GS YUASA ACADEMY
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Lead Acid Battery Construction

Introduction

This training course deals with how a lead acid battery is constructed.

It will provide you with information on the components and manufacturing methods used in lead acid battery construction.

The lead acid battery construction course consists of the following modules:

Overview of components
Battery container & lid
Plates & separators
Final assembly & filling
Charging & formation process
Finishing & labelling

Each module has its own training video, downloadable resources and some will be followed by a short multiple-choice test.

Once you have completed all modules there will be a final test to check your understanding and knowledge.

Once passed you will earn a certificate for the completion of this course.

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Module 1 - Overview of Components

GS Yuasa lead acid batteries are manufactured from the following separate components using quality materials and state of the art assembly procedures:

- Plates
- Separators
- Inter-connectors and terminals
- Container
- Lid
- And Electrolyte

Module 2 - Battery Container & Lid

GS Yuasa vehicle battery containers are manufactured in a single piece from injection moulded polypropylene.

Most industrial battery containers are manufactured from Acrylonitrile Butadiene Styrene or ABS.

The container is divided into equal sections called cells.

The number of cells is dictated by the voltage of the battery.

Three cells for a 6 Volt battery and six cells for a 12 Volt.

The lid is manufactured from the same material as the case and dependent on battery type and specification can have the following design features:

- Gas recombination labyrinth
- Flame arrestor valve to prevent any external source of ignition entering the battery
- Pressure relief valve to release any excess pressure created during operation
- State of charge indicator to give a visual guide to battery voltage
- Vent pipe aperture for open vent types
- Cell caps apertures for maintenance if required

Module 3 - Plates & Separators

We will now look at the components used to make up the battery plates. Starting with the grids.

The grids have a dual function.

Firstly, they provide mechanical support for the active material paste that reacts chemically with the electrolyte to produce and store electrical energy.

Secondly, the grid is used to transport the electrical energy produced by the chemical reaction out of the battery via the current collection tab, intercell connectors and terminals.

Depending on the battery specification the grids are manufactured from alloys of lead antimony or lead calcium by casting, expanding or punching.

Cast grids are manufactured by pouring molten lead alloy into a mould and allowing it to cool.

Continuous casting or concast is a high speed continuous version of the standard casting process.

Expanded grids are manufactured using a continuous automated process.

A lead alloy strip is pierced, stretched and then expanded to form a grid with a diamond pattern.

Punched foil grids are also manufactured using a continuous automated process.

A rolled lead alloy sheet is fed through a stamping machine that punches the grid from the sheet using a die.

Finally, performance optimised grids which are manufactured using either casting or punching.

These have been designed to reduce the grid's electrical resistance increasing the battery's ability to quickly supply high levels of current.

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Once manufactured the grids have an active paste material applied to their surface.

This paste is made up from a mixture of lead and other materials the composition of which are known only to GS Yuasa.

The complete plates are then dried in an oven to cure and harden the paste and bond it to the grid.

The paste reacts with the sulphuric acid in the electrolyte solution to produce and store electrical energy.

In a complete battery after its first charge the positive plate paste becomes lead dioxide and the negative plate paste porous lead.

Once dried the plates are assembled alternately in a pack.

To prevent short circuits the positive and negative plates must be kept apart.

To do this a separator is used as a barrier between the plates to prevent any contact.

The separators are either thin envelopes made of microporous polyethylene, sheets of paper or glass fibre matting.

The number of plates in a pack is dictated by the required battery specification.

Higher specification batteries will always contain more plates per pack than lower specification products.

When the pack has been assembled all the negative plates are welded together across the current collection tabs using a cast on strap.

This process is then repeated across the positive plates to form a complete pack.

Module 4 - Final Assembly & Filling

One pack is inserted into each cell of the battery container with the positive and negative post lugs in the correct position for lid installation.

To complete the battery circuit the packs in each cell are connected using either an over partition cell connector or a welded inter cell connecting plate.

The packs are connected in series, positive plates in one cell to the negative plates in the adjoining cell to achieve the required battery voltage.

The battery lid is then installed and heat sealed or glued to the container.

The positive and negative posts are then welded to the relevant post lug.

The complete battery is then pressure tested for leaks.

It is then filled with an electrolyte solution typically made up of approximately 35% concentrated sulphuric acid and 65% deionised water.

The strength or ratio of acid in the electrolyte solution has a direct relationship to the batteries performance and service life.

Higher acid concentrations increase plate corrosion, paste deterioration and therefore reduce battery life.

At this point industrial product has a high voltage test carried out to ensure there are no pin hole leaks in the case.

This is known as a pin hole test.

Module 5 - Charging & Formation Process

Once the battery has been fully assembled it must be finished using a process known as formation charging.

To do this the battery is connected to a direct current charging device for several hours and charged to a nominal voltage.

For a lead acid battery, the nominal voltage is 2 volts per cell which is the mid-point between the fully charged and fully discharged state.

However, when the battery has rested and stabilised after charging, the actual voltage will be approximately 2.12 volts per cell

After charging any capacity testing will be carried out.

Module 6 - Finishing & Labelling

After charging the battery is thoroughly cleaned before labels are applied.

All GS Yuasa batteries are manufactured and labelled in compliance with all required European and international standards.

Battery data sheets include all relevant information.