



# DEEP CYCLE BATTERY MAINTENANCE

# MAINTENANCE



**TROJAN<sup>TM</sup>**  
**DEEP CYCLE**

Trojan makes battery care simple with this guide featuring information on proper testing, watering, cleaning, storage, charging, equalizing and system configuration. Includes a handy glossary for your reference.

**Building and Maintaining Better Batteries  
Since 1925**



## Simple Steps For Longer Battery Life

Trojan Battery Company has manufactured batteries for eighty years. Our experience shows that the key to achieving optimum performance and long life is a solid battery maintenance program using the simple procedures outlined here.

### Equipment:

Trojan recommends the following equipment for use in battery care and maintenance:

- Wrench
- Distilled Water
- Voltmeter
- Hydrometer
- Post Cleaner
- Baking Soda
- Petroleum Jelly
- Goggles & Gloves

**CAUTION: Always wear protective clothing, gloves, and goggles when handling batteries and electrolyte.**



## Inspection

1. Examine the outside appearance of the battery.
  - Look for cracks in the container.
  - The top of the battery, posts and connections should be free of dirt, fluids and corrosion. (If batteries are dirty, see Cleaning section.)
  - Replace any damaged batteries.
2. Any fluids on or around the battery may indicate that electrolyte is spilling, leaching or leaking out.
  - Leaking batteries must be replaced.
3. Check all battery cables and connections.
  - Look closely for loose or damaged parts.
  - Replace any cable that is broken or frayed.

**WARNING: Do not smoke near batteries.**

4. Tighten all wiring connections to the proper specification (following page.) Be sure there is good contact with the terminals.

**WARNING: Do not over-tighten terminals. Over-tightening can result in post breakage, post meltdown or fire.**

## Proper Torque Values for Connection Hardware

### Flooded

- Automotive: 50-70 in-lbs
- Side: 70-90 in-lbs
- Wingnut: 95-105 in-lbs
- LPT: 95-105 in-lbs
- LT: 100-120 in-lbs

### Gel

- Button: 90-110 in-lbs
- LT: 100-120 in-lbs

## Specific Gravity Testing

*(Flooded batteries only)*

1. Do not add water prior to testing.
2. Fill and drain the hydrometer 2-4 times before drawing a sample from the battery.
3. Have enough sample electrolyte in the hydrometer to completely support the float.
4. Take a reading, record it and return the electrolyte to the cell.
5. Check all cells in the battery, repeating the steps above.
6. Replace vent caps and wipe off any electrolyte that might have been spilled.
7. Correct the readings to 80°F:
  - Add .004 to readings for every 10° above 80°F.
  - Subtract .004 for every 10° below 80°F.
8. Check the state of charge using the table on the next page.

The readings should be within the factory specification of 1.277 +/- .007. If any specific gravity reading registers low, follow these steps:

1. Check and record voltage level(s).
2. Put batteries on a complete charge.
3. Take specific gravity readings again.

If any specific gravity reading still registers low, follow these steps:

1. Check voltage level(s).
2. Perform equalization charge. (See Equalizing).
3. Take specific gravity readings again.



If any specific gravity reading still registers lower than the factory specification, one or more of these conditions may exist:

1. The battery is old and nearing end of life.
2. The battery was left discharged too long.
3. Electrolyte was lost due to spillage.
4. A weak or bad cell is developing.
5. The battery was over-watered prior to testing.

Batteries in conditions 1-4 should be taken to a specialist for further evaluation or retired from service.

### Open-Circuit Voltage Testing

For accurate voltage readings, batteries must remain idle (no charging, no discharging) for at least 6 hours, and preferably 24 hours.

1. Disconnect all loads from the batteries.
2. Measure the voltage with a DC voltmeter.
3. Check the state of charge with the table below.
4. Charge the battery if it registers 0-70% charged.

If battery registers below table values, these conditions may exist:

1. The battery was left discharged too long.
2. The battery has a bad cell.

Batteries in these conditions should be taken to a specialist for further evaluation, or retired from service.

| % STATE OF CHARGE | SPECIFIC GRAVITY CORRECTED TO 80° F | OPEN-CIRCUIT VOLTAGE |        |         |
|-------------------|-------------------------------------|----------------------|--------|---------|
|                   |                                     | 6 VOLT               | 8 VOLT | 12 VOLT |
| 100               | 1.277                               | 6.37                 | 8.49   | 12.73   |
| 90                | 1.258                               | 6.31                 | 8.41   | 12.62   |
| 80                | 1.238                               | 6.25                 | 8.33   | 12.50   |
| 70                | 1.217                               | 6.19                 | 8.25   | 12.37   |
| 60                | 1.195                               | 6.12                 | 8.16   | 12.24   |
| 50                | 1.172                               | 6.05                 | 8.07   | 12.10   |
| 40                | 1.148                               | 5.98                 | 7.97   | 11.96   |
| 30                | 1.124                               | 5.91                 | 7.88   | 11.81   |
| 20                | 1.098                               | 5.83                 | 7.77   | 11.66   |
| 10                | 1.073                               | 5.75                 | 7.67   | 11.51   |

*State of charge as related to specific gravity and open-circuit voltage*

### Watering

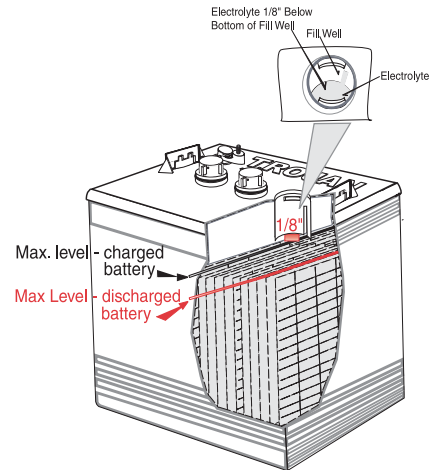
*(Flooded batteries only)*

Water should only be added after fully charging the battery. Prior to charging, there should be enough water to cover the plates. If the battery has been discharged (partially or fully), the water level should also be above the plates.

*Important things to remember:*

1. Do not allow plates to be exposed to air.
2. Do not fill the water all the way up to the cap.
3. Do not use water with a high mineral content.
4. Use only distilled or deionized water.

**CAUTION: The electrolyte is a solution of acid and water, so skin contact should be avoided.**



*Procedure:*

1. Remove the vent caps and check the electrolyte level; the minimum level is to the top of the plates.
2. If there is no electrolyte visible, add just enough water to cover the plates.
3. Replace and tighten all water vent caps.
4. Put batteries on a complete charge before adding any more water. (See Charging section.)
5. Once charging is completed, remove the vent caps and check the electrolyte level.



**6. Add water until the electrolyte level is 1/8" below the bottom of the fill well.**

7. Clean, replace and tighten all vent caps.

**WARNING: Never add acid to a battery.**

### **Cleaning**

1. Check that all vent caps are tight.
2. Clean the battery top with a cloth or brush and a solution of baking soda and water.
  - Do not allow any cleaning solution or other foreign matter to get inside the battery.
3. Rinse with water and dry with a clean cloth.
4. Clean battery terminals and the inside of cable clamps with a post and clamp cleaner.
5. Reconnect the clamps to the terminals and thinly coat them with petroleum jelly.
6. Keep the area around batteries clean and dry.

### **Storage**

*Important things to avoid:*

1. Freezing - Avoid locations where freezing temperatures are expected. Keeping batteries at a high state of charge also prevents freezing. (See table next page.)
2. Heat - Avoid direct exposure to heat sources, such as radiators or space heaters. Temperatures above 80° F accelerate the battery's self-discharge characteristics.

*Procedure:*

1. Completely charge the battery before storing.
2. Store the battery in a cool, dry location, protected from the elements.
3. During storage, monitor the specific gravity (flooded batteries) or voltage.
  - Stored batteries should be given a boost charge when they show a 70% state of charge or less. (See table previous page.)
4. Completely charge the battery before re-activating.

5. For optimum performance, equalize the batteries (flooded) before putting them back into service. (See Equalizing section.)

### **Electrolyte Freezing Point@Various States of Charge\***

| SPECIFIC GRAVITY | %STATE OF CHARGE | FREEZING TEMPERATURE |
|------------------|------------------|----------------------|
| 1.280            | 100              | -92.0°F              |
| 1.265            | 92               | -71.3°F              |
| 1.250            | 85               | -62.0°F              |
| 1.200            | 62               | -16.0°F              |
| 1.150            | 40               | +5.0°F               |
| 1.100            | 20               | +19.0°F              |

\*Source: BCI Battery Service Manual 1995

### **Charging**

Correctly charging batteries requires administering the right amount of current at the right voltage. Most charging equipment automatically regulates these values. Some chargers allow the user to set these values. For proper charging, refer to the instructions that came with your charging equipment.

*Important things to remember:*

1. Become familiar with, and follow the instructions from, the charger manufacturer.
2. Batteries should be charged after each period of use.
3. Lead-acid batteries do not develop a memory and need not be fully discharged before recharging.
4. Charge only in well-ventilated areas. Keep sparks or flames away from a charging battery.
5. Verify charger voltage settings are correct.
6. Check electrolyte level. (See Watering section.)
7. Tighten all vent caps before charging.
8. Do not overcharge or undercharge the batteries.
9. Never charge a frozen battery.
10. Avoid charging at temperatures above 120° F.



## Equalizing

(Flooded batteries only)

**WARNING: Do not equalize Gel or AGM batteries.**

Equalizing is an overcharge performed on flooded lead-acid batteries after they have been fully charged. It helps eliminate stratification and sulfation, two conditions that can reduce the overall performance of a battery.

Trojan recommends equalizing only when low or wide ranging specific gravity (+/- .015) is detected after fully charging a battery.

### Procedure:

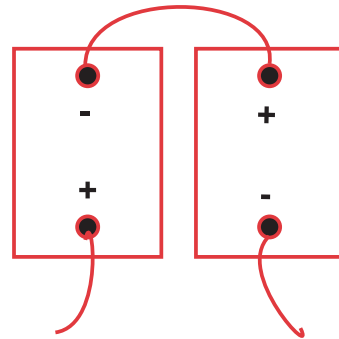
1. Verify that batteries are the flooded type.
2. Remove all loads from the batteries.
3. Connect battery charger.
4. Set charger to equalizing mode.
5. Start charging batteries.
6. Batteries will begin gassing and bubbling vigorously.
7. Take specific gravity readings every hour.
8. Equalization is complete when specific gravity values no longer rise during the gassing stage.

**NOTE: Many chargers do not have an equalization setting, so this procedure cannot be used.**

## How To Increase System Power

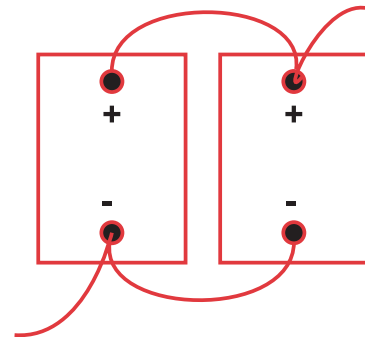
Two or more batteries can be easily connected to boost your system's voltage and/or capacity. There are three methods to obtain additional voltage and/or capacity, as described below:

**To increase voltage, connect batteries in series.**



Battery System: 12 Volt, 225 AH  
Using Two T-105 Deep Cycle Batteries  
(6 Volts, 225 AH)

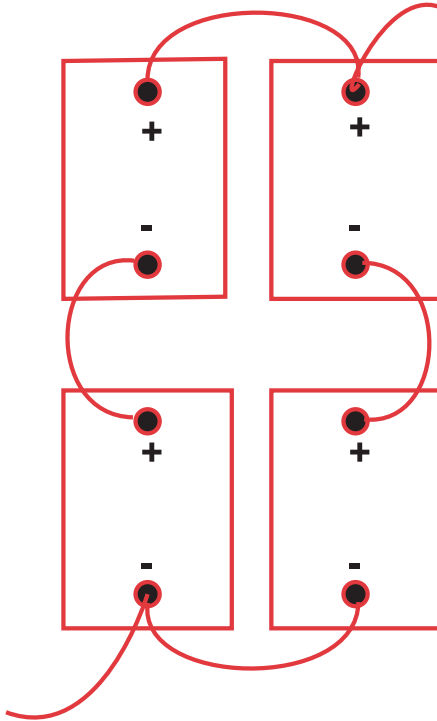
**To increase amp-hour capacity, connect batteries in parallel.**



Battery System: 6 Volt, 450 AH  
Using Two T-105 Deep Cycle Batteries  
(6 Volts, 225 AH)



## To increase both voltage and amp-hour capacity, connect batteries in series/parallel.



*Battery System: 12 Volt, 450 AH  
Using Four T- 105 Deep Cycle Batteries  
(6 Volts, 225AH)*

**NOTE:** These systems can also be configured using 12-volt batteries. It is not recommended that you mix batteries of different voltages within the same system.

## Battery Terms Explained

- 1. Active Material** - In the positive plates, the active material is lead dioxide. In the negative, it's metallic sponge lead. When a circuit is created, these materials react with sulfuric acid during charging and discharging.
- 2. Ampere (Amp)** - A unit of measurement for the electron flow or current through a circuit.
- 3. Ampere-Hour (Amp. Hr., AH)** - A unit of measure for a battery's electrical storage capacity, calculated by multiplying the current in amperes by the time in hours. (Example: A battery which delivers 5 amps for 20 hours provides 5 amps x 20 hours = 100 AH of capacity.)
- 4. Capacity Rating** - The time in minutes that a new, fully-charged battery will deliver 25 amperes or 75 amperes at 80° F and maintain a terminal voltage equal to or greater than 1.75 volts per cell.
- 5. Cell** - The basic current-producing unit in a battery. It consists of a set of positive plates, negative plates, electrolyte, separators and casing. A cell's nominal voltage is 2 volts. (Example: A 12-volt battery has 6 cells.)
- 6. Circuit** - The path followed by a flow of electrons. A closed, or short, circuit is a complete path. An open circuit has a broken path.
- 7. Cycle** - One discharge of a battery plus one recharge.
- 8. Depth of Discharge (DOD)** - The percentage of capacity actually removed from a battery compared to the total rated capacity.
- 9. Electrolyte** - In a deep cycle battery, it is a dilute solution of sulfuric acid and water.
- 10. Hydrometer** - A tool used to measure the specific gravity of the electrolyte solution.
- 11. Equalization** - An overcharge performed on flooded lead-acid batteries after they have been fully charged. This maintenance step helps eliminate stratification and sulfation.



## **Suggested Maximum Ampacity for Copper Wire**

| <b>WIRE GAUGE SIZE<br/>(AWG)</b> | <b>AMPACITY<br/>(AMPERES)</b> |
|----------------------------------|-------------------------------|
| 14                               | 25                            |
| 12                               | 30                            |
| 10                               | 40                            |
| 8                                | 55                            |
| 6                                | 75                            |
| 4                                | 95                            |
| 2                                | 130                           |
| 1                                | 150                           |
| 1/0                              | 170                           |
| 2/0                              | 265                           |
| 4/0                              | 360                           |

Ampacity is the ultimate safe current carrying capacity of the wire before damage occurs to the insulation. These are suggested ampacities. Refer to the National Electric Code or your local code for correct wire size usage.

**For more information, please visit  
[www.trojanbattery.com](http://www.trojanbattery.com) or call 800-423-6569  
and speak to our Applications Engineers.**



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