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PRESS – BASIC INFORMATION

Start of production of the Audi A3 Sedan: Győr becomes a fully-fledged car plant

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Short version

The home of the new A3 Sedan – Audi’s expands its site in Győr into a fully-fledged car plant

2,100 new jobs and an investment volume of more than €900 million – AUDI AG has expanded its plant in Győr, Hungary, into a complete automobile factory. The first models to be built at the new facility will be the Audi A3 Sedan and the S3 Sedan.

Audi’s site in Győr in the northwest of Hungary is not only the world’s biggest engine plant, for several years, it has also been responsible for the assembly of the TT Coupe and the TT Roadster, as well as the A3 Cabriolet and the RS 3 Sportback. For an investment of more than €900 million, an ultramodern car factory has now been built at the site with an annual capacity of 125,000 units. On floor space of nearly 270,000 square meters, equivalent to about 37 soccer fields, all production processes will take place – from pressing the sheet metal through to final assembly. The first models to be built at the new plant in Győr are the Audi A3 Sedan and the Audi S3 Sedan.

The foundation stone of the plant expansion was officially laid in July 2011; nine months later, AUDI HUNGARIA MOTOR Kft. was already celebrating the topping-out ceremony. With the car production now starting, the one-hundred-percent subsidiary of AUDI AG has created 2,100 new jobs directly. In the future, a total of 15,000 people will earn their living directly or indirectly from this plant.

The heart of the factory is the central building accommodating the analysis and pre-series center, quality assurance and up to 550 office jobs. It is located between the press shop and the body shop, which are laid out in a north-south alignment, and between the paint shop and the assembly hall, which form an elongated block in an east-west alignment.

The main feature of the press shop is the ultramodern large press by the name of Servo-PXL; powered by 14 electric finely adjustable servo motors, it has a total closing pressure of 8,100 tons. When the slides are braked in their downward movement, the press recovers kinetic energy. Tool changing takes just three minutes.



The body shop also utilizes the latest technology. In its final stage, more than 600 robots, over 400 welding electrode holders, nearly 300 geometry, process and handling devices, approximately 80 bonding systems, 20 welding and brazing units, seven folding machines and other devices will be in use. An inline laser measuring system monitors the dimensional accuracy of the car bodies at 23 stations and seven ultrasound devices are used for random checks.

Another novelty is to be found in the paint shop: In all painting cabins, a so-called dry separator filters the paint mist out of the air with the use of powdered stone; the waste air from the final-coat painting cabins is especially cleaned to remove solvents. Apart from the clear varnish, only water-based paint systems are used. Air recirculation in the spray cabins saves about 50 percent of the energy needed for heating, cooling and humidity regulation.

The final assembly, where about 1,000 people will work, consists of 146 different cycles with a cycle time of exactly two minutes. In line with the herringbone principle, there are pre-assembly groups on each side of the main assembly line for doors, the cockpit and the combination of drivetrain and suspension. Ergonomic criteria had high priority in the planning of the final assembly.

In the energy center, which supplies electricity, heat and cold, Audi also places a high value on efficiency and conservation of resources. Designed as a separate building, the energy center accommodates three gas boilers and a cogeneration heat and power plant in which a natural-gas engine drives an electricity generator whose waste heat is utilized by the heating system. The plant can also independently receive remote heat from an external combined heat and power plant. Efficiency is enhanced all over the site by numerous heat-recovery units.

When the production now starts, AUDI HUNGARIA MOTOR Kft. can look back on a 20-year history. Since the company was founded, it has developed into one of Hungary's biggest exporters and highest-revenue companies. Last year, Audi Hungaria produced 1,915,567 engines and 35,553 automobiles in Győr with almost 9,000 employees.



Long version

Audi expands its Hungarian site in Győr into a fully-fledged car factory

AUDI AG has expanded its site in Győr into a complete automobile factory. The expansion, which represents an investment volume of more than €900 million, is creating 2,100 new jobs in the northwest of Hungary. The first models to roll off the new production lines will be the Audi A3 Sedan and the S3 Sedan.

► Press shop

Powerful equipment needs strong foundations: The press shop in Győr has been constructed on a seamless slab of reinforced concrete 1.5 meters thick located eight meters below the surface of the ground. The slab is supported by 360 bored piles 15 meters long and 0.8 meters in diameter. The total floor space covers 26,000 square meters and has workplaces for up to 140 people.

The heart of the press shop is a large press line with the name Servo-PXL – the first of its kind at Audi. Compared with the predecessor generation, the equipment has a completely new design. The most important innovation is the 14 decentralized servo-motors comprising an electronically controlled single drive system, which replace the large, central drivetrain. They are not only significantly more efficient, but also allow the highly flexible adjustment of individual functions to suit the circumstances. The servo motors have a combined power of 5,460 kilowatts.

When the downward movement of the six slides of Servo-PXL is braked, the press recovers kinetic energy. Seven generator-storage units are installed in the basement of the press shop, whose rotors serve as flywheels. They save the energy for a few seconds and then return it to drive the machine. Another strength of the new press is the rapid changing of tools; which weigh up to 60 tons and are transported by cranes suspended below the hall's ceiling. Tool changing is fully automated and takes just three minutes.

With dimensions of 93 meters long, 22 meters wide and 12 meters high, Servo-PXL is comparatively compact, because a new technology makes interim storage superfluous when the sheet metal is transported inside the press. With a total closing pressure of 8,100 tons, the new large press can carry out 17 strokes per minute. It can process 250



to 300 tons of sheet steel and aluminum to produce 22,000 to 24,000 parts every day.

Managing these enormous forces is difficult. In order to meet Audi's high quality standards, highly qualified employees are required with keen eyes and a good tactile sense – to check the finished parts and to operate the equipment. Each tool has to be individually operated, and the sheet-metal plates frequently display deviations from the norm.

For this reason, the upstream strip-cutting machine examines the density of the sheet-metal plates, which it cuts from the large coils, with an electromagnetic process. In the press itself, some additional measuring techniques are already installed and yet more are planned for the future. They include so-called intelligent tools, which include sensors to monitor whether or not the sheet metal is optimally drawn into the press. If not, appropriate adjustments are made – on a scale of hundredths of millimeters for the precision required by Audi.

The material cycle in the Győr press shop is completely closed. Thanks to intelligent material use, offcuts are minimized right from the start – each window cut-out from a door for example is used to make two fuel-tank covers. All material left over is collected, pressed into cubes and taken away for recycling.

► **Body shop**

Like all sections of production, the body shop in Győr is based on the latest technology and is automated to a degree of 85 percent. When the plant is operating at full capacity, 600 employees will produce 480 car bodies every day in two shifts.

The factory is equipped with a total of no less than 1,440 machines, including more than 600 robots, over 400 welding units and approximately 80 bonding systems. The welding units are powered by electric motors – they are faster, more precise, more robust, quieter and lighter than the pneumatically operated predecessor generation. The factory's other machines are grippers, geometry stations, clinching and folding machines and welding stations for special tasks.

The car bodies are produced on factory floor space of 58,768 square meters. There are



groups of robots on both sides of the main line, which weld together components such as floor parts, wheel housings and longitudinal beams. With the addition of the bulkhead, rear parts, pillars, side parts and roof, the body gradually comes together; the last parts to be added are the tailgate and doors.

In the body shop for the Audi A3 Sedan, 16 different connecting techniques are in use – from resistance spot welding with 5,467 points to the 54.06 meters of structural adhesive. Wherever possible, bonding and welding take place in one operation, which saves time and reduces costs and weight. Measuring instruments are installed at each work station to monitor the consumption of electricity and compressed air.

Two machines are special highlights of the body shop. The so-called group framer attaches the large side frames to the body shell after exactly positioning them. Due to its large movable mass, it is largely made out of carbon-fiber-reinforced polymer (CFRP), making it 70 percent lighter than the previous model. A laser brazing machine connects the roof of the A3 Sedan with the side frames. The practically invisible zero joint that is created requires precision in a magnitude of three tenths of a millimeter at the most; the joint is then smoothed by brushes.

With the lasers, Audi applies the newest, especially energy-efficient generation of disc or diode lasers. The laser-remote welding of doors is particularly complex. A robot guides the laser beam with pivoting mirror optics; it moves extremely quickly from one joint to the next.

23 optical laser measuring devices monitor the dimensional accuracy of the assemblies produced by means of relative measurements. With the use of ultrasound measurements, specially trained employees check the stability of welded connections and of complete car bodies. A central equipment monitor constantly visualizes the current status of production and any possible disturbances in all areas of production.

As in all other areas of production at the site in Győr, a large-scale ventilation system ensures that the hall is permanently supplied with fresh air; rotary heat exchangers reduce energy consumption. When the body shop changes over to standby operation at the weekends, a switch-off concept is applied that supplies electricity only to the most important computers and switchboxes. This reduces the consumption of electricity by 80 percent.



The end structure of the hall accommodates offices, a professional room for training purposes, a small supermarket and a workshop, as well as a warehouse with more than 100,000 spare parts for the body shop – any defective components can be replaced immediately.

► **Paint shop**

With its efficient and resource-conserving technologies, the paint shop at the site in Győr sets new standards; it is one of the most environmentally friendly automobile paint shops in the world. When developed to full capacity, 250 employees and 80 robots will work here – the latter primarily in the paint cabins and PVC area, where underbody sealant is applied.

The paint is conveyed to the robots along pipes from the tanks in the so-called paint mixing room. There are 26 standard colors of base coat. Towards the end of the year, the special paint shop will go into operation in a separate building; it will be responsible for the individualized paintwork that Audi customers can order.

An important innovation in the paint shop in Győr is the dry separation in the air recirculation system. It cleans the air by removing paint particles. The proportion of recirculated air is 80 to 90 percent; this saves more than 50 percent of the energy required for heating and cooling and humidity regulation. In all paint cabins – for filler, base coat and final coat – a dry separator is integrated into the process for the paint mist that is not deposited onto the car bodies. The air stream carries this overspray out of the cabins; in a separate room it passes through powdered stone and is deposited there. The filtered clean air flows back into the recirculated air. The used powdered stone can be reused in the cement industry.

There is another innovation between the colored base coat and the clear varnish: The interim dryer works with extremely dry air instead of with the usual infrared radiation. To enhance quality, the final coat, which protects the bodywork from scratches and environmental influences such as acids and ultraviolet radiation, is the only paint that is not water based. An additionally installed special system cleans the waste air from the paint cabins to remove solvents: An absorption wheel conveys them into a carrier medium which stores them; they are blown out with hot air and then burnt in a thermic



processing plant. With this additional cleaning of waste air, emissions of solvents can be reduced by more than 70 percent.

At the finish line, the final station, LEDs fitted in tubes illuminate the car bodies indirectly – extremely evenly and with a maximum degree of energy efficiency.

► **Assembly**

With its total length of approximately 700 meters – including the logistics area – and large windows providing light from outside, the assembly hall is one of the most impressive buildings of the plant expansion in Győr. According to the herringbone principle, pre-assembly groups are located to the left and right of the main line – for the doors, the cockpit and the combination of drivetrain and suspension. The so-called “wedding,” where the car bodies come together with the mechanical components, is full automated in the third of the five assembly sections; with its 56 screw and bolt connections, it is the most complex stage of assembly.

Approximately 1,000 people will work here on floor space of 58,000 square meters; many of them will come from the previous TT assembly. On average, each group consists of ten employees who exchange activities every two hours.

Audi Hungaria places great importance on ideal ergonomic conditions. Each section of the assembly line has a height adjuster for the frames (“skids”) or for the suspended conveyor that moves the car bodies. Ergonomically designed assembly seats are installed in the section for door pre-assembly – employees can work in a sitting position. Handling devices such as for installing the battery and the seats or for fueling the cars relieves them of physically strenuous work.

An A3 Sedan consists of up to 10,000 parts and practically each one is unique – the many configuration possibilities that Audi offers its customers result in several million variants. For this reason, the assembly work is supported by complex logistics. “Supermarkets” related to particular assembly sections in the assembly hall supply the parts to be assembled; at the eastern end of the hall there is a logistics area for the supermarkets with floor space of 30,000 square meters.



The logistics employees who put together the load carriers here for part-specific transport wagons are supported by an online system, which ensures that they have taken the right part from the shelf. A pick-by-voice system is also used for parts commissioning. The logistics employees have to speak a reference number allotted to the part into the microphone of their headset; they then receive acoustic feedback as to whether or not the right part was selected. This system is new at Audi.

There are also numerous assembly assistance systems on the line that guarantee secure processes and high quality. They range from photo-sensors, which check whether the employees have taken all the components out of the load carrier or the shelf, to electronically regulated torque wrenches.

The last assembly stations of the Audi A3 Sedan are the startup and checking areas. When in operation, the road-driving simulation system installed there creates considerable waste heat, which is fed into the hall's heating system.

► **Logistics**

Many parts of the Audi A3 Sedan, the engine for example, come from the Győr itself or from local suppliers, while other components are delivered from Slovakia, Germany or other European countries. Most of the transport involved is by train. A network of train tracks runs through the plant area, ending at the engine factory, toolmaking and the press shop. There is also a connection to the external logistics optimizing center. Solely on the new part of the Győr site, the tracks have a total length of 8.8 kilometers.

Quite close to the site there is an external goods-handling area called the "logistics optimizing center." It is currently designed for about 600 suppliers, which deliver their parts on specified days. The material stored here is sufficient for an average of two to three working days. At another site, there is a supplier park where the suppliers pre-assemble their parts and commission them so that they arrive at the assembly line just in sequence – with short advance notice of one to five hours.

At the plant itself, at the interface between body shop, paint shop and assembly, there is the central body buffer, which ensures the required flexibility of the production flow. With 1,200 square meters of floor space and 30 a height of 30 meters, the building can



accommodate up to 414 unpainted and painted car bodies. The central body buffer is designed as a high-rack warehouse and is divided into three zones of equal size.

Three fully automatic shelf pickers, which receive their information from the central computer, transport the car bodies to their parking spaces and later retrieve them in the right order. Powered by electric motors, they carry out 35 placements and retrievals for painting and assembly each hour. With a horizontal speed of 10 kilometers per hour, the 25-ton pickers are quite fast.

► **Central building**

The central building is the heart of the automobile plant – with direct connections with the production sections of body shop, paint shop and assembly. Short distances result in quick communication. The second upper floor of the building accommodates up to 550 office workplaces relating to all sections of production; large windows and green atriums create a pleasant atmosphere. On the ground floor, quality assurance and the analysis and pre-series center are located with their workshops.

The analysis and pre-series center, which employs about 150 people, also has the function of a typical pre-series center at the Győr site. The primary purpose is to build the pre-series cars together with colleagues from the various areas of production. This stage of work takes place one year before the start of series production so that many improvements can be made and any problems can be solved in advance.

In addition to building pre-series cars, the central building is also where pre-series analysis and series analysis are located under one roof – a new approach at Audi. One of the most important tasks of the engineers here is to influence the products for future projects. They start work on future concepts several years before the start of a series; for example, they identify potential for optimization for future vehicle projects and make sure that the ideas are implemented. The close networking between pre-series analysis and series analysis in the analysis and pre-series center ensures a thorough know-how transfer – from the concept phase until a product is phased out.

The specialists of the analysis and pre-series center check the cars in all areas – bodywork, mechanics, electric/electronics, safety, and assistance systems. In the



reference review center of electronics, for example, there are synergies with assembly and quality assurance. With special reference equipment, startup programs and testing programs can be created for new electronic components. Before they go into production, the engineers check their suitability for series operation and approve them.

Quality assurance, the second user of the central building, also has the task of checking and analyzing the series-produced cars – in full operation, they audit four cars each day. The focus is on component quality and function. The quality assurance employees operate a large number of test devices in the context of their pre-series and series activities – the traditional “meisterbock” with measuring instruments to assess the precision of exterior and interior components, the hydropulse stand for analyzing any unwanted sounds, an acoustics test bench, a component climate test bench and a water sprinkler system to test for any leaks.

The highlights of quality assurance include the so-called “e-meisterbock” – this is where electronic components are examined, in some cases with computer tomography scanners and electron microscopes. A night-design chamber serves to test interior illumination.

Quality assurance is also responsible for the 1.2-kilometer test road in the northern part of the site, which includes a vibration segment with 14 different surfaces. All completed cars have to drive over this road before they are approved for release. Trained drivers check for anything unusual in terms of noise, vibration, handling and drivetrain. Every tenth Audi A3 Sedan also undergoes a road test beyond Győr which includes highway driving.

► **Energy supply**

The new energy center of the Győr site is situated between the large area of new buildings and the engine factory. It covers a ground area of nearly 7,000 square meters and supplies the plant with electricity, heat and cooling, as well as compressed air and drinking, cooling and process water. In addition, the plant can receive remote heat from an external source.



The heart of the energy center is a gas power plant with three large boilers, each with a power output of 26 megawatts. An additional combined heat and power plant, which uses a low-emission gas engine to generate electricity, supplies up to 2.7 megawatts of both electrical and thermal energy. The generators have a high efficiency of over 90 percent and can supply more than 5,000 households with heating energy.

All components in the energy center are designed for maximum efficiency. The waste heat of the air compressors for example is recovered and stored in the heat network; this adds up to about 3,500 megawatt hours of thermal energy each year, avoiding 1,000 tons of carbon-dioxide emissions. In the cooling processes, in combination with a free-cooling system, approximately 880 megawatt hours of electricity are saved each year. All supply lines for electricity, gas, water, air and compressed air are optimized for short distances and minimal losses.

For the supply of water, the plant has its own well with a depth of 380 meters. Waste water flows into the municipal sewage treatment plant, but the waste water from the paint shop first undergoes chemical and physical cleaning at the plant. Energy-efficient LED lamps are used for the factory's exterior and safety lighting; compared with conventional lamps, they achieve annual energy savings of about 300 megawatt hours.