

Communications Motorsport

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Audi sports prototypes: ultra-lightweight design in perfection

- **Le Mans prototypes show development steps in ultra-lightweight design**
- **Lightweight design quality of monocoque more than doubled since 1999**
- **Head of Audi Motorsport Dr. Wolfgang Ullrich: “Many of the ultra-lightweight design ideas from motorsport have the potential of positively influencing the development of our production models.”**

Ingolstadt, May 23, 2013 – Four more weeks until the Le Mans 24 Hours celebrates its 90th anniversary. Audi has set standards with its ultra-lightweight design in the area of the sports prototypes. In 15 years of development, the motorsport engineers have achieved best marks.

Since 1999, ultra-lightweight design has been playing a central role with Audi’s Le Mans prototypes (LMP). Materials, such as CFRP (carbon fiber reinforced plastic), harbor major potential for optimizing weight.

“In the space of 15 years, we’ve also achieved major progress in the area of ultra-lightweight design,” stresses Head of Audi Motorsport Dr. Wolfgang Ullrich. “Audi’s LMP sports cars have continually become lighter, stiffer, safer in crashes and more efficient. There is hardly another motorsport discipline in which the creativity of the engineers is rewarded as highly as it is with the Le Mans prototypes. Whether in terms of engineering design details or materials: many of the ultra-lightweight ideas from motorsport have the potential of positively influencing the development of Audi’s production models. Reducing the weight of the cars is the key to our successful future – in motorsport and in production.”

Even in its first LMP sports car – the 1999 R8R – Audi used a carbon fiber monocoque. Audi has significantly been reducing weight to this day:

- As the central chassis component, the monocoque supports the front axle, the front and lateral body parts and, since 2012, the hybrid system. The engine is directly connected to the rear. The monocoque thus transmits the torsional and bending forces which are introduced through the wheel suspensions, and absorbs the impact energies that are generated in accidents – in frontal or side crashes as well as in roll-overs.
- The Audi R8R (1999), the R8 (2000–2005), the R10 TDI (2006–2008) and the R15 TDI (2009–2010) all had open monocoques. For the R18 TDI (2011), Audi used a closed cell for the first time. Its one-piece design is a trend-setter for safety and weight. Up to then, the closed monocoques of competitors, for manufacturing reasons, had been made up of several elements.
- Although a closed cockpit requires the use of more material Audi has managed to cut the weight of the monocoque in half between 1999 and today, while surpassing all the safety and crash requirements of the FIA. Furthermore, Audi managed to again increase the torsional strength of the monocoque during this period of time despite the 50-percent reduction in weight. The comparison with a production car reveals interesting facts: with comparable torsional values, the weight of the carbon cell of the R18 only amounts to about a fourth of the weight of a body-in-white made of steel sheet.
- The torsional and bending stiffness of the cockpit can only be completely effective if the fully stressed assemblies of the engine and transmission provide the corresponding stiffness. The V6 TDI engine with a 120-degree cylinder bank angle is based on an innovative architecture of the crankcase: Underneath the main bearing, the crankcase is of a ladder frame design. The lateral suction port of the dry sump and the finning connect the bearing blocks with each other. In combination with the upper crankcase deck, this creates a stiff unit. The engine and the monocoque have nearly the same stiffness. This chassis design is complemented by the transmission housing. Since 2012, it has been made of a lightweight and stable full-carbon construction in which the mounting points for the rear axle are integrated. In addition, very light backstays from the monocoque to the transmission housing optimize the stiffness of the rear end.
- A chronological comparison illustrates the significance of the progress that has been made in ultra-lightweight design: The weight of a diesel engine, due to its design, exceeds that of a comparable gasoline engine in the two-digit percentage range. At the same time, the Audi R18 e-tron quattro, since 2012, has been accommodating a hybrid system including a motor at the

front axle. Still, the basic weight of the race car is below the minimum of 915 kilograms. Ballast weight is used to improve the set-up. The 1999 R8R, with a gasoline engine and without a hybrid system, weighed almost exactly 900 kilograms and hardly offered any latitude for ballast.

- Numerous smaller solutions have been accompanying the major steps. The carbon fiber gas pedal in the Audi R10 TDI already saved a few hundred grams of weight compared with an aluminum version. The lithium-ion battery that was used for the first time in the 2009 R15 TDI even proved to be seven kilograms lighter than a lead storage battery.

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The Audi Group delivered 1,455,123 cars of the Audi brand to customers in 2012. In 2012, the company posted revenue of €48.8 billion and an operating profit of €5.4 billion. Audi produces vehicles in Ingolstadt and Neckarsulm (Germany), Győr (Hungary), Changchun (China) and Brussels (Belgium). The Audi Q7 is built in Bratislava (Slovakia). In November 2012, CKD production of the Audi Q7 was added to the existing Audi A4, A6 and Q5 manufacturing operations in Aurangabad (India). At the Brussels plant, production of the Audi A1 has been running since 2010, while production of the new A1 Sportback began in 2012. The Audi Q3 has been built in Martorell (Spain) since June 2011. The company is active in more than 100 markets worldwide. AUDI AG's wholly owned subsidiaries include AUDI HUNGARIA MOTOR Kft. (Győr, Hungary), Automobili Lamborghini S.p.A. (Sant'Agata Bolognese, Italy), AUDI BRUSSELS S.A./N.V. (Brussels, Belgium), quattro GmbH in Neckarsulm and the sports motorcycle manufacturer Ducati Motor Holding S.p.A. (Bologna, Italy). Audi currently employs more than 70,000 people worldwide, including around 50,000 in Germany. The brand with the four rings plans to invest a total of around €11 billion by 2015 – mainly in new products and the expansion of production capacities – in order to sustain the company's technological lead embodied in its "Vorsprung durch Technik" claim. Audi is currently expanding its site in Győr (Hungary) and will start production in Foshan (China) in late 2013 and in San José Chiapa (Mexico) in 2016.

Audi lives up to its corporate responsibility and regards sustainability not only as a basis for financial success, but also as essential to ensure a worthwhile future for the generations to come. The company has therefore strategically established sustainability as a principle for its products and processes. Corporate responsibility includes fuel-efficient products, resource-efficient production processes, a future-oriented and fair personnel policy, effective involvement in society and responsible business operations in general. This gives the motto of "Vorsprung durch Technik" a new dimension that extends far beyond the products. The ultimate goal is CO₂-neutral mobility.