INSTALLATION & MAINTENANCE MANUAL

KF

ANSI
NEMA & IEC

HORIZONTAL END-SUCTION PUMPS

ANSI MODEL: KF438

Issued June, 2006

T. S. U.

♦♦♦♦*Do not run dry* ♦♦♦♦
This pump is NOT self priming. The pump must be filled with liquid before starting; otherwise severe damage may occur.

ANSIMAG®
"Simple by Design"

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1. Limited Warranty

One year limited warranty

Ansimag pumps are warranted by Ansimag to the original user against defects in workmanship and materials under normal use for one year after the date of purchase. Any part returned to an Ansimag- designated, authorized service location, shipping cost prepaid, will be evaluated for defects. Parts determined by Ansimag to be defective in material or workmanship will be repaired or replaced at Ansimag's option as the exclusive remedy.

Limitation of liability

To the extent allowable under applicable law, Ansimag's liability for consequential damages is expressly disclaimed. Ansimag's liability in all events is limited to and shall not exceed the purchase price paid.

Warranty disclaimer

Ansimag has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustration or descriptions.

Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in "LIMITED WARRANTY" is made or authorized by Ansimag.

Product suitability

Many states and localities have codes and regulations governing the sale, construction, installation and/or use of products for certain purposes, which may vary from those in neighboring areas. While Ansimag attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchasing and using a product, please review the product application as well as the national and local codes and regulations, and be sure that product, installation, and use complies with them.

Warranty exclusions

Wear items that must be replaced on a regular basis are not covered under this warranty. Such items include, but are not limited to mouth rings/pads, thrust rings, O-rings, bushings and shafts.

Items that have been subject to extreme heat or have been used with abrasive or incompatible chemicals are not covered under this warranty.

EC Declaration of Conformity

Manufacturer: Sundyne Corporation

Details of Equipment:

Model Prefix	Alternative Model Description	Description	Harmonised Standards applied in order to verify compliance to the Directive
KF	ALA (PR, PS, QS, QT Couplings)	Magnetic Drive	MACHINERY DIRECTIVE 98/37/EEC:
KF	ALI (PR, PS, QS, QT Couplings)	Sealless	EN 292-1 Safety of
K	ALA (A, B,C Couplings)	Centrifugal Pumps	EN 292-2/A1 T
K	ALI (A, B, C Couplings)		EN 809 Pumps a
KM	ALA (AA, AB Couplings)		
KM	ALI (AA, AB Couplings)		ATEX DIRECTIVE 94/9/EC:
KV	VALA		EN 13463-1 Nor
KV	VALI		Part 1: Basic m
KP	SPALA		EN 13463-5 N
KP	SPALI		Part 5: Protection

Directives to which the above equipment complies to:

Machinery Directive

Directive relating to Machinery (98/37/EC)

ATEX Directive

Directive on equipment and protective systems intended for use in potentially explosive atmospheres (94/9/EC)

Group II Categories 2 and 3 (gas)

Notified body:

Intertek Testing and Certification Ltd

Intertek House
Cleeve Road, Leatherhead,
Surrey, KT22 7SB
UK

Certification Numbers: **ITS03ATEX11180**

ATEX Technical Construction File Number: ATEX-ANSIMAG-001

Year in Which CE Mark was affixed: 1996

We certify that Plastic Lined magnetically driven bareshaft, close-coupled, and separately mounted pumps manufactured by the Sundyne Corporation meet the requirements of the above Directives, when installed, operated and maintained in accordance with our published Installation and Operating Manual. Plastic Lined magnetic drive pumps must not be put into service until all the conditions relating to safety noted in these documents have been met.

Authorised Signatories on behalf of Sundyne Corporation:

Name: Jeff Wiemelt **Position:** Vice President and General Manager of Sundyne Corporation, The Americas

Name: Kerry Kramlich **Position:** Pump Engineering Manager

Date of issue: 16th June 2003 **Place of Issue:** United Kingdom

SAFETY WARNING

Genuine parts and accessories have been specifically designed and tested for use with these products to ensure continued product quality and performance. Testing cannot be performed on all parts nor on accessories sourced from other vendors, incorrect design and/or fabrication of such parts and accessories may adversely affect the performance and safety features of these products. Failure to properly select, install or use authorised Sundyne parts and accessories is considered misuse, and damage or failure caused by misuse is not covered by Sundyne's warranty. Additionally, modification of Sundyne products or removal of original components may impair the safety of these products and their effective operation.

EUROPEAN UNION MACHINERY DIRECTIVE (CE mark system)

This document incorporates information relevant to the Machinery Directive 98/37/EC. It should be read prior to the use of any of our equipment. Individual maintenance manuals which also conform to the EU Directive should be read when dealing with specific models.

EUROPEAN UNION ATEX DIRECTIVE

This document incorporates information relevant to the ATEX Directive 94/9/EC (Directive on equipment and protective systems intended for use in potentially explosive atmospheres). It should be read prior to the use of any of our equipment.

Compliance to the Directive is based on Atmospheres having pressures up to but not exceeding 350psi and temperatures ranging from –120 °F to + 250 °F depending on the model.

As indicated in the ATEX Directive 94/9/EC, it is the responsibility of the user of the pump to indicate to Sundyne Corporation the Zone and Corresponding group (Dust or Gas) that the pump is to be installed within. Should the pump be put into service in a potentially explosive atmosphere, the user of the pump must put the grounding connector into use.

CAUTION

Read all instructions before removing pump from shipping container or preparing it for operation. It is important to install and operate the pump correctly to eliminate any possible mishap that may be detrimental to property or personnel. Keep this manual for future reference.

2. PUMP IDENTIFICATION (Pumps with NEMA & IEC/JIS Motors)

Every pump and wet end only unit shipped has a serial number, model number, and code number stamped on a stainless steel identification tag. This plate is riveted on a bracket or casing. Please confirm all information stamped on the plate as soon as pump is received. Any discrepancy between the order and the information stamped on plate must be reported to your local dealer. If pump is purchased with a factory supplied motor, the motor nameplate must also be checked to verify motor's compatibility with pump and with order. Pay special attention to voltage, HP, RPM, and frequency information. Maintenance instructions in this manual are based on KF Series ANSI models equipped with NEMA or IEC/JIS motors. Because Ansimag keeps permanent records for all pumps by serial number, this number should be included with all correspondence. The model number, including impeller diameter, together with the pump code number define the type of pump in detail.

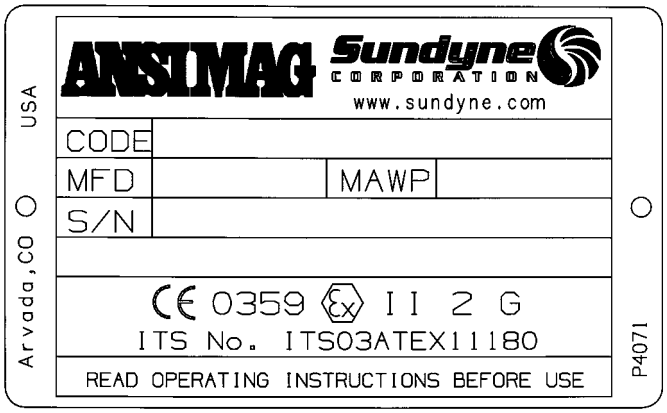


Figure 2-1 Name Plate

PUMP CODE	KF	438	C	03	PR	1	2	1	1	1

SERIES

KF-Series	**KF**

HYDRAULICS

ANSI		ISO		JIS	
438	**438**	i438	**i438**	j4310H	**j4310H**

CONFIGURATION

Close Couple	**C**
Long Couple	**L**
Wet End Only	**W**
Wet End Less Casing	**NC**

MOTOR FRAME

NEMA		IEC		JIS	
182/184TC	**03**	100/112 IEC & JIS	**32**	180M JIS	**50**
213/215TC	**04**	132 IEC & JIS	**33**	180L JIS	**51**
254/256TC	**05**	160 IEC & JIS	**34**	200 JIS	**52**
284/286TC	**06**	180 IEC	**35**	200 JIS 4 Pole	**53**
284/286TSC	**07**	200 IEC	**36**	225 JIS 2 Pole	**54**
324/326TC	**08**	225 IEC 4 Pole	**37**	250 JIS 2 Pole	**55**
324/326TSC	**09**	225 IEC 2 Pole	**38**		
364/365TSC	**10**				
405TSC	**11**	Wet End	**00**		

DRIVE SIZE

KL - 40HP	**KL**
KN -75HP	**KN**

O-RING

Viton	**1**
EPDM	**2**
PTFE Coated Viton	**3**
Gortex	**4**
Silicone	**5**

WEAR PARTS

SIC/CFR PTFE	**1**
SIC/SIC	**2**

WETTED MATERIAL

ETFE	**1**
ETFE w/ GFR Cont. Shell	**3**

PUMP CASE MATERIAL

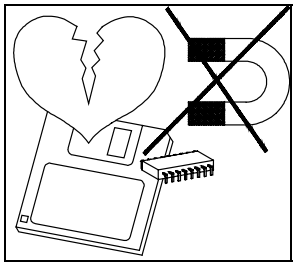
CI/ETFE	**1**

PUMP CASE FLANGE

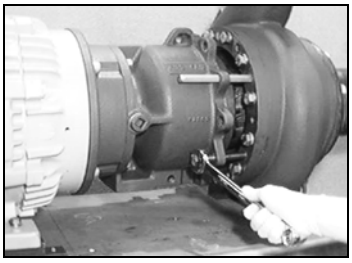
ANIS #150	**1**
ANSI #300	**2**
ISO PN 16	**3**
JIS 10 KG/CM2	**4**

3. SAFETY CHECK LIST

☑ **Warning! Magnetic Field Hazard.** Magnetic drive pumps contain some of the world's strongest magnets. These magnets are located in the impeller and outer drive magnet assemblies. The powerful magnetic fields could adversely affect persons who are assisted by electronic devices that may contain reed switches, and these people should not handle magnetic pumps or their parts. Pacemakers and defibrillators are examples of these devices.



Magnetic Field Hazard



DO Use jackscrews

DON'T use hands!

☑ **Warning! Magnetic Forces Hazard.** Use only the recommended disassembly and assembly procedures when separating the wet end from the drive end. These procedures are found in Sections 7-a and 8-a. The magnetic forces are strong enough to abruptly pull the drive end and wet end together. Be very careful to keep fingers away from mating faces of wet end and drive end to avoid injury.

☑ **Warning! Hot Surfaces Hazard.** These pumps are designed to handle liquids at temperatures up to 250^{o}F and will become hot on the outside. This creates a hazard of burns to personnel coming in contact with the equipment.

☑ **Warning! Rotating Parts Hazard.** The pump contains parts which rotate during operation. Before operation the pump must have the coupling guard secured in place and be completely assembled. To prevent injury during maintenance the pump and/or driver must be disconnected and locked out from the power source. Local safety standards apply.

☑ **Warning! Chemical Hazard.** The pumps are designed to handle all types of chemical solutions. Many are hazardous to personnel. This hazard could take the form of leaks and spills during maintenance. Plant procedures for decontamination should be followed during pump disassembly and part inspection. Keep in mind there is always the possibility of small quantities of liquid being trapped between pump components.

☑ **Caution! Magnetic field sensitive items.** Do not put **magnetic field sensitive items** such as credit cards, floppy diskettes or magnetic tapes near the impeller or drive magnet assemblies.

☑ **Caution! Magnetic Tools**. Do not use steel or iron tools near magnets. Steel tools such as wrenches and screwdrivers are easily attracted to magnets and can break them on contact.

4. PRINCIPLES OF MAGNETIC DRIVE PUMPS

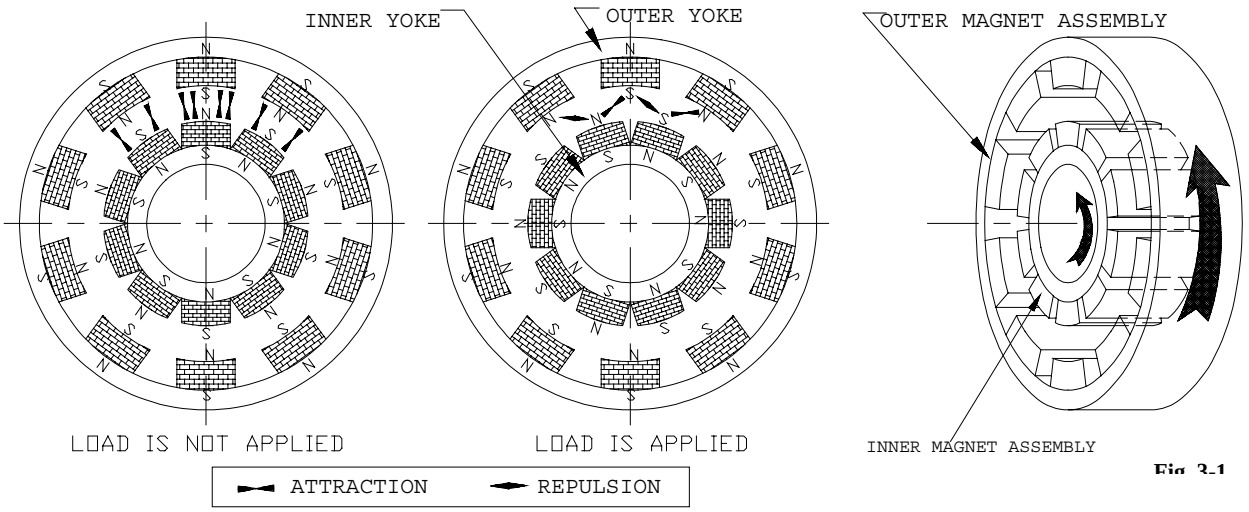


Fig. 4-1

A magnetic coupling consists of two magnet assemblies. One is the outer assembly (the driver magnet) and the other is the inner assembly (the driven magnet). The outer assembly is connected to a motor and the inner assembly is directly or indirectly attached to a pump impeller. As Figure 4-1 shows, at rest, magnet components of the outer assembly are aligned with their counterparts in the inner assembly. When load (torque) is applied, the coupling deflects angularly and the magnets create a force of simultaneous attraction and repulsion. This force is used to transfer torque from the motor to the impeller.

This **permanent-permanent magnet coupling** creates neither slippage nor induction currents during rotation. If excessive torque is applied, the magnets will de-couple. The magnets will not re-couple unless the pump is stopped. There is no energy loss in this permanent-permanent coupling unless an electrically conductive containment shell is placed between the outer and inner magnets. If an electrically conductive material is used for the containment shell, eddy-currents will be generated which will cause some energy loss. **Ansimag's KF Series pumps use only non-conductive containment shells.** Ansimag's KF Series pumps have an inner magnet assembly which is attached directly onto the impeller. The magnets are shown in Figure 4-2 behind the impeller.

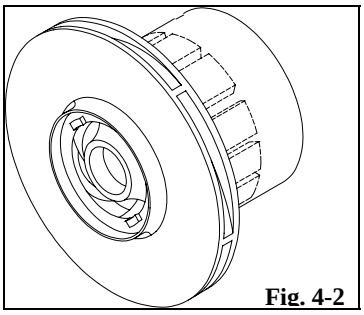
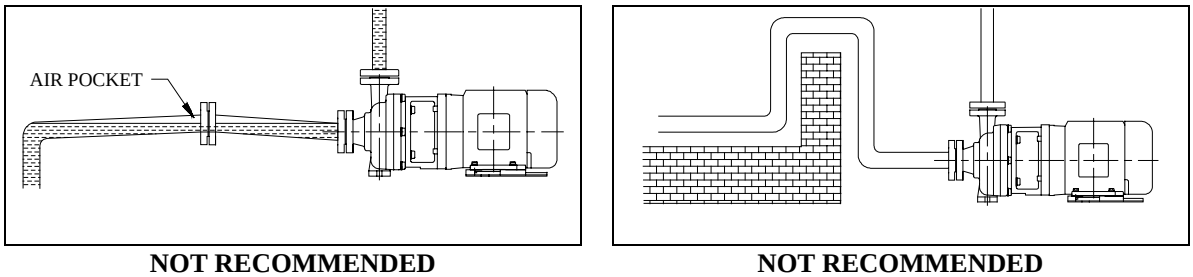


Fig. 4-2

5. PUMP INSTALLATION

5-a. PIPING

1. Install the pump as close as possible to the suction tank. Pumps are designed to push, not pull, liquid.
2. Ansimag recommends supporting and restraining both the suction and discharge pipes near the pump to avoid the application of forces and moments to the pump casing. All piping should line up with the pump flanges naturally to minimize any bending moments at the pump nozzles.
3. To minimize friction the suction line should have a short straight run to the pump, and be free of fittings, for a length equivalent to or larger than ten (10) times its diameter.
4. The suction line size should be at least as large as the pump's suction port or one size larger if the suction line is so long that it significantly affects NPSH available. **Never reduce the suction piping size**.
5. The suction line should have no high points since these can create air pockets.
6. The NPSH available to the pump must be greater than the NPSH required. Screens and filters in the suction line will reduce the NPSH available, and must be considered in the calculations.
7. **Caution: Do not install a check valve in the suction line even if a check valve is installed in the discharge line. The suction line check valve could shut off before the discharge line check valve closes. This would cause water hammer, which may burst the containment shell.**
8. The discharge piping should be equal in size to the pump outlet port.
9. A stop valve and a check valve should be installed in the discharge line. The stop valve is used when starting and stopping the pump, and to isolate the pump for maintenance. It is advisable to close the stop valve before stopping the pump. The check valve will protect the pump from water hammer damage. These recommendations are especially important when the static discharge head is high.



NOT RECOMMENDED **NOT RECOMMENDED**

Fig. 5-1: Pump Installations

5-b. FOUNDATION

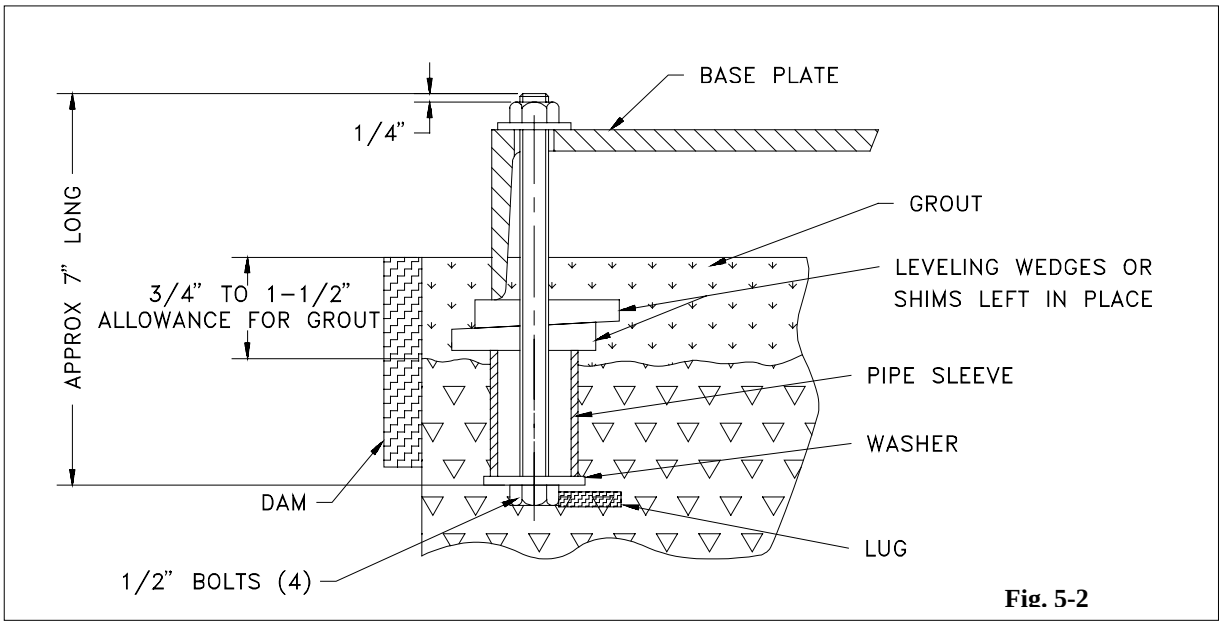


Fig. 5-2

1. The foundation should be sufficiently substantial to absorb vibration and form a permanent, rigid support for the base plate. This is essential for maintaining alignment of a long coupled unit. A concrete foundation should be satisfactory. Embed foundation bolts of the proper size (1/2" -13 x 7" recommended for ordinary installation) in the concrete, located by a drawing or template. Use a pipe sleeve larger than the bolt to allow enough base movement for final positioning of the bolts.

2. Support the base plate on rectangular metal blocks and shims, or on metal wedges with a small taper. Place the support pieces close to the foundation bolts. A spacing of 24" is suggested. Allow a gap of 3/4" to 1-1/2" between the base plate and the foundation for grouting.

3. Adjust the metal supports or wedges until the shafts of the pump and driver are level. Check the horizontal or vertical positions of the coupling faces as well as the suction and discharge flanges of the pump by means of a level. Correct the positions, if necessary, by adjusting the supports or wedges under the base plate as required.

4. When alignment is correct, tighten foundation bolts evenly but not too firmly. The units can then be grouted to the foundation. The legs of the base plate should be completely filled with grout and the leveling pieces, shims, or wedges should be grouted in place. The foundation bolts should not be tightened until the grout is hardened, usually about 48 hours after pouring.

NEVER OPERATE THE PUMP WITHOUT FIRST SECURING IT INTO POSITION!

5-c. INSTALLATION AND ELECTRICAL CONNECTIONS

Ansimag KF Series pumps are easily inspected without removing the casing from any piping, by separating the drive end from the wet-end. In a close-coupled pump this requires moving the motor, drive magnet and bracket backwards and away from the casing. To be able to do this the motor must have sufficient clearance behind the motor fan cover to move the motor backward approximately 12" [300 mm]. Close-coupled installations should feature the following:

1. Allow at least 12" [300 mm] of clearance behind the motor.

2. The base plate under the motor must be flat and long enough to allow for safe movement of the motor.

3. The motor electrical wiring should include a flexible section near the motor to allow movement of 12" [300 mm] for servicing of the pump without disconnecting piping. The recommended installation is illustrated in Figure 5-3.

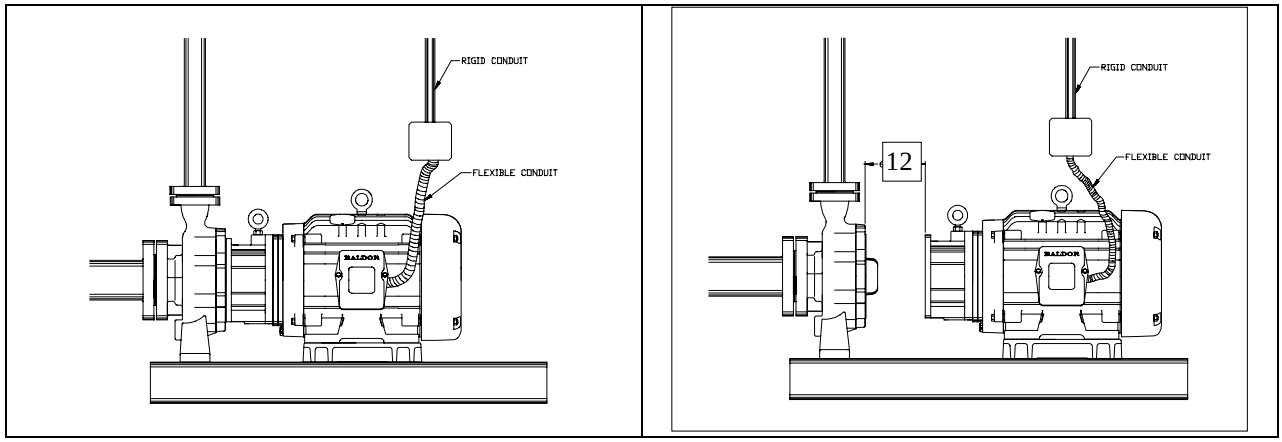


Fig.5-3: Flexible Electrical Connection on the Motor

6. PUMP START UP AND SHUTDOWN

6-a. PRE-START CHECKLIST

Before initial start up and after inspections of the wet end of pump, perform the following inspections:

1. With the pump starter locked out, manually turn the motor fan or flexible coupling to insure that it rotates freely. For a motor mounted directly to the pump (close coupled), insert a screwdriver or other tool through the fan cover and rotate the fan. It should **rotate freely**.
2. Check all electrical connections with a wiring diagram. Make sure that the voltage, frequency and horsepower on the motor nameplate match the line circuit.
3. Check that flange bolts are tightened and that the drain cover is in place.

6-b. START UP AND OPERATION

Caution!: KF Series horizontal end suction models are not self-priming pumps! The pump must be filled with liquid by gravity from a flooded suction tank or primed by other methods such as injecting liquid from an outside source into the pump and suction line with an attached foot valve.

1. Make sure that the **pump is full of liquid** and the suction valve is open.
2. Fully open the discharge valve once and then close it, so that any air trapped in the pump and suction line can be purged.
3. With the pump full of liquid, check motor rotation by jogging the pump and motor for about 1/2 second. The proper rotation is clockwise as viewed from the motor fan end. Once proper motor rotation is confirmed jog the motor 5 or 6 more times. This process is very important to **fully wet sleeve bushing and pump shaft,** and to purge some of the air trapped in the pump and discharge line.
4. Open the discharge valve once and close it again so that more air can be released downstream.
5. Turn the pump on. **Open the discharge valve slowly**. It is important to open the valve very **slowly.** Sudden opening of the valve while air is trapped between the pump and the valve may cause water hammer.
6. Keep the suction valve fully opened. **Do not use the suction valve to adjust flow rate. Adjust the flow rate with the discharge valve only.**

   NOTE: Subsequent pump starts do not require motor jogging or valve position changes provided that the piping and pump have remained full of liquid.

Caution! Do not run the pump dry. The pump may be severely damaged. The pumps use slide bearings that are lubricated by the pumped product. No lubrication, no bearings. Even short periods of dry running could damage the pump.

Caution! Do not Dead Head. Although the radial loads on the bearings are not a concern, the liquid in the pump will rapidly increase in temperature. This will continue until the boiling point is reached. Some liquids boil at temperatures sufficient to melt pump components and destroy the magnets. Other liquids will flash into vapor. This vapor collects at the main bushing causing dry running.

Caution! Cavitation. Prolonged cavitation may cause pitting on the pump components. Short term severe cavitation, such as that caused by a closed suction may damage the pump bearings.

Caution! Water Hammer. Sudden changes in fluid velocity can cause large, rapid pressure surges. These pressure surges can damage the pump, piping and instrumentation. Typical causes are rapidly closing valves. Check valves on the suction can also cause water hammer if the liquid has time to reverse direction before the valve closes.

Recommended! Power Monitors. We recommend installing a Sundyne power monitor on all pumps. These devices are very effective at protecting the pumps from dry running, cavitation or when frequent overload is expected. They are also very effective for stoppage during tank unloading applications.

- Dry Running
- Closed Valve
- Clogged Suction Filter
- Pump Seizure
- Severe Cavitation
- Excess (High) Flow

6-c.SHUTDOWN

If the pump is to be shut down for any reason, use the following procedure:

1. Close the discharge valve slowly to prevent water hammer.

2. Shut off the motor.

3. Close the suction valve.

TEMPERATURE CLASSIFICATION - (ATEX DIRECTIVE 94/9/EC)

The maximum surface temperature of a metallic magnetic drive pump is the **highest** temperature ascertained from any one of the following conditions:

1. The temperature of the pumped liquid, plus 20°C.

or

2. The ambient temperature plus 20°C.

or

3. The ambient temperature plus 39°C (only in the case of separately mounted pumps with oil lubricated bearing assemblies)

or

4. The temperature of the heating medium being used in the heating jacket (if fitted)

The actual classification is calculated by obtaining the maximum surface temperature and than using the following table to obtain the relevant Temperature Class:

Temperature Class
T1
T2
T3
T4
T5
T6

Example:

The pump is pumping a liquid with a temperature of 120°C. The pump is close coupled and therefore does not have an external oil lubricated bearings. The maximum ambient temperature in which the pump may operate is 30°C

Condition 1 equates to 120°C + 20°C = 140°C
Condition 2 equates to 30°C + 20°C = 50°C
Condition 3 does not apply.
Condition 4 does not apply.

Thus the maximum surface temperature of the pump is 140°C which equates to a temperature classification of T3.

7. DISASSEMBLY AND MAINTENANCE

WARNING! Before disassembly, the pump must have the drive "locked out" and be flushed of all dangerous liquids. **Follow all Federal, State, Local and company regulations with regard to pump decontamination prior to disassembly and inspection**. ANSIMAG KF Series pumps are provided with a low point casing drain to maximize pump decontamination.

Both the long coupled and close coupled KF Series pumps can be pulled back from the casing. Therefore, if permitted by company regulations, pump disassembly and inspection can be conducted on site.

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Before inspecting, be sure to have a spare casing O-ring on hand to install after the inspection is completed.

7-a. BASIC DISASSEMBLY FOR INSPECTION

Tools Needed: 15/16" wrench
3/4" wrench

1. Stop the pump, lock out the pump starter, shut off all the valves connected to the pump, and drain and decontaminate the pump. **Warning! Be sure the pump is flushed of dangerous or hazardous liquids and all internal pressure is relieved before opening the pump for inspection.**

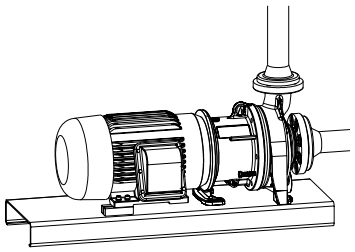


Fig. 7-1: KF Series pump

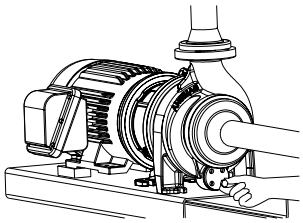


Fig. 7-2: Casing drain

7-a. BASIC DISASSEMBLY FOR INSPECTION (continued)

2. Remove the bolts securing the motor feet and the mounting plate foot to the base, then remove the six bolts (5/8-11x1.75) securing the pump bracket to the rear casing support.

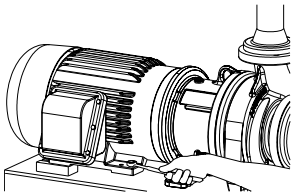


Fig. 7-3: Unbolt drive end from base

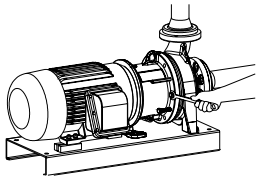


Fig. 7-4: Unbolt bracket from rear support

3. By using the two jackscrews, separate the magnetic coupling between the drive end and the wet end, then pull back the drive end at least 12" [300 mm]. **Caution! You are separating the magnetic coupling.**

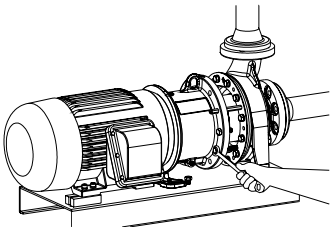


Fig. 7-5: Use jackscrews to pull motor back

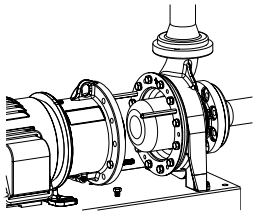


Fig. 7-6: Separate motor from pump wet end

4. Remove the two jackscrews from the mounting bracket and place them into two holes in the rear support, 180° apart. Using a 15/16" wrench, remove the (12) 5/8-11x2 bolts securing the rear support to the pump casing, then use the jackscrews to separate the rear support from the pump casing. **Caution! Wear protective clothing, eye wear and gloves as required for the pumped liquid. The impeller assembly contains very powerful magnets. Keep magnetic tools away from impeller.**

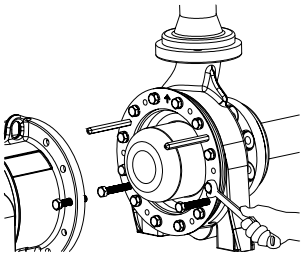


Fig. 7-7: Unbolt rear support from pump casing

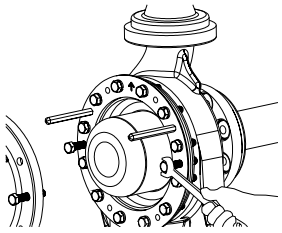


Fig. 7-8: Separate rear support from pump casing

7-A BASIC DISASSEMBLY FOR INSPECTION (continued)

5. Carefully pull out the containment shell along with the impeller and the shaft**. Caution! Magnetic attraction between the impeller and the rear support may cause the impeller to jump forward. When removing this assembly be sure to keep the eye of the impeller angled upwards so that the impeller can't jump forward and hit the casing or thrust ring.**

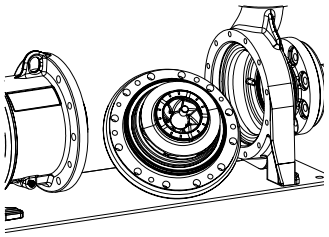


Fig. 7-9: Remove containment shell and impeller.

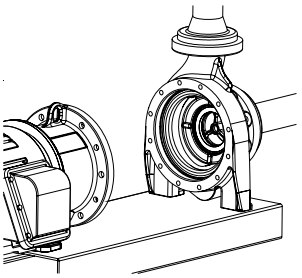


Fig. 7-10: View of pump casing and thrust ring

6. Remove the impeller from the containment shell. It will be easier to remove if you carefully hold down the edge of the rear support while pulling up on the impeller. Next, carefully remove the shaft from the containment shell**. Caution! If the shaft is dropped on a hard surface such as concrete the impact may cause the shaft to break.**

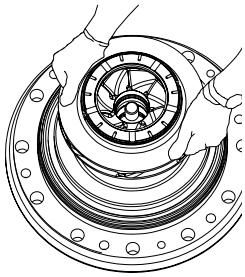


Fig. 7-11: Remove impeller from containment shell.

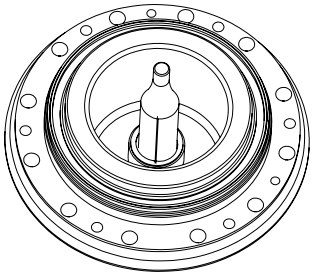


Fig. 7-12: Remove shaft from containment shell

7. If the shaft is difficult to remove, slip the removal tool, PT0735, over the shaft until it contacts the back thrust ring. With the containment shell oriented as shown in Fig. 7-13 (dome side up), firmly tap the assembly on the floor. **Caution! If the shaft is dropped on a hard surface such as concrete the impact may cause the shaft to break.**

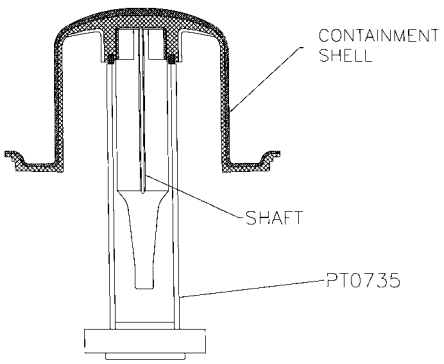


Fig. 7-13: Remove shaft with tool PT0735.

7-b. INSPECTION CHECKLIST

All wear parts in the KF Series pumps are pure sintered silicon carbide (SiC). Because of SiC's extreme hardness true wear will not occur. However it is still important to inspect the pump after the initial 500 hours or three months of operation, whichever comes first, to make sure there is no damage due to solids in the liquid, or cavitation or dry running. Inspect again in six or twelve months, depending on the results of the first inspection.

Before inspecting, be sure to have a spare casing O-ring on hand to install after the inspection is completed. To inspect the pump interior, be sure that the pump has **first been flushed of all dangerous liquids.**

Operating conditions vary so widely that recommending one schedule of preventive maintenance for all centrifugal pumps is not possible. In the case of magnetic drive pumps, particularly non-metallic pumps, **traditional maintenance techniques such as vibration monitoring are not useful or reliable for wet end preventive maintenance.** These techniques are effective only for bearing frames (non-liquid contact components) and for motor bearings. For best maintenance results, keep a record of actual operating data such as flow, pressure, motor load, and hours of operation. The length of the safe operation period will vary with different applications and can be determined only from experience.

The inspection checklist is as follows:

1. Check for cracks in **silicon carbide parts** such as the thrust ring and shaft.

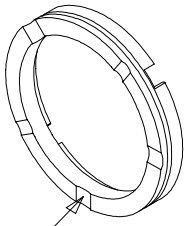
2. Check for signs of melting or deforming in the **shaft support, main bushing** and the **socket of the containment shell** where the pump shaft is held. Dry-running during initial startup or during operation may cause heat-related deflection or wear of these parts.

3. Inspect the **casing liner** to be sure there are no signs of abrasion or cuts deeper than 0.05" [1.3 mm]. Liner cracks may occur if the lining is corroded or placed in an extremely cold place, or if a chemical penetrates the liner and corrodes the outside metal casing. Most liner damage can be spotted visually. To detect hairline cracks, a 15-20 KV electrostatic discharge tester is recommended, which is often used to test lined pipe.

4. The SiC main bushing will not exhibit wear under normal operation. Polishing on SiC surfaces is a normal condition of running and does not require replacement. However, the inner surface must be checked for cracks, chips or scratches. Verify that the main bushing is tightly pressed into the impeller. It should be impossible to dislodge the main bushing by hand. Check for signs of melting around the circumference of the **main bushing**.

5. Check the **mouth ring** face for wear if your pump has a PTFE mouth ring or scoring if your pump has an SiC mouth ring. The lubrication flutes are reliable indicators of mouth ring wear. They should be at least 1/32" [0.8mm] deep. A part replacement procedure is described in Section 7-c.

Fig. 7-14



6. Check the **impeller vanes** for material trapped inside. If any of the five flow paths become clogged, a hydrodynamic imbalance may cause excessive wear to the mouth ring and main bushing.

7. Check the **inner magnet encapsulation** for cracks or grooves in excess of 1/32" [0.8mm]. Fluid inside the magnet area may cause swelling which could wear on the containment shell.

8. **Check for slurry.** If the pumped liquid contains slurry, it may build up near the back of the main bushing. This build-up may cause clogging of the journal bearing area of the main bushing and create a dry-run condition. Estimate the rate of build-up from the first inspection and schedule the unit for future maintenance accordingly.

9. Inspect the **containment shell** for signs of abrasion. Replace it if scratches or grooves in the inner surface are deeper than 1/32" [0.8mm]. Also replace if the outside has grooves deeper than 0.020 [0.5mm] inches. Inspect the back **thrust ring** for wear.

7-c. PARTS REPLACEMENT PROCEDURES

1a **Bushing removal** is accomplished using the ANSIMAG KF438 Bushing Removal Arbor (PT0736). This arbor is plastic to avoid damaging the SiC main bushing.

1b Place the impeller assembly vertically on the bed of an arbor press. Insert the arbor into the eye of the impeller. Slowly press the main bushing out. Do not allow the main bushing to fall onto a hard surface since this may damage the SiC parts.

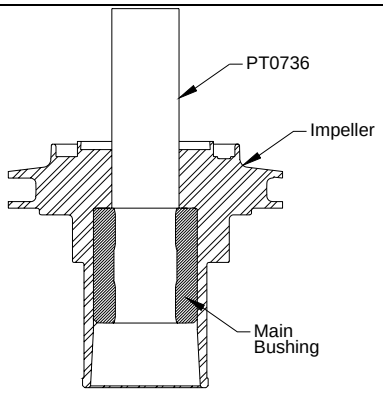


Fig. 7-15: Main bushing removal

2a **Impeller removal** is accomplished using the ANSIMAG Magnet Removal Tool (PT0735). This tool conveniently and safely allows the removal of the inner magnet assembly from the impeller.

Before beginning to separate the impeller from the inner drive, use a marking pen to indicate the original orientation of the two parts to each other. In this way, if the parts will be re-used, they can be re-assembled in the same orientation.

2b To begin, insert the Magnet Removal Tool into the bushing bore of the impeller, as shown in Figure 7-16. Be sure that the tool goes all the way to the bottom of the bushing bore.

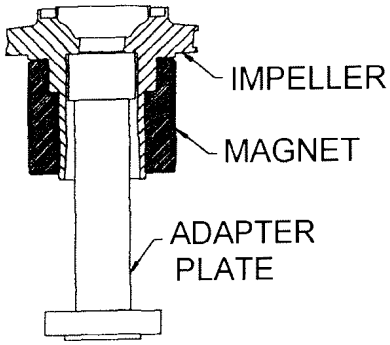


Fig. 7-16: Inner magnet removal

2c While holding the tool in place, drop the impeller assembly from a height of 2’ to 3’ [.67 to 1 m] onto the exposed face of the Magnet Removal Tool. Be sure to hold the impeller assembly vertically, with the mouth ring facing upward and the tool facing downward.
Caution! If the impeller has been in service, droplets of pumpage may spray upwards. Cover the impeller with a plastic bag before dropping the assembly.

Fig. 7-17: Magnet removal tool placed in bushing bore

2d The Magnet Removal Tool pushes against the shoulder of the impeller and the momentum of the drop causes the inner magnet assembly to slip down and off the impeller.

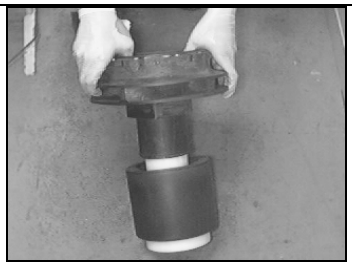


Fig. 7-18: Inner magnet and impeller separated

3. To remove the **mouth ring** from the impeller eye, perform the following steps. **Note:** The silicon carbide mouth ring should be removed only if inspection shows that replacement is required.

First, use a sharp knife to cut through the mouth ring O-ring at two locations, 180° apart. Next pull out the cut O-ring sections with pliers. Finally, carefully pry out the mouth ring using a screw driver.

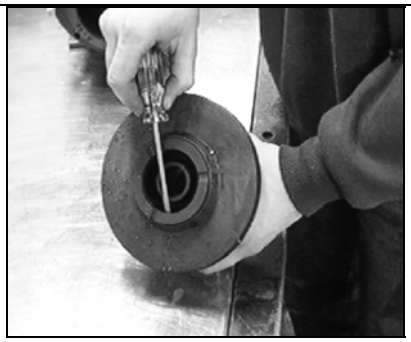


Fig.7-19: Remove mouth ring

4. To remove the **Containment Shell** from the rear support simply pull the two components apart; they are joined in a slip fit. If necessary, gently tap the domed section with a rubber hammer to separate the two components.

8. WET END ASSEMBLY

If impeller assembly is already complete, skip to Section 8-b.

8-a. IMPELLER ASSEMBLY

The parts shown in Figure 8-1 are the wet end's only rotating parts. From left to right the parts are:

- Mouth ring
- Impeller
- Inner magnet assembly
- Main bushing

Assemble as follows:

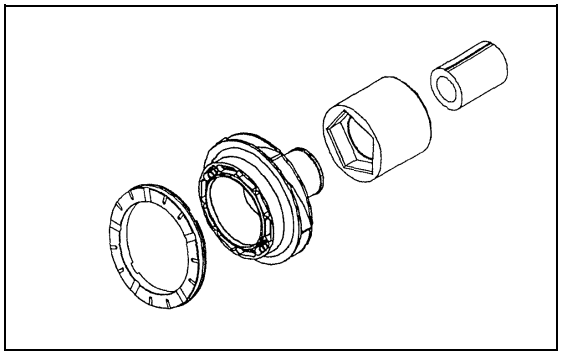
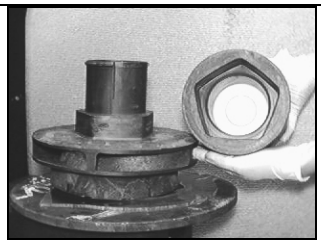
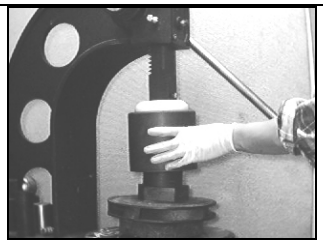
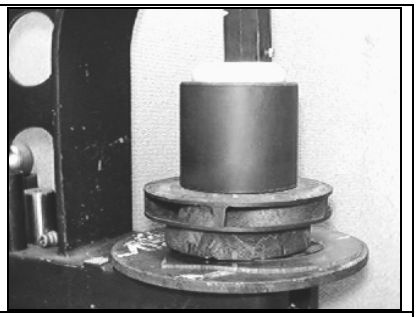
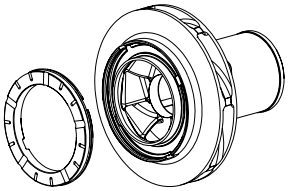
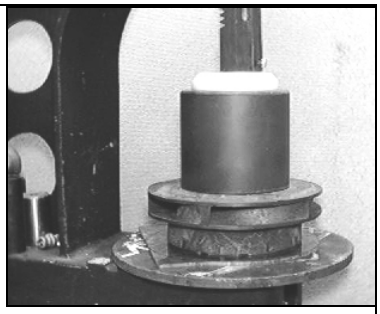


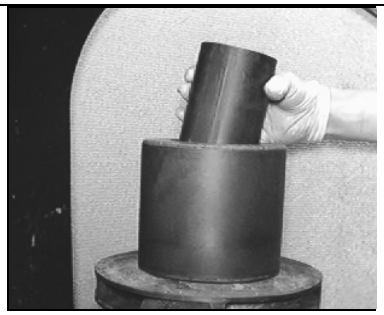
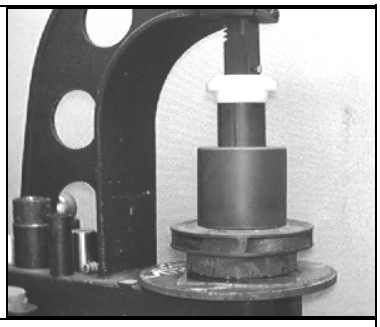
Fig.8-1: Impeller assembly

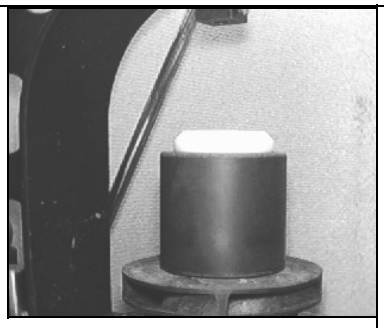
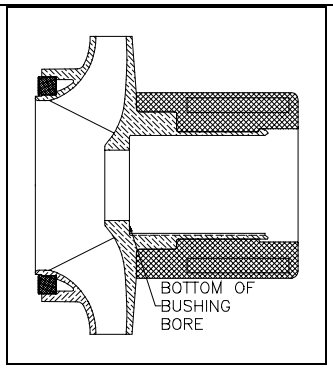
1. First, place the impeller on an arbor press, with the suction end facing down. Next, position the socket of the inner magnet assembly over the impeller. Rotate the inner magnet assembly to align its pentagon with that of the impeller. If the impeller and inner drive are both being re-used, align the alignment marks that were previously marked on the parts. Use the white Magnet/Bushing Arbor tool (PT0737) and the arbor press to press the inner magnet assembly onto the impeller.	 **Fig. 8-2: Line up pentagon of inner magnet assembly with pentagon of impeller**	 **Fig. 8-3: Use PT0737 tool to press inner magnet assembly onto impeller**

2 Figure 8-4 shows the inner magnet assembly completely pressed onto the impeller.	
	Fig. 8-4: Inner magnet assembly and impeller form single unit

3	Align the notches in the back of the mouth ring with the driving dogs in the impeller. Press-fit mouth ring with O-ring attached into the mouth ring seat in the eye of the impeller. The O-ring is used as a locking ring. It is important to apply even pressure when performing this step so as not to crack the ring.		
		Fig. 8-5: Press-fit mouth ring into impeller	**Fig. 8-6: Press mouth ring onto impeller**

4.	At this stage, the assembly must be dynamically balanced (see Sec. 10.2). This step is only required if the pump will be operated at speeds above 1800 rpm. If your impeller assembly requires balancing and you do not have access to balancing equipment, please return the assembly to ANSIMAG for balancing.

5	To insert the main bushing, align the two molded keys in the impeller bore with the two keyways on the main bushing (P3087). The main bushing is inserted using the same white PT0737 tool discussed in Step 1.		
		Fig. 8-7: Line up main bushing with keyway	**Fig. 8-8: Insert main bushing into impeller with PT0737 tool**

6.	Place the PT0737 tool onto the back of the main bushing and press the main bushing into the impeller bore. Press until firm resistance is felt. The tool has a shoulder which prevents too-deep insertion of the bushing. **Caution: Do not use a hydraulic press, since you can not feel when the cone-shaped side hits the bottom of the bore!**		
		Fig. 8-9: Main bushing inserted all the way into impeller	**Fig. 8-10. Bottom of bushing bore**

8-b. WET-END ASSEMBLY

1. Insert the larger end of the pump shaft into the socket of the containment shell, aligning the flat on the shaft with the flat in the socket. If necessary, gently drive the shaft into its socket with a soft hammer.
   Caution!: If the pump shaft is dropped on a hard surface such as concrete the impact may cause the shaft to break

   Align the containment shell to the rear support such that the groove in the shaft is "clocked" at the 11:00 O'clock position when viewed from the front, relative to the arrow inscribed on the opposite side of the rear support.

   Insert the rear casing into the rear casing support. If necessary tap it into place with a soft hammer until it is evenly seated.
   .

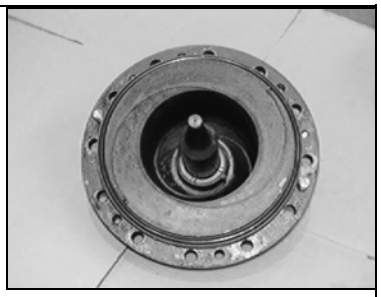


Fig. 8-11: Shaft in rear casing socket

2. Slowly place the completed impeller assembly onto the shaft and into the containment shell. Be careful to avoid chipping the main bushing while sliding it over the shaft.
   Caution! Magnet attraction between the impeller and the rear casing support may cause the impeller to jump forward. To avoid this, gently pull the impeller forward until it reaches its magnetically neutral position. At this position it will feel like the impeller is hovering on the shaft.

   Snap the casing O-ring into the O-ring groove of the containment shell.

3. Use the two guides to help support the containment shell and impeller assembly, and then line up the end of the shaft with the bore of the shaft support in the pump casing and fit together. Make sure the arrow inscribed on the rear support is pointing up when fitting the casings together.

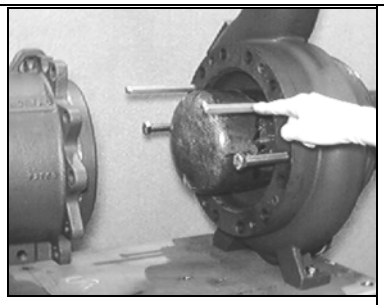


Fig. 8-12: Guides to support containment shell assembly

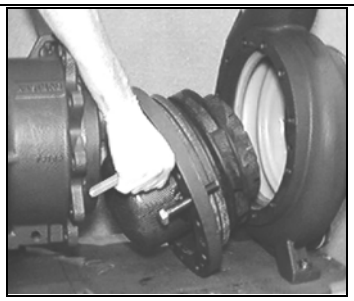


Fig. 8-13: Fit casings together

4. Push the assembly together until the bolts can be tightened. Avoid tapping on the rear support, since this could cause the casing O-ring to dislodge.

   Bolt the wet end together using twelve 5/8"-11 x 2" hex bolts. **Torque to 80 ft-lb [110 N - m].**

   Confirm that the impeller has some axial end play inside the casing of about 1/16" to 1/8" [1.6mm to 3.2mm] by rocking the assembled wet end back and forth. You should hear the impeller moving inside.

9. DRIVE END ASSEMBLY -Pumps with NEMA Motor (with C-face)* -IEC/JIS Motor (B5 with "D" flange only)*

9-a. MOTOR MOUNTING PLATE and OUTER DRIVE

If practical, place the motor vertically on a work table or floor so that shaft is pointing upwards. Be sure to cover the work surface with corrugated cardboard or similar material to prevent damage to the fan cover.
Caution: Motors with plastic fan covers may be damaged in the vertical orientation

DRIVE END MOUNTING : NEMA or IEC/JIS Motor Frame Mounting:

1. Mount the motor mounting plate to the motor flange using the 4 bolts provided. NEMA motors use socket head cap screws from the pump side while IEC/JIS motors uses hex bolts from the motor side. The bolt size varies with motor frame.

2. With the motor shaft key installed (an instant adhesive works well to hold the key in place), test the fit of the outer drive hub to insure that it will side freely onto the motor shaft, then remove the outer drive.

3. Slide the smaller end of the bracket over the motor shaft and onto the motor mounting plate. Secure the bracket with (4) 5/8"-11 x 1.75" (NEMA) or (4) 16 x 45 mm (IEC & JIS) hex bolts. **Torque to 80 ft-lb [110 N-m].**

4. Slide the outer drive into the bracket and onto the motor shaft, making sure that the shaft key is in place. The outer drive must be positioned so that the notch on its outer diameter aligns with the front face of the bracket. This will position the outer drive 1-1/16" from the bracket face as shown in Figure 9-1.

5. The outer drive hub is secured to the shaft with (3) 5/8-11 x 0.75" hex socket set screws, oriented 60^{o} apart. A 5/16" hex key must be used to tighten the set screws. **Torque to 60 ft-lb [82 N-m].**

6. For NEMA motors frame sizes 213/215TC and larger and IEC/JIS motors with frames 160 and larger*, install motor risers on the back feet of the motor. Tighten down the jackscrews in the risers to ensure contact between the risers and the base plate after pump installation. This will prevent unwanted vibrations at the motor fan end.
   *** ANSIMAG recommends using NEMA C-face with base motors for 213/215TC frames and larger and IEC/JIS B3/B5 (foot/flange) motors for 160 frame size and larger. These motors allow mounting of risers which greatly increase the safety when handling heavy motors.**

   The motor drive end is now ready to mount to the wet-end.

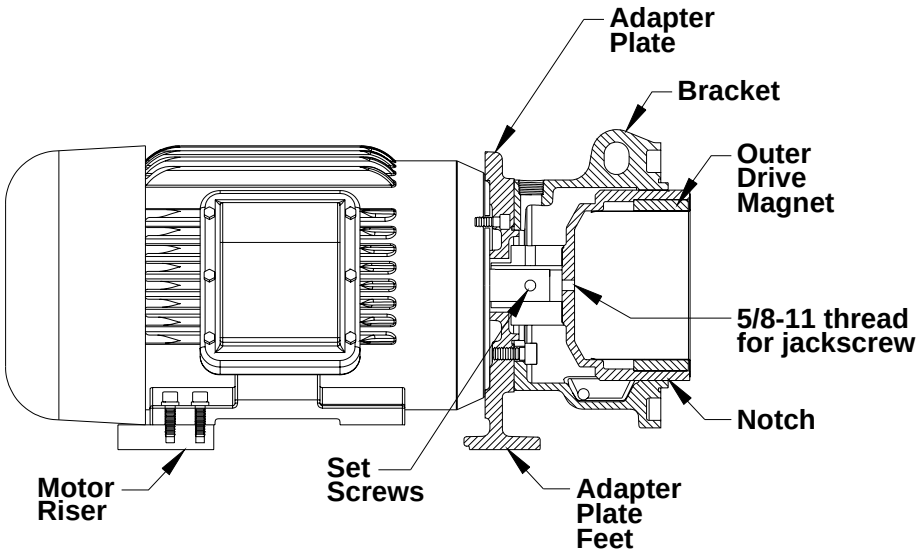


Fig. 9-1: DRIVE END ASSEMBLY, NEMA or IEC/JIS MOTORS

9-b. MOUNTING DRIVE END TO WET END

1. Line up the containment shell end of the wet end with front of the bracket and outer drive. **To control the magnet coupling forces during assembly advance the jackscrews to their full forward position.** This will minimize the magnet attraction during assembly. For additional safety, guide bolts from the wet end should engage the corresponding holes in the bracket flange. This will prevent the outer drive contacting the containment shell. Back out the jackscrews until the bracket flange mates with the rear support.

2. To mount to the pump wet end use (6) 5/8"-11 x 1.75" hex head screws to secure the assembly. **Torque to 80 ft-lb [110 N-m].**

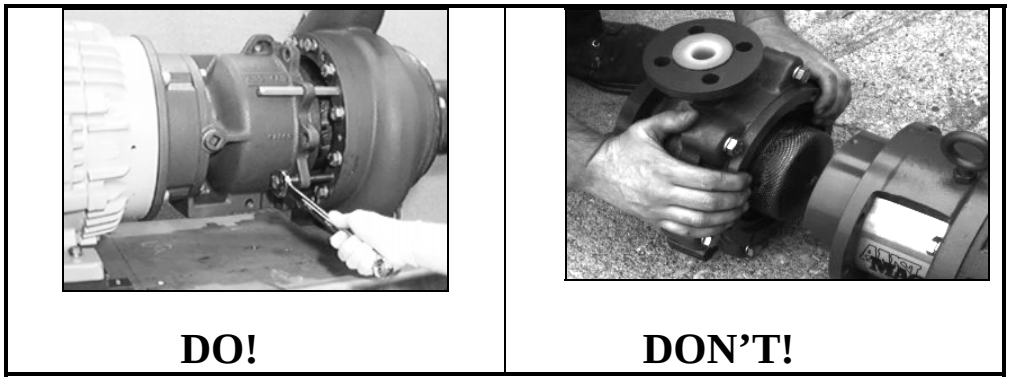


Fig.: 9-2 Use jackscrews for assembly or disassembly

CAUTION: KEEP FINGERS AWAY FROM MATING FACES TO AVOID INJURY!

10. TRIMMING & BALANCING IMPELLERS

10.1 TRIMMING

The procedure for trimming an ANSIMAG KF Series impeller includes performing a dynamic balancing operation following the trimming operation. This only applies to pumps being operated at speeds greater than 1800 rpm. If your impeller requires balancing and you do not have access to dynamic balancing equipment, please return the impeller to ANSIMAG for trimming and balancing.

1. Install ANSIMAG KF438 impeller arbor PT0740 into the jaws of the lathe by the ∅2.25" end. Verify that the TIR < 0.002" [0.051] at the free end.

2. Place the impeller assembly (impeller, magnet and main bushing) onto the free end of the arbor, as shown in Fig 10-2, being careful to avoid chipping the SiC bearings. Install the washer with the 1/2-13 socket head cap screw. Lightly tighten the screw (just enough to avoid slip while machining). Be aware of the magnetic attraction between the impeller and lathe jaws.

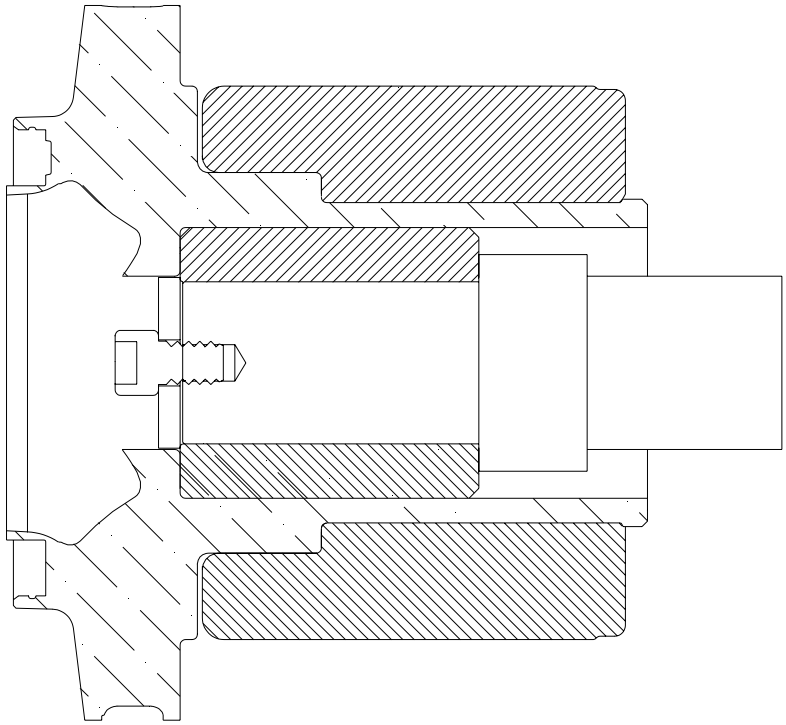


Fig.10-2: KF impeller on arbor

3. Adjust the lathe speed to 500 RPM.

4. Slowly take roughing cuts up to 1/8" [3.2 mm] diameter at a time across the impeller, proceeding from the impeller eye towards the lathe chuck (to avoid loosening the main bushing). After each cut across the impeller, carefully remove all trimmed plastic chips for

a clean start on the next cutting approach. As you near the desired trimming diameter, take smaller and slower cuts for a smoother finish.

5. After finalizing the diameter, deburr with a knife or file the outer edges of the shrouds to approximately 0.025" x 45º [0.5 mm x 45º]. Do not chamfer on the lathe.

6. Remove the impeller assembly from the arbor and clean up any loose material with a knife.

10.2 BALANCING IMPELLER / INNER DRIVE ASSEMBLIES

1. **All impeller/inner drive assemblies operating at a rotational speed greater then 1800 rpm must be balanced. The impeller must be trimmed to size and assembled to the inner drive before balancing. The impeller assembly must be two plane balanced.**

2. Obtain balancing arbor PT0808 from ANSIMAG. The arbor is designed for mounting the impeller between the bearings of the balancing machine. The drive belt can be positioned adjacent to the magnet end. Before installing the impeller on the arbor verify that the arbor is in dynamic balance.

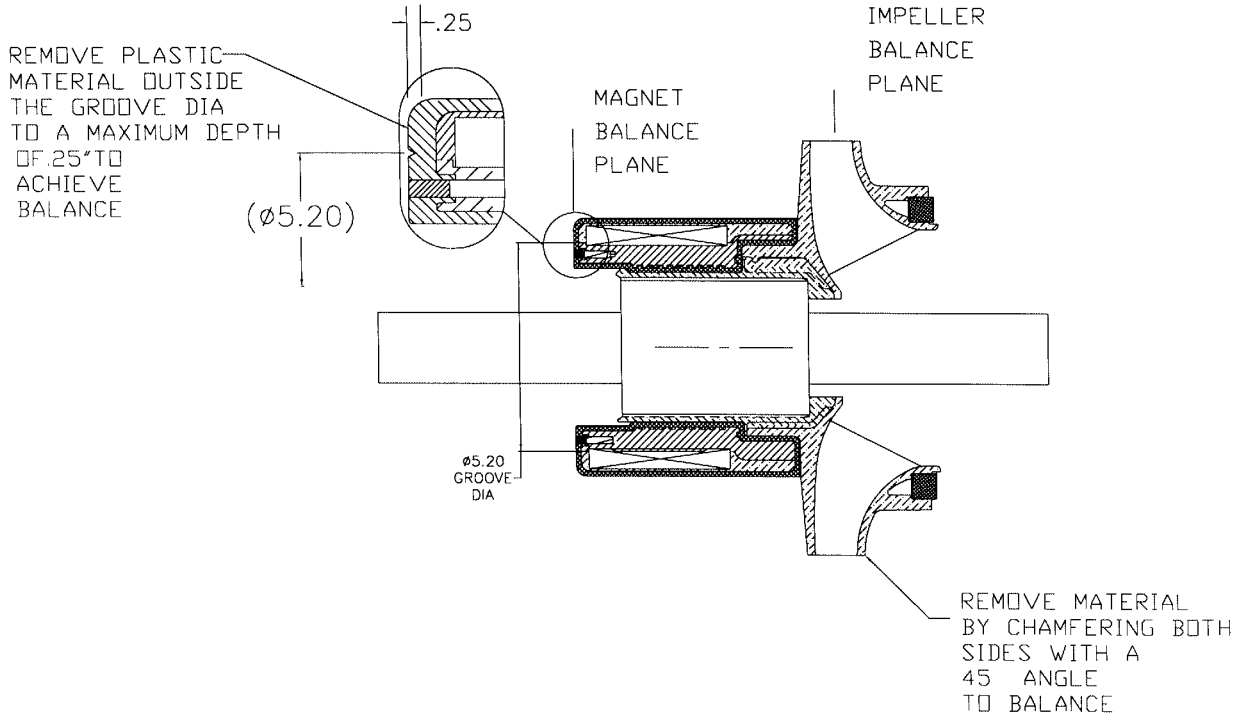


Fig.10-3: KF impeller mounted on balancing arbor

3. Remove the main bushing from the impeller assembly. Align the two keyways with the keys in the impeller ID and press the balancing arbor into the impeller bore as shown in the figure above. The arbor is sized to replace the bushing during the balancing operation. Mount the arbor with impeller on the balancing machine. The balance or correction planes are the center of the plastic material on the back of the inner drive and the center of the impeller discharge. The allowable unbalance at each plane is defined in the table 10.1 below:

Table 10.1: Allowable Unbalance for KF Impeller per ISO 1940, G6.3

	Magnet Balance Plane	Impeller Balance Plane
Allowable residual unbalance	24.9 g-mm or 0.98 g-in	58.6 g-mm or 2.31 g-in
correction radius	2.81 in. or 71.4 mm	1/2 trim diameter
Allowable unbalance mass	0.35g @ 2.81 in	0.50g @ Impeller OD

Note: Maximum correction at the magnet plane is 18 g-in or 470 g-mm.

4. Balancing is accomplished by removing plastic material from the back of the inner magnet assembly and from the impeller shrouds. The inner magnet assemblies have additional (ETFE) plastic added to the back face solely for the purpose of balancing**. See Figure 10.3** Up to 180° of arc or approximately 18 g-in (470 g-mm) can be balanced by removing material. If the impeller shows an initial unbalance of more than 18 g-in, remove it from the arbor. Remove the magnet from the impeller and re-assemble at a different orientation of the polygon. Proceed with balancing. Blend the ends of the removed sections to minimize turbulence and solids accumulation.

5. Material removal for balancing is most easily accomplished by use of a high speed, light duty, electric die grinder. Typically, these grinders have a 1/8" collet and operate at 20,000 to 30,000 rpm. Use a 1/4" diameter, double cut, cylindrical with radius end carbide burr.

6. Material removal at the impeller end is accomplished by removing material from the plastic between the back of the impeller rear shroud and the front end of the inner drive assembly. Material can be removed up to 180°. Blend the ends of the removed sections to minimize turbulence and solids accumulation.

7. Deburr the impeller using a sharp knife. Ensure that the unbalance is within the amounts specified above.

8. Reinstall the bushing.

11. PARTS LISTS

PART LIST 1

WET END PARTS – KF438, KFi438 , KFj438 PUMPS

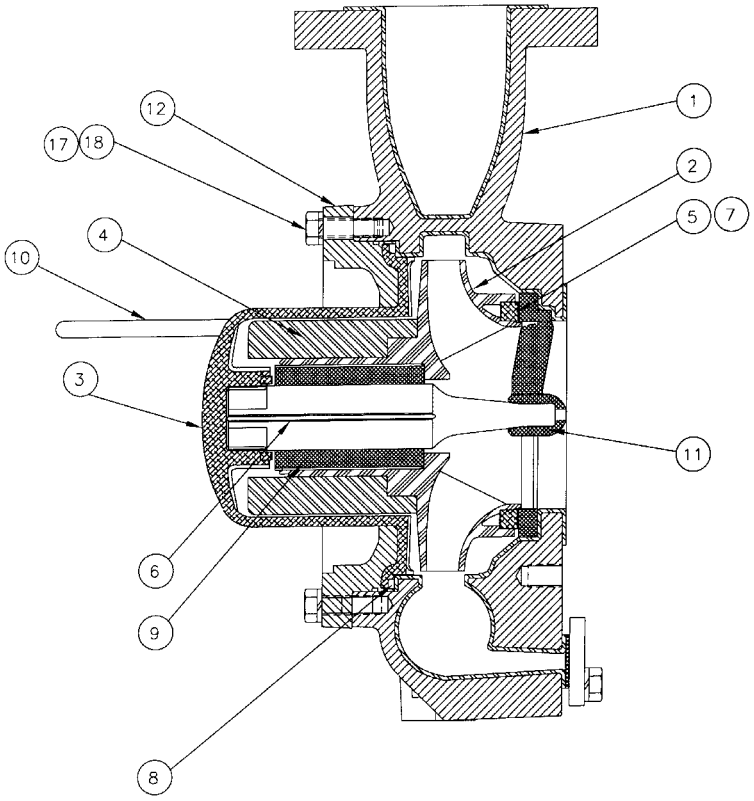


Figure 11-1 Wet End Cross Section

☑ Recommended Spare Parts for all levels of service.

		PART NAME	Qty	Part Number
☑	1	**KF438, KFi438, KFj438** Casing - 150# ANSI Flanges Ductile Iron w/ ETFE Lining	1	P3182A
		Casing - 300# ANSI Flanges Ductile Iron w/ ETFE Lining	1	P3182B
		Casing - PN16 ISO Flanges Ductile Iron w/ ETFE Lining	1	P3182C
		Casing - 10kg/cm^2 JIS Flanges Ductile Iron w/ ETFE Lining	1	P3182D
☑	2	Impeller - CFR-ETFE	1	P3120
☑	3	Containment Shell CFR-ETFE w/PTFE & Composite	1	P3144
☑	4	Inner Drive Assembly 8 mag. (J-drive) 16 mag. (K-drive)	1	 P3221A P3221B
☑	5	Mouth Ring Silicon carbide CFR-PTFE	 1 1	 P2672 P2751
☑	6	Pump Shaft -SiC	1	P3076
**	7	O-ring, mouth ring	1	P2961B

PART LIST 1, continued

		PART NAME	Qty	Part Number
		KF438, KFi438, KFj438		
☑	**8**	Casing O-ring	1	
		Viton®		P3095A
		EPDM		P3095B
		Gore-Tex® wrapped Teflon®		P3095C
		Encapsulated Viton®		
		Teflon® Encapsulated Viton®		P3095E
		Silicone		P3095D
☑	**9**	Main Bushing	1	
		Silicon carbide w/CFR-ETFE		P3087
	10	Guide Bolts	2	P2530
☑	**11**	Shaft Support/Thrust Ring	1	
		ETFE/SiC/Hastelloy		P3248
	12	Rear Support, Ductile Iron	1	P3085
	18	Hex bolts, Rear Support/Pump Case	12	HH5/8x2.00
		Lock Washer, Rear Supt/Pump Case	12	HL5/8
	17	Lock Washer, Rear Supt/Pump Case	12	HL5/8
*	**61**	Teflon^{R} Gasket, Drain	1	P1953T
*	**62**	Neoprene Gasket, Drain	1	P1953N
*	**63**	Drain Cover		
		ANSI 150# Flanges	1	P2895A
		ANSI 300# Flanges	1	P2895B
		ISO PN 16 Flanges	1	P2895C
		JIS10 Flanges	1	P2895D
*	**66**	Lock Washer, Drain		
		ANSI Flanges	4	HL1/2
		ISO or JIS Flanges	4	HLM12
*	**67**	Hex Bolts, Drain Cover		
		ANSI Flanges	4	HH1/2X1.25
		ISO or JIS Flanges	4	

* These parts are included when ordering pump cases.

** This item included when ordering mouth ring assembly.

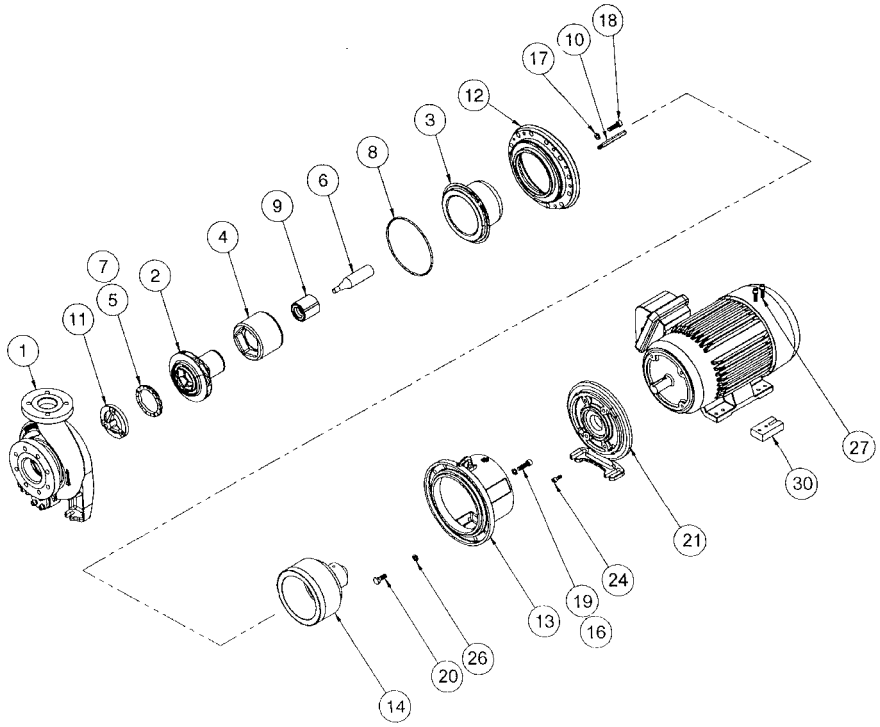


Figure 11-2 Exploded View of Pump

PART LIST 2

DRIVE END PARTS - ANSI KF PUMP WITH NEMA, IEC OR JIS MOTORS

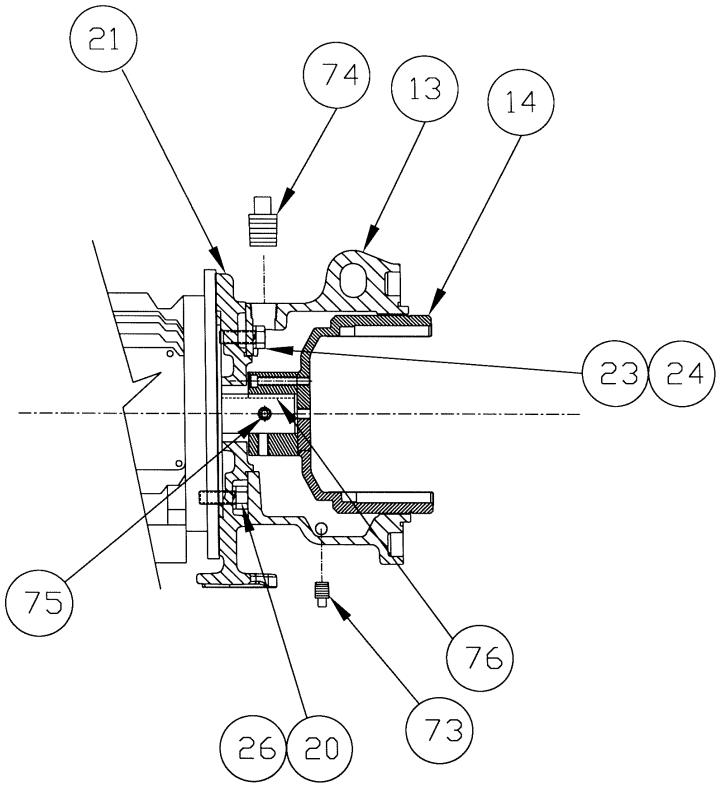


Figure 11-3 KF Drive End Cross Section

PARTS LIST 2 - Continued

	PART NAME	qty	KF438
13	Bracket, NEMA, close coupled	1	P3139
14	Outer Drive		
	NEMA, Close Coupled		
	182/184TC, L drive	1	P3215A
	213/215TC, L drive	1	P3215B
	254/256TC, L drive	1	P3215C
	284/286TC, L drive	1	P3215Q
	284/286TSC, L drive	1	P3215C
	324/326TC, L drive	1	P3215R
	324/326TSC, L drive	1	P3215G
	Long Coupled, L drive	1	P3215H
	284/286TC, N drive	1	P3215P
	324/326TC, N drive	1	P3215G
	324/326TSC, N drive	1	P3215P
	364/365TSC, N drive	1	P3215P
	405TSC, N drive	1	P3215G
	Long Coupled, N drive	1	P3215K
	IEC Frame, Close Coupled		
	100/112, L drive	1	P3224A
	132, L drive	1	P3224B
	160, L drive	1	P3224C
	180, L drive	1	P3224R
	200, L drive	1	P3224S
	160, N drive	1	P3224N
	180, N drive	1	P3224P
	200, N drive	1	P3224Q
	225 2 Pole, N drive	1	P3224Q
	225 4 Pole, N drive	1	P3224G
	250 2 Pole, N drive	1	P3224G
	JIS Frame, Close Coupled		
	100/112, L drive	1	P3224A
	132, L drive	1	P3224B
	160, L drive	1	P3224C
	180L, L drive	1	P3224S
	180M, L drive	1	P3224R
	200 4 Pole, L drive	1	P3224S
	160, N drive	1	P2694N
	180L, N drive	1	P2694Q
	200 2 Pole, N drive	1	P3224Q
	200 4 Pole, N drive	1	P3224G
	225 2 Pole, N drive	1	P3224Q
	250 2 Pole, N drive	1	P3224Q
16	Lock Washer, Bracket/Rear Support	6	HL5/8
19	Bolt, Bracket/Rear Support	6	HH5/8X1.75
20	Hex bolts, Bracket/Motor Mntng Plate		
	NEMA	4	HH5/8x1.75
	IEC & JIS	4	HHM16X45

PARTS LIST 2 – CONTINUED

	PART NAME	qty	KF438
21	Motor Mounting Plate, Close Coupled		
	NEMA		
	182/184TC	1	P3140A
	213/215TC	1	P3140A
	254/256TC	1	P3140B
	284/286TC	1	P3140D
	284/286TSC	1	P3140C
	324/326TC	1	P3140F
	324/326TSC	1	P3140E
	364/365TSC	1	P3140E
	405TSC	1	P3140F
	IEC		
	100/112	1	P3140H
	132	1	P3140I
	160/180	1	P3140J
	200	1	P3140K
	225 2 pole	1	P3140K
	225 4 pole	1	P3140L
	250 2 pole	1	P3140L
	JIS		
	100/112	1	P3140H
	132	1	P3140I
	160	1	P3140J
	180L	1	P3140K
	180M	1	P3140K
	200 2 pole	1	P3140K
	200 4 pole	1	P3140L
	225 2 pole	1	Consult Factory
	250 2 pole	1	Consult Factory
23	Lock Washer, Motor Mntng Plate/Motor		
	NEMA		N/A
	IEC & JIS 100/112 & 132	4	HLM12
	IEC & JIS 160/180 & JIS 180	4	HLM16
	IEC 200 thru 250 & JIS 180 thru 250	8	HLM16
24	Bolt, Motor Mounting Plate/Motor		
	NEMA 182/184TC thru 284/286TC	4	HS1/2X1.25
	NEMA 324/326TC thru 405TSC	4	HS5/8X1.50
	IEC & JIS 100/112 & 132	4	HHM12X35
	IEC 160/180 & JIS 160	4	HHM16X45
	IEC 200 thru 250 & JIS180 thru 250	8	HHM16X45
25	Jack Screws	2	HH5/8X4.00FT
26	Lock Washer, Bracket/Motor Mntng Pl		
	NEMA	4	HL5/8
	IEC & JIS	4	HLM16

PARTS LIST 2 – CONTINUED

	PART NAME	qty	KF4438
27	Bolt, Motor Riser		
	NEMA, Close Coupled		
	182/184TC		N/A
	213/215TC	2	HH3/8X1.00
	254/256TC thru 284/286TSC	2	HH1/2X1.00
	324/326TC thru 405TSC		N/A
	IEC, Close Coupled		
	100/112 & 132		N/A
	160 & 180	2	HH1/2X1.00
	200		N/A
	225 2 & 4 Pole, 250 2 Pole	2	HH1/2X1.00
	JIS, Close Coupled		
	100/112 & 132		N/A
	160 & 180 L & M	2	HH1/2X1.00
	200 2 & 4 Pole	2	HHM12X25
	225 2 Pole	2	HHM16X40
	250 2 Pole	2	HH1/2X1.00
28	Lock Washer, Motor Riser		
	NEMA, Close Coupled		
	182/184TC		N/A
	213/215TC	2	HL3/8
	254/256TC thru 284/285TSC	2	HL1/2
	324/326TC thru 405TSC		N/A
	IEC, Close Coupled		
	100/112 & 132		N/A
	160 & 180	2	HL1/2
	200		N/A
	225 2 & 4 Pole, 250 2 Pole	2	HL1/2
	JIS, Close Coupled		
	100/112 & 132		N/A
	160 & 180 L & M	2	HL1/2
	200 2 & 4 Pole	2	HLM12
	225 2 Pole	2	HLM16
	250 2 Pole	2	HL1/2
30	Motor Risers, Close Coupled		
	NEMA		
	182/1846TC frame,	1	NR
	213/215TC frame	1	P2852
	254/256TC frame	1	P2815
	284/286TC & TSC frame	1	P2816
	324/326TC &TSC frame	1	P2817
	IEC		
	160	1	P2924
	180	1	P2925
	200	1	P2926
	225	1	P2929
	250	1	P2930
	JIS		
	160	1	P2924
	180	1	P2925
	200	1	P2928
	225	1	P2927
	250	1	P2930

PARTS LIST 2 – CONTINUED

	PART NAME	qty	KF438
33	PUMP RISERS		
	NEMA frame		
	364/5TSC frame	1	P2854
	405TSC frame	1	P2855
	IEC frame		
	225 (2/4 pole)	1	P2855
	250 (2 pole)	1	P2923
	JIS frame		
	200	1	P2855
	225 (2 pole), 250 (2 pole)	1	P2923

12. COMMON CONVERSIONS

Ft (H^2O)	m (H^2O)	PSI	Kg/cm^2	KPa	inch Hg	mmHg	bar
1	0.3048	0.4335	0.03048	2.989	0.8851	22.48	0.02987
3.281	1	1.422	0.100	9.807	2.904	73.76	0.3685
2.307	0.7031	1	0.07031	6.895	2.042	51.87	0.0690
32.83	10.01	14.23	1	98.07	29.04	737.6	3.685
0.3349	0.1020	0.1450	0.01020	1	0.2961	7.521	0.01
1.132	0.3450	0.491	0.03443	3.377	1	25.4	0.0339
0.04457	0.5339	0.01933	0.001356	0.1330	0.03937	1	0.005
33.5	2.714	14.50	0.2714	100	29.5	200	1

Ft (in water) x 0.3048 = m (in water)
m (in water) x 3.2808 = Ft (in water)

PSI x 2.307 = Ft (in water)
Ft (in water) x .433 = PSI

Kg/cm^2 x 0.328 = Ft (in water)
Ft (in water) x 3.049 = Kg/cm^2

PSI x 6.895 = KPa
KPa x 0.1450 = PSI

Volume

Ft^3	m^3	liter	gallon (US)	gallon (UK)	Lbs of water
1	0.02832	28.32	7.481	6.229	62.44
35.31	1	1000	264.2	220.00	2205
0.03531	0.001	1	0.2642	0.2200	2.204
0.1337	0.003785	3.785	1	0.8327	8.347
0.1606	0.004545	4.548	1.201	1	10.025
0.01620	0.0004537	0.4537	.1198	0.09975	1

Temperature Conversions

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	ΔF	Δ°C
-60	-51	0	-18	60	15.6	120	48.9	180	82.2	240	116	300	149	360	182	1	0.6
-55	-48	5	-15	65	18.3	125	51.7	185	85.0	245	118	305	152	365	185	2	1.1
-50	-46	10	-12	70	21.1	130	54.4	190	87.8	250	121	310	154	370	188	3	1.7
-45	-43	15	-9.4	75	23.9	135	57.2	195	90.6	255	124	315	157	375	191	4	2.2
-40	-40	20	-6.7	80	26.7	140	60.0	200	93.3	260	127	320	160	380	193	5	2.8
-35	-37	25	-3.9	85	29.4	145	62.8	205	96.1	265	129	325	163	385	196	6	3.3
-30	-34	30	-1.1	90	32.2	150	65.6	210	98.9	270	132	330	166	390	199	7	3.9
-25	-32	35	1.67	95	35.0	155	68.3	215	102	275	135	335	168	395	202	8	4.4
-20	-29	40	4.44	100	37.8	160	71.1	220	104	280	138	340	171	400	204	9	5.0
-15	-26	45	7.22	105	40.6	165	73.9	225	107	285	141	345	174	405	207	10	5.6
-10	-23	50	10.0	110	43.3	170	76.7	230	110	290	143	350	177	410	210	11	6.1
-5	-21	55	12.8	115	46.1	175	79.4	235	113	295	146	355	179	415	213	12	6.7

°F=1.8°C+32 °C=0.55 x (°F-32)

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