



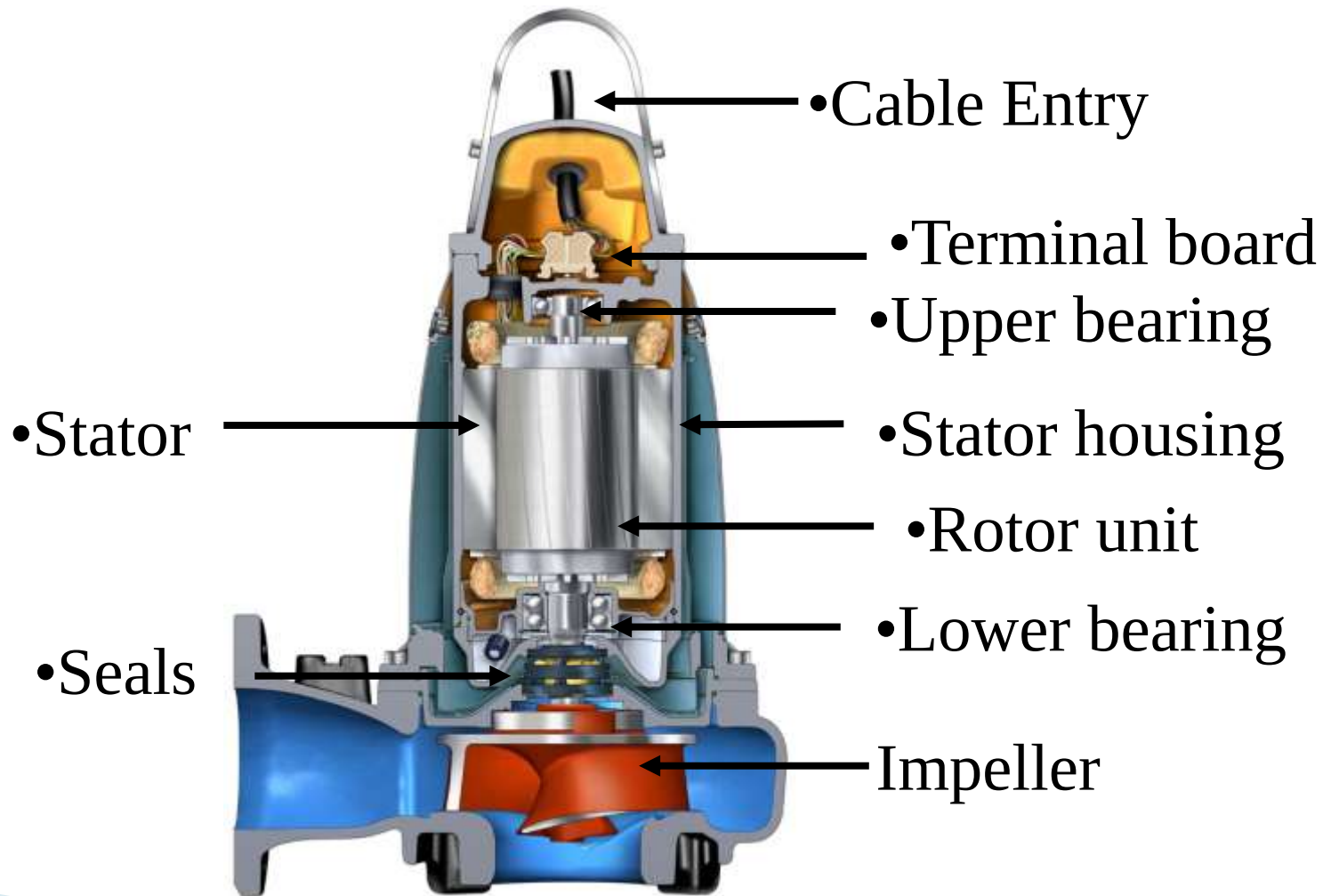
Submersible Pump Maintenance and Repair

Presented by: Rick Alvarez

What we'll talk about....

- ▶ Why Perform Preventative Maintenance?
 - Identification of Major Components
 - Cost of Pumping
 - Pump and System Curves
 - Best Efficiency, POR, AOR
 - ▶ What Does Preventative Maintenance Consist Of?
 - Electrical
 - Mechanical
 - Checklist
 - Maintenance Report
 - ▶ What If My Pumps Need Repair?
 - Difference between a repair and a complete overhaul
 - Procedure for refurbishing a submersible pump
 - ▶ Summary
- 

Identification of Major Components

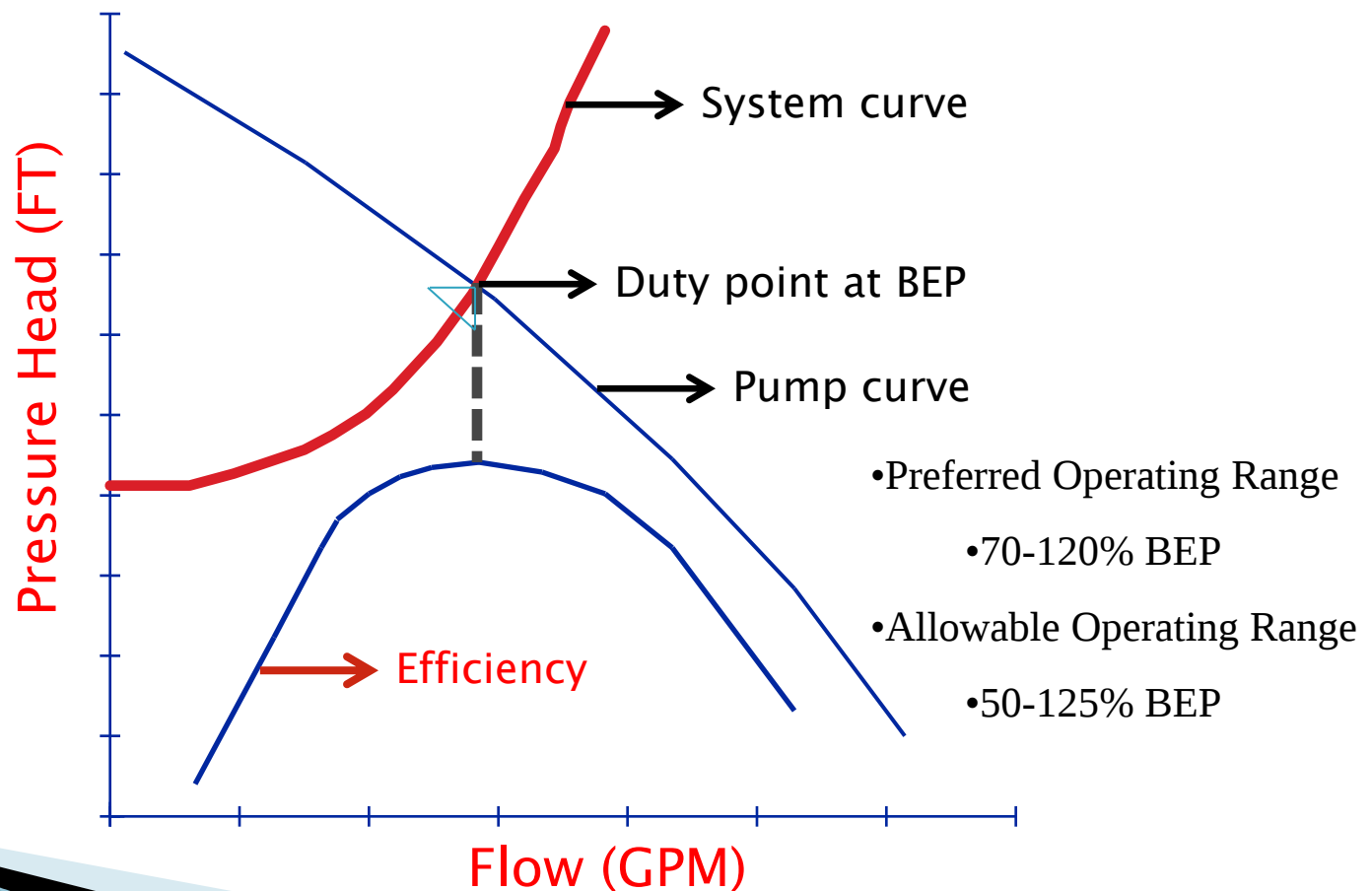


What is the cost of pumping?

- ▶ Energy used to operate pumps
 - Dependent on flow rate, total pressure and overall pump efficiency
 - ▶ Labor and parts to maintain and repair pumps
 - ▶ Cost will inevitably go up without preventative maintenance!
 - Efficiency decreases
 - Catastrophic failure WILL happen!
- 

Pump and System Curves

- It is always best for the duty point to be near the pump's best efficiency point (BEP)



What does Preventative Maintenance Consist of?

IMPORTANT NOTES:

Always follow proper safety procedures!!!

Lockout/tagout

Confined Space

Always read and follow the instructions and safety precautions in your O&M manual!



What does Preventative Maintenance Consist of?

Electrical

▶ Control Panel

- Check and tighten all terminations
- Inspect and test control panel operation
- Test telemetry/alarms
- Record voltage
- Identify and correct any issues

▶ Pump

- Amp readings
 - Motor winding resistance
 - Megger readings
 - Overtemp/leakage sensors
- 

What Causes.....

High Amps

- ▶ Running pump far right of BEP (runout, overloaded motor)
- ▶ Partial drag on impeller (towels, wipes, rags, etc.)
- ▶ Blockage or clog
- ▶ Impeller clearance too tight

Low Amps

- ▶ Running pump far left of BEP (deadhead)
- ▶ Closed discharge valve
- ▶ Partially clogged check valve
- ▶ Air in force main

Resistance Check Through Cable

- Indicator of possible motor winding problems
- All readings should be the same



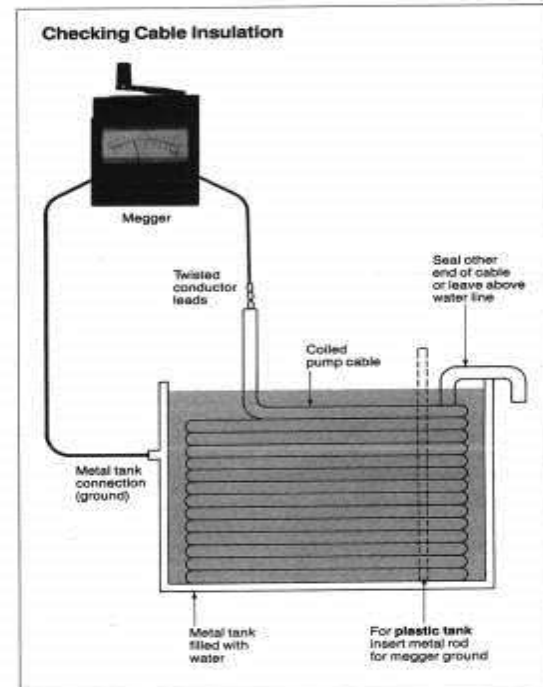
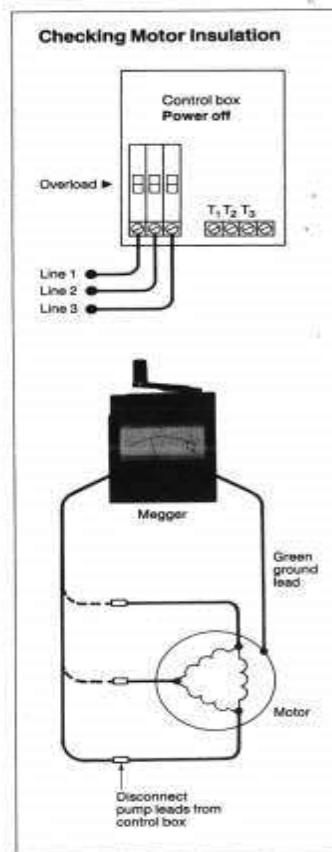
Motor Insulation Test



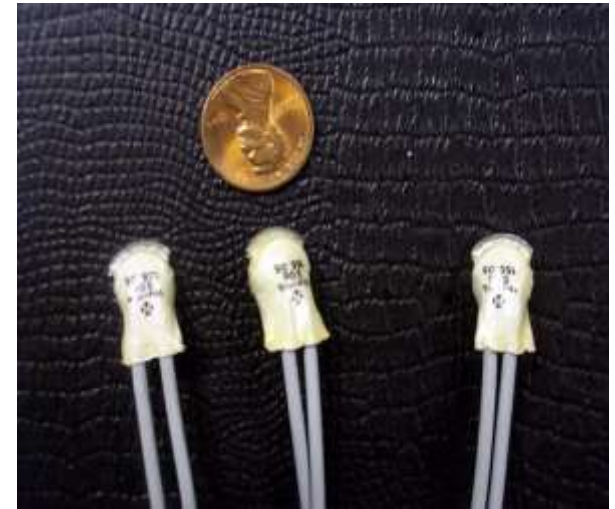
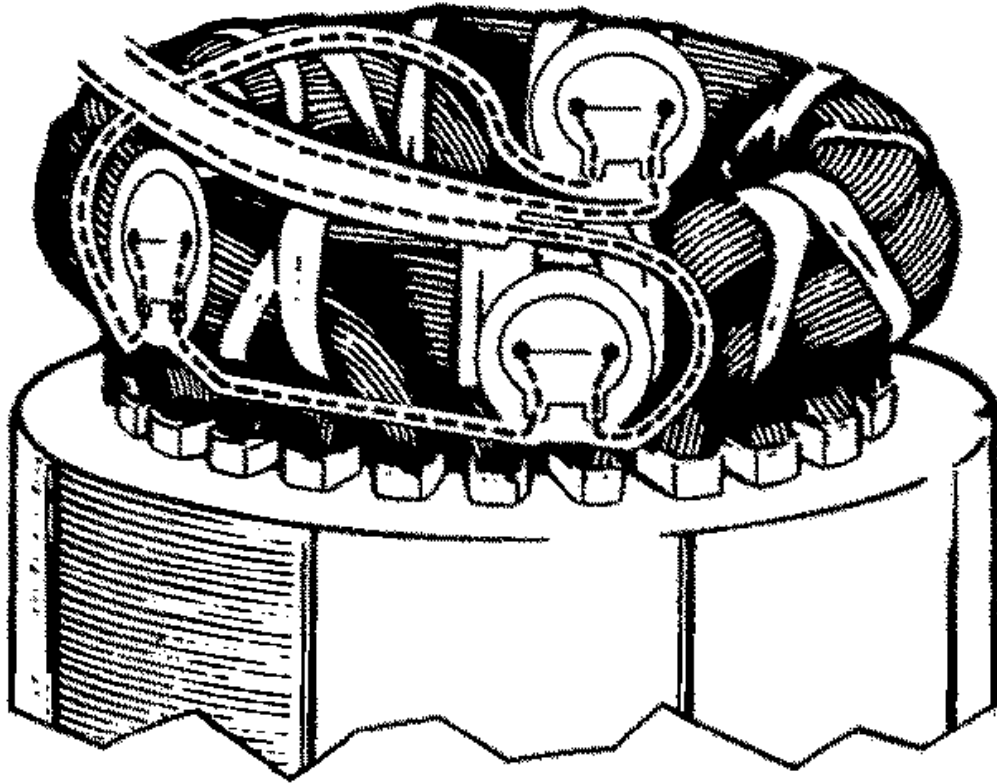
Megger Readings

- ▶ Less than 100 megohms
unserviceable– repair required
- ▶ 500 megohms
moisture present/ insulation degraded– repair should be scheduled
- ▶ 1000 megohms
serviceable, but showing signs of degraded insulation
- ▶ 2K megohms
new condition

Insulation Checks



Stator Thermal Switches



Three (3) Switches Wired In Series, Placed In The Stator End Turns
When The Stator Is Wound, With Two Leads Coming out of The Stator.

Flygt Leakage Sensor

- Reed contact
- in polyurethane filler

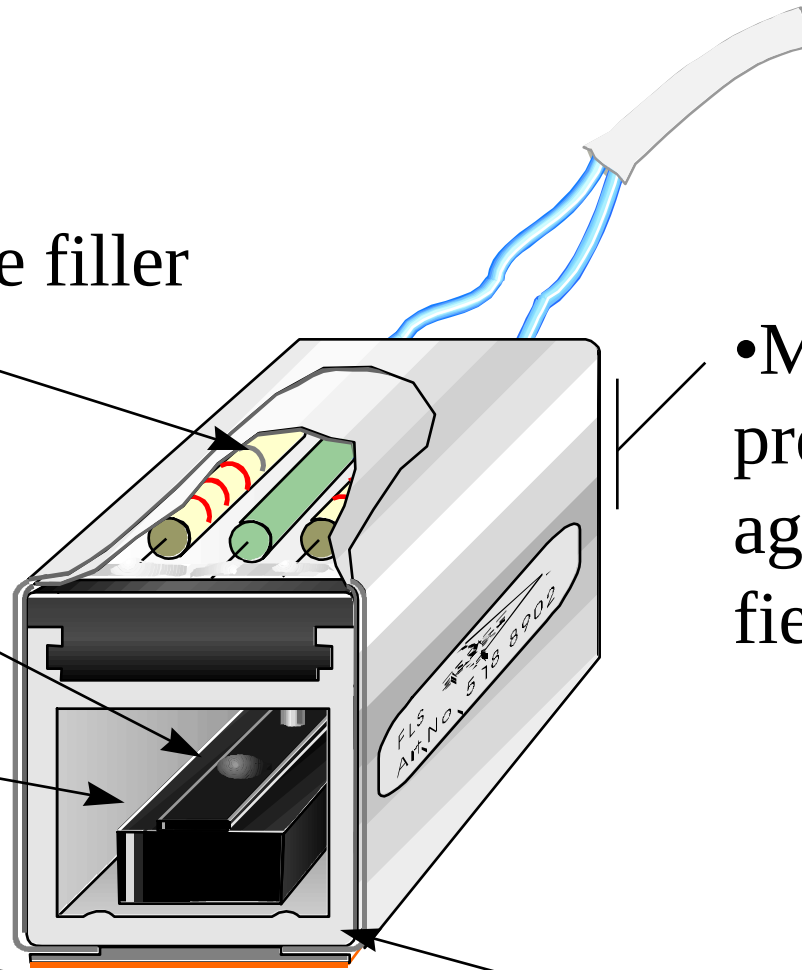
- Magnet

- Floating
- body

- Tape for
- fixing

- Metal sheet protecting against magnet field

- Aluminum profile



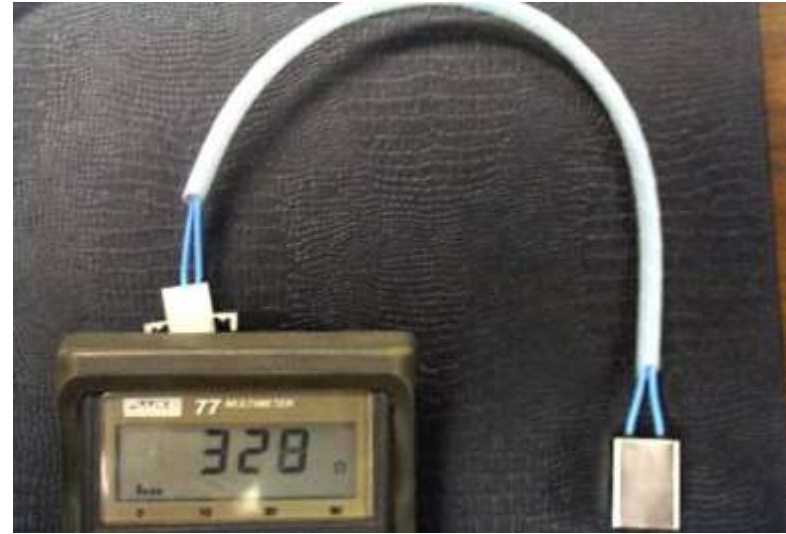
Flygt FLS Leak Detector



- The normal or safe condition resistance reading or values of the FLS

unit is in the 1500 Ohms range. At this point the switch contacts are

- open.



- The leak or fail condition resistance reading or values of the FLS

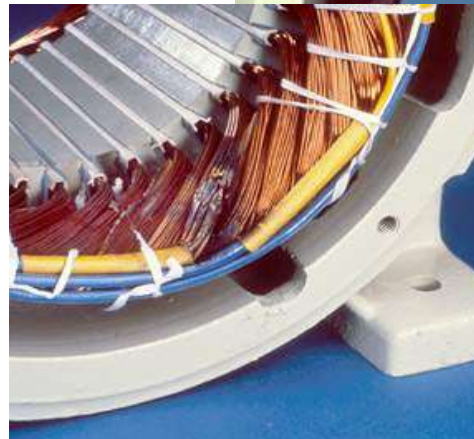
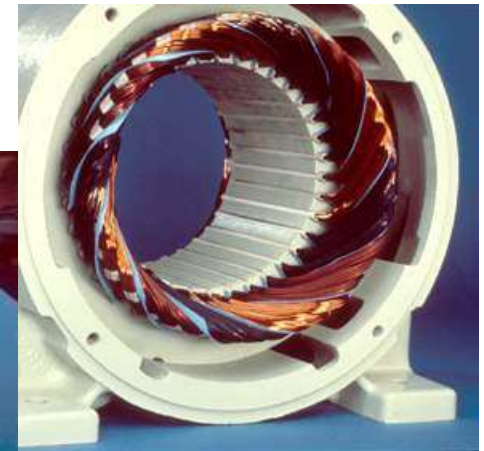
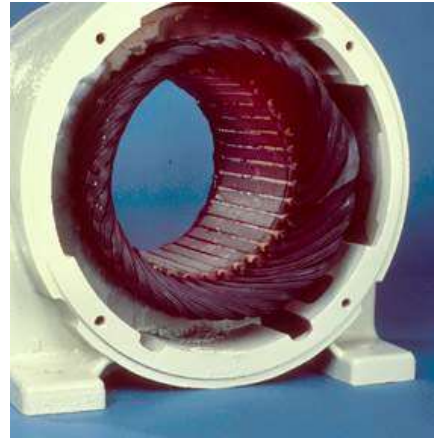
unit is in the 300 Ohms range. At this point the switch contacts are

- closed.

•Overheated motor or failed thermal sensor will result in an open circuit

Motor Failure.....

- ▶ Overloaded
 - Properly sized breakers/overloads
- ▶ Unbalanced Voltage
 - Phase monitor
- ▶ Voltage Surge
 - TVSS/voltage monitor



What does Preventative Maintenance Consist of?

Mechanical

▶ Change oil or coolant

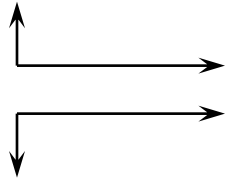
- Inspect oil or coolant for evidence of sewage
 - Minute amounts are normal and not usually a cause for concern
- Inspect motor chamber for evidence of sewage
 - Should be thoroughly inspected to determine where it's coming from.
 - Cable entry
 - Failed seals

▶ Check Impeller

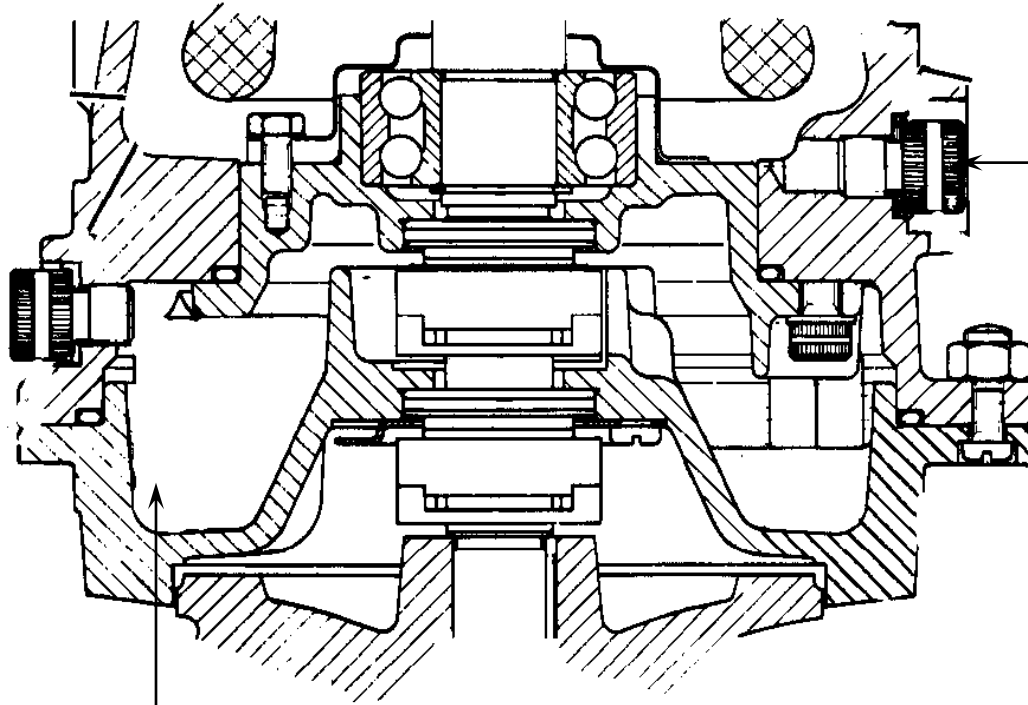
- Note any physical damage or excessive wear
 - Adjust clearance to OEM specs (if adjustable)
 - If not adjustable, pump may require new wear ring
- 

Oil Chamber

Always Replace
The “O” Ring Or
“Dubo Washer”



Slowly Remove
The Oil Inspect.
Plugs As This Is
A Pressurized
Section Of The
Pump



Never Over
Tighten The
Inspect. Plugs

Always Fill The Oil Housing To The Required
Capacity According To The O&M Manual For
The Pump You Are Working On.

Mechanical Failure.....



Bearings

- ▶ Evidence of rubbing or wear
- ▶ Inadequate lubrication
- ▶ Improper handling
- ▶ Excessive hours
- ▶ Vibration

Seals

- ▶ Two types of Failure – physical damage or separated faces
 - Operating outside AOR?
 - Impeller worn and unbalanced?
 - Cavitation or suction recirculation?

Maintenance Checklist

1. Check electrical condition of insulation on power cable(s) and on all phases of the motor (in Meg Ohms).
2. Check for any loose or faulty electrical connections within the control panel.
3. Measure resistance between stator windings (in Ohms).
4. Check voltage supply between all phases of the electrical control panel.
5. Check voltage balance between all phases on the load side of the pump / mixer control panel with pump / mixer running (VAC).
6. Check amperage draw on all phases of the motor (in Amps).
7. Check condition and operation of the motor thermal protection control system (if equipped).
8. Removal of pump / mixer from the lift station for physical inspection.
9. Check condition of upper and lower shaft seals (inspect condition of motor / stator housing, if applicable).
10. Check condition and operation of leakage and bearing sensors (if equipped).
11. Drain oil from oil housing and replace with new oil.
12. Check for worn or loose impeller or propeller.
13. Check impeller wear rings (rotating & stationary) – Note wear rings are a wear item and are not included in the cost of this contract.
14. Adjust clearances as needed for optimal operation.
15. Check for any unusual noise in the upper and lower bearings.
16. Clean, reset and check operation of the level control system (if equipped).
17. Check for physical damage of power and control cables.
18. Check for correct shaft rotation.
19. Reinstall the pump / mixer and check operation (if liquid level in the station permits).
20. Test the pump / mixer operating cycle, under load (if liquid level in the station permits).
21. Perform draw down test on pumps to establish GPM being produced (when possible).
22. Perform shut off head test on pumps to establish pressure being produced (when possible).
23. Check operation of valves and associated equipment.

Submersible Pump Maintenance Report

- Technician will complete a maintenance report
- Identifies any corrective action that may be required.
- Ensures compliance with manufacturer warranty requirements



PUMP STATION MAINTENANCE REPORT

TECH: _____	OWNER: _____
SALES: _____	PROPERTY MANAGEMENT: _____
DAY: _____	STATION: _____
DATE: _____	CONTACT: _____
TIME: _____	PHONE#: _____
JOB#: _____	

WORK SCOPE:

MAINTENANCE CHECK POINTS

INSPECT ALL LEVEL CONTROLS FOR PROPER OPERATION	☐																														
CHECK INDICATOR LIGHTS FOR BURNED OUT BULBS	☐																														
VERIFY OPERATION OF TELEMETRY	☐																														
HOUR METERS: #1 _____ #2 _____ #3 _____ #4 _____	☐																														
INSPECT AND RECORD AMP READINGS:																															
<table border="1"> <tr> <th colspan="3">SINGLE PHASE</th> <th colspan="3">3 PHASE</th> </tr> <tr> <td>PUMP#1: R _____</td> <td>C _____</td> <td>S _____</td> <td>PUMP#1: L1 _____</td> <td>L2 _____</td> <td>L3 _____</td> </tr> <tr> <td>PUMP#2: R _____</td> <td>C _____</td> <td>S _____</td> <td>PUMP#2: L1 _____</td> <td>L2 _____</td> <td>L3 _____</td> </tr> <tr> <td>PUMP#3: R _____</td> <td>C _____</td> <td>S _____</td> <td>PUMP#3: L1 _____</td> <td>L2 _____</td> <td>L3 _____</td> </tr> <tr> <td>PUMP#4: R _____</td> <td>C _____</td> <td>S _____</td> <td>PUMP#4: L1 _____</td> <td>L2 _____</td> <td>L3 _____</td> </tr> </table>	SINGLE PHASE			3 PHASE			PUMP#1: R _____	C _____	S _____	PUMP#1: L1 _____	L2 _____	L3 _____	PUMP#2: R _____	C _____	S _____	PUMP#2: L1 _____	L2 _____	L3 _____	PUMP#3: R _____	C _____	S _____	PUMP#3: L1 _____	L2 _____	L3 _____	PUMP#4: R _____	C _____	S _____	PUMP#4: L1 _____	L2 _____	L3 _____	☐
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MEG CHECK PUMPS: #1 _____ #2 _____ #3 _____ #4 _____	☐																														
WET WELL CONDITION:																															

YEARLY CHECK POINTS – DATE LAST COMPLETED

PULL PUMPS AND CHECK SEAL OIL	☐
CHANGE OIL & PRESSURE CHECK	☐
CHECK IMPELLER CLEARANCE AND ADJUST TO OEM SPECIFICATIONS	☐
☐ FACE ☐ RADIAL SPEC _____	☐
CHECK FOR DETERIORATING PARTS	☐

What If My Pump Needs Repair

- ▶ Difference between a repair and an overhaul
 - A repair simply replaces whatever component or components failed.
 - An overhaul begins with a complete inspection and restores the machine back to OEM standards or better
- 

Procedure For Refurbishing a Pump

- ▶ Disassemble, clean, sandblast all components
- ▶ Write complete disassembly report
 - identify all components required to restore the pump to OEM specs



Procedure For Refurbishing a Pump

- ▶ Analyze motor
 - Surge Test
 - Megger Test
 - Winding resistance Test
 - Visual inspection
 - Bake stator to remove any moisture



Procedure For Refurbishing a Pump

- ▶ All wear parts are replaced with new
 - Seals
 - Bearings
 - O-rings
 - Impeller/wear ring (if required)
- ▶ Damaged components can be restored by:
 - Welding, coating, plating machining, grinding, etc.



Procedure For Refurbishing a Pump

- ▶ Rotating assembly is constructed with all components
 - Total Indicator Runout is verified to $<.003''$
 - Certified balance to 4W/N
- ▶ Entire pump is assembled
 - Pressure tested
 - Test run for amp draw, phase balance, vibration
 - Painted and preserved for shipping



Procedure For Refurbishing a Pump

- ▶ Optional procedures for difficult applications:
 - Ceramic coating on impellers
 - Tungsten Carbide coating on impellers, wear rings, volutes
 - Chrome plating on shafts

Summary

- ▶ Preventative maintenance
 - Extends the life of your pumps
 - Sustains the efficiency of your pumps
 - Identifies potential problems before the point of catastrophic failure
 - Protects your investment
- 

Summary

▶ Repair

- Make sure the shop you choose has all the necessary tools, procedures and qualifications
- A properly refurbished pump will perform as new and provide many more years of trouble-free operation



Questions?

Thank YOU!