Stop-Start Technology

A fundamental fuel saving strategy is to switch off the engine when it isn’t needed. The value of this advice is supported by an increasing number of vehicle manufacturers that are introducing Stop –Start technology to their new models.

Quite simply, instead of relying on the driver to switch off the engine, the car now does it automatically – only restarting when it’s time to drive away, charge the battery or change cabin temperature by operating the air conditioning or heater.

Benefits of stop-start technology

- Various vehicle manufacturers are claiming fuel consumption reductions in the order of 5 to 8 percent from this feature alone - a very significant amount at a time when every fraction of a litre decrease is important.

- An equally noteworthy aspect of the technology is its ability to reduce a vehicle’s CO2 emissions, which is becoming increasingly important in Europe where CO2 emission standards are driving the development of cleaner and more fuel efficient vehicles. And we can expect to see it become more common here as well.

History of stop-start technology

First developed and used in the 1980’s, Stop – Start wasn’t widely accepted initially and of the manufacturers that did offer it, most didn’t persevere with it for very long.
However a number of European and Japanese manufacturers have dusted it off from time to time since, with varying degrees of success.

**Stop-start technology in Australia**

For Australian buyers, more highly developed and sophisticated Stop – Start systems reappeared in conventional models (as opposed to hybrids such as Toyota’s Prius) from around 2010 when a couple of European makers launched it here.

Initially it came only in certain diesel models with manual transmissions, which somewhat limited its appeal to the buying public.

Since then though, we’ve seen a steady broadening of the range of vehicles fitted with it, as well as its transition to automatic and petrol models.

- For most manufacturers Stop – Start, rather than being a stand-alone feature, is included in a suite of fuel and emission saving strategies. Low rolling resistance tyres, weight savings and energy recovery systems are a few examples of these.

Manufacturing stop-stop technology

Like most technologies, each manufacturer has its own way of doing things and Stop-Start is no different.

- Some makers utilise a conventional looking, though substantially up-rated, starting system while at the other end of the spectrum is a belt driven combined starter / alternator unit.

- Hybrid models typically use a traction motor / generator for engine
start. Similarly, the vehicle’s electrical system can resemble a conventional system, incorporate an extra battery for starting or even a high-tech super-capacitor just to run the starter, thereby eliminating the need for more or bigger batteries.

**Changes to engines and transmissions**

Start – Stop has also required some changes to engines and transmissions.

**Restart immediately**

One challenge is that engines need to restart immediately. A typical requirement is that the engine needs to restart in less than one turn of the crankshaft and within about 400mS of the start request.

**Restart before it has completely stopped**

There is also the possibility that the engine will need to be restarted before it has completely stopped, as would be the case if the vehicle was stopping for a traffic light which changes to green at the very last moment.

Few drivers would accept a function that required them to wait until the engine had completely stopped before it could restart, so to ensure a seamless driving experience, many Stop – Start systems utilise some form of clever starter that can engage with the engine even before it stops turning so it’s ready to restart the engine if needed.
Many systems utilise a two-stage starter solenoid to independently manage starter engagement and power application.

**Engine management systems**

Engine management systems have also needed to become smarter so they can identify the position of the crankshaft at any time and be able to initiate a restart without the previously common practice of needing to turn it through an almost full revolution.

**Automatic transmissions**

Automatic transmissions also needed to adapt as they traditionally relied on the engine to drive the pump that ran the hydraulic control system. With the engine stopped a conventional transmission would lose hydraulic pressure and disengage, needing a few seconds to restore operation after the restart.

Electric oil pumps and hydraulic accumulators to store pressurised oil have resolved this issue.

**Charging systems**

Probably the biggest change has been to charging systems. It’s estimated that a conventional vehicle needs to be driven around 12 km to restore the charge taken from the battery during every start.

Clearly, a vehicle that may need to restart every few hundred metres in city traffic
would soon discharge the battery if special attention was not paid to the charging system.

Batteries fitted to Stop – Start models generally have a larger capacity to cope with this. Smart charging systems and so called ‘mild hybrid systems’ that ramp up alternator output during braking and deceleration are common too.

**Electrical and engine mechanicals**

Mazda’s Skyactive system with i-stop, first seen in Australia on certain Mazda3 models, takes another tack. Through a combination of changes to electrical and engine mechanicals, it effects precise control over the piston position during shutdown, then uses re-establishment of combustion to re-start the engine with a small amount of extra torque from the starter-motor.

**How Stop - Start systems operate**

Stop- Start systems operate within defined parameters which will, to some degree, vary from maker to maker:

- Generally though the system will not operate unless the vehicle is stationary, the engine is at operating temperature, the battery has a certain level of charge and the cabin temperature is within a certain range.

- Gearshift, brake pedal, handbrake lever position and, for manual vehicles, clutch pedal position are also factors in the systems operation. Stop-Start operation is generally inhibited if there is high electrical load, as would be the case with a discharged battery, or when there is high demand on the heater or air conditioner.
• Most systems provide a switch that allows the driver to disable the function as required.

Summary

• As will now be clear, Stop-Start systems require a great deal of re-engineering in order to work reliably and seamlessly.

• While we acknowledge that there are fuel savings to be had from switching off the engine when stationary, the reality is that if the vehicle isn’t designed for Stop-Start operation, reliability problems are likely to arise.

• Starters, batteries and electrical systems of conventional vehicles are simply not designed for such frequent use.

• However there is nothing wrong with switching off the engine when it’s clear that the vehicle won’t be moving for a prolonged period of time.