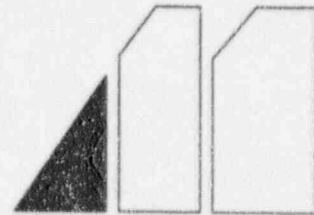


MILLSTONE NUCLEAR POWER STATION
MAINTENANCE PROCEDURE



Overhaul of Fuel Pool Cooling Pumps

MP 720.11

Rev. 4

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Approval:

A handwritten signature in black ink, appearing to be "J. Newman", written over a horizontal line.

PORC Mtg. No:

1-97-088

Date:

5-28-97

Effective Date:

6-3-97

Level of Use
General

Subject Matter Expert:
J. Newman

Millstone Unit 1
Maintenance Procedure

Overhaul of Fuel Pool Cooling Pumps

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1. PURPOSE

1.1 Objective

The objective of this procedure is to provide instructions for overhauling the fuel pool cooling pumps.

1.2 Discussion

This procedure provides guidance for overhauling the fuel pool cooling pumps. Each of these pumps is a 4 X 11SC horizontal, split-case, centrifugal pump manufactured by the Ingersoll-Rand Pump Co.

The overhaul instructions provided in Sections 4.1 through 4.5 cover pump removal, disassembly, cleaning, inspection, repair, assembly, and operational checkout.

1.3 Responsibilities

1.3.1 If necessary, Condition Based Maintenance Department is responsible for balancing impeller and shaft.

1.4 Applicability

This procedure applies to the following local IDs:

- M4-11A(PMP), "1A Fuel Pool Cooling Pump-Pump"
- M4-11B(PMP), "1B Fuel Pool Cooling Pump-Pump"

2. PREREQUISITES

2.1 General

2.1.1 This pump falls within the ASME Section XI boundary. Planned repair or replacement of pressure-retaining components has been evaluated in accordance with WC 3, "ASME Section XI Repair and Replacement Program."

2.2 Documents

- 2.2.1 C MP 710A, "Horizontal Shaft Alignment"
- 2.2.2 MP 791.0 (Att), "Fuel Pool Cooling (310)"
- 2.2.3 WC 10 (Att), "Lifted Lead and Jumper Device Data Sheet"

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2.3 Measuring and Test Equipment (M&TE)

2.3.1 All M&TE has been calibrated in accordance with WC 8, "Control and Calibration of Measuring and Test Equipment" and the calibration is current.

2.3.2 QA torque wrenches (click or dial type) with a minimum accuracy and maximum torque wrench full scale value listed in the table below for the specified torque application range.

Specified Torque Application Range	Maximum Torque Wrench Full-Scale Value	Minimum Accuracy
114 to 126 ft•lbs	Between 150 and 600 ft•lbs	5%

2.3.3 Dial indicator with a 1-inch travel and minimum accuracy of ± 0.0005 inch, such as QA-1504 (four required)

2.3.4 Inside micrometer with a range of 2 to 3 inches and an accuracy of ± 0.0005 inch, such as MPS-49

2.3.5 Inside micrometer with a range of 3 to 4 inches and an accuracy of ± 0.0005 inch, such as MPS-50

2.3.6 Inside micrometer with a range of 5 to 6 inches and an accuracy of ± 0.0005 inch, such as MPS-52

2.3.7 Outside micrometer with a range of 0 to 1 inch and an accuracy of ± 0.0005 inch, such as QA-1568

2.3.8 Outside micrometer with a range of 1 to 2 inches and an accuracy of ± 0.0005 inch, such as QA-1569

2.3.9 Outside micrometer with a range of 2 to 3 inches and an accuracy of ± 0.0005 inch, such as MPS-42

2.3.10 Outside micrometer with a range of 5 to 6 inches and an accuracy of ± 0.0005 inch, such as MPS-44

2.3.11 Thermocouple thermometer capable of measuring up to 400°F with an accuracy of $\pm 1^\circ\text{F}$, such as QA-1703

2.4 Tools and Consumables

2.4.1 Tools

- Abrasive stone(s)
- Allen wrenches
- Cold chisel
- Coupling puller
- Crescent wrenches
- Drill
- Drill bit, No. 7
- Feeler gage
- Files
- Grease gun
- Impact Wrench
- Level
- Machinist's scale
- Mallet
- Mechanic's set of combination wrenches
- Mechanic's standard tool kit
- Pipe wrenches
- Razor knife
- Ruler
- Scraper
- Set of Allen wrenches
- Sharp knife (for cutting gasket material)
- Sledgehammer (2 lbs)

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- Small grinder
- Snap gage
- Snap ring pliers
- Socket set with ratchets and breaker bar
- Spanner wrench
- Strap wrench
- Tap, $\frac{1}{4}$ -inch UNC
- Wire brush

2.4.2 Equipment

- Bearing puller or arbor press
- Chain fall, $\frac{1}{2}$ -ton capacity minimum
- Dial indicator alignment fixture
- Eyebolts, $\frac{7}{16}$ inch (two required)
- Hydraulic press
- Induction bearing heater
- Paint buckets (1-gallon capacity)
- Receptacle for draining bearing housing oil (1-quart capacity minimum)
- Rope (approximately 40 feet, $\frac{1}{2}$ -inch diameter)
- Slings, 1-inch diameter minimum, one at 4 feet, two at 2 feet
- Shackles, $\frac{3}{8}$ inch, (two required)
- Stands (horses) and planks
- Torch with rosebud (two required)
- Tube light
- V-blocks or lathe

2.4.3 Spare Parts

- Bearing end cover gasket (2 required)
- Case wear ring (2 required)
- Casing gasket
- Coupling key
- Coupling gasket
- Impeller
- Impeller key
- Impeller setscrew (6 required)
- Impeller wear ring (2 required)
- Mechanical seal assembly (2 required)
- Radial bearing
- Radial bearing housing
- Seal ring (2 required)
- Shaft
- Shaft sleeve (2 required)
- Shaft sleeve nut (2 required)
- Shaft sleeve O-ring (2 required)
- Thrust bearing
- Thrust bearing housing

2.4.4 Consumables

- Approved anti-seize compound such as nuclear-grade Never-Seez
- Approved cleaning solvent such as Polywater Hydrafoam 2020 All Purpose Cleaner
- Approved gasket adhesive such as aviation-grade Permatex
- Approved shaft sleeve O-ring lubricant such as Versilube
- Approved thread sealant such as PRI 101N
- Pump lubricant
- Coupling lubricant
- Cribbing
- Emery cloth (coarse and medium)
- Fine-grit abrasive
- Gasket sheet material, $\frac{1}{64}$ inch (casing gasket)
- Herculite
- Low-lint cloths
- Scotch Brite pads
- Tape

2.5 Definitions

- 2.5.1 DE-MAGNETIZE—To deprive of magnetic properties
- 2.5.2 Radial end—Inboard (coupling) end
- 2.5.3 Thrust end—Outboard end
- 2.5.4 TIR—Total indicated runout

3. PRECAUTIONS

- 3.1 Prior to disassembly, match mark components as necessary to aid in reassembly. Do *not* match mark delicate parts or critical mating surfaces.
- 3.2 Ensure all chemical consumables to be used in or on power plant components are controlled in accordance with CC 1, "Control of Chemical Consumable Products," and that a Restricted Use Permit has been issued as necessary.
- 3.3 Ensure all combustible materials, flammable liquids, compressed gasses, and ignition sources are used in accordance with WC 7, "Fire Protection Program."

4. INSTRUCTIONS

4.1 **Pump Disassembly**

4.1.1 DISCONNECT the following:

- Seal water piping
- Upper casing vent piping

4.1.2 Refer To Attachment 1, and REMOVE fasteners securing gland plates (S-14) to casing.

4.1.3 SLIDE gland plates away from casing as far as possible.

4.1.4 UNCOUPLE pump and motor as follows:

- a. REMOVE coupling guard.
 - b. MATCH MARK the following components:
 - Pump coupling hub
 - Coupling covers
 - Motor coupling hub
 - c. REMOVE fasteners securing coupling cover halves.
 - d. REMOVE grid.
 - e. REMOVE coupling gasket.
- 4.1.5 REQUEST dual verification, and MEASURE as-found coupling hub separation dimension as follows:
- a. MEASURE minimum coupling gap.
 - b. PUSH motor shaft outboard and MEASURE maximum coupling gap.

NOTE

One half of the difference between the minimum and maximum coupling hub gap measurements is the as-found coupling hub separation dimension.

- c. CALCULATE as-found coupling hub separation dimension.
- d. RECORD as-found coupling hub separation dimension onto Attachment 5.

NOTE

The instructions for draining the thrust bearing housing are the same as those for draining the radial bearing housing.

4.1.6 DRAIN bearing housings as follows:

- a. POSITION suitable receptacle beneath thrust bearing housing.
- b. REMOVE plug from bottom of bearing oiler, and DRAIN oil into receptacle.

NOTE

The rotating assembly can be removed from the pump without moving the motor.

4.1.7 IF motor must be moved in order to gain access to pump components, MOVE motor as follows:

- a. MARK motor leadwires.
- b. DISCONNECT motor leadwires.
- c. RECORD lifted leads onto WC 10 (Att), "Lifted Lead and Jumper Device Data Sheet."

NOTE

Motor weighs approximately 460 lbs.

- d. DISCONNECT any conduit that could interfere with movement of motor.
- e. RIG motor as necessary to permit motor to be turned.
- f. REMOVE motor hold-down fasteners.
- g. LIFT motor and ROTATE motor as necessary.
- h. IF applicable, REMOVE and LABEL motor shims.
- i. PLACE motor support blocks beneath motor.
- j. LOWER motor onto support blocks.

4.1.8 REMOVE upper casing as follows:

NOTE

Upper casing weighs approximately 80 lbs.

- a. REMOVE fasteners securing upper casing to lower casing.
- b. REMOVE casing dowels.
- c. INSTALL, but do *not* tighten, jacking bolts into lower casing.
- d. Evenly TIGHTEN jacking bolts, and JACK upper casing from lower casing.
- e. IF necessary, RIG upper casing.
- f. LIFT upper casing as straight as possible, and MOVE it to a suitable work area.

4.1.9 REMOVE rotating assembly as follows:

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- a. REMOVE thrust bearing oiler.
- b. REMOVE two thrust bearing housing dowels.
- c. REMOVE fasteners securing thrust bearing housing to case bottom half.
- d. REMOVE radial bearing oiler.
- e. REMOVE two radial bearing housing dowels.
- f. REMOVE fasteners securing radial bearing housing to case bottom half.

NOTE

Rotating assembly weighs approximately 105 lbs.

- g. IF necessary, RIG rotating assembly.
- h. LIFT rotating assembly as straight as possible, and MOVE it to a suitable work area.
- i. COVER openings as necessary to prevent foreign objects from entering system.
- j. REMOVE casing gasket (170).

4.1.10 DISASSEMBLE thrust-end components as follows:

- a. REMOVE fasteners securing thrust bearing end cover (160B) to thrust bearing housing (159).
- b. REMOVE thrust bearing end cover (160B).
- c. REMOVE thrust bearing end cover gasket (262).
- d. REMOVE thrust bearing snap ring (397).
- e. Using bearing puller, REMOVE thrust bearing housing (159).
- f. REMOVE thrust bearing (204).

- g. REMOVE thrust bearing housing seal ring or bearing isolator (308B) as applicable.

NOTE

Pumps equipped with a bearing isolator have no flinger.

- h. IF equipped, REMOVE flinger (157).
- i. LOOSEN setscrews (S-13) securing collar (S-12) to shaft sleeve.
- j. REMOVE mechanical seal assembly (429) as a single unit.
- k. REMOVE setscrews securing shaft sleeve nut (127) to shaft.
- l. REMOVE shaft sleeve nut (127).
- m. REMOVE shaft sleeve O-ring (456).
- n. REMOVE shaft sleeve (8).

4.1.11 DISASSEMBLE radial-end components as follows:

- a. REMOVE pump coupling hub as follows:
 - 1) MOUNT coupling puller onto pump coupling hub.

NOTE

The coupling hub has an interference fit of approximately 0.001 to 0.003 inch. Coupling hub removal *may* require the application of heat.

- 2) TIGHTEN coupling puller until coupling hub offers moderate resistance.



WARNING



To prevent injury to personnel, all combustible materials, flammable liquids, compressed gasses, and ignition sources must be used in accordance with WC 7, "Fire Protection Program."



CAUTION



To prevent damage to coupling hub during removal, heat must be applied *evenly* to coupling hub.

- 3) Using a torch with a flame-spreading nozzle, *evenly* HEAT pump coupling hub and TIGHTEN coupling puller until coupling hub slides off shaft.
- 4) REMOVE coupling hub key (12).
- 5) REMOVE coupling cover and seal.
- b. REMOVE fasteners securing radial bearing end cover (160A) to radial bearing housing (159).
- c. REMOVE radial bearing end cover (160A).
- d. REMOVE radial bearing end cover seal ring or bearing isolator (308A) as applicable.
- e. REMOVE radial bearing end cover gasket (262).
- f. Using bearing puller, REMOVE radial bearing housing (159).
- g. REMOVE radial bearing (205).
- h. REMOVE radial bearing housing seal ring or bearing isolator (308B) as applicable.

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NOTE

Pumps equipped with a bearing isolator have no flinger.

- i. IF equipped, REMOVE flinger (157).
- j. LOOSEN setscrews (S-13) securing collar (S-12) to shaft sleeve.
- k. REMOVE mechanical seal assembly (429) as a single unit.
- l. REMOVE setscrews securing shaft sleeve nut (127) to shaft.
- m. REMOVE shaft sleeve nut (127).
- n. REMOVE shaft sleeve O-ring (456).
- o. REMOVE shaft sleeve (8).

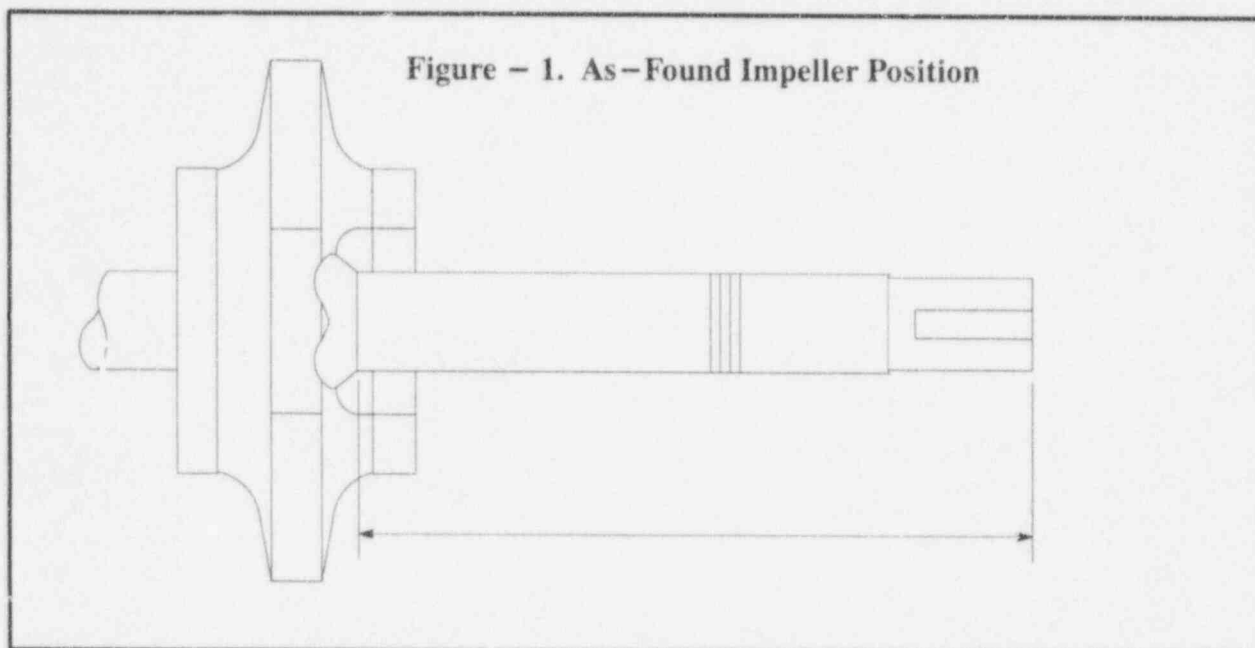
4.1.12 REMOVE casing wear rings (6).

4.1.13 REMOVE impeller as follows:

NOTE

When measuring the as-found dimension between inboard end of shaft and face of impeller hub, an accuracy of at least $\frac{1}{32}$ inch is necessary.

- a. Refer To Figure - 1, and, using a machinist's scale, MEASURE as-found dimension between inboard end of shaft and face of impeller hub.



- b. RECORD measured dimension onto Attachment 5.
- c. MATCH MARK impeller with respect to direction of rotation.
- d. REMOVE impeller setscrews.

NOTE

A small amount of heat may be required to remove the impeller.

- e. IF necessary, using a thermocouple thermometer and heating torch with rosebud, HEAT impeller hub to 150 to 350°F, and REMOVE impeller from shaft.

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- f. REMOVE impeller key (11).

NOTE

Lower casing removal is unlikely. Pump maintenance is normally performed with the lower casing installed.

- 4.1.14 IF lower casing removal is necessary, **PERFORM** the following:

- a. DISCONNECT suction and discharge piping.
- b. REMOVE fasteners securing lower casing to baseplate.
- c. REMOVE lower casing dowels.

NOTE

Lower casing weighs approximately 315 lbs.

- d. RIG lower casing.
- e. *Carefully* LIFT lower casing and LOWER onto cribbing.
- f. REMOVE suction and discharge piping gaskets.
- g. COVER suction and discharge pipe openings.

4.2 Pump Cleaning and Inspection



CAUTION



All chemical consumables to be used in or on power plant components must be controlled in accordance with CC 1, "Control of Chemical Consumable Products," and a Restricted Use Permit must be issued when necessary.

- 4.2.1 Using an approved cleaning solvent, **CLEAN** all components.
- 4.2.2 Using a fine-grit abrasive or Scotch-Brite pad, **REMOVE** the following from all mating flanges:
- Dirt
 - Paint
 - Loose scale
 - Corrosion
 - Burrs
 - Raised surfaces

NOTE

Structural damage and defects include breakage, cracks, deformation, distortion, corrosion, pitting, scoring, scratches, erosion, abrasion, galling, and indications of misalignment.

- 4.2.3 Visually **INSPECT** all components for wear, structural defects, and damage.
- 4.2.4 **IF** inspection results are *not* satisfactory, Refer To Section 4.3, and **REPAIR** or **REPLACE** applicable component(s).

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4.2.5 REQUEST dual verification, and, with V-blocks positioned beneath bearing locations, INSPECT total indicated runout (TIR) at the following shaft locations:

- Thrust bearing
- Thrust-end shaft sleeve
- Impeller
- Radial-end shaft sleeve
- Radial bearing
- Coupling hub

4.2.6 RECORD the following onto Attachment 5:

- Measured TIR values
- M&TE serial No.
- Calibration due date

4.2.7 IF inspection results are *not* satisfactory, OR TIR is *greater than* 0.002 inch, Refer To Section 4.3, and REPAIR or REPLACE shaft. |

4.2.8 REQUEST dual verification, and MEASURE wear ring clearance at the following locations:

- Thrust-end impeller-to-case wear ring
- Radial-end impeller-to-case wear ring

4.2.9 RECORD the following onto Attachment 5:

- Measured clearance values
- M&TE serial numbers
- Calibration due dates

4.2.10 IF wear ring inspection results are *not* satisfactory, OR impeller-to-case wear ring clearance is *not* 0.010 to 0.021 inch, Refer To Section 4.3, and REPLACE impeller wear rings.

NOTE

When installing bearing isolators, the outside diameter must be measured between the stator O-ring and the radial location chamfer.

4.2.11 IF bearing isolators will be installed, **PERFORM** the following:

a. **REQUEST** dual verification, and **MEASURE** interference fit between bearing isolators and their respective bores at the following locations:

- Thrust bearing housing seal bore inside diameter and thrust bearing isolator stator outside diameter
- Radial bearing housing seal bore inside diameter and radial bearing isolator stator outside diameter, impeller side
- Radial bearing end cover seal bore inside diameter and radial bearing isolator stator outside diameter, coupling side

b. **RECORD** the following onto Attachment 5:

- Measured interference fit values
- M&TE serial numbers
- Calibration due dates

c. IF any interference fit is *not* 0.001 to 0.003 inch, Refer To Section 4.3, and **REPAIR** or **REPLACE** the following as applicable:

- Radial bearing housing or bearing isolator
- Thrust bearing housing or bearing isolator
- Radial bearing end cover or bearing isolator

4.2.12 IF all inspection results are satisfactory, Go To Section 4.4 and **ASSEMBLE** pump.

4.3 Pump Repair



CAUTION



This pump falls within the ASME Section XI boundary. Repair or replacement of pressure-retaining components must be evaluated in accordance with WC 3, "ASME Section XI Repair and Replacement Program."

- 4.3.1 IF applicable, Refer To "ASME Section XI Repair and Replacement Plan," and REPAIR or REPLACE pressure-retaining components as necessary.
- 4.3.2 IF impeller-to-case wear ring inspection results are *not* satisfactory, OR clearance is *not* 0.010 to 0.021 inch, REPLACE impeller wear ring (4) as follows:

NOTE

The instructions for replacing the thrust-end and radial-end impeller wear rings are the same.

- a. REMOVE impeller wear ring (4) as follows:
- 1) REMOVE wear ring setscrews.
 - 2) CUT or GRIND wear ring from impeller.
- b. INSTALL impeller wear ring (4) as follows:
- 1) Using a small file or fine-grit abrasive, REMOVE any burrs from wear ring seating surface.
 - 2) Using an approved cleaning solvent, CLEAN wear ring seating surface.

NOTE

Impeller wear ring has an interference fit of 0.002 to 0.007 inch on impeller hub.

- 3) HEAT impeller wear ring.
- 4) With larger OD of wear ring facing impeller, INSTALL impeller wear ring onto impeller, and ENSURE wear ring is firmly seated against shoulder.

NOTE

Wear ring setscrews *cannot* be installed into the same holes from which they were removed. If the impeller is *not* new, the wear ring setscrews holes must be drilled and tapped approximately one half the distance from the existing holes.

- 5) Using a drill with a No. 7 drill bit, DRILL three holes (approximately 120° apart) 1/2-inch deep into mating joint of impeller hub and wear ring.
- 6) Using a 1/4-inch UNC tap, THREAD three holes drilled in step 4.3.2.b.5).
- 7) INSTALL and TIGHTEN impeller wear ring setscrews.
- 8) STAKE wear ring setscrews.

4.3.3 REQUEST dual verification, and MEASURE wear ring clearance at the following locations:

- Thrust-end impeller-to-case wear ring
- Radial-end impeller-to-case wear ring

4.3.4 RECORD the following onto Attachment 5:

- Measured clearance values
- M&TE serial numbers
- Calibration due dates

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4.3.5 PERFORM applicable action:

- IF impeller-to-case wear ring clearance is *less than* 0.010 inch, MACHINE impeller wear ring as required to achieve proper clearance.
- IF impeller-to-case wear ring clearance is *greater than* 0.014 inch, REQUEST FLS to provide instructions for further maintenance.

4.4 Pump Assembly

4.4.1 IF lower casing was removed, Refer To Attachment 1, and INSTALL lower casing as follows:

- a. REMOVE covers from suction and discharge pipe openings.
- b. INSTALL suction and discharge piping gaskets.

NOTE

Pump lower casing weighs approximately 315 lbs.

- c. RIG lower casing.
- d. *Carefully* LIFT lower casing and LOWER onto baseplate.
- e. INSTALL lower casing dowels.
- f. INSTALL and TIGHTEN fasteners securing lower casing to baseplate.
- g. CONNECT suction and discharge piping.

4.4.2 INSTALL new parting flange gasket as follows:

- a. With top surface of upper casing facing downward, POSITION upper casing onto ground or work surface.



CAUTION



To prevent damage to gasket, casing mating surfaces must be free of dirt and foreign material before installing gasket.

- b. ENSURE gasket and upper casing mating surfaces are thoroughly cleaned.
- c. POSITION $\frac{1}{64}$ -inch gasket material over upper casing mating surface.
- d. CUT gasket material *larger* than size required.

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- e. CUT holes in gasket to allow for lower casing stud bolts and dowel pins.
- f. APPLY approved gasket adhesive to lower casing mating surface.
- g. POSITION gasket onto lower casing mating surface.
- h. RIG upper casing.
- i. LIFT upper casing as straight as possible.
- j. With holes in upper casing aligned with stud bolts in lower casing, LOWER upper casing onto lower casing.

NOTE

To ensure even pressure on gasket, at least eight casing bolts should be installed symmetrically around casing. For best results, two casing bolts should be installed at each end of casing and four casing bolts should be installed in middle of casing.

- k. Using a diagonal sequence, INSTALL and TIGHTEN eight casing bolts symmetrically around casing.
- l. ALLOW gasket adhesive to cure for at least four hours.
- m. WHEN at least four hours has elapsed, REMOVE eight casing bolts.
- n. RIG upper casing.
- o. LIFT upper casing as straight as possible.
- p. MOVE upper casing to suitable area.



CAUTION



To prevent leakage around wear rings and stuffing box, the gasket must overhang 0.010 inch into the casing at these locations.

- q. Refer To Attachment 3, and, using a razor knife, TRIM casing gasket such that gasket extends into case bottom half approximately 0.010 inch at the wear ring and stuffing box locations.
- 4.4.3 IF impeller was removed from shaft, INSTALL impeller (3) as follows:
- a. INSTALL impeller key (11) into shaft.
 - b. POSITION radial–end shaft sleeve (8) onto shaft, and ENSURE shaft sleeve is properly seated over impeller key.
 - c. Using an approved lubricant, LUBRICATE radial–end shaft sleeve O–ring (456).
 - d. INSTALL radial–end shaft sleeve O–ring onto shaft.
 - e. Refer To Attachment 5, and THREAD radial–end shaft sleeve nut (127) onto shaft.
 - f. ADJUST shaft sleeve nut until the dimension between the inboard end of shaft and impeller side of the shaft sleeve is equal to the dimension measured in step 4.1.13.a.
 - g. INSTALL, but do *not* tighten, setscrews securing radial–end shaft sleeve nut to shaft.

NOTE

A small amount of heat may be required to install the impeller.

- h. IF necessary, using a thermocouple thermometer and heating torch with rosebud, HEAT impeller hub to 150 to 350°F.

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NOTE

1. The impeller must be installed such that it rotates counterclockwise when viewed from the driven (inboard) end.
 2. The impeller must be installed in the same position it was in prior to removal.
-
- i. INSTALL impeller onto shaft such that the impeller rotates counterclockwise when viewed from the driven (inboard) end.
 - j. ENSURE impeller is properly seated over key and firmly seated against shaft sleeve gasket.
 - k. POSITION thrust–end shaft sleeve (8) onto shaft, and ENSURE shaft sleeve is properly seated over impeller key.
 - l. Using an approved lubricant, LUBRICATE thrust–end shaft sleeve O–ring (456).
 - m. INSTALL and TIGHTEN thrust–end shaft sleeve nut (127) onto shaft.
 - n. INSTALL, but do *not* tighten, setscrews securing radial–end shaft sleeve nut to shaft.

4.4.4 INSPECT impeller concentricity as follows:

- a. MOUNT shaft and impeller assembly on V–blocks.
- b. REQUEST dual verification, and, using a dial indicator, INSPECT shaft and impeller assembly for high spots and TIR at the following locations:
 - Circumference of thrust–end impeller wear ring
 - Circumference of radial–end impeller wear ring

NOTE

Machining of wear rings may be required if high spots or excessive TIR are detected. To ensure that machining of wear rings does *not* result in excessive clearances, FLS should be consulted before machining.

- c. IF high spots are detected OR TIR is greater than 0.002 inch, REQUEST FLS to provide instructions for further maintenance.
 - d. RECORD the following onto Attachment 5:
 - As-left TIR values
 - M&TE serial numbers
 - Calibration due dates
- 4.4.5 REQUEST FLS to determine if impeller and shaft must be balanced.
- 4.4.6 IF directed by FLS, REQUEST Condition Based Maintenance Department to balance impeller and shaft.
- 4.4.7 MOUNT shaft and impeller assembly on stands.
- 4.4.8 INSTALL thrust-end components as follows:
- a. With larger OD of wear ring facing impeller, POSITION thrust-end case wear ring (6) over impeller hub.
 - b. POSITION collar (S-12) over shaft sleeve (8).
 - c. Using an approved lubricant, sparingly LUBRICATE seat ring (S-2) and bellows (S-4).
 - d. Carefully WIPE lapped sealing faces of seat (S-1) and washer (S-4) until thoroughly clean.
 - e. Using an approved lubricant, sparingly LUBRICATE seat (S-1) and washer (S-4).
 - f. ASSEMBLE mechanical seal components.
 - g. POSITION mechanical seal assembly (429) over shaft sleeve.

- h. INSTALL gland plate O-ring (S-11) onto gland plate (S-12).
- i. POSITION gland plate (S-14) onto shaft.
- j. IF thrust bearing seal ring is being installed, PERFORM the following:
 - 1) INSTALL flinger (157).
 - 2) With lip of seal facing bearing, INSTALL thrust bearing seal ring (308B) into thrust bearing housing (159).
- k. IF thrust bearing isolator (308B) is being installed, PERFORM the following:



CAUTION



Caution must be used to prevent cocking or overexerting the bearing isolator in the bearing housing. If the bearing isolator is able to be seated with hand pressure only, the interference fit is inadequate. The bearing isolator must have 0.001 to 0.003 inch interference fit.

NOTE

A 15 degree by 0.015 inch chamfer is provided on the bearing isolator to help prevent overexertion and to ensure the isolator is installed squarely. A hand arbor press is recommended for seating the bearing isolator into the bearing housing. Slight shavings of the isolator stator O-ring may be expected with a good press fit. Any sheared O-ring material must be removed.

- 1) ENSURE the expulsion port is positioned downward (at the 6 o'clock position) and INSTALL thrust bearing isolator (308B) into thrust bearing housing (159).
- 2) REMOVE any sheared O-ring material.
- 3) Using an approved lubricant, sparingly LUBRICATE thrust-end of shaft (10).



CAUTION



To prevent damage to the thrust bearing isolator internal O-ring, even pressure must be applied to the bearing isolator rotor when installing bearing housing onto shaft.

- l. INSTALL thrust bearing housing (159).
- m. INSTALL thrust bearing (204) as follows:
 - 1) IF replacement bearing includes bearing shields, REMOVE bearing shields.



CAUTION



To prevent damage to bearing during heating process, bearing temperature must *not* exceed 250°F.

- 2) HEAT bearing to 200°F, and ENSURE temperature does *not* exceed 250°F.
 - 3) IF using an induction bearing heater, DE-MAGNETIZE bearing.
 - 4) INSTALL bearing onto shaft, and HOLD bearing firmly against shaft shoulder until bearing cools.
 - n. INSTALL thrust bearing snap ring (397).
 - o. Using an approved gasket adhesive, INSTALL thrust bearing end cover gasket (262).
 - p. POSITION thrust bearing end cover (160A) over thrust bearing housing (159).
 - q. INSTALL and TIGHTEN fasteners securing thrust bearing end cover (160B) to thrust bearing housing (159).
- 4.4.9 INSTALL radial-end components as follows:

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- a. With larger OD of wear ring facing impeller, POSITION radial-end case wear ring (6) over impeller hub.
- b. POSITION collar (S-12) over shaft sleeve (8).
- c. Using an approved lubricant, sparingly LUBRICATE seat ring (S-2) and bellows (S-4).
- d. Carefully WIPE lapped sealing faces of seat (S-1) and washer (S-4) until thoroughly clean.
- e. Using an approved lubricant, sparingly LUBRICATE seat (S-1) and washer (S-4).
- f. ASSEMBLE mechanical seal components.
- g. POSITION mechanical seal assembly (429) over shaft sleeve.
- h. INSTALL gland plate O-ring (S-11) onto gland plate (S-12).
- i. POSITION gland plate (S-14) onto shaft.
- j. IF radial bearing seal ring is being installed, PERFORM the following:
 - 1) INSTALL flinger (157).
 - 2) With lip of seal facing bearing, INSTALL radial bearing seal ring (308B) into radial bearing housing (159).
- k. IF radial bearing isolator (308B) is being installed, PERFORM the following:



CAUTION



Caution must be used to prevent cocking or overexerting the bearing isolator in the bearing housing. If the bearing isolator is able to be seated with hand pressure only, the interference fit is inadequate. The bearing isolator must have 0.001 to 0.003 inch interference fit.

NOTE

A 15 degree by 0.015 inch chamfer is provided on the bearing isolator to help prevent overexertion and to ensure the isolator is installed squarely. A hand arbor press is recommended for seating the bearing isolator into the bearing housing. Slight shavings of the isolator stator O-ring may be expected with a good press fit. Any sheared O-ring material must be removed.

- 1) ENSURE the expulsion port is positioned downward (at the 6 o'clock position) and INSTALL radial bearing isolator (308B) into radial bearing housing (159).
- 2) REMOVE any sheared O-ring material.
- 3) Using an approved lubricant, sparingly LUBRICATE radial-end of shaft (10).



CAUTION



To prevent damage to the radial bearing isolator internal O-ring, even pressure must be applied to the bearing isolator rotor when installing bearing housing onto shaft.

- l. INSTALL radial bearing housing (159).
- m. INSTALL radial bearing (204) as follows:
 - 1) IF replacement bearing includes bearing shields, REMOVE bearing shields.

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CAUTION



To prevent damage to bearing during heating process, bearing temperature must *not* exceed 250°F.

- 2) HEAT bearing to 200°F, and ENSURE temperature does *not* exceed 250°F.
 - 3) IF using an induction bearing heater, DE-MAGNETIZE bearing.
 - 4) INSTALL bearing onto shaft, and HOLD bearing firmly against shaft shoulder until bearing cools.
- n. Using an approved gasket adhesive, INSTALL radial bearing end cover gasket (262).
- o. IF radial bearing end cover seal ring is being installed, with lip of seal facing bearing, INSTALL radial bearing end cover seal ring (308A) into radial bearing end cover (160A).
- p. IF radial bearing end cover isolator (308A) is being installed, PERFORM the following:



CAUTION



Caution must be used to prevent cocking or overexerting the bearing isolator in the bearing housing. If the bearing isolator is able to be seated with hand pressure only, the interference fit is inadequate. The bearing isolator must have 0.001 to 0.003 inch interference fit.

NOTE

A 15 degree by 0.015 inch chamfer is provided on the bearing isolator to help prevent overexertion and to ensure the isolator is installed squarely. A hand arbor press is recommended for seating the bearing isolator into the bearing housing. Slight shavings of the isolator stator O-ring may be expected with a good press fit. Any sheared O-ring material must be removed.

- 1) ENSURE the expulsion port is positioned downward (at the 6 o'clock position) and INSTALL radial bearing isolator (308A) into radial bearing end cover (159).
- 2) REMOVE any sheared O-ring material.
- 3) Using an approved lubricant, sparingly LUBRICATE radial-end of shaft (10).



CAUTION



To prevent damage to the radial bearing isolator internal O-ring, even pressure must be applied to the bearing isolator rotor when installing bearing housing onto shaft.

- q. POSITION radial bearing end cover (160A) over radial bearing housing.
- r. INSTALL and TIGHTEN fasteners securing radial bearing end cover (160A) to radial bearing housing (159).
- s. INSTALL pump coupling cover and seal.
- t. INSTALL pump coupling hub as follows:

- 1) INSTALL pump coupling hub key onto shaft.



WARNING



To prevent injury to personnel, all combustible materials, flammable liquids, compressed gasses, and ignition sources must be used in accordance with WC 7, "Fire Protection Program."



CAUTION



To prevent damage to coupling hub during installation, heat must be applied *evenly* to coupling hub.

NOTE

1. Coupling hub has an interference fit of approximately 0.001 to 0.003 inch on shaft. Coupling hub installation *may* require the application of heat.
2. The coupling hub must be installed flush with the end of the shaft.

- 2) *Evenly* HEAT pump coupling hub to 250 to 300°F.
- 3) INSTALL pump coupling hub onto shaft, and ENSURE the following:
 - Coupling hub is properly seated over key.
 - Face of coupling hub is flush with end of shaft.

4.4.10 INSTALL rotating assembly as follows:

NOTE

Rotating assembly weighs approximately 105 lbs.

- a. IF necessary, RIG rotating assembly.

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- b. LIFT rotating assembly and LOWER rotating assembly until approximately one foot above lower casing.
- c. ALIGN the following with lower casing:
 - Case wear rings
 - Impeller
 - Bearing housings



CAUTION



To ensure proper seating of the rotating assembly, the portion of the casing flange gasket that overhangs 0.010 into the lower casing must be turned upward before installing the rotating assembly.

- d. *Carefully* PULL upward on 0.010 overhang portion of the casing flange gasket.
 - e. *Slowly* LOWER rotating assembly into lower casing, and ENSURE the following:
 - Rotating assembly is lowered as straight as possible.
 - Case wear rings are properly mated with roll pins.
 - Rotating assembly does *not* rest on gasket overhang.
- 4.4.11 INSTALL, but do *not* tighten, fasteners securing gland plates (S-14) to lower casing.
- 4.4.12 INSTALL dowels aligning thrust bearing housing (159) to lower casing.
- 4.4.13 INSTALL and TIGHTEN fasteners securing thrust bearing housing to lower casing.
- 4.4.14 INSTALL dowels aligning radial bearing housing (159) to lower casing.
- 4.4.15 INSTALL and TIGHTEN fasteners securing radial bearing housing to lower casing.

4.4.16 REQUEST dual verification, and MEASURE as—left shaft end play dimension as follows.

- a. PUSH shaft towards thrust end of pump as far as possible.
- b. POSITION dial indicator against end of shaft.
- c. PULL shaft towards radial end of pump, and MEASURE total shaft end play.
- d. RECORD the following onto Attachment 5:
 - Measured end play value
 - M&TE serial No.
 - Calibration due date

4.4.17 IF shaft end play dimension is *not* 0.008 to 0.010 inch, REQUEST FLS to provide instructions for further maintenance.

NOTE

The position of the impeller can be adjusted by turning the shaft sleeve nuts.

4.4.18 IF impeller is not centered in lower casing, CENTER impeller in lower casing.

4.4.19 WHEN impeller is centered in lower casing, PERFORM the following:

- INSTALL and TIGHTEN setscrews securing shaft sleeve nuts to shaft.
- INSTALL and TIGHTEN setscrews securing impeller to shaft.

NOTE

The instructions for setting the thrust--end mechanical seal assembly are the same as those for setting the radial--end mechanical seal assembly.

4.4.20 SET mechanical seal assemblies as follows:

- a. SCRIBE a line on shaft sleeve $2\frac{5}{16}$ -inch from face of stuffing box.
- b. POSITION inside end of collar (the end facing the impeller) at line scribed in step 4.4.20.a., and TIGHTEN collar setscrews (S-13).

4.4.21 INSTALL upper casing as follows:

- a. RIG upper casing.
- b. LIFT upper casing as straight as possible.



CAUTION



To prevent leakage, the upper and lower casing mating surfaces must be thoroughly clean and free of burrs, nicks, and raised surfaces.

- c. ENSURE mating surfaces of upper and lower casing are thoroughly clean and free of burrs, nicks, and raised surfaces.



CAUTION



To prevent damage to rotating assembly and case wear rings, upper casing must be lowered evenly and carefully onto lower casing.

- d. With upper casing aligned with wear rings and studs in lower casing, *carefully* LOWER upper casing onto lower casing.
- e. REMOVE rigging.
- f. ENSURE upper casing is properly seated.

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- g. REMOVE eyebolts from upper casing.
- h. INSTALL case dowels.
- i. INSTALL, but do *not* tighten, casing bolts.
- j. TORQUE casing bolts as follows:
 - 1) Refer To Attachment 4, and, using the tightening sequence shown, TORQUE casing bolts to initial torque of 40 ft•lbs (38 to 42 ft•lbs).
 - 2) Using the tightening sequence shown, TORQUE casing bolts to a secondary torque of 80 ft•lbs (76 to 84 ft•lbs).
 - 3) REQUEST dual verification, and, using the tightening sequence shown, TORQUE casing bolts to a final torque of 120 ft•lbs (114 to 126 ft•lbs).
 - 4) RECORD the following onto Attachment 5:
 - Measured final torque value
 - M&TE serial numbers
 - Calibration due dates

4.4.22 INSTALL, but do *not* tighten, fasteners securing gland plates (S-14) to casing.

4.4.23 Using a strap wrench, ROTATE shaft by hand, and ENSURE shaft turns freely without binding.

4.4.24 IF shaft does *not* turn freely without binding, REQUEST FLS to provide instructions for further maintenance.

4.4.25 IF motor was moved in order to gain access to pump components, MOVE motor as follows:

NOTE

Motor weighs approximately 450 lbs.

- a. **RIG** motor as necessary to permit motor to be repositioned on foundation.
- b. **LIFT** motor.
- c. **REMOVE** motor support blocks from beneath motor.
- d. **IF** necessary, **POSITION** motor shims beneath mounting feet.
- e. **POSITION** motor in as-found location.
- f. **INSTALL** and **TIGHTEN** motor hold-down fasteners.
- g. **CONNECT** motor leadwires.
- h. **RECORD** landed leads onto WC 10 (Att), "Lifted Lead and Jumper Device Data Sheet."
- i. **CONNECT** any conduit that was disconnected during disassembly.
- j. **BUMP** motor and **ENSURE** proper direction of rotation.

4.4.26 **ALIGN** and **COUPLE** pump and motor as follows:

- a. **SET** motor rotating assembly at center of its end play, and **MAINTAIN** rotating assembly in that position.
- b. **REQUEST** dual verification, and **MEASURE** gap between face of motor coupling hub and face of pump coupling hub.
- c. **IF** motor and pump coupling hub separation dimension is *not* between $\frac{1}{16}$ and $\frac{3}{16}$ inch, **MOVE** motor as necessary.
- d. **RELEASE** motor rotating assembly from center of its end play position.
- e. **RECORD** as-left pump and motor coupling hub separation dimension onto Attachment 5.

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- f. REQUEST dual verification, Refer To C MP 710A, "Horizontal Shaft Alignment," and ALIGN pump and motor to the following tolerances:
- Angular (face-to-face) alignment *no greater than* 0.002 inch TIR
 - Parallel (rim-to-rim) alignment *no greater than* 0.002 inch TIR
- g. RECORD the following onto Attachment 5.
- As-left alignment values
 - M&TE serial numbers
 - Calibration due dates
- h. ALIGN match marks for the following components:
- Pump coupling hub
 - Coupling covers
 - Motor coupling hub
- i. INSTALL coupling cover seals.
- j. INSTALL coupling gasket.
- k. INSTALL grid.
- l. Refer to MP 791.0 (Att), "Fuel Pool Cooling (310)," and using coupling grease, LUBRICATE spaces between and around grid.
- m. WIPE off excess grease flush with grid.
- n. INSTALL and TIGHTEN fasteners securing coupling cover halves.

4.4.27 CONNECT the following:

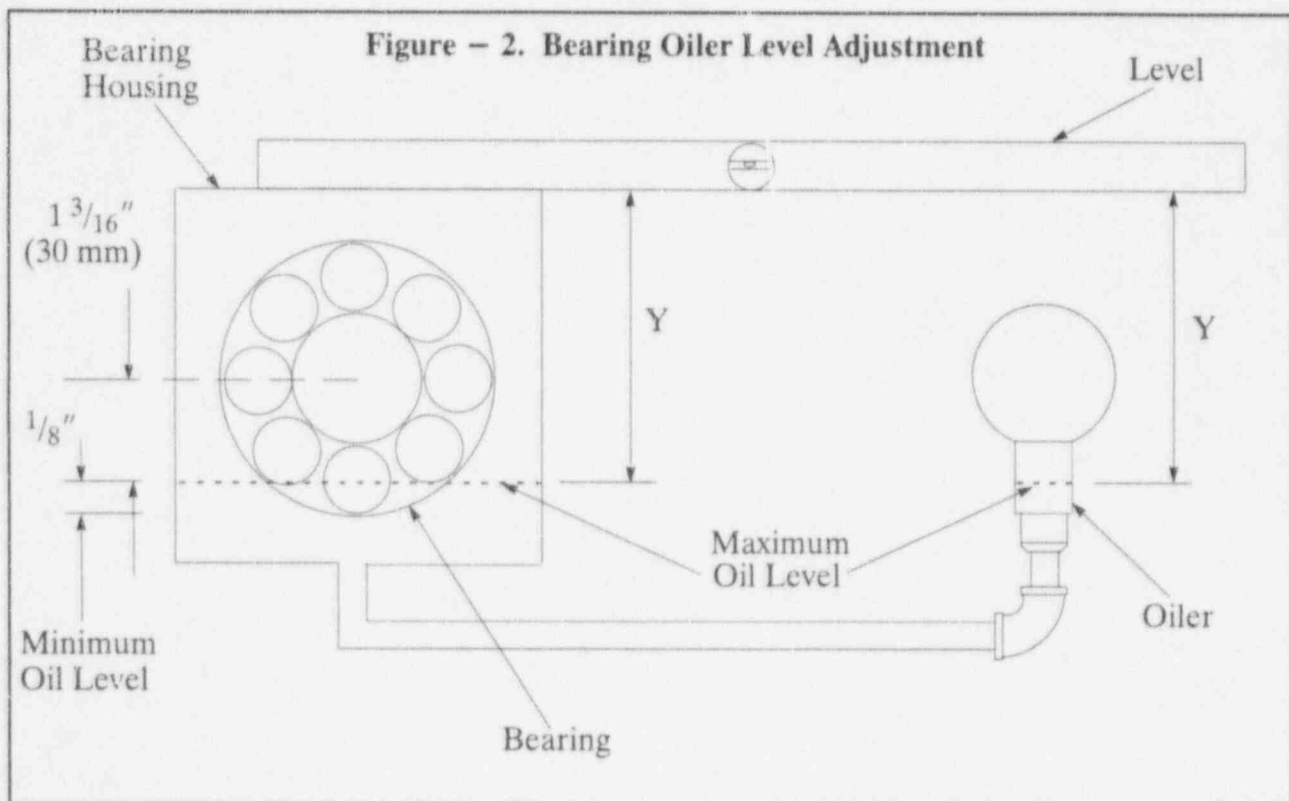
- Upper casing vent piping
- Seal water piping

4.4.28 Using an approved thread sealant, **INSTALL** bearing oilers.

NOTE

Maximum bearing housing oil level is $\frac{1}{2}$ way up the bottom most ball of the bearing, and should be clearly marked on the outside of the bearing housing. Minimum oil level is $\frac{1}{8}$ inch below the maximum oil level mark. If the housing is not marked, the proper dimension to the maximum oil level location is approximately $1\frac{3}{16}$ inch (30mm) down from the shaft centerline.

4.4.29 Refer To Figure – 2, and using a level and ruler, **MEASURE** the same distance (Y) down from the level, and **SET** the oiler and bearing housing oil level to the same height.



NOTE

The oil level will reside at the top of the oiler level adjustment arms. Maximum bearing housing oil level is $\frac{1}{2}$ way up the bottom most ball of the bearing. Minimum oil level is $\frac{1}{8}$ inch below the maximum oil level.

- 4.4.30 ADJUST bearing oiler level adjustment arms to obtain maximum oil level.
 - 4.4.31 Refer To Attachment 1 and MP 791.0 (Att), "Fuel Pool Cooling (310)," and FILL thrust and radial bearing housing assemblies as necessary to maintain oil level at the level shown.
 - 4.4.32 Evenly TIGHTEN fasteners securing gland plates (S-14) to casing.
 - 4.4.33 INSTALL coupling guard.
 - 4.4.34 NOTIFY Operations Department that pump maintenance is complete.
- 4.5 **Operational Checkout**
- 4.5.1 WHEN system conditions permit, REQUEST Operations Department to run, fill, and vent pump.
 - 4.5.2 INSPECT all joints and seals for leakage.
 - 4.5.3 IF leakage is detected, REQUEST FLS to provide instructions for further maintenance.

5. REVIEW AND SIGN-OFF

- 5.1 The review and sign-off of Attachment 5 and the AWO satisfy the review and sign-off of this procedure.

6. REFERENCES

6.1 NNECo Accident Prevention Manual

6.2 Drawings

- 6.2.1 NUSCo Drawing 25202-26007, Sheet 2, "Piping and Instrumentation Diagram, Fuel Pool Cooling System"
- 6.2.2 NUSCo Drawing 25202-29019, Sheet 3, "Fuel Pool Cooling Pump"
- 6.2.3 John Crane Packing Co. Drawing F-SP-11183, "John Crane Type-1 2¹/₂ D. Bellows Shaft Seal Ingersoll Rand Co." Rev. F

6.3 Vendor Manuals

- 6.3.1 Ingersoll-Rand Company, Form No. 7978-F "Instructions for Installation--Operation and Maintenance of 'S' Line General Service Pumps" 25202-365-004A
- 6.3.2 Falk Corporation, "Instructions for Installation and Maintenance--Sizes 20 Thru 140"

6.4 Administrative Procedures

- 6.4.1 CC 1, "Control of Chemical Consumable Products"
- 6.4.2 WC 3, "ASME Section XI Repair and Replacement Program"
- 6.4.3 WC 7, "Fire Protection Program"
- 6.4.4 WC 8, "Control and Calibration of Measuring and Test Equipment"
- 6.4.5 WC 10, "Jumper, Lifted Lead and Bypass Control"

6.5 Maintenance Procedures

- 6.5.1 C MP 710A, "Horizontal Shaft Alignment"

6.5.2 MP 791.0, "Plant Component Lubrication"

6.6 Other Documents

- 6.6.1 Millstone Unit 1 Maintenance Department Main Purchase Order (MPO) File #890
- 6.6.2 2/8/96 telcon record between Ingersoll-Dresser Pump Co. Tech rep. Manish Patel and NU Procedure Writer Tim McNerney
- 6.6.3 Replacement item evaluation form RIE-95-0054, "Coupling Type T20 Steel Flex"
- 6.6.4 11/18/96 Memo No. CBM-96-309 from D.W. Leubner of CBM to P.J. O'Neill of Unit 1 Tech Support regarding "Millstone Unit 1 (MP1) Spent Fuel Cooling Pump Coupling Alignment"
- 6.6.5 Engineering Evaluation M1-EV-960029, "Spent Fuel Pool Cooling Pump Alignment," dated 11/18/96
- 6.6.6 1/15/97 Memo No. CBM-97-014 from D. W. Leubner of CBM to Tim McNerney Unit 1 Maintenance regarding procedure change recommendations of "Overhaul of Fuel Pool Cooling Pumps" maintenance procedure
- 6.6.7 1/23/97 Memo No. CBM-97-028 from D. W. Leubner of CBM to Tim McNerney Unit 1 Maintenance regarding correction of procedure change recommendations to "Overhaul of Fuel Pool Cooling Pumps" maintenance procedure
- 6.6.8 Replacement item evaluation form PSE-MP1-E-95-018, "Fuel Pool Cooling Pump Bearing Seals" dated 2/24/95
- 6.6.9 Minor Modification MMOD M1-97555, "Fuel Pool Cooling Pump M4-11B Seal Replacement"
- 6.6.10 Action Request A/R 97004498, "Revise MP 720.11 for the Spent Fuel Cooling Pumps for installing the bearing isolators and adjustment of bearing housing constant level oiler"

7. SUMMARY OF CHANGES

- 7.1 Revision 4 incorporates interim changes 1 and 2. Change 1 removed lubricant types and quantities. Change 2 eliminated the requirement to set motor coupling lower than pump coupling during motor-to-pump alignment.

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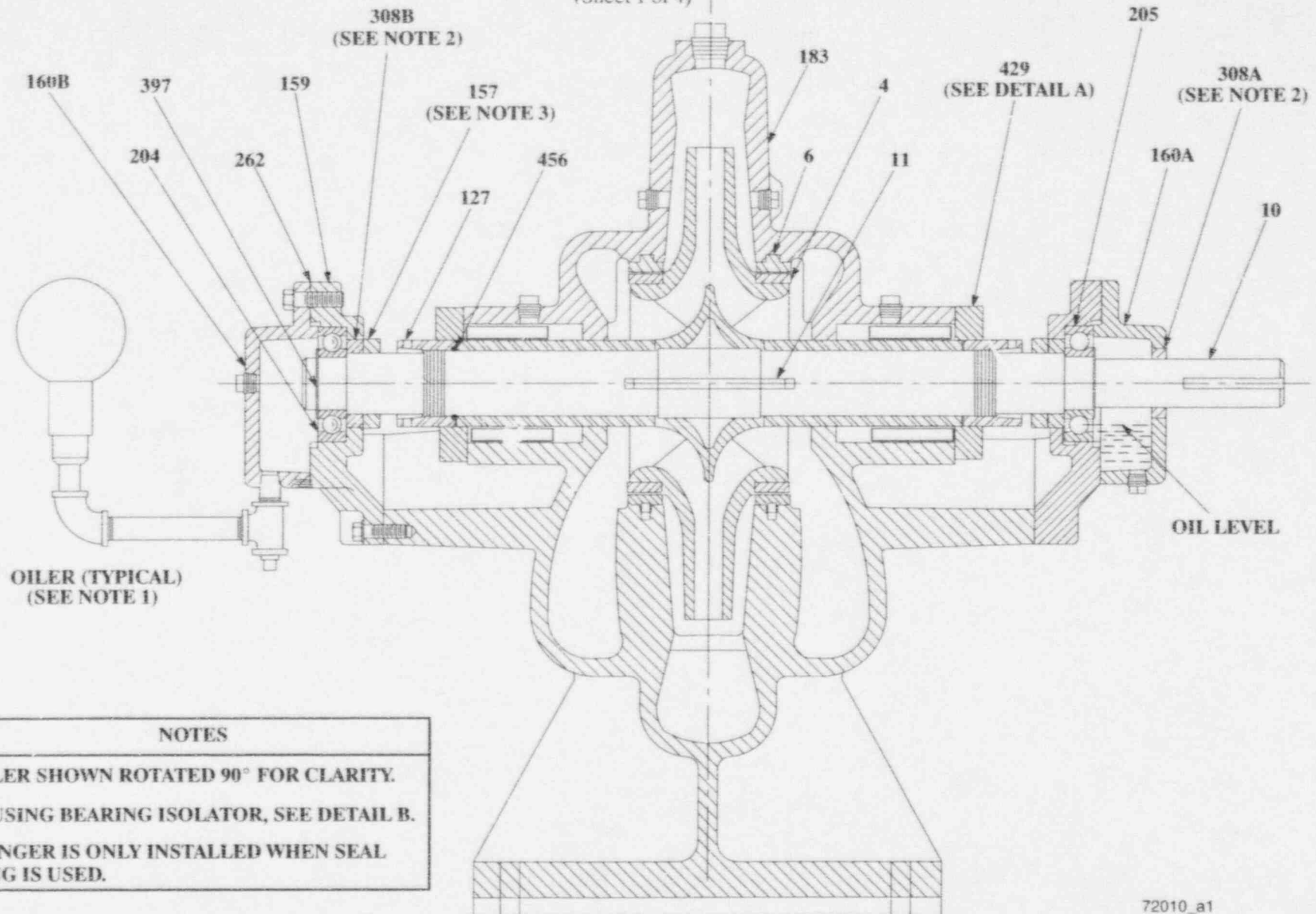
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7.2 This procedure was modified by A/R 97004498 as follows:

- Bearing isolator installation and removal instructions were added.
- The cross-section and exploded view drawings of the pump have been modified, and a new detail showing the bearing isolator assembly was added.
- The Inspection Data Sheet was modified to add bearing isolator interference fit measurements.
- Instructions were added to adjust bearing constant level oilers.

Attachment 1 Pump Cross-Section View (Sheet 1 of 4)



NOTES

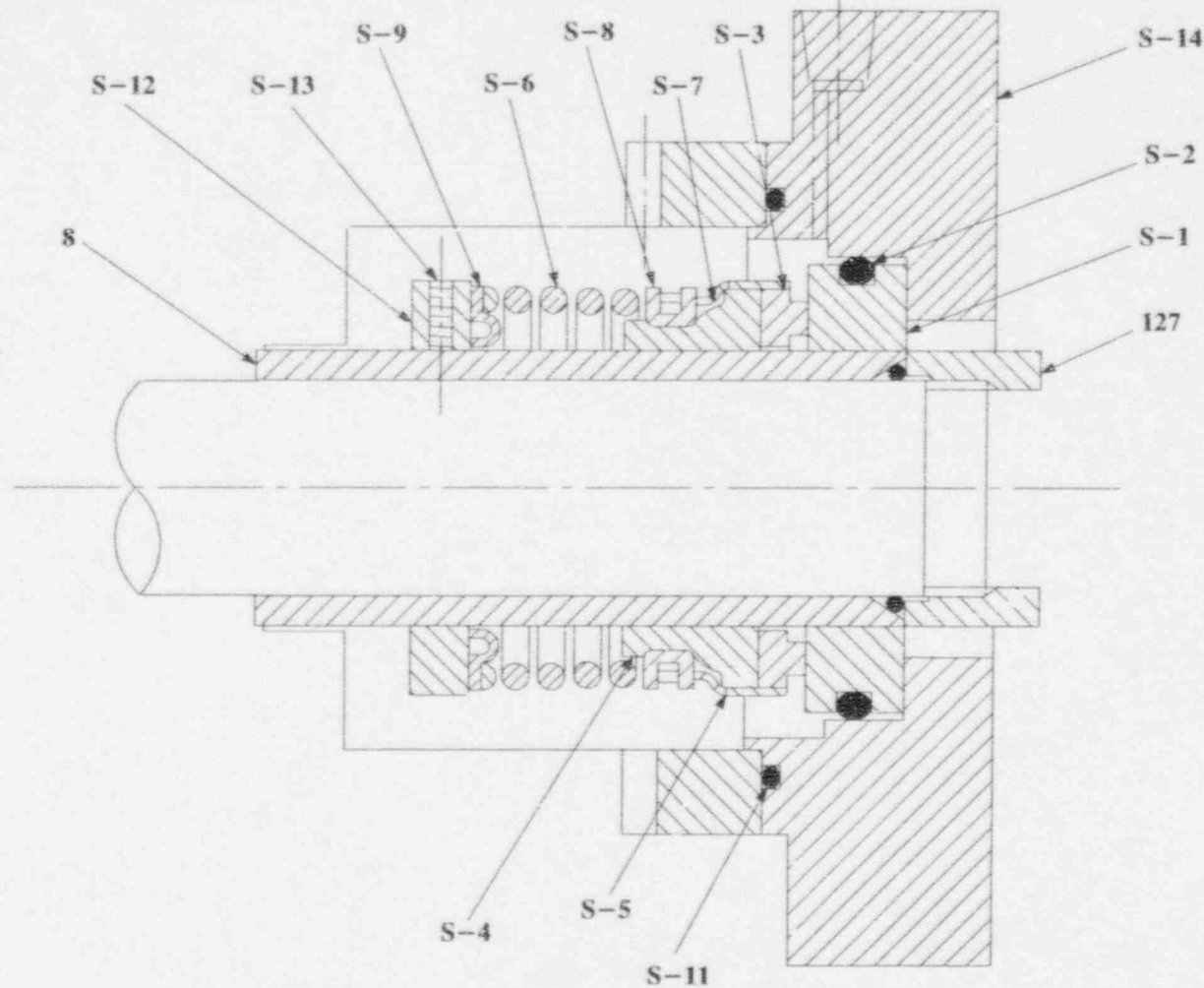
1. OILER SHOWN ROTATED 90° FOR CLARITY.
2. IF USING BEARING ISOLATOR, SEE DETAIL B.
3. FLINGER IS ONLY INSTALLED WHEN SEAL RING IS USED.

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Attachment 1 Pump Cross-Section View (Sheet 2 of 4)



DETAIL A: MECHANICAL SEAL ASSEMBLY

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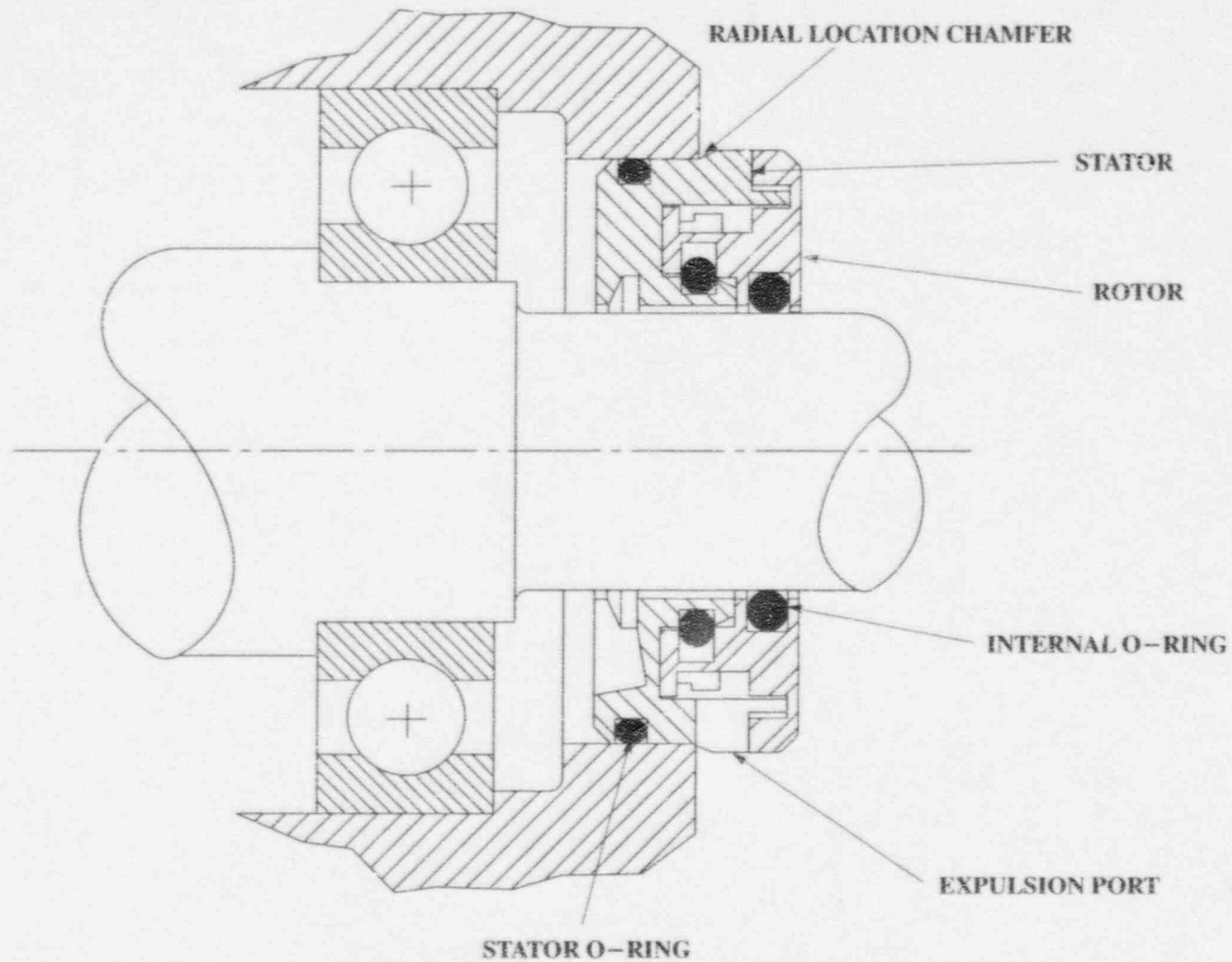
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Pump Cross-Section View

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DETAIL B: BEARING ISOLATOR ASSEMBLY

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Attachment 1
Pump Cross-Section View
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ITEM #	DESCRIPTION	ITEM #	DESCRIPTION
3	IMPELLER	S-1	SEAT
4	IMPELLER WEAR RING	S-2	SEAT RING
6	CASE WEAR RING	S-3	WASHER
8	SHAFT SLEEVE	S-4	BELLOWS
10	SHAFT	S-5	RETAINER
11	IMPELLER KEY	S-6	SPRING
12	COUPLING KEY	S-7	DISC
16	GLAND	S-8	DRIVE BAND
127	SHAFT SLEEVE NUT	S-9	SPRING HOLDER
157	FLINGER	S-11	GLAND PLATE O-RING
159	BEARING HOUSING	S-12	COLLAR
160A	RADIAL BEARING END COVER	S-13	SETSCREW
160B	THRUST BEARING END COVER	S-14	GLAND PLATE
170	CASING GASKET		
183	CASING		
204	THRUST BEARING		
205	RADIAL BEARING		
262	END COVER GASKET		
308A	SEAL RING OR BEARING ISOLATOR		
308B	SEAL RING OR BEARING ISOLATOR		
397	SNAP RING		
429	MECHANICAL SEAL ASSEMBLY		
456	O-RING		

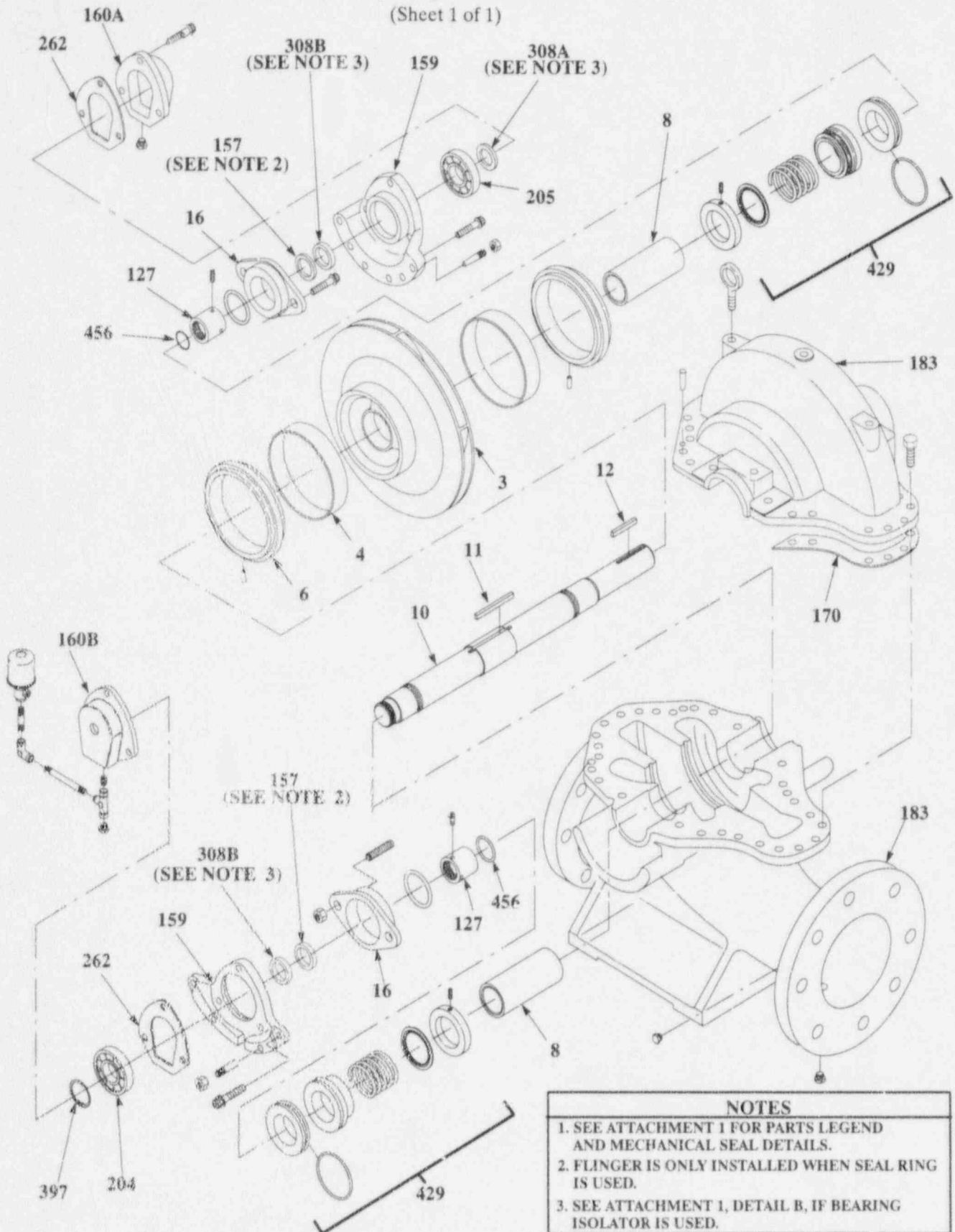
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Attachment 2 Pump Exploded View

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NOTES

1. SEE ATTACHMENT 1 FOR PARTS LEGEND AND MECHANICAL SEAL DETAILS.
2. FLINGER IS ONLY INSTALLED WHEN SEAL RING IS USED.
3. SEE ATTACHMENT 1, DETAIL B, IF BEARING ISOLATOR IS USED.

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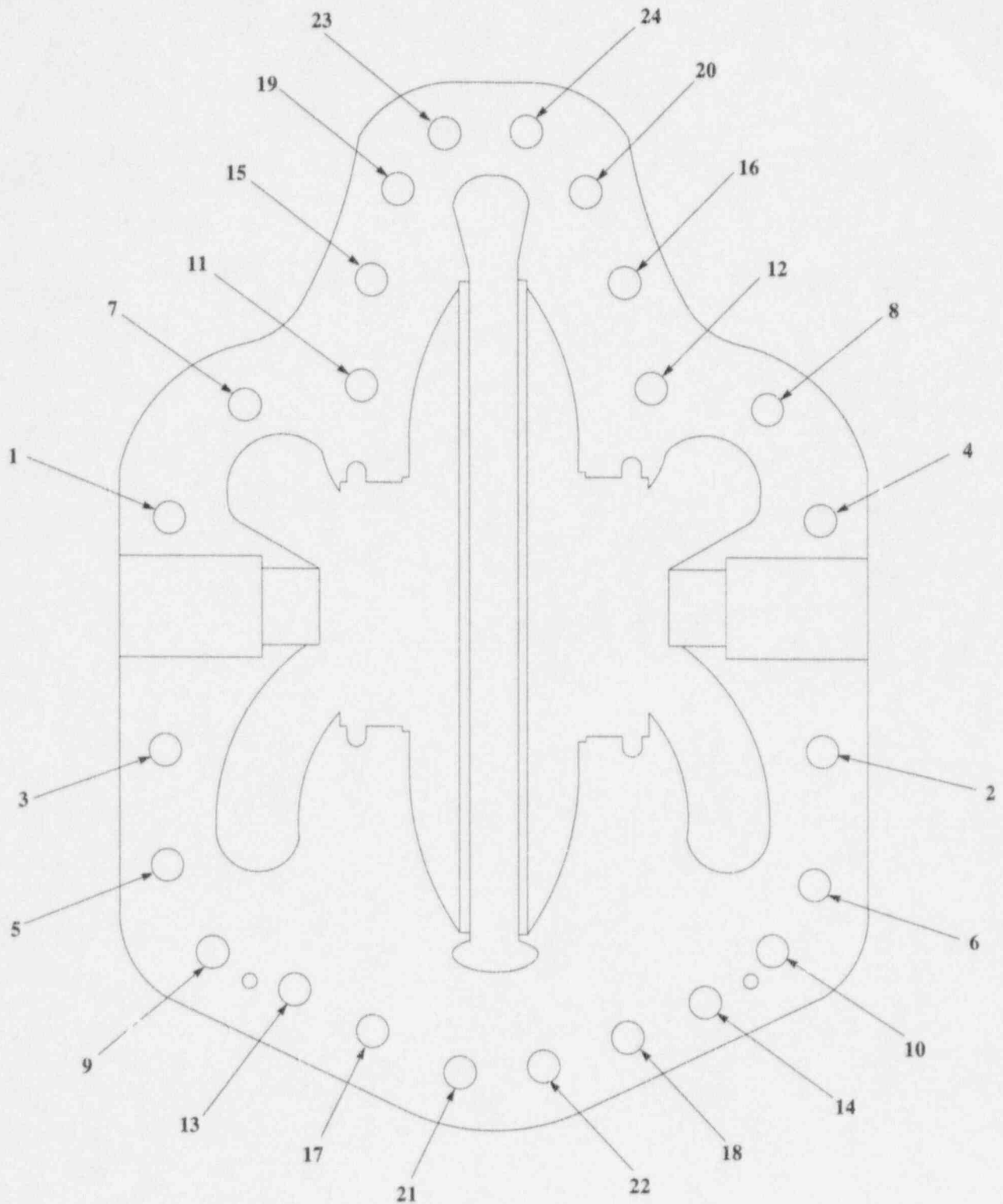
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Attachment 4
Upper Casing Bolt Tightening Sequence
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Attachment 5
Inspection Data Record
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AWO NO. _____

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STEP NO.	INSPECTION	ACCEPTANCE CRITERIA	INSPECTION RESULTS	PERFORMED BY / DATE	VERIFIED BY / DATE
4.1.5	As-Found Coupling Hub Separation	Reference Only	_____ "	_____	_____
4.1.13.a.	As-Found Dimension Between Inboard End of Shaft and Face of Impeller Hub	Reference Only	_____ "	_____	_____
4.2.5	Shaft Runout: Thrust Bearing Thrust-End Shaft Sleeve Impeller Radial-End Shaft Sleeve Radial Bearing Coupling Hub	TIR $\leq 0.002"$	_____ " TIR _____ " TIR _____ " TIR _____ " TIR _____ " TIR _____ " TIR	_____	_____
			M&TE Ser. No. _____ Cal. Due Date _____		

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Attachment 5
Inspection Data Record
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STEP NO.	INSPECTION	ACCEPTANCE CRITERIA	INSPECTION RESULTS	PERFORMED BY / DATE	VERIFIED BY / DATE
4.2.8 or 4.3.3	Thrust-End Impeller-to-Case Wear Ring Clearance Radial-End Impeller-to-Case Wear Ring Clearance	0.010 to 0.014" (New) 0.010 to 0.021" (In-Service)	$\frac{\text{ID}}{\text{ID}} - \frac{\text{OD}}{\text{OD}} = \frac{\text{CLR}}{\text{CLR}}$ $\frac{\text{ID}}{\text{ID}} - \frac{\text{OD}}{\text{OD}} = \frac{\text{CLR}}{\text{CLR}}$ M&TE Ser. No. _____ Cal. Due Date _____ M&TE Ser. No. _____ Cal. Due Date _____		
4.2.11.a.	Thrust Bearing Housing-to-Bearing Isolator Interference Fit Radial Bearing Housing-to-Bearing Isolator Interference Fit (Impeller Side) Radial Bearing End Cover-to-Bearing Isolator Interference Fit (Coupling Side)	0.001 to 0.003" 0.001 to 0.003" 0.001 to 0.003"	$\frac{\text{OD}}{\text{OD}} - \frac{\text{ID}}{\text{ID}} = \frac{\text{INTF}}{\text{INTF}}$ $\frac{\text{OD}}{\text{OD}} - \frac{\text{ID}}{\text{ID}} = \frac{\text{INTF}}{\text{INTF}}$ $\frac{\text{OD}}{\text{OD}} - \frac{\text{ID}}{\text{ID}} = \frac{\text{INTF}}{\text{INTF}}$ M&TE Ser. No. _____ Cal. Due Date _____ M&TE Ser. No. _____ Cal. Due Date _____		

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Attachment 5
Inspection Data Record
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STEP NO.	INSPECTION	ACCEPTANCE CRITERIA	INSPECTION RESULTS	PERFORMED BY / DATE	VERIFIED BY / DATE
4.4.4.b.	As-Left Impeller Concentricity: Circumference of Thrust-End Impeller Wear Ring Circumference of Radial-End Impeller Wear Ring	No High Spots $TIR \leq 0.002''$	 _____" _____" M&TE Ser. No. _____ Cal. Due Date _____		
4.4.16	As-Left Shaft End Play Dimension	0.008 to 0.010"	_____"		
4.4.26.b.	As-Left Coupling Hub Separation	$\frac{1}{8}''$ ($\frac{1}{16}$ to $\frac{3}{16}''$) With Motor at Center of End Play	_____"		
4.4.21.j.	Upper Casing Torque	120 ft•lbs (110 to 130 ft•lbs)	_____ ft•lbs M&TE Ser. No. _____ Cal. Due Date _____		

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Attachment 5
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STEP NO.	INSPECTION	ACCEPTANCE CRITERIA	INSPECTION RESULTS	PERFORMED BY / DATE	VERIFIED BY / DATE
4.4.26.f.	As-Left Motor-to-Pump Alignment:				
	Angular (Face-To-Face)	$TIR \leq 0.002"$	_____ " TIR		
	Parallel (Rim-To-Rim)	$TIR \leq 0.002"$	_____ " TIR		
			M&TE Ser. No. _____ Cal. Due Date _____		
			M&TE Ser. No. _____ Cal. Due Date _____		

COMMENTS _____

JOB SUPERVISOR _____

DATE _____

Level of Use
General

STOP

THINK

ACT

REVIEW

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