NEW TECHNOLOGY FOR LEAD/ACID BATTERY TESTING

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Introduction

Bitrode Corporation is a leading manufacturer of charging and testing equipment for the battery industry and produces a wide variety of production and laboratory equipment. The subject of this presentation is the newest model in the continuing effort to supply the industry with the best performing and most reliable equipment available.

High-rate discharge tester

Design

Bitrode Corporation has developed a battery production-line, high-rate discharge tester. The unit consists of a powered conveyor with stainless-steel rollers and variable-speed drive. The equipment uses a liquid cooled system with a fixed resistor in series with a power supply. The test control panel employs a CRT display screen and push buttons for programming and operation. Positioning of the test probes in any of the six axes of travel is accomplished by means of a potentiometer and hydraulic motor on each axis. Test probes and cables are liquid cooled. An ethylene glycol cooling system is employed along with a heat exchanger and modulating valve to minimize water consumption. Testing can be accomplished using the automatic fixture, or by hand with the pneumatically counterweighted manual probes and analog meter mounted in front of the test station. A hip-actuated conveyor stop button is used to position the battery in front of the manual test station. Failed batteries are accumulated at the end of the reject conveyor. The manual test station can be used to hand-check batteries on the reject conveyor. An electric eye stops the conveyor if the batteries accumulate when exiting the test fixture. The latter, ultimately, is designed to be upgraded for data input with a bar code reader in a totally automated production environment.

When a new battery code is entered, the test fixture will position and set the high-rate accept and reject criteria for that battery. For the test fixture to make these adjustments, an operator simply enters the battery code via the keyboard. The microprocessor then sets the appropriate parameters that have been pre-programmed for that battery type and performs the

0378-7753/88/$3.50

test. Thereafter, no adjustments and no operator attendance are required until a battery-type change occurs.

When testing, the CRT screen will display up to an 8 digit battery type number, terminal voltage, reject current, and test current (Fig. 1). The programming mode uses a fill-in-the-blanks menu that is very simple to modify and has a capacity of 450 battery types (Fig. 2). The test fixture employs variable resistive load (VRL) technology for high-rate testing. In the test sequence, the open-circuit voltage is checked for 0.5 s and must be above a minimum value and below a maximum value to pass. The battery is discharged for a preselected time at a terminal voltage and must exceed a pre-selected minimum amperage to pass the test. Programming a battery discharge profile is via an acid-resistant keyboard and CRT display screen. No other adjustments are required.

Operation

To start the test sequence, the system start button is depressed and the program security key moved to the engage position. The battery type to be programmed is selected. For the purposes of illustration (Fig. 2), battery type 3 has been selected. The program button is depressed to bring up the programming screen. Control values for this battery can now be inserted. Lower battery cut-off voltage will be set at 11.5 V. Upper battery cut-off voltage, when exceeded, requires the battery to discharge at the upper reject current. This value will be set at 13 V. Lower reject current is the normal test criterion and will be set at 1000 A. Upper reject current is the test criterion required when high open-circuit voltage is detected and will be set at 1200 A. Control voltage is the battery terminal voltage during test. It is controlled by a power supply in series with the battery and will be set at 5 V. Terminal type is for top or side and will be set to top. Polarity will be set for conventional or reverse. Battery case size will be set for small or large. Test time is adjustable up to 10 s in increments of 0.1 s, and will be set for 2 s. Each probe axis may be positioned by depressing the forward and reverse hydraulic motor controls located on the keyboard. There are six probe axes on the top and side terminal model and four on the top terminal model (Fig. 3). To position the next probe axis, the code for the second

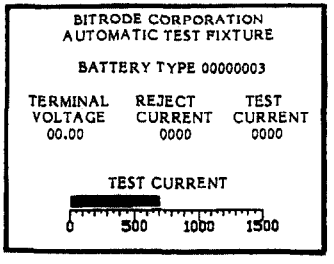

Fig. 1. Test screen.

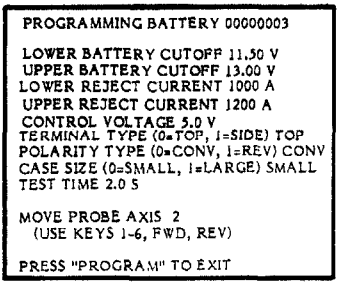

Fig. 2. Programming screen.

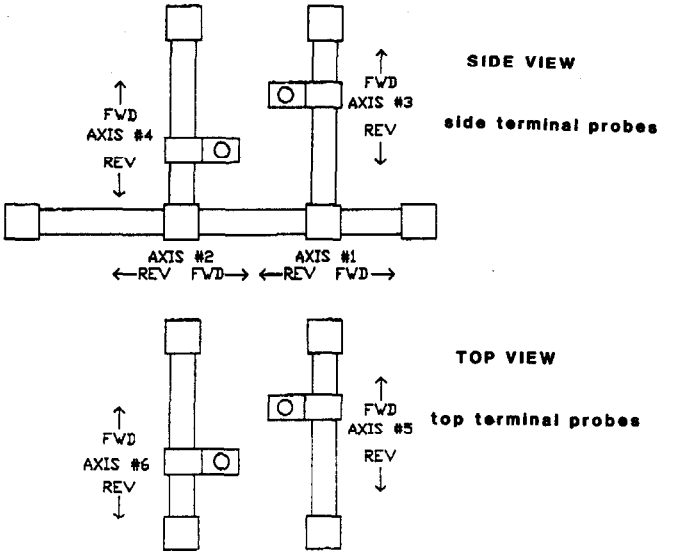

Fig. 3. Top- and side-terminal probe axes.

axis is depressed by using the forward and reverse controls to position the test probes. Once they are in position, the probe extend is pressed to check the location. If necessary, the other four probe axes can be checked by programming each one and following the same procedure.

To review the control values in the program, the enter key is depressed to step through the parameters. Low and high open-circuit voltage can be programmed. A lower and upper discharge current can be programmed. The battery control voltage is set. The configuration controls allow adaptation to various battery designs. The test time provides for a variation in the discharge profile, and the probe positioning allows adjustment for most batteries including studded terminals. To exit the program mode, the program key is depressed again and the test screen appears. The security key is moved to the disengage position to prevent unauthorized changes. When battery type 3 now enters the test fixture, and that test program is selected, the test probes and the control parameters will adjust to the values that were previously selected, and the test is performed.

The Bitrode test fixture has the ability to accept a wide variety of battery types including side terminal, studded-top terminal, golf cart, a Caterpillar 8D type, the T-top or DIN type, and the L terminal or Ford type. Special test probes have been custom designed for unusual applications. When a battery fails the high-rate test, a reject horn sounds and the reject gate extends to prevent the battery from continuing down the production line. Rejects are accumulated on the reject conveyor for re-testing. The reject conveyor can be mounted parallel or perpendicular to the production conveyor. Manual high-rate testing can be accomplished utilizing the pneumatically counterweighted test probes and the analog meter mounted in

front of the test station. The test is initiated by the air switch located in the right-hand test probe. The battery type is programmed into the microprocessor and all control and reject criteria are operable for the manual testing of that battery type. Batteries are brought into the proper location for testing by using the hip-actuated conveyor stop button.

Performance

The Bitrode test fixture will process about eight batteries per minute with a 0.5 s open-circuit voltage test and a 2 s high-rate discharge test. The conveyor speed and test rate will vary with the type of battery and the desired test time. For large batteries, such as the Caterpillar 8D, the test rate is about five batteries per minute because the conveyor stops during testing and it runs slower while transporting a large battery. A test rate of 8 batteries per minute is available for production lines that run predominantly standard automotive battery sizes.

High-rate testing can be accomplished by constant resistance, by constant voltage with rejection on a minimum discharge current, and by constant current with rejection on a minimum voltage. Each system has its merits. High-rate testers and test fixtures can be supplied for all of these discharge profiles. There are options that can be added to this system to develop a data base of test results and utilize it for statistical process control and to adjust for seasonality and variability of battery production. An RS232 output and a printer are available for data collection or transmission to a remote data acquisition system. A load bank is available with discharge currents up to 3000 A. The load bank can be air-cooled with a radiator for zero water consumption. All components are ruggedly designed to operate in the environment that is common around high-rate discharge equipment, and they are serviceable and replaceable. All high current load switching is done via solid-state devices, insuring millions of cycles without failure or wear. Bitrode maintains parts and service for all the hardware and software it sells and backs that up with customer service.