

APPLICATION NOTE

Preventive maintenance is more accessible than ever

The high cost of unplanned downtime is not news to anyone who maintains or manages a manufacturing facility. Lost productivity, wasted output, and delayed deliveries are just a few of the costly results. That's why more and more facilities are looking at incorporating some form of preventive maintenance (PM) program. Measuring key indicators of critical equipment on a regular basis can help you discover potential failures before they happen. That can reduce the risk of downtime significantly and can also keep systems operating at optimal performance levels.

In the past, companies have been reluctant to start a formal preventive maintenance system due to the cost, skills, and management layer required to develop the maintenance model, track the data, and train staff on the new approach. The good news is that advances in test and measurement technology, connectivity, and data management software, including the Fluke Connect software and wireless test tools, have reduced the complexity and cost of a preventive maintenance program, putting it within reach of most organizations.

Key tools for preventive maintenance

To be successful a PM program requires the right test tools to accurately measure key indicators, reliable data storage, and analytical tools that can root out the causes of emerging failures. If you measure electrical, thermal, vibration, and insulation resistance you should get a pretty good idea of your system health. Each of those measurements provides information about different aspects of the system, while at the same time overlapping to produce a more comprehensive picture of your entire system.

Vibration screening catches problems early

Vibration testing is very sensitive to subtle changes in equipment operation and can detect an issue before components are damaged. Excess vibration can indicate all kinds of internal issues, such as bearing failures, imbalance, misalignment, and looseness that shorten equipment life. When machinery is misaligned, friction starts to eat up both the hardware and the electrical supply. Handheld vibration meters and testers make vibration testing much easier and quicker than it used to be. They include a database of good/bad readings to provide a frame of reference and dynamically compare vibration signals to give you a diagnosis on the spot.

For example, the Fluke 805 FC Vibration Meter provides quantifiable results of bearing condition, overall vibration, and IR temperature. It measures overall vibration in the low frequency range and identifies bearing faults in the high frequency range. In addition to providing a number, the Fluke 805 FC provides a four-level scale for both overall vibration and bearing condition.



What goes into a PM program?

The short answer is that it depends on the type of facility, but there are some general components that are common to most PM programs, including identifying:

- The critical equipment in a plant based on the cost of the equipment, cost of downtime, and/or cost of ruined output
- Data measurements for that equipment that are early indicators of degrading performance or product quality
- A schedule for equipment inspection
- A standard process for taking, comparing, and storing measurement data
- A process for acting upon early warning signs

This allows users, who may not understand the significance of the measurement numbers, to determine the severity of the problem. They can also upload data to a PC (or to the Fluke Cloud with Fluke Connect) for trending analysis to get a clear view of changing bearing condition and deteriorating health of the machine. With the 805 FC and Fluke Connect smartphone app, vibration screening results can also be shared in real time with experts or colleagues for instant authorization of next steps.

Thermal Imaging sets the stage

An infrared camera (also called a thermal imager) can provide an infrared view of your entire electro-mechanical system, capturing the temperatures of both critical components and the entire integrated unit. The dual images are accurately aligned, making it much easier to spot trouble areas.

Using an infrared camera to scan a broad area first, such as the bearing housings on motors, the switches in circuit breaker panels, or the wiring connections of equipment, will reveal differences in temperature that help you zero in on problem areas. High temperatures alone don't necessarily mean trouble. However, if you see a component with a higher temperature than those around it, or you see the temperature of one component rise rapidly, you have good reason to look closer.

A coupling that is running warm could indicate misalignment. A hot spot at a connection point could mean a bad or loose connection. Abnormal heating on the electrical supply could mean a phase imbalance. In addition to helping you find a problem, an infrared scan can help you build a list of components to measure with other test tools such as a vibration tester or digital multimeter (DMM).

Insulation testing detects potential failures

Insulation problems on motors and drives are usually caused by excessive heat, improper installation, environmental contamination, mechanical stress, or age. Regular insulation testing can be combined with regular motor maintenance, to identify degradation.

An insulation multimeter like the Fluke 1587 FC combines insulation resistance testing with all of the most common digital multimeter functions making it the go-to tool for maintaining and troubleshooting motors. Checking motor windings, and line and load conductors at regular intervals, can help you detect deterioration before the motor fails so you can more accurately predict when to replace or restore the windings.

Checklist for setting up a smart-tool preventive maintenance program

- Identify the most important pieces of equipment
- Identify critical measurement and inspection points. Common practices include:
 - Noncontact infrared: scanning the bearing housings on motors, switches in circuit breaker panels, and wiring connections at important equipment
 - Taking good/bad vibration readings at each bearing location along the drivetrain while the machine is running in a steady state and at normal operating temperature
 - Making quick voltage and current checks, against the balance and loading thresholds
- Adopt a smartphone maintenance app with cloud-based data management
- Set up equipment logs for each piece of equipment, with
 - A baseline for each type of measurement (thermal, electrical, vibration)
 - Frequency of inspection (ranges from 3 to 12 months)
 - Text or audio notes, with pictures if helpful, outlining any special setup needed to get an accurate comparison (how much load, etc.)
- Train the team on the app, equipment log, and how to use it during inspection (scheduled vs. troubleshooting)
- Implement quick periodic inspections using handheld tools such as multimeters, IR thermometers, and vibration pens that are designed for non-specialist technicians



Benefits of connected workflow

The Fluke Connect® platform—wireless tools, smartphone app, asset management database and analysis software—provides immediate benefits to technicians and managers:

- **Safety** – leave wireless test tools in potentially dangerous environments, not technicians. For instance, disconnect power to a motor following standard safety procedures, then connect current meters to the power lines. Reenergize the motor, exposing only tools to electrical hazards or moving machinery. Read, record and store test results to the cloud while the technician is a safe distance away.
- **Accuracy** – wireless transmission and storage of data replaces manual recording and transcription. Technician's job is faster and more accurate as transcription errors are eliminated.
- **Preventive maintenance** – with data stored in the cloud, test results for machinery can be reviewed and compared against baselines or previous inspections to track any changes. Technicians or managers can then identify potentially damaging trends before failure occurs.
- **Speed and efficiency** – no need to stay alongside equipment waiting for intermittent faults to occur. Instead, wireless tools log events while the technician is performing other tasks or not on shift. Even better, measurement data from several tools can be viewed and correlated at the same time, helping spot related events.

For more information on connected workflows, visit flukeconnect.com

Electrical testing

DMMs and clamp meters take care of the standard voltage and amp measurements to help you detect a wide range of electrical problems that can contribute to a potential failure. Current unbalance is a common cause of motor overheating and can indicate power delivery problems or insulation resistance breakdown inside the motor windings. A voltage unbalance, of greater than two percent can also reduce equipment performance and cause premature failure.

A digital multimeter (Fluke 3000 FC DMM) can also check resistance across most connections. High resistance readings can signal degraded connections, which can reduce supply voltage, and cause nuisance tripping, and potential equipment failure. High resolution DMMs can also measure resistance across relay and circuit breaker contacts to detect degrading contacts.

Turning measurements into assets

Once all of these measurements are taken there is still the matter of how to manage that information to keep your equipment and systems running at their best. All of the

tools mentioned here can record and store measurements, and wirelessly transfer those measurements to the Fluke Connect app and save to the Fluke Cloud for analysis or historical records.

Fluke offers more than 40 Fluke Connect-enabled handheld tools and remote sensors that you can use to collect measurements wirelessly and review input from multiple modules simultaneously on a smartphone. You can also store measurements and images for each piece of equipment in a secure central database that can be accessed only by authorized team members. That way techs can access all the measurements and thermal images related to an asset on their smartphones from the field, compare them to the latest measurements, and determine whether there's a trend-to-the-worse in performance indicators.

Techs already know how to use a smartphone and the test tools, so training isn't an issue. Fluke Connect also supports knowledge sharing—among individuals and between individuals and the organization—which can expedite preventive maintenance, reduce unplanned downtime, and extend equipment life, enhancing your operation as a whole.

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