

Service.



## Running Gear in the Audi A8

Self Study Programme 285

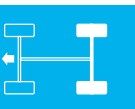
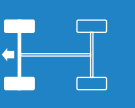
The requirements to be met by the new A8 running gear were highly diverse and thus led to a whole series of conflicting technical aims.

The remedy to these complex problems was found in the introduction of new concepts alongside progressive improvements to existing ideas and the close coordination of all sub-systems.

This approach meant that it was possible to raise the high level of active road safety of the predecessor model still further and thus to again set new standards in the luxury segment.



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The Self Study Programme contains information on design features and functions.

**The Self Study Programme is not intended as a Workshop Manual.**

**Values given are only intended to help explain the subject matter and relate to the software version applicable when the SSP was compiled.**

Use should always be made of the latest technical publications when performing maintenance and repair work.

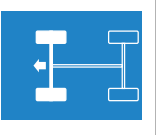
**New!**



**Attention!  
Note!**



# Front Axle



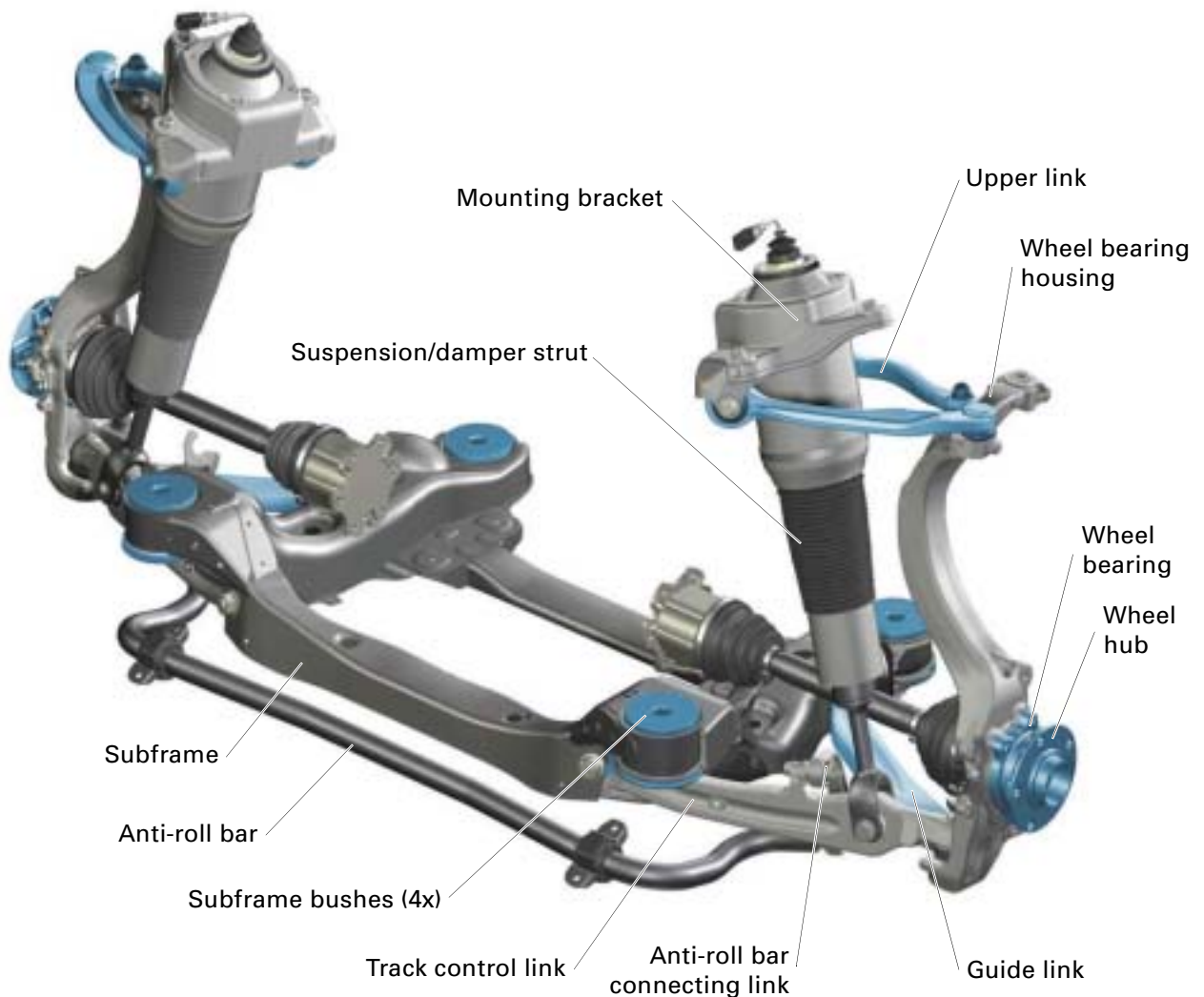
## Summary

The new A8 is fitted with the familiar four-link front axle (refer to SSP 161).

A significant new feature is the air suspension in combination with electronically controlled dampers (refer to SSP 292).

All axle components are new on account of the geometric and kinematic modifications as compared to the predecessor model, as well as the air suspension and the weight reductions achieved.

Wherever technically feasible, use is made of identical components for the VW Phaeton and Audi A8.



 VW Phaeton / Audi A8 identical components

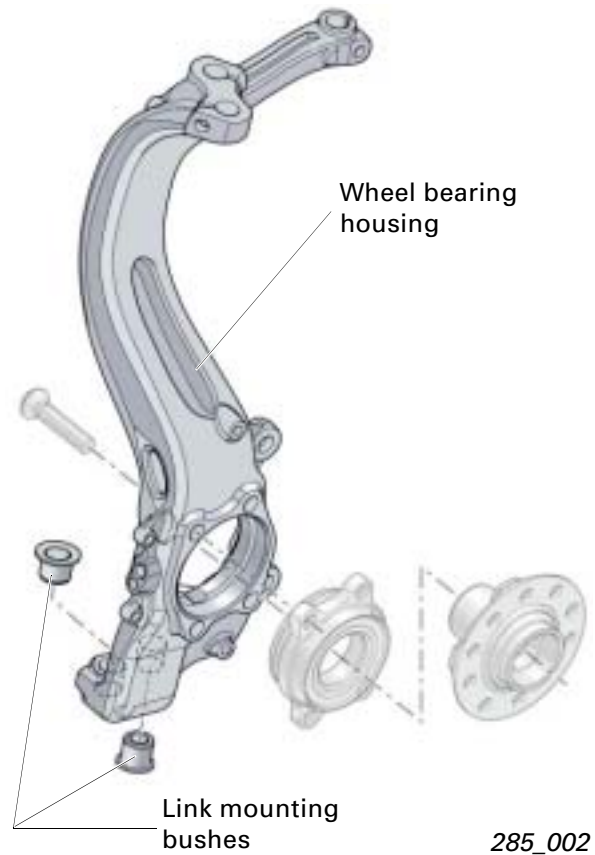
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## System components

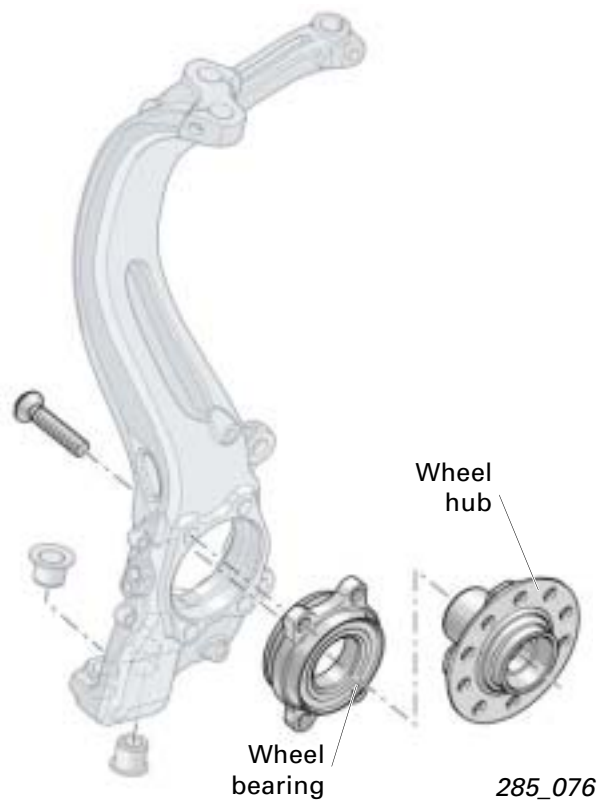
### Wheel bearing housing

The wheel bearing housing is a forged aluminium component. The guide and track control link mounts take the form of press-fit zinc-iron coated bushes.



### Wheel bearing

Use is made of a 2nd generation wheel bearing (flange bearing). A  $\text{Ø } 92 \text{ mm}$  bearing is employed for all engines. The wheel speed sensor ring forms part of the wheel bearing (refer to ESP).



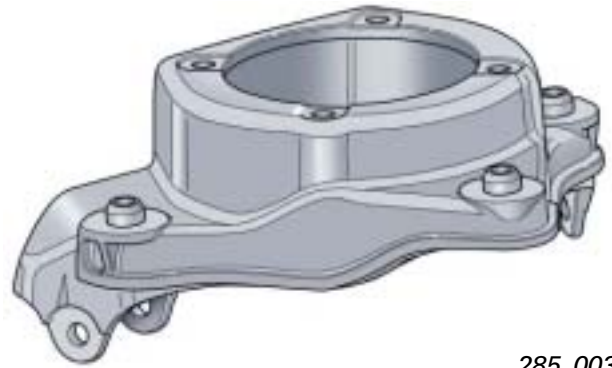
# Front Axle

## Mounting bracket

The mounting bracket is made of Poral cast aluminium. It is bolted to the body and designed to support the upper transverse links and the spring/damper unit.



Pay attention to body bolted joint tightening sequence!  
(refer to current Workshop Manual).



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## Links

The upper and lower links are made of forged aluminium. To minimise road noise and tyre vibration, the guide link is connected to the subframe by means of a large hydraulically cushioned bush.

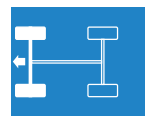


Heed installation positioning!  
(refer to current Workshop Manual).



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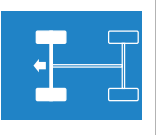
**Spring/damper unit**

Details of the design and operation of the air suspension system components can be found in SSP 292.



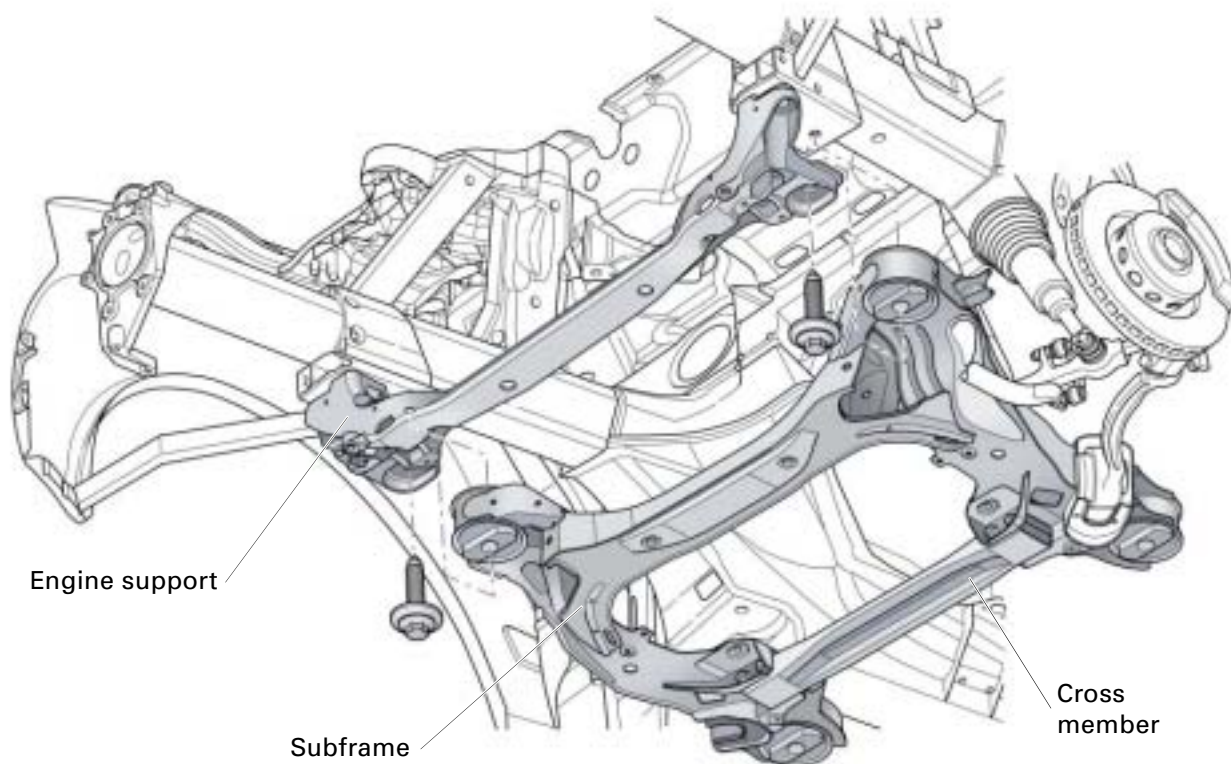
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# Front Axle



## Subframe

The subframe takes the form of a welded stainless steel shell. To increase rigidity, the U-shape is completed by a bolted cross member at the rear.

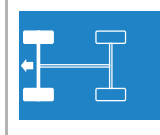


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## Engine support

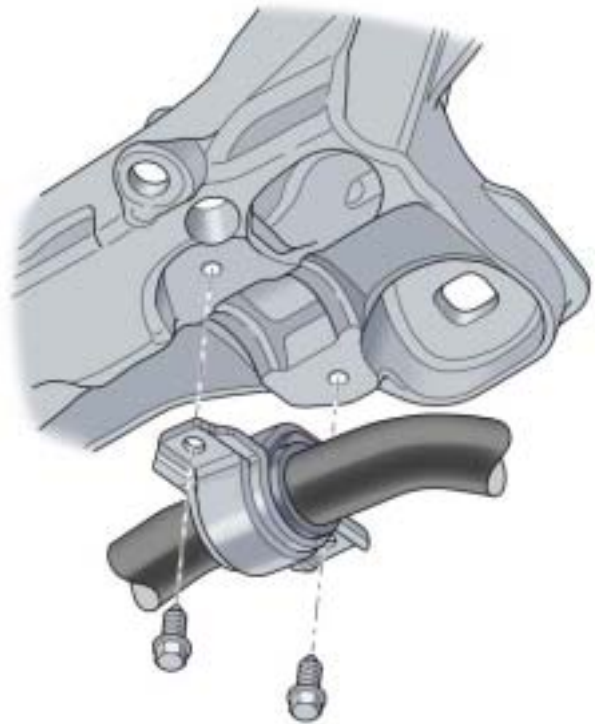
A new feature is an engine support bolted to the front attachment points of the subframe.



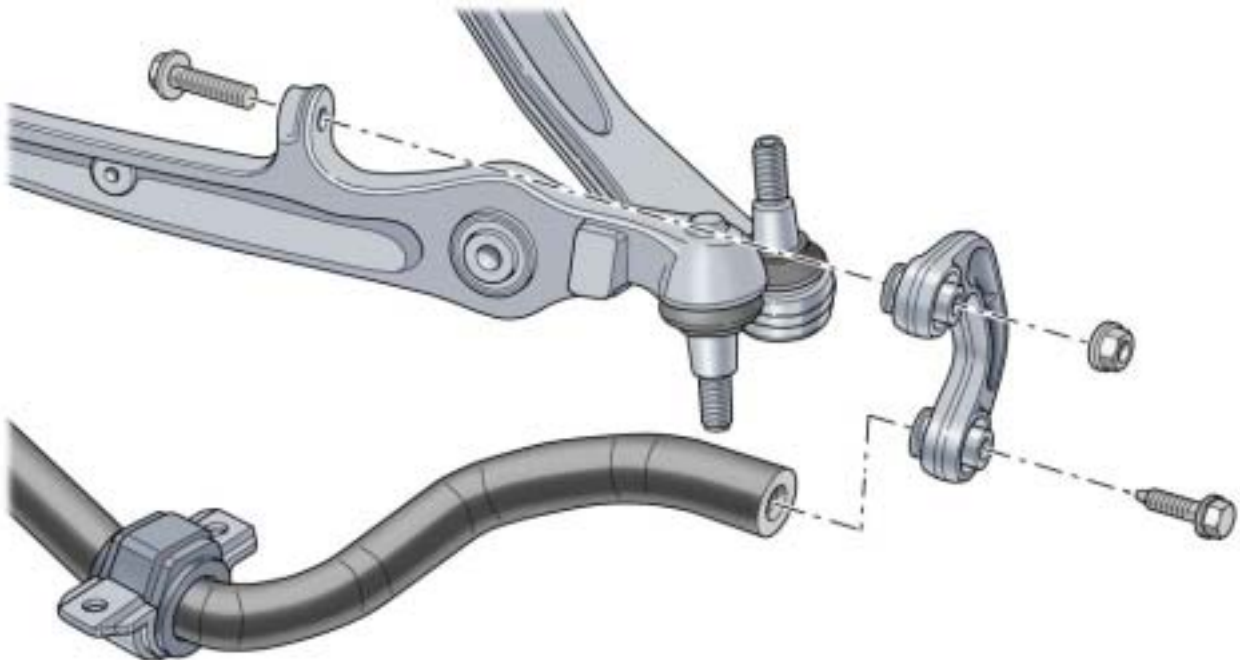


### Anti-roll bar

For weight-saving reasons, the vehicle is fitted with a tubular anti-roll bar. The anti-roll bar joins the two track control links by way of connecting links. A new development is the method of mounting the anti-roll bar at the engine support. The bushes are vulcanised onto the tubular bar and can no longer be replaced separately when performing service work.



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285\_007



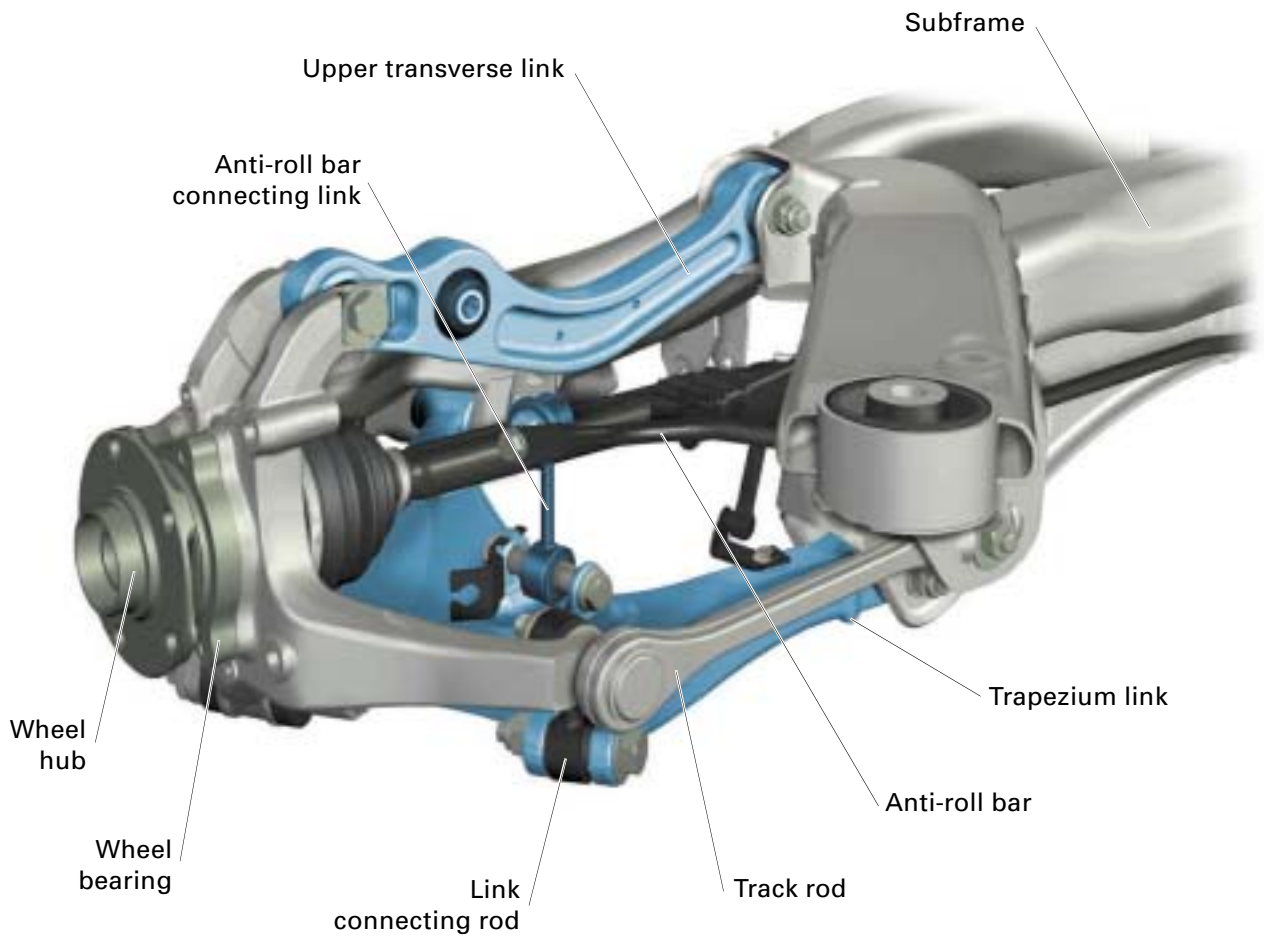
All mounting elements are to be attached in basic level setting ("Automatic" mode, refer to SSP 292).


# Rear Axle

## Summary

The rear axle is a more advanced version of the familiar A8' 02 trapezium-link axle. All axle components are new on account of the geometric and kinematic modifications as compared to the predecessor model, as well as the air suspension and the weight reductions achieved.

Wherever technically feasible, use is made of identical components for the VW Phaeton and Audi A8.

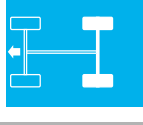


 VW Phaeton / Audi A8 identical components

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### Principal new features compared to A8 `02

- Use of air suspension in conjunction with electronically controlled damping
- Aluminium subframe to help reduce weight
- Joint arrangement of spring and damper at upper transverse link
- Connection of anti-roll bar to trapezium link
- Use of modified track rod to reduce change in toe on compression and extension of suspension
- Use of ball studs to connect wheel bearing housing and track rod, thus reducing secondary spring rate
- Use of slotted bonded rubber bushes in upper transverse link and connection between trapezium link and subframe

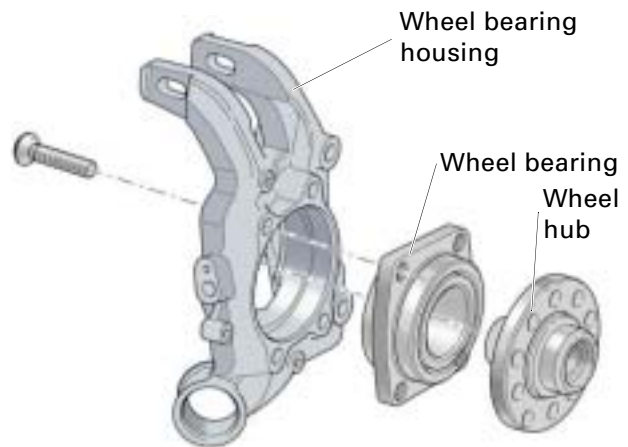


# Rear Axle

## System components

### Wheel bearing housing

The wheel bearing housing is made of gravity die cast aluminium.



### Wheel bearing and wheel hub

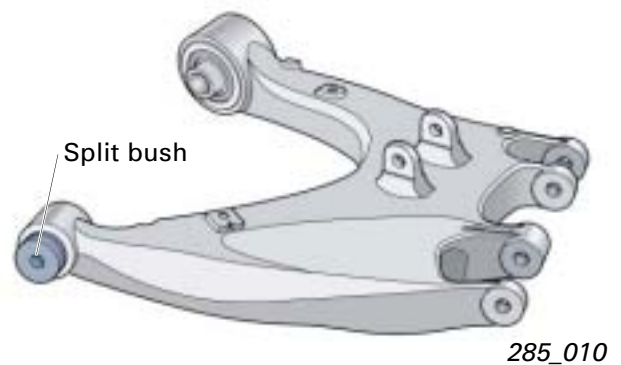
Use is made of a  $\varnothing$  85 mm 2nd generation wheel bearing (flange bearing). The wheel speed sensor ring forms part of the wheel bearing (refer to ESP).

### Trapezium link

The trapezium link is made of sand cast aluminium. It acts as lower connecting element between wheel bearing housing and subframe.

The anti-roll bar connecting link is now attached to the trapezium link.

The subframe mount takes the form of an asymmetrically split bush. This helps to enhance self-steering action in the event of load changes (e.g. braking and cornering).

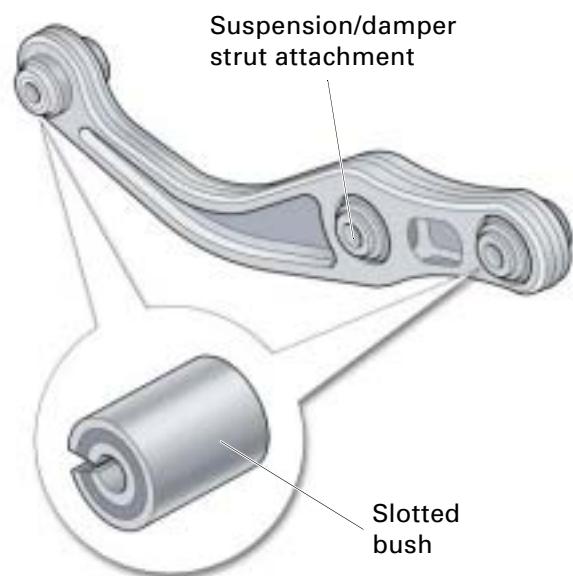


### Upper transverse link

The transverse link is a forged aluminium component. It forms the upper connection between wheel bearing housing and subframe.

Body support at the transverse link is provided by the suspension strut.

This is the first time new mounting elements have been used by Audi. The bonded rubber bushes are axially slotted to enable them to absorb great axial forces with minimum deformation. They nevertheless retain their torsional flexibility and the link can thus turn without any great resistance.



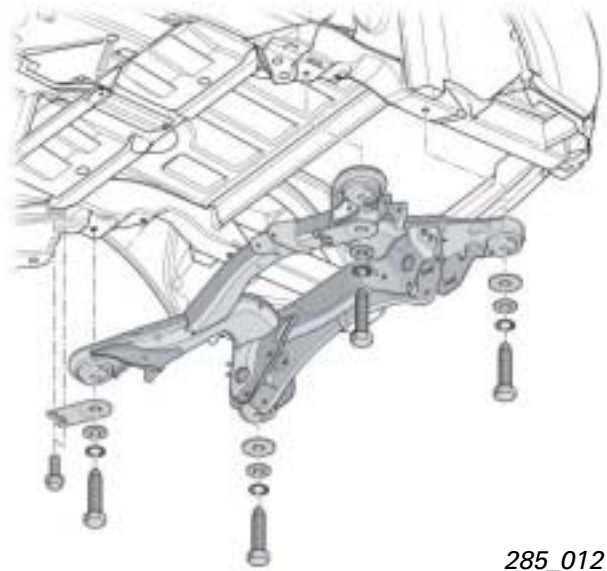
Refer to current Workshop Manual for information on Disassembly/Assembly.

## Subframe

For the first time use is made of an aluminium subframe, thus achieving a weight reduction of approx. 9 kg as opposed to a steel construction. Mounting at the body is provided by four identical hydro-bushes.



The bushes have a specified installation position in the subframe (refer to current Workshop Manual)!



285\_012

## Anti-roll bar

The anti-roll bar is mounted at the subframe and attached to the trapezium links by means of connecting rods.



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285\_014

# Wheel Alignment

## General procedure

The basic principles of wheel alignment and adjustment have been retained.

### Main changes over A8 `02

- The toe constant is now set in vehicle basic position (B=1).
- Balancing out of front axle toe values involves adjusting subframe together with engine support.
- On vehicles with adaptive cruise control, the distance sensor has to be checked/adjusted after changing rear axle toe values.

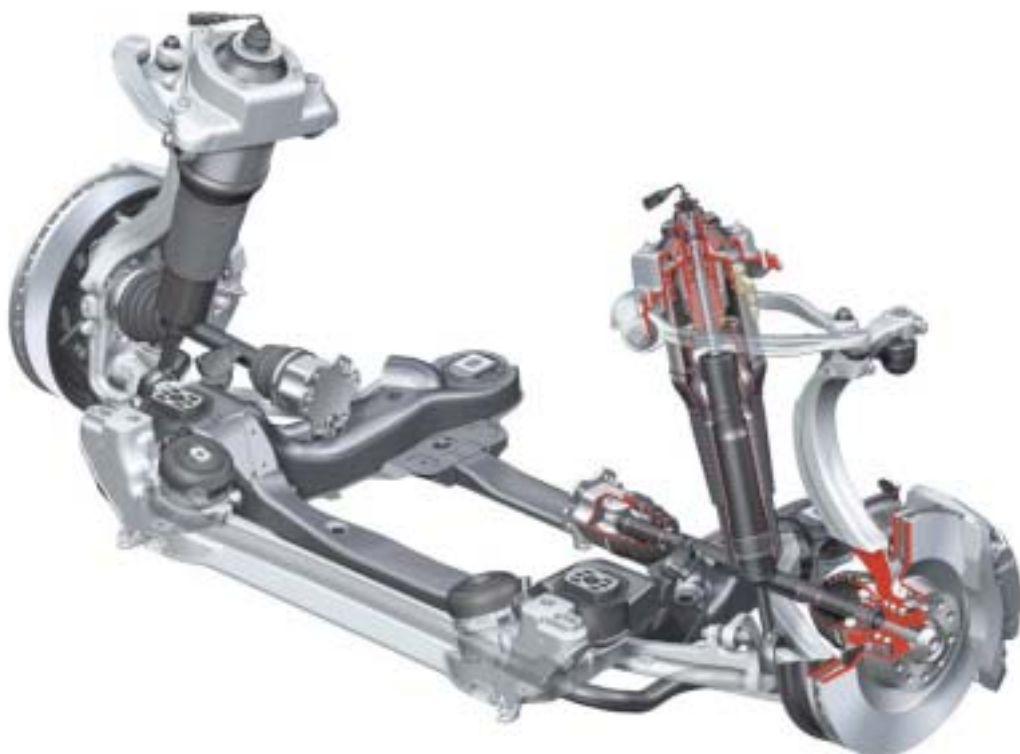


"Automatic" mode must be set shortly prior to wheel alignment. Vehicle must be at a settled level at the start of wheel alignment. For details, refer to wheel alignment computer user prompting.

## Front axle settings

As in the past, individual toe values and the toe change profile on suspension compression/extension (= "toe-in curve") can be set for the four-link front axle. The camber values can be balanced out between the right and left side of the axle.

This is achieved by moving the subframe sideways together with the engine support (for detailed information, refer to current Workshop Manual).



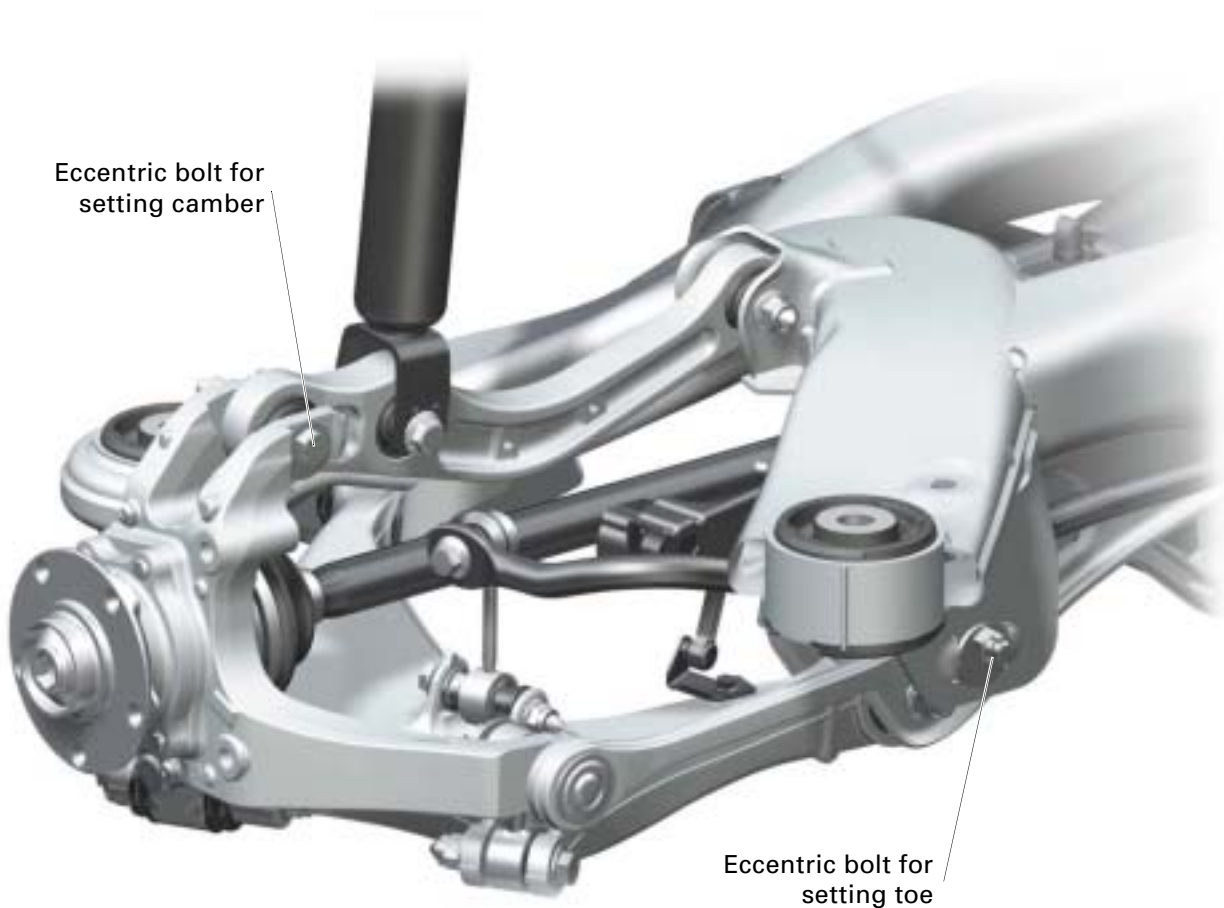
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## Rear axle settings

The camber is set by means of an eccentric at the transverse link/wheel bearing housing bolted joint.

(For detailed information, refer to current Workshop Manual).

The toe is set at the track rod/subframe bolted joint.



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# Steering System

## Summary

Customers can choose between mechanical and electrical steering column adjustment, as well as between power steering and Servotronic.

### Principal new features compared to A8 `02

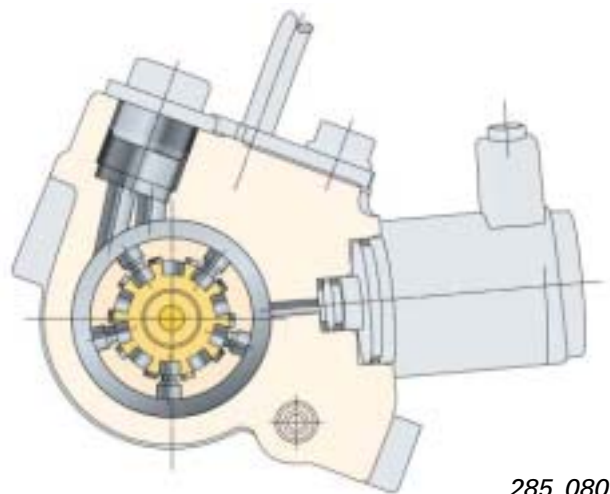
- Electrical steering lock
- Spindle-driven electrical steering column tilt adjustment
- Rigid track rods
- Variable steering ratio
- Servotronic II
- Larger steering mechanism piston diameter
- More detent positions at steering column splines

## System components

### Steering pump

Use is made for all petrol engines of the FP6 vane pump with a delivery volume of  $15 \text{ cm}^3$  per revolution. The maximum system pressure is limited to 125 bar.

For all diesel engines, use is made of the FP4 vane pump with a delivery volume of  $11 \text{ cm}^3$  per revolution. The maximum system pressure is again limited to 125 bar.



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## Steering mechanism

### Design:

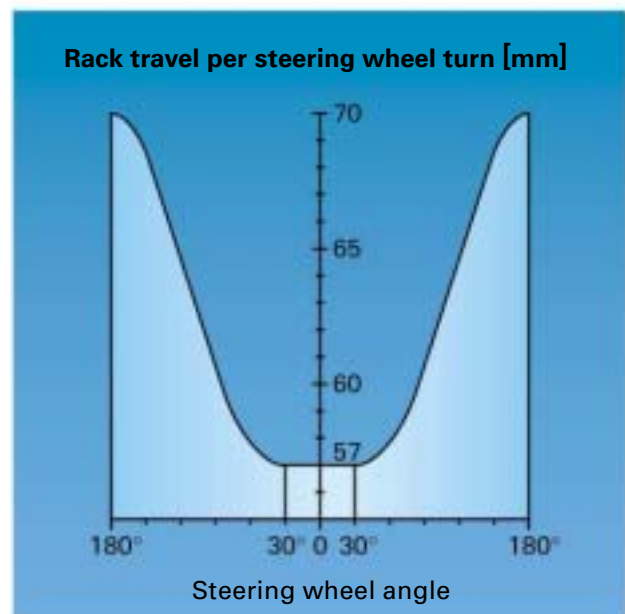
The rack and pinion steering mechanism essentially consists of a rack and pinion with mounting elements, piston and rotary slide valve.



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### Principal differences compared to A8 '02

- Manufacturing the rack splines with different modules and meshing angles permits variable translation of steering wheel movements into rack travel. This variable ratio achieves a more direct response with larger steering angles.
- The piston diameter was increased from 43 mm to 45 mm on account of the higher axle load on vehicles fitted with the full range of equipment.
- The rotary slide now has 10 grooves instead of 6, thus increasing the number of helices at the rotary slide. This produces a larger cross-section for the flow of fluid and lowers the sound level by reducing flow noise.



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# Steering System

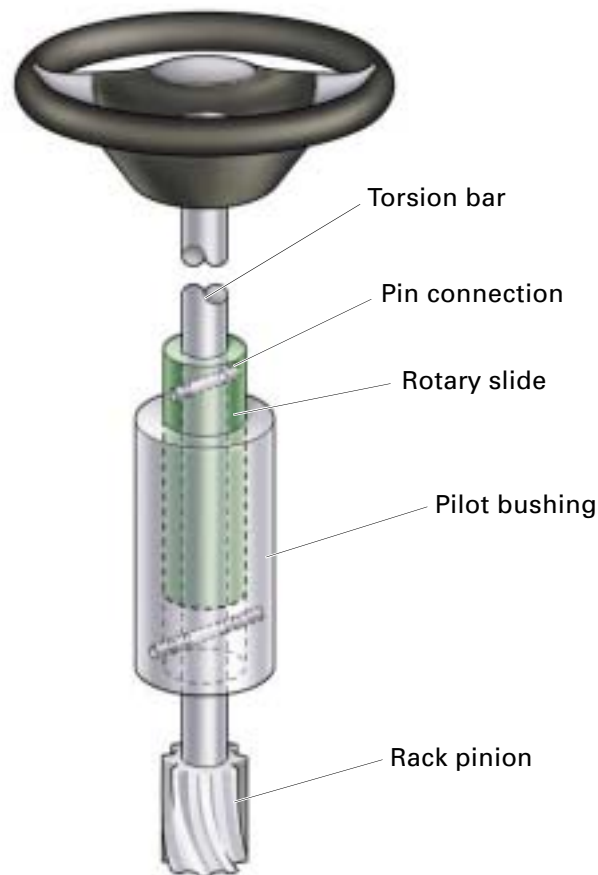
A torsion bar in the rotary slide valve is directly connected to the steering column shaft by way of a universal joint. The upper end of the torsion bar is rigidly linked to the rotary slide by means of a pin connection. The lower end is pinned to the rack pinion and pilot bushing.

Driver-induced steering motion causes a force to act on the torsion bar. The torsion bar is turned (= twisted) in a manner comparable to anti-roll bar torsion at an axle subjected to one-sided suspension compression.



The rotary slide is turned together with the torsion bar relative to the pilot bushing.

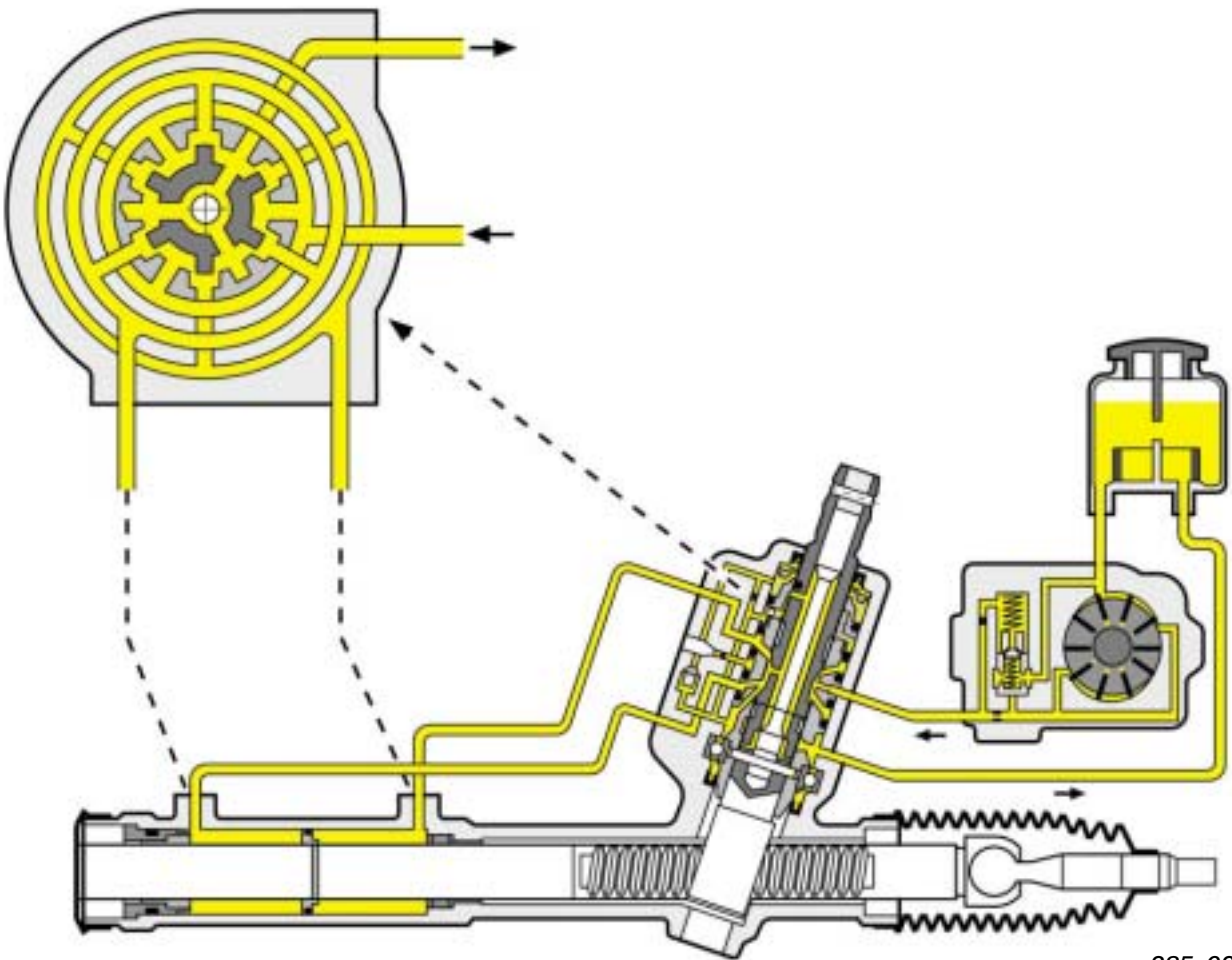
This results in a change in the relative positions of the grooves and bores in the rotary slide and pilot bushing. Specific fluid ducts can thus be opened and others closed depending on the angular offset between rotary slide and pilot bushing.



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## Neutral position

If force is not being applied to the steering wheel, the operating cylinder and pressure pipe are connected to the fluid reservoir and no pressure is built up in the system.



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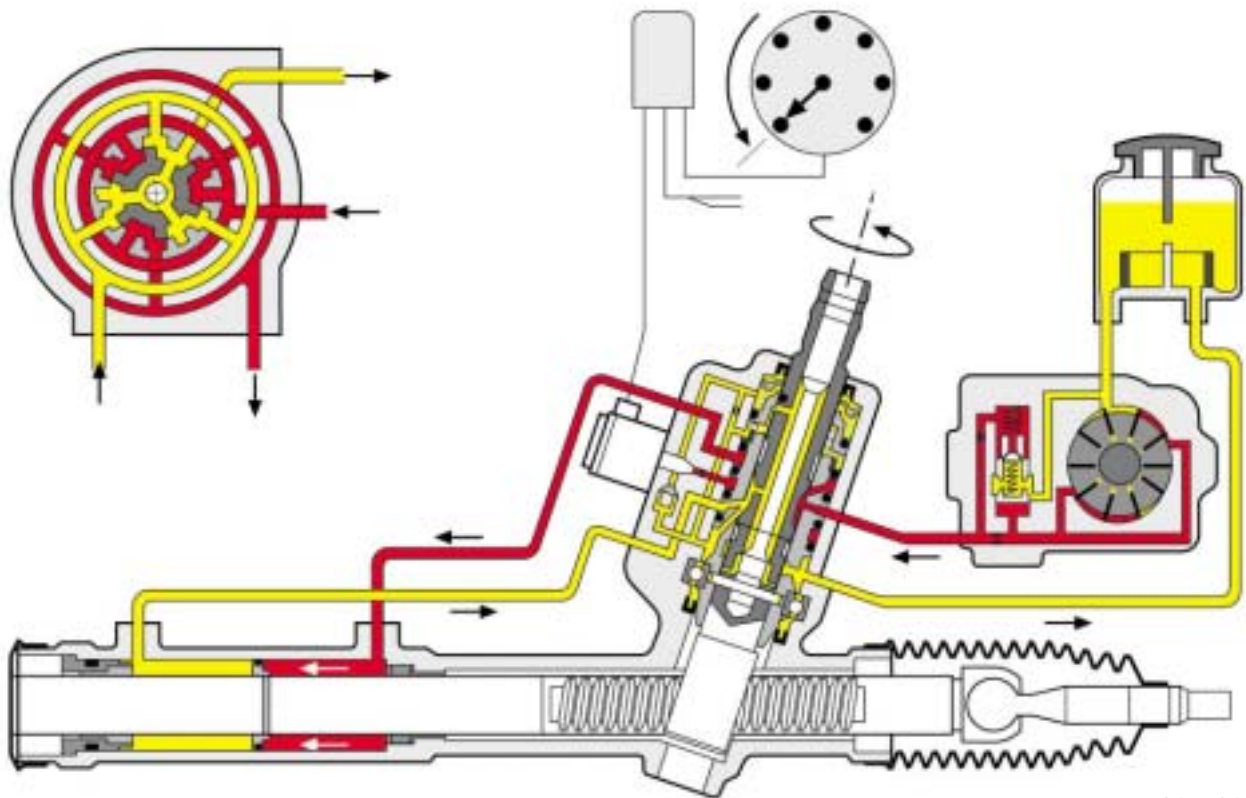
In the interests of clarity, the rotary slide is illustrated with 6 instead of 10 grooves.

# Steering System

## Left wheel lock

Turning the steering wheel to the left causes the torsion bar and rotary slide to be turned on account of the resistance exercised by the tyres and road surface to turning. This action opens up a fluid duct from the pressure pipe to the right operating cylinder. The left operating cylinder is connected to the return pipe to the fluid reservoir. The piston is subjected to a force acting in the direction of left wheel lock. The rotary slide continues to turn until the total piston and steering force is sufficient to move the wheels to left lock.

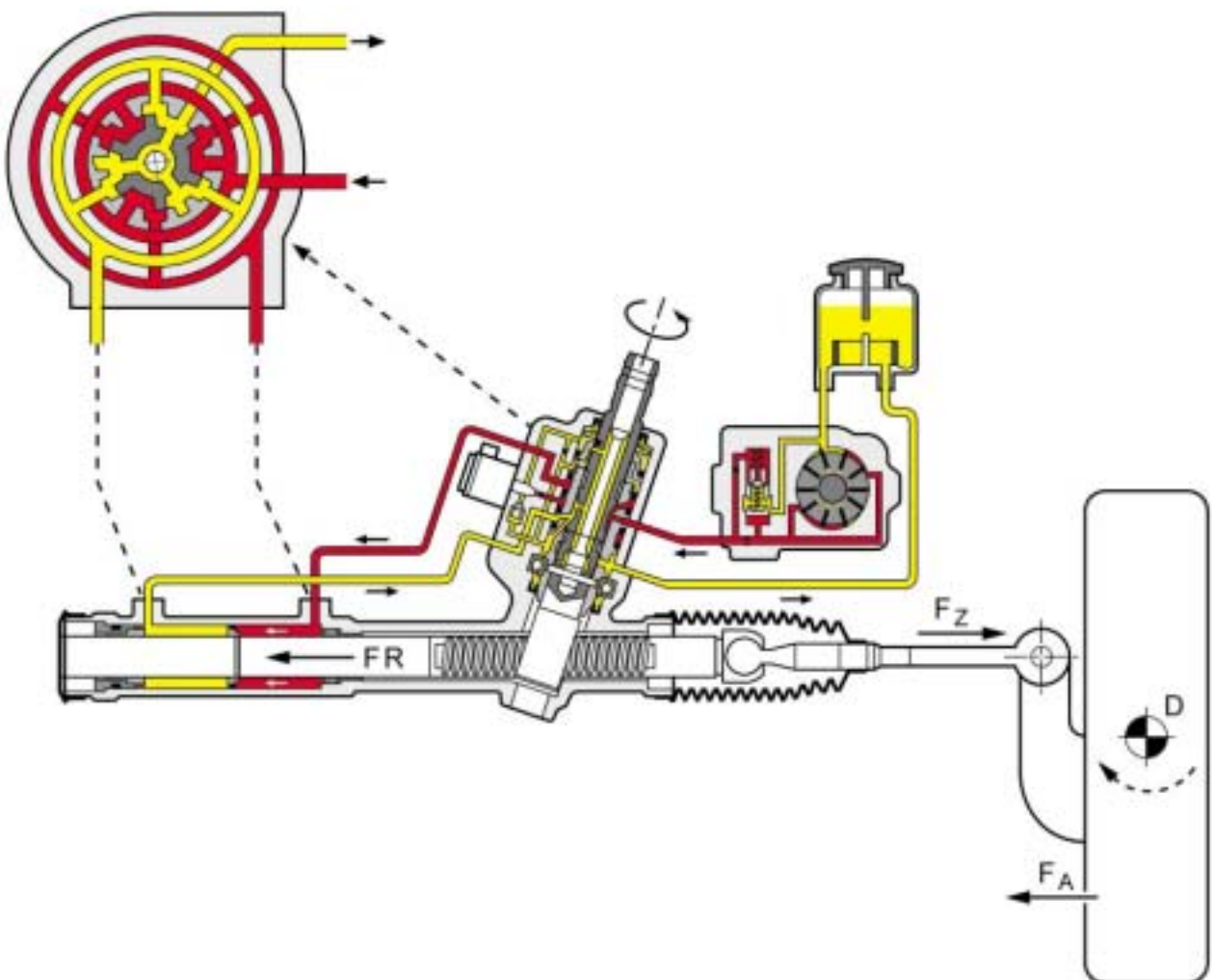
The associated movement of the rack pinion also causes the lower part of the torsion bar to be turned with the pilot bushing. This movement is maintained until there is no longer any turning of the torsion bar and thus no angular offset between the rotary slide and the pilot bushing (= neutral position). The return pipe to the fluid reservoir is re-connected to the operating cylinders and pressure pipe and the system is virtually depressurised again. Each time force is applied to the steering wheel, the torsion bar is turned and the above-mentioned sequence is implemented again.



285\_081

In the event of forces acting in the opposite direction, e.g. as a result of an uneven road surface, the power steering has a cushioning effect. This results in turning of the torsion bar due to the force of the rack acting on the pinion and torsion bar.

The rotary slide and pilot bushing are turned towards one another out of the neutral position. Fluid under pressure is then conveyed to the operating cylinder chamber, where it counteracts the rack movement.



285\_022

**Example:**

A bump in the road exerts force  $F_A$  on the front wheels, causing the wheel to turn about point D (to the right).

The resultant force at the rack ( $F_Z$ ) causes the pinion and torsion bar to turn. The fluid supply to the right cylinder side is then opened up and the left side is connected to the return. The reaction force  $F_R$  at the piston and rack equalises the action of force  $F_Z$  and thus prevents turning of the wheel.

# Steering System

## Servotronic solenoid valve N119

The solenoid valve acts as electrohydraulic converter for implementing the Servotronic function. It is of the proportional type and open when deenergised. The higher the current level actuating the valve, the smaller the opening cross-section.

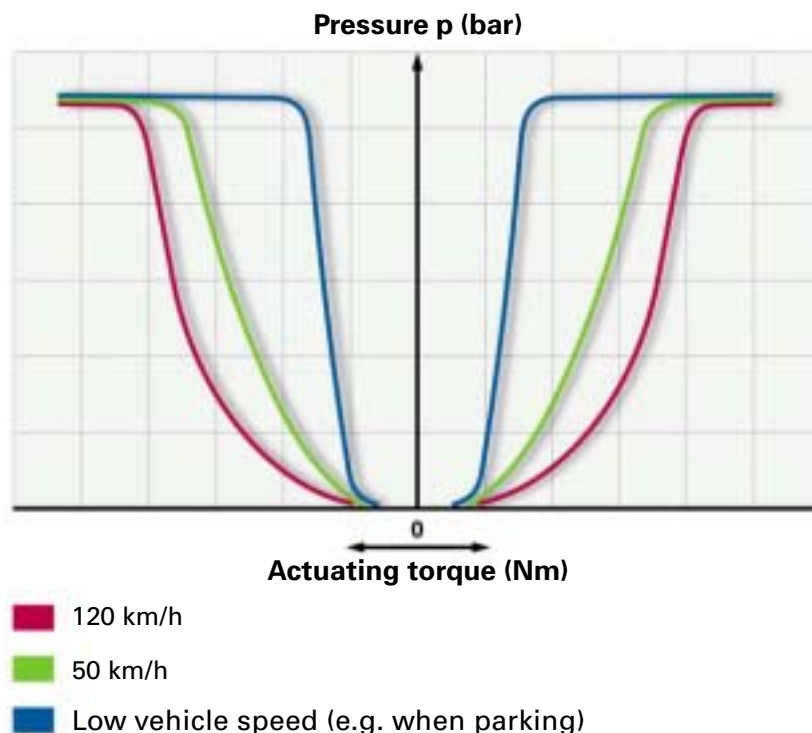


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## Servotronic operation

The higher the vehicle speed, the lower the force which has to be exerted by the driver on the steering wheel when changing direction. This basically applies to all steering systems (with and without servo action). Certain compromises therefore have to be made when designing the steering. It is important to avoid an impression of over-light steering at high vehicle speeds.

This is remedied by Servotronic. The Servotronic regulates the actuating torque at the steering wheel as a function of vehicle speed. The maximum servo action is provided when the vehicle is stationary or moving very slowly (e.g. when parking).



The Audi A8 '03 is fitted with the newly developed Servotronic II.

This again operates on the active hydraulic reaction principle.

The reaction piston is located above the pilot bushing. The piston is connected to the rotary slide and thus also to the torsion bar and is supported by way of balls on the centring element linked to the pilot bushing. When the steering wheel and thus also the torsion bar are not being turned, the balls are located in a guide collar. Fluid is applied to the chamber above the reaction piston. The force exerted by the reaction piston on the balls and thus on the pilot bushing varies in line with fluid pressure.

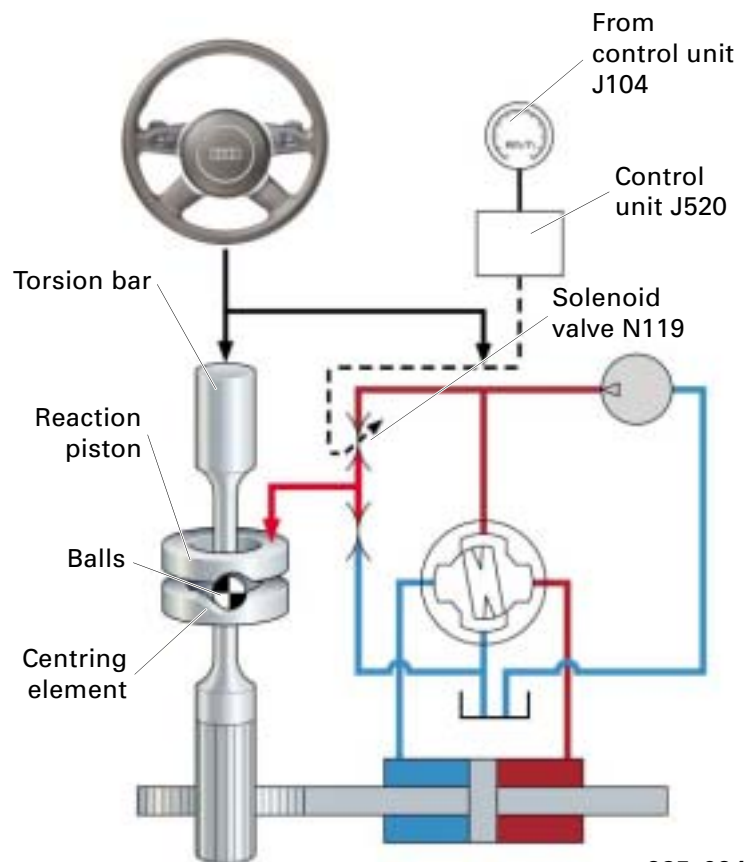
The higher the fluid pressure, the greater the force applied and thus the higher the actuating torque to be exerted by the driver on the steering wheel. The pressure control element is the Servotronic solenoid valve N119.

The valve is actuated by the onboard power supply control unit -2- J520. The input signal for the control unit is the vehicle speed signal from the ESP control unit J104. The larger the opening cross-section of the valve, the smaller the drop in pressure at the valve and thus the higher the pressure in the chamber above the reaction piston.

Different characteristic curves for steering wheel actuating torque and steering system pressure are thus obtained depending on vehicle speed.

**In addition to its actual function, the method of operation of the Servotronic II offers two further advantages:**

- The guide collar for the balls provides additional steering centring. Straight ahead stability is enhanced particularly at high speeds.
- Fluid pressure and volumetric flow rate are not reduced. This ensures that there is always a safety margin for dealing with emergency situations (e.g. in the event of abrupt, unforeseeable steering correction).



285\_024



# Steering System

## Steering column

As regards basic design, there is no difference between the principal components of steering columns with mechanical and electrical adjustment. Both are equipped with the electrical steering lock.

The steering wheel mounting splines now have 72 detent positions instead of 6.



285\_026

## Steering column with mechanical adjustment

The steering column is fixed in position by means of two sets of plates with eight steel plates each. Four plates each permit axial adjustment. The recesses in the plates for adjustment are arranged axially. The other four plates on each side are arranged vertically and permit vertical adjustment. Clamping is achieved by two rollers which run up a ramp on a cam plate during the locking process. The lever is fixed in position by an over-centre spring.



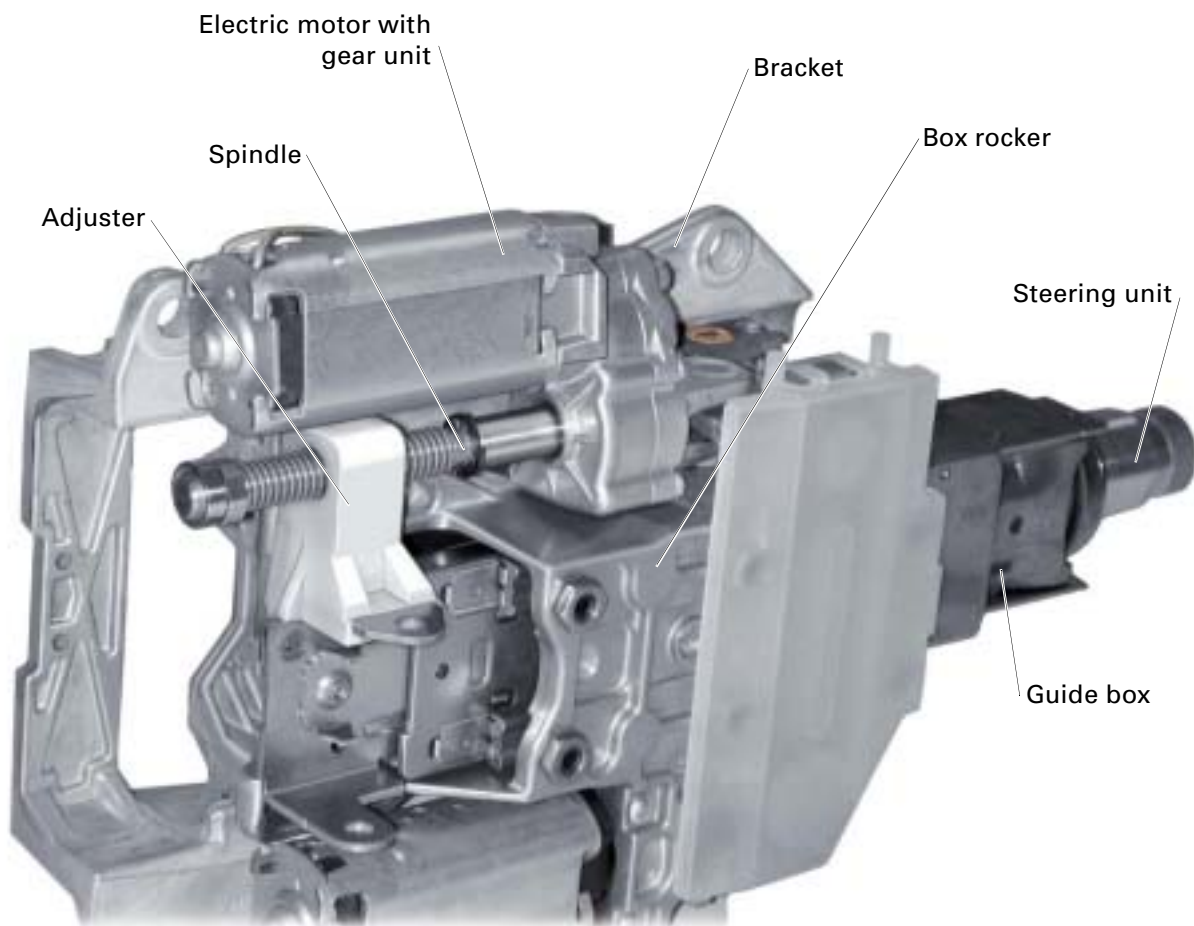
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## Steering column with electrical adjustment Axial adjustment

The electric motor with gear unit and spindle is permanently connected to the box rocker. The guide box with steering unit is permanently connected to the adjuster. The spindle is screwed into the internal thread of the adjuster.

The rotation of the spindle is converted into axial movement of the adjuster with guide box and steering unit. A Hall sensor in the electric motor measures the number of revolutions. The control unit uses this information to determine the current position in the steering column adjustment range.



285\_028



# Steering System

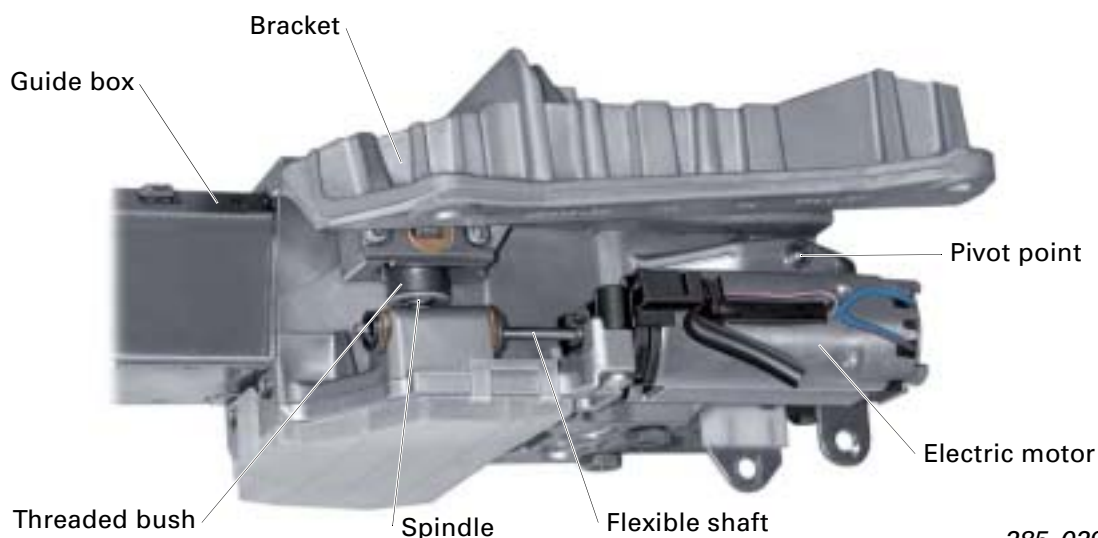
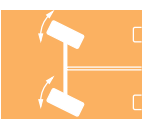
## Vertical adjustment

The box rocker with guide box and steering unit is swivel-mounted in the bracket. The electric motor with flexible shaft, spindle and gear unit is permanently connected to the box rocker.

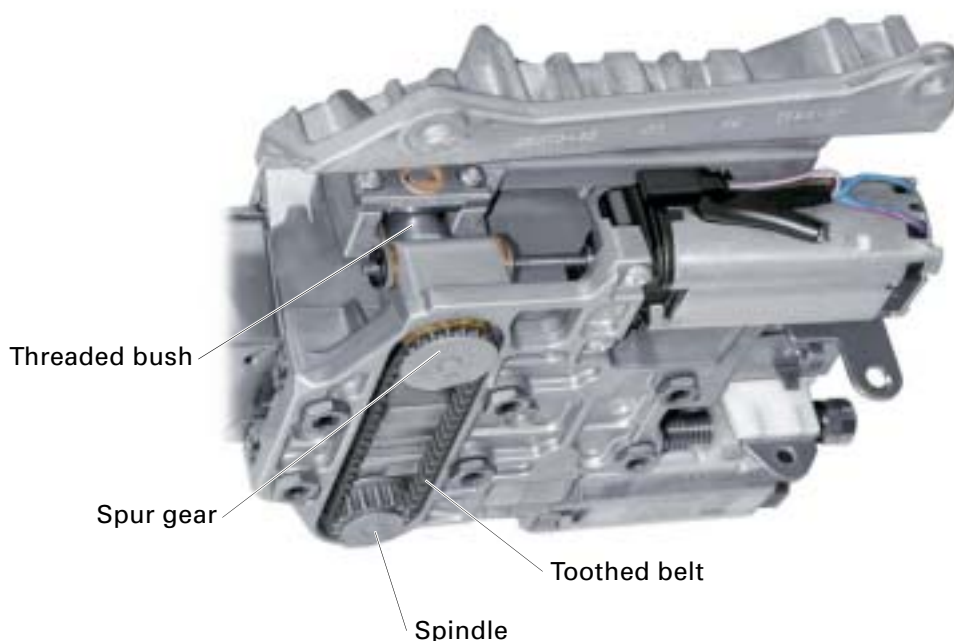
A threaded bush into which the spindle engages is mounted in the bracket. Rotation of the spindle produces vertical movement of the threaded bush. The rocker with guide box and steering unit is turned about the joint pivot point.

The other end of the spindle is permanently connected to a spur gear. A toothed belt transmits the rotation to a spindle on the other side of the steering column, where adjustment takes place with identical components. The two-sided mounting system provides far more rigid attachment of the steering column.

A Hall sensor in the electric motor measures the number of revolutions. The control unit uses this information to determine the current position in the steering column adjustment range.



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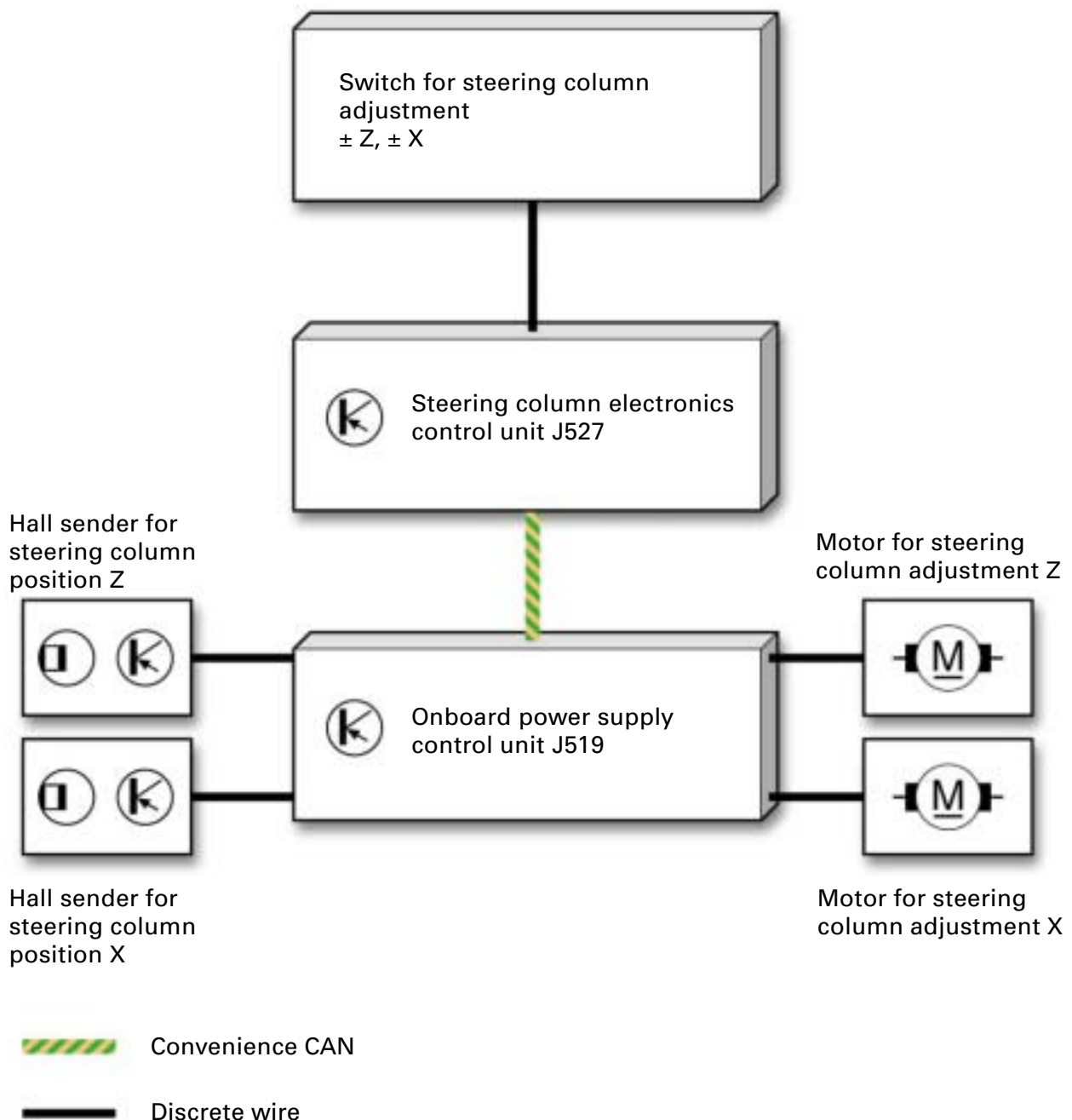


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### Steering column adjustment: Block diagram

Following initial assembly, the end positions are approached in Z (vertical adjustment) and X (axial adjustment) directions. These values are stored in the onboard power supply control unit J519.

Each time any further adjustment is made, the Hall senders record the number of revolutions of the corresponding adjustment motor. The control unit J519 uses these values and the stored end positions to determine the current position of the steering column in the adjustment range.



# Steering System

## Electrical steering column lock (ESCL)

### Summary

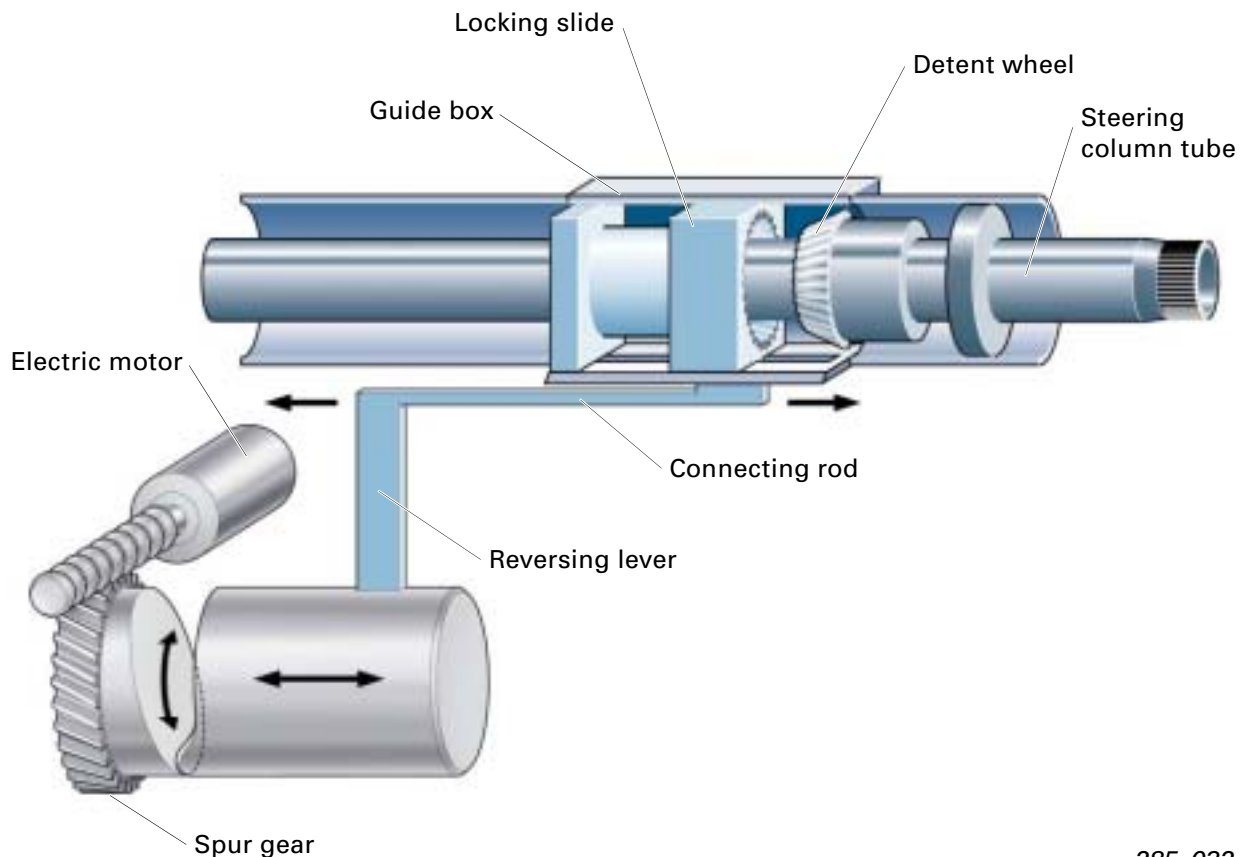
The A8 '03 is the first Audi vehicle to be fitted with an electrical steering column lock. Significant advantages have been achieved by installing the ESCL unit and the locking mechanism at different locations:

- Passive vehicle safety: Space for additional knee guards
- Anti-theft protection: Components less accessible
- Costs: Arrangement of control unit, motor and gear unit in one assembly

### Design:

The detent wheel with bevelled outer splines is connected by means of a friction clutch to the steering column tube. The axially adjustable locking slide with bevelled inner splines is mounted in the guide box.

The electric motor drives the spur gear by means of worm gearing. The axially adjustable reversing lever is mounted in the ESCL unit and linked by way of the connecting rod to the locking slide.



285\_032


**Operation:**

Actuation of the motor turns the spur gear. The side face of the spur gear takes the form of a ramp. The reversing lever runs on this ramp and is axially adjusted in line with the position of the spur gear and ramp position.

The movement of the reversing lever is transmitted directly to the locking slide. Meshing of the locking slide and detent wheel mechanically locks the steering column.



The ESCL unit is connected to the steering column by way of shear bolts and can only be replaced together with the steering column. For information on operation and electrical function refer to SSP 287 Control Units.

**Service:**

The ESCL function can be checked with VAS 5051 using the control element test. Matching is performed with the adaption function.



For details, refer to current Workshop Manual and assisted fault-finding.

# Brake System

## Summary

Use is made of two new brake systems:  
A 16-inch system for 6-cylinder engines and a  
17-inch system for all larger engines.

The principal new feature is the electrically  
actuated parking brake.

	Front axle		Rear axle	
Engine	V6 engines	V8 engines	V6 engines	V8 engines
Min. wheel size	16"	17"	16"	17"
Type of brake	16" FNRG 60 Aluminium floating frame- type caliper	17" 2FNR 42 AL Two pistons Aluminium floating frame- type caliper	16" C II 43 EPB Aluminium floating caliper	17" C II 43 EPB Aluminium floating caliper
Number of pistons	1	2	1	1
Piston diameter (mm)	60	2 x 42	43	43
Brake disc diameter (mm)	323	360	280	310

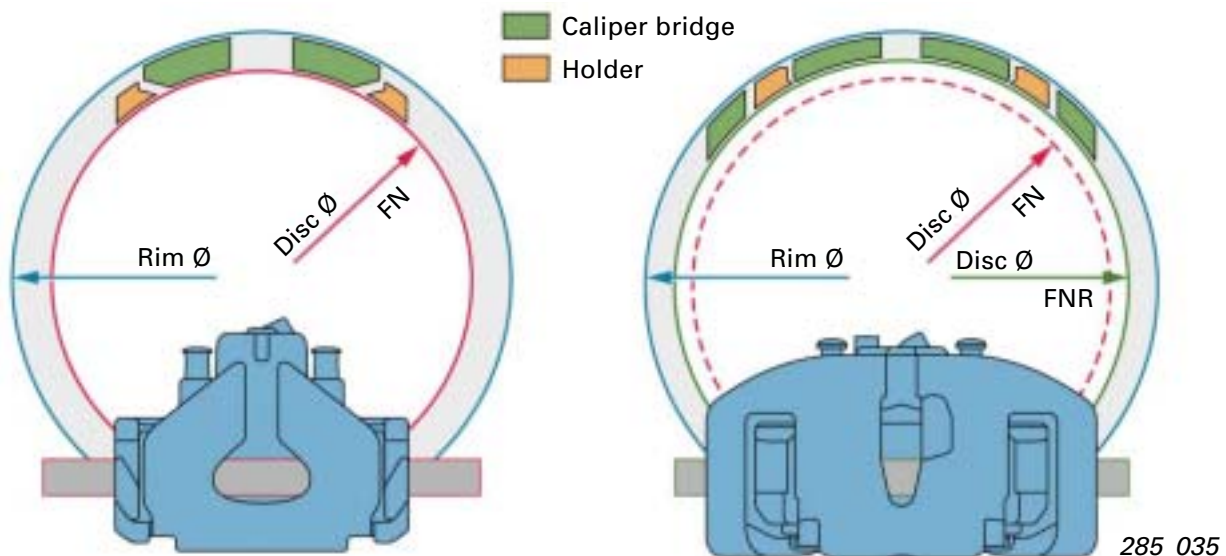
## System components

### Front axle brake caliper

A new design principle has been employed (floating frame type FNR). In this case the floating caliper is designed as a frame, thus permitting a considerable reduction in material thickness at the caliper bridge. For the first time it was possible to integrate a brake disc of 360 mm diameter into 17" wheels. In the past, 18" wheels were required for this brake disc dimension.



285\_034



285\_035

Comparison of technologies: FN and FNR disc brake in the same wheel

### Rear axle brake caliper

Use is made of an advanced aluminium floating-caliper brake. Brake disc diameter and pad area were enlarged to adapt them to the front brake dimension. This resulted in greater braking power and a longer pad service life.

Corrosion resistance was improved by the introduction of stainless steel pad springs and greater pad clearance in the pad guides. Further details were modified to optimise noise level, braking comfort and environmental compatibility.

The caliper concept was designed for use with the electromechanical parking brake.

# Brake System

## Brake servo

Use is made of a tandem vacuum-type brake servo (8+9 inch, basic design as for A4 and A6). In comparison to the A4 and A6, the transmission ratio has been increased to 7:1. The inlet valve flow characteristics have been optimised and the valve closing distance shortened. This results in far quicker and more precise servo response accompanied by a greatly improved operating feel. With V8 petrol engines, vacuum is supplied by a suction jet pump driven by the intake manifold vacuum. An electric vacuum pump is employed for the V6 petrol engine.

## Brake master cylinder

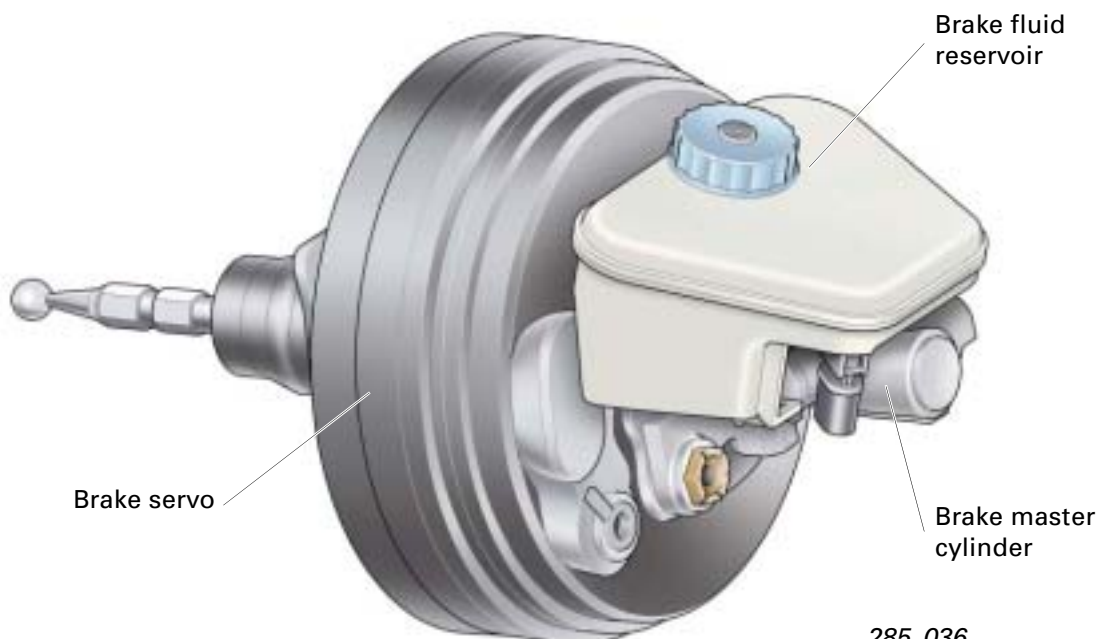
Use is made of a tandem brake master cylinder. As compared to the A4 and A6, the piston diameter was increased to 26.99 mm with a total stroke of 36 mm (18/18). The central valves of both brake circuits (diagonal configuration) have been designed for optimum flow. This permits the use of a self-priming ESP unit without a separate charging pump. These changes and the above-mentioned modifications to the brake servo result in a significant reduction in pedal travel prior to brake response in conjunction with less pedal force. Active safety is thus enhanced by shortening the stopping distance.

## Brake fluid reservoir

The brake fluid reservoir is a separate component fitted into the brake master cylinder.



For design reasons, the brake fluid reservoir is never to be completely drained, as this would permit the ingress of air into the pipes on account of the position of the connections. Refer to the current Workshop Manual for procedure for changing brake fluid.



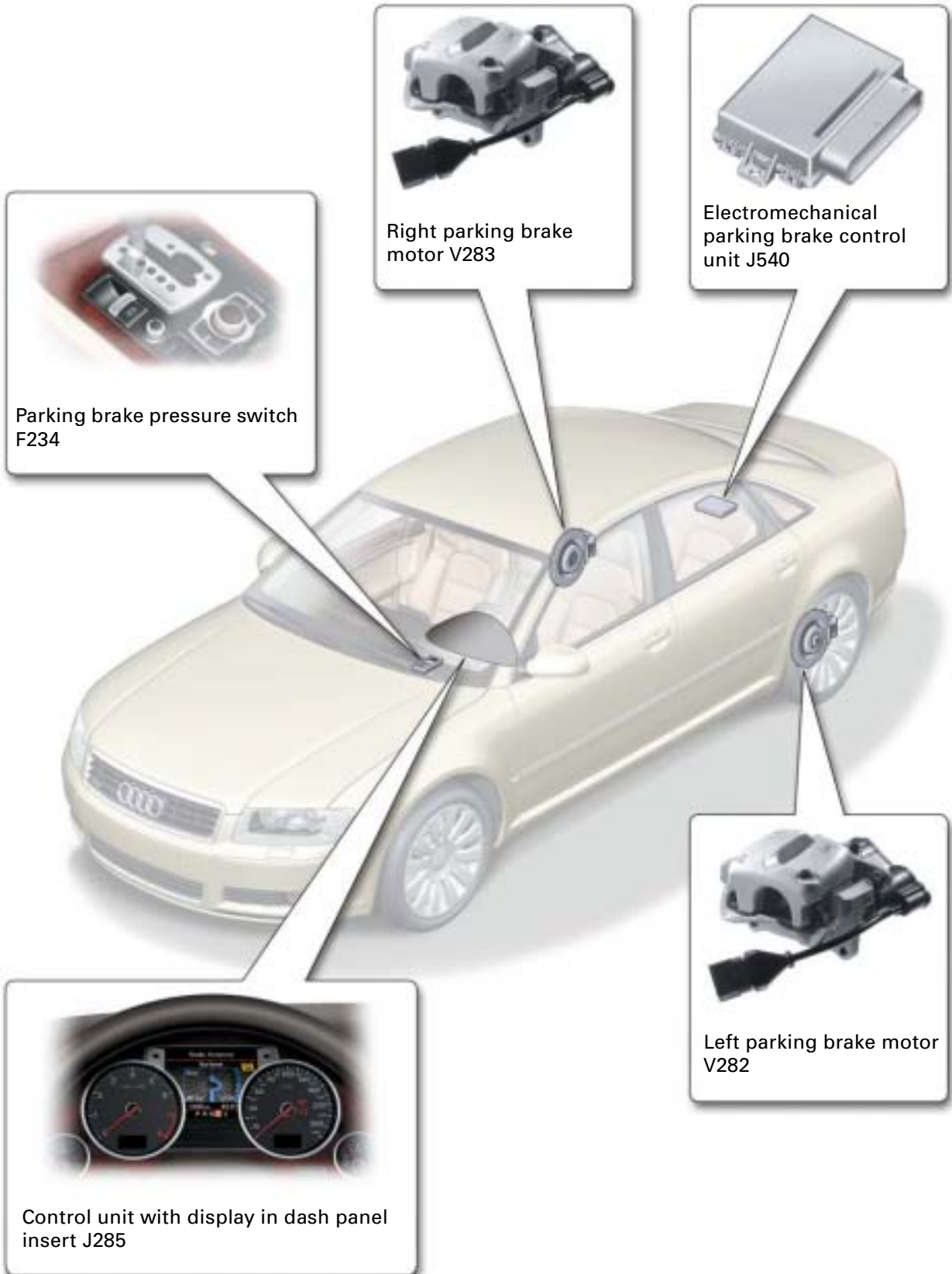
285\_036



	<b>Notes</b>	

# Electromech. Parking Brake


## Summary



285\_091

## Operation and display

The parking brake is actuated by the pressure switch F234 in the centre console. The brake is applied by pulling the switch. It is released by pressing the switch and at the same time pressing the brake or accelerator pedal.

 The electromechanical parking brake can still be applied by pulling the switch even when the ignition is off. The ignition must however be switched on for the brake to be released.



285\_041

Application of the parking brake is indicated by the parking brake display in the dash panel insert and a lamp in the switch.



Parking brake display

285\_042

# Electromech. Parking Brake

## System components

### Control unit J540

The control unit is fitted beneath the battery on the right side of the luggage compartment.

From the battery, the left and right parking brake motors V282/283 are actuated separately.

There are two processors in the control unit. Release decisions are taken by both processors.

Data transfer is by way of the drive system CAN (refer to "Data transfer").

The control unit contains an integrated micromechanical tilt angle sensor.



285\_043

### Parking brake motors V282/283

#### Design:

The brake pads are mechanically tensioned by way of a spindle mechanism. The thread on the shaft is self-locking.

The spindle is driven by a swash plate mechanism.

The mechanism is driven by a DC motor. The mechanism and motor are flanged to the brake caliper.

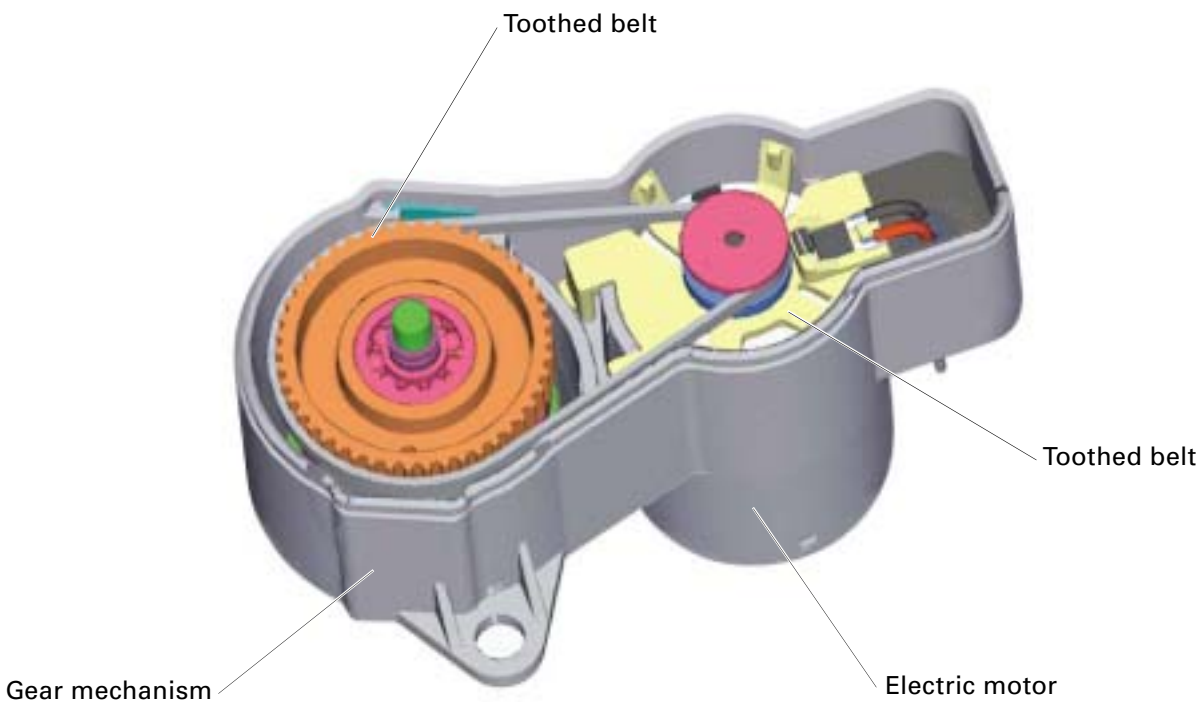


285\_072

### Operation:

Implementation of the parking brake function involves translating the rotation of the drive motor into a very short brake piston stroke. This is achieved through the use of a swash plate mechanism in conjunction with the spindle drive.

There are three transmission stages. The first reduction stage (1:3) is achieved by the motor/gear mechanism input toothed belt drive. The swash plate mechanism is responsible for the second stage. A speed reduced by a factor of 147 with respect to the electric motor drive speed is available at the gear mechanism output.



285\_044



# Electromech. Parking Brake

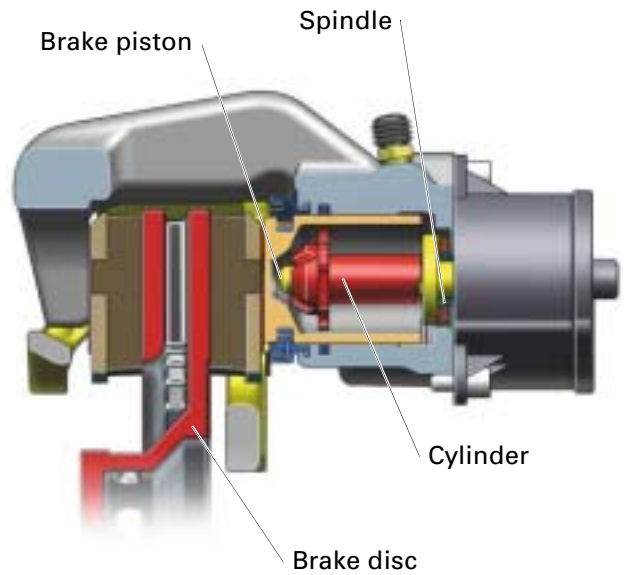
A spindle which drives the brake piston is responsible for converting the rotation into a stroke.

The spindle is driven directly by the swash plate mechanism. A cylinder is mounted such that it can slide axially in the brake piston.

Two plane surfaces stop the cylinder turning. The flared section at the end of the cylinder is provided with a forcing nut. Rotation of the spindle moves the forcing nut on the spindle thread.

The number of motor revolutions is measured by a Hall sensor.

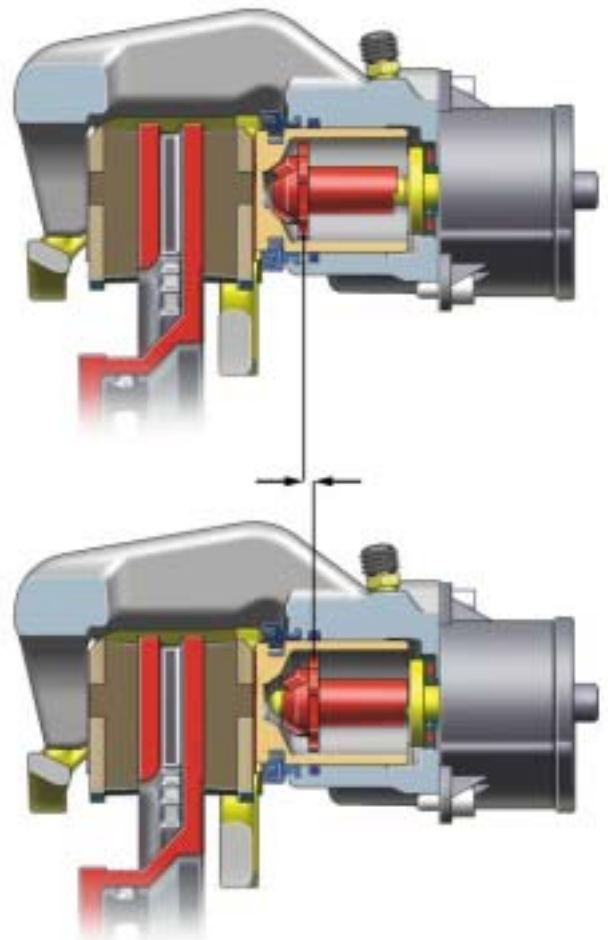
This enables the piston stroke to be calculated by the control unit.



285\_045

**Parking brake application:**

The nut moves forwards on the spindle. The cylinder makes contact with the piston. Cylinder and piston are pressed against the brake disc.



**Parking brake release:**

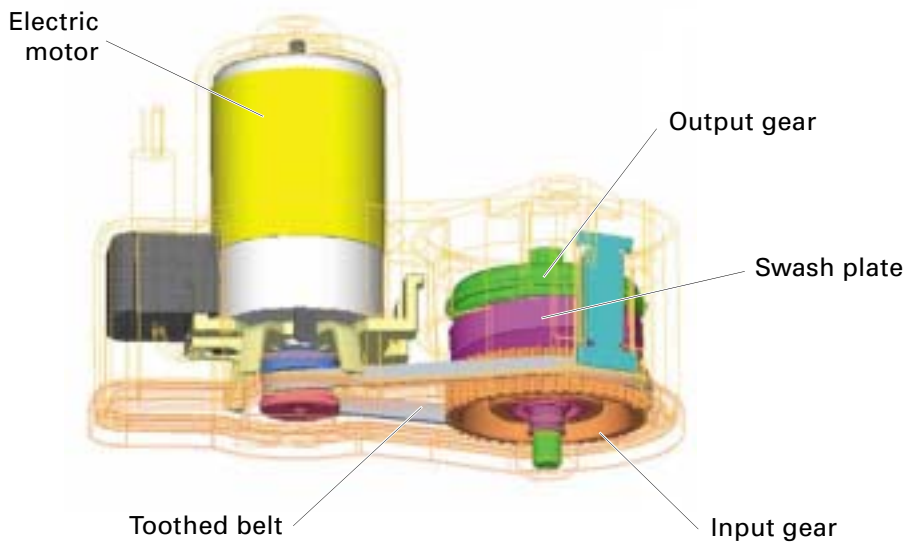
The nut is screwed back on the spindle, thus relieving the load on the cylinder. The recovery of the sealing ring moves the piston back and releases the brake disc.

285\_046

**Mode of operation of swash plate mechanism**

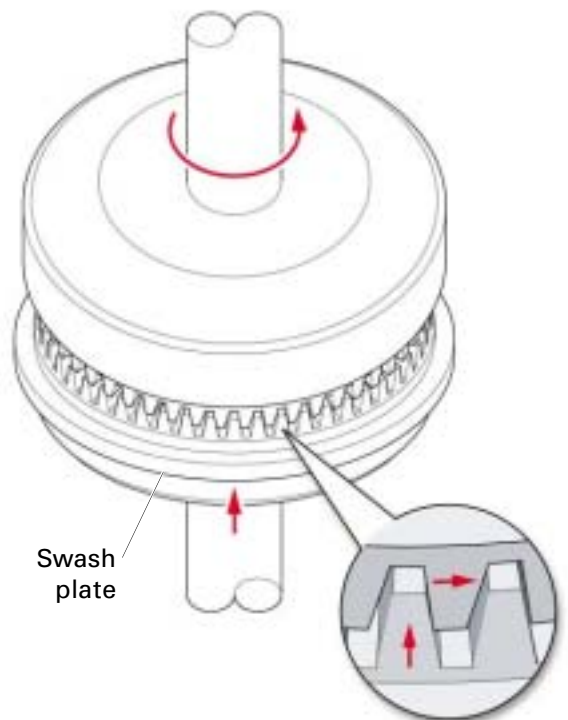
A wheel (swash plate) with bevelled splines is mounted on the input gear. It is mounted obliquely with respect to the input gear shaft.

This causes the plate to wobble as the input gear rotates. The plate is fixed in position by keyways in the gear housing. It cannot turn freely.



285\_047

The swash plate has 51 teeth, the output gear 50 teeth. As a result of this so-called "pitch error", the swash plate teeth always make contact with the flanks of the output gear and never coincide with the tooth spaces. Consequently, the output gear is moved on by a small angle of rotation.

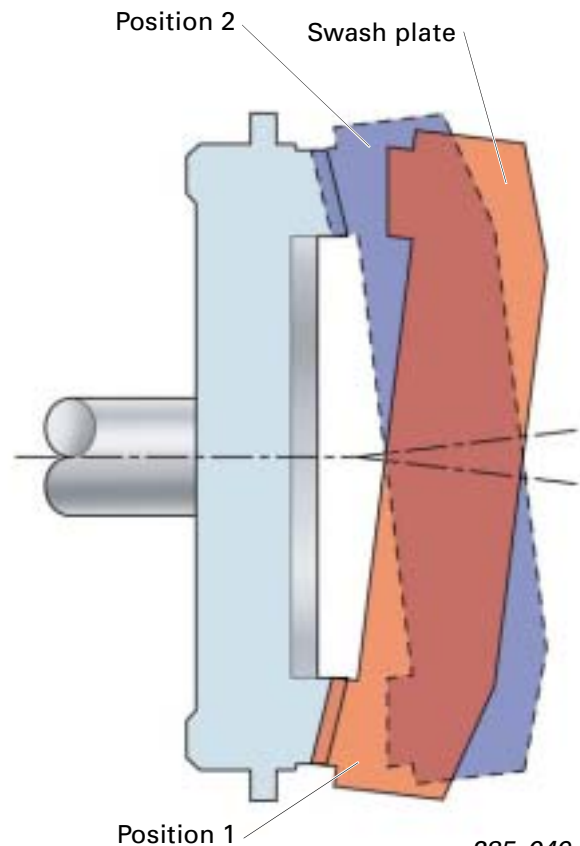


285\_048



# Electromech. Parking Brake

Two output gear teeth are meshed with two swash plate teeth in the course of one revolution of the input gear. The wobble causes the second pair of teeth (position 2) to be meshed after half a revolution of the swash plate. In position 1, the output gear is moved on such that the tooth of the swash plate again makes contact with an output gear flank in position 2. As a result of this sequence, each half revolution moves on the output gear and the spindle connected to it by half a tooth face width.



285\_049

## Functions

The following functions are provided by the electromechanical parking brake:

- Parking brake function
- Dynamic emergency braking function
- Adaptive starting-off assistant
- Brake pad wear recognition and play correction

### Parking brake function

The tensioning force set by the system is sufficient for all driving situations. A text message in the dash panel insert centre display warns the driver in the event of gradients exceeding 30 %. Activated status is indicated by lamps in the switch and dash panel insert.

The brake is automatically re-tensioned if the disc cools down after parking the vehicle. For this purpose, the current disc temperature is constantly established by way of a simulation model in the control unit.



## Dynamic emergency braking function

Pulling the parking brake pressure switch F234 slows the vehicle at a maximum deceleration rate of  $8 \text{ m/s}^2$ .

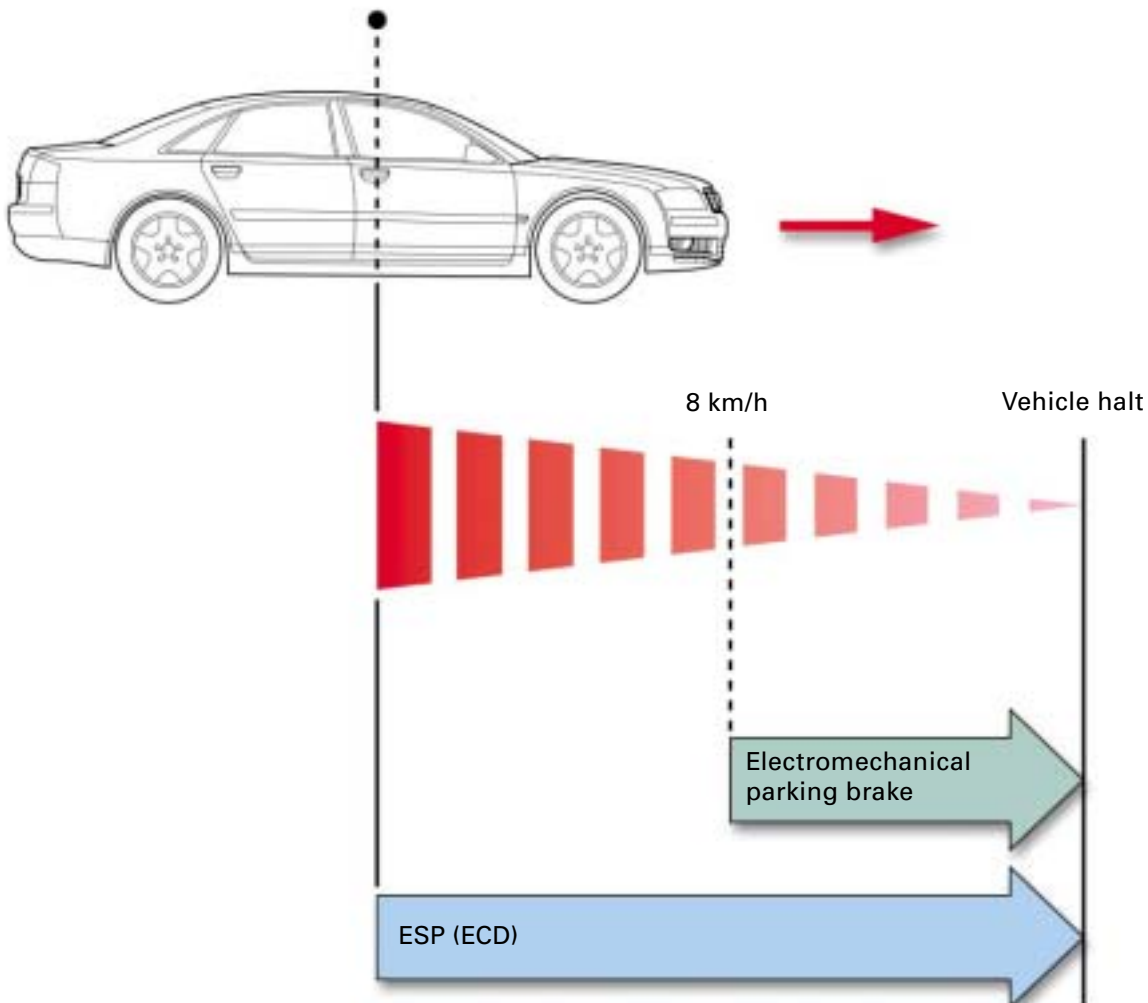
Operation corresponds to that of the handbrake lever. The vehicle is braked as long as the switch is pulled. Braking action is terminated on releasing the switch.

If the vehicle is travelling at a speed of more than  $8 \text{ km/h}$ , braking is implemented by the ESP. With the accelerator pedal still pressed, engine torque is reduced to idling level and brake pressure is built up by the ESP assembly at all four wheel brakes. The cruise control system is deactivated if in operation.

Actuation of the switch at vehicle speeds below  $8 \text{ km/h}$  causes the parking brake to be applied.

To prevent possible incorrect operation (triggered for example by the front passenger), active emergency braking function is deactivated as soon as the accelerator is pressed again.

Activation of emergency braking function



# Electromech. Parking Brake

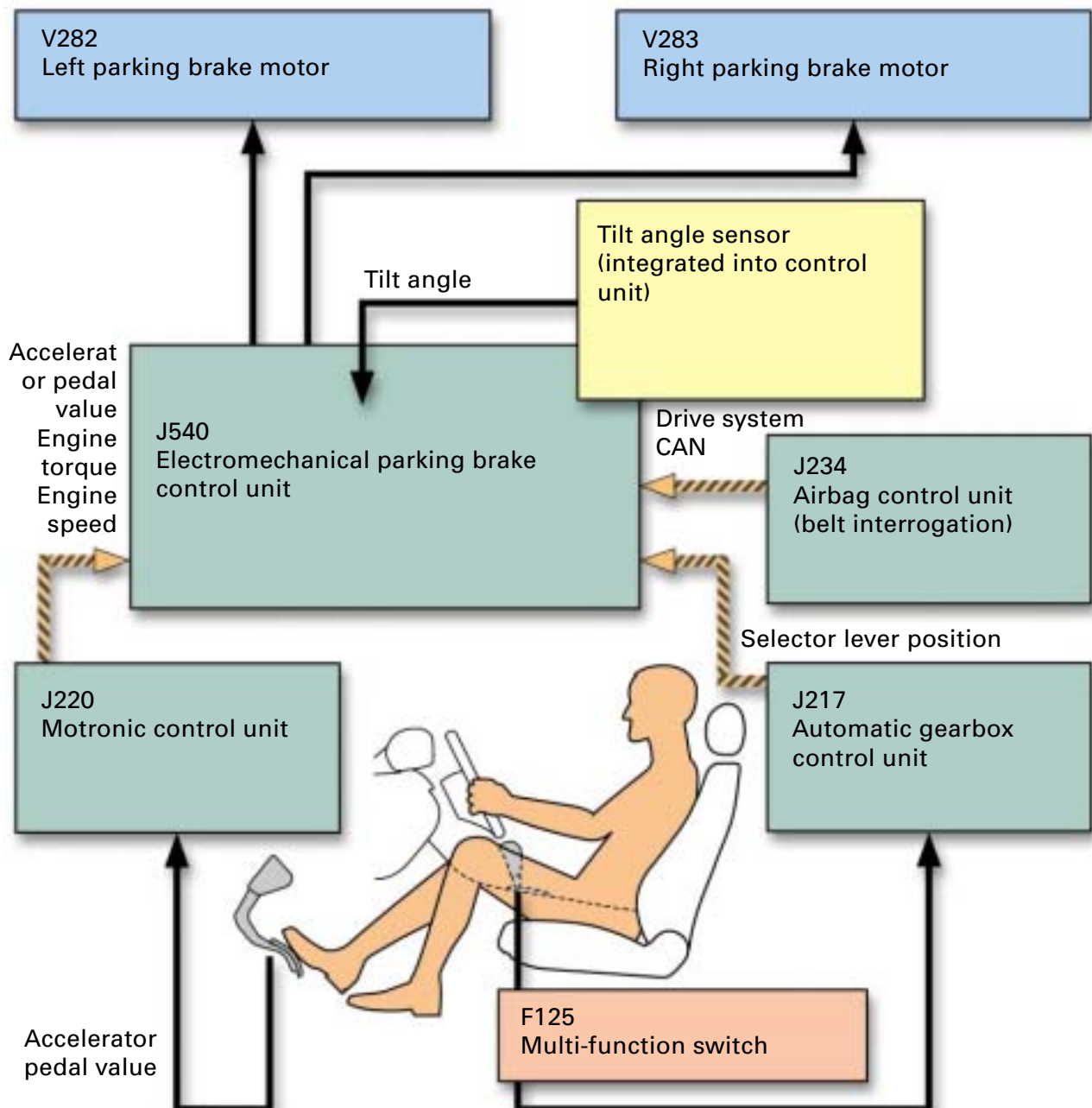
## Adaptive starting-off assistant

This function permits smooth hill starting and stops the vehicle rolling back. The function is only activated if seat belt is fastened.

The tilt angle is measured by a sensor in the control unit. In addition, the control action makes allowance for engine torque, accelerator pedal position and gear selected. The parameters listed above govern the point at which the parking brake is released when driving off.

Automatic calibration of the tilt angle sensor and starting-off parameters takes place constantly.

Whenever the vehicle is started on the flat, its acceleration behaviour is evaluated and adjusted for control purposes to the parameter set stored in the control unit. The function can be deactivated at the workshop but not by the driver.



## Brake pad wear recognition and play correction

The pad thickness is automatically determined cyclically (approx. every 500 km) with the vehicle stationary and the parking brake not applied. For this purpose the brake pad is moved out of neutral position (= end position) towards the brake disc. The control unit uses the value measured by the Hall sender to calculate the brake pad travel and thus the pad thickness.

Measurement is performed with the vehicle parked, the ignition lock applied and the parking brake released.

If drivers regularly use the parking brake, the wear measurement may be less precise than if the parking brake is seldom applied.

## Special system functions

### Pad change mode

Pad change is performed using the diagnosis tester VAS 5051 with the parking brake not applied.

In basic setting function 5, the cylinder is fully retracted by the spindle drive (refer to Releasing parking brake on Page 38). The pad can be replaced after resetting the brake piston with the special tool VAS T10145.

In basic setting function 6, the cylinder is moved back towards the piston (refer to Applying parking brake on Page 38). The pad thickness is entered in adaption function 6 (for detailed information, refer to current Workshop Manual).

### Roadworthiness test mode

Metered braking on a dynamometer is necessary for checking parking brake operation.

Roadworthiness test mode is recognised after 3 seconds if the rear wheels are turning at a constant speed of between 3 and 9 km/h on the dynamometer roller.

Terminal 15 must be on for this purpose.

The parking brake application action is modified by the control unit: Each time the switch is actuated, the piston is moved by a defined small amount and the brake applied slightly more.

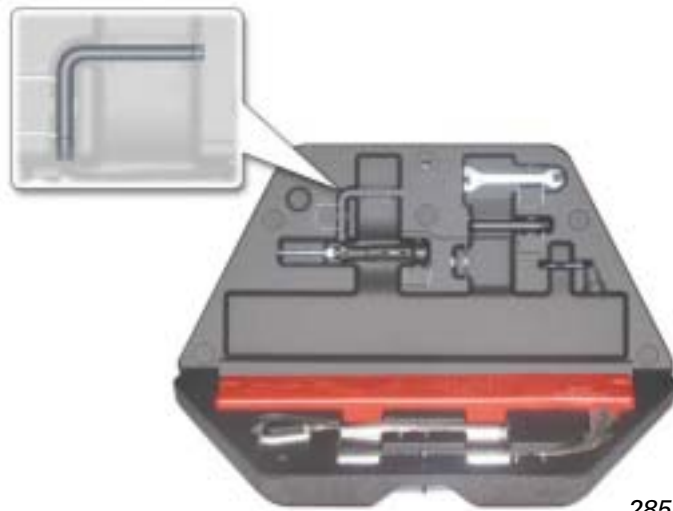


# Electromech. Parking Brake

## Emergency release

An applied parking brake can be released mechanically if electrical actuation is no longer possible or in the event of mechanical problems with parking brake components. An emergency key is provided for this purpose in the vehicle tool kit. The vehicle is to be jacked up and the appropriate wheel removed.

The Torx head at one end of the key is used to remove the actuator from the brake caliper. The spindle can then be turned with the opposite end of the emergency key until the brake is released.



285\_085

## Fault displays

Flashes constantly if parking brake has not been properly applied. Flashing on actuating parking brake pressure switch F234 indicates a wiring fault.



285\_086

Fault detected by control unit restricting operation.



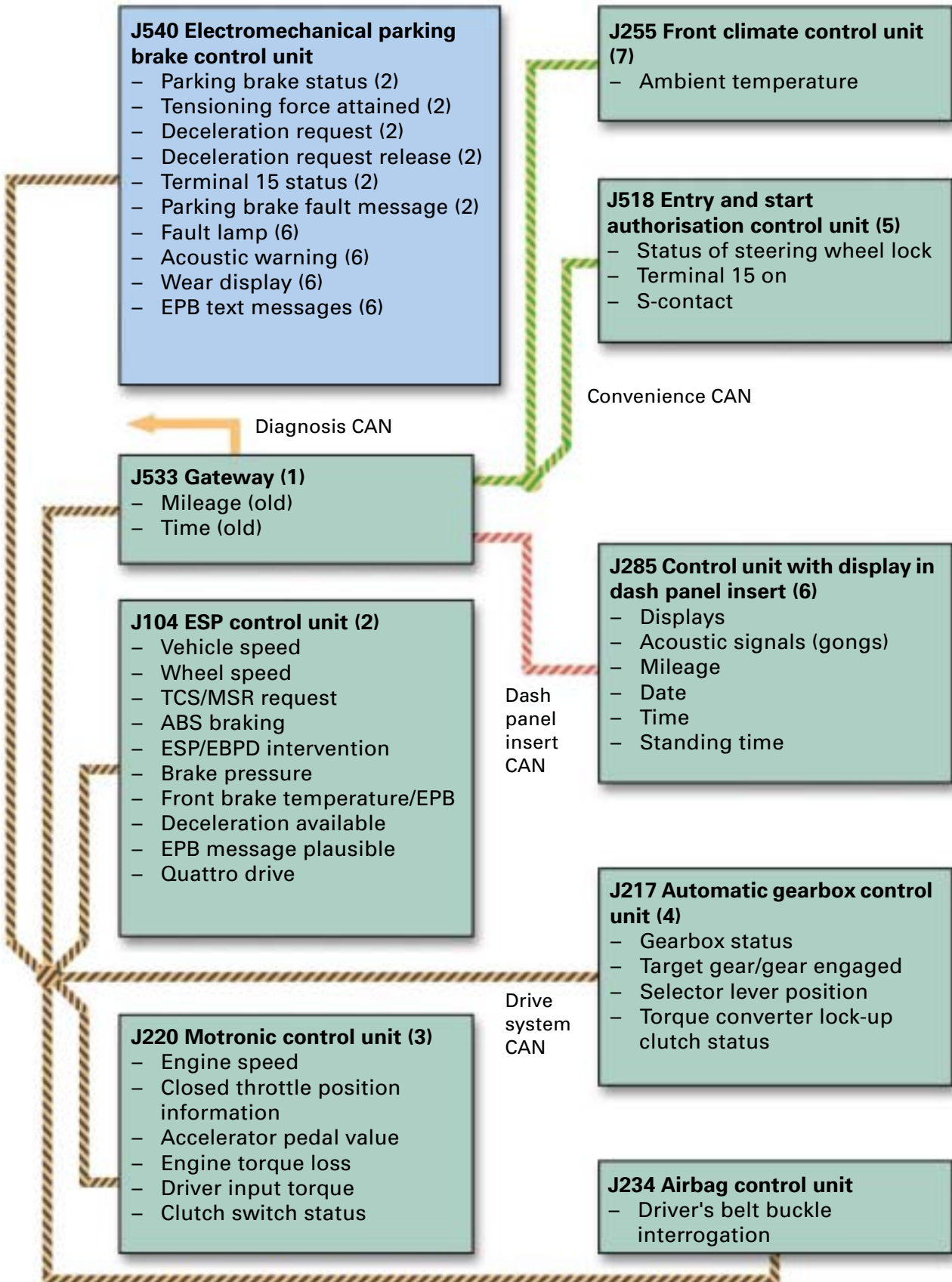
285\_087

System fault; vehicle should no longer be driven for safety reasons.



285\_088

# Electromechanical parking brake CAN data exchange



# ESP

## Summary

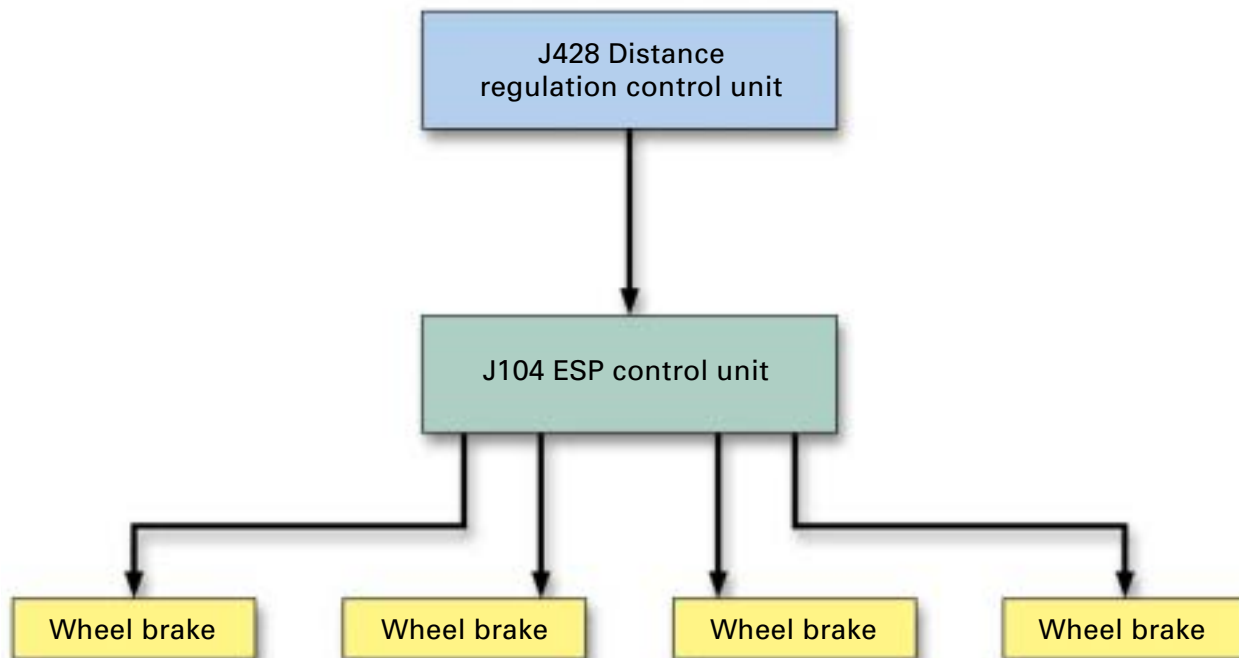
The Audi A8 '03 is fitted with the ESP 5.7 already used in the Audi A4. In addition to the necessary software adaptation to the new vehicle, the main new features are as follows:

### Communication interface ECD (electronically controlled deceleration)

The interface enables other vehicle systems to actuate the ESP. The ESP control unit J104 can be informed directly of deceleration requests. The ECD request involves deceleration of the vehicle at a maximum rate of  $8 \text{ m/s}^2$ .

Brake pressure is built up evenly at all four wheels.

The interface in the A8 is used by the electromechanical parking brake and adaptive cruise control functions.



285\_052

### Active speed sensors

The new sensors detect the corresponding wheel speed directly at the wheel bearing by way of magnetic multipoles. Direction of rotation and size of air gap are also determined (refer to System components for design and operation).



285\_053

### New software modules

The TCS function has been upgraded to include improved traction on non-compacted surfaces (e.g. deep snow). Greater wheel slip values are accepted for acceleration when travelling straight ahead or with small steering angle. Directional stability has priority when cornering. The permissible slip values are reduced.

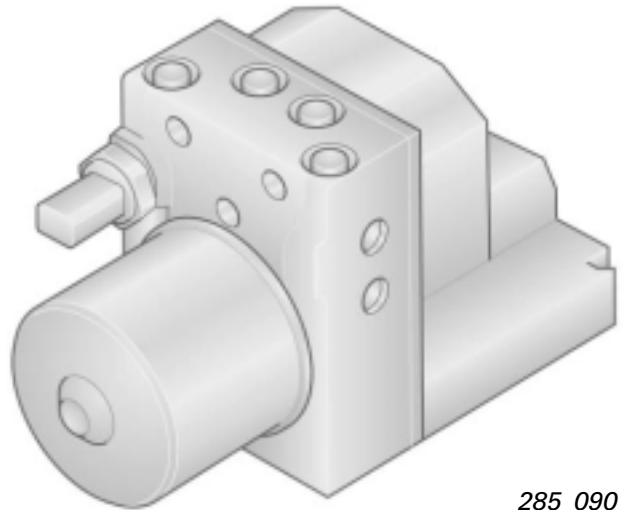
ESP control action is reduced if a sporty driving style is required. Directional stability is maintained but larger float angles are permitted, leading to higher wheel slip values in transverse vehicle direction. A sporty driving style is recognised from evaluation of accelerator pedal actuation.



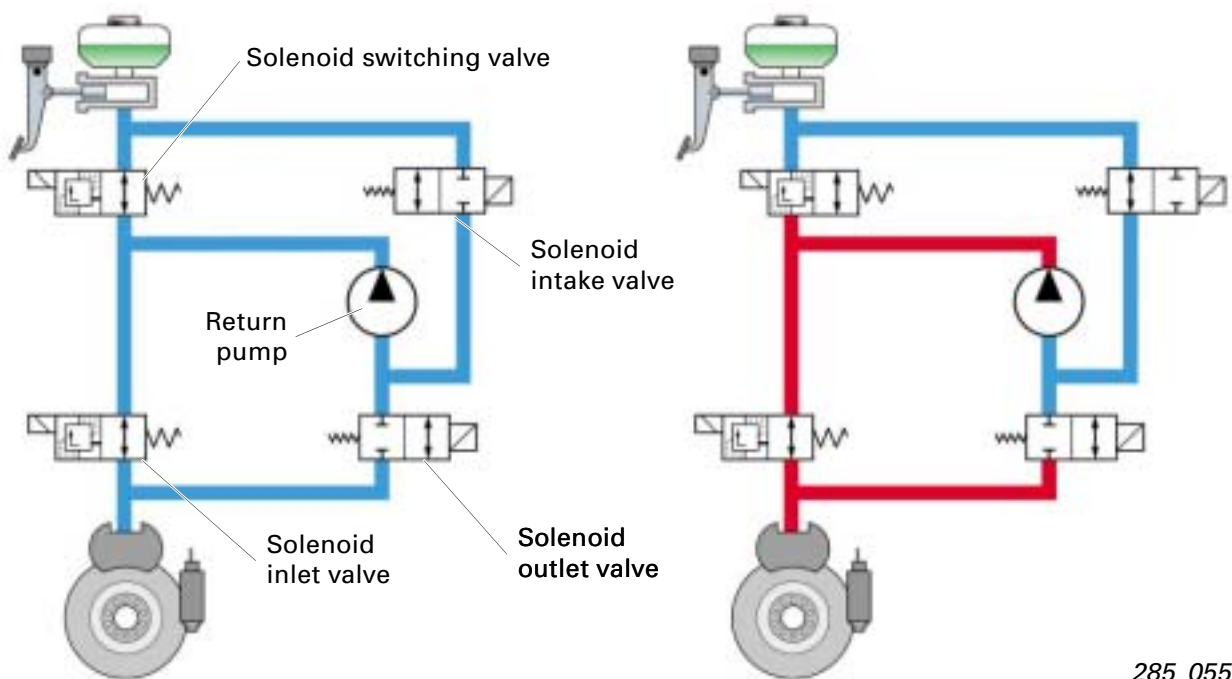
## System components

### Hydraulic modulator

The basic version of the hydraulic modulator corresponds to that in the Audi A4. Compliance with noise level requirements with adaptive cruise control action necessitates the use of integrated suction dampers. These take the form of small chambers which dampen brake fluid pulsation by way of rubber diaphragms. This modified modulator is used exclusively in vehicles fitted with adaptive cruise control. Attainment of a high level of braking comfort requires the use of the linear solenoid inlet and switching valves developed for the ESP 5.7.



285\_090



285\_055

ECD request not active: Valves deenergised  
Driver can regulate brake pressure by way of open solenoid switching and inlet valves.

Pressure build-up in response to ECD request: Solenoid switching and intake valves energised, return pump suction action via open solenoid intake valve and pump regulates brake pressure.



### Mode of operation of linear solenoid valves

Application of current to the coil of the solenoid valve causes a magnetic force  $F_M$  to act on the sealing element.

The sealing element is pressed onto the seat in the valve housing. The forces exerted by the spring ( $F_F$ ) and the hydraulic fluid ( $F_H$ ) act in opposition to the magnetic force.

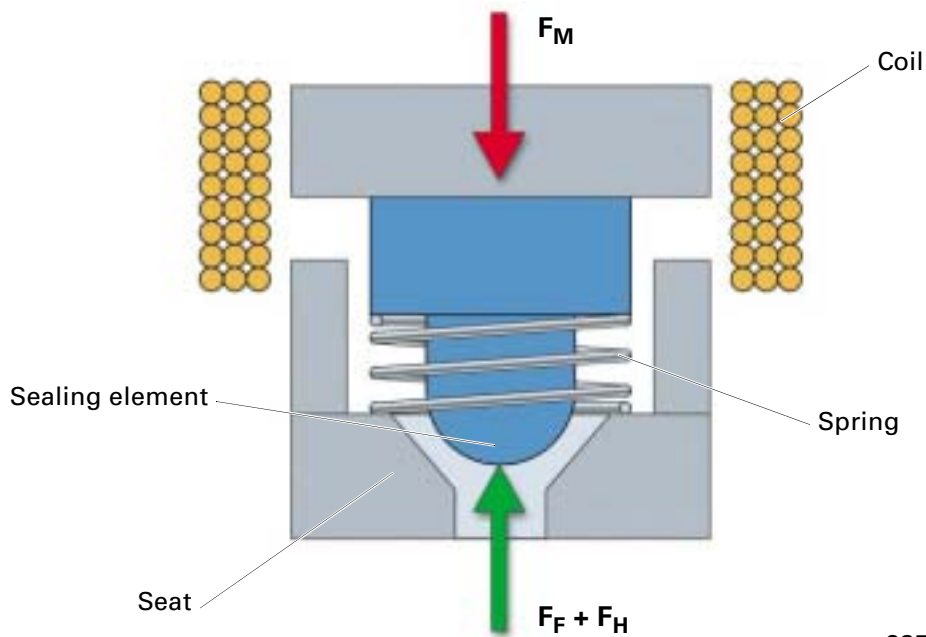
If  $F_F + F_H$  becomes greater than  $F_M$ , the sealing element is lifted off the seat and the valve opens. The higher the valve actuation current, the greater the hydraulic fluid pressure must be to open the valve.

Varying the current level makes it possible to set different opening pressures.

In addition, the valve stroke (= valve opening cross-section) can be set in the range between valve closed and valve fully open.

This mode of operation enables the brake pressure to be varied as required.

Such action is a prerequisite for comfortable vehicle deceleration.



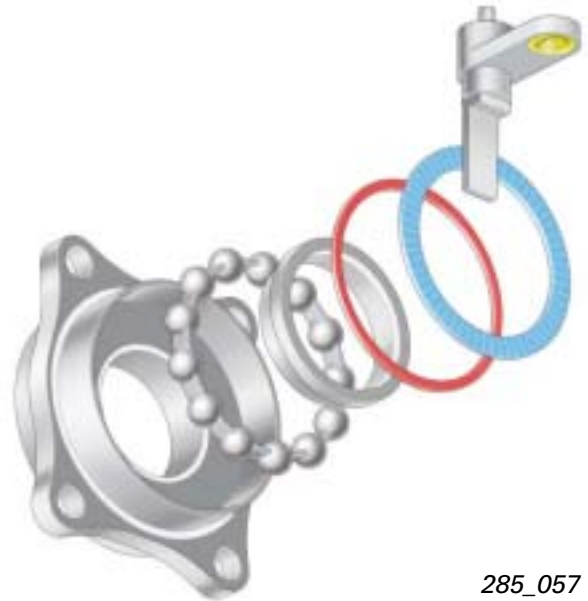
285\_056



## Speed sensors G44-47

### Design:

The measuring element is a Hall sensor consisting of three Hall elements. The conventional sensor ring is replaced by a magnetised wheel bearing seal carrying 48 pairs of north/south poles (multipole).

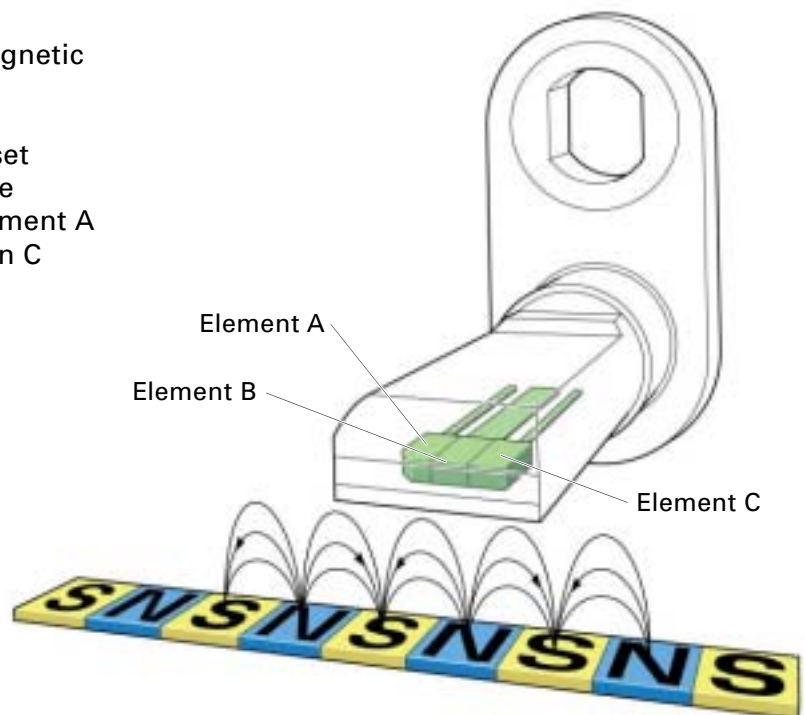


285\_057

### Operation

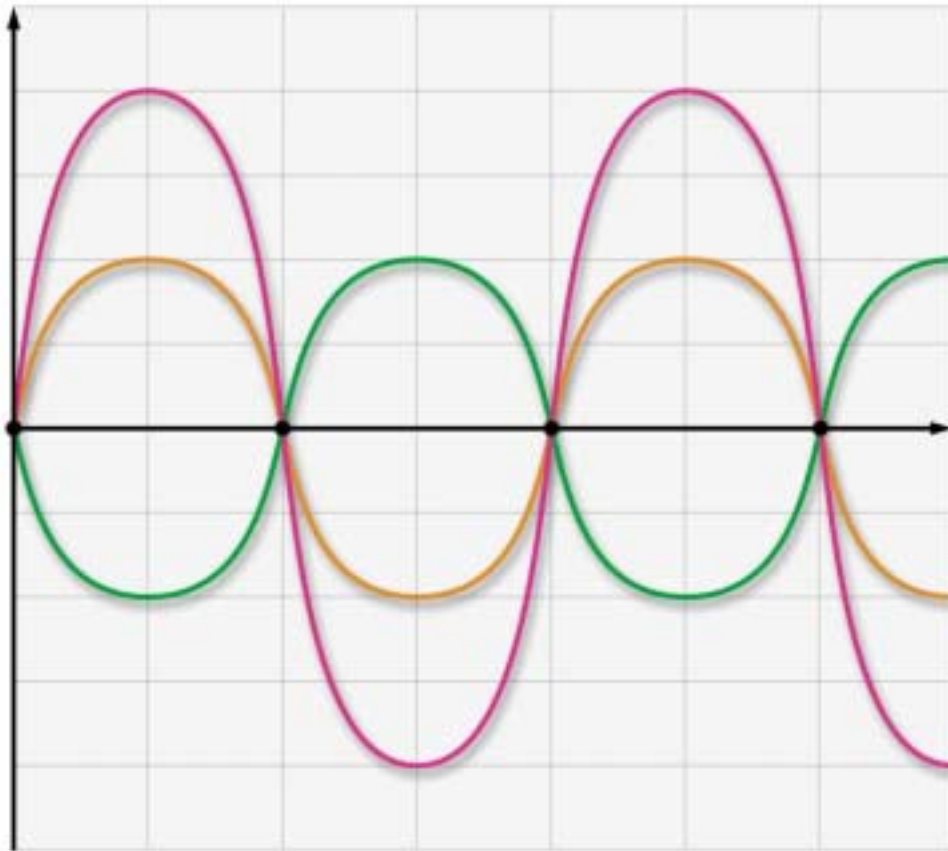
The sensor detects changes in magnetic flux density.

The three Hall elements are in offset arrangement. The gap between the elements is selected such that element A senses a magnetic maximum when C detects a magnetic minimum.



285\_058

A difference signal A-C is formed in the sensor.



- Signal A
- Signal C
- Difference signal A-C

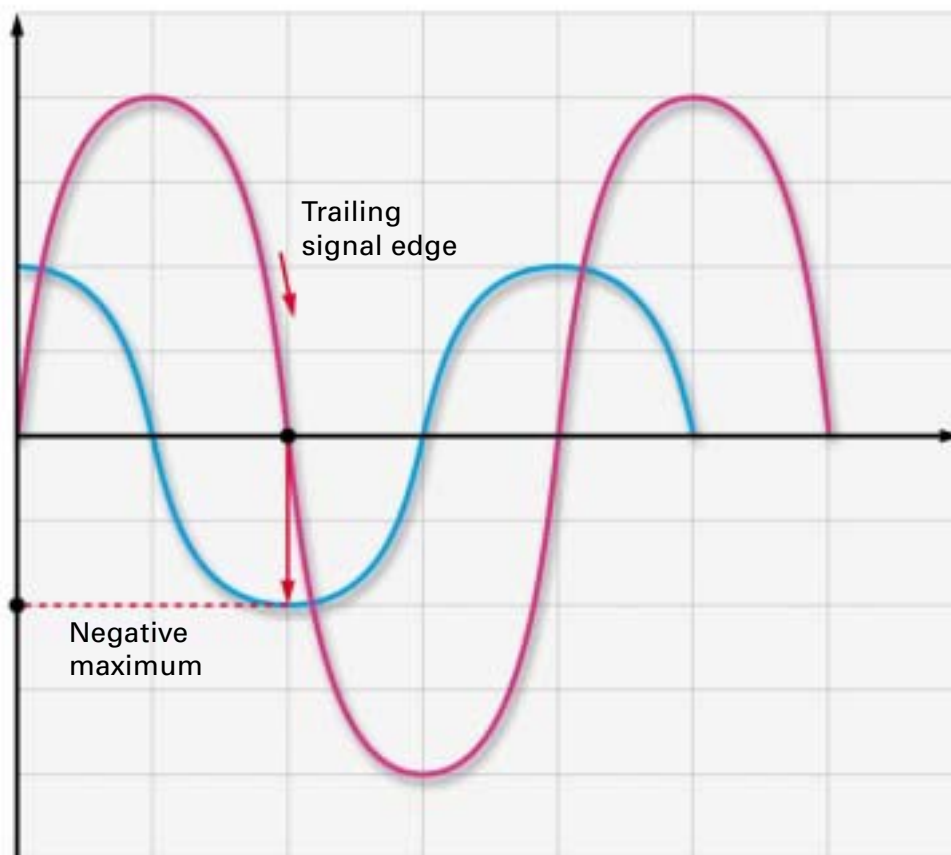
285\_074



# ESP

Hall element B is located centrally between A and C. Element B detects a magnetic maximum if signals A and C and thus also the difference signal are at zero. The point at which signal B reaches its maximum value (positive or negative) is evaluated for detection of direction of rotation.

If, for example, zero crossing of the difference signal A-C is reached by a trailing signal edge and the signal B maximum is then negative, anti-clockwise rotation is recognised.



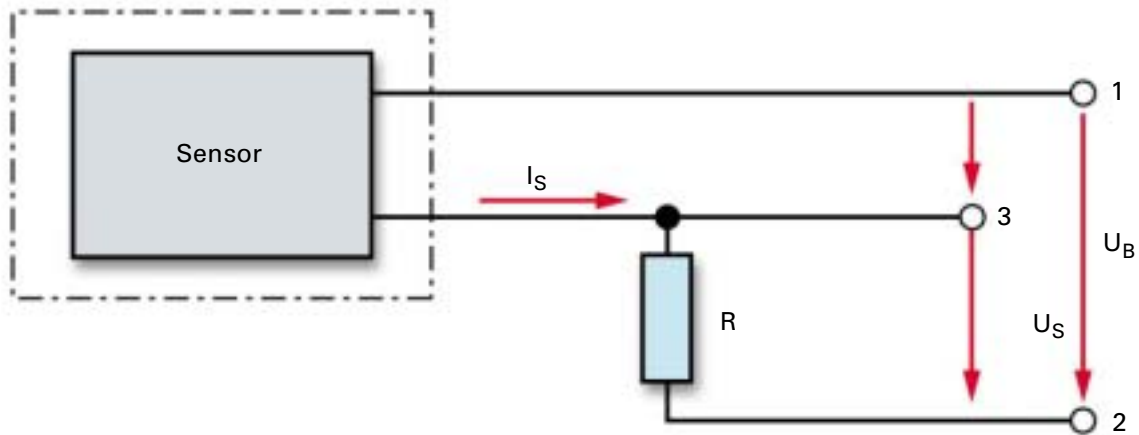
- Difference signal A-C
- Signal B

285\_075

## Electrical configuration

The speed sensor is connected by way of a current interface to the ESP control unit, which is fitted with a low-impedance shunt R. The speed sensor has two electrical connections and forms a voltage divider together with the shunt.

Battery voltage  $U_B$  is applied between connections 1 and 2. The sensor signal produces a drop in voltage  $U_S$  at the shunt. This signal voltage is evaluated by the control unit.



285\_061

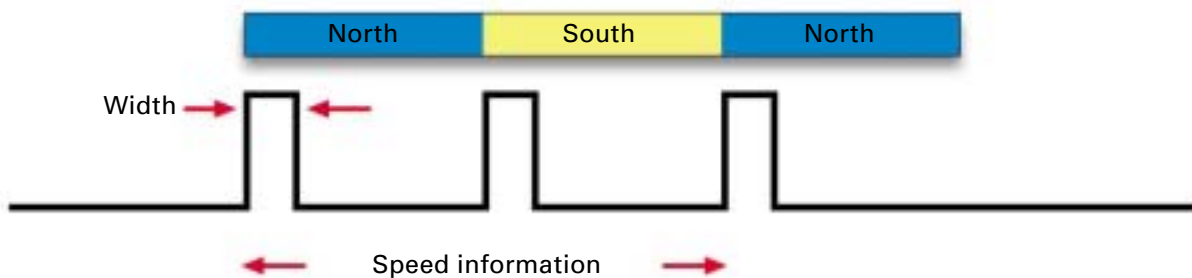
The output signal of the speed sensor is a PWM signal (PWM = pulse width modulation). The number of pulses in a specific time unit provides the

- speed information.

The following information is encoded by means of the pulse width:

- Direction of rotation
- Size of air gap
- Installation position
- Detection of stop

The correct air gap size is important for system operation and is detected and evaluated for system self-diagnosis.



285\_062

## Diagnosis

Within the scope of self-diagnosis the system is monitored for mechanical faults, electrical faults and implausible signals.

The most important system data are stored in the measured value blocks and can be read out with the diagnosis tester VAS 5051.

Detailed information can be found in the relevant Workshop Manual.



# Tyre Pressure Monitoring

## Summary

The Audi A8'03 is fitted with a new version of the tyre pressure monitoring system, the principal new features of which are described in the following.

### Aerials

Use is made of active aerials. The radio signals transmitted by the tyre pressure sensors are converted by the aerials into digital signals.

There are two aerial versions which differ in terms of the carrier frequency (433/315 MHz) to be processed.

### Data transfer

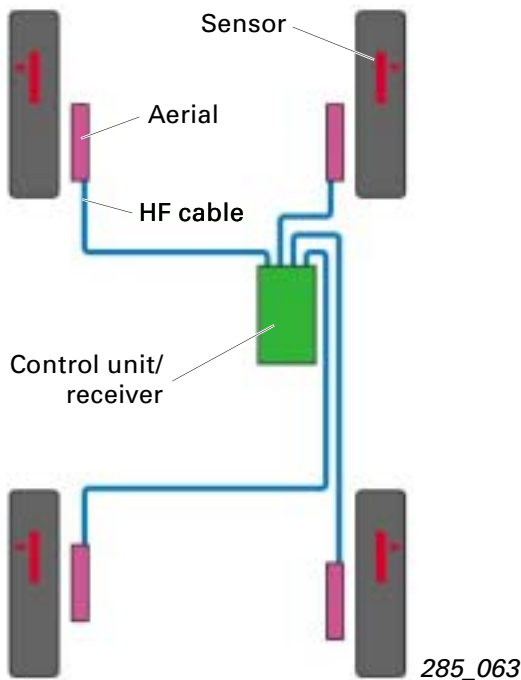
The digital signals are transferred from the aerials to the tyre pressure monitoring control unit via the LIN bus.

The major advantage of this method is the minimal susceptibility to electromagnetic interference.

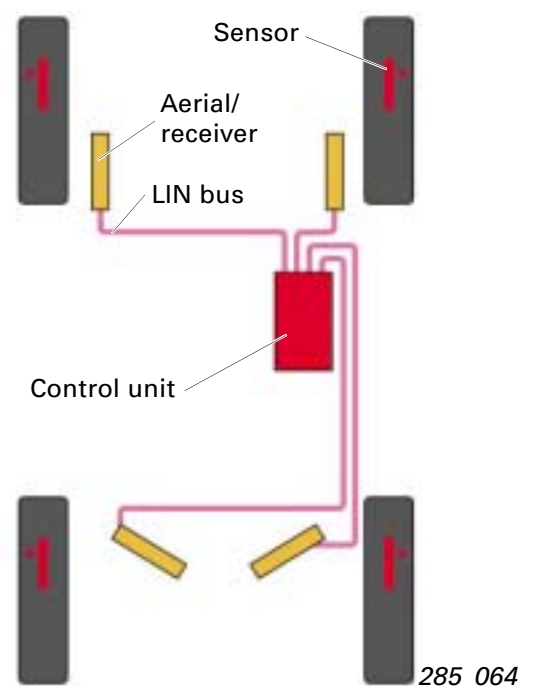
### Tyre pressure monitoring control unit

The control unit is located beneath the rear seat bench. There is no sensor signal conditioning in the control unit.

Only one control unit frequency version is required as the signals are already conditioned in the aerials.



1st generation components and networking (Audi A8 up to '03)



2nd generation components and networking (Audi A8 as of '03)

## Control concept

System operation forms part of the MMI control concept.

Pressing the CAR button and selecting "Systems"- "Tyre pressure monitoring system" provides a display of the current tyre pressures and temperatures or enables the following settings to be made:

- System activation/deactivation
- Storage of tyre pressures

(Refer to operating manual for detailed information)



285\_065

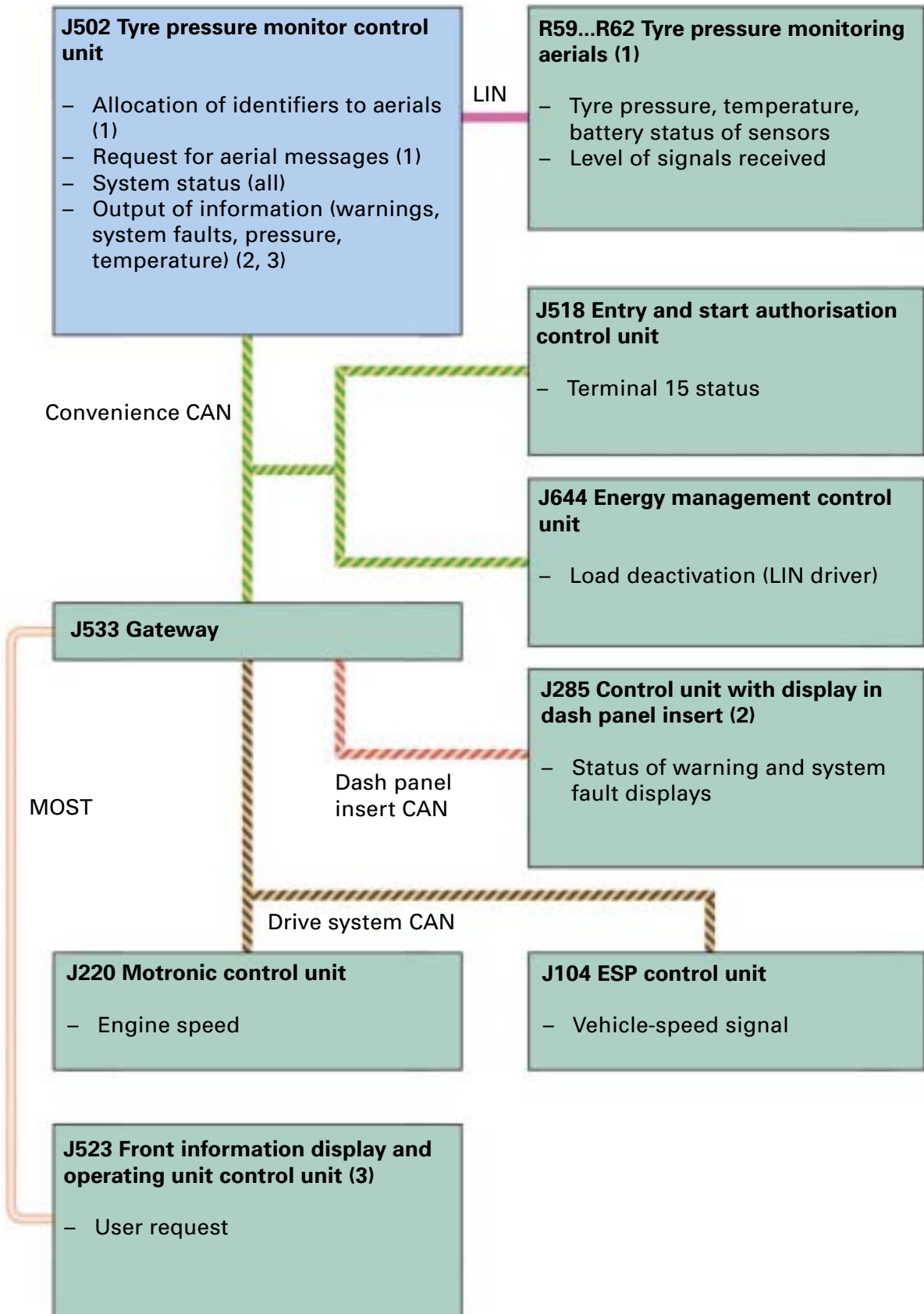
## Warning displays

Warnings continue to be displayed in the dash panel insert. The two-stage warning priority system has been retained (refer to operating manual for detailed information).



# Tyre Pressure Monitoring

## Tyre pressure monitoring system CAN data exchange



285\_067



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**Service**

The range of service diagnosis options has been extended.  
Aerial diagnosis is performed constantly and does not have to be started separately.

(For details, refer to current Workshop Manual and assisted fault-finding)




# Run Flat System - PAX

## Summary

For the first time in the luxury class, a "run flat" wheel system is available as an option for the Audi A8 '03. As compared to other systems, the PAX run flat system represents an optimum compromise between handling, comfort and durability requirements. Both a summer and a winter version are available.

## Design:

The system consists of rim, support ring, tyre and tyre pressure sensor. All components have been newly developed.

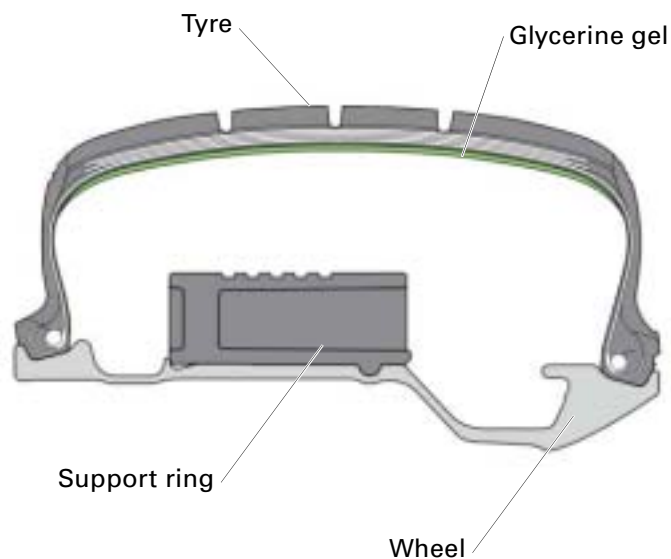
The rim is of a completely new geometrical design.

The support ring is fitted onto the centre of the rim and is made of a heavy-duty plastic with honeycomb structure.

The tyre is no longer tensioned behind the rim flange by means of its bead, but rather inserted in the rim seat.

The geometrical and structural design of the PAX tyre differs considerably from conventional tyres, above all in the area of the side wall and bead.

A glycerine gel is applied to the inner surface of the tyre to reduce the friction between support ring and tyre in run flat mode.

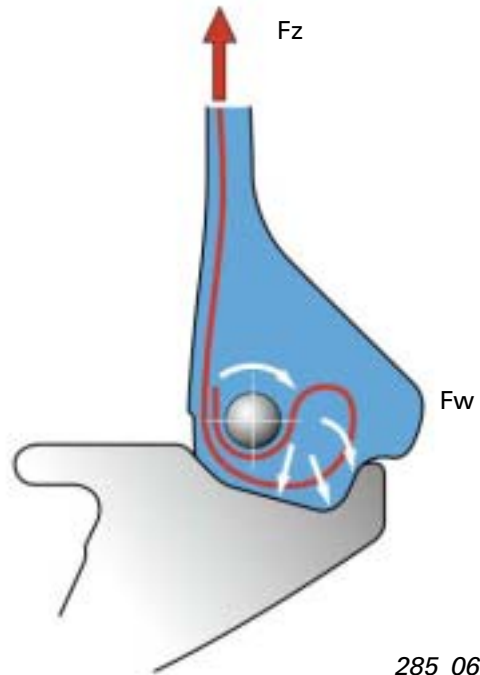


285\_068

**Operation:**

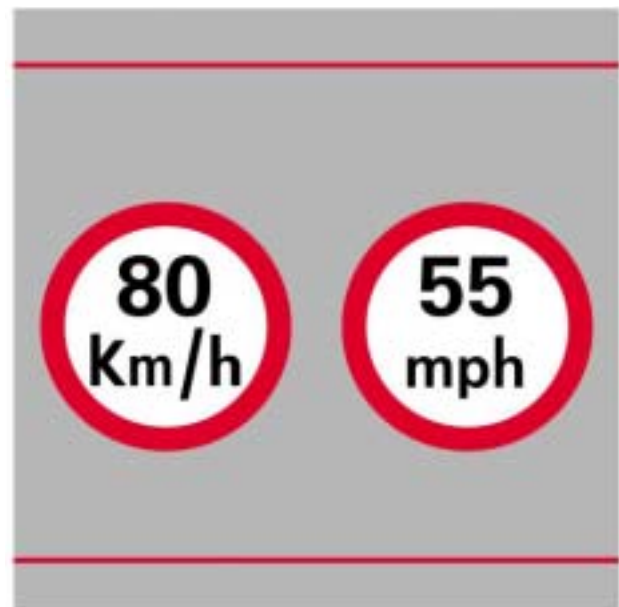
In the event of partial or total loss of pressure, the tyre rests on the support ring. The special design of the bead seating on the rim stops a flat tyre coming off. This is particularly critical in situations involving cornering with the tyre side wall subject to tensile load.

The tensile force  $F_z$  causes the tyre bead to rotate about the bead core, thus producing a force  $F_w$  in the outer bead area which presses the bead more firmly onto its seat.



285\_069

PAX enables a fully laden vehicle to be driven for a maximum of 200 km at a speed of max. 80 km/h even with a completely flat tyre. Despite the use of the gel, component temperature and hence wear increase, in particular on account of the friction between tyre and support ring. A high degree of ride comfort is maintained even in run flat situations. A loss of pressure is thus not always immediately apparent. For this reason, PAX always includes the tyre pressure monitoring function. Run flat mode is indicated on the dash panel insert centre display.



285\_070

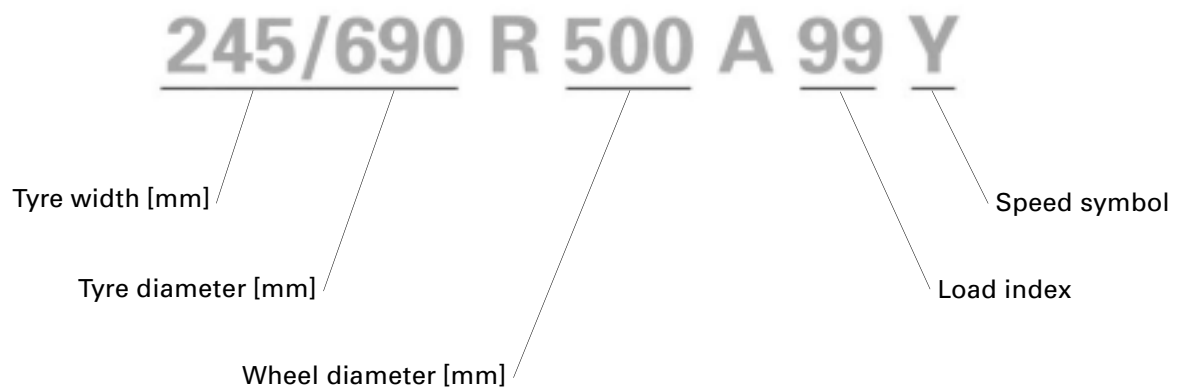


# Run Flat System - PAX

## New tyre designation

PAX tyres have a new designation.

Arithmetically, the wheel used for the A8 corresponds to a wheel size of 18.3".



285\_068

## Service

Tyre removal/fitting involves completely new procedures.

New tyre fitting machines and PAX attachments for conventional fitting machines are available.





