



OWNERS MANUAL

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

MODELS NN, NH F16 & F16K W/CYCLOSEAL CUTTER OPTION

PLEASE READ CAREFULLY

**YOUR WARRANTY MAY BE VOID IF
INSTRUCTIONS ARE NOT
FOLLOWED**

**Note: when ordering parts give
pump model and serial number**

CORNELL PUMP COMPANY

16261 SE 130th Ave

Clackamas, OR 97015 USA

Phone: 503-653-0330

Fax: 503-653-0338

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MODELS NN, NH, F16 & F16K W/CYCLOSEAL & CUTTER

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CORNELL PUMP COMPANY
TERMS AND CONDITIONS OF SALE

LEGAL EFFECT: These Terms and Conditions of Sale ("Terms") and the associated Order Acknowledgement (collectively, the "Agreement") are binding upon Cornell Pump Company ("Cornell") and the purchaser of products and services from Cornell ("Buyer"). Except as otherwise agreed to in writing by Cornell, these Terms shall apply to, and form a part of, all sales of products and services (collectively, "Products"). Additional or different terms shall have no effect unless agreed to in writing by Cornell.

Cornell may suspend its performance of any order if Buyer defaults in the performance of its duties under any order or under any other agreement between Cornell and Buyer.

ACCEPTANCE: The sale of Products by Cornell to Buyer is expressly conditioned on Buyer's acceptance of these Terms.

CHANGES: Any changes proposed by Buyer after formation of this Agreement that affect the delivery schedule or requirements, or otherwise affect the scope of this Agreement, shall be submitted in writing by Buyer to Cornell and shall become binding only if agreed to in writing by Cornell. Any modifications to price or delivery as a result of such changes shall be determined by Cornell in its sole discretion.

CANCELLATION AND REVISION: No order may be cancelled or revised, in whole or in part, without the written consent of Cornell. In the event that Cornell consents to any cancellation or revision, Buyer shall reimburse Cornell for all of Cornell's losses, costs, and damages caused by such cancellation or revision, including, but not limited to, any costs arising from changes in design or specifications.

CREDIT: The amount of credit offered by Cornell to Buyer is based on a number of factors, including, but not limited to, Cornell's opinion of Buyer's capacity, ability, and willingness to promptly pay for Products. Cornell reserves the right to revoke Buyer's credit and/or suspend performance on any order in the event that, in Cornell's opinion, there is a material adverse change in Buyer's financial condition, or Buyer has not, within the agreed upon time, fully paid for Products previously supplied under any other agreement with Cornell.

PAYMENTS: Standard terms for customers who qualify for credit are ½ 15 days, net 30. Unless otherwise agreed to in writing by Cornell, Buyer shall pay all amounts due within thirty (30) days of receipt of invoice. A monthly service charge of 1.5% may be charged on amounts owed by Buyer to Cornell that have not been paid on time, subject to the maximum amount permitted by law.

TITLE AND LIEN RIGHTS: The Products will remain personal property, regardless of how the Products are installed or affixed to any realty or structure. After delivery to Buyer, Cornell will have all such rights, including security interests and liens, in the Products as lawfully may be conferred upon Cornell under any applicable provision of law. Buyer agrees to cooperate fully with Cornell in the filing of any financing statements, including Uniform Commercial Code filings or other documents necessary to perfect such interests and liens. If Buyer breaches this Agreement, or defaults on any obligations, before paying all amounts due for the Products, Cornell may take any and all actions permitted by law to protect its interests, including, where permissible, repossession of such Products.

SHIPMENTS: All sales are ex-works factory. Risk of loss shall pass to Buyer upon shipment. Shipping contracts made by Cornell shall be to Buyer's account. All claims for loss or damage after shipment shall be filed by Buyer with the carrier. Buyer shall be liable to Cornell for the full price of the goods, irrespective of loss or damage in transit. Cornell shall not be required to provide freight cost receipts to Buyer at the time of invoice.

LIMITED WARRANTY: Cornell warrants, to Buyer only, that Products manufactured by Cornell are free from defects in material and workmanship for the periods set forth in Exhibit 1. If a failure to conform to specifications or a defect in materials or workmanship is discovered within the applicable period, Cornell must be promptly notified in writing within thirty (30) days of such discovery. Within a reasonable time after such notification, Cornell shall correct any failure to conform to specifications or any defect in materials or workmanship, or in lieu of such repair, and at Cornell's sole option, shall replace the Products or the applicable portion thereof.

Any such repair shall be performed at Cornell's facility, unless otherwise designated by Cornell. Buyer shall pay any cost incurred as a result of shipping the Products, or any portion thereof, to Cornell. Cornell shall pay any cost incurred in returning the Products, or any portion thereof, to Buyer. For repairs done at Cornell's facility, Cornell will pay for any costs of labor and materials, and any expenses incurred by Cornell in making such repairs.

Cornell may opt to send replacement parts in lieu of repair at Cornell's facility. Cornell may also opt to perform repairs at Buyer's facility or site. If such repairs are performed for the convenience of Buyer, Buyer shall pay for all costs of labor and materials. If such repairs are performed for the convenience of Cornell, Buyer shall, in Cornell's sole discretion, pay a portion of the costs of labor and materials. Cornell shall have no

obligation to pay or reimburse Buyer or any third party for any expense incurred as a result of any Products, or any repair or attempted repair of any Products.

The warranty provided herein shall not apply in the event of any (a) defects caused by a failure to provide a suitable installation environment for the Products, (b) damage caused by the use of the Products for purposes other than those for which the Products were designed or intended, (c) damage caused by disasters such as fire, flood, wind, or lightning, (d) damage caused by unauthorized attachments or modifications, (e) other abuse or misuse, including improper installation, (f) reasonable wear and tear, and (g) defects in equipment or components not manufactured by Cornell. Cornell shall pass on any warranties for equipment and components not manufactured by Cornell to the extent that such warranties may be passed on.

CORNELL DISCLAIMS ANY AND ALL WARRANTIES AND REPRESENTATIONS WITH RESPECT TO THE PRODUCTS PROVIDED HEREUNDER, WHETHER EXPRESS OR IMPLIED, ARISING BY LAW, CUSTOM, ORAL OR WRITTEN STATEMENTS OR OTHERWISE, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR THAT THE PRODUCTS WILL GENERATE CERTAIN RESULTS, WORK IN COMBINATION WITH OTHER COMPONENTS OR AS AN INTEGRATED SYSTEM OR WILL FULFILL ANY OF BUYER'S PARTICULAR PURPOSES OR NEEDS.

COMPLIANCE WITH LAWS: Buyer shall comply with all laws and regulations governing the purchase or license, installation or use of the Products, including, without limitation, obtaining all licenses, permits and registrations and fulfilling all other requirements of governmental agencies, and Cornell shall have no obligation or responsibility of any kind with respect thereto. Buyer shall only export or re-export the Products in compliance with all applicable U.S. export control laws and regulations.

LIMITATION OF LIABILITY: Cornell's aggregate liability for any claim, loss, cost, damage, or liability arising out of or related to this Agreement, including, but not limited to, any liability arising from negligence, warranty, indemnity, contract, strict liability, or operation of law, shall in no event exceed the purchase price paid by Buyer for the affected Products. IN NO EVENT SHALL CORNELL BE LIABLE FOR, OR OBLIGATED IN ANY MANNER TO PAY, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL, OR PUNITIVE DAMAGES OF ANY KIND.

INDEMNIFICATION: Buyer shall indemnify, defend and hold harmless Cornell, its affiliates, and their respective directors, officers, members, employees, agents, contractors, successors, and assigns from and against all losses, damages, expenses, claims, demands, suits, judgments, penalties, and costs of any kind whatsoever, including attorneys' fees and expenses arising out of this Agreement or Buyer's use, acts, or omissions in connection with any Products.

GOVERNING LAW AND FORUM: This Agreement shall be governed in all respects by the laws of the State of Oregon, U.S.A. (excluding any conflicts of laws principles that would lead to the application of another state's laws). Buyer submits to the jurisdiction of the state and federal courts of Oregon for the purposes of resolving any dispute arising under or in connection with this Agreement.

CORNELL PUMP COMPANY
TERMS AND CONDITIONS OF SALE

Exhibit 1

Warranty Coverage By Product

Product	0-12 Months	13-18 Months	18-24 Months	25-36 Months	37-60 Months
Refrigeration Pumps	100%				
Irrigation Pumps	100%				
Food and Hot Oil Pumps	100%				
Industrial Pumps	100%				
Municipal Pumps	100%				
Submersible Pumps*	100%		50%		25%
DAF Pumps	100 %	(6 months)			
Other pumps not listed	100%				
Parts	100%				
Warranty for Motors, Controls, and other accessories not manufactured by Cornell are provided by the manufacturer of those products.					

*Permanent Pump Installations

Proration periods are based on months after shipment (unless otherwise agreed upon).

Wear Parts: This limited warranty does not cover parts that by nature of their function require replacement as the result of normal wear and tear (seals, wear rings, wear plates, or other parts subjected to abrasion, cavitation, or corrosion) unless a defect in materials or workmanship can be determined by Cornell.

Effective Date: February 15, 2010

Supersedes All Previous Warranties

CAUTION/WARNING PAGE

START-UP INSTRUCTIONS – PAGE 3200-326

- CAUTION:** Single port impellers (food pumps) have threaded shafts. Improper rotation will cause failure.
- WARNING:** Never operate electric motors or pumps without protective cover, etc. Before disconnecting any electrical wiring, shut off the main switch, or serious personal injury may result.
- CAUTION:** If pumpage does not start immediately, no amount of additional pumping will solve the problem.
- WARNING:** Do not run pumps equipped with mechanical seal dry.
- CAUTION:** Do not exceed maximum recommended operating pressure for the pump. Consult factory as needed.
- WARNING:**

PRESSURE TESTING – PAGE 3200-353

- WARNING:** Failure to follow instructions on this may damage pump or cause serious personal injury.
- CAUTION:** Do not operate pump when at test pressure.
- CAUTION:** For mechanical seal only. Do not run dry.

IMPELLER LOCKSCREW INSTALLATION – PAGE 3200-14

- CAUTION:** Lockscrew failure can damage impeller and volute. Proper torque during installation is important.

BELT DRIVES/FLEXIBLE COUPLINGS – PAGE 3200-311

- CAUTION:** All rotating parts should be properly protected. Guards should be installed. Do not operate pumps when the guards are removed.

CHOPPER IMPELLER AND CUTTER-BAR INSTRUCTIONS – PAGE 3200-355

- WARNING:** Chopper impellers and cutter bars have VERY SHARP edges. DO NOT place body parts in suction spool, pump inlet, or clean-outs at any time. Wear protective gloves when working on chopper impellers, cutter bars, and associated components.

INSTRUCTIONS FOR MECHANICAL SEAL – PAGE 3200-632

- CAUTION:** Do not run pump dry unless pump is equipped with Run-Dry option.
- CAUTION:** Once the rotating portion has been placed on the shaft, the rest of the installation must be made at once.

DISMANTLING AND ASSEMBLING F18 AND EM18 CORNELL PUMP FRAMES – PAGE 3200-821

CAUTION: Never hammer the shaft or parts attached to the shaft or you will ruin both the shaft and the bearings.

DISMANTLING AND ASSEMBLING F18DB, EM18DB, AND F18DBK – PAGE 3200-826

CAUTION: Never hammer the shaft or parts attached to the shaft or you will ruin both the shaft and the bearings.

DISMANTLE AND REASSEMBLE A CORNELL PUMP WITH THREADED SHAFT – PAGE 3200-417

CAUTION: If the sleeve has an “O” ring it should not be heated.

DISMANTLING AND ASSEMBLING EM5/F5 AND EM5K/F5K CORNELL FRAME PUMPS – PAGE 3200-459

CAUTION: Never hammer the shaft or parts attached to the shaft or you will ruin both the shaft and the bearings.

DISMANTLING AND ASSEMBLING F16 AND F16K CORNELL FRAME PUMPS – PAGE 3200-810

CAUTION: Never hammer the shaft or parts attached to the shaft or you will ruin both the shaft and the bearings.

MOUNTING PUMPS TO ENGINES – PAGE 3200-12

CAUTION: All engine driven pumps must be supported and alignment must be assured before bolting frame to engine flywheel housing.

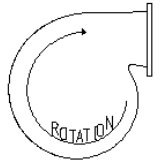
OPERATION OF COMPRESSORS LOCATED IN CLOSE PROXIMITY TO PUMP

WARNING: Do not allow compressed air to pressurize the pump or vent-off compressed air through the pump as this may damage pump or cause serious personal injury.

Startup Checklist

BEFORE THE STARTUP OF ANY PUMP, A CAREFUL CHECK MUST BE MADE TO ENSURE THAT ALL IS IN ORDER

1. Reread all instructions and check for compliance on each point.
2. Make sure:
 - a. All fasteners at gasketed surfaces are properly tightened.
 - b. Belts and couplings (shaft) are properly adjusted, aligned, and guards are in place.
 - c. All thrust blocks and supports are adequate.
 - d. The pump and/or baseplate is bolted securely to a solid foundation. There must be no piping loads on the pump casing, support suction or discharge piping, and piping must be clean and free of debris and obstruction, gaskets in place and all joints secure.
 - e. That all electrical connections and electrical equipment are installed by a qualified and licensed electrical contractor.
 - f. The pump rotates freely by hand. Then check the pump rotational direction with very short on/off power pulses on the starter switch.
 - g. Pumps with cutting mechanism or axial adjusted wear plates should be checked for proper axial clearances. This includes MP and SP slurry pumps, cutter pumps, ST self-primers, and chopper pumps product lines. See section in manual pertaining to wear plate or cutter adjustment for proper clearance for adjustment and procedure.
 - h. Pumps with mechanical seal must not run dry unless equipped with the run-dry feature.



CAUTION

Some pumps are equipped with threaded shafts (Food pumps, etc.). Improper rotation will cause failure and costly repairs. If you are unsure if your pump has a threaded shaft, contact factory.

Pumps with mechanical seal must not run dry unless equipped with run-dry option.

3. Check the valves for proper position. If the system has a discharge gate valve, start with valve closed. The speed of opening depends upon the size and length of your discharge pipe and capacity of the pump. The valve should not be more than .25" open until the line is filled. The purpose of this procedure is to reduce the possibility of a water hammer or shock if filling is too rapid.
4. **For Stuffing Box with Packing**

When first starting the pump, there should be a leakage. If the packing is too loose, air will suck in around the packing and the pump will not prime. After the pump is primed, back off on packing gland nuts to free leakage. Several minutes later, gradually and evenly tighten packing gland nuts until leakage is reduced to a trickle. Do not attempt to shut off all the leakage.

For Stuffing Box with Mechanical Seal

Read and comply with all seal instructions within manual. During shipment a seal may be jolted, which could cause leakage. However, any leak should stop after a brief period of operation.

5. **Instructions For Pumps with Balance Line and Wear Rings**

Wear rings and balance lines are vital for a successful pump operation. They perform two important functions. First, they reduce the pressure at the stuffing box. Second, they reduce axial thrust loads. Wear rings should be replaced if the clearance has increased to about .03" per side. Balance lines should be kept free of obstructions and they should be replaced if they are pinched, bent, or corroded.

6. **Motors**

Check the power supply voltage, amperage, temperature and RPM with the motor nameplate. Review item 2F with respect to rotation.

NOTE: Large motors must not be started and stopped more than five times per hour.

CAUTION

Whether placed inside or outside, the motor should be mounted on a base four to six inches higher than surrounding floor level.

7. **Cornell Bearing Frames**

In general, the considerations for a bearing frame are the same for that of electric motors.

NOTE: If a frame is oil lubed (denoted by 'K' on serial number plate and sight gauge on the side of the frame), put appropriate oil in per lubrication instructions. Make sure support systems are in place and working such as special lubricants, seal water, etc.

If the pump is used in winter, provisions must be made for protection of the pump and piping from freezing. Add a heater if necessary. If the pump is not used in the winter, the volute should be drained to prevent damage.

WARNING

Never operate electric motors or pump equipment without all protective covers, screens and guards properly in place. Before disconnecting any electrical wiring, shut off the main switch and lock it out.

8. Check to make sure the screens are in place. A screen or strainer should have a free opening at least three times the area of the suction pipe.

9. Bump start the driver and check for proper rotation. Improper rotation can be harmful to persons and equipment.

10. Start the driver. If pump is primed or filled with liquid, the pumping will start immediately.

Cornell Centrifugal Pump Priming

A centrifugal pump is primed when all the internal passages of the pump are filled with the liquid to be pumped. Do not operate any pump without being properly primed unless it has been specifically designed for such operation.

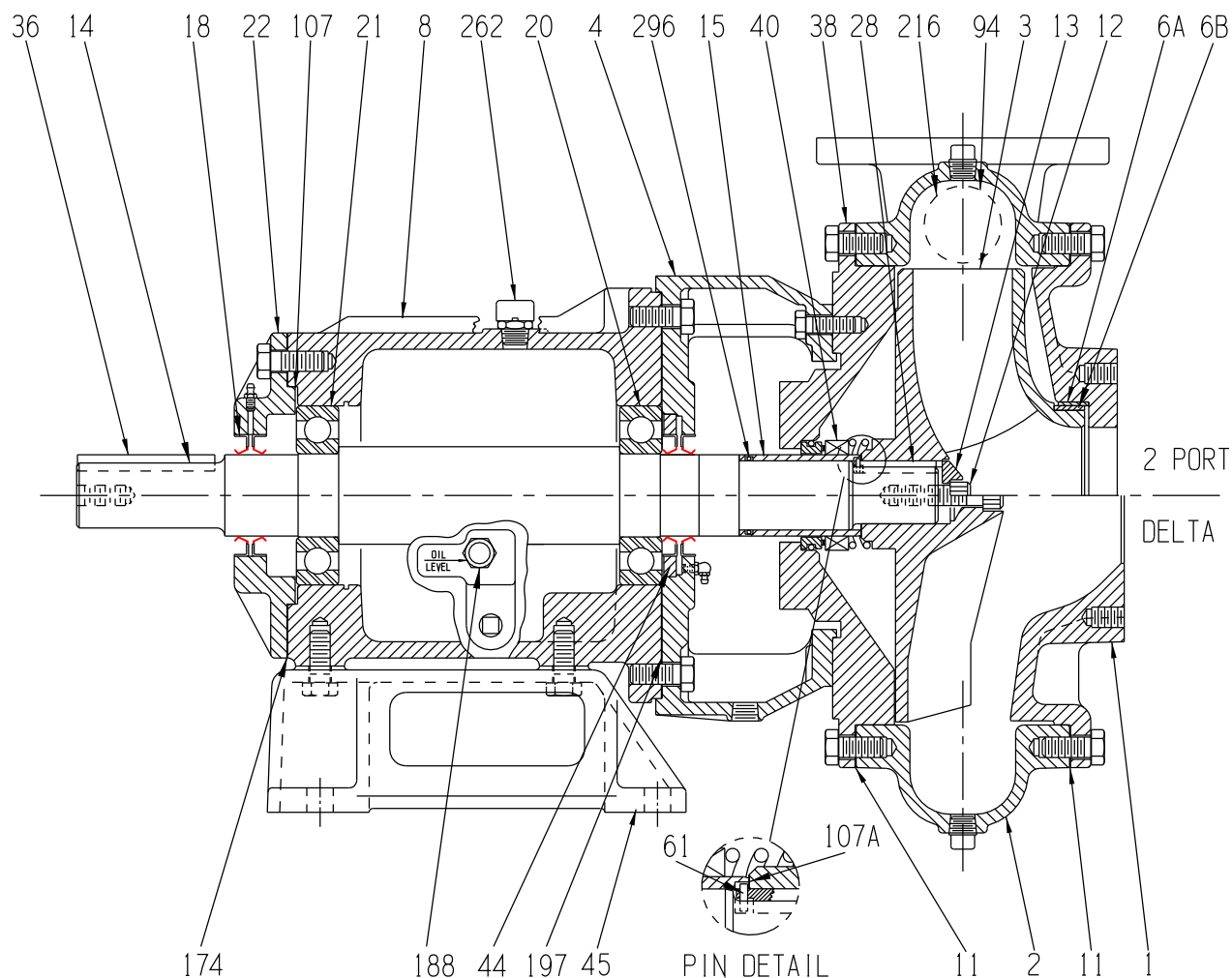
When the pump is primed and the unit is started, the pumpage will start to flow immediately. If it does not, recheck the system for complete prime and possible air leaks. Correct the deficiencies and restart.

CAUTION

If the pumpage does not start immediately, no amount of additional pumping will solve the problem.

WARNING

Do not allow compressed air to pressurize the pump or vent-off compressed air through the pump as this may damage pump or cause serious personal injury.



PARTS LIST

- 1. SUCTION COVER
- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 6A. VOLUTE WEAR RING
- 6B. IMPELLER WEAR RING (OPTIONAL)
- 8. FRAME
- 11. VOLUTE GASKET
- 12. IMPELLER LOCK SCREW
- 13. IMPELLER WASHER
- 14. SHAFT
- 15. SHAFT SLEEVE
- 18. LIP SEALS(4 FOR OIL, 2 FOR GREASE)
- 20. PUMP END BEARING
- 21. DRIVE END BEARING
- 22. BEARING COVER
- 28. IMPELLER KEY
- 36. DRIVE END SHAFT KEY
- 38. BACKPLATE
- 40. MECHANICAL SEAL
- △ 44. BRACKET INSERT RING
- 45. MOUNTING FOOT
- 61. LOCK PIN
- 94. VOLUTE CLEANOUT COVER
- 107. SHIMS
- 107A. IMPELLER SHIMS
- △ 174. BEARING COVER GASKET
- △ 188. OIL LEVEL SIGHT GAUGE
- △ 197. PUMP BRACKET GASKET
- 216. VOLUTE CLEANOUT COVER GASKET
- 262. BREATHER
- 296. O-RING (SLEEVE)

OIL LUBRICATED SHOWN

△ USED ON OIL LUBE FRAMES ONLY

✓ RECOMMENDED SPARES

A17768



CORNELL PUMP COMPANY

16261 SE 130TH. AVE. CLACKAMAS, OR., 97015

SOLIDS HANDLING MODELS W/REVERSIBLE VOLUTE
F16/F16K HORIZONTAL FRAME W/CYCLOSEAL

INSTRUCTIONS

ALIGNMENT OF FLEXIBLE COUPLINGS AND BELT DRIVES

It is not commercially feasible to furnish bed plates which, when placed on an uneven foundation, will not spring and cause misalignment. It is, therefore, necessary to support them on foundations that can furnish the required rigidity.

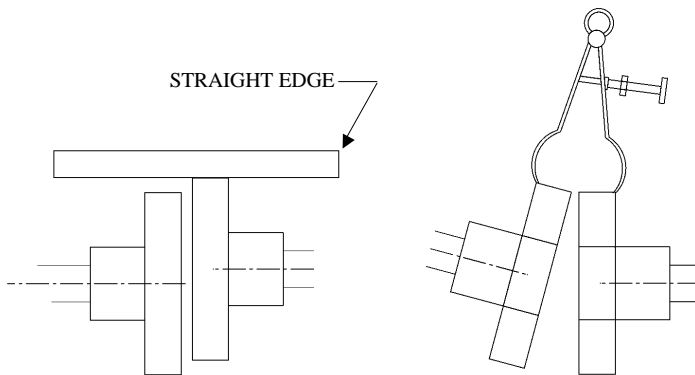
Misalignment causes whipping of the shaft, adds thrust to bearings, leads to excessive maintenance and potential failure of equipment. It is imperative that alignment be carefully checked prior to placing pump in operation. This is done after securing to bed plate or foundation and making pipe connections.

Flexible couplings must permit some lateral floating of the shaft to take care of thermal expansion and so move without excessive thrust on bearings.

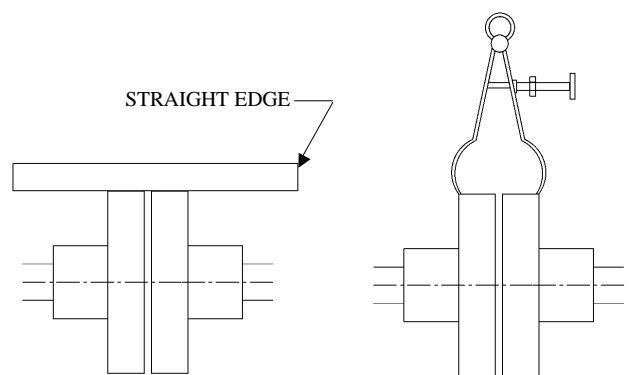
Numerous types of flexible couplings are available. Some are easier to align than others, but all serve the purpose of connecting two shafts capable of transmitting torque while allowing for minor misalignment (angular, parallel or a combination).

DO NOT assume the word flexible means the couplings are designed for misalignment. Couplings can be lined up by use of a straight edge, inside caliper, thickness gauge or outside caliper. The two ends of the couplings must be concentric and the sides parallel with no angular misalignment.

INCORRECT ALIGNMENT



CORRECT ALIGNMENT



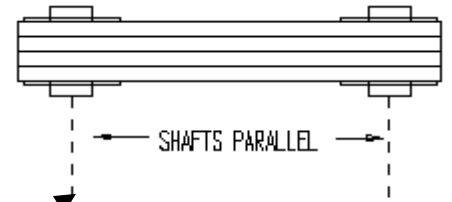
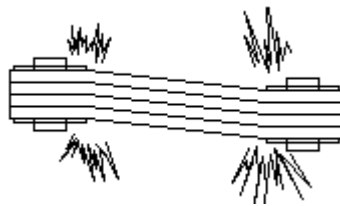
WARNING

All rotating parts should be properly protected. Guards should be installed to prevent the operator from coming in contact with shafts, drives, or other rotating elements. Do not operate pumps when the guards are removed or serious personal injury may result.

INSTRUCTIONS BELT DRIVES

1. Use a matched set of V-Belts.
2. Clean oil and grease from sheaves.
Remove rust and burrs.
3. Slack off on take-up until belts can be placed in grooves without forcing.
4. Tighten the take-up until the belts are snug.
5. Align sheave grooves like this - - - - -

NOT THIS - -



6. Align shafts like this - - - - -

NOT THIS - -



7. Run drive at full speed and adjust take-up until only slight bow appears in slack side of belts. Vertical drives, drives with extremely short centers, and drives carrying pulsating loads must be operated tighter than others.

Never use belt dressing.

8. Give belts a few days running time to become seated in sheave grooves, then readjust take-up.
9. Store belts in clean, cool, dark place.

WARNING

All rotating parts should be properly protected. Guards should be installed to prevent the operator from coming in contact with shafts, drives, or other rotating elements. Do not operate pumps when the guards are removed.

Pressure Testing

CAUTION: DO NOT OPERATE PUMP WHEN AT TEST PRESSURE

WARNING: Failure to follow instructions may damage pump and/or result in serious personal injury.

MAXIMUM TEST PRESSURE

Maximum test pressure should not exceed 125% of shutoff pressure or 150% of design pressure, whichever is greater. Refer to Cornell Catalog for operating pressure limits of your pump. If your calculated test pressure is above these limits, consult factory prior to proceeding.

TEST FLUID

Liquid may be pumpage or water or any liquid compatible with pump materials.

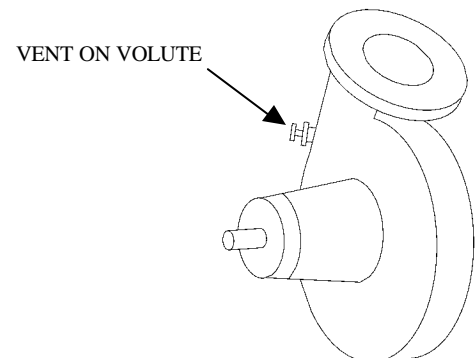
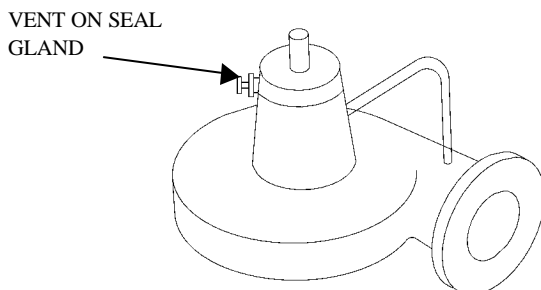
For pumps equipped with packing: **WARNING: Do not use compressed air to pressure test pump.**

- Fill pump gradually with liquid by gravity flow (10 PSI max. pressure).
- Vent air from volute and close vent valve.
- Raise pressure gradually to required test pressure. See "Maximum Test Pressure."
- Allow packing to leak freely (special protection of motor may be necessary).
- If packing is tightened to reduce leakage, lubricant may be squeezed out of packing. Loss of packing lubricant may require replacement of the packing.

FOR PUMPS EQUIPPED WITH SINGLE SEAL:

CAUTION: DO NOT RUN SEAL DRY – SEE SEAL INSTRUCTIONS

- Open vent valves on volute or seal gland if shaft vertical (the seal gland in a horizontal pump will not have a vent valve).
- Fill pump gradually with liquid by gravity flow (10 PSI max. pressure).
- Vent air from volute and close vent valve.
- Vent air from seal gland (If shaft vertical) and close vent valve.
- Raise pressure gradually to required test pressure. See "Maximum Test Pressure."



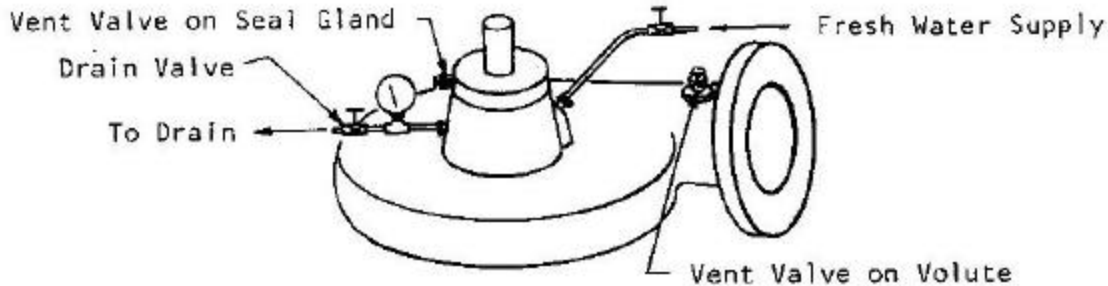
PRESSURE TESTING

CAUTION: DO NOT OPERATE PUMP WHEN AT TEST PRESSURE

FOR PUMPS EQUIPPED WITH DOUBLE SEAL, OUTSIDE SEAL WATER SUPPLY.

CAUTION: DO NOT RUN SEAL DRY – SEE SEAL INSTRUCTIONS

- A. Turn on supply water to seal chamber, close drain valve.

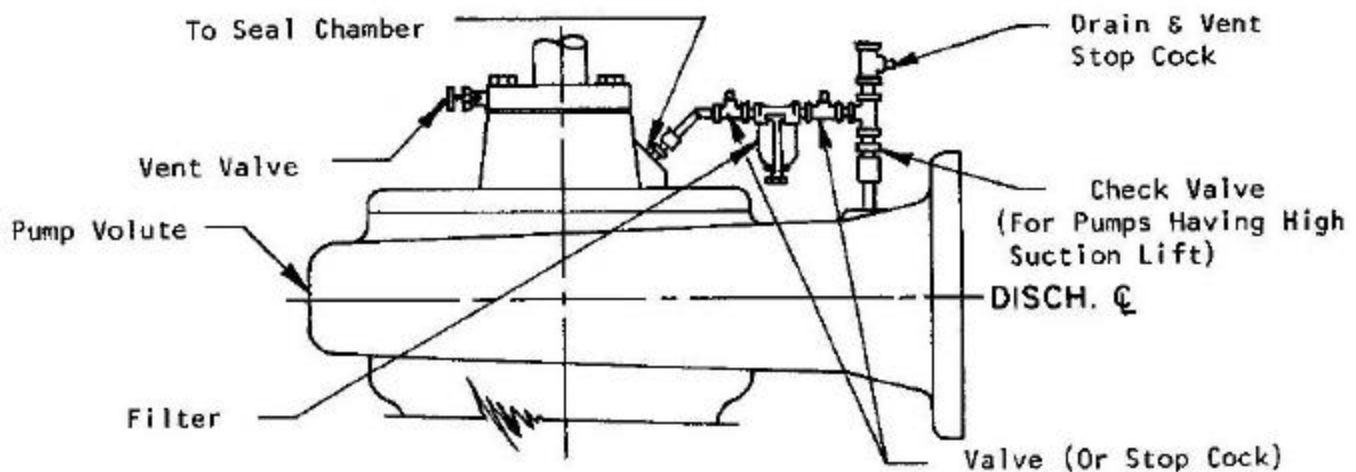


- B. Open vent valve in seal gland and vent off air.
C. Close vent valve.
D. Raise pressure of supply water to pressure at which hydrostatic testing will be done. If water supply cannot be raised to required test pressure, close valve in supply line to trap all seal water in seal chamber.
E. Fill pump gradually with liquid by gravity flow (10 PSI max. pressure).
F. Vent air from volute and close vent valve.
G. Raise pressure gradually to required test pressure. See "Maximum Test Pressure."

For pumps equipped with double seal, pumpage lubricated (from line containing filter from volute to seal chamber).

CAUTION: DO NOT RUN SEAL DRY – SEE SEAL INSTRUCTIONS

- A. Open vent valve in seal gland and volute. (Horizontal pump has vent valve on volute only).
B. Open valves in line from volute to seal chamber on each side of filter.



- C. Fill pump gradually with liquid by gravity flow (10 PSI max. pressure).
D. Vent air from volute and close vent valve.
E. When liquid without bubble is flowing steadily from the vent valve on the seal gland, close vent valve.
F. If filter has glass or plastic bowl and test pressure is over 50 PSI, close valves on both sides of filter.
G. Raise pressure gradually to required test pressure. See "Maximum Test Pressure."

How to Dismantle and Reassemble a Cornell Back Pullout Pump w/Keyed Shaft (packing and seal)

Some parts mentioned in these instructions may not apply to your pump. Refer to your specific part's page for part names.

Dismantling

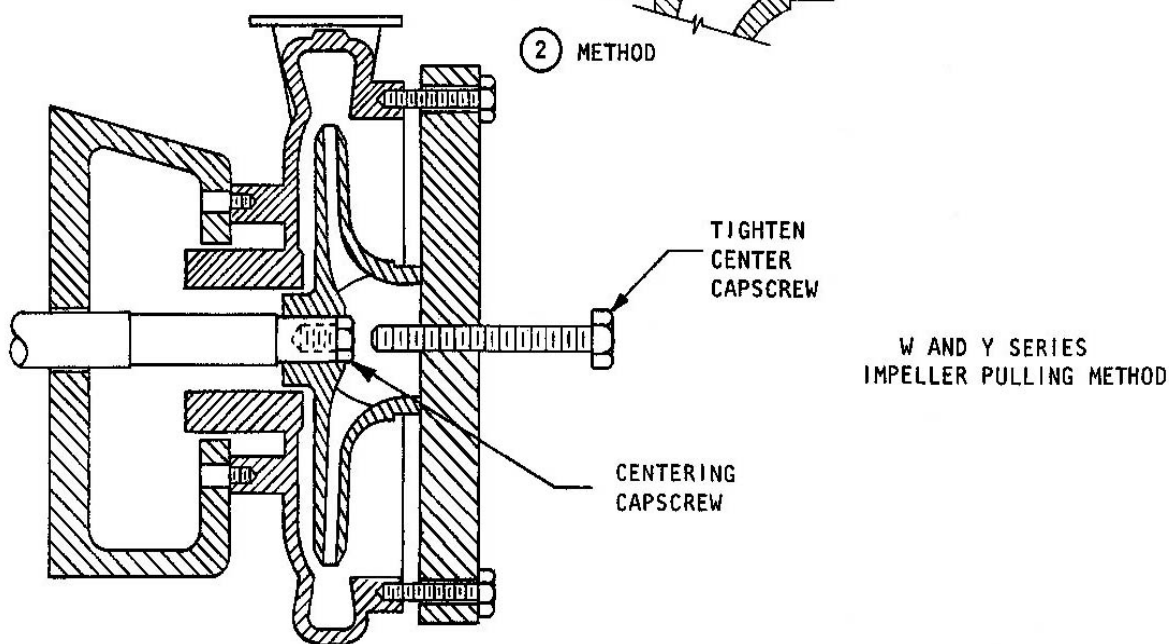
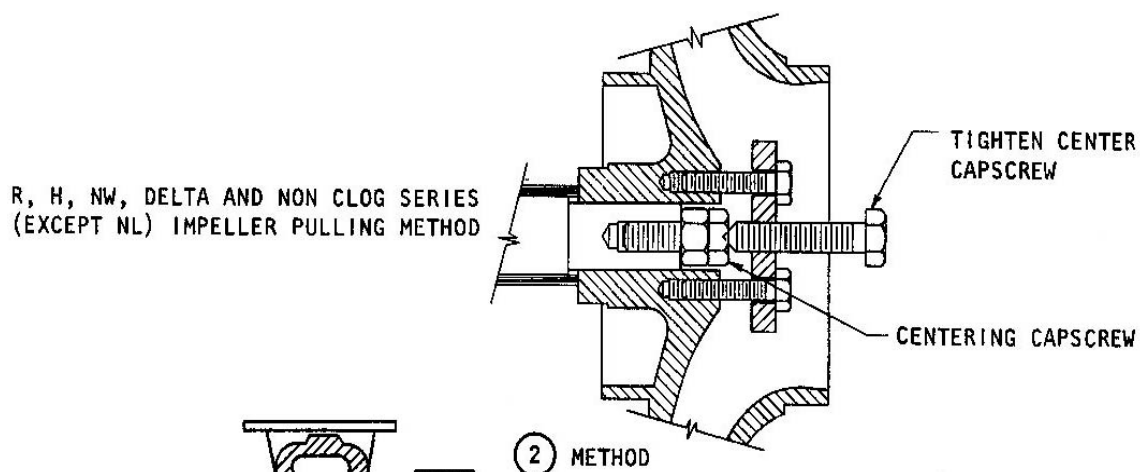
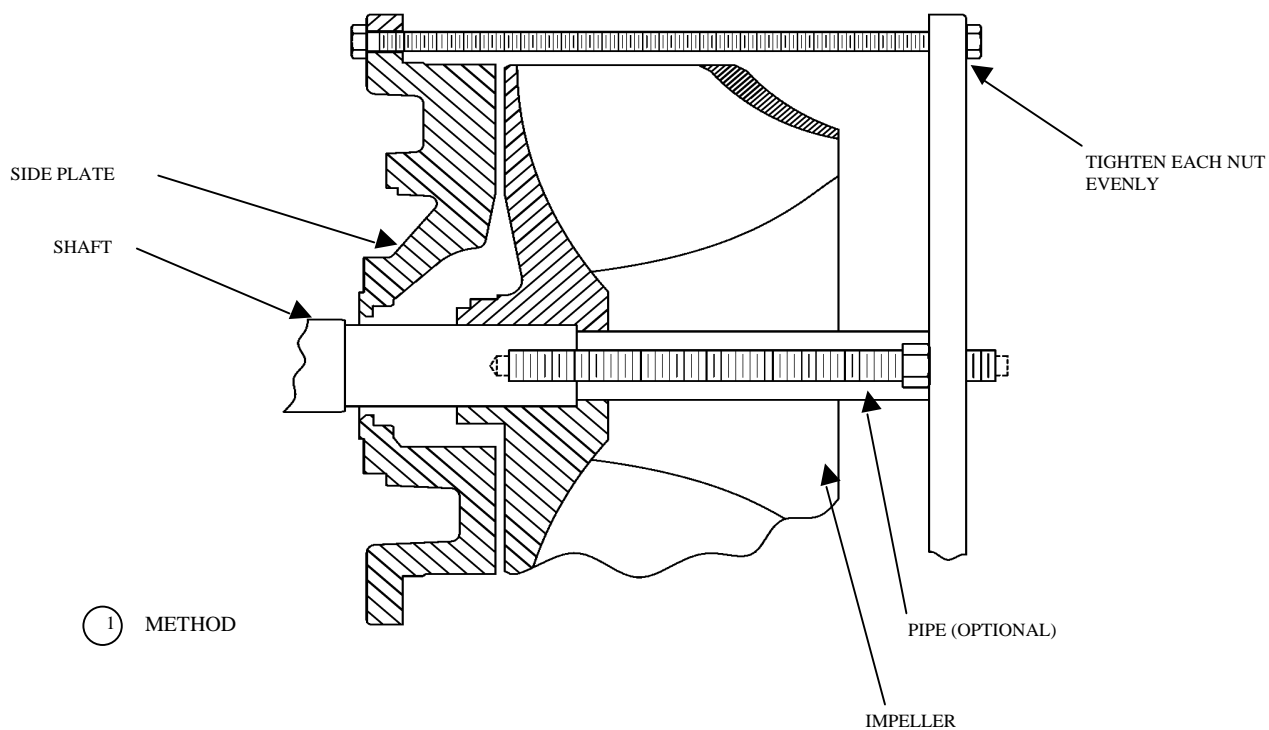
1. Remove balance line (47) if applicable.
2. Remove all capscrews from volute (2). Insert two of these screws into tapped holes in backplate (38). Tighten screws to jack the volute free from the backplate exposing the impeller (3). Remove volute. Make sure volute doesn't fall onto impeller.
3. Remove impeller lockscrew (12) by breaker bar not by impact wrench. Make sure to apply steady and even torque to break lockscrew loose. Allen head tooling to remove lockscrew should be in excellent condition. Discard lockscrew, under emergency conditions this may not be possible. New lockscrew should be used when possible. Remove the impeller washer (13).
4. If pump has a mechanical seal (40), remove any flush lines to seal gland (5A). Remove gland cap screws evenly until capscrews are free of backplate. If pump has packing (10), loosen gland nuts (32).
5. Space wedges in pairs 180° apart between impeller and backplate. Be sure wedges are placed along impeller vanes. Tap opposed wedges at the same time to force off the impeller. See page 3200-401 for alternate method. Use extreme care to avoid damage to impeller, shaft and bearings. Completely remove impeller and impeller key.
6. Unbolt and remove backplate from bracket (4). Remove mechanical seal (40) (see instructions).
7. Remove sleeve (15) only, if necessary. Install sleeve puller over outside diameter of sleeve and lock puller to sleeve with set screws (see sleeve puller on page 3200-401). Remove puller and sleeve with standard gear puller. If parts page shows an O-ring (296) in sleeve, sleeve can be pulled off by hand.
8. The suction wear ring (6) can be removed by drilling the ring longitudinally in three places to relieve compression and collapsing the three sections together. Use care not to drill into the volute casting. Better control is obtained if small pilot holes are first drilled and then enlarged to "cut" the ring. This same technique is used to remove the hub wear ring (7).

Reassemble

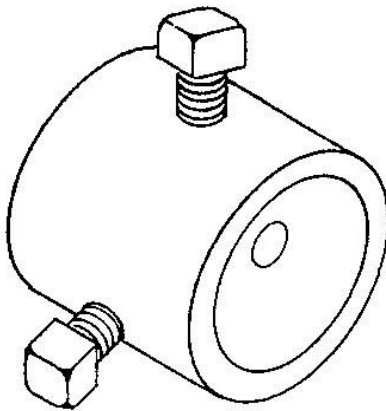
1. To replace sleeve (15): heat new sleeve very uniformly to about 400° for about 10 minutes. Slide it on the shaft quickly. However, if sleeve has on O-ring, it should not be heated. NOTE: remove burrs on shaft around keyway before replacing sleeve.
2. Pump with mechanical seal (40): each seal has its own particular assembly procedures. Read instructions for the particular seal type before proceeding, or damage to seal parts will result. Where applicable, follow instructions for mechanical seal.
 - 2a. Pump with packing (10): to repack stuffing box, remove the gland (5) and pull out the old packing. Insert an extra sleeve in the stuffing box to insure proper alignment of new packing (10) which is then slipped into the stuffing box ring by ring. Stagger the splits in the packing rings 120°. To insure proper pressure on each ring, push all the way down and tap lightly.
3. Replace backplate (38).

4. Use new gaskets (11). For emergency use, old gaskets should be moist and flat.
5. Replace impeller key (28) and impeller (3). (For solids handling pumps, install impeller shims to maintain .030" minimum clearance between backplate and impeller backvanes.) Use long capscrew and several washers to press on impeller (per page 3200-401). Do not use impeller lockscrew. The threads must be long enough to enter the shaft approximately eight threads or turns by hand. This is necessary to protect the threads in the shaft.
6. After replacing impeller, remove long capscrew and replace with proper impeller lockscrew with impeller washer. The impeller lockscrew should always be new. See Impeller Lockscrew Instruction page for Loctite requirements and torque requirement.
7. Replace volute, sliding it carefully over register. Bolt volute to backplate.
8. For seals, bring the gland and gasket against the face at the seal chamber and tighten the bolts evenly. For packing, replace the packing gland.
9. Reconnect any lines that may have been removed (balance, flush, etc.).

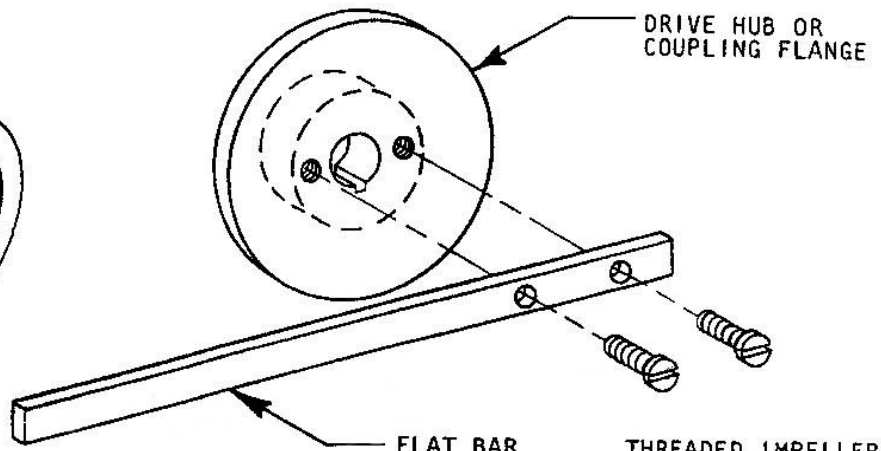
DISMANTLING METHODS



DISMANTLING METHODS



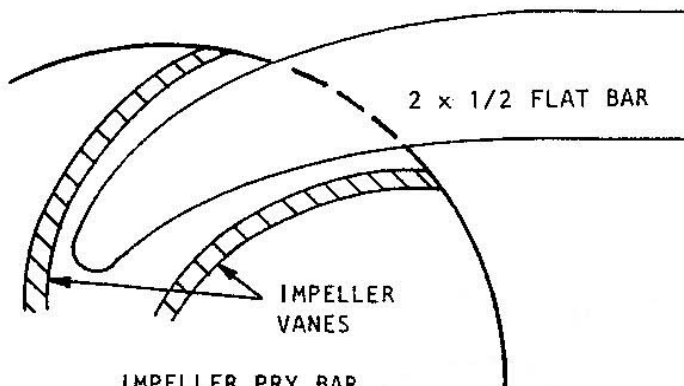
SLEEVE PULLER



DRIVE HUB OR
COUPLING FLANGE

FLAT BAR

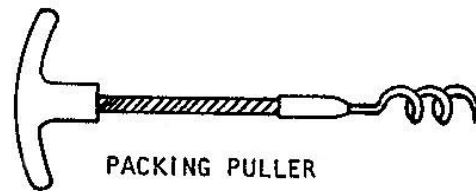
THREADED IMPELLER
PULLING METHOD



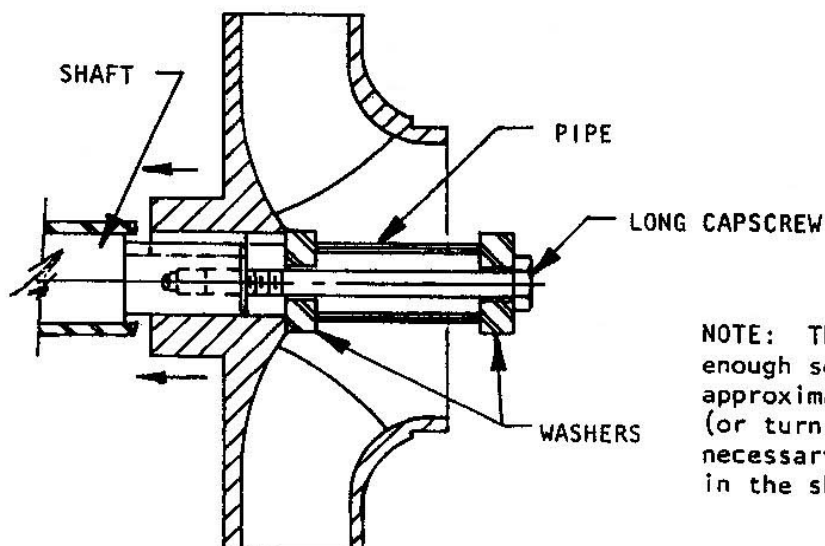
2 x 1/2 FLAT BAR

IMPELLER
VANES

IMPELLER PRY BAR
FOR THREADED IMPELLERS



PACKING PULLER



SHAFT

PIPE

LONG CAPSCREW

WASHERS

INSTALLING IMPELLER METHOD

NOTE: The capscREW must be long enough so it will enter the shaft approximately eight (8) threads (or turns) by hand. This is necessary to protect the threads in the shaft.

Impeller Lockscrew Installation

Impeller lockscrews are always right hand socket head capscrews. Stainless steel lockscrews are supplied with Loctite 262, which should be applied to lockscrew thread and shaft thread prior to installation.

Torque for Impeller Lockscrews

First determine size and material of lockscrew, then torque to the appropriate value listed in the table below.

<u>Size</u>	<u>Stainless Steel Lockscrew Nonmagnetic (302, 303, 304, 316 Series)</u>
.38 – 16UNC	20 Ft-lb
.50 – 13UNC	40 Ft-lb
.62 – 11UNC	90 Ft-lb
.75 – 10UNC	135 Ft-lb
1.00 – 8UNC	265 Ft-lb
1.12 – 7UNC	360 Ft-lb
1.25 – 7UNC	510 Ft-lb
1.50 – 6UNC	875 Ft-lb

Lubrication

Do not lubricate impeller lockscrew or tapped hole or between the lockscrew and the impeller washer or between the impeller washer and the impeller. Make sure parts are clean and dry; however, it is not necessary to remove the protective coating from the screw. Lubricated bolts can be overstressed with the torques indicated.

DO NOT USE LOCKSCREW TO INSTALL THE IMPELLER

CAUTION

Lockscrew failure can damage impeller and volute.

The impeller screw must be of the best material, properly forged and machined to rigid specifications not available from local suppliers.

Buy only lockscrews available from Cornell to be sure of quality.

Impeller Lockscrew Removal

1. Break loose impeller lockscrew with breaker bar. **CAUTION:** Care should be taken when removing lockscrew to prevent damaging screw head.
2. If breaker bar will not loosen impeller lockscrew, apply heat to the lockscrew for 2-4 minutes. Do not exceed 400° F. **CAUTION:** Care should be taken when applying heat so as not to receive serious burns.
3. Allow lockscrew to cool and remove with breaker bar.

Dismantling and Assembling Cornell Frames F16 and EM16 Grease Lubed and F16K Oil Lubed

Oil lubricated frames are denoted by a “K” on the serial plate and an oil level sight gauge on the side of the frame.

Dismantling (refer to parts page for names and locations of parts)

1. Remove the deflectors from the shaft.
2. Remove the drive end shaft key.
3. Remove the capscrews from the bearing cover or drive end bracket.

Note: Oil lubricated frames have double lip seals at the drive and pump ends. Grease lubricated frames have a single lip seal at the drive and pump ends. If the lip seals are to be saved, the shaft should be cleared of burrs or sharp protrusions which would cut the seal. If the seals are removed or replaced, see parts page for orientation of the lips. Paired seals have a grease passageway between them and are arranged so that the grease will move through the inner and outer seal.

Slide the bearing cover or drive end bracket off the shaft. Remove the capscrews from the pump bracket. Slide the pump bracket off the shaft.

4. The shaft and bearings can now be removed by pressing on the drive end of the shaft.
5. Remove the bearings from the shaft with a bearing puller. If the bearings are to be saved, keep them absolutely clean. If contaminated, wash only in clean fluid.

CAUTION: Never hammer the shaft or parts attached to the shaft or you will ruin both the shaft and the bearings.

Assembling

1. Press the drive end and pump end bearings onto the shaft. Pressure should be applied to the inner race.
2. Press the shaft into the frame through the drive end until the pump end bearing is approximately flush with the pump end of the frame.
3. Install the pump end lip seal(s) into the bracket as shown on the parts page. Slide the pump bracket (with gasket for oil lubed frames) over the shaft, taking care not to damage or fold the lip seal(s). Install and tighten the capscrews.
4. Install the lip seal(s) in the bearing cover or drive end bracket as shown on the parts page. Reinstall the shims in the drive end of the frame (if present when disassembled). If new shaft, bearings, frame, bearing cover or drive end bracket are being installed, insert shims to maintain 0.007” to 0.012” shaft end play. Slide the bearing cover (with gasket for oil lubed frames) or drive end bracket over the shaft. Install and tighten the capscrews.
5. Install the deflector and lubricate per section 3200-901 for grease lubed frames, or section 3200-902 for oil lubed frames.

CUTTER MODIFICATION KIT

REMOVAL, ASSEMBLY, AND ADJUSTMENT INSTRUCTIONS

WARNING

Rotating cutter ring, stationary cutter plate, and rotating assembly have VERY SHARP edges. DO NOT place body parts in pump inlet or clean-outs at any time. Wear protective gloves when working on assembly.

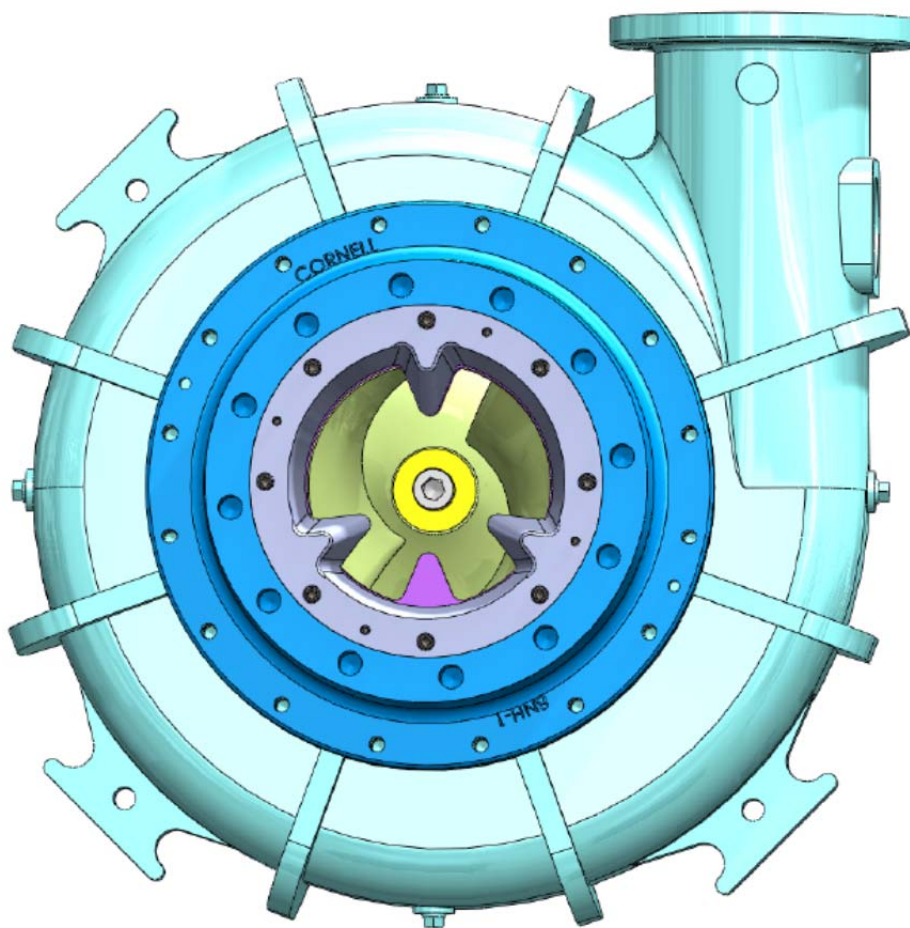


Figure 1. Cutter Modification Kit Assembly

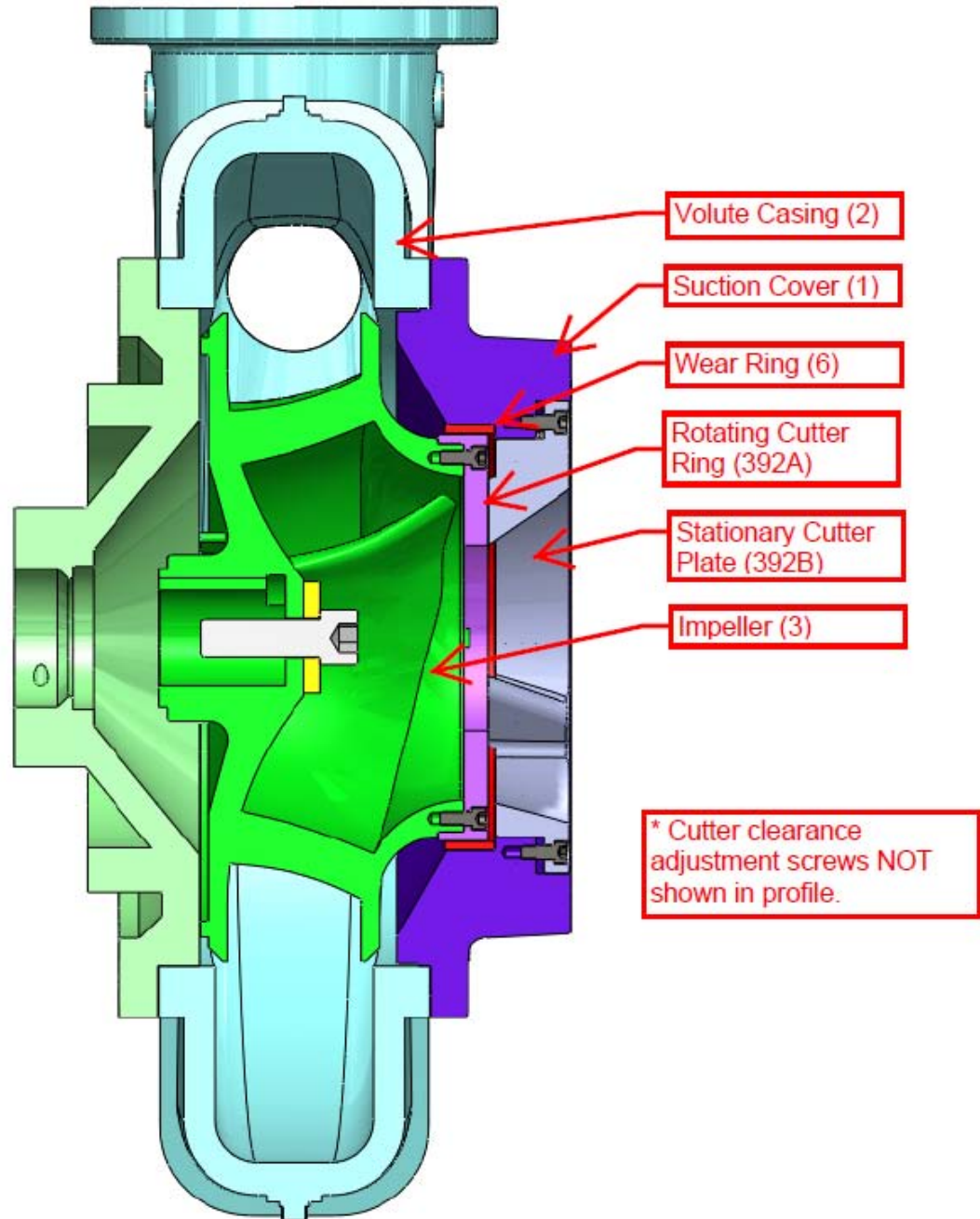


Figure 2. Cutter Modification Kit Profile

Dismantling:

Isolate and lockout all power to the pump and motor. Disconnect external connections (inlet piping, discharge piping, coupling alignment, frame-baseplate bolts/shims). Disconnect pump from volute casing and suction cover thus exposing the rotating element impeller (3) and cutter ring (392A) *Figure 2*. Remove all cap screws from rotating cutter ring (392A) *Figure 3*. Use pry bars if necessary to completely remove ring. Inspect and replace as necessary.

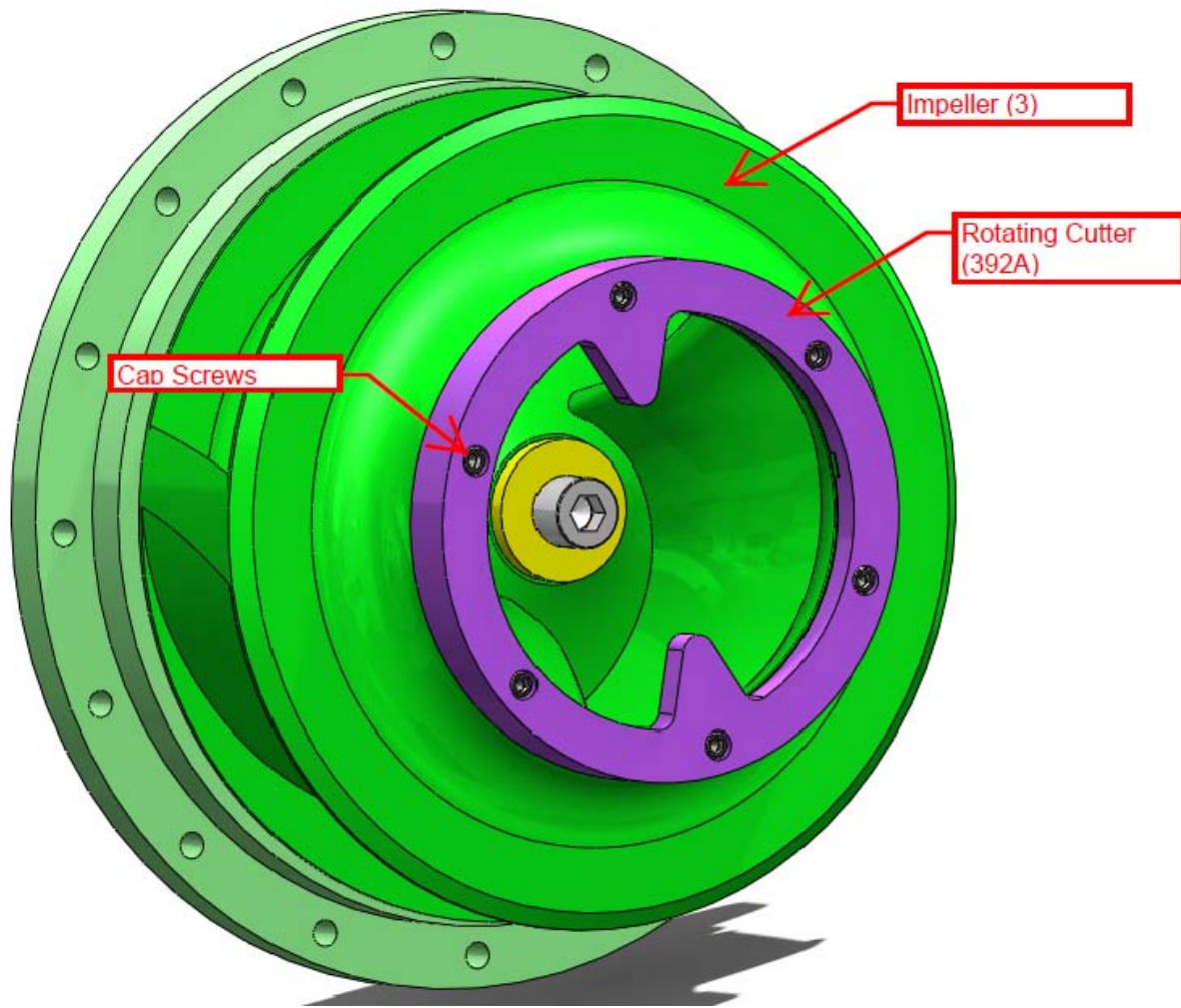


Figure 3. Rotating Cutter Ring and Impeller Subassembly

To remove the stationary cutter plate (392B) on suction inlet, loosen adjustment set screws and remove all cap screws *Figure 4*. Use pry bars if necessary to removing plate from assembly. Inspect and replace as necessary.

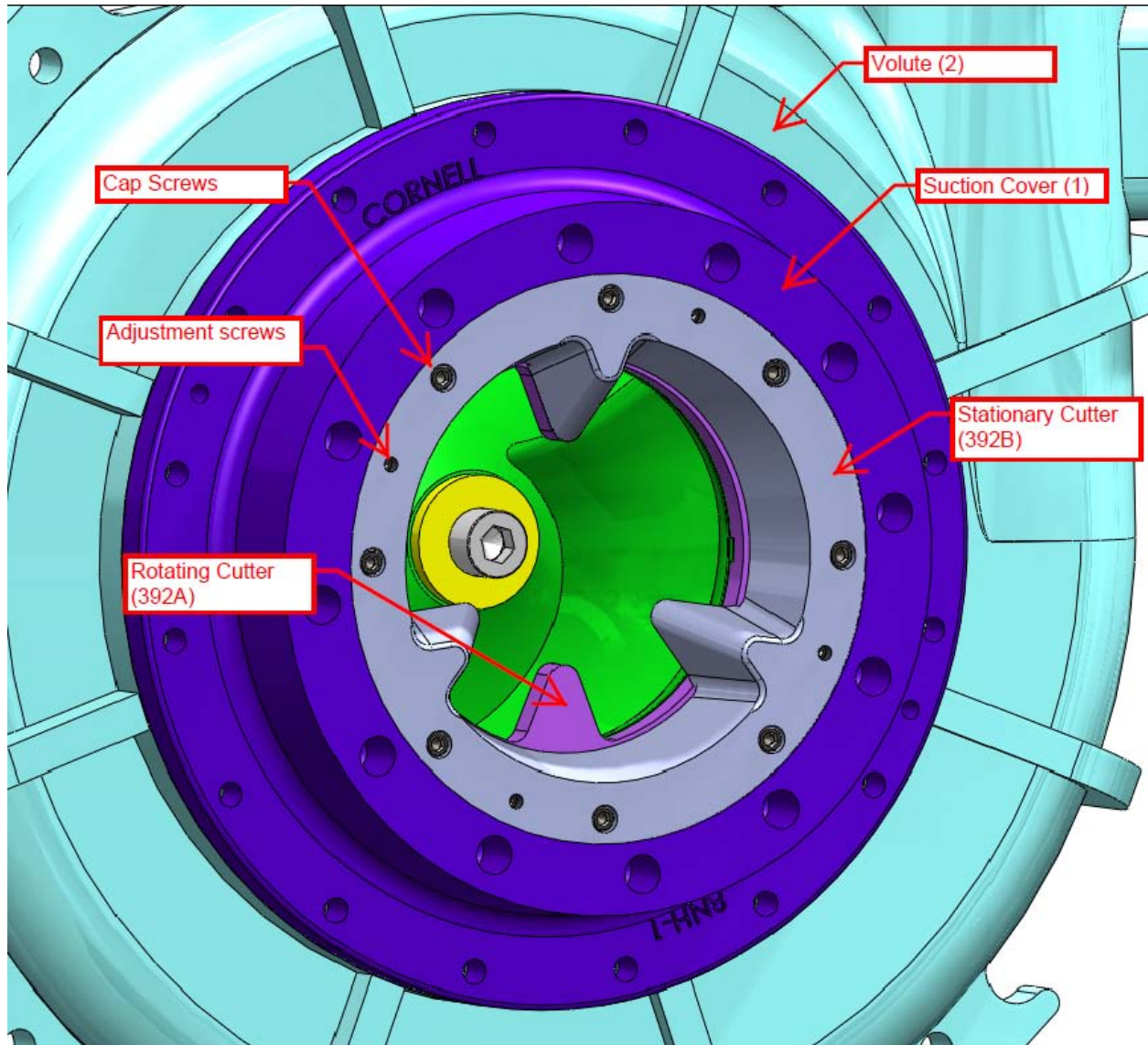


Figure 4. Stationary Cutter Plate and Suction Inlet

Assembly:

Register Rotating Cutter Ring on Impeller *Figure 5*. Use keyways as a guide. Bolt together using cap screws as shown in *Figure 5*. Double-check backvane clearances on assembly. (Backvane to backplate clearance should be approximately .030" *Figure 8*)

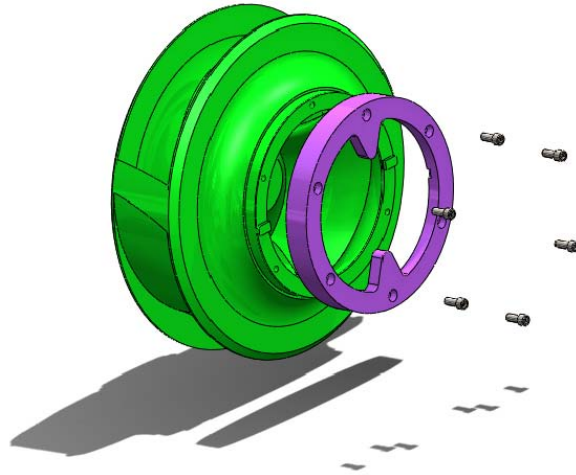


Figure 5. Register and Bolt Rotating Cutter Ring to Impeller

Install volute (2) and suction cover (1) (if applicable) on rotating assembly *Figure 6*.

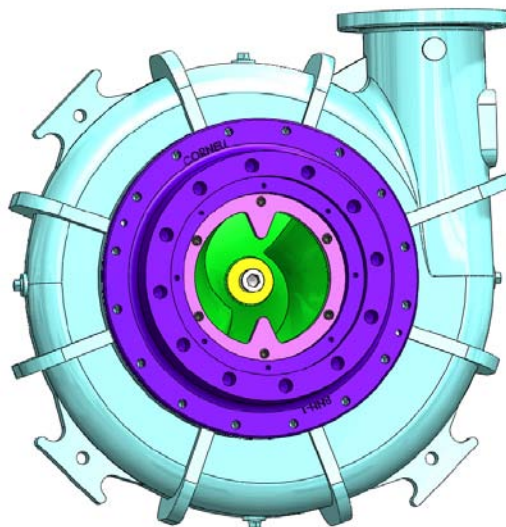


Figure 6. Installed Rotating Subassembly on Volute and Suction Cover

Register stationary cutter plate (392B) to volute casing (2) and suction cover (1) (if applicable) till the stationary cutter plate bottoms out on rotating cutter ring (392A) *Figure 7*. Evenly adjust set screws to a .010" to .020" clearance (Each 1/4 turn of set screw is approximately .010" of adjustment) *Figure 8*. Initially start with a quarter turn of each set screw and then check clearances. Loosely tighten stationary cutter plate to volute and/or suction cover with cap screws. Evenly torque cap screws to recommended 20ft-lb. Re-check cutter clearance and adjust set screws and cap screws as necessary to achieve clearances. Check for rubbing of assembly by rotating the pump. Re-do clearances if rubbing occurs. The set clearances may need to be increased if this occurs.

WARNING

Stationary cutter plate should NOT protrude above the volute casing or suction cover. Do NOT reassemble if this condition exists. Pump will not seal.

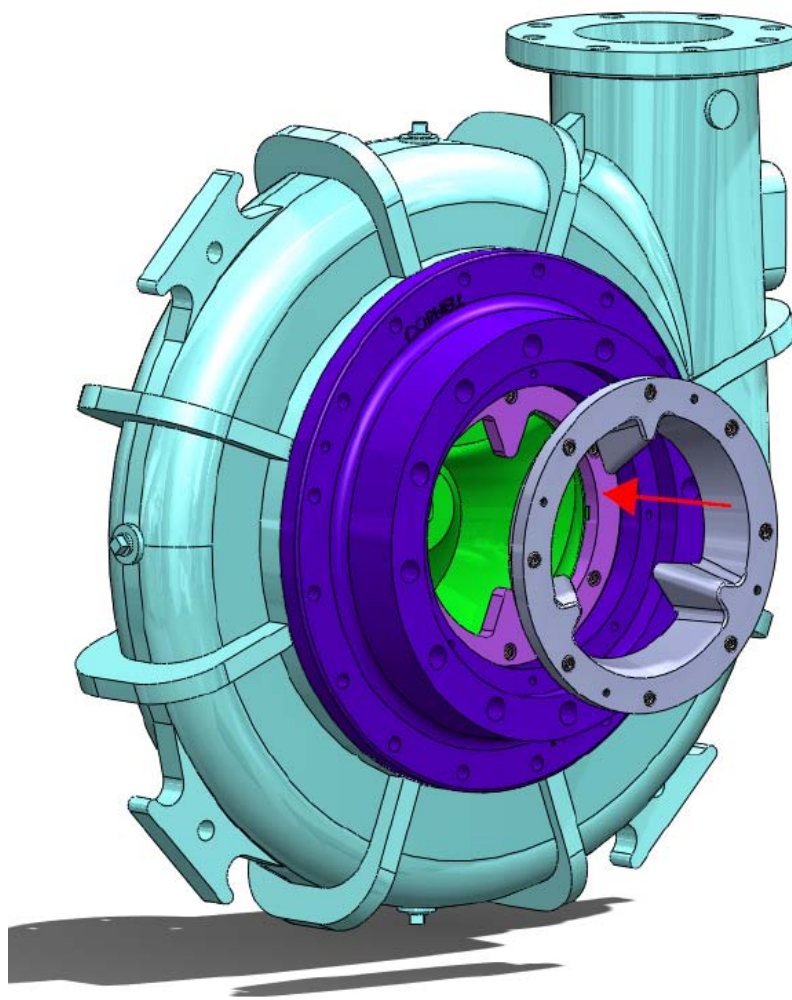


Figure 7. Registering Stationary Cutter Plate to Pump Assembly

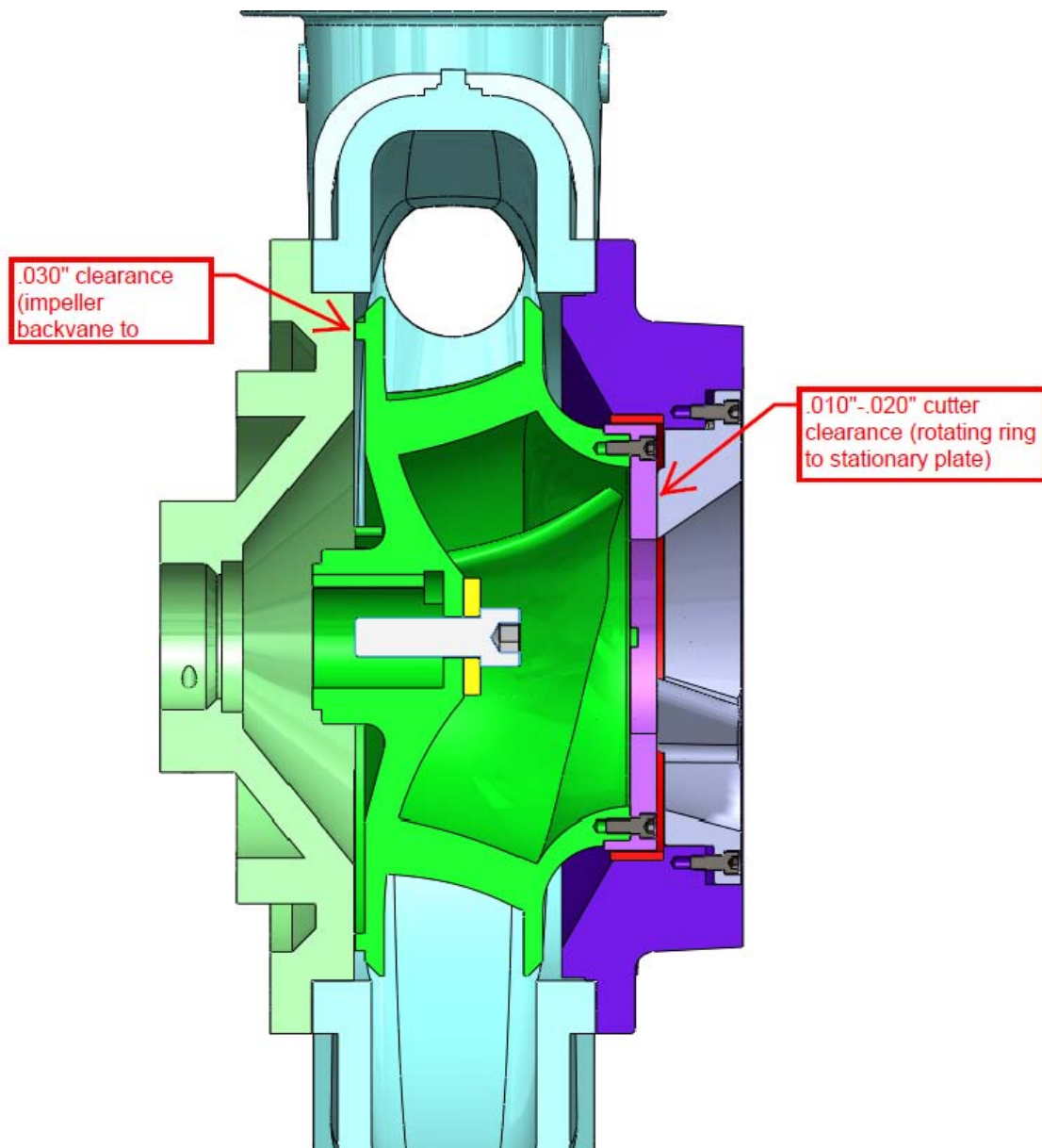


Figure 8. Backvane and Cutter Clearances

Adjusting:

Due to wear during operation, the clearance between the cutter ring, cutter plate, and impeller should be checked and adjusted yearly.

- Disconnect external connections (inlet piping, discharge piping, coupling alignment, frame-baseplate bolts/shims) to gain access to suction inlet of pump.
- Isolate and lockout all power to the pump and motor. Remove the coupling guard so that the pump can easily be rotated by hand.
- Loosen cap screws holding stationary cutter plate (392B) to volute casing (2) or suction cover (1). Do NOT completely remove from assembly.
- Bottom out the stationary cutter plate (392B) to the rotating cutter ring (392A) such they are touching at their teeth. Remove debris if necessary.
- Evenly set stationary cutter plate (392B) to rotating cutter ring (392A) clearance between .010"-.020" using adjustable set screws. Each 1/4 turn of set screw is approximately .010" of adjustment. Start with a quarter turn to test setting clearances.
- Check clearances in at least three locations. Adjust as necessary.
(If clearances are not achievable, then replace with new cutter kit.)
- Evenly torque cap screws on stationary cutter plate to 20ft-lb.
- Re-check cutter clearance after torquing cap screws on cutter plate. Adjust as necessary to achieve clearances within tolerance.
- Rotate pump by hand to check for rubbing. If rubbing is present, proceed through steps above to set clearances again. If necessary, increase the clearance but within .010"-.020" range.

WARNING

Stationary cutter plate should NOT protrude above the volute casing or suction cover. Do NOT reassemble if this condition exists. Pump will not seal.

- Connect pump back to external connections and place back into service.

LIP SEAL SLEEVE INSTALLATION VC/VF FRAMES

Some parts mentioned in these instructions may not apply to your pump. Refer to your specific parts page for part names.

DISMANTLING

1. Remove balance line, if applicable
2. Remove all capscrews from volute. Insert two of these screws into tapped holes in backplate. Tighten screws to jack the pump assembly (motor, brackets, frame, impeller, backplate) free of the volute.
3. Remove and discard the impeller lock screw (under emergency conditions this may not be possible; always use a new impeller lock screw purchased from the factory). Remove the impeller washer.
4. If pump has a mechanical seal, remove any flush lines to seal gland. Remove gland capscrews evenly until capscrews are free of backplate. If pump has packing, loosen gland nuts.
5. Space wedges in pairs 180° apart between impeller and backplate. Be sure wedges are placed along impeller vanes. Tap opposed wedges at the same time to force off the impeller. See page 3200-401 for alternate method, if applicable. Use extreme care to avoid damage to impeller, shaft and bearings. Completely remove impeller and impeller key.
6. If pump is equipped with single mechanical seal (Cycloseal™), the rotating element of the seal will now be exposed and can be pulled off the sleeve by hand. If seal is to be reused, be extremely careful not to damage the seal faces.
7. Unbolt and remove backplate from frame or bracket.
8. If the pump is equipped with a double mechanical seal, the seal and seal gland will have to be removed at this time.
9. Unbolt and remove pump end bracket from frame. If shaft under lip seal does not have a lip seal sleeve in place, the lip seal should be removed and replaced.

REASSEMBLY

1. Press the new lip seal into the pump end bracket so that the lip will face toward the pump end bearing when the bracket is installed. Press the seal in far enough that the shell is flush with the cast surface on the bracket.
2. Measure from the bearing step on the shaft a distance of 1.125" toward the impeller end of the shaft and mark with a felt pen (see illustration).
3. Position the lip seal sleeve with its flange against the shoulder of the shaft step that the lip seal runs against. Place the installation tool over the lip seal sleeve and against the flange and tap until the non-flanged end of the lip seal sleeve is even with the felt pen mark. For the 2.5" lip seal sleeve, an installation tool can be made from a length of Class 200, 2.5" PVC pipe. For the 3" lip seal sleeve, an installation tool can be made from a length of Schedule 40, 3-inch PVC pipe.

4. Though the installation flange on the lip seal sleeve can be snipped and peeled off, it is better to leave it intact. Reinstall the pump-end bracket and bolt in place taking care not to fold or cut the lip seal or rest the weight of the bracket against the lip seal while sliding the bracket over the shaft.
5. Reinstall mechanical seal, backplate, impeller per manual instructions for the particular seal design used. See page 3200-415 for the final reassembly instructions, if applicable.
6. Relubricate the pump end bearing per manual instructions.

Lubrication Instructions Grease Lubricated Frame Pumps

If frame is oil lubricated (denoted by a 'K' on the serial number plate and view gauge on side of frame), see "Lubrication Instructions – Oil Lubricated Frame Pumps," page 3200-902.

Bearing in all frames are greased at the factory before shipment.

Lubrication requirements vary with speed, power, load, ambient temperatures, exposure to contamination and moisture, seasonal or continuous operation and other factors. The brief recommendations which follow are general in nature and must be coupled with good judgement and consideration of the application conditions. For regreasing periods refer to table below. When adding grease be sure the grease and fittings are absolutely clean.

Grease used for these bearings should be equivalent to one of the following manufacturer's products:

G.E. Long Life Grease No. D682C5
Mobil Mobilux No. EP2
Shell Alvania EP2
Texaco Multifak AFB 2

To lubricate frame bearings, remove plastic cover from zerk fittings and be sure the fitting and end of grease gun are clean. Use hand-operated grease gun only and pump a small amount of grease into each bearing cavity. The surplus grease will go through the bearing and into the center part of the frame.

For regreasing periods and approximate quantity, refer to table below.

First determine frame size (located on serial number plate).

Example: 5HH-65B4 4NNT-VF16 10YB-F18DB 6NHTA-VC18 4RB-EM16

RECOMMENDED REGREASING PERIODS FOR FRAMES

	FRAME SIZE				
	2-5-11 and EM309	6-7-8-16 60B4 through 68B4	10-12-13-13D 18-18D	20-24	30
Total Running Time	2,000 hours	1,500 hours	1,000 hours	1,350 hours	2,000 hours
8-Hour Day Service	36 weeks	27 weeks	18 weeks	24 weeks	36 weeks
24-Hour Day Service	12 weeks	9 weeks	6 weeks	8 weeks	12 weeks
Approximate Amount of Grease per Line Fitting	.5 cubic inch	1.25 cubic inch	2 cubic inches	3 cubic inches	4 cubic inches
Approximately	3 pumps with grease gun hand operated	6 pumps	12 pumps	18 pumps	23 pumps with grease gun hand operated

Lubrication Instructions Oil Lubricated Frame Pumps

If frame is grease lubricated, see “Lubrication Instructions – Grease Lubricated Frame Pumps,” page 3200-901.

The ball bearings are lubricated by the oil in the frame housing.

Add oil through the pipe plug opening at the top of the housing and fill to the level indicated on the side of the housing. Be careful to keep out dirt and moisture. The oil level must be maintained; check and fill when pump is not operating. The type and grade of oil used is very important for maintenance-free operation.

Oil used should be a turbine oil equivalent to one of the following manufacturer’s products:

Oil Temperature to 150°F	Oil Temperature Over 150°F
ISO VG32 Mobil DTE 797 Lubriplate HO-0 Chevron Turbine Oil GST 32 Shell Turbo T Oil 32	ISO VG68 Mobil DTE Oil Heavy Medium Lubriplate HO-2 Chevron Turbine Oil GST 68 Shell Turbo T Oil 68

If checking oil temperature is not feasible, measure the bearing frame temperature at the drain connection.

In general, the bearing frame temperature will be approximately 10°F lower than the oil temperature.

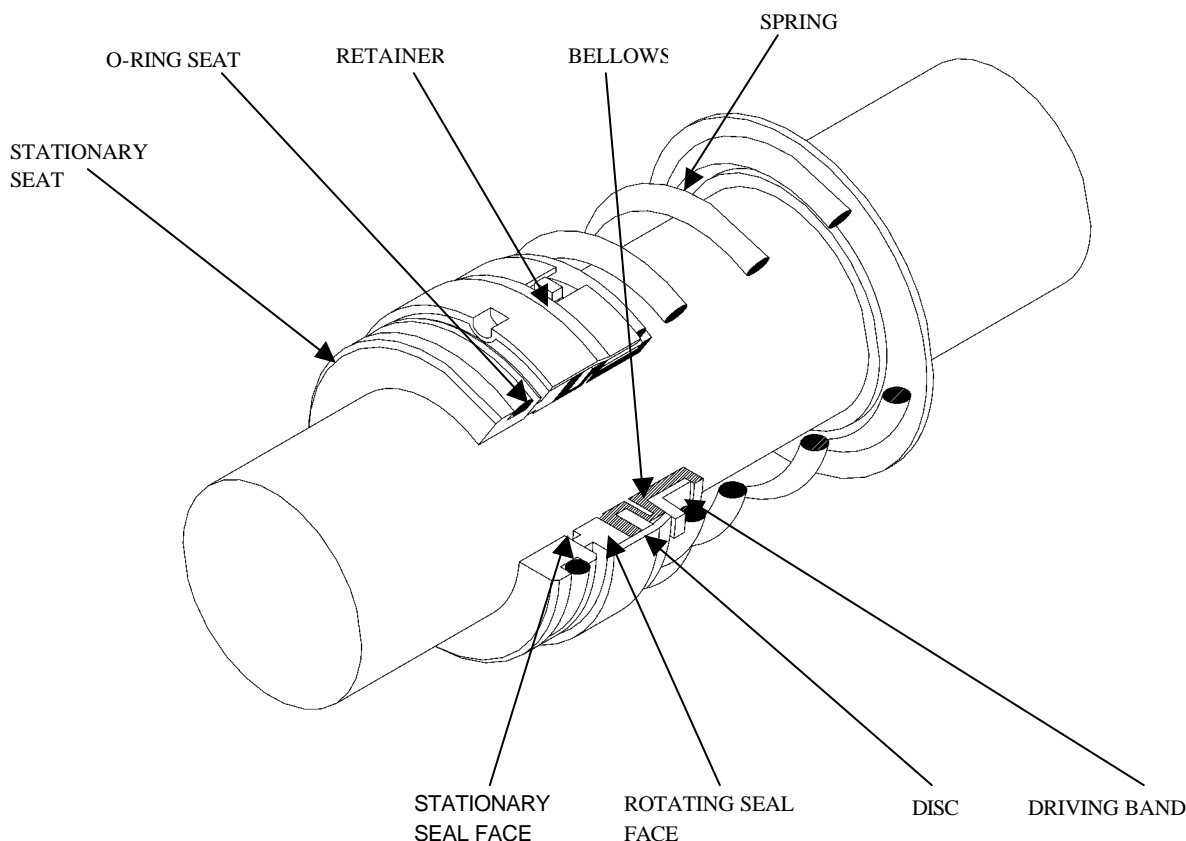
Oil recommendation is based on a minimum of 70 SSU at operating temperature.

<u>FRAME SIZE</u>	<u>CAPACITY (OIL)</u>	<u>OIL RENEWAL</u>
F5K	1 QUART	3-4 MONTHS
F85K/85DBK	1.5 QUARTS	3-4 MONTHS
F13K/13DBK	1.5 QUARTS	3-4 MONTHS
F16K	2 QUARTS	5-6 MONTHS
F18K/18DBK	3 QUARTS	5-6 MONTHS
F12K	4 QUARTS	5-6 MONTHS
F24DBK	8 QUARTS	5-6 MONTHS
F20DBK/TBK	9 QUARTS	5-6 MONTHS

Lip Seals (grease)

All oil-filled frames will have lip seals in their bearing covers. All lip seals must be lubricated through the grease fittings placed in the bearing cover at either end of the frame. Lubricate with a small amount of multiple-purpose grease after every two to six months, depending upon environment.

INSTRUCTIONS FOR MECHANICAL SEAL JOHN CRANE TYPE 1, TYPE 2, AND TYPE 21 SINGLE MECHANICAL SEAL For Cornell Solids Handling Pumps



The location of the mechanical seal in your pump is shown in the cross-section drawing of the pump. The stationary seat is held in the backplate. All other parts of the seal rotate with the shaft and impeller.

STARTING

The seal chamber must be full of liquid before operating the pump. If the shaft is vertical open the vent until liquid comes out to be sure chamber is full (not necessary for pumps with Cycloseal as seal chamber is self-venting). **CAUTION: DO NOT RUN PUMP DRY unless pump is equipped with Run-Dry option.**

MAINTENANCE

No maintenance is required. However, the pump should be examined at regular intervals for leakage resulting from wear of the sealing faces. Occasionally new installations will leak for a short time. These must be inspected daily. If the leakage does not reduce to almost zero, the assembly should be examined for proper seal installation.

DISMANTLING THE MECHANICAL SEAL

Page 2 of 2

If seal is to be removed, remove the impeller according to the instructions for dismantling the pump. The rotating portion of the seal may now be seen. Slide off the seal spring. Lubricate the shaft and remove the remainder of the rotating portion being careful to avoid damaging the primary seal. The rubber bellows will be firmly attached to the shaft and considerable pressure will be required to remove it.

REMOVING SEAT

If the seal is being replaced, remove gland and press out the stationary seat. For pumps with double seals remove the seat from the stuffing box also.

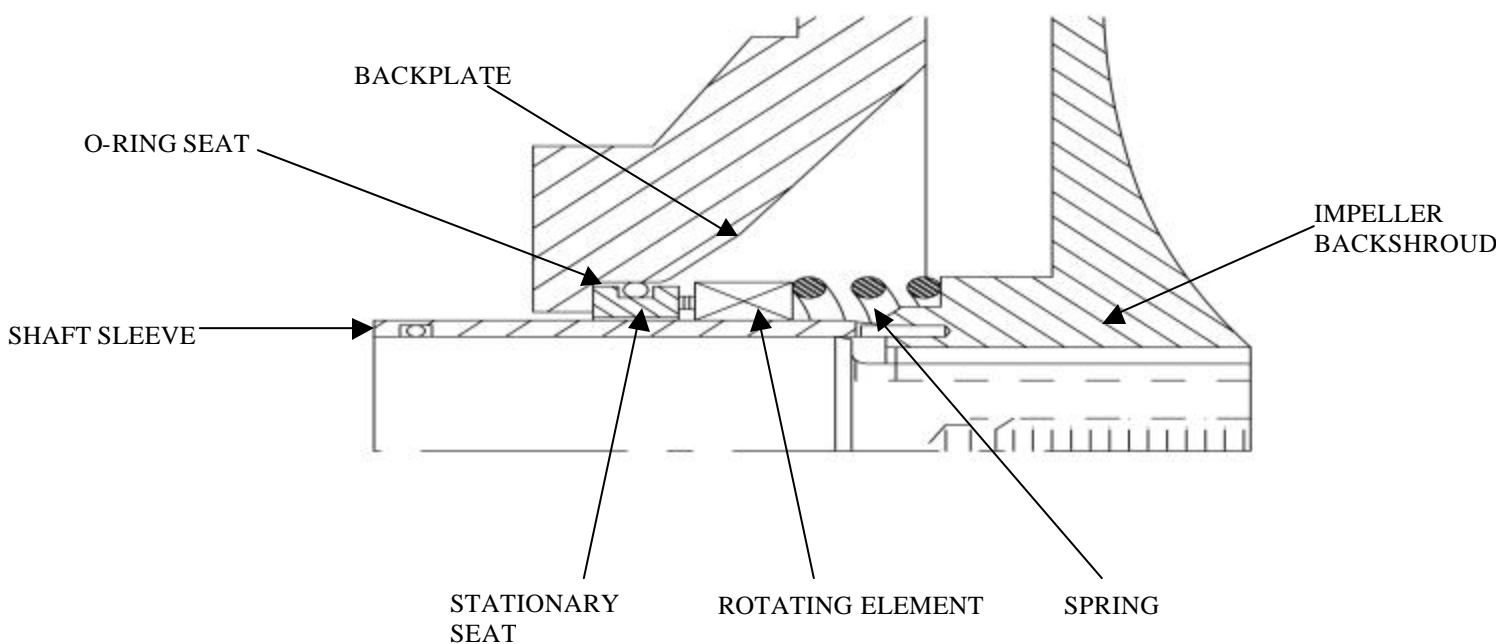
INSTALLING THE MECHANICAL SEAL

Clean all parts of the pump before starting reassembly. Special attention should be given to the backplate and the impeller hub.

- Clean and lubricate the shaft.
- Install the stationary seat in the backplate.
- Oil the outer surface of the seat and the "O" ring with a light oil (not grease). Place a cardboard disc on the sealing face to avoid damage. Press the seat into the gland or stuffing box using firm steady pressure. Make sure the seat is all the way in. Slide the gland with the gasket over the shaft.
- Wipe the lapped sealing faces of the seat and the primary seal perfectly clean. Use extreme care to avoid marking the sealing face or the primary seal. Slide the rotating portion of the seal, including spring on the shaft.

CAUTION: Once the rotating portion has been placed on the shaft, the rest of the installation must be made at once. Delay may result in the rubber bellows seizing on the shaft in the wrong position.

Install the impeller. For pumps with Cycloseal, be sure that the spring slides over the impeller hub and pushes against the backshroud of the impeller (on some Cycloseal models, a spring retainer or spacer is used to hold the spring. Refer to pump sectional drawing)



Typical assembly for Cycloseal pumps

Cornell Pump Company

Lubrication Instructions – Electric Motors

BALL BEARING LUBRICATION

Bearings in motors are greased at the factory before shipment.

Lubrication requirements vary with speed, power, load, ambient temperatures, exposure to contamination and moisture, seasonal or continuous operation and other factors. The brief recommendations which follow are general in nature and must be coupled with good judgement and consideration of the application conditions. For regreasing periods refer to table below. When adding grease be sure the grease and fittings are absolutely clean.

Grease used for these bearings should be equivalent to one of the following manufacturer's products:

Exxon Polyrex EM
Mobil Mobilith SHC 220
Chevron SRI #2
Texaco Polystar RB

CAUTION: These are Polyurea based greases and should never be mixed with lithium base greases. Mixing of the two greases can cause the base thickener to become ineffective allowing the grease to become pure oil and flowing out of the bearings causing bearing failure.

NOTE: If lubrication instructions are shown on motor, they will supersede these general instructions.

To lubricate electric motor bearings, use a hand-operated grease gun only. Pump grease into fitting until new grease appears at pressure relief plug. For minimum possibility of over-greasing, and for best results, lubricate when the motor is not running.

Bearings will become unusually hot until excess grease escapes from the relief plug.

End of season: Pump in grease until old grease is expelled from relief plug. Store.

Beginning of season: Start up motor. Let motor run until surplus grease is expelled.

RECOMMENDED REGREASING PERIODS FOR MOTORS

	HORSEPOWER			
	1.5 TO 7.5	10 TO 40	50 TO 150	200+
Total Running Time	2,000 hours	1,500 hours	1,000 hours	750 hours
8-Hour Day	36 weeks	27 weeks	18 weeks	13 weeks
24-Hour Day	12 weeks	9 weeks	6 weeks	4 weeks

PUMP TROUBLE SHOOTING GUIDE

SYMPTOMS	CAUSES	CORRECTIONS
Failure to pump	Pump not properly primed. Speed too low or head too high. Not enough head to open check valve. Air leak. Plugged suction. Too high a suction lift.	Prime pump correctly. Consult Cornell Factory. Consult Cornell Factory. Check and rework suction line. Unplug suction. Consult Cornell Factory.
Reduced performance	Air pockets or small air leaks in suction line. Obstruction in suction line or impeller. Insufficient submergence of the suction pipe. Excessively worn impeller or wear ring. Too high a suction lift. Wrong direction of rotation.	Locate and correct. Remove obstruction. Consult Cornell Factory. Replace impeller and/or wear ring. Consult Cornell Factory. See start-up instructions.
Driver overloaded	Speed higher than planned. Liquid specific gravity too high. Liquid handled of greater viscosity than water. Too large an impeller diameter. Low voltage. Stress in pipe connection to pump. Packing too tight.	Reduce speed. Consult Cornell Factory. Consult Cornell Factory. Trim impeller. Consult power company. Support piping properly. Loosen packing gland nuts.
Excessive noise	Misalignment. Excessive suction lift. Material lodged in impeller. Worn bearings. Impeller screw loose or broken. Cavitation (improper suction design). Wrong direction of rotation.	Align all rotating parts. Consult Cornell Factory. Dislodge. Replace bearings. Replace. Correct suction piping. See start-up instructions.
Premature bearing failure	Balance line plugged or pinched. Worn wear rings. Misalignment. Suction or discharge pipe not properly supported. Bent shaft. Water or contaminants entering bearings. Lubrication to bearings not adequate. Wrong type of lubrication.	Unplug or replace. Replace. Align all rotating parts. Correct supports. Replace shaft. Protect pump from environment. See Lubrication Instr. (O&M Manual). See Lubrication Instr. (O&M Manual).
Electric motor failure	High or low voltage. High electric surge. Poor electric connection. Overloads. Bearing failure. Cooling vent plugged (roden, leaves, dirt, etc.) Water is sucked into motor.	Check voltage with voltage meter. Monitor voltage and consult power co. Turn power off, clean and check connections. Check amperage. Do not exceed nameplate full load amperage. Change bearings in motor. Install proper screens. Protect pump from environment.
Rapid wear on coupling cushion	Misalignment. Bent shaft.	Align. Replace shaft.