

MIDTRONICS

Battery Management Innovation

Battery Conductance



Industrial Battery Testing

Questions & Answers

The use of conductance technology to assess battery state of health has resulted in a series of questions about conductance testing. The following are answers to some of the most frequently asked questions:

1. *What is conductance and ohmic testing?*

Conductance describes the ability of a battery to conduct current. It is the real part of the complex admittance. Various test data have shown that at low frequencies, the conductance of a battery is an indicator of battery state-of-health showing a linear correlation to a battery's timed-discharge capacity test result. This can be used as a reliable predictor of battery end-of-life.

In simplest technical terms, Ohmic technology is based on Ohm's law, which expresses the relationship between volts, amperes and ohms in an electrical circuit. Ohm's law can be expressed as follows: Volts (E) = Amperes (I) x Ohms (R). If any two of the three values of voltage (volts), current (amperes) or Resistance (Ohms) are known, the third value can be calculated using the above expression of the law.

Thus, Ohmic technology attempts to use voltage and current to determine the resistive characteristic of a battery. Higher resistance equates to a reduced ability to produce current. This characteristic is translated into a measurement of resistance or impedance (Ohms) in some Ohmic technologies; more recent technology uses a converse measurement, called conductance.

Through years of laboratory and field-based research, conductance has been found to correlate with battery capacity as measured in a timed discharge test. Since voltage and specific gravity testing are not predictive, timed discharge testing is very time-consuming and expensive, conductance testing is a very effective and economical way of analyzing the health of your battery systems.

2. *How long has the Midtronics conductance test method been used for testing batteries?*

The original technology was developed by Motorola in the 1970s for testing automotive batteries. Today's products are manufactured under license from Motorola, and include many new patents in North America, Europe and Japan. Midtronics has been developing and manufacturing conductance testers for more than ten years, and customers include the world's major battery manufacturers, major automotive manufacturers, telecommunications providers, electric power utilities, UPS manufacturers, and organizations in a variety of other industries. Midtronics has manufactured tens of thousands of battery conductance testers under the PowerSensor™, Midtron®, and Celltron® brands, as well as various private labels. Our products are manufactured and used extensively throughout the globe, making Midtronics the world leader in battery management technology.

3. *Has conductance testing been proven and accepted by the international community?*

Yes. Extensive data has been gathered by the global telecommunications industry, battery manufacturers worldwide, international rail and transportation providers, and the electric power industry. This data has been presented to the IEEE Standards Committee, which now includes conductance testing in its draft standard for testing sealed valve-regulated batteries. Additionally, the data has also been presented to the International Lead Zinc Research Organization, the Battery Council International, and the International Telecommunications Energy Conference.

4. *What is a conductance reference value?*

A conductance reference number is a benchmark value, which is based on data collected of known good batteries. It is important to remember that a reference value provides an estimate of where the reading should be, but it is not an exact value. Trending the life of the battery using conductance, over time, is the best method.

5. *Can a test be conducted without a reference value?*

Yes. First, take the age of the batteries into consideration. If the batteries are 1-5 years old, then take a few of the highest conductance measurements and use the average of those values. If the batteries are greater than 5 years old, use the highest reading. If the batteries are less than 1 year old, the string average can be used. New batteries should read within 15% of each other. These are general guidelines. The Celltron Ultra has a "Reference Developer" built-in to help facilitate this process.

6. *How can conductance readings be used with a reference value?*

A significant number of tests on a variety of valve regulated lead acid (VRLA) batteries demonstrate that conductance is predictive of battery state-of-health. Since conductance is directly related, and very nearly linear with timed-discharge capacity, a reading of the percentage of a known conductance reference value is a reliable predictor of a capacity test result. The conductance tester gives a quantitative measurement in Mhos (or Siemens), as well as a qualitative indication (percent of reference) of a battery as related to a standard.

7. *What is the proper method of interpreting conductance?*

Trending is the preferred method. Taking a "snapshot" may not provide enough information required for warranty administration. Unlike other testing techniques that require interpretation and mathematical calculation, conductance readings can be read instantly and can be related directly to the condition of the battery

being tested. Midtronics testers also output a % of the reference with a pass/warning/fail threshold built in.

8. *Since the qualitative conductance test requires a standard, how can that standard be established?*

The most effective method for the establishment of a reference requires the performance of a timed discharge test to locate a cell or battery that performs to 100% of the rated discharge capacity. A conductance test can then be performed and a reference established. A sample of 20 or more new batteries can also be used to establish a standard. Without a set reference value, conductance testing can still be utilized to trend state of health, as batteries can be monitored through periodic conductance readings and the observation of deterioration over time.

9. *Will the battery manufacturer have reference numbers for my batteries?*

Many battery manufacturers now publish conductance reference or base-line values. If not, a specific reference value can be established during installation for a new, healthy battery. An average can also be used from a sample of batteries of the same model, manufacture date, installation date and service history as detailed in the operating guidelines and instruction manuals.

10. *What if the batteries I am testing are really old? How do I determine what to use for a reference number?*

For older batteries, combine conductance testing with a full physical inspection for any visible faults. Utilize the highest measurement as an initial benchmark and the string average as a starting point for comparison. If any batteries deviate by 30% below the highest jar, consider a discharge test to determine actual run-time.

11. *Can conductance testing be used to evaluate the quality of inter-cell connections?*

Yes. Since a conductance reading of a cell plus an inter-cell connection can easily be related to the conductance of the cell alone, conductance provides a very simple and reliable indication of the system's inter-cell connection quality.

12. *Can Midtronics conductance testers measure the condition of sealed valve-regulated batteries as well as flooded cells?*

Yes. Correlation studies have been performed on a significant number of valve regulated cells. These studies have shown that conductance test results are very predictive of battery timed discharge capacity, while voltage measurements are shown to be of little value. This data has been presented to a number of international organizations. Additionally, recent data

includes gel batteries, and flooded cells.

13. *What kinds of batteries and cells can be tested utilizing conductance?*

Typically any 2-volt to 16-volt, lead-acid, 1 to 6000 ampere-hour cells can be tested.

14. *Can a Midtronics conductance test be made while the battery is on "float" or on-line?*

Yes. The current test technology enables successful testing of batteries while on float charge. In certain cases, an excessive amount of AC ripple current can interfere with any test method. If this is the case, consider using the Celltron ULTRA, which was specifically designed for these noisy systems.

15. *How large are Midtronics conductance testers?*

All Midtronics conductance testers are hand-held portable instruments. They are built to very rugged standards, yet weigh less than 3 pounds (1 kilogram) each. The testers are easily transportable and each includes some form of protective carrying case.

16. *What is the optimal point of contact when making a conductance test?*

Making direct contact with the lead post will usually provide the most consistent and accurate test result. In order to facilitate this contact (which can be difficult depending on the battery post design), Midtronics offers a variety of battery test interfaces, including clamps and contact probes of differing sizes. Contact with stainless steel post hardware will skew test results. However, if the only access point is stainless steel, it is OK to test there. It may be helpful for the user to experiment with different battery post designs to identify which test contact location provides the best conductance result.

17. *What if I cannot test my batteries directly at the post because of physical constraints?*

If battery and cabinet construction makes testing at the post or lead strap impossible, BE CONSISTENT with every test. If you must test on the hardware, test in the same spot for every cell, every time. If you are inconsistent with your probe or clamp placement, your reading will be inconsistent as well. Typically 12-volt batteries are fairly consistent regardless of the point of contact. 2-volt jars can yield greater variance from stainless steel to the lead pad or strap.

18. What is a Kelvin Connection and why is it needed for accurate conductance measurement?

The Kelvin Connection refers to any four-point connection electrical test interface. This technique provides for both a test signal injection and detection circuit. It provides an electronic method to reduce the affect of the variable resistance of the test interface. It is used to ensure the most accurate conductance measurements possible.

19. Does battery temperature affect conductance measurement?

Yes. High temperatures make the conductance test result increase and cold temperatures have the opposite effect. However, Midtronics testers have a built in temperature compensated algorithm to prevent an error due to low or high temperature. Most battery performance data is calculated at an optimal battery operating temperature of 77° Fahrenheit (25° Celsius). An Infrared Temperature Sensor is a standard component with the complete Celltron test kit to accurately determine battery temperature and is also available from Midtronics as an accessory.

20. Can the data collected by the Celltron be manipulated by PC?

Yes. Midtronics offers a software program to facilitate the downloading and manipulation of data collected with the Celltron. Data is presented in a graphical format and can be utilized for trend analysis as well as historical archiving. An infrared strip printer is also available for on-site printing and record keeping.

21. Is there a formula to calculated conductance using internal resistance/voltage/amp-hours?

No, they cannot be directly calculated.

and display a good or bad decision. These batteries are commonly used in automotive applications. Midtronics is the standard in automotive dealerships & battery retailers throughout the world.

23. Can I test the entire 24, 36, 48,120, 220/240, or 600 volt system?

No. The Celltron is designed to test batteries/cells for lead/acid batteries with anywhere from 1 to 8 cells. That is a nominal 2-volts up to a nominal 16-volts. The Midtron or SecurePower will test either 6-volt or 12-volt batteries only. Midtronics testers will test any batteries as long as the system can be tested at the 12-volt level or less. The system voltage is not as relevant as is the lowest battery terminal voltage that can be safely accessed. Some cabinet/battery designs limit or restrict access to the individual batteries. Midtronics recommends testing the smallest battery segment possible.

24. I used to test batteries with an impedance or resistance tester. Can I convert those reference numbers to conductance reference numbers?

No, they cannot be directly calculated to each other. Midtronics testers measure the conductance as an AC function. Impedance meters use a pulsed load and calculate the resistance based on the step change in the current when the load is pulsed. Conductance is also an AC test. However, conductance testers look at the "real" part of the complex admittance, called conductance or sometimes acceptance. These techniques are interrelated, but they are not identical. Additionally, different manufacturers take measurements using different frequencies.

25. Can I get longer cables with an expanded "Y" conjunction?

Yes, it is available only as an option. However, it's limited to 6 and 12-volt batteries only.

26. If I send my tester in for an upgrade or repair how long will it take?

Midtronics upgrades and repairs all products within 24-48 hours.

Product Information Questions:

22. I have batteries in my generator and vehicles that are rated in CCA. Which tester should I use?

The best tester to use is the Celltron Start or Start Plus. Both these testers output the available CCAs



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