



Suggested Actions

Establish a pumping system maintenance program that includes the following:

- Preventive actions
- Predictive actions
- Periodic efficiency testing.

Resources

DOE and Hydraulic Institute, *Improving Pumping System Performance: A Sourcebook for Industry*.

Hydraulic Institute—HI is a non-profit industry association for pump and pump system manufacturers; it provides product standards and a forum for the exchange of industry information for management decision-making. In addition to the ANSI/HI pump standards, HI has a variety of energy-related resources for pump users and specifiers, including training, guidebooks, and more. For more information, visit www.pumps.org, www.pumplearning.org, and www.pumpsystemsmatter.org.

U.S. Department of Energy—DOE's Pumping System Assessment Tool (PSAT) can help you assess pumping system efficiency and estimate energy and cost savings. PSAT uses pump performance data from Hydraulic Institute standards and motor performance data from the MotorMaster+ database.

Visit the BestPractices Web site at www.eere.energy.gov/bestpractices for more information on PSAT and for upcoming training in improving pumping system performance and in becoming a qualified pumping system specialist.

Maintain Pumping Systems Effectively

Effective pump maintenance allows industrial plants to keep pumps operating well, to detect problems in time to schedule repairs, and to avoid early pump failures. Regular maintenance also reveals deteriorations in efficiency and capacity, which can occur long before a pump fails. Wear ring and rotor erosions, for example, can be costly problems that reduce wire-to-water efficiency by 10% or more.

The amount of attention given to maintenance depends on how important a system is to a plant's operations. Downtime can be expensive when it affects critical processes. Most maintenance activities can be classified as either preventive or predictive. Preventive maintenance addresses routine system needs such as lubrication, periodic adjustments, and removal of contaminants. Predictive maintenance focuses on tests and inspections that detect deteriorating conditions.

Preventive Actions

Preventive maintenance activities include coupling alignment, lubrication, and seal maintenance and replacement. Mechanical seals must be inspected periodically to ensure that either there is no leakage or that leakage is within specifications. Mechanical seals that leak excessively usually must be replaced. A certain amount of leakage is required, however, to lubricate and cool the packing seals. But the packing gland needs to be adjusted if the leakage exceeds the manufacturer's specifications. The packing gland must be replaced if it has to be tightened excessively to control leakage. Overtightening causes unnecessary wear on the shaft or its wear sleeve and increases electric power use. Routine maintenance of pump motors, such as proper lubrication and cleaning, is also vital.

Predictive Actions

Predictive maintenance helps minimize unplanned equipment outages. Sometimes called "condition assessment" or "condition monitoring," it has become easier with modern testing methods and equipment. The following methods apply to pumping systems:

Vibration analysis. Trending vibration amplitude and frequency can detect an impending bearing failure. It can also reveal voltage and mechanical imbalances that could be caused by impeller erosion or coupling problems. Changes in vibration over time are more meaningful than a single "snapshot" of the vibration spectrum.

Motor current signature analysis. Sometimes called "dynamic analysis," this reveals deteriorating insulation, rotor bar damage, electrical system unbalance, and harmonics. It can also pick up system problems such as malfunctioning control valves that cause flow rate disturbances. Tracking the signature over time is more valuable than a single snapshot.

Lubrication oil analysis. This applies only to large, oil-lubricated pumps, and is an expensive procedure. Oil analysis can detect bearing problems caused by metal particles or chemical changes that result from overheating, and seal problems caused by pumped fluid in the oil. It also provides guidance on proper oil-change intervals.



Periodic efficiency testing. Testing the wire-to-water efficiency and keeping records to spot trends is useful.

Finally, see the checklist of maintenance items below, which can be tailored for many kinds of systems, applications, and facilities.

Basic Maintenance Checklist

- **Packing.** Check for leakage and adjust according to the instructions of the pump and packing manufacturers. Allowable leakage is usually 2 to 60 drops per minute. Add packing rings or, if necessary, replace all the packing.
- **Mechanical Seals.** Check for leakage. If leakage exceeds the manufacturer's specifications, replace the seal.
- **Bearings.** Determine the condition of the bearing by listening for noises that indicate excessive wear, measuring the bearing's operating temperature, and using a predictive maintenance technique such as vibration analysis or oil analysis. Lubricate bearings according to the pump manufacturer's instructions; replace them if necessary.
- **Motor/Pump Alignment.** Determine if motor/pump alignment is within the service limits of the pump.
- **Motor Condition.** Check the integrity of motor winding insulation. These tests usually measure insulation resistance at a certain voltage or the rate at which an applied voltage decays across the insulation. A vibration analysis can also indicate certain conditions within motor windings and lead to early detection of developing problems.

References

Extend Your Motor's Operating Life, DOE Motor Systems Tip Sheet, 2005.

Test for Pumping System Efficiency, DOE Pumping Systems Tip Sheet, 2005.

About DOE's Industrial Technologies Program

The Industrial Technologies Program, through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. The Industrial Technologies Program is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

The Industrial Technologies Program encourages industry-wide efforts to boost resource productivity through a strategy called Industries of the Future (IOF). IOF focuses on the following eight energy and resource intensive industries:

- Aluminum
- Forest Products
- Metal Casting
- Petroleum
- Chemicals
- Glass
- Mining
- Steel

The Industrial Technologies Program and its BestPractices activities offer a wide variety of resources to industrial partners that cover motor, steam, compressed air, and process heating systems. For example, BestPractices software can help you decide whether to replace or rewind motors (MotorMaster+), assess the efficiency of pumping systems (PSAT), compressed air systems (AirMaster+), steam systems (Steam Scoping Tool), or determine optimal insulation thickness for pipes and pressure vessels (3E Plus). Training is available to help you or your staff learn how to use these software programs and learn more about industrial systems. Workshops are held around the country on topics such as "Capturing the Value of Steam Efficiency," "Fundamentals and Advanced Management of Compressed Air Systems," and "Motor System Management." Available technical publications range from case studies and tip sheets to sourcebooks and market assessments. The Energy Matters newsletter, for example, provides timely articles and information on comprehensive energy systems for industry. You can access these resources and more by visiting the BestPractices Web site at www.eere.energy.gov/industry/bestpractices or by contacting the EERE Information Center at 877-337-3463 or via email at www.eere.energy.gov/informationcenter/.

BestPractices is part of the Industrial Technologies Program Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together emerging technologies and best energy-management practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

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