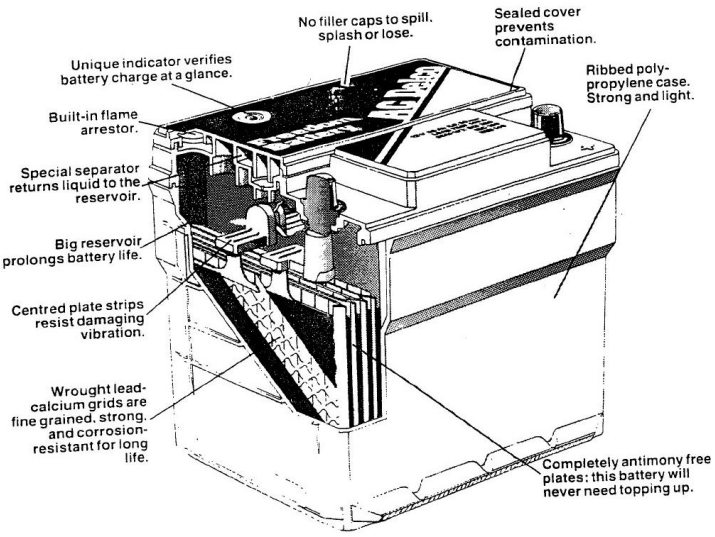
TTE Training Ltd.

Phase 2

Electrical Course Notes

E2-CN-008

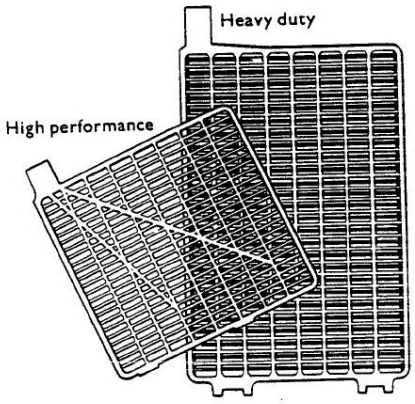


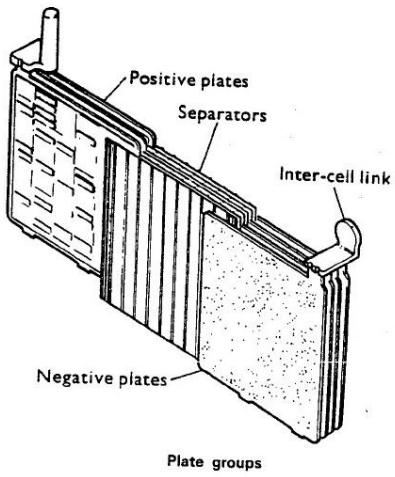
Battery Maintenance

Batteries

Introduction

A battery consists of several individual cells connected to produce a required voltage. Each cell contains positive and negative plates immersed in an electrolyte; the voltage produced is dependent upon the chemical composition of the active material contained in the plates.





Before describing the most common types of rechargeable battery used on site, it is necessary to outline the safety precautions.

Safety

Protective clothing: when filling a battery with electrolyte, rubber gloves and goggles (or better still a full-face shield) must be worn to protect the hands and eyes. When large quantities are being carried or when splashing is likely to occur, a full-length rubber apron must be worn.

Mixing Electrolyte: when mixing electrolyte for lead/acid batteries to the required specific gravity, distilled water must never be added to the concentration solution or a serious explosion may result.

(ADDING WATER TO ACID RESULTS IN A CHEMICAL REACTION GIVING OFF HYDROGEN!)

The acid solution **must always be added to distilled water** to bring the electrolyte slowly up to the required specific gravity. However, after the electrolyte (Sulphuric acid and distilled water solution) has been mixed to the correct specific gravity it is then safe to add extra distilled water. For example, when topping up electrolyte levels after charging. Distilled water must be used as part of the electrolyte as it is free from any impurities and chemicals. Any contamination i.e. if ordinary tap water is used it will affect the chemical reaction taking place in the battery.

Burns: The electrolyte of lead acid batteries is diluted **Sulphuric acid,** and the electrolyte of alkaline batteries is a solution of **Potassium Hydroxide.** Both solutions are corrosive and are sufficiently concentrated to cause severe burns.

Acid Burns: If acid has been spilled on to the skin the affected area **should immediately be flooded with water and as soon as is possible, removing any contaminated clothing as required. Medical attention should always be obtained.** Spillages should be cleared using a solution of sodium bicarbonate

Alkali Burns: These should also immediately be **flooded with water and as soon as is possible, removing any contaminated clothing as required. Medical attention should always be obtained.** Spillages should be cleared using a solution of boracic acid.

IMPORTANT

Always seek medical advice for Acid and Alkali burns.

Explosion Risk: When batteries are being charged, an explosive mixture of gasses is given off and an explosion will occur if this is ignited. The charging areas should be well ventilated and notices forbidding smoking and the presence of naked lights should be prominently displayed. Leads should never be clipped on or off unless the charger is switched off, otherwise a spark may occur and ignite the explosive mixture.

Short Circuits: Under no circumstances should any metal object be laid on a battery. If this happens a short circuit can occur, which can cause an explosion. The object itself can become sufficiently hot to cause severe burns.

General Maintenance

Cleanliness: It is important to keep a battery clean and dry. If grey – white deposits form round the filler caps and terminals of nickel – cadmium cells, although not detrimental to the battery, this should be removed occasionally (N.B. these deposits are Potassium Carbonite Crystals and are not harmful to the skin).

Not only should the tops of the cells be kept clean, but it is essential that battery sets fitted in cabinets with earth – monitoring equipment (e.g. the Bradley – Murdoch d.c. supply units) should be inspected for accumulation of deposits on the base and sides.

After cleaning, the terminals and connectors should be lightly coated with a suitable protective insulating grease, e.g. Silicon, Komoline, Petroleum Jelly etc.

Keep all equipment for lead-acid and alkaline batteries separated and do not use on both. If acid is accidentally introduced into a nickel – cadmium battery it will cause irreversible damage. For alkaline batteries examples are nickel-cadmium battery –

abbreviated to Ni Cad and Nickel Hydrate / Iron Oxide – abbreviated to Ni Fe e.g. the chemical symbols are used to form a word.

General Inspection

Check all connections for tightness and all cables for cuts or splits. Excessive need to top up, could in the case of a single cell, mean that it is leaking or if the majority require attention, that the battery charging rate is too high. Battery rooms should be adequately ventilated and if forced ventilation is fitted e.g. fans or ventilation ducting, then check that it is operating correctly.

Its operation can be the same as that of the NiCad battery – as shown in the illustrations.

Sealed Nickel – Cadmium Batteries (Alkaline)

This type of battery is increasingly being used in both new applications and as replacement for vented nickel – cadmium especially in equipment that has been replaced by less power consuming semiconductor technology, e.g. tripping supplies for H.T. breakers (Brookness units). New applications include their function is to save the units program in the event of mains failure (N.B. these batteries are a non – rechargeable type). The chargeable nickel-cadmium battery can be found in fire – alarm panels, instrument essential/vital supplies, and portable instruments, programmable logic controllers (PLC).

When operated as recommended the sealed Nickel – Cadmium battery is maintenance free. Although the construction of the cell is different than the vented type, the chemical components are identical, i.e. nickel – hydrate for the positive plate, cadmium oxide for the negative plate and potassium hydroxide for the electrolyte. The cell can be sealed as it is constructed in such a way that the free oxygen given off during charging is recombined in a chemical reaction within the cell. However, if a sealed cell is overcharged or subject to excessive heat, this free oxygen will build up in the cell and will be released through a safety vent. Some types, e.g. button cells do not have a safety vent fitted and if overcharged the sealing gasket is broken and the cell will be irreversibly damaged.

Charging

These batteries are a non-rechargeable type. Experience has shown that sealed nickel – cadmium cells are adversely affected by high temperatures. The cell case temperature should be kept below 20 degrees C for maximum battery life.

Vented Nickel Cadmium Battery & NiFe Battery (Alkaline)

A vented nickel cadmium battery is made up of individual cells, each cell with a negative and positive plate immersed in electrolyte. The active material in the negative plate is cadmium oxide with nickel hydrate in the positive plate. The electrolyte is an alkaline solution of potassium hydroxide, the electro – chemical reaction between the two plates produces a nominal cell voltage of 1.2 volts.

The function of the electrolyte is to provide an adequate supply of ions and water to support the reactions of the two plates. The electrolyte is mainly a current carrying medium and consequently there is no significant change in the specific gravity (S.G.) readings of a fully charged or discharged cell. However, the S.G. does fall gradually in service and minimum recommended reading must not be below 1.145. Only distilled or de-ionised water must be used for topping up.

NiFe Battery

This is also an alkaline battery. The positive electrode is Nickel Hydroxide, the negative electrode is Iron Oxide, and the electrolyte is potassium hydroxide (same as NiCad).

Charging

The optimum charging rate is one that will maintain the battery in a high state of charge with minimum water consumption. Nickel – cadmium batteries cannot be damaged by overcharging providing the electrolyte does not fall lower than the minimum level mark. Unnecessary high rates of charge can cause high water consumption and therefore more maintenance.

With most batteries being used in a standby situation, an automatic method of charging is required. This is achieved using a rectifier/charger which supplies the normal d.c. load and a continuous low rate charge to the battery, (i.e. the charger load and battery operate in parallel). The rate of charge used for vented nickel – cadmium batteries is a constant voltage charge of 1.45 volts/cell. With this method of charging, the value of the charging current will depend upon the state of charge of the battery. If the battery has discharged the initial current will be very high and is normally limited to a set value by the charger. As the battery is charged the current will reduce to its final continuous low rate with an overall battery voltage equivalent to 1.45 volts / cell. Most rectifier/ chargers have quick/ boost facilities for recharging the batteries after a deep discharge.

Vented lead acid (Plante' cell) battery

A vented lead acid battery is made up of individual cells, each cell with a negative and positive plate immersed in electrolyte. The active material in the negative plate is lead in a "spongy" form the positive plate is lead oxide. The electrolyte is diluted sulphuric acid, the electro – chemical reaction between the plates produces a nominal cell voltage of 2 volts.

Unlike an alkaline cell the electrolyte in a lead acid cell forms part of the electro – chemical reaction. Therefore, the state of charge of the battery can be determined by the S.G. of the electrolyte. A fully charged lead acid battery will have an S.G. reading of 1.210. Only distilled or de-ionised water must be used for topping up.

The level of charge of a lead acid battery can also be determined by measuring the voltage across the main terminals as per the table below.

Charge %	Voltage
100%	12.6
75%	12.4
50%	12.2
25%	12.0

Storage Capacity or Ampere Hours

Normally this is abbreviated to Ah and is used to express the storage capacity of a battery when a sustained current is drawn from it from fully charged over a measured length of time to fully discharged. As an example, a 200Ah (20-hour rate) battery can handle a 10-amp load for 20 hours before fully discharged or 20 amps for 10 hours. In practice this definition can only be used as a rough guide as the discharge is nonlinear and other factors such as battery condition and temperature have to be considered.

Charging

When used in a standby mode, the charger, battery and load are connected in parallel. The charger supplies the load current continuously whilst maintaining the battery in a charged condition. The normal float level of a floating battery system is equivalent to 2.25 volts/cell. As with the vented nickel – cadmium charging system, this is a constant voltage method, and the charging current is dependent on the state of charge of the battery. The S.G. of a fully charged cell is 1.210 at 15 degrees C. Most charger/rectifier units have a quick/ boost facility to charge the battery following a large discharge.

Topping – up

Inspect electrolyte levels regularly and if required, top – up with distilled water to the maximum level mark. **NEVER** let the electrolyte fall below the minimum level mark. Do not leave filler caps open for longer than necessary. Avoid splashing water when topping – up as a wet battery can cause earth faults.

IF IN DOUBT ASK !!!