



TUTHILL
VACUUM SYSTEMS

**ISO 9001
CERTIFIED
QUALITY SYSTEM**

Manual 1857-1

Models:

KMBD-240C

KMBD-400C

KMBD-540C

KMBD-720C

KMBD-850C

KMBD-1200C

KMBD-1600C

KMBD-2000C

KMBD-2700C

KINNEY VACUUM BOOSTERS

Instruction Manual

Revision 12/99

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INTRODUCTION This manual covers the Installation, Operating, and Maintenance of the Mechanical Booster Pumps listed in Table 1.

KMBD Models	(1)	(2)
240C, 400C, 540C, 720C, 850C, 1200C, 1600C, 2000C, 2700C	Mechanical Seals	Slinger Seal

(1) Interconnecting cooling water between drive shaft bearing housing and the two oil reservoirs. Mechanical seals are used throughout.

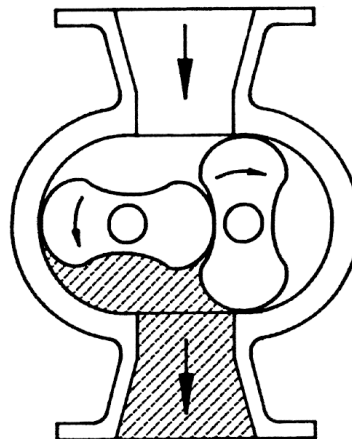
(2) Water cooled only at drive shaft bearing housing. Rotor seals are slinger type and a mechanical seal on the drive shaft.

Table 1

DESCRIPTION Kinney Vacuum Boosters are lobe type, positive displacement units, designed with extra heavy shafts and bearings to permit high power input. They incorporate a unique rotor profile in which all gas joints or mating surfaces are sealed vacuum tight.

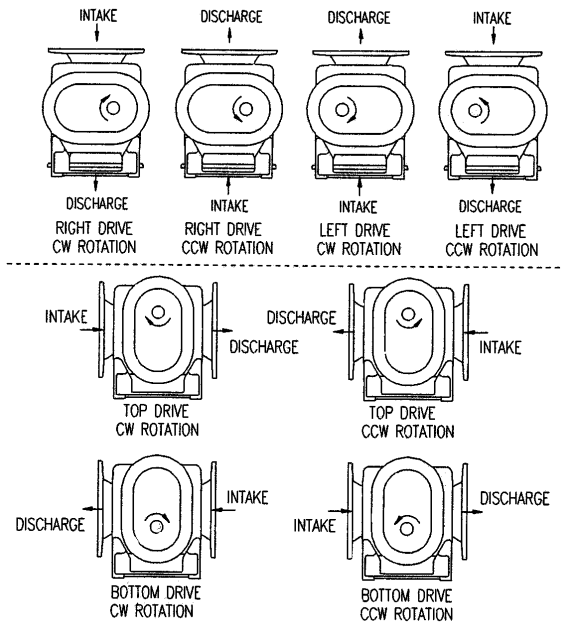
Unit construction consists of two figure eight shaped rotors enclosed in a precision machined housing supported at each end by precision bearings. The power drive turns the drive rotor directly and rotates the driven rotor by means of specially forged, heat treated, crowned and ground precision helical gears.

Efficient and effective vacuum pumping is accomplished by trapping a volume of gas at the booster inlet and between each rotor and the booster housing. This volume of gas is quickly and cleanly evacuated by the fast revolving rotors which carry the air to the exhaust side of the booster where the air is then discharged to the backing pump.



Flow Direction by Rotation

Refer to the illustration below before installing inlet and discharge piping.



KMBD Model	Approximate Oil Capacity		Port Size	Max.	Approximate Weight lbs. (kg)	
	Vertical	Horizontal	inch (mm)	RPM	Vertical	Horizontal
400 400BP	1 Quart (0.95 Litre)	0.5 Quart (0.47 Litre)	4 (100) 2 (51)	3600	195 (90) 400 (180)	180 (90) N/A
540 720 720BP	1.5 Quarts (1.42 Litres)	1 Quart (0.95 Litre)	4 (100) 4 (100) 2.5 (63.5)		260 (120) 300 (135) 560 (255)	240 (110) 280 (130) N/A N/A
850 1200 1600 2000 2700	4 Quarts (3.79 Litres)	2.5 Quarts (2.37 Litres)	** 6 (150) 10 (250)		430 (195) 510 (252) 580 (265) 685 (310) 790 (360)	450 (205) 500 (248) 540 (245) 645 (295) 750 (340)

Table 2 Specifications

INSTALLATION

General

Carefully check to ensure that no transit damage has been sustained. If damage has occurred from shipment a claim must be filed with the carrier immediately; preserve the shipping container for inspection by the carrier. Do not return the booster to the factory without first obtaining shipping instructions from Tuthill Vacuum Systems.

Remove protective covers and plugs only as connections are made. Mount the booster on a flat, level surface of sufficient rigidity. Shim under the legs where necessary so as to have each leg of the booster support a proportional share of the booster weight. This is necessary to prevent eventual twisting of the booster.

Safety

Booster housing and associated piping or accessories may become hot enough to cause major skin burns on contact.

Internal and external rotating parts of the booster and driving equipment can produce serious physical injuries. The booster should never be run with the inlet or discharge piping removed. If it becomes necessary to inspect the rotating parts of the booster or to change V-belts, be absolutely sure that all power to the motor controls has been shut off, the motor controls are locked out and properly tagged before proceeding.

Avoid extended exposure in close proximity to machinery with high intensity noise levels. Wear adequate ear protection.

Use proper care and good procedures in handling, lifting, installing, operating, and maintaining the equipment.

Other potential hazards to safety may also be associated with operation of the equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.

CAUTION

Disconnect and lockout power source before any work is started.

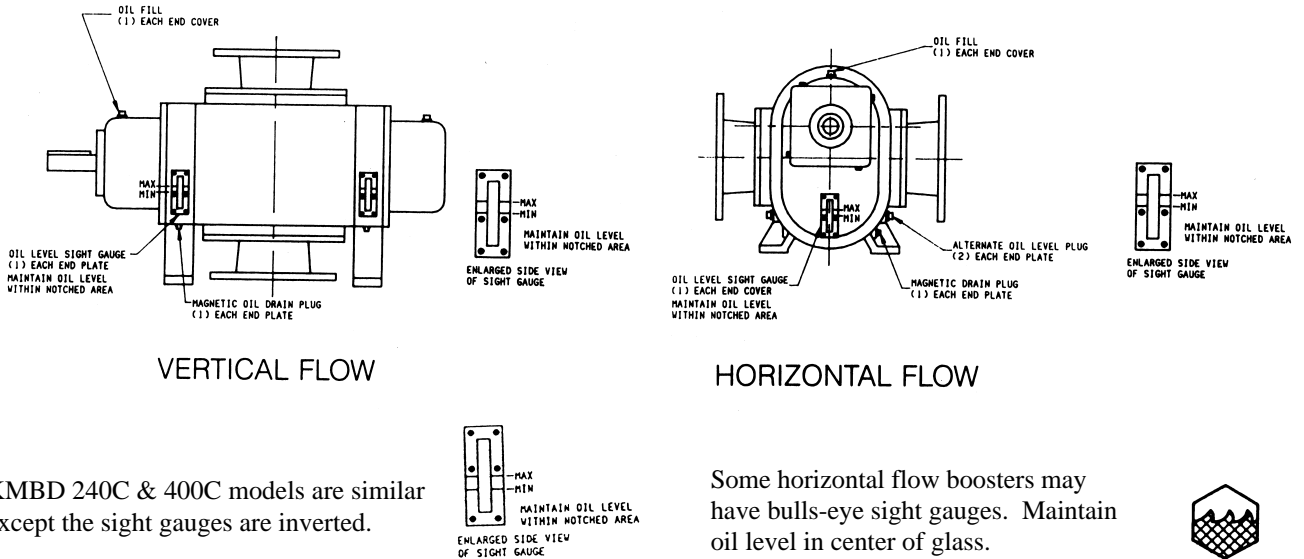


Figure 1 Lubrication

Lubrication

Before starting the booster fill reservoir as instructed below:

1. Remove fill plugs from gear end and free end plates.
2. Pour oil through fill hole until oil appears in sight glass. Slowly bring oil up to center of glass. See Figure 1.
3. Reseal plugs and reinstall in end plates.

Oil levels should be checked frequently. Booster must be shut down to properly check oil level.

Note: Oil may not be added while booster is operating. Oil reservoirs are under vacuum.

Time lapse between oil changes will vary depending on operating conditions. Higher blower operating temperatures are directly related to higher oil temperatures. Boosters utilizing the water cooling option can extend the interval between oil changes by a considerable amount. Consult the factory if temperature questions arise.

Every Kinney booster is factory tested, oil drained and shipped dry to its installation point. Oil reservoirs must be filled to proper level before operation.

Boosters with mechanical seals are splashed lubricated. One or both gears dip into an oil reservoir on the drive end to lubricate bearings while an oil slinger provides the same lubrication on the opposite end.

Kinney KV-100 oil is recommended for use on boosters with typical vacuum applications. Consult Tuthill Vacuum Systems on oils for use where hazardous or chemically active materials may be present.

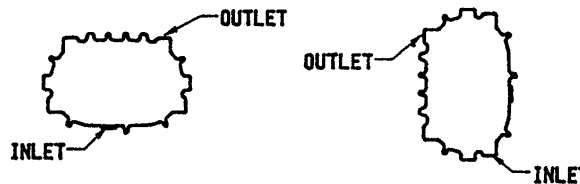
Add vacuum oil to the booster in the quantity shown in Specifications on page 2. The oil level must be maintained within the notched area of the sight glass. See figure 2.



WARNING: Never attempt to change or add oil while booster is running. Failure to heed this warning could result in damage to the equipment or personal injury.

Water Liquid Cooling Instructions

Entrance into the water jacket cavity is through any of the (5) 1” NPT cooling connection holes in each end plate. For best results, the cooling liquid should be introduced at the bottom of the end plates and exits at the top in a diagonal direction as shown below



COOLING WATER SPECIFICATIONS

Flow rate: Depending on operating conditions, 1/2 to 1 gallon per minute will be required for both end plates.

Maximum Pressure: 75 PSIG

Piping Connections

Manifolding should be no smaller than the pump connections in order to minimize restrictions to gas flow. Accurately align the mating flanges to the inlet and discharge manifolding to prevent distortion of the booster housing. Temporarily fit a fine wire mesh filter at the suction port if solid particles are likely to be entrained into the air stream and remove the filter when particles no longer appear. This is especially desirable on new installations and when manifolds have been welded. The manifolding to and from the booster should be fitted with flexible connections to isolate vibrations, absorb expansion and contraction due to thermal change, and to absorb misalignment differences. If the booster is to be water cooled, connect a clean supply to the 1/4” NPT connection on the seal adapter housing adjacent to the drive shaft. The drain line will be connected on the bottom of the non-drive end reservoir, see Figure 3 for connection locations.

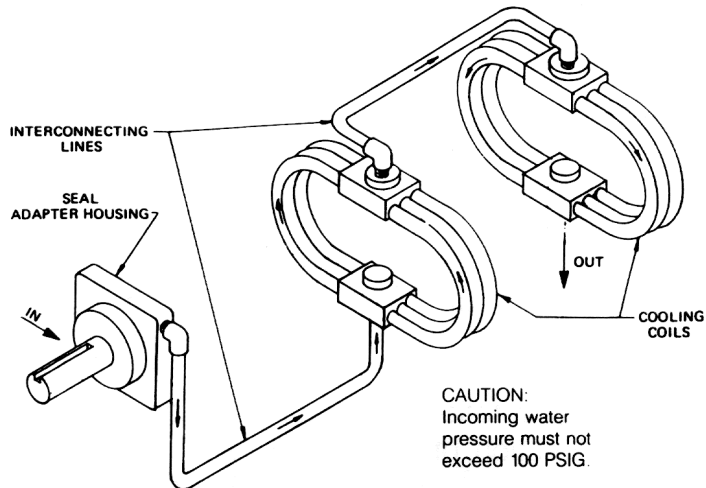


Figure 3 Cooling Water Piping Harness

The partly water-cooled slinger seal version has cooling water to the seal adapter housing only. The cooling coils and interconnecting water line are omitted and the interconnecting line leading from the seal adapter housing is led to the drain.

The air-cooled configuration requires no cooling water. However, cooling water can be circulated through the seal adapter housing on most models without modification to the booster. Cooling the bearing housing will prolong the life of the mechanical seal therein.

An on-off valve should be provided on the incoming line and a regulating valve located in the drain line. The drain line should terminate at an open drain to enable the operator to better regulate the water flow.

Water Cooled End Plate Option

Units having water cooled end plates can be identified by the connecting hose which runs from the top of the drive end plate to the bottom of the rear end plate. See Figure 4.

Units that will operate with continuous discharge gas temperatures of 250° F (121° C) or more must be connected to a water (liquid) supply in order to maintain reasonable oil temperatures. Generally a water flow of ½ to 1 GPM (1.9 - 3.8 L/min) is sufficient to maintain oil temperatures below 150° F (65° C).

WARNING: If unit is to be located outside or in a building where



ambient temperatures can fall below freezing then care must be taken to ensure the water or liquid used for cooling does not freeze and damage the blower end plates. End plates must be drained of liquid during downtime unless a recirculating unit using a glycol mixture has been installed.

NOTE: Units are never shipped from the manufacturer with liquid in the end plates.

COOLING WATER SPECIFICATIONS

Flow rate: Less than 2 GPM (7.6 L/min) total for both end plates.

Maximum Pressure: 100 PSIG (6.895 bar G)

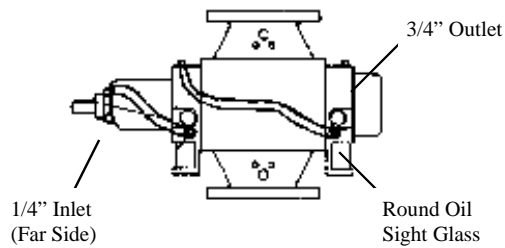


Figure 4 Mechanical Seals-Water Cooled End Plates

C-Flanged Coupling Installation

Woods Coupling

1. Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shafts.
2. Slide one coupling flange onto each shaft, using snug-fitting keys where required.
3. Position the flanges on the shafts. It is usually best to have an equal length of shaft extending in to each flange. Move one flange to its final position. (Usually the motor shaft.) Torque fasteners to proper value. Slide the other flange far enough away to install the sleeve. With the two piece sleeve, do not move the wire ring to its final position, allow it to hang loosely in the groove adjacent to the teeth.
4. The coupling employs a two-piece sleeve with a wire ring. Force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screw driver.
5. **CAUTION:** Coupling sleeves may be thrown from the coupling assembly with substantial force when the coupling is subjected to a severe shock load or abuse.

Electrical Connections

Wire the motor and other electricals such as solenoid valves and temperature switch to the proper voltage and amperage as indicated on the nameplate of each component being wired. Turn the booster by hand after wiring is completed to determine that there are no obstructions and if the booster turns freely; then momentarily start the booster to check the direction of rotation. The illustration on page 2 shows direction of air flow in relation to rotor rotation. The air flow direction can be reversed by reversing the appropriate motor leads.

OPERATION

Starting the Pump

Check the oil for proper level at both ends of the booster. Add or drain oil as necessary to bring the oil to the correct level. See Figure 1. Too much oil particularly on the gear end can result in excessive heat generation. Too little oil will possibly result in failure of the timing gears, bearings, and mechanical seals.

Start the backing pump. When pressure is reduced sufficiently, start booster pump. A pressure switch can be installed to start the booster at a predetermined pressure. If the booster is water cooled, turn on the cooling water when the booster is started. Adjust the water flow so that the discharge water temperature is no more than lukewarm (70° to 80° F).

Operating

The upper temperature limits for booster pump operation are between 350° and 375° F measured in the exhaust gas stream with a thermocouple. When this temperature limit switch is installed, as the temperature exceeds the predetermined temperature, the booster motor will stop and cannot be restarted until the temperature drops below the trip setting of the temperature switch.

NOTE: These upper limits are not for continuous operation. Consult Kinney for detailed information or assistance.

CAUTION: Use of a thermowell insulates the thermocouple. Invalid and delayed reading will result. This can result in ineffective protection devices.

Stopping the Booster

CAUTION: Venting the booster to pressures above cut-in while running can damage the booster.

Stop the booster by turning off the motor. Isolate the booster from the vacuum system and vent the booster to atmosphere. Turn off the cooling water if water cooled. Stop the backing pump. Refer to component instruction manual.

MAINTENANCE

General

Scheduled maintenance consists of changing lubricating oil every 250 to 1500 hours of operation. Change the oil more frequently if pumping corrosive vapors or where excessive operating temperatures are encountered. Boosters with mechanical seals on the rotors can generally run the full 1500 hours before an oil change is required.

Proper oil drain schedules require oil to be changed before the contaminant load becomes so great that the oil's lubricating function is impaired or heavy disposition of suspended contaminants occur. To check the condition of the oil, drain a sample into a clean container and check for the presence of water or solids. Slight discoloration of the oil should not necessitate an oil change.

NOTE: When changing oil be sure to reseal the drain and fill plugs. This is especially important on slinger seal series which have no mechanical seals on the rotors. Air leaks past these plugs can cause rapid loss of oil from end covers resulting in booster failure. Oil levels should be checked every 24 hours of operation.

Spare Parts

Refer to the parts list and assembly drawing for your particular model. Repair kits are available for all models. These kits contain all the seals, bearings, o-rings, locks and special retaining screws necessary for an overhaul. Always have complete booster model number and serial number when ordering.

In developing a stock of spare parts, consider the following:

- 1) The degree of importance in maintaining the booster in a "ready" condition.
- 2) The tie lag in parts procurement.
- 3) Cost.
- 4) Shelf life (seals and o-rings).

Contact Tuthill Vacuum Systems Sales Department for any assistance in selecting spare parts.

Repair Service

With proper care Kinney Vacuum Boosters will give years of reliable service. The parts are machined to very close tolerances and require special tools by mechanics who are skilled at this work.

When ordering parts, give all booster nameplate information, plus the item numbers and names as taken from the appropriate assembly drawing in this book. Numbers shown in brackets () in the following repair procedures correspond to item numbers in the drawings.

Should major repair become necessary, it is strongly recommended that the booster be returned to the factory for repair or to one of the authorized service facilities that specialize in vacuum booster repair. Contact the factory for the location nearest you. **Units which are still under warranty must be returned to Tuthill Vacuum Systems (TVS) for service.**

NOTE: Before returning any unit, you must call TVS Service Department (800) 225-3810, for authorization and proper return procedure.

If your in-house mechanics have been properly trained in booster repair, special assembly tools are available through TVS Service Department.

Long Term Storage

1. Spray the interior (lobes, housing and end plates) with rust preventative.
2. Fill both end bells completely full of oil.
3. Firmly attach a very prominent tag stating that the end bells are full of oil and must be drained and refilled to proper levels prior to startup.
4. Apply a rust preventative grease to the drive shaft.
5. Attach a desiccant bag to either of the covers to prevent condensation from occurring inside the booster. Make sure any desiccant bag (or bags) is so attached to the covers that they will be removed before startup of the booster.
6. Store the booster in an air conditioned and heated building if possible. At least insure as dry conditions as possible.
7. If possible, rotate the drive shaft by hand at least monthly in order to prevent the seals from setting in one position.

DISASSEMBLY KMBD-240C & KMBD-400C

- 1) Disconnect cooling water lines (274 & 181). Do not disturb cover bushings (120) or it will be necessary to retest cooling coils for leakage as described in the assembly procedure. Covers should be re-tested if water is detected in drain oil, (mechanical seal boosters only).
- 2) Drain oil from both ends of booster and remove inlet and outlet port fittings (38 or 48).
- 3) Remove bolts (93), use jack screw holes to remove seal housing. Remove cover using jack screws. Seal mating ring will come off with cover.
- 4) Remove cap screws (26A & 26B and both end covers (6 & 7). Two jack screw holes are provided on each other.
- 5) Remove lockwire (49), socket head screws (66), and drive shaft (45).
- 6) Remove flat head allen screws (29) from end of each rotor shaft. Remove washer (25), spacers (57), and oil slinger (21).
NOTE: The flat head screws have nylok in their threads and may be difficult to remove. Strike the head a couple of blows with a flat face hammer for easy removal.
- 7) Mark housing, end plates, rotors and gears before proceeding with disassembly. There are two methods which can be used to disassemble the rest of the unit. Method "A" requires an arbor press while Method "B" requires the use of bar or yoke pullers.
- 8) Align timing marks on gears (Figure 6A). Rotate drive gear clockwise approximately three teeth and mark a matching reference line on each gear as shown in Figure 6B. This gear position is necessary so rotors will clear and not jam. Do not allow the gears to move from the matched reference line while pulling. Use a light rocking motion to insure that the lobes have not jammed. Remove driven gear first then drive gear.



WARNING: Failure to properly pull this gear could result in damage to rotor keyway or a bent rotor shaft. Never use excessive force.

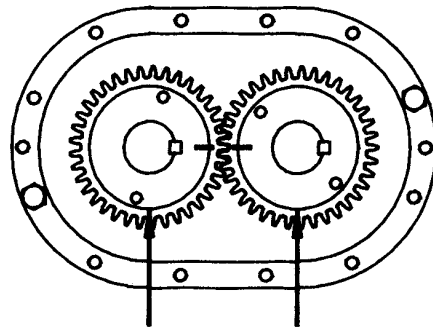
- 9) Remove button head allen screws (30) and bearing retainer rings (14) from both end plates.
- 10) Attach a pair of bar pullers to the bearing bores of the free end plate. Use 10-32 x 4" long screws. Alternately push both rotors from the end plate. Separate end plate from housing.

- 11) Turn the unit around and attach a single bar puller to either bore and push rotor from end plate making sure the rotor is vertical in the housing (for support) while removing. Repeat for opposite rotor. Note the location of timing shims (16), oil slinger (20), and spacers (17 & 18).
- 12) Tap end plate from housing.
- 13) **Mechanical Seal Boosters** – Tap out bearings from both end plates. Note location of spacers under bearings and retain for reassembly. To remove seals (54) use a cape chisel or similar tool, being careful not to nick or cut the bearing or seal bores. Remove the labyrinth seal (51) in the same manner. The seals will be damaged by removal and must be replaced.

Slinger Seal Boosters – Carefully tap out seal slinger (238), spacer (123), and bearings. The oil slinger stator (79) should not be removed unless it is damaged or the end plate is to be replaced.

NOTE: On some older units the oil seal slinger is made up of two separate parts, items 238 & 129. The newer design combines these two parts and is identified as item 238.

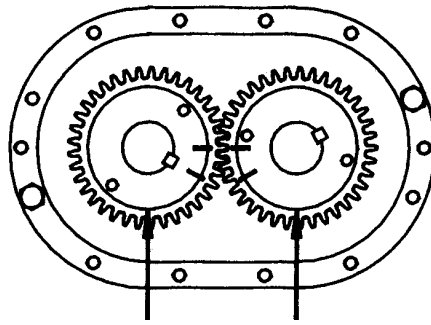
- 14) Clean all parts with a good grade of clean solvent and replace any worn or damaged parts with factory approved parts. New bearings, seals, and o-rings should be installed at each assembly.



Drive Gear Driven Gear

Keyways in line and timing marks matched

Figure 6A



Drive Gear Driven Gear

Timing marks advanced 3 teeth
(Reference marks aligned)

Figure 6B

NOTE: Position of timing marks is for removing or installing driven gear. To remove the drive gear, advance three teeth in the opposite direction.

ASSEMBLY OF KMBD-240C & KMBD-400C

General

The assembly procedure is generally the same for all series, but where there are differences notations will be made.

All vacuum joints, end covers, seal casings and plugs should be sealed with an RTV Silicone Sealer, Kinseal or equal, unless o-rings have been provided.

Dowel pins are used to locate end plates, housing and drive end cover in the proper location relative to each other. Be sure they are in place.

It is recommended that the gear end rotor shaft bearings be purchased from Tuthill Vacuum Systems, as they are specially ground to locate the rotors with correct end clearance relative to the gear end plate. Do not use standard bearings which have not been flush ground within .001 tolerance. Use factory approved parts only.

It is suggested that long feeler gauges (12") be used to check the interlobe timing. Preferably (2) .006, (1) .005, (1) .004, and (1) .003. These gauges will provide all the combinations from .003 to .021, and also .024, which is the total.

Preparation Of End Plates For Assembly

1) Remove all nicks, scratches, etc. from all sealing surfaces. Clean all parts thoroughly.

2) **Mechanical Seal Boosters** – Press in new labyrinth seals (51) into bores of both end plates (4) making sure the scalloped areas of seal case are aligned with openings in vent area of seal bore. Coat O.D. of mechanical seal with sealer and press into seal bore, coming to rest on top of labyrinth seal. Make sure seals are fully seated without deforming case. Keep sealer from carbon surface. Carefully wipe carbon with soft tissue and cleaning agent (acetone) before continuing assembly.

Slinger Seal Boosters – Press in new oil slinger stators (79) if required.

Gear End Assembly

3) Stand rotors (1) on arbor press table with gear end shafts up. See Figure 7. Two keyways should point in the same direction, to the right.

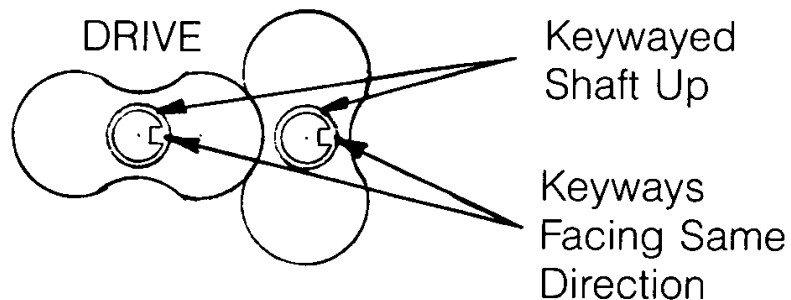


Figure 7

4) Carefully install gear end plate over rotor shafts.

NOTE: The drive rotor should always be on the left side. Make sure the end plate feet are facing in the proper direction so the assembled unit will have the same drive shaft location as before.

5) **Mechanical Seal Boosters** – Some earlier models used an o-ring (314) under the mating portion of the mechanical seal. This has been discontinued and o-rings should not be used with newly purchased seals. Check lapped surface of seal mating ring to be sure it is perfectly clean. Use soft tissue and cleaning agent if necessary. Place a few drops of lubricating oil on its surface and install on shaft with lapped surface coming to rest on top of carbon. Gently press with fingers to insure compression is taking place and ring is not hung up for any reason.

Slinger Seal Boosters – Slide slinger (238) over shaft. Also install spacer (129) if two piece.

Installation of Timing Gears

- 6) Lubricate shafts and press the double row ball bearings (9) onto rotor shafts and into end plate bores.

CAUTION: These bearings have been flush ground at the factory. The inner race will have a black dot etched on the surface. This dot must be up and visible when bearings are installed. Secure with bearing retainers (14), and socket head screws (30).

- 7) Check clearance between the face of the end plate and rotor lobes. See exploded view for correct gear end clearances. If clearances are not within specifications, recheck parts to find cause of improper clearances before proceeding.

- 8) Install spacer (17) (.260 thickness) on one shaft and spacer (18) (.200 thickness) and oil slinger (20) on the other shaft.

NOTE: Oil slinger and its spacer should always be mounted on lower rotor for horizontal flow units. It can be mounted on either shaft for vertical flow units.

Install timing shim in same location as found in disassembly.

This does not necessarily insure the unit will be in proper time.

Adjustments can be made later in the assembly process.

- 9) Insert gear keys (24) in their proper location and flush with top of shaft. Use the two keyways facing to the right. Tight fit required. Coat shafts and keys with lubricant. Install drive gear (right hand helix) on drive rotor (left side). To install driven gear, align reference marks as shown in Figure 6B. Install driven gear carefully to avoid mashing any teeth when engaging opposite gear. Secure with spacers (57), washers (25), and flat head allen screws (29).

NOTE: All timing gears must be used in sets, as they are matched and serially numbered.

- 10) Remove assembly from press and stand on work table with gears facing downward. Place blocks under end plate to prevent assembly from falling over. Drive gear should remain on left side.

- 11) Place small bead of sealer around the periphery of the end plate, encircling each bolt hole. Install rotor housing (3) and secure with 4 screws evenly spaced.

- 12) Check clearance between end of lobes and housing using a flat bar and feeler gauges or a depth micrometer. Refer to exploded view for free end clearances.

- 13) Place a small bead of sealer around the periphery of the housing, encircling each bolt hole. Install free end plate and secure with 4 screws.

Housing and Free End Assembly

Adjusting Rotor Interlobe Clearance

- 14) **Mechanical Seal Boosters**– Install mating rings same as gear end, No. 5.
Slinger Seal Boosters – Install seal slinger same as gear end. Install bearing spacers (123) on each shaft.
- 15) Lubricate shafts and install roller bearings (10).
CAUTION: Inner race of bearing has a flange on one side only. This flange must face outward. See Figure 8.
- 16) Install oil retainer rings (14) with button head screws (30). Only two required for each ring.
- 17) Install spacer (67) on each shaft. Install oil slinger (21) on lower rotor, (either shaft on vertical flow units) spacer (57) on opposite shaft, washers (25), and screws (29). Lay assembly down with drive on left for timing.
- 18) Using feeler gauges take interlobe readings and record on each side of housing as indicated in Figure 9. By removing or adding shim behind the helical gear, it rotates as it is moved in or out and the driven rotor turns with it, thus changing the clearance between rotor lobes. Changing the shim thickness .006 will change the rotor lobe clearance .003 or one half the amount.
EXAMPLE: Referring the Figure 6, check the clearance at AA (right hand reading) and BB (left hand reading). If AA reading is .009 and BB reading .003 by removing .006 shims, the readings will change one half the amount removed or .003. AA should then read .006 and BB should read .006. The final reading should be within .002 of each other.
To determine the amount of shim to add ore remove, subtract the small figure from the larger. If the right side reading is higher than the left side, remove shim. If the right side reading is lower, add shim.
- 19) Install drive shaft (45) and secure with allen screws (66). Check drive shaft runout behind keyway. Do not exceed .002 T.I.R. (Total Indicator Reading). Install lockwire (49).
- 20) Remove temporary cap screws from gear end plate and apply a bead of sealer around end plate (not cover), encircling all holes, and install gear cover (6) and secure with cap screws (26A).
NOTE: If cooling coil or fittings were disturbed or water was detected in drain oil, they should be retested with air pressure to check for leaks and resealed. (Mechanical Seal Boosters only.)
- 21) Install cover (6).
- 22) Install new mechanical seal (76) into seal housing (91), and press in lip seal (13).
- 23) Install mating ring (76) onto drive shaft and install assembled seal housing.
- 24) Be sure to lubricate seals before final assembly.

Drive Shaft Seal Assembly

Complete Booster Assembly

- 25) Install free end cover (7) following the same procedure used to install the gear cover. Secure with cap screws (26B).
- 26) Apply sealer and install both port fittings (38 or 48).
- 27) Install all necessary cooling water lines.
- 28) Prior to putting booster into operation, follow Installation and Operation instructions. Observe the oil level frequently, during the initial hours of operation. A badly installed or damaged oil seal will result in oil loss.

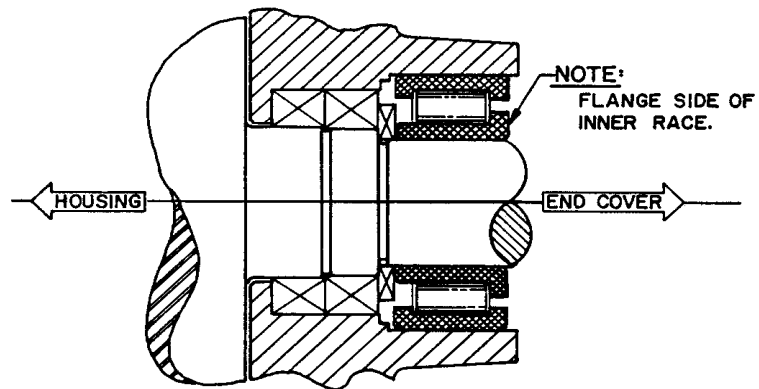


Figure 8

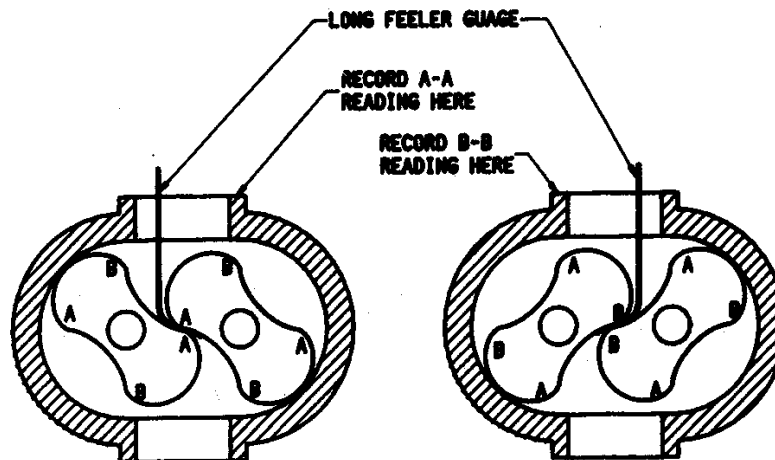


Figure9

DISASSEMBLY

KMBD-540

KMBD-720

KMBD-850

KMBD-1600

KMBD-2000

KMBD-2700

- 1) Disconnect cooling water lines (274 & 181). Do not disturb the large hex head screw (97). If it is removed, loosened, or water is detected in drain oil, the coil assembly must be retested as described in the assembly procedure.
- 2) Drain oil from both ends of booster and remove port fittings (38 or 48).
- 3) Remove motor and drive coupling.
- 4) Remove bolts (93) and take off seal housing (91) using jack screws.
- 5) Remove cover (6), mating ring (76) will come off with cover.
- 6) Remove drive shaft screws (66) and locks (65). Tap shaft lightly to remove.
- 7) Remove gear lock nuts and washers (35 & 36). Models KMBD-850C, 1200C, 1600C, 2000C, and 2700C (horizontal flow series, top drive only). Remove cap screws (396), washers (136 & 80), and oil slinger (20) if furnished. These items are not shown on exploded view but are listed on parts list.
- 8) Position the timing gears for pulling by first matching the timing marks on the gears. See Figure 10A. Turn the drive gear clockwise five teeth and mark a matching reference line on each gear as shown in Figure 10B. The rotor lobes are now in their most open position. Using a gear puller, the driven gear (left hand helix) may now be removed without jamming the rotors. This gear is in two parts – the gear rim and hub. It is not necessary to disassemble. Do not allow the gears to move from matched reference line while pulling. Use a light rocking motion while pulling the gear to insure that the lobes have not jammed.
WARNING: Failure to properly pull this gear could result in damage to rotor keyway or a bent rotor shaft. Never use excessive force.
- 9) Remove drive gear. It is not necessary to remove keys from rotor shafts.

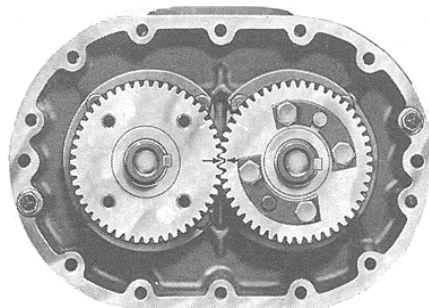


Figure 10A

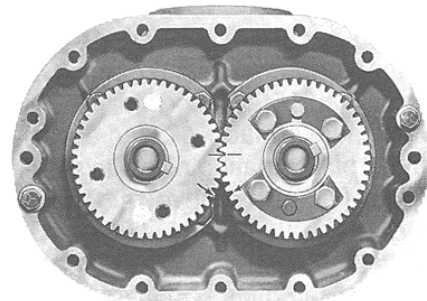


Figure 10B

- 10) Remove cap screws (62), locks (61), and bearing lock rings (14).
- 11) Install two screws temporarily to hold end plate to housing.
- 12) Remove the free end cover (7) rotor shaft socket screws (26 & 69), washer (25), spacer (57), oil slinger (21) (must be pried off on KMBD-850C, 1200C, 1600C, 2000C, 2700C models), roll or dowel pin (68), socket head screws (30) and oil retainer rings (14 & 15).

NOTE: On KMBD-540C and KMBD-720C models, it is not necessary to remove item 15 unless the end plate is being replaced.

NOTE: The flat head screws have nylok in their threads and may be difficult to remove. Strike the head a couple of blows with a flat face hammer for easy removal.

- 13) Using two yoke style pullers with pressure screws attached to free end plate bores, pull end plate from housing. Tap out the bearings (10).

Mechanical Seal Boosters – Tap out mechanical seal (54), spacers (123), and labyrinth seal (51).

Slinger Seal Boosters – Tap out seal slinger (238) and spacers (123).

The oil slinger stator (79) should not be removed unless it is damaged or the end plate is to be replaced.

NOTE: On some older units the oil seal slinger is made up of two separate parts – items 238 & 129. The newer design combines these two parts and is identified as item 238.

- 14) Using a single yoke puller with longer screws, push out one rotor at a time making sure the rotor is vertical in the housing (for support) while removing.
- 15) Remove the two temporarily installed screws and tap gear end plate from housing and remove bearings and seals.
- 16) Clean all parts with a good grade of clean solvent and replace any worn or damaged parts with factory approved parts. New bearings, seals, and o-rings should be installed at each assembly.

ASSEMBLY

KMBD-540

KMBD-720

KMBD-850

KMBD-1600

KMBD-2000

KMBD-2700

General

The assembly procedure is generally the same for all series, but where there are differences, notations will be made.

All vacuum joints, end covers, seal casings and plugs should be sealed with an RTV Silicone Sealer, Kinseal or equal, unless o-rings have been provided.

Dowel pins are used to locate end plates, housing and drive end covers, in the proper location relative to each other. Be sure they are in place.

It is recommended that the gear end rotor shaft bearings be purchased from Tuthill Vacuum Systems, as they are specially ground to locate the rotors with correct end clearance relative to the gear end plate. Do not use standard bearings which have not been flush ground within .001 tolerance. Use factory approved parts only.

It is suggested that long feeler gauges (12") be used to check the interlobe timing. Preferably (2) .006, (1) .005, (1) .004, and (1) .003. These gauges will provide all the combinations from .003 to .021, including .024, which is the total.

Preparation Of End Plates For Assembly

- 1) Remove all nicks, scratches, etc. from all sealing surfaces. Clean all parts thoroughly.
- 2) **Mechanical Seal Boosters** – Press in new labyrinth seals (51) into bores of both end plates (4) making sure the scalloped areas of seal case are aligned with openings in vent area of seal bore. Coat O.D. of mechanical seal with sealer and press into seal bore, coming to rest on top of labyrinth seal. Make sure seals are fully seated without deforming case. Keep sealer from carbon surface. Carefully wipe carbon with soft tissue and cleaning agent (acetone) before continuing assembly.

Slinger Seal Boosters – Press in new oil slinger stators (79) if required.

Gear End Assembly

- 3) Stand rotors (1) on arbor press table with gear end shafts up. See Figure 11. Two keyways should point in the same directions, to the right.

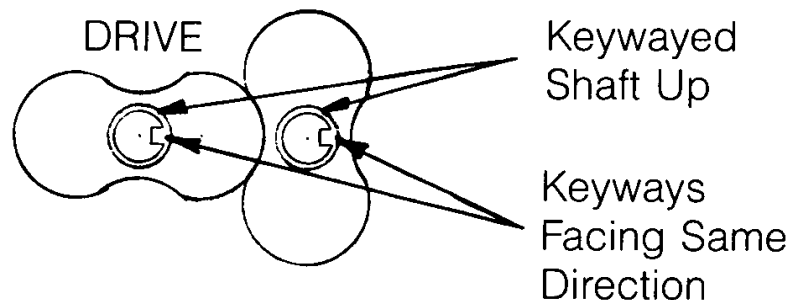


Figure 11

- 4) Carefully install gear end plate over rotor shafts.

NOTE: The drive rotor should always be on the left side. Make sure the end plate feet are facing in the proper direction so the assembled unit will have the same drive shaft location as before.
- 5) **Mechanical Seal Boosters** – Check lapped surface of seal mating ring to be sure it is perfectly clean. Use soft tissue and cleaning agent if necessary. Place a few drops of lubricating oil on its surface and install on shaft with lapped surface coming to

rest on top of carbon. Gently press with fingers to insure compression is taking place and ring is not hung up for any reason.
Slinger Seal Boosters – Slide slinger (238) over shaft. Also install spacer (129) if two piece.

- 6) Lubricate shafts and press the double row ball bearings (9) onto rotor shafts and into end plate bores.

CAUTION: These bearings have been flush ground at the factory. The inner race will have a black dot etched on the surface. This dot must be up and visible when bearings are installed. Secure with bearing retainers (14) or (14 & 15) on KMBD-540C and 720C models, locks, and cap screws (61 & 62).

- 7) Check clearance between the face of the end plate and rotor lobes. See exploded view for correct gear end clearances. If clearances are not within specifications, recheck parts to find cause of improper clearances before proceeding.

- 8) Insert gear keys (24) in their proper location and flush with top of shaft. Use the two keyways facing to the right. Tight fit required. Coat shafts and keys with lubricant.

- 9) Install drive gear (right hand helix) on drive rotor (left side). To install driven gear, align reference marks as shown in Figure 10B. Install driven gear carefully to avoid mashing any teeth when engaging opposite gear. Secure with gear lockwasher (36) and lock nut (35).

NOTE: All timing gears must be used in sets, as they are matched and serially numbered.

- 10) Remove assembly from press and stand on work table with gears facing downward. Place blocks under end plate to prevent assembly from falling over. Drive gear should remain on left side.

- 11) Place small bead of sealer around the periphery of the end plate, encircling each bolt hole. Install rotor housing (3) and secure with 4 screws evenly spaced.

- 12) Check clearance between end of lobes and housing using a flat bar and feeler gauges or a depth micrometer. Refer to exploded view for free end clearances.

- 13) Place a small bead of sealer around the periphery of the housing, encircling each bolt hole. Install free end plate and secure with 4 screws.

- 14) **Mechanical Seal Boosters**– Install mating rings same as gear end, No. 5.

Slinger Seal Boosters – Install seal slinger same as gear end. Install bearing spacers (123) on each shaft.

- 15) Lubricate shafts and install roller bearings (10).

CAUTION: Inner race of bearing has a flange on one side only. This flange must face outward. See Figure 8 on page 17.

Installing Timing Gears

Housing & Free End Assembly

Adjusting Rotor Interlobe Clearance

- 16) Install oil retainer rings and screws (14 & 30, spacer (57) (model 540C & 720C only), washer (25), screw (29), oil slinger and dowel (21 & 68), and screw (69).

NOTE: Oil slinger should always be mounted on lower rotor for horizontal flow units. It can be mounted on either shaft for vertical flow units.

- 17) Lay booster assembly down and torque timing gear nuts at this time. See exploded view for proper torques.
- 18) The driven gear is made of two pieces. The outer gear shell is fastened to the inner hub with four cap screws and located with two dowel pins. A laminated shim, made up of .003 laminations, separates the hub and the shell. By removing or adding shim laminations, the gear shell is removed axially relative to the inner hub. Behind the helical gear, it rotates as it is moved in or out and the driven rotor turns with it, thus changing the clearance between rotor lobes. Changing the shim thickness .006 will change the rotor lobe clearance .003 or one half the amount.

EXAMPLE: Referring the Figure 9 on page 17, check the clearance at AA (right hand reading) and BB (left hand reading). If AA reading is .009 and BB reading .003 by removing .006 shims, the readings will change one half the amount removed or .003. AA should then read .006 and BB should read .006. The final reading should be within .002 of each other.

To determine the amount of shim to add or remove, subtract the small figure from the larger. If the right side reading is higher than the left side, remove shim. If the right side reading is lower, add shim.

When removing gear shell from driven gear, it is not necessary to remove gear lock nut. Make sure bolt locks are in place because the dowel pins must come off with the gear shell.

- 19) Bend over lock tabs of gear lockwasher (936) and gear screw locks. KMBD-850C, 1200C, 1600C, 2000C, 2700C models, horizontal flow series (top drive only). Reinstall oil slinger (20) to lower rotor and secure with washer (136 & 80) and cap screw (396), if furnished. Not used on older models.
- 20) Install drive shaft, making sure both surfaces are clean and free of all burrs. Drive shaft runout should not exceed .003 T.I.R. (Total Indicator Reading). measured behind keyway.
- 21) Remove temporary cap screws from gear end plate and apply a bead of sealer around end plate (not cover), encircling all holes, and install gear cover (6) and secure with cap screws (26).
NOTE: If cooling coil or manifold screw have been disturbed, they should be retested with air pressure to check for leaks. (Mechanical Seal Boosters only.) If leaks occur, disassemble and replace o-rings.

Drive Shaft Seal Assembly

- 22) Install new mechanical seal (76) into seal housing (91), and press in lip seal (13).
- 23) Install mating ring (76) onto drive shaft.
- 24) Install assembled seal housing.
- 25) Install free end cover (7) following the same procedure used to install the gear cover.

Complete Booster Assembly

- 26) Apply sealer and install both port fittings (38 or 48).
- 27) Install all necessary cooling water lines.
- 28) Prior to putting booster into operation, follow Installation and Operation instructions. Observe the oil level frequently during the initial hours of operation. A badly installed or damaged oil seal will result in oil loss.

TROUBLE SHOOTING BOOSTERS

Problem	Possible Cause	Solutions
Knocking or rapping	Unit out of time from worn bearings or gears	Replace worn parts
	Rotors making contact from excessive temperature	Reduce temperatures by lowering differential pressure
Excessive operating temperatures	Pressure differential too high	Reduce pressure across booster by lowering cut in pressure Check blank-off pressure of forepump, and system for leaks
Lack of volume	Worn clearances	Reestablish clearance
	Reduced speed	Check motor
Abnormal bearing and gear wear	Inadequate lubrication	Maintain correct oil levels. Improve oil change frequencies Initiate oil sampling program
Loss of oil	Worn seals	Replace seals

PARTS LIST FOR KMBD-240C, 400C

ITEM NO.	PART DESCRIPTION	Mech. Seal	Slinger Seal	ITEM NO.	PART DESCRIPTION	Mech. Seal	Slinger Seal
1	Rotor	2	2	57	Spacer	1	1
3	Housing	1	1	66	Screw, Cap	2	2
4	End Plate	2	2	67	Spacer	2	2
6	Cover, DE	1	1	70	Sight Glass	2	2
7	Cover, BE	1	1	76	Seal , Mech	1	1
8	Gear Assy	1	1	79	Retainer	-	4
9	Brg, Ball	2	2	85	Plug, Pipe	6	6
10	Brg, Ball	2	2	91	Adapter, Seal	1	1
13	Seal, Lip	1	1	92	O-ring, Vit	1	1
14	Retainer	4	4	93	Screw, Cap	4	4
16	Shim	6	6	94	Cooling Tube	2	2
17	Spacer	1	1	98	Plug Pipe	10	10
18	Spacer	1	1	118	Shim	5	5
20	Slinger, Oil	1	1	120	Bushing	4	4
21	Slinger, Oil	1	1	121	Plug, Pipe	4	4
22	Pin, Dowel	6	6	123	Spacer	2	2
23	Key	1	1	165	Conn, Tube	4	4
24	Key, Gear	2	2	166	Conn, Hose	2	2
25	Washer	4	4	174	Plug, Pipe	2	2
26A	Screw, Cap	12	12	180	Elb, St	2	2
26B	Screw, Cap	12	12	181	Hose, ID	1	1
29	Screw, Cap	4	4	234	Tag, Oil Level	2	2
30	Screw, Cap	16	16	238	Slinger	—	4
31	Plug, Mag	2	2	241	Screw	12	12
38	Port (KMBD-200)	2	2	242	Sight Glass Frame	2	2
40	Screw	24	24	243	Sight Glass Window	2	2
45	Shaft, Dr	1	1	244	Window Gasket	2	2
49	Wire-Safety	1	1	245	Frame Gasket	2	2
51	Seal, Lab	4	4	303	Plate	2	2
54	Seal, Mech	4	4	309	Screw	8	8

PARTS LIST FOR KMBD-540C, 720C

ITEM NO.	PART DESCRIPTION	Mech. Seal	Slinger Seal	ITEM NO.	PART DESCRIPTION	Mech. Seal	Slinger Seal
1	Rotor	2	2	68	Pin, Dowel	1	1
3	Housing	1	1	69	Screw, Cap	1	1
4	End Plate	2	2	70	Sight Glass	2	2
6	Cover, DE	1	1	76	Seal, Mech	1	1
7	Cover, BE	1	1	79	Retainer	1	1
8	Gear Assy	1	1	85	Plug, Pipe	6	6
9	Brg, Ball	2	2	91	Adapter, Seal	1	1
10	Brg	2	2	92	O-ring, Vit	1	1
13	Seal	1	1	93	Screw, Cap	4	4
14	Retainer	2	2	94	Cooling Coils	2	2
15	Retainer	4	4	95	O-ring, Vit	4	4
21	Slinger, Oil	1	1	96	O-ring, Vit	4	4
22	Pin, Dowel	6	6	97	Bushing	4	4
23	Key	1	1	98	Plug Pipe	10	10
24	Key, Gear	2	2	118	Shim	5	5
25	Washer	1	1	121	Plug, Pipe	3	3
26	Screw	28	28	123	Spacer	2	2
29	Screw	1	1	166	Conn, Hose	2	2
30	Screw	4	4	174	Plug, Pipe	2	2
31	Plug, Mag	2	2	180	Elb, St	2	2
35	Locknut	2	2	181	Hose, ID	1	1
36	Washer-Gear Lock	2	2	234	Tag, Oil Level	2	2
38	Port	2	2	238	Slinger	—	1
40	Screw	28	28	241	Screw	12	12
45	Shaft, Dr	1	1	242	Sight Glass Frame	2	2
51	Seal, Lab	4	4	243	Sight Glass Window	2	2
54	Seal, Mech	4	4	244	Window Gasket	2	2
61	Plate	4	4	245	Frame Gasket	2	2
62	Screw	8	8	303	Plate	2	2
65	Plate, Loc	2	2	309	Screw	8	8
66	Screw, Cap	4	4				

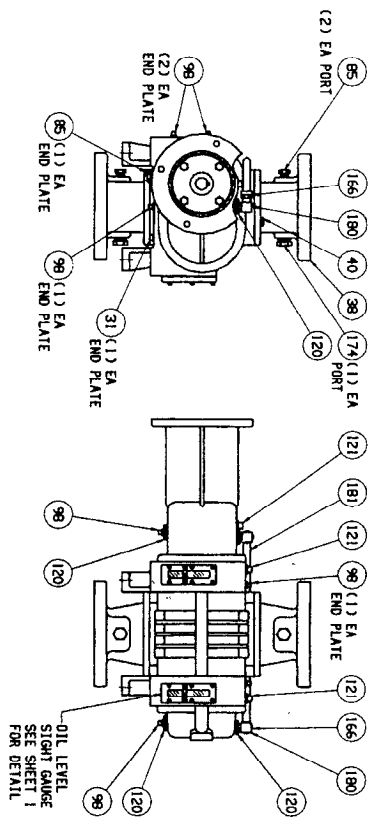
PARTS LIST FOR KMBD-850C, 1200C, 1600C, 2000C, 2700C

ITEM NO.	PART DESCRIPTION	Mech. Seal	Slinger Seal	ITEM NO.	PART DESCRIPTION	Mech. Seal	Slinger Seal
1	Rotor	2	2	66	Screw, Cap	4	4
3	Housing	1	1	68	Pin, Roll	1	1
4	End Plate	2	2	69	Screw, Cap	1	1
6	Cover, DE	1	1	70	Sight Glass	2	2
7	Cover, BE	1	1	76	Seal, Mech	1	1
8	Gear Assy	1	1	79	Retainer	-	1
9	Brg, Ball	2	2	85	Plug, Pipe	6	6
10	Brg, Roll	2	2	91	Adapter, Seal	1	1
13	Seal, Lip	1	1	92	O-ring, Vit	1	1
14	Retainer	4	4	93	Screw, Cap	4	4
21	Slinger, Oil	1	1	94	Cooling Coils	2	2
22	Pin, Dowel	6	6	95	O-ring, Vit	4	4
23	Key	1	1	96	O-ring, Vit	4	4
24	Key, Gear	2	2	97	Bushing	4	4
25	Washer	1	1	98	Plug Pipe	6	6
26	Screw	28	28	118	Shim	5	5
29	Screw, Cap	1	1	123	Shim Seal	2	2
30	Screw, Cap	6	6	166	Conn, Hose	3	3
31	Plug, Mag	2	2	174	Plug, Pipe	7	7
35	Locknut	2	2	180	Elb, St	2	2
36	Lockwasher	2	2	181	Hose, ID	1	1
38	Port	1	1	236	Tag, Oil Level	2	2
40	Screw	28	28	238	Slinger	—	4
45	Shaft, Dr	1	1	241	Screw	12	12
48	Port	1	1	242	Sight Glass Frame	2	2
51	Seal, Lab	4	4	243	Sight Glass Window	2	2
54	Seal, Mech	4	4	244	Window Gasket	2	2
57	Spacer	1	1	245	Frame Gasket	2	2
61	Plate	6	6	303	Plate	2	2
62	Screw	12	12	309	Screw	8	8
65	Plate, Loc	2	2				

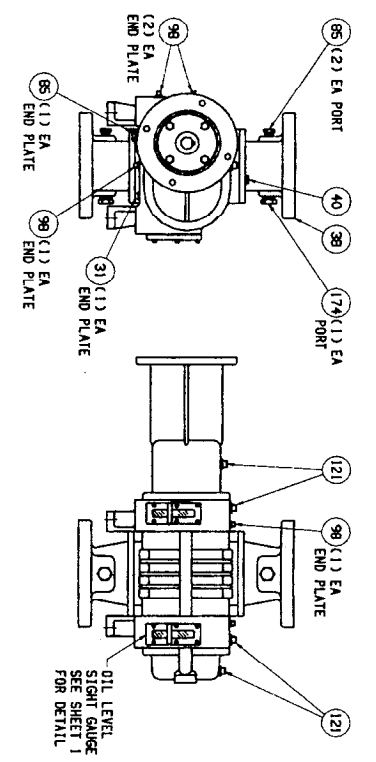
METRIC CONVERSIONS MECHANICAL VACUUM BOOSTER

TORQUE CHART	
Part	(N-m) Torque
Rotor Shaft Flat Hd Screw (3/8-16)	48
5/16 Cap Screw	23
1/4 Cap Screw	14
Retainer Button Hd Screw 10-32	4
3/8 Cap Screw	57
Timing Gear Shaft Nut (540 & 720)	149
Timing Gear Shaft Nut (850,1200,1600,2000 & 2700)	190
1/2 Cap Screw	122
Rotor 3/4 Structural Bolt	353
Bearing Ret Cap Screw (3/8-16)	41
Nose Piece Flat Hd Screw (1/4-20)	11
Dust Slinger Flat Hd Screw (10-32)	5
1/2 Cap Screw	102
3/4 Cap Screw	353

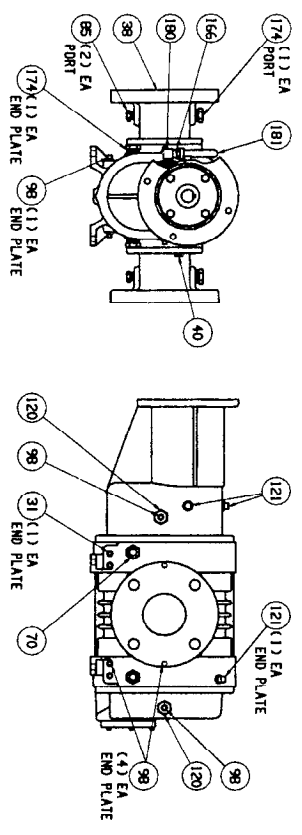
CLEARANCES					
KMBD Model	Gear Eng	Free End	Interlobe		Rotor, Tip to HSG at Ports
240C	.08-.13	.15-.25	Center Timed		.17-.19
400C		.30-.43			
540C		.28-.41			
720C		.10-.18			.28-.41
Model	Gear End	Free End	Interlobe	Tip-Dowel	Tip-Port
850C	.10-.18	.28-.41	Center Timed	.18-.30	.28-.41
1600C		.43-.56			
2000C		.53-.66			
2700C		.64-.76			



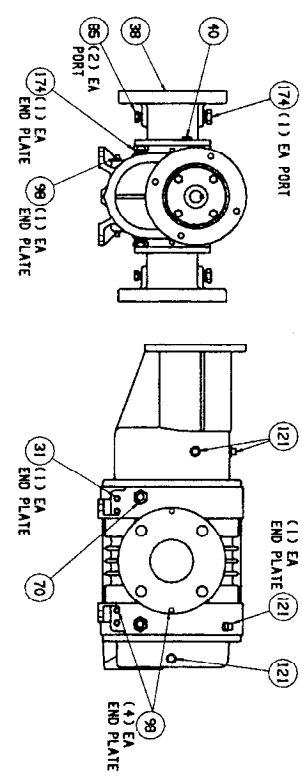
VERTICAL FLOW/MECHANICAL SEAL



VERTICAL FLOW/SLINGER SEAL



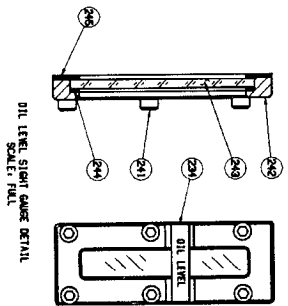
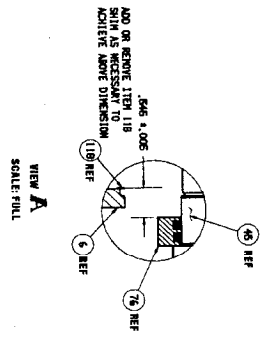
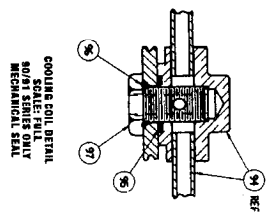
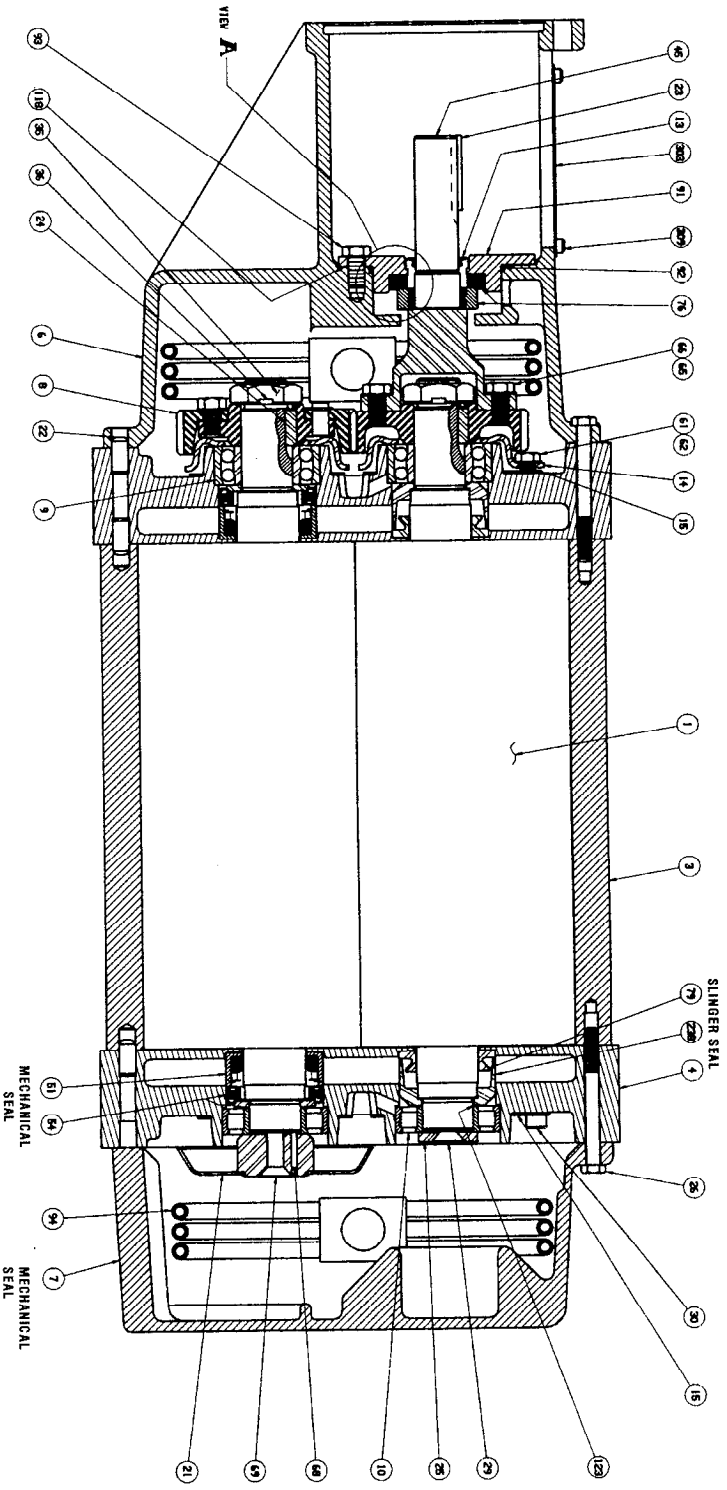
HORIZONTAL FLOW/MECHANICAL SEAL



HORIZONTAL FLOW/SLINGER SEAL

KMBD 240C & 400C

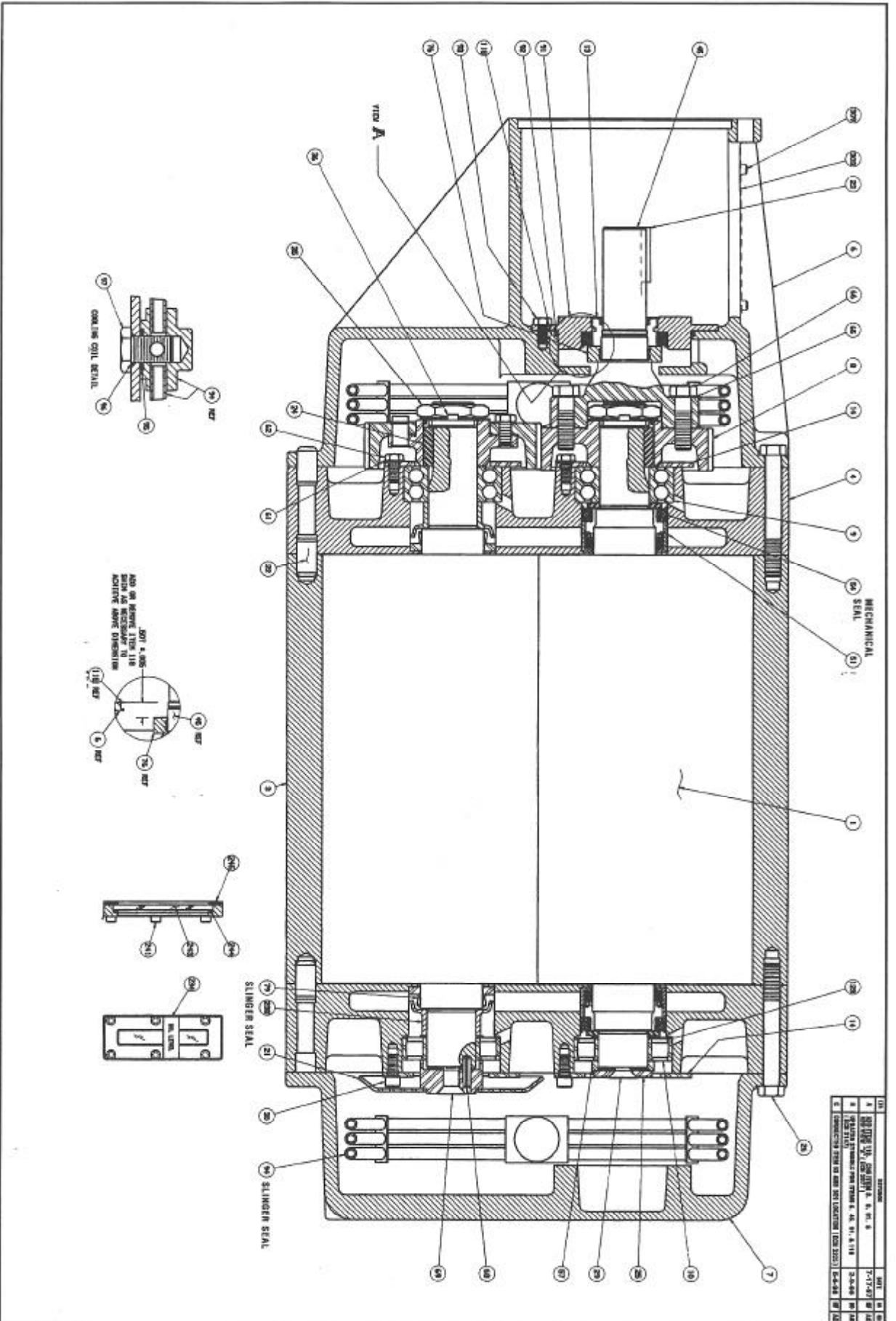
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B	11/11/71	J. S. W.	J. S. W.
C	11/11/71	J. S. W.	J. S. W.



NOTE: TO LOWER OIL LEVEL FOR MOTOR MOUNTING KIT INFORMATION

KMBD 540C & 720C

See page 25 for parts list



KMBD 850C, 1200C, 1600C, 2000C, 2700C

See page 26 for parts list

