



## Pump Maintenance - Repair

Brian Trombly  
Mo Droppers  
Cummins Bridgeway, Gaylord, Mi



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### The basic centrifugal pump consists of two main elements:

- 1. The rotating element – which includes an impeller and a shaft.
- 2. The stationary element – which includes a casing, stuffing box (or seal cavity) and bearings.



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### Pump Reliability Factors

#### ~ Sizing factors:

- A 100 HP electric motor on a 50hp load will work and run smooth and cool and only use 50 HP of energy. (Still not recommended).
- A 100 GPM pump on a 50 GPM demand is a bad bet. Pump will run rough, hot and waste energy. Pumps need to be sized based on pressure, flow-rate and head. The wrong pump for the job will cost you \$\$\$ in energy and maintenance cost.



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## Pump Reliability Factors

### ~ Installation factors:

- Bases, sole plates, foundations
- Shaft alignment
- Piping
- Environmental effects on application

Even the right pump for the job will fail if not installed properly.



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## Preventive Maintenance

### ~ Primary Goals:

- Prevent Breakdowns
- Maintain Adequate Pumping Capacity

### ~ Secondary Goals:

- Lower cost to operate
- Prolonged equipment life



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## Preventive Maintenance

### ~ Achieve your goals:

- Create a preventive maintenance program; follow manufacturers recommendations
- Maintain good inspection and maintenance records
- Be familiar with your pump systems
  - Review and keep Installation and operation manuals; including, pump performance curves
  - Review and keep parts and maintenance manuals



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### Preventive Maintenance

- Recommended to check the following:
  - **Weekly**
    - Record suction/discharge gauge readings
    - Record elapsed time meter readings
    - Record amp readings if possible
  - **Monthly**
    - Exercise valves
  - **Semiannually**
    - Check impeller clearance if applicable
    - Check oil levels in seal and motor housing
  - **Annually**
    - Change oil in seal and motor housing if applicable
    - Test alarms for proper operation
    - Perform basic electrical tests



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### Preventive Maintenance

- ~ **Maintain other equipment**
- Include all pump system equipment when performing preventive maintenance and inspections
  - Controls
  - Isolation valves
  - Check valves
  - Pressure control valves
  - Gauges
  - Compressors
  - Etc....



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### Preventive Maintenance

- ~ **Parts inventory:**
- Identify critical parts and purchase spares; especially, if parts are special order with longer lead times.
  - Bearings
  - Seals
  - Gaskets, O-rings
  - Power cords
  - Impellers
  - Etc.....



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## Preventive Maintenance

### ~ Spare pump inventory:

- Recommended to inventory back up pumps for critical installations.
  - Allows for limited downtime when failures occur
  - Allows for lower repair cost. Pump repairs, preventive maintenance and shipping charges are lower when "emergency" work does not need to be performed



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## Troubleshooting

### ▪ Noisy Operation

- Mechanical noise issues:
  - Bad Bearings
  - Debris in impeller
  - Impeller wear, balance, etc...
  - Wear rings
  - Seal plate
  - Coupling misalignment
  - Belts and sheaves



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## Troubleshooting

### ▪ Noisy Operation

- Hydraulic noise issues:
  - Cavitation
  - Vortexing
  - Surging or water hammer
  - Excessive velocity (through valves and fittings)



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## Pump Reliability Factors

### ~ Cavitation:

- Cavitation is a damaging force in fluid systems.
  - Vibration energy damages bearings and seals.
  - Erosion damages impellers pump housings.

Cavitation normally occurs at the suction of the pump, when suction pressure is too low and allows vapor bubbles to form as the fluid enters the pump.



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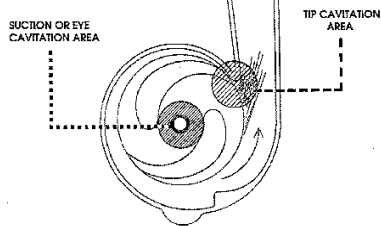
## There are two types of cavitation

### ~ Suction Cavitation

Occurs at the eye of the impeller

### ~ Discharge Cavitation

Occurs at tip of the impeller



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## Troubleshooting

### ▪ Low Flow

#### – Possible Causes for low flow:

- Backward rotation
- Debris in impeller
- Closed discharge valve
- Open bypass valve
- Clogged suction
- Worn impeller, wear ring, wear plate
- Excessive clearances
- Vortexing



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## Troubleshooting

### ▪ Low Pressure

#### – Possible Causes for low pressure:

- Wrong speed
- Clogged suction
- Suction line air leak
- Worn impeller, wear ring, Wear plate



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## Troubleshooting

### ▪ Electrical fault or trip

#### – Possible Causes for electrical fault:

- Seal failure
- Pump motor (moisture)
- Pump motor (thermal)
- Pump motor overload
- Supply power issue
  - Phase loss
  - Phase reversal
  - Under voltage
  - Over voltage



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## ELECTRICAL SAFETY

### ▪ Electrical testing should only be performed by trained and authorized personnel.

- Apparatus being tested should be completely disconnected and isolated from it's line voltage source.
- Follow lock-out, tag-out procedures.
- Discharge capacitance in equipment by short circuiting or grounding it.



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## Electrical Testing

- Motor winding Insulation resistance test
  - Megohm insulation tester required (megger)
    - Checking for leakage to ground due to insulation failure, contamination or moisture.
- Motor winding continuity test
  - Ohm meter required (multi-meter recommended)
    - Looking for balanced resistance between all legs of a 3 phase motor. Single phase motor testing procedures will be different due to separate start and run windings. Each winding will need to be isolated and tested separately; with any capacitors out of the circuit.



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## Meter Examples



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## Impeller with cavitation damage



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QUESTIONS ?

**THANK YOU !**



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