RS02252

INSTALLATION AND OPERATING PROCEDURES

FOR C&D TECHNOLOGIES®

Deep Cycle Series (DCS) Products
Used in Electric Vehicle Applications

FOLLOW MANUFACTURER'S PUBLISHED INSTRUCTIONS WHEN INSTALLING, CHARGING AND SERVICING BATTERIES

For additional information: www.cdtechno.com
For Technical/Warranty Assistance, contact:

C&D Technologies, Inc.
200 Precision Drive, Suite 150
Horsham, PA 19044
+1 800-543-8630 or +1 717-553-7001
Fax +1 215-619-7899

Before handling cells or storing cell for future installation take time to read this manual. It contains information that could avoid irreparable damage to the battery and/or void product warranty.

General:

The purpose of this manual is to inform installers how to receive, install and maintain C&D Technologies® Deep Cycle Series (DCS) batteries for use in electric vehicle (EV) applications.

Battery Description:

The valve regulated lead acid (VRLA) battery is a minimal maintenance system utilizing an oxygen recombination cycle to minimize gassing and eliminate electrolyte maintenance. The dilute sulfuric acid electrolyte is immobilized by absorbent glass mat (AGM) separators. Each of the 2 volts direct current (VDC) cells (6 cells per unit) in each unit has a unique self-resealing one-way valve to relieve any excess pressure generated during overcharging conditions.

I. Safety

Installation and servicing of batteries should be performed or supervised by personnel knowledgeable of lead acid batteries standard safety practices including appropriate personal and equipment safety precautions. Additional information on safety and environmental aspects of this product are available on the *L84* Safety Data Sheet (SDS) at www.cdtechno.com.

Electrical Hazards

Battery systems present a risk of electrical shock and high short circuit current. Remove any personal metal objects (e.g. watches and rings), use properly insulated tools, and wear eye protection and rubber gloves. Observe circuit polarities, use a voltmeter to check potentials before making connections and do not make or break live circuits without following all proper safety precautions.

Disposal

Lead acid batteries are to be recycled. VRLA 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. For assistance contact C&D Technologies at www.cdtechno.com.

Chemical Hazards

Any liquid emission from a battery may be electrolyte, which contains dilute sulfuric acid. This liquid 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, promptly flush eyes with water and 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. If contained, assure the container has adequate ventilation to prevent accumulation of potentially explosive vented gas. Refer to the current issue of the National Electric Code (NEC) and other applicable building codes.

Caution

Do not attempt to remove battery vents or add water as this presents a safety hazard and voids the warranty. Wash hands after any contact with the battery lead terminals.

II. 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 ten (10) days. Also check the packing slip to make sure all material has arrived.

The batteries are shipped fully charged. Open Circuit Voltage (OCV) measurements should not be below 12.48 volts per 12-volt unit.

III. Storage Instructions

Store batteries in a clean, dry, cool (20°F – 90°F / -6°C – 32°C) area away from radiant heat sources. Recharge DCS batteries in storage at least every six (6) months or before their OCV declines to 12.48 VDC. Follow instructions as outlined in Section VI. Freshening Charge.

IV. Freshening Charge

Batteries that are stored longer than the allowable time, or where the OCV is less than 12.48V require freshening charge prior to installation. Recommended freshening charge as follows:

> **Constant Voltage:** Charge at 14.40 V/battery for 24 hours. Batteries may be connected in series. Multiply the number of series connected batteries by 14.40V to obtain the overall circuit voltage.

V. Installation Guidelines

Installation of C&D® DCS batteries into electric vehicles will depend on specific vehicle designs and processes, which are developed by the vehicle manufacturer. Following are guidelines that should be followed for any installation:

1. **Short Circuit Protection:** All tools and equipment must be properly designed and insulated to prevent short circuiting the battery terminals.
2. **Lifting and Handling:** The batteries must not be lifted by the terminals. If possible, the battery should be lifted from the base. If the battery is lifted by side compression all measures must be taken to make sure that the plastic container is not damaged from over compression.
3. **Battery compartment:** The battery compartment must allow gases to escape to the atmosphere, sealed containers must be avoided. The compartment must be designed and located to avoid high temperatures (see section *VI. Application Information* for temperature limitations).
4. **Replacement:** The battery installation must allow for replacement of the battery under field conditions.
5. **Voltage:** Check battery voltage prior to installation. Voltage must be above 12.48 VDC.
6. **Connections:** Torque according to specifications on product labeling.

Please contact C&D Technologies with any questions or concerns regarding battery compartment design or installation/removal processes.

VI. Application Information

Each electrical vehicle design will have different charging parameters. The following are charging and environmental limits:

Specification	Minimum	Typical	Maximum
Nominal Operating Voltage Range	9V	12V	16V
Functional Operating Voltage	7.2V		16.7V
Recharge	Varies**	104-108%	110%
Operating Temperature – *Normal*	-4°F (-20°C)		140°F (60°C)
Operating Temperature – *Extreme*	-40°F (-40°C)		185°F (85°C)*

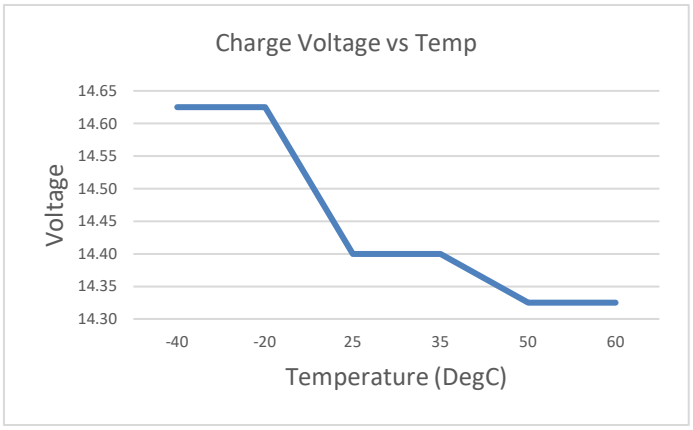
*Severe impact to life of battery

**See C&D for PSOC applications

The following are recommended voltage compensations based on temperature:

Charge Voltage

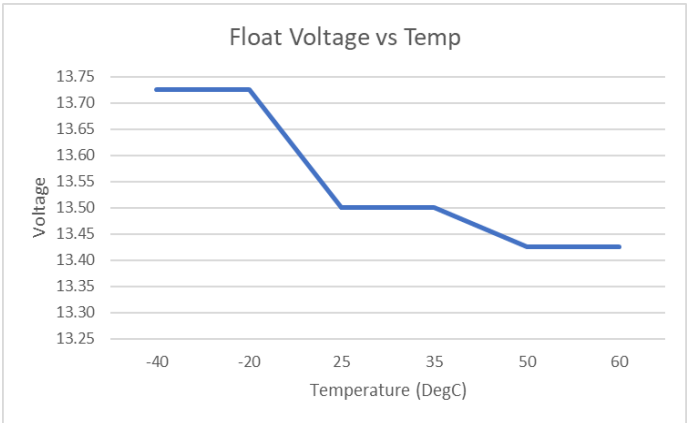
Voltage	Temp °C (°F)
14.63	-20 (-4)
14.40	25 (77)
14.40	35 (95)
14.33	50 (122)



- Charge: constant 14.4v
- Temp compensation = -0.005V/C per Deg C
- 25°C (77°F) < Temp compensation > 35°C (95°F)
- 25°C (77°F) > no Temp compensation < 35°C (95°F)
- -20°C (-4°F) < no Temp compensation > 50°C (122°F)

Float Charge

Voltage	Temp °C (°F)
13.73	-40 (-40)
13.73	-20 (-4)
13.50	25 (77)
13.50	35 (95)
13.43	50 (122)
13.43	60 (140)



- Float: constant 13.50v recommended. Can be 13.50-13.80 at 25°C (77°F)
- Temp compensation = -0.005V/C per Deg C
- 25°C (77°F) < Temp compensation > 35°C (95°F)
- 25°C (77°F) > no Temp compensation < 35°C (95°F)
- -20°C (-4°F)< no Temp compensation > 50°C (122°F)

VII. Periodic Maintenance

These VRLA batteries are maintenance free with respect to the electrolyte. However, the charging voltage, temperature, performance, and connection resistances must be monitored, and any necessary corrective actions taken if irregular values are observed to assure reliable standby power when required. All EV self-diagnostic testing parameters must be reviewed and approved by C&D Technologies as compliant with the warranty. C&D recommends that all connections be checked for proper torque on a minimum annual basis using calibrated equipment.

VIII. Recycling

C&D® DCS batteries must be recycled after replacement. C&D Technologies has designated approved recycling locations for proper handling. Disposal of lead-acid batteries by other means may violate state and federal law. Please contact C&D Technologies for additional information.

200 Precision Drive, Suite 150 Horsham, Pennsylvania 19044 USA | www.cdtechno.com