ROLLS BATTERY ENGINEERING

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The positive power choice

Bulletin 610, Battery Ventilation

This bulletin describes battery ventilation and is meant as a general guide as local codes and engineering practices need to be followed.

Battery ventilation is very important and can be minimized by using the correct voltage settings and three-step charging. Please see bulletin #605 for charging details.

This bulletin describes the worse case of battery gassing assuming the battery is fully discharged and then fully charged as quickly as possible.

Hydrogen Liberation

As the battery cell voltage reaches 2.35 VPC the majority of gassing begins. At this point approximately half the electrical energy causes water to break down into hydrogen and oxygen gas. If we know how much extra energy is required to fully charge the battery then we know how much energy is available to create hydrogen gas. This is generally accepted as 20% or for a 100 AH battery will require an electrical input of 120AH. Not all this extra is used to create hydrogen, some is dissipated as heat but for simplicity it is assumed all extra energy is used to create gas.

Through calculations we can show that 1 AH of over charge will in fact produce 0.42L of hydrogen gas PER BATTERY CELL. Also for every volume of hydrogen a ½ volume of oxygen is produced. This must be considered because to remove the hydrogen the oxygen must also be removed.

For our example consider a 100AH 6V (3 cells) we would have:

20 AH x 0.42L H_2 (/ AH-cell) x 3 cells = 25.2 L of hydrogen or

A total gas volume of:

25.2 + 25.2/2 = 37.8L to include the oxygen.

This gives us general statement that a 6V battery has the potential to produce

37.8L of gas per 100AH capacity or

12.6L per cell per 100AH

For example if designing a 48V 1000AH bank with series connections 24 cells total).

H2 = # of cells x 12.6L x CAP (20hr rate) / 100 or

24 cells x 12.6L/AH x 1000 AH/ 100AH = 3,024L

Note: If you have parallel connections you must use the total number of cells. If the above were two parallel strings then it would need to be doubled.

Gas Loading and Ventilation

Once the volume is known the loading needs to be known in order to properly vent the box or area. It can be shown that the fastest a battery can be charged without permanently damaging the battery is 5 hrs. The gassing occurs in the last 20% of charge or in 1 hour (60 minutes). Gassing occurs at a consistent rate over this hour and can be assumed to be constant. For a 100AH 6V we have:

37.8 L or 1.33 ft^3 of hydrogen.

To remove it as fast as it is produced then the area needs to be evacuated by at least that amount (1.33 ft^3 per hour or 1.33/60 min = 0.022 standard cubic feet per minute).

For a 100 AH 6V 0.022 SCFM Hydrogen and 0.044 SCFM Oxygen

Hydrogen Explosions Limits and Ventilation Systems

Hydrogen is explosive in concentrations above 4%. Ventilation systems, for the purpose of this bulletin maybe groups into two types. The first is a tight battey box and the other is a large room. The tight battery box may be vented using a explosion proof blower that will suck air through the box. If a safety factor of 25% is used then the blower can be sized by the gas load. There are explosion proof ventilators such as www.zephyrvent.com/ that are very reasonably priced, explosion proof and will turn on when the batteries begin to gas.

If the room is large the hydrogen and oxygen will dissipate and mix with the air. This means more gas must be evacuated. Methods and calculations used are beyond the scope of this bulletin.

It should be remembered that by controlling the cell voltage gassing can be greatly reduced were venting can simply be to the atmosphere through a static vent or “chimney”. Usually this is sufficient for small systems.