AUDI A3 E-TRON

From 0 to 100 km/h (62.14 mph) in 7.6 seconds and a top speed of 222 km/h (137.94 mph) – the Audi A3 Sportback e-tron adds an extra highlight to the sporty character of the compact premium car line. In accordance with the ECE standard for plug-in hybrid vehicles, its average CO_2 emissions are a mere 35 grams per km (56.33 g/mile) – equivalent to consumption of 1.5 liters of fuel per 100 km (156.81 US mpg).**

Thanks to the ultra lightweight construction philosophy of Audi, the unladen five-door model complete with all electrical components weighs less than 1,580 kilo-grams (3,483.30 lb), with space for five occupants and plenty of cargo. It comes complete with all the brand's strengths – elegant design, sporty chassis, top-notch ergonomics, excellent build quality and an extensive choice of high-end assistance and infotainment systems.

The 1.4 TFSI combustion engine is one of the most modern power units of Audi. Inside the engine compartment, looking in the direction of travel, it is positioned a few centimeters further to the right than usual, to create space for the high-voltage components. Its crankcase is made from diecast aluminum, weighing little more than 100 kg (220.46 lb).

The four-cylinder engine is state of the art in every respect – its low frictional losses, its turbocharger, its intercooler and its thermal management. One special feature is the way the exhaust manifold is integrated into the cylinder head. After a cold start, it brings the coolant swiftly up to operating temperature. At high loads the water jacket lowers the temperature of the exhaust gas.

Thanks to the high electric range of up to 50 kilometers (31.07 miles), many customers will only rarely experience the gasoline engine of the Audi A3 Sportback e-tron in action. Another effect of the plug-in hybrid concept is that the TFSI is often only activated in kickdown situations, and is therefore subjected to high loads while still cold. For that reason, the developers have equipped it with a variety of protective features. These include modified cylinder liners and piston rings, plus a sensor to measure oil quality.

Developing 110 kW (150 hp) and 250 Nm (184.39 lb-ft), the 1.4 TFSI is a powerful unit. It supplies peak torque across the entire speed range from 1,750 through 4,000 rpm, thus harmonizing excellently with the electric motor. The maximum of 330 Nm (243.40 lb-ft) is available virtually from the off, and is maintained constantly across a broad speed range up to about 2,200 rpm. Its maximum output is 75 kW. The system output of the A3 Sportback e-tron is 150 kW (204 hp), and system torque is 350 Nm (258.15 lb-ft). With the combination of electric motor and combustion engine, an overall operating range of up to 940 kilometers (584.09 miles) is possible. And its road performance is unwaveringly sporty: It takes a mere 4.9 seconds to sprint from 0 to 60 km/h (37.28 mph).

The electric motor is a permanently excited synchronous machine. It weighs 34 kilograms (74.96 lb) and is liquid-cooled via a cooling jacket in the stator. The electric motor is located between the

engine’s dual-mass flywheel and the newly developed separating clutch, the K0 clutch. When the TFSI starts, it is tow-started by the electric motor via the clutch. As soon as the former has achieved the same speed as the electric motor, the clutch is opened. This smooth, highly precise process takes place within half a second.

Together with the K0 separating clutch, the electric motor is integrated into a newly designed six-speed e-S tronic, which transfers the power to the front wheels. Like all Audi dual-clutch transmissions, it consists of two subsidiary transmissions that are served by the two multi-plate clutches K1 and K2. Gears are shifted by switching the clutches. This takes just a few hundredths of a second and happens without any noticeable interruption in propulsive power.

Depending on the level of charge, the voltage ranges between 280 and 390 volts. The battery consists of 96 prismatic cells arranged into eight modules of twelve cells each. Including the electronic components – the battery management controller and the battery junction box – the battery system weighs 125 kilograms (275.58 lb). Its housing is bolted to the vehicle floor at five points, and the lower shell is made from aluminum.

An elaborate liquid cooling system ensures that the battery is kept within a suitable temperature range during operation. Drivers of the Audi A3 e-tron will be able to start electrically in hot summer conditions and at sub-zero winter temperatures alike. Four cooling plates regulate the temperature of the high-voltage battery’s eight modules. The cooling system represents a separate low-temperature circuit in the car and runs on a separate cooler housed in the engine compartment. If need be, it can be connected to the air conditioning system and even divided into two subsidiary circuits.

In the event of a crash sufficiently severe to trigger the belt tensioners or airbags, the entire system is disconnected from the power supply. The flat-shaped battery is installed under the rear bench seat – an area where the high-strength and ultra-high-strength steel components of the occupant cell form an especially strong structure. Its housing and interior structure are equally of a very sturdy design.

The 12-volt battery for the low-voltage consumers and the 40-liter (10.57 US gallons) fuel tank are located above the rear axle. Both components barely impinge on the trunk of the A3 Sportback e-tron – in the standard configuration it measures 280 liters (9.89 cubic ft) and 1,120 liters (39.55 cubic ft) with the rear seat backs down.

Audi supplies the A3 Sportback e-tron with a universal charging lead as standard. The customer can interchange the connecting plugs so that the lead can be used both with domestic power sockets and with industrial power sockets, for full charging performance. These connecting plugs are country-specific in design, so that the A3 Sportback e-tron can be recharged anywhere in the world.

For easy use at home, the charging lead can be clipped into a wall-mounted holder. Even this holder has an Audi design, and as well as being a convenient way to store and use the lead, it is lockable. The charging equipment is thus protected against theft even when kept outdoors.

The charging lead supplies the car with alternating current from the grid via the charging connection, which is in the Singleframe grille behind the fold-out four rings. As well as a status LED, the unit includes two pushbuttons allowing the user to choose between timer-controlled charging and immediate charging. In the car, the alternating current fed in by the charger is converted into direct current for the battery.

From an industrial power socket, it takes slightly more than two hours to charge the battery fully. From a normal domestic power socket in Europe, the charging process takes about three hours and 45 minutes. Audi is working intensively on a joint project with a supplier of renewable power, because electric driving only makes ecological sense if such power is available.

Another medium-term project of Audi is automatic charging without physical contacts, referred to as Audi wireless charging. Here the charging process involves an alternating magnetic field between the stationary charging pad on the ground and the mobile charging pad in the car, similar to the principle used by an electric toothbrush.

The power electronics, located in the engine compartment, then convert the stored direct current into three-phase current for the electric motor. It has six high-performance transistors for this task. The power electronics, which include a DC/DC converter for connecting up the vehicle's 12-volt electrical system, are compact and light in weight. They have a total volume of 8 liters (0.28 cubic ft) and weigh 10 kilograms (22.05 lb). Together with the charger, it is incorporated into the same cooling circuit as the traction battery.

There are yet more special components for electric driving. The air conditioning compressor has an electric drive integrated into the high-voltage network. A thermoelectric heating element and a gasoline-powered auxiliary heater round off the interior heating system.

The hybrid management is configured to function in harmony with the electric motor. Up to medium loads the electric motor, now functioning as alternator, largely handles retardation. The energy that it recovers is fed into the traction battery. The wheel brakes only become active if the driver presses the pedal more forcefully.

Braking recuperation is just one of several operating statuses of the Audi A3 Sportback e-tron. The car is almost always started electrically, even at very low temperatures, in extremely hot conditions or when battery charge is very low. The electric motor's high torque enables the sporty compact car to accelerate away powerfully. It goes from 0 to 60 km/h (37.28 mph) in 4.9 seconds – with quiet but forceful propulsion.

In the electric mode the Audi A3 Sportback e-tron can travel at up to 130 km/h (80.78 mph) – it could go faster, but that would not be efficient. When traveling at a constant 100 km/h (62.14 mph), generally only the electric motor is active provided there is sufficient energy in the battery. As soon as the driver steps hard on the accelerator, for instance to overtake, and causes the pedal to go beyond a certain resistance point, it prompts the TFSI to cut in via the K0 separating clutch. In the boost mode the Audi A3 Sportback e-tron accelerates with all of 350 Nm torque (258.15 lb-ft).

When the driver releases the accelerator at high speed, the hybrid management enters the gliding mode. Now both drives are entirely deactivated and are no longer developing braking torque. When stepping off the accelerator at medium and low speeds, the system recovers energy through coasting recuperation; braking recuperation then becomes active when the brake pedal is pressed, except if a full brake application is needed.

The driver has several ways of actively managing the vehicle's response. They can choose from three programs using a button in the driving area and the e-S tronic selector lever. The EV characteristic map gives priority to electric drive, whereas the Audi A3 Sportback e-tron behaves very sportily in the S program. The hybrid hold mode can be selected via a menu in the MMI. This mode preserves the electrical energy stored in the battery for later use. In addition, the driver can specify detailed settings in the Audi drive select control system. Different stages of coasting recuperation are permanently assigned to the individual Audi drive select modes. Within certain ranges, this enables the driver to influence how the battery is charged while on the move.

The Audi A3 Sportback e-tron displays supply precise information about the driveline status. The powermeter in the instrument cluster shows the system's overall output, as well as the status of the driveline and the battery charge. The monitor for the MMI navigation plus shows the energy flows in the hybrid system. In addition, the driver information system displays the operating ranges and consumption figures for electricity and gasoline.

Under the Audi connect umbrella Audi is currently developing an entire portfolio of innovative online services for the A3 Sportback e-tron. Drivers can use these to monitor and manage a wide range of functions via their iOS or android smartphone or via a web portal.

The driver can call up the car's status – such as the battery's momentary charge status, the electric range or its current parked location. They can program charging schemes remotely from their mobile phone or computer. They have the option of starting and stopping charging or setting the charging timer and climate control scheme to reflect when they next plan to drive the car. They can thus specify in detail at what time on what days they want to drive off with the battery fully charged.

The climate control planner, the third aspect, works similarly. The owner of an Audi A3 Sportback e-tron can for instance specify a target temperature for the interior according to a differentiated timetable. Adjusting the climate in advance while still hooked to the power socket is much more efficient than when driving electrically, because it does not then constitute a drain on the car battery and thus optimizes the electric range. In addition, it also adjusts the drive components to the appropriate temperature for the conditions. Finally, the web portal gives the owner the chance to check their trip data, e.g. power consumption, distance driven and speed.

**Figures depend on the tires/wheels used.

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