Operations Challenge Maintenance Event
2010-2013

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Tool List for Wilo Operations Challenge Maintenance Event

Tools	Quantity	Sears Part Numbers
Craftsman Small Ball Peen Hammer	1	38461
Craftsman Hammer (Plastic and Rubber Heads)	1	38304
Craftsman 6 Piece Metric Hex Bit Set (3/8") 4-10mm	1	34448
Craftsman 9 Piece Metric Socket Set (3/8") 10-19mm	1	34545
Craftsman Scraper/Pry Bar	2	37359
Craftsman 3/8" Ratchet	1	44808
Craftsman 3/8" Microtork Wrench	1	44594
Craftsman 3/8” x 6" Extension set	1	34533
Craftsman 1/2" Ratchet	1	44809
Craftsman Cotter Pin Puller	2	4319
Craftsman 5 piece punch set	1	4285
Craftsman 1/2" - 3/8" Adaptor	1	4259
Craftsman #2 x 8” Phillips Screwdriver	1	41296
Tool Box	1	12773
Seal Installation Tool	1	Wilo #001
Oil dispenser pump with tubing	1	Oil Safe 3 Liter Drum, #101003 w/ Pump #102000
Proto 17mm, 3/8” drive, 6 point socket	1	Proto #5217MH
Torque wrench (½”)	1	Proto #6016
Funnel	1	
Drain pan	1	
Multi-Lock Hasp	2	
Lock-out Tag	2	
Pen/Pencil/Marker	2	
Lock-out Locks	4 pair	4 colors, 2 each

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Operations Challenge Maintenance Event
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Introduction

The purpose of this event is to test the knowledge and skill of each Operations and Maintenance (O&M) team to respond to separate and simultaneous “Moisture Reset” failure conditions for a submersible pump and a submersible mixer. The pump and mixer shall be in adjacent simulated slide rail mounted installations; the O&M teams shall safely remove them from service, perform and document the required service to repair the units, and then place them back into service. The teams shall be tested on their knowledge of safety regulations, mechanical ability to service and repair the units, planning ability and teamwork.

Equipment

Each team shall be tested using the following equipment arrangement:

1	Wilo Model FA10.33E pump with 5.6 HP, 4 pole air-filled motor (163.1#)
1	Wilo Model TR 50-2 mixer with 2.7 HP, 4 pole air-filled motor (224.4#)
1	Thern Model 5110 Manual Mechanical Hoist capable of lifting a minimum of 1000#
1	Wilo Master Control Panel (MCP)
2	36” by 60” by 5/8” Rubber service floor pad, service table, tool box, lubricants and spare parts
1	Competition platform constructed of 4” (100 mm box beams) complete with discharge elbow for pump, stub rail assemblies for the pump and mixer

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Premise

MIXER PORTION

The “moisture reset” button for the mixer in the basin has “disengaged” (means failure) on the control panel. The mixer can continue to operate, but the plant has decided to pull the mixer for service and replace the front mechanical seal and oil in 2 chambers. Mixer will be hoisted out of the simulated basin, rotated 90 degrees and reinstalled on the rail in a position facing outwards such that the portion of the mixer being serviced is outside of the simulated basin.

At this time, the outer seal chamber and gearbox will be checked for water intrusion and the outer (propeller side) mechanical seal will be inspected. The team will drain all oil from the 2 chambers, remove the propeller, and then remove and replace the mechanical seal. Oil will be replaced in these 2 chambers in the unit and then mixer will be ready for re-installation back in its original operating position using the hoist.

PUMP PORTION

The “moisture reset” button for the pump in the basin has “disengaged” (means failure) on the control panel. The pump can continue to operate, but the plant has decided to pull the pump for service and rebuild the block seal in the unit. Pump will be hoisted out of the simulated wet pit and placed on the floor pad where the repair will take place.

At this time, the pump will be drained of the mechanical seal oil and the volute and impeller will be removed from the pump thus allowing access to the block mechanical (cartridge) seal. The seal will then be removed and rebuilt using new faces and then put back together. The seal will be installed in the pump and then the impeller and volute will be attached. The event will then simulate replacing the mechanical seal oil and reinstall the unit into the basin via the hoist.

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Competition

Pre-event preparation

During this **3** minute period, the team will have the opportunity to ask questions, inspect the mixer and pump and open and presort the tools in the toolbox. The torque wrenches shall be set at this time and setting confirmed by a judge. All tools must remain in the toolbox when the event begins. The hoist winch handle may be adjusted during this time with the aid of an event judge. Each member will be issued color coded lock out locks and keys and must start with the locks in hand. The red lock shall be designated as the "Safety Supervisor". Each member must maintain possession of his or her key during the entire event if they have installed a lock. The lockout tags may not be dated or signed during this time. They may only be filled in after the start of the actual timed event. The team members must start behind the designated starting line until the event has started.

GENERAL RULES AND INFORMATION

- All bolts (except mixer propeller bolt) will be tightened to a specific torque of 30 ft-lbs (41 Nm) using a torque wrench and proper technique. The mixer propeller bolt and all socket head ("Allen head") drain plugs will be tightened to a specific torque of 10 ft-lbs (13 Nm).

- All lifts must be performed with the hoist. Specifically, the complete pump, the complete mixer, the pump motor/seal housing assembly, and the pump motor must be lifted using the hoist. The motor may not completely leave the ground without being attached to the hoist.

- Do not raise motor with volute attached more than 6" off the floor before releasing the volute from the motor/seal housing assembly. Any higher than 6" will be considered a safety hazard and be penalized.

- The hoist operator must use the handle in its intended manner and a separate team member shall guide the equipment out of or in to its intended position.

- No work may begin on the pump until it is resting on the matted work area. No work may begin on the mixer until it is lowered fully and seated again on the rail.

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- The platform shall have a complete steel plate deck. The black painted area represents the wet well. The area of the platform around the hoist shall be covered with diamond plate and shall be the only area of the platform on which the team members are permitted to stand and or place tools and parts. The work must be performed without stepping, standing or leaning on the wet well area of the platform. Any tools or parts placed in the wet well area of the platform will receive a penalty.

- When recording data off the performance curves and O&M manuals, that there may be a difference between the actual data and what is recommended in the O&M manual. Reasonable allowances have been taken into consideration for any measurement and/or reading as required on the worksheet.

- Any reasonable type of gloves may be worn, including latex (except as noted). However, if torn, replace immediately. (*Failure to do so will result in a stiff time penalty*) **NOTE:** Leather work gloves must be used for holding the impeller (see Pump Competition, step 16).

- Determine which unit to remove first as there is a single hoist. The tasks are written assuming that the pump is removed first—the choice is for each team to make.

- All gasket seals will be colored red or white (natural) to help verify they have been changed during the event.

- The seal faces will be red or silver (natural) to help verify they have been changed during the event.

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- The “starting” position for the hoist shall be with the boom facing over the platform, parallel to the long side of the platform. The pin shall be in the first hole with the boom collapsed to the smallest length such that teams must determine and set the proper pin position. The cable and hook shall be in a neutral position with the hook attached to the body of the hoist prior to starting in the same position for all teams. The hoist operator and the judge shall verify that the hoist safety pins are in place prior to using the hoist to perform the first lift.

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- The control panel shall feature the following components for each piece of equipment:
    a. Circuit breaker
    b. Hour meter
    c. Hand/Off/Auto (HOA) switch
    d. Thermal reset button
    e. Moisture reset button

- Each team member performing tasks on the pump or the mixer shall be required to lock out and tag out <u>both the pump and mixer</u> at the control panel prior to any contact with the equipment. All locks must be fully engaged at time of installation. Each team must designate a Safety Supervisor and that person shall use the red safety lock. The Safety Supervisor will be responsible for signing, dating, installing and removing the lock-out tags. The Safety Supervisor will be the first lock installed and the last lock removed from the circuit breakers.

- The starting position for the panel is with the circuit breakers in the “ON” position, the seal moisture reset for both the pump and mixer is in the “out” position (indicating tripped) and the HOA switches are in “AUTO”.

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- The breaker can accept up to 3 locks at 120 degree increments or the teams may use the multi-lock hasp if 4 locks are used.

- The ending position for the panel is with the circuit breakers in the “ON” position, the seal moisture reset for both the pump and mixer is in the “in” position (indicating reset) and the HOA switches are in “AUTO”.

- After all service work is completed, all tools shall be returned to the toolbox and the lock out and tag out removed by each member and the hoist returned to its “starting” position. Generally, tools that start in the tool box must finish in the tool box. Old plug gasket seals may be returned in the tool box or the drain pan.

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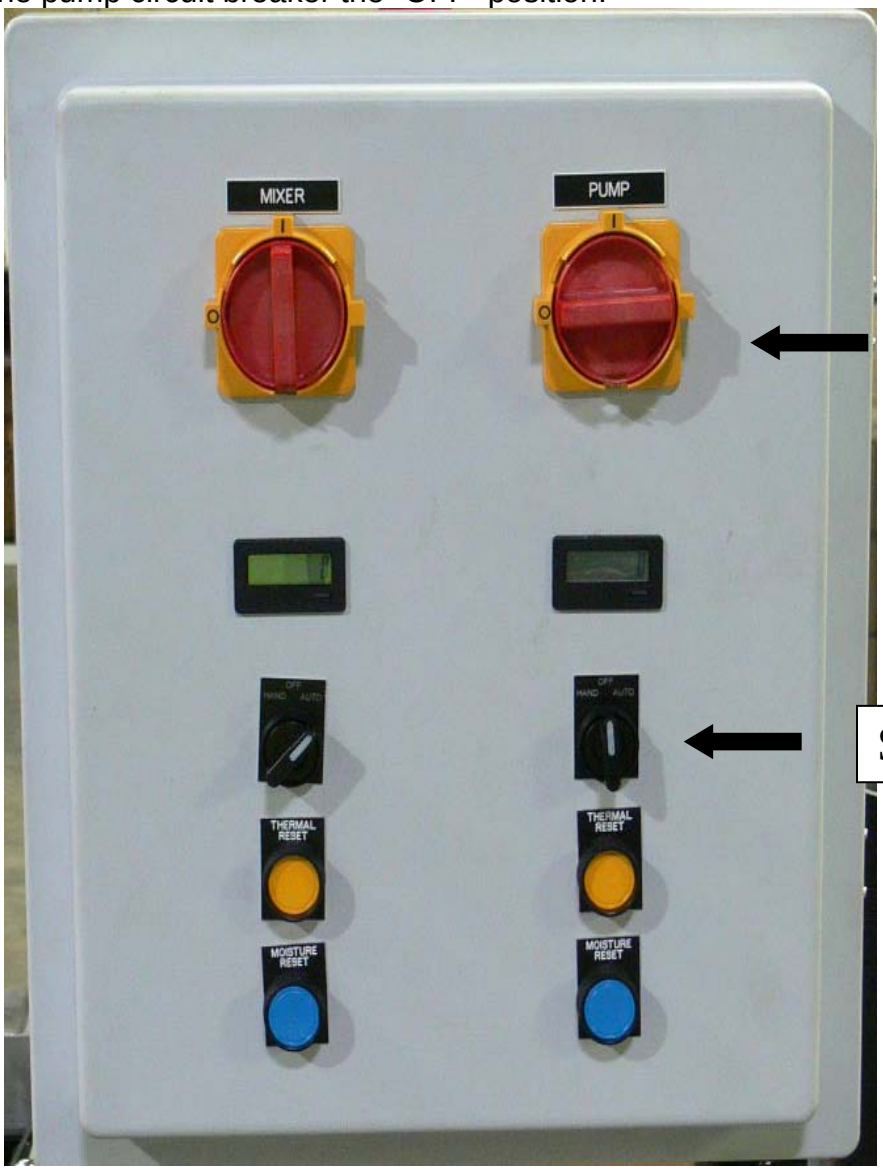
Event Tasks

Pump Competition

1. Turn the pump HOA switch to the “OFF” position.
2. Turn the pump circuit breaker the “OFF” position.



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3. Lock out of pump circuit breaker by Safety Supervisor.
    - Lock out tag to be signed and dated by Safety Supervisor.
    - Use the red lock, the multi-lock hasp (optional) and the lock-out tag to lock out the pump breaker.

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4. Turn pump HOA switch to the “HAND” position to verify the pump will not re-energize.

5. Verbalize “Pump locked out”.

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6. Place pump HOA switch to the “OFF” position.

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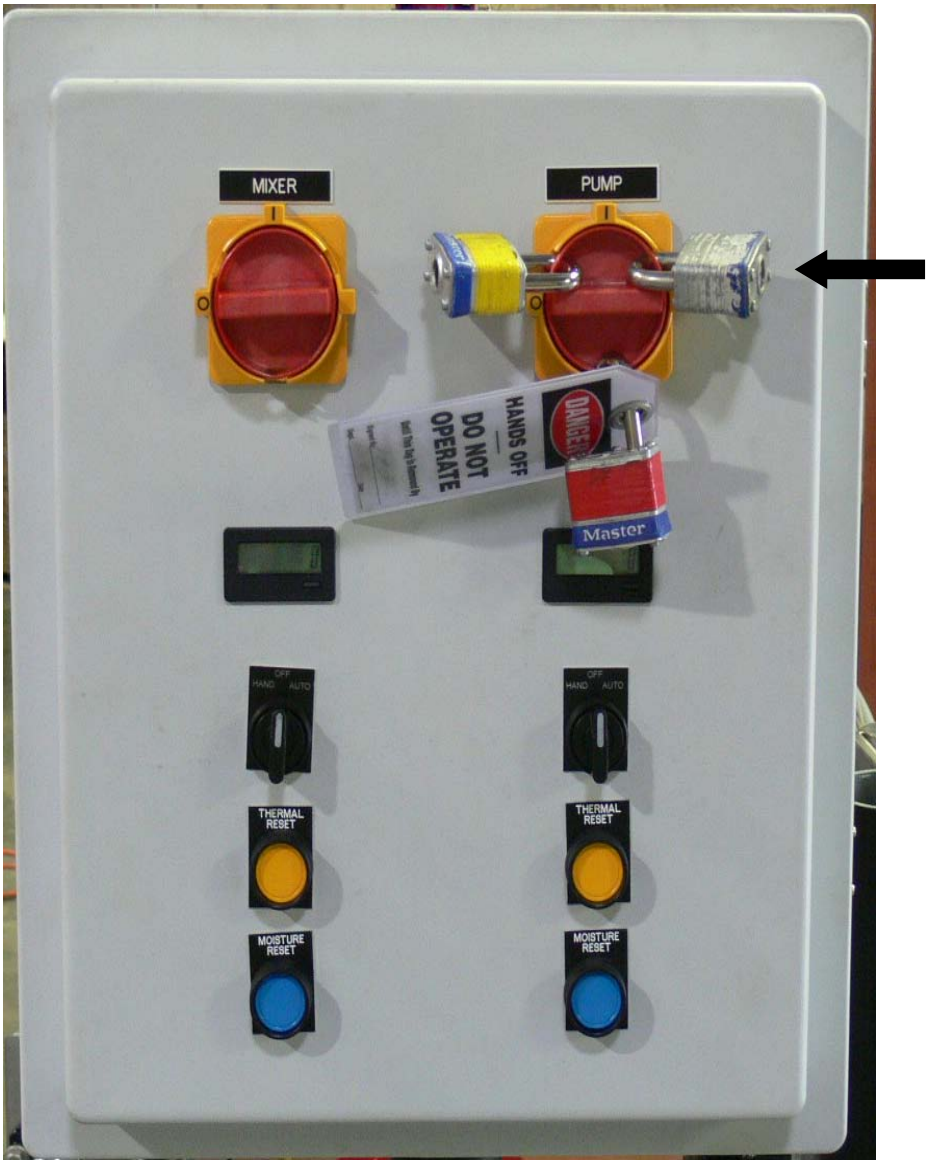
7. Place any other locks on pump circuit breaker as needed.



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8. Unlatch the hook on the hoist from the starting position and extend the boom to the desired hole location (if hoist has not already been used for the mixer).

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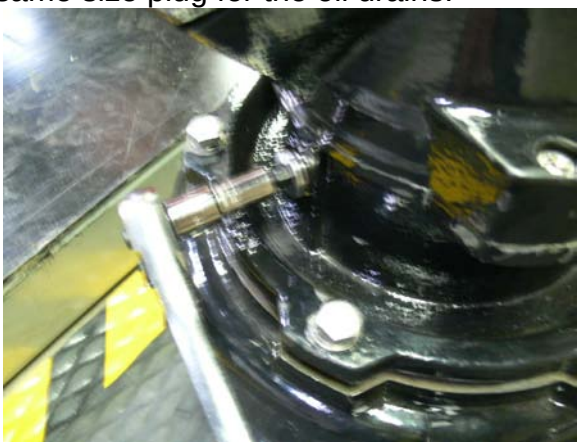
9. Reaching from the side of the platform attach the hook to the clevis on the pump.

10. Remove the pump from the slide rail using the hoist set the pump to the service floor pad work area with the pump in a vertical position.

11. Drain oil from the seal housing.
    - Remove socket head drain plug (10 mm hex bit).

      NOTE: The drain plug we will be using is the larger plug typically located under the cable connection. Some pumps may have a moisture probe installed in this location. The probe should be removed and replaced with the larger plug. The housing should be rotated so the plug faces towards the platform edge closest to the pump. Both the mixer and the pump use the same size plug for the oil drains.



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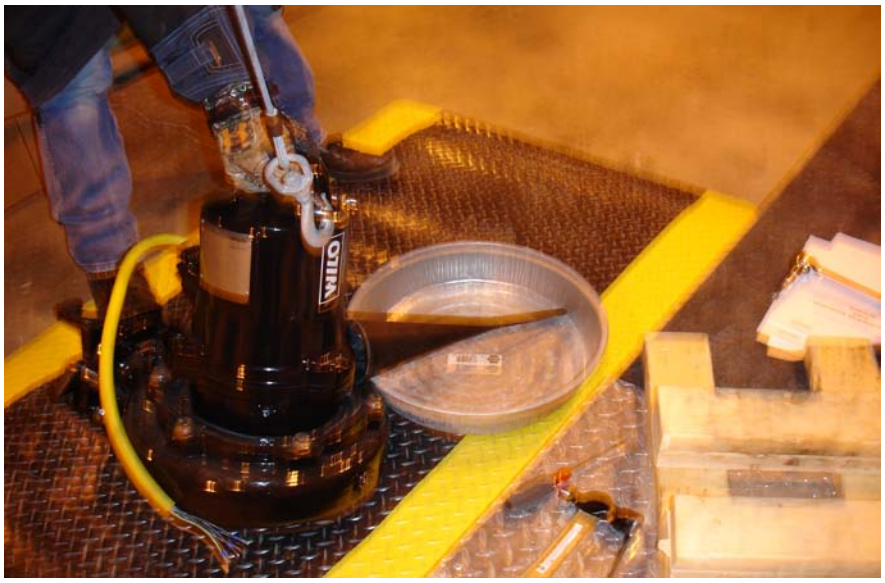
- Position funnel under drain plug and place other end in the drain pan and lean the pump towards the drain pan to facilitate draining the oil. Hold at no more than a 45° for the entire drain time.



- Verbalize 10 second count (“one-one thousand, two one-thousand…” etc).

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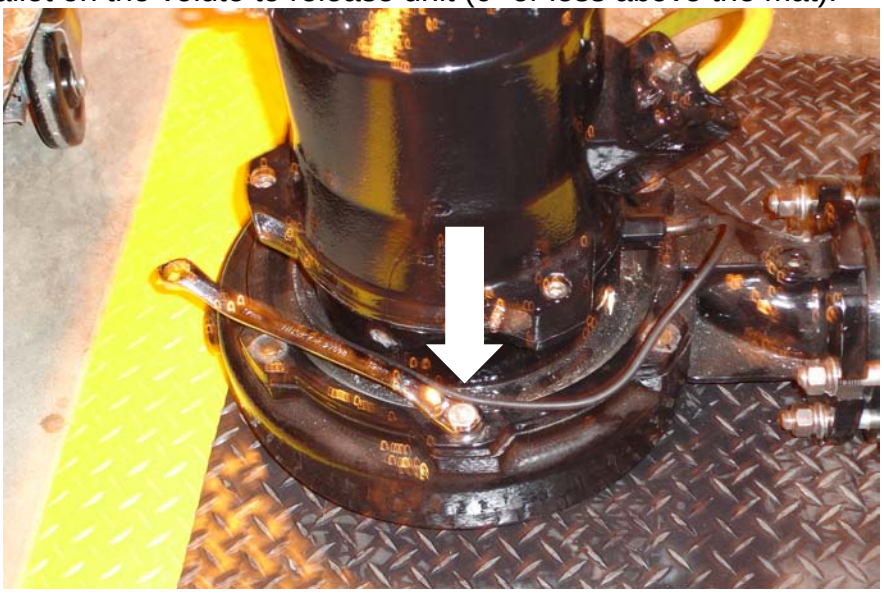
12. Replace nylon washer on oil drain plug (if red color coded washer is removed, replace with white (natural) or vice versa).

13. Remove the pump volute by removing six (6) hex head bolts and lock washers (19 mm socket/wrench) and, using the hoist for the lift, pull the motor with the impeller attached out of the volute. If the volute sticks to the motor housing, use rubber mallet on the volute to release unit (6" or less above the mat).



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14. Lower the motor, seal housing and impeller on to the floor pad work area using the hoist.

15. Lay the motor, seal housing and impeller on to its side to expose the impeller bolt.

16. Remove the impeller.

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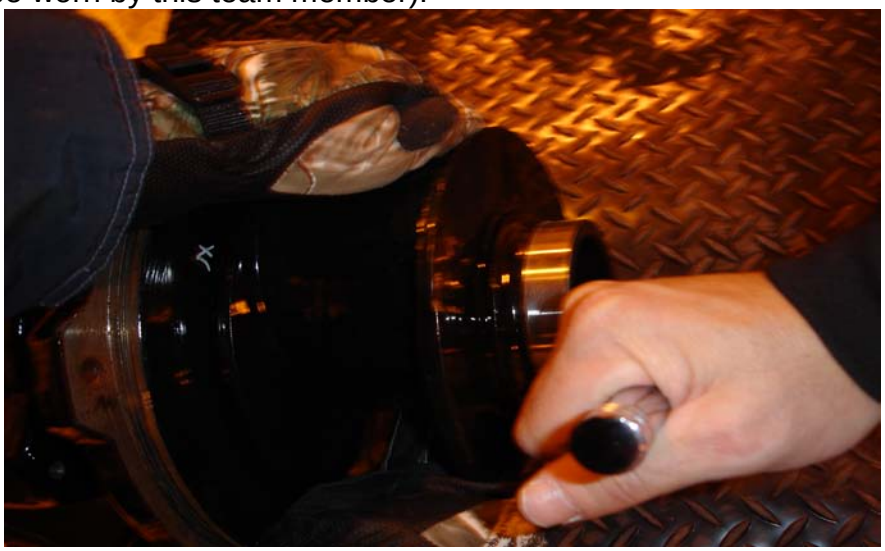
- Restrain impeller from turning for next step (leather work gloves must be worn by this team member).



- Remove impeller bolt, special lock washers and bushing (17 mm socket and 6” extension).

- Remove the impeller from the motor shaft by using the two (2) gray pry bars supplied. NOTE: The motor shaft is tapered and only a small amount of force is needed to release the impeller from the shaft. The impeller bolt has a special lock washer attached to it and the impeller has a recessed bushing that may fall out when impeller is removed.

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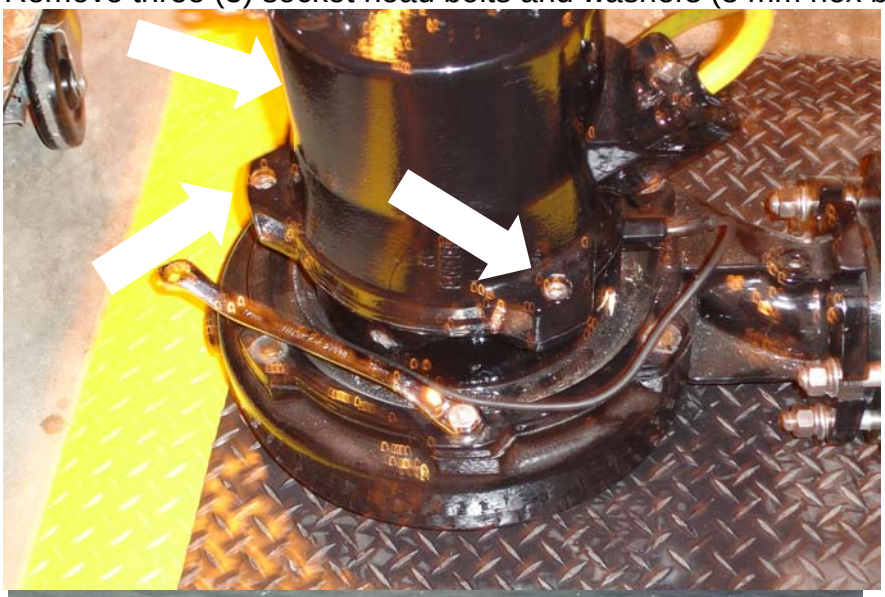
17. Remove the motor from the seal housing.
    - Remove three (3) socket head bolts and washers (8 mm hex bit).



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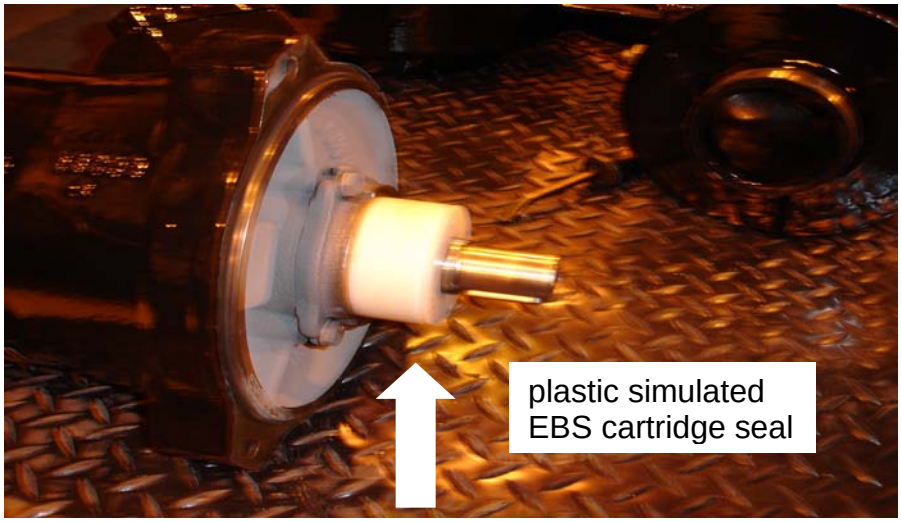
- Lift the motor out of the seal housing with the hoist. If the seal housing sticks to the motor, use rubber mallet on the seal housing to release unit (6” or less above the mat).

- Place the motor on the floor pad and lay it on its side.



18. Remove the plastic simulated EBS cartridge seal by hand and set on the table of the work area where the stainless steel EBS seal is to be rebuilt.

19. Rebuild the stainless steel EBS cartridge seal on the seal rebuild table.

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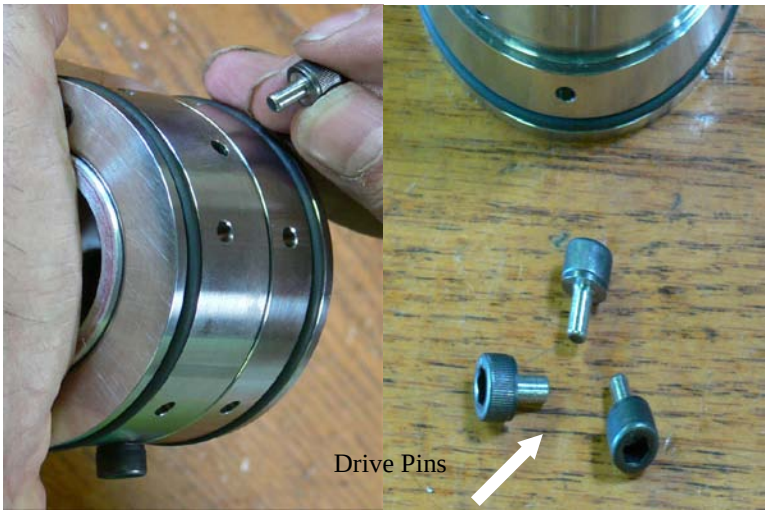
- Remove the three (3) drive pins (NOTE: Both seal faces will be either red or silver (natural)).



- Separate the cartridge halves and remove seal faces.

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- Install new faces (if red color coded faces are removed, replace with silver (natural) or vice versa).

- Press cartridge halves together, insert the three (3) drive pins.


  - NOTE: Seal faces must be aligned and have full inner diameter opening.

- Verbalize “Seal rebuilt”. 

- Return the plastic simulated EBS cartridge seal back to the pump to be reinstalled.

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20. Reinstall the plastic simulated EBS cartridge seal.
    - Place seal on shaft o-ring end first.
    - Use the aluminum seal installation tool and rubber mallet to seat o-ring into top of motor housing with 2-3 sharp blows.

21. Reinstall seal housing.
    - Use the hoist to lift the motor.
    - Align seal housing so that the drain plug faces the platform edge closest to the pump when installed.
    - Lower motor onto seal housing and replace bolts and washers.
    - Tighten bolts to 30 ft-lbs (41 Nm) with the ½" torque wrench.

22. Replace impeller.
    - Lay the motor and seal housing on its side on the work area.
    - Install the impeller with impeller bolt, lock washer, and bushing (properly orientated).
    - Tighten impeller bolt to 30 ft-lbs (41 Nm) with the ½" torque wrench.

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23. Simulate refilling the seal housing with 0.7 liters of oil.

- Verbalize 8 oil dispenser pump strokes.

24. Install drain plug in seal housing.
    - Tighten to 10 ft-lbs (13 Nm) using the 3/8” torque wrench.

25. Replace volute.
    - Use hoist to lift the motor with seal housing and impeller attached and lower into volute.
    - Install six (6) double washers and six (6) hex head bolts.
    - Tighten volute bolts in a cross pattern to 30 ft-lbs (41 Nm) with the ½” torque wrench.

26. Using hoist, reinstall pump on to rail system.

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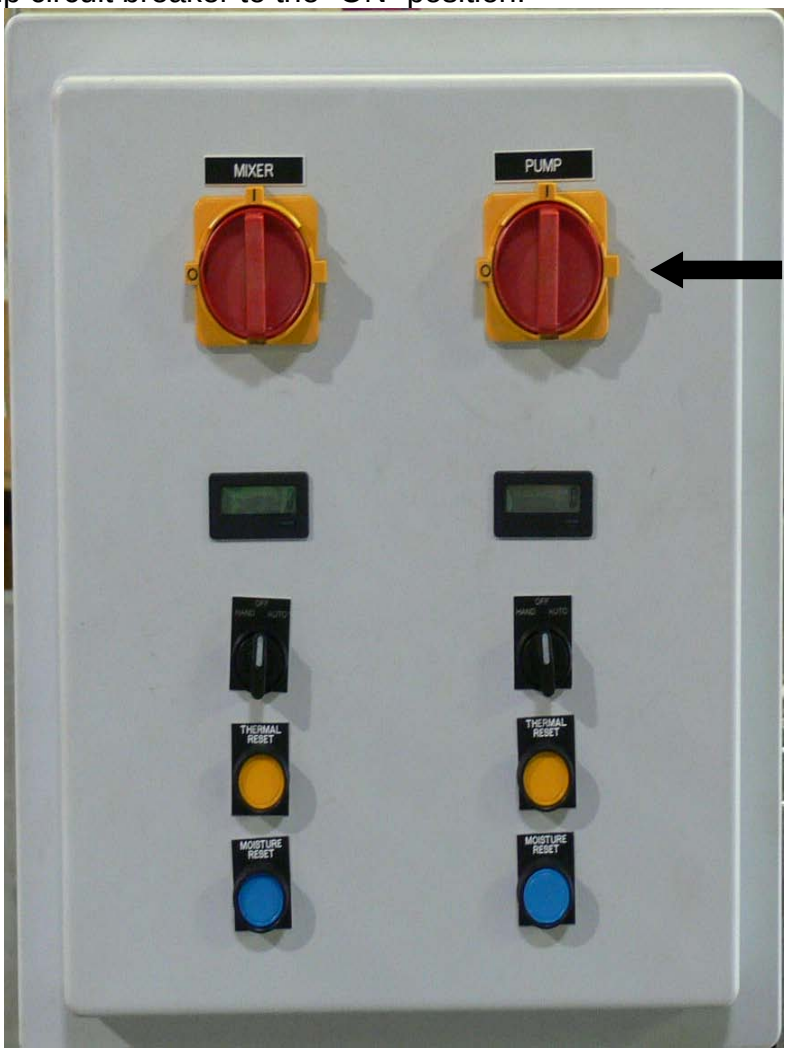
27. Remove locks and tag.
    - Remove all locks except the red lock.
    - Remove Safety Supervisor's red lock last.
    - Remove the multi-lock hasp if used.

28. Turn pump circuit breaker to the "ON" position.



- Verbalize "Pump breaker on".

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29. Depress the pump moisture reset button.

- Verbalize “Moisture probe reset”.

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30. Move the pump HOA switch to the “AUTO” position.

- Verbalize “Pump in auto”.

NOTE: Placing the equipment back in service at the panel must follow this sequence.

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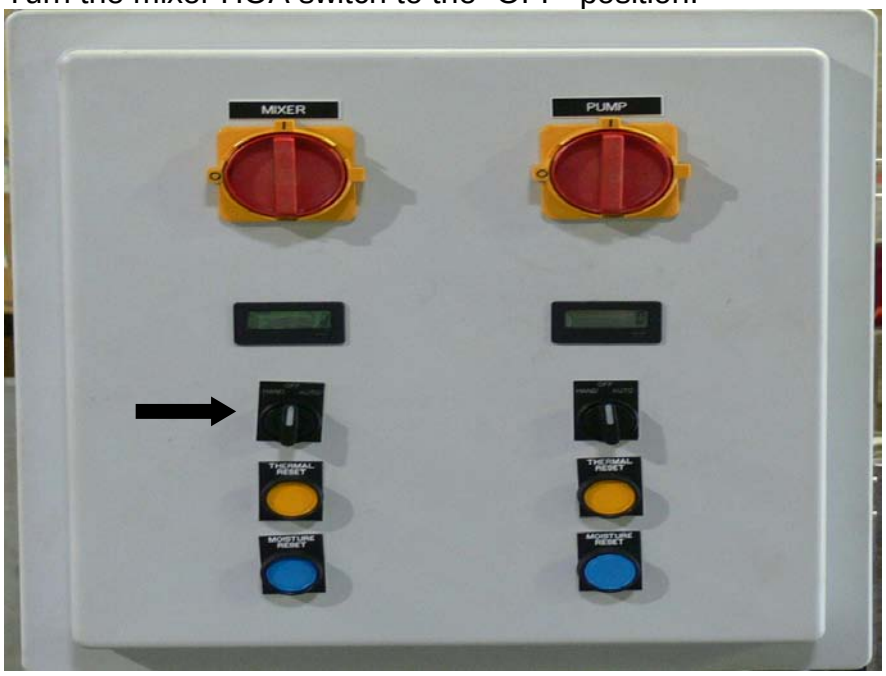
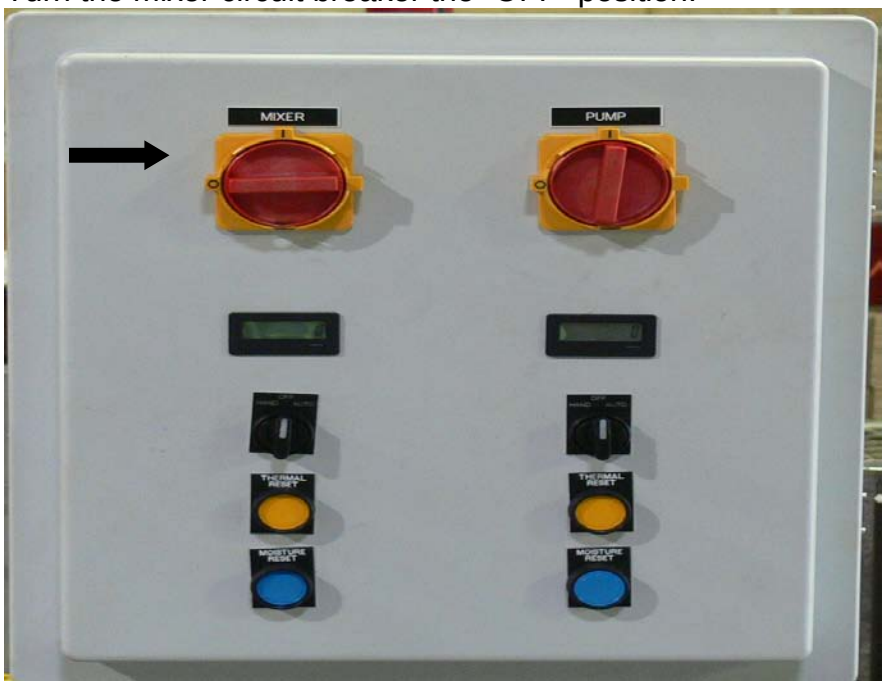
Mixer Competition

1. Turn the mixer HOA switch to the “OFF” position.



2. Turn the mixer circuit breaker the “OFF” position.



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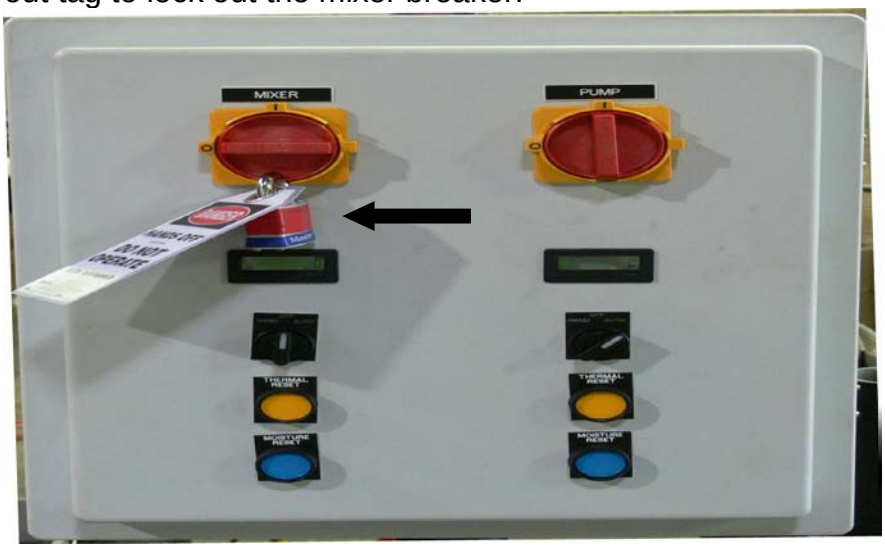
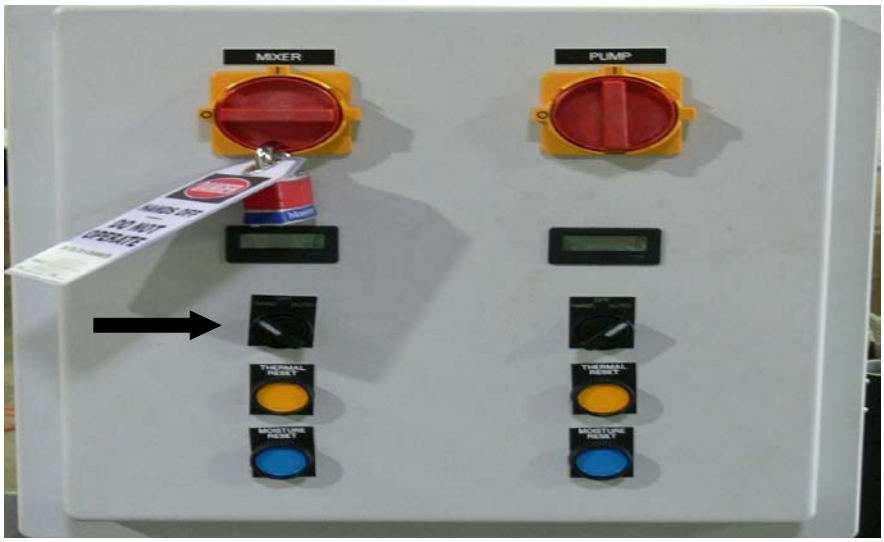
3. Lock out of mixer circuit breaker by Safety Supervisor.
   - Lock out tag to be signed and dated by Safety Supervisor.
   - Use the red lock, the multi-lock hasp (if needed or desired) and the lock-out tag to lock out the mixer breaker.



4. Turn mixer HOA switch to the “HAND” position to verify the mixer will not re-energize.



5. Verbalize “Mixer locked out”.

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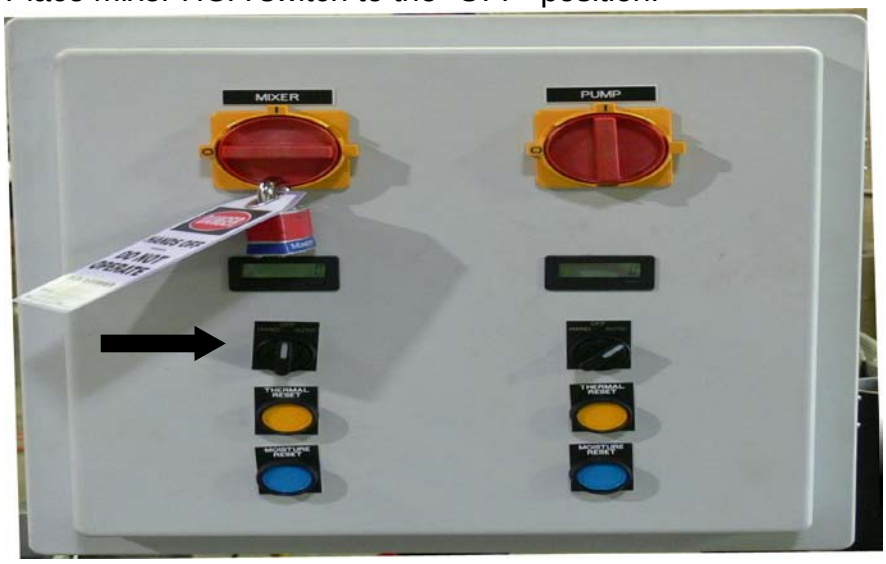
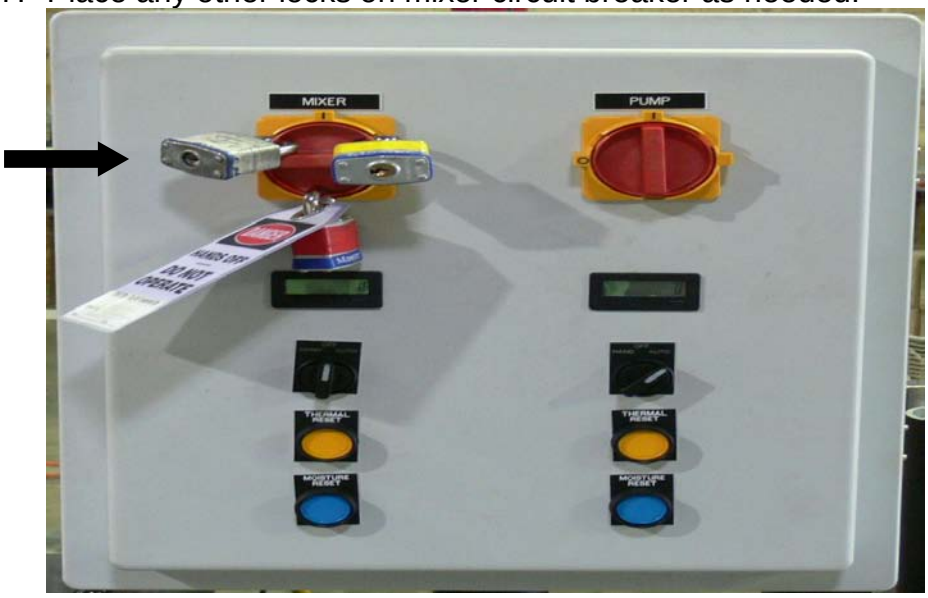
6. Place mixer HOA switch to the “OFF” position.



7. Place any other locks on mixer circuit breaker as needed.



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8. Unlatch the hook on the hoist from the parked position and extend the boom to the desired hole location (if hoist has not already been used for the pump).

9. Reaching from the side of the platform attach the hoist hook to the clevis on the mixer.

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10. Remove the mixer from the slide rail using the hoist, rotate the unit 90 degrees and reinstall on the rail with the propeller facing out so that the body of the mixer can be serviced without leaning over the platform.

11. Place oil drain pan on floor under the pre-chamber and gearbox drain plugs.

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12. Drain oil from pre-chamber.
    - Remove the socket head plug (when facing propeller, left side, front plug, 10 mm hex bit).

    - Verbalize 10 second count (“one-one thousand, two one-thousand…” etc).

13. Verbalize “Oil is contaminated”.

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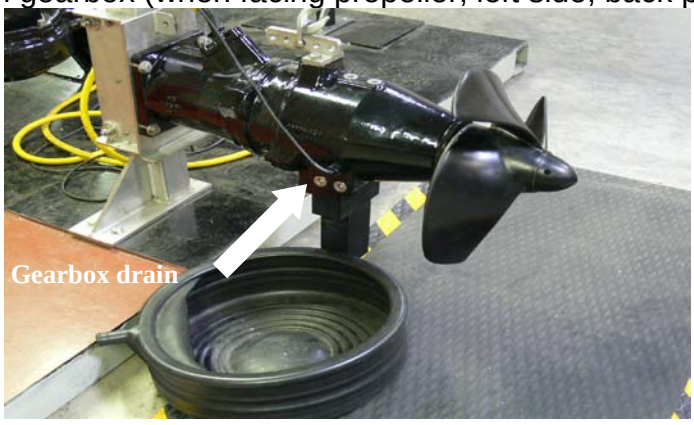
14. Replace nylon washer on pre-chamber oil drain plug (if red color coded washer is removed, replace with white (natural) or vice versa).

15. Drain oil from gearbox (when facing propeller, left side, back plug).



- Remove socket head drain plug (10 mm hex bit).
- Verbalize 10 second count ("one-one thousand, two one-thousand…" etc).

16. Verbalize "Oil is clean".

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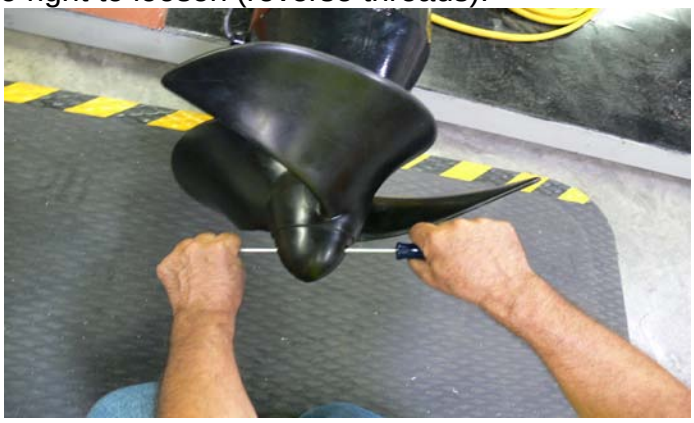
17. Replace nylon washer on gearbox oil drain plug (if red color coded washer is removed, replace with white (natural) or vice versa).

18. Reinstall the pre-chamber and the gearbox drain plugs.
    - Torque each drain plug to 10 ft-lbs (13 Nm) using the 3/8” torque wrench.

19. Remove the propeller nose cone.
    - Insert screwdriver into hole in nose cone.
    - Turn to right to loosen (reverse threads).



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20. Remove the propeller.

- Remove propeller bolt and flat washer (6 mm hex bit).

- Slide propeller off the splined shaft.

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21. Remove the mechanical seal.

NOTE: This step should not be started until the pre-chamber has been drained to avoid an “oil spill”.

- Remove the steel mechanical seal cover by hand or with the aid of the rubber mallet.

- Remove the mobile portion of the mechanical seal by hand or with the cotter pin puller.

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- Remove the stationary portion of the mechanical seal by hand or with the cotter pin puller (stationary face shall be drilled in two places, 180 degrees apart, so that the cotter pin puller may be used to assist removal. Be sure to remove O-ring if it doesn't come out with the stationary face!).



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22. Install new mechanical seal (if red color coded seal is removed, replace with silver (natural) or vice versa).

- Push the new stationary face down the shaft with your hands (o-ring side of the seal should be facing the mixer) and press firmly into seat.

- Push the new mobile face and tension spring down the shaft with your hands.

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- Install the steel mechanical seal cover by hand.

23. Replace the propeller.
    - Slide propeller back on to the splined shaft.

    - Thread propeller bolt with flat washer in the end of the shaft.
    - Tighten to 10 ft-lbs (13 Nm) with 3/8” torque wrench and 6 mm hex bit.
    - Replace the propeller nose cone and tighten with hand to snug fit.

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24. Refill the gearbox with oil.

- Remove the gearbox fill plug (rear oil fill hole - top of mixer).

- Replace the nylon washer (if red color coded washer is removed, replace with white (natural) or vice versa).
- Fill the gearbox with 0.5 liters of oil, verbalize 5 pump strokes.

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25. Refill the pre-chamber with oil.
    - Remove the pre-chamber fill plug (front oil fill hole, top of mixer).

    - Replace the nylon washer (if red color coded washer is removed, replace with white (natural) or vice versa).
    - Fill the pre-chamber with 1.2 liters of oil, verbalize 14 pump strokes.

NOTE: This task must be done <u>after</u> the propeller is tightened, compressing the mechanical seal and avoiding an “oil spill”.

26. Using hoist, reinstall mixer back to original orientation.

27. Remove locks and tags.
    - Remove all locks except the red lock.
    - Remove Safety Supervisor’s red lock last.
    - Remove the multi-lock hasp if used.

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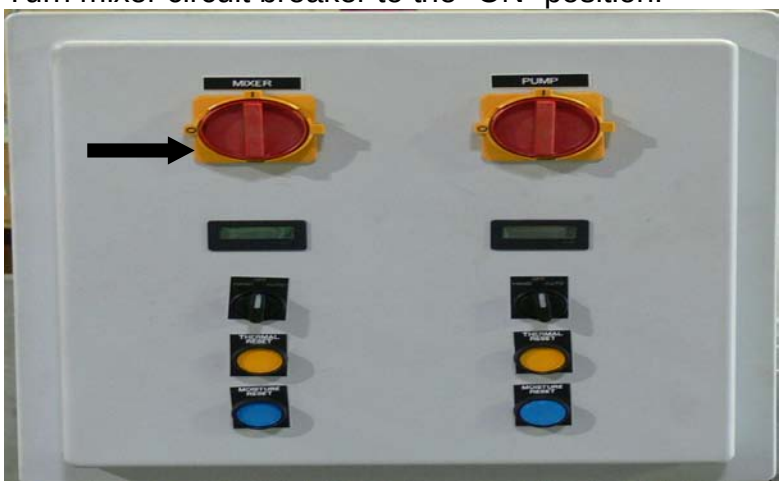
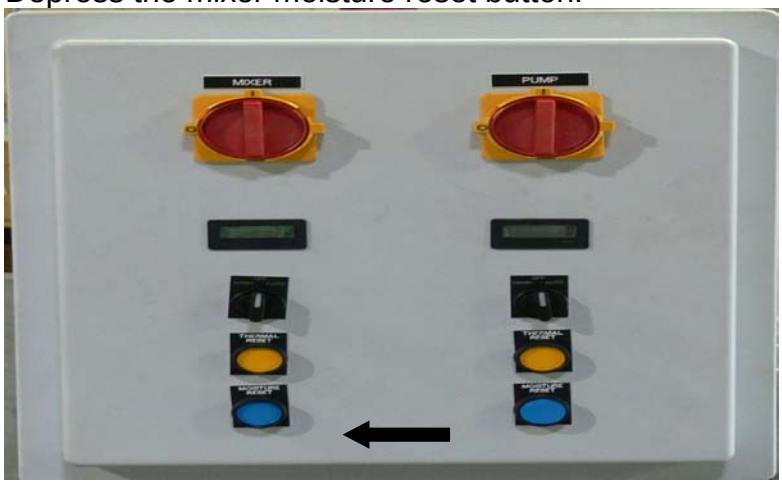
28. Turn mixer circuit breaker to the “ON” position.



- Verbalize “Mixer breaker on”.

29. Depress the mixer moisture reset button.



- Verbalize “Moisture probe reset”.

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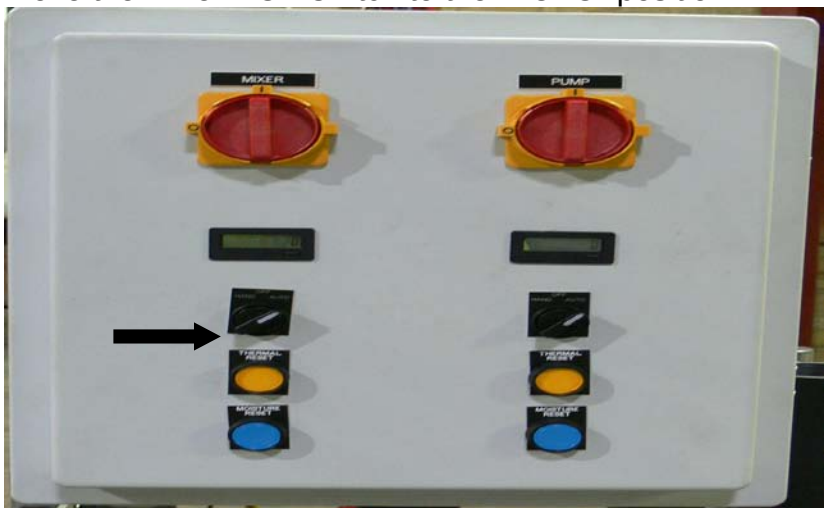
30. Move the mixer HOA switch to the “AUTO” position.



- Verbalize “Mixer in auto”.

NOTE: Placing the equipment back in service at the panel must follow this sequence.

Final Steps

1. Complete question sheet for the pump (questions taken from 4 page study guide).
2. Return tools and supplies to their original position.
3. Return hoist to its “starting” position.

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Event Safety and Judging Notes

1. Appropriate safety attire such as steel toe boots, hardhats and safety glasses must be worn.

2. Gloves must be worn at all times during the event but may be removed to take the quiz. Leather gloves must be worn for removal and handling of the pump impeller (ref. Pump Competition, step 16).

3. Personal protective equipment must be worn at all times, if a glove is torn, or hard hat falls off, the team member must replace it immediately or a stiff penalty will be assessed.

4. Caution must be exercised when handling hoist hook and care taken to ensure that the cable weight does not injure a team member.

5. Any reason to stop the event due to equipment failure could result in a restart from the beginning, as decided by the team Captain and Head Judge. Also, any reason to stop the event due to the abuse or misuse of tools and/or equipment could result in a restart from that point or as decided by the head judge. Depending on the situation, a time penalty could be added.

6. If the Head Judge stops the event due to abuse or misuse of tools or equipment, time will continue to run. Depending on the severity of the situation, penalty time could be added on to the event time in addition to the time the team was stopped.

7. Failure to perform any task will result in stiff penalties.

8. Failure to communicate tasks performed out loud as specified in the following task list will result in penalties. When directed to count seconds out loud, always use “one one-thousand, two one-thousand, three one-thousand”, etc. Counting the number of times you are doing a task can be “one-two-three”, etc.

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9. Upon finishing the event, all team members are asked to remain outside of the challenge curtain area until the judges have finished scoring and evaluating the team's performance. When finished, the Head Judge will review the event and scoring results with the Team Captain.

10. Judges are asked to supply the team captain with their raw time in minutes and seconds. The event scorekeeper will do actual tabulation, conversion and reporting of the finished time.

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11. A 20 minute time limit has been imposed for the completion of all required tasks. If, at the 20 minute mark, teams have not completed all the work, the event will be stopped and penalties will be assessed for all uncompleted tasks.

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