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Since 1950... it's all we do.

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MAINTENANCE

Below are guidelines for maintenance of the Battery. Your previous knowledge of lead acid batteries may not require this much attention, but remember, the more interaction you have with the battery (The Heart of the System) the better service lift you can expect from your investment.

The Battery warranty as it pertains to records, only requires that "reasonable records be kept". Use your best judgment.

Weekly

1. Record hydrometer reading of pilot cell (the cell with the lowest specific gravity when you first received the battery. Once a year select a different cell to be the pilot cell).

2. Check the water level of all cells (add as needed – only when battery is fully charged). Use **ONLY DISTILLED WATER!** Using tap or well water will void your warranty.

3. Record Amp/Hrs consumed.

4. Inspect connections for corrosion (clean as needed).

Bi-Monthly

1. Record hydrometer readings of all cells (after the battery is fully charged).

   A. If the average readings are less then 1.275 – 1.285 check all charging sources and adjust as needed.

   B. If one or two cells read 20 points more of ***less*** than the average, circle those readings and check for improvement at next monthly reading. If the low cells do not improve, the cells are in need of an equalize charge, specific gravity internal inspection.

2. Check water level (add as needed). **Use ONLY DISTILLED WATER!** Using tap or well water will void your warranty.

3. Record Amp/hrs consumed.

BATTERY BUILDERS, INC.
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BATTERY CHARGING

Each time a battery is discharged (80%) and then recharged, it's referred to as a "cycle." An average battery lasts 1500-1800 cycles. If a customer doesn't discharge to 80% and puts the battery on charge, we call this act "short-cycling." Short cycling will decrease the life of the battery.

During the charging process the sulfate in the battery plates, which accumulated during discharge is driven back into the electrolyte. This increases the specific gravity and brings the on charge voltages up to 2.50 to 2.75 volts per cell, depending on the age of the battery.

In a fully charged condition, the active material on the positive battery plate is lead peroxide. The active material on the negative plate is sponge lead. When a battery is discharging, the components of the cell undergo chemical changes and the composition of the plates, both negative and positive, turn to lead sulfate. The sulfate comes from the sulfuric acid in the electrolyte solution. This combines chemically with the active material of the plates. This reaction also reduces the specific gravity of the electrolyte which approaches water (1.000). The cell voltages also decrease during the discharge. During recharge, the discharging reaction is reversed and the chemical energy is restored. When these reactions are complete, the cells are fully charged.

Equalize Charge

Some cells take less charge than others due to slight differences in the construction of the battery. An occasional equalizing charge will correct the cell-to-cell imbalances and bring them all up to the same capacity, An equalize charge is a 3 hour continuation of the standard recharge at no more than the battery's finish rate. A minimum 3 amp per 100 amp hour equalize charge rate is necessary to receive the full benefit of the equalize charge. A lower rate will require a longer charging period.

If there is more than 0.020 specific gravity variation between any cells, the battery should be equalized. Improper charging can reduce the battery's capacity and life.

Word R shared
Procedures
Battery Charging

Undercharging

Undercharging can cause sulfation to remain on the plates, reducing cell performance. Sulfation also slowly occurs when batteries are stored for months without receiving a periodic freshening charge. The cells of a sulfated battery give low specific gravity and voltage readings.

Undercharging also results in insufficient gassing which creates a high acid content at the bottom of the cell, eventually leading to sulfation. Periodic equalizing charges can correct this condition.

Overcharging

Overcharging produces corrosion of the positive grids and excessive gassing, which loosens active material in the plates, particularly the positives. The material, sifting down between the separators and the plates, is deposited in the bottom of the jar as a fine brown sediment. Overcharging also increases the temperature of the battery and in some cases may carry it to excessive temperatures, which are destructive both to the plates and the separators. Overcharging, which is accompanied by excessive gassing, results in a needless loss of water, requiring constant attention to keep the cells filled to the proper level with electrolyte. Habitual overcharging decreases the period of useful service a battery can give.

PROCEDURES FOR BATTERY MAINTENANCE

A. A normal cycle for a battery is 8 hours of work, 8 hours of charge, and 8 hours of rest (cool down).

B. Usually every 5th charge should be an equalizing charge. This should serve to bring all cells up to a 100% charge state.

C. Before a battery is put on charge:
   1. Electrolyte levels should be checked in each cell.
   2. If no electrolyte can be seen, water should be added just enough until you can see liquid in the cell. (Only do this to prevent damage to the plates. Normal watering is done after charge but you do not want to begin charging a dry cell.)
   3. Replace the vent caps before charging

D. After a battery has been charged:
   a. Recheck electrolyte levels.
   b. Fill to no more that ¼ to ½ inch above the splash guard as overfilling causes acid loss. Acid loss means capacity loss, cell imbalances, high heat, and premature battery failure.

E. If you notice any problems with a battery or battery damage, promptly notify qualified battery specialists to prevent extended abuse and minimize repair costs.

F. A battery is 80% discharged when the specific gravity is 1.170.* A battery is 100% discharged when the specific gravity is 1.140.* At the 80% discharge level the battery should be taken out of service and recharged unless it is extremely hot (in which case it needs to cool down before recharge). *These figures are general rules of thumb.

G. A battery is fully charged when the specific gravity reaches 1.275 to 1.285. Some high gravity batteries have a full charge of 1.320. Consult the manufacturer's specification for each battery.

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STOP PREMATURE BATTERY FAILURE

CHARGING AND ROUTINE MAINTENANCE

A lead-acid battery being used in an industrial lift truck should last about 1800 charge/discharge cycles (assuming a regular 80% discharge of rated amp-hour capacity).

The control of the charge profile is very important to maximize battery life. Therefore the charger must be properly sized to the battery it will charge. Using improperly sized chargers can lead to undercharging or overcharging; neither is good for the battery.

How can you combat premature battery failure? The key is to first understand the three main causes; unbalanced charging, overdischarge during operation, and inadequate routine maintenance.

UNBALANCED CHARGING - Unbalanced charging takes one of two forms; overcharging or undercharging. Either form of abuse will damage your battery's most vulnerable component -- its positive plate. Both overcharging and undercharging greatly accelerate the normal slow, natural rate of disintegration of the plate, shortening battery life.

Overcharging increases the corrosion of the positive grid metal, and the accompanying gas dislodges the active material. Once the eroded material is released into the electrolyte, it will gradually accumulate in the bottom of the battery cell, blocking space and eventually causing internal short circuits. Additionally, shedded material may be electrodeposited on the negative plate forming spikes (dendrites) which can also cause shorts. This plate erosion inevitably reduces the amp-hour capacity. Overcharging will also increase corrosion and result in electrolyte loss. And to add insult to injury, overcharging also produces high temperatures (i.e., above 110° F) within the battery, further speeding the degradation process.

When a lead-acid battery is undercharged, some of the lead sulphate produced during normal discharge remains unconverted. As this lead sulphate builds up on the positive plate (sulphation occurs), the plate material expands, leading to buckling or fracturing of the plates and subsequent separation. This partial separation of plate material (which affects both positive and negative plates) will in turn produce a progressive reduction in capacity. Undercharging also curtails the gassing phase of the charging cycle during which the electrolyte is mixed. Sulphation again results, this time due to a layer of highly concentrated acid remaining at the bottom of the battery cells.

OVERDISCHARING lead-acid batteries also causes positive plate damage. This is why the battery discharge indicator on the truck must be properly adjusted. Batteries should be charged when they become 80% discharged. At that level, battery voltage drops rapidly, resulting in higher currents that can damage the battery and the lift truck.

INADEQUATE ROUTINE MAINTENANCE - Routine maintenance is one of the essential keys to ensuring satisfactory battery life -- neglect it and battery performance will suffer. Keeping batteries in good repair must be an integral component of operations.

Battery cells need routine topping off with water approved for lead-acid battery use. Low water levels will result in permanent loss of battery output due to sulphation of the upper parts of the plates. On the other hand, overfilling, like overcharging, causes electrolyte loss which reduces battery capacity and cell voltages. Increased attention to battery maintenance will help to cure the problem, as will the use of a single point watering system.

Accumulated dirt on the cell covers will eventually become electrically conductive due to acid impregnation, especially when the cells have been overfilled. The result is excessive current leakage leading to reduced discharge capacity and increased charging costs. Another, more critical result is the very real increase of the risk of electric shocks and explosions.

Charging cables and battery plugs must be kept in good condition. Worn cables carry the danger of short circuits -- and potential personal injury or damage to the battery or vehicle. Poor contacts produce severe heating under heavy loads.

Part of the routine maintenance should be equalization of the cells. The charger has an equalize button that should be initialized at regular intervals. Usually twice per month is sufficient depending on usage. Individual cells make up a battery. It is the goal of the mfg. plant to build identical cells. In reality, this is not the case, every cells is slightly different. When these cells are cycled daily, these small differences (in voltage) will grow. As the differences grow, the battery becomes less efficient and the weak cells may tend to sulfate more quickly thus shortening their life. To correct this problem, a battery should be equalized at regular intervals. In equalization a charge current is applied for a specific amount of time such that the range in voltages between cells is minimized. Equalization is important because it helps to prevent one or more cells from failing prematurely. It is inevitable that a battery will fail at some point. One failure mode is when all the cells fail due to "old age" at about the same time. Another, less desirable failure mode, is when one or two cells fail early because they weren't equalized according to the manufacturer's maintenance schedule.

Understanding the root causes of premature battery failure provides the key to their cure. Electronic monitors and controls, increasingly sophisticated chargers, and single point watering systems will simplify battery charging and maintenance, but the ultimate solution is the commitment to a good maintenance program.

CAPACITY CHART

Aprox Values

Gravity	Voltage	% Capacity
1.285	2.13	100%
1.275	2.12	97%
1.265	2.11	92%
1.255	2.10	85%
1.245	2.09	78%
1.235	2.08	70%
1.225	2.07	63%
1.215	2.06	55%
1.205	2.05	47%
1.195	2.04	40%
1.185	2.03	33%
1.175	2.02	25%
1.165	*2.01*	*17%*
1.155	2.00	10%
1.145	1.99	2%