C&D TECHNOLOGIES

GASSING AND VENTILATION

When charging the typical lead acid battery a portion of the charging current, that which is in excess of that required to maintain 100% state of charge, will electrolyze water in the electrolyte thus generating free oxygen and hydrogen gas to be vented from the battery. Naturally, the venting of hydrogen is of concern since a 4% mixture of hydrogen in air is the lower flammability limit, where the mixture of hydrogen in the air can either ignite or explode. For this reason it is recommended that no more than a 2% level be allowed to accumulate. OSHA classifies a room with a hydrogen concentration 2% or less is classified as non-explosive.

VRLA Battery Operation

The valve regulated lead acid (VRLA) battery is unique in that it incorporates an oxygen recombination cycle which occurs at the negative plate of the cell and minimizes the generation of hydrogen. As a result, the VRLA battery will typically have a recombination rate of 95 to 99% and will emit only a very small fraction of the hydrogen as would be emitted by a vented (wet) lead acid battery.

Battery Ventilation

Per NEC Article 480 the VRLA battery must be equipped with a pressure relief valve to prevent excessive build up of pressure within the cell. Also, provision must be made for sufficient diffusion and ventilation of any gasses emitted from the battery to prevent the accumulation of an explosive mixture (4% hydrogen in air).

As indicated by the classification of the VRLA battery, they contain a self-resealing, one way valve which will relieve any internal pressure generated due to overcharging which is in excess of between 1 and 2 psig and will then close preventing entry of the outside air into the cell.

The volume of gas emitted by the VRLA battery is very small under normal float and equalization charging conditions and special mechanical ventilation would not normally be required. Hydrogen is lighter than air and disperses quickly throughout the surrounding atmosphere.

Unrestricted air movement around the individual batteries in a system and the normal requirements for air circulation and heat removal in occupied areas is typically more than adequate to prevent any build up of an explosive mixture of hydrogen gas where VRLA batteries are concerned. Naturally, this indicates that the VRLA battery should never be charged in a “sealed” container lacking ventilation.

However, the oxygen recombination feature of the VRLA battery and resulting low emissions of hydrogen gas does allow for its use in industrial and commercial areas where the vented (wet) lead acid cells would not be acceptable. For example, the UPS series of VRLA batteries are utilized within UPS systems installed directly in data centers and in compliance with UL1778. The TEL series are used in commercial and industrial facilities business areas and equipment rooms, without special ventilation systems, in direct support of telecommunications equipment.

The 12V VRLA series of batteries are also UL recognized under the UL category of “Emergency Lighting and Power Batteries (BAZR2)” under the following file numbers:

Please Note: The information in this technical bulletin was developed for C&D Dynasty 12 Volt VRLA products. While much of the information herein is general, larger 2 Volt VRLA products are not within the intended scope.

GAS GENERATION AND CHARGING VOLTAGE

The VRLA battery is designed to provide up to 99% recombination under normal charging conditions and as a result is often utilized in occupied areas without concern for a hazardous build up of hydrogen gas. Critical to minimizing the gas emitted from the VRLA battery is the use of the proper float charging voltage of between 2.25 and 2.3 volts per cell and limited use of the equalization voltage of 2.4 volts per cell. As the charging voltage per cell is increased above 2.3 volts per cell the gassing rate increases dramatically. As noted in Table 1, the gassing rate at 2.3 volts per cell is approximately 0.0185 cc/hr/AH/cell. However, this rate could increase by a factor of 20 or more at 2.5 volts per cell. For this reason, the VRLA battery float voltage should be limited to the recommended range of 2.25 to 2.30 volts per cell average at 77 degrees F, and the equalization voltage should be limited to 2.4 volts per cell. The lower the charging voltage, while still being able to maintain the standby capacity of the battery, the lower will be the gassing rate of the battery.

Table 1 indicates the gassing rate to be expected from each of the VRLA batteries at the charging voltages of 2.3 volts per cell (float voltage) and 2.4 volts per cell (accelerated voltage). Note that the gassing rates are so small that they are given in cubic centimeters (cc) per hour and that there are 28,317 cubic centimeters per cubic foot.

Table 1 - Battery Gassing Rates

SingleVRLA Battery Gassing Rate cubic centimeter/hour/battery		
	Accelerated	Float
Battery	Gassing Rate cc/hr/batt.	Gassing Rate cc/hr/batt.
UPS12-100MR, UPS12-150MR, TEL12-30	1	<1
UPS12-210MR, TEL12-45, TEL12-70, VRS12-33IT/HIT, VRS12-50IT	2	<1
UPS12-300MR, UPS12-305PLP, UPS12-350MR, UPS12-355PLP, UPS12-400MR, UPS12-405PLP, TEL12-80, TEL12-90, TEL12-105FS, TEL12-115FN, VRS12-75HIT, VRS12-88HIT	3	1
UPS12-475MRLP, UPS6-490, UPS12-490MRLP, UPS12-495PLP, UPS12-540MR, UPS12-545PLP, UPS12-600MRX, TEL12-125, VRS12-100HIT	4	1
UPS12-615MRF, UPS12-680MRF, UPS6-620MR TEL12-150F, TEL12-160F, TEL12-160FW, TEL12-170F/FG, TEL6-180F	5	1.5
UPS12-700MRF, TEL12-180F, TEL12-210F/FG	6	1.5
UPS12-1000MRF	7	2

Please refer to RS-990 for Liberty product information

ROOM VENTILATION REQUIREMENTS

It is advisable to calculate the actual gas emissions to be expected from a battery system and the required air ex-changes to prevent an accumulation of hydrogen if only to provide assurances of the local building inspector of the safety of the installation. This only requires knowledge of the battery gassing rate (ref. Table 1) and the unoccupied volume of the room to determine the air exchange rate required to assure a maximum buildup of hydrogen of 2%.

BATTERY GASSING EXAMPLE

Assume 40 each of the UPS12-300MR batteries were installed in a 10' x 10' x 10' room with an unoccupied volume of 800 cubic feet.

Allowable max. gas accumulation: 2% of 800 cubic feet = 16 cubic feet

Total battery gassing rate at 2.4 volts per cell: 40 each UPS12-300MR x 3 cc/hr/battery = 120 cc/hr
120 cc/hr ÷ 28,317 cc/cubic feet ÷ .0042 cubic feet per hour

Hours to build a 2% concentration of gas in the unoccupied volume assuming no air exchange:
16 cubic feet ÷ 0.0042 cubic feet per hour = 3776 hours or 158 days

Since the uniform building code requires a minimum of 2 air exchanges per hour for an occupied space, 2% of the equivalent unoccupied volume is 2% of 800 cubic feet x 2 exchanges per hour or 32 cubic feet per hour. With the subject battery only generating 0.0042 cubic feet per hour, there is a resulting safety factor of 7619 (32 cubic feet/hr ÷ 0.0042 cubic feet/hr.).

BATTERY SYSTEM INSTALLATION AND OPERATING RECOMMENDATIONS FOR MINIMUM GASSING

As was noted in the Battery Gassing Example, where the use of the battery in an occupied space provided a safety factor of 2269 with respect to explosive gas accumulation, the gassing rate is almost insignificant in most practical applications.

The following recommendations summarize the general guidelines to follow to minimize gassing and assure safety of the installation.

1. Float charge the VRLA battery at the recommended 2.25 to 2.30 volts per cell average at 77° F (25° C).
2. Adjust the float charging voltage to reflect the requirements of operating temperatures other than 77° F (25° C) when the ambient is expected to be more than 10° F (5.6° C) different from this.
3. Use a temperature compensated charging voltage if frequent wide variations of the ambient are anticipated.
4. Do not charge the VRLA battery at temperatures above 122°F (50°C).
5. Provide for free flow of air around the individual batteries (0.5" spacing between units).
6. Provide for the natural or forced ventilation of the battery area to avoid any accumulation of gas over long periods of time.
7. Calculate the expected accumulation of gas within the battery area and the safety margin.

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