

WERTS WELDING & TANK SERVICE INC

INSTALLATION & OPERATING MANUAL FOR

B630 BLOWERS Rev C (June 2025)

1. RECEIPT OF GOODS.

- a. Inspect package/crate on arrival. If any damage is apparent, notify the carrier and report the problem to your authorized Werts Welding & Tank Service Inc representative immediately. If possible, take a photograph of the damaged area.
- b. In all cases, when the blower is removed from the packaging/crate, check the blower for any sign of physical damage and turn the drive shaft gently to ensure it rotates freely. If in doubt, inform your authorized Werts Welding & Tank Service Inc. representative immediately and if possible, photograph any signs of physical damage.

2. LIFTING

- a. The bare shaft blower must be mechanically lifted and with eyebolts. This allows the blower to be safely lifted and without distortion.
- b. If the blower is mounted on a baseplate, the blower must NOT be lifted with the eyebolts as the increased strain from the extra weight of the baseplate may distort the blower casing and this is very likely to cause the rotors to contact other rotor or the casing, which can lead to catastrophic equipment failure. Either special lifting points should be fitted to the baseplate designed to enable it to be lifted without distortion, or it should be lifted by placing 2 equal slings, 1 under each end of the baseplate, lifting very carefully to avoid distortion.

3. BEFORE BEGINNING INSTALLATION

- a. All Installation, operating and maintenance personnel must read this manual and ensure that the blower is installed and operated in accordance with the instructions contained therein.
- b. Check that the orientation of the blower is correct per Illustration 1. If it is necessary to change the orientation, the gear end casing oil trough must be repositioned so that the lowest point of the gear is immersed in oil.
- c. Do not remove the inlet and outlet protective covers until installation actually begins. This will help avoid foreign objects / debris from entering the blower.
- d. Once the covers have been removed, it is vital that there is no introduction of dirt or any other objects into the inlet or outlet ports at any time. The rotors must be free of any possible obstruction as the blower is built to have very tight clearances between the rotors and between the rotors and the casing.

- e. Ensure that it is NOT connected to any mechanical or electrical power supply in any way, including protection devices.

4. INSTALLATION

- a. All personnel should understand that all positive displacement blowers are built to very fine tolerances and have specific clearances between the moving parts. It is vital that there should be no introduction of dirt or objects into the blower inlet or outlet as this would almost certainly result in a catastrophic failure.
 - i. *Truck Mount*: The blower must be mounted to the truck on a bracket sufficient to support the weight of the blower and accessories, as well as withstand the vibration produced by the blower in operation. A sufficiently robust bracket must also be used to reduce stress and eliminate distortion on the blower housing. If the blower is to be mounted in a vertical flow configuration using an "L" Bracket, always ensure diagonal support straps are used.
 - ii. *Foundation / Baseplate mount*: The blower must be mounted on either a solid level foundation or on a baseplate accommodating the drive motor. The foundation/baseplate must be level and sufficiently sound to withstand vibration and to ensure no distortion of the blower when in operation.
 - *Foundation Mounting*: The blower should be bolted down uniformly to the holes provided in the casting.
 - *Baseplate Mounting*: When the blower is mounted on a baseplate with the drive motor, the complete baseplate must be carefully shimmed with steel shims when mounted on the securing bolts to ensure it is level. The baseplate must be tightened down evenly such that there is no distortion to the baseplate or the blower.
- b. Once the blower is in position and the securing bolts fully tightened, the blower should be gently rotated manually. It must rotate freely with no tight spots and the rotors must not contact each other or touch the casing. If there is a tight spot or the rotors will not rotate freely, the cause must be investigated, and corrective action taken before continuing with the installation.

5. DRIVE ALIGNMENT

- a. The normal drive arrangement is either by direct coupling the blower to the drive shaft or drive motor through a coupling or by driving pulleys fitted with a V-belt drive.
- b. PTO Shaft. Ensure correct PTO which is adequate for the speed and horsepower required by the blower is mounted per manufacturer's instructions and rotates the correct direction (see Table 4 and Illustration 1). Use only a properly sized and balanced driveline at the correct angle, typically between 1 and 7 degrees.
 - i. To avoid becoming entangled and to reduce potential damage to the driveline, install the power take off and/or shaft in a protected area, ideally between the frame rails.
 - ii. If PTO/ driveshaft must be installed in an exposed position, install an adequate safety guard.
 - iii. Coupling. It is essential that the blower and drive are aligned accurately to avoid distortion to the blower casing. The coupling should be fitted in accordance with the instructions supplied by the manufacturer.
- c. V-Belt Drive: Taper lock bush type pulleys are recommended. If another type of pulley mounting is used, it must be carefully pressed on to the shaft to avoid damage to the bearing. Do not use a hammer to install the pulley. The pulley must be mounted as close as possible to the cover of the drive shaft bearing.
- d. An approved guard of suitable quality must be used to prevent injurious accidents.

6. PLUMBING & INLET & DISCHARGE FILTER/SILENCERS

- a. Once the blower has been installed and bolted down onto its foundation, the plumbing can be connected. It is important that the plumbing is installed so that the pipe flanges connect freely to the blower without any strain as this can cause distortion to the blower with potentially catastrophic results. Also, the plumbing must be clean internally and free from any contamination.
- b. Normally, the blower is fitted with a combined inlet filter/silencer and discharge silencer, and all should be located as closely as possible to the blower. As for the plumbing, the inlet and outlet filters/silencers must be installed without putting any strain on the blower or the plumbing connected to the blower.
- c. Ensure no dirt or objects enter the system during installation / fit-up.
- d. When the blower has been installed and the plumbing and filters/silencers have been fitted, the blower must be checked again manually that it rotates freely without tight spots or contact of moving parts. Any problems in this respect must be investigated and remedied immediately.
- e. Note: It is recommended that in pressure applications the blower be equipped with a discharge silencer.

7. LUBRICATION

- a. Note: All blowers are shipped from the factory drained of all lubricating oil, so it is essential that the gear case is filled with oil.
- b. Drive end grease bearings must be greased before startup.
- c. The gear end is oil lubricated. Remove the fill plug, fill with oil until the oil reaches the fill plug level, and replace the plug.
- d. Do not over fill as this will cause the gears to overheat and could result in damage.
- e. If the casing is over filled, allow the excess oil to drain from the fill plug and then tighten the fill plug.
- f. The oil level should be checked at least once a week or after every 100 hours of operation.
- g. The bearings at the drive end are grease lubricated, therefore apply grease to the zerk fittings until it comes out of the weep holes which must be always kept clear of dirt and paint. Grease must be applied at 3-month intervals or every 500 hours in operation, whichever is the sooner.
- h. Consult Table 1 for the appropriate oil and grease to suit the prevailing ambient conditions where the blower is to be used. Different oils may be necessary between summer and winter where there are large temperature differences, in which case the oil will need to be changed as the seasons change.

8. PROTECTION DEVICES

- a. Pressure Relief Valve (PRV). The most important protection unit is the PRV and all blowers should be fitted with this to protect the blower against over pressure. For the B-630 blower, a 15 psi PRV is recommended.
- b. In vacuum applications, a vacuum relief valve should be fitted to protect the blower against excessive vacuum.
- c. The area around the PRV should be clearly marked to keep personnel clear at all times, in case it discharges.
- d. If other overload protection is fitted, such as an electrical current overload or a pressure overload switch, the PRV need only pass the volume of air necessary to prevent surge during variable speed operation.
- b. Pressure Switch. A pressure operated electrical protection unit (or vacuum operated in a vacuum application) should always be fitted to shut down the blower in the event of a pressure overload at the outlet (or excessive vacuum at the inlet). It should not be set at a higher pressure than 2 psi above the maximum allowable operating pressure as shown in Table 4.
- c. Current Overload. This will operate when the electrical current exceeds the maximum full load current and should be set with a 2 second maximum delay.

9. INITIAL START UP PROCEDURE

Before starting the blower for the first time, and after it has been shut down for maintenance, the following initial checks should be made:

- a. Check that the unit is isolated from mechanical or electrical supply.
- b. Inspect the blower mounting, drive line, PTO, and air filter for damage.
- c. The blower and plumbing must be free of any dirt or foreign objects.
- d. The blower must be securely mounted on the securing/mounting bolts and they should be checked that they are properly and evenly tightened.
- e. The blower must be level and correctly aligned to the PTO or motor. If it is direct coupled, check that the companion flange / coupling bolts are correctly tightened. For a V-belt drive, the units must be correctly aligned and the V- belts tensioned in accordance with the manufacturer's recommendations.
- f. The oil level must be checked in accordance with 7. LUBRICATION above.
- g. Check manually that the blower rotates freely and that there are no tight spots. If there are, this must be investigated and corrected before proceeding.
- h. It is recommended that when the electricity is connected, a check is made that power is also connected to all the appropriate safety and protection equipment.

10. STARTING THE BLOWER

- a. Check that the interior of the blower and the inlet and discharge plumbing is clean and that there has been no introduction of dirt or other contaminants.
- b. The oil levels must be checked and topped off if necessary. DO NOT OVER FILL. If the drive end bearings are grease lubricated the drive end bearing zerk fittings should be greased until the grease escapes from the grease weep holes.
- c. Check that the blower is level and correctly aligned with the drive. Ensure all mounting bolts are firmly tightened. If a V-belt drive is used, check that the belts are correctly tensioned. Also ensure that the inlet and outlet plumbing is correctly positioned so that it is not putting any strain on the blower that could cause distortion of the blower casing.
- d. If all the above is satisfactory, for stationary unit connect the electrical supply to the drive motor and protection equipment.
- e. Remove the camlock dust cap and connect the hot air hose.
- f. Use the PTO or motor to briefly turn over the blower to check that the blower is rotating in the correct direction. If it is not, take corrective action to resolve the problem.
- g. Once all the above checks have been carried out satisfactorily, start the blower and run for 15 minutes with load. During this time, use a safe method such as a heat sensing gun to check that the blower casing and bearing housings are not overheating. Under these conditions and over this period of time, heat should not be generated but always use caution as the blower and accessories may become hot enough to cause serious skin burns.

- h. If the above test is satisfactory, increase the load gradually to full load over a period of 30 minutes and then run it at full load for another hour. The blower must be monitored constantly throughout this period. If there is any sign of overheating or any other problem occurs, the blower must be shut down immediately and the fault diagnosed and rectified, otherwise serious damage could result.
- i. The blower should be regularly monitored for the first 2 days of operation.

11. ROUTINE MAINTENANCE

- a. Once in operation, the oil level should be checked at least weekly.
- b. It is very important for safety reasons and for the blower, that when checking the oil level, the blower must be stopped for at least 15 minutes prior to checking the level to allow the oil to settle. If the blower needs topping off, the truck engine / electrical power must be shut off, and the blower allowed to cool to a safe level prior to maintenance.
- c. The frequency of oil change will depend on several factors such as the number of hours in operation, changes in the environmental conditions and the load factor. Under normal operation the blower oil may be changed annually unless the blower is subject to long periods of very heavy continuous load, in which case more frequent oil changes are recommended, or if the environmental conditions such as temperature change between summer and winter occur that require a different grade of oil to be used. See 7. LUBRICATION.
- d. For a belt drive installation, while checking the oil level, the belt tension should be checked and adjusted if necessary.
- e. It is important that the inlet filter element is cleaned regularly. If it becomes blocked and restricts the air flow to the blower, the blower could overheat. Cleaning should be conducted in accordance with the instructions supplied by the manufacturer of the filter.

12. OPERATING AND SAFETY

- a. Always keep body parts, clothing, tools, and other objects away from machine openings and rotating parts during operation. Failure to do so can result in serious or fatal injury, or catastrophic damage to equipment.
- b. Whenever working on the blower during a shutdown, such as for checking oil levels or other maintenance work, it is essential for safety reasons that the truck engine is shut down or blower is otherwise isolated from the power supply before work on the blower begins.
- c. All personnel working close to the blower while it is running MUST wear suitable ear protection as all positive displacement blowers are loud when operating.
- d. All personnel involved in maintenance should be trained in lifting techniques. Many of the components within a blower are heavy and need care when lifting to protect both the personnel and the components.
- e. When maintenance work is to be performed

- i. The blower and all accessories, including the protection devices, must be isolated from the engine or power supply.
 - ii. The inlet and outlet must be disconnected from the blower to eliminate the risk of any pressure difference within the system causing “windmilling”, which is inadvertent rotation of the rotors while work is being carried out. The blower rotors rotating during maintenance work could cause very serious injury.
- f. During maintenance or inspection, the rotation of the rotors and gears can be locked by inserting feeler gauges between the rotors.
- g. Do not start the blower with the plumbing disconnected. In the very unlikely event that this is necessary, all personnel must keep well clear, especially clear of the inlet and outlet. A coarse screen cover should be bolted over the inlet to prevent the introduction of dirt or other contaminants.
- h. The blower should be checked regularly while in operation.
 - i. Listen for any change in the sound/noise– this can indicate a problem is developing.
 - ii. Check that it is not overheating but **DO NOT TOUCH THE BLOWER CASING**, as temperatures can exceed 300° F even in normal operation.
 - iii. If the level of vibration increases other than for a change in load, this should be investigated.
 - iv. Ensure all protection devices are connected and functioning. Do not disconnect while the blower is running.
- i. The oil level must be checked at least weekly if the blower is running continuously, more frequently if it is running for long periods at a high load factor and/or at or near the maximum recommended speed. If there are frequent stop/starts, check the oil level every time before starting. The blower must be stopped to check the oil level and left to stand for 15 minutes minimum for the oil to settle before the level is checked. Failure to do this could result in a false low-level reading being taken and the blower topped off unnecessarily, leading to over filling which could cause the bearings to overheat. If, after at least 15 minutes standing, the oil level is low, top off as necessary, but do not overfill.

13. CONTACTS

If you require assistance or any additional information, please contact your local Authorized U.S. ‘Werts Welding & Tank Service Inc’ Representative.

For more information about HR Blowers, please visit www.hrblowers.co.uk/us.

TABLE 1: TROUBLESHOOTING

Problem	Possible Cause	Remedy
Low Airflow	1. Blower Speed too low	Check PTO shaft speed and compare with Performance Chart. If belt driven, check belt drive for slippage; adjust if required
	2. Excessive Pressure (Over Pressurization)	Check Inlet vacuum and discharge pressure and ensure pressure/vacuum relief valves are set correctly and are operational. Reduce amount of product being introduced into the airflow.
	3. Obstruction in pipes	Check pipes, filter, relief valves, isolation valves and silencer to ensure an open flow path. Reduce amount of product being introduced into the airflow.
	4. Excessive Slip	Check internal clearances for excess wear, contact your authorized U.S. HR Blower representative.
Excessive Airflow	5. Blower Speed too high	Check speed and compare with Table 4
	6. Pressure too high	See 2 and 3 above
	7. Unbalanced or rubbing rotors	Inspect blower body for hotspots. Check drive alignment, coupling and/or V-belt
	8. Blocked inlet filter	Change or clean
Overheating	9. Incorrect or inadequate lubrication	Confirm correct oil specification and correct lubrication levels in gear case
	10. Excessive pressure rise	See 2 and 3 above
	11. Drive misalignment	Check and re-align
	12. Blower speed too low	See 1 above
Vibration or Noisy Operation	13. Drive Misaligned	See 11
	14. Unbalanced or rubbing rotors	See 7 and 19
	15. Worn Bearings & Gears	Replace bearings and gears. Contact your authorized U.S. HR Blower representative.
	16. Loose motor, blower or plumbing	Check and re-tighten bolts where loose
Seizure	17. Over pressurization	See 2 and 3
	18. Misalignment	See 11
	19. Build-up of foreign material	Clean off foreign material
Driveshaft Breakage	20. Excessive overhung load / misalignment	Change or repair unit. Check pulley dimensions. Realign and tension. Change drive configuration.
	21. Over pressurization	See 2 and 3

PLEASE NOTE, UNAUTHORIZED ATTEMPT AT EQUIPMENT REPAIR WOULD INVALIDATE MANUFACTURER'S WARRANTY.

TABLE 2: RECOMMEND OILS AND GREASES

Supplier	Ambient Air Temp (F)	Max Oil Temp (F)	Gear Oil	Bearing Grease
Mobil Oil Co Ltd	-6 to 39	120	DTE Medium	Mobilpex 48
	32 to 77	162	DTE Extra Heavy	Mobilplex 48
	68 to 104	216	DTE HH	Mobilplex 48
Shell Oil Ltd	-6 to 39	120	Tellus S2 M 46	Gadus S2 V100 3
	30 to 81	162	Tellus S2 M 100	Gadus S2 V100 3
	64 to 104	216	Morlina S1 B 460	Gadus S2 V100 3
Esso Petroleum Co Ltd	-6 to 39	120	Teresso 46	Beacon 3
	30 to 81	162	Teresso 100	Beacon 3
	64 to 104	216	Teresso 460	Beacon 3
Texaco Ltd	-6 to 39	120	Regal R+O 46	Regal Multiflax Prem
	30 to 81	162	Regal R+O 150	Regal Multiflax Prem
	64 to 104	216	Regal 460	Regal Multiflax Prem
Elf Oil Ltd	-6 to 39	120	Olina 32	Multi 3
	30 to 81	162	Olina 100	Multi 3
	64 to 104	216	Movixa 460	Multi 3
BP Lubricants Ltd	-6 to 39	120	Energol HLP 36	Energrease LS3
	30 to 81	162	Energol HLP 100	Energrease LS3
	64 to 104	216	Energol CS 460	Energrease LS3
Burmah Castrol Ltd	-4 to 37	108	Hyspin AS 32	Spheerol AP3
	27 to 72	153	Hyspin AWS 100	Spheerol AP3
	63 to 104	216	Alpha ZN 460	Spheerol AP3
Chevron Oils Ltd	-6 to 39	120	OC Turbine Oil 46	Dura-Lith Grease 3
	30 to 81	162	OC Turbine Oil 100	Dura-Lith Grease 3
	64 to 104	216	OC Turbine Oil 460	Dura-Lith Grease 3
Amoco Oil Company	-6 to 39	120	Amoco AW46	Rykon Prem 3
	30 to 81	162	American Ind Oil 150	Rykon Prem 3
	64 to 104	216	American Ind Oil 460	Rykon Prem 3
Gulf Oil	-6 to 39	120	Hydrasil 46	Gulf Crown 3
	30 to 81	162	Hydrasil 100	Gulf Crown 3
	64 to 104	216	Harmony 460	Gulf Crown 3
Total Oil	-6 to 39	120	Azolla 46	Multis Special 3
	30 to 81	162	Azolla 100	Multis Special 3
	64 to 104	216	Azolla 460	Multis Special 3
Caltex	-6 to 39	120	Rando Oil 460	Regal Starfac Prem 3
	30 to 81	162	Rando Oil 150	Regal Starfac Prem 3
	64 to 104	216	Ursa Oil P460	Regal Starfac Prem 3
Millers Oils	-6 to 39	120	Millmax 46	Delta 3EP
	32 to 77	162	Millmax 100	Delta 3EP
	68 to 104	216	Millube 460	Delta 3EP

If any oil from one of the major companies cannot be acquired, the oil and grease specification provided below should be adhered to. Any reputable oil company should be able to supply a satisfactory oil based on these specifications.

Oil Specification

The oil used should be a straight mineral oil (Anti-wear, anti-rust, anti-foam and anti-oxdyent additions are allowed but EP and any additives which emulsify are not allowed).

The oil should have a viscosity of not more than 2500 centistokes at the minimum ambient temperature (cold starting) and not less than 30 centistokes for the highest oil temperature reached on maximum load. When there are large seasonal variations in ambient temperature, summer and winter grades will be required.

Grease Specification

A high quality No3 National Lubricating Grease, Institute mineral oil grease with a calcium complex or lithium base should be used.

NOTE- WERTS WELDING & TANK SERVICE INCUK LTD CANNOT ACCEPT RESPONSIBILITY FOR ANY FAILURE CAUSED THROUGH LUBICATION NOT CONFIRMING TO THE SPECIFICATION.

Approximate Oil Capacities

Follow filling guidance in the Section 7. Lubrication and in the back of this manual.

TABLE 3: APPROXIMATE OIL CAPACITIES

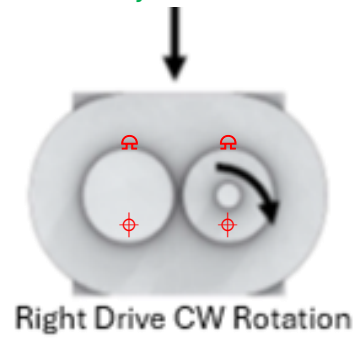
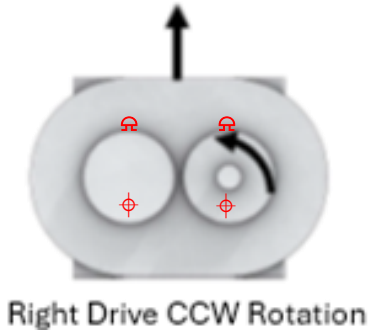
B-630 Gear End Oil Capacity	Approximate Gearcase Oil Capacity
Vertical Air Flow	61 ounces (1.9 Quarts)
Horizontal Air Flow	27 Ounces (0.84 quarts)

TABLE 4: B-630 BLOWER PRESSURE, FLOW, AND SPEED

Speed (Blower RPM)	7.3 PSI		10 PSI		13 PSI		16 PSI	
	CFM	HP	CFM	HP	CFM	HP	CFM	HP
1200	306	16	282	22	264	36	-	-
1400	376	18	353	30	335	36	300	41
1600	410	21	417	33	400	40	365	51
1800	518	24	494	36	476	43	441	56
2000	576	26	553	40	535	50	500	60
2200	653	29	629	43	612	53	576	63
2400	718	32	694	47	676	59	641	70

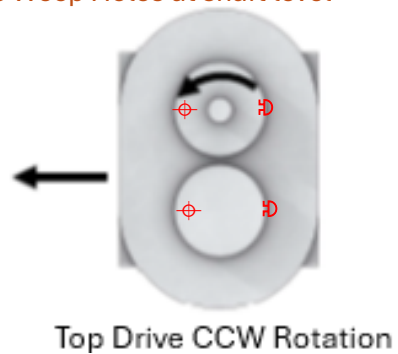
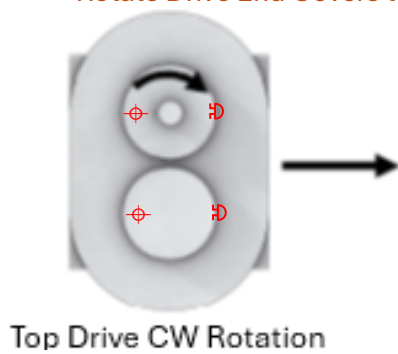
ILLUSTRATION 1: AIRFLOW PATH FOR B-630 BLOWER

Standard Rotations - No Adjustments Necessary



Adjustments Necessary

Rotate Drive End Covers to position Grease Weep Holes at shaft level



Adjustments Necessary

Rotate Drive End Covers to position Grease Weep Holes at/below shaft level
ALSO Rotate Gear Trough and Gear Box to ensure trough and gears are immersed in oil

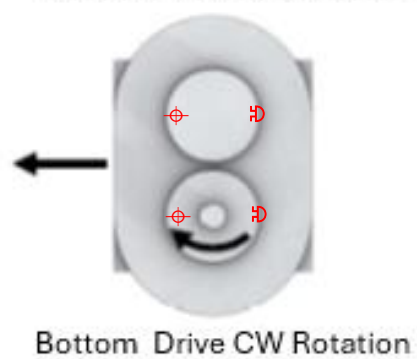
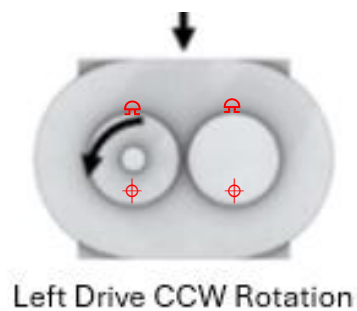
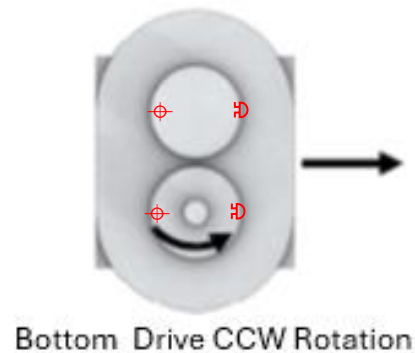
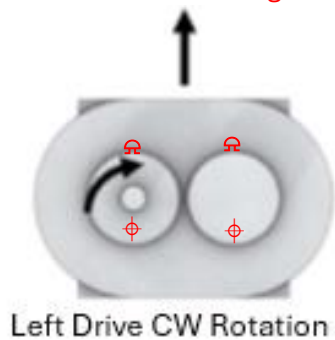
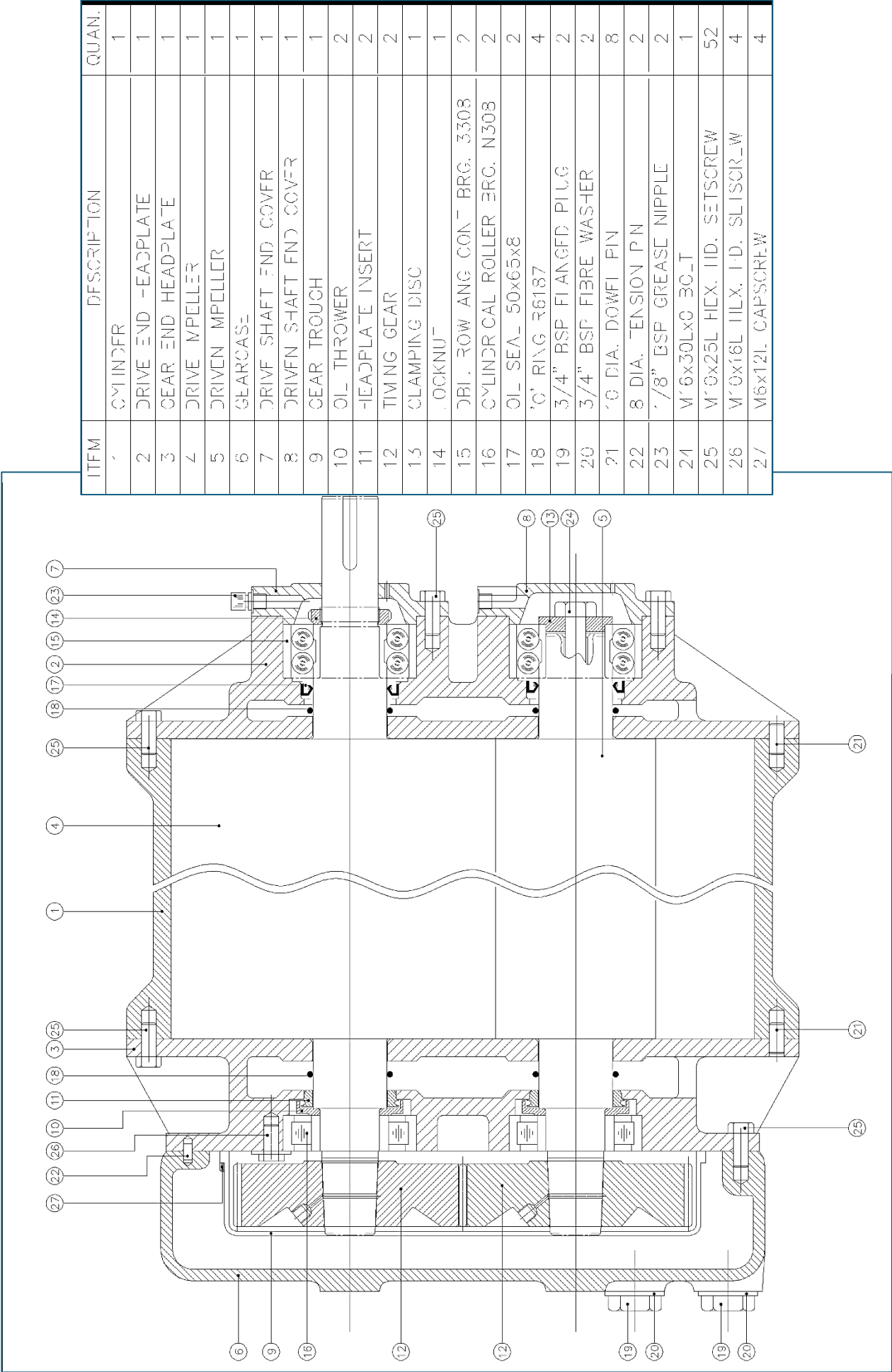


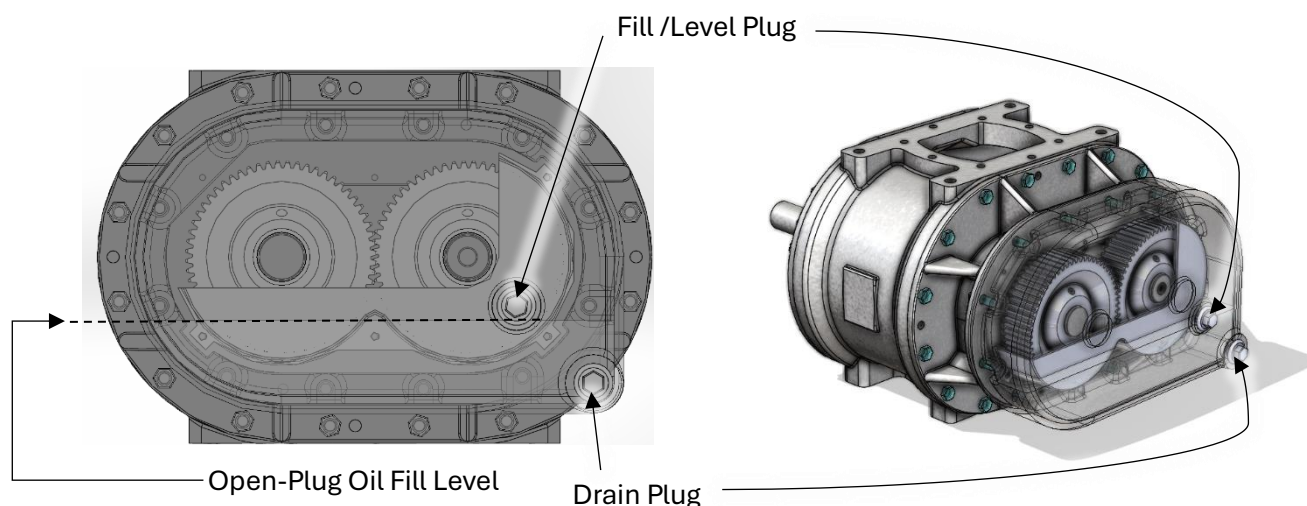
ILLUSTRATION 2: ILLUSTRATED PARTS BREAKDOWN FOR B-630 BLOWER



B-630 Vertical Flow

Illustrated below is a representative view of the gear end (non-drive end) of the B-630 blower in a Vertical Flow Configuration.

ILLUSTRATION 3: B-630 GEAR END COMPONENTS, VERTICAL FLOW



B-630 Oil Drain Procedure

- a. Remove fill plug
- b. Remove drain plug
- c. Allow oil to drain, checking for particulates, discoloration, or fouling.

B-630 Oil Fill Procedure

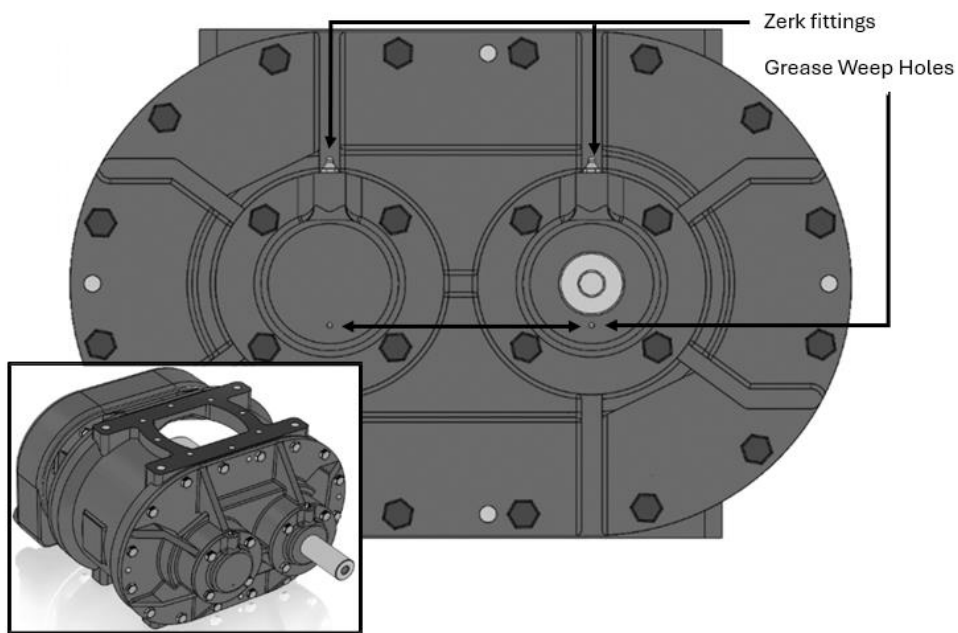
- a. Replace drain plug
- b. Remove fill plug
- c. Add oil slowly until level with bottom of fill plug hole
- d. Allow the oil to settle, clean of any excess oil from gear case and fill plug hole
- e. Replace fill plug

B-630 Vertical Flow, per Section 7, to lubricate the drive end of the unit:

- a. Use the zerk fittings to add grease until grease escapes from the weep hole.
- b. It is expected that after the blower's first few hours following re-greasing, additional grease will exit from the weep hole which may be simply wiped away.
- c. If grease has hardened and is no longer the consistency of fresh grease, it is a sign of either too infrequent re-greasing, or the temperature rating of the grease is too low.

Please note: If the blower is to be used in a non-standard orientation (Refer to Illustration 1), the grease weep holes should always be oriented below the shaft. The covers can be rotated into the correct position by removing the four retaining bolts. Great care must be taken to ensure that the shims are retained and are not disturbed, as the blower will not rotate correctly without them.

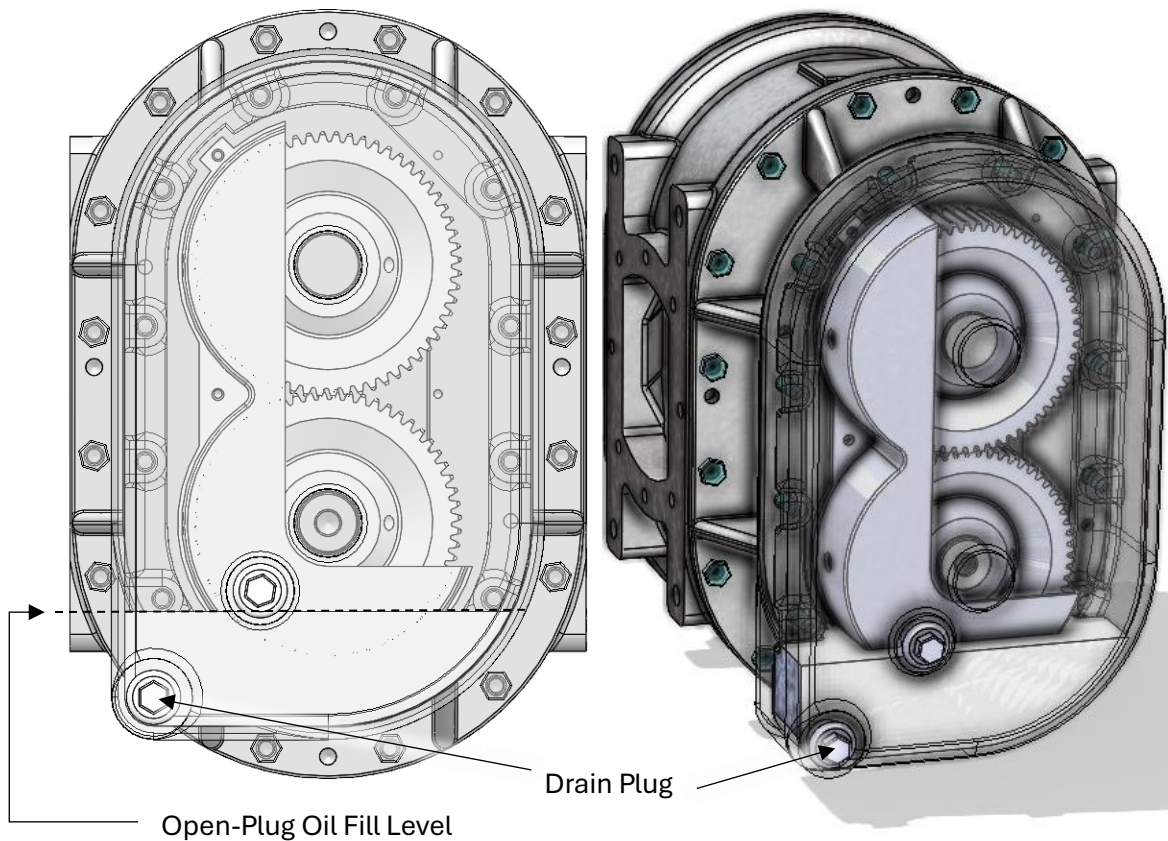
ILLUSTRATION 4: B-630 DRIVE END EXTERNAL COMPONENTS, VERTICAL FLOW



B-630, Horizontal Flow

Illustrated below is a view of the gear end (non-drive end) of the B-630/ blower in a Horizontal Flow Configuration

ILLUSTRATION 5: B-630 DRIVE END INTERNAL COMPONENTS, HORIZONTAL FLOW



B-630 Oil Drain Procedure

- a. Remove fill plug
- b. Remove drain plug
- c. Allow oil to drain, checking for particulates, discoloration, or fouling.

B-630 Oil Fill Procedure

- a. Replace drain plug
- b. Remove fill plug
- c. Add oil slowly until level with bottom of fill plug hole
- d. Allow the oil to settle, clean of any excess oil from gear case and fill plug hole
- e. Replace fill plug

B-630 horizontal Flow, per Section 7, to lubricate the drive end of the unit:

- a. Use the zerk fittings to add grease until grease escapes from the weep hole.
- b. It is expected that after the blower's first few hours following re-greasing, additional grease will exit from the weep hole which may be simply wiped away.
- c. If grease has hardened and is no longer the consistency of fresh grease, it is a sign of either too infrequent re-greasing, or the temperature rating of the grease is too low.

Please note:- If the blower is to be used in a non-standard orientation (refer to Illustration 1) the Grease weep holes should never be above the shaft axis. The covers can be rotated into the correct position by removing the four retaining bolts. Great care must be taken to ensure that the shims are retained and are not fouled, as the blower will not rotate correctly without them.

B-630 Oil – Grease Horizontal Flow

ILLUSTRATION 6: B-630 DRIVE END EXTERNAL COMPONENTS, HORIZONTAL FLOW

