





Battery Management System



BMS Introduction



Battery management

Battery management is an unknown science and not many people really understand how a battery works or better still how to maintain the battery correctly.

FACT! 95% of all engine failures are attributed to the BATTERY!

We at Desiccant Dryair have been developing a battery management system since 2005 when we were asked to include it as part of a CHE Trial for the Singapore Army in Singapore.



CHE is a **Controlled Humidity Environment** and we were given a motorised field gun to prove corrosion control over a 1 year period. The system was externally monitored to collect data and evaluate the final results. We had to include a Battery Management System to allow the vehicle to be in a state of readiness at all times during the trial.

This was where a very simple beginning has ended up developing into a very sophisticated management system. We have proven our system against other manufacturers during many trials.

We now have over **30 years of charging experience** within the company and over the past 7 years have worked closely with Hawker Enersys to develop a system that is proven with charging Armasafe batteries used by **Armies** and **Military forces** around the world.

Our system is the best available on the market today and developed to assist fleet managers in both civil or military applications.

Problems with batteries.

- 1. A vehicle will not start when required without a good battery; this causes issues with both everyday vehicles and vehicles put into long term storage.
- 2. Readiness of military frontline and emergency vehicles are difficult to maintain.
- 3. Many institutions use a simple charger to maintain many different battery types.
- 4. Parasitic loads on vehicles will drain a battery in a number of weeks.
- 5. Battery replacement is very costly, justification to the tax payer in many cases.
- 6. A battery if not used will deteriorate as the electrolyte will separate in to sulphuric acid and water. This process is called stratification.



Our solutions

At **Desiccant Dryair** we can offer a system that will solve all of the issues detailed above.

- 1. A vehicle will not start if the battery is in poor condition. Our system will keep batteries in top condition on vehicles used daily or in very long term storage.
- 2. We have a 100% success rate on every showcase we have carried out with the **British**, **Australian** and **Singaporean Armed Forces**.
- 3. We can charge most types of battery and can apply a specific charging algorithm from a manufacturer. We can charge 12 and 24 up to 38 Volt systems of the following types.
 - Wet Lead Acid/ Dry Lead Acid
 - VRLA
 - AGM
 - Gel
 - Calcium / calcium
 - Nicad
 - Many others.

- 4. Parasitic loads are accounted for automatically and the charger will compensate for this and display the parasitic value.
- 5. We have great success in battery recovery even at deep discharge condition as low as 0.25 Vdc per battery. In many cases we can recover sulphated and bad cells.
- 6. We have a storage facility that will destratify the electrolyte at pre determined periods automatically.

Fully Intelligent 4 Stage Battery Management System

Stage One – BULK CHARGE

Current sent to the batteries at the maximum safe rate they will accept until voltage rises to near (80-90%) full charge level.

Stage Two – ABSORPTION

The voltage remains constant and current gradually tapers off as the internal resistance increases during charging. During this stage the charger puts out maximum voltage.

Stage Three – FLOAT CHARGE

This is the voltage supplied to the battery after being fully charged to maintain that capacity by compensating for self-discharge of the battery cells. With the appropriate voltage for the battery type and with proper temperature compensation, a float charge may be kept indefinitely without damage to the battery.

Stage Four – STORAGE

After the batteries have been charged for a predetermined period, it goes to bulk charge for one hour to prevent stratification of the electrolyte.

Advantages of our Battery Management System.

- Determines the state of a battery at any given time, both remotely or on site.
- Alarms when the charge is longer than the battery capacity allows.
- Capable of maintaining most major battery types (see below).
- Dead battery recovery capabilities.
- Auto voltage detection.
- Can transmit fault data via Email or SMS.
- Total remote access.
- Temperature and voltage correction to compensate for longer charging lead lengths.
- Small and compact.

System is compatible with these battery types:

- VRLA AGM and GEL
- Wet Lead Acid
- Calcium/Calcium
- NiCad 18 and 20 cell
- Lead Acid Antimony

This system combined with our **Controlled Humidity Environment** system, ensures that stored vehicles will always be in a complete state of readiness. Commercial fleets of vehicles would also benefit from this system, including Heavy Goods and Fire and Ambulance Services





Control room Mysql Database + PC computer 192.168.0.1 All camps will be monitored by the Control Room.

There will be installed MYSQL server with WEB based application to monitor all devices:

- · battery chargers,
- energy meters,
- dehumidifiers.



Control Room will communicate with the Camps by Ethemet network.

The computer will have software which will read all data like:

- · battery charger voltage
- · current, power consumption
- · humidity process values
- set points
- temperature
- · vehicle registration number
- type of battery
- schedule the time for discharging of the battery



All data will be saved on the MYSQL database.

Software will be able to:

- add spare fields for example drivers sumame, technical problems etc.
- MOT dates
- gather historical data:
 - date of charging
 - discharging
 - alarm values of humidity
 - temperature in buildings

OPERATORS WITH SPECIAL ACCESS LEVEL WILL BE ABLE TO SEE OVERVIEW OF BUILDINGS





Connection between each building will be released by **Modbus TCP/IP** protocol (LOCAL ARENA NETWORK - CAT5E cable)



Larger Dehumidifiers like **VRF2500** (with dedicated PLC) can be connected directly to local arena network)

Application

- Power generation
- Fire pump
- Medical
- Military
- Industrial

Charger requirements you should be specifying



Multi-stage charging

Optimal calibration, specific to battery type with dual 12 & 24Volt

Low ripple with automatic multiple Ac voltage & Frequency

Temperature compensation

AutoBulk

Reverse polarity and short-circuit protection with automatic reset

Diagnostics and alarm outputs

Communication and information

Standards compliance UL CSA CE NFPA110 FM

The 5 main causes of battery failure

- 1. Excess gassing kills batteries.
- 2. High ripple kills VRLA batteries.
- 3. Incorrect voltage kills batterie
- 4. High temperature kills batteries.
- 5. Stratification kills batter

1. Excess gassing kills batteries.

Manual bulk (boost) causes gassing. Bulk charging will be automatically terminated as the battery cells reach their charged capacity.





2. High ripple kills VRLA batteries.

DC Current Ripple creates heat within a battery which VRLA batteries cannot dissipate.

VRLA's should be charged with a charger that has <5% Ripple.

By smoothing the output or switching at high frequency the ripple can be decreased.



- · Different recommended charging voltages for different chemical compositions
- · Each battery type must be matched to the correct charger
- Imagine a CA/CA charger connected to a Gel battery

3. Incorrect values kills batteries.

- · Different recommended charging voltages for different chemical compositions
- $\boldsymbol{\cdot}$ Each battery type must be matched to the correct charger
- Imagine a CA/CA charger connected to a Gel battery

4. High temperature kills batteries.

- 95% of engines failing to start are due to poor battery condition
- A battery is a chemical means of storing electricity
- · Batteries should be charged at 20C or 68F

Example on 12V Lead Acid Batteries:

- Float = 13.6V Bulk = 14.1V
- At 50°C this equals 0.54 volts, the same effect as being in bulk
- 50°C 20°C = 30 x .003mVx 6 = 0.54
- 13.6 v 0.54 = 13.06v @ 50°C

If no temperature control, it is the same as adding the 0.54 V at 20C = 13.6+0.54 = 14.14This would be on bulk charge therefore gasing the battery.

| Battery Description | Float | Boost |
|---------------------|-------|-------|
| 12V Wet LA | 13.5 | 14.1 |
| 12V CA/CA | 13.8 | 15.6 |
| 12V LA Antinomy | 13.5 | 14.7 |
| 12V VRLA - AGM | 13.5 | 14.4 |
| 12V VRLA - Gel | 13.5 | 13.8 |
| 10 Cell Nicd | 14.1 | 14.5 |
| 18 Cell NiCd | 25.6 | 26.1 |
| 20 Cell NiCd | 28.2 | 29.0 |
| 24V Wet LA | 27.0 | 28.2 |
| 24V CA/CA | 27.6 | 31.2 |
| 24V LA Antinomy | 27.0 | 29.4 |
| 24V VRLA - AGM | 27.0 | 28.8 |
| 24V VRLA - Gel | 27.0 | 27.6 |

Note: Voltages shown are for 20°C /68° F.

5. Stratification kills batteries.



This is where a long period of float charge has occurred and the electrolyte separates. See diagram below Applying a Bulk (equalise) voltage is required to prevent separation of the electrolyte.

Our system is fully automatic, plug in and forget. We have great experience in delivering fleet stability.

How to prevent Stratification.

A fully charged battery is connected to a load (light bulb) and the chemical reaction between sulphuric acid and the lead plates produces the electricity to light the bulb.

This chemical reaction also begins to coat both positive and negative plates with a substance called lead sulphate also known as sulphation (shown as a yellow build-up on plates).

This build-up of lead sulphate is normal during a discharge cycle. As the battery continues to discharge, lead sulphate coats more and more of the plates and battery voltage begins to decrease.

During the battery recharge cycle lead sulphate (sulphation) begins to reconvert to lead and sulphuric acid.

At float charging only, the charger will maintain a full charge, reduce gassing and water loss. However, this lower voltage does not provide enough gassing to prevent a battery condition called Battery Stratification. Battery Stratification is caused by the fact that the electrolyte in the battery is a mixture of water and acid and, like all mixtures, one component, the acid, is heavier than water. Therefore, acid will begin to settle and concentrate at the bottom of the battery.

This higher concentration of acid at the bottom of the battery causes additional build-up of lead sulphate, which reduces battery storage capacity and battery life. In order to prevent Battery Stratification, an Equalization must be applied periodically.

Approvals

- FM 1321 & 1323
- UL 1236 (SC)
- CSA 22.2
- CE
- EMC: Emissions EN6100-6-3 Immunity EN6100-6-2
- Self-cert
- Low-volt directive
- Safety Integrity Level (SIL)



