

Tech Note 2019-08

Technical Guidelines to avoid disappointment when purchasing batteries for solar applications

Consider a **200AH** battery requirement for solar installations.

The first question is what is the discharge rate. Stationary batteries are usually specified at C10 (20amps for 10 hours) and solar at C100 (2 amps for 100 hours). These discharge rates give different capacities. Eg. The Solar GEL battery Type ES-12200 is rated 220AH @ C100, 200AH @ C20 and 187 @ C10. Knowing the actual discharge time may allow for optimising the battery further.

The lowest cost battery is the SLI (Starter, Lights, Ignition) battery which is normally flooded so must be kept upright at all times. It is designed for vehicle application where the design criteria are high start amps for a few seconds, low cost, low mass and a life of 3 years. These SLI batteries are brilliant in achieving these objectives but when used on solar they are very disappointing. They are not designed for deep discharge and service life of less than 50% of the expected 3 years is often the result. We do not recommend this technology and do not offer this battery. The SLI battery can have a price of 50% to 75% of the AGM technology/

The AGM (Absorbent Glass Mat) technology is a 'sealed' cell with a vent cap to allow hydrogen to escape and is referred to a VRLA (Valve regulated Lead Acid). They are usually flat plate design. These have excellent short term current ability and are extensively used on UPS applications where deep discharges are infrequent. The failure mechanism of a lead acid battery is positive plate corrosion. The published anticipated life is often based on the life for the positive plate to corrode away without other failure mechanisms such as deep cycle etc. AGM are often quoted as 12 year life but often a life of 5 to 7 years is experienced due to other failure mechanisms. These are susceptible to high ambient temperatures and high ripple currents which must be avoided. Drying out of the battery is one of the failure mechanism. This is rated as 1200 cycles at 50% DoD.

The lead acid GEL battery has the electrolyte turned into a gelly by adding SiO_2 . This causes cracks in the GEL when it sets and allows the recombination of O_2 from the positive plate through the GEL to the negative. The GEL comes in flatplate design as well as tubular design. The GEL has more electrolyte and drying out is less of a problem than the AGM. The cycle life is better than AGM but the cost is higher by about 10% to 15%. This is rated as 1800 cycles at 50% DoD.

The best technology for solar cycles is the tubular cell and this is used for professional and commercial applications. The capital cost is higher than the flat plate cells but the amortized life cost per cycle is lower. For comparison, the tubular GEL battery has a German tested cycle life under IEC solar cycles at 6400 cycles.

The Lithium battery family includes a number of types. LFP Lithium Iron Phosphate LiFePO_4 , NCM Lithium Nickel Manganese Cobalt Oxide, LCO Lithium Cobalt Oxide LiCoO_2 , LMO Lithium Manganese Oxide LiMn_2O_4 and LTO Lithium Titanate. These generally trade off energy density for safety.

Lithium batteries have the advantage over lead acid of higher energy density or put another way, are lighter. If it moves then one of the Lithium batteries is probably the best option. Theoretically it is 3 to 8 times lighter but in practice one can expect a mass saving of 50% when compared with lead acid. This loss of size advantage is due to the technology and extra electronic and ancillary equipment which protects it against under, over charging, over current and high temperature usually called a BMS. It has a high cycle life of 3000 cycles. It also cost more.

Cost per Cycle/12v:

Lithium LiFePO_4	=	R5,00/Cycle
AGM battery	=	R4,46/cycle.
Flat Plate GEL	=	R3,32/ cycle
Tubular GEL	=	R2,18/cycle.

All 'sealed' batteries have the problem of starting their life when they are made and not when you take delivery. We ensure our 'sealed' batteries are generally not older than 6 months when sold. The German BAE OpzV Tubular GEL is only manufactured to order so delivery is 14 to 16 weeks.