GOLF CAR/EV BATTERY CARE & MAINTENANCE GUIDE

1. BATTERY TYPE EXPLANATION

1.1. Flooded, Maintenance Accessible Design

These batteries are filled with liquid electrolyte. The maintenance accessible design utilizes removable vent caps to access the vent well opening for watering and testing. Flooded designs should always remain upright to avoid leaking acid.

1.2. Valve-Regulated, (VRLA) Non-Accessible Design

A VRLA battery utilizes a "recombinant" technology. This means that the oxygen normally produced on the positive plate is absorbed by the negative plate. This suppresses the production of hydrogen at the negative plate. Water (H_2O) is produced instead, retaining the moisture within the battery.

It never needs watering, and should never be opened as this would infuse the battery with excess oxygen from the air. In addition to damaging the battery, opening it also voids the warranty.

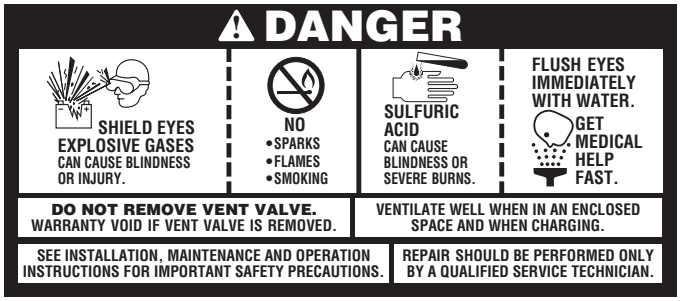
2. BATTERY INSTALLATION

2.1. Safety Precautions

- **Always** wear safety glasses and a face shield when working on or near batteries.
- All batteries generate explosive hydrogen gas. Keep sparks, flames and cigarettes away from batteries at all times. Do not connect or disconnect "live" circuits. To avoid creating sparks, always turn charging and testing equipment off before attaching or removing clamps.
- Perform all work in a well ventilated area. Never lean directly over a battery while boosting, testing or charging it.
- Batteries contain corrosive sulfuric acid that can destroy clothing and burn the skin. Neutralize acid spills with paste made of baking soda and water or large quantities of water.

2.2. Safe Installation

- Before removing old battery(ies), mark the positive (+) and negative (-) cables for proper connection to the new battery(ies).
- All batteries in the equipment should be approximately the same age.
- Always disconnect the ground cable first [usually negative (-)] to avoid any sparking around battery. Then disconnect the positive (+) cable and carefully remove the old battery(ies).
- Clean and inspect. If necessary, repaint or replace the tray, hold-down and/or battery cables. Cable ends must be clean and corrosion free. Cables must not be frayed or bare.
- Put corrosion protection washers on battery terminals. Install new battery(ies) in same position as old ones and tighten hold-down. Be sure terminals will clear hood, fender, box lid, etc. to avoid vehicle damage and/or explosion.
- Connect positive cable first. Connect ground cable last. Never over tighten or hammer cables onto terminals.
- Coat terminals and cable connection with a corrosion protection spray.



California Proposition 65 Warning

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

2.3. Battery Connections

Please use the following guidelines to ensure proper cable connections. Faulty battery cable connections can lead to poor performance, battery damage, and potential safety hazards.

Torque Values – Do not over-torque the cable connections. The following torque values should be used when attaching battery cables so there is good contact with the terminals and a secure fit. Over-tightening these connections can cause battery damage or other potential safety hazards.

SAE or Automotive Post: 50-70 inch-pounds
Stud Terminal: 120-180 inch-pounds

Terminal Protection – Keep battery tops dry and clean. A moist condition will result in electrical leakage across the battery to the metal hold-down, causing a corrosion buildup on hold-down and terminal connections.

- With vent caps firmly in place, periodically clean battery tops, hold-down and terminal connection with a baking soda solution and brush. Flush with clear water. Dry off thoroughly.
- Check all terminal connections and tighten firmly. Apply a thin coating of petroleum jelly or protection spray to retard corrosion.

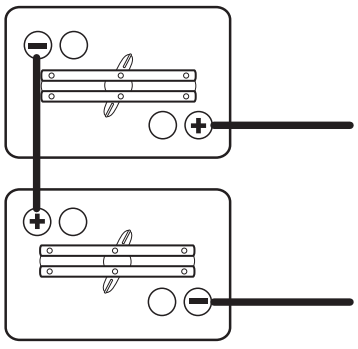
2.4. Ventilation

Always keep batteries in a properly ventilated area, especially when charging. Never install or charge any type of battery in a completely sealed container. Even with AGM and Gel VRLA batteries oxygen and hydrogen will escape from the battery in an overcharge condition (as is typical of any type battery). These potentially explosive gasses must be allowed to vent to the atmosphere and must never be trapped in a sealed battery box or tightly enclosed space!

2.5. Multiple Battery Connection Options

Series

A "series" system increases the voltage, but keeps the battery capacity (cranking amps, amp hours, reserve minutes, and minutes running time) the same. Therefore, two 12-volt batteries connected in series (POS to NEG, NEG to POS) will deliver 24 volts at the same rating as one battery: During recharge, each battery receives the same amount of current; e.g. if the charger is putting out 10 amps, both batteries are getting 10 amps.

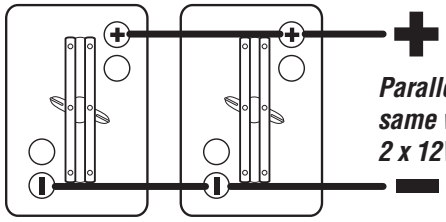


Series hookup increases voltage… 2 x 12V = 24 Volts

Parallel

A "parallel" system increases the capacity available, but keeps the voltage the same. Therefore, two 12-volt batteries with 110 RC and 65 Ah will deliver 12 volts, 220 RC and 130 Ah (Actually, since each battery's load is lighter, the reserve capacity may be more than double.).

During recharge, the current (amps) is split between the batteries. The battery that is discharged the most will receive more current than the other until both are brought up to full charge.



Parallel hookup keeps same voltage… 2 x 12V = 12 Volts

Series/Parallel

A "series/parallel" system provides a combination of voltage and capacity for special applications. Note: Never mix different types and sizes of batteries in the same bank.

2.6. Battery Orientation

A flooded battery design will spill acid if placed on its side so it must be upright at all times. A Gel or AGM spillproof design will not leak or spill if on its side. This allows for more installation options.

3. CHARGING INFORMATION

3.1. Inspection and Cleaning

- Prior to any testing, visually inspect the battery. Look for cracked or broken case or cover, loose cable connections, leaking case-to-cover seal, corrosion, and damaged or leaking terminals.
- Neutralize any corrosion with baking soda/water paste or battery cleaner spray. Scrape or brush off the residue and wash the area with clean water. Following your visual inspection, check the battery's state of charge with a voltmeter.
- You must boost charge a weak battery before load testing. If fully charged, perform a load test.

3.2. Charging Tips

- To avoid a battery explosion, never attempt to charge a frozen battery. Allow it to warm up to room temperature before placing on charger.
- If the temperature of the batteries or the outside temperature is below 60°F (15°C), their capacity will be reduced and they will require more hours of charge. The colder the batteries are, the faster they will build up in voltage and reduce the charging rate.
- Never overcharge batteries. Excessive charging will shorten battery life.
- Prior to charging, read the manufacturer's instructions for proper charger hook-up and use.
- Turn charger off prior to hook-up to avoid dangerous sparks.

For Flooded:

- If the electrolyte is accessible, verify that plates are covered before beginning to charge. At the end of charge, add distilled water as needed to bring levels to approximately 1/8" below the bottom of the extended vent tube. If water is added, charge for an additional 30 minutes to mix. If electrolyte levels are low, but battery is not accessible, remove battery from service.
- Always check specific gravity and temperature readings before charging batteries. Correct specific gravity readings to 80°F (27°C).
- The maximum charge rate in amperes should be no more than 1/3 of the battery's reserve capacity minute rating. If the terminal voltage exceeds 16.0 volts while charging, reduce the charge rate.
- DO NOT OVER- OR UNDER-CHARGE. If the battery temperature reaches 125°F (52°C) during the charging cycle, the rate should be lowered or the charge interrupted until the battery has cooled to room temperature. Specific gravity reading should be corrected to 80°F (27°C). For each 10 degrees above 80°F (27°C), add four points to the hydrometer reading, (i.e., 90°F (32°C) at 1.250 Sp. Gr. = 1.254 Sp. Gr.) For each 10 degrees below 80°F (27°C), subtract four points from the hydrometer reading.
- Continue charging and reduce the rate as needed until a two-hour period results in no increase in voltage or decrease in current.
- If batteries do not come up to full charge, after following the charger manufacturer's instructions, check for low line voltage and/or a faulty charger. Consult your power company or electrician.
- If violent gassing or spewing of electrolyte occurs, or the battery case feels hot to the touch, temporarily reduce or halt charging.

For GEL or AGM VRLA:

- Gel and AGM (Absorbed Glass Mat) batteries require a constant potential, voltage-limited charger. Charging a Gel or AGM battery on a typical shop charger may greatly shorten its life.
- For 12-volt batteries, charge to at least 13.8 volts but no more than 14.6 volts at 77°F (25°C).
- For 8-volt batteries, charge to at least 9.2 volts but no more than 9.7 volts at 77°F (25°C).
- For 6-volt batteries, charge to at least 6.9 volts but no more than 7.3 volts at 77°F (25°C).
- The open circuit voltage of a fully charged 12-volt battery is 12.8V at 77°F (25°C). However, as the battery charges, the building internal pressure (voltage) causes resistance to the charge. Therefore, the on-charge voltage must be higher (at least 13.8V) to overcome this internal pressure (voltage) during charging.

3.3. Equalizing Charge for Golf Car Batteries

After the batteries are fully charged, they may need an equalizing charge to bring the battery voltages closer together. Only equalize golf car batteries when they have **a low specific gravity** (below 1.250) or a **wide-ranging specific gravity** between batteries (0.030) after being fully charged. **Only perform an equalize charge on batteries that are flooded/wet.**

Gel or AGM batteries should NEVER be equalized. Be sure to check the electrolyte level to make sure plates are covered with water before charging. Also check that all vent caps are properly secured. Set charger to equalizing mode. Since an equalize charge is in essence an overcharge, the batteries may gas showing bubbles during this process. **It is important to measure the specific gravity every hour. When the gravity no longer rises, discontinue the equalize charge.**

4. METHODS FOR TESTING

4.1. Hydrometer Check

(flooded only) Use a hydrometer to take the specific gravity readings of all cells. If the variation between the highest and lowest cell reading in any one battery is .50 (50 points gravity) or more, it is a good indication that it has a failing cell. This test is most effective if the battery is partially discharged.

4.2. Voltmeter Check

If the top connections are accessible (flooded battery), read the voltage of each cell. A variation between the highest and lowest cell readings of any one battery of .50 volts or more indicates a possible failing cell.

If the voltage of each cell cannot be measured (flooded or VRLA), test the terminal voltage of each battery if a set of batteries is being checked. Compare the voltages of the batteries. If the battery voltage readings vary between .05 volts or more, that is a good indication of a weak or failing battery. This test is most effective if the battery is partially discharged.

4.3. Load Testing

If a hydrometer or voltmeter check indicates a battery is failing, fully charge it and conduct a load test. Golf car batteries should be tested at a rate of 75 + or – 1 amperes @ 80°F (27°C). Record the discharge time in minutes for the cell voltage to reach 1.75 volts. A battery which delivers 50% or less of its rated capacity in minutes should be replaced.

4.4. Checking the State of Charge

Accessible Flooded Batteries – Before adding water, take an open circuit voltage reading and/or hydrometer reading of one cell. Use a different cell each time. If the readings are below 75%, charge the battery. If the electrolyte level is too low to read with a hydrometer, add water and take the hydrometer reading the following day. After the vehicle has been driven and the water has had an opportunity to mix. Check electrolyte levels in all cells. If necessary, add only clear, odorless drinking water to bring the liquid level to approximately 1/8" below the bottom of the extended vent tube. Distilled water is preferred, especially if the water in your area has high iron. Do not over fill any cells. Excess electrolyte may be forced from an overfilled cell and cause corrosion on adjacent metal parts, reduce performance, and shorten life. In cold weather, do not fill cells with water and let stand with out running engine or driving the vehicle long enough to allow water to mix with acid. Otherwise, freezing might occur and the battery may crack or explode.

Non-Accessible Flooded or VRLA Batteries – are maintenance-free and are designed to eliminate the need to add water. Use a voltmeter to check the state of charge. DO NOT OPEN FLUSH COVER BATTERIES! If opened, serious personal injury can result and warranty will be voided.

5. STORAGE

Batteries that are not in service during the off-duty periods must be cared for as follows:

For Flooded:

- Keep fully charged.
- Never allow batteries to stand in a discharged condition. After each use, no matter how short, batteries should be fully charged.
- Store in cool, dry place with temperatures not below 32ºF (0ºC) or above 80ºF (27ºC). A flooded battery at 1.100 specific gravity will freeze at 19ºF (-7ºC).

5. Storage *continued*

- Keep in an upright position.
- Never stack batteries directly on top of each other unless they are in cartons. Do not stack more than 3 high.
- Always test and charge if necessary before installation.
- It is important that batteries should be charged every 45 days or when specific gravity readings drop to 1.200, corrected to 80ºF (27ºC).
- Test flooded batteries every 4-6 months and recharge if necessary.

Batteries Self-Discharge When Not in Use:

- at 100ºF (38ºC) Discharge Rate = 3 points in specific gravity per day
- at 80ºF (27ºC) Discharge Rate = 2 points in specific gravity per day
- at 50ºF (10ºC) Discharge Rate = 1/2 points in specific gravity per day
- at 30ºF (-1ºC) Discharge Rate = 1/10 points in specific gravity per day

For GEL or AGM VRLA:

- Batteries should be stored indoors in a clean, level, dry and cool location. Recommended storage temperature is 0°F to 90°F (–18°C to 32°C).
- Stored lead-acid batteries self-discharge and must be given a charge six months from date of manufacture to prevent permanent performance degradation.
- Recommended charge during storage is at a constant voltage of 13.80V for 12V, 9.2V for 8V, or 6.90V for 6V battery for 24 hours at 77°F (25°C).

6. BATTERY RECYCLING

Lead-acid technology has been around for over 150 years. An innovative recycling infrastructure has been developed to recycle essentially 100% of a lead-acid battery, and industry-supported regulation ensures that these products are returned to appropriate locations. Surrounded by fertile farmland, East Penn has always been committed to the highest environmental standards through a company-wide dedication to environmental health and safety. Our U.S. EPA-permitted facility is a model for the lead-acid battery recycling industry. Contact East Penn at www.dekabatteries.com to find out more about recycling your batteries.

EAST PENN manufacturing co., inc.
Lyon Station, PA 19536-0147 • Phone: 610-682-6361 • Fax: 610-682-4781
Order Department Hotline: 610-682-4231
www.dekabatteries.com

E.P.M. Form No. 1932 Rev. 3/13