Battery Maintenance

One of the important components of your unit is the storage battery. We depend on it from the moment of unit start up to shutdown, yet, it is surprising how many operators do not understand how it works.

The following information has been compiled from the Association of American Battery Manufacturers Inc., for those of you interested in the principle of battery operation and maintenance.

HOW IT WORKS

CHEMICAL ACTION OF DISCHARGE

See Figure 1. When a cell is discharged (a 12 volt battery has 6) by completing an external circuit, as in switching on the lights, the sulfuric acid acts on both positive and negative plate active materials to form a new chemical compound called lead sulphate. The sulphate is supplied by the acid solution (electrolyte) which becomes weaker in concentration as the discharge proceeds. The amount of acid consumed is in direct proportion to the amount of electricity used from the cell. When the acid in the electrolyte is partially used up by combining with the plates, the battery can no longer deliver electricity at a useful voltage and the battery is said to be discharged.

CHEMICAL ACTION OF CHARGE

See Figure 2. By passing an electric current through the battery in a direction opposite to that of the discharge, the lead sulphate is decomposed. The sulphate is expelled from the plates and returns to the electrolyte, thereby gradually restoring it to its original strength. This action frees the plate of active materials of sulphate and they are restored to their original chemical condition, ready to deliver electricity again. Hydrogen and oxygen gases are given off at the negative and positive plates respectively as the plates reach the fully charged condition. This is the result of the decomposition of water by an excess of charging current not utilized by the plates.

The most valuable characteristic of the lead-acid storage battery is its chemical reversibility. This means that, unlike a dry-cell battery which must be thrown away when it becomes discharged, the storage battery may have an electrical current passed through it in the direction opposite to the direction of discharge and the battery's active chemicals are restored to the "good-as-new" state.

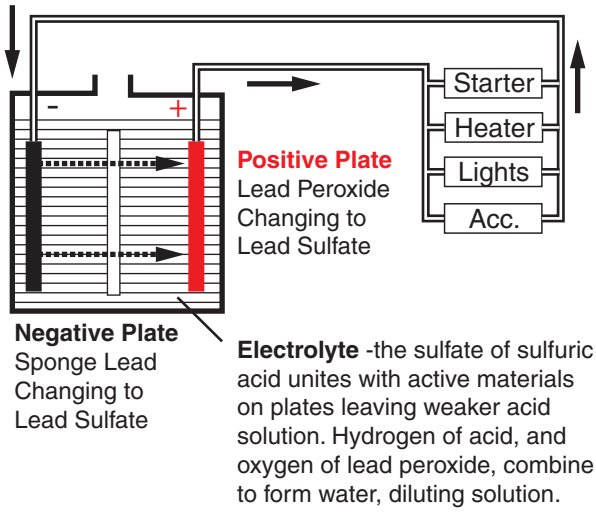


Figure 1 During the Discharge

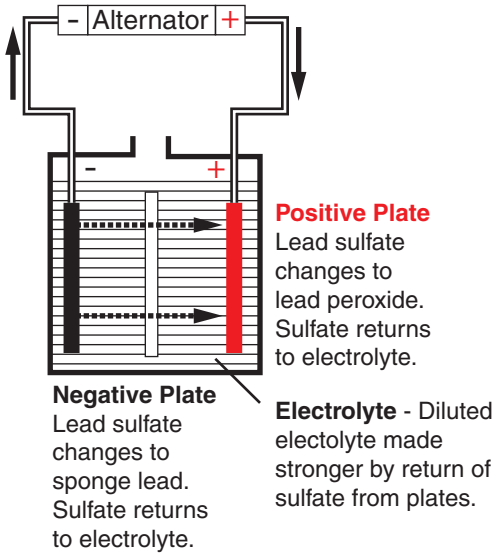


Figure 2 During the Charge

SPECIFIC GRAVITY

Let us suppose we have a simple balance scale and on one side we put exactly one pint of water. On the other we put exactly one pint of battery electrolyte (solution of sulfuric acid in water). The scale would go down on the electrolyte side indicating that the electrolyte is heavier than the pure water.

The electrolyte in a fully charged battery is usually 1.26 times as heavy as an equal volume of pure water when both liquids are at the same temperature. The battery electrolyte would therefore be described as having a “Specific Gravity” of 1.260 meaning that its weight is 1.260 times the weight of pure water. When the battery discharges, the sulfuric acid in the electrolyte combines chemically with the plates and the remaining electrolyte becomes lighter in weight. By determining the relative weight of the electrolyte we can tell how much acid has combined with the plates and therefore estimate how much electrical energy is still left in the battery. But actual weighing of the electrolyte would be inconvenient, so we use instead an instrument called a Hydrometer. This consists of a glass barrel and bulb syringe for sucking up a sample of the electrolyte to float an enclosed glass hydrometer calibrated to read in terms of specific gravity. See Figure 3.

READING SPECIFIC GRAVITY

The depth to which the float sinks in the liquid indicates the relative weight of the liquid compared to water and gives us a measure of the specific gravity of the liquid. The hydrometer floats low in the liquid if the specific gravity is low and it floats high in the liquid if the specific gravity is high. The hydrometer float is made of glass and is equipped with a paper scale built inside the hydrometer with marks on it which must be read on a level even with the liquid surface, and this reading indicates the specific gravity of the liquid.

When reading the hydrometer, disregard the curvature of the liquid where the surface rises against the float stem and the barrel, which is due to surface tension. Keep the float vertical.

Figure 4 graphically illustrates the relationship between specific gravity readings and the combination of the acid with the plates for various states of charge. Note the use of color to indicate the distribution of the acid. Also, note the corresponding height of the hydrometer float for each condition. The hydrometer gives an indication of how much unused sulfuric acid remains in the solution and is therefore a convenient measure of the approximate capacity still available in a normal cell. For accuracy, the liquid level of the cell should be at normal height when a hydrometer reading is taken. The electrolyte should be thoroughly mixed with any water which may have just been added. Hydrometer readings should, therefore, never be taken immediately after water has been added. The water should be thoroughly mixed with the underlying electrolyte, by charging, before hydrometer values are reliable.

The following table illustrates typical ranges of specific gravity for a cell in various stages of charge with respect to its ability to crank the engine at 80°F.

1.260 Sp. Gr.	1.280 Sp. Gr.	100% Charged
1.230 Sp. Gr.	1.250 Sp. Gr.	75% Charged
1.200 Sp. Gr.	1.220 Sp. Gr.	50% Charged
1.170 Sp. Gr.	1.190 Sp. Gr.	25% Charged
1.140 Sp. Gr.	1.160 Sp. Gr.	Doubtful
1.110 Sp. Gr.	1.130 Sp. Gr.	Discharged

When reading a hydrometer, the barrel must be held vertically and just the right amount of acid be drawn up into the barrel with bulb fully expanded to lift the float freely so that it touches neither side, nor the top nor bottom stoppers of the barrel.

The hydrometer barrel and float must be kept clean with soap and water so the float will not stick to the sides. The float must be inspected occasionally for cracks which would allow acid to enter the airtight float and make any reading with it unreliable. If the paper scale inside the float is wet, it is an indication that the float leaks, and should not be used.

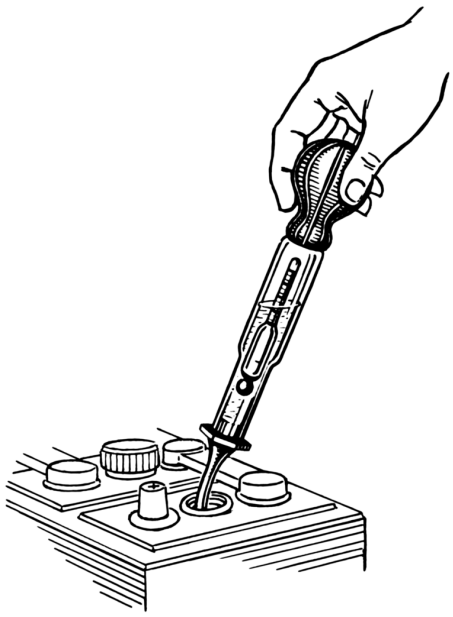
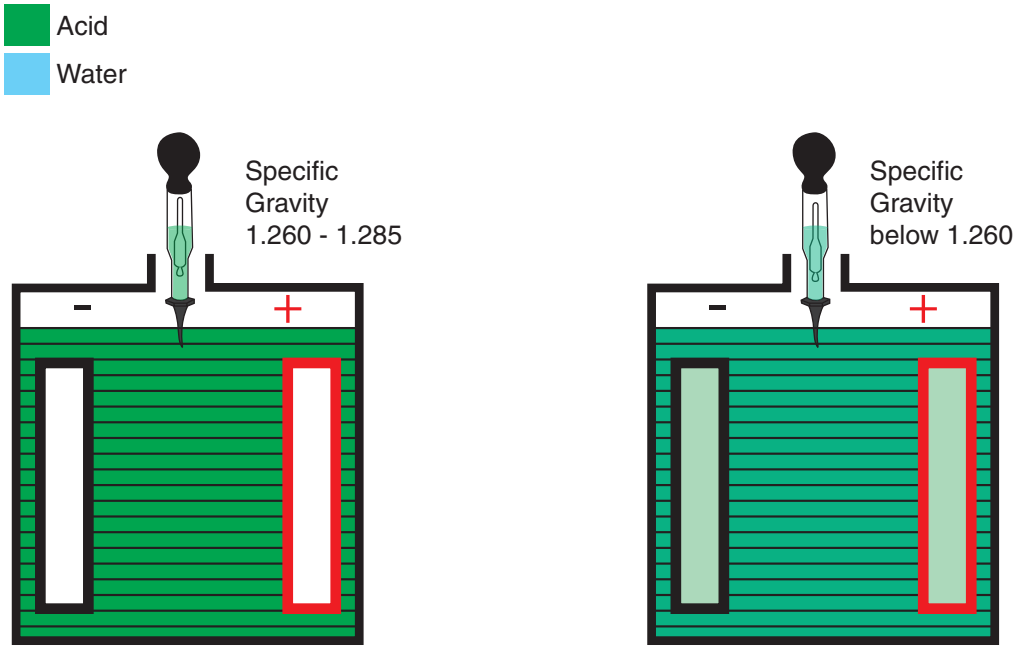


Figure 3 Using a Hydrometer



Fully Charged
Acid in water gives electrolyte specific gravity of 1.260

Going Down
As battery discharges, acid begins to lodge in plates. Specific gravity drops.

Unsafe
Battery half discharged. More acid in plates, less in electolyte. Starting failure in sight if battery is allowed to remain in vehicle.

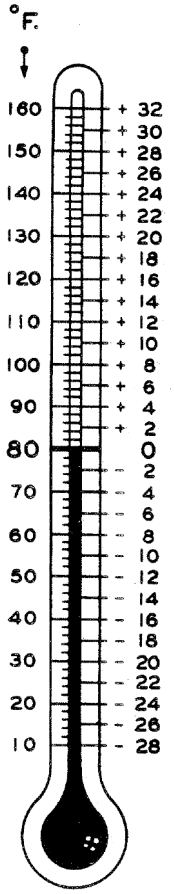
Discharged
Acid almost entirely in plates, leaving weak electrodes behind. Specific gravity lower, almost that of water.

Figure 4 Specific Gravity Readings

TEMPERATURE CORRECTION

No hydrometer reading is strictly correct until a temperature correction has been applied. At ordinary temperatures, it is not usually necessary to correct a hydrometer reading for the temperature effect, but at extremes of temperature the correction is important.

Hydrometer floats are calibrated to indicate correctly only at one fixed temperature. If used in acid at any other temperature, a correction must be applied. The reason for this lies in the fact that the acid volume expands when it is heated and shrinks when it is cooled. When expanded, due to heat, it will not be as dense and will not raise the hydrometer float as high in the acid, and this will cause the reading to be low. When the acid is cooled, the acid shrinks in volume and becomes denser, which causes the hydrometer to rise higher and read too high. The error due to temperature is well known and we can easily correct it if we know the temperature of the acid which surrounds the float in the hydrometer. Figure 5 illustrates the correction for hydrometer readings when the acid temperature (not air temperature) is above or below 80°F.



Example 1
Temperature below 80°F.
Hydrometer Reading: 1.250
Acid Temperature: 20°F
Subtract .024 Sp. Gr.
Corrected Sp. Gr. is **1.226**

Example 2
Temperature above 80°F.
Hydrometer Reading: 1.235
Acid Temperature: 100°F
Add .008 Sp. Gr.
Corrected Sp. Gr. is **1.243**

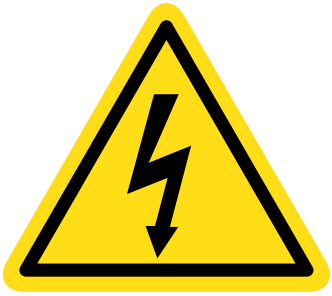
Figure 5 Temperature Correction

SERVICING DO'S AND DON'TS

⚠ WARNING

Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes or clothing.

Batteries produce explosive gases. Keep sparks, flame and cigarettes away. Ventilate when charging or servicing in an enclosed space. Always shield your eyes when working near batteries. When removing battery cables, always turn the battery disconnect switch(es) OFF first, then disconnect the negative (-) cable. When installing a battery, always connect the positive (+) cable first. This procedure will help to prevent a spark which could cause an explosion.



Use extreme caution when working with the batteries. An electric shock could be fatal.

All electrical cables and connectors must be in good condition (free of corrosion, damage, etc). Use caution in wet weather to avoid danger from electrical shock. Never attempt electrical testing or repair while standing in water.

Do not wear electrically conductive jewelry, clothing, or other items while working on the electrical system.

1. Keep the battery top clean. Use a stiff bristle brush, being careful not to scatter the corrosive particles with the bristles.
2. You can wipe off battery tops with a cloth moistened with a water and ammonia or baking soda solution.
3. Do not clean with solvents.
4. Replace cables with broken or corroded strands. It takes a complete cable to transfer full voltage.
5. Clean both the terminals and battery cable ends with a wire brush, whenever they are disconnected, to remove any corrosion. Coat surfaces with mineral grease or vaseline after clamp terminals are tightened.
6. Keep battery cradles operable and holddowns tight.
7. Make periodic hydrometer tests. A failing battery can be detected before the situation becomes critical.
8. Keep the water level up, but, avoid over filling. The excess may be forced out later along with acid and do serious damage to adjacent components.
9. Normally battery water is distilled water, but it may be drinking water that is free of minerals. Even slightly impure water is better than no water.
10. Adding water to a cell will lower the specific gravity of the electrolyte, but, this does not mean that the cell has lost any of its charge. Make your hydrometer test later.
11. Watch for batteries that require excessive water. That need may be an indication of a charging system out of adjustment and you may be subjecting your battery to the damaging effect of over charging.

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