Engineer's Notebook

Battery Testing

Testing Batteries without Fuss

All-power-all-the-time computer environments demand UPS battery testing without interruption

Industries that rely on uninterruptible power supply (UPS) units increasingly rely on battery testers to keep tabs on battery supply. Some battery manufacturers have adopted battery testers as standard equipment for follow-up maintenance service.

UPS systems increasingly are installed in facilities where equipment cannot be allowed to stop operating due to a power failure or maintenance. One new way to test secondary battery performance while keeping the UPS on-line is to check its internal resistance. The internal resistance of a secondary battery is measured with low-resistance measurement techniques.

Reasons to Use a Battery Tester

Battery testers offer the following advantages to users:

1. The battery in a UPS can be checked without shutting down the power line. This is essential for UPS units used in hospitals, computing facilities, telecom companies, and financial institutions where power interruptions can be disastrous.
2. High-performance battery testers can perform battery checks and report the results without intricate operation. The latest testers feature an internal memory function that retains the measurement values and results. In some cases, more than 200 pieces of data can be stored—enough capacity to sufficiently cover one UPS unit. The data can also be printed along with statistics using a tester's printer or commercial standard printer.
3. Battery testers are easy to use. Users not familiar with measuring instruments can use battery testers with ease. Battery testers show results using a three-rank LED lamp and audible beeping if the comparison threshold values are input in advance. The three-rank lamp evaluates the battery state at either Pass, Warning or Fail. The comparison threshold values to input depend on the battery manufacturer and type.

Besides internal resistance and voltage, today's battery testers can also measure battery temperature. The operational life of a battery varies greatly depending on the environmental conditions, making it essential to measure the temperature of a battery in order to understand its state.

Secondary Battery

A secondary battery is one that can be used repeatedly after recharging and differs from primary batteries, such as manganese dry cells, that cannot be used anymore once they are discharged. Another distinction of secondary batteries from primary batteries is that secondary batteries are capable of discharging large current; as a result, they are used for equipment that requires large current. Typically secondary batteries are lead-acid batteries and nickel cadmium (Ni-Cd) batteries. However, in order to address environmental concerns and the need for batteries that can power smaller devices for longer periods for time, new nickel metal hydride (Ni-MH) and lithium ion (Li-ion) batteries were developed and put into use. These batteries are smaller, provide a large capacity, and pose little danger of polluting the environment.

Checking Battery Deterioration

There are basically two general methods for checking battery deterioration: the charging/discharging test method, and the internal-resistance measuring method. Each method has strengths and weaknesses.

The charging/discharging test method is capable of accurately measuring the discharge capacity of the battery but requires a considerable amount of time. There are two methods for conducting this type of testing: discharging a fully charged battery until it is completely discharged and discharging a fully charged battery for a few minutes and then using that information to estimate when the batter will be fully discharged

Measuring the internal resistance evaluates the deterioration of the battery on the basis of the correlation between the measured internal resistance and the discharge capacity of the battery. Research indicates a correlation between a decrease in a secondary battery's capacity and increase in its internal resistance.

Although the internal resistance of secondary batteries varies according to battery type and its capacity, the figure generally ranges from several milliohms to several hundred ohms. For secondary batteries, internal resistance is measured by applying a constant alternating current to avoid any effects from the DC voltage generated by the second battery. This method is called the ac four-terminal method and is distinguished from the DC four-terminal method in which direct current is applied.

In resistance measurement, the four-terminal method is used to measure items, such as batteries, with very low resistance. The AC four-terminal method is a popular one. The input impedance of the voltmeter is large. Therefore, practically no test current flows to the voltmeter. As a result, it is possible to measure the resistance of the subject only, with the lead resistance and the contact resistance excluded.

Although the accuracy of the measured results suffers somewhat, the internal-resistance test can be conducted very quickly, and the test equipment can be fairly small.

Voltage and Temperature Measurement

Voltage measurement is performed simultaneously with the measurement of specific gravity during maintenance for lead storage batteries and alkaline storage batteries. If the voltage is extremely low, the battery may be damaged (it may have an internal short circuit). If the voltage is high, it is possible that a charger or another battery connected in series with the battery in question could suffer damage.

Temperature measurement is important for two reasons. One: Because the internal resistance changes according to the temperature. This allows workers to use the temperature of the electrolytic solution to determine the extent of battery deterioration. The second reason is to discover damaged batteries. A battery with an internal short circuit will reveal itself by heating up when it is charged.

Material for this article contributed by Hioki USA Corp., manufacturer of the 3550 series of internal-resistance battery testers.