The Power of Positive Ground

(And other assorted electrical system mysteries)

By Bob Vitrikas

Remember when cars had 6 volt positive ground electrical systems? All seemed to work OK so why change to 12 volt negative ground systems?

Just the basic facts ma'm:
Let's start with the basics. A car battery typically comes in either 6 or 12 volt specification and has a negative (-) and positive (+) terminal. The positive terminal is usually larger than the negative terminal. To determine if your car is negative or positive ground, look at the positive and negative terminals on the battery. If the positive terminal goes to ground, usually on the chassis, then your car is positive ground. If the negative terminal goes to ground then, voila! Your car is negative ground.

Electricity flows from negative to positive. Electricity in your positive or negative ground vehicle flows from the negative battery terminal through the chassis of your car. In every battery electricity flows from the negative terminal to the positive terminal. On every spark plug the spark flows from the center electrode (negative) to the outside tang (positive) which is attached to the threaded portion of the spark plug. Every spark plug ignition engine works with a positive ground coil. If the coil leads are reversed, the engine will be hard to start, use more fuel, loose power, and spark plugs will wear out quicker.

Given that electricity flows from negative to positive, why not make the whole electrical system positive ground? Well that's exactly what many automotive engineers did in the early days. But, (there's always a 'but' isn't there?) according to the Lucas Overseas Technical Correspondence Course manual, "With the insulated return system the orthodox arrangement was to earth the negative pole of the supply, and this became known as the single pole negative earth system, which was used for vehicles for several years - on British vehicles up to about 1936. It was then found that certain specific advantages were obtained by earthing the positive pole of the battery instead of the negative. Thus we had the introduction of the positive earth system…".

As we now know the British switched back to negative ground in the mid to late 1960s. For example, MG initially had positive ground systems, then switched to negative ground with the M Type in 1928 continuing thru the P Types in 1935 and 1936, then back to positive ground until the 1968 MGB when they once again adopted negative ground along with the rest of the British motor industry (and the world for that matter).

Some think positive ground reduced corrosion. Hmm try to sell that to the owner of an old rusting British car. Seriously, there is evidence to support the view that positive ground systems are less prone to corrosion, particularly at battery and electrical connections. Hmmm…

The 1968 MGB introduced the MG world to the benefits of negative ground.

Ford Model Ts had a negative ground electrical system until 1927 when the 1928 Model A had a positive ground system. In the U.S. there were a mix of positive and negative ground cars until the mid 1950s. In 1956 Ford and most American car manufacturers switched to negative ground at the same time they upgraded from 6 to 12 volt electrical systems. Most British cars switched from positive to negative ground in the 1960s.

So what changed? Vehicle electrical systems got complicated.

It is commonly taught to follow circuits from positive to negative. As a result, mechanics have an easier time tracing problems and understanding the flow of electricity with negative ground systems so serviceability is a key reason cars switched to negative ground systems. It simply made them easier to service. In addition to serviceability, negative ground systems make it easier to install negative ground cigarette lighters, stereo systems, electronic ignitions, LED lights and of course all modern alternators are negative ground. Lucas made some positive ground alternators in the '60s but that was quickly abandoned. The introduction of transistor radios and

ignition systems that required negative ground also likely contributed to the switch from positive to negative ground systems. Standardization among auto, aviation, electronic equipment manufacturers, and their component suppliers was a key factor. Likewise having a 12 volt system makes it easier to source electrical components, brighter lights, as well as more reliable starting, especially with a larger, high compression motor.

Then things got really complicated; modern electrical systems:

With the increased popularity of electric vehicles, you may wonder if their electrical systems are using higher voltage components. They do, sort of. Electric vehicles have two electric systems; 12v for lights, accessories, etc and high voltage (currently up to 800v) for the electric drive train.

Many non-electric vehicles have two batteries. Gas/electric hybrid vehicles may have three or more 12v batteries! Why is this? They use a second, smaller battery, as an auxiliary power source in case the main battery, usually used for starting, fails. The backup battery ensures that the all essential computer data is preserved for a variety of computer controlled functions such as the engine management computer which is optimized through computer learning and how the vehicle is driven. Other more mundane functions such as radio presets, memory seats etc. also need data backup. I recently had the opportunity to test this when the main battery in my 2019 MINI kicked the bucket. Sure enough that little auxiliary battery did its job and when the main battery was changed, no saved data was lost. Whew!

Auxiliary batteries also power vehicle functions which operate when the vehicle is turned off, such as fans for the climate control and cooling computerized components. These fans typically run for 15-20 minutes after the engine is turned off. Now I know the cause of the mysterious wheezing and whirring going on in my 2018 Chrysler minivan after I turn the engine off. And don't forget powering the tailgate and side doors on your minivan (you have one of these don't you?) even though the vehicle may have been sitting for many days without running. And also don't forget the remote key fob that opens the doors and rear hatch, turns on the engine etc.

More interesting stuff. If your car has an economy mode you should know that several things are happening when you push that little button.

- Start-stop function is activated.
- Engine power peak is electronically limited.
- Output of power hungry components such as the A/C system is reduced.
- Charging voltage to the battery can be significantly reduced.
- Exaggerated accelerator pedal operations are implemented with a slight delay with the aim of minimizing unnecessary fuel consumption.

Knowing which battery needs replacing can be a tricky business but with the above knowledge you may be able to better understand which battery— starting or auxiliary, is needed. When it comes time to replace the battery, I suggest taking it to your dealer. Unfortunately it's no small (or inexpensive) job to replace a car battery these days. Going about it the wrong way can lead to failures in your modern car's electronics. I needed to replace the main battery in my 2019 MINI recently and Crown MINI took a couple of hours to do the replacement. There are a lot of computers to re-boot! I had a similar experience with my 2018 Mercedes. That battery replacement took about 4 hours with seven computers to re-boot. Ouch!

When replacing your battery it's important to replace it with an equivalent battery in terms of technology, performance class and size. Here are the types of batteries, courtesy of AKO Drive. https://ackodrive.com/car-guide/types-of-car-batteries/:

- Once upon a time … we had 6 volt or 12 volt lead acid batteries in our cars. Remember when you had to regularly check the water level in your battery by removing the plastic caps on the top of the battery case? Actually it was a mixture of water (preferably distilled) and sulfuric acid. MGAs and early MGBs had twin 6 volt batteries hooked up in series to produce 12 volts. Located behind the seats and under a panel they were a pain to access and difficult to remove, often resulting in battery acid running down your arms and onto your legs. Ouch! There are several types of wet cell batteries.

— Starting, Lighting, Ignition (SLI) batteries are most commonly used in car applications where a high amount of cranking amperes (current) is required to start the vehicle. Once started the generator or alternator takes over the duties of supplying electricity and charging the battery.

— Deep Cycle Battery, commonly known as marine batteries, are designed to provide a steady and consistent flow of electricity over an extended

period. They can endure deep discharge and charging cycles without losing their effectiveness.

— Lead acid batteries are reliable, affordable and easily obtained. However they do require periodic maintenance (topping up with distilled water).

- Valve-Regulated Lead-Acid Batteries (VRLA) are another type of wet cell battery, a.k.a. sealed lead-acid batteries. Because they are sealed they don't need topping up and don't vent gases so are well suited for use in confined spaces with poor ventilation. These are the batteries commonly found in today's vehicles as the main battery. There are two types of VRLA batteries; gel cell batteries and Absorbed Glass Mat (AGM) batteries.

— The gel cell battery uses a jelly like electrolyte instead of a sulfuric acid and water mixture. They are resistant to heat, spillage (thank you very much!), shock and electrolyte evaporation. They also provide a longer charge cycle life, last longer, and are maintenance free. The gel cell battery or Enhanced Flooded Battery (EFB), can be replaced by either another equivalent EFB battery or upgraded to an AGM battery.

— The AGM battery has their electrolyte held in glass mats, preventing spills and leaks and are safer and corrosion resistant. Absorbent Glass Mat (AGM) battery must always be replaced by an AGM battery in an identical housing and a similar performance class.

Still with me? OK, here we go for a deep dive into today's sophisticated batteries!

- Lithium-Ion batteries are commonly used in today's electric and plug-ion hybrid electric vehicles. They have a high power to weight ratio, excellent energy efficiency and low self-discharge. They also have the endearing quality of being recyclable making them eco-friendly.

- Sodium-Ion batteries are replacing lithium-Ion batteries as a sustainable, less expensive option.

- Solid-State batteries are an emerging technology that promise fast charging and high power output. Stay tuned for future developments!

- Nickel-Metal Hydride (NiMH) batteries offer an alternative to lead-acid batteries. They have a higher energy density, are eco-friendly, and can be recharged multiple times but … they lose their charge after sitting for an extended period, and can have a memory effect if they are not charged and discharged properly.

- Silver Calcium batteries offer enhanced performance, especially in cold start conditions, improved efficiency, and longer lifespan compared to lead-acid batteries. They also have a longer shelf life. But they are a tad more expensive. They are commonly used in modern cars and commercial vehicles due to their superior starting power and reduced maintenance.

Did you know that replacing the battery usually requires that it be registered with the manufacturer. This is best done by the dealer. If you don't register the battery, error messages may occur and comfort functions may not work. I had this occur on my Mercedes while in the middle of nowhere Nevada on the 'Loneliest Road in America.' Turned out the previous owner had replaced the main battery with an aftermarket battery and hadn't registered it. If the new battery is registered it may take a few days for the system to detect the new state of the battery and reset the error messages

automatically. This is a complicated process that varies by vehicle manufacturer. If you'd like to learn more about modern vehicle batteries and related control systems, check out this site sponsored by the 'Banner Power Company.

https://www.bannerbatterien.com/en/Battery-knowledge/7-HOW-TO-Correctly-registering-start-stop-batteries#:~:text=If a new battery is, to the on-board electronics.

What's that sensor on the negative terminal of my starting battery? That is an Electronic Battery Sensor (EBS) or Intelligent Battery Sensor (IBS). The EBS is a key part of vehicle energy management, monitoring the car battery status, and temperature enabling the EBS to control the charging voltage and current. These measurements are used to calculate important parameters such as the state of charge, state of function - staring ability, and overall condition, age of battery and a variety of other values. This data is then sent to the vehicle's computer which regulates the vehicle's energy balance and if needed, restricts the use of comfort functions such as heated seats or A/C, and may switch off the start-stop function. Once the alternator has recharged the battery sufficiently, these 'nice to have' functions are restored.

This is what an EBS/IBS looks like. Not very big but it has a big job to do!

Going forward:
As we head into winter, be aware that frequent short trips, operating in start-stop mode, driving in stop-and-go traffic, sub-zero temperatures and running additional electrical equipment such as heated rear window and mirrors, defrosters, heated seats, etc will put a drain on the main starting battery. To avoid the inconvenience of a dead battery, consider charging your battery in the fall and spring.

To charge your negative ground battery, connect the red charger lead (+) to the positive battery terminal, then connect the black charger lead (-) to the chassis or engine block. Do NOT connect the lead to the carburetor, fuel lines or sheet metal body parts! If your car has a positive ground system, connect the black charger lead (-) to the negative battery terminal, then connect the red charger lead (+) the chassis or engine block. Do NOT connect the lead to the carburetor, fuel lines or sheet metal body parts! When your battery is charged, disconnect the battery charger from the AC power outlet, remove the charger chassis ground and then the charger battery connection.

Better safe than sorry my friends. If your battery needs to be replaced in your modern ride, IMO bite the bullet and pay the dealer to replace your battery!