Sealed Lead Acid Batteries (SLAB) Explained

DDB Unlimited
8445 Highway 77 North
Wynnewood, OK 73098
800-753-8459
405-665-2876
www.ddbunlimited.org
sales@ddbunlimited.com

SEALED LEAD ACID BATTERIES (SLAB) EXPLAINED

This document is intended to provide the user with an overview of the operation of Sealed Lead Acid Batteries (SLAB) and does not get into the chemical considerations of the design and manufacture that are quite complex. The current day SLAB battery has evolved over the past 30 years into a product that is reliable and safe to use in stationary platforms that require long term battery backup applications.

There are many other chemistries of batteries such as Lithium Ion that can provide superior performance but at the same time are more expensive and have some safety concerns. The recent Lithium Ion application at 30,000 sites of AT&T is a good example where they have had fires and explosions at a number of sites is that the product may not be as safe as previously thought.

The major change occurred in the automotive industry when the charging method was changed from a DC generator to an AC alternator which was driven by the increased requirements of stable voltage, much higher current demands and prevention of battery over charging. Diode isolation of the alternator simplified the battery discharge problem of the alternator and the electronic regulator provided the stable and accurate voltage required for the electronics in the vehicle especially the computer which controls the engine and other vehicle functions. The introduction of the SLAB or maintenance free battery occurred during the generator phase and since there was no method of insuring overcharging of the battery it was not well received. The major problem with over charging is boiling and evaporation of electrolyte.

The Sealed Lead Acid Battery (SLAB) used in telecom and industrial applications really became popular in the mid 90's due to the fact that it was safer to handle and significantly reduced the presence of hydrogen out gassing which can lead to explosions and potential personnel hazards. The SLAB battery being sealed also prevented the potential for electrolyte leaks which also requires special OSHA requirement for spill prevention. The SLAB has also included the valve regulated (VRLA) release of battery pressure when the battery internal pressure exceeded 5 PSI.

The major maintenance issue with any battery array is the connections to the battery. Corrosion is typically the critical issue that occurs because of electrolysis and exposure to oxygen and containments. The use of NO-OX or similar antioxidant material will typically prevent this from becoming an issue. Insuring that the connections are secure and tight also reduces the resistance build up that is typically dissipated in heat and lost current capacity.

A so called maintenance free battery SLAB depends on an intelligent charging method that nearly eliminates over charging which is the primary reason for the electrolyte to boil and evaporate. Most current day rectifiers use a three step charging process which is typically a closed loop feedback method (1) initial high current charge, (2) top off charge at reduced charge current, (3) float charge which is typically in the range of 1 to 3 amps depending on the amp hour rating of the battery. Initially there is the deep charging cycle where the current provided to the battery under charge may be as high as 10 to 20 amps which is typically current limited by the rectifier. Two factors determine this period which are the initial voltage of the battery and the amount of charging current. The industry standard for charging is 0.1 times the amp hour rating of the battery. Most SLAB batteries can accept up to 0.2 of the amp hour rating for a short period of time (less than 2 hours) without damaging the battery. Extended periods of high current charging will typically shorten the life cycle of the battery. As the battery begins to accept the charging current the amount of current is reduced over time. The top off usually occurs in the charging current range of about 3 to 5 amps and is typically the longest period of the charging process. The float charge also referred to as the standby charging is the final phase of the charging process and is typically in the range of 1 to 3 amps.

The typical charging process of a Lead Acid battery depends on the initial float voltage of the battery after discharge. Those systems that have Low voltage Drop Out (LDO) insure that the battery array voltage will never be below the LDO voltage value. Those systems without LDO are indeterminate as to what voltage may exist in the battery array and as such may require a much higher charge current to charge the array than with LDO. The typical charging period is between 12 to 14 hours for LDO systems and may be much longer without LDO.

The life cycle of a typical SLAB battery is about 5 years due to the fact that as the battery ages the efficiency of the battery to provide current is reduced by about 5% per year of operation assuming a nominal amount of battery backup usage. A greater frequency of battery backup usage will deplete this life cycle further. A typical battery backup would be about 90% of the time the charge is in the float mode which is like shelf life for standard alkaline batteries. The normal brownout and transmission line switching which provide momentary loss of power is accounted for in the estimate. The extended battery backup of storms that might extend the battery backup is considered to be no more than 10 periods per life cycle year. Those areas that have greater than normal storms activity may require a shorter life cycle consideration.

Selecting the rectifier current requirements should include a safety margin of about 20% to allow for variations of equipment current due to variation in traffic flow and operation over the temperature extremes of the equipment. In addition to the equipment current requirement there is the charging of the battery bank that needs to be considered. Keep in mind that the current will always flow from the highest voltage source and in the case of the rectifier by design will always be the highest voltage source as long as the rectifier is being powered. Most rectifiers have a current limit for charging the batteries which is typically in the range of 10 to 20 amps. If the system is equipped with LDO then the lowest voltage of the battery bank would be 42 volts (may be adjustable) in a 48 volt system. Without the LDO the battery bank may require higher initial current due to lower voltage. This is based on the industry standard that the individual battery cell is at or less than 1.75 volts per cell is the definition of a fully discharged battery. This charging current must be added to the equipment current in order to properly size the rectifier. The current limit of charging the batteries may require longer than the typical 12 to 14 hour charge time to fully recover the battery array.