In the fight against downtime and non-compliance, plant maintenance professionals face an ever increasing array of responsibilities. First and foremost, they need to keep many varying types of equipment running, and running at peak performance rate. If a system is running at less than 100 percent optimum performance, then people are wasting time and, as the saying goes, “Time is Money”.

If a piece of machinery is running at less than 100 percent of manufacturer specifications, then it will probably wear down prematurely. That too wastes money and drains resources. The equipment has to be running safely so as to minimize the risk of injury on the job. Injuries result in lost productivity and cost a lot of money. The equipment needs to be running efficiently so as to not waste energy. Wasted energy is wasted money and is harming the environment.

Now here’s the kicker... as if being held accountable for all the aforementioned is not enough, the plant maintenance professional has to do it all while minimizing the disruption of others. If the line has to be brought down, it has to be planned well in advance so contingencies can be put in place to keep the workforce productive.
Repairing devices as they break down is no longer an acceptable business practice. Maintenance has become preventive and scheduled maintenance. More than ever, plant maintenance professionals must rely on their test equipment to assist them in getting the job done quickly, safely and with minimum disruption.

THE LINEUP

Proximity Voltage Detectors
A basic safety tool used to simply detect whether or not voltage is present. Before performing any electrical work, establishing whether a circuit is live is a basic practice. The “Test Before Touch” principal is taught to future electricians on day 1 of their training. The typical voltage detector will flash and emit an audible warning if voltage is present. Proximity voltage detectors do have limitations. They detect AC voltage only. They will not indicate voltage inside grounded enclosures, shielded cables and cables that are wet internally. They may also be incapable of indicating the presence of voltage if a cable is partially buried or if the operator is isolated from ground. Manufacturers have added features such as a current detector or a flashlight to make the detector a more versatile tool.

The Wiggy
The venerable solenoid type tester, known as a “Wiggy”, is a staple in every electrician’s tool box. The Wiggy is the perfect tool for day to day ‘go/no go’ line voltage testing. The operation of the meter is very simple since there are no switches to inadvertently set incorrectly. And since the presence of power creates a perceptible vibration and an audible alert, there is no need to read a gauge or scale. Solenoid voltmeters are extremely rugged and are not very susceptible to damage.
Phase Rotation Detector
A required tool anywhere three phase power is used to feed power to motors and drives. The rotation tester is used to determine phase rotation direction and to identify the correct connections before wiring in a new motor.

Multimeter and Clamp Meter
When it comes to taking basic voltage and current measurements, look no further than the duo formed by the digital multimeter and the current clamp meter. Long a staple in the toolbox, they still are called upon to get the job done. There isn’t a plant maintenance professional that would be caught on the job without them. Great multi purpose tools, they can also be used to check resistance, capacitance, frequency and continuity. Manufacturers have also added features such as datalogging, voltage detection and infrared thermometers to further expand their capabilities.

Insulation Testers
Electric conductors are insulated with protective sheathing not only to prevent electric shock but also to prevent current loss upstream of the intended point of use. If electric components are not provided with the proper amount of voltage and current they will operate inefficiently and fail prematurely. As insulation fails, the amount of current loss increases. Common causes of insulation failure include excessive heat or cold, moisture, dirt, corrosive gases, oils and vibration. Insulation testers, or megohmmeters, are an extremely cost-effective way to avert downtime associated with failure of motors, transformers, generators, cables, wires and other insulated conductors as a result of bad or deteriorating insulation.
Whether it is a new equipment installation or an older, operating system, insulation testing provides the baseline data for comparison to future testing results. Environmental conditions such as temperature and humidity that can be a challenge to control contribute to the deterioration of insulation. As a result, insulation test readings are relatively meaningless without some value or specification to compare them to. Keeping a record of test results over time can identify trends that are indicative of insulation breakdown. There are several manufacturers of affordable and accurate insulation testers. They should also be considered a must for the preventative maintenance tool box.

**Clamp-On Ground Resistance Meter**

Whether called “earth” or “ground” a critical element of any power system is grounding. A failed ground becomes a safety hazard and since it no longer provides a reference, testing becomes all but impossible. Any preventive maintenance schedule should include periodic ground check. The clamp-on ground resistance testing technique gives the user the ability to measure the resistance of ground conductors without having to disconnect parallel ground rods. Furthermore, this method also eliminates the need to drive auxiliary ground stakes, something that is difficult to do inside buildings. This type of measurement also offers the advantage of including the bonding to ground and the overall ground connection resistances. The clamp-on ground resistance meter is a must in the tool box of the plant maintenance professional.

**3-Phase Power Meter**

A “must have” for any person who maintains or troubleshoots three-phase power. Three-phase power quality meters help prevent and troubleshoot problems in power distribution systems. A powerful predictive maintenance tool, the three-phase power meter will help detect and prevent power quality issues before they can cause downtime and lost production time. The three-phase power meter also assists in load studies and verifies system capacity prior to the addition of new loads. Of equal importance, the power meter facilitates
energy assessments. If your company is investing in energy saving devices, the three-phase power analyzer is the tool that will give you the before and after picture you'll need to support or disapprove the investment.

Hand Held Oscilloscopes
With the ever-increasing use of computer-based systems in plant automation, the hand held oscilloscope has become a must-have for the maintenance professional. Events happen so quickly that they are impossible to see without the ability of a scope to trigger on an event. Once the waveform is captured, a multi-input (multi-channel) scope will let you easily compare waveforms. These channels can be displayed separately, simultaneously, or simultaneously with one inverted, added, or subtracted. The latest digital storage oscilloscopes now offer advanced features that have traditionally been available only in more expensive models. Bandwidth options of up to 200 MHz are now available, providing the ability to work in a broad range of applications. Displays are getting larger, thereby increasing the waveform viewing area. Also, manufacturers are now including advanced menu driven measurement features to make the job easier.

Thermal Imaging Cameras
The use of thermal imaging cameras as preventative maintenance and inspection tools has grown rapidly in the past five years. This technology is no longer limited to use by the military and security services. Applicable industries now include, but are not limited to, facilities maintenance, fire fighting, water damage restoration, mold assessment and carpet cleaning and restoration.

The technology (thermography) is based on the fact that all object’s emit infrared radiation and the amount of radiation is related to the objects temperature. As temperature increases, the amount of radiation emitted increases. Thermal imaging cameras allow the operator to see variations in temperature. Warmer objects stand out well compared to their cooler background or surroundings.
The use of thermography as part of a preventative maintenance and repair program is a proven way to identify potential areas of equipment failure and costly downtime. Thermal imagers can be used to inspect electrical panels for loose and corroded connections, scan motor control centers, pumps, compressors, and transformers for hot spots. This all adds up to the ability to identify faulty wiring, poor insulation or electrical imbalance.

Thermal imagers not only identify problem areas, they also have the ability to provide a permanent record with the thermal image and digital photograph. This information can be made a part of the preventative maintenance process by comparing images and photographs for temperature changes over time. The number of thermal imaging camera suppliers seems to increase each year bringing down the prices to reasonable levels. They should be seriously considered as an addition to the maintenance engineer’s tool box.

Infrared Thermometers

Infrared thermometers have been referred to as the poor man’s thermal imaging camera. They too can be used in a preventative maintenance program to identify hot spots in electrical systems and components by measuring surface temperature. The thermometers use a lens to focus the infrared radiation emitted from the target surface onto a detector. The detector converts the radiated energy to an electrical signal which can be displayed as a temperature. This technology allows for temperature measurements from a distance without contacting the surface being measured.
There are several other beneficial features offered by infrared thermometers: measurement of high temperatures (>1300°C) are easily achieved; it is a very fast process which saves time when many measurements must be taken; and moving targets and hazardous or physically inaccessible areas can be measured. They are also an extremely affordable tool. In the last few years the costs of infrared thermometers has dropped dramatically. Accurate thermometers that measure up to 1000°F are readily available for $100 or less making them an absolute must for any tool box.

A craftsman is only as good as his tools. When the costs of down-time are measured in the tens of thousands of dollars, it certainly makes financial sense for the plant maintenance professional to be ready for any contingency by being armed to the teeth.

About the Author: Scott Black is product specialist at Extech Instruments.