

Manufacturing the New Audi A8

More than EUR 300 million has been invested in the latest aluminium processing and plant technologies at Audi's Neckarsulm plant ready for manufacturing the new Audi A8. The level of automation in the body shop is as high as 80 %.

Pioneer in Aluminium

The Audi A8, which came on to the market in 1994, was the first vehicle with a fully aluminium body. In June 2000, Audi proved with its A2 model that aluminium is also suitable for volume production. And Audi is again setting standards with the new Audi A8. "In the production of the A8, we apply innovative techniques for processing aluminium and the latest machinery in body construction and assembly," explains Dr. Jochem Heizmann, Board Member for Production at Audi. More than EUR 300 million has been invested in the production site and in the Aluminium Competence Centre in Neckarsulm. Around 1,300 employees will be involved in the production of the new Audi

flagship in the body shop, as well as in the paint shop and in assembly.

The investment sum includes the completely new body shop (EUR 180 million). Building work began on this in January 2000. In the meantime, the 175-metre long, 60-metre wide and 35-metre high building complex has been completed. Here, the aluminium body with the Audi Space Frame (ASF) will be manufactured for what is the third generation of the A8. A floor space of 24,000 square metres is available on two storeys. In addition, a logistics annex has been built covering 3,900 square metres. Around 350 people are employed in the new A8 body construction plant.

156 robots ensure an automation level of 80 %. Klaus-Dieter

More than EUR 300 million has been invested in Audi's Neckarsulm plant for manufacturing the new Audi A8.

Zachow, Head of the A8 Parts Production, explains: "That's a level we also achieve in volume production on the A2 or the A6 in Neckarsulm." As a comparison: in the body shop of the previous A8 there were 25 robots in operation, which was an automation level of 20 %. "The higher level of automation on the new A8 means a shorter cycle time. Compared

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with the predecessor, we save over 50 % in production time in body construction alone. We also improve process reliability, which allows us to raise the reproducible quality considerably," explains Roland Schad, Project Leader for Production on the A8.

Combination of Welding Technologies

This is brought about among other things by innovative manufacturing processes. For example, there is a combination of conventional laser and arc welding in the laser MIG hybrid welding process (MIG stands for Metal Inert Gas), which is completely new in vehicle construction using aluminium.

"We have achieved synergy effects by combining both joining processes. We are therefore extending the limits of current thermal joining processes with regard to productivity, efficiency, seam quality and process reliabil-

ity," says Stephan Helten, who is responsible for laser technology at the Aluminium Centre in Neckarsulm. A welding seam length of 4.5 metres is thus achieved per vehicle. Laser MIG hybrid welding is used in the area of the lateral roof frame, which is fitted with various functional panels.

As well as the hybrid welding seams, there are also 2,600 punch rivets (1,100 on the predecessor), 64 metres of MIG welding seams and 20 metres of laser welding seams on every A8 body. The greater use of punch riveting on the successor model means that 500 spot welds and 178 clinch connections that joined together the body of the previous A8 are no longer required.

Another innovative joining technique is roller-type hemming. Here, rollers secured to a robot arm bend the outer panel over the inner panel and create a powerful connection by the application of a hem-bonding adhesive. The add-on components on the new

A8 (doors, bonnet and tailgate) and the connection of the wheel arch with the side-panel frame are processed in this way.

Inductive gelling is also a production first. In this process, the hem-bonding zones on the add-on components are heated through targeted induction (electric field) that hardens the hem-bonding adhesive. The component is thus stabilised and any



Dr. Jochem Heizmann, Board Member for Production at Audi: "In production, we use innovative techniques for processing aluminium and the latest machinery in body construction and assembly."



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single component in the successor model, at the same time with a reduction in weight of around 600 grams.

A whole range of other light-weight construction measures have been adopted on the new A8: the aluminium rear auxiliary frame alone enables a weight reduction of around nine kilograms. Components such as the instrument panel support made of aluminium and magnesium, cast-rolled wheels or the sprayed-on acoustic insulation in the underbody area signify a weight saving of one kilogram in each case. Compared to a conventional steel body of this size, around 40 % of the weight can be trimmed off in the new A8.

At the end of the body production line, a computer-controlled CNC milling machine mechanically processes the connecting zones for the suspension and the front-end module. At the same time, the position of the vehicle is determined via mechanical sensors and the machining is correspondingly controlled by a computer programme. It is possible to achieve a perfectly adjusted assembly of the front-end module and the suspension through the high precision of the milling process. The precision with which the running gear is connected to the body is a basic prerequisite for the new top model's excellent handling properties.

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slipping of the outer panel in relation to the inner panel is avoided.

The dimensional accuracy is monitored at 14 stations during the production process by the inline measuring concept using laser measuring sensors. A laser beam from a pre-defined position is projected onto a point on the component. The distance to the laser head and thus the dimension of the component is defined through the reflection of the beam. Any deviations can thus be recognised and resolved immediately.

A single-piece side-panel frame in aluminium is installed on the new A8 for the first time in the large vehicle class. The frame, which is more than 3.45 metres long, weighs less than seven kilograms. The side panel still consisted of eight parts on the previous model. This single-piece aluminium frame has been in volume production at Audi since 2000 on the A2. This is also pioneering work in vehicle construction using aluminium.

Number of ASF Components Reduced

Compared to the predecessor, the number of components on the further developed Audi Space Frame (ASF) has been reduced from 334 (including add-on parts on the previous model) to 267. This is achieved by the use of large-format panels such as the

single-piece side-panel frame, as well as extruded sections such as the three-metre long hydro-formed roof frame and multi-functional large castings such as those used for the radiator tank or B-post.

The reduction in parts and weight on the new ASF is well represented by the last two components mentioned: whereas the radiator tank on the "old" A8 still consists of seven different parts and weighs over five kilograms, it will be cast in one piece as a multifunctional part on the successor model. The weight is around three kilograms. The same is true of the B-post, which was previously composed of eight parts (4,254 grams), but is now produced as a



Body construction for the new Audi A8: around EUR 180 million has been invested in the completely new body shop at Neckarsulm.



Measuring the body of an Audi A8.

Paint Shop

The finished body shell of a new A8 is then transported to a height of 26 metres by a conveyor belt over a 315-metre long, completely covered bridge into the paint shop. The paint shop, one of the most up-to-date in the world, was already prepared for the launch of the luxury-class vehicle following completion of the third building phase in October 2000. The third building phase enabled the introduction of "segmenting" or painting in various part sections separated according to the model series. Audi also took into account the increasing demands on the paint shop brought about by the growing number of aluminium vehicles. The total amount of investment for the paint shop was over EUR 300 million.

Every A8 body can be applied with 15 different series colours and numerous special paint finishes. In total, 1,250 people work in the paint shop in Neckarsulm, of which around 150 are exclusively concerned with the paint finish for the A8.

The process then moves from the paint shop to the assembly area, which was converted, extended and restructured at a cost of around EUR 60 million. Some 800 people are employed there in an area covering some 36,000 square metres. Final assembly of the new A8 takes

place in 74 cycles (each cycle being six metres) on a single line that is over 440 metres long in total.

A new development on the A8 is the outsourcing of the doors and the front-end module. The doors are dismantled immediately after the start of the assembly process and transported via an electric trolley line to the second floor of the new south annex for pre-assembly. There, the door modules are completely assembled and tested, subsequently brought via conveyors to almost the halfway point of the assembly line and attached to the body once again.

"Marriage"

The joining of the drive components with the body – the so-called "marriage" – is also new. Whereas "only" the engine, transmission and the front and rear axle were located separately using two installation vehicles on the previous A8, Audi has changed over to a driverless transport system (FTS) that enables complete installation. In other words, not only the complete suspension and drive units are placed on and located by a single installation vehicle but also the exhaust system, fuel tank and propeller shaft.

The screws are tightened with electronically controlled screwdrivers throughout the assembly

area. In this EC screwdriving technology, the employee on the production line scans in the vehicle's identification number and thus "primes" the screwdriving operation. The system now "knows" how many screw points must be tightened and to what torque, and stores the data in relation to the identification numbers. A protocol is finally created to ascertain whether the screw operation has been carried out successfully. In this way, every screw operation on the new A8 is comprehensively documented.

The testing requirements for the electrics/electronics on the new A8 have become so complex that a second test centre was necessary

Second Test Centre for Electronics

Following assembly, the vehicle passes to the restructured finish area, which comprises the car wash, seal inspection, surface control, the audits of the quality assurance, battery recharging, scanning of the car inspection card and the headlight test rig.

In addition, a new second test centre has been built. Head of Parts Production Zachow explains: "We focused our attention on the electronics very early on with regard to the production. The testing requirements for the electrics/electronics on the new A8 have become so complex that a second test centre was necessary." This is hardly surprising, as the new Audi top model is equipped with a range of electronic features. In the full spec, up to 65 control devices, which form a highly complex electronics network, can communicate with each other in the saloon.

Each of these functions is checked in the test area. In order to carry this out, there is a Mobile Programming Station (MPS), a combined test rig that carries out headlight and wheel alignment and an infotainment test rig.

The new A8 in Neckarsulm will be produced in a two-shift operation with a capacity of 100 vehicles per day. Production, from the start of body construction to the point at which the new A8 rolls off the line as a finished vehicle, takes seven days, one day less than the predecessor's cycle time. (rs)