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Product Information Bulletin

Date Issued		PIB #
07/27/2012	HBC Battery Owner's Manual	24

YEAR / BRAND / TYPE / MODEL #

This information is for reference to all our Newmar Dealers and Service Centers

Product Information

Attached you will find a Harris Battery Owner's Manual that is a useful tool if you are having issues with Chassis batteries or if you have a coach that will be in storage.

HARRIS BATTERY

Harris Battery Company, Inc.

Battery Owner's Manual

HBCJSH JAN 2012

Harris Battery Company, Inc.
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HARRIS BATTERY

Harris Battery Company, Inc.

Harris Battery makes battery care simple and easy to understand with this comprehensive guide featuring information on, but not limited to, proper testing, storage, charging. Our experience shows that the key to achieving optimum performance and long life is a solid battery maintenance program using the simple procedures outlined herein:

Caution:

Always wear protective clothing, gloves, and goggles when handling batteries and electrolyte. DO NOT SMOKE NEAR BATTERIES!

Battery terminals and related accessories contain lead and lead alloys and components. You should thoroughly wash your hands after handling.

Batteries normally produce explosive gases, which can cause personal injury. Therefore, do not allow flames, sparks, or lighted substances near your battery. When working near your battery, always shield your face and protect your eyes. Always provide proper ventilation.

Keep batteries out of reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Shield you eyes when working near your battery to protect against possible splashing of acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and seek prompt medical attention. Seek immediate medical attention, if battery acid is accidentally swallowed.

For more in-depth and detailed information, please refer to the Battery Service Manual, printed and distributed by the Battery Council International.

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Table of Contents

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SECTION I

How a Battery Works

A storage battery is an electrochemical device. It stores chemical energy that can be released as electrical energy upon demand. When the battery is connected to an external load, such as a starter, the chemical energy is converted into electrical energy and current flows through the circuit.

SECTION II

Purpose of the Battery

The three main functions of automotive battery are to:

1. Supply power to the starter and ignition system so the engine can be cranked and started.
2. Supply key-off power or the extra power necessary when the vehicle's electrical load requirements exceed the supply from the charging system.
3. Act as a voltage stabilizer in the electrical system. The battery smooths out or reduces high voltages (transient voltages) that occur in the vehicle's electrical system. These excessively high voltages could damage other components in the electrical system if it were not for the protection provided by the battery.

Storage batteries are used in other fields for a variety of tasks such as providing power for lighting units and propelling special vehicles, UPS (Uninterruptable Power Supply), Back-Up Power, load leveling, etc.

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SECTION III

How a Battery Operates

When two unlike electrode materials (such as the positive and negative plates of a lead-acid battery) are immersed in an electrolyte solution (such as sulfuric acid and water), a voltage is developed and a battery is created. The voltage developed depends upon the types of materials used in the electrodes and the electrolyte used. The voltage is approximately from 2.1 to 2.2 volts per cell in a typical lead-acid battery and is dependent on the concentration of the sulfuric acid electrolyte. Electrical energy is produced by the chemical reaction between the different electrode materials and the electrolyte. When the chemical reaction starts, electrical energy flows from the battery as soon as there is a circuit between the positive and negative terminals (whenever a load such as the headlamps is connected to the battery). The electrical current flows as electrons through the outside circuit and as charged ions between the plates, inside the battery.

The voltage of the lead-acid storage battery is determined by the materials used in its construction. These chemicals are:

- Lead dioxide – the material on the positive grid
- Sponge lead – the material on the negative grid
- Sulfuric acid – the electrolyte

SECTION IV

Battery Storage

Each year, seasonal changes bring renewed concerns about the proper storage procedure for lead-acid batteries. Since lead-acid batteries are electrochemical systems, temperature affects a variety of their characteristics, such as electrical performance and life. Proper storage of batteries helps achieve better performance and longer life, while increasing reliability and value.

Important Note: *Periods of inactivity can be extremely harmful to lead-acid batteries, up to and including catastrophic failure. When a battery discharges for an extended period without proper*

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maintenance charging, the battery can suffer irreparable damage leading to the battery's premature failure. When placing a battery into storage, follow the recommendations below to insure that the battery remains healthy and ready for use.

I The most important things to avoid:

1. Freezing: Avoid locations where freezing temperature is expected. Keeping a battery fully charged will help to prevent freezing – a discharged battery is more susceptible to freezing. Freezing results in irreparable damage to the battery's plates and container.

2. Heat: Avoid direct exposure to heat sources such as radiators or space heaters. Temperatures above 80 degrees Fahrenheit accelerate the battery's self-discharge rate and characteristics.

II Step by step storage 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 open-circuit-voltage and the specific gravity (flooded batteries). Batteries in storage should be re-charged when they show a 70% charge or less (12.4 for a 12 volt). See Table 2.

4. Completely charge the battery before re-activating.

***Note**: Swollen batteries are the result of overcharging. Batteries will never swell from the result of their design, chemical reaction, from being in storage, or from Manufacturer Defect. Even defective batteries left unattended for an extended period will not swell. Be sure not overcharge a battery.*

All batteries, regardless of their chemical make up, undergo a process called local action or self-discharge. The rate or speed at which this process occurs is dependent upon the chemical reactants in the battery's composition. The chemical reactants in a lead acid battery consist of lead dioxide or lead peroxide in the positive electrode, sponge lead in the negative electrode and sulfuric acid in a dilute solution, called electrolyte.

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One basic principal in chemistry states that as the quantity of reactants increases, the rate of reaction increases. The number of plates in each cell, the density of the active material, and the concentration of pure sulfuric acid in the electrolyte solution all play a part in the rate at which the battery self-discharges during storage.

If your vehicle is not going to be driven for 25 days or more, remove the (-) negative (black) cable from the battery. This will help to keep your batteries from discharging faster. If your vehicle is not going to be driven for a period longer than 90 days, you should remove the batteries, ensure that they are fully charged to a 12.6 volts (100% state of charge), and store in a cool, dry place. If a battery is allowed to discharge during a storage period, ensure that the battery is fully recharged to 12.6 before reinstalling it into the vehicle.

Allowing batteries to stand for an extended period without maintenance charging will result in both reduced performance and premature failure. To preserve optimum battery performance and long service life, recharge the batteries when the voltage drops to 12.4 volts. A 12-volt battery is 100% fully charged at 12.73 volts.

A discharged battery can be re-charged. When fully recharged, a battery is again ready to deliver power. The charge-discharge-charge cycle can be repeated. Eventually, the battery will experience plate or separator deterioration and the battery's power will diminish naturally over time, or until some other external factor causes the battery to fail.

SECTION V

Recommended Storage Practices

Batteries should be stored fully charged to 100% state of charge (SOC) in a cool, dry location, protected from the elements. Wind chill factors have been known to freeze batteries which would not freeze at normal ambient temperatures. Direct exposure to heat sources, such as radiators or space heaters, will accelerate the rate of self-discharge and increase the frequency of required boost charging.
According to the Battery Council International, batteries in storage should be charged when the specific gravity value drops .040 points. When hydrometer readings are not accessible, open circuit voltage (OCV) readings may be used. While in storage, a freshening charge should be given when the battery voltage drops below 12.4 volts. The table below shows open circuit voltage values at various states of charge and recommended recharge times at various charge current rates.

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SECTION VI

Effects of Temperature

Temperature plays a critical role in the performance of a battery. At higher temperatures, battery capacity generally increases, usually at the cost of battery life.

As the temperature increases, the rate of reaction increases. A general rule of thumb is that every 10 degrees F increase in temperature results in a two to three fold increase in reaction rate. Therefore, storing batteries in a hot environment accelerates the self-discharge rate characteristic.

At lower temperatures, the battery capacity generally decreases. Furthermore, as the temperature decreases, the rate of reaction decreases, slowing the self-discharge characteristic.

In extremely cold climates, batteries stored outdoors may be subject to freezing. Freezing usually results in irreparable damage to the plates and containers. It is therefore imperative that batteries that are subjected to freezing temperatures be stored fully charged or at a high state of charge.

SECTION VII

Battery Charging

Charging batteries properly 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. Both automatic and manual equipment can present difficulties in charging. In either case the original instructions for your charging equipment should also be referenced for proper charging. Here is a list of helpful items to remember when charging.

1. Become familiar with the charger and follow the instructions issued by the charger manufacturer.
2. Batteries should be recharged after each period of use.
3. Lead-acid batteries do not develop a memory and do not need to be fully discharged before recharging.

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4. Charge only in well ventilated area. Keep sparks or flames away from a charging battery.
5. Verify charger voltage settings are correct.
6. Check electrolyte level.
7. Tighten all vent caps before charging.
8. Do not overcharge the battery. Overcharging causes excessive gassing, heat buildup, and battery aging.
9. Do not undercharge the batteries. Undercharging causes stratification.
10. Do not charge a frozen battery.
11. Avoid charging at temperatures above 120 degrees Fahrenheit.
12. Correct the charging voltage to compensate for temperatures above and below 80 degrees Fahrenheit.

- Add .028 volts per cell for every 10 degrees below 80 degrees Fahrenheit.
- Subtract .028 volts per cell for every 10 degrees above 80 degrees Fahrenheit.

SECTION VIII

Discharging

Discharging batteries is entirely a function of your particular application. However, below is a list of helpful items:

1. Shallow discharges will result in longer battery life.
2. 50% (or less) discharges are recommended.
3. 80% discharge is the maximum safe discharge.
4. Do not discharge flooded batteries 80% or more on a consistent basis. This will shorten life of the battery.

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5. Do not leave the battery in a state of discharge for any length of time.
6. Lead-acid batteries do not develop memory and do not need to be fully discharged before recharging.
7. Batteries should be charged after each period of use.
8. Batteries that a charge but cannot support a load are most likely bad and should be tested. Refer to the section on battery testing for proper procedure.

Recharge Time vs. State of Charge

If the batteries have been in service prior to storage, they should be given a boost charge before being placed in storage and immediately prior to returning to service.

Proper storage of lead-acid batteries will help achieve better performance and longer life, while increasing reliability and value to the user.

Percentage charge of Charge	Specific Gravity Corrected to 80 F	Open Circuit Voltage per Cell	Hours charge at 5 Amps.	Hours charge at 10 Amps.	Hours at 20 Amps.
100	1.277	2.122	0	0	0
90	1.258	2.103	5	3	1
80	1.238	2.083	10	5	3
70	1.217	2.062	16	8	4
60	1.195	2.04	21	10	5
50	1.172	2.017	26	13	6
40	1.148	1.993	31	16	8
30	1.124	1.969	36	18	9
20	1.098	1.943	41	21	10
10	1.073	1.918	47	23	12

Note: Multiply by 6 for 12-volt batteries to determine unit voltage.

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SECTION IX

Overcharging and undercharging

The battery is just one part of the vehicle's electrical system. The charging system or small continuous discharges can have a great effect upon the life of the battery. A bulb under the hood or in the trunk that stays on when the vehicle is not running can discharge the battery. With normal driving, this is usually not enough to cause the vehicle not to start, but it will have an effect on life. The repeated discharging and recharging of the battery will shorten life.

Most of today's vehicles have solid-state voltage regulators that are typically integrated with the generator. The regulators eliminate the problem of adjusting the voltage setting. These settings are made by the manufacturer for the typical service requirements of its vehicles. However, if the examination of the battery indicates an overcharge or undercharge problem, the voltage setting and the output of the generator need to be verified. A generator (alternator) or voltage regulator failure will typically result in corresponding battery failure. Since the electrical output should be checked over a wide operating range, it may be necessary to use a computerized testing unit that can simulate all ranges of operation. There are also battery testers that have charging system tests included in their functions.

SECTION X

Battery Inspection

There are many tools to help in properly caring for and maintaining batteries. Below is a list of the basic items recommended for the inspection process:

- Wrench
- Distilled Water
- Voltmeter
- Hydrometer
- Post Cleaner

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- Baking Soda
- Vaseline
- Goggles & Gloves

Examine the outside appearance of the battery.

- Look for cracks in the container.
- The top of the battery, the posts, and connections should be clean, free of dirt, fluids, and corrosion.
- Repair or replace and damaged batteries.

Fluids on or around the battery may be an indication that electrolyte is spilling, leaching, or leaking out.

- Immediately remove leaking battery from service and replace.

Check all battery cables and their connections.

- Look closely for loose or damaged parts.
- Replace any cable that is broken or frayed.

SECTION XI

Battery Testing

Battery testing is an integral, necessary, and required part of periodic vehicle maintenance, whether or not a starting problem has occurred. Maintenance charging the battery in the vehicle will help to prevent battery failure from external causes.

Visual inspection alone is not sufficient to determine the overall health of the battery. Both open circuit voltage and specific gravity readings can give a good indication of the battery's charge level, age, and health. Routine voltage and gravity checks will not only show the state of charge

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but also help spot signs of improper care, such as undercharging and over-watering, and possibly even locate a bad or weak battery. The following steps outline proper routine voltage and specific gravity testing on batteries.

I Specific Gravity Test (Flooded batteries only)

1. Do not add water at this time.
2. Fill and drain the hydrometer 2 to 4 times before drawing out a sample.
3. There should be enough sample electrolytes in the hydrometer to completely support the float.
4. Take the reading, record it, and return the electrolyte back to the cell.
5. Check all cells in the battery.
6. Replace the vent caps and wipe off any spilled electrolyte.
7. Correct the readings to 80 degrees Fahrenheit:
    - Add .004 to readings for every 10 degrees above 80 degrees Fahrenheit.
    - Subtract .004 for every 10 degrees below 80 degrees Fahrenheit.
8. Compare the readings.
9. Check the state of charge using Table 2.

The readings should be within the factory specification of 1.277 +/- .007. If not, follow the steps below.

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

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If any specific gravity reading is still not within the factory specification, follow the steps below.

1. Check the voltage level(s).
2. Perform equalization charge. Refer to the Equalization section for the proper procedure.
3. Take specific gravity readings again.

If any specific gravity reading is still not within the factory specification of 1.277 +/- .007 then one or more of the following conditions may exist:

1. The battery is old and approaching end of life.
2. The battery was in a state of discharge too long.
3. Electrolyte was lost due to spillage or overflow.
4. A weak or bad cell is developing.
5. The battery was watered excessively prior to testing.

Batteries in conditions 1 – 4 should be re-charged and evaluated by a battery specialist.

II Open Circuit Voltage Test

For accurate open-circuit voltage readings, the battery must remain idle (no charging, no discharging) for at least 6 hours, preferably 24 hours.

1. Disconnect all loads from the batteries.
2. Measure the voltage using a DC voltmeter.
3. Check the state of charge using **Table 1**.
4. Charge the battery(s) if it registers 0% to 70% charged.

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If battery registers below the **Table 1** *values, the following conditions may exist:*

- The battery was in a state of discharge for too long.
- The battery has a bad cell.

A severely discharged battery should be re-charged and evaluated by a battery specialist.

Percentage of Charge	Specific Gravity Corrected to 80 F	Open Circuit Voltage
100	1.277	12.73
90	1.258	12.62
80	1.238	12.50
70	1.217	12.37
60	1.195	12.24
50	1.172	12.10
40	1.148	11.96
30	1.124	11.81
20	1.098	11.66
10	1.073	11.51

Table 1. State of Charge as related to Specific Gravity and Open-Circuit Voltage

SECTION XII

Battery Failure

Factors that are important in determining the cause of premature failure are application, installation, service and maintenance charging history, general battery condition, and age of the battery. If a battery tests "bad," that does not necessarily mean that the battery is bad due to Manufacturer Defect. ***Batteries are warranted against defective materials or workmanship in the manufacturing process.*** Most battery testers can only tell you if the battery is either working or not working (i.e. "good" or "bad"). Through proper system and battery testing, it is important to determine the cause of the failure in order to prevent reoccurrence of the problem.

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SECTION XIII

Battery Replacement

When removing batteries always remove the primary battery ground or (-) negative (black) cable before removing the (+) positive (red) cable. This will help prevent electrical shorting, which could damage your electrical components.

When installing new batteries, install the (+) positive (red) cable first, and do not install the ground or (-) negative (black) cable until you are completed with the installation. This will help to prevent electrical shorting, which could cause damage to your electrical components.

- Note: Do not cross the (+) positive and (-) negative connections as this will result in damaging the battery.

SECTION XIV

Proper Torque Values for Connection Hardware

Tighten all wiring connections to the proper specification.

- Stud terminals require 80 to 120 inch pounds
- Automotive post terminals require 50 to 70 inch pounds
- Wingnut terminals require 95 to 105 inch pounds
- Button terminals require 90 to 110 inch pounds

Warning: *Do not over-tighten terminals! Over-tightening can result in terminal breakage. Breakage or cracks in the terminal can lead to terminal meltdown and fire!*

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Summary

When a battery failure is premature, the reason for failure is usually the result of a single cause. Careful inspection will lead to that cause even when the secondary failures have occurred due to the primary cause. If the cause of failure is not evident in the first element inspected, inspect the other elements until the cause of failure is determined. It is best practice to isolate the magnitude and area of failure with electrical tests prior to disassembly.

If the battery has been in service for a prolonged period, it will usually fail due to multiple causes. This is the natural failure mechanism of a battery. All batteries have a limited life and will eventually fail. Actual service life will the a function of the design combined with factors from the application. When multiple causes of failure are noted in older batteries, this indicates a good balance between design, materials, and application.

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