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Battery Construction

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Case. Most automotive battery cases (container or covers) are constructed of polypropylene, a thin (approximately 0.08 in., or 0.02 mm, thick), strong, and lightweight plastic. In contrast, containers for industrial batteries and some truck batteries are constructed of a hard, thick rubber material. Inside the case are six cells (for a 12 volt battery). Each cell has positive and negative plates. Built into the bottom of many batteries are ribs that support the lead-alloy plates and provide a space for sediment to settle, called the sediment chamber. This space prevents spent active material from causing a short circuit between the plates at the bottom of the battery. A maintenance-free battery uses little water during normal service because of the alloy material used to construct the battery plate grids.

Grids. Each positive and negative plate in a battery is constructed on a framework, or grid, made primarily of lead. Lead is a soft material and must be strengthened for use in an automotive battery grid. Adding antimony or calcium to the pure lead adds strength to the lead grids. Battery grids hold the active material and provide the electrical pathways for the current created in the plate. Maintenance-free batteries use calcium instead of antimony, because 0.2% calcium has the same strength as 6% antimony. A typical lead-calcium grid uses only 0.09% to 0.12% calcium. Using low amounts of calcium instead of higher amounts of antimony reduces gassing. Gassing is the release of hydrogen and oxygen from

the battery that occurs during charging and results in water usage. Low-maintenance batteries use a low percentage of antimony (about 2% to 3%), or use antimony only in the positive grids and calcium for the negative grids. The percentages that make up the alloy of the plate grids constitute the major difference between standard and maintenance-free batteries. The chemical reactions that occur inside each battery are identical regardless of the type of material used to construct the grid plates.

Positive plates. The positive plates have lead dioxide (peroxides), in paste form placed onto the grid framework. This process is called pasting. This active material can react with the sulfuric acid of the battery and is dark brown in color.

Negative plates. The negative plates are pasted to the grid with a pure porous lead, called sponge lead, and are gray.

Separators. The positive and the negative plates must be installed alternately next to each other without touching. Nonconducting separators are used, which allow room for the reaction of the acid with both plate materials, yet insulate the plates to prevent shorts. These separators are porous (with many small holes) and have ribs facing the positive plate. Separators can be made from resin-coated paper, porous rubber, fiberglass, or expanded plastic. Many batteries use envelope-type separators that encase the entire plate and help prevent any material that may shed from the plates from causing a short circuit between plates at the bottom of the battery.

Cells. Cells are constructed of positive and negative plates with insulating separators between each plate. Most batteries use one more negative plate than positive plate in each cell; however, many newer batteries use the same number of positive and negative plates. A cell is also called an element. Each cell is actually a 2.1 volt battery, regardless of the number of positive or negative plates used. The greater the number of

plates used in each cell, the greater the amount of current that can be produced. Typical batteries contain four positive plates and five negative plates per cell. A 12 volt battery contains six cells connected in series, which produce 12.6 volts (6*2.1 = 12.6) and contain 54 plates (9 plates per cell, 6 cells). If the same 12 volt battery had five positive plates and six negative plates, for a total of 11 plates per cell, or 66 plates, then it would have the same voltage, but the amount of current that the battery could produce would be increased. The amperage capacity of a battery is determined by the amount of active plate material in the battery and the area of the plate material exposed to the electrolyte in the battery.

Partitions. Each cell is separated from the other cells by partitions, which are made of the same material as that used for the outside case of the battery. Electrical connections between cells are provided by lead connectors that loop over the top of the partition and connect the plates of the cells together. Many batteries connect the cells directly through the partition connectors, which provide the shortest path for the current and the lowest resistance.

Electrolyte. Electrolyte is the term used to describe the acid solution in a battery. The electrolyte used in automotive batteries is a solution (liquid combination) of 36% sulfuric acid and 64% water. This electrolyte is used for both lead-antimony and lead-calcium (maintenance-free) batteries. Electrolyte is sold premixed in the proper proportion and is factory installed or added to the battery when the battery is sold. Additional electrolyte must never be added to any battery after the original electrolyte fill. It is normal for some in the form of hydrogen and oxygen gases to escape during charging as a result of the chemical reactions. The escape of gases from a battery during charging or discharging is called gassing. Only pure distilled water should be added to a battery. If distilled water is not available, clean drinking water can be used.