THE U.S. ARMY
BATTERY MAINTENANCE MANAGEMENT PROGRAM
Presented by: PulseTech Products Corporation
www.pulsetech.net

Field Support:

Roy Johnson
315-489-8823
rjohnson1@twcny.rr.com
Eastern US, International, USMC 2 MEF

Tom Pigorsh
719-331-0329
tom.pigorsh@comcast.net
Western US, Pacific, USMC I and 3 MEF

Steve Reed
615-614-2917
sereed1117@gmail.com
National Guard/Reserve Component

Military Sales:

Briza Justice
1-800-580-7554, ext 152
bjustice@pulsetech.net

Warranty / Service:

Jonathan Lewis
1-800-580-7554, ext 166
jlewis@pulsetech.net
For the past 23 years, PulseTech has been working with the US Military to help reduce the consumption of vehicle and equipment lead-acid batteries.

Kuwait

87,000 Batteries

Afghanistan

20,000 Batteries
BATTERY MAINTENANCE MANAGEMENT PROGRAM

PulseTech Background

87,000 Batteries

373K+ Batteries Consumed in FY 2016

FY16 Battery Cost $80 Million?

Vehicle Battery Quantity - Base

Lead Acid: 6TMF – Wet (consignment)
VRLA: 6AGM (Armasafe plus) (consignment/Depot)

<table>
<thead>
<tr>
<th>NIIN</th>
<th>Description</th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
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<td>6TMF-Wet Lead Acid</td>
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<td>12V BCI-34</td>
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<td>014469498</td>
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<td>015825710</td>
<td>Exide Group 31 BFV AGM Battery</td>
<td>48</td>
<td>770</td>
<td>1,568</td>
<td>7,203</td>
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</table>
It takes all these components to have a successful BMMP!

- Trained Technicians
- Strong (enforced) SOP
- Fix and Charge equipment as required (not waiting for when batteries are so completely dead the equipment can no longer be slave started…)
- Charge during schedule services.
- Utilize mitigation devices.
Battery: A device that transforms chemical energy into electric energy.

Cell: An electrochemical device, composed of positive and negative plates, separator, and electrolyte, which is capable of storing electrical energy. When encased in a container and fitted with terminals, it is the basic "building block" of a battery.

Cold Cranking Amps or CCAs represents the amount of power a new (fully charged) battery can deliver for 30 seconds at 0 degrees Fahrenheit before the voltage falls to 7.20 V (six cells).

Cranking Amps or CA represents the amount of power a new (fully charged) battery can deliver for 30 seconds at 32 degrees Fahrenheit before the voltage falls to 7.20 V (six cells). This rating can also be referred to as Marine Cranking Amps (MCA).

Reserve Capacity or RC: The number of minutes a fully charged battery at 80 °F will discharge 25 amps until the battery drops below 10.5 volts.

Amp hour or AH is a rating usually found on deep cycle batteries. If a battery is rated at 100 amp hours it should deliver 5 amps for 20 hours, 20 amps for 5 hours, etc.

Open-Circuit Voltage: The difference in potential between the terminals of a cell when the circuit is open (i.e., a no-load condition).
(+)-plates are connected to make a 2 volt cell.

All 6 cells are connected inside the box to make a 12 volt battery.

The case is filled with electrolyte (sulfuric acid & water).

Electrolyte must always cover the battery plates (but don’t fill to top).
6T Conventional Battery Design

These batteries are flooded ("wet") cell lead acid 6T type batteries. Though they may appear similar they have different chemistry, capacities and voltages.

> Transport Class – wet battery (hazardous)  > Environmental designation – “hazardous”

6TMF/TYPEII (for consignment)
Usually 725 CCAs
NSN 6140-01-446-9506
Lead Calcium Plates

6TL – Most are Interstate Batteries
Usually 625 CCAs
NSN 6140-01-446-9506
Lead Calcium Plates

6TLFP/TYPEI (Dry with over-packed electrolyte)
NSN 6140-01-446-9498
Lead Calcium Plates
AGM batteries use an **Absorbent Glass Mat** to contain all the electrolyte.
Advantages of AGM batteries:

• VRLA – Valve Regulated Lead Acid: Contains one-way safety valves to prevent out-gassing & loss of liquid during normal operation.

• Longer life, Less maintenance, and Safer:
  – Transportation class = Non-spillable
  – No leaking acid
  – Eliminates corrosion to terminals & battery trays
  – No holes in your clothes, or burning skin
  – Reduced chance of battery explosion
  – Battery won’t leak or spill even if tipped over or accidentally cracked.

• Some are made with High purity lead (not recycled) plus a little tin.

• Lower internal resistance
  – More Cranking Amps, More usable reserve capacity, and Faster recharge

• 6TAGM battery does have the potential to freeze:
  - Fully charged = -94F or -70C
  - Extremely Over-discharged (>6Vdc) = 14F or -10C
These batteries are 6TAGM (VRLA) lead acid batteries. Though they may appear similar they also have different chemistry and capacities.

**EXIDE – 6TAGM**  
NSN 6140-01-485-1472  
PN: 6TL100G0A  
CCA - 1100

**ENERSYS – 6TAGM**  
NSN 6140-01-485-1472  
PN: 9750N7025  
Pure Lead Tin Plates  
CCA - 1225

**FIAM – Batcore 6TAGM**  
NSN 6140-15-180-0587  
PN: FAMX12120  
NSN is now invalid  
CCA - 1100
2HN Flooded vs AGM Battery Design

These batteries are commonly found on power generation equipment, and various other types of support equipment. Both are authorized for use on equipment that require this size 12V battery.

2HN – Flooded Type
Wet NSN: 6140-01-390-1969
Lead Antimony Plates
CCA - 150

Optima Spiral Core AGM (VRLA)
NSN 6140-01-529-7226
Pure Lead Tin Plates
CCA - 450
4HN Flooded vs AGM Battery Design

4HN – Flooded Type

- **4HN Wet**
  - NSN: 6140-01-390-1968
  - Lead Antimony Plates

AGM (VRLA) 4HN Replacements

- **Concorde AGM**
  - NSN: 6140-01-476-8945
  - Lead Calcium Plates

- **Teledyne/Gill AGM**
  - NSN: 6140-01-610-6102
  - Pure Lead Tin Plates
Group 31 AGM (VRLA) Battery Design

Optima Group 31 Batteries
AGM Spiral Cell Battery
Threaded Terminals- P/N D31T
NSN 6140-01-457-5469
100 & 200KW, Skid Steer, etc.

Exide Group 31
AGM Flat Plate Battery
Automotive Terminals
P/N 31A925XLW
NSN 6140-01-582-5710
BFV Hull battery

MILP/PC Enersys Group 31
AGM Flat Plate Battery
Automotive Terminals
P/N 0790-2412
NSN 6140-01-662-7350
NEW: BFV Hull battery

Automotive Terminals – P/N D31A
NSN 6140-01-502-4973
Commercial and Engineer Equip
Other VRLA AGM Battery Options

VRLA / AGM
NSN: 6140-01-505-1940
CCA – 1125
Used on Engineer Equip

VRLA / AGM Flat Plate
NSN: 6140-01-556-4352
CCA – 785
Used on HMMWV power turrets

AGM Spiral Core
NSN: 6140-01-378-8232
CCA - 800
Shown With - 6T Adapter Plate
NSN: 6160-01-453-0858
Used on Generators and other Support Equipment
A little voltage means a lot!

Only .7 volt difference

12.9 OCV

Full charge

12.2 OCV

½ charged

12.65V Minimum Install Vdc on new Batteries.

AGM state of charge versus OCV
Common Causes of Battery Failure

A battery is like a piggy bank. If you take out more than you put in, soon it is empty!!
**Mission Permitting:** All corrective actions should be done while the batteries are mounted in the vehicle, generator or system.

Corrective maintenance is intended to reverse or correct a problem that has already occurred.

Once you have found a dead or questionable battery--

The first question that must be asked is:

“**Why?**”
Deficit charging -

One of the most prevalent problems facing the military

- When the vehicle cannot fully charge the battery during normal operation. This results in a decline in capacity (shorter run time of electronics) and reduced battery life.

Typical causes are:

- Engine alternator voltage and/or amperage is too low
- Engine run time not long enough to recharge batteries
- High accessory loads (lights, radios, etc.)

Solutions:

- Install a higher amperage alternator
- Shut off accessories when possible (or leave engine running)
- Periodically use an external charger to service and re-condition the batteries
Battery Imbalance is very common in Vehicles with 12/24 Systems.

Batteries should be within .2 Vdc of each other.

The problem is very easy to correct with the Pro HD and the 490 digital analyzer in your SATS.
Mixing different types of batteries together

Connecting different types of batteries together in the vehicle \textbf{WILL} lead to shorter battery pack life and possible overcharge, undercharge and battery imbalance problems. Premature failure \textbf{WILL} happen.

\textbf{Solution:}

- \textbf{NEVER} mix different battery types.
Leaving batteries in a discharged condition; even a partial discharge, will cause sulfation on the plates that reduces battery capacity and leads to premature battery failure.

Service batteries whenever you service the vehicle!

Solution:
• Check batteries before storing vehicle & recharge batteries if needed.
• If the vehicle or equipment is not used on a regular basis, periodically check the battery OCV and charge when necessary.
• Charge whenever the battery OCV is:
  • Wet/flooded: 12.5 or less
  • AGM: 12.7 or less
• When storing vehicles that have on-board electronics, use the maintenance charger provided in the SATS trailer to prevent reoccurring battery discharge.
PulseTech has a patented high frequency pulsation charging system which has been proven to break up naturally occurring sulfation on all types of lead acid batteries, including flooded, AGM, VRLA, and GEL.

The entire charging cycle is controlled by microprocessors that consistently evaluate a battery's condition to ensure the appropriate amount of charge is being applied.
Whenever possible always conduct Diagnostics and Charging on the platform before removing batteries. Most batteries are physically damaged during Installation, Removal and Transportation.

When organizing dismounted batteries for charging we highly suggest you start charging the newest batteries in the best shape (CCAs and health) first. These batteries will recover the quickest. Look for these and other manufacture date markings:

**Shipping Dates**

**6TAGM Month/Year**

Optima batteries use a Julian date. The first 4 numbers, reading left to right, First digit is the year. Next 3 digits are the date of the year via Julian calendar. The battery to the left was manufactured in 2013 on the 209th day, which is 28 July 2013.
Historically the three most common methods of battery testing have been:

- **Digital Multi-meter**
- **Common Tool Room Load Tester**
- **Specific Gravity Tester (Duo-check)**
The 490 series conductance testers can be used repeatedly without heating up, opening caps or dealing with sulfuric acid, and provides the operator with a digital read-out that displays:

- Cold Cranking Amps (CCA)
- Whether the battery needs to be recharged and re-tested
- If battery needs to be replaced
- OCV

**Diagnostics – New types**

**CONDUCTANCE TESTING** - Uses an algorithm to compare the battery’s available capacity to a known standard.

**Battery Analyzers NSN 6130-01-510-9594**

**Mini Battery Load Tester**
NSN: 6625-01-463-8499.

**490 PT+ Replacement Paper**
NSN: 7530-01-357-6852
Chargers: So, why PulseTech?

AGM batteries need a high quality charger: Voltage must be properly controlled to prevent overcharging / gassing of the battery.

ALL PulseTech Chargers have these common features:

• Function anywhere in the world; input voltage can range between 110 - 250Vac.

• PulseTech patented high frequency pulsation charge algorithm.

• Smart Charging; Microprocessor controlled charging circuits.

• One switch operations (on/off). Minimizes training requirements.

• On-platform charging capability. No need to remove batteries or cables on any equipment type.

• Reverse polarity protection.

• No spark between leads.
Pro-HD 12/24V Charger

- The Pro-HD is an auto sensing 12/24V pulse charger designed to charge any type of lead acid battery (AGM or flooded cell) using the supplied clamps or NATO connector.

- Standard on all SATS.

- Recovers single 12V or single 24V batteries as well as 24V battery packs in the vehicle.

- Repairable at the unit level.
HD Pallet Charger

- The Pallet Charger is a 12V, 6.5 amp per channel, 12-station charging unit.
- The charger can be connected to any type or size 12V lead acid battery (AGM or flooded cell).
- Charge stations 1-12 each operate in isolation from one another, allowing any combination of batteries to be recharged at the same time.
- Repairable at the Unit Level. Charging cards, Power and Charge Cables, and Power Switch have NSNs.

NSN 6130-01-532-7711
Bench Top 6 and 12 Station Chargers  

- The PRO-PC-6 and PRO-PC-12 are 12V, 6.5 amp per channel multi station chargers.
- They can be connected to any type or size 12V lead acid battery; AGM, VRLA, Flooded, or Gel.
- Charging stations each operate in isolation from one another, allowing any combination of batteries to be recharged at the same time.
- Repairable at the Unit Level. Charging cards, Power and Charge Cables, and Power Switch have NSNs.

PRO-PC-12  Part# 746X871

PRO-PC-6  Part# 746X860
Replacement Parts available for Pallet charger, PRO-PC-12 and PRO-PC-6 chargers.

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<thead>
<tr>
<th>Item</th>
<th>Part#</th>
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<tr>
<td>Charging Board</td>
<td>740X373</td>
<td>5998-01-645-7646</td>
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<tr>
<td>Charging Cable – 8’</td>
<td>740X375</td>
<td>6150-01-618-5359</td>
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<td>Power Cord - CORD 14/3 SJTOW 6’3&quot;</td>
<td>740X415</td>
<td>6150-01-618-0289</td>
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<td>Power Switch</td>
<td>740X411</td>
<td>6110-01-645-8549</td>
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<tr>
<td>Connector</td>
<td>740X458</td>
<td>5935-01-645-8488</td>
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</table>
BATTERY MAINTENANCE MANAGEMENT PROGRAM

Battery Service Equipment Set (BSES)
NSN: 6130-01-541-9731

Set Includes the following:
• 1ea – HD Pallet Charger
• 1ea – Pro-HD 12/24V Charger
• 1ea – Redi-Pulse Pro-12 Maintainer
• 1ea – 490PT+ Battery Analyzer
• 10ea – MBT-1 Battery Testers

490PT+ Battery Analyzer
NSN 6130-01-510-9594

Mini Battery Load Tester
NSN: 6625-01-463-8499

Pro-12 Battery Maintainer
NSN: 6130-01-535-2718

Pallet Charger
NSN: 6130-01-532-7711

Pro HD
NSN: 6130-01-500-3401
Corrective Maintenance

**World Charger 12V**  
NSN 6130-01-477-4703

**USMC World Charger 12V**  
NSN 6130-01-618-4572

**Dual 24V Charger**  
NSN: 6130-01-609-9818

**Xtreme Dual 12V Charger**  
NSN: 6130-01-609-9818
Solar Charging Systems

Battery maintenance devices used on vehicles to prevent and break up large crystal sulfates on battery plates which occur in discharged batteries.

Sulfate crystal formations slowly destroy the battery’s capacity.

Solar maintenance systems are designed to offset equipment naturally occurring self-discharge.

New solar charge systems maintain and/or charge battery systems.
Preventive Maintenance (PM)

6.3 Watt Pulse Solar Chargers

24V NSN 6130-01-487-0035
12V NSN 6130-01-546-8432
These include complete install kits.

24 V – Solar Pulse Charge Monitor System

NSN: 6130-01-558-5371
Plugs into NATO slave.

24-Volt 6.3 Watt - Pulse Charge Monitor System

NSN: 6130-01-497-0964

12 and 24 Volt Pulse Charge systems:
Solar or AC charge.

24V System NSN: 6130-01-521-1387
24V System w/case: NSN 6130-01-540-3380
24V AC charge Only NSN: 6130-01-521-1329
12V System NSN 6130-01-521-1317
12V AC charge Only NSN: 6130-01-521-1765

12 V - 5-Watt Solar Pulse Charger

NSN 6130-01-446-7154

12V - SP2 SolarPulse 2Watt Solar Maintainer

NSN 6130-01-535-2718

BATTERY MAINTENANCE MANAGEMENT PROGRAM
Inside the charger is a circuit board that produces a high frequency pulse to enhance the charge current.

The 9x11-in solar panel is mounted on an angled box for better solar collection. It supplies 200 milliamps at 28 volts while producing 1/2 amp-hour of charge current per 24 hours of sunlight.

Your job is easy. Just secure the solar panel to the hood, roof or deck of the vehicle with a hook-and-PILE strip, connect it to the NATO socket and let the sun do the rest!

When the vehicle goes in for maintenance, remove the charger and leave it with your unit until the vehicle comes back.

PS 738 10 MAY 14

Here are four ways to stop needless battery replacement:

- Start the skid loader weekly and run it for an hour.
- Every other week, plug a charger into the vehicle’s NATO receptacle and fully charge the battery set.
- For long-term storage, make sure you disconnect the skid steer loader’s batteries.
- For skid loaders stored outdoors in the motor pool, use a solar charging system, like the Solar Pulse Monitor System, NSN 6130-01-558-5371. It simply plugs into the NATO receptacle and no modifications are needed.

BATTERY MAINTENANCE MANAGEMENT PROGRAM

PS Magazine Article – PS738, May 2014

PS Magazine Article – PS779, Oct 2017

Solar Pulse Charge Monitor System (SPCMS)  NSN: 6130-01-558-5371

Preventive Maintenance (PM)
Pro 12, Battery Maintainer system. NSN: 6130-01-535-2718

This unit is lightweight and capable of operating from any mounting position.

- 12 Outputs that can functionally maintain 12 different type 12V lead acid batteries at once.
- 12V - 750 mA dc per output.
- High frequency voltage pulsing to disulfate batteries.
**Grid System: NSN: 6130-01-497-0966**
This is a flexible system that comes standard with *everything needed to fit the shape / size of most standard buildings.*

- VAC to VDC power supply (with standard 3 prong plug), junction box, wiring, conduits, wire connectors, mounting hardware, drop chains, and much more.
- Input power required, 85-265 VAC, Output 30Vdc.
- Capable of supporting up to 30 drop down reels.
* Some buildings may require additional mounting hardware.

**24-Volt Drop Pulse & Charge Reel: NSN: 6130-01-497-0971**
Charges & maintains 24-Volt lead-acid batteries

- Microprocessor controlled, monitors and charges as needed.
- Never overcharges, LEDs indicate charge status.
- Utilizes optimized high frequency Pulse Technology.
- Retractable 38’ cable with a quick disconnect connection.
- 3 options for connecting to batteries:
  > Nato connection, Clamps, or bolt on lug connection.
The PowerPulse® systems are designed to ensure maximum battery performance on anything from a single 12-Volt lead-acid batteries to series / parallel systems up to 48V.

PowerPulse systems are not chargers, they are performance devices designed to help batteries charge faster and provide maximum performance and power by generating an intermittent, optimized high frequency pulse that reduces existing sulfate deposits and keeps them from building up again.

The systems are weather proof, and designed to supplement your existing charging system. They can be powered in two different ways. When the battery is being charged either by an onboard charger or a separate charging system, it will use the charging current as a power source. The rest of the time PowerPulse uses a small portion of the battery’s own energy so it is working 24-hours a day so you don’t need an electrical outlet. Accordingly, it should only be used on vehicles or equipment that are regularly used and frequently charged.

The Jump Start is a simple to use 24V jump start system that connects directly to the Nato slave receptacle. The battery pack can be removed from the cart for hard to reach equipment.

The system uses advanced AGM lead acid batteries that are non-hazardous and can be shipped safely via any transportation mode. The batteries in the Jump Start model are designed to deliver high amperage for starting turbine and piston engines. In addition, the Jump Start has a built-in charger and when left plugged into an AC source, the charger will maintain the batteries at 100% efficiency, but will never overcharge them.

Repairable at shop level: Replacement Battery pack has NSN. Battery pack NSN 6130-01-618-0951
PM Reminders:

Check batteries on a regular basis to ensure:
   > Batteries are clean and connections are tight and clean.
   > Battery hold-down brackets are tight.
   > Conductance test, check each battery and charge as needed.

Conclusion:

The information and maintenance practices described today will provide direct benefits in terms of:
   > Increased readiness / Lower battery-related expenses
   > Reduce man-hours and the longest battery life possible

Additional Info:  Optima battery military discount for personal use is available. Go to the below link for more info: http://milbatteries.com/optima-home/