

Technical Bulletin

Topic: Golf Car Battery Separators

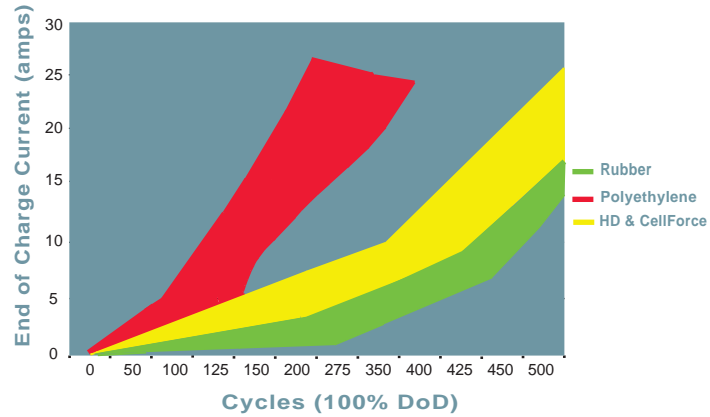
1. Introduction

Golf car batteries are a special breed of lead-acid battery. While most SLI (automotive) lead-acid batteries have moved away from the antimonial-lead grid alloys (for reduced gassing and water-loss) golf car batteries embrace these alloys. The golf car battery manufacturers learned long ago that nothing cycles deeper and longer than a battery made using 4-6% antimony in the positive grid. In addition to hybrid alloy grids to obtain the long life and abuse resistance required by the Golf Cart and other deep cycle applications, battery manufacturers also make use of thicker plates and denser positive active material (paste) to obtain the desired performance parameters.



2. Antimony and the “Rubber Effect”

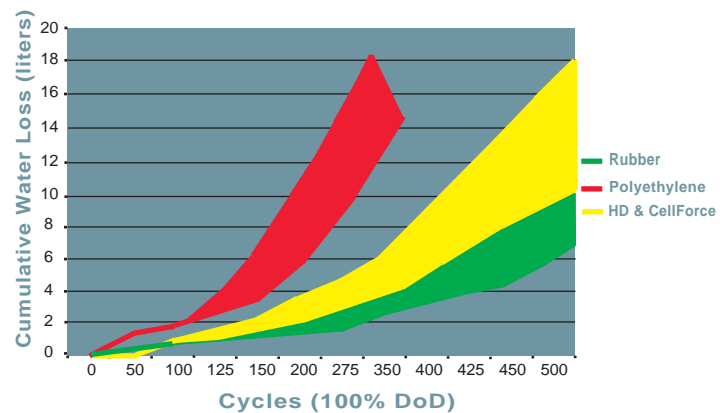
Antimony is one of the keys to lead-acid battery performance and life in deep cycle applications such as golf car. The antimony serves to promote a stable grid to paste interface and leads to stronger paste adhesion and conductivity. There are some down-sides to antimony. As the battery ages and the positive grids begin to corrode, antimony is released. The antimony dissolves in the acid and eventually migrates to the negative plate where it “plates out” as metallic antimony. Antimony has a lower hydrogen over potential than lead and immediately causes a notable increase in “gassing”. Gassing results in the loss of water as hydrogen and oxygen but also as vapor which is carried out of the cell by the escaping gas. Lower hydrogen over-potential also reduces the charge acceptance of the negative plate and causes an imbalance in the negative and positive material in the battery. The entire process of antimony poisoning the negative and the associated gassing is evident by an increase in the end-of-charge current.



Rubber based separators reduce the effects of antimony resulting in less water loss while improving charge efficiency. Testing shows that antimony is still plated-out on the surface of the negative plate but its effects are limited. Daramic offers multiple separator products that are designed for golf car applications and have the “Rubber Effect”. In Daramic products like Flex-Sil, the separator is actually made of natural rubber. In other Daramic products such as “HD” or “CellForce”, the separator is made from polyethylene for its increased strength and incorporates a rubber additive. All these separator products function in a similar way, reducing water-loss and increasing battery life / performance.

3. Glass Mat for Longer Life

The use of a glass mat glued to the positive ribs of the separator facing the positive plate is crucial for long, deep cycle battery life. Features of the glass mat that must be considered are porosity, thickness and stiffness.



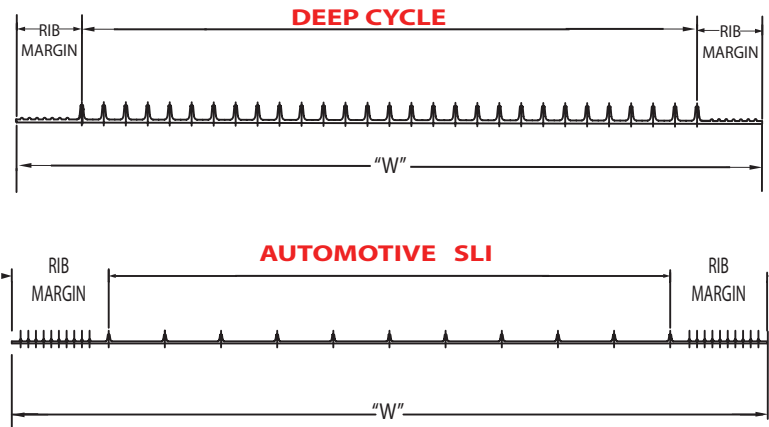
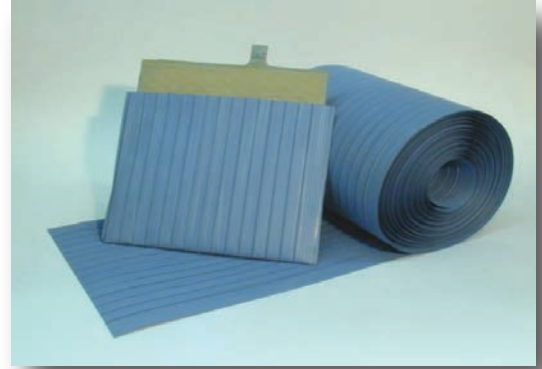
Correlations between these properties and battery life have been proven. A good golf car battery separator has a stiff glass mat that is well supported by the separator ribs. These attributes allow the glass mat to act somewhat as a compression spring keeping the active material in place during high vibration and deep cycling.

4. Rib Design for Better Support

Another key to a well designed golf car battery separator are the ribs. The rib height, pitch (spacing), shape and strength are all very important for good battery performance. Of course the main function of the rib is to create an acid reservoir for the positive plate. An equally important function of the ribs is to compress and support the positive active material (paste) via the attached glass mat. As the battery is cycled the positive plate will begin to “shed” the active material and the combination of separator ribs and glass mat serve to keep the active material in place. Less shedding means a lower tendency for the shed material to cause life-limiting problems such as “mossing” which leads to short circuits.



trend toward high-speed assembly leans toward enveloping plates since that is the technology used in their portion of the industry. The enveloped plate makes the cell and battery more resistant to vibration and “mossing” shorts. An added benefit permits the battery designer to eliminate the plate or mud-rest in the container. As one might imagine, larger plates can be used in the enveloped cell in the absence of the mud-rest. The downside of using envelopes is that acid tends to become trapped in (or outside) the envelopes and the battery cycle life is compromised.



The other option for a golf car battery is the use of leaf separators. Cells employing leaf separators have some performance advantages in that they do not have an issue with trapped acid. At the end of charge, the acid in the cell tends to be more homogeneous. More uniform acid distribution results in better use of the plate surface. The downside of leaf separators is the need for plate-shortening mud-rests. In the Daramic product line there are some issues that make the roll vs. leaf decision a non-issue. For example for HD and CellForce, these products are offered in both roll and leaf format and can be enveloped or sleeved if necessary. Flex-Sil on the other hand can not be enveloped and is only available in leaf form. In the end there remain two options for separator design and in some regard the choice is fully dependant on the requirements of the battery manufacturer.

5. Roll vs Leaf Separator in Golf Car

This is a topic that may be somewhat controversial among golf car battery manufacturers. There are basically two schools of thought, 1) High-speed assembly using roll-stock separators and enveloped plates or 2) Hand or semi-automated assembly using leaf separators. The SLI battery community with its

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