BITE® 3
Battery Impedance Test Equipment

- **Determines health of lead-acid cells up to 2000 Ah**
- **On-line testing with Pass/Warning/Fail calculations**
- **Measures impedance, interconnection resistance and cell voltage**
- **Windows CE operating system with 32 MB of memory**
- **Measures float and ripple currents**
- **Includes ProActiv™ Database Management Software**

DESCRIPTION

The Megger BITE 3 Battery Impedance Test Equipment determines the health of lead-acid cells up to 2000 Ah by taking measurements of the most important battery parameters. The BITE 3 measures cell impedance, an internal ohmic test, cell voltage, intercell connection resistance and ripple current. And, for the first time in a battery instrument, the BITE 3 measures float current and the harmonic content of the ripple current. There is even a built-in spectrum analyzer to show the harmonic content of the ripple current. It has firmware that can be upgraded through the Internet and supports multiple languages.

The BITE 3 is one of the easiest instruments to use. Its measurements, along with temperature, specific gravity and other battery data, can provide the best basis for evaluating the overall health of batteries from terminal plate to terminal plate and to a lesser extent, the charger (from ripple current and its harmonic content.) Megger recommends that the BITE 3 be made part of a comprehensive battery maintenance program with readings taken and recorded semi-annually for flooded, lead-acid cells and quarterly for VRLA.

Unlike load-cycle testing which is expensive, non-predictive and time-consuming (but does provide actual capacity data), the BITE 3 is quick, reliable and easy to use. With a rapid test time, one person can easily, quickly and precisely measure cell and string parameters without taking the system off line. Furthermore, in as little as four keystrokes, the instrument is ready to take battery measurements (five, if the power button is included). The processor of the BITE 3 uses a Windows® CE Operating System and can store more than 1 million cells' data in any string configuration. It is menu-driven that is easy to navigate. Its unique data analysis screens provide immediate feedback on the status of cell impedance, (see Figure 1, Battery Analysis Report). The first part of the report is the numerical data. The second part is the impedance deviation graph and the third part is the impedance deviation graph but in ascending impedance order. The ascending impedance graph groups the weakest cells together for easier analysis. With the optional printer, this report can be printed by the user and left at the site as a record for future reference.

PROACTIV DATABASE MANAGEMENT SOFTWARE

The first of its kind, ProActiv is a powerful software package that organizes and analyzes battery data in an MS Access database. Used in conjunction with the BITE 3, ProActiv manages the transferred test data from the BITE 3 by organizing it according to your needs and displaying it in an extremely useful manner. Once the database is configured to your liking and test data are transferred from the BITE 3, it provides red, yellow and green bands that coincide with user entered pass, warning and failure limits. ProActiv allows the user to organize and manage battery data such as voltages, impedance, intercell connection resistance, ripple current, and specific gravity. ProActiv even has a place for IR thermographs, diagrams and graphics to store with the battery data. It is an all-encompassing battery database management tool.

Having such a tool becomes even more important when you consider the following: battery testing is crucial to ensure a battery system provides standby and emergency power to operate devices such as emergency lighting, UPS

systems, operating controls, switchgear components, protective relays and continuous process systems. Failure of a battery system within environments such as utilities, hospitals and manufacturing plants can result in operational failure of the devices connected to it. ProActiv assists the user to avoid battery failures, budget for future battery string and cell replacements, and plan battery changeouts in an orderly manner.

The BITE 3 along with ProActiv software offer the most comprehensive data analysis system to provide confident and reliable evaluation of batteries in the dc network. Together, they combine to make the most powerful battery health analyzer available on the market today.

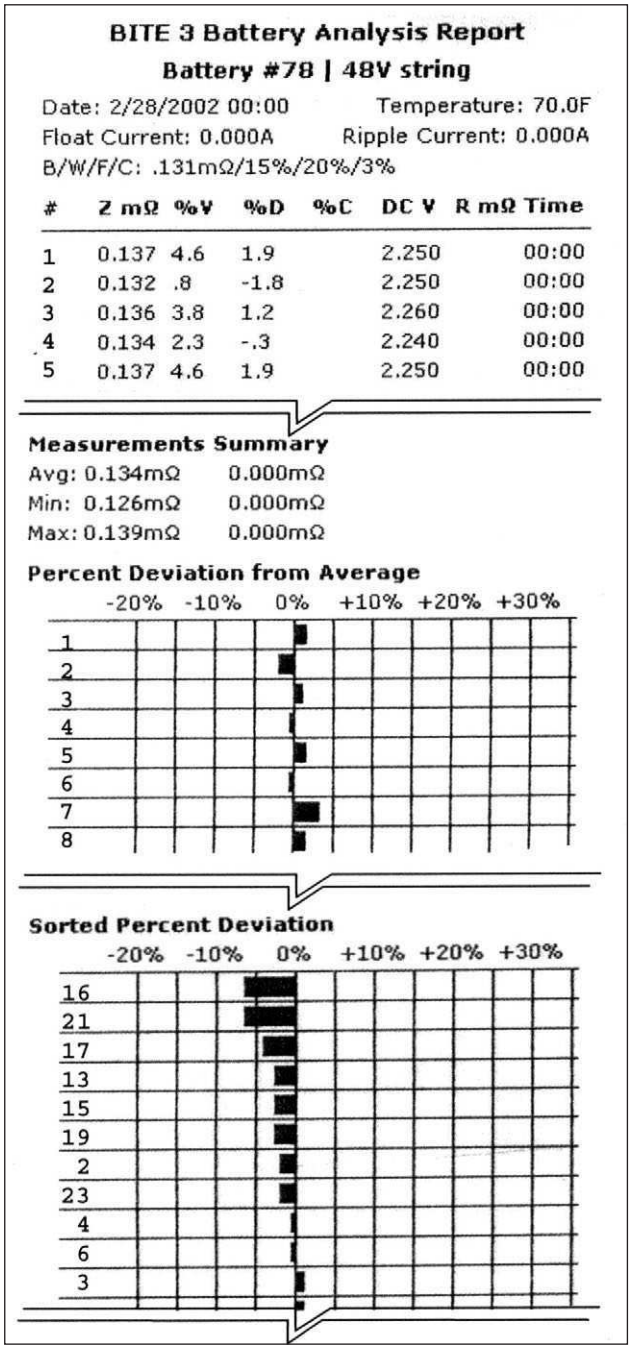

Figure 1: Battery Analysis Report

APPLICATIONS

It is known that impedance is correlated to battery capacity and there has been a long-standing question as to when a user should replace a cell. See Figure 2. Recent studies by EPRI* and other organizations indicate that when the impedance of a sealed battery increases by about 50% from its baseline value, the cell has degraded to less than about 70% capacity. BITE 3 and ProActiv allow the user to trend data and to enter baseline values for comparison purposes and to make decisions whether on-site or in the office. Both the BITE 3's impedance deviation graph and the trend graph in ProActiv clearly show the status of a cell which helps users to decide what action needs to be taken to ensure battery back up reliability based on users' criteria.

A battery's internal impedance increases as its capacity decreases due to various factors such as age, ambient temperature, discharge history, etc. The BITE 3 measures internal impedance and dc voltage for lead-acid cells up to 2000 Ah in capacity. It also measures intercell connection resistance, float current and ripple current and the harmonic content of the ripple current to provide a much better evaluation than any other single instrument. Impedance finds electrical path problems due to plate sulphation, post-seal corrosion, dry-out (loss of compression), poor intracell welds and intercell connections and more. These data let the user determine maintenance needs such as:

- Cell replacement criteria based on impedance trends
- Jumper out a cell or two
- Clean and/or retighten intercell connectors
- Shorten the maintenance interval, etc.,
- Evaluate float current and ripple current effects

Typical installations that can be tested using the BITE 3 include:

- Electrical power generation plants
- Substations — utility, railroad, industrial
- Telecommunications facilities — OSP, Wireless, POPs, MTSOs, Fiber Regens
- UPS systems — standard and cabinetized batteries
- Railroad — Signals and Communications, CTC
- Aircraft power supplies
- Marine and military

**Stationary Battery Monitoring by Internal Ohmic Measurements* EPRI, Palo Alto, CA: 2002. 1002925

FEATURES AND BENEFITS

- Calculates impedance automatically and stores results for on-site review to make immediate decisions.
- Serial connector for uploading stored data to a personal computer and to download data from ProActiv.
- Measures lead-acid cells up to 2000 Ah to test a wide range of batteries.
- On-line testing requiring no downtime and introduces less risk to battery testing compared to load testing and other techniques.
- Stores more than 1 million cells' data in any string configuration – no need to stop, download, delete and continue.

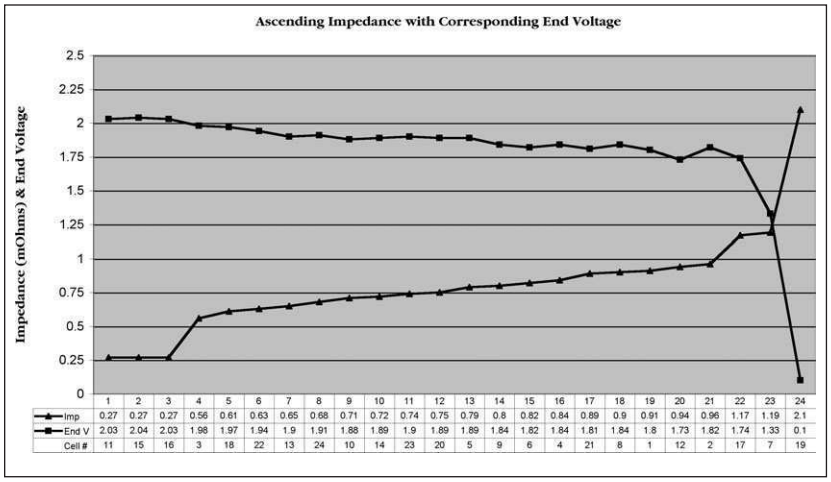

Figure 2: Ascending impedance compared to load test

- Firmware and software updates are fast and easy for ProActiv and the BITE 3 through the Internet.
- No programming skills required. ProActiv is an easy to use, fully functional battery database capable of storing as much information and data as your hard drive (or network) has memory to store.
- ProActiv has the ability to import images such as IR thermographs, diagrams or photographs. This helps to document visual inspections, string configurations, installation techniques, or other aspects of battery systems. Images and data are stored together, providing convenient and easy access.
- The BITE 3 and ProActiv accommodate multiple languages.

TEST PROCEDURE

The BITE 3 works by placing the lead set at the cell terminals to measure the voltage drop of the ac current signal applied by the instrument to the cell while it is on-line. During each measurement, impedance is calculated following Ohm's Law, displayed on the LCD, and stored. It also measures, displays and records dc voltage, interconnection (strap) resistance, float and ripple currents. Float and ripple current measurements are performed separately at the start of the test. This is because current is the same everywhere in the series connection of the string in accordance with Kirchhoff's law. All of these data together help determine the overall health of the entire battery string's electrical path from terminal plate to terminal plate and to a lesser extent, the charger (by measuring ripple current and its harmonic content).

An innovative, patent-pending measuring technique is being employed so that a clamp-on current sensor is no longer necessary. It is well-recognized that the best way to measure current is with a shunt. Since the battery has many straps, simply by determining a strap's resistance, it can be used as a shunt to determine float and ripple currents. First, while across an intercell connector, the instrument applies a current and measures the voltage drop of the intercell connector to calculate the resistance of the intercell connector. Then, it measures the strap again without the instrument current. A mathematical calculation is performed to determine float and ripple currents and the intercell connection resistance.

The optional CT can be used with short strings in parallel configurations to measure "escape current." Other techniques do not measure the current and can overstate the health of batteries in these types of configurations. By using a CT to measure the actual current in the cell being tested, better results are obtained.

ProActiv can download string header info (with baselines and limits) into the BITE 3 along with the most recent data (even if measured by a different BITE). See Figure 3. Then using the menus, simply scroll to the site and string and start taking readings. When finished, close the test and continue to the next string. At the conclusion of the test, simply download to a PC for further data analysis and long-term trending. Its versatility allows comments to be added about the string. These comments will be uploaded with the battery data. Additional comments about the site, string and/or cell such as ambient and pilot cell temperature can be stored by using the keypad to enter them.

DATA ANALYSIS

The interface between BITE 3 and ProActiv is an advanced, state-of-the-art feature that ensures that everyone has access to the latest information and data on which to base intelligent battery decisions. Not only can emergency cell replacement criteria be developed but also budgetary planning for string replacements can now become part of the fiscal planning process.

ProActiv has the ability to download site and string information and data as well as firmware updates to the BITE 3. The data downloaded into the BITE 3 gives access to the most recent data for the strings being tested during the upcoming week or month.

With previous data loaded, better analysis can be performed simply by comparing the last result to the most recent result. Any cell that changes by more than a few percent suggests that further investigation is warranted.

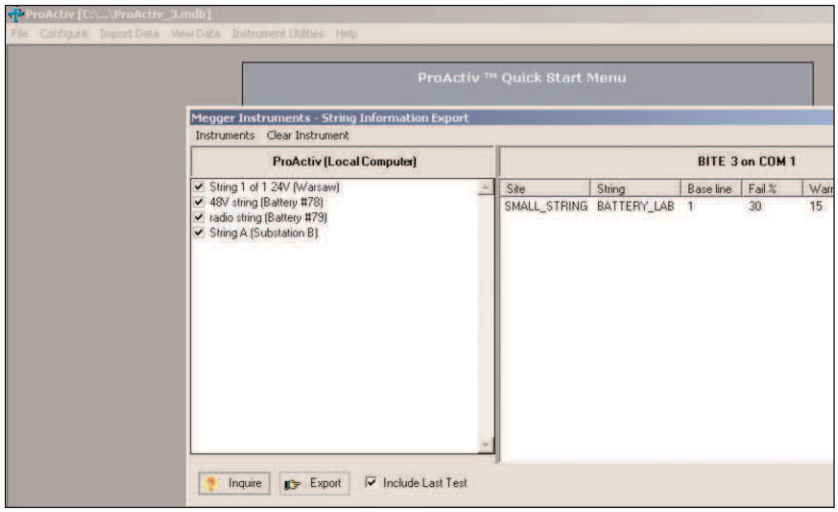

Figure 3: ProActiv to BITE 3 download screen

On-Site Interpretation

Impedance readings for individual cells can be used to compare to the string average. Individual cells with deviations of more than ±15% for flooded and ±35% for VRLA typically indicate a problem with that cell. The Battery Analysis Report clearly shows the cells that are weakest when compared to the string average and the other cells in the string. It is typically the one or two weak cells that can take the string off line. By comparing each cell to the string average, it is possible to determine which cell is the weakest in the string and by how much.

If previous data were downloaded through ProActiv, then a comparison of each cell to its previous reading (%C) can provide additional information about each cell. The Battery Analysis Report is designed to provide as much information as possible on which to make decisions while on site; decisions to ensure that the string will properly support the load.

Trending Analysis

Impedance readings can be used for trending to determine replacement criteria. Battery cell impedance values should be recorded and compared to previous readings to determine the position of the cell on the curve of impedance versus cell life. Based on experience, a variation of ±20% from baseline of a flooded lead-acid and ±50% for VRLA cells indicate significant change in the electrical path to warrant serious evaluation of the health of the battery system. Megger maintains a database of impedance values by some manufacturers and battery size/type. The BITE 3 with baseline values entered can be used as a trending tool while on site. Trending is the best method available to know the most about the health of batteries.

Configuring the ProActiv Database

There are three basic steps to setting up ProActiv:

- Configuring battery manufacturers, models, sites, and strings including baselines and limits
- Entering data from previous BITE downloads, manually or directly from the BITE 3
- Performing data analysis

ProActiv is configured by entering and setting up each battery manufacturer and battery model type used in a dc network. Optionally, other information such as sales contact names, purchase order numbers or technical support contact names may be added. Extensive model information may be entered including model type, plate count, rating, charger type, baseline impedance value as well as warning and fail percentages. Limits on other parameters can also be set such as upper and lower float voltage limits and specific gravity limits.

All of the individual battery cell information can then be configured under a specific site name, string ID, battery model, installation date, and charger information. If a cell needs to be replaced, but the same model is not available, ProActiv will allow it to be replaced with another manufacturer or model. ProActiv keeps track of cell-level information and data and this is reflected when viewing information and data for that string. In instances where there is such a large installed battery base and a string is replaced, some of the better cells may be used in other strings to replace weak cells. ProActiv allows the user to keep track of these movements.

Entering Data

Data entry is easy with the Data Entry Wizard: direct import of test data from a BITE, manual entry, via browsing for a file. When uploading from a BITE 3, ProActiv can automatically create a site and string for a new site that hasn't been prevoulsy configured in ProActiv. Digital photographs and IR thermographs can be imported also into ProActiv to document the health and condition of the battery.

Performing Data Analysis

The last step is "analyze." Using both numerical data displays and graphs, the user can see how the batteries in the dc network are performing based on the user-entered limits for each parameter. Graphs can be printed and saved as bitmaps to export to other programs for written reports. A summary report may be printed which lists all cells' data and each cell's status. The graph shown in Figure 4 clearly shows which cells are in the pass (green), warning (yellow) and fail (red) bands. It is possible to select and graph one cell and verify its entire history.

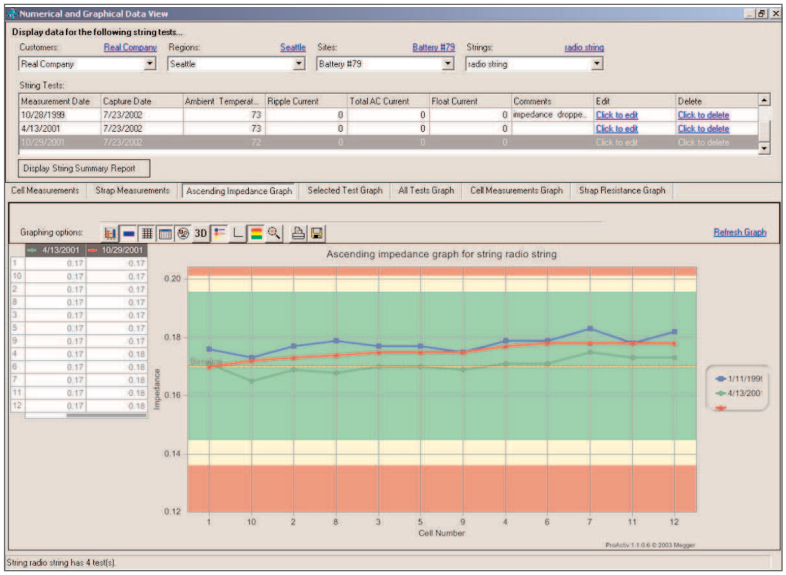

Figure 4: ProActiv ascending impedance graph with Pass/Warning/Fail bands

ACCESSORIES

The BITE 3 has many accessories that enhance its versatility. There are several lead sets, a printer, lighted probe extensions and a CT.

The lead set family contains:

- AMP/Burndy lead set for small telco batteries
- Quick Disconnect lead set for ELU systems, security systems, etc.
- Kelvin Clip lead set for other types of batteries

The CT is for measuring escape current in short strings in parallel configurations. The lighted probe extensions are ideal for measuring batteries in (dark) cabinets. The extensions eliminate the need to take the battery off line and can be tested during normal working hours, saving time and money. As with previous BITEs, it is a one person job since the batteries need not be removed from the cabinet.

SPECIFICATIONS

BITE 3 Instrument

Impedance Range and Resolution

0.05 to 1.000 mΩ	1 µΩ resolution
1 to 10.00 mΩ	10 µΩ resolution
10 to 100.0 mΩ	0.1 mΩ resolution

Voltage Range and Resolution

1 to 30 V dc across probes

1 to 8.0 V dc	1 mV resolution
8.0 to 30.00 V dc	10 mV resolution

Current Range and Resolution

0.5 — 9.99 A ac/dc	0.01 A resolution
10.0 — 99.9 A ac/dc	0.1 A resolution

Accuracy
dc voltage: ±(1% rdg +1 lsd)
ac impedance: ±(5% of rdg +1 lsd)
ac/dc current: ±(5% rdg +0.5 A)

Precision
Better than 0.5% one sigma

Source Output Current
1/2 A rms

Display
1/4 VGA LCD

Settling Time per Reading
3 seconds maximum

Battery Pack
2 to 4 hours continuous
4.8 V dc, 7000 mAh, quick charge NiMH battery pack

Temperature

Operating:	32° to 105° F (0° to +40° C)
Storage:	-5° to 130° F (-20° to +55° C)
Humidity:	20 to 90% RH, noncondensing

Safety
Designed to meet IEC 61010-1 specifications

Dimensions
8.6 x 4 x 9.5 in.
220 x 100 x 237 mm

Weight
5.7 lbs (2.6 kg)

Charger

Supply Voltage
100 to 130 V, 50/60 Hz, 14 VA
210 to 250 V, 50/60 Hz, 14 VA

Output
6.50 V dc at 1.10 A dc charging (max.)

Optional Printer

Thermal, with 4-1/4 in. (110 mm) printing width

ProActiv System Requirements

Processor
300 MHz Pentium II or better

Operating System
Windows 98
Windows Me
Windows NT 4.0 (SP6a required)
Windows 2000 (SP2 recommended)
Windows XP
Note: Windows 95 is not supported

Software
Microsoft® Internet Explorer 5 or later
Microsoft .Net Framework
Will be automatically installed by ProActiv if it is not already installed on your computer. For additional information about Microsoft .Net Framework please visit: www.microsoft.com/net

Hard Drive Space
100 MB

System Memory (RAM)
64 MB (128 MB recommended)

Other Drives
CD-ROM (used only for installation)

Communications Port
COM (used only for importing data from test equipment or to download information to the BITE 3)

Monitor/Display
True color, 800 x 600 resolution

Additional Information
For improved usage, an internet connection will make it easy to get automatic ProActiv software updates.
The user should have Microsoft Excel 9.0, or later, to import AVOLink or COMLink files into ProActiv.

ORDERING INFORMATION

Item	Cat. No.
BITE 3, 110/230 V ac, 50/60 Hz, CE-marked	BITE 3
Included Accessories	
ProActiv™ software	BI-90001
Canvas carrying case	35788
RS-232 null modem cable	33533-1
Line charger	EV6280-333
Battery	EV6121-492
Dual-point lead set	BI-10002
Tip kit	BI-10017
Operating manual	AVTMBITE3

Item	Cat. No.
Optional Accessories	
Printer, battery-operated, 110 V ac	35755-3
Printer, battery-operated, 220 V ac	35755-4
Printer paper, 1 roll	26999
AMP/Burndy lead set	BI-10004
Kelvin clip lead set	BI-10005
Quick Disconnect lead set	BI-10006
Cigarette lighter charger	EV6280-332
Current transformer kit	35873
USB-serial adapter	35871
Probe extensions, lighted	35865
Hard-sided carrying case	35890
Standard transit case	35915
Field test shunt, 0.01 Ω, current rating 10 A	249003
Field test shunt, 0.001 Ω, current rating 100 A	249004
Field test shunt, 0.0001 Ω, current rating 500 A	249005

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ISO STATEMENT
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