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The Model 6000 - Automated Industrial Battery Optimization System (IBO)

with ECO-PULSE TECHNOLOGY

US Patent 8,330,428 B2

The Model 6000 series of Automated Industrial Battery Optimization Systems (IBO) resulted from years of field experience and scientific testing, in over 40 different countries, using our Model 4800 Battery De-sulfation System. The Model 4800 has been the "workhorse" of the industrial battery de-sulfation industry for many years, with nearly 500 industrial systems in operation, allowing us to collect experience on hundreds of thousands of batteries - worldwide. This vast experience with forklift, automotive, marine, golf cart and Telecom batteries, allowed us to develop the Next Generation of Battery Devices, **powered by ECO-Pulse Technology!**

The ECO-PULSE Technology creates individually controlled pulse currents, then measures the effect of those individual pulses upon the battery. Once the effect of the previous pulse is compared to the desired effect, ECO-PULSE will then adjust the subsequent pulse(s) always obtaining the desired battery effect. This rapid and exact pulse adjustment process continues until the battery is fully optimized, which in most normally sulfated batteries is about 5 minutes.

The World's Most Advanced Battery Optimization Technology:

The **Model 6000** system **incorporates "space age design features,"** implementing the most advanced scientific technologies available. BattRecon's advanced **Command and Control** electronics systems were designed by our Chief Engineer, a retired NASA space vehicle engineer, who recently worked on the Mars Science Laboratory's Curiosity Rover shown in the photo to the left. Our Engineer contributed to the design of the "Throttle Valve Controllers" for the 8 Mars Lander engines, shown in the descent of the Mars Rover illustration above. He also worked on the motor controllers and sensor electronics for the sky crane landing system winch components and the articulating arm and associated sensor electronics. **http://www.youtube.com/watch?v=BudlaGh1A0o**

The Model 6000 is Designed to:

1) Reduce or eliminate battery **sulfation related labor** (service), service related training, service related transportation costs, and service employment costs. The 6000 will also reduce battery capitalization and storage costs, battery transportation and logistics costs, and increase the life expectancy of the batteries reducing waste and re-cycling costs.

2) Automatically and periodically, optimize the batteries **saving from 10 to 60% of the "re-charging," or "Float Charging" electrical consumption.** The system may also be programmed to interrupt the "battery to charger connection" to control the Charge Return Factor of the charger, saving wasteful overcharging of the battery.

3) The Eco-Pulse system allows you to discontinue the wasteful and less effective "Equalization Charging" process now used for many types of batteries.

4) Maintains the batteries in their maximum discharge performance at a very low cost.

5) Measure, display and record the charging electrical energy consumption in **Kilowatt Hours (KWH) and AMP/Hours** into the battery during the charging or optimization process. This enables accurate energy efficiency analysis and monitoring.

6) Some variants have an **Optional Impedance Testing System**, to measure, display and record the **battery's impedance**, thus providing a remote means to determine battery serviceability, battery performance and project battery life remaining.

7) The optional **WIFI connection** transmits data to a PC computer, or through an existing client network allowing **remote viewing and control of the machine.** The client may then receive periodic battery condition data reports including the impedance of the batteries, or they may remotely switch to a manual operational mode to optimize or maintenance charge the batteries, or simply perform a functional test to check the Battery Health.

8) **Automatically and periodically maintain the batteries** in an "optimized condition," which maximizes the battery useful life and reduces the re-charging time after a discharge event,

9) Provide an **Internet Web Based Monitoring and Technical Support System** that may be used to allow the remote connection and control of the machine for testing and troubleshooting purposes. This connection may be used to allow BZI Engineers to monitor and control the machine for testing of a battery during optimization at the client's location. The software program allows the client to record and playback battery optimization sessions. This saved file of the actual battery charge – BattRecon – load test, could then be emailed to BZI or other technical support personnel, for replaying and analysis on their local computers.

10) The Model 6000 may be configured with individual control panels to allow each Model 6000 system to be controlled manually with switches and knobs, or in a "Black Box" configuration only accessible using a wireless PC computer.

The Battery and System Metrics

The Model 6000 will display some of all of the following battery system metrics:

1) **[VPC]: The calculated Volts per Cell value.**
2) **[BAT]: The nominal battery voltage during setup, the measured battery voltage during operation or when the system is connected to a battery.**
3) **[KWH]: The Energy Consumption applied to the battery during re-charging, during float charging, during maintenance charging, or during optimization, measured in Kilo Watt Hours (KWH)**
4) **[AMPS]: The current measured in AMPS flowing into or out off the battery**
5) **[Ah]: The Amp-hours flowing into or out off the battery**
6) **[Time]: The Charge, BattRecon or Discharge "Z" Test Cycle Time**
7) **[Z]: The battery bank impedance**
8) **[T-A and/or T-B]; The internal temperature of the Model 6000 critical components.**
9) **{T-X]: Optional external temperature monitoring.**

System Specifications:

1) **Line Input Voltage:** 110 VAC 50 or 60HZ, 220 VAC 50 or 60HZ **(Clients must specify if the line input is 50 or 60 hz, and if the line voltage is 110/120VAC, or 220/240 VAC)**

2) **Line Input Amperage:** from 0-22 amps @ 120 VAC at 50 or 60HZ. When using 220 VAC, the line requirements will be about 0-15 amps, at 50 or 60 HZ. The Model 6000 series are frequency sensitive and the 50 or 60 hz selection must be made at the time of the order.

3) **The Patent Pending ECO-PULSE Technology increases the computer controlled operating pulses placing more de-sulfation energy into the battery at the lowest possible energy consumption. Eco-pulse also modifies each successive pulse depending upon the most previous pulse, creating the World's fastest and most thorough optimizing system!**

4) **Energy Efficiency Analysis:** The Model 6000 series of battery optimization systems have the capability to measure the **actual Kilo-watt hours of the energy being consumed by the battery during charging, or by the BattRecon process.** This allows the operator to easily calculate the efficiency of their charging systems, their battery's electrical efficiency, and the amount of useable energy being stored in precise KWH energy measurements.

5) **Integral Battery Charging Capability: Some v**ariants of the Model 6000 will have an onboard battery charger to more efficiently charge the battery, compared to traditional chargers.

6) **Battery Voltage Capability**: either 12/24/36/48 volt batteries, or 24/36/48/80 volt batteries. The client must select the version prior to shipment.

7) **DC Output Amperage RMS (Average)**: 0-22 amps RMS

8) **Output Amperage Peak to Peak**: 10-225 amps variable by the user because of our exclusive and Patented **VARIABLE POWER PULSE TECHNOLOGY sm**.

9) **Models 6000 Series Weight:** Approximately 25 lbs (This may vary depending on the chassis configuration).

10) **Model 6000 Case Dimensions:** Approximate Case dimensions (inches): 15.5" Wide, 14.5" Deep and 10.5" Tall. (External dimensions can be changed to accommodate different machine variants)

11) **Battery Optimization Capability:** The Model 6000 can work with lead-acid batteries such as AGM, Gel, VRLA and flooded batteries. The battery capacity can be as low as 50 A/H, or in excess of 3000 A/H.

12) **Operational Description:** The operational system is a computer controlled, high power pulse width modulated process with our new Patented (US Patent 8,330,428 B2) **"Multi-Channel"** design. Our unique **"Variable Power Pulse Technology sm"** allows you to control the **"Power of the Pulse."** Our new Patent Pending **ECO-PULSE Technology** is the heart of the Industrial Battery Optimization Process and can operate in a Single or Dual Channel Mode.

13) **Safety Systems:**

Peak Amperage Current Limitation is incorporated into the circuitry so that in the event the **Peak AMPS** exceeds the factory default settings, the system will shut down

AMPS RMS Current Limitation is incorporated into the circuitry so that in the event the **AMPS RMS** exceeds the factory default settings, either during charge or discharge, the system will shut down.

Overvoltage Limitation is incorporated into the circuitry so that in the event the Model 6000 detects excessively high voltage, the system will shut down.

Temperature A and B Limitation is incorporated into the circuitry so that in the event the internal system components each a critical temperature, the system will shut down.

Optional External Battery or Equipment Temperature Sensors may be incorporated into the circuitry so that in the event the internal system components each a critical temperature, the system will shut down.

14) **Optional Panel Configurations:** The Model 6000 can be either produced with a Manual Operator's Control Panel as shown in the previous photo on page 1, or developed with a cost saving Remote Control system powered by a WIFI connected PC based wireless "Black Box System."

Manual Control Panel Features

1) The control panel is constructed of a high strength; aircraft grade composite resin material, which has the graphics designs "dye imbedded" into the plastic using a patented, heat –vapor, subliminal, transfer system. This technology is a space age, state of the art process allowing the graphics to be embedded on a molecular basis within the plastic material, resulting in a **"glass like" depth and feel to the finish.** This process ensures years of brilliant appearance, with superb scratch and fade resistance. There are no exposed silkscreen lines to wear off, no low quality vinyl lettering or decals; simply the most brilliant aircraft grade finish you have ever seen on an industrial machine! In addition, the images and graphics are so sharp and clear, that you would easily compare them to the quality of a high-resolution photograph!

2) The Model 6000 may have as many as three optional Mode Select switches, one Start Switch and one Fault/Reset indication light. The Mode Select Switches are: 1) **Charger By-Pass Mode**, 2) **BattRecon Mode**, and 3) the **"Z" Impedance Testing Mode.** The Mode select Switches, also considered **"Manual Mode Start Switches,"** which illuminate green when selected and are operational. The **Stop Switch** discontinues any operational mode that the system may be in and illuminates **RED** when it has been activated. The **FAULT/RESET** switch illuminates **RED** when a fault has occurred. This generally means that the system has timed out, or a malfunction has been detected. In either case, investigate the possible cause before turning the machine ON and OFF and trying again.

3) **Charger By-Pass Mode:** Charger By-Pass will simply allow the Model 6000 to interrupt the charger - to - battery bank connection(s), to apply an optimization or maintenance charging process to the battery bank(s). **The Charger By-Pass function also allows the operator to measure and store the KWH used during a charging cycle for energy efficiency analysis.**

During Charger By-Pass Mode, the system will display: 1) Volts Per Cell, 2) Battery Voltage, 3) Energy Consumption to recharge the battery expressed in KWH and Amp/hours, 4) Charge Current flowing to the battery, 4) Device Temperature, 5) Charge Cycle Time

4) **BattRecon Mode:** All versions of the Model 6000 utilize the new ECO-PULSE System to rapidly and efficiently optimize the battery(s). The system is Peak Current limited to 250 amps and operates on either a 12/24/36/48 volt bank of batteries, or a 24/36/48/80 volt bank depending on which machine version you have. The operator will select the battery bank voltage, the Peak Current, the optimization time and the reptitive sequential time interval. If the operator sets the time to 00:00:00, then the system will run indefinitely. If a time value greater than zero is selected, then the system will operate until that time interval is reached.

   Once the BattRecon cycle is complete based upon the parameters input by the operator, the Model 6000 will terminate the process, display the runtime in minutes AND KWH of energy used to optimize the battery and store the data in the internal memory for future reference.

5) **The "Z" Impedance Testing Mode:** The Model 6000 has the optional capability to provide an impedance test to determine the "Battery Health " of the battery banks. The system uses a unique pulse width modulated process allowing the measurement of battery bank impedance calibrated in milli-ohms. This value may be compared to factory new specifications, or the BZI Worldwide Data Base, to determine the condition of the batteries. Advanced BZI battery condition algorithms, operator specific data analysis and statistical forecasting analysis; allows the cell tower operator to precisely predict the life remaining of individual battery banks.

6) The **Dual Function Selection Switch** is located in the center of the control panel and is used by the operator to change data fields on the display, and to change and save the values within each data field. The switch has two basic functions, 1) **a push button function to select (toggle between) different data fields**, and 2) **a rotary switch function** that allows the operator to **increase (clockwise rotation) or decrease (counter clockwise rotation)** the values within each data field. Pressing the knob inwards cycles between data fields from top to bottom, and rotating the switch will change the numerical values within the selected data field. Once the selected field has been changed by rotating the switch, then the button must be pushed again to save the values in memory. From then on, the field values will remain the same until the operator chooses to change and save them again.

7) The **Control Panel Door** allows easy access for maintenance or calibration. **DO NOT OPEN AND ATTEMPT TO SERVICE THIS MACHINE WITHOUT PROPER CERTIFICATION. HIGH CAPACITIVE VOLTAGES ARE PRESENT THAT MAY CAUSE INJURY OR DEATH. ONLY CERTIFIED MODEL 6000 SERVICE TECHNICIANS ARE AUTHORIZED TO OPEN THE CONTROL PANEL DOOR.**

8) **Circuit breakers** mounted on the support panel interrupt the electrical power to the system in the event that there is an electrical fault.

9) A **DC Output Fuse** is installed inside the access door and is rated at 60 amps for the BattRecon side of the machine, and 150 amps for the Charger By-Pass side of the machine. In the event that the fuse is blown, then a new fuse will have to be installed by a certified technician.

DO NOT TOUCH THE EXPOSED BATTERY CONNECTORS, LEADS OR BATTERY TERMINALS WHEN OPERATING THE MODEL 6000 SYSTEM. SERIOUS ELECTRCIAL SHOCK, INJURY OR DEATH MAY RESULT. TURN OFF THE Model 6000 INPUT POWER BEFORE REMOVING THE BATTERY CONNECTORS OR CLAMPS.

Warranty: The Model 6000 system warranty:

Limited Warranty: 1- year limited parts warranty covers manufacturers defects, excluding damage from misuse, shipping or operator error. The IGBT transistors and fuses are not a warranty item and are considered a normal "wear and tear devices." However, IGBTs are a very low cost, are low cost and take only a few minutes to replace. The Battrecon systems have a very low rate of failure in the field, probably in the 2-3% rate, so the operator can be assured that these systems require little maintenance or repair.

The labor warranty is limited to 90 days, provided the system is return shipping pre-paid to BZI or an authorized dealer. Repairs after the initial 90 days are limited to a maximum of $600 labor under our "Extended Care" program.

"Extended Care" Extended Warranty: We provide an infinite flat rate labor repair warranty, which begins after the Limited Warranty expires. In the event the machine fails: 1) beyond the initial 1 year warranty, 2) the machine becomes inoperative from normal wear and tear (excluding physical damage) or 3) simply needs a performance overhaul or adjustment; then the cost of the repair will not exceed the published, flat rate repair. The current flat rate repair cost is $600.00 per occurrence, plus shipping charges. The flat rate repair cost may be adjusted on an annual basis, or at the discretion of the company. Other terms and condition may apply.

International Clients:
Our international clients are encouraged to purchase our International Spares Parts and Tools kit as the cost of shipping a small replacement part, plus the downtime waiting for the part, is often prohibitive. In the event a repair is required, BZI will refer the client to the closest geographical Warranty Repair Station, or work with the client's local technician to get the machine working again.

BZI Reserves the right to modify or change the product specifications without prior notice.

Wireless Operation

The integration of a wireless WIFI connection to the Model 6000 allows the system to provide bi-directional communication capability between the Model 6000 and a remote computer. This allows the Model 6000 to transfer battery data in real time to the PC based centralized management system of the client.

The battery could be connected to the Model 6000 located in London, England, while the operator, could remotely monitor and control that battery located from anywhere in the world, such as Paris France, as an example. The operator could perform such duties as; 1) downloading the battery data metrics for a period of time, 2) initialize a Manual Mode Session and apply a maintenance charge or optimization process, 3) conduct a brief "Z" impedance test of the battery bank to determine the health f the batteries, or 4) record and replay a previous battery optimization cycle.

BZI has developed a PC based, Graphical User Interface (GUI) shown to the right, that allows the operator to remotely monitor and operate the Model 6000.

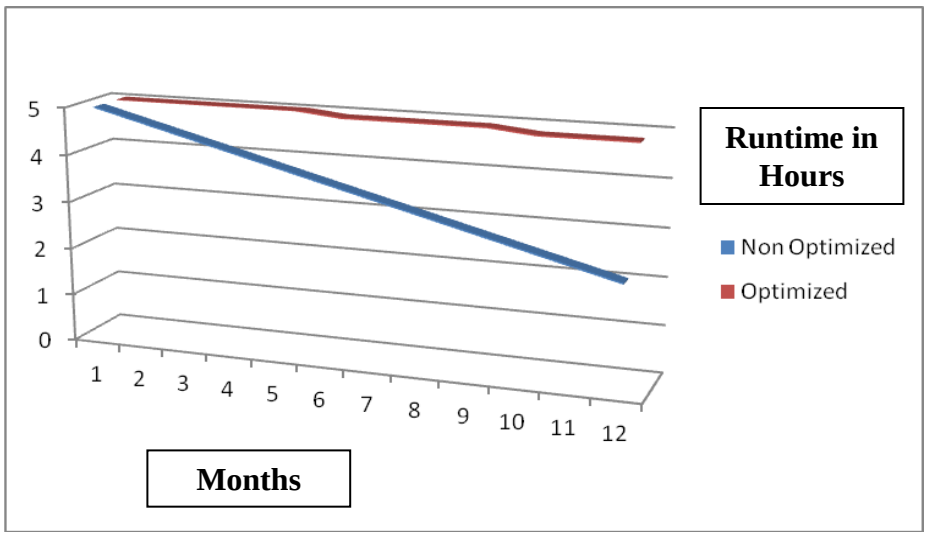
What is Battery Optimization?

Battery optimization is the periodic removal of excessive daily sulfation within the battery.

The conventional battery operational cycle begins with a battery in a nearly optimized condition, whether new or recently returned from service. As the battery is used on a daily basis a small amount of **"Excess Daily"** sulfation remains on the plates. This "excess" sulfation is unnoticeable at first, however , the slowly increasing resistance soon begins to reduce the runtime of the battery, ultimately requiring a battery de-sulfation service to restore lost performance. This "excess daily " sulfation, if not removed, soon becomes the damaging and difficult to remove crystalline form of sulfation. When the "excess daily" sulfation is removed using the IBO system, sulfate crystals are prevented from forming, eliminating excess battery sulfation **for the life of the battery!**

While the charging cost per charge measured in watts slowly increase day after day, the daily runtime of the battery is diminishing effectively reducing the "charge wattage to runtime ratio" or the "capacity" of the battery. As an example, the battery performance that began with a 5-hour runtime on day one, will typically be reduced to about a 3-hour runtime within about a year as illustrated by the blue trace in the chart below. How soon that happens depends on many factors, but the net result is during that period of decline, the battery is using the **more re-charging wattage for a drastically reduced runtime capacity.** Most operators

experience a 30 to 50% reduction in productivity before they take action, which when averaged, is **wasting 15 to 30% of their electricity bill** each month.



Battery optimization as shown in the red trace, keeps the battery at a constant state of optimization or lowered resistance. Batteries that are optimized daily or weekly, will eventually diminish in capacity from natural causes other than sulfation. However, optimization will: 1) allow maximum use of the battery's intended life cycles, 2) effectively reduce the electrical charging cost caused by **"non productive compensation"** of the battery by about 15 to 40%, 3) reduce or eliminate weekly or periodic equalization charging , 4) dramatically reduce or eliminate services required for de-sulfating the battery, 5) reduce the periodic watering of the battery, and 6) reduce the Charge Return Factor to save about 10 to 40% of the daily electrical charging costs.

"Non productive compensation" is: The use of additional charging cycles to perform the same amount of work (Payload). As the battery slowly sulfates, the useable runtime capacity slowly diminishes causing the operator to initially charge more times per month to accomplish the same payload. As the battery performance continues to diminish from sulfation, the operators soon find themselves using two battery charge/discharge cycles, to accomplish the same payload as they previously accomplished with one cycle.

A battery's life span is often rated by the number of charge and discharge cycles it can perform before it is considered "worn out." If a battery is rated to perform 1200 cycles in a lifetime, and 25% of those charge cycles are "**a non - productive compensation,**" then the battery will "cycle out" wasting about 300 cycles combating the effects of sulfation, rather than performing productive work. The implementation of daily battery optimization will not only slash electrical charging costs compared to payload, but extend the life of the battery by adding hundreds of productive cycles to the battery.

The conventional approaches to combating excess daily sulfation are; 1) the excess daily overcharge using a high charge return factor, and 2) the weekly "Equalization Charge." These techniques, compared to battery optimization, are energy inefficient, do not reduce or eliminate costly de-sulfation service intervals and waste productive battery life cycles. The equalization charge is simply an additional charge cycle placed upon the battery to mix acid and reduce sulfation induced resistance, without a working, productive use of that charge cycle, or Payload. This further aggravates the **"non productive compensation factor"** caused by excess daily sulfation, further reducing the productive battery life cycles. Unlike battery optimization, if equalization charging or excessive daily charging were the answer to excess daily sulfation, then batteries in the field would never sulfate past one day, or be removed from service for sulfation accumulation.

The ultimate solution is the automatic application of the Patented (US Patent 8,330,428) BattRecon **IBO process** to optimize the battery on a daily or other periodic basis. IBO is simply returning the battery's internal resistance to the lowest possible level after every charge cycle. Also referred to as a **"Periodic Equalization Strategy," (PES)**, the basic IBO system allows the battery charger to charge

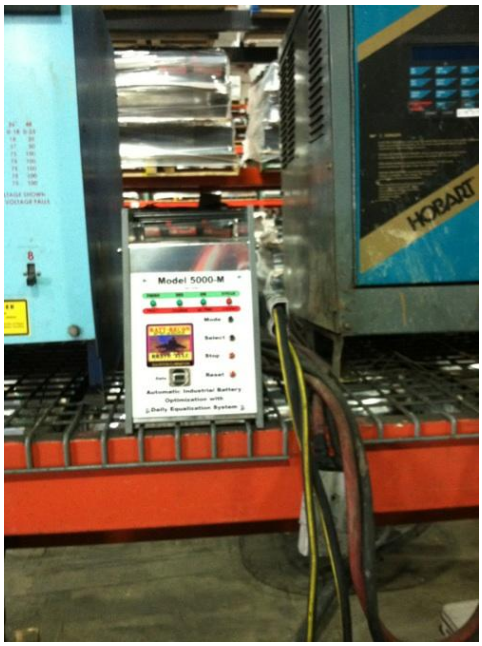
the battery without interference, after which the IBO takes over and applies a few minutes of the Batt-Recon process to the battery. The result is a battery that is always scientifically optimized with respect to sulfation induced internal resistance.

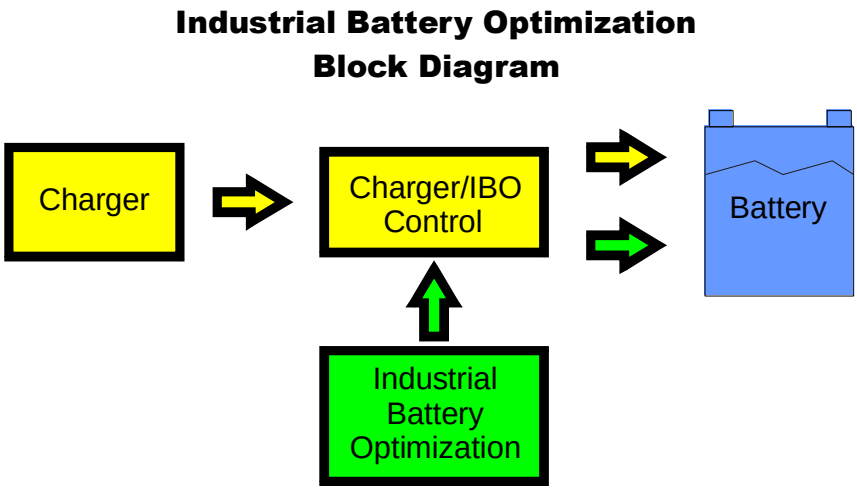
The IBO/PES system is connected inline between the battery and the existing battery charger. The battery(s) will be connected on a daily, weekly or monthly basis to the Model 6000, while the Model 6000 will have a one-time connection to the charger. Each time the battery is to be re-charged it is connected to the Model 6000 and the charger is allowed to charge the battery without interference. Once the charger is finished with it's native charge profile, the IBO takes control of the battery and automatically applies the default Batt-Recon (PES) schedule for "x" minutes, probably between 1 and 5 minutes as determined by the operator. The Batt-Recon/PES process removes any "daily sulfation" that has been left behind by the charger, which reduces the internal resistance to the lowest possible level optimizing the battery. Ideally the process should be applied to the battery after every charge for about 1 minute, as an alternative a weekly application of 5 minutes would be recommended.

The IBO can be used to **control any charger's Charge Return Factor**, or the daily degree of battery overcharging. The vast majority of today's industrial battery chargers have a daily overcharge ranging between 30 and 50%. This is due to the design of the charger, the need to overcharge daily to remove sulfates and mix the acid within the electrolyte. With IBO/PES, the battery's sulfation levels are minimized daily using only a few watts of electricity, replacing the previous high wattage daily overcharge used to remove excess daily sulfation.

What are the benefits of a Periodic Equalization Strategy?

1) PES Saves electricity compared to the effective workload
2) PES allows the utilization of all possible battery life cycles.
3) PES Reduces or eliminates sulfation services.
4) PES Allows the fine tuning of the charge return factor using any charger.
5) PES reduces or eliminates the weekly equalization charge for sulfation.
6) PES Reduces the battery's watering requirements.





OPERATION of the MODEL 6000

The Model 6000 system operation is very simple and easy to use. The machine can be operated in either **MANUAL** or **AUTO SEQUENCE MODES**. Some version may have an **AUTO START** feature enabled, which allows the machine to start optimizing the battery each time it is connected to a different battery.

The **MANUAL MODE** allows you to choose between **ONLY** Charging the battery using **CHARGE BY-PASS MODE**, **or** de-sulfating the battery using **BATT-RECON MODE**, **or** perform an **IMPEDANCE TEST** of the battery (if impedance testing is an installed option on your machine). The **AUTO SEQUENCE MODE** would simply automatically cycle between first **CHARGING**, then applying **BATTRECON**, then performing an **IMPEDANCE TEST** of the battery (if impedance testing is installed).

To Operate in MANUAL MODE:

1) With the battery NOT connected to the machine, turn on the AC power to the machine.
2) If you have previously used the machine and do not want to change any of the parameters, then press the switch for the desired function and allow the machine to begin that function. **If this is a new battery type or voltage than a previous operation, then you should verify the machine parameters match your battery.**

To Change Field Parameters:

1) Press the desired function , then quickly press the **STOP** button. (This allows you to change data fields on the display window).
2) Using the center black rotary knob, press and release inwards on the knob to toggle between data fields on the display. The data field that can be changed will have a blinking cursor highlighting it. To adjust a value in a data field, simply rotate the black knob to move the values up or down. When you are satisfied with the value in a data field, carefully press the black knob inwards to save that value and jump to the next field.

Each mode has different fields that may be adjustable by design of the function. If you move to a field that is not adjustable, then rotating the black knob will have no effect on that field. When you change the values in a data field, then you must press inwards on the black knob one more time to jump to another data field, in order to save the changes you have just made. If no changes are made in the blinking data field, simply press the black knob inwards to skip this field and toggle to the next field.

Note: When pressing inwards on the black knob take care not to inadvertently rotate the knob as you press or release the knob, as this may change the values in the field.
When you finish changing any data field, then press the encoder inwards one time and the display will jump to the next data field.

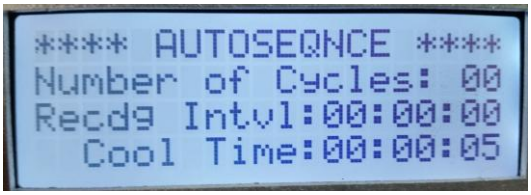
To Operate in AUTO SEQUENCE MODE:

If you had previously used the machine on a battery of the same type and voltage, and are now repeating the same process on a similar battery:

1) Press and hold the Center Black Knob inwards and press the FAULT/RESET button.

The machine will then start charging the battery, then apply the BattRecon process, then perform an impedance test if that option is installed on your machine. The machine will use the parameters set and saved within each MANUAL MODE FUNCTION and simply cycle between them for the number of times you have set in the AUTO SEQUENCE MAIN MENU. It will repeat this AUTO SEQUENCE MODE operation until you power the AC Power ON/Off, after which you will have to set the AUTO SEQUENCE MAIN MENU upon starting the AC Power again.

To Enter into AUTO SEQUENCE MODE MAIN MENU shown below, you simply press and hold the black rotary knob inwards, being careful not to rotate the knob, then press the FAULT/RESET button and release both the rotary knob and the FAULU/RESET switch. The AUTO SEQUENCE MAIN MENU will be displayed and you can select the number of times for the machine to cycle through the Charging – BattRecon and Load Test modes. If you set the Number of Cycles to: 0, then you will have one cycle (the default cycle). If you set it to 1, then you will have one additional cycle for a total of two. If you set the number to 3, then you will actually cycle a total of 4 times.



Once you have entered the selected number of cycles, press the black Center Knob inwards carefully, then release and this cycle count is saved. The **Recording Interval** is set in the software so skip this function. The **Cool Time** is the delay between the different modes, usually 5 seconds is enough. If you want a longer delay period, then set it in this field and press the Center Black knob to save. When finished, press and hold the Black Center Knob and press the FAULT/RESET button. The machine will automatically start the sequence and continue until all functions are finished. Then if you want to do another like kind battery, simply connect that battery and press and hold the Black Center Knob and press the FAULT/RESET button and the machine will again repeat the same sequence.

Adjustable Fields in CHARGER BY-PASS MODE:

1**)** **VPC:** The VPC or volts per cell, which is the calculated VPC of the number of battery cells divided into the battery voltage. When the charger raises the VPC above the set number, then the mode is completed and the machine stops or switches to another cycle.

2) **BAT:** The battery nominal voltage is set to match the battery voltage you are working with. The battery voltage must be set correctly, or the machine may not function.

3) **TIME:** The time is adjustable between zero and 99 hours, 99 minutes and 99 seconds of total charging time. If you set the time to zero, the machine will run indefinitely, if you set it to 1 second or greater, it will allow the charger to connect to the battery for that period of time.

Adjustable Fields in BATRECON MODE:

1) **BATT:** The battery nominal voltage is set to match the battery voltage you are working with.

2) PEAK: The peak amplitude applied to the battery is variable between 10 and 230 amps Peak to Peak. The typical golf cart, auto start battery or scissors type of flooded battery would have about 140 amps peak applied to it for 5 minutes. AGM type batteries in the 12V category typically would be worked at about 90 to 120 peak for 5 minutes. Forklift batteries would be worked at about 225 peak for five minutes, and tubular batteries at about 200 peak. Most batteries will improve about 10 % more if you apply a second charge and BattRecon cycle.

3) **TIME:** The time is adjustable between zero and 99 hours, 99 minutes and 99 seconds of total BattRecon time. If you set the time to zero, the machine will run indefinitely, if you set it to 1 second or greater, it will allow the BattRecon Mode to connect to the battery for that period of time.