

# Porsche Engineering Magazine



**No interference**

New EMC test chamber in operation

**A look back at the past**

The new Porsche Museum

**Perfection is in the detail**

Focus on Exclusive & Tequipment

**Safely tucked in with Porsche**

New hospital bed design

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## Dear Readers,



We are ambitious. Our aim is always to be one step ahead. Our ambition drives us to be faster than others. Porsche is famous for speed and for technical depth. Because we focus on creating the products of the future.

These virtues are more important than ever in light of the major economic challenges we are all facing. In all areas of technology we must take what is good and improve on it.

Our ambition is what transforms every customer project into a challenge. Our engineers know that there is always room for improvement. They translate this principle into every language and are understood throughout the world. Anyone who is constantly looking ahead can also occasionally take the time to glance over their shoulder. In this issue we have allowed ourselves the luxury of looking back over our history. You can find out more about Porsche's very first model and get a taste of the newly opened Porsche Museum in Stuttgart. The museum has on display some of the many and varied Porsche customer development projects from the last 75 years. In this issue we have highlighted some examples.

Despite the challenges mentioned, we deeply value using our skills on behalf of less privileged people. You can read about the development of a special production machine for a workshop for disabled people which allowed us to

demonstrate not only our technical skills but also our social commitment.

Even during the development of state-of-the-art hospital beds our engineers have followed the principle that there is always room for improvement and have left their mark on the design. We also give an insight into some of the products we have developed for Porsche Exclusive & Tequipment which make each of our cars unique.

Porsche and innovation have always gone hand in hand. We offer you the chance to find out about the inspirational Porsche fourth dimension, the new Panamera. You can also take a look at our new EMC test chamber in Bietigheim. Come with us on a brief journey through the world of development and find out first hand about our fascinating work and the principles that guide us.

We hope you enjoy the latest issue of our magazine.

Dr. Peter Schäfer and Malte Radmann,  
Managing Directors of Porsche Engineering

## About Porsche Engineering

At Porsche Engineering, engineers are working on your behalf to come up with new and unusual ideas for vehicles and industrial products. We develop a wide variety of solutions for automotive manufacturers and suppliers, ranging from designing individual components and complex modules to planning and implementing complete vehicle development projects, including managing the start of volume production. What makes our services special is that they are based on the expertise of a major car manufacturer. Whether you need an

automotive developer for your project or would prefer a specialist system developer, we can offer both, because Porsche Engineering works at the interface between these two areas. All the expertise of Porsche Engineering has been brought together in Weissach, but is available all over the world, including on-site at your premises. Wherever we work, we bring a part of Porsche Engineering with us. If you would like to find out more about the different areas of our business, please visit our website at [www.porsche-engineering.com](http://www.porsche-engineering.com)

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### Impressum · Porsche Engineering Magazine

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Design: Machart-Design, Stuttgart  
Repro: Piltz Reproduktionen, Stuttgart  
Printing: Leibfarth&Schwarz, Dettingen/Erms  
Translation: TransMission Übersetzungen,  
Stuttgart

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## The Porsche under the Hospital Bed



Safely tucked in with Porsche. Porsche Engineering develops new drive and control units for hospital and nursing beds.

### Even hospital beds need good brakes

Manufacturers of medical products are required to meet increasingly strict standards. The development process is characterised by high safety and quality

requirements and short innovation cycles. The demands placed on these products are not only the result of legislation and competition. Patients also require the latest technology in the products they use. One company that has to meet these high standards is Völker,

which specialises in the production of innovative hospital and nursing beds. In order to ensure that its products meet the requirements of professional hospital care and comply with the latest technical standards, Völker turned to Porsche Engineering for help.

It's true that the engineers at Porsche Engineering are not accustomed to dealing with hospital beds on a daily basis, but they are experts in developing electronic systems and electric

motors. In the many departments at Porsche Engineering, a wide variety of products are developed for customers every day, so an innovative drive system for hospital beds was another exciting new project.

### A Porsche in the hospital

This development project resulted in engineering a system based on a LIN



The newly developed nurse control unit



The new hand control unit. Both devices are laser welded to ensure that they are robust and water-tight

(local interconnect network) bus, consisting of four basic components: an electric drive motor, a hand control unit for patients, a nurse control unit and a power supply. The system meets the latest safety standards in the field of medical technology and is designed for use in a demanding hospital environment.

### One type of motor for all the drive functions

What makes this development so special is that the new HV02 motor can be used as the main drive unit for a wide range of functions, such as the telescopic lift. It can also function as a single drive unit for the trapezoid lift and the propulsion system and as a dual drive unit for adjusting the mattress frame, which is divided into four parts. The motor is designed for easy installation, as in the automotive industry. The connector system meets the highest industry standards. No wire or soldered joints are needed as the connectors are based on the Poka-Yoke principle, which helps to prevent faults.

The developers from Porsche Engineering naturally focused on good brakes, in the same way as they would do with a sports car. Even with larger loads, such as heavy patients, the brakes ensure that the mattress frame remains safely in its preset position by using a specific holding torque.

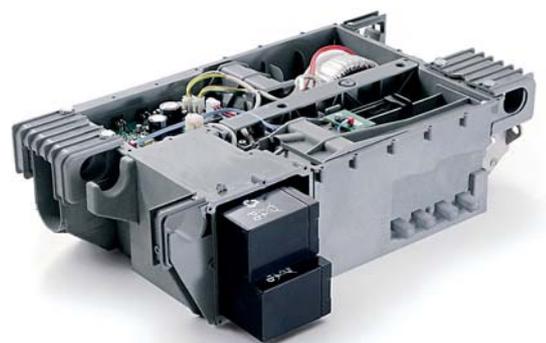
### A dual drive unit is better

The dual drive unit in the centre of the bed moves the parts of the bed which support the patient's back and those which support the thighs. The adjustment angles are permanently stored in the dual drive system, which allows for positioning without a homing mode and limit switch. Another benefit of the new unit is that partial manual adjustment of the back support is now possible without the bed having to move to the limit switch before it can continue operating.

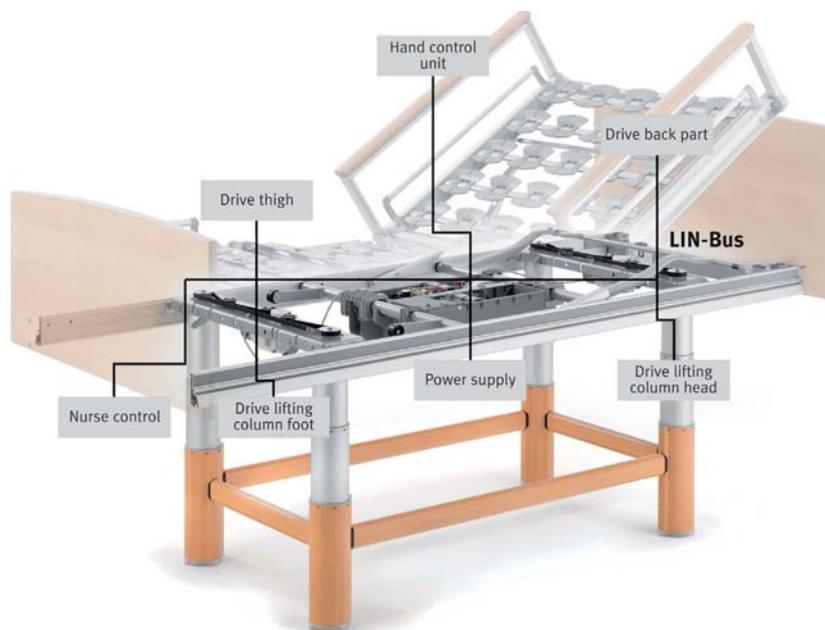
### Single-fault safety guaranteed

The new electronic system developed by the Porsche engineers guarantees single-fault safety without the patient functions needing to be blocked, for example. A pulse width modulation system ensures that the bed moves at a uniform speed, even with varying loads, which has allowed the safe operating load to be increased to 250 kilograms. A 300 VA transformer is used for this purpose. This is the equivalent of double the previous power supply. The significant power reserve in the transformer also gives it a longer duty cycle (20 percent instead of the conventional 10 percent). At the same time, the heat loss from the transformer has been reduced.

The newly developed battery system also offers a number of benefits. The increased capacity of 7.2 Ah allows the adjustment functions to be used without mains power supply for a longer period of time which increases patient safety. The battery no longer functions only as an emergency backup.



A glimpse into the internals of the DA01. The easily removable batteries are clearly visible



The LIN bus system, which has been specially designed to meet the requirements of the Völker beds, controls all the motors and drive components

### Bed controls to meet every need

The hardware and software of the Völker LIN bus system was created on the basis of the Porsche Engineering development model for mechatronic components. It was successfully tested by TÜV SÜD Product Service GmbH for compliance with international standards. The specification far exceeds the requirements of the DIN EN 60601-2-38 and FDIS 60601-2-52 standards.

A new feature developed by Porsche Engineering is the plug-and-play extension which is fully compliant with the LIN standard. This allows components to be added to and removed from the LIN bus while the bed is in use. As a result, the bed can be equipped with a variable number of hand control units and nurse control units which are auto-

matically recognised and integrated by the system. Customers can also add additional control units to the beds at a later date, simply by plugging them in. The number of cores in the cables in the wiring loom has been reduced from 14 to 3 or 4, which significantly lowers the risk of the system failing. The standardised connectors allow components to be plugged into any of the sockets on the bed.

### Designed for safety

The safety concept developed by Porsche Engineering ensures that all the bus components, including the motor management unit, the power supply and the control units, have self-monitoring functions which are independent of one another. Critical safety parameters, such as the power supply or the position, are subjected to re-

dundant tests. If the tests do not produce plausible results, the power and therefore the control functions are shut off. The developers have ensured the safety of the system by taking a functional approach to safety, similar to that employed in the automotive industry, and by applying a highly detailed FMEA (failure mode and effects analysis).

### Service technicians in mind

It is only to be expected that the engineers at Porsche Engineering constantly come back to automotive concepts. For example, they have developed a diagnostics tool similar to that used by service technicians in a car workshop. This tests all the components connected to the bus and makes troubleshooting much easier and quicker. The software can be updated without problems simply by exchanging the hand control unit and the nurse control unit.

### Objectives achieved

All the objectives of the development project were achieved. Porsche Engineering deliberately based its project on the high product development standards in the automotive industry. This has given the bed manufacturer Völker a higher quality product and a decisive advantage over its competitors. An ongoing risk assessment was carried out by TÜV SÜD Product Service through-out the course of the project. The main focus was on safety and availability, because the highest priority is to ensure that patients are not put at risk.

## Four “Porsches” for Markgröningen



Porsche Engineering develops four machines for the disabled workshop in Markgröningen to help with the production of jerry can lids.

Michael Holdreich simply can't stop smiling. And why is he so happy? It's quite simple. "Because he now has his very own Porsche," explains Frank Sayer, project engineer from Porsche Engineering. The "Porsche" in this case is standing on a work bench and is blue and box-shaped. It is one of the four machines developed by the engineers at Porsche Engineering for the disabled workshop in Markgröningen. The machine helps in the production of jerry

can lids. Michael Holdreich and his colleagues produce around 1.5 million of these each year.

A total of ten engineers developed the four machines for the disabled workshop in Markgröningen as part of the trainee development programme at Porsche Engineering. During the 18-month programme, trainees work on a project which allows them to put into practice what they have learned.

The group considered very carefully which project they should choose. Finally they decided to support a charitable organisation and to use their skills for the benefit of the employees in the workshop at Markgröningen.

The call from the team came just at the right time for Karl-Heinz Dettling, works manager at the workshop. He had been looking for a suitable machine to help his employees with the production of jerry can lids for a long time. At that point each individual lid had to be produced manually using a lever press operated with one hand. This was very tiring work. "It was not only monotonous for the people here but it also meant that



Contract production of jerry can lids

they were putting a strain on one side of their bodies,” said Dettling. The new machine has also reduced the number of rejects and the time needed for quality control, making more time available for producing the lids. In three stages the machine brings the clip, the seal and the lid together (see the picture on the left hand page). One major benefit of the machine is that the employees themselves decide when to start the mechanical press process. “This is particularly important, because it ensures that the employees are not subjected to mental stress,” explains Sayer.

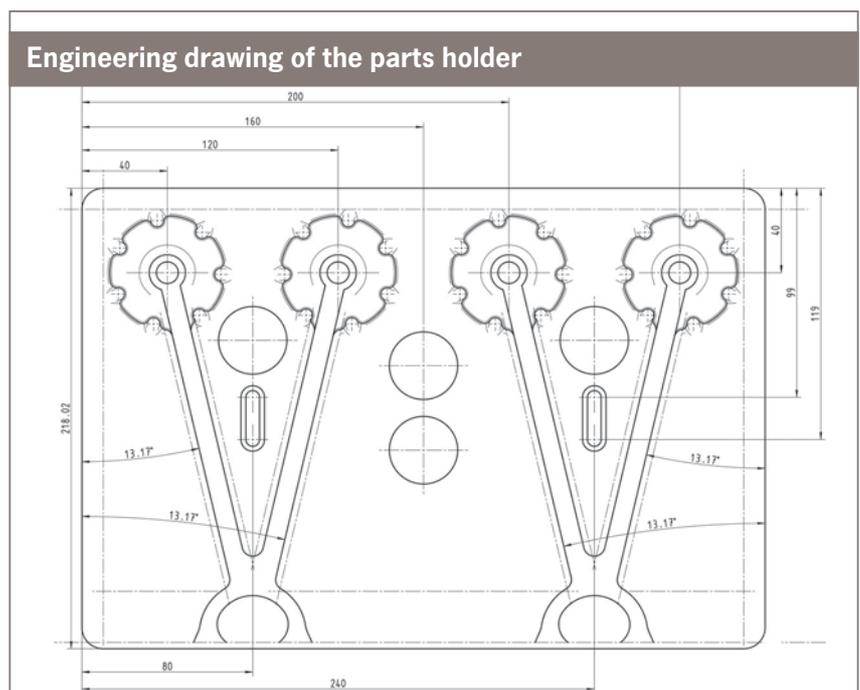
The requirements specification for the project was comprehensive, but this did not present a problem for the team at Porsche Engineering. “The engineers have succeeded in producing a superb machine,” says Dettling. The employees in the workshop are able to work more efficiently and they are also taking pleasure in their work, which is clear from their faces. They now not only have one

Porsche but four, which all of them enjoy using.

The project team demonstrated that it was able to meet complex challenges and, in particular, to develop a machine

specially designed for the needs of a specific user group. This meant that the work processes were adapted to suit the users and not vice versa. The team achieved all its objectives and the original project description “Development of a device to make assembly work easier and increase productivity” has become a reality. The implementation of the machines was divided into four areas. While one group worked on the controls and sensors, another purchased the necessary materials. A third group designed the parts holders and base plate and the fourth group was responsible for the press unit and the frame.

The best thing of all is that, because the lids can now be manufactured more quickly, the workshop’s productivity has increased. As a result, it can take on additional orders and offer its employees more variety in their work.



## The 911 Targa: Topless in Seven Seconds



As well as the panoramic views offered by the glass roof in the Targa, it also conceals a series of ingenious technical solutions and gives the interior of the car a light and airy feel.

It is the attention to detail which makes the 911 Targa a typical Porsche. The 1.54 square metre glass roof is a particularly striking feature, with impressive levels of technical sophistication. The roof consists of two sections: the sliding roof at the front and the glass rear screen. The roof can open fully and slide under the rear screen in only seven seconds, leaving an opening 0.45 square metres in size.

The sliding roof comes with a new, more opaque blind as standard. Fully extended, the blind covers the entire area of the sliding roof. It can be electrically operated independently of the roof. The blind protects the occupants of the car from excessive UV light and heat. The drive unit for the blind is mounted on the sliding roof. Therefore the power cable for the drive unit must be long enough to provide power when the roof is open. The

cable could have caused a problem when the roof is closed, but a simple solution has been found. Like a seatbelt, the cable is rolled up using a spring which keeps it tensioned. This prevents kinks forming in the cable that could cause it to break. As a result, driver and passengers can enjoy their journey even at temperatures above 30 °C (86 °F), with the help of the automatic climate control system which comes as standard.

## Equipped for extremes

According to the Porsche engineers, the drive system for the roof is as complex as the mechanism of a watch. It is powerful, rapid and almost frictionless. The precision engineers have ensured that the sliding roof made of laminated glass can open or close in seven seconds even in extreme situations. At high speeds in particular – the 911 Targa 4S has a top speed of 297 km/h (185 mph) – the roof is exposed to powerful wind forces and turbulence. However, all the seals in the moving part of the roof are designed in such a way that they are pretensioned by the wind forces and therefore do a more effective job. The design ensures that there are no gaps in the seals and no whistling noises. A sophisticated coating on the faces of the seals helps to prevent the friction in the sunroof guide rail from reaching excessive proportions. The coating is applied in a layer only a few micrometres thick and has a much longer service life than conventional coatings made of grease, for example. The engineers have not only set high standards for the seal faces, but also for the roof module itself.



The Targa roof has a hinged rear screen

Its special design guarantees maximum stability and allows about 300 individual components for the drive, seal and operating systems to operate smoothly within a temperature window of around 85 °C (185 °F).

### Protection against heat and cold

The engineers have shown particular skill in the design of the glass panels. The coating allows around one third of

the sunlight to penetrate into the car, but only 17 percent of its energy in the form of heat. As a result, the interior of the car remains pleasantly bright. The electrically operated blind cuts out even more sunlight. The new fabric from which the blind is made is more opaque and increases the amount of shade from 50 to 96 percent. This means that the blind filters out around 96 percent of the sunlight, corresponding to a reduction in brightness from 1400 to 600 lux. In other words, this is the equivalent of normal indoor lighting. The glass roof filters out a high proportion of the UV rays with the help of a special film between the two layers of glass. This makes the film unobtrusive and ensures that the glass roof does not have the very dark appearance of some sunglasses. As a result, driving the Targa with the roof closed is a bright and pleasant experience even in countries where there are high levels of UV light.

### Technical data: the Targa roof

**Weight:**

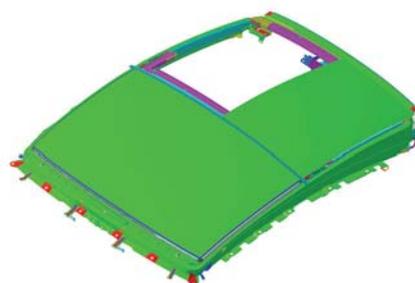
52 kg

**Dimensions (length x width):**

104 cm x 180 cm

**Materials:**

Frame — steel/aluminium composite structure; Sliding roof — multi-layer laminated glass with UV-light-absorbent film between the layers; Rear screen — toughened safety glass.



## No Interference



A glimpse behind the scenes of the new chamber for measuring electromagnetic compatibility at the Porsche Engineering site in Bietigheim-Bissingen.

Nowadays, people expect to listen to the radio, make phone calls, surf the net and use Bluetooth and navigation systems in their cars, which means that cars contain increasingly sensitive systems. Ensuring that all the equipment functions smoothly is the job of the specialists at Porsche Engineering. The new test chamber in Bietigheim will help them to achieve their objectives.

Electronic components play an essential role in the vast majority of high-tech

products. The number and complexity of these components has increased rapidly in recent years, particularly in the automotive industry. As a result, the need to measure electromagnetic compatibility (EMC) in order to avoid or prevent electronic interference of all kinds has also grown.

### **Working in the new EMC test chamber**

When Ralf Fanz gets to grips with a new prototype, it's rather like the proverbial

search for the needle in the haystack. Step-by-step he tests every electric motor, however small, which may operate the windscreen wipers, the electric windows or the door mirrors, for example, for electromagnetic compatibility with radio and mobile phone frequencies. "There are many causes of poor reception," explains the head of the EMC centre in Bietigheim. "For example, inadequate shielding of the motor or an unsuitable cable layout." The highly skilled technicians and engineers in the EMC team in Bietigheim are hot on the trail of the causes of interference. Their investigations take place in an anechoic chamber which is lined with tiles made of ferrite (iron oxide) and carbon-loaded foam pyramids to provide protection

from interference and ensure that all the measurements are reproducible. A second EMC test chamber has recently been brought into operation in order to investigate the causes of interference quickly during the process of developing electronic systems. The latest Porsche prototypes are tested in the chamber, which has a floor area of 43 square metres and is 3.6 metres high.

### EMC – a quality feature

EMC is an essential quality feature for Porsche. Safety is a very important factor for all the electronic components in cars. As a result, the EMC standards which the Porsche cars must meet are much more demanding than those required by legislation, just like the requirement for perfect reception of all the radio services offered in the cars. It is not only the seats, rain sensors, central locking, navigation systems, airbags and coolant and oil level displays, but also the climate control system, distance sensor, antitheft systems, tyre pressure control monitoring system and other electronic functions that make sports cars into a complex challenge for the EMC specialist. Modern cars have between 40 and 100 control units and sensors. As a

result, a great deal of expert knowledge is needed to identify all the sources of interference in a car.

### The sequence of events in an EMC test

At Porsche Engineering the traditional vehicle test consists of several phases. First of all, measurements are taken of the vehicle as a whole. After this, all the components except those which are being investigated are disabled and the components under investigation are analysed in more detail. As soon as a source of interference is identified, every possible effort is made to eliminate it. This can involve direct intervention in the control unit or shielding the feed wires. The process is not as simple as it may seem, because every change can give rise to new problems. "This is why experience is so important in this type of work," explains Ralf Fanz.

If all the individual components come up to scratch in the tests, they are operated again as part of the car as a whole, and new measurements are taken. During this process, new sources of interference may arise, which are gradually eliminated until the car is ready for volume produc-

tion. It can take more than a year to complete all the tests and resolve all the problems.

It is worth mentioning that the experts from Porsche Engineering not only test sports cars, but also take on third-party projects. For example, electrically adjustable hospitable beds are also tested in the anechoic chamber, because their electronic systems could interfere with critical medical devices in the hospital. In addition, the control unit of the bed must not affect resuscitation equipment, such as defibrillators.

However, the specialists in Bietigheim also analyse road sensors, fire service radio systems and the electronic components of water sports equipment. "The requests from customers have changed significantly over the last few months. The complexity of the projects is growing and customers value the extensive experience and comprehensive expertise of Porsche Engineering in its role as an end-to-end development partner," says Ralf Fanz. "We not only work on the electronics systems for sensors which operate in the millivolt range, but also on systems for hybrid and electric vehicles which use more than 300 volts."



The futuristic walls of the new anechoic chamber

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## The importance of EMC

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**Ensuring the electromagnetic compatibility of components consists primarily of two tasks. On the one hand, the effect on other devices or cars of interference emitted by electronic components must be limited. On the other hand, EMC involves protecting the component from electromagnetic influences. Different principles for different areas of application have been laid down by law.**

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# Milestones in Customer Development

“The important thing is not to stop questioning.”

Albert Einstein

Only the people who ask the right questions will hit upon the inspiring ideas. At Porsche Engineering, these ideas must fulfil one criterion in particular. They must be feasible, which generally means suitable for volume pro-

duction. This applies to vehicles, individual components and tests. Our engineers constantly demonstrate their curiosity and their creative ideas, their pioneering spirit and their extensive experience.

1954	1959	1973	1975
			
<b>“Jagdwagen” Typ 597</b>	<b>PFM 3200 aircraft engine</b>	<b>Long-term research project</b>	<b>SAVE</b>
<p>This vehicle is a true all-rounder; it can be driven on- and off-road and it is also amphibious. It was developed in 1954 for the German army. The all-wheel-drive off-road vehicle had the opportunity to demonstrate its technical superiority. During a presentation, the Typ 597 had to pull its competitors out of the mud where they had become stuck.</p>	<p>From 1959 onwards Porsche had a programme for developing small aircraft engines. In 1981 the development process made a quantum leap forward with the PFM 3200 aircraft engine. The engine was based on the familiar and multi-talented flat-six engine from the 911 which had been extensively modified and fitted with a propeller.</p>	<p>In 1972 the Club of Rome published a report called “The Limits to Growth”. Porsche’s response was a long-term research project known as the FLA. The aim was to cover 300,000 kilometres in 20 years in one car. Durable and reusable materials were used in order to achieve the main objective of saving resources.</p>	<p>The SAVE vehicle is designed to provide emergency treatment after accidents. The modular design allows a conventional small van, for example, to be converted into an ambulance. The SAVE system was created in 1975 and set standards in ambulance design throughout the world.</p>
1981	1984	1987	1994
			
<b>Linde forklift truck</b>	<b>TAG – McLaren</b>	<b>Boat engine</b>	<b>C88 Chinese concept car</b>
<p>Porsche began developing an entire model range of innovative forklift trucks for Linde AG at the beginning of the 1980s. This was not so much business as pleasure, because it allowed Porsche to demonstrate that industrial trucks do not have to be ugly.</p>	<p>This 1.5 litre engine produces more than 1000 bhp. The high-performance engine was developed for the British racing team McLaren which dominated Formula 1 at the beginning of the 1980s and won three world championships in a row.</p>	<p>An engine, based on the 8-cylinder 928 engine, was developed in 1987 for use in offshore racing boats. A four-valve version was used and it was fitted with KKK turbochargers with cooled turbo housings. The charge air and the exhaust system were cooled using sea water.</p>	<p>Porsche presented the C88 concept car, which was specially developed for the Chinese market, at an international family car conference in Beijing in November 1994. There is a particular reason behind the name C88 given to this model for the Far East. In Chinese the number 88 means “good luck”.</p>

In fact, they've been doing this for more than 75 years. We are ambitious and our aim is always to be one step ahead.

Development is a continuing process, as experience shows. The entire know-

ledge base of Porsche Engineering forms the foundation for solving technical problems in many areas and projects. On these pages you will find examples of the products which Porsche Engineering has developed

over recent decades for its customers. Other customer development projects are on display in the "Mediathek" at the new Porsche Museum in Zuffenhausen. You can discover more about the museum on pages 16 and 17.

1977	1979	1980	1981
 <p><b>ORBIT</b></p>	 <p><b>Typ 995</b></p>	 <p><b>Typ 960</b></p>	 <p><b>Airbus cockpit</b></p>
<p>The ORBIT is a fire service vehicle. ORBIT stands for optimum rescue and fire fighting capabilities with integrated assistance. Depending on requirements, different modules can be added to the basic design. This research study from 1977 has a similar modular design to the SAVE ambulance and also played a pioneering role.</p>	<p>In Weissach Porsche carried out a research study with the internal code 995 on behalf of the German Federal Ministry of Research and Technology. The study was based on the 928. The focus was on noise emissions and fuel consumption, along with a number of active and passive safety measures.</p>	<p>A research study in 1980 with the name Typ 960 aimed to reduce fuel consumption without weakening safety-related components. To this end, the body was made from HSLA steels. The use of high-strength, low-alloy steels represented a major innovation in car design in 1980.</p>	<p>In the early 1980s Porsche developed a new cockpit in cooperation with aircraft manufacturer Airbus. To improve working conditions in the cockpit, the engineers from Weissach put themselves in the position of the pilots. The development of the cockpit layout created a new trend in which monitors replaced the then standard analogue instruments.</p>

1996	2001	2004	2007
 <p><b>Harley Davidson – V-Rod, VR1000 race engine</b></p>	 <p><b>DeWind – wind turbine</b></p>	 <p><b>Alber – wheelchair</b></p>	 <p><b>Fendt – tractor</b></p>
<p>In 1984 Porsche developed the Evolution engine and participated in the design of the Revolution engine. The V-Rod was the first water-cooled Harley engine. In 2002 the engineers in Weissach developed the race engine, ready for volume production. This was the start of a new Harley Davidson model range.</p>	<p>In the early 1940s, Porsche designed a range of wind power plants for generating electricity. This involved important research in the field of renewable energy. Designers today are still making use of the experience gained on this project. In 2001 Porsche produced this design for a wind turbine for the Lübeck-based DeWind AG.</p>	<p>The development of an off-road electric wheelchair in 2004 represented unknown territory for Porsche. The name of the spring-suspension model, which was developed on behalf of Ulrich Alber GmbH, was "Adventure". The wheelchair had hydraulic damping and full independent suspension.</p>	<p>Porsche has a long tradition of designing agricultural machinery, dating back to its "Volkstraktor", a best seller in the 1930s. Current developments, such as this Fendt tractor, are an impressive combination of technical expertise and the styling which is characteristic of Porsche.</p>

## New Museum in Stuttgart-Zuffenhausen



The exhibits in the new Porsche museum are just as eye-catching as the building itself. Visitors find themselves in a new and completely white world covering an area of 5600 square metres.

### Travelling in Time through the History of Porsche

One of the greatest and most spectacular building projects in the history of Dr. Ing. h.c. F. Porsche AG was completed in December 2008: the new Porsche Museum in Stuttgart-Zuffenhausen. Located directly in the very heart of this unique sports car company so rich in tradition, the Museum serves to present the fascinating thrill and diversity of the Porsche brand to visitors from all over the world. More than 80 cars are on display in the 5,600 square metre (60,250 square feet) Exhibition Area styled and designed futuristically by the Viennese architects Delugan Meissl, ranging from

the legendary wheel hub motor of the Lohner-Porsche, the world's first hybrid automobile built as far back as in 1900, all the way to the latest generation of the Porsche 911.

### From the exhibition straight to the road: the "Museum on Wheels"

Porsche cars do not grow old. Instead, they become classics still suited in every respect for road use. Indeed, this is one of the secrets behind the success of the brand, which is also why the exhibits proudly presented in the Porsche Museum are always on the move, nearly all of the vehicles exhibited being entered regularly in historical races and drive

events as Porsche's "Museum on Wheels". In 2009, for example, the 550 A Spyder will be making an appearance in the Italian Mille Miglia and the 356 Carrera Abarth GTL will be entering the Classic Adelaide in Australia. So instead of a conventional, static exhibition, the visitor is able to enjoy a constantly changing succession of cars with rarities rearranged time and again.

### Welcoming the visitor as a true guest: generosity is seductive

The Porsche Museum welcomes the visitor with a generous gesture, the monolith opening up between the lower level and the street level to the generous height

of 10 metres or almost 33 feet to enhance the broad open space of the area in front of the Museum. Having passed through the main entrance, the visitor will come to the Lobby leading on to the bistro and coffee bar as well as the Museum shop, the cloakroom and cash registers. The rising design of the roof on the basic building structure provides ample space opposite the entrance for a second floor where the reading hall of the Archives is clearly in sight.

Moving up an escalator, the visitor enters the Exhibition Area in the upper part of the building covering an area of approximately 5,600 square metres or 53,800 square feet. Now he can decide whether to start his tour of the Museum in chronological order with the history of the Company prior to 1948 or whether he would like to move on directly to the main exhibition area a few steps higher, following the likewise chronological presentation of the Company's history after 1948.



More than 80 eye-catching exhibits are on show



The famous Porsche "Jagdwagen" (hunting car) is on display in the Porsche Engineering area



Visitors can experience the fascination of Porsche on different levels

### How is a Porsche created?

The question as to "how a Porsche is created?" is also answered right in the middle of this journey in time through the history of the Company: Reaching the central point on the Exhibition Level, the visitor is offered an insight into the Weissach Research and Development Centre as well as the Car Production Plant in Zuffenhausen. In the process, cutaway models demonstrate how

a Porsche is created, developed and built for the customer.

The focus is on design, development and production, films and exhibits informing the visitor of development processes taking place in parallel and offering a good impression of how, through cooperation and networking, high-quality products may be developed to full production standard within a relatively short time.



The Porsche No. 1 is one of many highlights of the new museum. You can find out more about the car in the museum itself or from page 26 onwards

**Unique: the “transparent” Museum Workshop and the Porsche Archives**

Porsche lives out its history – and customers live out Porsche’s history too. To ensure the highest level of care and maintenance for the brand’s historical cars, Porsche has established a special Museum Workshop where private customers are also able to have their classic cars restored. The visitor, in turn, has the opportunity to watch Porsche’s master mechanics and specialists working on all kinds of classic Porsches. For before the visitor even enters the exhibition, he will pass by the glass partition to the Museum Workshop, enjoying a truly unique experience of transparency offered the world over in this way only by the new Porsche Museum.

The historical Porsche Archives with all its treasures has also moved to the new Museum and is partly in sight through glass walls from the lobby. After registering in advance, specialists and enthusiasts are able to visit the archives for their research on the history of Porsche.

**The creative think-tank: Porsche Engineering**

During his – or her – journey through the history of Porsche, the visitor will also encounter Porsche Engineering. Ever since Ferdinand Porsche established his Construction Office in 1931, Porsche has offered external clients a wide range of

engineering services. Exceptional exhibits such as the rare Porsche Hunting Car built in 1956, the C88 concept car developed for the Chinese market in 1994, and the McLaren MP4 TAG Formula 1 racing car powered by a TAG Turbo engine made by Porsche emphasise the sheer diversity of Porsche’s development activities for other manufacturers.

Dates and facts	
<b>Overall cost:</b>	Approx. Euro 100 million
<b>Dimensions of Museum Building:</b>	140 metres/459 feet long, 70 metres/230 feet wide
<b>Overall surface of Museum Building:</b>	25,800 square metres (277,600 square feet)
<b>Weight of Museum Building:</b>	Approx 35,000 tonnes
<b>Concrete:</b>	Approx 21,000 cubic metres
<b>Steel:</b>	Approx 6,000 tonnes
<b>Excavation (earth):</b>	Approx 66,000 cubic metres
<b>Facade area of Exhibition Building:</b>	Approx 10,000 square metres (108,000 square feet) made up of approx 30,000 rhomboid sections
<b>Exhibition area:</b>	5,600 square metres/60,250 square feet
<b>Exhibits:</b>	Approx 80 Museum cars and 200 small exhibits
<b>Overall collection of Museum cars:</b>	More than 400 exhibits
<b>Conference area:</b>	Approx 600 square metres/6,450 square feet, flexible arrangement thanks to moving partitions
<b>Roof terrace:</b>	Approx 800 square metres/8,600 square feet
<b>Other Features:</b>	Christophorus Restaurant, Museum Workshop, Porsche Archive, Museums Shop, Coffee Bar, Museum Restaurant “Boxenstopp”
<b>Porsche Museum, Porscheplatz, 70435 Stuttgart, Germany, <a href="http://www.porsche.de/museum">www.porsche.de/museum</a></b>	

## Engineering Art



Porsche Exclusive & Tequipment are synonymous with the highest level of personalisation possible in a Porsche.

The creativity and individuality of our customers are realised by the specialists at Porsche Exclusive & Tequipment through their advanced technical skills, carefully selected materials and close attention to detail. The result is often a completely unique vehicle. Almost any-

thing is possible for different models from sophisticated and stylish interiors using hand-sewn, high-quality leather through to Aerokits and SportDesign packages. These have, of course, been tested in Porsche's own wind tunnel. Porsche Exclusive represents individuality

right from the factory, when a customer orders a new Porsche. For cars which are already on the road, the Porsche Tequipment programme offers a variety of retrofit personalisation options. A wide range of optional extras are available in almost all product categories for the sports cars and the Cayenne.

We would like to present some of these products here and explain the complex development process which underlies them.



The Cayman Aerokit underwent extensive testing in the wind tunnel in Weissach

### Perfection is in the detail

Where perfection is required, the Porsche development engineers are not far behind. Details are more than just individual components. They form part of a harmonious whole. Each element must not only be visually appealing but also technically excellent. For this reason all the Exclusive & Tequipment products for specific models are developed, tested and coordinated in relation to the complete car by the same Porsche engineers and designers who create Porsche cars. All of this happens primarily in the Porsche development centre in Weissach, from the design right through to the final approval. All the products undergo time-consuming tests for functionality and durability during the development process because they must adhere to strict Porsche quality guidelines and standards. We will take a look in more detail at these activities using specific products as examples.

One of these examples is the Cayman Aerokit. It is the perfect complement for the car's elongated coupé shape. It makes the Cayman look even more sleek and dynamic. It also improves the car's aerodynamic efficiency, while retaining its existing drag coefficient. The result of extensive wind tunnel testing is a perfectly balanced car with aerodynamically coordinated wheel loads on the front and rear axle. An improved nose area with spoiler lips in the body colour and a new fixed rear spoiler increase the Cayman's stability and agility and, of course, make it even more enjoyable to drive.

### Just a part. Part of a dream.

Another example of the detail involved in development work is represented by the two double-ended tail pipes designed to look like four exhausts in the rear apron of the Cayenne. The design is original and makes a powerful, eye-



The rear spoiler of the Cayman improves its stability and agility

catching impression which brings to mind the Carrera GT. The sports tail pipes highlight the athletic appearance of the Porsche Cayenne. The precision-cast components are produced using a combination of existing manufacturing processes and materials. They are not only pleasing to the eye of the car owner, they are also heat resistant and exceptionally corrosion resistant, which ensures that the engineers can be proud of the products they have developed. The exhaust system is the perfect example of detailed functionality. During the design of the sports tail pipes a precision-cast aluminium com-



Exclusive finish for components, for example using carbon fibre (left); Cayenne sports tail pipes (right)

ponent was used for the first time, together with several other parts made of stainless steel. The tail pipes were ready for volume production in just ten months.

New technologies were used to join the components of the pipes together. Rapid prototyping allowed sample parts to be produced in a very short time which could be fitted to cars and thoroughly tested on the road. Rapid prototyping is a process in which a component is built up in layers from amorphous or free-form materials using physical and/or chemical effects. The process can significantly shorten development times and reduce the associated costs.

During the production of the tail pipes, a tool made of more than 70 individual parts is used for injection moulding delicate and highly sensitive wax components, which are then manually removed from the mould with great care and

bonded together to form a wax stick or casting cluster. A ceramic shell must be applied to the wax casting cluster in the next stage of the precision casting process. This is achieved by dipping the casting cluster several times into a ceramic bath. Following the fully automated process of creating the ceramic shell, which takes several days, the wax is melted, the shell is fired and the precision parts are cast out of aluminium alloy using a low-pressure casting process. In the subsequent assembly phase, the coated, precision-cast cover weighing only 450 grams is combined with the stainless steel components to form a part which is ready to be fitted to the car. Despite the fact that the cover appears much larger than the standard tail pipe, the total weight is no greater than the original. The cast component has a highly complex shape, because of its functionality, and this shape becomes very obvious during the assembly pro-

cess. Contact surfaces, clips and drilled holes for the inner cone, together with the support and mounting for the twin stainless steel pipes, result in a labyrinthine interior behind the solid outer cover. The shape leads to large undercuts and different wall thicknesses in the precision-cast component. The design of the assembly and the high level of accuracy of the precision casting process mean that no machining is needed. The delicate aluminium casting gives the sports tail pipe a unique and more dynamic appearance.

### **Cayenne S sports exhaust**

The Porsche sound is powerful, throaty and sporty. And the best thing about it is that there's even more where that came from. All you need to do is fit a sports exhaust system. A modified main silencer produces an even more throaty and beefy V8-style sound. Two tail pipes



Carbon fibre door-sill guard from Porsche with optional lighting

run right and left into the striking double-ended tail pipe covers made from chromed stainless steel. The design of the tail pipes is similar to that of the standard double tail pipes of the Cayenne Turbo. However, a connecting bar gives these pipes a unique appearance which is exclusive to the Cayenne S with sports exhaust system. The tail pipes are neatly built into the rear apron of the Cayenne Turbo, which is included in the package with the sports exhaust.

The standard Sport button is used to adjust the car's settings to the sports exhaust. Switching to sports mode means that a more sporty engine and transmission management system is used automatically. The dampers are changed to the sports setting by the Porsche Active Suspension Management (PASM)/Porsche Dynamic Chassis Control (PDCC) systems and the chassis is lowered. If the driver wants a more comfortable damper setting in cars with PASM/PDCC while retaining the other aspects of sports mode and the sports exhaust, the PASM/PDCC can be separately adjusted along with the chassis height. The sound of the sports exhaust is intelligently managed, taking into con-

sideration the load, the speed of the car, the engine speed and the gear which is selected. The sound changes depending on how the car is driven. If the driver has a calm driving style, the throaty Porsche sound is created. Sporty driving produces a much more aggressive sound.

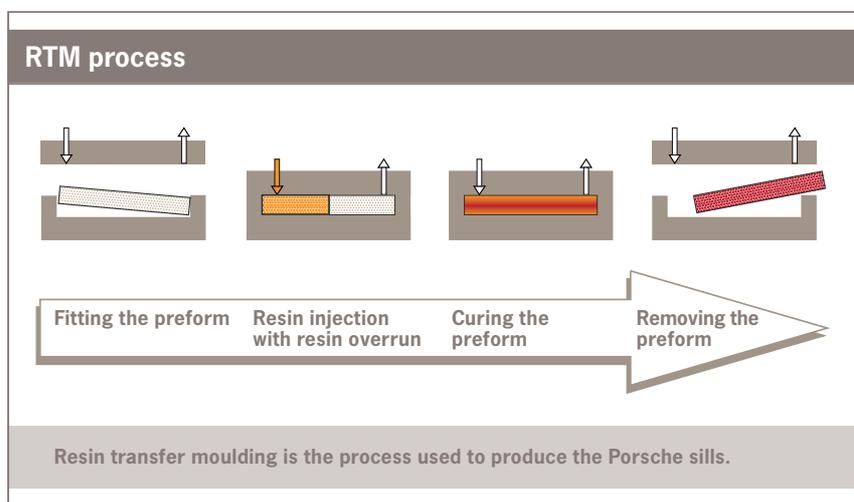
**Automation replaces manual tasks**

Porsche sill covers make a distinctly sporty impression. Both the illuminated and non-illuminated versions made from carbon fibre are manufactured using a resin transfer moulding (RTM) process. The secret of the process is that hot re-

sin is automatically injected into the layers of carbon fibre in an enclosed metal mould and no longer needs to be applied manually. The process also has major technical advantages. Alongside faster manufacturing times, the level of automation and the reliability of the process can also be increased.

As a result, there are no longer any variations in the weight or quality of the product. In addition, the quality of the surface is significantly improved, which gives a better appearance. For this reason, the process is also used to manufacture doors for Porsche Motorsport.

Several stages are involved in the RTM process. Firstly, the dry carbon fibres in textile form which are used for reinforcement are placed in an open, pressure-tight, two-sided mould that can be heated. The textile material is pressed together when the two halves of the mould close. Resin is then injected into the mould under pressure. Once the mould is completely full, the resin is cured at the specified temperature.



## The Fourth Dimension: the New Panamera



The design, profile and silhouette of the Panamera clearly indicate that it is a new member of the Porsche family. Designed as a four-door sports tourer, the Panamera is multi-talented and has an impressive interior design.

This car combines sporty driving dynamics, a spacious, flexible interior and the superb comfort of a Gran Turismo. Joining the 911, Boxster and Cayman sports cars and the sporty Cayenne SUV, the Panamera is Porsche's fourth model range.

Welcome to the new Panamera!

The innovative interior design of the Panamera is impressive even at first glance. You can find out more about it here.

The second glance is under the bonnet where the top-of-the-range model has an engine that produces 500 bhp. At the market launch, which takes place in

Germany on 12 September 2009, the top Panamera models will be available with a V8 engine and luxury fittings.

### **A new feeling of space and a new driving experience**

With a centre console which runs all the way from the dashboard to the



The centre console which runs from the front to the back of the Panamera enhances the interior design

rear seats, Porsche's four-door Gran Turismo offers a new feeling of space and a new driving experience in all four seats. The interior is ergonomically designed for the driver and gives each passenger his or her own personal space in tailor-made individual seats. The low seating position and the sporty, low-slung steering wheel offer the direct contact with the road which is so characteristic of Porsche. Alongside these traditional values, the Panamera also offers owners numerous options for customising the interior. A smooth or a natural leather finish is available in a total of 13 colour and material combinations, including four two-tone colourways and seven optional interior decors using exclusive materials such as carbon fibre and natural olive wood.

### **Keeping you cool**

As well as offering driving pleasure, the new Panamera comes with four-zone automatic climate control as an optional extra, with individual temperature, fan speed and air distribution settings for each seat. In the event of an accident, the driver and passengers in the new Panamera are protected by driver and front passenger airbags, curtain airbags and, in the front seats, side and knee airbags. Side airbags are available as an optional extra for the rear seats. The comfort seats provided as standard in the front of the Panamera S and 4S have a sporty design and eight different electrical adjustments to ensure that the driver and front passenger travel in complete comfort. The two individual back seats have a folding central arm rest and offer

plenty of headroom and legroom even for tall passengers. In the Panamera Turbo the electric seat adjustment is combined with a comfort memory package that also allows the seat cushion to be extended and the lumbar supports to be adjusted and includes electric adjustment of the steering column. Other options, such as adaptive sports seats and adjustable comfort seats in the rear, are also available on request.

### **Beautiful sound — both inside and out**

The new Panamera is the first Porsche to offer an optional top-quality high-end audio system, the surround sound system from the Berlin audio specialist Burmester, one of the most prestigious high-end audio companies in the world. This



The Panamera comes with a 1300 watt surround sound system from audio specialist Burmester

is the first time that large and powerful loudspeakers of this kind have been used in a standard production car and incorporated into the design of a car right from the concept phase. The loudspeakers, which have a surface area of more than 2400 square centimetres, produce a sound very similar to that of a live concert. A total of 16 loudspeakers are supplied by 16 amplifier channels with a total output of more than 1000 watts. This ensures a unique sound which is complemented by an active subwoofer with a 300 watt class D amplifier.

### Ample space for long journeys

The luggage compartment demonstrates the practicality of the Panamera in everyday use. When the rear lid is opened, four suitcases can easily be placed behind the rear seats. The height of the luggage space allows them to be stowed in an upright position. The volume of the Panamera S and 4S luggage compartment is 445 litres. In the case of the Panamera Turbo this figure is 432 litres. With the rear seat backs folded down, the space available increases to a generous 1250 litres.

Initially the Panamera will be available only with a V8 engine and with rear-wheel and all-wheel drive. The entry level Panamera S boasts a 4.8 litre V8 which produces 400 bhp (294 kW). The seven-gear Porsche Doppelkupplung (Porsche double-clutch gearbox or PDK) is available as an option. The Panamera S can go from 0 to 100 km/h (62 mph) in 5.4 seconds and has a top speed of 283 km/h (176 mph). Combined fuel consumption is 10.8 l/100 km and CO<sub>2</sub> emissions are 253 g/km, in accordance with the Euro 5 emissions and consumption standard.

### Even sportier

The sporty Panamera 4S has a 4.8 litre V8 engine with a power output of 400 bhp (294 kW). The seven-gear PDK delivers the power to all four wheels. For the Panamera 4S, 0 to 100 km/h (62 mph) takes 5.0 seconds and the car has a top speed of 282 km/h (175 mph). Combined fuel consumption is 11.1 l/100 km

and CO<sub>2</sub> emissions are 260 g/km, in accordance with the Euro 5 standard.

The top-of-the-range Panamera Turbo has a 4.8 litre V8 biturbo engine producing 500 bhp (368 kW). This model also has the seven-gear PDK delivering power to all four wheels. The all-wheel drive Panamera Turbo can accelerate from 0 to 100 km/h (62 mph) in only 4.2 seconds. Its top speed is 303 km/h (188 mph). Combined fuel consumption is 12.2 l/100 km and CO<sub>2</sub> emissions are 286 g/km.

All the Panamera models have direct fuel injection, low-friction powertrains and lightweight bodies. In addition, the Panamera variants with the automatic PDK (Porsche Doppelkupplung) offer the new auto start-stop function. This automatically turns the engine off when the car comes to a stop with the brakes on, for example at traffic lights or in a traffic jam.



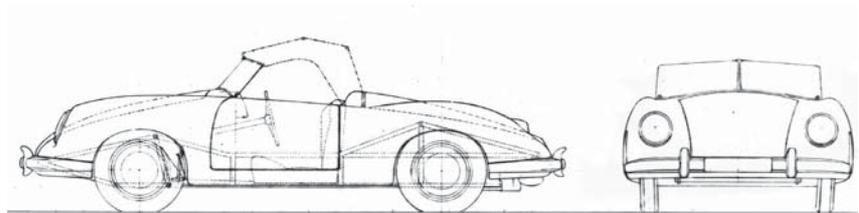
The buttons for the most important systems are on the left and right of the gear lever

## The Typ 356: The Porsche No. 1



“In the beginning I looked around and could not find quite the car I dreamed of. So I decided to build it myself.”

Ferry Porsche



The Porsche design and engineering company, which was founded in 1931, tried to make a new start after the Second World War, but times were hard for a firm that specialised in time-consuming and costly engine and vehicle design.

However, in the spring of 1947 Ferry Porsche began thinking about building a sports car using Volkswagen parts. Initially the car was known as the “VW Sport” and then it was given the design

number 356. Ferry Porsche, son of Ferdinand Porsche and deputy manager, had the vision of “building a sports car that I like myself”. The Porsche engineers were fascinated by the idea of the sports car and had produced a road-going chassis by February 1948.

Not long after that the new car was fitted with a stylish roadster body made of aluminium. The authorities in the Austrian province of Carinthia officially approved the mid-engined sports car

with the chassis number 356-001 on 8 June 1948. However, the family company had to fight for its place on the exclusive sports car market.

Only three weeks after receiving official approval, the Porsche 356 “No. 1” underwent its first test when Herbert Kaes, Ferdinand Porsche’s nephew, won his class in the Innsbruck city race on 1 July 1948. Volume production of the coupé and cabriolet versions of the Typ 356/2 began in the second half of 1948 and



52 cars had been built by hand in Gmünd by 1950. Like the prototype, the Porsche Typ 356/2 had an aluminium body, but the engine was moved to the back of the car in order to make luggage space available behind the front seats. After Porsche returned to Stuttgart in 1950, volume production of the Porsche 356 began in a factory building rented from the Reutter bodywork company.

By the tenth anniversary of the first 356, more than 25,000 Porsche sports cars had left the plant in Zuffenhausen. When production finally stopped in 1965, the total number of cars produced was 78,000. It was the successor to the 356, the Porsche 911, designed by Ferry Porsche's son Ferdinand Alexander, which helped the company to become one of the world's leading producers of sports cars.

Technical data	
<b>Kerb weight</b>	585 kg
<b>Permissible load</b>	200 kg
<b>Engine</b>	Four-cylinder, two-valve, naturally aspirated, overhead valve, air-cooled mid engine
<b>Stroke/bore</b>	64mm/75mm
<b>Capacity</b>	1131 cc
<b>Power</b>	35 bhp at 4000 rpm
<b>Fuel system</b>	Downdraught carburettor
<b>Transmission</b>	Rear-wheel drive, four-speed gear box
<b>Chassis</b>	Steel tube chassis with aluminium body, independent suspension, mechanical drum brakes
<b>Dimensions and weight</b>	Wheelbase 2150 mm, track front 1290 mm, track rear 1250 mm, weight 585 kg
<b>Performance</b>	Top speed 135 km/h (84 mph)
<b>Silencer type</b>	Oval resonator silencer with no baffles, side inlets and a fish-tail exhaust
<b>Transmission type</b>	Engine, single-plate dry clutch, four-speed manual gearbox with one reverse gear, rear axle with differential
<b>Number and type of brakes</b>	Hand brake: mechanical internal expanding brakes on all four wheels Foot brake: mechanical internal expanding brakes on all four wheels
<b>Wheelbase</b>	2150 mm
<b>Turning circle</b>	10.2 m



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