After a life span of eight years which has seen more than 770,000 vehicles roll off the production line, Smart is now launching the second generation of the now iconic Fortwo. The new vehicle continues the distinctive concept embodied by this ultra-compact two-seater. A whole host of original solutions deserve a closer look – from the plastics technology which features in the body panelling and the panoramic roof to the automated transmission and the economical engines.
1 Introduction

The new Smart Fortwo has been on the market as a Coupé and Cabrio version since April 2007. The scope of variants includes a choice of three petrol engines rated at 45 kW and 52 kW (naturally aspirated) and 62 kW (turbocharged), plus a turbocharged 33 kW direct-injection diesel engine. Similarly to its predecessor, the new Smart Fortwo (series A/C 451) is once again the epitome of a compact two-seater predestined for urban use. Smart has maintained the established concept while developing the vehicle substantially in accordance with changes in the law and customers’ expectations. The Smart Fortwo retains its characteristic features, despite considerable optimisation measures in the area of design and construction.

2 Vehicle Concept and Design Features

The new Smart Fortwo retains the vehicle layout with rear wheel drive, which has proven the only satisfactory solution for a vehicle length which now stands at 2,695 mm. Concept studies showed that the dynamic changes of axle load have a particularly critical effect on braking when such a short vehicle is fitted with a front-mounted engine.

Statutory requirements on the protection of pedestrians in Europe and crash performance stipulations in the USA have necessitated marginal growth in x direction to the tune of 195 mm in comparison to the predecessor model. Requirements in the areas of driving dynamics and passive safety clearly indicated a need to position the drive train at the rear axle. This is the only way of reconciling parameters such as directional stability, minimal dynamic changes of axle load and satisfactory crash performance.

Table 1 and Table 2 show dimensions and weights of the new Smart Fortwo.

In just eight years, the Smart Fortwo has become firmly established as an integral part of the motoring world. It has acquired the character of an icon for the Smart brand – its concept and design remain unique to this day. It has also won broad social acceptance, as demonstrated by its inclusion in the collection of the Museum of Modern Art in New York, for example. In order to meet the needs and expectations pertaining to the status which the car has achieved, the onus has been on retaining defining elements and developing these with due sensitivity.

2.1 Exterior Design

The following terms of reference apply with regard to the stylistic elements for the exterior: One-box architecture, large wheels, minimalist overhangs, headlamps positioned over the front grille, round rear lights. The steel body shell which is partially visible as the vehicle’s outer skin combines with plastic panelling to define a contrasting two-colour design as a characteristic stylistic element. This contrasting design also emphasizes the employed combination of materials.

A pronounced shoulder line lends the body of the car a longer appearance. In contrast, the design of the wings emphasizes the horizontal lines, investing the body structure with width and ensuring that the vehicle sits firmly on its wheels.

2.2 Interior Design

The interior of a Smart Fortwo traditionally imparts a feeling of space, despite the compact nature of the actual dimensions. Clearly structured functional elements emphasize the vehicle’s modular design. The extensive use of textile elements on instrument panel and door trims bring the two-material/two-colour concept to life inside the vehicle. Integral seats featuring sporty contours exude a solid, robust character which emphasizes the importance that has been attached to the passive safety concept.

The newly designed instrument panel retains the signature Smart division into two levels while now sporting straight lines as opposed to the previous sweeping S form, Figure 1. Controls, displays and indicators are bundled according to functions – the air conditioning control unit is positioned on the top level of the centre console, for example, while the instrument cluster, air vents and dashboard instruments are located on the instrument panel.

3 Engines

Totally new, compact three-cylinder engines with a capacity of 799 ccm lend the new Smart Fortwo performance capabili ties far beyond those of its predecessor. There is a choice of three naturally aspirated engines, rated at 45 kW and 52 kW and a turbocharged variant generating 62 kW of power. Plus a 33 kW cdi. As on the predecessor, the engines are mounted transversally in front of the rear axle, inclined at an angle of 45 degrees towards the rear and interlocked with an automated five-speed manual transmission (AMT).

3.1 Petrol Engines

Both engine variants, Figure 2, feature a weight-conscious all-aluminium design, from the oil pan to the cylinder head cover. The cylinder barrels take the form of grey cast iron liners. Gas exchange is controlled by four valves per cylinder. The variable valve timing system (VVT) provides for optimum spreading of the intake and outlet cams for every engine speed by electro hydraulic means. The corresponding maps are defined in the Bosch ME 7 engine controller. The long-stroke design contributes to a favourable torque characteristic – and to a small block length, with a cylinder spacing of 80 mm.

Fuel metering is carried out by an electronic injection system, which converts the commands, that the driver inputs via the accelerator pedal, into acceleration by means of an electronic accelerator. A non-return fuel delivery system with a pressure-controlled low-pressure pump (delivery module) in a plastic tank supplies fuel to the fuel distributor rail of the injectors. The engine, which is supercharged at a maximum of 0.5 bar, possesses a sensor which supplies information on the pressure situation upstream of the turbo, thus enabling more exact control of the induction manifold pressure. The exhaust system is attached to the body shell in such a manner as to isolate it from vibration, rather than being fitted to the engine as on the predecessor. The compact muffler system also bears the catalytic converter, as previously.

3.2 Diesel Engine

With a capacity of 799 ccm, the three-cylinder diesel engine, Figure 3, in the Smart Fortwo is the smallest direct-injection engine in the world. It has undergone a thorough revamp for deployment in the compact two-seater, resulting in ten per cent more power (33 kW at 3,800 rpm) and a corresponding rise in the maximum torque (110 Nm ranging from 2,000 to 2,500 rpm).

High-tech credentials include a light-alloy design for the cylinder block and cylinder head and state-of-the-art injection technology. The common rail injection system operates at maximum pressures of 1,600 bar. It now employs new seven-hole injectors to allow even finer atomisation of the fuel than previously.

In order to minimise the already low level of particle emissions, the engine is equipped with a diesel particle filter (open system) as standard (in D, A, CH). The Smart Fortwo cdi emits 0.013 g of particles per km; this value will fall considerably from 2008, when the closed system becomes completed.