

## Introduction

There are many factors to consider in the design and construction of a flooded lead acid battery. As with any product, key design features to eliminate problems are a top priority from one design generation to the next. Continuous effort to identify and control problems in long service life products is a challenge.

## History

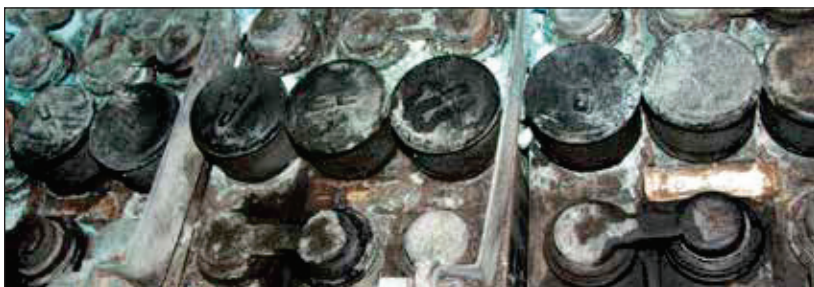
As far back as the early 1970s, the need for improvement of post seal designs has been a major factor for both manufacturers and users of systems. Today, 40 years later, post seal failures are still a fairly common occurrence for some post seal designs.

This white paper discusses the problems of post seal leaks, the factors that create them, and design considerations that will eliminate post seal leaks in most situations.

## The problems with post seal leaks

Battery post seals are designed to prevent the loss or escape of electrolyte from cells. The chemical properties of the electrolyte can cause corrosion and degradation to the electro-mechanical integrity of terminals and inter-cell connectors (*Figure 1*). Even the smallest amounts of corrosion can increase the internal resistance from one cell to another and affect the performance of the entire battery system.

Besides the obvious electrical problems mentioned above, they are costly and often impossible to correct. Capillary movement of the electrolyte will continue if the post seal is not 100% restored during repair/maintenance leading to more frequent and often less effective repairs over the service life of the system. Internal crevice corrosion (*Figure 2*) inside the post and seal structure itself is a non-correctable failure that requires cell replacement rather than repair. Solid fixed seal designs often have to be removed from service to allow repair methods to be performed.



*Figure 1: Excessive corrosion due to seal leak*

## The cause of post seal leaks

Capillary action will allow movement of the acid through the porous lead surface of the posts. As the acid wicks up the posts, it can cause a high resistance oxidation to occur where the acid contaminated lead is exposed to the air. If the acid finds it's way into a pre-existing flaw in the post, a condition called crevice corrosion can occur where the corrosion of the lead grows internal to the post structure and causes failure, as seen in *Figure 2*.

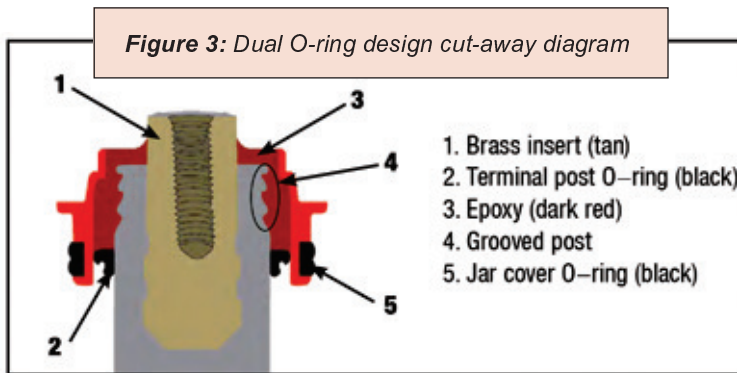
Another cause for post seal leaks is over-charging a battery system, which accelerates positive plate grid corrosion. As the plates undergo grid corrosion, they move and expand both horizontally and vertically. "Positive plate expansion due to grid corrosion is one of the most common reasons for post seal problems."

During maintenance, each individual post must be checked periodically to ensure it's integrity is sound enough to prevent electrolyte from escaping. The results of the corrosive process can be seen in *Figure 2*.

All of the elements and actions described above must be coordinated and executed with consistent precision in order to stop post seal leaks from ruining an entire battery system. This takes a massive effort from engineers and technicians, especially if they monitor several battery systems. Not every company or technician is capable of paying such close attention to all of the aspects of battery system maintenance. Approaching each cause individually will yield measurable benefits for a system's longevity, but it will require a lot of work. On the other hand, utilizing batteries that incorporate dual O-ring seals and grooved battery posts can reduce the frequency of post seal leaks caused by all the factors.

## Solution

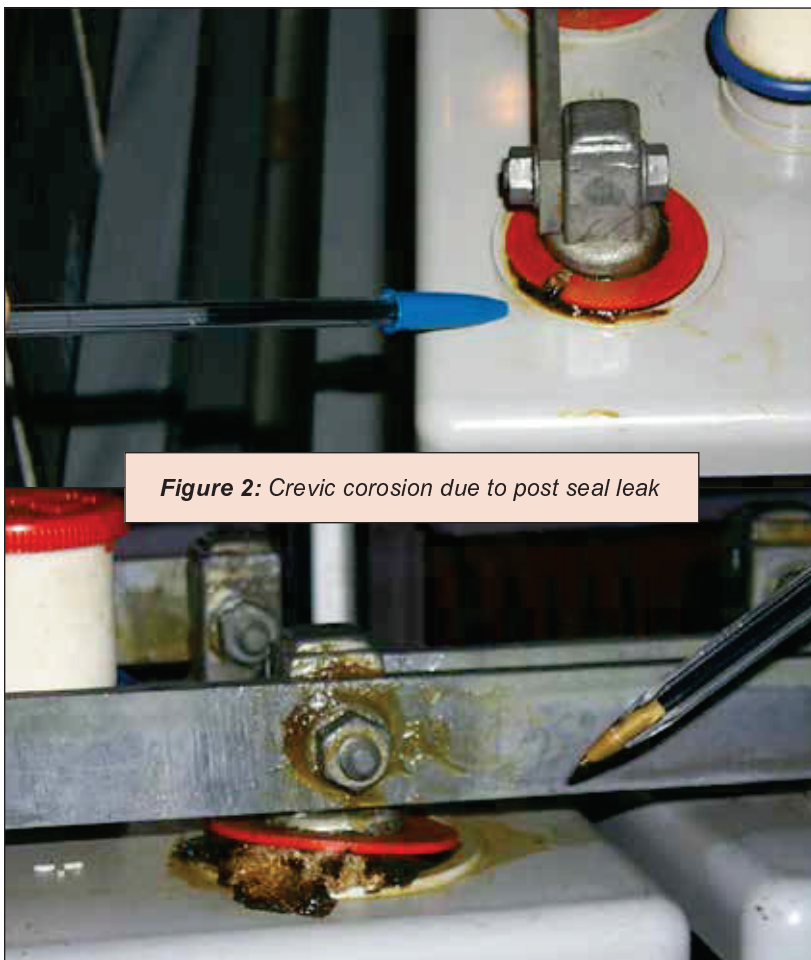
A dual O-ring system (elements two and five in *Figure 3*) adds a second seal around the outside of the cap that adds additional protection from electrolyte escaping the cell. This allows the cover seal to expand and contract along with modest variations in internal temperature caused by overcharging / overuse, or high external temperatures while the internal seal prevents electrolyte from escaping up the post into the electrical connections. This added flexibility restricts the corrosive electrolyte from penetrating the seal and harming the battery. In this way, the double O-ring prevents corrosion and reduces the prevalence of problems associated with post seal failures on single O-ring design types.



Grooved battery posts have a unique shape on the top of the terminal that secures inside the cap, securing the two components together (element 4 in *Figure 3*). The grooved posts also help prevent any shifting that may happen as a result of temperature changes. By providing a lip to hold the cap in place, there is also less of a chance that the seal will loosen, exposing voids in the seal.

Specially designed tubular plates, which eliminate cross laterals in the grid structure, eliminate the largest source of grid corrosion and plate expansion. This greatly reduces the forces the plates themselves put on the seals, again reducing the chances of a post seal failure.

Patented design features make purchasing higher quality flooded lead-acid batteries more cost effective over the service life of the battery than the lower-quality and less well-designed counterparts. With batteries, there is a clear connection between the design and composition and the true service life the battery provides, given all maintenance and environmental factors are the same. Less advanced batteries may appear attractive initially, but once the higher maintenance costs and more frequent cell turnovers are considered, the cost comparison shifts to favor the higher quality product.



*Figure 2: Crevic corrosion due to post seal leak*

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