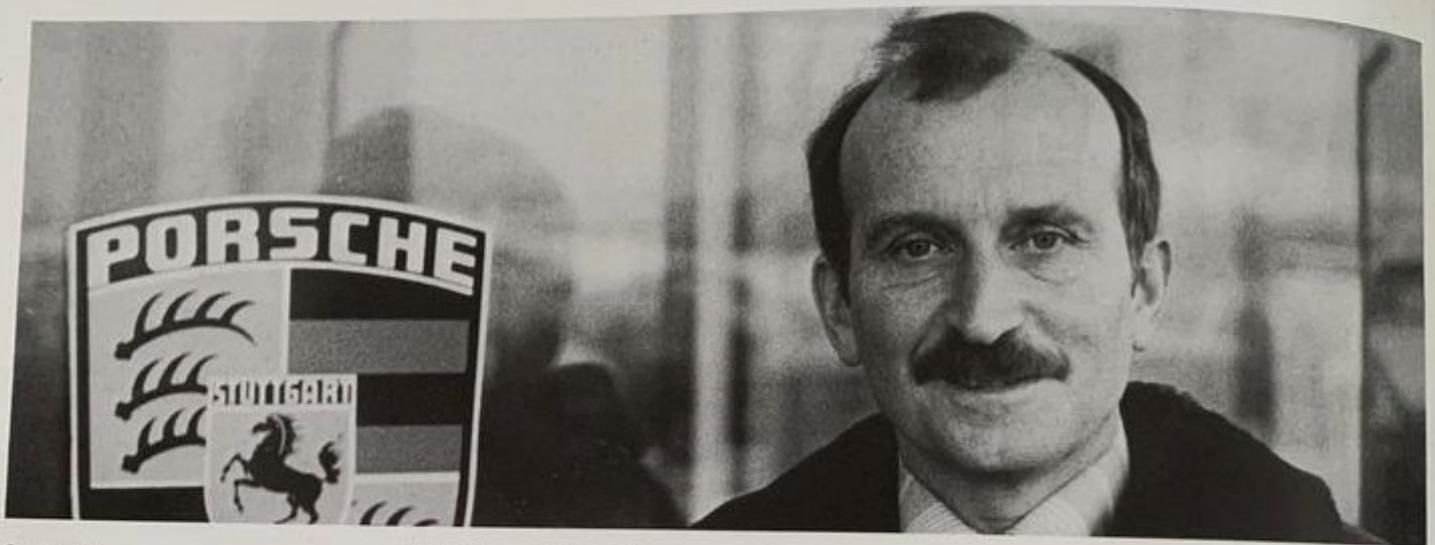


PORSCHE 928

THE ALTERNATIVE





Gentlemen,

Recently you were informed that PORSCHE is introducing a new model to the market, the PORSCHE 928 sports car, to be sold by you.

This sports car is the result of careful study of developments in the automobile market, namely the individual needs of our customers, the products of our competitors and of course the technological developments, to which we have again made decisive contributions with this car. It's a sports car again, so we have remained true to our longterm policy in spite of all speculation.

The PORSCHE 928 is our answer to the challenge of a market, our leading model of a now complete range of cars. With it we - you and us - will want to tackle the immediate future together.

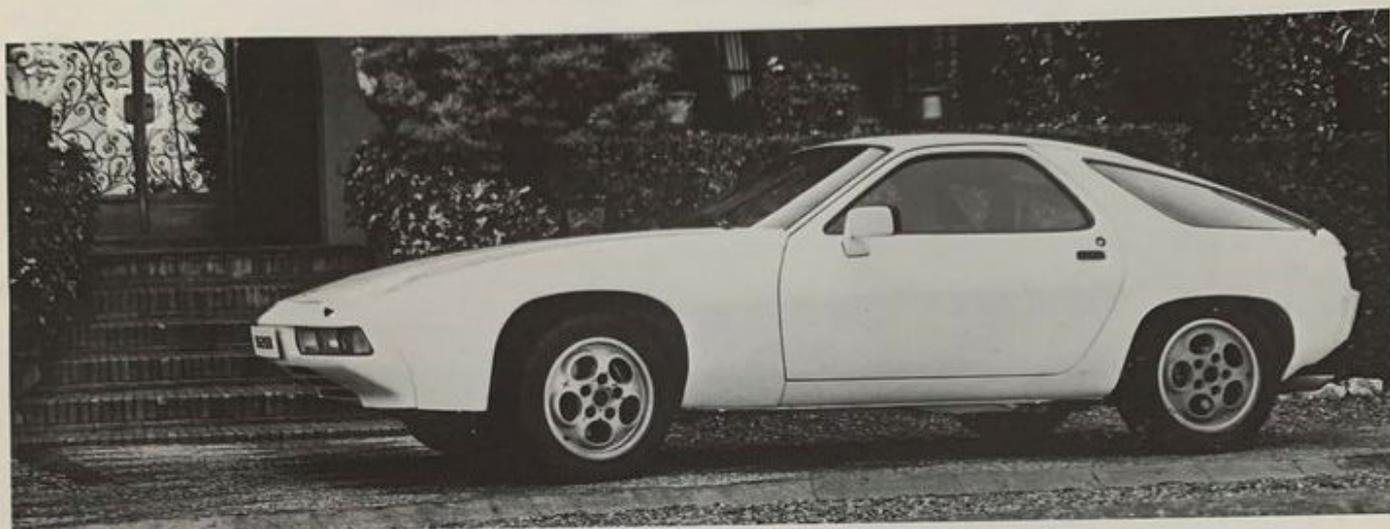
You will want to know our objectives with the »new big model«. We have thought out four major objectives.

1. The trend for a high-priced car is continuing without interruption. Thus we must take advantage of this opportunity by **extending our range to include the high-priced market.** The 928's conception will help us to win new customers, and to win back lost customers.

This is really important, since the share of high-priced sports cars on the total passenger car market increases disproportionately. This means that when someone decides on an expensive car, it is very seldom a sports car.

So we are forced to increase our share of the sports car market considerably, so as to exploit fully the trend for high-priced cars.

The market will accept the PORSCHE 928 as a genuine alternative to the high-priced saloons. Particularly since the 928 will usually be bought as a second car to an appropriate saloon. The number of seats in a sports car will not be so important as in the lower price classes.



2. The purchasing motivation of our, and therefore your, customers is shifting slowly but surely. While several years ago the hard, sporty image dominated, a second group emerged and is still growing, which wants a combination of sport and comfort.

In order not to lose these customers, i.e. to **stabilise the present number of customers**, we have designed the 928 as a technical alternative to the 911 model range. Thus you have something, the 928, to offer in order to keep old customers, and you can also cater for customers who want something more expensive, but not a turbo.

3. The leading manufacturer of sports cars is PORSCHE. This PORSCHE image is an important factor for the sales of our sports cars. Our **claim of domination** in this market sector can only be maintained by way of systematic **building-up**, and in fact in the exclusive sports car field we must be able to offer the right car to each and every potential customer.

This means that we need different sports car concepts, i.e. a **wide range of models both in engineering and price**, to cover the market starting at DM 20,000. With this range you too will have the opportunity to meet customers' needs and increase your sales.

4. Finally, the 928 is here to safeguard your, and our future. This is only possible by exploiting fully the manufacturing capacity on a long-term basis. In the coming years we will repeatedly be faced with new legislation concerning the automobile, and corresponding social demands. With the 928 we can all look forward to a rosy future.

When reviewing our present range of models we must be aware that we cannot stay on the market for ever even with the best possible product at the present time. Each product is subjected to life cycles. The 928 is our contribution. Now it is up to you to make your contribution by way of your investment, your abilities and your diligence, so that the 928 will be completely successful on the market.

My best wishes are accompanying you.
Yours,
Lars R. Schmidt

Love at second sight

Explanation of the 928 styling



Porsches were always sports cars which became accepted after second sight. Maybe you can still recall the reaction when the 911 targa was introduced? This love at second sight is the reason, amongst others, why the 911 is as young today as it was 10 years ago.

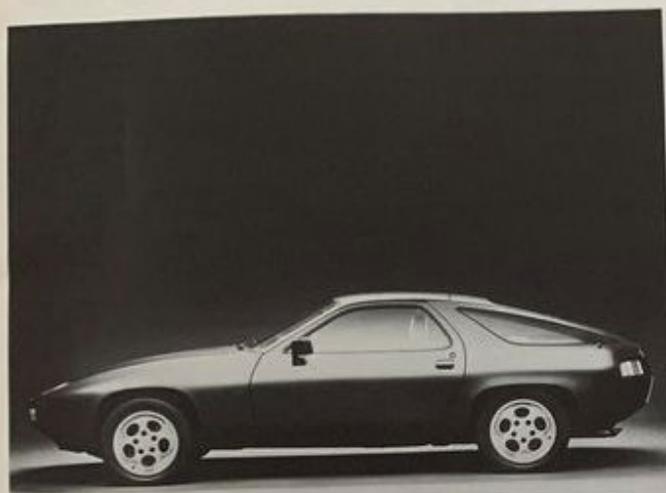
How did the 928 styling originate?

Many different factors had to be combined to result in interesting aesthetics. The 928 was designed to have as many Porsche styling points as possible and to be clearly different to other sports cars on the roads – an important marketing principle. Then there was the safety legislation, and detailed regulations such as »Stipulations for tail lights«. And of course acceptable aerodynamic values had to be reached, e.g. those concerning air penetration and directional stability. Finally there were engineering factors, among them the transaxle, the chassis, the water cooling, the slim V8 engine and the spacious passenger compartment.

The 928 styling with a fastback is an intentional continuation of Porsche tradition in that it is aerodynamically superior, because of the comparatively short front end and a gently tapered and rounded



tail, guaranteeing low air turbulence. As well as improving directional stability, the large-surface tail end also means a large passenger compartment and an outstanding amount of headroom for rear seat passengers in a sports car.



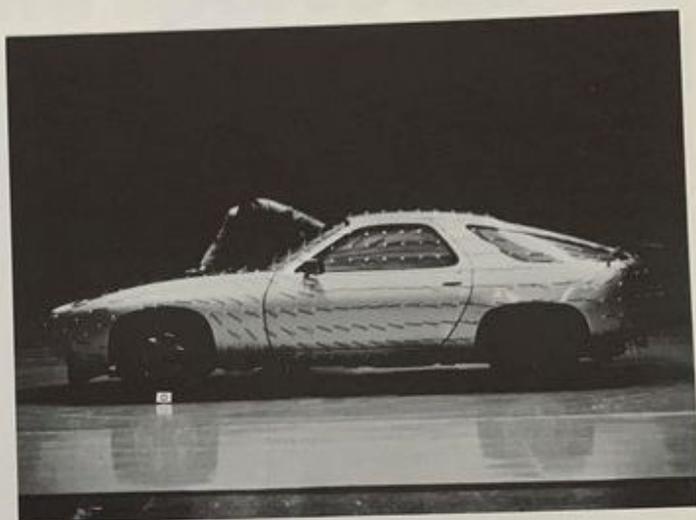
We also believe that rounded forms are more interesting than clean-cut lines, which can be absorbed immediately and do not have anything new to offer to the observer. The 928 looks different from each angle, and remains interesting.

One of your first questions will be, why isn't the Porsche 928 fitted with sporty spoilers? From racing experience, spoilers were mounted as the speeds rose to counteract the tendency to lift. The body styling was designed for lower speeds and was now insufficient for the task. Spoilers were used to keep the cars on the ground. A new car, as the 928, which is designed right from the start for 250 km/h, doesn't need aerodynamic aids. But the 928 should not be linked entirely with racing, as it will enjoy a luxury car image. Wouldn't spoilers on this type of car be slightly out of place when introduced on the market?

As you can see, the 928 is also a 2 + 2 seater coupe, just as all Porsches were designed as coupes at the beginning. In contrast to the 356 and 911 model ranges, we are

now dealing with a water-cooled engine. The radiator needs air, but large radiator openings at the front end had to be avoided. Further, in Porsche tradition, we wanted an uninterrupted and soft style, which includes a smooth, clean bonnet. We have been so successful that an observer might assume the 928 has an air-cooled engine. The specified bumpers would have dominated the styling, if we had followed the solution of other companies. Your customers might miss them at first sight and ask about them. Mounted railway sleepers might demonstrate safety, but they are not aesthetic. The 928 does offer this safety. It is an integral part of the impact zone in the entire body, in that we have a plastic coat on the impact carriers in the same colour as the body. This, too, is Porsche tradition. Not to show off with bumpers. Even on the 356 they were considered as part of the body.

We found another task in our aesthetic conception, in designing interesting and pleasing car proportions compatible with the space



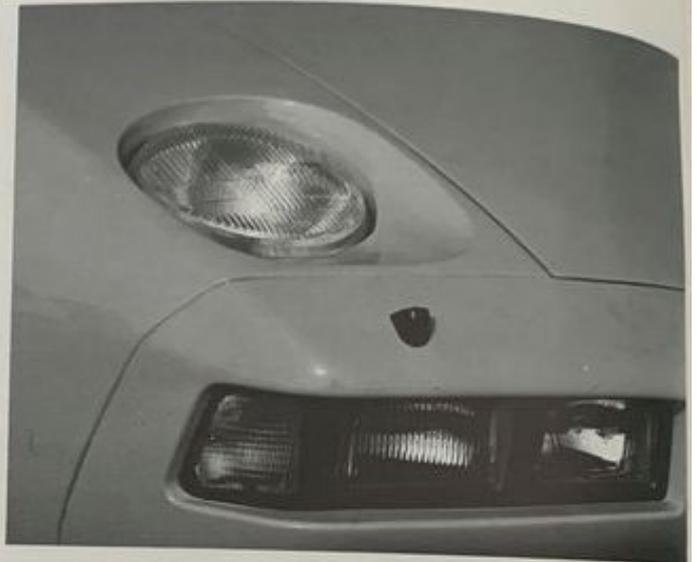
requirements of the engine, transaxle, rear axle and passenger compartment. This is why we have moved the wing edges in and reduced the width of the bonnet. By doing the same with the bonnet joints, it appears to be very long. We have avoided wheel arch flares; these look good on narrow cars, although they are merely a technical necessity resulting from larger wheel and tyre sizes.

The sides of the roof have been

pulled in considerably for the same reason. We made optical reductions in the length and width by inclining the body at the corners. If the observer moves around behind the car, the length diminishes at the front, but even then the width is not obvious.

Occasionally the appearance of a car is not determined by how wide, long and high it is, but how it behaves. The 928 impresses the observer as a well proportioned, powerfully dynamic, tough, modern and interesting car from any angle of viewing. We believe we have been successful in tailoring the best possible clothes for optimal engineering, which even visually underlines the impression of a top sports car.

In the windows you will see styling from the 911, the coupe – when you observe the rear window – and the targa, because of the rollover bar. But the optical impression is completely new because of their connection, and the pronounced roundness of the side panels, especially the rear window.



We do not have an isolated rollover bar, but a composite housing, the sides of which are extremely rigid triangles, the rigid sides of which are arranged at the best angles. This way the highest possible resistance can be offered against forces from any angle.

In addition to passive safety, yet more advantages of active safety – the visibility. The door frame just behind the front passenger's seat head restraint is not obvious (you'll find this yourself). On the driver's side it is out of the field of view, and if we look back at an angle (as in parking) the frame seems very, very narrow.

So far as aesthetics are concerned such a detail may or may not be welcome at first sight. But in this form it has not originated **only** because of styling, but because it fulfils a practical function. Safety sets the limits, the stylists «only» had to find the best aesthetics, a style which had to harmonise with the entire design.

Are you surprised because you didn't see the wheel spokes? The 928 has them, of course, but the large wheel openings needed to cool the brakes are more obvious. We believe that a car with round shapes, like the 928, would be best with round wheel openings, so that the spokes are very difficult to recognize – this is another innovation on the 928.

Harmony is for us more than just a matter of feeling. The parallel lines of the surface must blend nicely. This way we control the balance. Therefore we have not only designed the wings with great care, but the bonnet and tail, the roof, the bumpers, everything. This devotion to detail, to completeness, is evident in the lasting harmony of parts, and in the reflections when you move around this car. And the view will change constantly, and will always be harmonic.

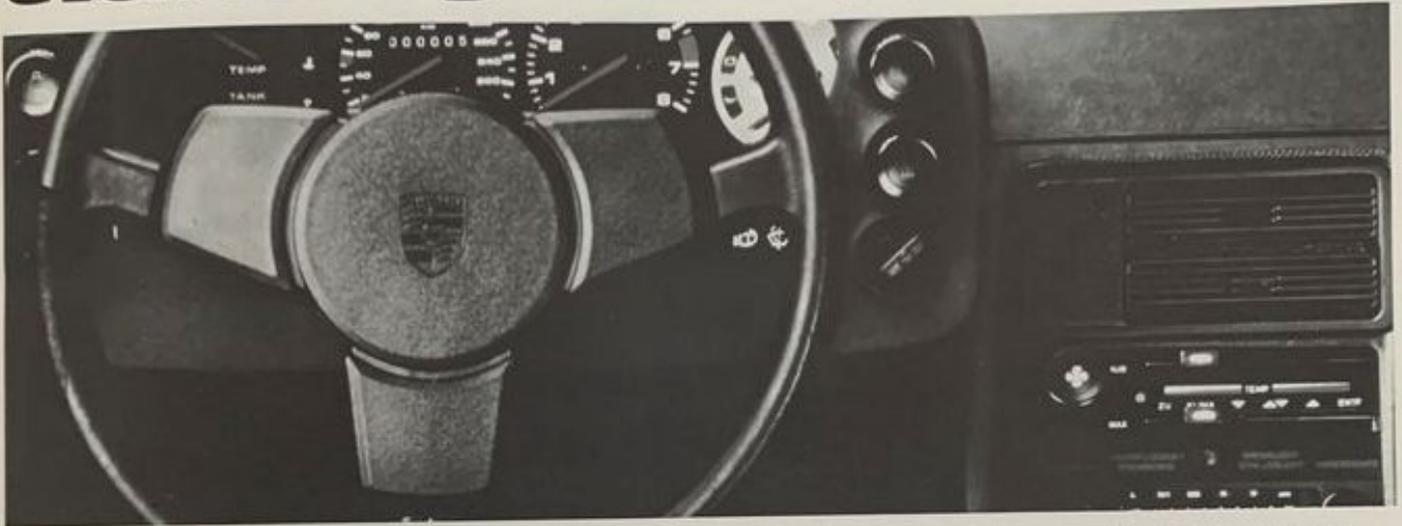


The Porsche 928 has the largest possible round headlights – a typical styling element for Porsche. So that the bonnet surface is broken up slightly, the headlights remain in view even when folded away.

Folding away is towards the rear – another safety factor.

It is our opinion that car drivers will use their headlights for daytime driving (like motorcycle riders) to increase the safety factor in the coming years. This is why the raised headlights must harmonise with the general body styling.

Passenger compartment luxury, even for a genuine sports car



The passenger compartment had to be very spacious and tidy, which is why we lowered the instrument panel. The most important instruments are in the field of view when you look through the steering wheel. The others are in the centre console.

The steering wheel, instrument panel, accelerator pedal and footrest are all adjustable to provide individual comfort regardless of seating position and body size.



Switches have been arranged in such a manner that the driver does not have to take his hands off the steering wheel except to operate the main switches. Except for the rotary light switch, all the others are push-button switches. We have to prevent the lights from being turned on accidentally when the driver wants fog lights, or tail fog light.

All illuminated instruments in the centre console, which unlike the main instruments could not be recessed in the instrument panel, are also non-reflecting thanks to a new type of special glass. This glass has a laminated coat which prevents the radiation of light in unwanted directions, but is clear to the driver.



Even adults could travel comfortably from Stuttgart to Munich in these rear seats; from character and comfort standpoints they are almost equal to conventional seating. When you sit down the soft padding will be compressed in such a way, that in addition to a soft and comfortable feeling there is also lateral support even when the car is driven quickly.

After you have slid the front seat forward, it will be impressive for your prospective customers to verify this.



Just as the entire body was so carefully designed, each centimeter of the passenger compartment was designed conscientiously; each cover, each pillar trim, everything the eye catches. As far as we know the Porsche 928 is the first car to be designed through and through in this way. For instance, the radio speakers have been arranged organically in the «dead angle», but in such a way that the sound is bounced back and forth off the windows to provide a hi-fi effect.

Or observe the location of the rear window wiper. Technically it was planned in the rear window. We have not only installed it to harmonise with the styling, but have located it in an empty space which was there and not used anyway.

Each part was designed and installed to harmonise between technical necessity and styling requirements. You should demonstrate this devotion to detail to your customers, for the 928 is already as perfect as we know how to make it.

928 driving enjoyment



Driving a Porsche means active driving, commanding an enormous power potential in all driving situations. And the 928 makes this active driving even more relaxed and easy. Sporty driving has again been made possible, in that each opportunity to save weight has been exploited.



It's like riding a thoroughbred horse. Restrained power, which can be released in dynamic bursts – a coiled spring – and which can be pulled up with a bit. This is surely a different style of riding than the sluggish hack or the whipping of a strong half-breed, which coasts

along the track and pulls up before the post.



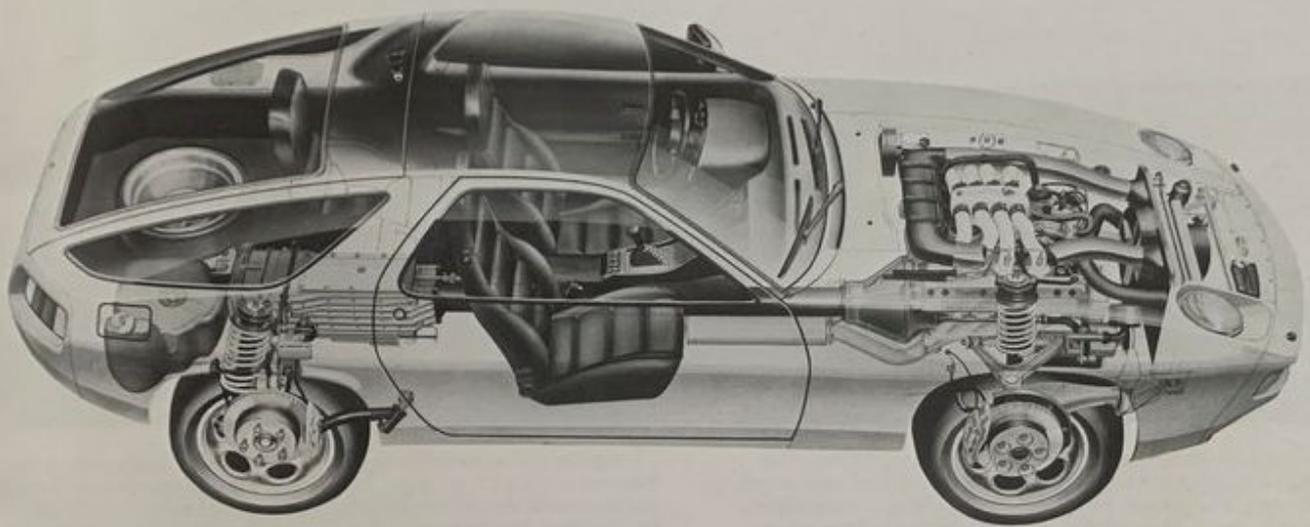
The 928 is the powerful, elegant, technically perfect motor car among other willing, striving amateurs.

In spite of its immense sportiness we have succeeded in eliminating any nervousness in the steering, through which the driver keeps contact with the road surface and must react to different road surface conditions. And in those circumstances where perfection in handling has to prove itself, namely at very high speeds or on poor road surfaces, the 928 behaves itself so well that it will actually correct any mistakes made by the driver when his sporting instinct, stimulated by the type of vehicle he is driving, runs away with him!

When the driver is accustomed to the width of the 928 as compared with the 911, he can drift through the curves just as in his previous car; this is mainly because of the 928's power.

Sporty driving is possible in any desired manner – all with a high degree of comfort, since the driver will not be bothered by bad surfaces. The elegant, powerful appearance of the 928 offers genuine sportiness in a comfortable manner.

A technical alternative - Porsche 928



It sounds like a cliché, but it's a fact of life that the manufacturing companies of the western world are committed to constant growth. Price increases for raw materials and finished components can't be offset simply by better rationalisation, nor can the steadily rising labour costs. Smaller profit margins are indicated, losses threatened. The only ways of balancing the situation without excessive price increases, are greater production and a more extensive range of products.

Porsche is also confronted with this problem, just like any other company. But here is the solution.

- extension of the range into the high-priced market
- improvement of the market share by winning new customers
- having a product for customers going up in class
- keeping customers who might have left
- the ambition of many drivers for a high-value car, which is also practical

Of course, one could ask whether all these objectives couldn't have been reached also with a top model of the 911 - as previously achieved with the Carrera and Turbo. This possibility was considered deeply at management level at Zuffenhausen and Ludwigsburg, where it was finally decided that face-lifting alone would not provide successful marketing opportunities. It is known today that future market projections must mean not only models in different price classes, but technical

alternatives too. In fact, alternatives which possess all of the typical German properties. Genuine sportiness, futuristic engineering progress, maximum degree of quality, comprehensive standard equipment and realistic prices. In other words, the best possible at a reasonable price.

A completely new design concept proved to be the best alternative to the air-cooled, rear engine 911. A new Porsche sports car, the 928 with a water-cooled, front-mounted engine, and a transaxle,

What is expected from the 928?



Throughout the entire research and development programme Porsche engineers based their studies on the 911. It was used as a comparative bases. Since the 928 would fall in a higher price class, it had to offer that much more accordingly.

One thing was definite, the 928 had to be a genuine sports car. Sportiness means driving enjoyment through outstanding performance, optimal roadholding, direct contact with the road surface, and ergonomical handling.

But all this was not to mean a loss in comfort. This is why the designers of the 928 were always conscious of the need to give comfort a higher degree of priority for this price class. At first sight this might seem a paradox, especially when the average British roadster still placed emphasis on sportiness defined by harshness and fresh air. But even the 911 had provided new standards of sophistication, combining the qualities of a sports car and a comfortable saloon. In comfort, Porsche wanted to

achieve a good ride, low noise, operating and temperature comfort, a roomy passenger compartment and generous luggage space.

The term riding comfort should be defined in detail. Riding comfort should never mean a couch on wheels! Rather, it means that the driver is guaranteed a safe, untiring and relaxed journey, and that his vehicle corresponds with the obvious aesthetic and living standards of its owner.

- In other words this means
- optimal passenger compartment size under the premise of a genuine sports car
 - adequate sports car luxury in the passenger compartment,
 - easy operation, and the elimination of technical problems
 - minimum noise levels and
 - very good heating and ventilation.
- And in performance,
- good directional stability
 - high sidewind stability
 - no spinning
 - no aquaplaning sensitivity.

It should also be remembered that in designing a new car, existing and future worldwide legislation has to be considered. Porsche is not a car of today, and just for today; it is not dated. The customer will want to purchase a car with an immensely high (and very desirable) degree of model consistency.

Porsche depends on worldwide sales for its products. Of particular importance is the US market with its considerably stricter registration stipulations. Full compliance with them was a matter of survival. Consequently the 928 has been designed as a basis for further developments. Future legislation can be incorporated in the new car without raising major difficulties or calling for compromises.

What was already begun in the 911 range in a futuristic and exemplary manner, has been continued with the 928. Longterm applications have been found wherever possible. How important this could be (and how valuable it can be in sales talks), longevity is only one aspect of economy. Economy was one of the general objectives in the development of this car and thus fuel consumption, low maintenance and low service requirements will have to be measured just as highly as the traditional high resale value.

Wealthy customers will find fuel savings less important than the freedom of maintenance. It will mean that he seldom has to visit the workshop. And since one loves to drive a Porsche, and parts with it unwillingly, it is a positive point to make differentiating the 928 from many of its rivals. The reduced corrosion guarantees permanent safety, also a point which the big Porsche has over other cars.

The engineering objectives of the 928 in focus

The 928

- is a genuine sports car
- has outstanding performance
- offers optimal roadholding
- has direct contact with the road surface
- provides ergonomical (physiological) handling

The 928 offers

- maximum comfort
- riding comfort
- temperature-controlled comfort
- noise comfort
- adequate sports car luxury and passenger compartment size

The 928 possesses

- optimal handling properties
- excellent directional stability
- high sidewind stability
- Weissach axle to counteract spins
- little inclination to aquaplaning

The 928 complies with

- worldwide legislation and future projects

It offers

- optimal active and passive safety
- high economy
- long term warranty
- extended service intervals of 20,000 km (12,000 miles)
- reasonable fuel consumption
- high resale value

How was it realised technically?



You are right in expecting us to come up with high engineering standards when we develop a new Porsche. Porsche must always have something of a special technical nature – it can't be an everybody's car. This, too, is a requirement which had to be considered when the

engineering objectives were planned. That a highly specialised sports car can't be a simple installation of parts and components one after another, but a complex, interrelated and optimally matched ENTIRETY, is a matter of course for professionals. As all the technical considerations were combined, the sports car silhouette was evolved.

To define good handling, we understand an easy-going but still sporty reaction. How could such handling be achieved? From experience with the VW-Porsche 914 we had learned that the low moment of inertia around a high axis (centre mounted engine) and therefore the intended good manoeuvrability of the car is not always without problems. Sometimes it tests the limits of the driver's capability, requiring quick reactions and a high level of concentration. This might emphasise the sportiness, but at the expense of ride comfort and relaxation.

Consequently we had to provide a high moment of inertia around the high axis. Furthermore, Porsche engineers insisted on an even weight distribution. You already know the advantages – very good straight-line and cornering stability and therefore relaxed, predictable steering.



A solution to this problem (even weight distribution with a high moment of inertia) is ultimately only possible by separating the masses (engine, transmission and battery) as far apart as possible. A further basic consideration from experience is that the closer an automobile manufacturer comes to standard design principles for his products, he is that much more likely to conform with future aspects of safety legislation.

A really individual car, such as the 911 with its rear engine, might, in a few years, find it increasingly difficult to conform, since legislation will make no exceptions for this type of design with regard to safety. It is logical therefore to mount the engine conventionally at the front, the transmission at the rear and a transaxle between.



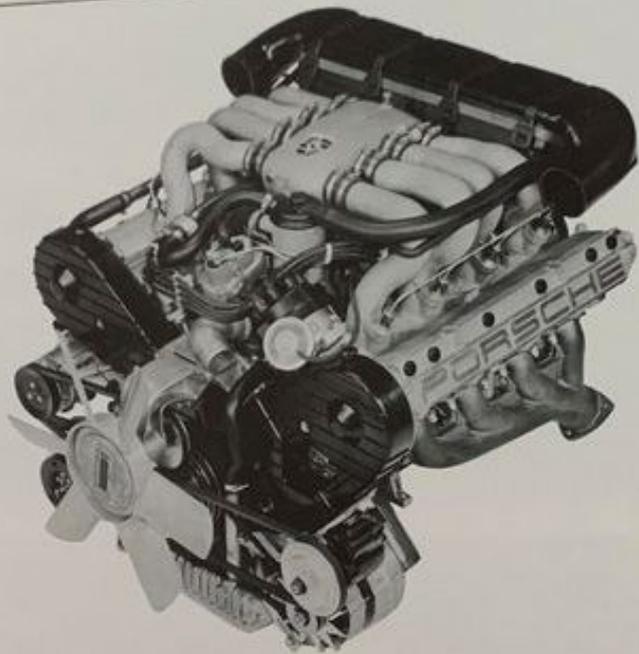
Here is a point of interest. Work was already progressing on the 928 when the research and development department was confronted with the same problem for the 924, and found a solution in principle in the same way. Although production of the 924 started sooner, the problems were solved by work on the 928. Since you are already perfectly familiar with the 924, you also know about the other transaxle advantages from this car:

- the high front axle load provides good sidewind behaviour and good resistance to aquaplaning;
- the recognised winter condition assets of Porsche sports cars have been maintained to a large degree by the weight of the transmission on the rear axle.

A survey of transaxle advantages for the customer:

- optimal directional stability
- good side wind behaviour
- outstanding resistance to aquaplaning
- proven Porsche traction in winter
- completely relaxed driving.

Porsche designs the sleekest V-8 engine

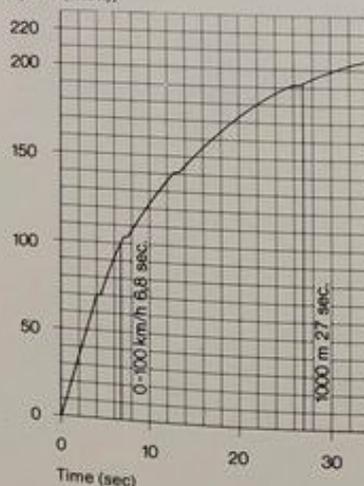


As with the 911, the engine is a completely new design, providing a basis for any modifications which might be necessary in the future. Experience has taught us that emission control legislation can be fulfilled best by engines with not too high a specific output. The 928 develops 56 bhp/litre with a compression ratio of 8.5:1. Like the 911, it runs on regular grade fuel (91 RON), and that must be an interesting feature for you to put across.

To reach the required power output, a large capacity engine had to be developed. The 928 therefore has an 8-cylinder, 4.5 litre short stroke engine with one overhead camshaft per bank of cylinders. It develops 240 bhp (177 kW) at 5500 rpm. It produces its maximum torque of 36 mkp (267.6 lb.ft) as low as 3600 rpm. The torque curve is very flat (see diagram). This results in very good flexibility.

To obtain excellent driving performance, as much weight as possible was pared from the car. This wasn't so simple on a car in the luxury class. The problem was solved by using a great deal of aluminium. The 928, weighing 1450 kg, accelerates from 0 to 100 kph in 6.8 seconds (0-160 kph in 17 seconds) and reaches a top speed of more

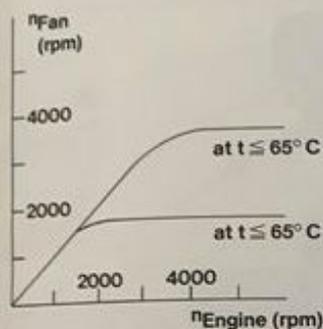
Porsche 928
Acceleration diagram
Speed (km/h).



than 230 kph (143 mph). A standing start kilometre takes just 27 seconds - these are values which can be quantified! The 928 even beats the Ferrari 365 GT, which costs DM 98,000 and does have a somewhat higher maximum speed, but is slower in acceleration.

The engine is a V8. It is not only built especially low, but is also virtually vibration-free. These are advantages which are particularly important for a front-engined sports car.

As with the 924, the 928's engine is also water cooled. In this way it was not only easier to meet legislation concerning noise insulation, but it was also easier to meet the requirements for a comfortable heating system.



The cooling effect of the water is assisted by a fan. Since the air flow will not be sufficient in all situations to cool the water adequately, a fan is mounted behind the radiator to draw additional air through the core. However a fan which runs continuously uses up power and increases the noise level, so we looked for a way of operating the fan only when it was needed.

On the 928 this has been achieved with a special coupling, which works with viscous oil and is known therefore as a visco-coupling. At low water temperatures (and when the air temperature is low also) the fan runs at only very low speeds. This results in a low noise level and a low amount of power absorbed from the engine.

On the other hand at high water temperatures the fan will turn at the same speed as the engine up to about 3500 rpm. But the fan speed will not increase as the engine goes faster still. This results in a good

cooling effect, a not excessively high fan power requirement, and a favourable noise level.

Fuel is supplied from two pumps. There is the continuous fuel injection, as used on all Porsche models. As you know already from the 911, the CO levels are especially low from this system manufactured by Bosch (with some help from Porsche).

As with many technical aspects, the 928 driver will benefit from Porsche's racing experience as regards the clutch. The 4.5 litre engine develops very high torque, and this would mean high release forces for a large diameter, single-plate clutch disc, leading to difficulties with transmission synchronisation because of its immense moment of inertia. Therefore Porsche engineers turned to the lighter, hydraulically operated twin-plate clutch proven in endurance racing. So Porsche is the first automobile manufacturer to install a twin-plate clutch in a standard production car. Other manufacturers, such as Daimler-Benz, have found help for their large volume 4.5 litre engines with an automatic transmission. We have been able to comply extensively to the customers' desire for comfort, and have avoided the problem of higher pedal pressures. Moreover, the high moment of inertia from a clutch disc would have considerably reduced the service life of the transmission synchronisation. Porsche avoids these high pedal pressures with the newly developed twin-plate clutch, and keeps the moment of inertia very low by means of the relatively small clutch diameter.

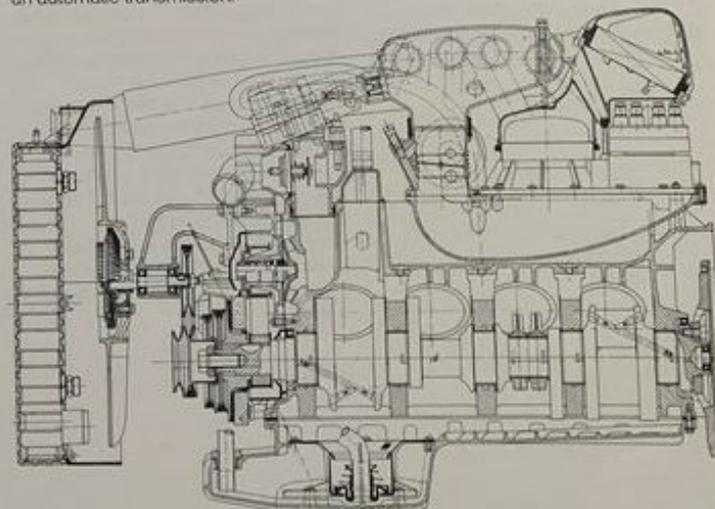
Now a look at the engine, its output, and its transmission:
 4.5 litre, V8, 240 bhp at 5500 rpm,
 36 m.k.p. (267.6 lb.ft) at 3600 rpm;
 maximum revolutions, 6300 rpm.
 Single overhead camshaft per bank of cylinders
 short stroke
 water cooled
 wet sump with forced oil lubrication
 compression ratio 8.5 : 1
 regular grade fuels (91 RON)
 very good flexibility
 0 - 100 kph in 6.8 seconds
 top speed above 230 kph
 twin-plate clutch
 five-speed manual transmission or
 three-speed automatic transmission
 (from October 1977).

The engine's power is transmitted from the clutch to the gearbox via a main-shaft in the transaxle tube.

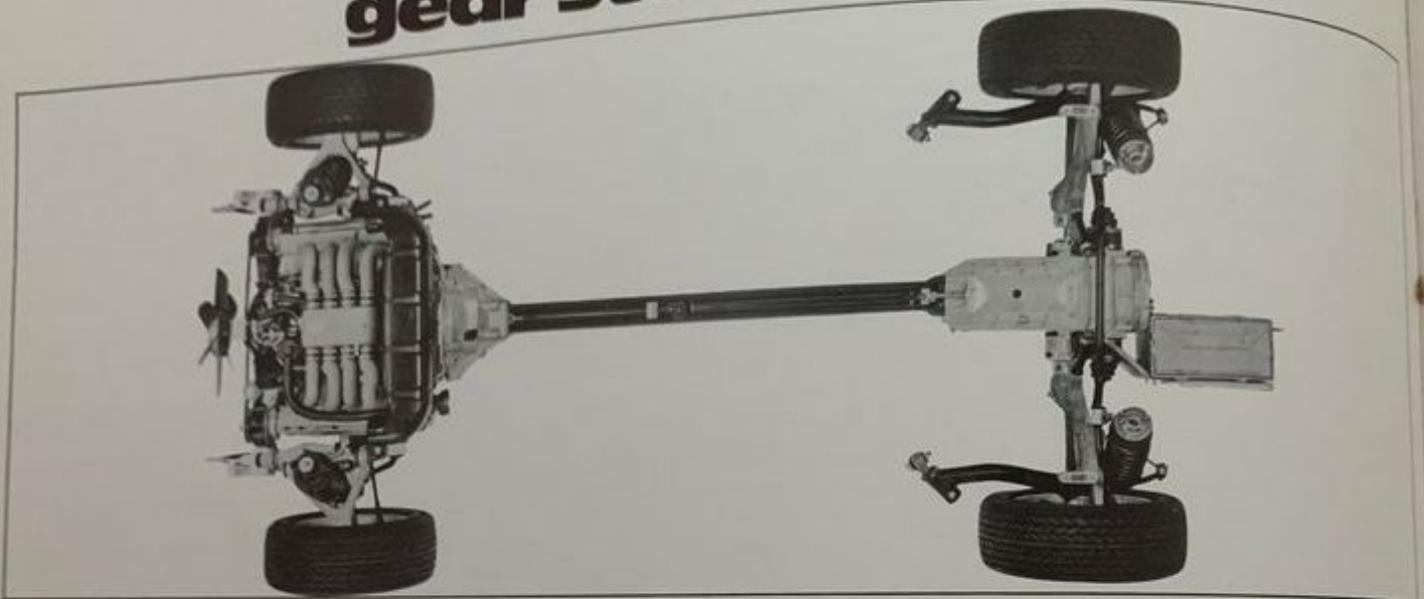
The 928's standard transmission is a five-speed gearbox to justify the sporty image, but the customer can order it with a three-speed automatic transmission as optional equipment. This is a Daimler-Benz automatic gearbox, the shifting range of which is designed to give a sporty effect. Ride comfort and temperament are guaranteed even for the Porsche driver who doesn't want to do without an automatic transmission.

The five-speed manual transmission is a new design for the 928. For particularly sporty drivers a 40% locking differential, as for the 911, is offered as optional extra equipment. Here, too, is an innovation. Fifth is a direct gear i.e. different from the 911, and in this way the noise level is kept considerably lower. In fact, noise suppression is a major point on this sports car. For example, three silencers arranged behind each other reduce the exhaust noise.

That the new 4.5 litre engine of the 928 will provide above average sports car performances will probably be taken for granted in your sales talks. But engine performance alone is not enough to establish sports car standards. Performance must also be realised on the road. Where problems could begin for many other famous cars is where driving enjoyment begins with a Porsche - with the running gear.



New running gear standards



This will be of special interest to your customers. The 928 has an outboard scrub radius on the front axle, made possible by the application of floating caliper brakes (see diagram). This innovation has achieved the desired directional stability and directionally stable steering when braking the car on a road with different surface conditions under the left and right wheels. Particularly, this point is a major factor in relieving stress on the driver.

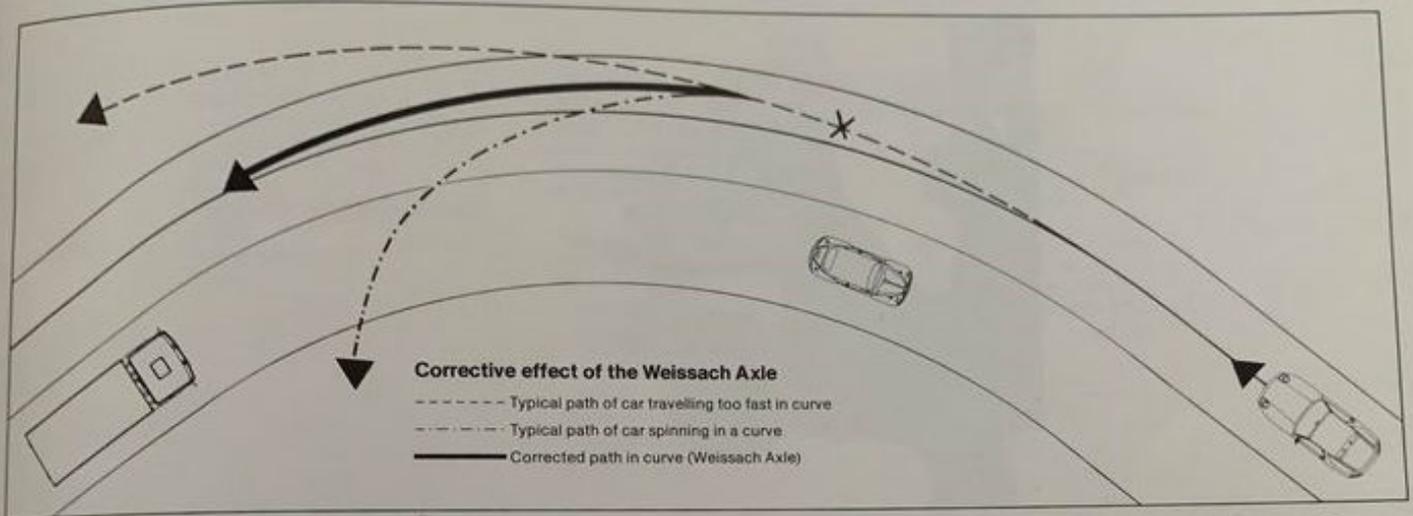
The running gear has suspended the front wheels independently on double wishbones. Comfort is provided by the coil springs, which through proper location compensate for differences in weight from the installation of special equipment.

The safety rack and pinion steering, common at Porsche for many years, with power assistance as standard, permits the finest possible steering. Comfortable, easy to operate, but still with definite contact with the road surface and never transmitting a jolt. The 928's steering is absolutely quiet because of the well-balanced tyres. The power assistance is dependent on engine speed in reversed proportion. This is of major importance, so that the steering wheel is easy to turn even when parking, and at the same time the steering is fully responsive at high speeds.

The so-called anti-dive means 30% less dip at the front end of the car when braking. The unpleasant dipping of the car when braking is almost completely eliminated by the substantial anti-dive factors at the front and rear axles.

An absolute innovation is the rear axle (see diagram). Here we are talking in particular about three effects, which are very important for handling and are the main reasons for really well controlled handling.

The common, and dangerous spinning behaviour has been eliminated by an articulated leverage on the lower rear axle link of the double wishbone. You already know this type of behaviour. If you drive into a curve and take your foot off the accelerator, most cars will turn into the curve tighter than corresponds with the curve radius.



This could lead to the car spinning out at very high speeds. The more powerful the engine and the higher the power to weight ratio, the more definite the load change reaction. Tests at Porsche have proved that a driver must react in less than 0.3 seconds to prevent this often very dangerous spinning tendency. Since this fast reaction would be too much to ask from the normal driver, the rear axle has been designed to correct the wheel position automatically.

The new Porsche rear axle is an engineering feat without equal, a pace-setting contribution for active safety. This is the reason why it is quite worthwhile to drive a Porsche, even with speed limits. The image of Porsche has been founded on performances of this type for many years.

The second feature is front and rear stabilisers. They reduce body roll and improve road surface traction. The double wishbone permits a camber characteristic which

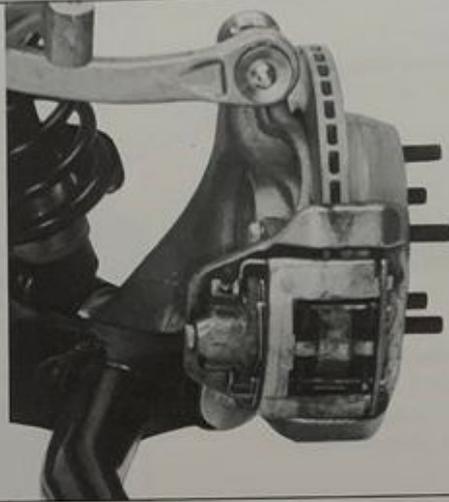
guarantees sporty driving capabilities and at the same time keeps tyre wear to a minimum. This not only relieves stress on the driver, but also on his wallet.

The third feature is the so-called anti-squat. It reduces the sinking of the car when moving off by about 60% (particularly important for soft suspension).

Although it has been known for many years that genuine ride comfort is a contribution to driving safety, it is still a popular misconception

that soft suspension is essential to ride comfort. The 928 proves convincingly just what must be understood by real ride comfort. It is attained by the well designed suspension of the 928 running gear and transaxle design. Road surface bumps are noticed, but not transmitted. This means that the 928 needs little effort and is completely tireless to drive. Disturbing forces and influences are kept away from the driver. He can relax and cover long stretches in the 928.

Brakes



We have already mentioned that the outboard scrub radius was only achieved by application of floating caliper brakes, which are also mounted on the rear axle. It is part of a car's comfort, that the force which has to be applied to the brake pedal is assisted very effectively by a pressure booster.

The dual circuit, diagonal braking system (you know, of course, that steering corrections are kept to a minimum when braking a car of which one brake circuit of this system has failed) is equipped with inboard disc brakes front and rear. The rear floating caliper brakes are combined with double-shoe parking brakes (dual hydraulic drums; similar to those of 911).

Tests in Weissach have shown that with the application of floating caliper brakes the brake fluid will only heat very little even when the brake discs are subjected to maximum loads. Fading because of vapour lock in the brake fluid is completely eliminated

The 928 has size 7 J x 16" wheels, which are cast aluminium and fitted with tubeless 225/50 VR 16 low profile tyres. The inflatable spare wheel is located underneath the rear luggage compartment.

Survey of running gear

Front axle:
outboard scrub radius
– very good directional stability
– steady steering and stopping
approx. 30 % anti-dive
Coil springs
– good absorption of road surface bumps
Double wishbones
Stabilizer

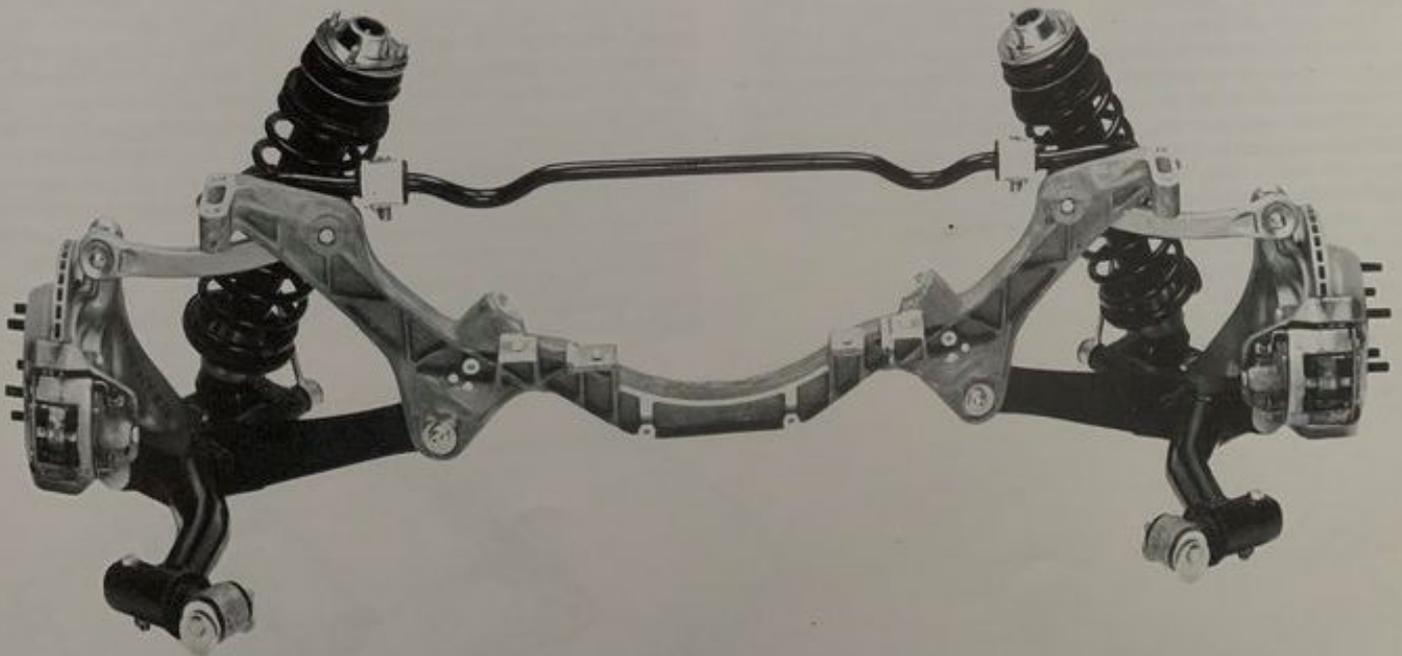
Steering:
Safety rack and pinion type
Power assistance
Direct contact
No road surface jolts
Smooth steering

Rear axle:
Double wishbones with articulated leverage
– no spinning
– pre-programmed wheel camber changes
– about 60 % anti-squat and 50 % anti-dive

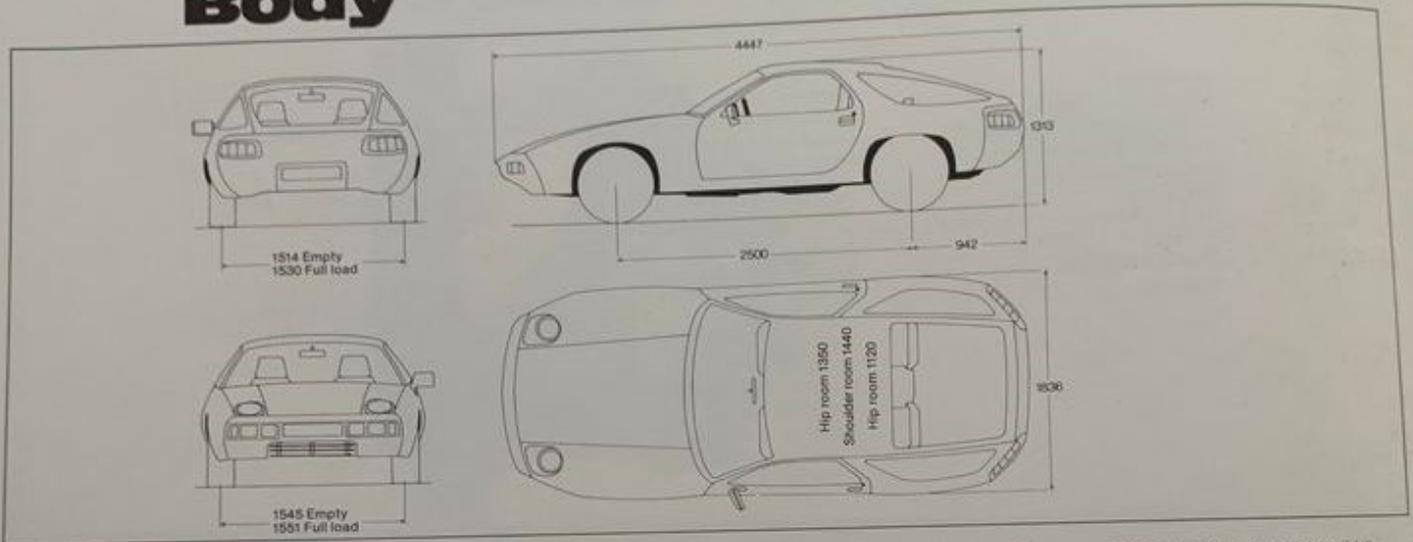
Stabilizer
– well-tamed handling
– low tyre wear

Brakes:
Dual circuit, diagonal braking system
Pressure booster
Floating caliper brakes
Disc brakes, front and rear, inboard
Double shoe parking brake

Wheels:
7 J x 16" – pressure cast rims
225/50 VR 16 low profile tyres
Inflatable spare wheel on steel rim



Body



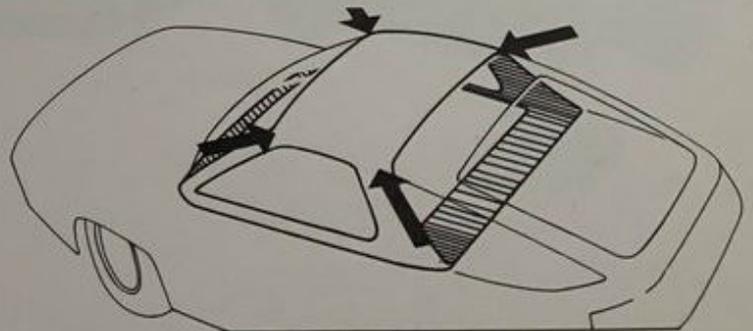
The clean lines of the body blend with the large glass areas, which are an aid to safety. The whole car has a powerful and sporty appearance. The 200 litre luggage compartment is accessible through the large rear window, which is hinged at the top as a tailgate and is easy to open, assisted by two gas pressure springs. Its volume can be doubled to a considerable 400 litres by folding down the rear seat backrest. For the sportscar field this is a large volume luggage compartment. Even bulky items with up to 90 cm width, 36 cm height and 140 cm length can be stored without difficulty beneath a cover. The lid can only be opened with the key. If the lock has been operated, the lid will open automatically under spring pressure.

This single-handed method of operation will be appreciated when shopping. The tools are housed in the rear panel, and there is space for the warning triangle.

Not only the ideal styling, but also the size contributes to the balanced and streamlined appearance of the 928. The car is 445 cm long, 184 cm wide and 131 cm high. In size therefore it is larger than the 911. Its turning circle is 11.5 metres. To save weight the bonnet, wings and doors are made of aluminium.

The engineers have found an optimal yet aesthetic solution to the problem of energy absorption. Front and rear aluminium bumpers, which will withstand an impact at speeds up to 8 kph without deforming, are built into the body and are attached to the side members with impact tubes. From the outside they seem to be part of the body and are covered with polyurethane foam rubber which is weatherproof, repairable, and will recover its shape after a knock. The lights are recessed into the bumpers. The standard fog and driving lights with H3 bulbs are located in the front bumpers.

The concealed headlights (H4) are swivelled open into the wings and are operated by an electric motor from the lights switch. Since the range of the low beam (and the high beam) will depend on load conditions, the driver can regulate them manually from inside the car. Headlight cleaners are standard equipment. If the lenses are very dirty a washing solution can be sprayed on to the surfaces to be cleaned in a separate phase. The glass is first flushed with clear water. And then flushed again after the application of the washing solution.



Survey of body:

- sporty, powerful styling
- many aluminium parts
- hot galvanised sheet metal
- treated cavities
- large windows
- concealed headlights
- large demisted rear window with wiper
- 200 or 400 litre luggage compartment
- built-in impact zones made of polyurethane
- absorption of impact energy from collisions up to 8 kph
- high payload
- optional extra equipment: electric sliding roof, air conditioning, automatic transmission

The standard rear window wiper, as well as the two-stage rear window demister covering the entire height of the single-layer safety glass window (fast defroster action) serve the same purpose, namely aiding active safety by means of good visibility. Laminated safety glass is used for the windscreen. The convex rear side windows are also fixed, since the full ventilation of the fresh-air system will be satisfactory in all climates.

The 12-volt 66 Ah battery (80 Ah is optional equipment) and the 66 litre fuel tank are installed behind the transmission due to

the transaxle design. The tank is made of blown polyethylene and is therefore flexible, so that it will 'give' when pressure is applied. The strict US safety legislation and crash requirements have been met without difficulty thanks to the engineering features in the body.

The position of the low maintenance battery fulfils a special purpose. Suspended from the transmission in its own metal box, its weight contributes to improvement of transaxle oscillation and provides extra load on the rear axle.

If desired, the 928 will be delivered with an electric sliding roof. It can be lifted at the rear to provide draught-free ventilation and a relatively low noise level even at high speeds.

The gross vehicle weight is 1870 kg, the kerb weight 1450 to 1540 kg, depending on equipment, which means an average of 375 kg for payloads.

Since the 928 driver will want to haul boats, horse trailers or caravans, the permissible trailer load has been kept high intentionally. Without brakes it is 750 kg and with brakes it is 1600 kg. The 928 will have no trouble in hauling even large trailers - by no means least because of its powerful engine. And something else, even though the 928 is a genuine sports car, driving it with a caravan is fun!

The maximum roof load is 35 kg. Provisions have been made for the installation of ski holders, easy and fast to install and remove trailer hitches, as well as tyre chains.

Passenger compartment



Like no other car in its price class, the Porsche 928 demonstrates how operating comfort should be to aid driving safety. We just want to cover the special features here. The combination of technical, pace-setting, stress-relieving innovations, with the objective of increasing safety and comfort, is unequalled. But please judge for yourself.

When you sit down and take hold of the steering wheel, you already have the first technical refinement in your hands. The instruments, combined with the steering console, adjust for height with the steering column. In this way each driver can adopt his own optimal seating position. The instruments are always in the correct field of view, and of course the view of the road is improved considerably.

Just as interesting is the central indicator lamp. It is located exactly in the driver's field of view above the steering wheel and can't be missed should it report a functional failure. Such as:

- oil pressure
- oil level
- brake circuit failure
- brake fluid failure, etc.

If any important function fails (e.g. oil pressure) the central indicator lamp flashes continuously and can't be turned off. Single lamps of less importance are located on the centre console, while oil pressure and oil level, fuel level, battery charge, etc. are also in the instrument binnacle in the driver's field of view.

As well as the main indicator lamp, there is also a central information panel with lettered and illuminated indicators in the centre console. This indicate less important malfunctions and can be turned off; they are not in the field of view, and don't therefore disturb the driver, lighting up only as a reminder. Of course the driver turns off the parking brake indicator lamp when releasing the handbrake before moving off.

Lamps indicating the following conditions can be turned off:

- brake pad wear
- parking brake
- coolant level
- coolant temperature
- fuel level
- windshield washer fluid level
- tail lights
- stop lights

Each time the car is started the driver is automatically reminded about the defects, but he can turn off some of the indicator lamps himself.

The major advantage of the Porsche indicator system is that it does not have to be activated by the driver, since an exact diagnosis is delivered with the warning.

The rear window demister is regulated automatically. At first it uses the full 300 Watts, but switches to a low heating value of 75 Watts after 10 minutes, automatically by way of a timer relay. This is combined with the electrically heated exterior rear view mirror, which is electrically controlled from the inside.

Electric window controls are provided to correspond with the price class of the 928. Another device which aids comfort is the vacuum-operated central door lock system. An exception is the boot lock, which can only be opened with a key to prevent theft. A one-key system has been maintained, except for the lockable compartment in the rear.

The parking brake lever is between the driver's seat and the door. Even those who were used to the normal centre position of the parking brake will soon get used to this location. We already know, from experience with the 914 and the 924, that this is just a matter of familiarisation.

The engine bonnet can be released from the interior, but the fuel filler flap has to be released from the outside since the distance from the right rear position to the driver is too long for a cable. This is not really important, since the 928 has a lockable filler cap anyway.

Double air nozzles are installed in both doors. The driver or front passenger can aim one at his body if he wants, and use the other to defrost or demist the side windows with a stream of warm or cold air.

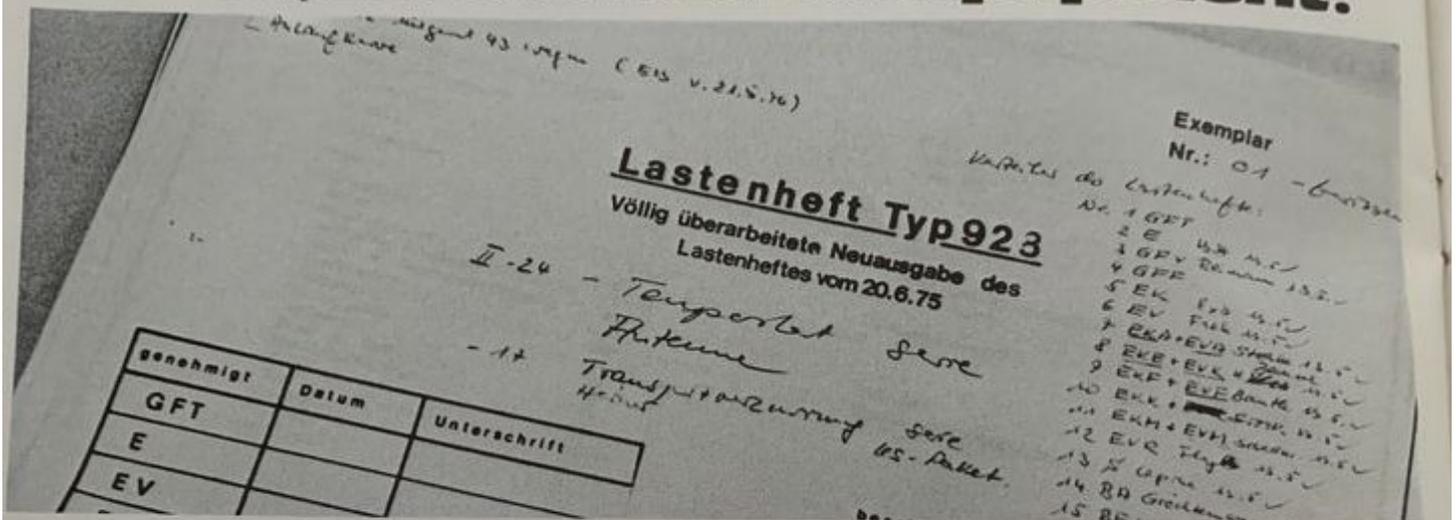
To keep the temperature in the car as low as possible in strong sunshine, the new Porsche has sun blinds in the rear window as a standard feature. Tinted glass windows can also be fitted optionally. Further air conditioning is also available, and if installed, the lockable glove box serves as a refrigerator, since it is connected to the air conditioning system. Those travelling on a hot summer's day, or living in hot climates, will appreciate this when wanting to keep bars of chocolate, film, or other heat-sensitive items cool! The warm water heater, with a built-in ventilation system, will satisfy even the highest demands.

Ladies will be pleased about another attention to detail - the illuminated make-up mirror which is recessed in the roof lining.

With the Porsche 928, we believe that customers who buy a car in this price class should not only get engineering perfection, but also a hand-tailored, individual sports car. This includes the adjustable steering console and the adaptation of pedals and gear lever to the size of the usual driver (although these latter adjustments must be made in the workshop). Of course, the tempostat speed control is standard equipment in the 928 to relieve stress on the driver.

All the switches and controls are arranged so that the driver wearing a seat belt can reach them easily and comfortably (see article "And this is what it is like in a Porsche 928").

Other standard equipment:



- front three-point automatic seat belts
- built-in head restraints
- intermittent windscreen wiper
- instrument illumination rheostat
- four loudspeakers: two in the doors, two in front trim
- lockable box between rear seats, with illuminated ash-tray
- tail fog light
- adjustable armrests

The passenger compartment is divided by the centre tunnel with its seats and consoles. The driver and passenger have all the comfort of a large saloon, including a lot of legroom and elbow space which is generous even for large people.

Even the rear seats, consisting of two bucket type seats, offer an outstanding amount of room for a sports car. Figures and dimensions will be less revealing than a live demonstration. But if you do ask customers to sit in the 928, remember that tall people are not normally asked to sit in the rear, so ask a small to medium size adult for the demonstration, perhaps a young lady, a larger girl, or a child. After long test drives through the Sahara the Porsche test team agreed that sitting in the rear seats could be comfortable, even on long trips under normal conditions. Remember that a sports car is not a saloon. A 2 + 2 seater will

normally only have emergency seats in the rear and they are there only for one reason, to make it possible to take a third or fourth person occasionally. Statistics show that on average only 1.1 persons ride in a sports car; only on the tenth trip is there a second person in the car. The buyer of a sports car, and certainly the buyer of a Porsche, is not looking for an absolute maximum in space, which is offered only by a saloon or an estate. What he wants is a genuine sports car with sports car styling, and the potential use as a 2 + 2 seater. A good compromise is needed, and has been found in the 928.

The noise level is exceptionally low. The inside noise level at idling speed is hardly 7 sone at 1000 rpm, whilst driving (on a dynamometer) and under full load, 29 sone were recorded at maximum torque (3600 rpm) and 44 sone for the maximum power output (5500 rpm). Even wind noise is generally found to be quiet.

Porsche has again established a new milestone in automobile technology, not only with the engine and running gear, with the transmission and brakes, but also with equipment in the passenger compartment. The driver can concentrate on driving, and on the road; he is not concerned with engineering, which merely assists the driver in enjoying his task to the full.

Survey of passenger compartment comfort:

- height adjustment of steering/instrument console unit
- central warning system
- electrically heated outside rear view mirror
- rear window demister with low heating timer relay
- central door locking system
- air conditioning as optional extra equipment
- individual adjustment of pedals and gear lever
- low interior noise level
- electrically adjustable seats as optional extra equipment

Economy

Surely a sports car like the 928 will hardly be bought for economic reasons. But still, economics can be important for the customer in the high-price class, and could influence and justify his decisions. They will remain secondary, because the more important considerations will be prestige, exclusiveness, driving enjoyment, individualism, safety, etc.

But for Porsche it was important, at a time of increasing fuel price and the shortage of crude oil, to design a car in this price class that its owner could compare on economy with any mass production make. These are the particular advantages of the Porsche 928:

- regular grade fuels
- average consumption 13 litres (21 m.p.g.) DIN
- longterm warranty
- low maintenance costs
- model consistency
- maximum dependability
- extremely favourable resale value.

Even our turbo customers know that they lose less in % value when selling their Porsche, than they would with a Ferrari or Lamborghini. The longterm warranty is again based on the galvanised body, the generous application of aluminium, and the various corrosion resistant lines. For instance, the brake lines are made of a copper/nickel/iron alloy, the fuel lines are galvanised and chromatised, and then receive a plastic coat. These are contributions to safety and dependability which hardly any other manufacturer offers.

Even the low maintenance must be mentioned. In fact there is virtually no maintenance, because the service intervals are 20,000 kms (12,000 miles) and repairs are seldom necessary.

Economy begins with the prices, and the 928 compares favourably with other sports cars. The buyer of a 928 can have a lot of money left in his account! The 928 is a real car, superior to its competitors on every score. And it won't be difficult to prove this claim.

How important is Porsche's new 928 on the market?



Interview with the marketing manager, Mr. Ledert

Mr. Ledert, rumours concerning the Porsche 928 have been in circulation for a long time, not least because of sensational press reports. Often there has been a question concerning the position of the Porsche 928 and this is interesting for every salesman. And now the first actual question. Which Porsche is now the Porsche »flag-ship«, if the term »flag-ship« can be used for a sports car at all, the »turbo« or the »928«?

Ledert:

The same question will be asked by many customers. It will have to be answered with 928 or with turbo, depending on the attitude and interests of the person asking. Both models have a leading position in our sports car programme.

The Porsche turbo chosen by AMS readers as the »best sports car of all classes« is brilliant in particular because of the outstanding performance values, such as acceleration and top speed. Its close relationship with the racing turbos of groups 5 and 6 guarantees it a leading position in the minds of performance orientated customers.

A different category of customers, previously not attracted to the Porsche marque, definitely sees the 928 as the new top model. It is a category of customers, for which in spite of all sportiness much importance is placed on riding comfort and passenger compartment roominess in addition to the new styling. There are also many car buyers, for whom the exclusiveness of a model is in very close relation with the number of cylinders or displacement. Consequently you will see, that your flag-ship thoughts can only be answered in the view of the customers.

You have explained its position in the model range, but where would you position the Porsche 928 on the market? Is it a comfortable vehicle, a sporty coupe?

Ledert:

This is a very difficult question, about which our salesmen will have to have very precise conceptions. The most important point, **the Porsche 928 is a genuine sports car!** And therefore it will have to be allocated to the sports car market.

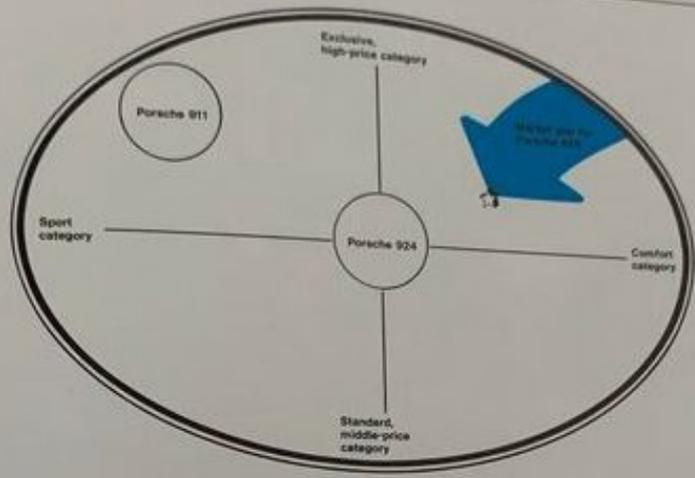
Within the sports car market itself it can be characterized as follows. As all Porsche sports cars, it offers an especially high amount of driving enjoyment and implies a compromise of a rather limited transport function. The sports car styling is amalgamated with its driving enjoyment, which expresses a very special, individual style of living by way of its extravagance and elegance.

A Porsche, and especially the 928, is a product personality on its own and has reached a certain high level, for which maximum comfort and luxury equipment is taken for granted.

What will be the opinion of it from its future owners?

Ledert: Chiefly as a personal car. This, of course, does not mean that it will not be used as a business car. Not at all. But it surely will not be an official business car, rather an individualist to underline the personal character of the owner.

The 928 will always be the first car, even if it is purchased as a second car.



So much on its position in the sports car market. Which part do you think the 928 will play in the total market?

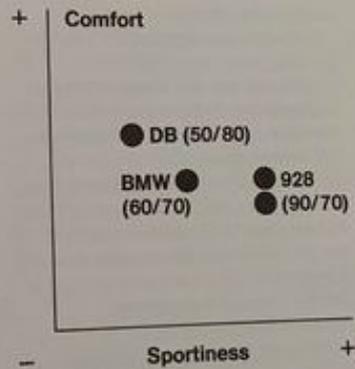
Ledert:

In addition to this precise social part we have imagined that it will have a rather aggressive function in the automobile market. For the automobile buyer, who is chiefly looking for comfort and luxury, the 928 is a genuine alternative to the luxury coupes and sedans (see chart; limited to a few purchasing motives).

For whoever is looking for genuine sportiness with extravagance, comfort and luxury, there is actually only one model – the 928. It will be the pike in the fish pond. Since it offers safety, comfort and luxury, which only the top competition models can demonstrate, it is in a preferred situation to substitute these models. On the other hand it is so superior to them, that for a prospective customer with genuine sports car (928) ambitions none of these competitive models could really be considered.

You know that automobiles will chiefly be classified according to two product properties – comfort and sportiness – if safety, the price and styling receive about the same evaluation.

Graphically we would see a comparison of the 928, the DB 450 SLC and the BMW 6.33 like this (see figure).



I would like to make a brief summary. The 928 is the exclusive model from Porsche next to the turbo, again a genuine sports car, which also offers optimal comfort. Consequently it is genuine competition for luxury coupes and sedans; but cannot be considered as a substitute because of its sportiness and extravagance. But you, Mr. Ledert, consider it primarily as a sports car, which is standing before a great future because of its ideal combination of sporty performance, excellent comfort and individual personality.

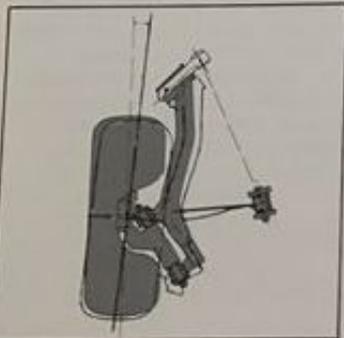
The Porsche 928 offers not only everything, which the others offer, it offers more. And this is a further chance for our salesmen after introduction of the 924, the small brother. Its perfected design conception and devotion right up to the smallest detail will make a successful automobile of the 928.

New standards in running gear technology



Interview with Mr. Eyb, the 928 project manager

Mr. Eyb, when speaking about the 928, the most outstanding feature and innovation mentioned is the running gear, in particular the rear axle. What is so special about it?



Mr. Eyb:

The running gear and its function can really only be considered in conjunction with the transaxle design, in other words the uniform front axle and rear axle loads and the high moment of inertia around the vertical axis. It was our assignment to have the running gear support the basically good natured handling resulting from this, which was supposed to offer the same amount of comfort without impairing the sportiness of the car.

For the front axle we chose a double wishbone axle with an outboard scrub radius.

Both wishbones make it possible to keep the camber change as well as the location of the roll center within desired limits.

The double wishbone design also makes it easier to influence the anti-dive, specified here with 30 %.

An outboard scrub radius was chosen, so that different braking forces between the left and right wheels and the road (caused by different road surface conditions on left and right sides) will produce a steering moment on the front wheels, which counteracts the disturbing moment of the entire car.

For example, the left side wheels are running on a normal road surface, the right side wheels on a wet road surface. Consequently the left wheels will brake stronger than the right wheels and the car will turn to the left. Because of the outboard scrub radius both front wheels receive a steering moment aimed toward the inside when braking. Since the left wheel brakes stronger than the right one, the front axle "steers" to the right and counteracts the total car turn direction.

There is another advantage with an outboard scrub radius. The "disturbing force lever arm" (this is the distance from centre line of wheel to steering axis) is small, so that for example wheel unbalance will produce only slight moments of disturbance in the steering. Steering "vibration" is reduced considerably.



Coil springs around shock absorbers are used for the suspension. Let us first summarize at this point.

The running gear was designed to support the comfort accentuated handling of the transaxle design. This has been accomplished by way of an outboard scrub radius. The advantages are good directional stability and no veering out when braking. What engineering innovations do you have on the rear axle?

Mr. Eyb:

We have tested all known rear axle designs, but none of them satisfied our demands. So we made it an objective, to design a better one. We decided for a double wishbone axle. Both wishbones, similar to the front axle provide the desired camber change and roll centre characteristic over the bump travel.

An important feature of the rear axle is a device against movement of the car when decelerating in a curve. Each rear axle has the characteristic, that the wheel on the outside of the curve, which is heavily loaded and especially responsible for handling, makes a reaction in direction of toe-out when the car is decelerated (accelerator pedal released). We put a small control arm on the front end of the lower wishbone, which introduces a steering movement via the lower wishbone during deceleration (in other words power toward the rear), which moves the wheel in direction of toe-in. Consequently it counteracts the normal steering behaviour of the axle and prevents spinning (see fig.).

The rear axle also has an anti-dive of about 50 % and anti-squat of about 70 %.

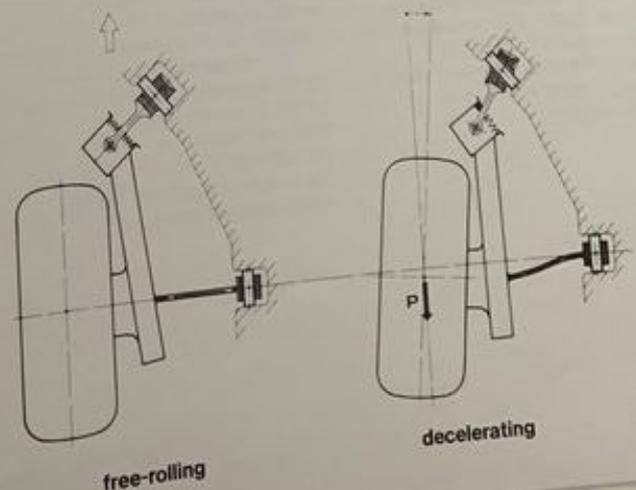
In other words the 928 rear axle offers three special effects for driving safety and riding comfort. Prevention of spinning when changing loads, stable handling by way of pre-programmed wheel camber change and an excellent compensation against anti-dive and anti-squat.

The advantages of independent wheel suspension and standard production use of stabilizers is apparently so self-evident at Porsche, that you don't really have to mention them any more. Is this true?

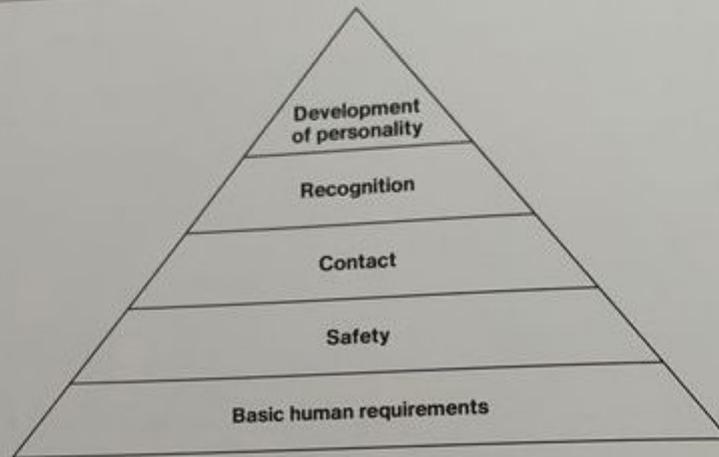
Mr. Eyb:

Yes, good road holding is a matter of course for us. Requirements for this are constant road surface contact of the wheels under all driving conditions and low body tilt at high lateral acceleration.

Thank you very much for your information.



Safety - a good reason to buy a 928



Safety in a car is a very important motive, as you must realise. And if this motive is not discussed at the point of sale, it is only because it is taken for granted in a Porsche. Word of mouth propaganda, based on harmless incidents caused by the driver, together with confirmation by independent road testers, and proven by Porsche in many tests in the research and development centre at Weissach, enable the safety aspect to be part of the Porsche image.

Always make use of the safety features of the 928 when dealing with a customer, so that you can clinch the deal. These safety features are the extra ingredient that can't be measured in terms of money. What is this extra safety worth to you, Mr. Customer?

Of course, some customers would be willing to take a certain risk in buying a car, to satisfy other motives such as sportiness, top speed, or characteristic features. But even they would prefer to lose as little safety as possible because of these motives.

Obviously you point out both forms of safety to your customers – active and passive. You should always have these 10 points on the tip of your tongue.

For active safety:
good natured handling
braking
operating comfort
steering

For passive safety:
front end crash resistance
tail end crash resistance
side crash resistance
roof strength
passenger compartment safety
steering displacement

It is interesting to realise that in most countries legislation is limited to regulations for passive safety, to prevent damage when involved in an accident. One thinks and acts for the minor citizen.

Porsche cannot share this opinion for its customers. Of course, we also try very hard to obviate and reduce the results of such unpleasant matters when caused by a third party. But we want something else. We want to give the Porsche driver a car with which he can prevent the occurrence of any dangerous situation.

Active safety

How

a) the **good natured handling** results from the transaxle design, the balanced distribution of weight with the new rear axle, the running gear with an

outboard scrub radius on the front axle; you will be able to find this information separately in the product description.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Solution for page ...
Very good directional stability
Resistance to side winds
Resistance against aquaplaning
Good winter properties
No veering out when braking
No spinning in curves
Smooth, direct steering.

Solution box page ...

And don't forget the excellent acceleration, with which dangerous situations can be left behind.



b) Brakes

According to our tests at Weissach the 928 can be stopped from 100 kph in 3.2 seconds. When compared with other cars this is an outstanding result, which can be a great help to the driver. The braking system itself (dual circuit, diagonal braking system) guarantees high efficiency under all conditions, particularly since an electric pad wear indicator is provided. Even the weaker sex can attain optimum braking from the large discs, helped by the pressure booster. Fading is virtually eliminated by the adoption of floating calipers, especially since the front and rear discs are ventilated.

c) Operating comfort

Driving safety is only achieved by providing a comfortable, relaxed environment, free from unnecessary distractions. Therefore we consider operating comfort as an important contribution to driving safety.

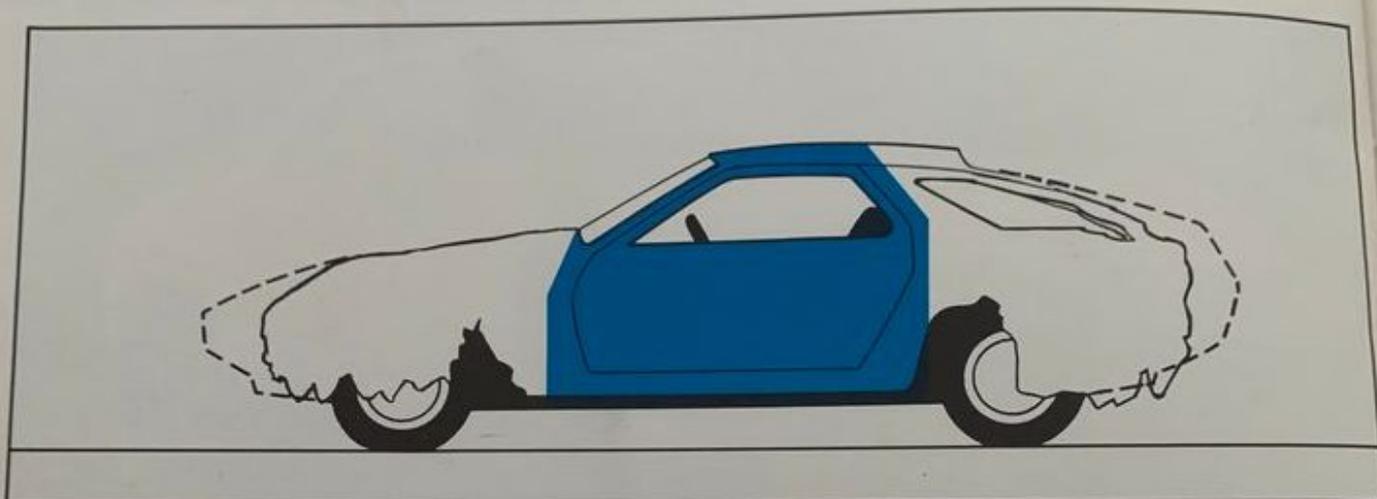
We can start with the major requirements for being able to drive. First of all there is the correct seating position accomplished by seat and steering wheel adjustment, which is of basic importance for good visibility and untiring driving. The integration of the steering wheel and instrument console guarantees that the instruments are always in the field of view, so that the driver's attention is not diverted from the road.

Fumbling with the exterior rear view mirror through an open window while driving has been reduced to merely pressing a button. This way, when changing drivers the perhaps smaller lady will be more inclined to adjust the exterior mirror for herself. Otherwise this is often neglected, leading to danger when cutting into different traffic lanes.

The same applies to convenient operation of all levers and switches while wearing a belt, as well as the winders to open or close the windows. Perhaps you have noticed that this will cause the steering wheel to move slightly, and the car to leave its course? This can be dangerous in narrow streets, but with

electric window controls short or long pressure on a switch is all that's needed, without impairing car control. For good visibility at all times, and to prevent uncertainty when driving, there is electric heating for the rear window and exterior rear view mirror; headlamp beam height is controlled from inside the car, spotlights, foglights and tail fog lights are fitted, as are headlamp washers.

The illuminated ash-trays, and the armrests provided when the door pocket covers are shut, also belong to driving comfort. You see - the best active safety, for the benefit of your customers!



Passive safety

The 928, too, was subjected to intensive **crash tests** (see figures showing front, tail, side crashes), as called for by legislation. The pre-programmed energy absorption takes place in due consideration of the transaxle design. A general deformation starts at the point of forces taking effect, whereby the rigid passenger compartment cell remains excluded.

A jolt from the front will first hit the elastically suspended bumper and acts on the impact tubes or impact dampers in front of the side members. In principle only the side members on the transaxle unit will be concerned, while the body deforms and is pushed over these parts. The impact will not even hit the passenger compartment cell directly, instead the parts located underneath.

The side member will deform from the front to the rear, whereby only a section will be concerned depending on the strength of impact. This has an advantage in that a cheaper section repair can be carried out as long as the damage is limited. In other words the car has been designed that in light front end collisions only the front end will be damaged and the impact will not be transmitted to the rear. Further the pressure from the rear is less, since the heavy masses are located in front of the passenger compartment.

The tank is made of blown polyethylene and consequently so elastic, that pressure will deform it. This safety tank has provided fulfillment of all US regulations concerning tail end collisions.

The 928's body is self-supporting and thus offers so much roof strength, that it has held in all roll-over tests.

As a matter of course elimination of hard, pointed, protruding levers, corners or edges, by the application of soft plastic materials and thick padding injuries from impacts are prevented quite extensively and the passenger compartment is made safe. Further the Porsche **safety steering column** with two cross joints, one deformation element and an elastic steering

coupling is also installed in the 928. The driver is protected in the passenger compartment by the three spoke safety steering wheel with impact pad and deformation element. Further the standard equipment includes 3-point retractor belts on the front seats and lap retractor belts for the rear seats. Head restraints are part of the seat back rests.

All in all it can be said, that Porsche has applied pace-setting safety research in the 928. Naturally all legislation concerning passive safety has been fulfilled. The large step forward has been accomplished with active driving safety by way of the 928's overall design conception and its running gear.

Porsche has designed the sleekest V-8 engine

Interview with Porsche 928 project managers, Gorissen and Flegl



Gentlemen, a bundle of power in a compact room – this is the impression we have when looking at the front of the 928 and knowing that 240 HP or 177 kW are sleeping underneath. How was this possible and what are the special features of this engine?

Gorissen:

Yes, it was not quite so simple to install such a large and powerful engine in the front end of this car, especially since the Porsche typical low front end was to be maintained.

A compact and low V engine with 8 cylinders and 4.5 liters of displacement is the result of our deliberations, the best which we could reach from our own objectives. And our objectives right from the beginning of research and development were:

- high torque over a wide speed range,
- powerful traction even at low speeds
- large nominal output at relatively low speed
- smooth running

- low maintenance requirements
- fulfilment of future emission control legislation
- use of regular grade fuels
- low, short and as narrow as possible design.

A narrow and low engine was possible by way of a parallel arrangement of valves with bucket tappets and only **one** overhead camshaft for each bank of cylinders. The strength of the valve drive made it possible to have a speed limit of about 6,500 rpm. This is quite high for an engine with 8 large separate cylinders.

This 90° V8 engine is a completely new design from us and runs almost without vibration. In comparison to the flat engine of the 911 it appears to have a very strong crankshaft running in only 5 main bearings. There are two connecting rods on each lifting journal. The relatively low number of bearing surfaces reduces the lubrication problems.

By the way the connecting rods are forged from sintered steel and are distinguished by an especially good fatigue strength. The pistons of the engine run – without extra liners – direct in the light alloy engine block. A special pickling treatment makes the cylinder bearing surfaces especially hard and wear proof.

Flegl:

As far as your question is concerned about special features, the 928 engine is an engine with a low share of steel; it consists to a greater extent of lighter and also more expensive aluminium, and in fact the entire block.

Special is also the toothed belt used to drive the camshafts; no gear wheel against gear wheel. This reduces the noise level considerably. The hydraulic tappets have the advantage, that they are free of maintenance and that the valve clearance does not have to be adjusted. This expensive workshop job is omitted. The hydraulics for the tappets is connected to the engine oil circuit and

is regenerated accordingly every 20,000 km (12,000 miles) automatically.

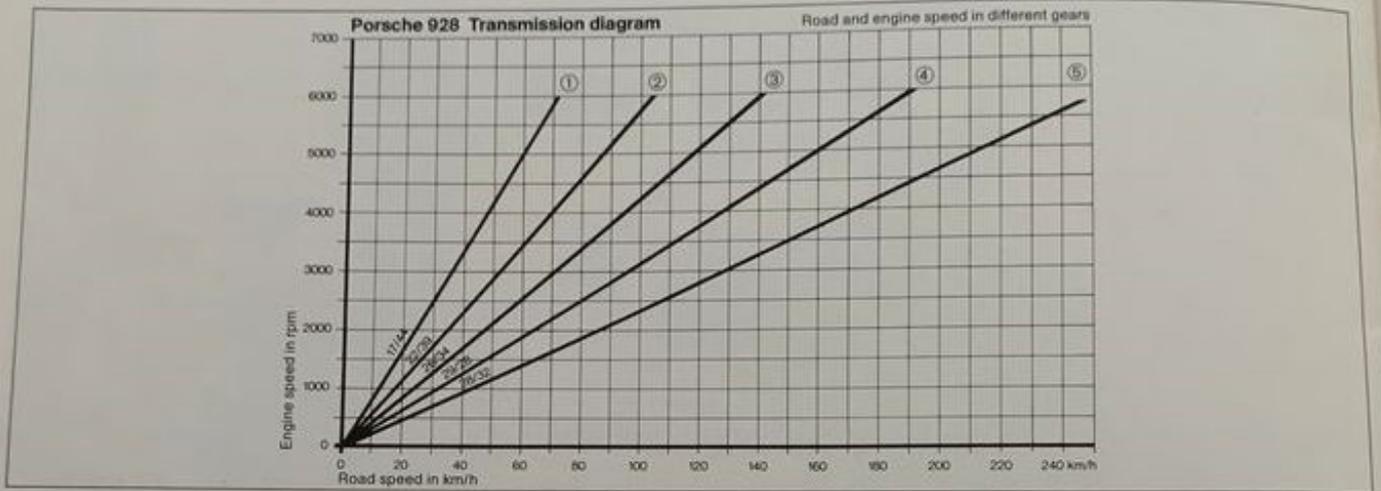
Lubrication of corresponding engine parts is by forced circulation with the unproblematic wet sump, which can be applied for water cooling. In this manner a relatively lower amount of oil (just barely 7 liters) is required. In the radiator an oil cooler is installed as a heat exchanger.

The fuel injection is the well-known continuous fuel injection system from Bosch.

The contactless transistor ignition system functions free of wear, failure proof and it is not restricted by any top speed limit.

Gorissen:

As far as cooling is concerned it must also be mentioned that there is an additional, mechanically driven fan in the front end of the car, which is torque limited and temperature controlled (equals visco-coupling). To keep the noise level low, the fan runs only up to about 3,400 rpm proportional to the engine speeds and then remains constant in speed.



A bimetallic spring is mounted on the front end of the visco-coupling, whose bending depends on the warmth of the air outlet behind the radiator.

This bimetallic spring will open a valve between the supply and working chamber of the coupling after a certain heat development in the cooling system. The temperature controlled switching begins at 28° C air temperature. Complete switching is accomplished at 62° C.

The oil entering into the working chamber produces a power train between the drive and fan at appropriate slip because of the viscosity of the oil. The fan never runs at more than about 50 % of the maximum crankshaft speed.

The advantages of the fan are fast reaching of operating temperature. The switched off fan does not require drive output from the engine; consequently higher effective output from engine, lower noise level.

In other words sleekest V8 engine ever, lowest amount of steel in an engine, parallel valve arrangement, toothed belt drive, hydraulic tappets, extra fan - special engineering features of the 928 engine. Then there is also the wet sump lubrication which is not common for Porsche. Mr. Flegl, could you maybe tell us something about the clutch and transmission?

Flegl:

You are already familiar with the double plate clutch. The transmission is located in front of the rear axle, different than on the 924. And you also know that we have a 5-speed manual transmission and a 3-speed automatic transmission as optional extra equipment. Fifth gear is direct, i.e. the engine speed and running gear speed are at a ratio of 1 : 1 and this provides low noise level driving.

The 3-speed automatic transmission is still sporty; it will shift from

first into second gear under full throttle at 5,900 rpm, or from second into third gear at 5,250 rpm.

For the driver it is important to know, that the kickdown can still be used at 75 km/h to downshift into first gear. On the basis of our test drives we are of the opinion, that the automatic transmission is well suited, is fun and provides pleasant handling due to the high torque and flat torque curve.

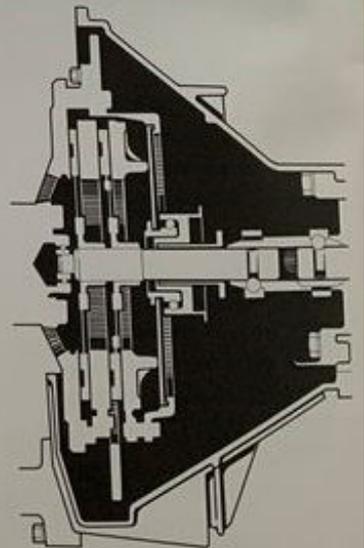
Doesn't the automatic transmission reduce the driving performance?

Flegl:

This will be hardly noticeable in the top speed. When moving off from a traffic light the car with an automatic transmission will even be better, since the tractive power will not be interrupted by changing gears.

In other words sporty driving, whether with manual or comfortable automatic shifts, which the car can allow itself on the basis of the high torque. Each type of driver will be

completely satisfied. Gentlemen, thank you very much for this talk.



(K 1) Our recommendation for question (1):

Yes, I felt the same way as I saw it for the first time. But since I learned the reasons for this styling, I see it in all together different aspect.

The long hood of Ferraris and Lamborghinis results from the long engine design and is made for styling only, while it lacks on practical use (large turning circle, small overhang angle – important for garage drive-ways – etc.). The car is stable because of the **forward centre of gravity**, the engine. The 928 also has its engine up front. But the aerodynamics also have to be considered in addition to directional stability. And I'm sure that you know, that the most favorable aerodynamic shape is a **drop** – with the thick end facing forward. The Italians have a shape like a drop turned around; therefore in spite of a streamlined shape they are not quite so aerodynamic.

We could have given a long hood look to the 928. But we wanted to keep it **as aerodynamic as possible**. This includes the smooth fastback rear end with **hardly any break-away edge**, which would create drag. The Italians need a lot of engine power to counteract this force. Further you'll surely agree with me, that supermodern Italian styling soon becomes old. The 928 is timeless just as all Porsches.

Naturally every observer will need a certain amount of time to get **accustomed** to the unusual styling of the 928; but a car which is technically different than other cars has the **right to look different** than the others. Don't you agree?

The important catchwords have been underlined. Are yours at least analog in meaning?

(K 2) Our recommendation for question (2):

Would you like the car like this? What would you say, if it were equipped in this condition with bumpers meeting US legislation?

Railway sleepers look strong, but they are not **beautiful**. Aren't you of the same opinion? The 928, too, has a **well functioning impact zone**, which is separate of the body. Luckily it was possible on the 928 to **integrate** them, in that they have been covered with an **elastic plastic coat** in the **colour of the car's body**. Impacts from collisions up to 8 km/h are **just as harmless** as in the case of rubber pads on the 911.

What is **your** opinion of this example giving solution?

(K 3) Our recommendation for question (3):

Yes and, since there are **two versions** of impact zones. The American version with hydraulic **impact dampers**, which you could have as optional extra equipment, return to their original position after an accident as though there had not been an impact.

The **impact tubes** as standard equipment in Europe absorb the impact energy by deformation of the tubes, which have to be replaced **in a workshop** afterwards. The plastic coat is not damaged.

(K 4) Our recommendation for question (4):

This opinion was correct earlier – in the first years of the 911 model range. In the meantime a lot has been done here, too.

Just as much attention has been given to comfort and sportiness in this new development, the 928. With comfort we understand first of all **riding comfort**, that the cars have an excellent springing and vibrating behavior; have a good-natured handling and are easy to drive, and secondly **comfort in the passenger compartment**. May I explain this somewhat more in detail?

What you indicated, was almost exactly the requirements which the research departments had to fulfill. We have now been successful, by dividing the heavy masses – engine and transmission – to the ends of the car (the so-called transaxle principle), of not only an optimal **weight distribution** of 50 : 50 and therefore optimal directional stability, but also a **good-natured reaction** to steering motions (perhaps comparable with a long pole of a tight-rope artist instead of a short pole) and a high degree of **resistance against side winds**.

Since the engine – by the way the transmission, too – is installed very deep, the car has a low centre of gravity. In conjunction with the wide track and the low car height along with optimal suspension the lateral tilt is kept to a minimum, even when driving fast in curves.

But not enough: Porsche has also designed a completely new **rear axle**, with which something has been reached, which is unique. The so-called **spinning effect** (explain!) has been eliminated. This for your question concerning strenuous driving.

And as far as riding comfort is concerned? Maybe it would be best when you check this in a test drive. You'll be pleasantly surprised!

(K 5) Our recommendation for question (5):

If you would please look at this diagram: **the major weights are at the ends of a car**, the engine front and the **transmission rear**. This results on the one hand in **even loads** for both axles as well as a **higher moment of inertia** around the vertical axis. (You know, that each object has a gravity centre. Well, the vertical axis is an imaginary vertical axis which goes through this centre of gravity.)



If the masses were as close to the vertical axis as the arms of an ice-skater, the car could turn around this axis easily.

Since the masses are located at each end, the car will not react sensitively to steering motions, but sooner **good-natured**; one speaks of a higher moment of inertia.

You know, that cars with a front centre of gravity will understeer; you have to fight the steering wheel on curves; while cars with a rear centre of gravity tend to oversteer.

Neutral steering behavior under all road conditions is only offered by cars like the 928, with the centre of gravity in the middle.

In other words neutral steering behavior, optimal directional stability, high resistance to side winds and good-natured reaction are the special properties of a transaxle design.

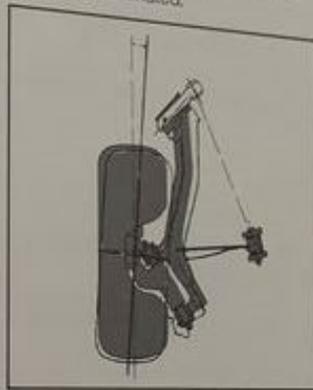
(K 6) Our recommendation for question (6):

The rear axle, as the entire running gear, must only be seen in conjunction with the transaxle design. It was our objective to support the handling properties resulting from the transaxle and to also improve the sportiness. To maintain the wheel camber **change** within certain limits (perhaps make sketch of wheel camber), we have chosen independent wheel suspension on double wishbones.

An important new feature of the rear axle is a **device to stop the car from spinning out** when decelerating in a curve; since every rear axle has the characteristic, that heavily-loaded wheel on the outside of a curve, which has special influence on handling, will be forced in direction of toe-out when releasing the accelerator pedal (deceleration).

Consequently Porsche provides a **small control arm on the front end of the lower wishbone**, which when decelerating will put in a steering movement to the wheel via this wishbone and turn the wheel towards toe-in. This counteracts the normal behavior of the axle and prevents spinning out.

Further the rear axle is designed, so that there is hardly any dive from braking, and squatting of the tail end is practically eliminated.



(K 7) Our recommendation for question (7):

Naturally the brakes are a **dual-circuit diagonal braking system**, which guarantee excellent efficiency under all circumstances. Further an **electric indicator** shows when pads need replacement.

The braking effect is outstanding, namely from 100 km/h to a full stop in 3.2 seconds, this is better than that of a Mercedes 450 SLC.

Even your wife can easily obtain optimal braking effect from the **large-sized discs** in conjunction with a **pressure booster**. Fading, for example when driving down long steep hills, is practically excluded by the application of **floating caliper brakes** and **disc brakes with inboard ventilation**. This is been proven in long tests under extreme driving conditions.

We can proudly claim that there is nothing better or safer on the market!

(K 8) Our recommendation for question (8):

Now, first of all there is the **especially low and compactly built V engine with 8 cylinders**, 4.5 liters displacement and 240 HP. Unusual is the **parallel valve arrangement** with bucket tappets, which favoured the low design; further it is an engine with a **very low share of steel**, since it is chiefly made of light-weight aluminium.

It runs almost free of vibration and is very quiet – thanks to **toothed belt drive**. The valve clearance does not have to be adjusted because **hydraulic, maintenance-free tappets** are used.

These are important advantages, which you will find to be pleasant when driving this car and which round off the Porsche riding comfort.

(K 9) Our recommendation for question (9):

You are right, if you are referring to the great amount of force required to release the clutch of a 4.5 liter engine. One large single-plate clutch would place too much load on the transmission's synchronization.

This problem was also known in racing, and Porsche had designed the **double-plate clutch** for this purpose and tested it under the hardest conditions. It is now also installed in the 928 and permits an unproblematic transmission of engine power to the gearbox.

(K 10) Our recommendation for question (10):

Porsche had already designed many **water-cooled engines for other automobile companies**, which have been proved thousand times over. Last but not least this is why the Porsche Research and Development Center in Weissach is known as the mecca in automotive engineering.

And to answer your direct question concerning the fan, an **extra fan** is also used in the 928 to improve the cooling effect at higher speeds and temperatures. This fan functions with **temperature control and speed limit**.

(K 11) Our recommendation for question (11):

If you consider the displacement, the **weight and the size of the 928**, you would expect a much higher consumption figure than it actually is: only **13 liters** (21 mpg according to DIN) and in fact **regular grade fuels**. The 928 is surely one of the most economical cars in this price category.

Also of importance are the **long intervals between inspections**, the **elimination of complicated service jobs** such as adjustment of valve clearance, the high resale value because of the **longterm warranty** and the Porsche **model consistency** as well as the great **dependability**.

Its special economy is really evident when comparing it with similar competition models, e.g. Ferrari or Jaguar.

(K 12) Our recommendation for question (12):

On passenger compartment comfort you probably mean the **luxury of equipment** as well as **operating comfort**, the resistance to fatigue and all of the technical functions, which all assist the driver.

As you can see, the entire inside is a **new design**. No patchwork, but a tastefully completed entirety. The **well-chosen decors** of the valuable materials can be varied in many ways, so that you can make up your individual Porsche alone with the interior decorations; regardless whether you prefer this genuine tartan pattern or these colour combinations designed especially for Porsche.

Please **sit down** inside and you will notice how soft, tireless, ergonomical etc. the seats are and how they provide good location.

A generous amount of space, sufficient storage space. And the **loudspeakers** work according to the radiation principle of expensive hi-fi sets.

Further there is **absolutely no glare** from the instruments which have a new laminated coat of glass.

Various **control instruments** relieve you of the trouble of having to think of things such as fuel, water temperature or sufficient windshield washing water etc.

Porsche placed a high value on operating comfort (and now make a practical demonstration!):

- **Central warning**
12 functions are monitored by 12 small separate lamps and one large central lamp in the main field of view, which either stays on or flashes depending on the importance of the warning.
- **Electrically heated and inside-operated outside mirror**
- **Tempostat**
- **Height adjustment** for steering
- **Individual adjustment** of pedals
- **Regulation of headlight beam range** from inside with a rotary knob
- **Headlight cleaners**
- **Rear window wiper**
- **Rear window demister** with power-save relay
- **Electric** window controls
- **One-key system**
- **Central locking system**
- **Electric sliding roof** as optional extra equipment

With all of these you will have less or at least easier work, which helps in particular active safety and prevents fatigue.

(K 13) Our recommendation for question (13):

The 928 does not just as a matter of course fulfill **all American safety legislation**; it is superior to it, because it is built for the future. Let it concern a **collision** from the front, rear or side – the energy will always be absorbed by the outside body parts and the strong passenger cell will hardly be influenced at all. We have already talked about the **impact zone** for the bumpers. Now there is the **crash zone** of the body (for crash speed of 50 km/h there is a 80 mm long deform zone of the front and without any mentionable damage to the passenger compartment).

Of course there is a **safety steering column** (breakaway points and a large, very well padded impact shell).

In the **passenger compartment** you will not find any sharp edges, corners or hard buttons, on which someone could injure himself.

Porsche is leading in the field of active safety, that is by improvement of the relation between car and driver (I might recall our sports car driving courses).

With this car you can still react, when others have already taken off on their own. **Driver's mistakes will be absorbed** by good-natured handling. You might recall the properties from the **transaxle design** and the **axles**. And what about the braking system!

The optimal functioning passenger compartment equipment and **operating comfort** from Porsche are sufficient to prevent extensively the occasions leading to wrong reactions in the first place (for example, electric window controls, outside mirror adjustment from inside, switches in steering wheel range, absolutely no glare or reflection, and others).

Porsche used applied safety research of an example-giving nature in designing the 928.

(K 14) Our recommendation for question (14):

Both the 928 and the Turbo are the leading models in our sports car range.

There are two different car design conceptions with equal claim to the top position. You, the customer, must decide which model is the top model for you on the basis of your individual requirements.

Contents:

Statement of Sales Director, Mr. Schmidt
Love at second sight (styling)
928 driving enjoyment
General description
How important is Porsche's top model on the market?
New running gear standards
Safety – a good reason to buy a 928
Economy
Porsche has designed the sleekest V 8 engine
Do you cheat yourself?