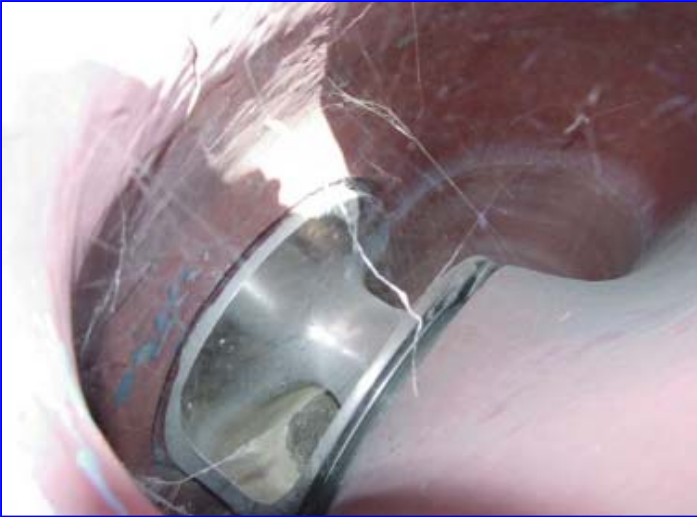


Cornell Centrifugal Pump, Model 10NHPP-F12K, 10 in. inlet, 10 in. outlet, stainless steel construction, 75 hp., 460 volts, 3 phase.





OWNERS MANUAL

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

FOOD HANDLING PUMP



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 Co.

P.O. Box 6334, Portland, OR 97228 USA
Phone: 503-653-0330 Fax: 503-653-0338

CORNELL FOOD HANDLING PUMPS

Models: 3NLP, 4NMP, 4NMPP, 6NHP, 6NHPP, 8NHPP, 10NHPP, 12NHPP Horizontal Frame Mounted Configuration with Packing or Cycloseal

(Replaces pump manual: 1328, 1346, 1381, 2069, 2072, 2073, 2083, 2092, 2102, 2159, 2202, 2213, 2250, 2274, 2275, 2276, 2328, 2335, 2388, 2451, 2468, 2469, 2485, 2497, 2498, 2499, 2500)

<u>INDEX</u>	<u>DESCRIPTION</u>	<u>PAGE NO.</u>
1	TITLE PAGE	3200-300
2	INDEX PAGE	
3	WARRANTY PAGE	
4	CAUTION/WARNING PAGE	3500-2
5	START-UP INSTRUCTIONS (CAUTION/WARNING)	3200-326
6	FLEXIBLE COUPLING - BELT DRIVE INSTR. (WARNING)	3200-311
7	PRESSURE TESTING (WARNING/CAUTION)	3200-353
8	PUMP SUPPORT ASSEMBLY	3200-705
9	DISMANTLING METHODS	3200-401
10	INSTRUCTION FOR MECHANICAL SEAL (CAUTION)	3200-632
11	IMPELLER LOCKSCREW INSTALLATION (CAUTION)	3200-14
12	RUN-DRY SEAL INSTRUCTIONS AND PARTS PAGE	3200-625
13	INSTRUCTIONS FOR PACKING	3200-20.1
14	ELECTRIC MOTOR LUBRICATION INSTRUCTIONS	3200-20.5
15	FRAME LUBRICATION INSTRUCTIONS - GREASE & OIL	3200-901/902
16	PUMP TROUBLESHOOTING GUIDE	3200-380
	PUMP DISMANTLE & REASSEMBLE INSTRUCTIONS	
17	CORNELL W OR Y SERIES AND NL SERIES THREADED SHAFT (3NLP)	3200-412
18	CORNELL PUMP W/THREADED SHAFT	3200-417
	FRAME DISMANTLE & REASSEMBLE INSTRUCTIONS	
19	CORNELL F5/F5K AND EM5/EM5K FRAME	3200-459
20	CORNELL F12/F12K AND VF12 FRAME	3200-474
21	CORNELL F16/F16K AND EM16 FRAME	3200-810

INDEX NO.	DESCRIPTION	PAGE NUMBER
22	CORNELL F18/F18K AND EM18 FRAME	3200-821
25	CORNELL F18DB/F18DBK AND EM18DB FRAME	3200-826
PARTS PAGE		
24	MODEL 3NLP-F5/F5K W/ PACKING	A18116
25	MODELS 4NMP & 4NMPP-F5/F5K W/ PACKING	A17614
26	MODELS 4NMP & 4NMPP-F16/F16K W/ PACKING	A18117
27	MODELS 4NMP & 4NMPP-F5/F5K W/ CYCLOSEAL	A17932
28	MODELS 4NMP & 4NMPP-F16/F16K W/ CYCLOSEAL	A17933
29	MODELS 6NHP & 6NHPP-F16/F16K W/ PACKING	A17613
30	MODELS 6NHP & 6NHPP-F16/F16K W/ CYCLOSEAL	A17920
31	MODEL 8NHPP-F18/F18K W/ PACKING	A17504
32	MODEL 8NHPP-F18/F18K W/ CYCLOSEAL	A17908
33	MODEL 10NHPP-F12/F12K W/ PACKING	A18123
34	MODEL 10NHPP-F12/F12K W/ CYCLOSEAL	A17732
35	MODEL 12NHPP-F12/F12K W/ PACKING	A18154

STANDARD TERMS & CONDITIONS AND WARRANTY FOR REFRIGERATION PUMPS

THIS AGREEMENT, CONSISTING OF THESE TERMS AND CONDITIONS AND ORDER ACKNOWLEDGMENT IS BINDING UPON CORNELL PUMP COMPANY, HERINAFTER “**SELLER**”, AND THE CUSTOMER, HEREINAFTER “**BUYER**”, AND IS THE ENTIRE AGREEMENT.

1. **LEGAL EFFECT:** Except as expressly otherwise agreed to in writing by an authorized representative of Seller, the following terms and conditions shall apply to and form a part of all Quotations and any orders resulting from Quotations. Additional or different terms of Buyer’s purchase order or other form of acceptance or any other form of Buyer are rejected in advance and shall not become a part of any Orders. All offers to purchase from Buyer or orders or contracts of sale resulting from Quotations are subject to final acceptance in writing by an authorized representative of Cornell Pump Company.

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

No employee, agent, dealer, or distributor of Seller has any authority to change or enlarge the terms of any Quotation or Order. No change shall be valid unless it is in writing and signed by an authorized officer of Seller.

2. **ACCEPTANCE:** The price quoted in the quotation shall be the Purchase Price unless otherwise agreed in the purchase order. The purchase price for equipment shall include standard packaging for ground shipment. Field services shall be provided at seller’s standard rates. All other costs, including packaging for storage, freight, insurance, taxes, customs duties and import/export fees, or any other item not specified in the contract, shall be paid by Buyer unless separately stated in the quotation and included in the price quoted. Any sales, use, or other taxes and duties imposed on the transaction(s) or the equipment supplied shall be paid by the Buyer.

The sale of goods and services is expressly conditional on Buyer’s acceptance of Seller’s terms and conditions as stated herein and on the typed portion of the attendant quotation. Unless otherwise specified in writing, all quoted prices are firm for thirty (30) days from the date of offer. Provided that Seller’s terms and conditions have not been previously accepted by Buyer, Buyer’s receipt of goods or services shipped under this

Agreement constitutes Acceptance of these terms and conditions.

3. **DOCUMENTATION:** Seller shall provide Buyer with the data/documentation which is specifically referenced in the quotation. Additional copies of standard data/documentation or requests for special data/documentation will be made available to Buyer at additional cost.

Documentation includes, but is not restricted to: drawings, specifications, instruction manuals, training materials, and other such data or artwork furnished to the Buyer or the Buyer’s subcontractors. The definitions and restrictions set forth in the following subparagraphs apply regardless of the type of media on which the documents are provided.

A. **DOCUMENT CLASSES** Documentation shall comprise two classes: Class 1 shall include all documents describing the standard functionality and operation of the Seller’s products, commonly referred to as Installation, Operational and Maintenance manuals, which are not produced exclusively for the Buyer. Class 2 shall include all documents produced by the Seller specifically for the Buyer for the purpose of facilitating the fair use of the goods and services provided under this contract.

B. **COPYRIGHTS:** Ownership of copyrights for all documents in all classes is retained by the Seller. The Buyer is granted a license to make, without further approval by the Seller, as many as 25 copies of any portion of a Class 1 documents so long as the copied portion includes the copyright and trademark statements found on the title page of the original document and does not exceed more than 50 percent of the document content. The Buyer is further granted a license to make as many as 25 copies, in whole or in part, of any Class 2 document so long as the copied portion includes the copyright and trademark statements found on the title page or title block of the original document.

C. TRANSLATIONS: Any translation of either class 1 or class 2 documents is subject to review by the Seller.

D. TRADEMARKS: The Buyer is granted a license to use the Seller's trademarks in documentation produced by the Buyer for the purpose of facilitating the fair use of the goods and services provided under this contract so long as the trademarks are treated in a manner that is consistent with applicable United States trademark laws and clearly identified as trademarks of the Seller. A list of said trademarks is available upon request of the Buyer.

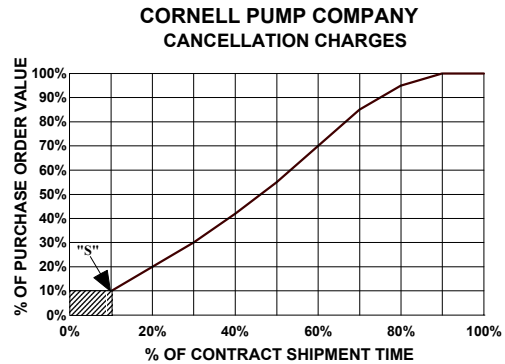
Documents provided to the Buyer, or copies of copyrighted material(s) made by the Buyer under the provisions set forth in subparagraph "B" above, may be used by the Buyer or the Buyer's subcontractors only for the purpose of facilitating the fair use of the goods and services provided under this contract. Said documents contain information considered to be under this contract. Said documents contain information considered to be the Seller's confidential and proprietary property, and may not be disclosed to any other third party without written permission of the Seller.

4. CHANGES: Buyer's changes made after formation of this Agreement that affect the schedule or requirements for services or otherwise affect the scope of this Agreement shall be submitted in writing by Buyer and shall become binding only if approved in writing by Seller's cognizant representative. All charges and delays resulting from such changes shall be solely determined by Seller and shall be binding upon Buyer.
5. TERMINATION AND SUSPENSION: Provided that Seller receives adequate written notice from Buyer, Buyer may terminate or suspend performance at Buyer's convenience subject to all reasonable charges, which charges shall be solely determined by Seller.

Buyer cannot cancel or alter Orders without the Seller's written consent. If Seller grants such consent, Buyer will reimburse Seller for all of Seller's losses and expenses caused by such cancellation or alteration, including without limitation all of Seller's additional costs caused by changes in design or specifications, or by product revisions, and all consequential damages incurred by Seller as a result of such cancellation or alteration. Cancellation charges shall be as follows:

- a. On all Orders under \$250,000.00, if Buyer cancels the Order, Buyer shall pay Seller (i) a minimum cancellation charge of 15 percent of

the purchase price; and (ii) any damages and expenses described in this paragraph that exceed 15 percent of the purchase price.



- b. On all Orders over \$250,000.00, if the Buyer cancels the Order, buyer shall pay the Seller (i) minimum cancellation charges determined per graph above; and (ii) any damages or expenses described in this paragraph that exceed minimum cancellation charges determined per graph above.

6. TAX: All government charges upon the services tendered by this Agreement, including, but not limited to, use, occupation, VAT, income, export and import taxes, shall be paid by Buyer or, in lieu thereof, Buyer shall furnish Seller with a tax exemption certificate acceptable to the authority imposing the tax on Seller.

Any applicable customs fees, visa fees, brokerage fees, work permits, work taxes, or other taxes related to the project will be invoiced at cost.

7. CREDIT: The amount of credit offered by Seller to Buyer is contingent upon Seller's opinion of Buyer's capacity, ability, and willingness to promptly pay for goods and services received under the terms of this Agreement. Provided that, in Seller's opinion, there is a material adverse change in Buyer's financial condition and/or Buyer has not, within the agreed time, fully paid for goods and services previously supplied under this and/or another Agreement(s) with Seller, Seller reserves the right to revoke Buyer's credit and/or suspend performance on this and/or other orders for goods and services.

Customers who do not qualify for a line of credit, or who are in default on a line of credit may qualify for other payment alternatives such as cash in advance, irrevocable letter of credit or other third party financing solely at the discretion of the Seller.

8. **PAYMENTS:** Standard terms for customers who qualify for credit are ½% (one half of one percent) 15 days, net 30 except as noted below. A monthly service charge of 1.5% may be charged on amounts owed by Buyer to Seller that have not been paid within by the due date, subject to the maximum amount permitted by law.

Periodic invoices for Milestone Payments shall be issued when the contract price exceeds \$100,000. In such cases, invoices shall be issued based on the following milestones:

On all Orders over \$100,000, as follows:

- 15% on submittal of drawings
- 25% on release to manufacture
- 50% at time of shipment
- 10% 30 days after shipment

On all Orders over \$250,000, as follows:

- 25% upon receipt of order
- 10% upon submittal of drawings
- 15% upon receipt of approved drawings
- 50% at time of shipment

Changes as provided in Clause 4 entitled "Changes" may cause additional periodic invoices to be issued.

These terms apply to partial and complete shipments. Buyer agrees to make full payment under these terms without setoff. Company shall have the absolute right to require payment under an irrevocable letter of credit in such form as is specified by Company at the time of its acceptance of Distributor's orders for Products, or by any other means specified by Company.

If any proceeding is initiated by or against Buyer under any bankruptcy or insolvency law, or if, in Seller's judgement, Buyer's financial condition at the time the equipment is ready for shipment does not warrant the extension of credit to Buyer, Seller may require full payment, in cash, prior to making shipment. If Seller does not receive full cash payment within fifteen (15) days after it notifies Buyer that such payment is required and that the equipment is ready for shipment, Seller may cancel the Order as to any unshipped item. In that event, Buyer will pay Seller the cancellation charges, damages and expenses, as described in Clause 5 entitled "Termination and Suspension".

9. **TITLE AND LIEN RIGHTS:** The equipment will remain personal property, regardless of how it is installed or affixed to any realty or structure. After delivery to Buyer, Seller will have all such rights, including security interests and liens, in the equipment

as lawfully may be conferred upon Seller by contract under any applicable provision of law. Buyer agrees to cooperate fully with Seller in the filing of any financing statements, including Uniform Commercial Code (UCC) filings or other documents necessary to perfect such interests and liens. If Buyer defaults in its obligations under the Orders before the price (including any notes given therefore) of the equipment has been fully paid in cash, Seller may take any and all actions permitted by law to protect its interests including, where permissible, repossession of such equipment.

10. **INSPECTIONS:** Buyer may make reasonable inspections of goods at Seller's factory. Seller reserves the right to determine the reasonableness of the request and to select an appropriate time and location for such inspection. All costs of inspection shall be solely determined by Seller and shall be to Buyer's account. No inspection or expediting by Buyer at the facilities of Seller's suppliers is authorized.

Additional tests including Factory Acceptance Tests or demonstrations requested by Buyer are not part of any contract unless separately identified and priced. Unless Buyer objects in writing at the conclusion of such tests or demonstrations, specifying the nature of its objections, Buyer shall be deemed to have accepted the System.

Buyer shall be responsible for receiving, storing, installing, commissioning and maintaining all equipment.

11. **SHIPMENTS:** With the exception of resale products as defined in Clause 12 below, all sales are Ex-Works Factory. Shipping contracts made by Seller shall be to Buyer's account. All claims for loss or damage after risk of loss has passed to Buyer shall be filed by Buyer with the carrier. Buyer shall be liable to Seller for the full price of the goods, irrespective of loss or damage in transit. Seller shall not be required to provide freight cost receipts to Buyer at the time of invoice.

A. **TRANSPORTATION:** Transportation expenses shall be paid by the Buyer. Seller shall select the carrier and freight forwarder. Fully insurable values shall be declared with the resultant insurance premiums being paid by Buyer. Shipping and insurance charges shall be prepaid by Seller and added to the Buyer's invoice at cost, unless otherwise specified by Buyer.

B. **SCHEDULES:** Dates quoted by Seller are estimated based upon Buyer's specified requirements at time of order

acceptance. Delays in receipt of approvals and/or information, changes that result in delays, or requested deferment of schedules may cause additional expense to Seller. Accordingly, in addition to the escalation provisions of subparagraph "C" below, Seller shall be entitled to an extension of time, and reimbursement of costs as defined in Clause 4 entitled "Changes". The change in price shall be evenly divided among any invoices remaining to be issued. Further, the Buyer will take delivery of the shipment of the goods within fifteen (15) days of notification by the Seller that the goods are ready for shipment. Failure to take delivery of the goods within the specified time frame may result in a storage fee of \$100.00 per day per pump.

- C. ESCALATION: All prices quoted are based on scheduled shipments within six (6) months from date of order acceptance. Delays caused solely by Seller beyond the quoted delivery date shall not be subject to escalation. If shipments requested are to be made after six (6) months from date this Agreement is formed, the invoiced balance of the contract price shall be subject to price escalation at a rate of one percent (1%) per month for each month in excess of six (6) months up to a maximum of 6% per year.
- D. SALES FOR EXPORT: In the case of sales for export, Buyer or Seller, whichever is the proper party under the applicable statute or regulation, will procure, and arrange for any necessary extensions of, all required export, import or other licenses or authorizations. If Buyer, as the proper party, fails to arrange for such licenses or authorizations prior to or by the scheduled date of shipment, Seller may at its option treat any such failure as a cancellation of the Order (s) and, upon notice from Seller, Buyer will pay Seller the cancellation charges, damages and expenses, as described in Clause 5 "Terminations and Suspension".

12. RESALE PRODUCTS: Resale products are goods (that are sold with Seller's goods) which are not manufactured by Seller and which are supplied as an accommodation to Buyer. Standard documentation

shall be only as supplied by the resale product manufacturer.

SELLER MAKES NO WARRANTY FOR RESALE PRODUCTS, EITHER EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE SOLE WARRANTY SHALL BE THAT OF THE RESALE PRODUCT MANUFACTURER.

Buyer agrees that Seller shall not be liable for delays caused by resale product manufacturer. Buyer further agrees that Buyer's SOLE AND EXCLUSIVE REMEDY for Seller's breach of the stated responsibility shall be limited to the difference between the resale product manufacturer's price to Seller and Seller's price to Buyer for resale products in such breach.

13. LIMITED WARRANTY: Seller warrants, to its original Buyer, that goods manufactured by Seller are free from defects in material and workmanship for 36 months from date of shipment. If a failure to conform to specifications or a defect in materials or workmanship is discovered within this period, Seller must promptly be notified in writing within thirty (30) days, which notification, in any event must be received no later than 37 months from the date of shipment. Within a reasonable time after such notification, Seller will correct any failure to conform to specifications or any defect in materials or workmanship, or in lieu of such repair, and at its sole option, shall replace the equipment. THE ABOVE ARE THE BUYER'S EXCLUSIVE REMEDIES FOR BREACH OF WARRANTY.

Seller does not warrant: (a) defects caused by failure to provide a suitable installation environment for the product, (b) damage caused by use of the product for purposes other than those for which it was purchased, (c) damage caused by disasters such as fire, flood, wind, and lightning, (d) damage caused by unauthorized attachments or modification, (e) any other abuse or misuse by the Buyer, including improper installation.

THE FOREGOING LIMITED WARRANTIES AND REMEDIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND REMEDIES. IN NO CASE SHALL SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES BASED UPON

ANY LEGAL THEORY. SUCH DAMAGES INCLUDE, BUT ARE NOT LIMITED TO LOSS OF PROFITS, LOSS OF SAVINGS OR REVENUE, LOSS OF USE OF THE PRODUCT OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, DOWNTIME, THE CLAIMS OF THIRD PARTIES INCLUDING CUSTOMERS, INJURY TO PROPERTY AND, UNLESS PRECLUDED UNDER APPLICABLE STATE LAW, BODILY AND PERSONAL INJURY.

If Buyer is in default (including, but not limited to, the failure of Buyer to maintain a current account with Seller) under the Order of any other agreement between Buyer and Seller, Buyer's rights under the warranty shall be suspended and the original warranty period will not be extended.

Equipment performance is not warranted or guaranteed unless separately agreed to by Seller in accordance with its guarantee policy. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy.

14. EQUIPMENT RETURNS: Equipment returns must have prior written authorization by the Seller. Returned equipment must be shipped "PREPAID" and must be tagged with a RGA Number. Equipment manufactured to the Buyer's specification will be credited only to the extent of the reuse value. Only unused and current materials purchased within one (1) year of return request will be considered. All equipment returns are subject to a minimum 15% restocking charge.
15. FORCE MAJEURE: Seller shall in no event be liable for delays in delivery of the equipment or other failures to perform caused by fires, acts of God, strikes, labor difficulties, acts of governmental or military authorities, delays in transportation or procuring materials, or causes of any kind beyond Seller's control.
16. PATENTS: Seller shall defend and indemnify the Buyer against any actions of third parties based on claims that the goods manufactured by Seller constitute an infringement of a valid patent of the United States for the benefit of such third parties, provided that Buyer notifies Seller in writing of any such claim within five days thereof and thereafter gives necessary authority, information and assistance to Seller for the defense of such action. In the event that the goods manufactured by Seller are held to be infringing in

such action and their use is enjoined, Seller shall, at Seller's expense, modify goods so they become non-infringing, or, if modification is not possible, refund the Buyer's purchase price for the hardware items that are infringing and remove them at Seller's sole expense. Buyer agrees that Seller shall not be liable and the Buyer shall fully indemnify Seller if infringement is based upon the use of the goods in connection with goods not manufactured by Seller or in a manner for which the goods were not designed by the Seller or if the goods were designed by the Buyer or were modified by or for the Buyer in a manner to cause them to become infringing.

17. GENERAL PROVISIONS: (a) Neither party shall have the right to assign its rights or obligations under this Agreement except with the written consent of the other party, provided, however, that a successor in interest by merger, by operation of law, assignment, purchase, or otherwise of the entire business or either party, shall acquire all interest of such party hereunder. Any prohibited assignment shall be null and void. (b) There are no understandings, Agreements or representations, expressed or implied, not specified in this Agreement. (c) No action, regardless of form arising out of transactions under this Agreement, may be brought by either party more than two (2) years after the cause of action has occurred. (d) No representative of Seller has any authority to modify these terms and conditions unless the modification is contained in a written instrument signed by a duly authorized Vice President of Seller. (e) This Agreement is formed and shall be construed under the laws of the State of Oregon. (f) All stenographic, typographical and clerical errors in quotations or pump curves and specifications may be corrected at any time by the Seller.
18. INSURANCE: Buyer shall bear all risk of and responsibility for damage or loss to the equipment after Seller delivers the equipment to the carrier at its point of shipment. Buyer agrees to provide and maintain adequate insurance for the equipment supplied under the Orders to fully protect Seller's interest during the time between delivery and final payment. Loss or damage by fire or other causes during such period shall not relieve Buyer from its obligations under the Order.
19. LIMITATION OF LIABILITY: Seller's total liability for any and all losses and damages arising out of any and all causes whatsoever including, without limitation, defects in the goods, services, software, documentation, or supplied under this Agreement, shall in no event exceed the purchase price of the applicable item(s).

20. GENERAL INDEMNIFICATION: Seller agrees to defend, indemnify, and save harmless Buyer from any claims for bodily injury or property damage, and any costs, expenses, or damages incurred as a result thereof, which are based solely on the negligence, gross negligence or intentional misconduct of Seller's employees, agents, contractors, or subcontractors.

Buyer agrees to defend, indemnify, and save harmless Seller from any claims for bodily injury or property damage, and any costs, expenses, or damages incurred as a result thereof, which are based solely on the negligence, gross negligence or intentional misconduct of Buyer's employees, agents, contractors, or subcontractors.

21. NONWAIVER: Any failure by any party to strictly enforce the terms and conditions as stated in this Agreement or to exercise any rights acquired hereunder shall not constitute a waiver of such terms or rights and shall not affect the right of the party to enforce or exercise such terms or rights in the future.

22. SEVERABILITY: If any one or more of the provisions or subjects contained in the Agreement shall for any reason be held invalid, illegal, or unenforceable, it shall not affect the validity and enforceability of any other provisions or subjects.

23. SAFETY: Buyer shall ensure that Seller's personnel are not exposed to unreasonable hazards on or in the vicinity of the worksite. Buyer shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the worksite. Seller shall ensure that Seller's personnel will comply with the Buyer's documented safety regulations provided to the Seller while on the worksite.

Seller shall ensure that Seller's personnel are provided with basic safety training for the normal work environment. Site specific training shall be provided at the Buyer's expense.

24. HAZARDOUS LOCATIONS: Seller reserves the right to refuse to dispatch personnel to worksites threatened by warfare, terrorist activities, or other unsafe conditions as determined by the Seller's management. A variety of factors will be considered in determining whether a location is hazardous, including whether the country within which the work is to be performed is

under a "Travel Warning Status" as determined by the U.S. Department of State. Seller reserves the right to recall personnel if the worksite does not meet reasonable health and safety standards. Time spent in hazardous locations will be billed at applicable hazardous location rates.

25. DRUG TESTING: Seller has a drug-free workplace policy in effect.

26. LIVING CONDITIONS: If meals and living accommodations are provided by the Buyer, Seller reserves the right to recall the Seller's personnel if the accommodations and meals are not suitable (as determined by the Seller's management). Seller reserves the right to make alternate arrangements at the cost of the Buyer if other accommodations are available.

27. MAXIMUM TIME ON THE WORKSITE: Seller reserves the right to replace personnel after two weeks for North American (includes Canada and Mexico) locations and four weeks for international locations at the Buyer's expense.

28. SELLER'S PERSONNEL ON THE WORKSITE: Seller reserves the right to determine the number of Seller's personnel required for implementation of a project. All costs for the Seller's personnel on worksite shall be paid by the Buyer.

29. COMMUNICATION ACCESS: Buyer shall provide at no cost to Seller unlimited access to telephone, fax, and data transmission lines to the Seller's personnel on worksite for communicating with the Seller's office for purposes associated with the required work.

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.

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.

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.

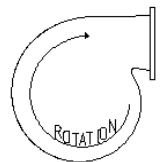
MOUNTING PUMPS TO ENGINES – PAGE 3200-12

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

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. Belts and couplings (shaft) are properly adjusted, aligned, and guards are in place.
 - b. All thrust blocks and supports are adequate.
 - c. 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.
 - d. That all electrical connections and electrical equipment are installed by a qualified and licensed electrical contractor.
 - e. The pump rotates freely by hand. Then check the pump rotational direction with very short on/off power pulses on the starter switch.
 - f. Pumps with mechanical seal must not run dry.



CAUTION

Food Pumps (single port impellers) have threaded shafts. Improper rotation will cause failure and costly repairs.

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 2E 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 AK@ 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. Start the driver. If 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.

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.

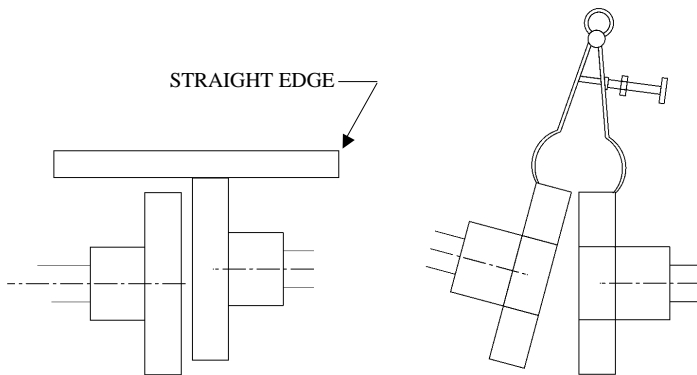
Misalignment causes whipping of the shaft, adds thrust to bearings, leads to excessive maintenance and potential failure of equipment. It is imperative that alignment be carefully checked prior to placing pump in operation. This is done after securing to bed plate or foundation and making pipe connections.

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

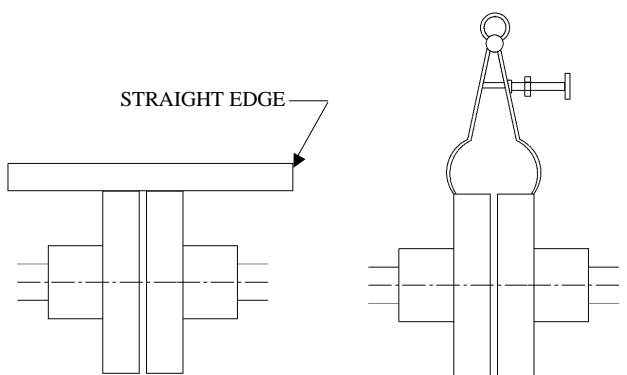
Numerous types of flexible couplings are available. Some are easier to align than others, but all serve the purpose of connecting two shafts capable of transmitting torque while allowing for minor misalignment (angular, parallel or a combination).

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



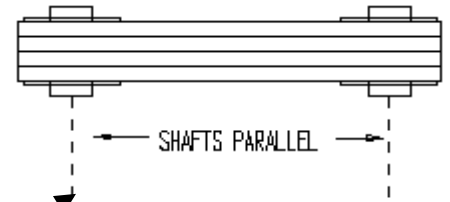
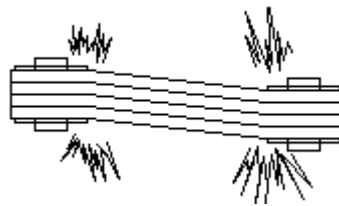
WARNING

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.

TEST FLUID

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

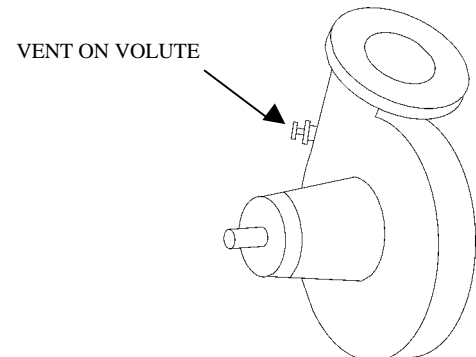
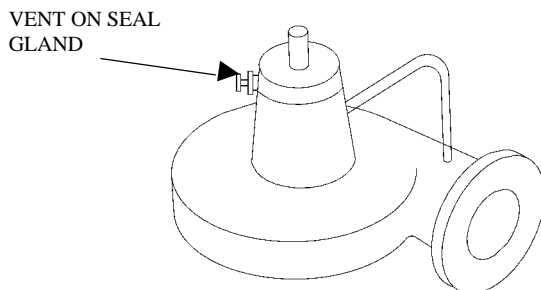
For pumps equipped with packing:

- a. Fill pump gradually with liquid by gravity flow (10 PSI max. pressure).
- b. Vent air from volute and close vent valve.
- c. Raise pressure gradually to required test pressure. See "Maximum Test Pressure."
- d. Allow packing to leak freely (special protection of motor may be necessary).
- e. 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

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



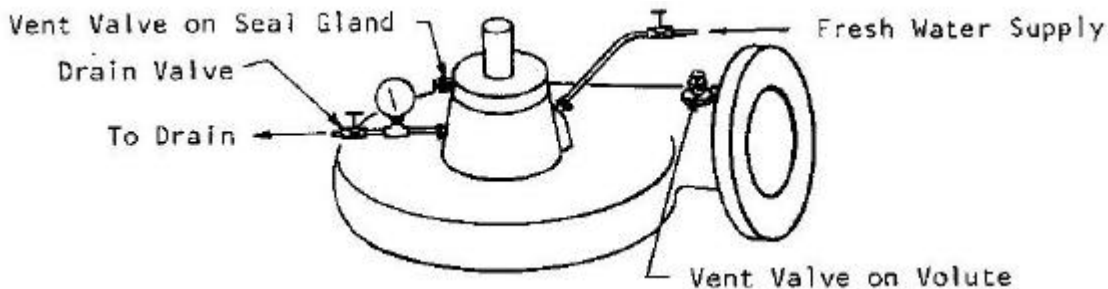
PRESSURE TESTING

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.

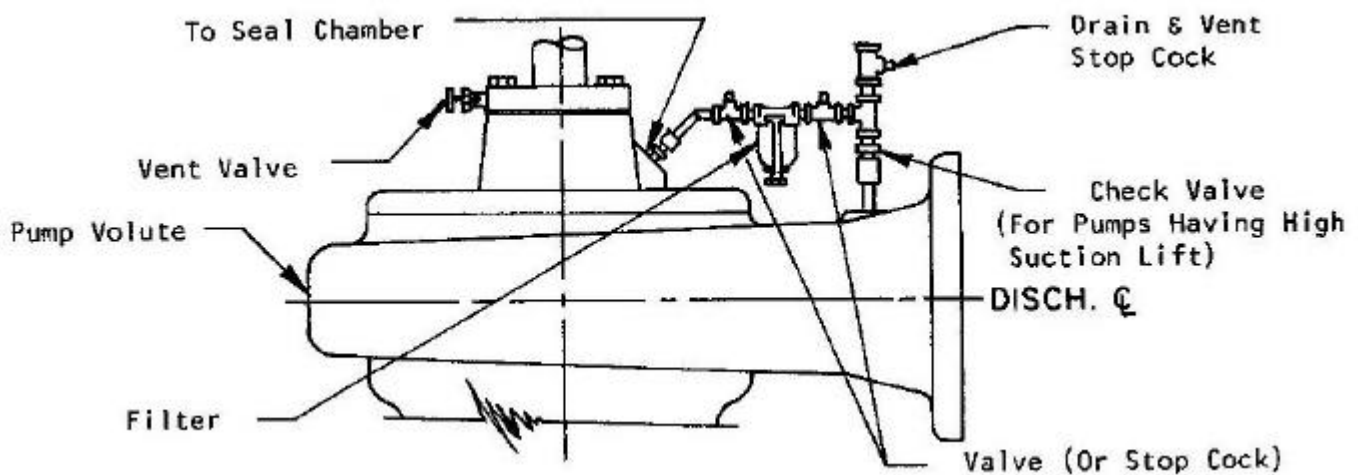


- B. Open vent valve in seal gland and vent off air.
C. Close vent valve.
D. Raise pressure of supply water to pressure at which hydrostatic testing will be done. If water supply cannot be raised to required test pressure, close valve in supply line to trap all seal water in seal chamber.
E. Fill pump 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."

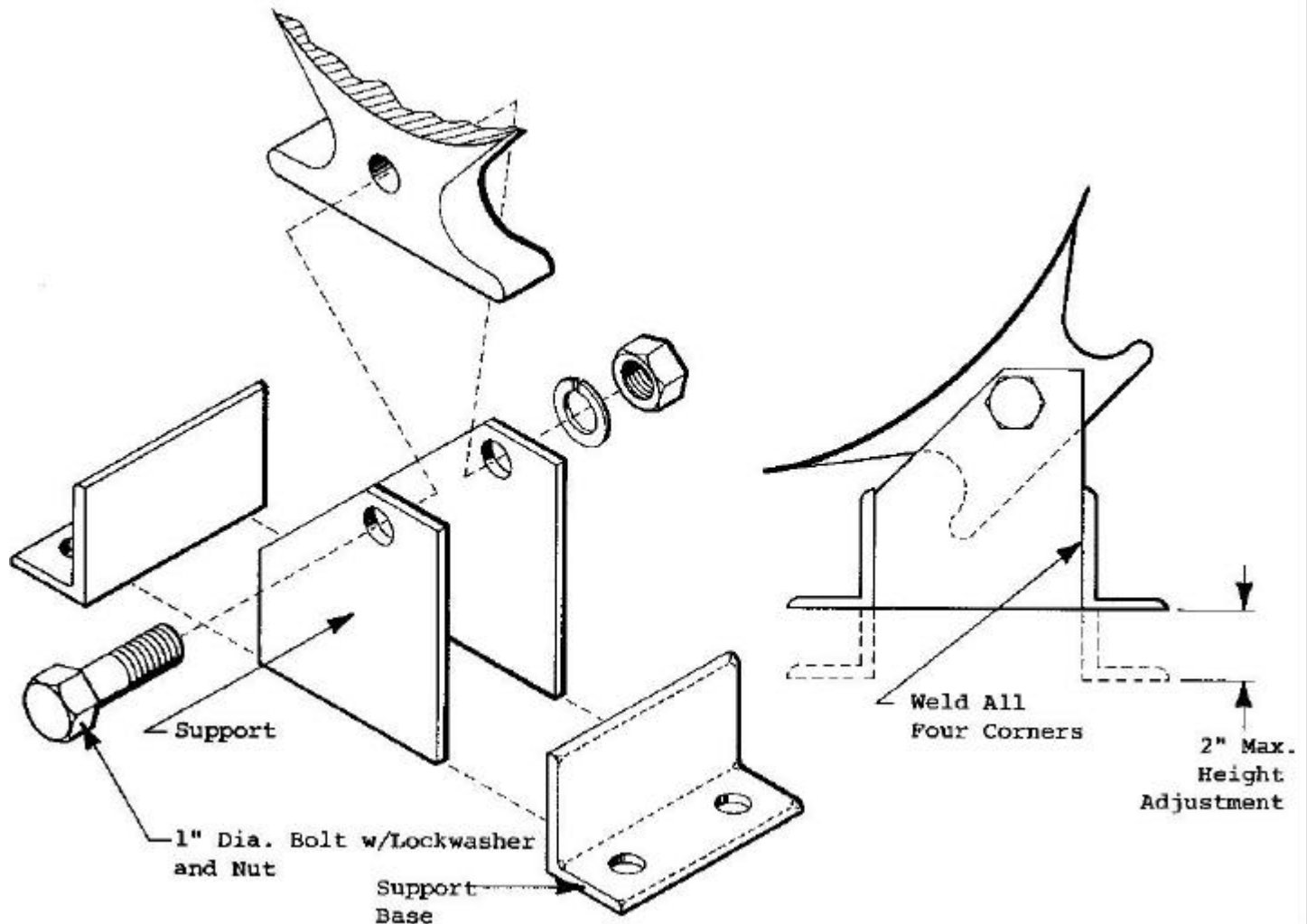
Pump Support Assembly (For Volutes with Lifting Lugs)

The pump support assembly for the volute with lugs have been designed to allow the greatest versatility during installation. Variations of as much as 2 inches in height are possible.

Recommended installation:

Bolt the feet of the frame to the rear support and place shims under the volute until the entire unit is approximately level. At this point make the final shimming adjustments to align the sheaves, couplings, or other drivers.

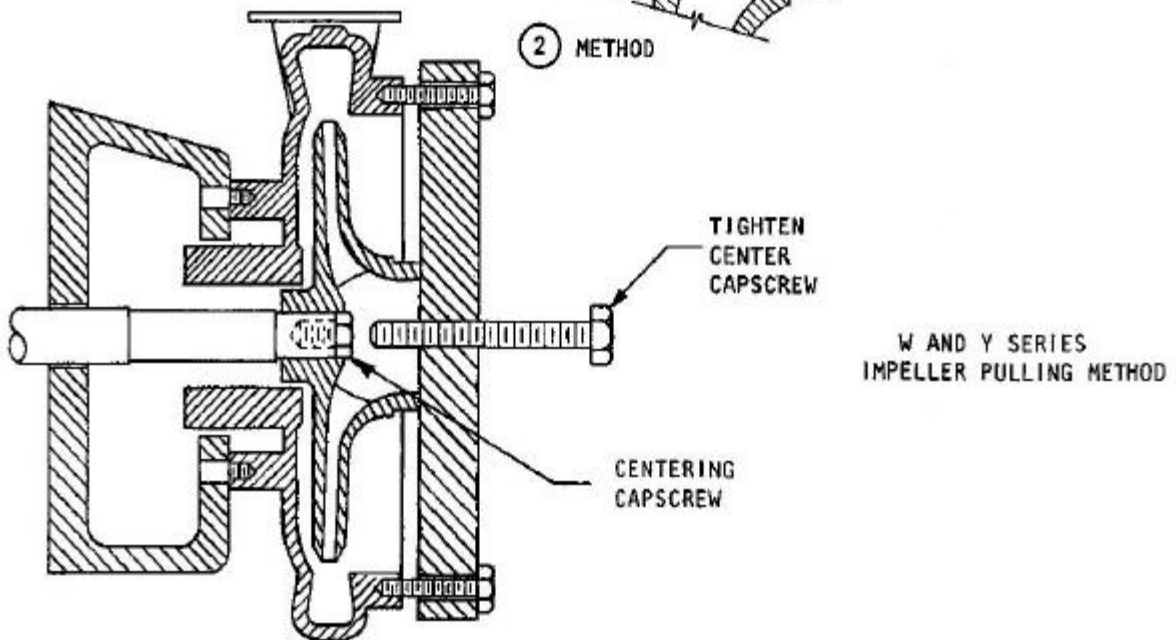
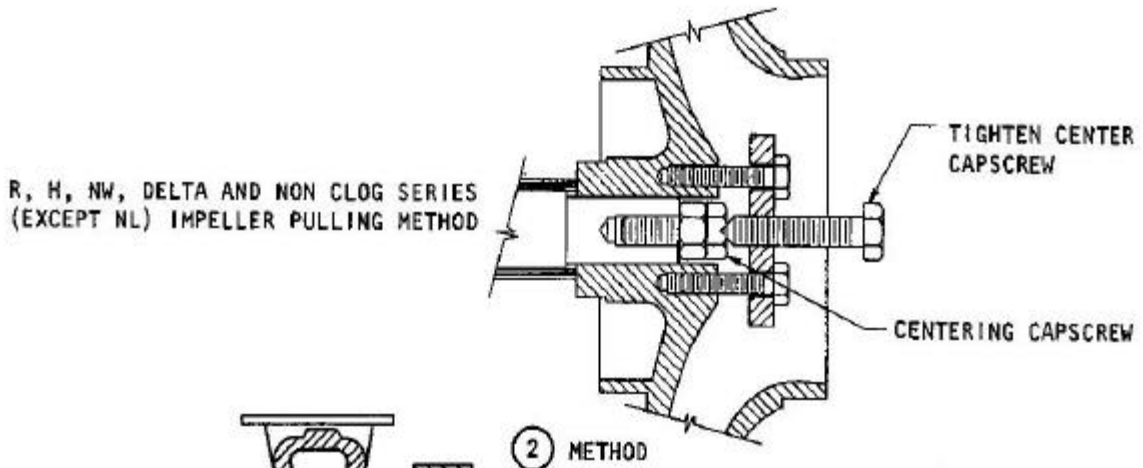
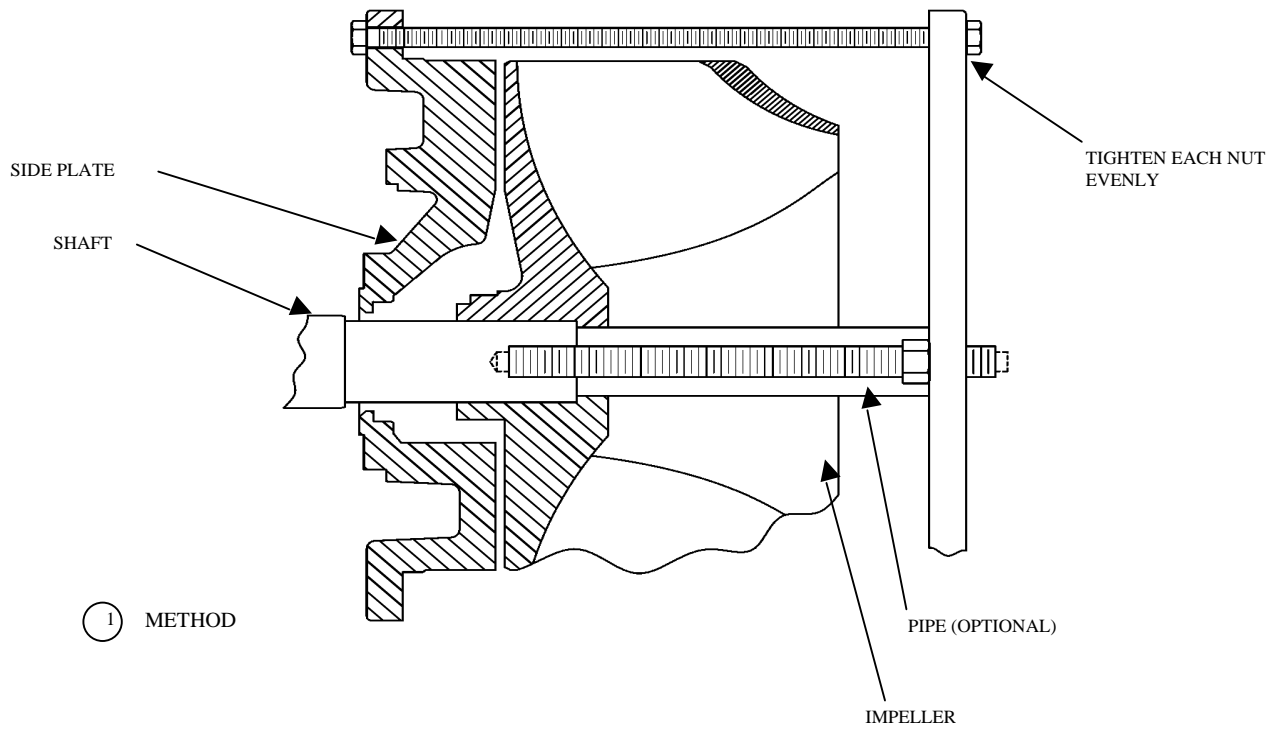
Bolt two pump support risers to each of the two lower lifting lugs, use the one-inch diameter bolts provided. Bolt two pump support bases to the support area you have provided. Weld each corner to secure into place. Repeat this process for the other side.



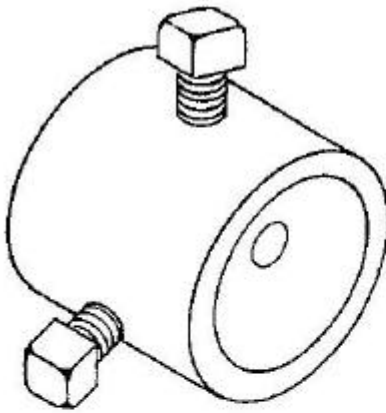
PUMP SUPPORT ASSEMBLY

(2 Required)

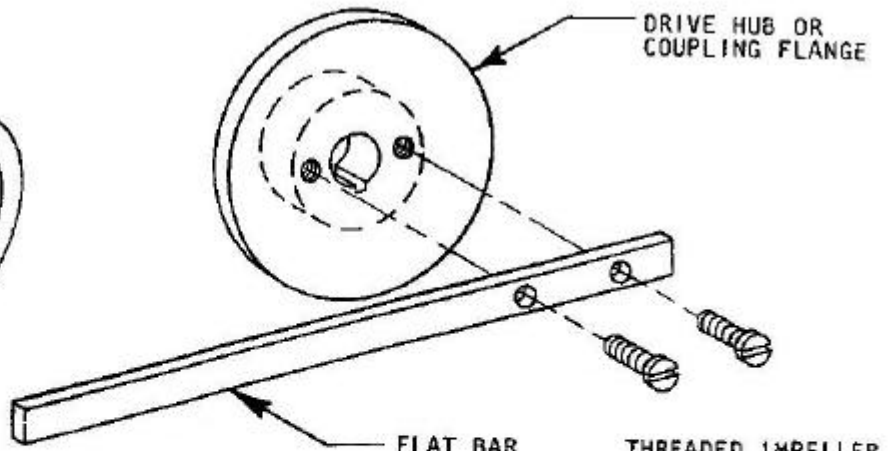
DISMANTLING METHODS



DISMANTLING METHODS



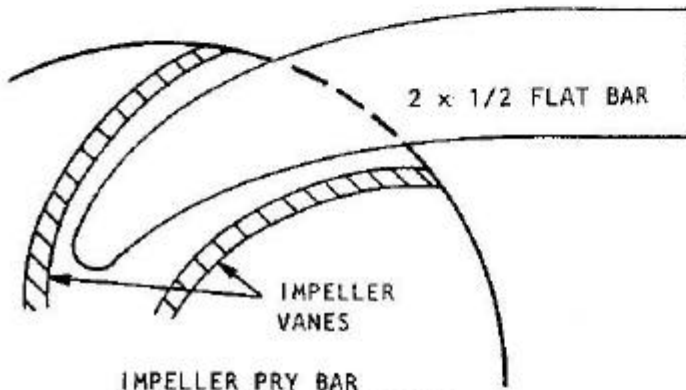
SLEEVE PULLER



DRIVE HUB OR COUPLING FLANGE

FLAT BAR

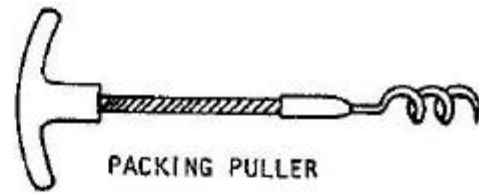
THREADED IMPELLER PULLING METHOD



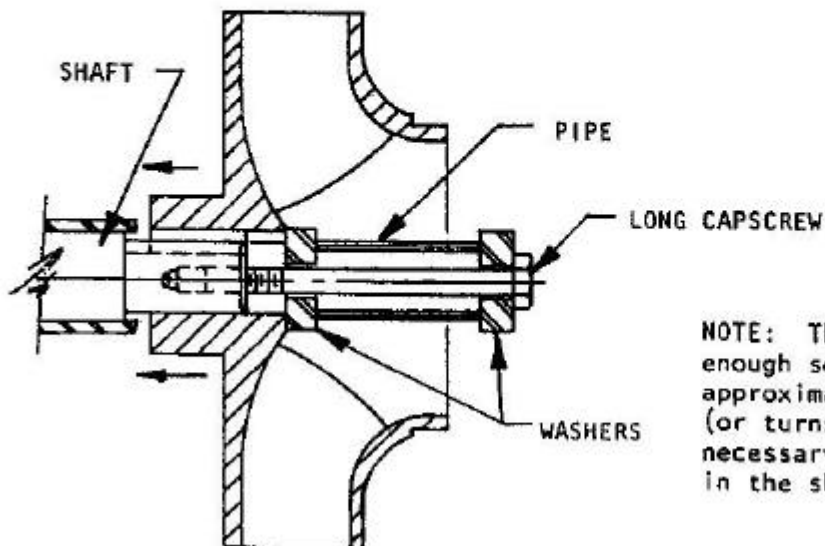
2 x 1/2 FLAT BAR

IMPELLER VANES

IMPELLER PRY BAR FOR THREADED IMPELLERS



PACKING PULLER



SHAFT

PIPE

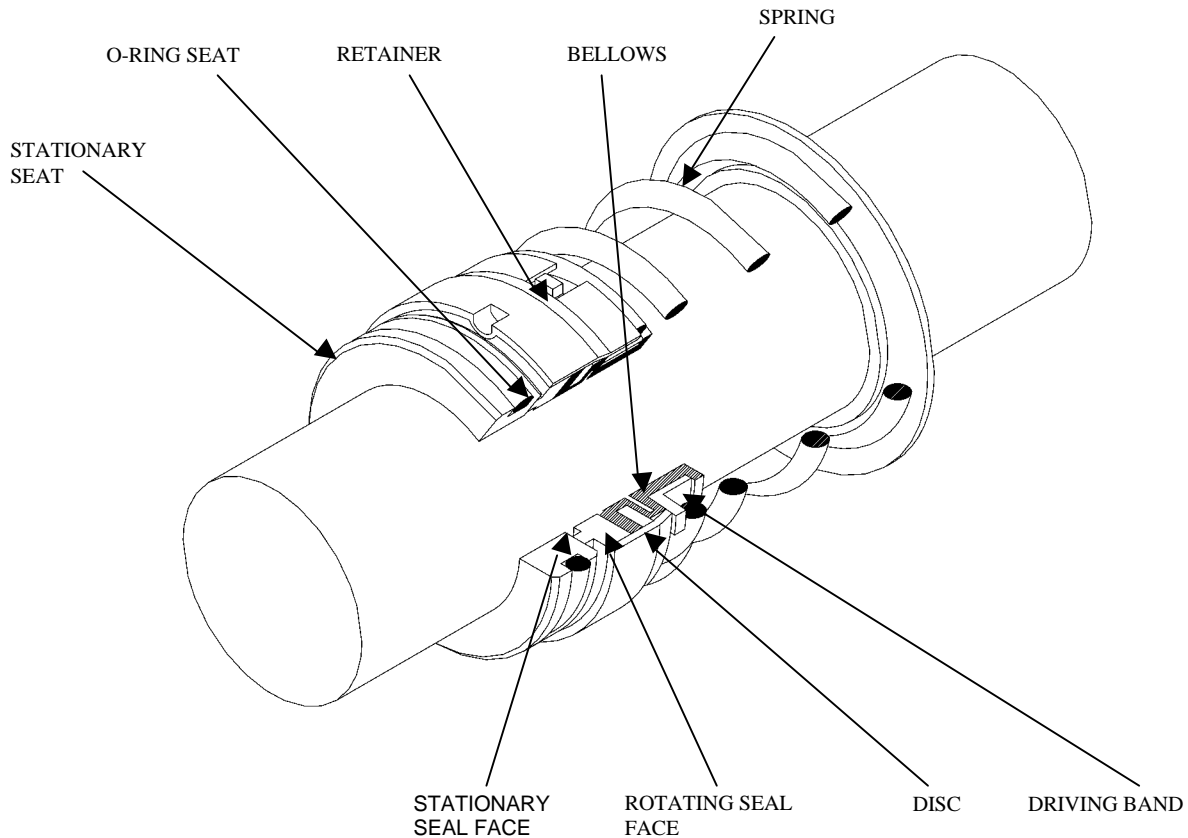
LONG CAPSCREW

WASHERS

INSTALLING IMPELLER METHOD

NOTE: The cap screw 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.

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

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.

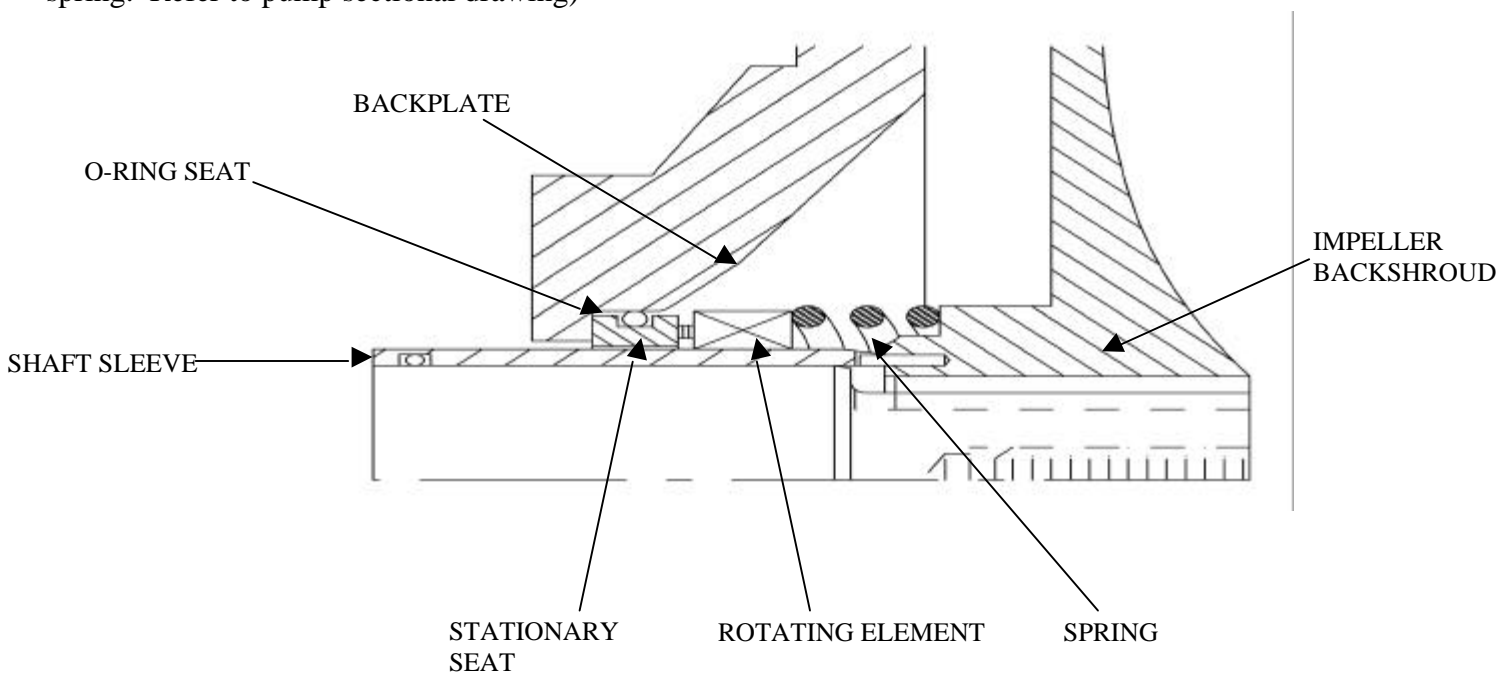
INSTALLING THE MECHANICAL SEAL

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

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.

Run-Dry Seal Instructions and Parts Page

Pumps equipped with Cornell's patented Cycloseal® (patent # 5,489,187) system have an optional run-dry feature. The run-dry feature employs an auxiliary gland and reservoir mounted to the backplate. The rotation of the drive shaft circulates lubricant from the reservoir to the gland, then back to the reservoir. The lubricant serves to cool the seal faces even when there is no liquid in the pump casing.

THE RUN-DRY RESERVOIR LUBRICANT LEVEL SHOULD BE MAINTAINED TO THE TOP SIGHT GLASS; however, lubricant will circulate as long as the lubricant level is above the bottom sight glass. When filling the reservoir with lubricant, be sure the air has been purged out of the upper circulation hose to prevent vapor locking.

Oil changes recommended every 1000 hours or once a year.

The reservoir lubricant should be a non-volatile substance that is compatible with the mechanical seal elastomers, will not cause rusting, and will not freeze in cold climates.

Lubricant can be added either during pump operation or while shutdown.

If water begins to accumulate in the reservoir, or the oil level depletes rapidly, this may indicate mechanical seal failure. Leakage of oil from the gland would indicate a damaged or worn lip seal.

The optional run-dry feature is used for 2 different applications:

1. Backup Run-Dry Applications

With the backup run-dry feature, the pump can operate for a short period of time with no liquid in the pump casing without causing damage to the mechanical seal. The run-dry option is not intended for extended periods of operation without liquid in the pump casing, but rather as a safety feature to save the mechanical seal should the pump unexpectedly lose prime or inadvertently be started without being primed.

Recommended reservoir lubricants:

Chevron Turbine Oil GST 32 (or other ISO viscosity grade 32 or below) (synthetic oil recommended)
Transmission fluid or Hydraulic oil

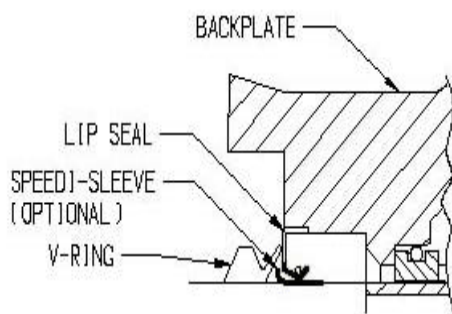
2. Extended Service Run-Dry Applications (Large Capacity Reservoir/Redi-Prime® Reservoir)

(NOTE: Internal pump tolerances have been modified for this application refers to BOM).

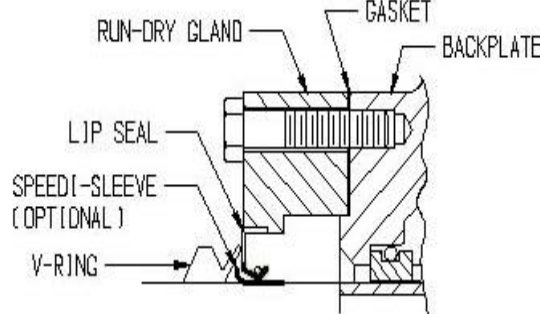
With the extended service run-dry feature, the pump can operate for several hours with no liquid in the pump casing without causing damage to the mechanical seal.

Recommended reservoir lubricants:

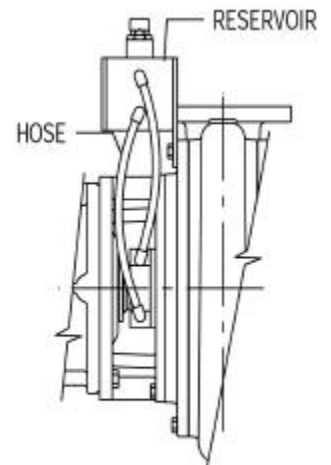
Royal Purple Barrier Fluid FDA 22,
Synthetic White Oil (or other ISO viscosity grade 22 or lower synthetic oil)



RUN-DRY PARTS
(INTEGRAL AUXILIARY GLAND)



RUN-DRY PARTS
(BOLT-ON AUXILIARY GLAND)



GLAND TO RESERVOIR PIPING

LA20245

INSTRUCTIONS FOR PACKING

Stuffing box maintenance consists of tightening packing to reduce the leakage to a trickle. Install additional packing rings or replace packing.

If adding a new packing ring to an old packing does not reduce the leakage to an acceptable level, remove the old packing completely. Inspect the shaft sleeve. Installing new packing against a worn sleeve will not give satisfactory service.

To remove packing, twist two packing pullers (see drawing 3200-401) into the exposed packing ring 180° apart. Next pull ring out of the stuffing box cavity. Pull subsequent exposed packing ring until all rings are removed. The lantern ring has two holes 180° apart and it can be removed with the same two packing pullers.

Before installing packing into the box, insert the packing gland to make sure it enters freely to the full depth of the gland.

Make sure that each ring is cut square on a mandrel of correct size and length and insert each ring of packing separately, pushing it squarely into the box. Successive rings of packing should be rotated so the points are 120° apart. Install lantern ring (if required) in proper position to the packing rings as shown on the parts page.

Install packing gland so that it just begins to enter the stuffing box without cocking and so the full packing is under uniform pressure. Tighten the gland only enough to draw the necessary vacuum for priming. Start the pump with the gland loose so there will be initial leakage. Tighten up slightly and evenly on the gland nuts at 15 or 20-minute intervals so leakage is reduced to a trickle. Do not stop leakage completely.

LUBRICATION OF PACKING WITH LANTERN RING AND GREASE CUP

If your pump has a lantern ring and grease cup for lubricating the packing it will contain “Insoluble pump and packing lubricant.” This compound reduces friction and prolongs the life of the graphited packing. Do not use standard multi-purpose grease. It will wash out the graphite particles, increase friction and heat. Refill grease cup with “Insoluble pump and packing lubricant” as required. If you’re repacking a pump, apply a liberal coating of this compound to all surfaces of the packing before installing each ring. Replenish grease cup as required.

LUBRICATION INSTRUCTIONS – ELECTRIC MOTORS

BALL BEARING LUBRICATION

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

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:

G.E. Long Life Grease No. D6A2C5
Mobil Mobilux No. EP2
Shell Alvania EP2
Texaco Multifak AFB 2

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

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 18-18D	20	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 3200-902.

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 150⁰F	Oil Temperature Over 150⁰F
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 10⁰F lower than the oil temperature.

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

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.

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 contaminates 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.

How to Dismantle and Reassemble A Cornell W or Y Series and NL Series-Threaded Shaft (Packing and Seal)

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

DISMANTLING

1. Remove balance line if applicable.
2. Remove screws from suction cover and tap cover lightly with hammer. Insert two of these screws into tapped holes in the cover. Tighten screws to jack the cover free.
3. Impeller threads are right hand. To remove impeller, attach flat bar to drive hub or coupling flange on the drive end of shaft (see page 3200-401). Looking from the impeller end, have the lever rest to your left on the table or floor. Hold impeller firmly and lift lever, then rapidly reverse and ram the lever onto table or floor. Repeat this operation with increased intensity until the impeller thread unlocks. If this method does not unlock the impeller, use an impeller pry-bar, see page 3200-401. With the flat bar-drive hub used in the previous method, unscrew and remove impeller.
4. If pump has a mechanical seal, remove any flush lines to seal gland. Remove gland capscrews evenly until capscrews are free of volute. If pump has packing, loosen gland capscrews. Then apply impeller pulling tool (see page 3200-401) to free both impeller and volute.
5. Remove volute and shaft key.
6. Remove sleeve only if necessary. Install sleeve puller outside diameter of sleeve and lock puller to sleeve with set screws (see sleeve page puller on page 3200-401). Remove puller and sleeve with standard gear puller. If parts page shows an "O" ring groove in sleeve then sleeve can be pulled off by hand.
7. The suction wear ring 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.

REASSEMBLE

1. To replace sleeve, heat new sleeve uniformly to about 400⁰ for about 10 minutes. Slide it on the shaft quickly. However, if the sleeve has an "O" ring, it should not be heated.
NOTE: Remove burrs on shaft around keyway before replacing sleeve.
- 2a. Pump with mechanical seal: Each seal has its own particular assembly procedure. Read instructions for the particular seal type before proceeding, or damage to seal parts will result. When applicable, follow instructions for mechanical seal.
- 2b. Pump with packing: To repack stuffing box, remove the gland and pull out the old packing. Insert an extra sleeve in the stuffing box to insure proper alignment of new packing, which is then slipped into the stuffing box, ring by ring. Stagger the splits in the packing rings 120⁰. To insure proper pressure on each ring, push all the way down and tap lightly.
3. Replace volute by sliding it carefully over shaft. Bolt volute to bracket or frame.
4. Thread impeller onto shaft hand tight.
5. For seals, bring the gland and gasket against the face at the seal chamber and tighten the bolts evenly. For packing, replace packing gland.
6. Use new gaskets. For emergency use, old gaskets should be moist and flat.
7. Replace suction cover and reconnect any balance or flush lines.

How to Dismantle and Reassemble a Cornell Pump With Threaded Shaft (Packing and Seal)

Some parts may be mentioned in these instructions that do not apply to your pumps. Refer to your specific parts page for parts names.

Dismantling:

1. Remove balance line if applicable.
2. Remove all capscrews from volute. Insert two of these screws into tapped holes in back side of plate. Tighten screws to jack the volute free from the back side plate exposing the impeller. Remove volute. Make sure volute doesn't fall on to impeller.
3. Impeller threads are right hand. To remove impeller, attach flat bar to drive hub or coupling flange on drive end of shaft. (See page 3200-401). Looking from the impeller end have the lever rest to your left on the table or floor. Hold impeller firmly and lift lever, then rapidly reverse and ram the lever onto table or floor. Repeat this operation with increased intensity until the impeller thread unlocks. If this method does not unlock the impeller use an impeller pry-bar (see 3200-401). With the flat bar-drive hub used in the previous method, unscrew and remove impeller.
4. If pump has a mechanical seal, remove any flush lines to seal gland. Remove gland capscrews evenly until capscrews are free. If pump has packing, loosen gland capscrews.
5. Unbolt and remove back side plate from frame or bracket.
6. Remove sleeve 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 groove in sleeve, then sleeve can be pulled off by hand.
7. The suction wear ring 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.

REASSEMBLING:

1. To replace sleeve: Heat new sleeve very uniformly to about 400⁰F for about ten minutes. Slide it on the shaft quickly. **CAUTION:** If the sleeve has an "O" ring it should not be heated. **NOTE:** Remove burrs on shaft around keyway before replacing sleeve.
- 2a. Pump with mechanical seal: Each seal has its own particular assembly procedures. Read instructions for the particular seal before proceeding or damage to seal parts will result. Where applicable, follow instructions for mechanical seal.
- 2b. Pump with packing: To repack stuffing box, remove the gland and pull out the old packing. Insert an extra sleeve in the stuffing box to insure proper alignment of new packing, which is then slipped into the stuffing box, ring by ring. Stagger the splits in the packing rings 120⁰. To ensure proper pressure on each ring, push all the way down and tap lightly.
3. Replace back side plate.
4. Use new gaskets. For emergency use, old gaskets should be moist and flat.
5. Add thrust washer and thread impeller onto shaft, hand tight.
6. Replace packing gland.
7. Replace volute, sliding it carefully over register. Bolt volute to back side plate.
8. Reconnect any lines that may have been removed (balance, flush, or etc.).

Dismantling and Assembling Cornell Frame Pumps EM5/F5 Grease Lube and EM5K/F5K Oil Lube Frames

Oil lubricated frames are denoted by a "K" on the serial plate and an oil level sight 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 drive end shaft key.
3. Remove capscrews from drive end bearing cover, engine bracket, and pump end bracket.

NOTE: Oil lubricated frames have double lip seals at 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 that 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 and bracket off the shaft.

4. The shaft and bearing can now be removed by pressing on the drive end of the shaft.
5. Remove 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.
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 housing.
3. Install the pump end lip seals into the bracket as shown on the parts page. Hot oil pumps do not use pump end lip seals. Place the bracket O-ring in the counterbore of the bracket as shown on the parts page. The O-ring can be held in place with a bead of grease or STP.
4. Slide the bracket over the shaft, taking care not to damage or fold the lip seals and bolt the bracket in place. Tighten the bracket bolts so that the bracket comes up against the frame face, metal to metal. Torque to 30 foot pounds.
5. Install the drive end lip seals into the bearing cover. Re-install shims in drive end bearing bore (if present when disassembled). If new shaft, bracket, frame, engine bracket, bearings or bearing cover are being installed, insert shims to maintain 0.002" to 0.010" shaft endplay. Place gasket on drive end bearing cover and slide bearing cover over shaft, taking care not to damage lip seals. Bolt the bearing cover down.
6. Replace the deflectors and lubricate per page 3200-901 for grease lubricated frames; page 3200-902 for oil lubricated frames.

Dismantling and Assembling Cornell Frame Pumps F5 Grease Lube Frame for Nautilus

Dismantling: (Refer to parts page for names and locations of parts).

1. Remove the deflectors from the shaft.
2. Remove drive end shaft key.
3. Remove capscrews from drive end bearing cover and pump end bracket. F5 frames for the Nautilus pumps have a single lip seal at the drive end and a labyrinth seal in the bracket at the pump end. If the lip seal is 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 lip. Slide the bearing cover and bracket off the shaft. Remove the wavespring.
4. The shaft and bearings can now be removed by pressing on the drive end of the shaft.
5. Remove 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.

Assembly:

1. Press the drive end and pump end bearings onto the shaft.
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 housing.
3. Place the wavespring over the drive end of the shaft, and position it against the drive end bearing.
4. Slide the bracket over the shaft, and bolt the bracket in place. Tighten the bracket bolts so that the bracket comes up against the frame face, metal to metal. Torque to 30 foot pounds.
5. Install the drive end lip seal into the bearing cover. Place gasket on drive end bearing cover and slide bearing cover over shaft, taking care not to damage the lip seal. Bolt the bearing cover down.
6. Replace the deflectors and lubricate per manual page 3200-901 or 3200-902.

Dismantling and Assembling Cornell Frame Pumps Horizontal F12 Oil/Grease and VF12 Grease Lubrication

Dismantling: (Refer to parts drawing for names of parts)

1. Remove the deflector from the shaft.
2. Remove drive end shaft key.
3. Remove capscrews from both bearing covers. Observe the lip seals in each cover. If these 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, make a note on the "Direction" of sealing. The "Direction" of sealing is important if the lip seals are replaced. Remove both bearing covers.
4. Remove bearing locknut and lockwasher.
5. Press shaft out toward pump end. Drive end bearings will remain in frame.
6. Press drive end bearings out of frame toward drive end. Note: Snap ring in drive end need not be replaced or removed unless damaged. Pull pump end bearing off shaft with suitable puller.

If the bearings are to be saved, keep absolutely clean. If there is reason to believe that they may be contaminated and need cleaning, wash only in clean fluid.

NEVER hammer the shaft or parts attached to the shaft or you will ruin both the shaft and bearings.

Assembly:

1. Press pump end bearing into frame. Press bearing 1/8 of an inch into the bore.
2. For Horizontal F12 Oil: Replace bearing cover gasket and then replace pump end bearing cover with grease fitting on horizontal centerline and same side of frame as sight gage (less lip seals). Tighten cover bolts evenly.
For Horizontal and Vertical F12 Grease: Replace bearing cover gasket and then replace pump end bearing cover with grease fitting on left side horizontal and vertical centerline as viewed from driver (less lip seal). Tighten cover bolts evenly.
3. Press drive end bearing onto shaft (back to back orientation). Replace lockwasher and locknut.
4. If snap ring is removed replace before pressing shaft into frame.
5. Press shaft into housing until drive end bearing comes firmly against snap ring.
6. Remove pump end bearing cover and press lip seals into cover. Replace gasket and bearing cover.
7. Install drive end bearing cover without gaskets or lip seals and check for clearance between cover and face. Shims between drive end bearing cover and bearing may be required to maintain a gap of .025 to .045.
8. For Horizontal F12 Oil: Replace drive end bearing cover gasket, then replace drive end bearing cover with grease fitting on horizontal centerline and same side of frame as sight gage and lip seals.
For Horizontal and Vertical F12 Grease: Replace drive end bearing cover gasket, then replace drive end bearing cover with grease fitting on left side horizontal and vertical centerline as viewed from driver and lip seal.
9. Replace deflector.
10. Replace drive end key and lube frame per page 3200-901 for grease lubricated frames, or page 3200-902 for oil lubricated frames.

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 0.003" to 0.010" 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.

Dismantling and Assembling Cornell Frames F18 and EM18 Grease Lubed and F18K 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. Press the shaft out toward the drive end. The pump end bearing remains in the frame and can now be removed. The drive end bearing is still on the shaft. Remove the bearing lock nut and washer. Remove the bearing 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 shaft bearing spacer and the drive end bearing onto the shaft. Pressure should be applied to the inner race. Replace the lock washer and locknut.
2. Press the pump end bearing into the frame. Place a shim on the bearing and install the pump bracket. Do not include gasket.
3. Press the frame bearing spacer in the drive end of the frame. Press the shaft in the drive end of the frame until the bearing contact the frame bearing spacer.
4. Remove the pump bracket and shim.
5. Install the pump end lip seal(s) in 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.
6. 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 bearings, frame, bearing cover or drive end bracket are being installed, insert shims to maintain 0.021" maximum shaft endplay. (Axial of the bearing is approximately .017". Shaft endplay cannot be less). Slide the bearing cover (with gasket for oil lubed frames) or drive end bracket over the shaft. Install and tighten the capscrews. shaft endplay.
7. Install the deflector and lubricate per page 3200-901 for grease lubed frames, or page 3200-902 for oil lubed frames.

Dismantling and Assembling Cornell Frames F18DB and EM18DB Grease Lubed and F18DBK 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. Press the shaft out toward the drive end. The pump end bearing remains in the frame and can now be removed. The drive end bearing is still on the shaft. Remove the bearing lock nut and washer. Remove the bearing 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

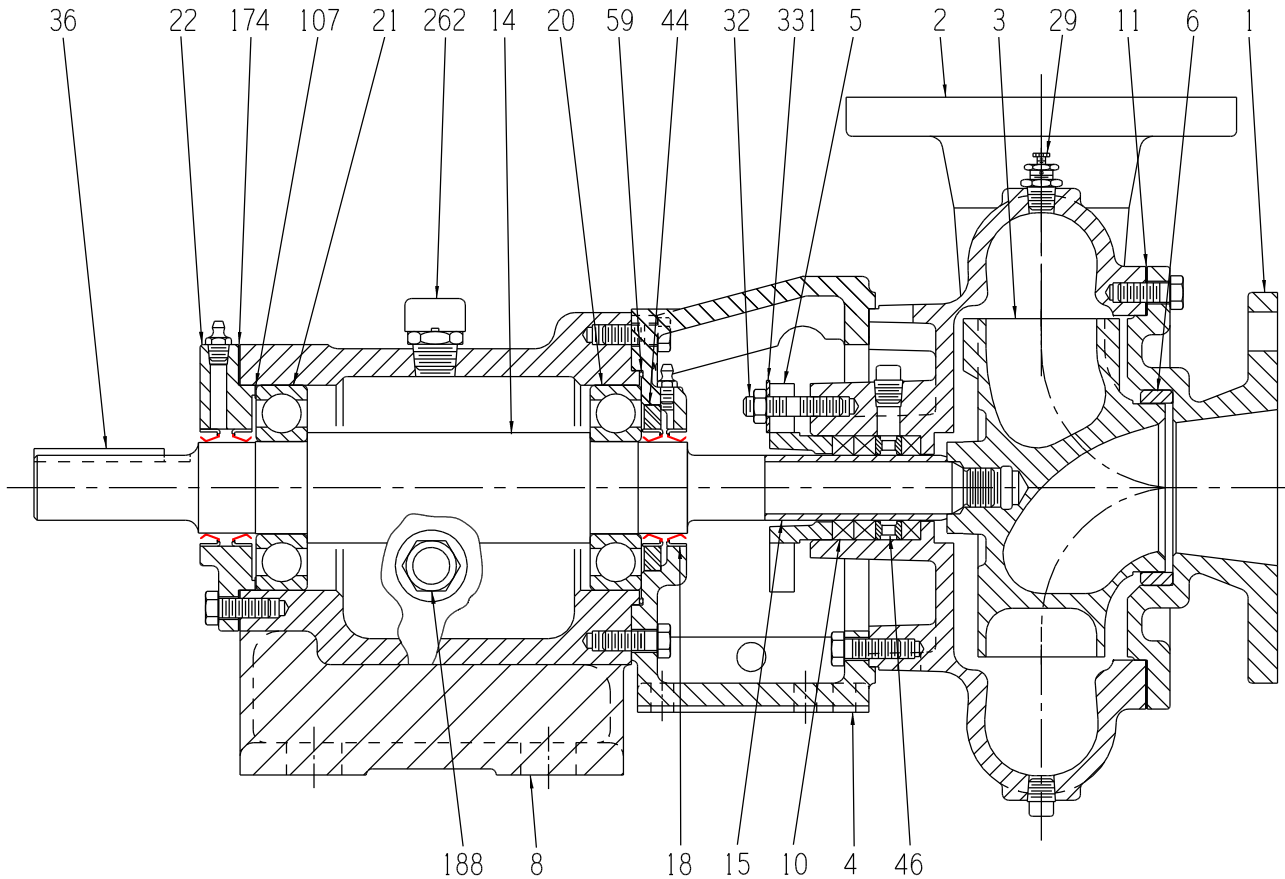
1. Press the drive end bearings onto the shaft (back to back). Pressure should be applied to the inner race. Replace the lock washer and locknut.
2. Press the pump end bearing into the frame. Place a shim on the bearing and install the pump bracket. Do not include gasket.
3. Press the shaft in the drive end of the frame until the drive end bearing contacts the frame shoulder.
4. Remove the pump bracket and shim.
5. Install the pump end lip seal(s) in 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.
6. 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 bearings, frame, bearing cover or drive end bracket are being installed, insert shims to maintain 0.003" to 0.010" shaft endplay. Slide the bearing cover (with gasket for oil lubed frames) or drive end bracket over the shaft. Install and tighten the capscrews.
7. Install the deflector and lubricate per page 3200-901 for grease lubed frames, or page 3200-902 for oil lubed frames.

NOTE: Replace wear ring when there is a noticeable reduction in pump discharge pressure.

Case wear ring inside diameter = 13.786"

Impeller wear ring outside diameter = 13.7486"

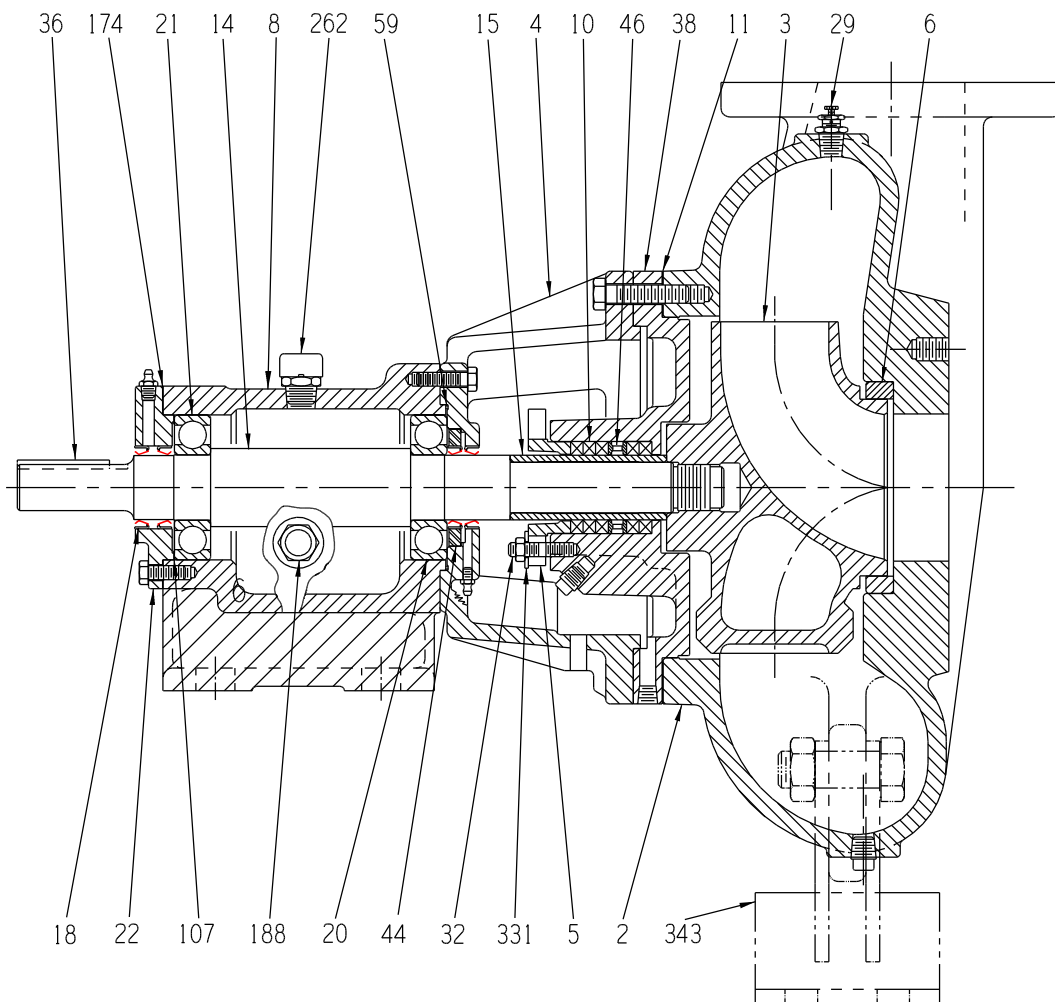
Nominal wear ring clearance = 0.38"



PARTS LIST

- 1. SUCTION COVER
- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 14. SHAFT
- 15. SHAFT SLEEVE
- 18. LIP SEAL (P.E.)
- 20. PUMP END BEARING
- 21. DRIVE END BEARING (2)
- 22. BEARING COVER (P.E.)
- *29. VENT PLUG
- 32. GLAND STUD & NUT
- 36. DRIVE END SHAFT KEY
- 44. BRACKET INSERT RING
- 46. LANTERN RING (OPTIONAL)
- 59. O-RING
- 97. GREASE CUP (OPTIONAL)
- 107. SHIMS
- 174. BEARING COVER GASKET (D.E.)
- 188. OIL LEVEL SIGHT GAUGE
- 262. BREATHER
- 331. GLAND CLIPS (2)

*NOT ALWAYS USED



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 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
- 29. VENT PLUG
- 32. GLAND STUD & NUT
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- Δ 44. BRACKET INSERT RING
- 46. LANTERN RING (OPTIONAL)
- 59. BRACKET O-RING
- 107. SHIMS
- Δ 174. BEARING COVER GASKET
- Δ 188. OIL LEVEL SIGHT GASKET
- 262. BREATHER
- 331. GLAND CLIPS (2)
- 343. PUMP SUPPORT ASSEMBLY (4NMPP ONLY)

OIL LUBRICATED SHOWN

Δ USED ON OIL LUBE FRAMES ONLY

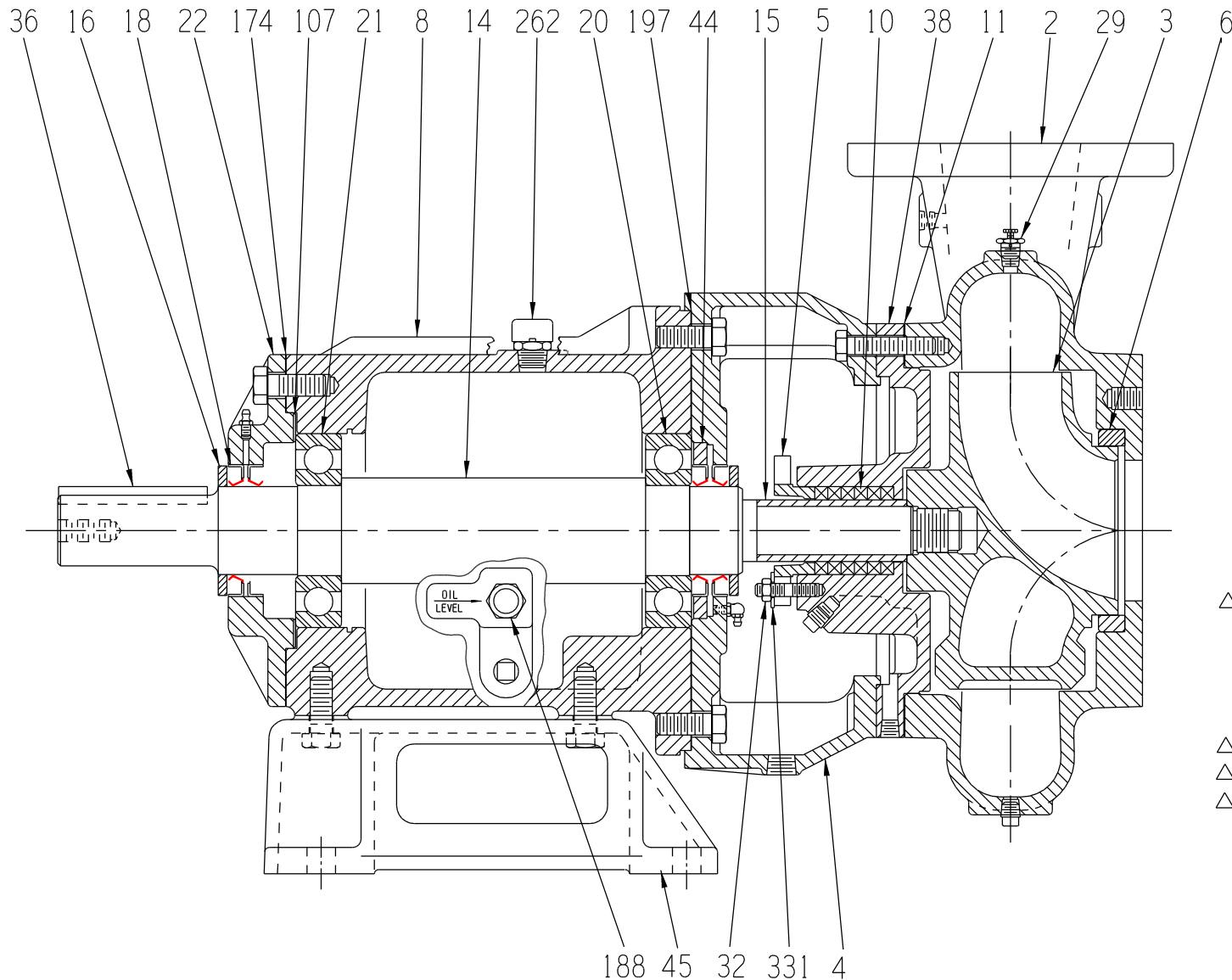
NOTE: LUBRICATION PIPING NOT SHOWN



CORNELL PUMP COMPANY

16261 SE 130TH. PORTLAND, OR 97015

MODELS 4NMPP & 4NMP WITH PACKING
F5 (grease lube)/F5K (oil lube) horizontal frame



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 4. PUMP BRACKET
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 14. SHAFT
- 15. SHAFT SLEEVE
- 16. DEFLECTOR
- 18. LIP SEALS (4 for oil; 2 for grease)
- 20. PUMP END BEARING
- 21. DRIVE END BEARING
- 22. BEARING COVER
- *29. VENT PLUG
- 32. GLAND STUD & NUT
- 36. SHAFT KEY (D.E.)
- 38. BACK SIDE PLATE
- △ 44. BRACKET INSERT RING
- 45. MOUNTING FOOT
- 46. LANTERN RING (OPTIONAL)
- 97. GREASE CUP (OPTIONAL)
- 107. SHIMS
- △ 174. BEARING COVER GASKET
- △ 188. OIL LEVEL SIGHT GAUGE
- △ 197. PUMP BRACKET GASKET
- 262. BREATHER
- 331. GLAND CLIPS (2)
- 343. PUMP SUPPORT ASSEMBLY (4NMPP ONLY)

NOTE: OIL LUBE CONFIGURATION SHOWN

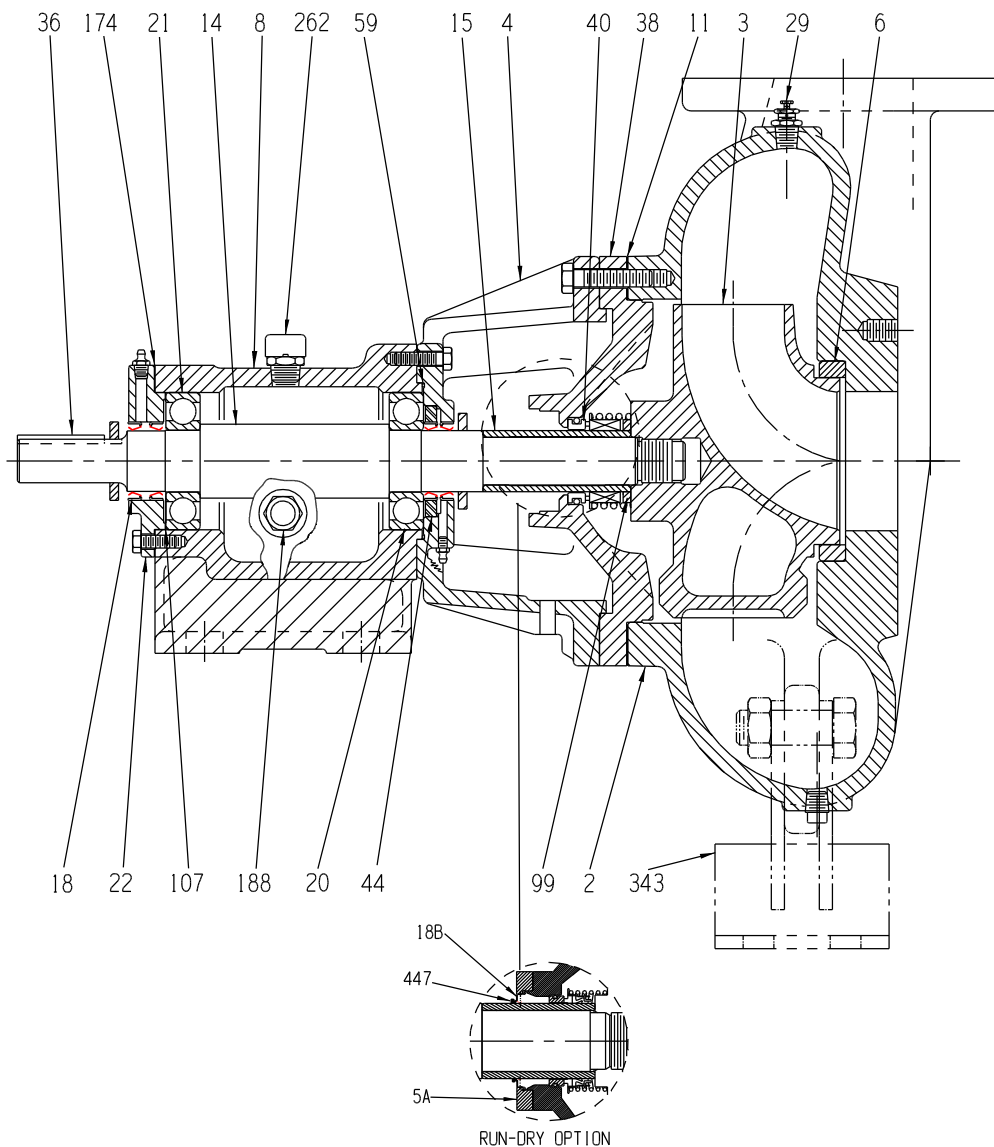
△ USED ON OIL LUBE FRAMES ONLY

*NOT ALWAYS USED



CORNELL PUMP COMPANY

MODELS 4NMPP & 4NMP WITH PACKING
 F16 (grease lube)/F16K (oil lube) horizontal frame



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5A. RUN DRY GLAND
- 6. WEAR RING
- 8. FRAME
- 11. VOLUTE GASKET
- 14. SHAFT
- 15. SHAFT SLEEVE
- 16. DEFLECTOR
- 18. LIP SEALS (4 FOR OIL; 2 FOR GREASE)
- 18B. LIP SEAL (RUN-DRY)
- 20. BEARING (P.E.)
- 21. BEARING (D.E.)
- 22. BEARING COVER
- 29. VENT PLUG
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- 40. MECHANICAL SEAL
- △ 44. BRACKET INSERT RING
- 59. BRACKET O-RING
- 99. SEAL SPACER
- 107. SHIMS
- △ 174. BEARING COVER GASKET
- △ 188. OIL LEVEL SIGHT GAUGE
- 262. BREATHER
- 343. PUMP SUPPORT ASSEMBLY (4NMPP ONLY)
- 447. V-RING

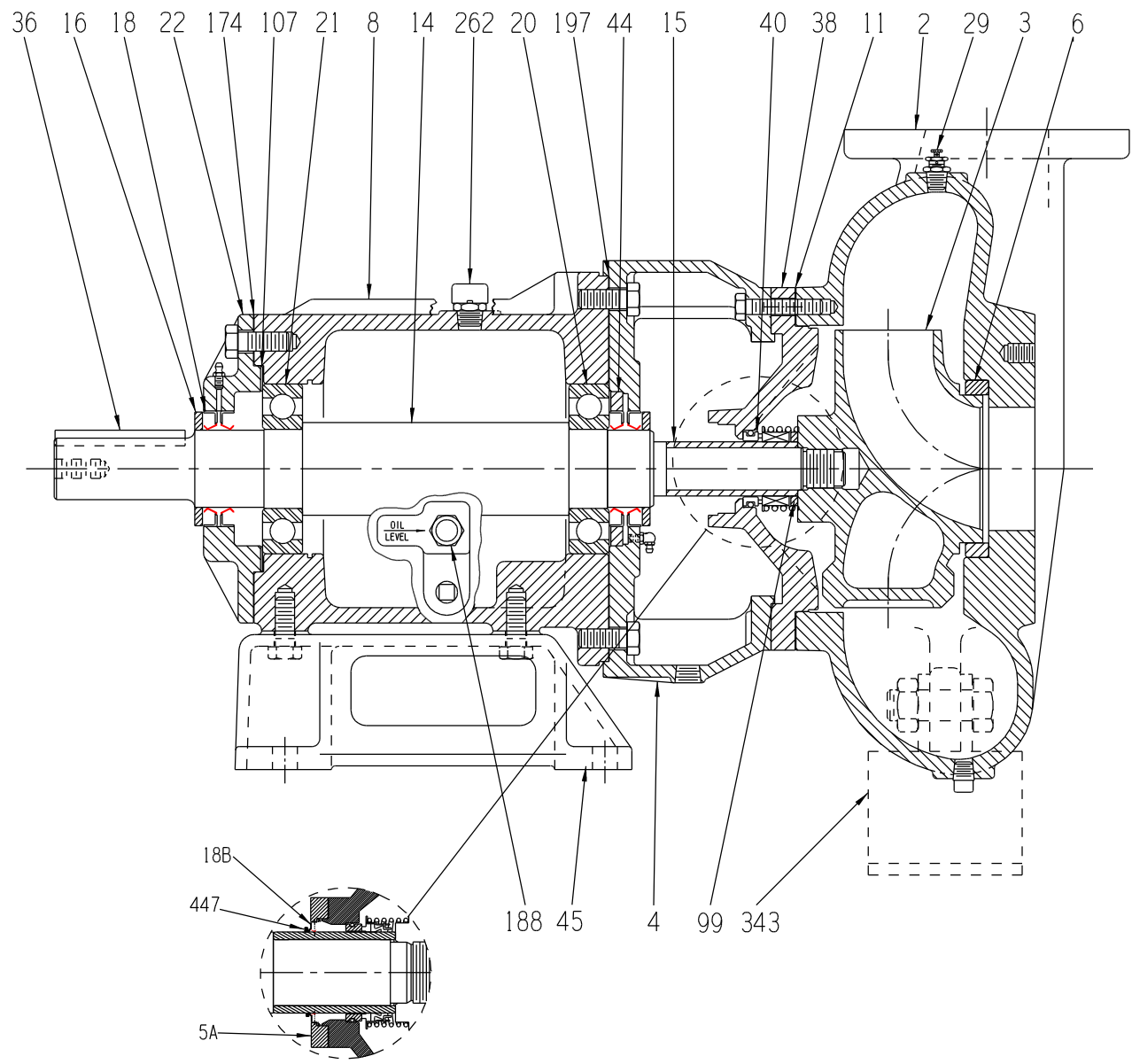
OIL LUBRICATED SHOWN

△ USED ON OIL LUBE FRAMES ONLY



CORNELL PUMP COMPANY

MODELS: 4NMP & 4NMPP W/CYCLOSEAL
F5 (GREASE LUBE) / F5K (OIL LUBE) HORIZONTAL FRAME



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5A. RUN DRY GLAND
- 6. WEAR RING
- 8. FRAME
- 11. VOLUTE GASKET
- 14. SHAFT
- 15. SHAFT SLEEVE
- 16. DEFLECTOR
- 18. LIP SEALS (4 FOR OIL; 2 FOR GREASE)
- 18B. LIP SEAL (RUN-DRY)
- 20. BEARING (P.E.)
- 21. BEARING (D.E.)
- 22. BEARING COVER
- 29. VENT PLUG
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- 40. MECHANICAL SEAL
- △ 44. BRACKET INSERT RING
- 45. MOUNTING FOOT
- 99. SEAL SPACER
- 107. SHIMS
- △ 174. BEARING COVER GASKET
- △ 188. OIL LEVEL SIGHT GAUGE
- △ 197. BRACKET GASKET
- 262. BREATHER
- 343. PUMP SUPPORT ASSEMBLY (4NMPP ONLY)
- 447. V-RING

RUN-DRY OPTION

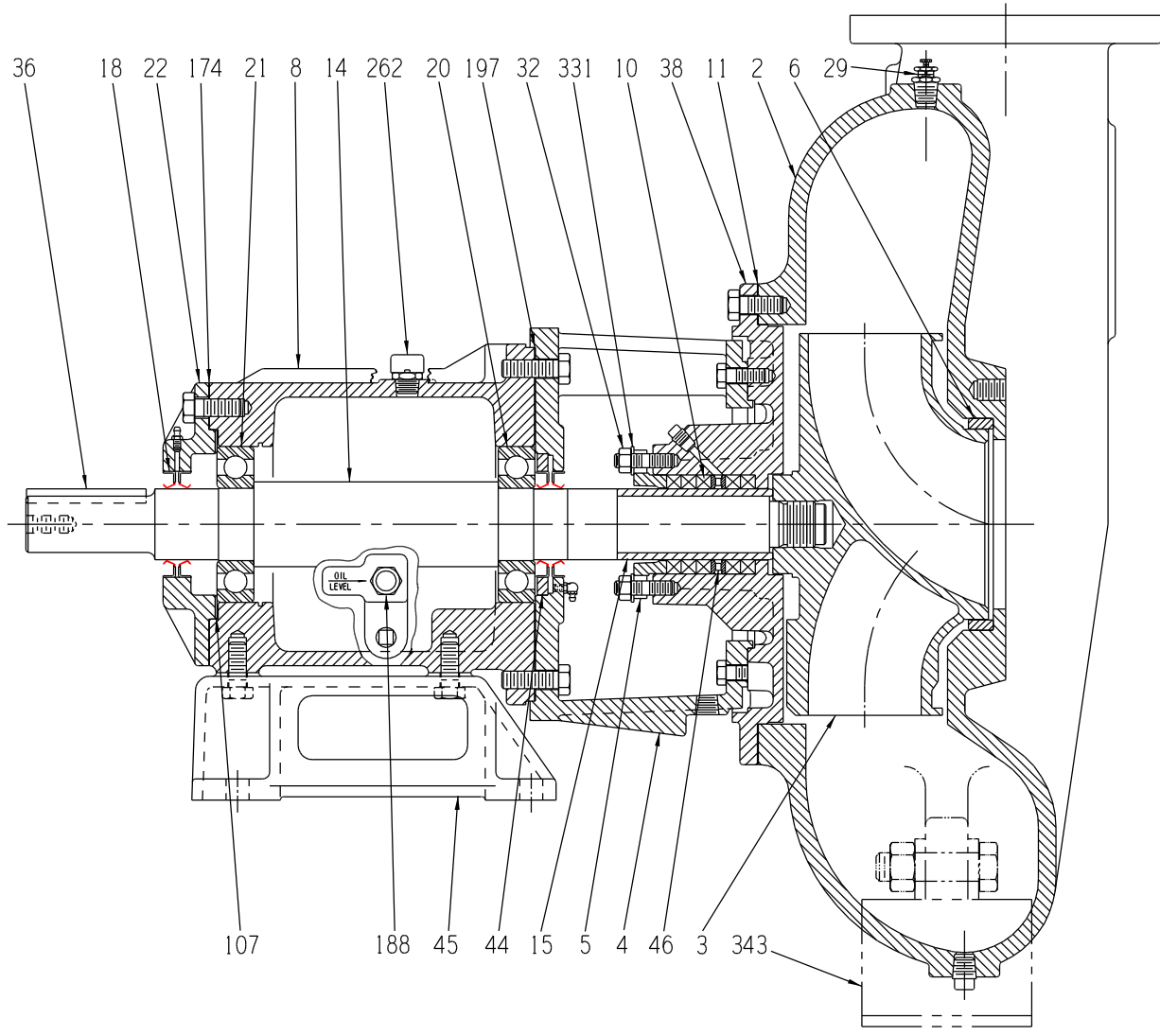
OIL LUBRICATED SHOWN

△ USED ON OIL LUBE FRAMES ONLY



CORNELL PUMP COMPANY

MODELS: 4NMP & 4NMPP W/CYCLOSEAL
 F16 (GREASE LUBE) / F16K (OIL LUBE) HORIZONTAL FRAME



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 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
- 29. VENT PLUG
- 32. GLAND STUD & NUT
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- △ 44. BRACKET INSERT RING
- 45. MOUNTING FOOT
- 46. LANTERN RING (OPTIONAL)
- 55. MOTOR
- 107. SHIMS
- △ 174. BEARING COVER GASKET
- △ 188. OIL LEVEL SIGHT GAUGE
- △ 197. PUMP BRACKET GASKET
- 262. BREATHER
- 331. GLAND CLIPS (2)
- 343. PUMP SUPPORT ASSEMBLY (6NHPP ONLY)

OIL LUBRICATED SHOWN

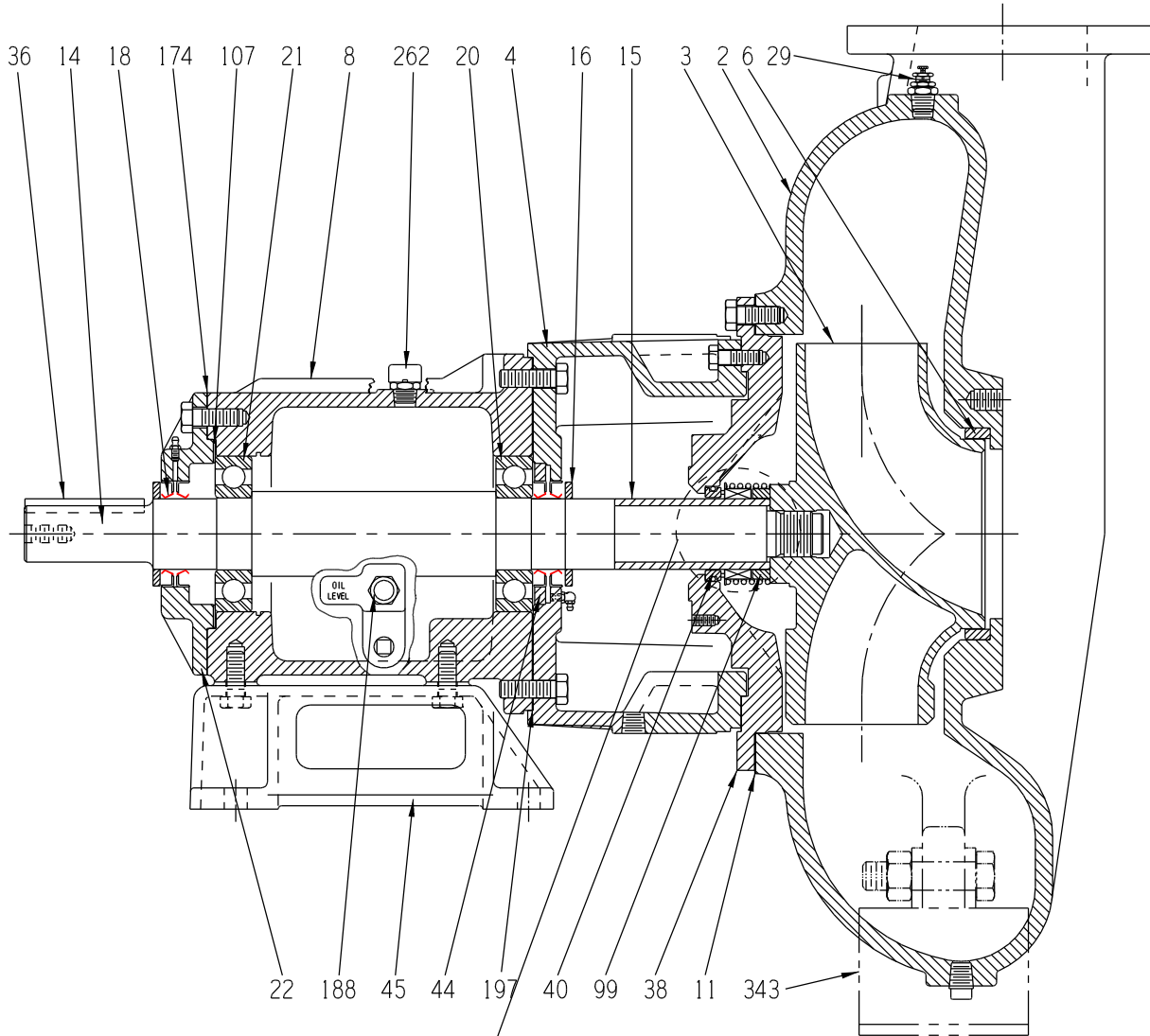
△ USED ON OIL LUBE FRAMES ONLY

NOTE: LUBRICATION PIPING NOT SHOWN



CORNELL PUMP COMPANY
 16261 SE 130TH. PORTLAND, OR 97015

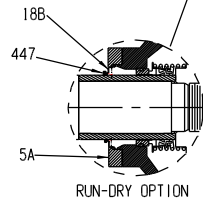
MODEL : 6NHP & 6NHPP W/PACKING
 F16 (GREASE LUBE) / F16K (OIL LUBE) HORIZONTAL FRAME



PARTS LIST

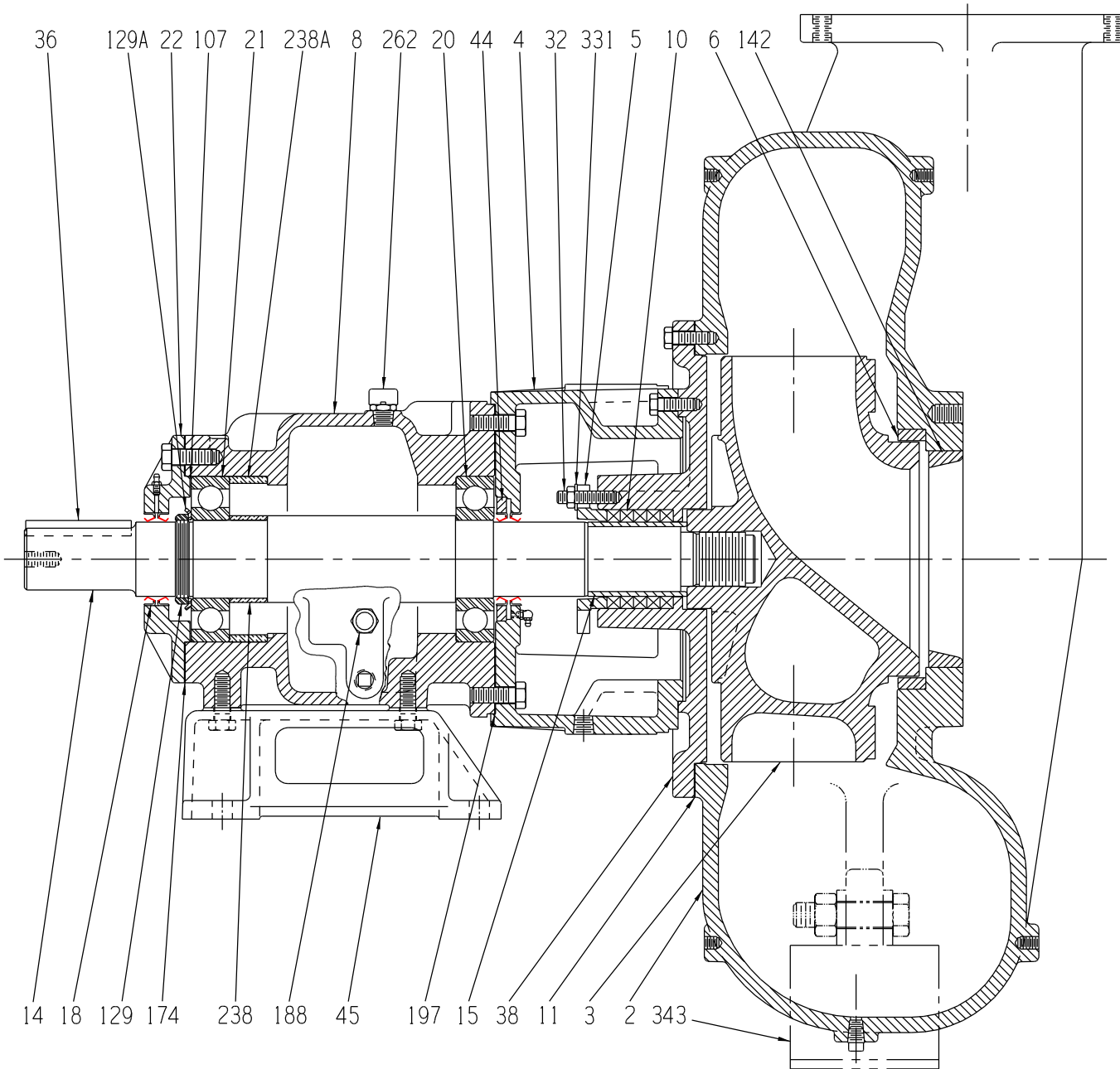
- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5A. RUN DRY GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 11. VOLUTE GASKET
- 14. SHAFT
- 15. SHAFT SLEEVE
- 16. DEFLECTOR
- 18. LIP SEALS (4 FOR OIL; 2 FOR GREASE)
- 18B. LIP SEAL (RUN-DRY)
- 20. PUMP END BEARING
- 21. DRIVE END BEARING
- 22. BEARING COVER
- 29. VENT PLUG
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- 40. MECHANICAL SEAL
- Δ 44. BRACKET INSERT RING
- 45. MOUNTING FOOT
- 99. SEAL SPACER
- 107. SHIM
- Δ 174. BEARING COVER GASKET
- Δ 188. OIL LEVEL SIGHT GAUGE
- Δ 197. PUMP BRACKET GASKET
- 262. BREATHER
- 343. PUMP SUPPORT ASSEMBLY
- 447. V-RING

OIL LUBRICATED SHOWN



RUN-DRY OPTION

Δ USED ON OIL LUBE FRAMES ONLY



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 4. BRACKET
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 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
- 32. GLAND STUD & NUT
- 36. SHAFT KEY (D.E.)
- 38. BACK SIDE PLATE
- △ 44. BRACKET INSERT RING
- 45. MOUNTING FOOT
- 107. SHIMS
- 129. LOCK NUT
- 129A. LOCK WASHER
- 142. SUCTION INSERT
- △ 174. BEARING COVER GASKET
- △ 188. OIL LEVEL SIGHT GAUGE
- △ 197. PUMP BRACKET GASKET
- 238. SHAFT BEARING SPACER
- 238A. FRAME BEARING SPACER
- 262. BREATHER
- 331. GLAND CLIP
- 343. PUMP SUPPORT ASSEMBLY

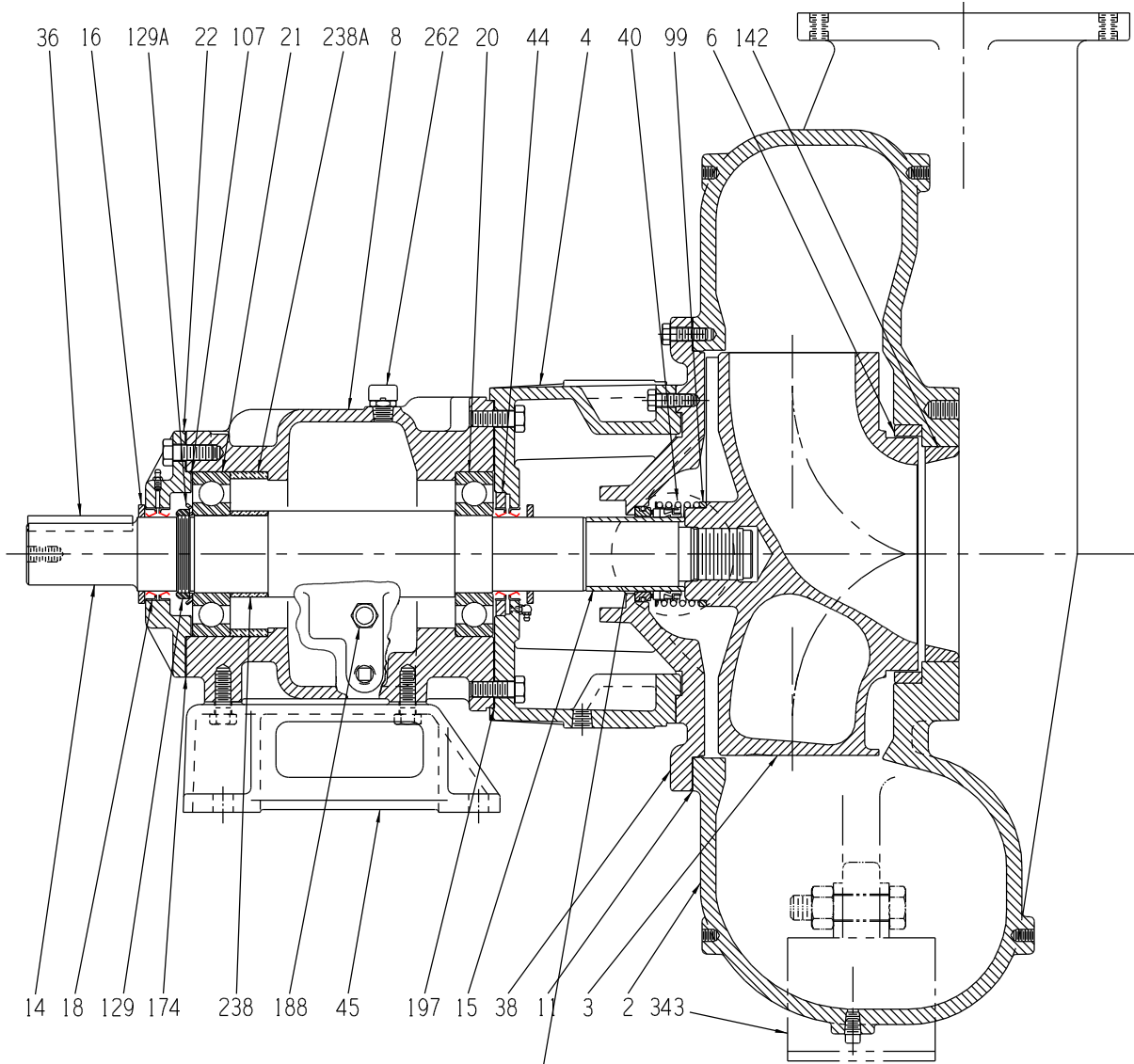
OIL LUBRICATED SHOWN

△ USED ON OIL LUBE FRAMES ONLY
NOTE: LUBRICATION PIPING NOT SHOWN

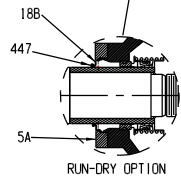


CORNELL PUMP COMPANY
16261 SE 130TH. PORTLAND, OR 97015

8NHPP-F18K WITH PACKING
F18 (GREASE LUBE) / F18K (OIL LUBE) HORIZONTAL FRAME



- PARTS LIST**
- 2. VOLUTE
 - 3. IMPELLER
 - 4. BRACKET
 - 6. SUCTION WEAR RING
 - 5A. RUN DRY GLAND
 - 8. FRAME
 - 11. VOLUTE GASKET
 - 14. SHAFT
 - 15. SHAFT SLEEVE
 - 16. DEFLECTOR (2)
 - 18. LIP SEALS (4 For oil; 2 for grease)
 - 18B. LIP SEAL (RUN-DRY)
 - 20. PUMP END BEARING
 - 21. DRIVE END BEARING
 - 22. BEARING COVER
 - * 29. VENT PLUG
 - 36. DRIVE END SHAFT KEY
 - 38. BACKPLATE
 - 40. MECHANICAL SEAL
 - △ 44. BRACKET INSERT RING
 - 45. MOUNTING FOOT
 - 99. SEAL SPACER
 - 107. SHIM
 - 129. LOCK NUT
 - 129A. LOCK WASHER
 - 142. SUCTION INSERT
 - △ 174. BEARING COVER GASKET
 - △ 188. OIL LEVEL SIGHT GAUGE
 - △ 197. PUMP BRACKET GASKET
 - 238. SHAFT BEARING SPACER
 - 238A. FRAME BEARING SPACER
 - 262. BREATHER
 - 343. PUMP SUPPORT ASSEMBLY
 - 447. V-RING



OIL LUBRICATED SHOWN

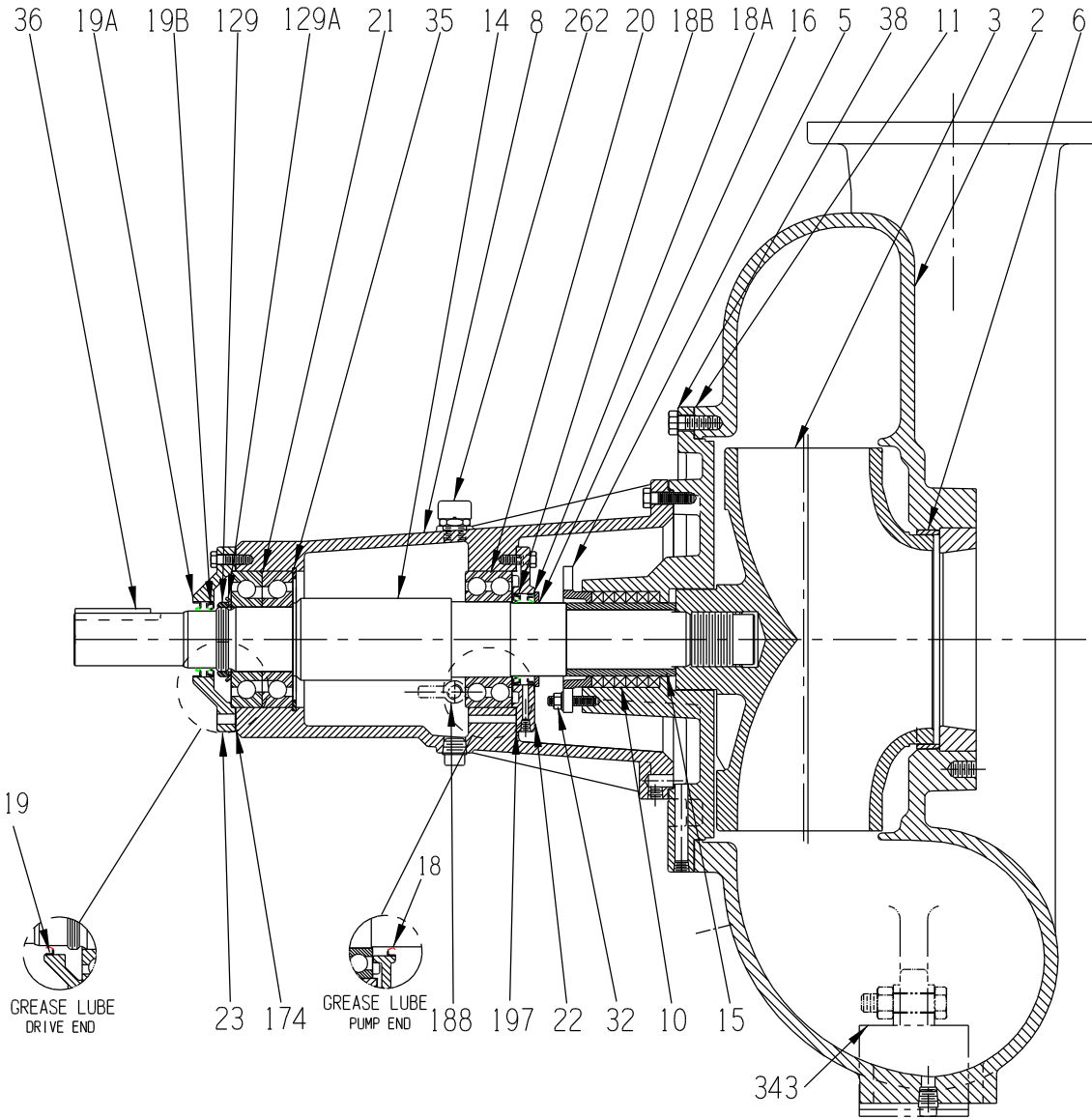
△ USED ON OIL LUBE FRAMES ONLY

* NOT ALWAYS USED



CORNELL PUMP COMPANY

8NHPP-F18K WITH CYCLOSEAL
 F18 (GREASE LUBE)/F18K (OIL LUBE) HORIZONTAL FRAME



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 12. IMPELLER LOCK SCREW
- 13. IMPELLER WASHER
- 14. SHAFT
- 15. SHAFT SLEEVE
- 16. DEFLECTOR
- 18. CLOSURE SEAL (P.E.)
- 18A. OUTER SEAL (P.E.)
- 18B. INNER SEAL (P.E.)
- 19. CLOSURE SEAL (D.E.)
- 19A. OUTER SEAL (D.E.)
- 19B. INNER SEAL (D.E.)
- 20. BEARING
- 21. DRIVE END BEARING (2)
- 22. BEARING COVER (P.E.)
- 23. BEARING COVER (D.E.)
- 32. GLAND STUD & NUTS
- 35. INTERNAL SNAP RING
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- 94. CLEAN OUT COVER (NOT SHOWN)
- 129. LOCK NUT
- 129A. LOCK WASHER
- △ 174. GASKET (D.E.)
- △ 188. VIEW GAGE
- △ 197. GASKET (P.E.)
- 216. CLEAN OUT COVER GASKET (NOT SHOWN)
- 262. BREATHER
- 343. PUMP SUPPORT ASSEMBLY

OIL LUBRICATED SHOWN

△ USED ON OIL LUBE FRAMES ONLY

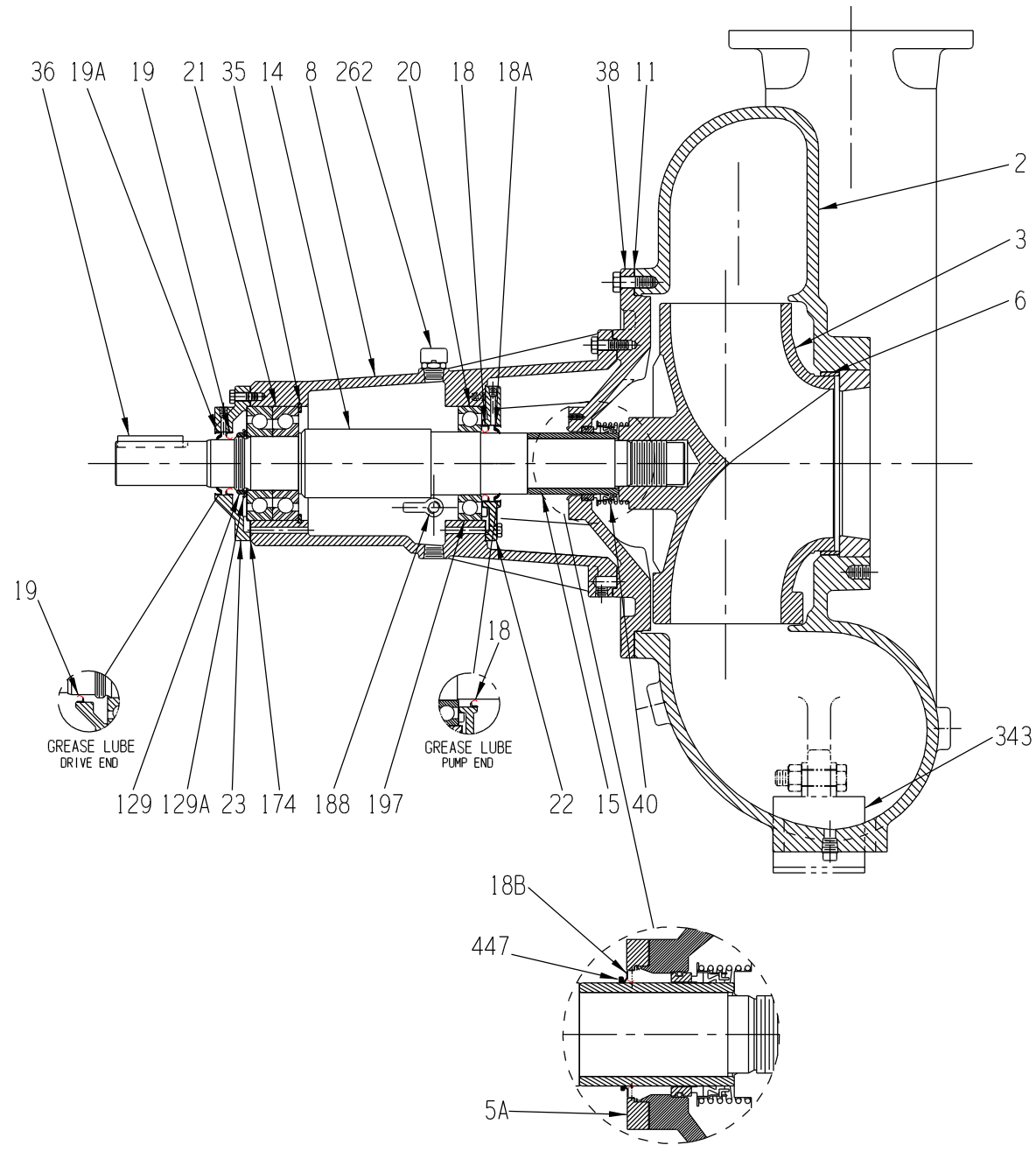


CORNELL PUMP COMPANY

10NHPP WITH PACKING
F12 (GREASE LUBE)/F12K (OIL LUBE)

PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 5A. RUN DRY GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 11. VOLUTE GASKET
- 14. SHAFT
- 15. SHAFT SLEEVE
- △ 18. LIP SEAL (P.E.)
- 18A. OUTER LIP SEAL (P.E.)
- △ 18B. LIP SEAL (RUN-DRY)
- 19. LIP SEAL (D.E.)
- 19A. OUTER LIP SEAL (D.E.)
- 20. PUMP END BEARING
- 21. DRIVE END BEARING (2)
- 22. BEARING COVER (P.E.)
- 23. BEARING COVER (D.E.)
- 35. INTERNAL SNAP RING
- 36. DRIVE END SHAFT KEY
- 38. BACKPLATE
- 40. MECHANICAL SEAL
- 94. CLEAN OUT COVER (OPTIONAL NOT SHOWN)
- 129. LOCK NUT
- 129A. LOCK WASHER
- △ 174. BEARING COVER GASKET (D.E.)
- △ 188. OIL LEVEL SIGHT GAUGE
- △ 197. BEARING COVER GASKET (P.E.)
- 216. VOLUTE CLEANOUT COVER GASKET (OPTIONAL NOT SHOWN)
- 262. BREATHER
- 343. PUMP SUPPORT ASSEMBLY
- 447. V-RING



△ USED ON OIL LUBE FRAMES ONLY

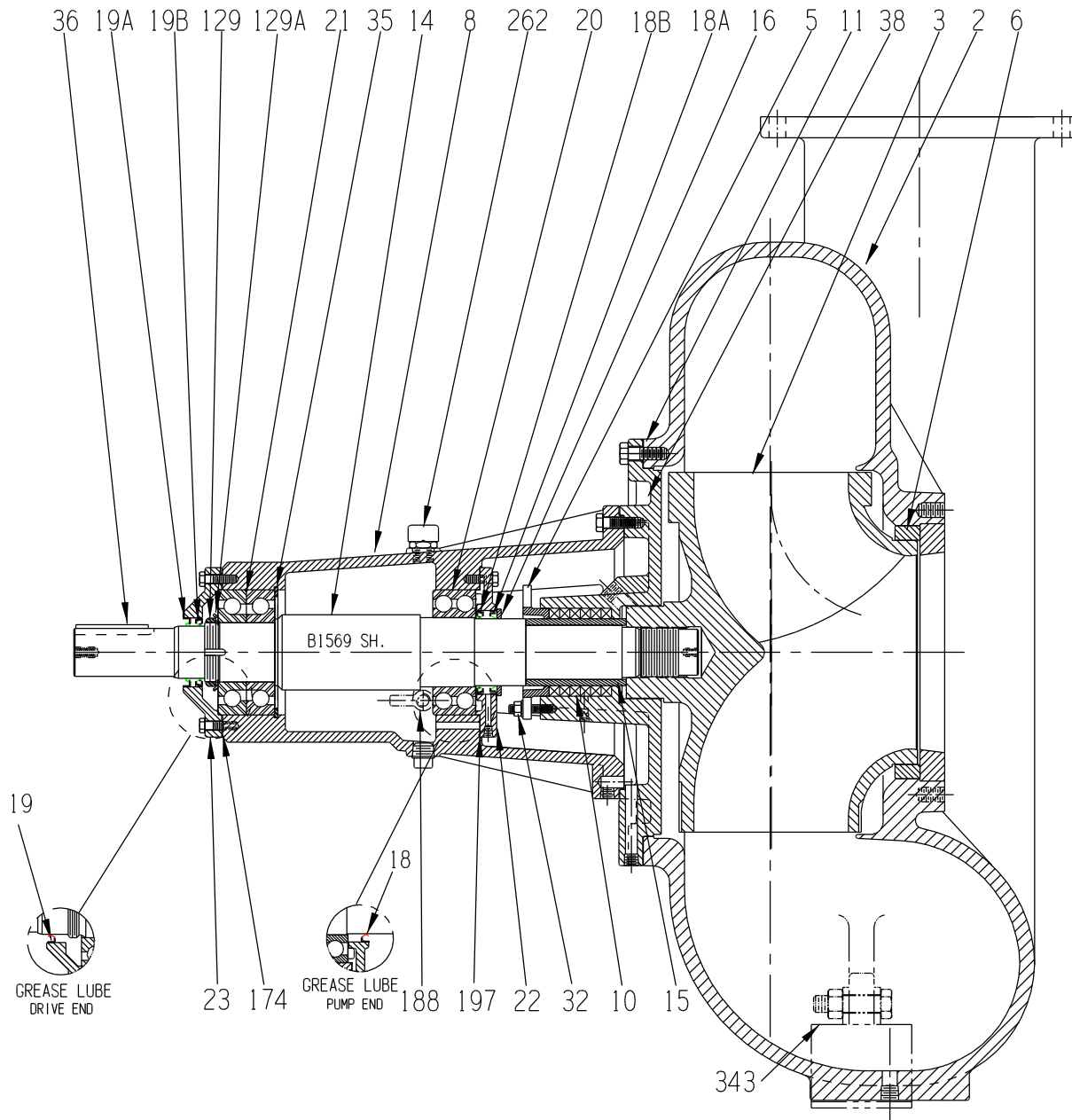
RUN-DRY OPTION

OIL LUBRICATED SHOWN



CORNELL PUMP COMPANY

MODEL : 10NHPP WITH CYCLOSEAL
F12 (GREASE LUBE)/F12K (OIL LUBE) HORIZONTAL FRAME



PARTS LIST

- 2. VOLUTE
- 3. IMPELLER
- 5. PACKING GLAND
- 6. SUCTION WEAR RING
- 8. FRAME
- 10. PACKING
- 11. VOLUTE GASKET
- 12. IMPELLER LOCK SCREW
- 13. IMPELLER WASHER
- 14. SHAFT
- 15. SHAFT SLEEVE
- 16. DEFLECTOR
- 18. CLOSURE SEAL (P.E.)
- 18A. OUTER SEAL (P.E.)
- 18B. INNER SEAL (P.E.)
- 19. CLOSURE SEAL (D.E.)
- 19A. OUTER SEAL (D.E.)
- 19B. INNER SEAL (D.E.)
- 20. BEARING
- 21. DRIVE END BEARING (2)
- 22. BEARING COVER (P.E.)
- 23. BEARING COVER (D.E.)
- 32. GLAND STUD & NUTS
- 35. INTERNAL SNAP RING
- 36. SHAFT KEY (D.E.)
- 38. BACKPLATE
- 94. CLEAN OUT COVER (NOT SHOWN)
- 129. LOCK NUT
- 129A. LOCK WASHER
- △ 174. GASKET (D.E.)
- △ 188. VIEW GAGE
- △ 197. GASKET (P.E.)
- 216. CLEAN OUT COVER GASKET (NOT SHOWN)
- 262. BREATHER
- 343. PUMP SUPPORT ASSEMBLY

OIL LUBRICATED SHOWN

△ USED ON OIL LUBE FRAMES ONLY



CORNELL PUMP COMPANY

12NHPP WITH PACKING
F12 (GREASE LUBE)/F12K (OIL LUBE)