

## Introduction

This training course deals with new technology GS Yuasa products.

It will provide you with information on modern emission reduction systems and the application of GS Yuasa products to these vehicles.

The course consists of the following modules:

- Modern vehicle emission control
- Introduction to new battery technologies
- AGM battery
- EFB battery
- AGM battery care

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.

## Module 1 - Modern Vehicle Emission Control

Because of increasing environmental pressures, vehicle manufacturers are having to reduce emissions and improve fuel economy.

New EU legislation on emissions targets passed in 2009 commit vehicle manufacturers to cut the average CO2 emissions from new vehicles.

These regulations are becoming ever more stringent over time.

Vehicle manufacturers have therefore developed various eco-solutions to help save fuel and reduce emissions.

These systems include start-stop, charge management and regenerative braking.

Start-stop is a fully automatic system that, switches off the engine when the vehicle is stationary.

The engine is then restarted automatically by releasing the brake and depressing the accelerator pedal or clutch pedal dependent on transmission type.

This system dramatically increases the number of engine starts the battery must deliver.

A standard ignition vehicle may start a few times a day whereas on a start-stop vehicle this figure could easily reach 75 or more.

The battery also supports all electrical loads on the vehicle whilst the engine is not running and it is not being charged.

Start-stop vehicles must be able to determine if the engine can restart when the engine has been switched off.

Therefore, new electronic methods of monitoring the battery status are required.

When the alternator is charging, it can consume up to 10% of engine power.

Charge management systems monitor battery status and the vehicles electrical consumption.

The system controls the alternator and can suspend charging depending on battery status and vehicle operating conditions.

This improves fuel economy but also increases battery loads.

Use of this system requires the battery to support all electrical loads even though the battery is not fully charged.

Therefore, a battery that is optimised for partial state of charge operation and has a dramatically increased cyclic life is needed.

Regenerative braking systems harvest the kinetic energy normally lost when decelerating or braking.

This is then converted into electricity by the alternator and stored in the battery.

The alternator is activated only when the accelerator is released or the brake applied.

When the accelerator is depressed, the alternator is switched off ensuring full engine power is directed to the drive wheels.

The system monitors battery charge level.

If this falls below a threshold level it will continue to charge the battery even during acceleration to prevent complete discharge.

## Module 2 - Introduction to New Battery Technologies

To meet the requirements of these systems two new battery types have been developed.

Absorbed Glass Mat or AGM, which provides up to 360,000 starts.

And EFB which stands for Enhanced Flooded Battery which provides up to 270,00 starts.

AGM and EFB batteries both have improved performance characteristics over conventional flooded types. Both deliver a massively increased number of start cycles.

AGM offers around 20 times more engine starts and EFB 15 times more. Their high cyclic durability when deeply discharged provides a significant increase in general endurance.

Both batteries have a greatly increased ability to charge quickly and accept high levels of current produced by regenerative braking systems. This is known as dynamic charge acceptance.

They are also able to operate in a lower state of charge.

These batteries must be replaced like for like. If a vehicle is fitted with an AGM when manufactured then the replacement must also be an AGM, the same applies for EFB batteries.

Failure to comply with this will result in loss of emission reduction system functionality and premature battery failure.

## Module 3 - AGM Battery

AGM means Absorbed Glass Mat.

AGM may also be known as Valve Regulated Lead Acid or VRLA.

These batteries feature thin glass mat separators between their positive and negative plates.

The glass mat absorbs the liquid electrolyte trapping it very close to the surface of the plates.

This means there is no free electrolyte and no possibility of leakage, meaning that AGM batteries are the only type suitable for safe incabin fitment.

Self-discharge and internal resistance are reduced allowing the discharge and recharge rate to be significantly faster than conventional flooded types.

Due to the thinner separators and lack of an electrolyte reservoir above the plates a higher number of larger plates can be installed in each cell without increasing container size.

More plates are packed into each cell increasing pressures which gives exceptional levels of vibration resistance and durability.

The AGM battery features an individual cell valve design that maintains a partial pressure of approximately 2 psi in each cell.

This triggers the recombination of Hydrogen & Oxygen into water during battery charging.

The lid features a labyrinth that directs this condensed water vapour back into the battery and prevents any leakage if the battery is tilted.

Safety features such as 2 flame arrestors and pressure relief valves protect against damage caused by over-charging and eliminate the risk of any external ignition source entering the battery.

## Module 4 - EFB Battery

The Enhanced Flooded, or EFB, battery is based on a conventional flooded design but with improved specification and performance.

Like the AGM it also features increased cyclic durability and an improved ability to accept charge current due to its design and construction.

EFB batteries feature an increased number of thinner plates when compared to conventional types. They also contain anticorrosion additives and lower electrolyte acid content.

This reduces internal resistance and improves charge acceptance.

The negative plate active material includes carbon and lithium additives to further improve charge acceptance.

The positive plate features high density active material with special additives to increase surface area which improves battery durability, extending service life.

Normally the sulphuric acid in a flooded battery is equally distributed throughout each of the cells.

However, EFB batteries can be affected by acid stratification.

This is when the acid in the electrolyte solution settles at the bottom of the battery leading to permanent damage over time.

To prevent this, some EFB batteries feature an electrolyte mixing device to maintain total electrolyte circulation.

This utilises accelerating, braking and cornering forces to create a pressure difference between the lower and upper parts of the electrolyte.

The pressure difference forces the electrolyte to flow through the mixing device from the bottom to the top of the battery.

## Module 5 - AGM Battery Care

AGM and EFB charging voltages are the same as for any conventional battery type.

When installed as an upgrade on a conventional standard ignition vehicle no special adjustments to the charging system are required.

An AGM battery has extremely low internal resistance which results in almost no heating even under high charge and discharge current conditions.

Due to its design and construction it is essential that when charging off the vehicle the correct type of equipment is used.

Constant current or boost chargers must not be used as this will result in excessive heating of the battery.

This will cause the electrolyte to boil which increases internal pressure. The resulting vapour loss will dry out the battery, greatly reducing its lifespan and performance.

Therefore, GS Yuasa recommend the use of smart chargers that are compatible with AGM type batteries.