

Equipment condition assessment is fundamental to equipment reliability and maintenance and to equipment asset management. The predictive maintenance technologies of vibration analysis, infrared thermography, oil analysis, motor circuit analysis, and ultrasound detection get most of the attention. However, there is a wider spectrum of nondestructive testing (NDT) techniques that can be used to keep tabs on equipment condition.

Some NDT techniques can be used in a time-based program to monitor equipment components; others are employed for examining suspected failures identified by other means or as a check of the condition of critical components when they are returned to service after a maintenance intervention.

### Impediments to technology use

When suppliers of NDT products and services were asked about the major impediments companies face when considering use of nondestructive testing technologies, answers centered around people, equipment, and money.

"Personnel qualifications" was the reply from William Blum of NDT Consulting Group, and Kathie Green of Magaflux, a division of ITW, said "environmental issues and lack of training."

Some noted the perceived difficulty of understanding and operating equipment, and suggested equipment with more user friendly interfaces. Also, it was suggested that more economical systems and products would lessen the impact of expensive systems.

To combat the cost issue, Betsy Blazar of the American Society for Nondestructive Testing urged technicians to stress "risk reduction, downtime reduction and expense exposure, product integrity, and safety" with management.

Norman Eisenberg of Thermostest Inc. advised staffers to "be persistent" if there are budgeting problems and people are too busy to give them time to demonstrate what can be done with these technologies.

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Alan Bandes of UE Systems defined the impediments as "a need for training and understanding of the technologies as well as where, when, and how to use each type of technology and getting management committed to supporting a comprehensive condition monitoring program." His suggested solutions were to "attend courses and conferences, consult with colleagues, and plan ahead. Then work on educating management to understand the impact the program will have on the company's bottom line."

### Resources for reference

The accompanying guide is presented as a foundation for building an NDT reference file of appropriate contacts and resources for your organization.

The guide is arranged in five sections: NDT for mechanical equipment, NDT for electrical systems, ultrasonic inspection for both electrical and mechanical equipment, NDT training, and NDT services. The technology supplier guide lists companies and indicates their product or service offerings. The company directory lists specific information about these suppliers.

The American Society for Nondestructive Testing (ASNT) defines NDT as the examination of an object, material, or system with technology that does not affect the object's future usefulness. It is also noted that NDT includes many methods that can detect internal or external imperfections; determine structure, composition, or material properties; and measure geometric characteristics.

### NDT for mechanical equipment

- Eddy current testing induces an electromagnetic field into nonferromagnetic tubes or parts and detects changes in signal that indicate discontinuities.
- Magnetic flux leakage inspection of ferrous tubes induces a magnetic field and detects magnetic flux lines "leaking" from a discontinuity in the magnetized area.
- Remote field or transmission eddy current uses a transmitter and receiver coil arrangement that can provide qualitative reports on nonferrous tube wall loss as a percent of nominal wall thickness.
- Magnetic particle inspection uses magnetic particles spread on the surface of ferromagnetic parts to reveal surface cracks transverse to an applied magnetic field. Particles can be coated with a fluorescent to render them more visible under ultraviolet light.
- Liquid penetrant inspection, for magnetic or nonmagnetic parts, reveals discontinuities open to the surface by indicator stains formed by capillary action of liquid dye drawn from cracks to a developer spread on the part's surface.

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- Remote visual inspection techniques use optics, often in prehensile fiberoptic instruments, to give an inspector a close-up view of interior surfaces through access openings without disassembling the equipment.
- Radiography provides views of parts similar to an x-ray photograph or real-time fluoroscopy. The thickness and type of material can be revealed with various techniques and exposure sources.

### NDT for electrical systems

- Motor current analysis techniques use a current transformer and datalogger to collect motor current spectra that can be analyzed for indication of defects associated with the rotating element.
- Motor circuit analysis instruments measure resistance in conductor path, inductance, capacitance to ground, and resistance to ground off-line using closely controlled ac and dc signals to detect a variety of motor problems.
- Conductor path resistance detection techniques detect "hot spots" or mismatched circuit conditions using milliohmmeter testing.
- Insulation testing instruments or high-potential testing devices use off-line application of high voltage to evaluate the integrity of ground insulation systems.
- Ground resistance testers measure the leakage current flowing to and through an insulation system to ground under the pressure of a known voltage. The results are returned in (meg) ohms.
- Surge comparison testers insert controlled electrical pulses into an off-line motor and examine return pulses to derive information about the condition of motor windings.

### Ultrasonic inspection

- Airborne ultrasound detection instruments can be used to identify leaks, arcing, corona discharge, bearing noise, and other problems in mechanical and electrical equipment.
- Pulse echo technology detects flaws or measures thickness by measuring the elapsed time between transmission of an ultrasonic pulse into the material to be tested and the receipt of reflected echo.