Gardner Denver

PARTS LIST OPERATING AND SERVICE MANUAL

BLOWERS/VACUUM PUMPS

11CDL – R SERIES

ENERGY STAR PARTNER

37-1-616
Version 04
April 3, 2015

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.

INSTRUCTIONS FOR ORDERING REPAIR PARTS

For pricing and ordering information contact your nearest AUTHORIZED FACTORY DISTRIBUTOR. When ordering parts, specify Blower MODEL and SERIAL NUMBER (see nameplate on unit).

Use this Parts List to select the parts you require. Where NOT specified, quantity of parts required per blower is one (1); where more than one is required per unit, quantity is indicated.

Rely upon the knowledge and experience of you AUTHORIZED DISTRIBUTOR and let them assist you in making the proper parts selection for you blower.

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, Inc.
1800 Gardner Expressway
Quincy, IL 62305
Phone: (800) 682-9868
Fax: (217) 221-8780

GARDNER DENVER LUBRICANT ORDER INFORMATION

Re-order Part Numbers for Factory-Recommended Lubricants.

AEON PD Synthetic Lubricant or AEON PD-Food Grade Synthetic Lubricant

AEON PD Synthetic Lubricant

Description	Part Number
1 Quart	28G23
Case/ 12 Quarts	28G24
5 Gallon Pail	28G25
55 Gallon Drum	28G28

AEON PD-Food Grade Synthetic Lubricant

Description	Part Number
1 Quart	28H97
Case/ 12 Quarts	28H98
5 Gallon Pail	28H99
55 Gallon Drum	28H100

AEON PD - XD Synthetic Lubricant

Description	Part Number
1 Quart	28G46
Case/ 12 Quarts	28G47
5 Gallon Pail	28G44
55 Gallon Drum	28G45

Call your local CycloBlower® Distributor to place your order for Gardner Denver Lubricants. Your Authorized Gardner Denver Distributor is:

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.

TABLE OF CONTENTS

INDEX

LIST OF ILLUSTRATIONS

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 blower inlet and discharge ports, revolving belts, sheaves, 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 or break any connections, etc., in the blower 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 blower 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 speed value 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 Customer Service for recommendations.

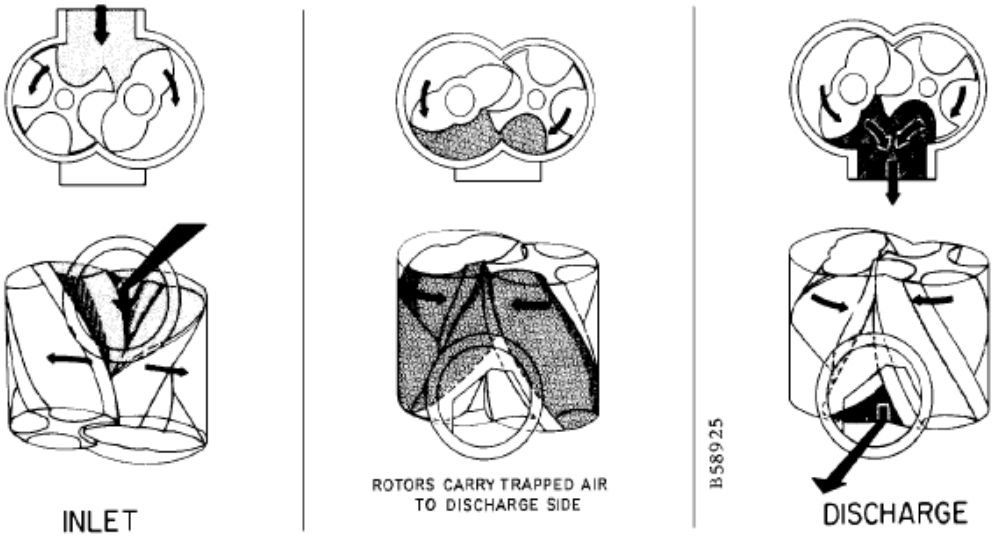


FIGURE 2-1 – OPERATING PRINCIPLE

GENERAL ï The CycloBlower® is a compact, rotary lobe type axial flow blower. 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 carriers. 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 drawing 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 11CDL Series CycloBlower® are of similar design and construction except for rotor length. The housing is a one-piece casting with flanged inlet and discharge openings.

The rotors are ductile iron with integral cast 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 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.

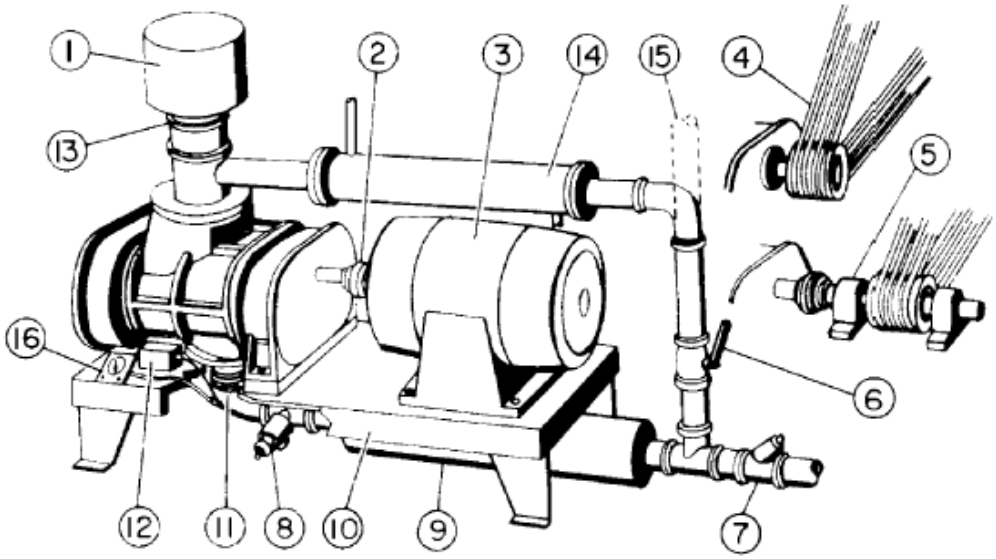


FIGURE 2-2 – ACCESSORIES AND SAFETY DEVICES

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 of 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. A grid type coupling is recommended. 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 .003ò in all directions. With lubricated or special couplings, follow the manufacturerôs instructions for installation and maintenance. Do not use couplings that may cause an axial thrust during operation.

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 that 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 manufacturerôs 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 leads 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 page 14), for V-belt drive overhung load calculations. (Figure 2-3), applies to V-belt calculations only. Exceeding overhung load limitations leads to premature bearing failure and potential shaft breakage.

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.

NOTICE

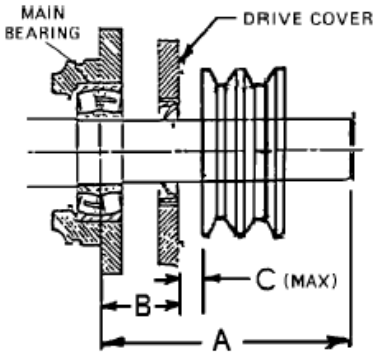
The sheave should be positioned as close as possible to the drive cover. This will reduce the overhung load and extend the bearing life.

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.

Synchronous-Belt Drive ï Synchronous belts are not recommended for usage on Gardner Denver positive displacement blowers. Installation of synchronous belts is critical and can result in alignment, tensioning and vibration problems, which contribute to higher than normal loads and stresses on the blowers.

11CDL Drive Shaft Location	Dimensions (Inches)			Maximum Allowable Moment (LB-IN)
	A	B	C (Max)	
Discharge End (Standard)	12.70	5.05	0.5	21,395
Gear End (Optional)	14.65	6.87	0.5	21,395

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

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

Key:
- Ac = Arc of Contact Factor (Refer to Arc of Contact Factor Chart above)
- Hp = Blower Horsepower for Operating Conditions
- S.F. = Drive Service Factor (use 1.4 S.F. for continuous duty applications)
- D = Blower Sheave Pitch Diameter in Inches
- RPM = Blower Sheave Speed
- Z = $\frac{\text{Large Sheave Pitch Diameter (in) ï Small Sheave Pitch Diameter (in)}}{\text{Sheave Center Distance (in)}}$

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 – V-BELT DRIVE OVERHUNG LOAD CALCULATIONS

Bypass Valve ï Installation of a bypass valve at the blower discharge (FIGURE 2-2, page 11) 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, page 11) 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, page 11).

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

Check Valve (FIGURE 2-2, page11) 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, page11) 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 blower operating pressure (1/2ò to 1ò Hg. In vacuum 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. 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, page 11). 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.

Estimated 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 of 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, page 17 & 18.

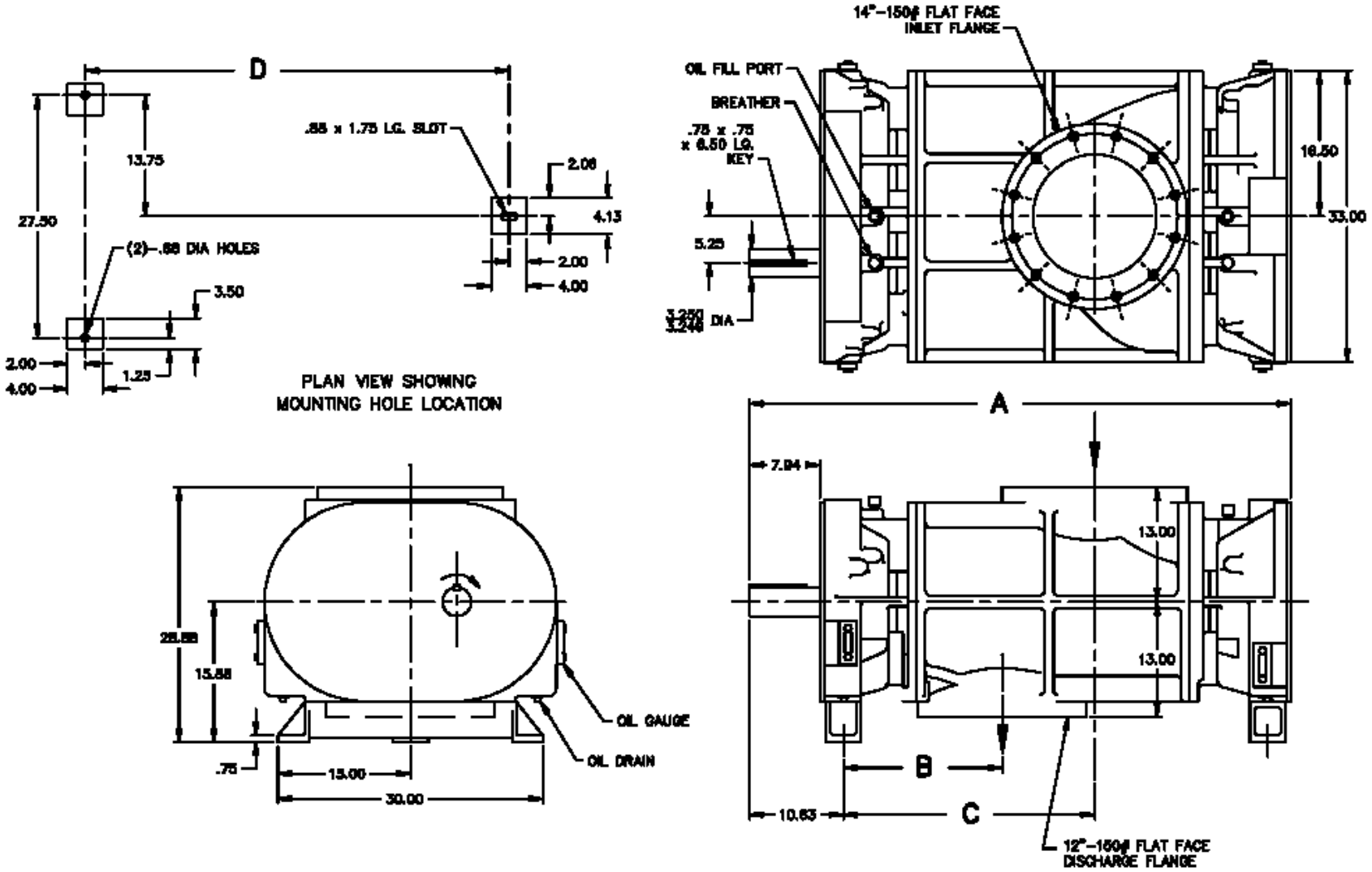


FIGURE 2-4 – OUTLINE DIMENSIONS

TOP INLET, MAIN ROTOR DRIVE

MODEL	WT. (lbs.)	A (Inches)	B (Inches)	C (Inches)	D (Inches)	OUTLINE DIMENSIONS DRAWING NO.
11CDL23R	3175	53.38	19.56	22.00	40	203CBT800
11CDL27R	3420	57.25	20.00	22.44	44	202CBT800
11CDL31R	3585	61.25	18.00	28.44	48	300CBT800

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 tables and text in section 3.

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,ò page 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

Operating beyond the specified operating limitations will result in damage to the unit.

R Series Models	Drive Shaft Speed (RPM)	Discharge Pressure* Sea Level (PSIG)	Dry Vacuum* (Inches Hg)	Wet Vacuum* (Inches Hg)
11CDL23, 11CDL27, 11CDL31	2200	20	17	----
11CDL23, 11CDL27, 11CDL31	2000	----	----	24

* Pressures or vacuums are gauged at immediate blower discharge or inlet. For suggested maximum ratings at reduced speeds, See (FIGURE 3-6, page 23).

FIGURE 3-1 – MAXIMUM RATING

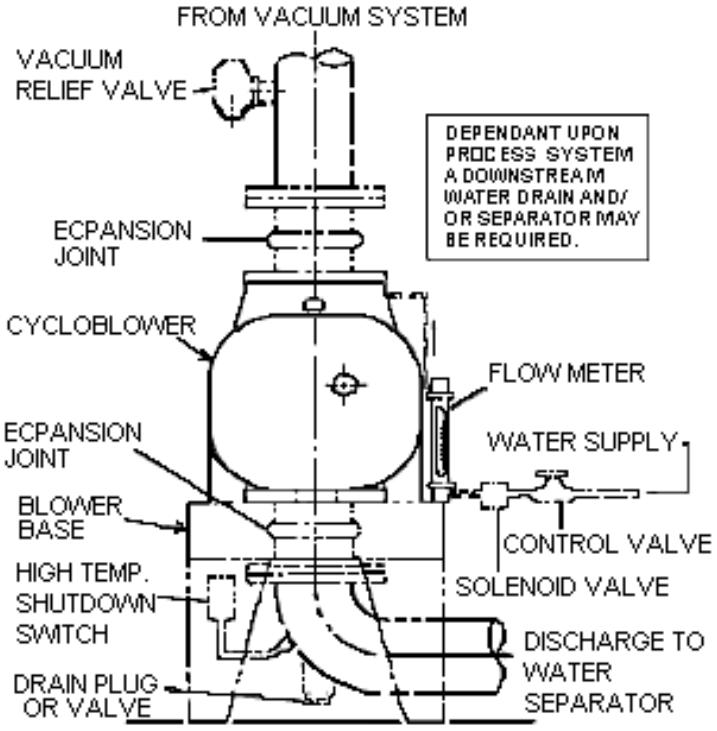


FIGURE 3-2– INLET WATER INJECTION DIAGRAM

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, page 19. 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 affect on allowable pressure (FIGURE 3-6 page 23). A bypass valve to bleed air from the discharge to atmosphere (FIGURE 2-2, page 11) 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.

	11CDL23	11CDL27	11CDL31
Liquid Rate (GPM)	4	4	4

FIGURE 3-3 – LIQUID RATE

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, page 19, or below the minimum speed shown in FIGURE 3-6, page 19. 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 3-2, for typical installation, and FIGURE 3-4, page 21 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; CI^- (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 3-4 – 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. Prior to shutdown, a dry out cycle of 5 minutes minimum with no water injection is required while the blower is 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°to 150°F.

The maximum permissible liquid rate on any size machine is shown in (FIGURE 3-3, page, 20). DO NOT EXCEED THIS.

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 should be used.

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.

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. Above 5000 feet, consult the nearest Gardner Denver Office.

FIGURE 3-5 – ALTITUDE – PRESSURE/VACUUM

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

SPEED ï Refer to, page 19, for maximum and (Figure 3-6, page 23) 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, page 23), as speed is reduced, pressure or vacuum must also be reduced.

EXAMPLE: Using a 11CDL27 blower, operating against 20 PSIG, minimum allowable speed is 1050 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. If the discharge temperature continues to exceed 355°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 275° 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
11CDL23	800	800	900
11CDL27	800	860	1050
11CDL31	800	800	930

Models	Minimum Speed (RPM) - Vacuum		
	Dry Vacuum	Wet Vacuum	
	Up to 17” Hg.	Up to 22” Hg.	24” Hg.
11CDL23	840	800	800
11CDL27	900	800	800
11CDL31	800	800	800

FIGURE 3-6 – MINIMUM SPEED, BASED ON 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.

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

☐ 7. ñJogòthe 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 – 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 and scheduling regular maintenance of the unit is valuable. 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 15-3/4 quarts and the gear end sump requires 8-1/2 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. Check oil level only when machine is not operating and maintain at middle of each sight glass.

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 4-1). 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 60° F	60°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	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 XD	AEON PD XD
	225°F to 300° F	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD AEON PD FG	AEON PD XD	AEON PD XD
	Greater than 300° F		AEON PD AEON PD FG	AEON PD XD	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 Temperatures			
	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
Greater than 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 oil used. Under severe operating conditions the oil should be changed every 1000 hours or more often. Under ideal operating conditions oil may 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 sump should be flushed with a clean solvent every forth oil change. Always use clean containers for oil and cleaning solvents.

MAINTENANCE

AIR FILTERS AND FILTER-SILENCERS

⚠WARNING

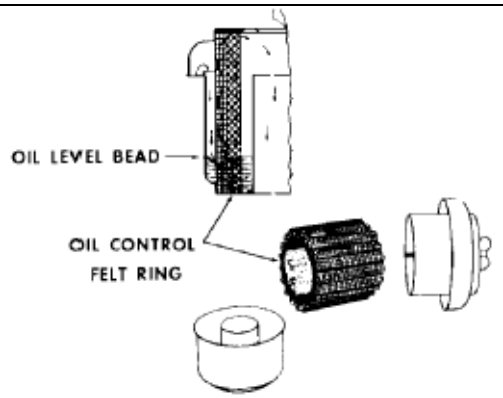
Servicing the air filters is one of the most important maintenance operations to be performed to ensure long blower life.

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 manufacturerôs 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, page 27) 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.

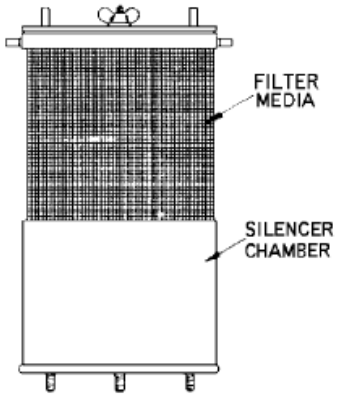


FIGURE 4-5 – OIL WETTED FILTER-SILENCER

Oil Wetted Filter-Silencer (FIGURE 4-5, page 28) 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 silencer can be supplied with an all-weather hood. If an oil wetted filter without silencer is used, the service instructions in the previous section will also apply.

Dry Type Filter and Filter-Silencer (FIGURE 4-6, page 28) 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 hydrodynamic 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 blower. Rotation arrows and color coding are used to distinguish clockwise seals from counterclockwise seals,
see Figure 7-13, page 45.

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.

Rotating components will cause severe injury in case of personal contact. Keep hands away 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.

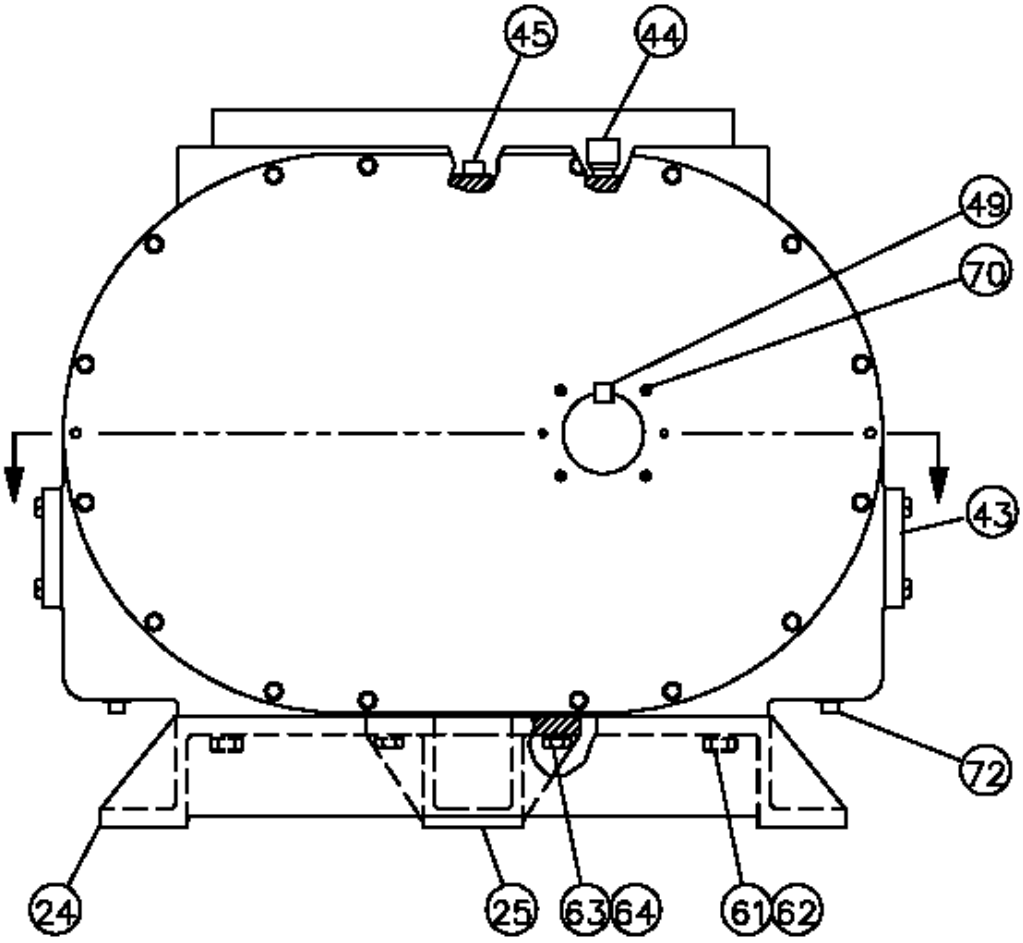
Reference numbers shown in the left hand column of the parts list are used to help locate parts shown on the drawing and sectional view. DO NOT ORDER BY REFERENCE NUMBERS.

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.

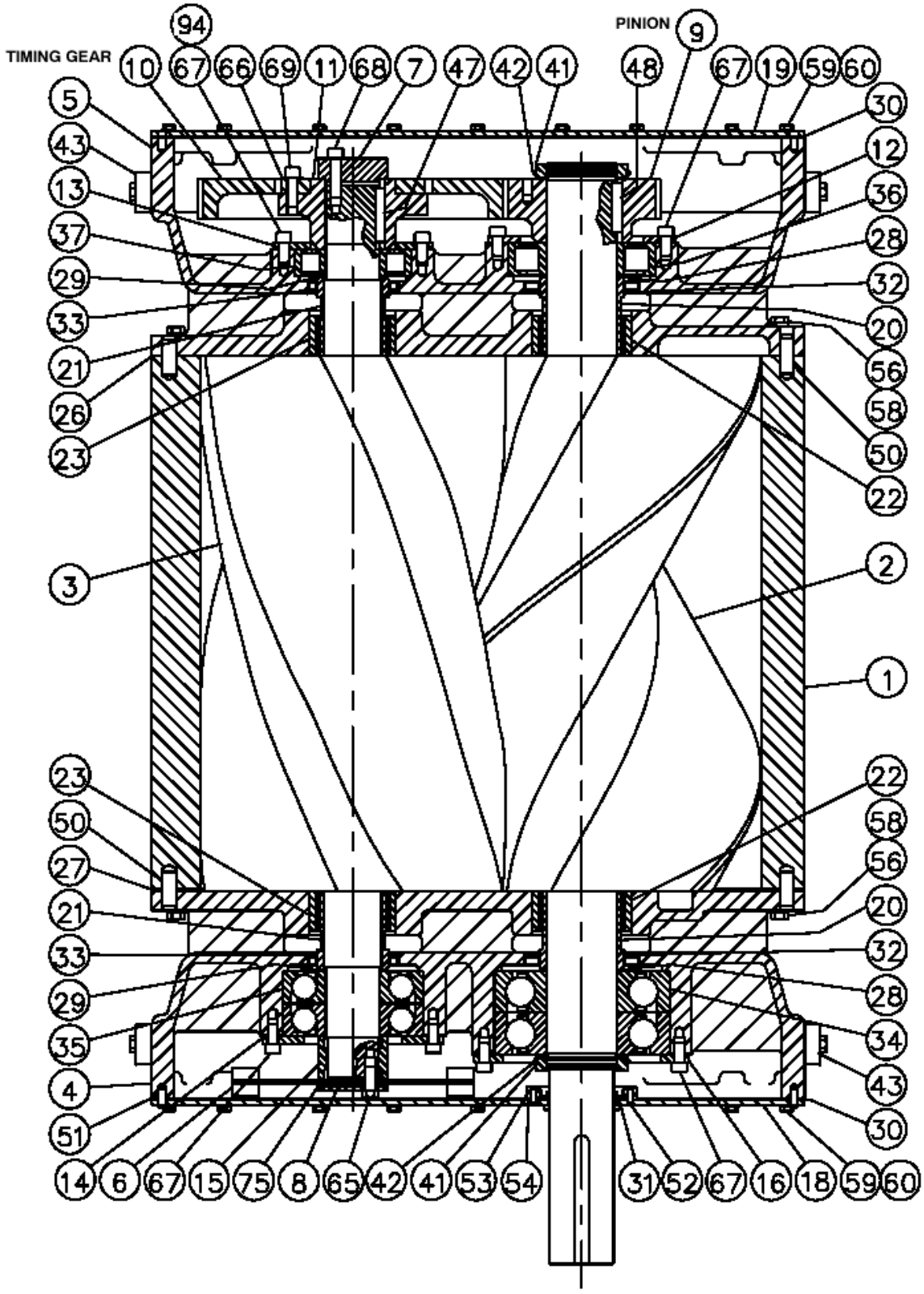
Teflon is a register trademark of DuPont

SECTIONAL VIEW
11CDL_ _ R – TOP INLET



300CBT799-B
(Ref. Drawing)

FOR LIST OF PARTS SEE PAGES 33 AND 34.



FOR LIST OF PARTS SEE PAGES 33 AND 34

300CBT799-B
(Ref. Drawing)

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

Ref. No	Name of Part	Qty.	Models 11CDL23R Part No.	Models 11CDL27R Part No.	Models 11CDL31R Part No.
1	HOUSING	1	301CBT002	302CBT002	303CBT002
	GROUP--ROTOR (Includes Ref. Nos. 2 & 3)	1	200CBT010A	203CBT010C	205CBT010A
2	** ROTOR	1			
3	ROTOR--GATE ASSEMBLY	1			
4	CARRIER--BEARING (DISCHARGE END)	1	211CBT006	213CBT006	215CBT006
5	CARRIER--BEARING (GEAR END)	1	210CBT006	212CBT006	214CBT006
6	SLINGERð OIL	1	8508482	8508482	8508482
7	PLATE--SHAFT CLAMP	1	8500739	8500739	8500739
8	PLATE--SHAFT CLAMP	1	8508476	8508476	8508476
	GEAR KIT (Includes Ref. Nos. 9 & 10)	1	300CBT6008	300CBT6008	300CBT6008
9	GEARð TIMING				
10	GEARð PINION				
11	HUBð GEAR	1	8500742	8500742	8500742
12	PLATE--BEARING CLAMP	1	8508479	8508479	8508479
13	PLATE--BEARING CLAMP	1	8508478	8508478	8508478
14	PLATE--BEARING CLAMP	1	8508477	8508477	8508477
15	SPACER	1	8508480	8508480	8508480
16	RETAINER	1	200CBT205	200CBT205	200CBT205
18*	COVERð END	1	8500746	8500746	8500746
19	COVERð END	1	8500747	8500747	8500747
20	SPACERð BEARING	2	8500749	8500749	8500749
21	SPACERð BEARING	2	8504514	8504514	8504514
22	SEAL--ROTOR SHAFT	2	8500750	8500750	8500750
23	SEAL--ROTORð SHAFT	2	8500390	8500390	8500390
24	FOOTð SUPPORT	1	8500752	8500752	8500752
25	FOOTð SUPPORT	1	8500751	8500751	8500751
26	SHIMð HOUSING	1	8500753	8500753	8500753
27	SHIM--HOUSING SET	1	8500760	8500760	8500760
28	SHIM--SHAFT SET	2	8500269	8500269	8500269
29	SHIM--SHAFT SET	2	8501514	8501514	8501514
30	GASKET	2	8500761	8500761	8500761
31*	SEALð OIL	1	307CBT199	307CBT199	307CBT199
32	SEALð OIL	2	306CBT199	306CBT199	306CBT199
33	SEALð OIL	2	306CBP199	306CBP199	306CBP199
34	BEARING--ANGULAR CONTACT	2	8500411	8500411	8500411
35	BEARING--ANGULAR CONTACT	2	8508458	8508458	8508458
36	BEARINGð ROLLER	1	8500045	8500045	8500045
37	BEARINGð ROLLER	1	8500044	8500044	8500044
41	LOCKNUTð BEARING	2	50Z18	50Z18	50Z18
42	WASHER	2	95N18	95N18	95N18
43	SIGHT GLASS OIL LEVEL	4	300CBT436	300CBT436	300CBT436
44	BREATHERð CRANKCASE	2	5L223	5L223	5L223

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

Ref. No	Name of Part	Qty.	Models 11CDL23R Part No.	Models 11CDL27R Part No.	Models 11CDL31R Part No.
45	PLUG--SQHD PIPE	2	64AA1	64AA1	64AA1
47	KEYð SQUARE	1	8500117	8500117	8500117
48	KEYð SQUARE	1	8500082	8500082	8500082
49	KEYð SQUARE	1	8508545	8508545	8508545
50	PINð DOWEL	4	62M112	62M112	62M112
51	PINð DOWEL	2	62M50	62M50	62M50
52 *	PINð DOWEL	2	62M22	62M22	62M22
53 *	ADAPTORð SEAL	1	8500762	8500762	8500762
54 *	GASKET--SEAL ADAPTOR	1	8500763	8500763	8500763
56	SCREW	36	655EE090	655EE090	655EE090
58	LOCKWASHER	36	95B5	95B5	95B5
59	SCREW--HEX HD	36	655ED04N	655ED04N	655ED04N
60	LOCKWASHER	36	95B3	95B3	95B3
61	SCREW	4	655EF070	655EF070	655EF070
62	LOCKWASHER	4	95B8	95B8	95B8
63	SCREW	2	655EF070	655EF070	655EF070
64	LOCKWASHER	2	95B7	95B7	95B7
65	SCREW	3	655EE05N	655EE05N	655EE05N
66	WASHER	5	95W49	95W49	95W49
67	SCREW SOHD CAP	16	75P75N	75P75N	75P75N
68	SCREW SOHD CAP	3	75P77N	75P77N	75P77N
69	SCREW SOHD CAP	5	75P2N	75P2N	75P2N
70 *	SCREW SOHD CAP	4	75P4N	75P4N	75P4N
72	PLUGð MAGNETIC	4	64BJ4	64BJ4	64BJ4
75	SHIM	1	77H68	77H68	77H68
94	SHIM SET ï BEARING RETAINER	1	303CBT732	303CBT732	303CBT732

* Double the quantity required for double extended driveshaft construction

Refer to Drawings on page 32 and 33.

** Rotors must be ordered and used in matched pairs.

NOTE: All units 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:

		11CDL23	11CDL27	11CDL31
Ref. No. 4	Discharge End	217CBT006	219CBT006	221CBT006
Ref. No. 5	Inlet End	216CBT006	218CBT006	220CBT006

OVERHAUL KIT – 314CBT6010

Description	Qty.	Part No.
Installation Sleeve for Oil Seal	1	303CBT074
Installation Sleeve for Oil Seal	1	304CBT074
Installation Sleeve for Drive Seal	1	305CBT074
Bearing Spacer	2	8500749
Bearing Spacer	2	8504514
Shaft Rotor Seal	2	8500750
Shaft Rotor Seal	2	8500390
Shim Housing	1	8500753
Shim Housing Set	1	8500760
Shaft Shim Set	2	8500269
Shim	2	8501514
Cover Gasket	2	8500761
Oil Seal	1	307CBT199
Oil Seal	2	306CBT199
Oil Seal	2	306CBP199
Ball Bearing (Angular Contact)	2	8500411
Ball Bearing	2	8508458
Roller Bearing	1	8500045
Roller Bearing	1	8500044
Bearing Locknut	2	50Z18
Bearing Lockwasher	2	95N18
Gasket-Seal Adaptor	1	8500763
Screw	3	655EE05N
Washer	5	95W49
Screw SOHD Cap	16	75P75N
Screw	3	75P77N
Screw SOHD Cap	5	75P2N
Screw SOHD Cap	4	75P4N
Oil Seal	1	304CBT199
Oil Seal	1	301CBT199
Sleeve ï Wear	1	80M18
Shim Set ï Bearing Retainer	1	303CBT732

IMPORTANT: For spare parts requirement in remote areas, export or where more than one unit is operating, a spare gear set is recommended.
For 11CDL series order Gear Kit Part Number 300CBT6008.

NOTE: Overhaul kit is recommended for spare parts and/or scheduled maintenance or overhaul requirements. The installation tools are reusable. The overhaul kit without the seal installation sleeves is part number 313CBT6010.

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

11CDL WITH MECHANICAL SEALS

Ref. No	Name of Part	Qty.	Models 11CDL23R Part No.	Models 11CDL27R Part No.	Models 11CDL31R Part No.
1	HOUSING	1	301CBT002	302CBT002	303CBT002
	GROUP--ROTOR (Includes Ref. Nos. 2 & 3)	1	200CBT010A	203CBT010C	205CBT010A
2	** ROTOR	1			
3	ROTOR--GATE ASSEMBLY	1			
4	CARRIER--BEARING (DISCHARGE END)	1	303CBT006	301CBT006	231CBT006
5	CARRIER--BEARING (GEAR END)	1	302CBT006	300CBT006	230CBT006
6	SLINGERð OIL	1	8508482	8508482	8508482
7	PLATE--SHAFT CLAMP	1	8500739	8500739	8500739
8	PLATE--SHAFT CLAMP	1	8508476	8508476	8508476
	GEAR KIT (Includes Ref. Nos. 9 & 10)	1	300CBT6008	300CBT6008	300CBT6008
9	GEARð TIMING				
10	GEARð PINION				
11	HUBð GEAR	1	8500742	8500742	8500742
12	PLATE--BEARING CLAMP	1	8508479	8508479	8508479
13	PLATE--BEARING CLAMP	1	8508478	8508478	8508478
14	PLATE--BEARING CLAMP	1	8508477	8508477	8508477
15	SPACER	1	8508480	8508480	8508480
16	RETAINER	1	200CBT205	200CBT205	200CBT205
18*	COVERð END	1	8500746	8500746	8500746
19	COVERð END	1	8500747	8500747	8500747
20	SPACERð BEARING	2	8502134	8502134	8502134
21	SPACERð BEARING	2	8504838	8504838	8504838
22	SEAL--ROTOR SHAFT	2	8500750	8500750	8500750
23	SEAL--ROTORð SHAFT	2	8500390	8500390	8500390
24	FOOTð SUPPORT	1	8500752	8500752	8500752
25	FOOTð SUPPORT	1	8500751	8500751	8500751
26	SHIMð HOUSING	1	8500753	8500753	8500753
27	SHIM--HOUSING SET	1	8500760	8500760	8500760
28	SHIM--SHAFT SET	2	8500269	8500269	8500269
29	SHIM--SHAFT SET	2	8501514	8501514	8501514
30	GASKET	2	8500761	8500761	8500761
31*	SEALð OIL	1	307CBT199	307CBT199	307CBT199
32	SEALð OIL	2	8502096	8502096	8502096
33	SEALð OIL	2	8504840	8504840	8504840
34	BEARING--ANGULAR CONTACT	2	8500411	8500411	8500411
35	BEARING--ANGULAR CONTACT	2	8508458	8508458	8508458
36	BEARINGð ROLLER	1	8500045	8500045	8500045
37	BEARINGð ROLLER	1	8500044	8500044	8500044
41	LOCKNUTð BEARING	2	50Z18	50Z18	50Z18
42	WASHER	2	95N18	95N18	95N18
43	SIGHT GLASS OIL LEVEL	4	300CBT436	300CBT436	300CBT436
44	BREATHERð CRANKCASE	2	5L223	5L223	5L223

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

11CDL WITH MECHANICAL SEALS

Ref. No	Name of Part	Qty.	Models 11CDL23R Part No.	Models 11CDL27R Part No.	Models 11CDL31R Part No.
45	PLUG--SQHD PIPE	2	64AA1	64AA1	64AA1
47	KEYð SQUARE	1	8500117	8500117	8500117
48	KEYð SQUARE	1	8500082	8500082	8500082
49	KEYð SQUARE	1	8508545	8508545	8508545
50	PINð DOWEL	4	62M112	62M112	62M112
51	PINð DOWEL	2	62M50	62M50	62M50
52 *	PINð DOWEL	2	62M22	62M22	62M22
53 *	ADAPTORð SEAL	1	8500762	8500762	8500762
54 *	GASKET--SEAL ADAPTOR	1	8500763	8500763	8500763
56	SCREW	36	655EE090	655EE090	655EE090
58	LOCKWASHER	36	95B5	95B5	95B5
59	SCREW--HEX HD	36	655ED04N	655ED04N	655ED04N
60	LOCKWASHER	36	95B3	95B3	95B3
61	SCREW	4	655EF070	655EF070	655EF070
62	LOCKWASHER	4	95B8	95B8	95B8
63	SCREW	2	655EF070	655EF070	655EF070
64	LOCKWASHER	2	95B7	95B7	95B7
65	SCREW	3	655EE05N	655EE05N	655EE05N
66	WASHER	5	95W49	95W49	95W49
67	SCREW SOHD CAP	16	75P75N	75P75N	75P75N
68	SCREW SOHD CAP	3	75P77N	75P77N	75P77N
69	SCREW SOHD CAP	5	75P2N	75P2N	75P2N
70*	SCREW SOHD CAP	4	75P4N	75P4N	75P4N
72	PLUGð MAGNETIC	4	64BJ4	64BJ4	64BJ4
75	SHIM	1	77H68	77H68	77H68
76	ADAPTER ï SEAL	2	8502137	8502137	8502137
77	ADAPTER ï SEAL	2	8502136	8502136	8502136
78	GASKETð SEAL	2	8502082N	8502082N	8502082N
79	GASKETð SEAL	2	8502083N	8502083N	8502083N
80	SPACERð BEARING	2	8504839	8504839	8504839
81	SPACERð BEARING	2	8502130	8502130	8502130
82	SPACERð RING	2	8502133	8502133	8502133
83	SPACERð RING	2	8502132	8502132	8502132
84	RINGð RETAINING	2	74D11	74D11	74D11
85	RINGð RETAINING	2	65W14	65W14	65W14
94	SHIM SET ï BEARING RETAINER	1	303CBT732	303CBT732	303CBT732

* Double the quantity required for double extended driveshaft construction

Refer to Drawings on page 32 and 33.

** Rotors must be ordered and used in matched pairs.

NOTE: All units 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:

		11CDL23	11CDL27	11CDL31
Ref. No. 4	Discharge End	217CBT006	219CBT006	221CBT006
Ref. No. 5	Inlet End	216CBT006	218CBT006	220CBT006

MECHANICAL SEAL OVERHAUL KIT – 316CBT6010

Description	Qty.	Part No.
Installation Tool for Drive Seal	1	305CBT074
Seal Spacer	2	8502134
Seal Spacer	2	8504838
Shaft Rotor Seal	2	8500750
Shaft Rotor Seal	2	8500390
Shim Housing	1	8500753
Shim Housing Set	1	8500760
Shaft Shim Set	2	8500269
Shim	2	8501514
Gasket Cover	2	8500761
Oil Seal	1	307CBT199
Mechanical Seal	2	8502096
Mechanical Seal	2	8504840
Ball Bearing (Angular Contact)	2	8500411
Ball Bearing	2	8508458
Roller Bearing	1	8500045
Roller Bearing	1	8500044
Bearing Locknut	2	50Z18
Bearing Lockwasher	2	95N18
Gasket-Seal Adaptor	1	8500763
Screw	3	655EE05N
Washer	5	95W49
Screw SOHD Cap	16	75P75N
Screw	3	75P77N
Screw SOHD Cap	5	75P2N
Screw SOHD Cap	4	75P4N
Gasket-Seal Retaining	2	8502082N
Gasket-Seal Retaining	2	8502083N
Shim Set ï Bearing Retainer	1	303CBT732
Sealant	1	25BC465
Adhesive	1	25BC886
O-Ring	2	8500958
O-Ring	2	8502140

IMPORTANT: For spare parts requirement in remote areas, export or where more than one unit is operating, a spare gear set is recommended.
For 11CDL series order Gear Kit Part Number 300CBT6008.

NOTE: Overhaul kit is recommended for spare parts and/or scheduled maintenance or overhaul requirements. The installation tools are reusable.

SECTION 6
DISASSEMBLY INSTRUCTIONS

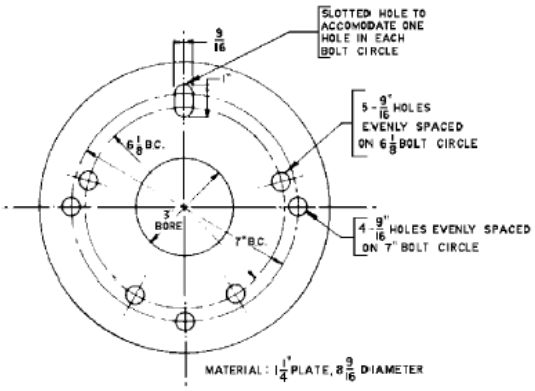


FIGURE 6-1 – ADAPTOR PLATE

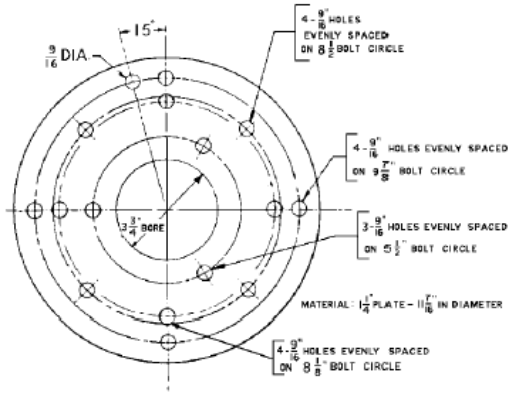


FIGURE 6-2 – BEARING PRESS PLATE

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 plates, (Figure 6-1), and bearing press plate, (Figure 6-2), for pulling the gear hub and pinion, and for installing bearings.

2. Provide bearing press plate, (FIGURE 6-2), for pulling the pinion gear and for installing the main rotor bearings. **Pulling directly on pinion teeth will cause gear wear. Pulling directly on the gear hub flange will distort the flange causing gear run-out**. The adaptor plates shown are designed for a jaw type hydraulic puller, (Figure 6-4, and Figure 6-5, page 36 & 37). Other type pullers are available, and if used, suitable adaptor plates should be provided.

FIGURE 6-3 – SPANNER WRENCH

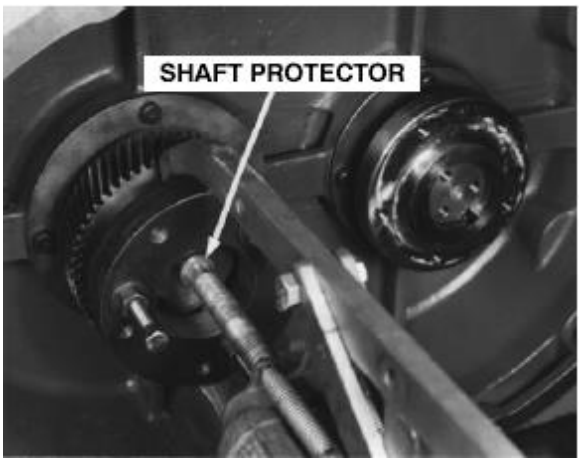


FIGURE 6-4 – BEARING PRESS PLATE

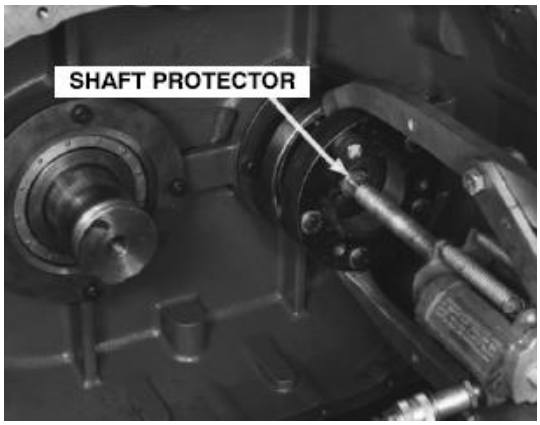


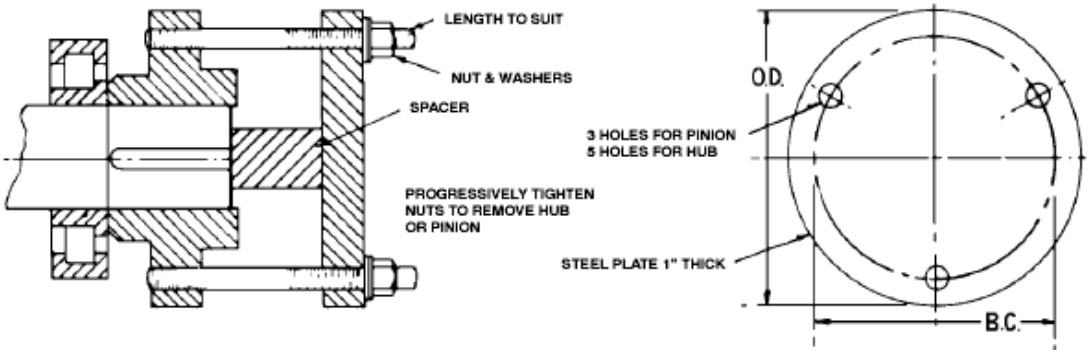
FIGURE 6-5 – ADAPTOR PLATE

3. Place the unit in a horizontal position, on a solid blocking, so the gear end bearing carrier hangs free. Drain oil from both carriers. At the gear end remove the cover, hub retainer plate, gear (slip fit on hub) and pinion locknut. A spanner wrench similar to that shown in (FIGURE 6-3, page 36), 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 bearing press plate and puller (FIGURE 6-4, page 39), and pull the pinion. Be sure to use a shaft protector to prevent damage to the end of the shaft. Remove the key from the shaft.
5. Mount the adaptor plate and puller (FIGURE 6-5), and pull the gear hub. Use a shaft protector. Remove the key from the shaft.
6. If a hydraulic puller is not available, the hub and pinion may be pulled as shown in (FIGURE 6-6).

⚠WARNING

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

7. Remove all gear end bearing carrier to housing screws. With four jack screws in tapped holes in the carrier flange, (FIGURE 6-7, page 41), 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, bearings, lip type oil seal and shaft seal. If the bearings are to be used, handle with care.



PINION					GEAR HUB			
O.D.	B.C.	Holes	Stud		O.D.	B.C.	Holes	Stud
7-3/4ò	6-1/8ò	(3) 9/16ò	1/2òï 13òUNC		7-1/4ò	5-1/2ò	(5) 9/16ò	1/2òï 13òUNC

FIGURE 6-6 – ALTERNATE ADAPTOR PLATES

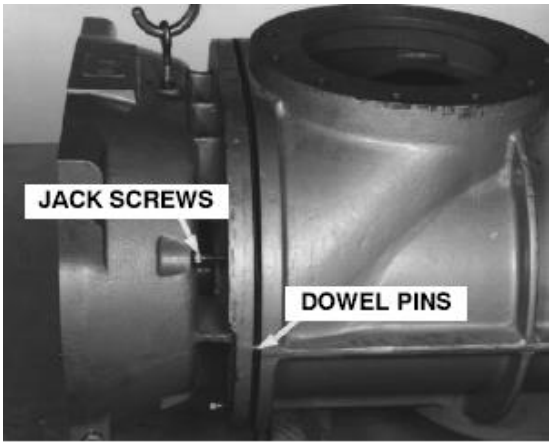


FIGURE 6-7 – BEARING CARRIER

FIGURE 6-8 – BEARING CLAMP PLATE

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

8. Remove the discharge end carrier cover, oil slinger, clamp plate, bearing locknut and bearing clamp plates. See (FIGURE 6-8).

9. Rig the plate (shown in FIGURE 6-2, page 39) and the puller shown in (FIGURE 6-9) and press the rotor shaft through the bearings. 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 adjust so the plate is square with the shaft. Press one rotor through the bearing at a time, then proceed to Step 10. Repeat Steps 9 and 10 on the second rotor.

10. When the rotor shaft is free of bearings, work the rotor through the housing and rig a sling to complete removal of the rotor from the housing, (FIGURE 6-10. page 42). Handle with care to prevent burrs on rotors and housing.

11. After removal of the rotors, rearrange blocking so the discharge end bearing carrier hangs free. Remove all screws and jack the carrier evenly from the dowel pins, FIGURE 6-11, page 42). Support the carrier as it is removed.

FIGURE 6-9 – PULLER

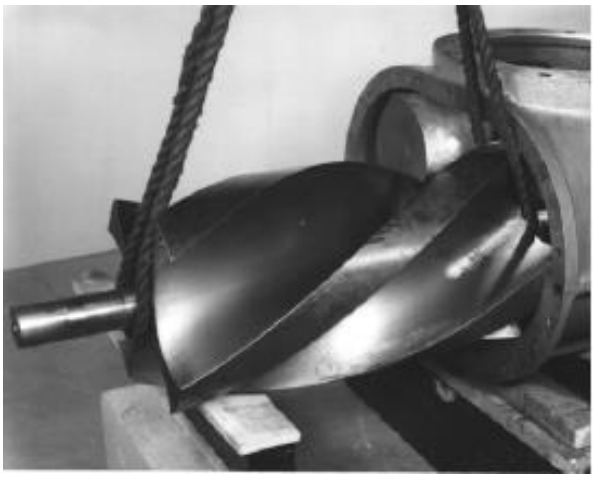


FIGURE 6-10 – ROTOR REMOVAL

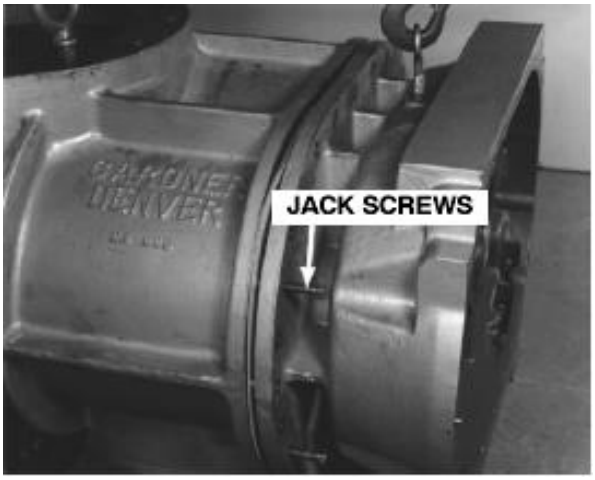


FIGURE 6-11 – BEARING CARRIER

SECTION 7
ASSEMBLY INSTRUCTIONS

NOTICE

The fastener & locknut torque values required during assembly are shown in FIGURE 7-32.

NOTICE

Illustrations for Assembly Instructions are taken from various sizes of CycloBlower minor variations in construction of some parts should not cause concern.

⚠WARNING

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 cause 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, page 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, 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 (22, 23) to prevent seizure and press into each bore of the gear end bearing carrier (5) (FIGURE 7-1, page 44). NEVER REUSE SHAFT SEALS. Refer to ñRotor Shaft Seals,òpage 28, 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 bolt presses the seal into place. Press the seal .010òto .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 .010òto .015òshim 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 babbitt lining.

2. To ease assembly in later steps, fit the bearing spacers (20, 21) to the seals (22, 23) (FIGURE 7-2, page 44). Be sure there are no burrs on the spacer O.D. and seal I.D. 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 the high spots from the seal I.D. to allow slip fit of the spacer. USE CROCUS CLOTH, not emery cloth.

   Never push the grooved end of the spacer through the bearing oil seal as the lip of the seal may be damaged. Apply Loctite 620 to the ID of the bearing spacer. When the spacers are fitted, slide them on the gear end shaft extension of the rotors with the grooved end toward the rotor. Make sure there are no burrs on either end of the spacer or end of the rotor. With the spacer seated against the face of the rotor, spin the shaft several times to evenly spread the Loctite 620. Place tape around the shaft to prevent the spacer from sliding off as shown in (Figure 7-4, page 41).

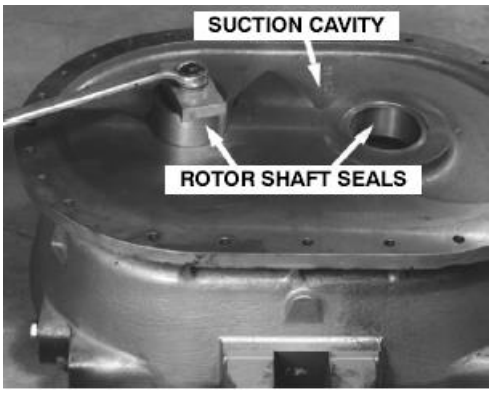


FIGURE 7-1 – ROTOR SHAFT SEAL

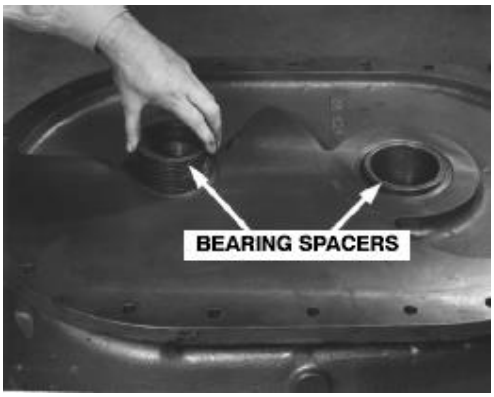


FIGURE 7-2 – BEARING SPACER

3. Place .030òthick aluminum shim (26) on the gear end bearing carrier (5). 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, page 44), of the carrier. Engage the dowel pins (50) with matching holes in the carrier with care. Tighten the carrier to housing screws (56, 58) evenly so the dowel pins will not be damaged.
4. Be sure the ends of the rotors (2, 3) and machined face of the carrier are free of burrs and dirt. Lower the gate rotor (3) into the housing (1) first (Figure 7-4). The gear end shaft extension, with the bearing must be suspended plum 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 babbit of the air seal. On older models, match timing marks on the end of the rotor lobes as shown in (FIGURE 7- 9, page 46). Rotors must be used in matched pairs. Identifying marks are stamped on the O.D. of the rotors on the same lobe as the timing marks.

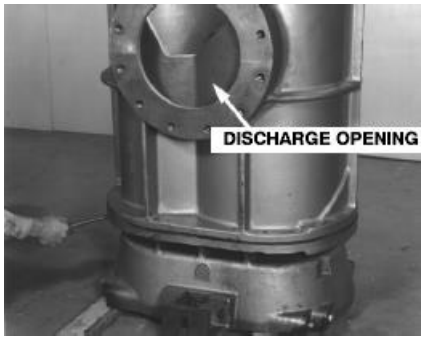


FIGURE 7-3 – DISCHARGE OPENING

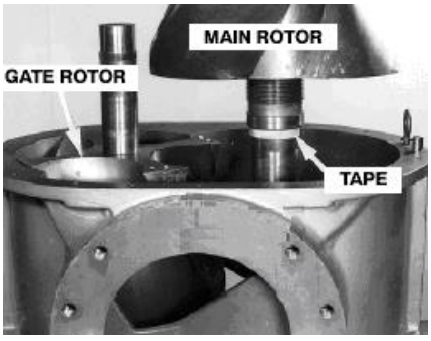


FIGURE 7-4 – ROTORS

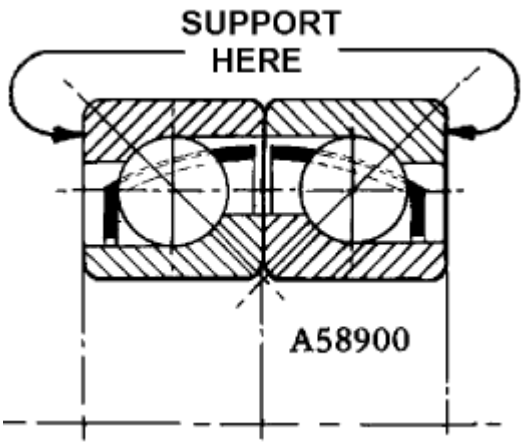


FIGURE 7- 5 – ANGULAR CONTACT BEARING ASSEMBLY

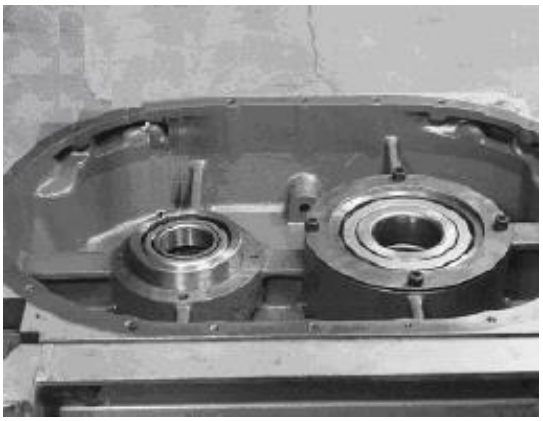


FIGURE 7-6 – BEARING INSTALLATION

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

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 (34, 35), bearing spacer (20, 21) and shim set (28, 29). The shaft shim set is determined as outlined in Steps 5 thru 8.

5. The angular contact bearings (34, 35) must be assembled as shown in (FIGURE 7- 5) to assure a ñfixedòbearing. The marked face of the inner bearing is placed down in the bearing bore; the marked face of the outer bearing is placed up.
6. Install the shaft seal (22, 23), and fit the bearing spacers (20, 21) in the discharge end bearing carrier (4) using the same method as outlined in Steps 1 and 2, page 40 and 41. To prepare for shim set measurement, slip bearings (34, 35) into the bore and install bearing retainer plate (14, 16), FIGURE 7-6. **Bearings must be assembled as directed in Step 5**. Bearings are slip fit in the bore.
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, page 42.

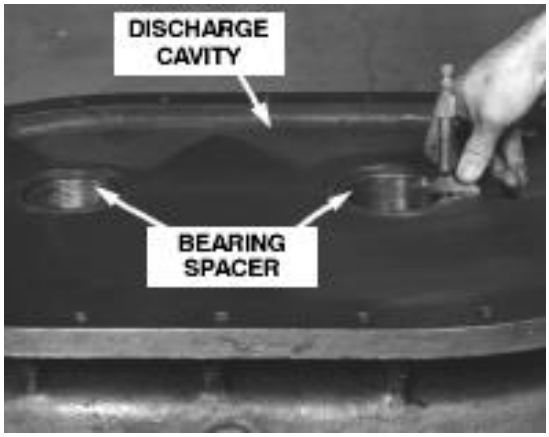


FIGURE 7-7 – DISCHARGE END BEARING CARRIER

Models	Total End Clearance (Suction & Discharge	Suction End	Discharge End
11CDL23	.041	.029	.012
11CDL27	.046	.034	.012
11CDL31	.051	.039	.012

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

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

8. To the micrometer reading add discharge end clearance shown in clearance chart, FIGURE 7-8, page 43, and .002òfor crush fit of shims and parts. This sum gives the thickness of the shim set (28, 29) for positioning the rotor the required distance from the face of the carrier for running clearance at the discharge end.

   EXAMPLE FOR 11CDL31 BLOWER: Micrometer reading of .060òplus .012òdischarge end clearance, FIGURE 7-8, page 43, plus .002òcrush gives shim set thickness of .074ò
   Figure shim set for each rotor and record measurements which will be used later in the assembly under Step 15 and 16.

The second set of measurements is used to determine total end clearance. To give proper rotor end clearance at both inlet 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 (27) as required between the flange of the housing and the discharge and bearing carrier. The thickness of the shim set is determined as outlined in Steps 9 and 10.

9. With a depth micrometer (FIGURE 7- 9, page 46), measure the distance from the end of the rotor lobes to the end of the housing. 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, page 46), plus, .002òfor crush fit, to determine the thickness of the shim set.

   EXAMPLE FOR 11CDL31 BLOWER: Micrometer reading of .090òplus .0.051òtotal end clearance plus .002òfor crush gives a shim set thickness of .143ò

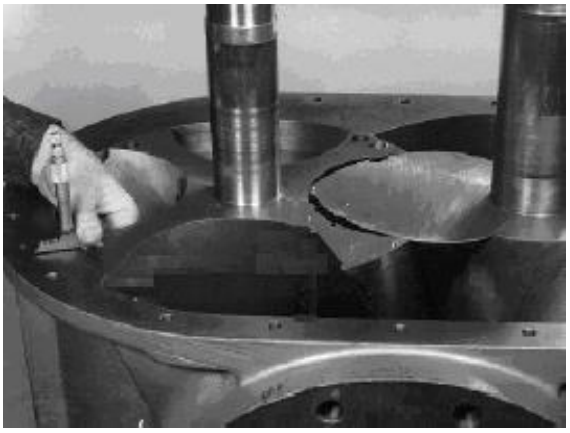


FIGURE 7- 9 – DEPTH MICROMETER

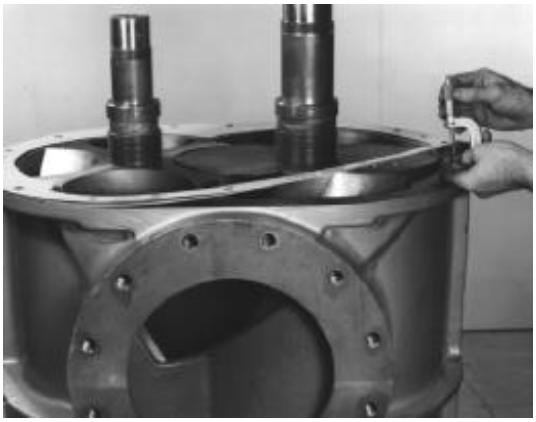


FIGURE 7-10 – OUTSIDE MICROMETER

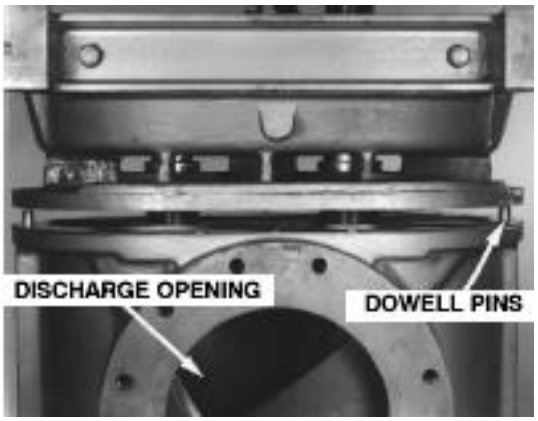


FIGURE 7-11 – DISCHARGE OPENING

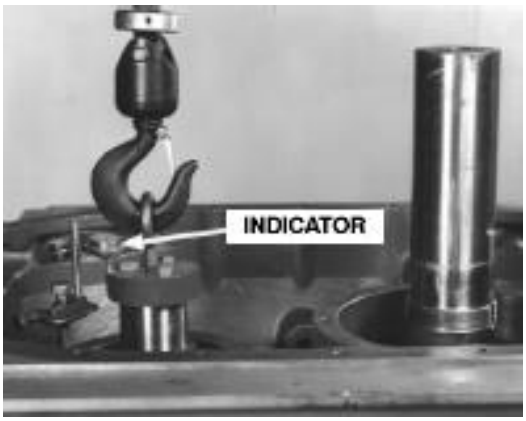


FIGURE 7-12 – DIAL INDICATOR

10. Select the correct thickness of aluminum shims (27) to give the shim set established in Step 9. Check the thickness of the shims with an outside micrometer (FIGURE 7-10, page 46). Place the shims on the end of the housing, 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, page 45). Apply Loctite 620 to the I.D. of the bearing spacer. Place them over the shaft extensions grooved end toward rotor. Be sure the spacer fits solidly against the rotor. 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.

11. Coat the I.D. of the shaft seals (22, 23) in the discharge end bearing carrier with oil. 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, page 45), 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 to housing screws (56, 58) evenly to prevent damage to dowel pins.

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, page 46). If the indicator reading differs from the chart and allowable tolerance, repeat Step 9 and 10 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 Inpro seals. They must be installed in the correct location and with proper orientation. Apply RTV sealant below the O-ring. Expulsion part positioned towards 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, page 48), measure the thickness of shaft shim sets 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 over the shaft extension, (FIGURE 7-14 page 48), up against the end of the bearing spacer.

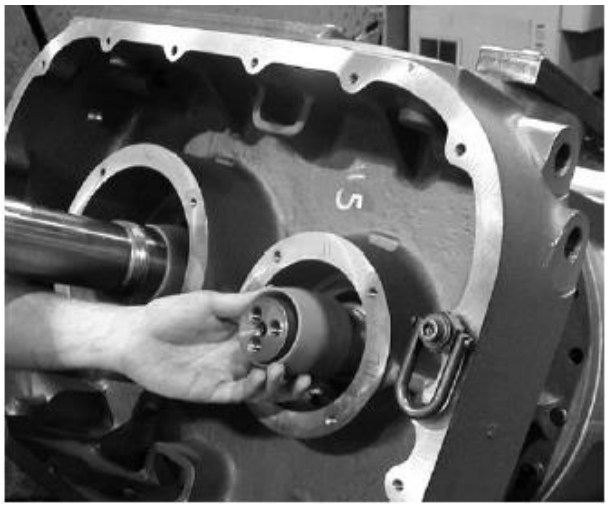


FIGURE 7-13 – SEAL INSTALLATION GUIDE

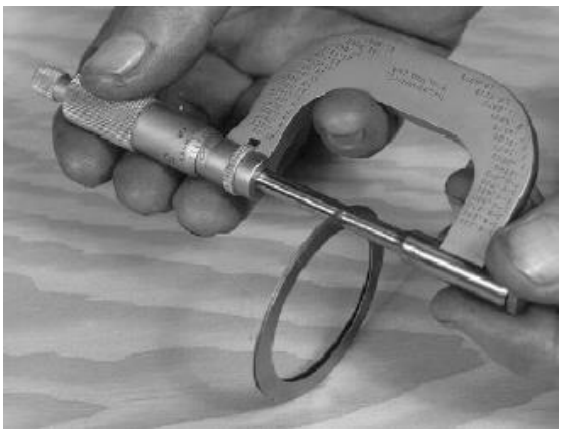


FIGURE 7-14 – BEARING SHIMS

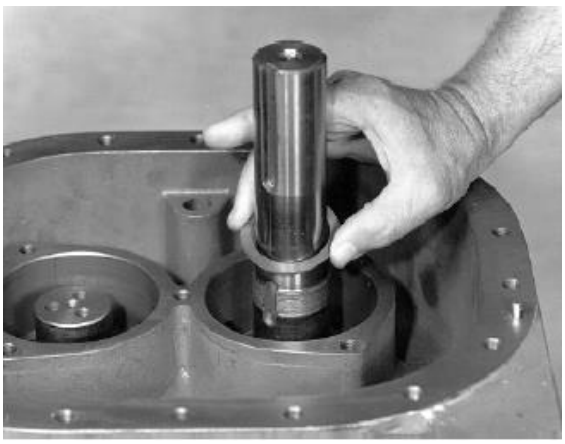


FIGURE 7-15 – BEARING SHIMS

17. Lightly coat the shaft extension and bearing bore with oil. Assemble bearings (34, 35), as shown in (FIGURE 7- 5, page 45), on the shaft. Assemble the press plate (refer to FIGURE 6-1, and FIGURE 6-2, Disassembly page 39), 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 the bearings and threads on the shaft, press one bearing over the shaft into 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.

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

18. Install the bearing clamp plate (14, 16) and four ñnylokòtype screws, (FIGURE 7-17). Install lock washer (42) and spanner type nut (41) on the main rotor shaft and drive up tight. This operation pulls the rotor shaft through the bearings until the 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 assembly**. The best method for tightening the nuts is with a wrench of the type shown in FIGURE 7-19, Disassembly page 50. Tighten the main rotor nut (41) to 248-375 ft-lb.

    Making sure the bearings are properly seated, measure the height the outer race of the main rotor bearing (34) extends above the bearing carrier surface (4) 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 (16) by taking the average of the measurements and subtracting 0.002òfrom the average measured height. (Required Shim Thickness = Average Measured Height ï 0.002ò). 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 thickness to insure the thickness is within +0.000/-0.001 of the required calculated thickness for each screw location. Install main rotor bearing retainer (16) with the required shim stack between the bearing retainer and the bearing carrier at each of the four ñNylokòtype screw (67) locations. Tighten screws to 118-140 ft-lb.

    Install bearing retainer plate (14) on the gate rotor with the four ñNylokòtype screws (67). Tighten screws to 118-140 ft-lb.

    Install the shaft spacer (15), oil slinger (6) and shaft clamp plate (8) on the gate rotor shaft using three hex head ñnylokòtype screws (65). (FIGURE 7-19, page 50).

    Be sure the reinforcing plate on the oil slinger is placed up and is located between the oil slinger and shaft clamp plate. Insert enough shim (75) behind the slinger so that the slinger is not distorted when the hex head nylock screws are drawn up tight. This operation pulls the gate rotor shaft through the bearings until the shims and bearing spacer are clamped solidly between the rotor end and bearings, assuring a fixed position of the rotor.

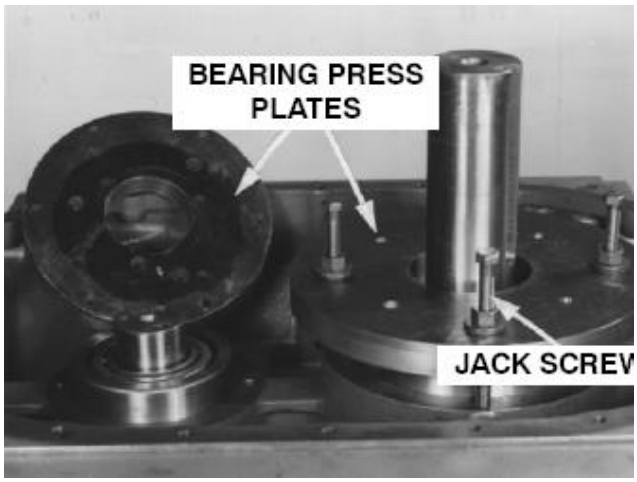


FIGURE 7-16 – BEARING PRESS PLATE

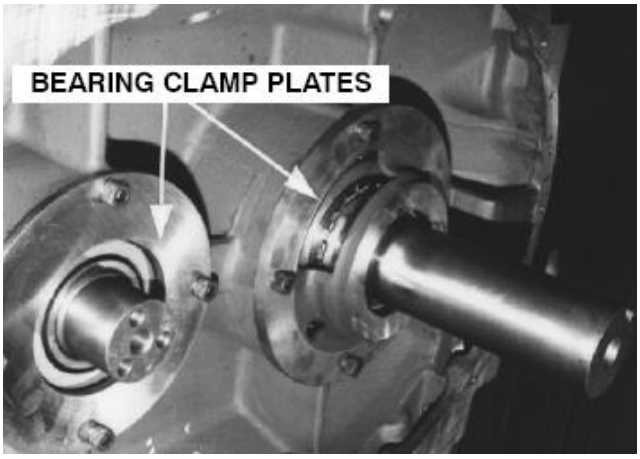


FIGURE 7-17 – BEARING CLAMP PLATES

FIGURE 7-18 ï DISCHARGE END CLEARANCE CHECK

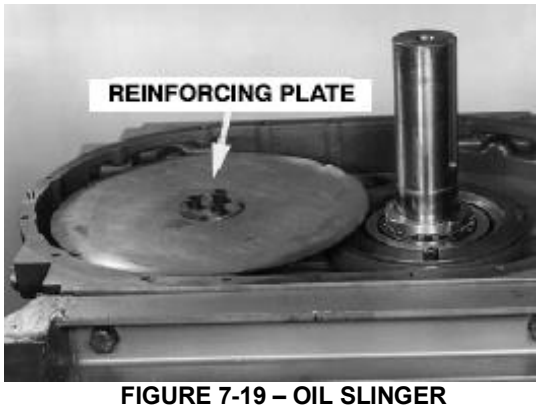


FIGURE 7-19 – OIL SLINGER

19. Check the discharge end clearance of the rotor with a feeler gauge through the discharge opening, (
20. FIGURE 7-18, page 50). Also check rotor end clearance at the inlet end through the inlet opening. Clearance should match those listed in the chart, (FIGURE 7-8, page 46), 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 the bearing solidly in the bore, and the bearing retainer nuts are tight, which clamp shims and bearing spacer solid 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 clearance.
21. Bend the ear of the lock washer (42) into the slot of the nuts (41) on the main rotor shaft extension. Oil the bearing generously.
22. Check the shaft extension and keyway for burrs. Install keyway tool. Push the oil seal (31) onto the shaft. Install the seal adaptor gasket (54) to the end cover (18) using four screws (70) and two dowels (52). Slide the end cover assembly over the shaft extension FIGURE 7-20 and mount the cover to the bearing carrier with screws (59) and washers (60). Remove the keyway tool. Drive dowels (51) into end cover/bearing carrier holes. Expulsion port on the seal should be positioned down, install and tighten temporary bolts. Rotate shaft 6 times. Replace temporary bolts with nylok bolts and tighten. Install drive key (49)

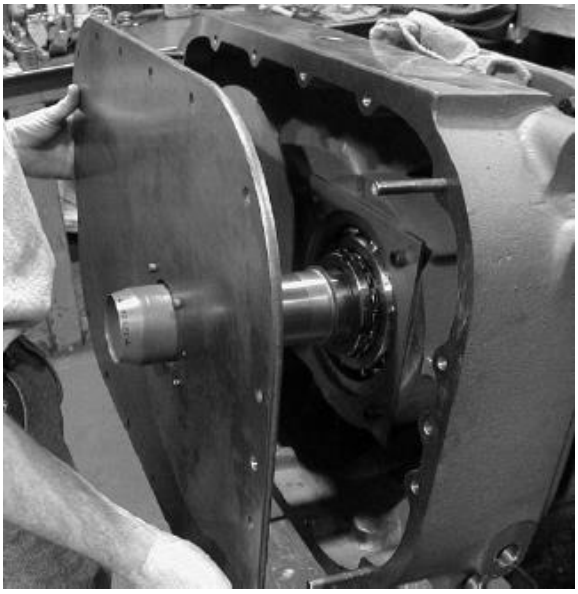


FIGURE 7-20 – END COVER ASSEMBLY

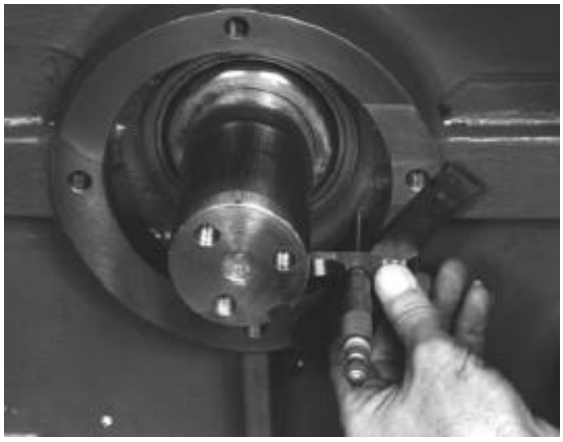


FIGURE 7-21 – BEARING BORE

FIGURE 7-22 – DEPTH MICROMETER

23. 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.

24. 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 in Step 22, measure the distance to the end of the bearing spacer, (FIGURE 7-22).

25. Install both seals using the installation tools. Expulsion port must be positioned down towards bottom of the unit. Press seals down and verify seal face is below the bearing spacer face.

26. Slide enough shims (28, 29) over the **main rotor shaft (largest shaft),** (FIGURE 7-24), up against the end of the bearing spacer 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.

27. Install the roller assembly of the bearing in the bore of the carrier (5) with the numbered side out. The roller assembly is slip fit in the bore. Coat the inner race of the bearing and shaft with oil. **Slide the inner race of the bearing on the shaft with the flange 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, page 53).

FIGURE 7-23 – OIL SEAL ON GATE ROTOR SHAFT ASSEMBLY

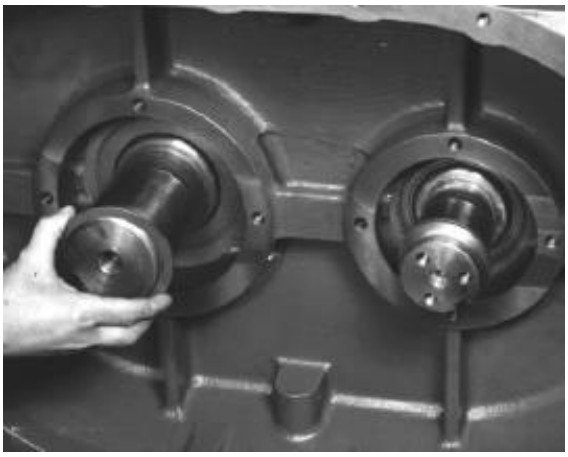


FIGURE 7-24 – SLIDE SHIMS OVER SHAFT ASSEMBLY

Tighten the nuts on the jack screws evenly to prevent cocking of the race.

28. Install the bearing clamp plate (12, 13) with ñNylokòtype screws (67), (FIGURE 7-26).

    Check the fit of the key (47) in the gear hub (11) and pinion (10). 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 (11) and pinion (10) and pull tight with a locking device, (FIGURE 7-26). Use the hub retainer (7) and screws (68) to pull the hub up tight against the bearing.

    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 (42) into the slot of the nut (41) holding the pinion. Oil the bearings generously.

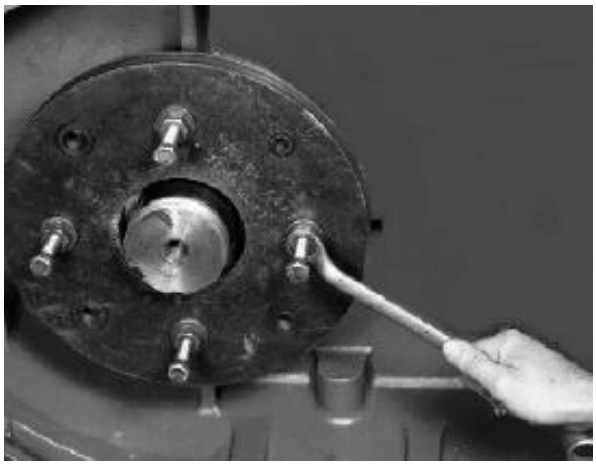


FIGURE 7- 25 – PRESS PLATE & JACK SCREW ASSEMBLY

FIGURE 7-26 – INTALL HUB & PINION PULL TIGHT

FIGURE 7-27 – SMALLEST MINUS READING

FIGURE 7-28 – SMALLEST PLUS READING

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 ñTIMING OF ROTORSòand is accomplished in the following steps.

29. Install the gear (9) on the hub, (FIGURE 7-27, page 54), 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 in the hub are centered with holes in the gear to allow radial movement on the gear for timing. Tighten the ñNylokòscrews (69) against the flat washers (66) (always use new washers) just tight enough to allow the gear to slip radially on the hub. Mount an indicator and button bracket as shown in FIGURE 7-27, page 54. In order to accurately follow the next four steps in timing, the indicator must be mounted in a clockwise position from 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.

30. **FINDING SMALLEST MINUS READING** ï (FIGURE 7-28, page 54). 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 the smallest number of thousandths from zero, not the 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.

31. **FINDING SMALLEST PLUS READING** ï (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.

FIGURE 7-29 – SETTING THE INTERLOBE CLEARANCE

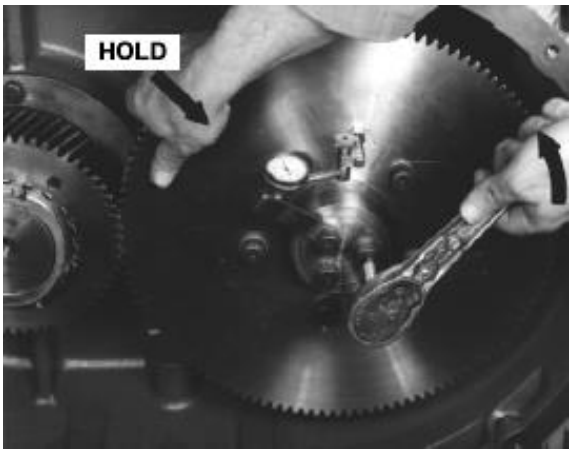


FIGURE 7-30 – HOLD GEAR & SHAFT FROM TURNING TIGHTEN FIVE GEARS TO HUB

32. **SETTING THE INTERLOBE CLEARANCE** ï (FIGURE 7-30 page 55). 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 2/3 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.

33. Hold the gear and shaft from turning and evenly tighten four gear to hub ñNylokò screws (69) (FIGURE 7-31). 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. Tighten screws securely. 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 (7) with pilot in the hub bore with three ñNylokôtype screws (68). Install gasket (30) and carrier cover plate (19). Install breathers (44) on bearing carriers (4, 5).

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

    If the blower is to be stored, refer to ñStorageò, page 9.

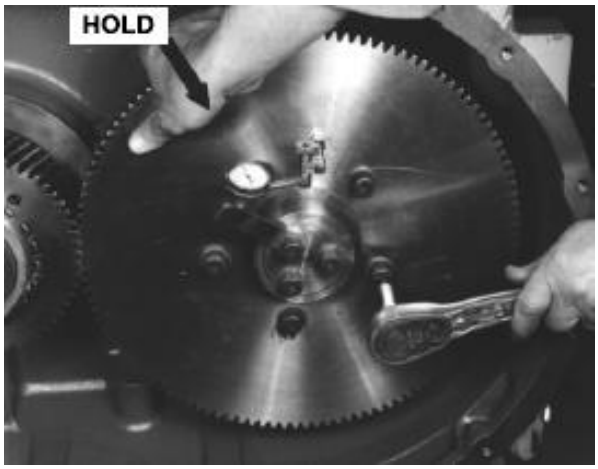


FIGURE 7-31 – FASTENER TORQUE VALUES

FASTENERS & LOCKNUTS (Ref. No.)		TORQUE VALUES (ft-lb except as noted)
Locknut	(4)	248 ï 375
Capscrew	(56)	75
Capscrew	(59)	38 ï 41
Capscrew	(61)	150
Capscrew	(63)	150
Capscrew	(65)	88 - 100
Socket Head Capscrew	(67)	118 ï 140
Socket Head Capscrew	(68)	110
Socket Head Capscrew	(69)	118 ï 140
Socket Head Capscrew	(70)	14.5 ï 15.5

NOTE: (Ref. No.) denotes items shown in drawing on pages 31 & 32.

FIGURE 7-32 – FASTENERS & LOCKNUT – TORQUE VALUES CHART

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

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