East River Station

Mechanical Maintenance Instruction

Title: Raw Water Pump Bearing Replacement

Procedure Number:

Written By:	_____	_____	_____
	Print Name	*Signature*	*Date*
Reviewed By:	_____	_____	_____
	Print Name	*Signature*	*Date*
Approved By:			
Maintenance Manager	_____	_____	_____
	Print Name	*Signature*	*Date*

Effective Date: _____

Next Review Date: _____

Table of Contents

1.0 PURPOSE

1.1. This instruction provides the necessary information to disassemble, inspect, and reassemble the Goulds 3180 raw water pump components during a bearing replacement.

1.2. The information is intended for use during normal component disassembly, inspection, and assembly or in conjunction with trouble shooting, repairs or normal preventive maintenance or inspections on an as required basis.

2.0 REFERENCES

2.1. Goulds 3180/85/81/86 Maintenance Checks (Form CK3180-86 Rev. 4/06)

2.2. Goulds Pumps Installation, Operation, and Maintenance Instructions

2.3. TB Wood's Flexible Coupling Manual

3.0 DEFINITIONS AND ACRONYMNS

3.1. Definitions

3.1.1. *Independent Verification* (IV) – A type of signature step in a technical work document or data sheet that requires an additional person confirm that activity was performed correctly.

3.2. Acronyms

3.2.1. M&TE - Measuring and Test Equipment

3.2.2. IV - Independent Verification

4.0 MATERIAL, SPECIAL TOOLS AND EQUIPMENT

4.1. Reference Appendix "A" for recommended tools, measuring and test equipment (M&TE), consumables, and rigging required to replace the raw water pump impeller.

5.0 PRECAUTIONS AND LIMITATIONS

5.1. **IF** these work instructions cannot be performed as written,
THEN stop work and notify Supervision.

5.2. **IF** abnormal conditions are encountered,
THEN stop work, inform personnel in the area that may be affected, and notify Supervision.

5.3. The importance of maintaining As Found conditions is important to failure mode determinations. Personnel should exercise care during the disassembly steps to preserve any abnormal equipment conditions.

5.4. Incorporate the STAR self-checking technique before and immediately after performing a task:

5.4.1. **STOP** - Pause before performing a task to enhance attention to detail. This is the most important step of any self-checking technique. The simple act of stopping increases the likelihood of performing the task correctly. Attempt to eliminate current or potential distractions.

5.4.2. **THINK** - Understand specifically what is to be done before working on any component. Identify the correct component, train, unit, etc., before taking any action.

5.4.3. **ACT** - Perform the intended action

5.4.4. **REVIEW** - Verify that the actual response is the expected response. If an unexpected response is obtained, take action as previously determined.

5.5. **HOLD POINTS** may be used in this procedure. If a Hold Point is encountered, do **NOT** continue to the next step without contacting supervision. Supervision is responsible to review the work, initial the Hold Point, and authorize work to continue.

5.6. **NOTE**, **CAUTION**, **WARNING**, and **CRITICAL STEP** boxes may be used throughout this procedure to provide information that must be considered prior to the performance of a step, or series of steps.

5.7. Be aware of the potential for misalignment of components/parts during assembly/installation. An example would be; the valve indicates **CLOSED** when valve is actually **OPEN**.

5.8. If the system/equipment is left unattended **OR** work is being performed in which foreign material may enter, all openings should be covered and:

5.8.1. A visual check for and removal of any foreign material that may have entered.

5.8.2. System or component is returned to the appropriate cleanliness level upon completion of work.

5.9. During the performance of this procedure, general housekeeping rules will be in effect.

5.10. The use of solvents and lubricants will be restricted to those approved for use in accordance with vendor or plant policies.

5.11. Take the appropriate precautions when working in the vicinity of high temperature fluid or components.

5.12. Welding leads, cords, wires, electrical cables, and other temporary support systems are kept off the walking surface in an elevated position or ramped over to eliminate tripping hazards or equipment damage.

6.0 PREREQUISITES

6.1. Prior to start of work, verify all work permits are obtained and filed per ConEd-COP-5-1-2 Work Permit Procedure.

6.2. All spare parts and tools are available prior to starting work (reference Appendix “A”).

6.3. The Precautions and Limitations, Section 5.0, have been read and understood.

6.4. Verify all PM tasks associated with the pump have been issued and scheduled to be worked with this procedure.

6.5. A permit is required for the performance of this work.

6.5.1. **ENSURE** the equipment is isolated, drained, de-pressurized and/or de-energized as required.

6.5.2. **VERIFY** isolation tags are hung and accepted.

6.6. Personnel performing these activities shall be qualified/certified or work under supervision of personnel that are qualified/certified.

7.0 PROCEDURE

NOTE 1:	These work instructions need **NOT** be performed in a Step-by-Step manner. It is expected that the general sequence of these work instructions be followed; however sections or steps may be repeated, performed in parallel or out-of-sequence as determined by supervision unless specifically noted otherwise within the instructions.
NOTE 2:	If any out-of-scope work or negative inspection results is identified during the performance of this procedure, or if the equipment produces results inconsistent with the intent of this procedure, consult your supervisor prior to commencing any troubleshooting or repair activities.

7.1. **VERIFY** Precautions, Limitations, and Prerequisites, Sections 5.0 and 6.0 have been performed and/or understood before beginning performance of actual work instructions.

7.2. **ENSURE** the system/equipment is safely isolated.

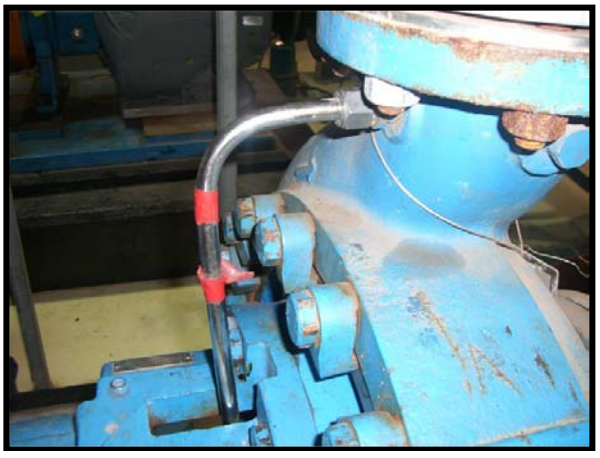
7.3. **NOTIFY** Operations to drain the pump oil.

7.4. **REMOVE** the pump insulation

7.5. **DRAIN** the residual water in the pump casing.

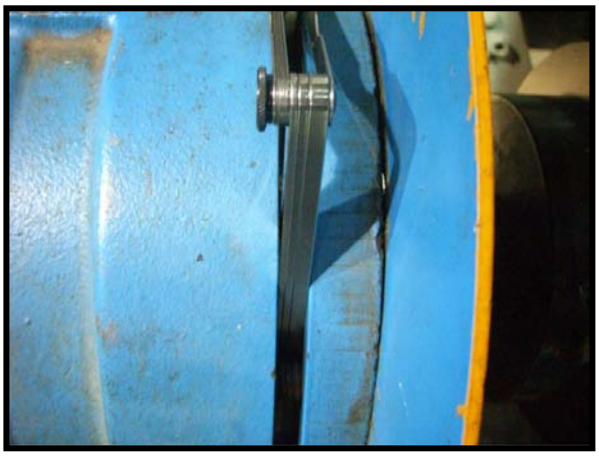
7.5.1. **INSTALL** a catch basin or bucket under the pump drain plug.

7.5.2. **REMOVE** the drain plug.



7.6. **INSTALL** the mechanical seal spacer clips.

7.7. **REMOVE** the mechanical seal flush line.



7.8. **MEASURE** and **RECORD** (on Attachment "B" – 10.1.) the distance between the bearing housing and bearing frame.

7.9. **REMOVE** the coupling

7.9.1. **REMOVE** the coupling guard.

7.9.2. **MATCH MARK** the coupling components (i.e., flex coupling motor/pump ends and bolts to bolt holes).

7.9.3. **REMOVE** the flex coupling.

7.9.4. **MEASURE** and **RECORD** (on Attachment "B" – 10.2.) the distance between the pump/motor coupling hubs.

7.9.5. **REMOVE** the pump coupling hub setscrew.

7.9.6. **REMOVE** the pump hub by tapping with a soft-faced hammer

7.9.7. **SIGN OFF** required for completion of Section 7.9 - **REMOVE** the coupling.

Completed By: _____ _____ _____

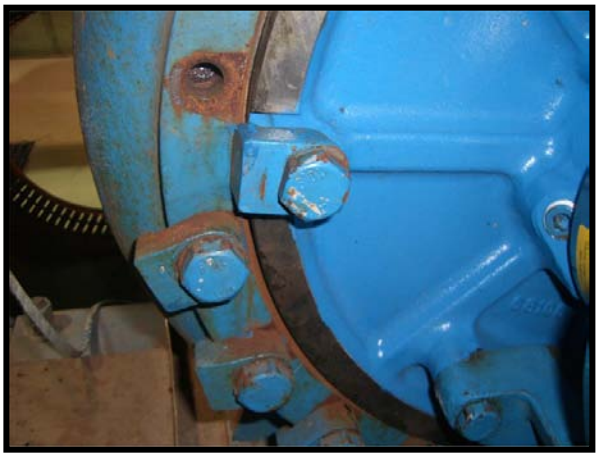
Print Name *Signature* *Date*

7.10. **REMOVE** the pump from the base.

7.10.1. **REMOVE** the bearing frame foot bolts.

7.10.2. **LOOSEN** casing bolts and TURN casing lugs 180°

7.10.3. **SNUG** casing bolts hand-tight.



7.10.4. **REMOVE** two sets of casing bolts and lugs.

7.10.5. **THREAD** the bolts/lugs into the two jacking holes.

7.10.6. **TIGHTEN** the bolts until they are bottomed.

NOTE: The back pull-out should be loose enough to pull out by hand.

7.10.7. **IF** back pull-out is **NOT** loose**, THEN INSTALL** a ¼ inch shim between lug and casing and retighten.

7.10.8. **SLIDE** the back pull-out out of the pump casing.

7.10.9. **INSTALL** rigging around the pump and **TRANSFER** to a cart.

7.10.10. **SECURE** the pump to a cart and **TRANSPORT** to a work area.

CRITICAL STEP CRITICAL

CRITICAL

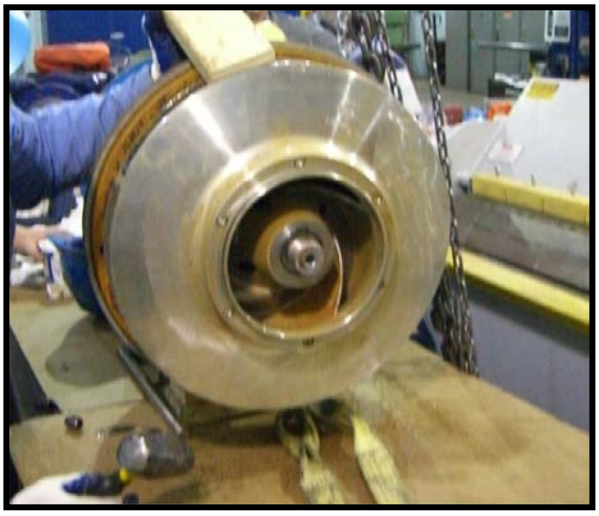
_____
Initials

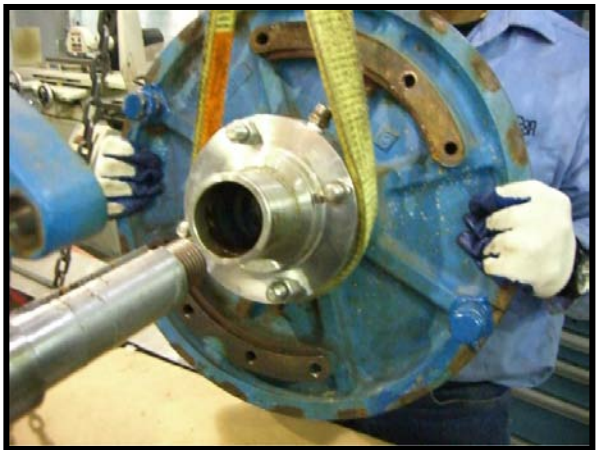
7.10.11. **INSTALL** a FME cover over the pump casing opening.

7.10.12. **SIGN OFF** required for completion of Section 7.10 - **REMOVE** the pump from the base.

Completed By: _____ _____ _____

Print Name *Signature* *Date*





7.11. **REMOVE** the rotating element.

7.11.1. **SECURE** the pump to a work bench.

7.11.2. **PREVENT** the coupling end of the shaft from turning with a strap wrench **OR WEDGE** a block of wood between the impeller vanes.

7.11.3. **REMOVE** the impeller nut.

7.11.4. **REMOVE** the impeller.

a. **TAP** the impeller from the dry side using a soft-faced hammer or block of wood.

b. **REMOVE** the shaft key.

7.11.5. **REMOVE** the stuffing box cover.

a. **ATTACH** rigging to the stuffing box cover.

b. **IF** the seal will be reused, **THEN** loosen the collar set screws.

c. **IF** the seal will be replaced, **THEN** do **NOT** loosen the collar set screws. The shaft sleeve may slide off with the stuffing box cover.

d. **REMOVE** bearing frame to stuffing box cover bolts.

e. **TAP** the cover from the dry side using a soft-faced hammer or block of wood.

f. **SLIDE** the stuffing box cover, off the shaft.

7.11.6. **REMOVE** the mechanical seal.

a. **IF** the seal will be replaced, **THEN LOOSEN** the Allen-head set screws of the seal drive collar.

b. Evenly **LOOSEN** and **REMOVE** the nuts on the mechanical seal.

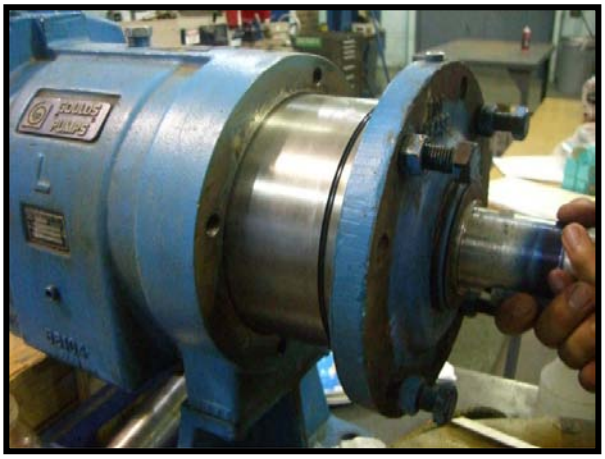
c. **SLIDE** the seal off the sleeve.

d. **REMOVE** the shaft sleeve.

7.11.7. **REMOVE** the coupling guard end plate.

a. **REMOVE** the bearing housing adjuster bolts.

7.11.8. **REMOVE** the labyrinth oil seals from each end of the fame.



7.11.9. **SLIDE** the rotating element out of the frame.

WARNING: Support both ends of the shaft when bearings are removed from the frame to prevent the rotating element from dropping.

a. **TAP** the impeller end of the shaft with a soft-faced hammer or block of wood.

7.11.10. **SIGN OFF** required for completion of Section 7.11 - **REMOVE** the rotating element.

Completed By: _____ _____ _____

Print Name *Signature* *Date*

7.12. **DISASSEMBLE** the rotating element.

7.12.1. **REMOVE** the thrust bearing housing.

a. **REMOVE** the thrust bearing retainer ring cap screws.

b. **TAP** the housing with a soft-faced hammer or block of wood at the 0°, 90°, 180°, and 270° positions.

c. **IF** the housing is tighter than a slip fit, **THEN USE** either the arbor or hydraulic press for removal.

7.12.2. **REMOVE** the radial bearing.

a. **PRESS** the bearing off the shaft using an arbor/hydraulic press.

b. **REMOVE** the spacer ring from the shaft.

7.12.3. **REMOVE** the thrust bearing lock nut.

a. **STRAIGHTEN** the lock washer tang(s)

b. **REMOVE** the lock nut using a spanner wrench

7.12.4. **PULL** the bearings off the shaft using a bearing puller.

a. **ENSURE** contact is made on the bearing inner races.

7.12.5. **SIGN OFF** required for completion of Section 7.12 - **DISASSEMBLE** the rotating element.

Completed By: _____ _____ _____

Print Name *Signature* *Date*

7.13. **CLEAN** and **INSPECT** pump components

NOTE: During the visual inspection, use Attachment "B" to record measurement results and Attachment "D" to document if the following components are acceptable or unacceptable. Use the Comment section to note any negative conditions and/or any consumable (gaskets, o-rings, etc.) replacement.

CRITICAL STEP CRITICAL

7.13.1. **CLEAN** and **INSPECT** the casing to determine or identify:

a. Erosive wear in the volute.
b. Frame to casing gasket sealing surface is free of burrs or gouges with raised edges and pitting or erosion damage.
c. Casing to frame fastener threads are clean and free of any damage.

_____
Initials

CRITICAL STEP CRITICAL

7.13.2. **INSPECT** the impeller to determine or identify:

a. Keyway and bore damage.
b. Pitting, erosion, or corrosion damage on the vanes trailing edge.

_____
Initials

7.13.3. **REMOVE** and **REPLACE** the impeller nut O-ring.

7.13.4. **MEASURE** and **RECORD** (on Attachment "B" – 10.3.) the inside diameter of the impeller bore

CRITICAL STEP CRITICAL

CRITICAL

Initials

7.13.5. **INSPECT** the pump shaft to determine or identify:

a. Large defects
b. Thread condition
c. Radii of all key ways
d. Key way straightness
e. Setscrew burrs
f. Bearing fit areas are smooth and free of gall marks

7.13.6. **MEASURE** and **RECORD** (on Attachment "B" – 10.4.) shaft run out

7.13.7. **MEASURE** and **RECORD** (on Attachment "B" – 10.4.) the outside diameter of the shaft at the bearing mounts.

7.13.8. **MEASURE** and **RECORD** (on Attachment "B" – 10.4.) the outside diameter of the shaft at the impeller mount.

7.13.9. **REMOVE** and **REPLACE** the shaft sleeve O-rings.

7.13.10. **MEASURE** and **RECORD** (on Attachment "B" – 10.5.) the inside and outside diameter of the shaft sleeve.

CRITICAL STEP CRITICAL
CRITICAL

Initials

7.13.11. **INSPECT** the pump coupling hub and key for:

a. Excessive wear
b. Signs of cracks or chips around bolt hole areas
c. Large defects
d. Radii of all key ways
e. Key way straightness
f. Setscrew burrs on key
g. Key fits into the hub key way

7.13.12. **INSPECT** the coupling spacer flex insert for wear/indents

7.13.13. **MEASURE** and **RECORD** (on Attachment "B" – 10.6.) the inside diameter of the hub bore.

CRITICAL STEP CRITICAL
CRITICAL

Initials

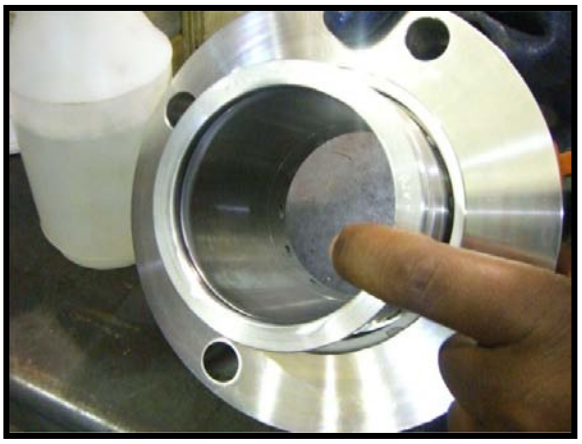
7.13.14. **CLEAN** and **INSPECT** the bearing frame to determine or identify:

a. Frame/foot for cracks
b. Corrosion or pitting

7.13.15. **REMOVE** and **REPLACE** the bearing housing O-ring.

7.13.16. **REMOVE** and **REPLACE** the radial and thrust labyrinth oil seal O-rings.

7.13.17. **MEASURE** and **RECORD** (on Attachment "B" – 10.7.) the inside diameter of the frame and housing bores.



CRITICAL STEP CRITICAL
CRITICAL

_____
Initials

7.13.18. **INSPECT** the mechanical seal to determine or identify:

a. Physical damage
b. Hardware rubbing
c. Erosion or abrasive wear

7.13.19. **INSTALL** a new seal O-ring.

a. **REMOVE** the O-ring

b. **CLEAN** the O-ring groove of any foreign debris

c. **INSPECT** O-ring groove for nicks, burrs, and scratches

d. **INSTALL** a new O-ring into the groove.

- **APPLY** a light film of approved lubricant to the O-ring.

7.13.20. **SIGN OFF** required for completion of Section 7.13 - **CLEAN** and **INSPECT** pump components

Completed By: _____ _____ _____

Print Name *Signature* *Date*

7.14. **REASSEMBLE** the rotating element.

7.14.1. **INSTALL** the radial bearing.

a. **INSTALL** the spacer ring up to the shaft shoulder.

b. **HEAT** the bearing on an induction bearing heater to approximately 212° F.

c. **SLIDE** the radial bearing on the shaft until it stops against the spacer ring.

7.14.2. **INSTALL** the thrust bearings.

a. **INSTALL** the thrust bearing retainer ring over the shaft with the small diameter facing the coupling end.

b. **HEAT** the first bearing on an induction bearing heater (212° F)

c. **ENSURE** the thick shoulder of the outer race is facing the coupling end.

d. **SLIDE** the bearing on the shaft until it stops against the shaft shoulder,

e. **HEAT** the second bearing to approximately 212° F.

f. **ENSURE** the thick shoulder of the outer race is facing toward the first bearing (back-to-back mounting).

g. **SLIDE** the bearing on the shaft until it butts against the first bearing.

NOTE:	Housekeeping tasks only take a few seconds if done immediately. Remember that a safe workplace depends on each and every employee taking responsibility for good housekeeping — to prevent fires, falls, and other accidents.

7.15. **VERIFY** the following housekeeping tasks have been performed during and after job completion:

7.15.1. **RETURN** rigging equipment, test equipment, and support materials to the proper storage location.

7.15.2. **CLEAN** and **ARRANGE** work areas to preclude the creation of tripping, slipping, and fire hazards.

7.15.3. **PLACE** all solvent and oily rag wastes in fire-resistant covered containers.

7.15.4. **STORE** materials so as **NOT** to obstruct access to fire protection equipment (including sprinkler heads), control valves, fire doors, alarm devices or panels, electrical panels, and motor control centers (MCCs).

7.15.5. **STORE** materials either stacked, racked, blocked, interlocked, or placed in an orderly manner so as to prevent sliding, falling, or collapse.

7.15.6. **ENSURE** all unused parts and components are returned to receiving for credit.

Verified By: _____ _____ _____

Print Name *Signature* *Date*

8.0 WORK REVIEW AND SIGNOFFS

8.1. Work Review

_____ 8.1.1. **VERIFY** the coupling guard is installed

_____ 8.1.2. **VERIFY** piping has been reconnected and all welds are completely welded.

_____ 8.1.3. **VERIFY** flanged joints are complete with gaskets installed and all bolts and threaded fittings are tight and have been assembled and torque to requirements.

_____ 8.1.4. **VERIFY** all auxiliary piping, wiring and instrumentation is terminated.

_____ 8.1.5. **VERIFY** all insulation and lagging has been installed.

_____ 8.1.6. **VERIFY** unused process and/or instrumentation openings are closed.

_____ 8.1.7. **VERIFY** all pipe supports, including hangers, seismic restraints, struts and clamps are in position and that all supporting hardware is properly assembled.

_____ 8.1.8. **VERIFY** the pump is adequately lubricated and all lubricant reservoirs are full.

8.2. Signoffs

8.2.1. The signatures below validates that all steps within this procedure have been completed and the results confirm the Raw Water pump is in an **OPERATIONAL** / **INOPERABLE** (circle one) condition.

8.2.2. **IF** the 10/20 Raw Water pump has been determined to be INOPERABLE
THEN record the corrective work request generated or other compensatory actions taken in section 8.2.3.

8.2.3. **IF** OPERABLE,
THEN N/A this section.

Completed By: Maintenance Mechanic	*Print Name*	*Signature*	*Date*
Reviewed By: Maintenance Supervisor	*Print Name*	*Signature*	*Date*

9.0 POST MAINTENANCE TESTING AND/OR ADJUSTMENT

9.1. **ALLOW** the pump to run for about 20 minutes to reach normal operating temperature, and then check for the following:

9.1.1. **VERIFY** any mechanical seal or packing leakage meets vendor or plant requirements.

9.1.2. **INSPECT** for any unusual fluid leaks.

9.2. **CHECK** with engineering for any hot torque requirements.

10.0 ATTACHMENTS

Attachment "A" – Recommended Tools, M&TE, and Rigging

DESCRIPTION	SIZE	QTY
Combination Wrenches	7/8", 1", 1-1/8", 1-1/4"	1 each
Crescent Wrenches	6", 8", 12"	1 each
Sockets	1/2" Drive x 11/16", 3/4", 15/16"	1 each
Large and Small Allen Wrench Sets		1 each
Drive Ratchet	1/2"	1
Flange Scrapers		2
Carbon steel brushes		2
Hammer	4 lb	1
Hammer – Soft face		1
Pin Punch Set		1
Channel Locks	440's	1
Long Feeler Gauge Set		1
Pinch Bar	48" long	2
Dial Indicators	0" – 1"	1
Inside Micrometer	1" – 2" & 2" – 3"	1 each
Outside Micrometer	1" & 2" – 3"	1 each
Outside Micrometer		1
Torque Wrench		1
Porta Power		1
Porta Power Ram	6"	1
Wooden Wedges		8
Alignment Shims		Various
Mechanical Seal Spacers		4
Bearing Cover O-ring		1
Transport Wagon		1
Water container for draining water	5 gal.	1
Parts Bags		Many

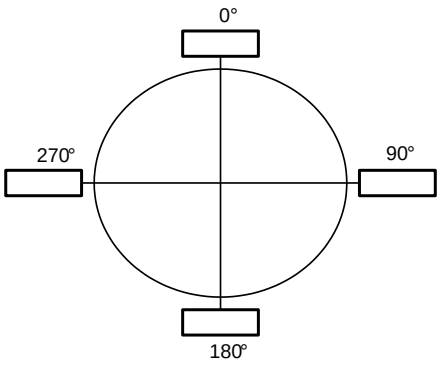
Attachment "A" (cont.) – Recommended Tools, M&TE, and Rigging

RIGGING EQUIPMENT – PUMP	SIZE	QTY
Nylon Slings		2
Chain Fall	1.5 ton	1
Shackles	1/2"	2

Attachment "B" – Measurement Results

10.1. **MEASURE** and **RECORD** the As-Found gap between the bearing housing and bearing frame.

Facing (circle one): Outboard - Inboard



10.2. **MEASURE** and **RECORD** the distance between the pump and motor shaft faces.

Shaft Distance: _____

10.3. **MEASURE** and **RECORD** the inside diameter of the impeller bore.

Impeller Bore: _____

10.4. **MEASURE** and **RECORD** the following shaft dimensions:

Runout: _____

OD at radial bearing mount: _____

OD at thrust bearing mount: _____

OD at impeller mount: _____

Attachment "B" (cont.) – Measurement Results

10.5. **MEASURE** and **RECORD** the shaft sleeve ID and OD.

Sleeve ID: _____

Sleeve OD: _____

10.6. **MEASURE** and **RECORD** the inside diameter of the coupling hub bore.

Coupling Hub Bore: _____

10.7. **MEASURE** and **RECORD** the inside diameter of the bearing frame and housing bores.

Bearing Frame Bore: _____

Bearing Housing Bore: _____

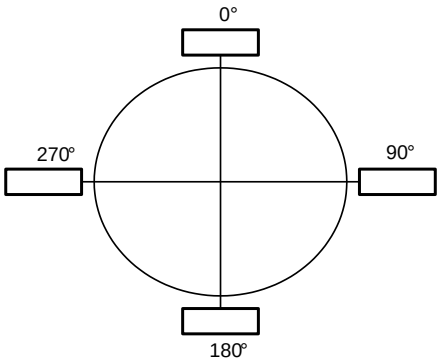
10.8. **MEASURE** and **RECORD** the gap between the retainer ring and thrust bearing housing (0.12” to 0.16”.

Gap: _____

Attachment "B" (cont.) – Measurement Results

10.9. **MEASURE** and **RECORD** the gap between the bearing housing and bearing frame with impeller thrust to starboard.

Facing (circle one): Outboard - Inboard



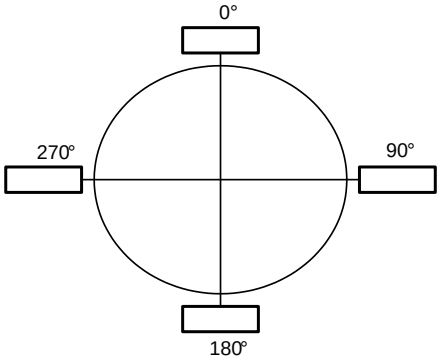
	0°	90°	180°	270°	Average Gap
Gap					

_____ + _____ + _____ + _____ ÷ 4 = _____

Attachment "B" (cont.) – Measurement Results

10.10. **MEASURE** and **RECORD** the gap between the bearing housing and bearing frame with impeller thrust to inboard.

Facing (circle one): Outboard - Inboard



	0°	90°	180°	270°	Average Gap
Gap	_____	+ _____	+ _____	+ _____	÷ 4 = _____

10.11. **DETERMINE** impeller adjustment.

Average Gap Impeller Starboard		Average Gap Impeller Inboard		Final gap between the bearing housing and bearing frame
_____	+	_____	÷ 2 =	_____

Attachment "C" – Fastener Torque Requirements

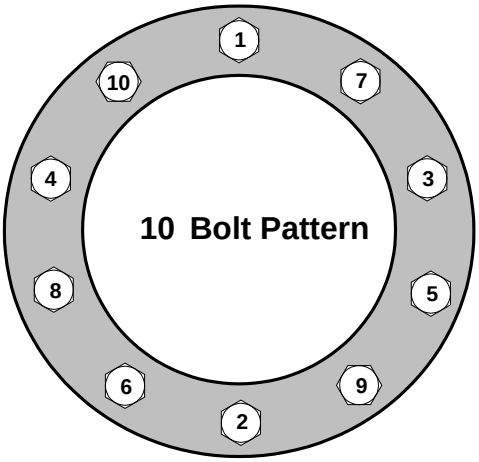
10.12. Torque the bearing locknut to 210 ft lbs.

Completed By: _____ _____ _____
Print Name *Signature* *Date*

Independent Verification: _____ _____ _____
Print Name *Signature* *Date*

10.13. Torque the bearing retainer to housing cap screws to 20 ft lbs in one pass and then a final pass in a clockwise direction to ensure even bolt loading.

Pass	Torque (ft. lbs.)	Actual Torque
1	Bring all nuts up finger tight.	N/A
2	20	
Final Pass Clockwise	20	



Completed By: _____ _____ _____
Print Name *Signature* *Date*

Independent Verification: _____ _____ _____
Print Name *Signature* *Date*

Attachment "C" (cont.) – Fastener Torque Requirements

STOP **THINK** **ACT** **REVIEW**

10.14. Torque the impeller nut to 600 ft lbs.

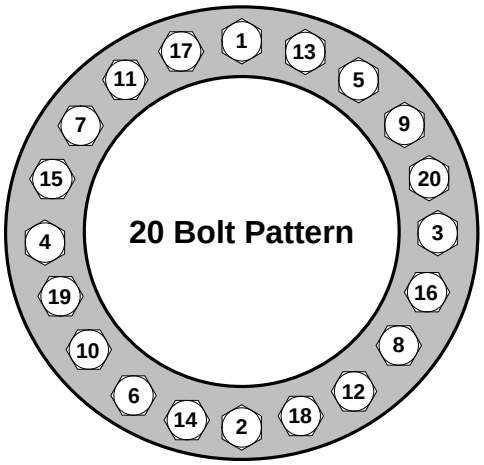
Completed By: _____ _____ _____
Print Name *Signature* *Date*

Independent Verification: _____ _____ _____
Print Name *Signature* *Date*

10.15. Torque the casing lug bolts to 125 ft lbs. Perform final pass in a clockwise direction to ensure even bolt loading.

Pass	Torque (ft. lbs.)	Actual Torque
1	Bring all nuts up finger tight. Then tighten snugly and evenly*	
2	42	
3	84	
4	125	
Final Pass Clockwise	125	

* Do **NOT** exceed 25 ft-lb



Completed By: _____ _____ _____
Print Name *Signature* *Date*

Independent Verification: _____ _____ _____
Print Name *Signature* *Date*

STOP **THINK** **ACT** **REVIEW**

Attachment "D" – Visual Inspection Results

After a visual inspection, use this attachment to document if the following components are acceptable or unacceptable. Use the Comment section to note any negative conditions and/or any consumable (gaskets, o-rings, etc.) replacement.

PART	ACCEPTABLE		COMMENTS
	YES	NO	
Pump Casing			
Mechanical Seal			
Bearing - Radial			
Bearings - Thrust			
Impeller			
Pump Shaft			
Coupling			