C&D TECHNOLOGIES

TECHNICAL BULLETIN

Condensed Installation & Operating Procedures For Valve Regulated Lead Acid (VRLA) UPS Batteries:

High Rate Max (MR)
Pure Lead Plus (PLP)
Pure Lead Max (PLM)

I. BATTERY DESCRIPTION

The valve regulated lead acid (VRLA) battery is a minimal maintenance system, which utilizes an oxygen recombination cycle to minimize gassing and eliminate electrolyte maintenance.
The dilute sulfuric acid electrolyte is immobilized either in absorbent glass mat (AGM) separators or in a gel medium. UPS series batteries are made up of up to 6 individual 2VDC cells, each with a unique self-resealing one way valve to relieve any excess pressure generated during overcharging conditions.

II. SAFETY CONCERNS

Installation and servicing of batteries should be performed or supervised by qualified personnel knowledgeable of lead acid batteries and required personal and equipment safety precautions.

• Electrical Hazards

Battery systems present a risk of electrical shock and high short circuit current. Remove metal objects (e.g. watches and rings); use insulated tools; wear eye protection and rubber gloves. Observe circuit polarities and do not make or break live circuits.

• Arc-flash Hazards

High voltage electrical systems including battery strings may present an arc-flash hazard. In some cases, an arc-flash hazard analysis may need to be completed on a fully installed battery system. Refer to national and local codes including the latest revision of NFPA 70E for additional information.

• Disposal

Lead acid batteries are to be recycled. Batteries contain lead and immobilized dilute sulfuric acid. Dispose of in accordance with Federal, State and local regulations. Do not dispose of in a landfill, lake or other unauthorized location.

• Chemical Hazards

Any gelled or liquid emissions from a battery is electrolyte which contains dilute sulfuric acid which is harmful to the skin and eyes;
is electrically conductive and is corrosive.
If electrolyte contacts the skin, wash immediately and thoroughly. If electrolyte enters the eyes, also seek medical attention. Neutralize spilled electrolyte with a solution of 1 lb. bicarbonate of soda (baking soda) to 1 gallon of water.

• Fire, Explosion and Heat Hazards

Batteries can contain an explosive mixture of hydrogen gas which can vent under overcharging conditions. Do not smoke or cause sparks in the vicinity of the battery. Do not install and charge batteries in a sealed container. Mount the individual batteries with a minimum of 0.5" between units to allow for convection cooling. If contained, assure the container or cabinet and room have adequate ventilation to prevent accumulation of potentially vented gas. Several codes or regulations may apply to the management of released gasses including but not limited to IEEE 1635, National Electric Code, National Fire code and OSHA standards.

• Caution

Do not attempt to remove battery vents or add water. This presents a safety hazard and voids the warranty.

III. RECEIVING INSTRUCTIONS

Upon receipt, inspect the batteries for physical damage to the containers and terminals. If found, a claim must be filed with the carrier within 10 days.
The batteries are shipped fully charged.
Their open circuit voltage should be a minimum of 2.07 volts/cell (6.2 and 12.4 VDC for 6 and 12 volt batteries respectively).

IV. STORAGE INSTRUCTIONS

Store batteries in a clean, dry, cool area away from radiant heat sources. Perform a freshening charge on batteries in storage every 6 months or when their open circuit voltage declines to 6.2 and 12.4 volts for 6 and 12 volt batteries respectively (which ever occurs first).

Pure lead batteries including Pure Lead Plus and Pure Lead Max series may be stored up to 24 months without a freshening charge, however they must be checked for voltage at least every 6 months. If the voltage has declined to 12.4V, or may reach 12.4V before the next voltage check, they should be given a freshening charge.

With all lead-acid batteries, self-discharge is accelerated by high temperatures. If storage temperatures exceed 77°F (25°C), storage intervals must be reduced. For every 15°F (8°C) increase in temperature above 77°F (25°C) the freshening charge and voltage check intervals should be reduced by half.

V. INSTALLATION INSTRUCTIONS

Typically individual batteries are connected in series to form a higher voltage string of batteries (e.g. 4 each 12 volt batteries connected in series for a 48 volt battery system). Two or more strings may then be connected in parallel to increase the total capacity of the system (e.g. two strings of 48 volt 75 ampere hour batteries connected in parallel for 48 volts at 150 ampere hours capacity).

Refer to figure 1, 2 and 3 for series and parallel connected batteries.

1. Series Connection of Individual Batteries

Place the individual batteries on the rack or shelf with 1/2 inch spacing between the individual units. If installing the units side to side, all the batteries should be placed with terminals of the same polarity (POS. or NEG) the front of the rack or shelf. If installing end to end the NEG. (-) terminal of battery 1 should be installed adjacent to the POS. (+) terminal of battery 2. Refer to figure 2.

The battery terminals and contact surfaces of the inter unit connecting cable lugs or bus bars should be cleaned with a brass bristle brush and lightly coated with protective No Ox Id or NCP 2 terminal grease.

Assemble the inter unit connections torquing the bolted connections to the values noted in Table 2.

Starting at the battery which is to be the positive output, label it as number 1 and then label the following batteries in ascending numerical order.

Measure the open circuit voltage of the series connected string of batteries. It should be approximately equal to the number of units times the per unit voltage. If this is not the case determine the cause and correct before proceeding (e.g. reversed polarity unit).

Select the appropriate size cable per the NEC code to handle the battery charge and discharge current. A fuse or circuit breaker should be used in the battery output circuit. With the circuit breaker or fuse open, connect the battery to the charger/load circuit.

2. Parallel Connection of Individual Strings of Batteries

When separate strings of batteries are to be connected in parallel their open circuit voltage's should be within 1 VDC of each other prior to making the connections. If a larger voltage differential exists, verify the correct polarities of each battery. If the differential still exists, battery strings may need to receive a freshening charge individually before being connected in parallel.

Each of the individual battery strings should be cabled separately to a common, junction point or box. They should not be "daisy chained" in parallel. Each string should also contain a separate fuse or disconnect switch to facilitate maintenance.

Refer to figure 3 for typical parallel connections. The parallel connections should be completed only when the charger and load are not connected to the battery output circuit.

VI. FRESHENING CHARGE

Once installed the battery system should receive a 24 hour freshening charge at 2.4 volts per cell average (14.4 volts/unit and 7.2 volts/unit average for 12 and 6 volt units respectively).

VII. FLOAT CHARGING

Following the freshening charge the battery system should be placed in operation at a float voltage of between 2.25 and 2.30 volts/cell average (approximately 6.8 and 13.7 volts/unit average for 6 and 12 volt units respectively).

VIII. PERFORMANCE TESTS

The battery system should be given a capacity discharge test at acceptance when new and biannually thereafter. When the capacity declines to 85% of rating the battery should be capacity tested annually.

The load current used for the capacity test should be derated for testing temperatures below 75°F.

IX. PERIODIC MAINTENANCE

These VRLA batteries are maintenance free with respect to the electrolyte. However the following measurements should be taken at regular intervals as shown on Table 1. Refer to C&D Technologies VRLA support documents and/or IEEE 1188 for additional information.

Visual Inspection – Battery system should be checked for signs of leaking, corrosion, discoloration and installation integrity.

Pilot Unit Temperature – Measure battery temperature at the negative terminal on units at different locations within the string. It is recommended to select 1 pilot unit for every 10 units in the string.

System Float Voltage – Measure float voltage from the most positive and most negative posts on the battery. Measurement should closely match charger settings and average between 2.25 and 2.30 Volts/Cell.

Unit Float Voltage – Measure individual unit voltage. 12V Units measuring less than 13.30V or 6V Units measuring less than 6.65V while on charge may require additional maintenance.

System Float Current – Measure online float current at any point within the battery string. Measurements should be trended over time as increasing float current can be a sign of battery aging. Baseline measurement should be established after 3 months on float charge.

Ripple Voltage and Current – Excessive AC Ripple Voltage and Current can lead to rapid aging and should be monitored closely. The maximum allowable ripple voltage during the float phase of charging is 0.5% of the float voltage. The maximum allowable ripple current is 5A rms per 100Ah of battery capacity.

Ohmic Measurement – Impedance, Conductance, Resistance or Admittance measurements should be taken directly from the battery post whenever possible. Baseline measurement should be established after 3 months on float charge and changes in Ohmic value should be trended on an individual unit basis over time.

Connection Resistance – The preferred method of checking connection integrity is by using a DLRO Meter and recording the resistance values of each connection. For new installations, remake any connection that is more than 10 percent above the average value or 5 micro-ohms, whichever is greater.

High Rate Load Test – Optionally, a high rate load test may be applied to individual units using a handheld tester. Test duration should not exceed 10 seconds.

Capacity (Performance) Test– Discharge testing of VRLA batteries to a published discharge rate and duration will give a true measure of the battery's state of health. Acceptance testing is typically completed within 3 months of installation.

The load current used for the capacity test should be derated for testing temperatures below 75°F.

Table 1 - Periodic Maintenance

Maintenance Task	High Rate Max	Pure Lead Plus	Pure Lead Max
Visual Inspection	Quarterly	Quarterly	Quarterly
Connection Resistance	Annually	Annually	Annually
Pilot Unit Temperature	Quarterly	Baseline measurements at 3 months Semi-Annual in years 1-4 Quarterly after year 4	Baseline measurements at 3 months Semi-Annual in years 1-6 Quarterly after year 6
System Float Voltage			
System Float Current			
Ripple Voltage & Current			
Unit Float Voltage			
Ohmic Measurement			
High Rate Load Test*			
Capacity (Performance) Test	25% of anticipated battery life, not to exceed 1 per year		

*Optional

Table 2 - Battery Terminal Torque Requirements				
Terminal Type	**Where Used**	**Hardware Type**	**Socket Size**	**Initial Torque**
Flag Terminal	Group U2	10-32 Bolt & Nut	5/16"	30 in-lbs
10-32 Inserted Terminal	Group U1, 22	10-32 Bolt	5/16"	30 in-lbs
1/4-20 Inserted Terminal	Group 24-99	1/4-20 Bolt	7/16"	90 in-lbs
1/4-20 TFA Inserted Terminal	Front Access	1/4-20 Bolt	7/16"	110 in-lbs
M8 TFA Inserted Terminal	Front Access	M8-1.25 Bolt	13mm	160 in-lbs

FIGURE 1: SINGLE STRING 48 VDC BATTERY

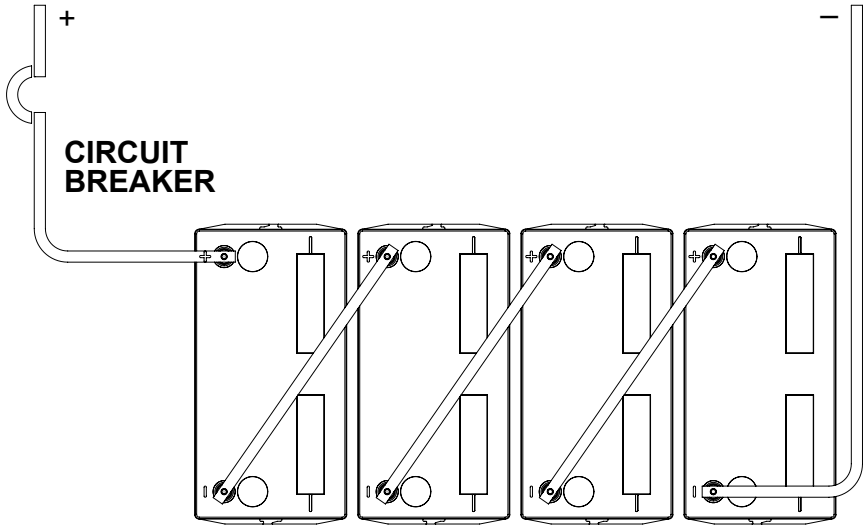


FIGURE 2: SINGLE STRING 48 VDC BATTERY

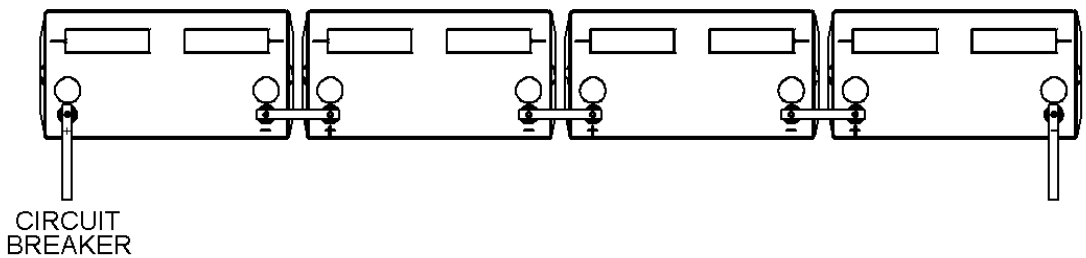


FIGURE 3: PARALLEL STRINGS OF 48 VDC BATTERIES

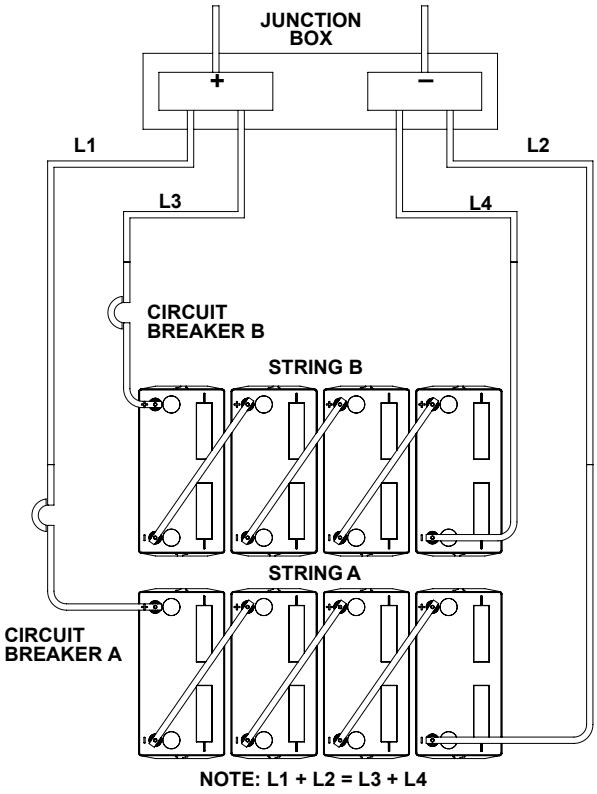
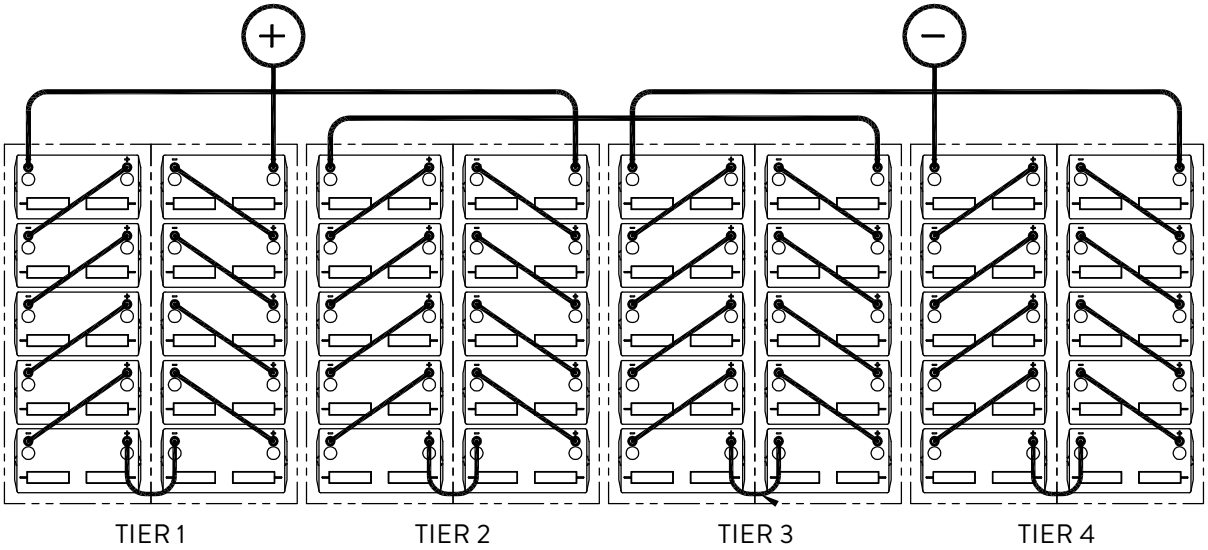


FIGURE 4: SINGLE STRING 480VDC BATTERY (4 TIER RACK)



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