TECHNICAL AND INFORMATIONAL GUIDE

What truck operators and fleets need to know about using AGM batteries to protect their efficiency and investments.

FREQUENTLY ASKED QUESTIONS

HOW IS AGM (ABSORBED GLASS MAT) DIFFERENT FROM A FLOODED DESIGN?

1. Absorbed Electrolyte: Unlike a "flooded" design, an AGM battery does not have free-flowing electrolyte within the battery. Separators made of mostly fine glass fibers hold the electrolyte like a partially saturated sponge.
2. Valve Regulated: AGM batteries are valve regulated. Valve regulation enables the hydrogen and oxygen created during charge and discharge to recombine back into water. This recombination keeps the battery water levels within proper limits. For this process to work, VRLA batteries must be charged at specific voltages. Each cell contains its own valve. If the battery is overcharged, gas pressure builds within the cell rapidly. If the pressure exceeds one and a half PSI, the valve(s) will open and let the gas escape, thus the term "Valve Regulated". If this continues, the battery will dry out and fail much like an overcharged flooded battery.

WHAT'S WRONG WITH FLOODED BATTERIES?

Absolutely nothing for certain applications. They can be great performers in the right type of application and service. And if truck designs would have stayed the same over the last 15-20 years, there would be no problem in just using flooded designs. Today's trucks are technological marvels - pushing efficiency gains into MPG ranges previously undreamed of and key-off loads from devices on par with modern hotels. They're also way more demanding on the truck's batteries.

WHY USE AN AGM BATTERY?

Many of today's heavy-duty trucks depend on batteries to do much more than crank the engine. Starting batteries alone aren't designed to withstand the continuous discharge and recharge that new auxiliary equipment and anti-idling law demands. AGM batteries recharge faster and have twice the cycle life of a conventional flooded product. AGM designs are also 20x more vibration resistant, which is critical for commercial vehicles that undergo intense use. They are also completely spillproof for easier installation, corrosion resistance, and added maintenance-free convenience.

WHY USE A FAHRENHEIT AGM BATTERY?

Fahrenheit batteries are designed with a revolutionary Thermal Shielding technology that provides the reinforced service life critical in Class 6, 7, and 8 trucks (2011 and newer). These applications are experiencing ever-increasing temperature elevations as a result of the following **High Heat Occurences:**

- Battery boxes positioned closer to the engine
- Reduced venting in battery boxes
- Aerodynamic skirting that reduces airflow to the battery box
- High heat generating, Exhaust Gas Recirculation (EGR) systems close to the battery box

The above occurrences have increased battery box temperatures from the traditional 10°F above ambient to now 140°F and beyond. Even in northern regions where high heat was traditionally not a problem, trucks are experiencing higher temperatures as a result of these high heat occurrences combined with heavier power demands. As the evolution of trucks continues to require the heavier cycle service performance of an AGM product, it is imperative to remember that Fahrenheit technology has a special reinforced cycle service design. This better equips it to withstand the grueling demands of extra electrical demand and key-off loads, especially in high heat environments. We are even finding that this technology extends cycle life under normal operating temperatures.

HOW DOES FAHRENHEIT TECHNOLOGY PROTECT AN AGM BATTERY FROM HIGH HEAT?

Life Extending Catalyst: The catalyst protects an AGM's battery recombination process by reducing internal heat and resisting thermal runaway. Use of the catalyst also reduces internal corrosion and accelerated aging.

Fahrenheit Case & Cover: Reinforced design helps safeguard performance from high heat. A Valve Regulated design has the propensity to experience bulging if it overcharges or reaches excessive temperatures. Excessive bulging is not good for an AGM design as it is built with an optimized amount of component compression to maximize performance. Fahrenheit technology protects that component protection to safeguard battery performance in high temperatures.

TempX Alloy: Strategic Alloy Technology to resist high heat and optimize the current flow within the battery.

WHAT DOES EAST PENN DO THAT IS SUPERIOR TO CLAIMS OF PURE LEAD?

East Penn's Fahrenheit products are engineered with Thermal Shielding Technology that includes a strategic grid alloy formula with high lead purity, specifically tailored to match the commercial truck application and improve the conductivity of the mass-to-grid interface. An enhanced mass-to-grid interface optimizes the battery's power delivery and promotes long life. East Penn's strategic alloy formula provides grids with corrosive tolerance, conductive performance, and manufactured integrity that a "pure lead" solution can't match. For more information about pure lead see https://fahrenheit31.com.

CAN I MIX AGM AND FLOODED BATTERIES WITHIN THE SAME BATTERY PACK?

No, you cannot mix AGM, Gel, and flooded batteries within the same battery pack. Batteries should be paired together with other batteries of similar age, ratings, and technology within the same battery pack.

WHAT IS CYCLE LIFE?

Cycle life is how many times you can discharge a battery and recharge the battery again before it degrades to the point it is no longer usable. A battery with extended cycle life survives longer than average under the more grueling demands of less than ideal environments and tough commercial use.

WHAT IS A GOOD WAY TO DETERMINE CYCLE LIFE?

Good cycle life performance depends on the criteria of the test. For example, if one test shows a battery can perform 1000 cycles, that could be good or bad depending on the test's criteria. 500 cycles might be an excellent performance on one test but on another test 500 cycles might indicate poor performance.

The SAE J2185 is a popular test to determine the effects that cycling will have on the battery's starting performance.

A 25 amp, 1-hour discharge is used to mimic the key-off loads at 122°F. The recharge is accelerated to 2.5 hours. After 26 cycles, there is a rest and a 50-second cranking simulation. The battery could fail during the 25 amp discharge, but in practice, the cranking simulation is the typical point of failure. A single 25 amp-hour cycle could represent one day of service in a vehicle with excessive hotel loads, or it could represent over a week of loads in a day cab vehicle. The fact that this is an individual battery test should be considered when evaluating the three or four battery system typical in many commercial trucks. In these systems, a single battery is supplying one-third or one-fourth of the vehicle's needs.

DOES THE BATTERY'S DOD (DEPTH OF DISCHARGE) AFFECT CYCLE LIFE?

Depth of discharge will affect cycle life. The harder any battery has to work, the sooner it will fail. The shallower the average discharge, the longer the life. It's important to size a battery system to deliver at least twice the energy required, to assure shallow discharges.

Follow these tips for the longest life:

- Avoid ultra-deep discharges. The definition of ultra-deep discharge may vary with application and battery type.
- Don't leave a battery at a low stage of charge for an extended length of time. Charge a discharged battery as soon as possible.
- Don't cycle a battery at a low state of charge without regularly recharging fully.
- Use the highest initial charging current available (up to 30% of the 20-hour capacity per hour) while staying within the proper temperature-compensated voltage range.)

IS THE VIBRATION RESISTANCE IN AN AGM DESIGN REALLY THAT IMPORTANT?

Vibration resistance is extremely important to battery life in almost any application, but especially in a commercially used vehicle and equipment that undergoes long hours of continual use. The glass mats in AGM batteries are wrapped around the positive plate, which helps prevent damage from vibration. The typical vibration test for on-road trucking applications was a test adopted from the SAE off-road work machine battery standard. This SAE J3060 Level 2 test is an 18-hour test at 5.0 peak G-force on the vertical axis at 30-36Hz. TMC RP-125 describes the same test. This test consists of about 2.2 million upward motion reversals and 2.2 million downward motion reversals where each reversal of direction requires the battery to absorb a force of 5 times its own weight. Metals will eventually break from fatigue. Holes can be rubbed through separators or the separators can move out of position. A battery that can survive this severe test is extremely unlikely to suffer degradation from vibration from typical road use in its service lifetime. East Penn's AGM products are especially designed to withstand the effects of vibration as seen from the results of utilizing these vibration tests.

SINCE AN AGM BATTERY HAS BETTER RESIST VIBRATION, IS IT STILL IMPORTANT THAT IT IS FIRMLY HELD DOWN?

Proper mounting is important. If the battery can bounce, slide around, or if the mounting system can flex excessively, on-the-road failure is possible – even with a vibration-resistant AGM design. The vehicle manufacturer and end user are responsible for correct mounting. Properly mounting and/or securing each individual battery is one of the best ways to prevent the batteries in a system from excessive vibration and damage.

CHARGING RELATED QUESTIONS

ARE THERE CONSIDERATIONS WHEN CHARGING AGM BATTERIES?

(Note: These parameters apply only to heavy-duty truck applications)

It is recommended that batteries be charged within the vehicles charging system: however, in the rare occurrence that an AGM battery needs to be charged outside of the vehicle's charging system, there are numerous chargers that can be used. Not all chargers are safe and can produce severe battery damage in only a few hours of use. Large "wheeled chargers" that are found in many shops must be avoided.

WHAT IS THE FIRST STEP WHEN CHARGING THE BATTERIES?

- Verify that a charger/setting is acceptable. Avoid high voltage. If there are multiple settings on a charger, each setting must be evaluated separately.
- Check voltage a few minutes after charging begins and periodically during charging. As the battery charges, the current will fall and the voltage may rise. It must not exceed 14.8 volts.
- If a charger/setting has been verified to not exceed 14.8 volts to a low current, the charger/setting is acceptable. (You don't need to watch the voltage every time.)

WE'RE HERE TO HELP.

If you have more questions about which type of batteries are right for your application, go to **www.fahrenheit31.com** and ask us anytime on our FAHRENHEIT HOTLINE form.

HOW DO I ACCURATELY HANDLE PROBLEMS WITH AUTOMATIC CHARGERS AND OVER-DISCHARGED BATTERIES?

(Note: These issues and solutions are not strictly limited to AGM)

ISSUES

- 12-volt batteries should never be discharged to less than 10.5 volts under load. Batteries as low as zero volts can often be recharged and be acceptable for returning to service.
- To prevent sparking and avoid problems associated with reversed hookups, many charger leads will not function until the charger senses a minimum voltage. If the voltage is too low, the charger will never turn on and no charging will ever occur.
- An automatic charger is expecting current acceptance to fall to a low value as the battery approaches a full state of charge. An over-discharged battery may have very low initial current acceptance. This can fool the charger into thinking the battery is "full". The charger will often indicate "full" and reduce the charging voltage to a subsistence level that will be ineffective.

SOLUTIONS

- Charge the battery on a wheel charger (any charger said to be unacceptable in previous section). Charge until the current has a reading above zero. Then charge 10 to 20 minutes (at the most) longer. Return battery to an automatic charger.
- Charge the battery with a second good battery connected in parallel. The second battery should be at least a little discharged so that it is not also seen as being "full" almost right away.

HOW DO I DETERMINE THE REQUIRED CHARGING TIME FOR MY BATTERIES?

The Typical Charging Time for Single Battery chart is designed to give approximate times for charging and should not be the deciding factor as to whether the battery is finished charging. An automatic charger compatible with the battery will look at how the voltage and/or current vary(ies) over time to determine the battery's state of charge. If charging is stopped prematurely, the battery will appear to be fully charged, however; this is just the elevated voltage from the recent charging activity. A much longer charging time than shown will not harm the batteries if using an appropriate voltage regulated charger. The required charging time is often much longer than most people realize. "Charge" is measured in ampere-hours (Ah). A typical Group 31 battery holds 85 to 105 Ah from "empty" to "full" (This is the 20-hour capacity rating). An overdischarged battery is less than empty. Charging is never 100% efficient. You normally need to add an extra 8-15% beyond what was removed.

TYPICAL CHARGING TIME (HOURS) FOR SINGLE BATTERY

OCV	SOC	Charger's Maximum Rate Setting		
		30 Amps	20 Amps	10 Amps
12.80	100%	0.0	0.0	0.0
12.60	75%	0.9	1.3	2.5
12.30	50%	1.9	2.7	5.1
12.00	25%	2.9	4.3	7.8
11.80	0%	4.0	5.7	10.7

HOW DO I DETERMINE IF MY BATTERY IS HALF DISCHARGED, FULLY DISCHARGED, OR OVER-DISCHARGED?

1. Example: an 85 ampere-hour battery, totally discharged: you need to supply 85Ah x (100% discharged) x (115% efficiency factor) = 97.75Ah. You need to supply about 100Ah to recharge completely.
2. To supply 100Ah, you could supply 5 amps for 20 hours, 10 amps for 10 hours, 20 amps for 5 hours, etc.
   A charger does not deliver its maximum current the whole time. When the battery approaches full charge, the charger limits the voltage by reducing the current. Consequently, a full charge takes about 3.5 more hours than the calculation above suggests. With an automatic charger, charge until the charger indicates that charging is complete. If you are attempting to charge an overdischarged battery, review the question at the top of the page.

HOW DO I PREPARE MY BATTERY FOR TESTING AND CHARGING?

You are responsible for your safety and the safety of all bystanders. Follow all BCI (Battery Council International) safety instructions for working around batteries, handling batteries, and charging batteries.

1. Visually inspect each battery for damage. Do not charge or test a damaged battery. Remove from service.
2. Inspect vehicle. Repair or replace ineffective hold-downs. Clean connections and terminals as needed. Replace damaged wiring.
3. Group 31 battery studs must not be used for testing or charging connections. Install adapters. The adapters must be tight against the lead "button" at the base of the stud. Alternatively, you may clamp directly to the sides of the lead button. Both sides of both clamps must make good electrical contact with the lead button.
4. Be sure to use the CCA rating for a handheld tester or to calculate the load for a load tester. Other ratings are often also displayed. Using the wrong ratings and calculations could lead to incorrect results.

TESTING RELATED QUESTIONS

HOW DO I EVALUATE THE CONDITION OF MY CHARGED BATTERY?

It is recommended that testing should not occur until at least 4 hours have passed since the battery was charged. Resting the battery reduces both good batteries called "bad" and bad batteries called "good."

The battery must be disconnected. (Some chargers continue supplying a maintenance charge while indicating, "done.") A handheld conductance tester's accuracy can be diminished when testing a battery that was recently charged. Resting also gives a better indication of battery shorts.

WHAT TESTING OPTIONS DO I HAVE?

1. BCI load test: Using a carbon pile or similar discharging device, load the battery at ½ of the CCA rating. Note voltage at 15 seconds and stop discharge. If voltage is less than 9.6 (70˚ F, normal temperature), replace battery.
2. Fixed load test: Similar to BCI test except voltage limit depends on CCA rating. See instructions or meter for details. If tester can do both 6-volt and 12-volt batteries, be careful of 12-volt batteries that fall into the "good" 6-volt battery range. These are bad.
3. Handheld conductance tester: Since AGM batteries have lower internal resistance than traditional lead acid batteries, they require electronic testers that are programmed specifically for them. Many older-model battery testers cannot adequately test AGM batteries and could prematurely condemn a good AGM battery.

WHAT ARE THE BCI AND FIXED LOAD TEST PROCEDURES?

1. Recharge if the OCV is below 75% state of charge (Refer to the chart above). Use a voltmeter to determine the OCV.
2. If you have an adjustable load meter, set the load for ½ the CCA rating.
3. Apply the load for 15 seconds. Battery should maintain a voltage greater than 9.6 volts at 70°F while load is applied.
4. If below 9.6 volts at 70°F, recharge and repeat test.
5. If below 9.6 at 70°F volts a second time, condemn and replace the battery.

BCI AND FIXED LOAD TEST PROCEDURE		
% CHARGE	OPEN CIRCUIT VOLTAGE (OCV)	
	FLOODED	AGM
100%	12.7-12.60	12.80 or higher
75%	12.40	12.60
50%	12.20	12.30
25%	12.00	12.00
0%	11.80	11.80

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