Gardner Denver®

C.Emery Nelson, Inc.
INDUSTRIAL AND POWER PLANT EQUIPMENT
ESTABLISHED 1922
7631 Commerce Street, Hamel, MN 55340
Ph: 763/ 420-3844 Fax: 763/420-2542

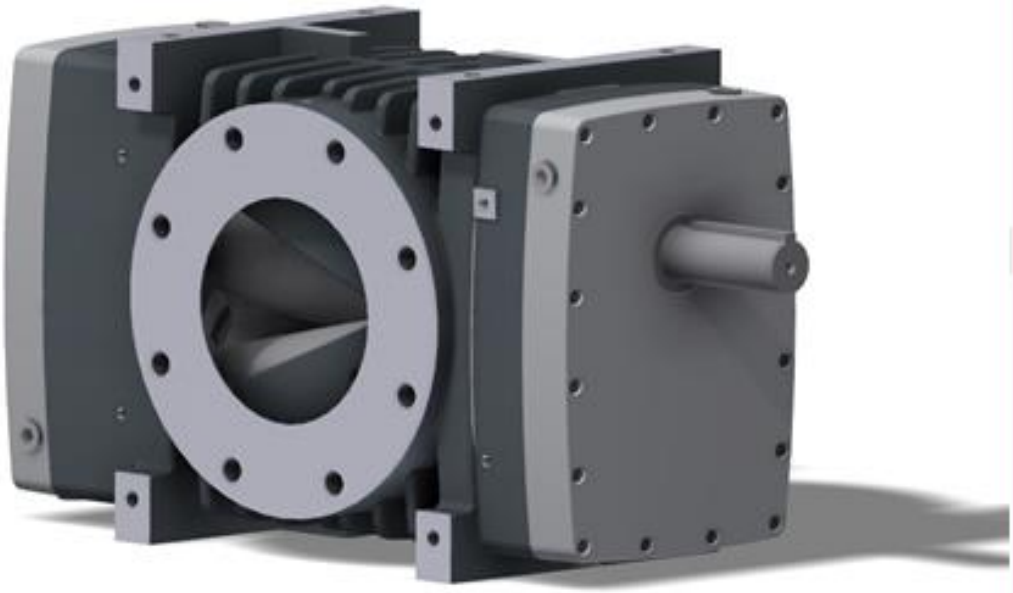
PARTS LIST OPERATING AND SERVICE MANUAL

HELIFLOW

INDUSTRIAL SERIES BLOWERS

4" GEAR DIAMETER

Models:
HYCH_CA
HYCH_CB



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Version 05
October 21, 2016

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.

Your AUTHORIZED DISTRIBUTOR can support your blower investment with these services:

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 DETERMINING BLOWER CONFIGURATION

1. Face the blower drive shaft.
2. In a **VERTICAL** configuration, air flow is horizontal.
3. In a **HORIZONTAL** configuration, air flow is vertical.
4. In a vertical configuration, a **BOTTOM HAND** exists when the drive shaft is below the horizontal center line of the blower. A TOP HAND exits when the drive shaft is above the horizontal center line of the blower.
5. In a horizontal configuration, a **RIGHT HAND** exists when the drive shaft is to the right of the vertical center line of the blower. A **LEFT HAND** exists when the drive shaft is to the left of the vertical center line of the blower.

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).

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

To Contact Gardner Denver or locate your local distributor:

visit: www.contactgd.com/blowers

or

call: (217)222-5400

FOREWORD

Gardner Denver® 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.

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 the thermostatic mixing valve or break any connections, etc., in the compressor air or oil system until the unit is shut down and the air pressure has been relieved.**
- **Electrical shock can and may be fatal.**
- **Blower unit must be grounded in accordance with the National Electrical Code. A ground jumper equal to the size of the equipment ground conductor must be used to connect the blower motor base to the unit base.**
- **Open main disconnect switch, tag and lockout before working on the control.**
- **Disconnect the blower from its power source, tag and lockout before working on the unit – this machine is automatically controlled and may start at any time.**

⚠ WARNING

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

- **Stop the unit if any repairs or adjustments on or around the 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 values shown on the nameplate.**
- **Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.**

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GARDNER DENVER HELIFLOW INDUSTRIAL SERIES BLOWERS
MATRIX/MENU

NOTICE TO CUSTOMER ï To find the construction options for Your blower unit, FILL IN THE BALANCE OF LETTERS OR NUMBERS FROM YOUR UNIT NAMEPLATE

	H	Y	C			A	A
COLUMN NUMBER:	1	2	3	4	5	6	7

FOLLOW THE LINE DOWN AND OVER FROM EACH SPACE THUS FILLED IN TO FIND THE APPROPRIATE CONSTRUCTION OPTION WITH WHICH YOUR MACHINE IS EQUIPPED.

COLUMN 1 ï BASIC DESIGNATOR

COLUMN 2 ï PRODUCT FAMILY

COLUMN 3 ï GEAR DIAMETER

A.		F.
B.		G.
C.	4ò	H.
E.		

COLUMN 4 ï CASE LENGTH

H. 12ò(HF 412)
L. 8ò(HF 408)
M. 6ò(HF 406)

COLUMN 5 ï CONFIGURATION

E. Std Blower ï Vertical-Bottom Hand-Right Discharged Timed, CCW
F. Std Blower ï Vertical-Bottom Hand-Left Discharge Timed, CW
G. Std Blower ï Vertical-Top Hand-Right Discharge Timed, CW
H. Std Blower ï Vertical-Top Hand-Left Discharge Timed, CCW
J. Std Blower ï Horizontal-Right Hand-Bottom Discharge Timed CW
K. Std Blower ï Horizontal-Right Hand-Top Discharge Timed CCW
L. Std Blower ï Horizontal-Left Hand-Top Discharge Timed CW
M. Std Blower ï Horizontal-Left Hand-Bottom Discharge Timed CCW

COLUMN 6 ï DESIGN VERSION

COLUMN 7 ï ADDITIONAL DESCRIPTION

A. Piston Ring Seal (STD)
B Mechanical Seal

INTRODUCTION
YOUR KEY TO TROUBLE FREE SERVICE

Thank you for investing in Gardner Denver quality. The Gardner Denver reputation for rugged dependability has been earned by over 50 years of service in demanding, industrial operations where downtime cannot be tolerated and efficient blower performance is expected.

Your Gardner Denver blower is a precision engineered blower that has been carefully manufactured and thoroughly tested at the state-of the-art Gardner Denver Blower Factory in Sedalia, Missouri.

As with other precision machinery, there are several relatively simple installation, operation and maintenance procedures that you must observe to assure optimum blower performance. There is no guesswork in the manufacture of your highly advanced Gardner Denver blower and there must be none in preparing the blower to get the job done in the field.

The purpose of this manual is to help you properly install, operate and maintain your Gardner Denver blower. It is essential that you review all sections of this manual in preparation for installing your blower. Follow the instructions carefully and you will be rewarded with trouble-free Gardner Denver serviceé year in and year out.

IMPORTANT GARDNER DENVER TELEPHONE NUMBERS

YOUR AUTHORIZED GARDNER DENVER DISTRIBUTION

NAME:

TELEPHONE:

FAX:

CONTACT:

C.Emery Nelson, Inc.
INDUSTRIAL AND POWER PLANT EQUIPMENT
ESTABLISHED 1922
7631 Commerce Street, Hamel, MN 55340
Ph: 763/ 420-3844 Fax: 763/420-2542

THANKSé FOR THE PRIVIEDGE OF SERVING YOU WITH DEPENDABLE GARDNER DENVER QUALITY.

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.

REMOVING PROTECTIVE MATERIALS

The shaft extension is protected with rust inhibitor which can be removed with any standard solvent.

⚠CAUTION
Follow the safety directions of the solvent manufacturer.

Blower inlet and outlet are temporarily capped to keep out dirt and other contaminants during shipment. These covers must be removed before start-up.

The internal surfaces of all HeliFlow blowers are mist sprayed with a rust preventative to protect the machine during shipment. Remove this film upon initial startup, using any commercial safety solvent. Position the blower so that the inlet and discharge connections are in the vertical position (vertical airflow). On vertically mounted units, it will be necessary to lay the unit on its side supporting the ends of the unit so as not to restrict the portion on the bottom side. Place a shallow pan on the under side of the unit. With the blower disconnected from power, spray the solvent in the top port, rotating the impellers by spinning the shaft manually. Continue this procedure until the unit is visibly clean.

⚠WARNING

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

SECTION 2
INSTALLATION

LOCATION

If possible, install the blower in a well lit, clean, dry place with plenty of room for inspection and maintenance.

FOUNDATIONS

For permanent installations we recommend concrete foundations be provided, and the equipment should be grouted to the concrete. It is necessary that a suitable base be used, such as a steel combination base under blower and motor, or a separate sole plate under each. Before grouting, equipment must be leveled, free of all strains, and anchored so no movement will occur during setting of grout. After grout has completely hardened, a recheck is necessary to compensate for shrinkage, etc. If required, add shims under blower feet after final tightening of foundation anchor bolts to remove strain from the blower housing. Where jack screws or wedges are used during grouting, they must be backed off or removed before final tightening of anchor bolts.

Where a concrete foundation is not feasible, care must be taken to insure that equipment is firmly anchored to adequate structural members.

MOUNTING CONFIGURATIONS

The blower flex-mounting design enables horizontal and vertical mounting configurations with top or bottom hand, right or left hand shaft positioning. The units are discharge timed allowing rotation in only one direction (refer to FIGURE 2-1).

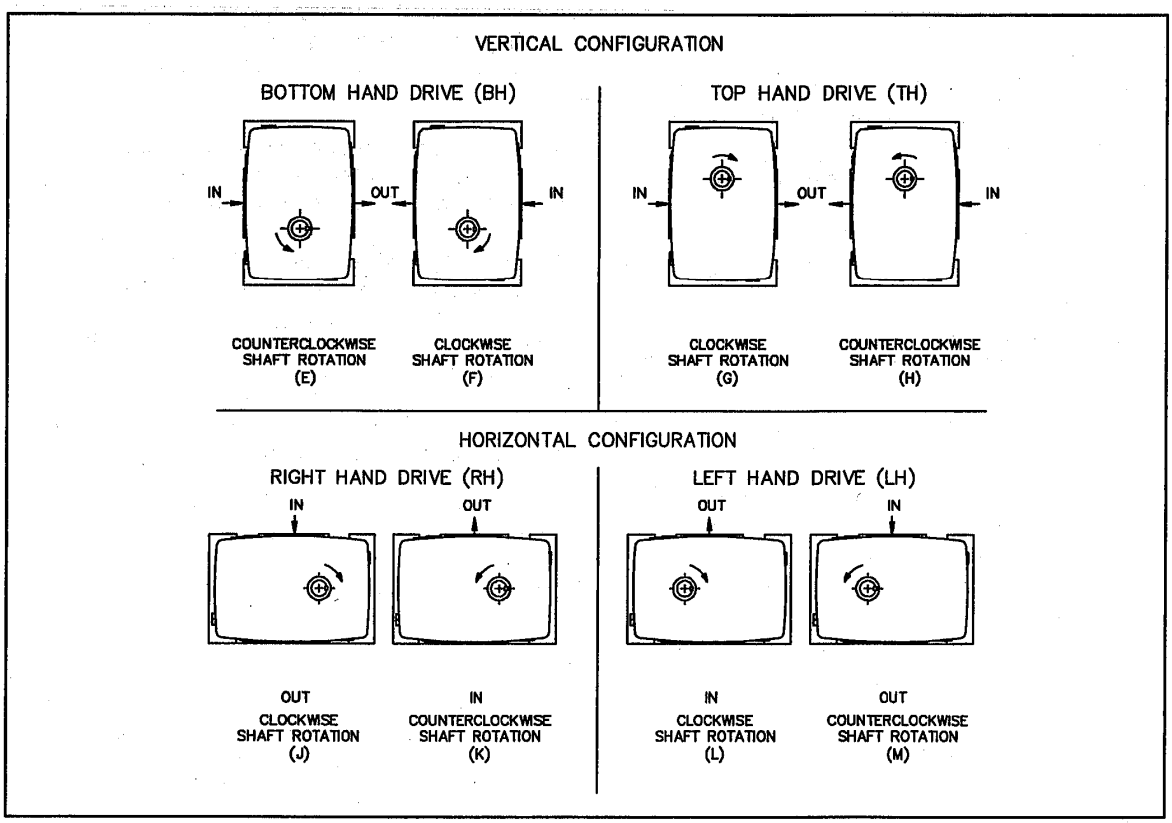


FIGURE 2-1– BLOWER MOUNTING CONFIGURATIONS

NOTICE

When changing mounting configuration, it will be necessary to reposition oil level gauge (H), and drain plug (A). Refer to FIGURE 3-1, page 14, for correct location.

DRIVE INSTALLATION

When selecting a V-belt drive, check to be sure the shaft overhung load limitation is not exceeded. Refer to FIGURE 2-2, page 12, for overhung load calculations and limitations.

Belt drives must be carefully aligned. Motor and blower pulleys must be parallel to each other and in the same plane within 1/32 inch. Belt tension should be carefully adjusted to the belt manufacturerÕs recommendation using a belt tension gauge. Check tension frequently during the first day of operation.

⚠WARNING

Overtightening belts leads to heavy bearing loads and premature failure.

On the direct connected units, alignment and lubrication of couplings to specifications of the coupling manufacturer is 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.

⚠WARNING

Exceeding overhung load limitations leads to unwarrantable premature bearing failure and shaft breakage.

The location of the sheave on the blower shaft greatly affects the stress in the shaft. The optimum blower sheave positioning is as close as possible to the blower drive cover, not to exceed dimension ñCò in Drive Shaft Illustration, FIGURE 2-2, see page 12.

The calculated shaft moment must not exceed the maximum allowable moment listed in Maximum Allowable Moment Chart, FIGURE 2-2, see page 12. If the calculated shaft moment exceeds the maximum allowable moment:

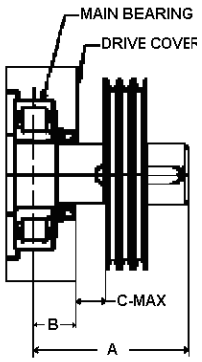
- Å Increase Sheave Diameters to Reduce Belt Pull
- Å Use Jackshaft Drive
- Å Use Direct Coupled or Gearbox Drive

To calculate shaft moment for a given V-Belt Drive Arrangement:

1. Use the formula for Calculation of Belt Pull, FIGURE 2-2, see page 12, to calculate belt pull. Refer to Arc of Contact Factor Chart, FIGURE 2-2, see page 12.
2. Insert the calculated belt pull into the formula for Calculation of Shaft Moment, FIGURE 2-2, page 12 to arrive at the calculated shaft moment.

Gear Diameter (Inches)	Dimensions (Inches)			Maximum Allowable Moment (LB-IN)
	A	B	C (Max)	
4	5.38	1.49	0.25	3200

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. = Actual Drive Service Factor
- D = Blower Sheave Pitch Diameter in Inches
- RPM = Blower Sheave Speed

$$Z = \left[\frac{\text{Large Sheave Pitch Diameter (in) ï Small Sheave Pitch Diameter (in)}}{\text{Sheave Center Distance (in)}}\right]$$

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 2-2 – BELT DRIVE OVERHUNG LOAD CALCULATIONS

PIPING

Inlet and discharge connections on all blowers are large enough to handle maximum volume with minimum friction loss. Reducing the pipe diameter on either inlet or discharge will only create additional line loss and increase the overall pressure differential.

Excessive weight of piping and fittings will cause internal misalignment and premature wear. Never allow the blower to carry the weight of the pipe. If possible, a spool or sleeve-type expansion joint should be installed between the unit and the piping. Where a flexible connection is not practical, the weight of the rigid connection must be separately supported. All system piping must be cleaned internally before connecting to the blower.

DO NOT use raised face flanges when connecting to the inlet or discharge of blower. Failure to comply can result in damage to internal components and/or complete operational failure.

Gardner Denver blowers are shipped dry from the factory. Do not attempt to operate the blower before following proper lubrication instructions. Permanent damage to the gears, bearings and seals will occur.

SECTION 3
MAINTENANCE

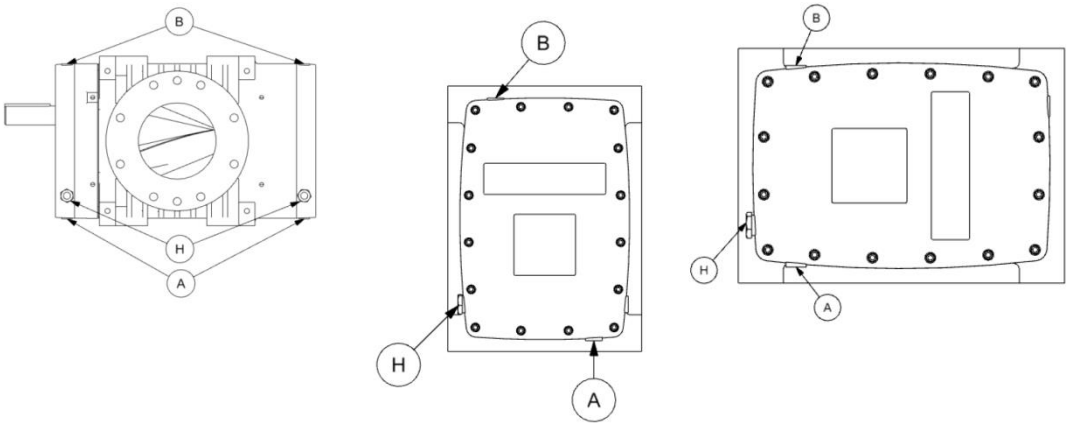


FIGURE 3-1 – LUBRICATION

A. Oil Drain Plug
B. Plug/Oil Fill
H. Oil Level Sight Gauge

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. Scheduling regular maintenance of the blower will insure long trouble-free service.

LUBRICATION
Gears and bearings are splash lubricated by an oil slinger in each sump. Check the oil level in both sumps daily. Do not operate the blower if the oil level is not in the middle of the sight gauge for each sump when the blower is not running.

FILLING PROCEDURE
Refer to FIGURE 3-1. While the blower is not running remove the plug (B) from each sump. Add oil to each sump until it reaches the middle of each oil level sight gauge (H). Secure the plug (B) in each end.

LUBRICATION SERVICE
Add fresh oil as required to maintain proper level. If premium grade mineral oil is used, the oil should be drained, the gearbox flushed and the oil replaced every 1500 hours or more frequently if inspection so indicates. The oil change period is governed by operating conditions such as load, temperature, dirt, humidity, fumes and the quality of the oil used. The oil drain plug is located at (A). With AEON PD synthetic blower lubricant, perform the above oil-change maintenance after 4500 to 7500 hours.

⚠WARNING

Do not overfill as this will tend to cause excessive heating of the gears and may damage the unit.

RECOMMENDED LUBRICANT

Oil Fill Ports	Vertical	Horizontal
Shaft End	1.0	1.25
Gear End	1.5	2.0

FIGURE 3-2 – APPROXIMATE OIL CAPACITIES (PINTS)

AEON PD is formulated especially for positive displacement blower service to provide maximum blower protection at any temperature. One filling of AEON PD will last a minimum of 4 times longer than a premium mineral oil. Refer to FIGURE 3-3, page 15.

Order AEON PD from your Gardner Denver Distributor.

AEON PD	**1 Quart Bottle**	**Part No. 28G23**
AEON PD	**12 Quart Case**	**Part No. 28G24**

Blower Discharge Temperature		Factory Tested Recommended and Approved Lubricant
° F	° C	AEON PD Synthetic Blower Lubricant One Superior Lubricant For All Operating Temperatures
32°	0°	
100°	38°	
275°	135°	
350°	177°	

FIGURE 3-3 – TEMPERATURE CHART

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

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

FIGURE 3-4 – LUBRICATION RECOMMENDATION

* 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.

ÿ The recommended operating range for AEON PD Synthetic Lubricant.

AIR FILTERS AND FILTER SILENCERS

⚠WARNING

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

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

In all cases refer to the filter manufacturerôs service instructions. Due to the many types of filters, it is not practical to give specific instructions covering all models.

NOTICE

No matter what type of filter is used, always make sure all seats, 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.

PERIODIC INSPECITIONS

A good maintenance program will provide for periodic inspections of the blower and drive components. The following inspections may prevent major repairs and downtime:

1. Observe the blower for vibration, heating, noise, oil leaks and excessive air leaks.

2. Check for proper operation of the filters, silencers, couplings, drive belts, motor (or power unit), relief valve, check valve, gauges and other controls.

3. Disconnect the drive and turn the blower by hand to check for drag, tight spots, bearing wear and gear backlash. Rotation should be free with no indication of drag or metallic interference.

4. Inspect the interior of the blower through the inlet or discharge port for cleanliness, corrosion and contact of internal parts.

5. Check the tightness of all screws, bolts and nuts.

SECTION 4
OPERATION

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

NOTICE
Machines are shipped without oil in the sumps. Do not operate before adding lubricant.

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

Each size blower has limits on pressure differential, running speed and discharge temperature which must not be exceeded. These limits are shown in the following tabulation. Refer to FIGURE 4-1, page 17.

⚠WARNING

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

It is important that the pressures and temperatures are measured directly at the ports of the blower to avoid error that may be caused by intervening pipe runs, fittings, etc.

Relief valves should be used to protect against excessive pressure or vacuum conditions. These valves should be tested at initial startup to be sure they are adjusted to relieve at or below the maximum pressure differential rating of the blower.

NOTICE
Relief valves should be placed as close as possible to the blower inlet or discharge.

In some instances, pressure may be relieved at a lower point than the blower maximum in order to protect the motor or the equipment served by the blower.

Discharge temperature switches are recommended to protect against excessive inlet restriction or inlet temperatures. Check valves in the discharge line on pressure blowers and in the inlet line on vacuum blowers are recommended to protect the blower from motoring backwards when shut down under load.

LIMITATIONS

For information regarding limitations, refer to FIGURE 4-1, below.

MAXIMUM OPERATING LIMITATIONS

SIZE	RPM	PRESSURE PSI	VACUUM IN HG	TEMPERATURE RISE ° F	DISCHARGE TEMPERATURE ° F
HF 412	4500	15	16	250	350

DO NOT EXCEED THESE LIMITS

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

FIGURE 4-1 – MAXIMUM OPERATING LIMITATIONS

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 impellers 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 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. With motor electrical power locked out and disconnected, turn the drive shaft by hand to be certain the impellers do not bind.

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

☐ 8. The internal surfaces of all Gardner Denver units are mist sprayed with a rust preventive to protect the machine during the shipping and installation period. This film should be removed upon initial startup.

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

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

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

SAFETY PRECAUTIONS

1. Do not operate blower with open inlet or outlet port.
2. Do not exceed specified vacuum or pressure limitations.
3. Do not operate above or below recommended blower speed range.
4. Blower is not to be used where non-sparking equipment is specified.
5. Do not operate without belt guard or coupling shield.

⚠WARNING

Do not exceed sheave or coupling manufacturer's rim speed limit.

6. The blower and blower discharge piping may be extremely hot and can cause skin burns on contact.

TROUBLE SHOOTING

No matter how well the equipment is designed and manufactured, there may be times when servicing will be required due to normal wear, the need for adjustment, or various external causes. Whenever equipment needs attention, the operator or repairman should be able to locate the cause and correct the trouble quickly. The Trouble Shooting Chart below is provided to assist the mechanic in those respects.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Knocking	1. Unit out of time. 2. Distortion due to improper mounting or pipe strains. 3. Excessive pressure differential. 4. Worn gears. 5. Worn bearings.	1. Retime impellers. 2. Check mounting alignment and relieve pipe strains. 3. Reduce to manufacturer's recommended pressure. Examine relief valve, re-set if necessary. 4. Replace timing gears. 5. Replace bearings.
Excessive blower temperature.	1. Too much oil in gear case. 2. Too low operating speed. 3. Clogged filter or muffler. 4. Excessive pressure differential. 5. Worn impeller clearances. 6. Internal contact.	1. Reduce oil level. 2. Increase blower speed. 3. Remove cause of obstruction. 4. Reduce pressure differential across the blower. 5. Replace impeller. 6. Correct clearances.
Impeller end or tip drag.	1. Insufficient assembled clearances. 2. Case or frame distortion. 3. Excessive operating pressure. 4. Excessive operating temperature.	1. Correct clearances. 2. Check mounting and pipe strain. 3. Remove causes. 4. Remove causes.
Lack of volume.	1. Slipping belts. 2. Worn clearances. 3. Dirty air filter	1. Tighten belts. 2. Re-establish proper clearances. 3. Clean or replace air filter
Excessive bearing or gear wear.	1. Improper lubrication.	1. Correct lubrication level. Replace dirty oil.
Loss of oil.	1. Bearing housing vents plugged. 2. Worn seal.	1. Clean vents. 2. Replace seals.

SECTION 5
SPECIAL TOOLS

ORDER SPECIAL TOOLS BY PART NUMBER. SEE PAGE 1 FOR ORDERING INSTRUCTIONS.

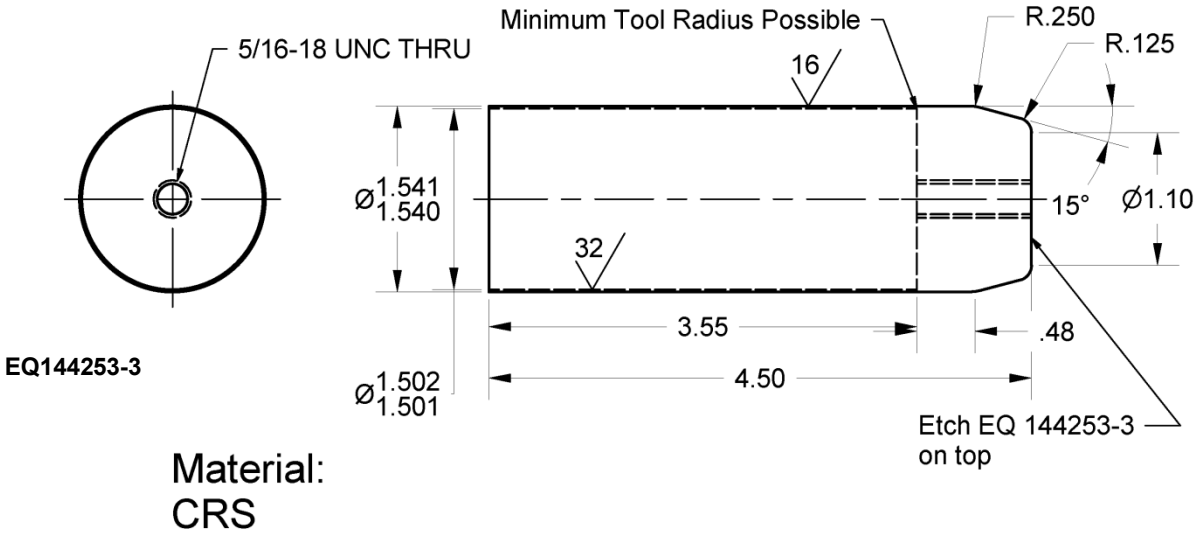


FIGURE 5-1 - SEAL PROTECTION SLEEVE

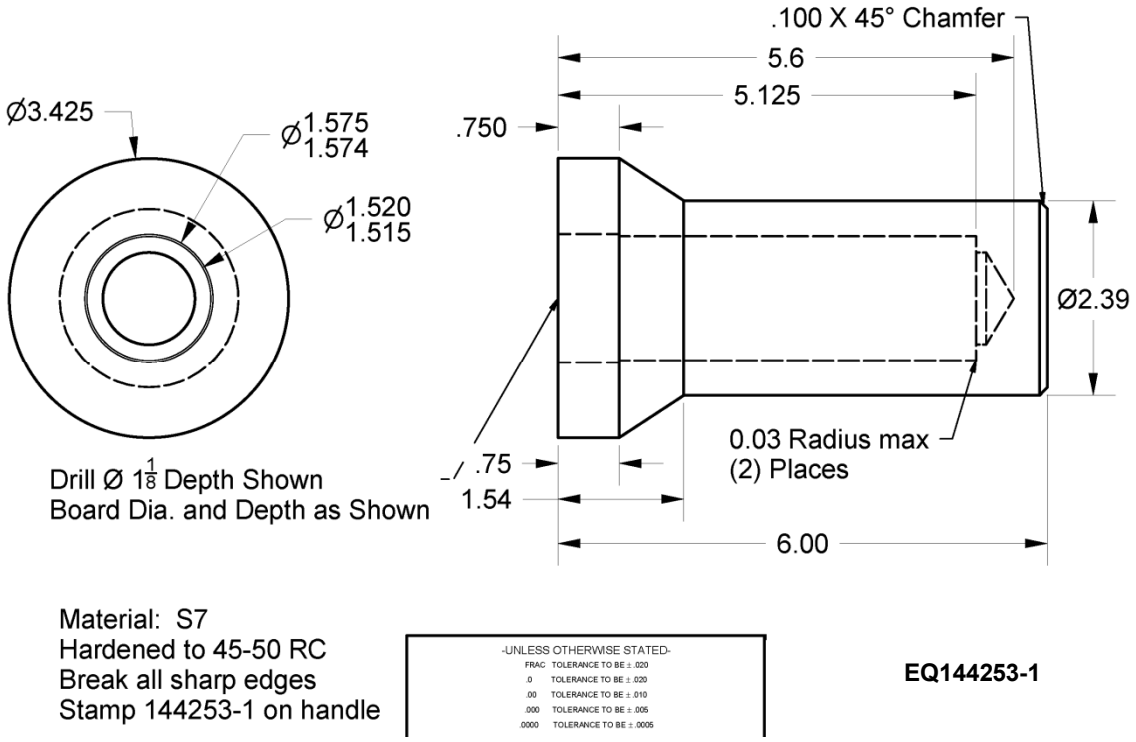
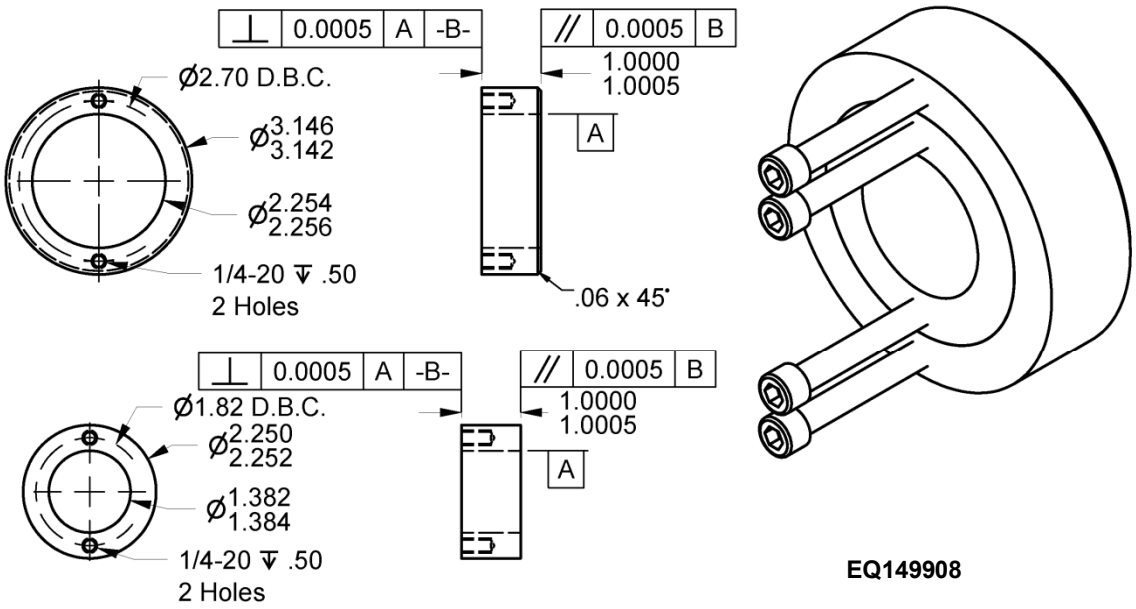


FIGURE 5-2 – BEARING DRIVER



Material: A2
Heat Treat 58/60 RC

FIGURE 5-3 – FALSE BEARING

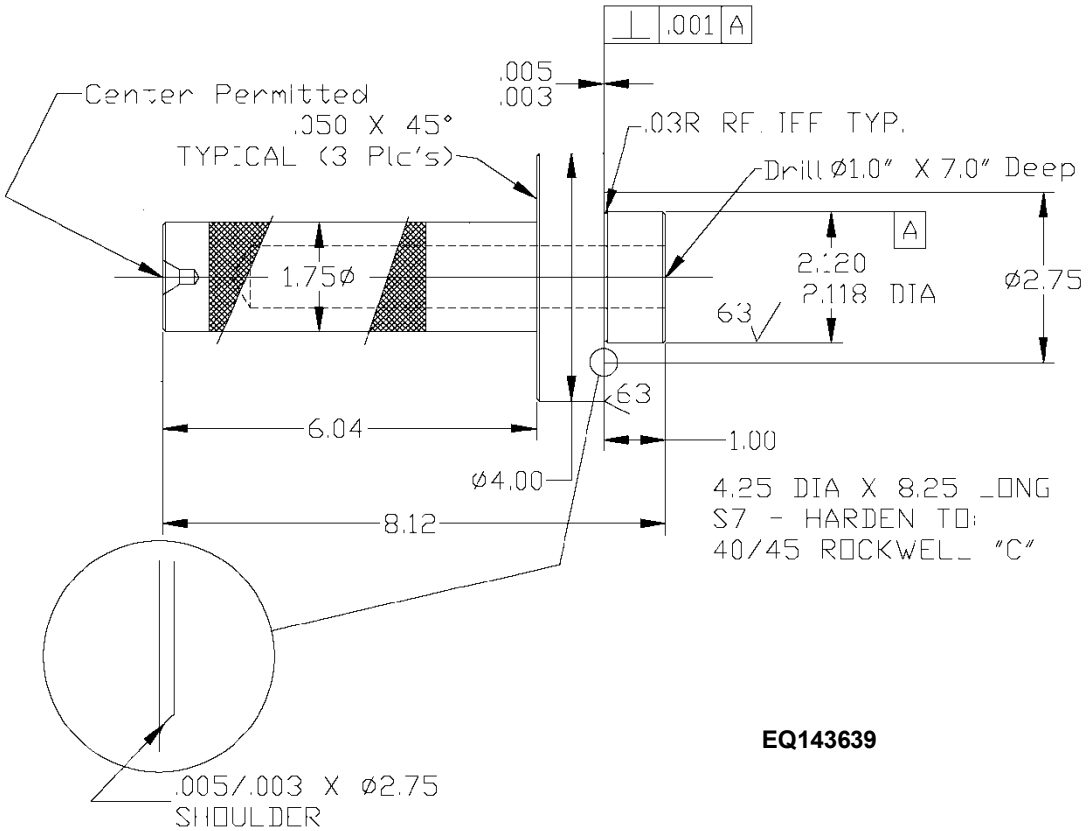
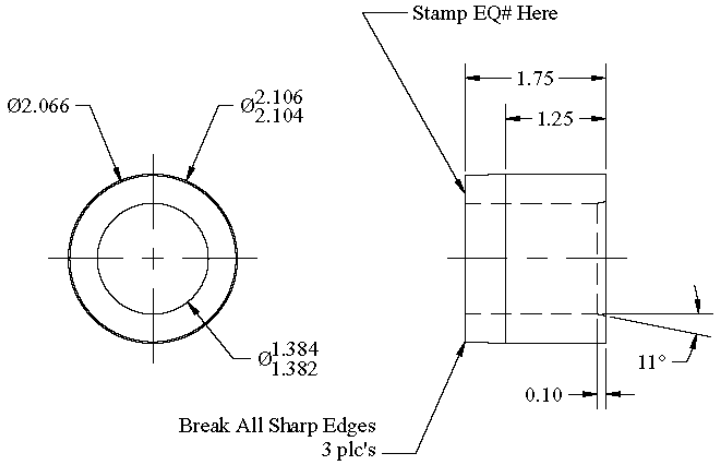


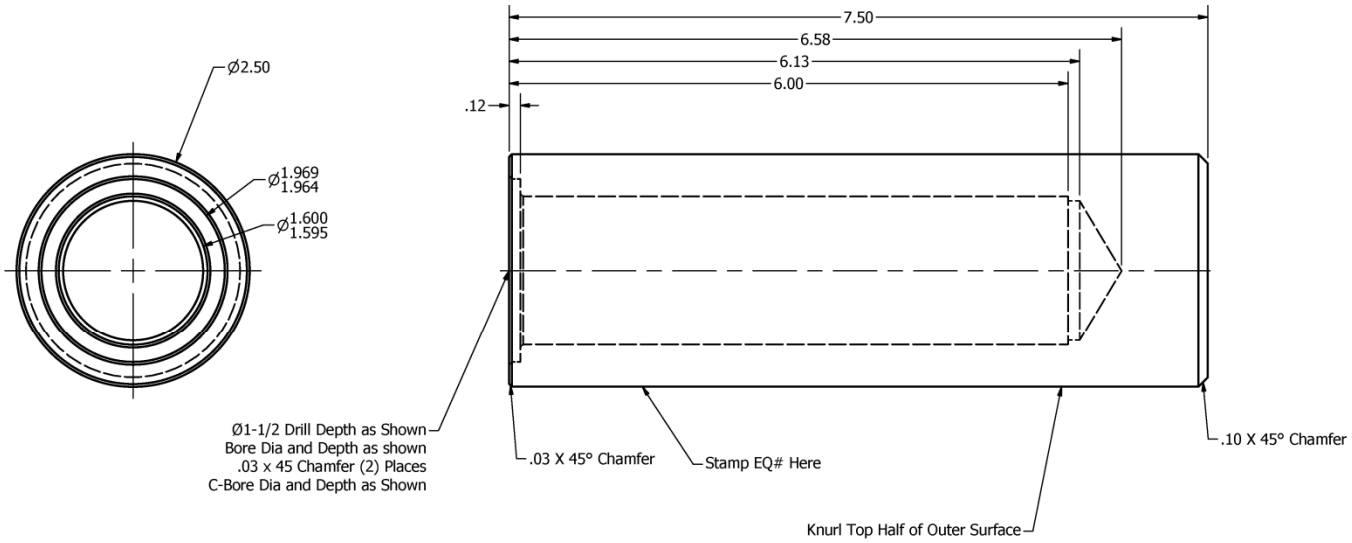
FIGURE 5-4 – INSERT DRIVER

Material: S7
Hardened to 45 - 50 Rc

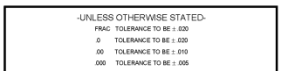


EQ143805

FIGURE 5-5 – ASSEMBLY GUIDE FOR RINGS

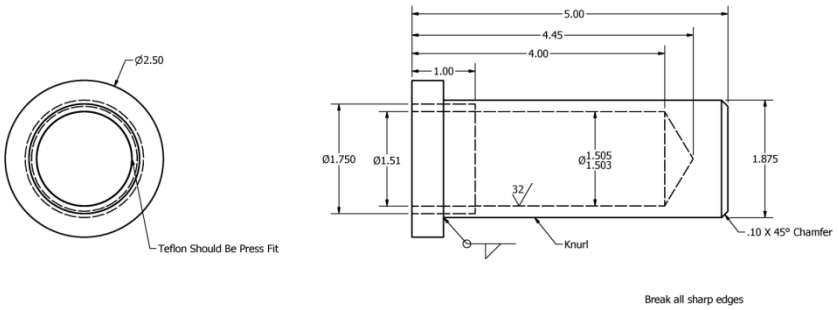


Material: S7
Hardened to 45-50 RC



EQ144253-2

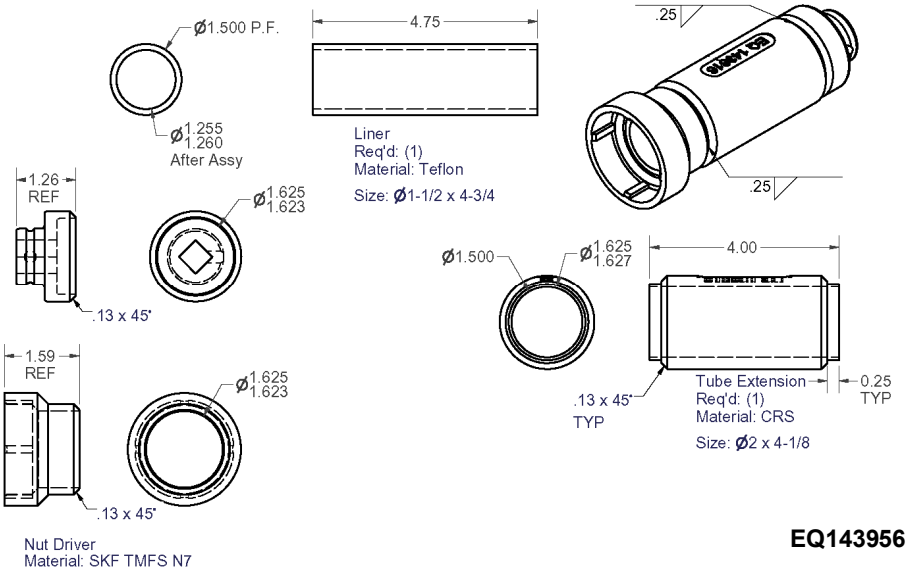
FIGURE 5-6 – SLINGER/CARRIER DRIVER



Material:
1) Teflon Bushing 1.75 OD x 1.5 ID x 1" (machine to size)
2) 4140 Pre-Hard

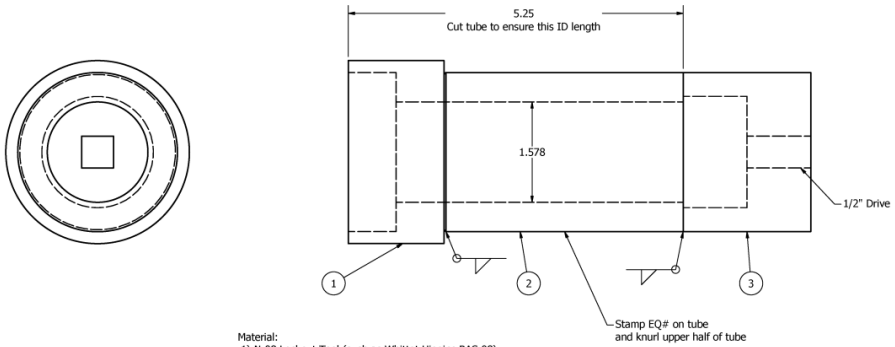
EQ144253-5

FIGURE 5-7 – SEAL DRIVER

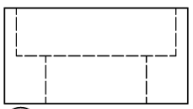


EQ143956

FIGURE 5-8 – NUT DRIVER



Material:
1) N-08 Locknut Tool (such as Whittet Higgins BAS-08)
2) 2-1/2 OD x 1-1/2" ID x 12" 4140 Tube
3) 1/2" Drive Socket with about the same OD (2.5") as the Tube (around 1-3/4" Socket)



1 Cut off shaft extension on locknut tool, flush with the back

EQ144253-6

Figure 5-9 – NUT DRIVER N-08

SECTION 6
DISASSEMBLY INSTRUCTIONS

2. Inspect the interior of the blower for any signs of rotor contact (rotor to rotor, rotor tip to case, rotor end to bearing housing). If there are signs of contact then the various clearances should be measured with feeler gauges prior to any disassembly.

3. Inspect the areas around the drive shaft seal and vent passages in the bearing housing and air cylinder for any signs of oil leaks.

4. Drain the oil from the gear end and drive end sumps by removing their drain plugs (2). A small amount of oil from <u>each</u> sump should be saved in the event that an oil analysis will be required.

5. Remove the screws (5) from the drive end sump cover (29). Remove the sump cover by sliding it off the drive shaft.

6. Inspect the drive shaft in the area of the oil seal for damage and wear. Inspect the oil seal (31).

7. Support the external surface of the drive end sump cover near the oil seal with blocks of wood. Drive the oil seal from the cover using the seal driver tool (EQ143956) and a press or small hammer.

8. Remove the screws (5) from the gear end sump cover (3). Remove the sump cover.

9. Remove the bolt (8), washer (6), and oil slinger (26) from the gear end of its rotor shaft.

10. If it appears the gears can be reused their backlash should be measured. Lock the idler rotor from turning by wedging a shop rag between the tip of a lobe and the air cylinder. Measure the backlash of the gears using a dial indicator and a magnetic base. The backlash should be measured in 3 places (every 1/3 turn).

11. Match mark the gears by making small punch marks on the ends of 2 meshing teeth.

12. Remove the 3 set screws from both gear locking assemblies (56). Note these are located through the unthreaded holes in the outer ring.

13. Remove the 6 capscrews from both locking assemblies. Thread 3 of these capscrews into the threaded holes in the outer ring of each locking assembly. Tighten the screws evenly to remove the locking assembly from each gear.

14. Remove the gears (9) from both rotor shafts.

15. Remove the stepped spacer (55) from each rotor shaft.

16. Remove the 4 bearing retaining screws (10) and washers (12) from the air cylinder.

17. Position the blower assembly vertically with the drive end up. Support the gear end of the air cylinder on blocks to protect the ends of the rotor shafts.

18. Remove the locknuts (36 & 84) from both of the rotor shafts on the drive end using nut driver tools (EQ143856 and 144253).

19. Remove the oil slingers (27 & 83) from its rotor shaft.

20. Remove the spacer (49 & 85) from each rotor shaft.

21. Remove the 6 socket head screws (21) and washers (20) that attach the bearing housing (24) to the air Cylinder (22).

22. Remove the bearing housing from the air cylinder using two 2 jaw pullers. The puller jaws must be narrow enough to fit in the rectangular holes in the bearing bosses. A shaft protector (soft spacer) must be placed over the end of each rotor shaft. Both pullers must be tightened evenly during this process. There are 2 dowel pins that locate the bearing housing relative to the air cylinder. If the bearing housing is tilted during removal these dowel pins may break out of their holes.

23. Remove the 2 seal flingers (34) from their bores in the bearing housing.

24. Remove the ball (58) and roller bearing (14) from their bores in the bearing housing using a ball peen hammer and punch. Exercise care not to damage the bearing bores.

25. Position the blower assembly horizontally.

26. Match mark the rotors by making small punch marks on the ends of meshing lobes.

27. Push the drive rotor (23A) shaft through the air cylinder using a 2 jaw puller. The puller jaws must be narrow enough to fit in the rectangular holes in the bearing boss. A shaft protector (soft spacer) must be placed over the end of the rotor shaft. Remove the drive rotor from the air cylinder.

28. Push the idler rotor (23B) shaft through the air cylinder using a 2 jaw puller. Remove the idler rotor from the air cylinder.

29. Remove the 2 seal flingers (34) from their bores in the air cylinder.

30. Remove the 2 roller bearings (58) from their bores in the air cylinder using a ball peen hammer and punch. Exercise care not to damage the bearing bores.

31. Inspect the 3 piston rings (15) on both ends of both rotors for signs of damage and abnormal wear. Remove the piston rings from each of the 4 ring carriers (33).

32. Inspect the ring carriers for signs of damage and abnormal wear. Normally it is not required to replace the ring carriers.

33. If a ring carrier is damaged it may be removed by heating with a torch. The rotor should be placed in a vertical position and continuously rotated while the ring carrier is being heated. Caution should be used when performing this procedure as the rotor can be damaged by uneven and extreme heating.

34. Inspect the inserts (32) in the 4 bearing bosses (2 in bearing housing and 2 in air cylinder) for signs of damage and abnormal wear. Normally it is not required to replace the inserts.

35. If an insert is damaged it may be removed by using a hydraulic press and suitable driver tool. It must be removed from the air side of the bearing housing or air cylinder.

SECTION 7
ASSEMBLY INSTRUCTIONS

1. Apply a light coating of loctite 620 to the outside diameter of 2 inserts (32). The wide face of the inserts must face the air side of the bearing housing (24). Position the holes in the inserts so that they are located at the 3, 6, 9, and 12 o'clock positions in the bearing housing bore. Support the bearing housing under the bearing bosses. Use a hydraulic press and insert driver tool (EQ143639) to install the inserts into the bearing housing from the air side. After they are installed ensure that the inserts are slightly below or flush with the air surface of the bearing housing. See FIGURE 7-1

    a. 1. For mechanical seal unit, apply a light coating of Loctite 620 to outside diameter of mechanical seal assembly (87) (containing metal cup and carbon). Support bearing housing under the bearing bosses. Using a hydraulic press and insert driver tool (EQ143639), press seal assemblies into respective bores (carbon side first) of bearing housing (24) from the air side. Repeat process for bearing housing integrated with air cylinder (22) and skip step 2.

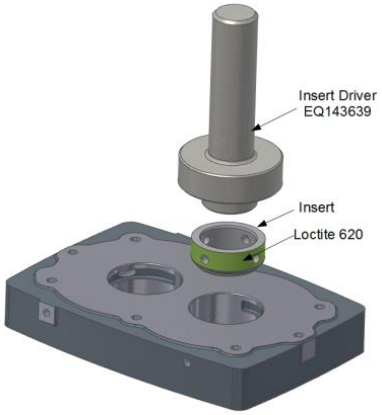


FIGURE 7-1 – INSTALL INSERT

2. Install 2 inserts into the air cylinder (22) from the air side using the same procedure and tooling as in step 1. Note the air cylinder must be supported by the bearing bosses during this procedure.

3. Apply loctite 620 to both ends of the drive (long) rotor (23A) shaft (on the largest diameter next to the rotor body). Support the rotor in a vertical position.

4. Heat 2 piston ring carriers (33) to 275 degrees F. After heating use a gauss meter to check the ring carriers for magnetism. The magnetic flux density must be less than one gauss. The carriers must be orientated so that their stepped face does not contact the rotor body. Drive the piston ring carriers up against the face of the rotor body at both locations using the Carrier driver tool (EQ144253-2). After the ring carriers have cooled ensure that they are still tight against the face of the rotor body.

    a. 4. For mechanical seal unit, uses two mechanical seal spacers (88) instead of piston ring carriers (33). The large diameter goes against rotor body. Skip steps 6, 8, 9, and 11.

5. Repeat steps 3 and 4 for the idler (short) rotor (23B).

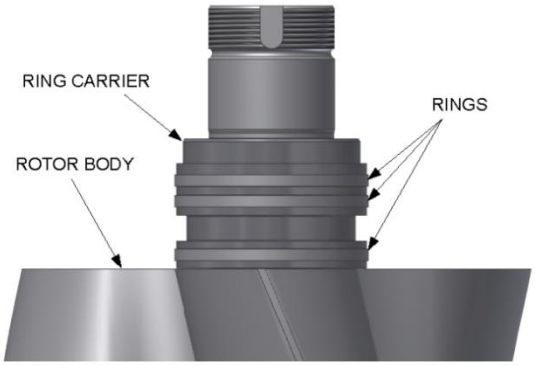


Figure 7-2 – INSTALL PISTON RINGS

6. Install the piston rings (15) into the 4 piston ring carriers starting with the ring closest to the rotor body. Ensure that the ring ends are hooked together properly. Offset the gaps in the rings 180 degrees. See Figure 7-2.

7. Position the air cylinder vertically with the gear end on the bottom. Determine the location of the blower discharge port. The discharge port has two feedback slots adjacent to the triangular opening. Refer to the arrows cast into the air cylinder to determine the air flow direction. From the blower model designation determine drive shaft (long rotor) location and the direction it rotates.

8. Apply oil to the inside diameter of the 2 inserts in the gear end of the air cylinder and to the outside diameter of the piston rings on the gear end of both rotors. Place a ring guide tool (EQ143805) on the gear end of both rotor shafts.

9. Install both rotors into the air cylinder. Verify that the long end of the drive rotor is pointing up and that the drive rotor is in the correct bore. Ensure that the rotation of each rotor matches the arrows on the outside of the air cylinder and ensure that the rotor lobes match the triangular shape of the discharge port. For proper slinger alignment, the key ways in the shafts much be oriented 90° from each others. Remove the ring guide tool from each rotor shaft.

10. Measure and record the total rotor to bearing housing end clearance for each rotor. This is accomplished by using a depth micrometer to measure the distance from the top edge of the air cylinder to the top of the rotor lobe while the rotor is held as vertically as possible.

11. Apply oil to the inside diameter of the 2 inserts in the bearing housing and to the outside diameter of the piston rings on the drive end of both rotors. Place a ring guide tool (EQ143805) on the drive end of both rotor shafts.

12. Apply Loctite Gasket Eliminator 515 to the sealing surface of the air cylinder. Use a roller to spread the gasket eliminator to an even coat.

13. Install 2 dowel pins (19) into the drive end of the air cylinder.

14. Install the bearing housing over the shafts of the rotors and onto the air cylinder. There is only one orientation of the bearing housing which will allow the dowel pins to line up with their mating holes. Remove the ring guide tool from each rotor shaft.

15. Attach the bearing housing to the air cylinder using 6 socket head screws (21) and washers (20). The screws should have a nylok insert. Tighten the screws in an alternating pattern starting with the middle ones. Torque the screws to 38 ft-lb in 2 steps.

16. Heat 2 seal flingers (34) to 275 degrees F. After heating use a gauss meter to check the flingers for magnetism. The magnetic flux density must be less than one gauss. Use the flinger drive tool (EQ143806) to drive them into position on the ends of the piston ring carriers of the drive end of both rotors. Be careful not the damage the threads on the rotor shafts. Ensure each flinger is seated against the shoulder on the ring carrier and that it is recessed below the end of the ring carrier.

    a. 16. For mechanical seal unit, the rotating portion of the mechanical seal (87) is used in place of slinger (34). DO NOT HEAT! Apply light coat of oil to o-ring inside rotating ring. Wrap threads of drive shaft with tape to protect o-ring inside rotating ring while installing on shaft. Use driver tool (EQ143806) to press rotating ring into place with large outside diameter first.

17. Position the air cylinder vertically with the gear end on the top. Support the cylinder so that the rotor shafts may extend through the bearing bores.

18. Heat 2 seal flingers (34) to 275 degrees F. After heating use a gauss meter to check the flingers for magnetism. The magnetic flux density must be less than one gauss. Use the flinger drive tool to drive them into position on the ends of the piston ring carriers of the gear end of both rotors. Ensure each flinger is seated against the shoulder on the ring carrier and that it is recessed below the end of the ring carrier.

    a. 18. For mechanical seal unit, the rotating portion of the mechanical seal (87) is used in place of slinger (34). DO NOT HEAT! Apply light coat of oil to o-ring inside rotating ring. Use driver tool (EQ143806) to press rotating ring into place with large outside diameter first.

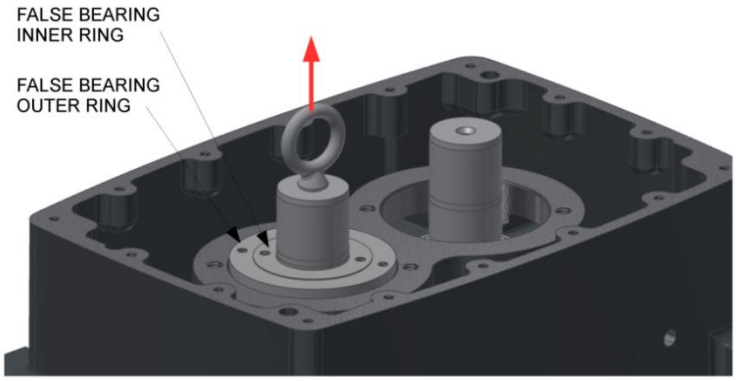


FIGURE 7-3 – MEASURE STEP IN FALSE BEARING

19. Put the false bearing (EQ149908) into the bearing bore for the idler (short) shaft. Screw an eye bolt into the end of the idler rotor and lift the rotor until the ends of the rotor lobes contact the end surface of the air cylinder. Using a depth micrometer measure and record the distance from the top surface of the outer ring of the false bearing to the top surface of the inner ring. The inner ring of the false bearing should be above the outer ring. See FIGURE 7-3.

    a. 19. For Mechanical seal unit, it is important to ensure the inner ring of false bearing is pressed down firmly to overcome the spring force of carbon ring in mechanical seal. Failure to do so will result in false measurements required for achieving desire rotor end clearances!

20. The number measured in step 19 should be .002òmin. If it is less than this then shims equal to the difference must be installed on the shaft of that rotor.

21. Lower the rotor and remove the eye bolt. Remove the false bearing. Install the required amount of shims (13) as determined in step 20 onto the idler rotor shaft.

22. Repeat steps 19 through 21 for the drive (long) rotor.

23. Apply oil to the drive and idler rotor bearing bores in the air cylinder.

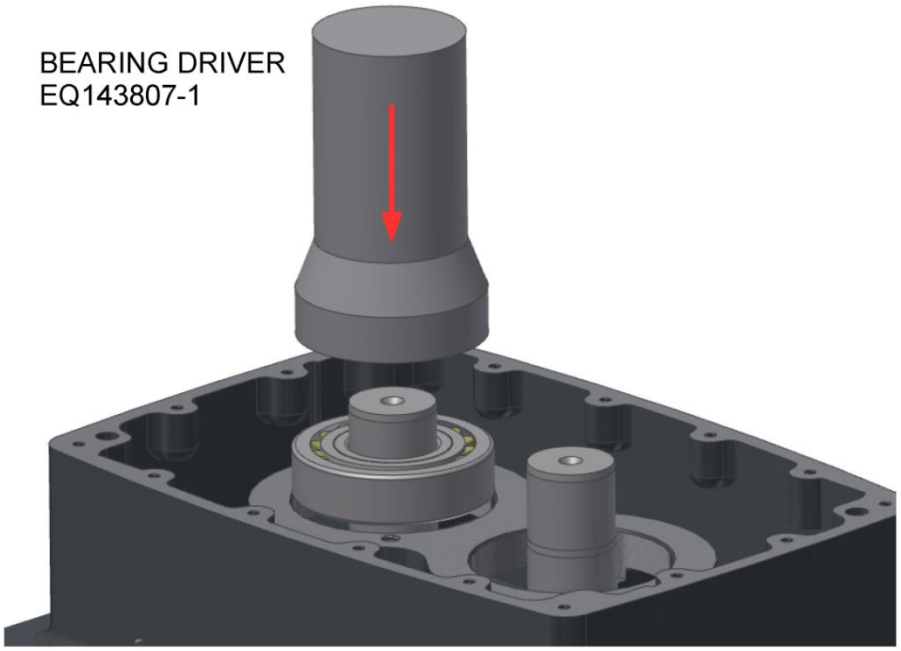


FIGURE 7-4 – PRESS BEARING ONTO ROTOR SHAFT

24. Place the air cylinder vertically in a hydraulic press with the gear end on top. The bottom of the idler rotor shaft must be in contact with the bed of the press. The bottom of the drive rotor shaft must not be in contact with the bed of the press. The blower air cylinder must be cradled on its sides but must not be restrained in the vertical direction. Place a roller bearing (58) over the rotor shaft with the numbers on the bearing facing up. Press the bearing onto the idler rotor shaft using the hydraulic press and the bearing driver tool (EQ143807-1). See FIGURE 7-4

25. Repeat step 24 for the drive rotor bearing. In this step the bottom of the drive rotor shaft must be in contact with the bed of the press and the bottom of idler shaft must not be in contact with the bed of the press.

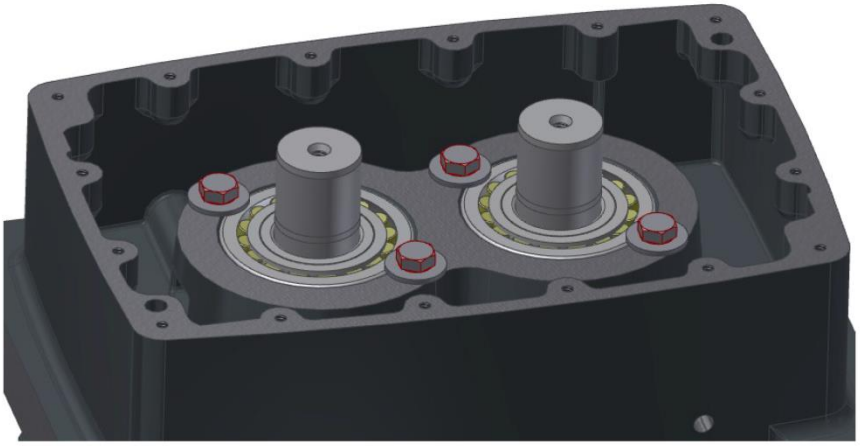


FIGURE 7-5 – INSTALL BEARING RETAINING SCREWS

26. Install the 4 bearing retaining screws (10) and washers (12) into the gear end of the air cylinder. The screws should have a loctite patch. Tighten the screws to 38 ft-lb. See FIGURE 7-5

27. Position the air cylinder vertically with the drive end on the top.

28. Apply oil to the drive and idler rotor bearing bores in the bearing housing.

29. Place the air cylinder vertically in a hydraulic press with the drive end on top. The bottom of the idler rotor shaft must be in contact with the bed of the press. The bottom of the drive rotor shaft must not be in contact with the bed of the press. The blower air cylinder must be cradled on its sides but must not be restrained in the vertical direction. Place a roller bearing (58) over the rotor shaft with the numbers on the bearing facing up. Press the bearing onto the idler rotor shaft using the hydraulic press and the bearing driver tool.

FIGURE 7-6 – INSTALL ROLLER BEARING

30. Repeat step 29 for the drive rotor bearing (14). In this step the bottom of the drive rotor shaft must be in contact with the bed of the press and the bottom of idler shaft must not be in contact with the bed of the press. The inner race and outer race (and rollers) must be engaged with each other while the bearing is being pressed onto the rotor shaft. See FIGURE 7-6.

31. Position the air cylinder vertically on a work table with the drive end on the top. Support the cylinder so that the rotor shafts are free to move in the vertical direction.

32. Measure the fixed end (gear end) axial clearance for both rotors. This can be accomplished by inserting feeler gauges between the end of the rotor lobe and the inner surface of the bearing housing. This clearance should be measured and recorded for all 3 lobes on both rotors. Compare these clearances to the requirements on the clearance drawing (301HYC499). Do not proceed with the assembly if these measurements are not equal to or greater than the minimum specified.

33. Position the air cylinder vertically with the gear end on the top. Support the cylinder so that the rotor shafts are free to move in the vertical direction.
34. Repeat step 32 (with gear end on the top) to measure the floating end (drive end) axial clearance.
35. With the gear end on top measure and record the gear end axial clearance for all 3 lobes on both rotors. Note there are no specifications on the clearance drawing for this measurement. This measurement will be used to determine the axial movement of the bearings.
36. Position the air cylinder horizontal.
37. Using feeler gauges measure the clearance between the rotor tips and the air cylinder. This measurement should be taken for the drive and the idler rotor. The first measurement (for both rotors) should be taken on the inlet side of the air cylinder (by going through the inlet port). The second measurement (for both rotors) should be taken on the discharge side of the air cylinder (by going through the discharge port). The clearance should be measured along the entire length of the lobe and for all 3 lobes on both rotors. Record these clearances and verify that they are within the range specified on the clearance drawing.
38. Obtain 2 gear locking assemblies (56). Each locking assembly comes with 9 capscrews. Remove 3 of these screws. The 6 remaining screws should be in a equally spaced pattern. Note these are metric (M6) screws.
39. Clean the inside and outside diameters of both locking assemblies. Clean the inside diameter of 2 gears (9). Clean the outside diameter of the idler and drive rotor shafts. Lightly oil the surfaces that have been cleaned. Note: DO NOT USE MOLYBDENUM DISULFIDE, MOLYKOTE, OR ANY OTHER SIMILAR LUBRICANTS.
40. Install a spacer (55) onto the gear end of both rotor shafts. Note this is a stepped spacer. The narrow end should be in contact with the bearing inner race.
41. Slide a locking assembly into a gear. The slits in the inner ring and in the outer ring must not be in line with each other. Install the gear and locking ring assembly onto the idler rotor shaft.
42. Push the locking assembly firmly up against the shaft spacer and finger tighten the 6 capscrews.

FIGURE 7-7 – TIGHTEN GEAR LOCKING SCREWS

43. Use a torque wrench to tighten the screws to 50 in.lbs in a diametrically opposite sequence while no exceeding 90° rotation Ensure that none of the screws will turn when 50 in.lbs is applied to them a second time. See FIGURE 7-7.

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44. Tighten the screws further to 100 in.lbs in a diametrically opposite sequence. While not exceeding a 90° rotation. Ensure that none of the screws will turn when 100 in.lbs is applied to them a second time.

45. Tighten the screws to a final torque of 150 in.lbs in a diametrically opposite sequence. While not exceeding a 90° rotation. Ensure that none of the screws will turn when 150 in.lbs is applied to them a second time.

46. Slide a locking assembly into a gear. The slits in the inner ring and in the outer ring must not be in line with each other. Install the gear and locking ring assembly onto the drive rotor shaft. Note the circular mark on each gear indicates the position of the largest runout. These marks must be 180 degrees apart when the gears are installed.

47. Push the locking assembly firmly up against the shaft spacer and hand tighten the 6 capscrews but leave them loose enough that the gear can be rotated on the shaft.

48. The first step in setting the interlobe clearance is to measure the total clearance between two meshing lobes. This is accomplished by determining the maximum feeler gauge thickness that will fit between the rotor lobes near the pitch diameter. The pitch diameter is just above the transition point from the flank of the lobe profile to the hub diameter. The clearance should be measured along the entire length of the meshing lobes. This measurement should be taken for each of the 3 interlobe meshes. The location of the smallest total interlobe clearance should be marked on the rotor lobes.

49. The total clearance between rotor lobes is to be divided with the larger (open) clearance on the leading side of the drive (long) rotor lobe and the smaller (closed) clearance on the trailing side of the drive rotor lobe. The minimum open clearance and the minimum closed clearance is specified on the clearance drawing (301HYC499). If the actual measured total clearance is larger than the sum of the open minimum and the closed minimum on the clearance drawing then the total clearance should be divided such that 1/3 of it is on the closed side and 2/3 of it is on the open side. Note neither of the actual clearances can ever be less than their minimum specified on the clearance drawing. The leading side of the drive rotor lobe is determined by looking through either the inlet or discharge port and rotating the rotor in the correct direction (as indicated by the arrows cast into the air cylinder). The first drive rotor lobe surface that meshes with an idler (short) rotor lobe is the leading side. As the drive rotor continues to rotate the trailing side of this same lobe will mesh with a different lobe on the idler rotor.

50. Rotate the rotors until the two lobes that have the smallest total interlobe clearance (as determined in step 48) are visible through the discharge port. Lock the idler rotor from turning by wedging a shop rag between the tip of a lobe and the air cylinder. Insert feeler gauges with a thickness equal to the desired closed clearance (as determined in step 49) between the drive rotor lobe trailing surface and the idler rotor lobe. Pull the drive rotor tight against the feeler gauges (drive rotor, feeler gauges, and idler rotor must be tight against each other). While holding the drive rotor tight against the feeler gauges rotate (in the direction that the rotor turns) the gear on the drive rotor until a tooth on it contacts a tooth on the gear on the idler rotor. Hand tighten the 6 capscrews in the drive gear locking assembly.

51. Use a torque wrench to tighten the screws to 50 in.lbs in a diametrically opposite sequence. Ensure that none of the screws will turn when 50 in.lbs is applied to them a second time.

52. Tighten the screws further to 100 in.lbs in a diametrically opposite sequence. While not exceeding a 90° rotation. Ensure that none of the screws will turn when 100 in.lbs is applied to them a second time.

53. Tighten the screws to a final torque of 150 in.lbs in a diametrically opposite sequence. While not exceeding a 90° rotation. Ensure that none of the screws will turn when 150 in.lbs is applied to them a second time.

54. Measure and record the interlobe clearance on both (open and closed) side of all 3 drive rotor lobes. Before proceeding with the assembly ensure that all of these clearances are equal to or greater than the minimums specified on the clearance drawing.

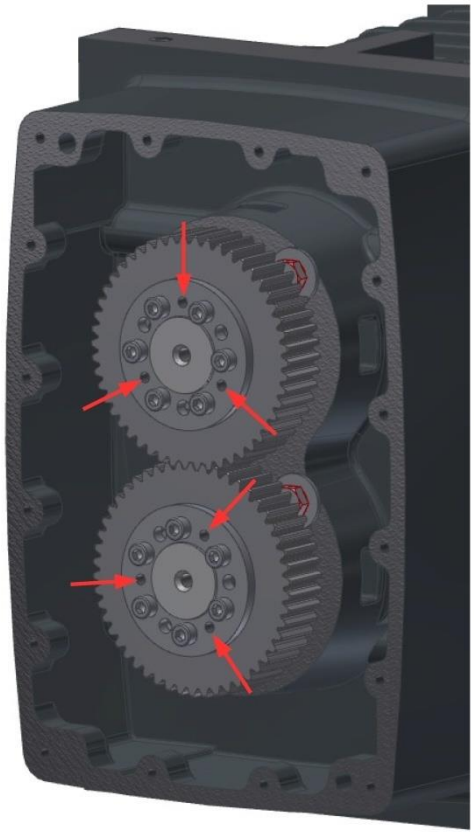


FIGURE 7-8 – TIGHTEN SET SCREWS

55. Apply loctite 243 to 6 set screws {M6 x 12mm}. Install 3 of these screws into each of the 2 gear locking assemblies. These set screws go between the existing screws in the locking assembly through the unthreaded holes in the outer ring into the threaded holes in the inner ring. The purpose of these set screws is to keep pressure on the spacer that is between the gear and bearing inner race. Tighten the screws to 25 in-lb of torque. See .FIGURE 7-8

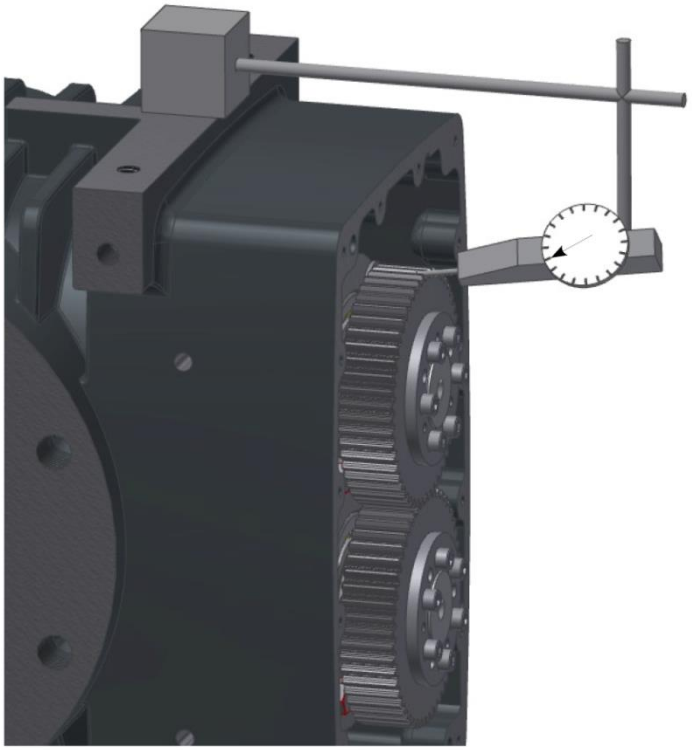


FIGURE 7-9 – MEASURE GEAR BACKLASH

56. Lock the idler rotor from turning by wedging a shop rag between the tip of a lobe and the air cylinder. Measure the backlash of the gears using a dial indicator and a magnetic base. Gear backlash is the distance (in the circumferential direction) a gear tooth can freely move when the mating gear is fixed. This should be measured in 3 places (every 1/3 turn) and recorded. Verify that the backlash is within the range specified on the clearance drawing. See FIGURE 7-9.

57. Use a feeler gauge to verify that there is at least .010ñclearance between the heads of the 4 bearing retaining bolts (10) and the inside surface of the gears.

58. Attach oil slingers (26) with bolts (8) and washers (6) to the gear end of the rotor shafts. Tighten the bolt to 132 in-lbs.

59. Install spacer (49) onto idler rotorshaft and (85) on drive rotor shaft

60. Install oil slinger (27) onto the drive end of the idler rotor shaft and (83) on drive rotor shaft.

61 Apply Loctite 262 to 2 bearing locknuts (36) & (84). Install the locknut (84) onto drive rotor shaft using nut driver tool (EQ144253). Install locknut (36) onto idler rotor shaft using nut driver tool (EQ143956). Tighten the locknuts to 70 ft-lb.

62. Measure the runout of the face of both gears using a dial indicator and a magnetic base. Verify that the runout is within the range specified on the clearance drawing.

63. Check that the oil seal bore in the drive end sump cover (29) is clean, dry, and free of nicks or burrs. Lay the cover flat with the external surface facing up. Support the area under the seal bore with a block of wood. Determine the proper orientation of the seal (31). The seal has two lips. The outer lip is shorter and when installed should point toward the keyway end of the drive rotor shaft. The inner lip is longer and should point toward the oil inside of the sump.

64. Drive the oil seal into the sump cover from the external surface using the seal driver tool (EQ143956) and a press or small hammer. After installation the seal case should be flush with the external surface of the sump cover. Apply oil to both of the seal lips.

65. Apply Loctite Gasket Eliminator 515 to the flange surface of the drive end sump cover.

66. Slide the seal protection sleeve (EQ143096-13) over the drive shaft. Apply oil to the outside surface of the sleeve. Gently slide the drive end sump cover over the drive shaft.

67. Attach the cover to the bearing housing using 16 screws (5). Tighten the screws to 96 in-lbs.

68. Remove the protective sleeve from the drive shaft.

69. Apply Loctite Gasket Eliminator 515 to the flange surface of the gear end sump cover (3).

70. Attach the cover to the gear end of the air cylinder using 16 screws (5). Tighten the screws to 96 in-lbs.

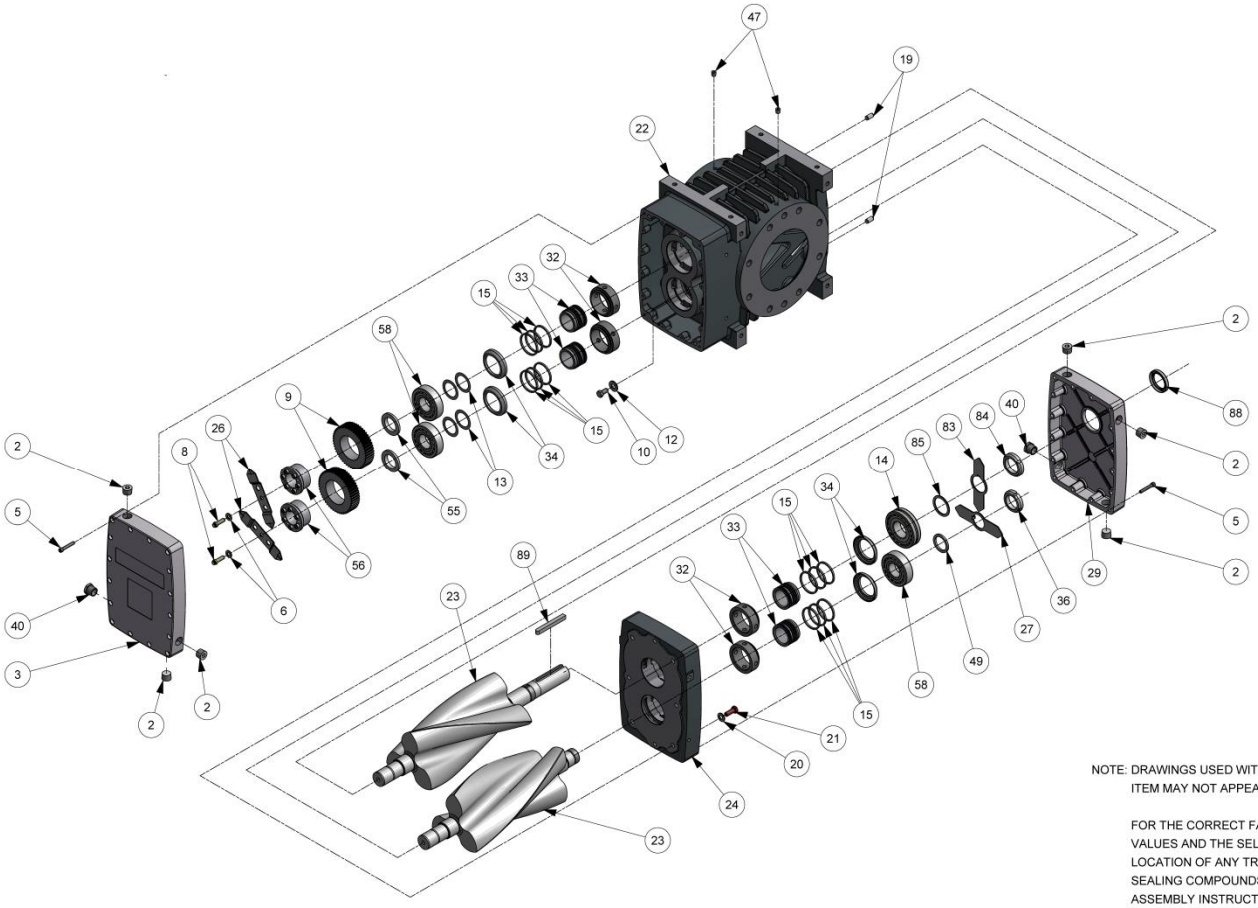
71. Install plugs (47) in the 4 instrument holes in the air cylinder near the inlet and discharge port.

72. Determine the appropriate hole in each sump cover for the oil level gauge (40). The oil level will be in the lower part of the oil sump. Apply Loctite 243 to the threads of each gauge. Install one oil level gauge in each sump.

73. Install plugs (2) in the 3 remaining holes in each sump cover. Note there are no external sump breathers used on this blower.

74. Measure the runout of the end of the drive shaft using a dial indicator and a magnetic base. Verify that the runout is within the range specified on the clearance drawing.

75. Check the keyway on the end of the drive rotor for burrs. Install the drive shaft key (89) into the drive shaft. Ensure that it is a snug fit. Tape the key to the shaft so that it does not get lost.



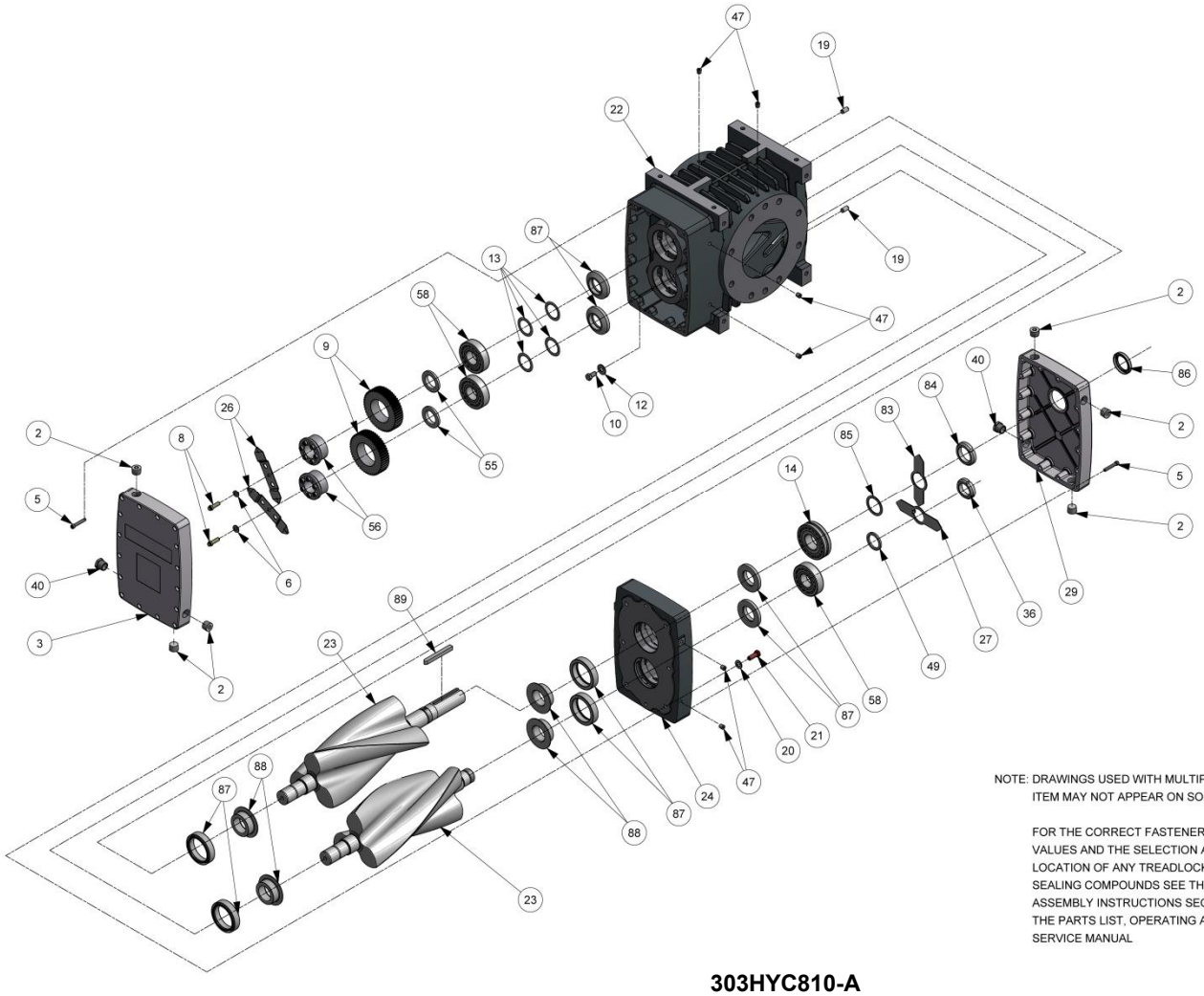
NOTE: DRAWINGS USED WITH MULTIPLE BILLS ITEM MAY NOT APPEAR ON SOME BILLS

FOR THE CORRECT FASTENER TORQUE VALUES AND THE SELECTION AND LOCATION OF ANY TREADLOCKING OR SEALING COMPOUNDS SEE THE ASSEMBLY INSTRUCTIONS SECTION OF THE PARTS LIST, OPERATING AND SERVICE MANUAL

302HYC810-A
(Ref. Drawing)

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

Ref. No.	Description	No. Req'd	MODEL 412 HYCH_CA
2	PLUG	6	64AC4
3	COVER-GEAR	1	300GYC602
5	SCREW	32	75P25
6	WASHER-PLAIN	2	95U2
8	SCREW	2	75LM115N
9	GEAR KIT	1	301HYC601
10	SCREW	4	655ED03P
12	WASHER-PLAIN	4	95U3
13	SHIM-SET	2	300GYC732
14	BEARING	1	12BA261
15	RING-PISTON	12	DF139986
19	PIN-DOWEL	2	62M48
20	WASHER-PLAIN	6	95W48
21	SCREW	6	655ED04N
22	CYLINDER-AIR	1	306HYC002
23	GRP-ROTOR CW DRIVE ROTATION	1	319HYC4028
23	GRP-ROTOR CCW DRIVE ROTATION	1	308HYC4028
24	HOUSING-BRG	1	303HYC006
26	SLINGER	2	305HYC173
27	SLINGER	1	304HYC173
29	COVER-DRIVE	1	300HYC477
31	SEAL-OIL	1	VP1108221
32	INSERT, PISTON RING	4	300GYC248
33	CARRIER, PISTON RING	4	300GYC1148
34	SLINGER, INTERNAL	4	302GYC173
36	LOCKNUT-BRG	1	50Z7
40	GAUGE-OIL LEVEL	2	40P31
47	PLUG	2	64AC1
49	SPACER	1	302HYC144
55	SPACER	2	300HYC144
56	LOCKING ASSEMBLY	2	22G39
57	SCREW	6	VP1004579
58	BEARING	3	12BA262
83	SLINGER	1	303HYC173
84	LOCKNUT-BRG	1	50Z8
85	SPACER	1	301HYC144
89	KEY-SQUARE	1	VP1108224



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14	BEARING	1	12BA261
19	PIN-DOWEL	2	62M48
20	WASHER-PLAIN	6	95W48
21	SCREW	6	655ED04N
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23	GRP-ROTOR CW DRIVE ROTATION	1	319HYC4028
23	GRP-ROTOR CCW DRIVE ROTATION	1	308HYC4028
24	HOUSING-BRG	1	304HYC006
26	SLINGER	2	305HYC173
27	SLINGER	1	304HYC173
29	COVER-DRIVE	1	300HYC477
36	LOCKNUT-BRG	1	50Z7
40	GAUGE-OIL LEVEL	2	40P31
47	PLUG	12	64AC1
49	SPACER	1	300GYC144
55	SPACER	2	300HYC144
56	LOCKING ASSEMBLY	2	22G39
57	SCREW	6	VP1004579
58	BEARING	3	12BA262
83	SLINGER	1	303HYC173
84	LOCKNUT-BRG	1	50Z8
85	SPACER	1	301HYC144
86	SEAL-OIL	1	VP1108221
87	SEAL	4	VP1108220
88	SPACER	4	303HYC144
89	KEY-SQUARE	1	VP1108224

WARRANTY

HELIFLOW INDUSTRIAL SERIES BLOWERS

GENERAL PROVISIONS AND LIMITATIONS

Gardner Denver, Inc. (the ñCompanyò) warrants to each original retail purchaser (ñPurchaserò) of its 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 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 directly to the manufacturer.

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 within the applicable Warranty Period as follows.

BARE BLOWERS

Basic bare blowers, consisting of all parts within, are warranted for 24 months from date of initial use or 30 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 ñunopenedòblower per Company instructions, will be cause for denial of 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 rate schedules caused by, but not limited to, location or inaccessibility of equipment, or labor provided by unauthorized service personnel is not provided for by this warranty.

Transportation of Company's choice, within the continental United States, is covered by this warranty for replacement of any blower which in the Company's judgment proved not to be as warranted. For user locations outside the continental United States, the Company will provide transportation, by the carrier of its choice, to and from the nearest Authorized Distributor and the Company's designated facility. The Company may require the return of any blower or part claimed not to be as warranted to one of its facilities as designated by the Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder 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 MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO THE PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY 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 within 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 the 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®

For additional information, contact your local representative or visit:
www.contactgd.com/blowers

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C. Emery Nelson, Inc.
INDUSTRIAL AND POWER PLANT EQUIPMENT
7631 Commerce Street, Hamel, MN 55340
Ph: 763/ 420-3844 Fax: 763/420-2542

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Please recycle after use.