

# Roots<sup>®</sup> 412 HPT Blower

## Installation Operation & Maintenance Manual



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## Do these things to get the most from your Roots Blower

- Check shipment for damage. If found, file claim with carrier and notify Howden.
- Unpack shipment carefully, and check contents against Packing List. Notify Howden if a shortage appears.
- Store in a clean, dry location until ready for installation. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- Read OPERATING LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.
- In event of trouble during installation or operation, do not attempt repairs of Roots furnished equipment. Notify Roots, giving all nameplate information plus an outline of operating conditions and a description of the trouble. Unauthorized attempts at equipment repair may void Roots warranty.
- Units out of warranty may be repaired or adjusted by the owner. Good inspection and maintenance practices should reduce the need for repairs.

**NOTE:** Information in this manual is correct as of the date of publication. Howden reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

For your nearest Howden Office, dial our Customer Service Hot Line toll free in the U.S.; 1 877 363 7668 or direct +1 832 590 2600.

**Roots products are sold subject to the current General Terms of Sale, ES104 and Warranty Policy WP-5020. Copies are available upon request.**

## Safety Precautions

It is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should be particularly noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Protect external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream.
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## Operating Limitations

A Howden Roots blower must be operated within certain approved limiting conditions to enable continued satisfactory performance. Warranty is contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in TABLE 1 for this truck application blower. These limits apply to this blower of normal construction, when operated under standard operating conditions. Be sure to arrange connections or taps for instruments used to measure temperature, pressure and vacuum at or near the inlet and discharge connections of the blower. These, along with tachometer will enable period checks of operating conditions.

### Pressure

The pressure rise, between inlet and discharge, must not exceed the figure listed in TABLE 1.

- The term “intermittent operation” is defined as operation for no longer than 10 seconds at maximum pressure list in TABLE 1, provided that the inlet restriction (filter pressure drop, etc.) does not exceed 20” (508 mm) of water.
- Also, in any system where the blower inlet is at a positive pressure above atmospheric, a maximum case rating of 25 PSI gauge (1725 mbar) should not be exceeded. Never should the maximum differential pressure be exceeded.

### CAUTION: Never cover the blower inlet with your hand or other part of body.

- Stay clear of inlet and discharge openings.
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (1725 mbar) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents without first consulting Roots.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be trained to exercise adequate general safety precautions.

## Temperature

Blowers are approved only for installations where following temperature limits can be maintained in service.

- Measured temperature rise must not exceed listed values when inlet is at ambient temperature. Ambient temperature is considered as the general temperature of the space around the unit. This is not outdoor temperatures unless unit is mounted outdoors.
- If inlet temperature is higher than ambient, the listed allowable temperature rise values must be reduced by 2/3 of the difference between the actual measured inlet temperature and the ambient temperature. Example:  $T_{inlet} = 150\text{ }^{\circ}\text{F}$  and  $T_{ambient} = 60\text{ }^{\circ}\text{F}$ ; Temperature rise limit,  $\Delta T_{new} = 350 - 2/3(150-60) = 290\text{ }^{\circ}\text{F}$ .
- The ambient temperature of the space the blower/motor is installed in should not be higher than  $120\text{ }^{\circ}\text{F}$  ( $49\text{ }^{\circ}\text{C}$ ).

## Speed

This blower may be operated at speeds up to the maximum listed in TABLE 1. Blower may be direct coupled to suitable constant or variable speed driver if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be a limiting factor.

Special Note: The listed maximum temperature rise may occur well before its maximum pressure is reached. This may occur at high altitude, low vacuum or at very low speed. The blower operating limit is always determined by the maximum rating reached first. It can be any one of the three: Pressure, Temperature or Speed.

## Installation

Howden Roots blowers arrive without lubrication in the sump, see lubrication section for details.

Howden Roots blowers are treated after factory assembly to protect against normal atmospheric corrosion. The maximum period of protection is considered to be one year under average conditions, if shipping plugs & seals or not removed. Protection against chemical or salt water atmosphere is not approved. Avoid opening unit until ready to start installation, as corrosion protection will be quickly lost due to evaporation.

If there is to be an extended period between installation and start-up, following steps should be taken to ensure corrosion protection.

- Coat intervals of cylinder, gearbox and drive end bearing reservoir with Nox-Rust VCI-10 or equivalent. Repeat once a year or as conditions may require. Nox-Rust VCI-10 is petroleum soluble and does not have to be removed before lubricating. It may be obtained from Daubert Chemical Co., 2000 Spring Rd., Oak Brook, IL. 60521.
- Paint shaft extension, inlet & discharge flanges and any other exposed surfaces with Nox-Rust X-110 or equivalent.
- Seal inlet, discharge and vent openings. It is not recommended that blower be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Nox-Rust VCI-10 vapor will escape and lose its effectiveness.
- Protect blower from excessive vibration during storage.

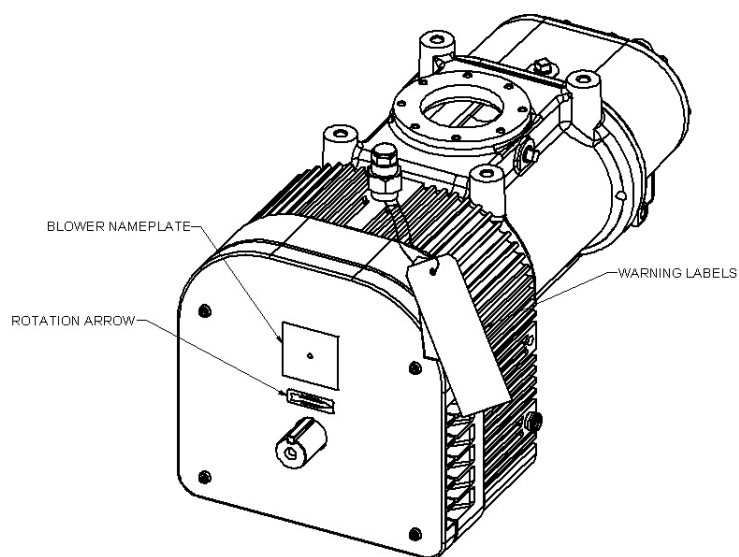
- Rotate shaft three to four revolutions every two weeks.
- Prior to start up, remove flange covers on both inlet & discharge flanges and covers on vent opening and inspect internal clearances. Also, at this time, inspect gear box intervals thru breather location for rust.

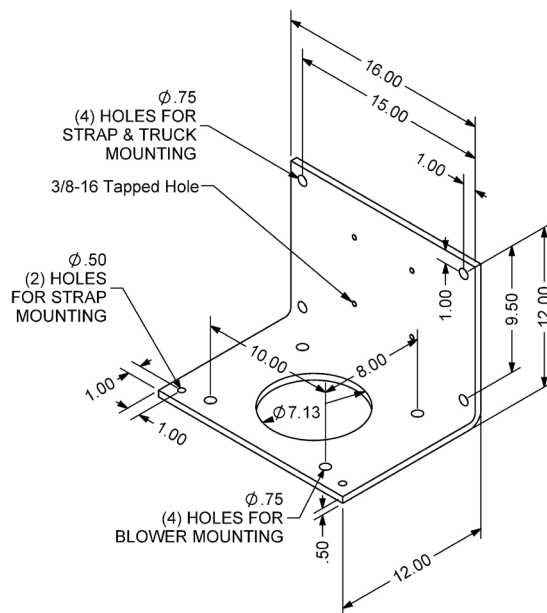
Because of the completely enclosed blower design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred; however, an outdoor location will normally give satisfactory service. Important requirements are that the correct grade lubricating oil be provided for expected operating temperatures, and that the blower be located so that routine checking and servicing can be performed conveniently. Proper care in locating drive and accessory equipment must also be considered.

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

## Mounting

Two methods are used to handle a unit. One is to install lifting lugs into the (4) 5/8-11 tapped holes in top of the unit. Test the lifting lugs for tightness and potential fractures by tapping with hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If unable to use the tapped holes in top of unit for lifting, lifting slings or a special cradle may be passed under the unit for vertical lift.





SKETCH 2

Bottom inlet, top discharge is standard orientation with CCW rotation on input drive shaft. Blower can be mounted either on roadside or curbside of truck chassis. Exact installation instructions cannot be given because of the variety of truck chassis available. See SKETCH 1 for basic details. Units are typically held in place on truck chassis by use of "L" shaped mounting bracket; see SKETCH #2 for basic details.

Check output speed range of PTO. It must be for the blower range.

The blower should be parallel to the truck frame to minimize vibration.

The PTO shaft must be within the manufacturer's angularity limits, not to exceed 5 degrees in the horizontal plane and 3 degrees in the vertical plane.

Brace mounting securely to reduce vibration.

Be sure air filter, oil level gauge, gear case breather and oil drain plug is not obstructed for normal maintenance.

Do not weld on the blower or base, bearings can be damaged by the passage of current.

### Piping

Install an adequate air filter on blower inlet. Servicing the air filters is one the most important maintenance operations. Servicing frequency of filter elements is not time predictable and must be by the user, depending on dust and moisture conditions but pressure drop shall never exceed 20" (508 mm) of water before servicing. Dry filter element life is typically 50 to 300 hours before replacement is necessary. Only replace, do not reuse dry filter elements via cleaning. Do not allow oil, grease or solvents to contact the element. Do not operate blower with damaged filter seals or element. Do not operate blower without filter element.

**WARNING:** All piping and accessories downstream of blower

should be rated for the internal pressures being subjected during full operation.

Insure that inlet and discharge piping are clear, clean and air tight. Do not allow dirt to enter the blower during piping operations.

Pressure service, install an air relief valve in discharge line as close to blower as possible. Vacuum service, install an air relief valve in inlet line as close to blower as possible. Do not use any caps, covers, plugs or valves between the blower and relief valve.

Install a check valve in the discharge line after the relief valve to prevent back flow of material into the blower and to prevent reverse rotation of the blower.

Provide a discharge bypass valve to the atmosphere for air bleed off to lower pressure when too high blower speed thus flow is present.

Pressure service, install an accurate pressure gauge at or near the blower discharge. Vacuum service, install an accurate vacuum gauge at or near the blower inlet.

Install an accurate vacuum gauge or indicator at inlet so able measure pressure drop across inlet filter.

Provide an adequate sized discharge line. Use as few of bends as possible; when bends are necessary, use long radius bends.

Make provisions in piping to allow for expansion as near to the blower as possible.

Use a dust cover at the final discharge opening when hose is removed.

Install discharge silencer after the check valve when additional noise reduction is required.

## Operation

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

- Be certain that no bolts, tools, rags, or debris have been left in the blower air chamber or piping.
- Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent.
- Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- Ensure oil levels in main sump are correct.
- Bump blower a few revolutions with driver to check that direction of rotation agree with arrow near blower shaft, and that both coast freely and come to a stop.

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

- Start blower, let it accelerate to full speed slowly, than shut off. Slowly engage the power take off and never pop the clutch on engagement. Listen for knocking sounds, both power-on and as speed slows down.
- After blower comes to complete stop, repeat above but let run 2 to 3 minutes. Check for noises, such as knocking sounds.
- After blower comes to complete stop, operate blower for about 10 minutes unloaded. Check oil levels. Observe cylinder and head plate surfaces for development of hot spots such as burnt paint, including impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have final check run of at least one hour under normal operating conditions. After blower is started, gradually close the inlet for vacuum service, or the discharge for pressure service. At this point it is recommended that pressure gauge be connected into the discharge line if not already provided, and that temperature gauge be installed on inlet and discharge. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in TABLE 1, shut down and investigate conditions in the piping system. Refer to trouble shooting check list for suggestions on various problems that may appear.

When the blower vacuum or pressure is at a maximum intermittent value for over 10 seconds, stop the blower and remove the line blockage manually. Otherwise the blower might seize due to excessive operating temperature and pressure.

Always start blower slowly with power take off and never pop the clutch on engagement.

Never operate blower above 25 PSI (1.72 bar) pressure rise on gauge at immediate blower discharge.

Do not operate blower with defective pressure relief valve.

See Table 1, for maximum pressure limits when operating below maximum speed or above sea level conditions.

See Table 2, for unit internal clearances.

## Vibration Assessment Criteria

With measurements taken near the bearing locations on the housing, see chart below for an appropriate assessment guide for blower mounted rigidly. In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. As shown on chart below, the level of all pass vibration will determine need to measure discrete frequency vibration levels and the action required.

## Lubrication

Blower efficiency and life depend on the quality of maintenance the blower receives. Maintenance must be done regularly and with care. A clean work space, tools, solvents, and wiping rags are necessary to avoid transfer of dirt into the unit. A maintenance chart listing each blower and scheduling regular checks of the unit is valuable.

Any premium grade, non-detergent industrial grade oil with rust, oxidation and foam inhibitors will be adequate for use for most applications. Example: Mobile DTE grade oil. Because of blower design features, the oil temperature will remain below 220 °F (104 °C) even at maximum blower operating temperature rise and ambient temperatures of up to 120 °F (49 °C). Oil life for mineral base oil is 2000 hours if operating below 180 °F (82 °C). General rule of thumb: Oil life at 200 °F (93 °C), would be only 1000 hours and at 220 °F (104 °C) would be only 500 hours. Therefore, if expected to run at the maximum continuous pressure operation or in elevated ambient conditions, such as inside enclosure or in warm environments, consider reduction in oil life and change with more frequency. When oil temperature does reach above 180 °F (82 °C), also good synthetic grade oil, such as Roots synthetic can be used to increase oil life by factor of 3X that of mineral base oils.

Oil sump is shared for both ends of the blowers and oil fill can be accomplished by removing breather (item 60) on drive end cover and filling to the center of sight glass (item 59) on the side of the reservoir on drive end of blower. Oil sump capacity is approximately 96 fluid ounces (2.85 liters).

Grade of oil to use is based on blower discharge temperature. See TABLE 3 for recommended oil grades.

### NOTE:

Blower discharge temperature of 250 °F, can typically be achieved  $\geq$  15 PSI (1000 mbar) pressure rise. However, can be reached sooner if operating blower at any of following conditions:

- a. higher altitude operation,
- b. high ambient temperature,
- c. excessive vacuum (inlet filter pressure drop high),
- d. lower blower operating speeds.

For operation at temperatures below 10 °F (-12 °C), the use of heat tracing and synthetic lubricants is recommended. The pour point should be at least 5 to 10 °F (3 to 5 °C) below the minimum expected ambient temperature.

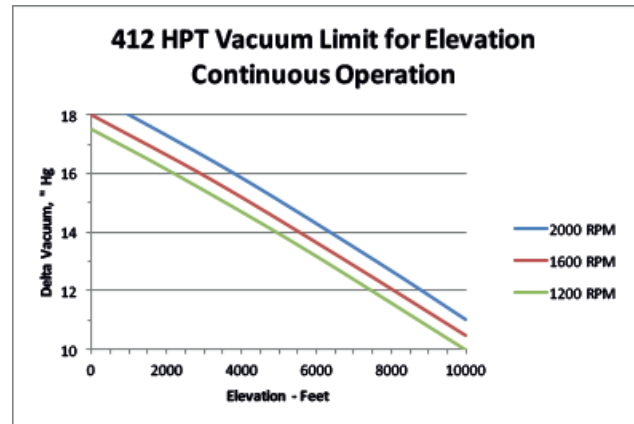
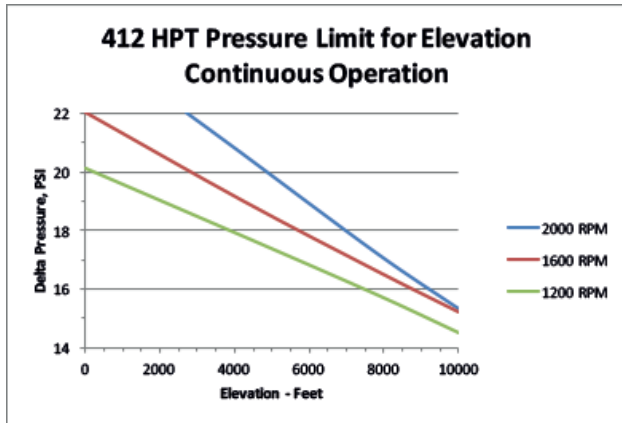
For adequate lubrication to the blower internal components, maximum allowable tilt and roll of the truck is 7.5 degrees for each direction or in combination.



**Table 1, Maximum Allowable Operating Conditions**

Model	Speed	Temperature rise		Pressure Rise		Vacuum	
		°F	°C	PSI	mbar	"Hg	mbar
412 HPT	2000	335	168	22 (continuous)	1517 (continuous)	18 (continuous)	609 (continuous)
	2000	335	168	25 (intermittent)	1725 (intermittent)	19 (intermittent)	643 (intermittent)

NOTE: Limited to minimum 1600 RPM operation at 22 PSI continuous pressure, or 18" Hg continuous vacuum at sea level conditions.



**Table 2, Unit internal clearances, inches (mm)**

TE	OTE	Inlet	Fronts	Backs
.005 - .007 (.13-.18)	.020 - .027 (.51 - .69)	.005 - .008 (.13 - .20)	.014 - .016 (.36 - .41)	.011 - .014 (.28 - .36)

NOTE: Maximum intermittent pressure occurs @ 3 PSI above continuous pressure limit.

**TABLE 3, Oil Grade Requirements**

Blower discharge temperature	Oil grade - ISO
32 °F to 100 °F (0 °C to 38 °C)	100
100 °F to 250 °F (38 °C to 120 °C)	150
Over 250 °F (120 °C)	220

## Troubleshooting Checklist

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with published performance.
	2	Wrong rotation	
	3	Obstruction in piping	Compare actual rotation with Figure 1, change driver if wrong. Check piping, valves, silencer to assure open flow path.
Low capacity	4	Speed too low	See item 1, if belt drive, check for slippage and re-adjust tension.
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare with published performance.
	6	Obstruction in piping	See item 3.
	7		Check inside of casing for worn or eroded surfaces causing excessive clearances
Excessive power	8	Speed too high	Check speed and compare with published performance.
	9	Excessive pressure rise	See item 5
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Correct blower mounting, drive alignment.
	11		Scale, sludge, rust or product build up Clean blower appropriately
Damage to bearings or gears	12	Inadequate lubrication	Check oil sump levels in gear and drive end headplates
	13	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil of recommended grade.
	14		See item 5.
	15	Excessive pressure rise	Check carefully. Re-align if questionable.
	16	Coupling misalignment	Re-adjust for correct tension.
		Excessive belt tension	
Vibration	17	Misalignment	See item 15
	18	Impellers rubbing	See item 10
	19	Worn bearings/gears	Check gear backlash and conditions of bearings and replace as indicated.
	20	Unbalanced or rubbing impeller	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance.
	21	Driver or blower loose	Tighten mounting bolts securely.
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping.
	23	Scale/sludge build-ups	Clean out interior of impeller lobes to restore dynamic balance.
	24	Casing strain	Re-work piping alignment to remove excess strain.
Driver stops, or will not start	25	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See item 10. Look for defective shaft bearing and/or gear teeth.
	26	Scale, sludge, rust or product build-up	Clean blower appropriately



## Inspection & Maintenance

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention there after may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION**.

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Except for impeller strips, which are intended to wear as necessary as blower temperature rise increases, this wear should be minimal if do not exceed maximum blower operating temperature rise. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration and wear, and may require replacement at varying periods.

Piston ring seals (28) are designed to operate without rubbing contact, once temperature and thermal growth have stabilized. The stationary rings will rub the rotating sleeve (38) briefly as a result of temperature cycles that occur during the startup and shutdown of the unit. The sleeves are hardened and the rings are coated with dry lubricant that provides for temporary break in wear. Replace piston ring seals if they become excessively worn.

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

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Some oil seal leakage may occur since an oil film under the lip is required for proper operation. Periodically leaked oil should be wiped off from surfaces. Minor seal weepage should not be considered as indicating seal replacement.

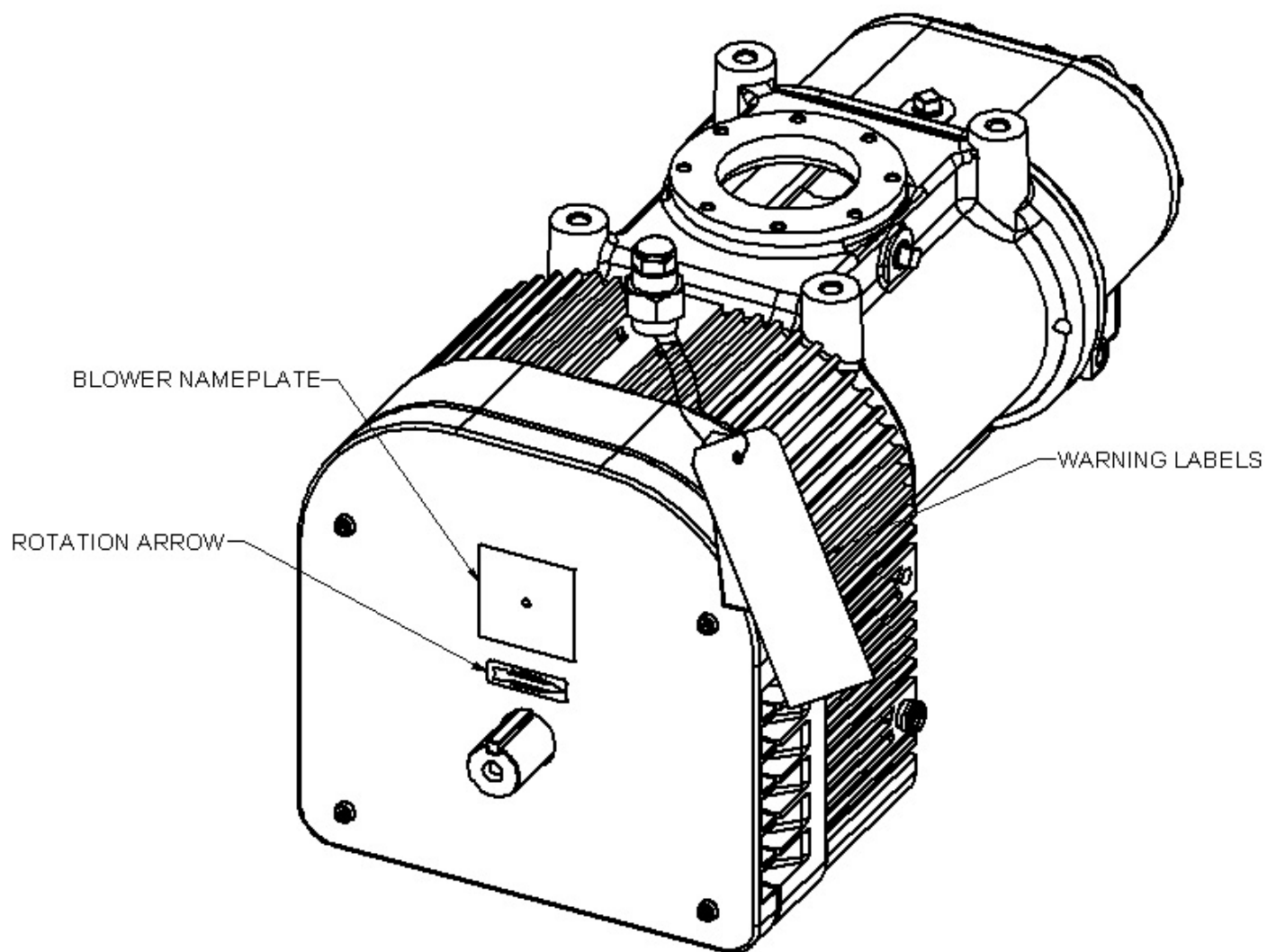
Timing gear wear, when correct lubrication is maintained, should be negligible. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance, backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

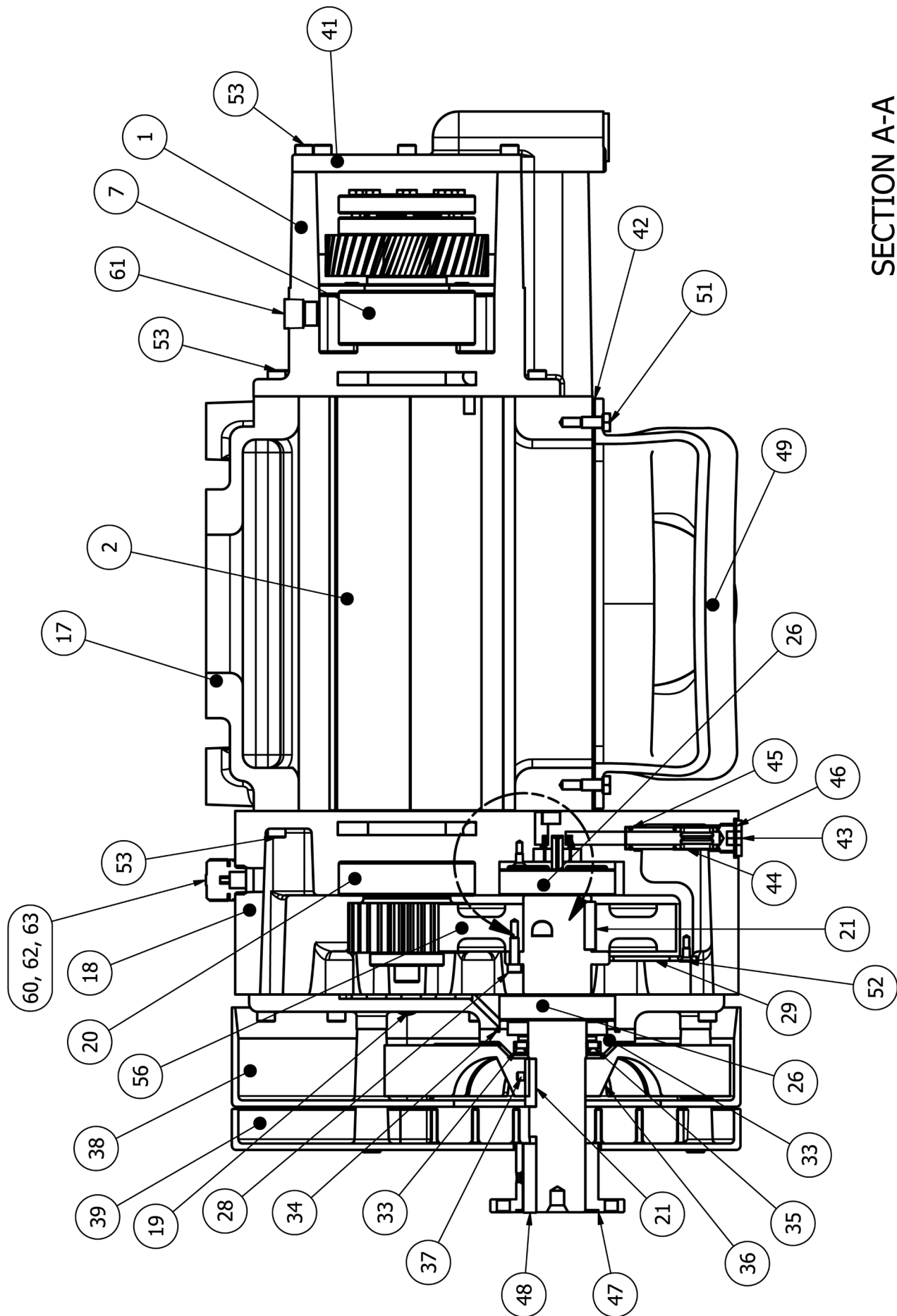
Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely. Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to your authorized Roots distributor.

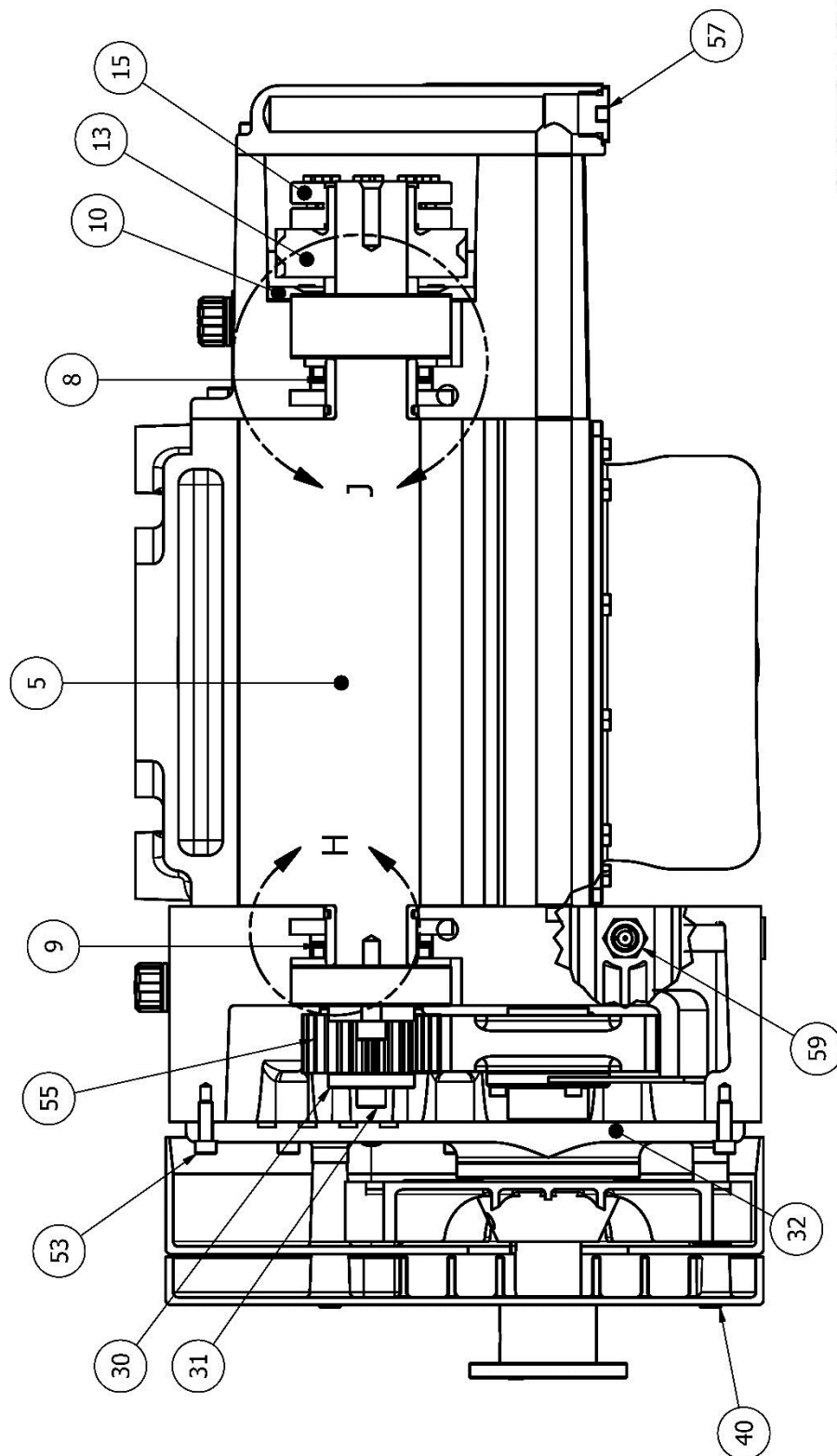
Warranty failures should not be repaired at all, unless specific approval has been obtained through a Sales Office or the factory before starting work. Unauthorized disassembly within the warranty period may void the warranty.

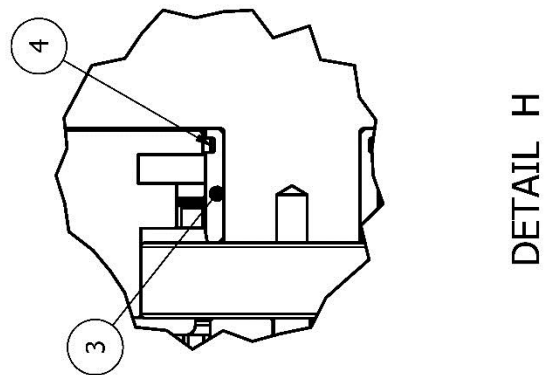
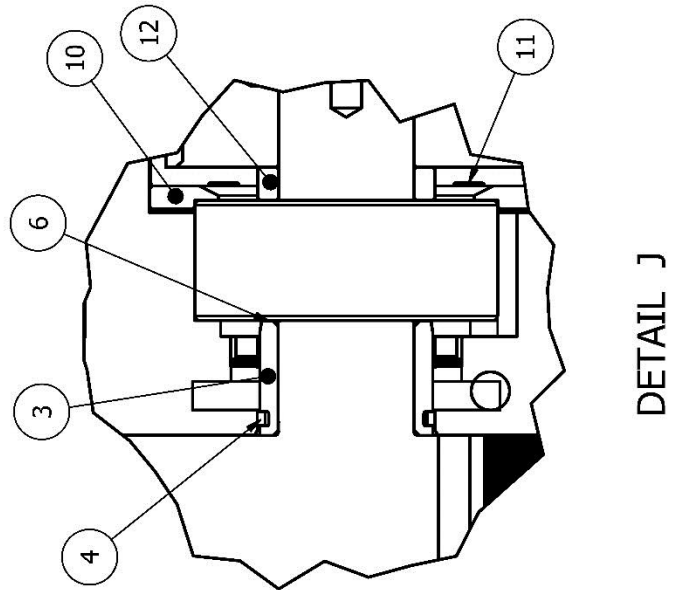
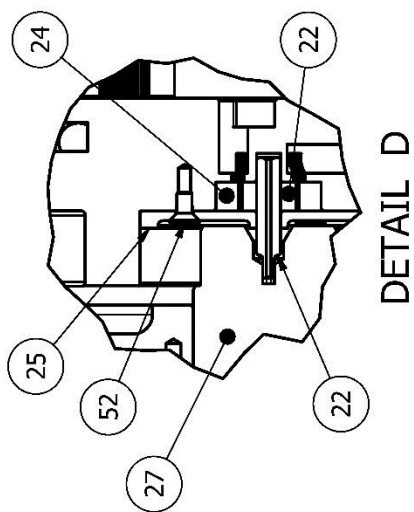
Item	Part Number	QTY	Description
1	RC-204836023	1	GEAR HSG, BLIND END
2	RC-204844023	1	IMP, DRIVE
3	RC-204742020	4	SLEEVE, SFT
4	12283001	4	PISTON RING
5	RC-204844S23	1	IMP, DRIVEN
6	RC-204743020	2	SHIM, BRG
7	10009028	2	BEARING, DOUBLE ROW ANGULAR CONTACT
8	13309027	2	SEAL, CW
9	13309028	2	SEAL, CCW
10	RC-204263021	2	CLAMP PLATE
11	13034016	16	SOCKET HEAD SCREW, M6-1x12
12	RC-204744020	2	SPACER, TIMING GEAR
13	RC-204617022/RC-204618022	1	TIMING GEAR Set (LH & RH)
15	RC-14029002	2	LOCKING HUB ASSEMBLY
17	RC-204834023	1	CYLINDER
18	RC-204840023	1	GEARBOX, DRV END
19	13230006	6	DOWEL PINS
20	10222060	2	BEARING, CYLINDICAL ROLLER
21	13234010	3	KEY, GEAR
22	RC-204745020	1	DRV PIN, OIL PUMP
23	RC-204750012	1	OIL PUMP, INNER
24	RC-204751012	1	OIL PUMP, OUTER
25	RC-204741020	1	COVER, OIL PUMP
26	10222059	2	BEARING, CYLINDRICAL ROLLER
27	RC-204615012	1	DRIVE SHAFT
28	13034018	3	SOCKET HEAD SCREW, M6-1x20
29	RC-204262021	1	OIL PAN CVR
30	RC-204261021	2	DRV END GEAR/BRG RET
31	13034017	2	SOCKET HEAD SCREW, M12-1.75x35
32	RC-204609022	1	COVER, DRV END
33	RC-204259021	1	SEAL HSG
34	10109533	1	O-RING, VITON, # 2-152
35	13309035	1	SEAL, CCW
36	RC-204613022	1	FAN
37	RC-14073001	1	SET SCREW-FLAT POINT, M6-1X10 (FAN)
38	RC-204842023	1	FAN SHROUD
39	RC-204611022	1	FAN SHROUD COVER
40	13034020	4	SOCKET HEAD SCREW, M8-1.25x90
41	RC-204838023	1	COVER
42	RC-204264021	1	GASKET, INLET ADP
43	RC-204268021	1	OIL FILTER
44	RC-14063001	1	OIL SCREEN
45	10109437	1	O-RING, VITON, # 2-014
46	RC-14072001	1	COPPER RING SEAL
47	N/A	1	Hub, PTO Drive (Supplied by customer)
48	N/A	1	Key, Drive Hub (Supplied by customer)
49	RC-206244023	1	INLET ADAPTOR
51	13690009	8	HEX HEAD CAP SCREW, M8-1.25x16
51 A	13690010	2	HEX HEAD CAP SCREW, M8-1.25 X 130
52	13753003	6	SOCKET SCREW, M5-.8x10 FLAT HD
53	13034019	50	SOCKET HEAD SCREW, M8-1.25x25
55	RC-204260021	1	PINION
56	RC-204616022	1	DRIVE GEAR
57	RC-14074001	2	HOLLOW HEX PLUG, 1-3/16-12 UN 2A
59	12066001	2	SIGHT GLASS
60	13005004	1	BREATHER
61	10008004	2	PIPE PLUG, 1/2" NPT
62	10047004	1	PIPE NIPPLE, 1/2" NPT
63	10078004	1	PIPE UNION, 1/2" NPT



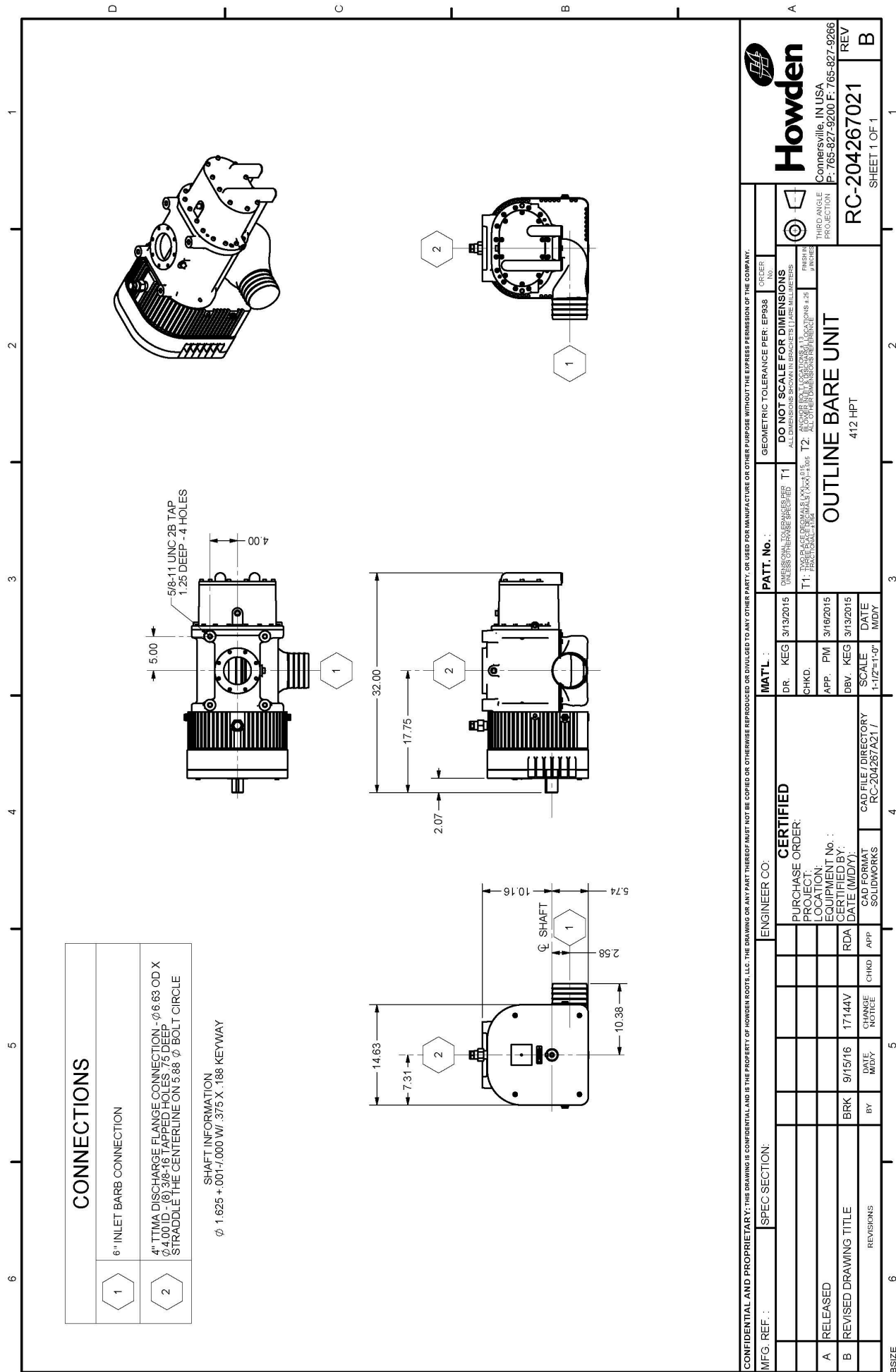


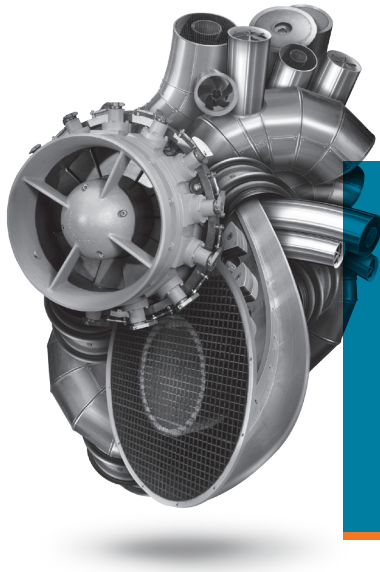
SECTION A-A  
SCALE 9/32











## At the heart of your operations

Howden people live to improve our products and services and for over 160 years our world has revolved around our customers. This dedication means our air and gas handling equipment adds maximum value to your operations. We have innovation in our hearts and every day we focus on providing you with the best solutions for your vital operations.



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### Revolving Around You™