



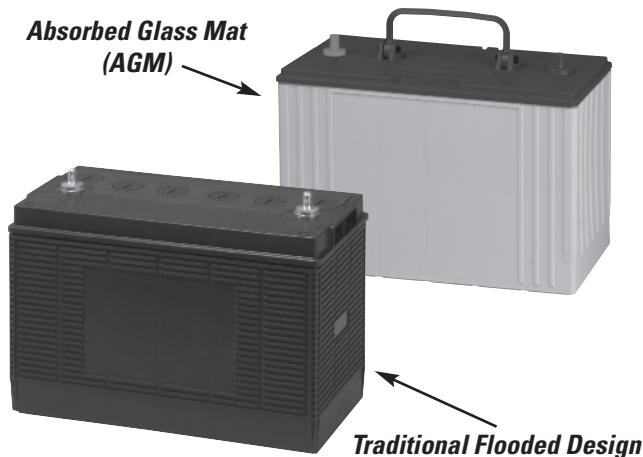
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TECHNICAL UPDATE

East Penn AGM Batteries in Heavy-Duty Truck Applications A GUIDE FOR IDENTIFYING, CHARGING, AND TESTING

IDENTIFICATION

Proper identification of the type of battery being used is critical to its longevity and performance.



AGM or Absorbed Glass Mat batteries can directly replace flooded batteries and some brands can be difficult to distinguish by sight without reading the label. They are compatible in terms of physical size and vehicle charging system requirements in most applications. Their weight and capacity can be slightly higher than a flooded battery of the same size (6 to 8 pounds higher with products of comparable amp hour ratings). Just like flooded batteries, AGM batteries of the same physical size can be designed with widely differing CCA ratings for a variety of differing needs. Vents and valves may be inconspicuous or hidden.

While AGM batteries may look similar to a flooded design, there are some internal differences that need to be recognized.

A. How is it different from a flooded design?

Unlike a “flooded” lead-acid battery, an AGM battery does not have free-flowing electrolyte. Separators made of mostly fine glass fibers hold the electrolyte like a partially saturated sponge.

AGM batteries are Valve Regulated Lead-Acid (VRLA) batteries that recombine the hydrogen and oxygen created during charge and discharge, 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.

There are two types of VRLA or Valve Regulated Lead Acid batteries, AGM and Gel (acid is in a thick gel form instead of a liquid).

B. Why use an AGM Battery?

AGM batteries offer superior starting power, high reserve capacity, and long lasting life. The advanced AGM technology and dual-purpose design makes East Penn’s AGM battery excellent for quick starts and for powering accessories and creature comfort items when your engine isn’t running. Heavy cycling East Penn AGM batteries are excellent for battery powered HVAC systems. All group 31 AGM batteries have the same case/cover configuration as a traditional group 31, which allows it to be used as an original equipment battery or as a drop in replacement.

C. What types of applications use AGM batteries?

AGM batteries can be used in several applications including truck starting, dual-purpose, and deep cycle applications. Similar to flooded, AGM batteries have different designs ideal for specific applications.

- **AGM Starting & Cycling** batteries are designed for larger engines that need high cranking power like dump trucks and loggers. They are also designed for cycling applications such as day cab, sleeper cab, and pick up and delivery.
- **AGM Starting & Heavy Cycling** batteries are a deep cycle version designed for applications where there is heavy auxiliary loads or the battery is the power source such as a battery powered HVAC system.

D. Can I mix AGM and Flooded batteries within the same battery pack?

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

CHARGING

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

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.

Many common battery chargers are not fully compatible with AGM batteries, however; they will not ruin the battery if used only once or twice over the battery's lifetime. Adversely, 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.

A. 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 15.4 volts.
- If a charger/setting has been verified to not exceed 15.4 volts to a low current, the charger/setting is acceptable. (You don't need to watch the voltage every time.)

B. Handling Problems with Automatic Chargers and Over-Discharged Batteries

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

1. 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.

2. Solutions

- Charge the battery on a wheel charger (any charger said to be unacceptable in Section A). 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.

C. Determining Required Charging Time

Typical Charging Time (Hours) for Single Battery				
OCV	SOC	Charger's Maxium 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

**OCV (open-circuit voltage) may be elevated by recent charging activity or depressed by recent discharging activity. This affects the accuracy of the SOC (state of charge) estimate.*

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 ampere-hours from "full" to "empty" (This is the 20-hour capacity rating). An over-discharged battery is less than empty. Charging is never 100% efficient. You normally need to add an extra 8-15% beyond what was removed.

Determine if the battery is half discharged, fully discharged, or over-discharged.

1. Example: an 85 ampere-hour battery, totally discharged: you need to supply $85\text{Ah} \times (100\% \text{ discharged}) \times (115\% \text{ efficiency factor}) = 97.75\text{Ah}$. 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 beginning of section B.

D. Preparing 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 expectations could lead to incorrect results.

TESTING

A. Evaluating the battery condition of a 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.

B. Testing options

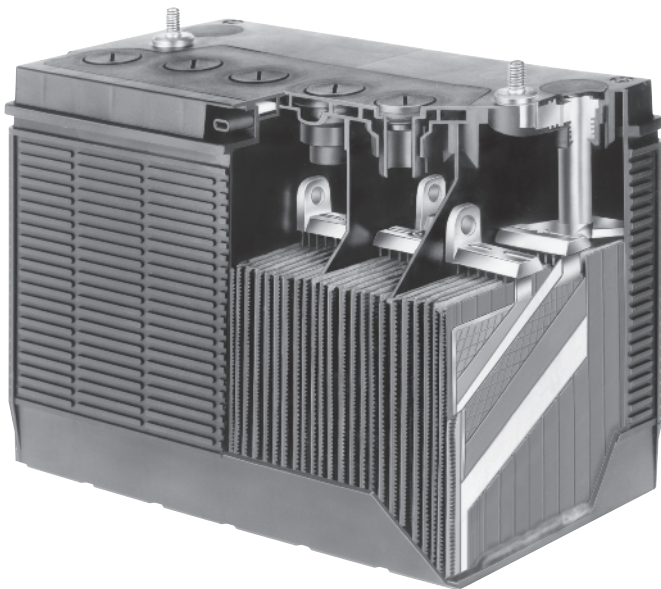
- BCI load test—Using a carbon pile or similar discharging device, load the battery at $\frac{1}{2}$ of the CCA rating. Note voltage at 15 seconds and stop discharge. If voltage is less than 9.6 (normal temperature), replace battery.
- Fixed load test—Similar to BCI test except voltage limit depends 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.
- 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.

C. BCI and Fixed Load Test Procedure

% CHARGE	OPEN CIRCUIT VOLTAGE	
	FLOODED	AGM
100	12.70-12.60	12.8 or higher
75	12.40	12.60
50	12.20	12.30
25	12.00	12.00
0	11.80	11.80

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 $\frac{1}{2}$ 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.

Flooded Dual Purpose Cutaway



Absorbed Glass Mat (AGM) Cutaway

