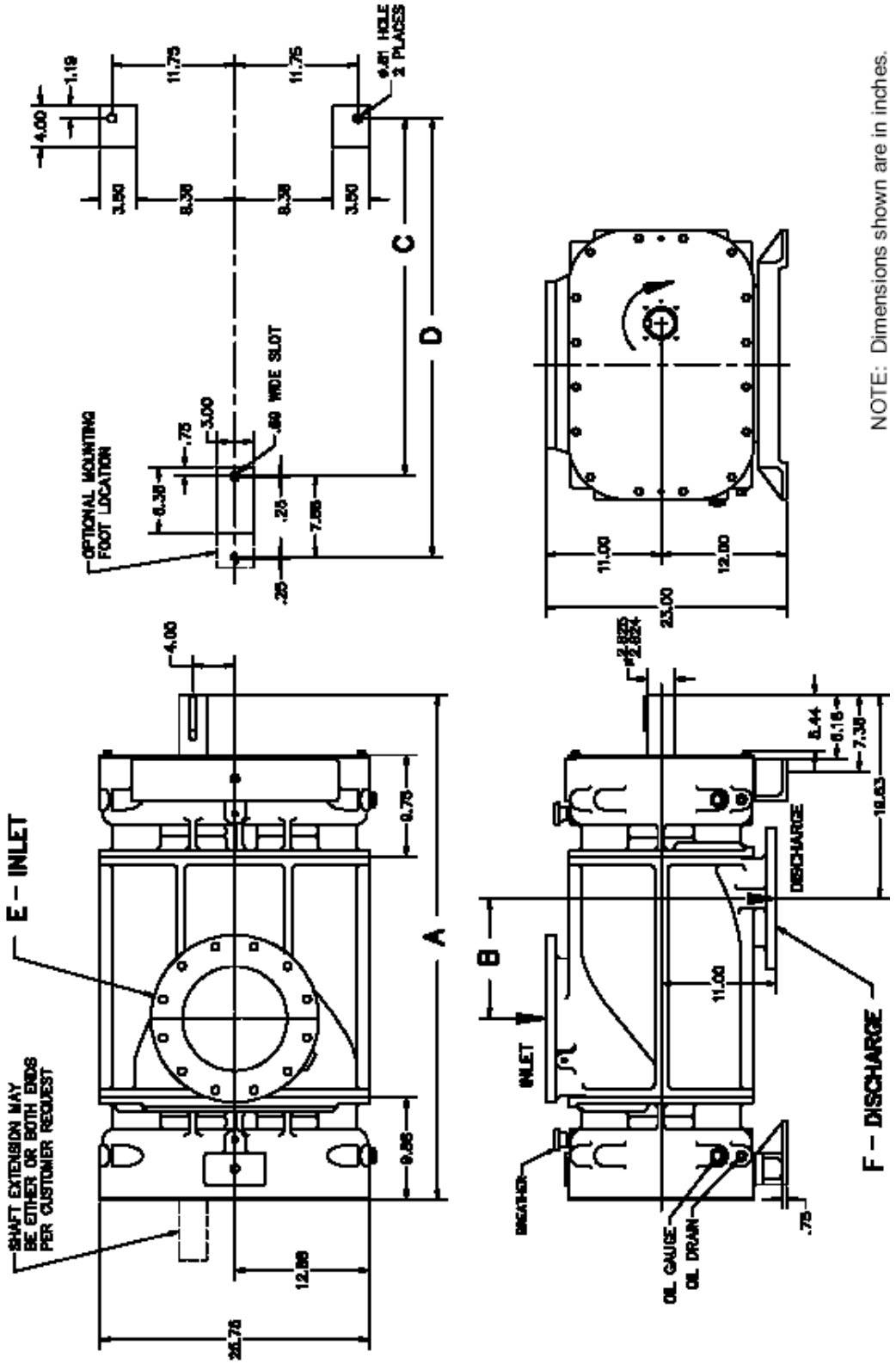


FIGURE 2-4 – OUTLINE DIMENSIONS

9CDL SERIES, TOP INLET, MAIN ROTOR DRIVE

MODEL	WT.	A	B (inches)	C (inches)	D (inches)	OUTLINE DIMENSIONS DRAWING NO.
9CDL13R	1475	38.56	5	24.16	32.04	301CBP800
9CDL18R	1680	43.56	6.50	29.16	37.04	302CBP800
9CDL23R	1905	48.56	11.50	34.16	42.04	303CBP800

MODEL	E – INLET	F – DISCHARGE
9CDL13R	8.00 FLANGE, 13.5 O.D., 8 HOLES .75 ï 10 UNC TAP, 11.75 DIA. B.C.	8.00 FLANGE, 13.5 O.D., 8 HOLES .75 ï 10 UNC TAP, 11.75 DIA. B.C.
9CDL18R	10.00 FLANGE, 16 O.D., 12 HOLES .875 ï 9 UNC TAP, 14.25 DIA. B.C.	8.00 FLANGE, 13.5 O.D., 8 HOLES .75 ï 10 UNC TAP, 11.75 DIA. B.C.
9CDL23R	10.00 FLANGE, 16 O.D., 12 HOLES .875 ï 9 UNC TAP, 14.25 DIA. B.C.	8.00 FLANGE, 13.5 O.D., 8 HOLES .75 ï 10 UNC TAP, 11.75 DIA. B.C.

FIGURE 2-5 – OUTLINE DIMENSIONS (CONTINUED)

SECTION 3
OPERATION

Future operating problems can be avoided if proper precautions are observed when the equipment is first put into service.

Before starting under power, the blower should be turned over by hand to make certain there is no binding or internal contact.

Each size blower has limits on pressure differential, running speed, and discharge temperature which must not be exceeded. These limits are shown in the following tabulation.

GENERAL ï A new blower from the factory must be checked and serviced before operation. The blower must be lubricated and operated according to the following instructions. Blower failure can be caused by operation at above rated pressure or below rated minimum speed. Both cause excessive discharge temperature and seizure of rotating parts.

STARTING BLOWER ï Start at reduced speed and no-load if possible. If speed is fixed, start without load by bleeding discharge to atmosphere. Starting should be smooth and free of vibrations. After initial no-load start, and operation is satisfactory, apply load gradually until maximum operating conditions are attained. BE SURE OPERATING CONDITIONS ARE WITHIN BLOWER RATINGS. Maintain a close check for severe vibrations, unusual noise, leaks and undue heating. The blower will gradually heat up due to compression, but after a reasonable length of time, temperature will stabilize. With very cold ambient conditions, warm up blower at no-load before going into full load service.

If the blower is used as part of a specific system, check the systemôs manual for any procedures that may be necessary when starting the blower.

PRESTART CHECK (For New or Overhauled Blower) ï see ñBlower Startup Checklist,òpage 24.

ROTATION ï Facing the main rotor drive shaft, rotation is clockwise when the shaft extension is at discharge end, and counterclockwise when the shaft extension is at the inlet end. An arrow indicating rotation is attached to the blower end cover near the drive shaft.

DAILY CHECK

1. Air filter tight, clean and serviced.
2. Proper oil level in oil sumps.
3. Observe pressure.
4. Relief valve functions.
5. Blower turns freely.

⚠WARNING

Over tightening belts lead to heavy bearing loads and premature failure.

R Series Models	Drive Shaft Speed (RPM)	Discharge Pressure* Sea Level (PSIG)	Dry Vacuum* (Inches Hg)	Wet Vacuum* (Inches Hg)
9CDL13, 9CDL18, 9CDL23	3000	20	17	----
9CDL13, 8CDL18, 9CDL23	2700	----	----	24

* Pressures or vacuums are gauged at immediate blower discharge or inlet and include inlet and discharge losses. For booster applications, consult Gardner Denver Compressor Division Customer Service. For suggested maximum ratings at reduced speeds, See FIGURE 3-6.

FIGURE 3-1 – MAXIMUM RATING

TYPE OF SERVICE ï The blower can be operated in either pressure or vacuum service.

Pressure ï Never operate the blower above the maximum pressure shown in FIGURE 3-1. Excessive pressure may cause overheating and blower failure, it is therefore most important to have an accurate pressure gauge in the discharge line as close to the blower discharge as possible. Reduced speeds have a direct bearing on allowable pressure (FIGURE 3-6). A bypass valve to bleed air from the discharge to atmosphere (FIGURE 2-2) may be used to control the pressure. NEVER reduce the blower speed to maintain a certain pressure before it is determined if the reduced speed is adequate for that pressure. An accurate pressure gauge must be maintained.

Vacuum ï The blower may be operated either in dry vacuum or wet vacuum service. Do not operate the blower above the maximum vacuums shown in FIGURE 3-1, or below the minimum speed shown in FIGURE 3-6. All vacuum ratings are based on standard atmospheric discharge. An accurate vacuum gauge and vacuum relief valve must be used as close to the blower inlet as possible.

Wet vacuum service employs a suitable liquid, normally water, injected into the system near the blower inlet to control temperature rise and increase the degree of vacuum developed. The liquid used MUST BE clean and free of foreign matter, chemical contaminants and hardness, which may cause corrosion, deposits, or damage in the rotor chamber. See FIGURE 3-4, for typical installation, and FIGURE 3-2, for water quality requirements. If the proposed water supply is questionable, or does not meet the water specification, a reputable water treatment service company should be contacted. They can recommend treatment and equipment to satisfy this specification.

pH Range at 25° C.....	6.5 ï 8.0
Conductivity at 25°C (MICROMHO/cm).....	Less than 250
Total hardness as $CaCo_3$ (ppm).....	Less than 100
Total Alkalinity as $CaCo_3$ (ppm).....	Less than 70
Chloride ion; Cl^- (ppm).....	Less than 30
Sulfate ion SO_4 ï 2 (ppm).....	Less than 50
Total iron; Fe (ppm).....	Less than 0.3
Silica; SiO_2 (ppm).....	Less than 20
Sulfide ion S^{-2} (ppm).....	0
Ammonium ion; NH_4+ (ppm).....	0

FIGURE 3-2 – WATER QUALITY REQUIREMENTS

If the injection water supply is allowed to run after blower shutdown, both the blower and adjacent discharge piping may fill with water and present a serious overload problem at the next attempted start. To prevent this, it is strongly recommended that an electric solenoid valve (normally open) be installed at the lowest point in the discharge elbow and/or connecting piping. The valve will open on blower shutdown and drain any water which might accumulate in the discharge piping. It is also recommended that a time delay be used between injection water shutoff and blower/motor shutdown to allow the interior of the blower to dry out prior to shutdown. Up to five minutes time delay may be required for larger blowers running under no load.

On wet vacuum service, temperature control and a minimum amount of rotor sealing is obtained with small quantities (1 gallon per minute) of injected liquid. Best performance is attained by using the amount of injected liquid that maintains the discharge air temperature in the range of 100°F to 150°F.

The maximum permissible liquid rate on any size machine is shown in FIGURE 3-3. DO NOT EXCEED THIS.

Liquid Rate (GPM)	9CDL13	9CDL18	9CDL23
	3	3	3

FIGURE 3-3 – LIQUID RATE

In applications where liquid carry-over from the upstream system may exceed these quantities, even for momentary periods, separation prior to blower inlet must be employed to reduce water flow to this figure or less.

Where inlet injection of water is used, it may be introduced in any convenient manner. No particular water pressure is required, only that sufficient to deliver the water to the injection point. A reliable metering device, such as a rotameter, to indicate water injection rate is supplied.

Since water injection is used primarily for discharge temperature reduction and control, overheating will occur with water shutoff or supply failure. Provisions against inadvertent water shutoff should be incorporated in every water-injected blower system.

A high discharge temperature safety shutdown switch should be used to protect the blower.

Individual system requirements will determine whether downstream (discharge side) separation of injection water may be required. Combination discharge silencers and separators are available.

See Engineering Data Sheet 37-1-432, for complete wet vacuum details.

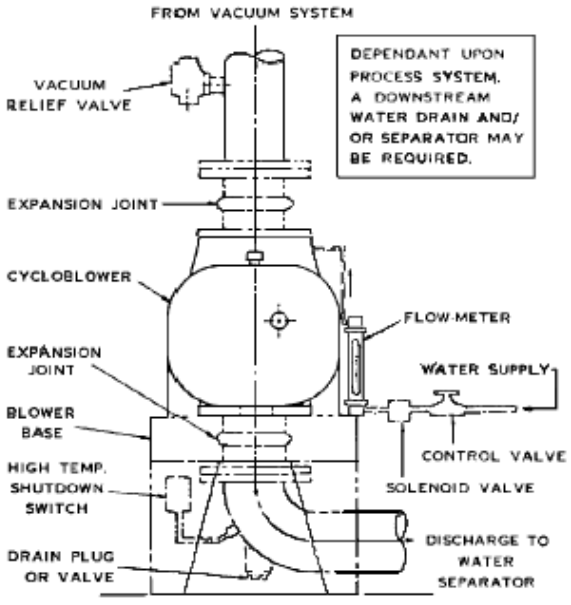


FIGURE 3-4– INLET WATER INJECTION DIAGRAM

Altitude (Feet above See Level)	Maximum Discharge Pressure*	Maximum Inlet Vacuum*
1000	19.3 PSIG	16.4 Inches Hg.
2000	18.6 PSIG	15.8 Inches Hg.
3000	17.9 PSIG	15.3 Inches Hg.
4000	17.3 PSIG	14.7 Inches Hg.
5000	16.7 PSIG	14.2 Inches Hg.

* Gauge readings are taken as close as possible to blower openings and include inlet and discharge losses. Above 5000 feet, consult the nearest Gardner Denver Compressor Division Customer Service.

FIGURE 3-5 – ALTITUDE – PRESSURE/VACUUM

ALTITUDE ï Maximum allowable discharge pressure and/or inlet vacuum with be decreased with operation at altitudes. See FIGURE 3-5.

SPEED ï Refer to FIGURE 3-1, for maximum and FIGURE 3-6, for minimum speeds. Never operate the blower below the minimum or above the maximum speed shown. There is a definite relationship between blower speed, discharge pressure and/or inlet vacuum, and the resulting discharge air temperature. Reduced speed at high pressure or vacuum can cause excessive heating which may result in rapid blower failure. For engine-driven units provide an accurate speed indicator.

Examples of minimum allowable speed at given pressures or vacuums are listed in FIGURE 3-6, as speed is reduced, pressure or vacuum must also be reduced.

EXAMPLE: Using a 9CDL13 blower, operating against 18 PSIG, minimum allowable speed is 1280 RPM.

NOTICE

Blower speed, line losses, elevation, and increased inlet temperatures will affect the maximum operating limitations.

OPERATING TEMPERATURE ï Blower air discharge temperature will increase with higher operating pressures or vacuums. Maximum allowable discharge is 355°F. Maximum allowable temperature rise is 255°F. If the discharge temperature continues to exceed 355°F., or temperature rise continues to exceed 255°F, stop the blower at once and correct the trouble.

⚠WARNING

Do not continue to run a blower that is overheating. Check the blower for damage before restarting.

Lubricating oil temperature will increase with increasing discharge air temperature. Oil temperature in the discharge end sump will exceed that in the inlet end sump. Oil sump temperatures at the discharge end in the 200 ï 250° F. range are not uncommon.

STOPPING BLOWER ï Where possible, reduce the system pressure to zero gauge before stopping the blower. To prevent backflow of foreign material into the blower on shutdown, provide a check valve in the discharge line.

On engine-driven units, idle the engine for a few minutes prior to shutdown.

EMERGENCIES ï In event of system failures, shutdown the blower immediately. Inspect the blower for foreign material backflow. If materials are found inside the blower housing, a thorough cleaning is necessary before restarting.

⚠WARNING
Do not operate a blower which is noisy, vibrating, or heating excessively.

Models	Minimum Speed (RPM) – Dry Pressure		
	Up to 15 PSIG	18 PSIG	20 PSIG
9CDL13	1050	1280	1540
9CDL18	1050	1050	1230
9CDL23	1050	1050	1300

Models	Minimum Speed (RPM)		
	Dry Vacuum	Wet Vacuum	
	Up to 17” Hg.	Up to 22” Hg.	24” Hg.
9CDL13	1185	1050	1050
9CDL18	1055	1050	1050
9CDL23	1050	1050	1050

FIGURE 3-6 – MINIMUM SPEED, MAXIMUM PRESSURE OR VACUUM

BLOWER STARTUP CHECKLIST

This startup procedure should be followed during the initial installation and after any shutdown periods or after the blower has been worked on or moved to new location. It is suggested that the steps be followed in sequence and checked off (ã) in the boxes provided.

☐ 1. Check the unit and all piping for foreign material and clean if required.

☐ 2. Check the flatness of the feet and the alignment of the drive. Feet that are bolted down in a bind can cause housing distortion and internal rubbing. Misaligned V-drives can cause the rotors to rub against the headplates and cause a reduction in the volumetric efficiency of the unit. Misaligned couplings can ruin bearings.

☐ 3. If the blower is V-belt driven, check the belt tension and alignment. Over-tensioned belts create heavy bearing/shaft loads which lead to premature failure.

☐ 4. Be sure adequate drive guards are in place to protect the operator from severe personal injury from incidental contact.

☐ 5. Check the unit for proper lubrication. Proper oil level cannot be over-emphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating and can ruin gears and cause other damage. Insure that grease lubricated bearings are properly lubricated.

☐ 6. Turn the drive shaft by hand to be certain the rotors do not bind.

☐ 7. ñJogò the unit with the motor a few times to check that rotation is in the proper direction, and to be certain it turns freely and smoothly.

☐ 8. Start the unit and operate 15 minutes at no load. During this time, check for hot spots and other indications of interference.

☐ 9. Apply the load and observe the operation of the unit for one hour. Check frequently during the first day of operation.

☐ 10. If malfunctions occur, do not continue to operate. Problems such as knocking rotors can cause serious damage if the unit is operated without correction.

SECTION 4
MAINTENANCE

GENERAL ï Blower efficiency and life depend on the quality of maintenance the blower receives. Maintenance must be done regularly and with care. Clean work space, tools, solvents, and wiping rags are necessary to avoid transferring dirt into the unit. A maintenance chart listing each blower is a valuable tool for scheduling regular checks of each unit. A good program, well carried out, will insure long trouble-free service from the blower.

LUBRICATION

Gears and bearings are splash lubricated. The discharge end sump requires 5-1/2 quarts and the gear end sump requires 5-1/2 quarts of oil. Filling with this amount of oil will bring the oil level to about the middle of the sight gauge. Add more oil if necessary to bring the level to the middle. DO NOT OPERATE THE BLOWER UNLESS OIL LEVEL IS AT THE MIDDLE OF THE SIGHT GAUGE. Do not overfill. Oil is added through the oil fill hole at the top of each bearing carrier.

RECOMMENDED LUBRICANT

AEON PD Synthetic Blower Lubricant is recommended. Refer to FIGURE 4-1, for AEON PD, AEON PD ï FG (Food Grade) and AEON PD ï XD (Extreme Duty) part numbers.

AEON PD is formulated especially for positive displacement blower service to provide maximum blower protection at most temperatures. Refer to FIGURE 4-2. One filling of AEON PD will last a minimum of 4 times longer than a premium mineral oil, depending on actual operating conditions. Order AEON PD from your Gardner Denver distributor or call Gardner Denver directly.

Convenient Package Sizes	AEON PD Part No.	AEON PD-FG Part No.	AEON PD-XD Part No.
1 quart	28G23	25H97	28G46
Case 12 quarts	28G24	28H98	28G47
1 gallon	28G40	28H333	28G42
Case 6 gallons	28G41	28H334	28G43
5 gallon pail	28G25	38H99	28G44
55 gallon drum	28G28	28H100	28G45

FIGURE 4-1 – AEON PD SYNTHETIC LUBRICANT

		Ambient Temperatures			
		Less than 10° F	**10°F to 32° F**	**32°F to 90° F**	**Greater than 90° F**
Blower Discharge Temperature	Less than 32°F	AEON PD AEON PD FG	AEON PD AEON PD FG		
	32°F to 100° F	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD AEON PD FG	
	100°F to 225° F	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD AEON PD FG
	225°F to 300° F	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD XD
	Greater than 300° F			AEON PD XD	AEON PD XD

FIGURE 4-2 – SYNTHETIC LUBRICANT CHART

If not using AEON PD synthetic blower lubricant, use turbine quality oils with rust and oxidation inhibitors, anti-foam additives and viscosities listed in FIGURE 4-3. Do not use oil that contains EP additives.

Blower Discharge Temperature	Ambient Temperature			
	Less than 10°F	10°F to 32°F**	32°F to 90°F	Greater than 90°F
Less than 32°F (0°C)	ISO 100	ISO 100		
32° F to 100° F (0° C to 38°C)	ISO 100	ISO 100	ISO 150	
100° F to 225° F (38° C to 105°C)	ISO 100	ISO 100	ISO 150	ISO 220
225° F to 300° F (105° C to 149°C)	ISO 150	ISO 150	ISO 220	ISO 220
Over 300° F (149°C)			***	***

FIGURE 4-3 – NON-SYNTHETIC LUBRICANT CHART

* For ambient temperatures less than 10° F, but not less than -20° F, the use of sump heaters, heated enclosures or synthetic lubricant is required.

** For ambient temperatures 10° F to 32° F, the use of oil sump heaters, heated enclosures or synthetic lubricant is recommended.

*** The lubricant viscosity must be 70 SUS minimum at the lubricant operating temperature.

The pour point of the lubricant should be at least 5° to 10° F below the minimum expected ambient temperature.

For continuous operation, where the lubricant temperature exceeds 200° F, synthetic lubricant is recommended.

Check the oil level at both ends of the blower daily. The oil change period is governed by operating conditions, such as load, temperature, dirt, humidity, fumes and the quality of the oil used. Under severe operating conditions the oil should be changed every 100 hours or more often. Under ideal operating conditions non-synthetic oil may be used up to 1000 hours. Use of AEON PD could extend the change interval up to 6000 hours based on a good oil analysis program. Good practice is to change the oil often enough that it appears clean and clear when drained from the sump. Oil sumps should be flushed with a clean solvent every fourth oil change. Use a solvent that is compatible with the oil being used. ALWAYS USE CLEAN CONTAINERS FOR OIL AND CLEANING SOLVENTS.

MAINTENANCE

AIR FILTERS AND FILTER-SILENCERS

⚠WARNING

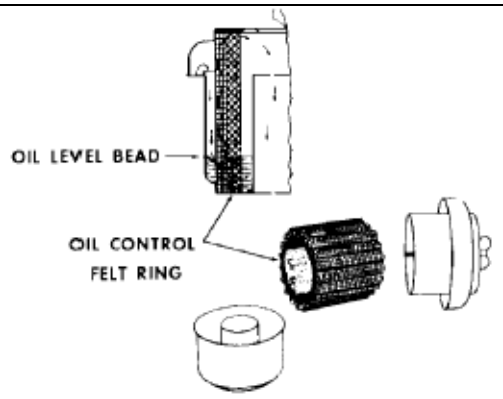
Servicing the air filters is one of the most important maintenance operations to be performed to insure long blower life.

Servicing frequency of filter elements is not time predictable. A differential pressure indicator, with a continuous gauge reading, should be installed across the inlet filter. It will tell how much of the service life of the filter element has been used. It will also eliminate both premature filter servicing and premature blower failure due to a plugged filter when the filter pressure drop is used to establish maintenance points.

In all cases refer to the filter manufacturer's service instructions. Due to the many types of filters, it is not practical to give specific instructions covering all models; however, the following paragraphs describe some of those most commonly used.

NOTICE

No matter what type of filter is used, always make sure all seals, gaskets, clamps and hose connections on the filter and inlet line are absolutely air tight. Each time the filter is serviced, inspect interior of the blower for dirt.



TEMPERATURE	OIL USED
-20° F to 0° F	Mixture of 2/3 SAE 10W and1/3 Diesel Fuel
0° to 30° F	SAE 10W
30° to 50° F	SAE 20
50° to 110° F	SAE 30
110° to 112° F	SAE 50

FIGURE 4-4 – OIL BATH FILTER

Oil Bath Filter (FIGURE 4-4) ï The following instructions also apply when the filter is equipped with a silencing chamber:

1. Remove cover, screen and bowl form the base.
2. Wash the screen and bowl.
3. Fill the bowl to oil level bead with oil listed.
4. Place the end of the screen bonded with felt down into the oil. Upside-down installation will result in heavy oil carryover.
5. Replace the cover and tighten wing nut securely.
6. Make sure all connections to the air filter are tight.

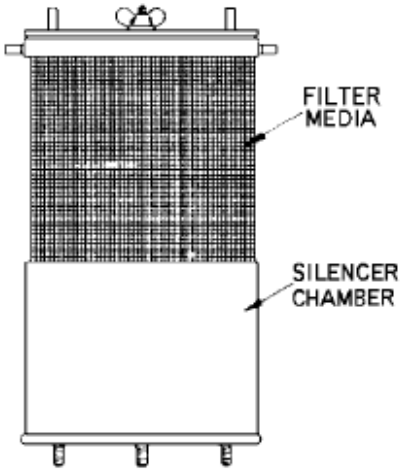


FIGURE 4-5 – OIL WETTED FILTER-SILENCER

Oil Wetted Filter-Silencer (FIGURE 4-5) ï Cleaning of the filtering media is accomplished by thoroughly washing in a commercial solvent and blowing dry with air. Blow from inside to outside to dislodge dirt particles from the finer screen sections. After the media is cleaned, recharge by dipping in oil. The filter silencer can be supplied with an all-weather hood. If an oil wetter filter without silencer is used, the service instructions in the previous section will also apply.

Dry Type Filter and Filter-Silencer (FIGURE 4-6) ï When the outside surface of the element appears to be evenly coated with dirt, it should be cleaned as follows:

1. Remove wing nuts and lift off the hood.
2. Loosen the outside retaining strap to remove the media.
3. Vibrate or blow off heavy dirt accumulation.
4. If required, wash the media in any carbon base commercial solvent and blow off the excess solvent.
5. Allow to dry and examine for damage or conditions requiring replacement.

Because the media in the dry type filter is of wool felt, it may become impregnated with oil or water, if present in any large degree. Corrosive gases may also attack the media. While such conditions are not common, they should be kept in mind.

FIGURE 4-6 – DRY TYPE FILTER AND FILTER-SILENCER

DISCHARGE SILENCER ï A drain may be provided in the silencer at the lowest point for draining condensate. Draining intervals will depend upon humidity conditions and must be established by the user.

ROTOR SHAFT SEALS ï Rotors have a labyrinth type shaft air seal to minimize air leakage along the shaft from the compression chamber. More air will leak through the seals at the discharge end since they are under higher air pressure. Excessive air leakage indicates shaft seal failure.

The air seal consists of two parts, a hardened steel bearing spacer with grooves cut into the outside diameter, and a steel-backed babbitt ring (shaft seal) pressed into the bearing carrier. The grooved end of the spacer and the shaft seal bore have a close fit when cold. When the blower reaches operating temperature for the first time, the babbitt embeds slightly into the grooves, forming a close running fit to control air leakage along shaft. No maintenance is required, except that bearing carrier removal usually will destroy the babbitt grooving and the shaft seal must be replaced. Shaft seals that have been in operation should not be reused as excessive leakage may result. The bearing spacer can be reused unless damaged. After installation of new seals, rotation of the blower may be tight for a few turns until bearing spacer grooves cut running ways into the babbitt. For seal replacement refer to Disassembly Section, page 36, and Assembly Section, page 40

BEARING OIL SEALS ï Oil leakage along each shaft from the oil sumps is prevented by a lip type seal pressed into the bearing carrier. These seals are unidirectional lip seals. The hydrodynamic spiral in the Teflon lip pumps the oil back into the sump. Usual causes of seal failure are: high temperature, rough surface on bearing spacer, damage during installation, and improper seal used. The radius at the end of the bearing spacer and O.D. should be highly polished to prevent seal lip damage during installation. Use only seals shown in parts list as they have been selected for blower service. They must be installed in the correct location and with the proper orientation or the oil will be pumped out of the pump. Rotation arrows and color coding are used to distinguish clockwise seals from counterclockwise seals, see FIGURE 7-13, Assembly Instructions page 44.

PERIODIC INSPECTIONS ï A well-organized maintenance program will provide for periodic inspection of the blower, drive and components. These inspections may prevent major repair and downtime.

1. Observe the blower for vibration, heating, noise, oil seal leaks, and excessive shaft air leaks.
2. Check for proper operation of the filters, coupling, drive, power unit, relief and check valves, gauges and other controls.
3. Disconnect the drive and turn the blower by hand to check for drag, tight spots, bearing wear (radial and axial) and gear backlash. Rotation should be free with no indication of drag or metallic interference.
4. Inspect the interior through the inlet or discharge port for cleanliness, corrosion or parts contact.

⚠WARNING

Rotating components will cause severe injury in case of personal contact. Keep hands sway from the blower inlet and discharge ports.

5. Check tightness of all screws and bolts.

SOME COMMON CAUSES OF BLOWER FAILURE

1. Poor air filter maintenance or incorrect selection.
2. Inadequate lubrication (wrong, dirty or low oil).
3. Backflow of materials into the blower.
4. Discharge pressure or inlet vacuum above blower rating.
5. Blower speed below minimum rating.
6. Blower speed too low for discharge pressure or inlet vacuum.

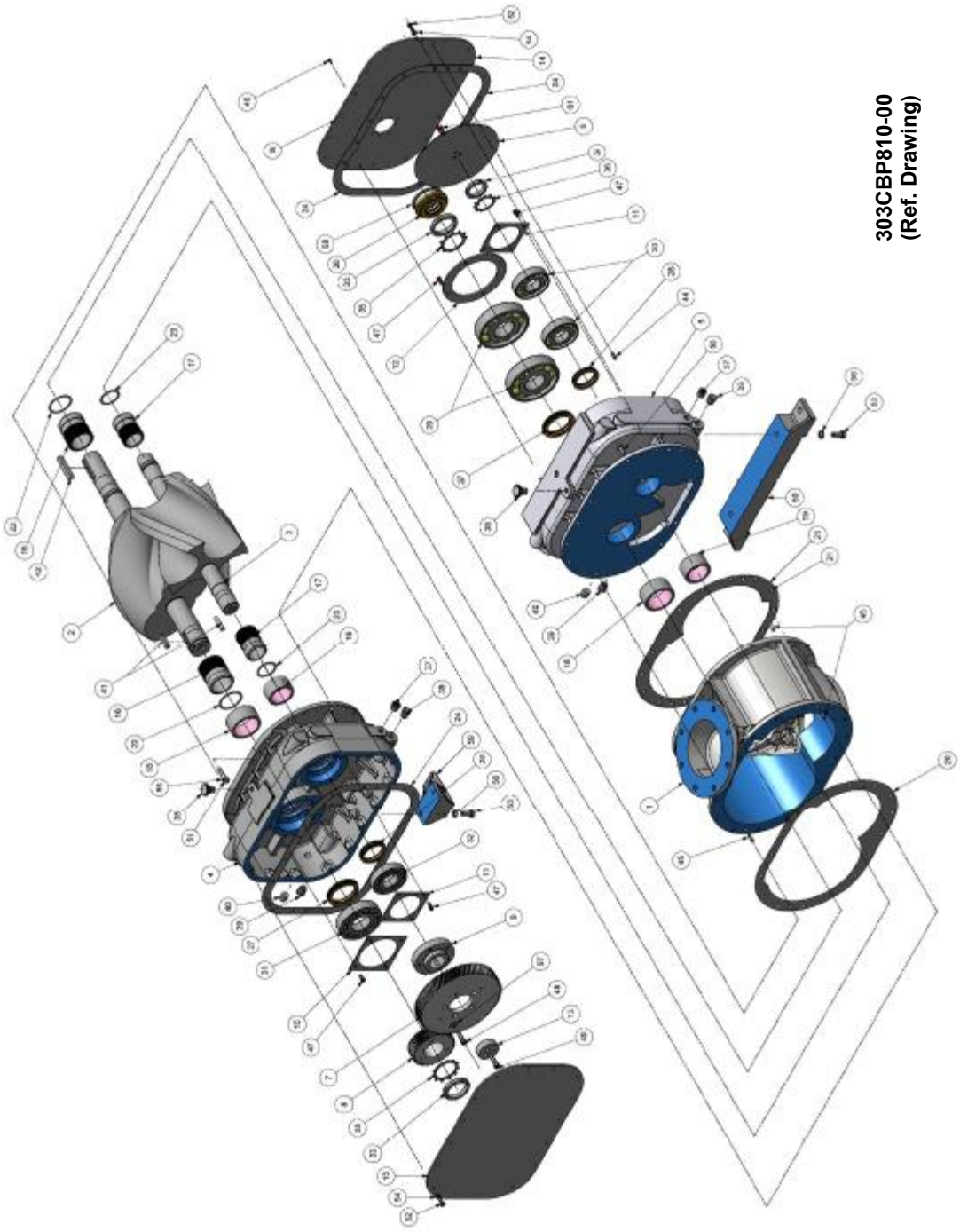
BLOWER OVERHAUL ï Refer to Disassembly Section, page 36, and Assembly Section, page 40.

REPAIR PARTS ï When ordering parts, specify Blower Model, Size and Serial Number.

Reference numbers shown in the left hand column of the parts list are used to help locate parts shown on the drawing and sectional view. DO NOT ORDER BY REFERENCE NUMBERS.

After locating the reference number, the part number may be found for your particular blower under the correct Model Number Column. Specify exactly the number of parts required (see column ñQty.ò). DO NOT ORDER BY SETS.

Teflon is a register trademark of DuPont



303CBP810-00
(Ref. Drawing)

FOR LIST OF PARTS SEE PAGES 32 & 33.

Order by Part Number and Description. Reference Numbers are for your convenience only.

Ref. No.	Name of Part	Qty.	Model 9CDL13R	Model 9CDL18R	Model 9CDL23R
1	HOUSING	1	300CBP002	301CBP002	302CBP002
	ROTOR GROUP (Includes Items 2 & 3)	1	200CBP010B	203CBP010A	205CBP010A
2	ROTOR ï MAIN				
3	ROTOR ï GATE				
4	BEARING -- CARRIER, Inlet End	1	8502791	8502791	8502791
5	BEARING -- CARRIER, Discharge End	1	327CBP006	326CBP006	325CBP006
6	SLINGER ï OIL	1	8500421	8500421	8500421.
	GEAR KIT, Includes Ref. No. 7 & 8	1	300CBP6008	300CBP6008	300CBP6008
7	GEAR PINION				
8	GEAR				
9	HUB ï GEAR	1	8500338	8500338	8500338
10	PLATE -- BEARING CLAMP	1	8500291	8500291	8500291
11	PLATE -- BEARING CLAMP	2	8500290	8500290	8500290
12	PLATE -- BEARING CLAMP	1	300CBP205	300CBP205	300CBP205
13	PLATE -- SHAFT CLAMP	1	8500416	8500416	8500416
14*	COVER ï END	1	8502796	8502796	8502796
15**	COVER ï END	1	8502797	8502797	8502797
16	SPACER ï BEARING	2	8500037	8500037	8500037
17	SPACER ï BEARING	2	8504506	8504506	8504506
18	SEAL -- ROTOR SHAFT	2	8500390	8500390	8500390
19	SEAL -- ROTOR SHAFT	2	8500389	8500389	8500389
20	SHIM ï HOUSING	1	8502896	8502896	8502896
21	SHIM -- HOUSING SET	1	8502890	8502890	8502890
22	SHIM -- SHAFT SET	2	8500257	8500257	8500257
23	SHIM -- SHAFT SET	2	8500253	8500253	8500253
24	GASKET ï COVER	2	8502800	8502800	8502800
25	ADAPTOR ï SEAL	1	8500034	8500034	8500034
26 *	SEAL ï OIL	1	60DD709	60DD709	60DD709
27	SEAL ï OIL	1	301CBT199	301CBT199	301CBT199
28	SEAL ï OIL	1	304CBP199	304CBP199	304CBP199
29	BEARING -- ANGULAR CONTACT	2	8500410	8500410	8500410
30	BEARING -- ANGULAR CONTACT	2	8500408	8500408	8500408
31	BEARING ï ROLLER	1	8501202	8501202	8501202
32	BEARING ï ROLLER	1	8501201	8501201	8501201
33	LOCK NUT ï BEARING	2	50Z15	50Z15	50Z15
34	LOCK NUT ï BEARING	1	50Z12	50Z12	50Z12
35	LOCK WASHER ï BEARING	2	95N15	95N15	95N15
36	LOCK WASHER ï BEARING	1	95N12	95N12	95N12
37	GAUGE -- OIL LEVEL	2	40P45	40P45	40P45
38	BREATHER ï CRANKCASE	2	5L223	5L223	5L223
39	PLUG ï MAGNETIC	4	64BJ4	64BJ4	64BJ4
40	PLUG -- SQHD PIPE	2	64AA3	64AA3	64AA3
41	KEY ï SQUARE	2	8500116	8500116	8500116

Order by Part Number and Description. Reference Numbers for your convenience only. *

Ref. No	Name of Part	Qty.	Model 9CDL13R Part No.	Model 9CDL18R Part No.	Model 9CDL23R Part No.
42 *	KEY ï SQUARE	1	8502822	8502822	8502822
43 *	PIN ï DOWEL	2	62M3	62M3	62M3
44 *	PIN ï DOWEL	2	62M50	62M50	62M50
45	PIN ï DOWEL	4	62M97	62M97	62M97
46 *	SCREW -- SOC HD LOCK	4	75P12P	75P12P	75P12P
47	SCREW -- SOC HD LOCK	16	75P6N	75P6N	75P6N
48	SCREW -- SOC HD LOCK	5	75P2P	75P2P	75P2P
49	SCREW -- SOC HD LOCK	3	75P77P	75P77P	75P77P
50	SCREW -- HEX HD	24	655EE060	655EE060	655EE060
51	SCREW -- HEX HD	8	655EE080	655EE080	655EE080
52	SCREW -- HEX HD	32	655ED04N	655ED04N	655ED04N
53	SCREW -- HEX HD	4	655EF060	655EF060	655EF060
54	WASHER ï LOCK	32	95B3	95B3	95B3
55	WASHER ï LOCK	32	95B5	95B5	95B5
56	WASHER ï LOCK	4	95B7	95B7	95B7
57	WASHER ï PLAIN	5	95W49	95W49	95W49
58 *	GASKET -- SEAL ADAPTOR	1	8500146	8500146	8500146
59	FOOT ï SUPPORT	1	8501089	8501089	8501089
60	FOOT ï SUPPORT	1	8502798	8502798	8502798
61	SCREW -- SOC HD LOCK	3	75P73N	75P73N	75P73N
87	SEALð OIL	1	300CBT199	300CBT199	300CBT199
88	SEALð OIL	1	305CBP199	305CBP199	305CBP199
89 *	SLEEVE ï WEAR	1	80M23	80M23	80M23
94	SHIM SET ï BEARING RETAINER	1	300CBP732	300CBP732	300CBP732

* Double the quantity required for optional double extended drive shaft construction.

** Delete for double extended driveshaft construction.

NOTE: All part numbers, as listed, are for the standard top inlet construction. For units built with optional top discharge construction, all parts are the same except bearing carriers.
Order as follows:

Ref. No 4, Inlet End Bearing Carrier ï Part No. 8502906;
Ref. No. 5, Discharge End Bearing ï Part No. 8502907 for Model 9CDL13R
Part No. 8502908 for Model 9CDL18R
Part No. 8502909 for Model 9CDL23R

OVERHAUL KIT -- 311CBP6010

	Description	Qty.	Part Number
	Installation Sleeve For Oil Seal	1	303CBP074
	Installation Sleeve For Oil Seal	1	304CBT074
	Installation Sleeve For Oil Seal	1	305CBP074
	Bearing Spacer	2	8500037
	Bearing Spacer	2	8504506
	Shaft Air Seal	2	8500390
	Shaft Air Seal	2	8500389
	Housing Shim	1	8502896
	Housing Shim Set	1	8502890
	Shaft Shim Set	2	8500257
	Shaft Shim Set	2	8500253
	End Cover Gasket	2	8502800
	Shaft Oil Seal	1	307CBP199
*	Bearing Oil Seal	1	306CBT199
*	Bearing Oil Seal	1	304CBP199
	Ball Bearing (Angular Contact)	2	8500410
	Ball Bearing (Angular Contact)	2	8500408
	Roller Bearing (Cylindrical)	1	8501202
	Roller Bearing (Cylindrical)	1	8501201
	Bearing Lock Nut	2	50Z15
	Bearing Lock Nut	1	50Z12
	Bearing Lock Washer	2	95N15
	Bearing Lock Washer	1	95N12
	Screw ï Socket Head Lock	4	75P12N
	Screw ï Socket Head Lock	16	75P6N
	Screw ï Socket Head Lock	5	75P2N
	Screw ï Socket Head Lock	3	75P77N
	Timing Washer	5	95W49
	Seal Adaptor Gasket	1	8500146
	Screw ï Socket Head Lock	3	75P73N
*	Bearing Oil Seal	1	300CBT199
*	Bearing Oil Seal	1	305CBP199
	Parts List and Service Manual	1	37-1-615
	Shim Set ï Bearing Retainer	1	300CBP732

IMPORTANT: For spare parts requirement in remote areas, export or where more than one unit is operating, a spare gear set is recommended. For 9CDL Series, order Gear Kit part number 300CBP6008.

NOTE: Overhaul Kit is recommended for spare parts and/or scheduled maintenance or overhaul requirements. The oil seal installation sleeves are reusable. The Overhaul Kit without the installation sleeves is part number 310CBP6010.

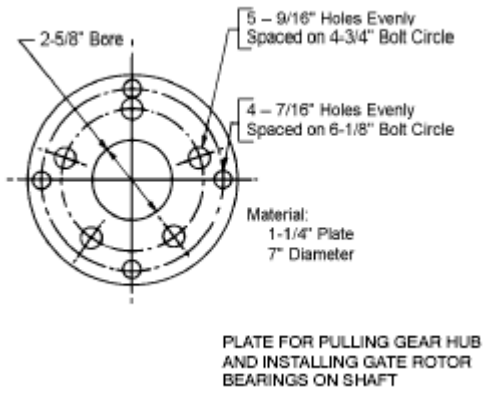


FIGURE 6-1 – ADAPTOR PLATE

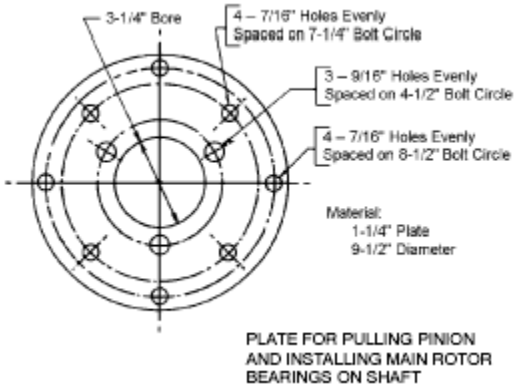


FIGURE 6-2 – ADAPTOR PLATE

NOTICE
Illustrations for Disassembly Instructions are taken from various sizes of CycloBlower. Minor variations in construction of some parts need cause no concern.

1. Provide adaptor plate, Figure 6-1, for pulling the gear hub (9), and for installation gate rotor bearings (29, 32).

NOTICE
Numbers in parentheses ( ) refer to key numbers in assembly drawings on pages 31 & 32

2. Provide adaptor plate FIGURE 6-2, for pulling pinion gear (7) and for installation of the main rotor bearings (30, 31).

FIGURE 6-3– SPANNER WRENCH

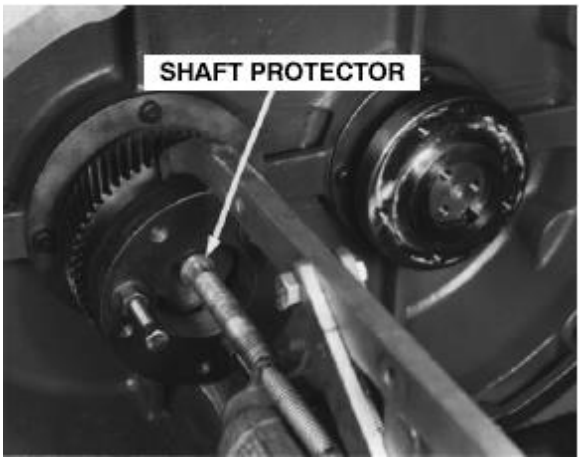


FIGURE 6-4 – ADAPTOR PLATES

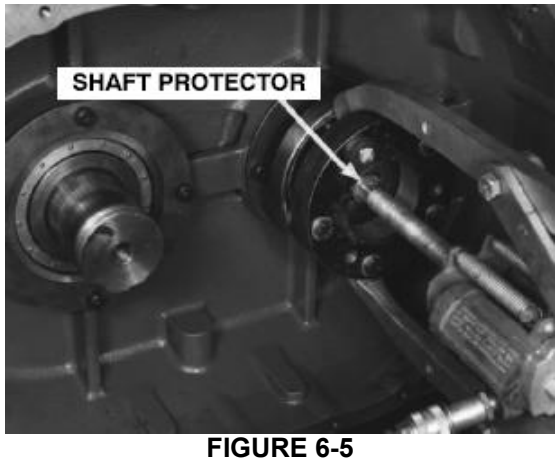


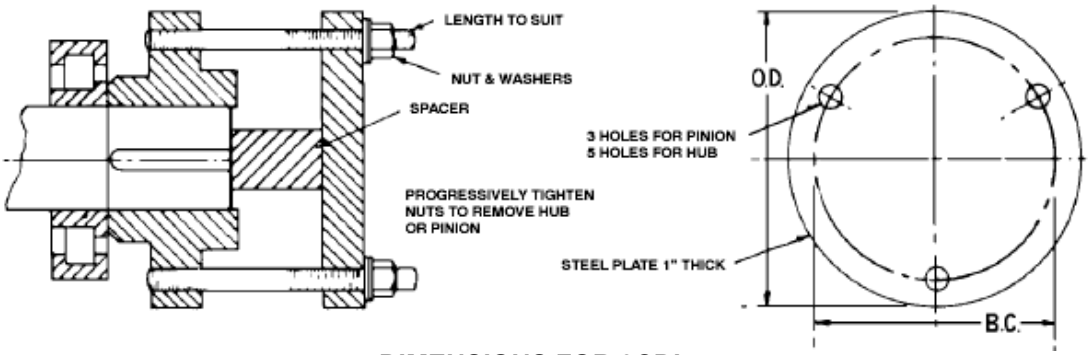
FIGURE 6-5

The adaptor plates shown are designed for a jaw type hydraulic puller, FIGURE 6-4 and FIGURE 6-5. Other type pullers are available, and if used, suitable adaptor plates should be provided.

⚠WARNING

Pulling directly on pinion teeth will damage teeth making timing difficult and will cause gear wear. Pulling directly on the gear hub flange will distort the flange causing gear run-out..

3. Place the unit in a horizontal position, on a solid blocking, so the gear end bearing carrier (4) hangs free. Drain oil from both carriers. At the gear end remove the cover (15), hub retainer plate (13), gear (8) which has slip fit on hub (9) and pinion locknut and lockwasher (33, 35). A spanner wrench similar to that shown in FIGURE 6-3, should be made to prevent damaging the locknut. This wrench is especially useful at assembly in saving time, and more important, assures proper tightening of the nuts.
4. Mount the adaptor plate (FIGURE 6-2) and puller (FIGURE 6-4), and pull the pinion (7). Be sure to use a shaft protector to prevent damage to the end of the shaft. Remove the key (41) from the shaft.
5. Mount the adaptor plate (FIGURE 6-1), and puller (FIGURE 6-5), and pull the gear hub (9). Use a shaft protector. Remove the key (41) from the shaft.
6. If a hydraulic or mechanical puller is not available, the hub and pinion may be pulled as shown in FIGURE 6-6.



DIMENSIONS FOR 9CDL

PINION				GEAR HUB			
O.D.	B.C.	Holes	Stud	O.D.	B.C.	Holes	Stud
5-3/4ò	4-1/2ò	(3) 9/16ò	1/2ò 13 UNC	6ò	4-3/4ò	(5) 9/16ò	1/2ò- 13 UNC

FIGURE 6-6 - ALTERNATE ADAPTOR PLATES

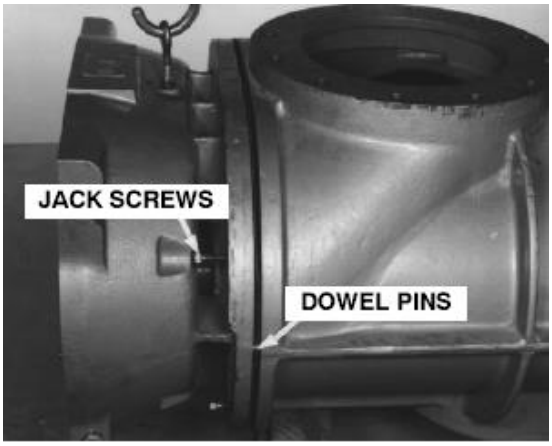


FIGURE 6-7

FIGURE 6-8

7. Remove all gear end bearing carrier to housing screws (50, 51) and lockwashers (55). With four jack screws in tapped holes in the carrier flange, FIGURE 6-7, pull the carrier. This also pulls bearings from the rotor shaft. Tighten jack screws evenly to prevent binding carrier on dowel pins and bearings. Support the carrier so it does not drop and damage shaft extensions. When the carrier is free, remove the bearing retainers (10, 11), bearings (31, 32), lip type oil seal (87, 88) and shaft seals (18, 19). If the bearings are to be used, handle with care.

⚠WARNING

Do not use a torch to heat the pinion to aid in removal. The pinion can be damaged by concentrated heat.

NOTICE

Never reuse shaft seals that have been in operation. Refer to "Rotor Shaft Seal," page 29.

8. Remove the discharge end carrier cover (14), oil slinger (6), bearing locknut (33, 34), and lockwashers (35, 36), bearing clamp plates (11, 12) and bearing clamp plate shims (94). See FIGURE 6-8.
9. Rig the adapter plates (shown in FIGURE 6-1 and FIGURE 6-2), and the puller shown in FIGURE 6-9, and press the rotor shaft through the bearing. Use a shaft protector. Be sure the bolts holding the plate are threaded into the tapped holes of the bearing housing far enough to prevent stripping of the threads, and evenly adjusted so the plate is square with the shaft. Press one rotor through the bearing at a time, then proceed to Step 10.

FIGURE 6-9

10. When the rotor shaft is free of bearings, work the rotor through the housing (1) and rig a sling to complete removal of the rotor from the housing, **Error! Reference source not found.**. Handle with care to prevent burrs on rotors and housing. Repeat Steps 9 and 10 on the second rotor.

11. After removal of the rotors (2, 3), rearrange blocking so the discharge end bearing carrier (5) hangs free. Remove all screws and jack the carrier evenly from the dowel pins, **Error! Reference source not found.**. Support the carrier as it is removed.

    Remove bearings (29, 30), lip type oil seal (27, 28) and rotor shaft seals (18, 19).

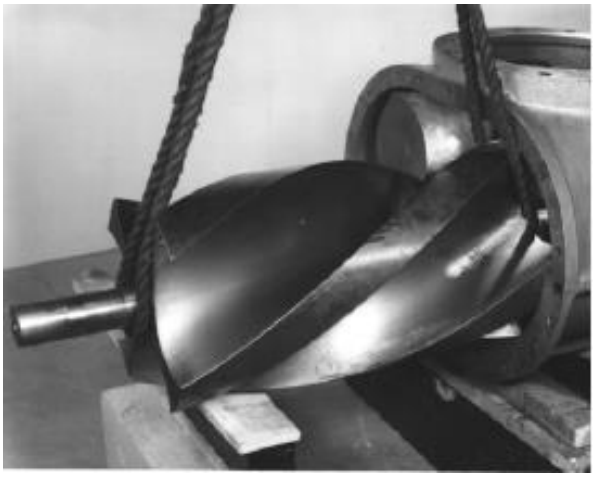


FIGURE 6 10

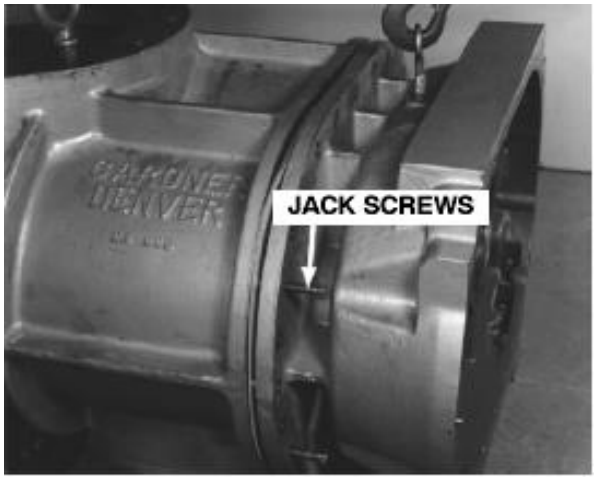


FIGURE 6-11

SECTION 7
ASSEMBLY INSTRUCTIONS

NOTICE
Illustrations for Assembly Instructions are taken from variations in construction of some parts should not cause concern.

NOTICE
Numbers in parentheses ( ) refer to key numbers in assembly drawings on pages 31 and 32.

The CycloBlower® is manufactured with close tolerances for efficient operation. All parts must be handled carefully to prevent burrs which will give false clearance readings and/or rapid wear.

All parts and oil passages must be thoroughly cleaned of dirt which will cause galling of close running parts. Clean work area, washing tank, tools, and wiping rags must be provided.

Refer to Parts List, Section 5 pages 31 and 32, for sectional views showing complete assembly of parts.

NOTICE
The following illustrations are of a standard blower with top inlet, bottom discharge, main rotor discharge end drive. Some variations will be noticed in the following illustrations for blowers of other arrangements.

There may be cases where foreign materials have entered the blower, or other causes have resulted in galling of the rotor ends, carrier faces, rotor lobes, or housing walls. Since the blower is designed with no contact of parts within the rotor chambers, these parts may be cleaned and polished for reuse unless galling is severe. Reuse of parts severely galled may result in loss of blower efficiency. All damaged parts which have been reworked should be checked for run-out or warpage before reuse.

Assembly of the ñRòSeries CycloBlower differs from earlier models in the approach to installing the oil seals. On previous models the installation of the lip seals into the bearing carriers was the first step in the assembly process. This was acceptable for seals with compliant lips but the hydrodynamic lip seals are made of Teflon and could be damaged by mishandling. On the ñRòSeries, the lip seals are not installed into the bearing carriers until after the rotors have been assembled. This requires that the lip seal is slipped over the rotor shaft so a hollow cylindrical pusher is needed as well as a short installation sleeve.

1. Oil the O.D. of the rotor shaft seals (18, 19) to prevent seizure and press into each bore of the carrier (5) (FIGURE 7-1). NEVER REUSE SHAFT SEALS. Refer to ñRotor Shaft Seals,ò page 29, for an explanation. A simple press utilizing a bolt and two bars, one across the seal and one underneath across the bearing bore, is an effective method for installing the seal. Tightening the nut on the bolt presses the seal into place. Press the seal .010ò to .015ò below the face of the carrier to prevent the end of the rotor from rubbing the end of the seal. A simple method is to place a .010ò to .015ò shim on the end of the seal under the press bar which will allow the seal to be pressed the correct distance below the face of the carrier. Handle the seal with care to prevent damage to the babbitt lining.
2. To ease assembly in later steps, fit the bearing spacers (16, 17) to the seals (18, 19) (FIGURE 7-2). Be sure there are no burrs on the spacer O.D. and seal I.D. The spacer should be SLIP FIT in the seal. A sloppy fit will cause excess air leakage and decrease blower efficiency. Do not drive the spacer through the seal as damage to the babbitt will result. It may be necessary to polish high spots from the seal I. D. to allow slip fit of the spacer. USE CROCUS CLOTH, not emery cloth.

   Inspect polished area of the spacer. Any imperfections may result in oil seal leakage. When spacers are fitted, apply Loctite 620 to the gear end shaft extension of the rotor in the area where the spacer will be located. Slide the spacer on the shaft extension with grooved end toward the rotor.

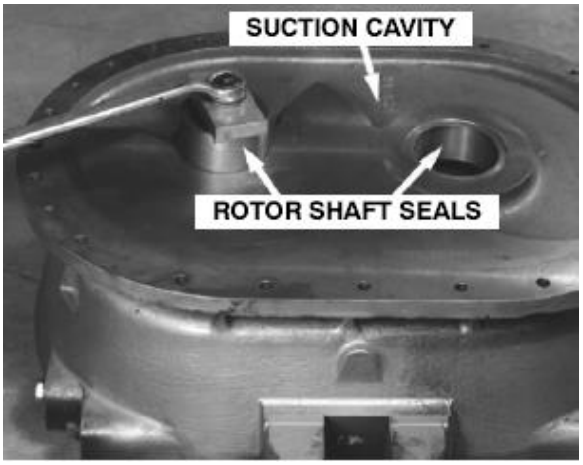


FIGURE 7-1

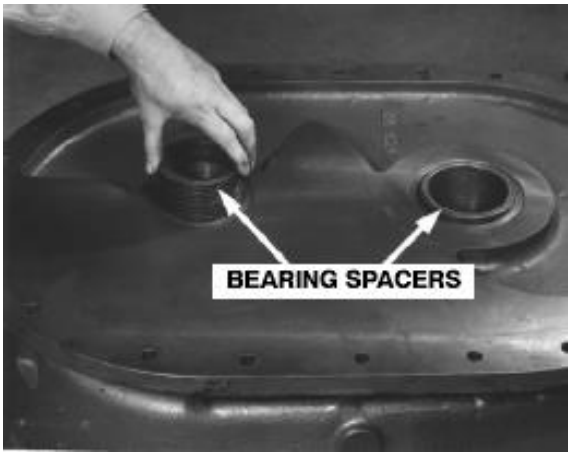


FIGURE 7-2

With the spacer seated against the face of the rotor, spin the spacer on the shaft several times to evenly spread the Loctite 620. Make sure there are no burrs on either end of the spacer or end of the rotor. Place tape around the shaft to prevent the spacer from sliding off as shown in FIGURE 7-4.

3. Place .030ò thick aluminum shim (20) on the gear end bearing carrier (4). The pointed section of the shim is positioned on the machined surface of the carrier to match the contour of the housing. Lower the housing (1), as level as possible, onto the carrier with the discharge opening up (FIGURE 7-3), and the inlet opening matching the cavity side (FIGURE 7-1), of the carrier. Engage the dowel pins (45) with matching holes in the carrier with care. Tighten the gear carrier (4) end bearing to housing (1) with screws (50, 51)and lockwashers (55) evenly so the dowel pins will not be damaged.
4. Coat the inside of both shaft seals (18, 19) and the grooved end of the bearing spacers (16, 17) with ñMolyò type grease for seal break-in purposes. Be sure the ends of the rotors (2, 3) and machined face of the carrier are free of burrs and dirt. The easiest method of assembly is to lower the gate rotor into the housing first (FIGURE 7-4). The gear end shaft extension of the rotors, with the bearing spacer installed in Step 2, goes down. Rotors must be suspended plumb when lowering so the shaft extension and bearing spacer can be carefully guided through the close fit of the shaft seal without damage to the babbitt lining.

NOTICE
If rotors are installed in reverse of above instructions, the gate rotor bearing spacer O.D. will drag on the main rotor lobe and be damaged.

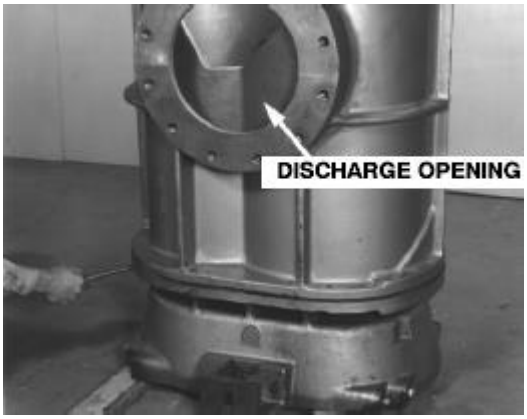


FIGURE 7-3

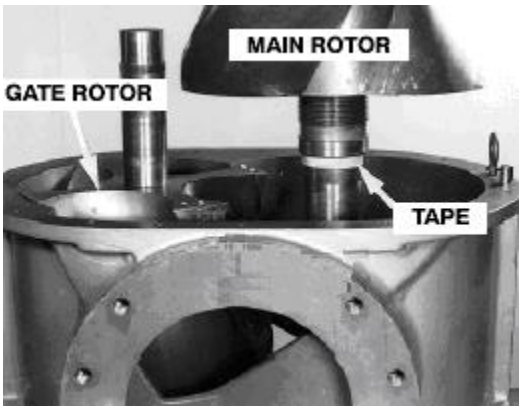


FIGURE 7-4

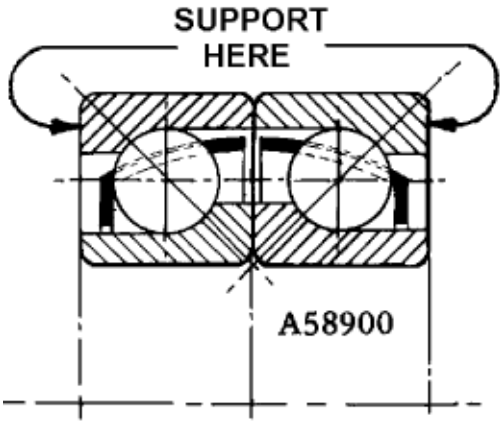


FIGURE 7- 5 – ANGULAR CONTACT BEARING ASSEMBLY

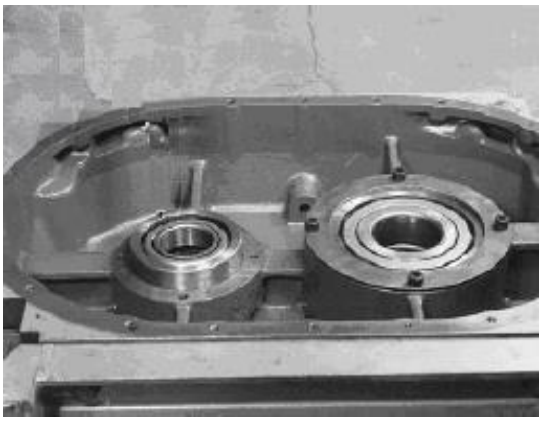


FIGURE 7-6

The CycloBlower is designed for no metal-to-metal contact with parts within the housing. To achieve this, some preliminary measurements are necessary before completing the assembly. **The first set of measurements are used to determine the shaft shim set thickness necessary for positioning the rotors in the housing to give the required clearance between the end of the rotors and the carrier face at the discharge end.** End clearance is maintained at the discharge end by two angular contact bearings, bearing spacer and shim set. The shaft shim set is determined as outline in Step 5 thru 8.

5. Install the shaft seal (18, 19), and fit the bearing spacers (16, 17) in the discharge end bearing carrier (5) using the same method as outlined in Steps 1 and 2, page 40. To prepare for shim set measurement, slip bearings into the bore and install bearing retainer plate (11, 12), FIGURE 7-6. **Bearing must be assembled as directed in Step 6**. Bearings are slip fit in the bore.

6. The angular contact bearings (29, 30) must be assembled as shown in FIGURE 7- 5, to assure a "fixed" bearing. The marked face of the inner bearing is placed down in the bearing bore; the marked face of the outer bearing is placed up.

7. Inspect bearing spacers for burrs on either end and polished area of O.D. Slip bearing spacer through the shaft seal with the polished end toward the bearing. Make sure the spacer is resting solidly against the bearing. With depth micrometer, measure the distance from the face of the carrier to the end of each of the bearing spacers, FIGURE 7-7.

8. To the micrometer reading add the discharge end clearance shown in the clearance chart, FIGURE 7-8, and .002 for crush fit of shims and parts. This sum gives the thickness of the shaft shim set (22, 23) for positioning the rotor the required distance from the face of the carrier for running clearance at the discharge end.

EXAMPLE FOR 9CDL18 BLOWER: Micrometer reading of .015òplus .009òdischarge end clearance, FIGURE 7-8, plus .002òcrush gives shaft shim set thickness of .026ò Figure shaft shim set for each rotor and record measurements which will be used later in the assembly under Steps 15 and 16.

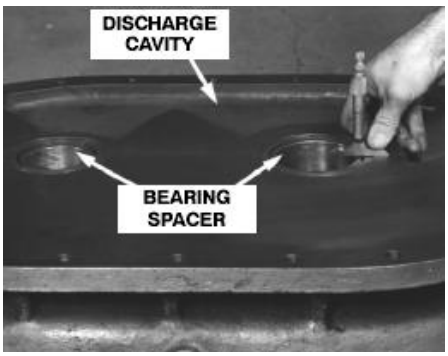


FIGURE 7-7

The second set of measurements is used to determine total end clearance. To give proper rotor end clearance at both suction and discharge ends (referred to as total end clearance) the distance between the face of the bearing carriers must be equal to the rotor length plus both end clearances. Total end clearance is obtained by adding shims (21) as required between the flange of the housing (1) and the discharge end bearing carrier (5). The thickness of the shim set is determined as outlined in Steps 9 & 10.

Models	Total End Clearance (Suction & Discharge)	Suction End	Discharge End
9CDL13	.025	.016	.009
9CDL18	.032	.023	.009
9CDL23	.038	.029	.009

Dimensions are for Ideal Clearances. Allow +/- 0.001 for Tolerance

FIGURE 7-8 – ROTOR END CLEARNACE CHART (UNIT COLD)

9. With a depth micrometer (FIGURE 7-9) measure the distance from the end of the rotor lobes (2, 3) to the end of the housing (1). Rotate rotors to check each lobe and record the **largest micrometer reading**. If the measurement varies more than .005ò remove the rotors and check for burrs on the gear end carrier face and the end of the rotors. To the largest micrometer reading add the Total End Clearance shown in the clearance chart, FIGURE 7-8, plus .002òfor crush fit, to determine the thickness of the shim set.

   EXAMPLE FOR 9CDL18 BLOWER: Micrometer reading of .005òplus .032òtotal end clearance plus .002òfor crush gives a shim set thickness of .039ò

10. Select the correct thickness of aluminum shims to give the shim set established in Step 9. Check the thickness of the shims with an outside micrometer (FIGURE 7-10). Place the shims on the end of the housing (1), matching the pointed section of the shims with the contour of the housing. Remove bearing spacers from the discharge end bearing carrier, FIGURE 7-7. If measurements in Step 8 differ, make sure the bearing spacer is placed over its respective shaft extension to assure proper end clearance of each rotor. Apply Loctite 620 to the shaft extension of the rotor in the area where the spacer will be located. Slide spacers over the shaft extensions, grooved end toward the rotor. Be sure the spacer fits solidly against the rotor.

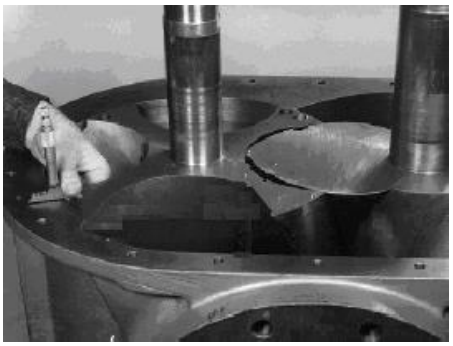


FIGURE 7-9

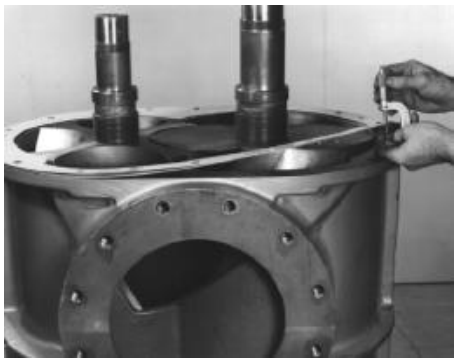


FIGURE 7-10

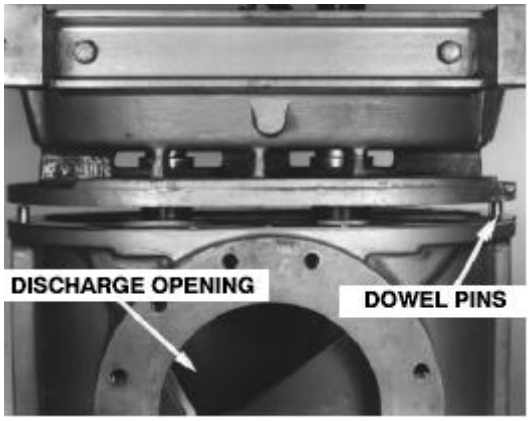


FIGURE 7-11

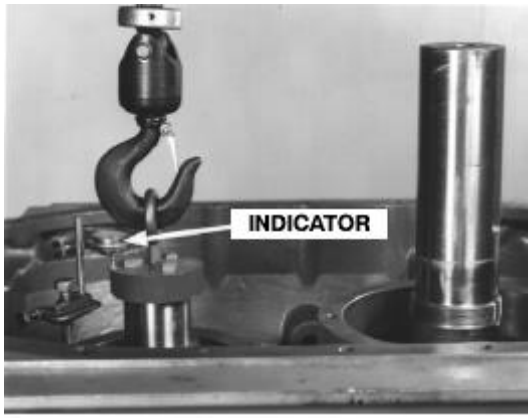


FIGURE 7-12

11. Coat the I.D. of the shaft seals in the discharge end bearing carrier with ñMolyòtype grease. Remove bearings from the carrier. Tag bearings so they will be reassembled in the same bearing bore from which the measurement was made. Match the cavity of the carrier, FIGURE 7-7, with the discharge opening of the housing FIGURE 7-11, and lower the carrier, suspended plumb, in place on the housing. Be careful not to damage I.D. of the shaft seal by the shaft extension. Be sure there are no shaft shims in place during this operation as sharp edges of shims will damage the seals. Tighten the carrier (5) to housing (1) with screws and lockwashers (50, 55) evenly to prevent damage to dowel pin holes.

12. With the dial indicator attached as shown in FIGURE 7-12, check the total end clearance. Set the indicator on zero and lift the rotor with a hoist until the end of the rotor strikes the face of the discharge end bearing carrier. The reading of the indicator will be the total end clearance and should match dimensions listed in the clearance chart, FIGURE 7-8. If the indicator reading differs from the chart and allowable tolerance, repeat Step 11 and 12 as well as check for burrs giving false readings.

NOTICE
Due to allowable machining tolerance of the rotor lengths, there may be cases where one rotor will be within limits and the other slightly over or under.

13. All internal oil seals are directional lip seals. They must be installed in the correct location and with proper orientation.

    Apply RTV sealant below the o-ring. Expulsion port positioned towards the bottom of the unit.

14. Using the correct installation tool, press the seal down into the bore. Verify that the seal face is below the bearing spacer face. Repeat for other shaft.

15. With micrometer, FIGURE 7-14, measure the thickness of shaft shim sets (22, 23) established in Step 5 thru 8. Be sure shims are clean of dirt and oil for true measurement.

16. Check the end of the bearing spacer for dirt and burrs. Be sure the bearing spacer is solid against the rotor. Slide shim set (22, 23) over the shaft extension, FIGURE 7-15, up against the end of the bearing spacer.

17. Lightly coat the shaft extension and bearing bore with oil. Assemble bearings, as shown in FIGURE 7- 5, on the shaft. Assemble the press plates (refer to FIGURE 6-1 and FIGURE 6-2 in Disassembly Section, page 36), on the bearing and install the jack screws, FIGURE 7-16. Progressively tightening nuts on the jack screws presses bearings in place. To prevent possible damage to threads on the shaft, press one bearing over the shaft into the bore at a time, rather than with both bearings stacked together. When the first bearing is flush with the top face of the bore, the second bearing may be started. Tighten nuts on the jack screws evenly to prevent cocking of the bearings on the shaft and in the bore.

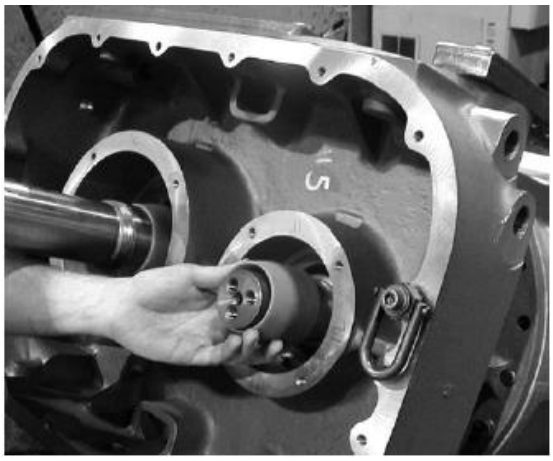


FIGURE 7-13

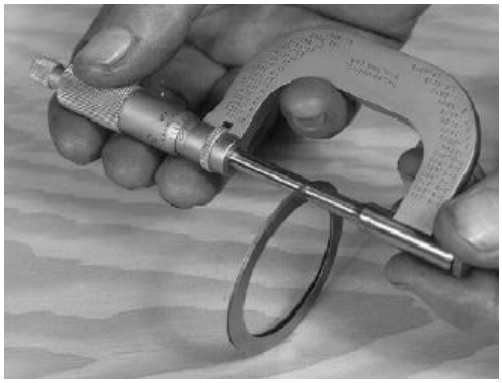


FIGURE 7-14

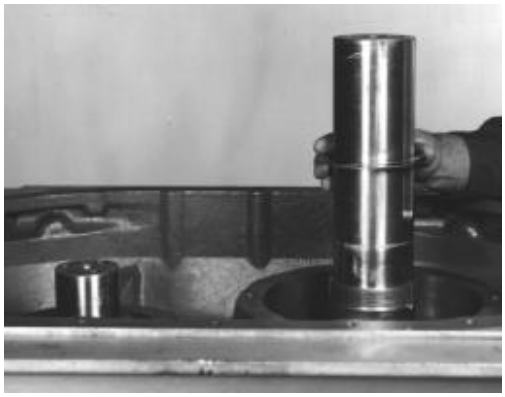


FIGURE 7-15

NOTICE
It is not recommended to hammer bearings of this size in place.

18. Install lockwashers (35, 36) and bearing retainer nuts (33, 34) on both shafts and drive up tight. This operation pulls the rotor shaft through the bearings until the shaft shims and bearing spacer are clamped solidly between the rotor end and bearing, assuring a fixed position of the rotor. **This is an important step in the assembly.** The best method for tightening the nuts is with a wrench of the type shown in Disassembly, Figure 6-3. Tighten the main rotor nut (33) to 230-250 ft-lb and tighten the gate rotor nut to 130-150 ft-lb.

    Making sure the bearings are properly seated, measure the height the outer race of the main rotor bearing (30) extends above the bearing carrier surface (5) with a depth micrometer. Measure the height in at least four places around the circumference of the outer race. Establish required shim thickness under the main rotor bearing retainer (12) by taking the average of the measurements and subtracting 0.004òfrom the average measured height. (Required Shim Thickness = Average Measured Height ï 0.004ò) Select a maximum of four shims from the shim kit (94) as required to obtain the required calculated shim stack thickness at each screw location. Using a micrometer, measure each stacked shim thickness to insure the thickness is within +0.001/-0.000 of the required calculated thickness for each screw location. Install main rotor bearing retainer (12) with the required shim stack between the bearing retainer and the bearing carrier at each of the four ñNylokòtype screw (47) locations. Tighten screws to 51-58 ft-lb.

    Install bearing retainer plate (11) on the gate rotor with the four ñNylokòtype screws (47), Figure 7-18. Tighten screws to 51-58 ft-lb.

19. Check the discharge end clearance of the rotor with a feeler gauge through the discharge opening, FIGURE 7-18. Also check rotor end clearance at the inlet end through the inlet opening. Clearance should match those listed in the chart, FIGURE 7-8, keeping in mind the allowable tolerance and possible .002òvariation in rotor lengths. Never allow rotors to run closer than allowable tolerance. Wider clearance will not result in blower failure but may affect efficiency. If the discharge end clearance is too great, make sure the bearing retainer plate is tight, holding bearing solidly against the end of the rotor, Step 18. If clearance is too close, remove the discharge end carrier and repeat the steps to establish shaft shim sets and total end clearance.

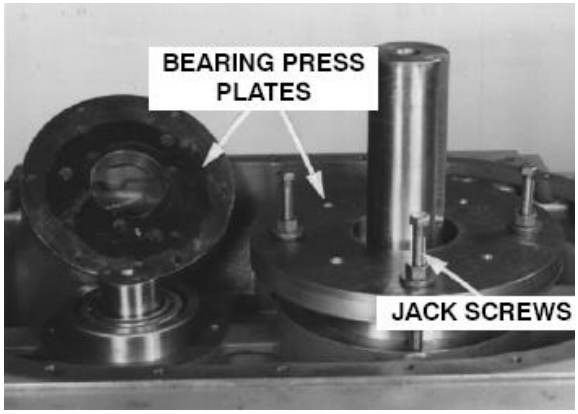


FIGURE 7-16

FIGURE 7-18

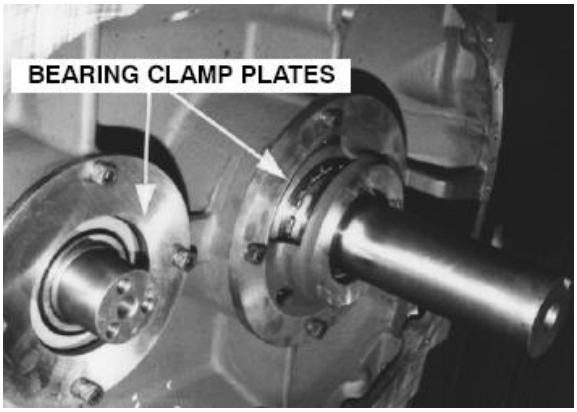


FIGURE 7-17

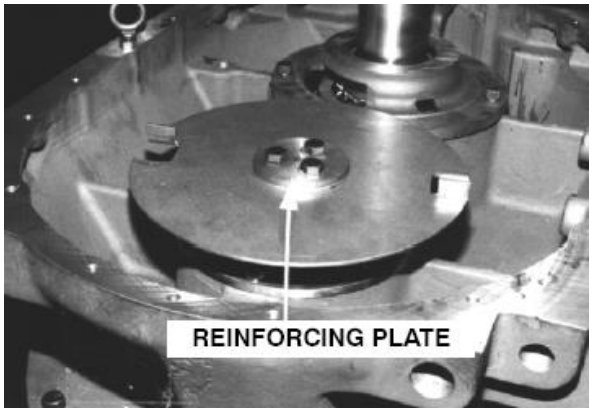


FIGURE 7-19

20. Bend the ear of the lockwasher (35, 36) into the slot of the nuts (33, 34) on the shaft extension. Oil the bearings generously. Install the oil slinger (6) with three (3) ñNylokòtype screws (61). Tighten screws to 118 ï 140 ft.-lb. The oil slinger is mounted on the shaft with the reinforcing plate up, FIGURE 7-19.

21. Check the shaft extension and keyway for burrs. Cover the shaft and keyway with the thin protective installation sleeve. Push the oil seal (26) into the seal adaptor (25). Install the seal adaptor gasket (58), seal and adaptor to the end cover (14) using four screws (46) and two dowels (43). Slide the end cover assembly and gasket (24) over the shaft extension (FIGURE 7-20) and mount the cover to the bearing carrier with screws (52) and washers (54). Tighten end cover screws to 38-41 ft-lb in a star pattern at least two passes. Remove the protective installation sleeve. Drive dowels (44) into end cover/bearing carrier holes. Install drive key (42).

NOTE: It is recommended to apply a thin coat of Dow Corning 736 sealant on each side of gaskets (58, 24) prior to installation.

The third important measurement for clearance is to provide for floating bearings at the gear end.

22. Turn the unit end for end, gear end up. With a depth micrometer on a perfectly flat parallel bar across the bearing bore, measure the distance to the shoulder in the bearing bore, FIGURE 7-21.

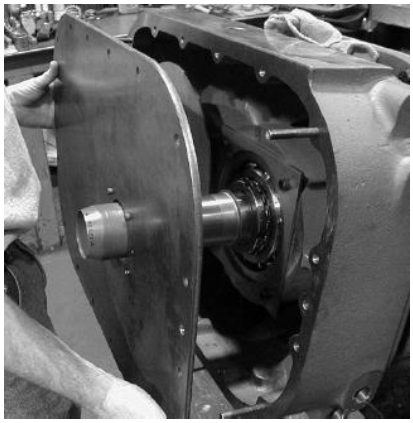


FIGURE 7-20

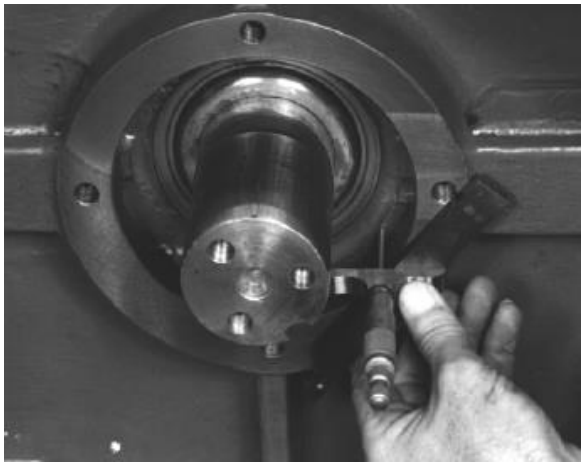


FIGURE 7-21

FIGURE 7-22

23. Remove tape from the shaft holding the bearing spacers in place. Tap the spacer to be sure it is solidly against the end of the rotor. This is important for the next measurement. With a depth micrometer on the same parallel bar used above, measure the distance to the end of the bearing spacer, FIGURE 7-22.
24. Slide the protective installation sleeves over each shaft. Install the green outside diameter oil seal (88) on the gate rotor shaft, (FIGURE 7-23) and the red outside diameter oil seal(87)on the main rotor shaft. The dirt lip and the rotation arrow should be down. Drive the seal flush with the bottom of the oil channel cast inside of the bearing bore. Remove installation sleeves.
25. Slide enough shims (22, 23) over the shafts, FIGURE 7-24, up against the end of the bearing spacer (16, 17) until the reading is .008ò to .013ò LESS than the reading in Step 22. This will give .008ò to .013ò running clearance between the inner race flange and the end of the bearing rollers.
26. Install the roller assembly of the bearing (31, 32) in the bore of the carrier with the numbered side out. Coat the inner race of the bearing and shaft with oil. **Slide the inner race of the bearing on the shaft with the flanged end out.** Assemble the press plate and jack screws as shown and press the inner race over the shaft solidly against the shims and bearing spacer, FIGURE 7-25. Tighten the nuts on the jack screws evenly to prevent cocking of the race.

FIGURE 7-23

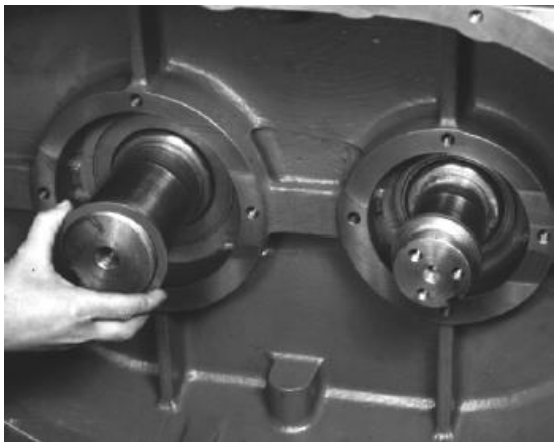


FIGURE 7-24

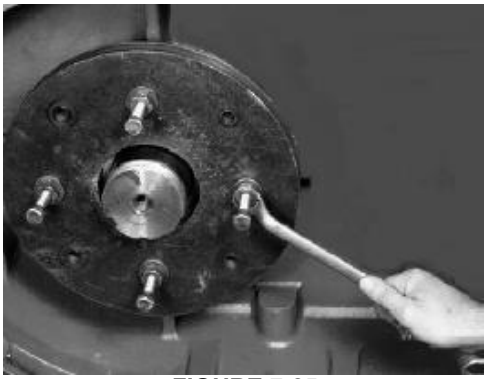


FIGURE 7-25

27. Install the bearing clamp plates (10, 11) with ñNylokòtype screws (47), FIGURE 7- 26, tighten screw to 51-68 ft-lb.

    Check the fit of the key (41) in the gear hub (9) and pinion (7). Check the pinion, hub and shaft extensions for burrs. Install the keys in the shafts, making sure of a snug fit. Heat the pinion and hub in oil or dry heat, such as an oven (NEVER USE TORCH) to 350°F, for thirty minutes minimum to allow for complete heat penetration. If heating with oil in a confined area, use of cooking oils will prevent undesirable odors.

    Lock the rotors from turning with a piece of hard wood or belting. Install the hub (9) and pinion (7) and pull tight with a locking device, FIGURE 7- 26. Use the hub retainer (13) and screws (49) to pull hub up tight against the bearing. Tighten screws to118-140 ft-lbs.

    Install lockwasher (35) and bearing retainer nut (33). Tighten nut to 230-250 ft-lb. As the hub and pinion cool, check for tightness. The bearing and bearing spacer must be clamped tight against the rotor. Bend the ear of the lockwasher (35) into the slot of the nut (33) holding the pinion. Oil the bearings generously.

The final check to be made for running clearances is dividing the interlobe clearance of the rotors to prevent metal-to-metal contact. This is referred to as **"TIMING OF ROTORS"** and is accomplished in the following five steps.

28. Install the gear (8) on the hub (FIGURE 7-27), which is a slip fit. If gear teeth were marked at disassembly, line up these marks. New gears are not marked and should be positioned so tapped holes allow radial movement of the gear for timing. Tighten the ñNylokòscrews (48) against the flat washers (57) (always use new washers) just tight enough to allow the gear to slip radically on the hub. Mount an indicator and button bracket as shown in FIGURE 7-27. In order to accurately follow the next four steps in timing, the indicator must be mounted in a clockwise position for the bracket. The gear has a 3/8-16 tapped hole for indicator support. When the indicator is mounted, hold the gear from rotating and with a wrench in one of the hub retainer screws, move the shaft in a clockwise direction until all slack is taken out of the gears and rotors to give a metal-to-metal contact. To prepare for the first reading, set the indicator at zero.

FIGURE 7- 26

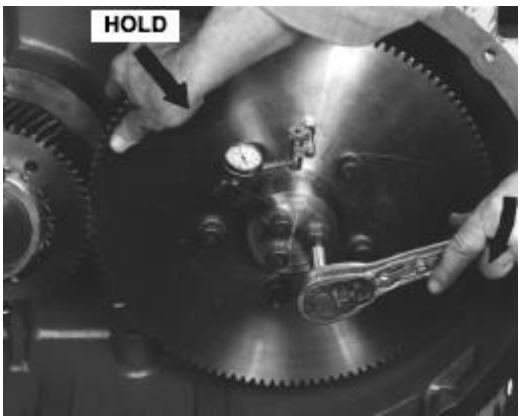


FIGURE 7-27

FIGURE 7-28

FIGURE 7-29

29 **FINDING SMALLEST MINUS READING** ï FIGURE 7-28. Hold the gear under clockwise pressure to maintain metal-to-metal contact. Rotate the shaft counterclockwise **two complete revolutions** with a wrench. (Do not rotate by moving the gear.) If at any time the indicator hand moves to the plus side, reset at zero, and again rotate two complete revolutions. Notice the place of the smallest reading (this is smallest figure on the indicator dial). Continue rotation until the smallest reading is again reached and reset the indicator at zero. This is the closest clearance of rotors in this direction of rotation. If the indicator pointer flutters at any time during rotation, check for burrs or dirt on the rotors or gear teeth.

30. **FINDING SMALLEST PLUS READING** - FIGURE 7-29. Hold the gear under counterclockwise pressure to take up all slack, and rotate the rotor clockwise **two complete revolutions** with a wrench. Note the place of the smallest plus reading, and continue rotation until the smallest reading is again reached and stop. This is the point of minimum interlobe clearance.

31. **SETTING THE INTERLOBE CLEARANCE** - FIGURE 7-30. The interlobe clearance is divided with 2/3 on the discharge side and 1/3 on the suction side. Hold the gear from turning. Move the shaft counterclockwise with a wrench just enough to obtain 1/3 of the indicator reading obtained in Step 29.

EXAMPLE: The minimum plus reading in Step 29 is +.018; move the rotor until the indicator reads +.012. This divides the interlobe clearance with 2/3 on the discharge and 1/3 on the suction side.

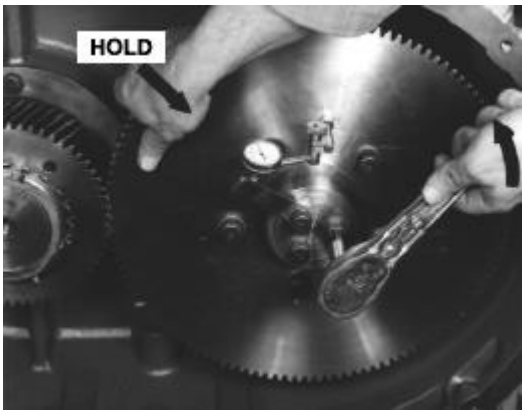


FIGURE 7-30

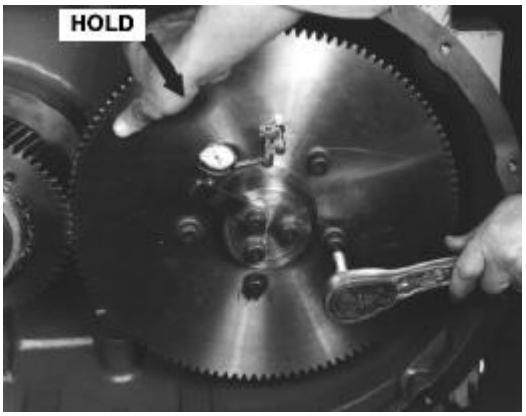


FIGURE 7-31

32. Hold the gear and shaft from turning and evenly tighten five gear to hub ñNylockòtype screws (48) (FIGURE 7-31). Tighten screws to 100-110 ft-lbs. Be sure the indicator reading does not change while tightening the screws. The rotors are held in time by the clamping action of the screws and distortion of the flat washers into the gear holes. Check interlobe clearance to make sure the 2/3 indicator reading is on the discharge side.

    Discharge side clearance is checked with a feeler gauge through the discharge opening in the housing. Rotate the blower several times to be sure timing has not slipped. Recheck the discharge side interlobe clearance and discharge end clearance. When timing is completed remove the indicator, button bracket and gear hub retainer plate. Install the hub retainer plate (13) with pilot in the hub bore with three ñNylokòtype screws (49). Tighten screws to 118-140 ft-lbs. Install the gasket (24) and carrier cover plate (15) with lockwashers (54) & screws (52). Tighten screws to 38-41 ft-lb in a star pattern making at least two passes. Install breathers (38) on bearing carriers (4, 5) Note: It is recommended to apply a thin coat of Dow Corning 736 sealant on each side of gasket (24) prior to installation.

    Referring to ñLubrication,ò page 25, fill the carriers with proper oil to the middle of the sight gauge. Cover all openings to prevent dirt entering the blower during transportation and installation.

    If the blower is to be stored, refer to ñStorage,òpage 9.

GENERAL PROVISIONS AND LIMITATIONS

Gardner Denver (the ñCompanyò) warrants to each original retail purchaser (ñPurchaserò) of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.
2. Any product which has, in the Company's judgment been subject to negligence, accident, improper storage, or improper installation or application.
3. Any product which has not been operated or maintained in accordance with normal practice and with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.
5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted

WARRANTY PERIOD

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, any part which in its judgment proved not to be as warranted with the applicable Warranty Period as follows,

BARE BLOWERS

Basic bare blowers, consisting of all parts within, are warranted for 12 months from date of initial use or 18 months from date of shipment to the first purchaser, whichever occurs first.

Any disassembly or partial disassembly of the blower, or failure to return the ñunopenedò blower per Company instructions, will be cause for denial of warranty.

OTHER COMPONETS

All other components are warranted for 12 months from date of initial use or 18 months from date of shipment to first purchaser, whichever comes first.

All costs of transportation of product, labor or parts claimed not to e as warranted and, of repaired or replacement parts to or from such service facilities shall be borne by the Purchaser. The Company may require the return of any part claimed not to be as warranted to on of its facilities as designated by Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

LABOR TRANSPORTATION AND INSPECTION

The Company will provide labor, by Company representative or authorized service personnel,
for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.
Labor costs in excess of the Company's rate schedule amounts or labor provided by unauthorized service personnel is not provided for by this warranty.

Replacement parts provided under the terms of the warranty are warranted for the reminder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components thereof.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABLILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES UNDER NO CIRCUMSTANCES HSALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented with 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

Gardner Denver

Specifications subject to change without notice

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