

# The Passat '97

## The Presentation

Construction and operation

Self Study Programme





The most remarkable features of the new Passat are its:

- High economy
- Dynamic body styling
- High-quality interior equipment designed with great attention to detail
- Pioneering safety engineering

In this booklet, we would like to provide you with an initial overview showing how we justify making these claims.

	Page
<b>The Passat '97</b>	<b>04</b>
<b>Environmental Protection and Recycling</b>	<b>08</b>
<b>Body</b>	<b>10</b>
<b>Vehicle Safety</b>	<b>15</b>
<b>Engines and Gearboxes</b>	<b>19</b>
<b>Running Gear</b>	<b>26</b>
<b>Brakes</b>	<b>29</b>
<b>Steering</b>	<b>30</b>
<b>Electrics</b>	<b>31</b>
<b>Extended Systems</b>	<b>36</b>



**Important ! / Note**



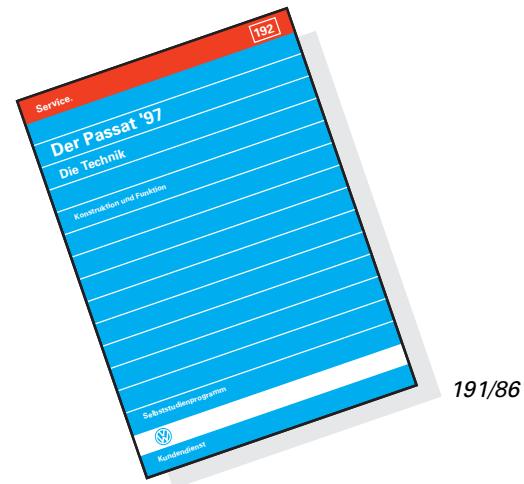
**New**

The Self Study Programme is not a Workshop Manual.  
Please refer to the relevant Service Literature for all inspection, adjustment and repair instructions.

# The Passat '97

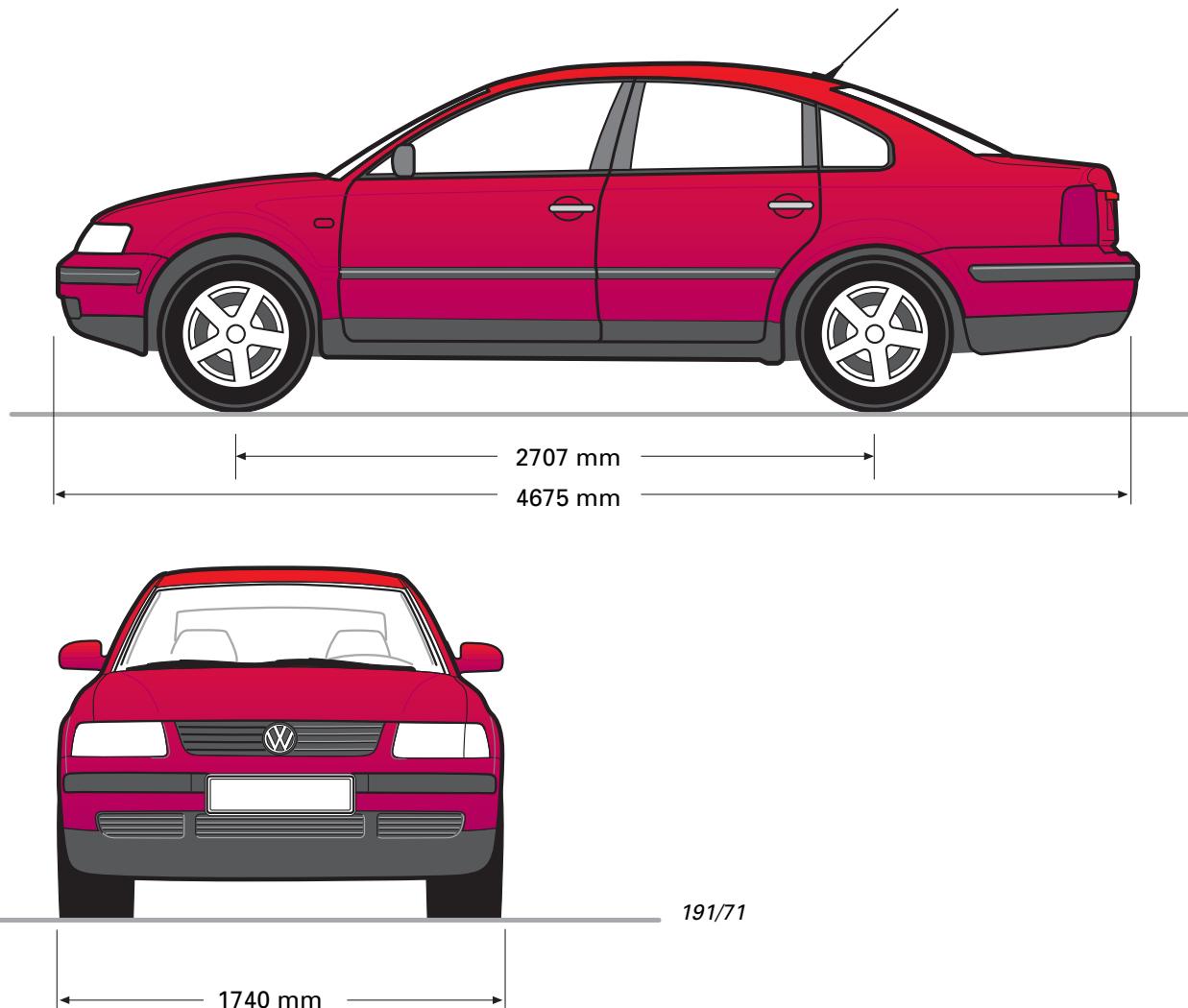
To avoid confusion, concise examples are used to illustrate the various aspects of this all-embracing vehicle concept.

You can find detailed information in Self Study Programme No. 192 Passat '97 – The Engineering.



191/73

## Dimensions and Weights



### Track widths

front	1498	mm
rear	1500	mm

### Weights

Unladen weight	appr. 1200	kg
Max. permissible weight	appr. 1805	kg

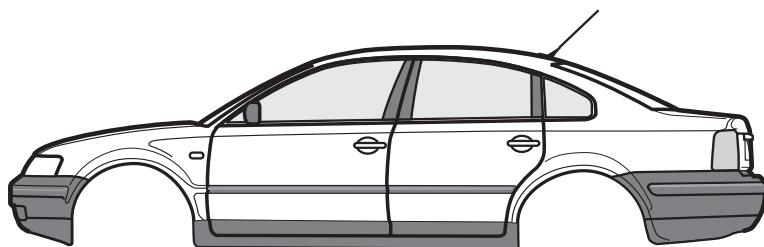
# The Passat '97

## The Platform - an Advantage for Workshops

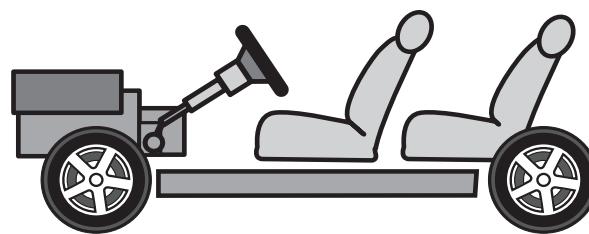
The term "platform" is frequently used in publications although its fundamental meaning is not explained. The result of this is that people are often unsure of what the term "platform" implies.

The vehicle consists of a) the platform and b) the body.

Design and vehicle characteristics dictate what form the body takes.  
In the eyes of the customer, the body characterises the styling of the vehicle as a whole.



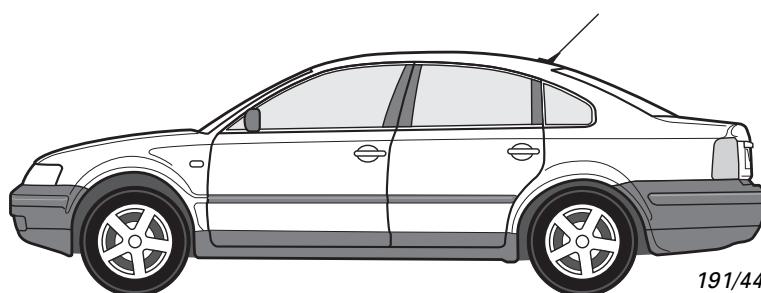
**The body**



191/76



**The platform**



191/44

**The Passat '97**



## Platform

The platform comprises both common parts and system parts.

### Common parts

e.g. sliding sunroof, steel rim

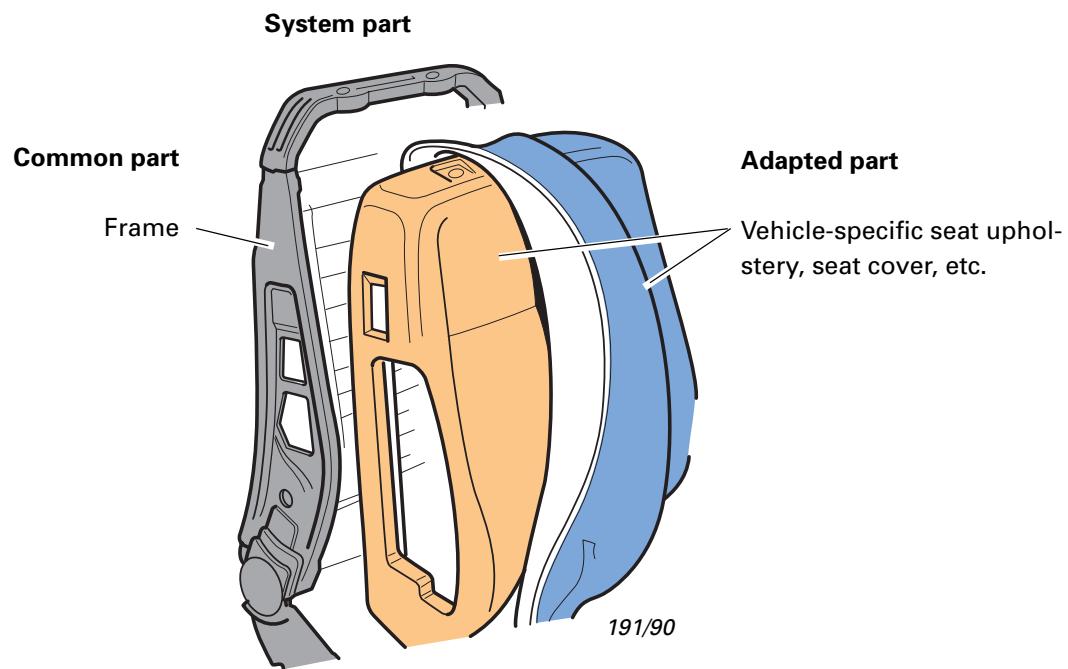
Common parts may only be used in platform vehicles without change.

They do not influence the design of the vehicle.

### System parts

e.g. seat

Some system parts are identical.  
They have to be adapted since they are the interface between the platform and body.



**The advantages for workshops like yourself are:**

- More clarity as regards the spare parts situation
- Simplified inventory management
- Fewer different special tools and fixtures
- Easier assembly and repair

# Environmental Protection and Recycling

The concept of eco-friendliness was pursued consistently throughout development of the new Passat.

We would now like to show you some aspects of this topic which are also of interest to workshops.

## Recycling

Not least the recycling requirements present workshops with problems such as identifying, presorting and storing materials and waste operating media.

**To achieve this, the following measures were taken:**

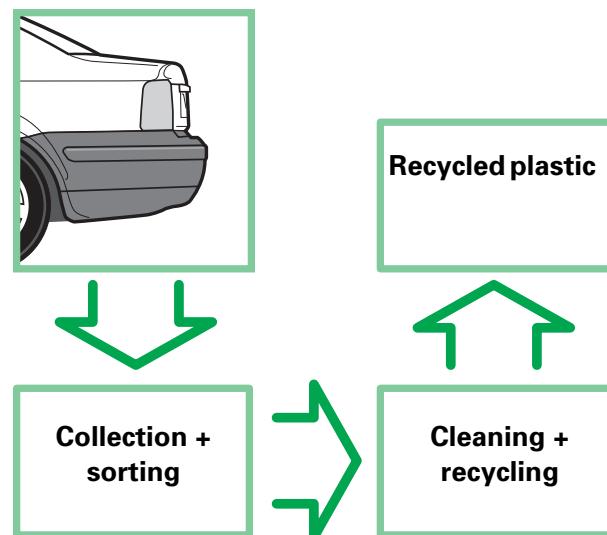
- Identification of plastic part materials
- Fewer composite materials
- Reduction in fine sealing through the use of laser welding
- No parts containing CFCs are used.

### Take bumpers for example:

Bumpers were previously manufactured from composites. What the term "composite" means is that different materials are combined with one another in such a way that subsequent separation into clean material streams is no longer possible.

If a plastic is to be recovered for recycling, it should, if possible, be sorted according to type for recycling purposes. This means that different types of plastic, for example, must not be mixed with one another.

The bumpers on the Passat are recyclable because they do not contain composites.



## Solvents

Even during production, every effort is made to keep environmental pollution to a minimum.

**To achieve this, the following measures were taken:**

- Full galvanisation means much less wax and PVC underseal
- Water-dilutable paints including water-based clear coat
- Stringent requirements for materials ensure lower emissions in the vehicle interior

## Energy + Resources

Raw materials and energy are in limited supply on the planet Earth.  
We must use them sparingly.

**To achieve this, the following measures were taken:**

- Less energy consumption during production through the use of new joining techniques (e.g. laser welding) and complete assemblies (e.g. side section of body),
- Full galvanisation and an 11-year warranty against corrosion perforation ensure high value retention and conservation of resources.

### Take laser welding for example:

During laser welding, a highly concentrated light beam with a high energy content is used instead of a gas flame to join the components. No additional welding material is required, as is the case during MIG welding for example. Laser welded seams are extremely clean and do not need to be reworked. Laser welding offers a more favourable energy balance than conventional welding techniques.



191/03

# Body

The following will be of interest to you:

- The Passat in the wind tunnel
- Fully galvanised body
- Greater body rigidity
- Use of high-strength steel parts
- Strategy of using common platform for body parts
- Ease of repair demonstrated using door module as example
- Rear collision demonstrated using bumper as example

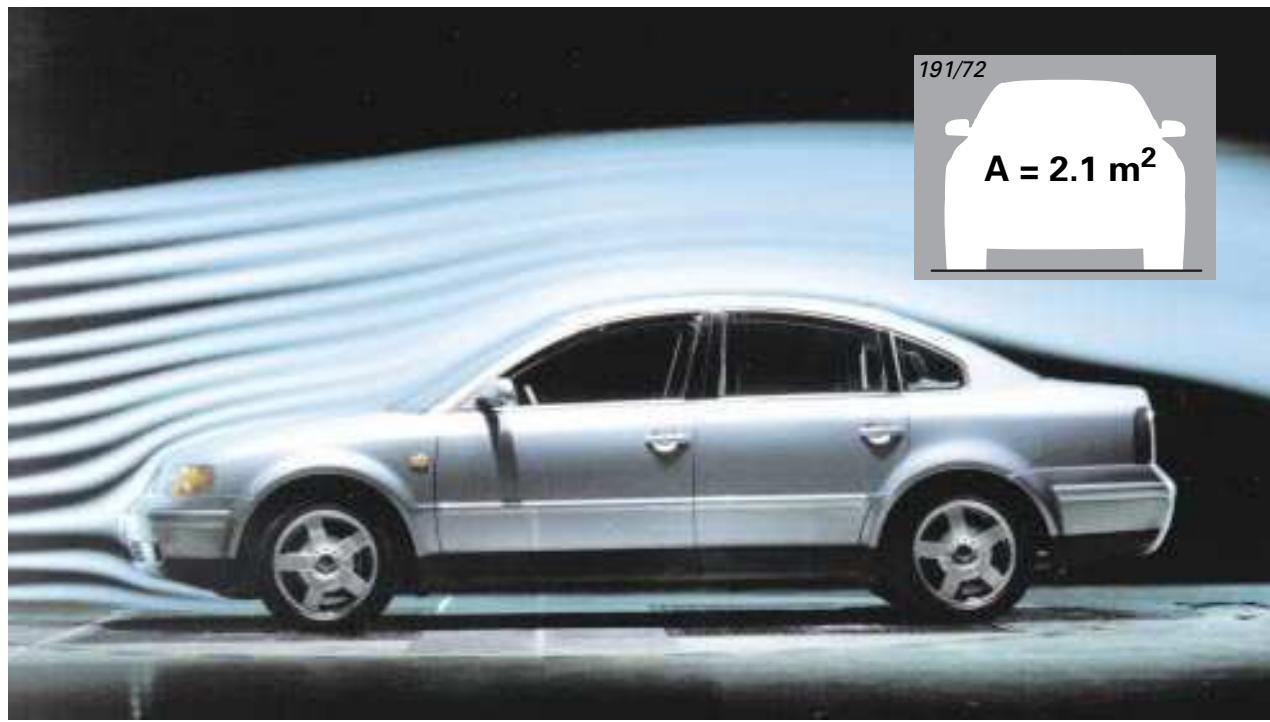
## The Passat in the Wind Tunnel

As you can see from the streamlines, the body of the new Passat is very aerodynamic.

No turbulence, which increases aerodynamic drag, occurs.

The new Passat has a drag coefficient of  $c_d = 0.27$ , making it the best in its class.

Accounting for the projected vehicle area ( $A$ ) of  $2.1 \text{ m}^2$ , aerodynamic drag is  $(Cd \times A) = 0.567 \text{ m}^2$ .



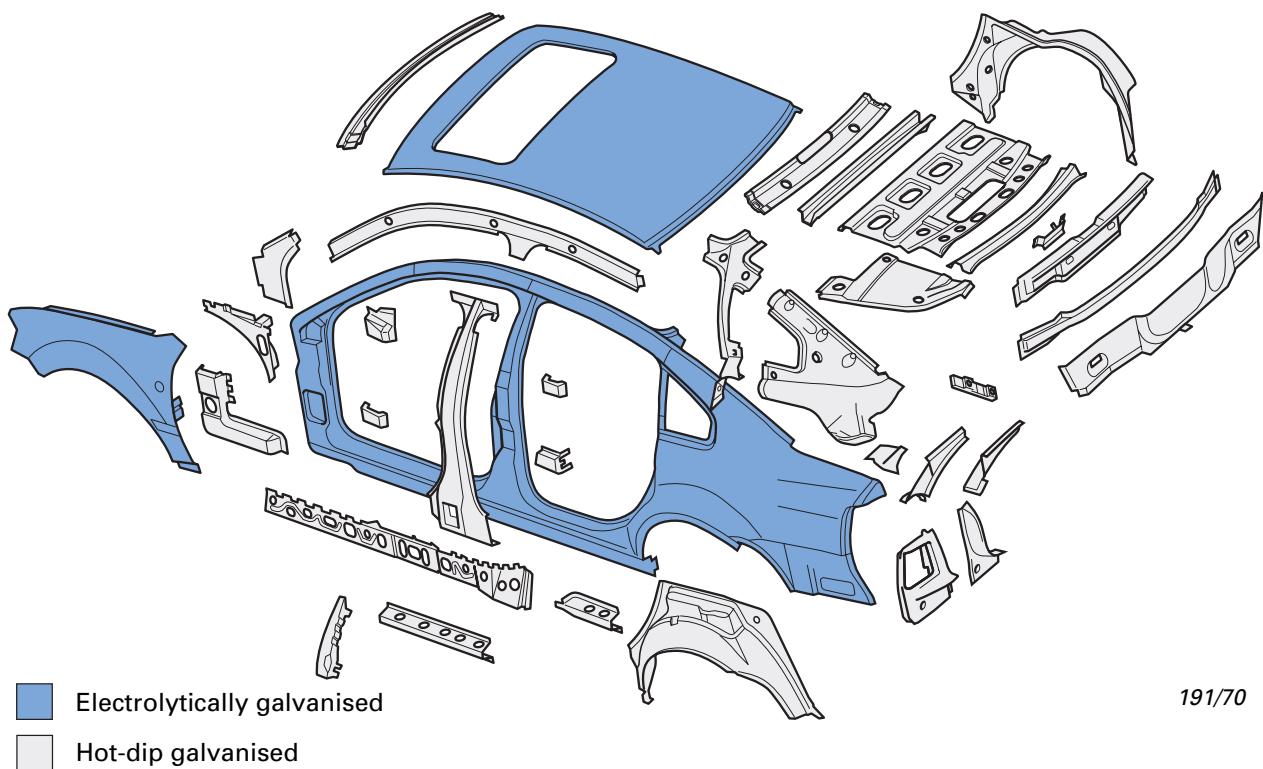
## Fully-galvanised Body

For the first time, the Passat has a fully galvanised body which comes with an 11-year anti-corrosion perforation warranty.

The drawing below shows you the parts which are hot-dip galvanised and those which are electrolytically galvanised.

Surface patterns, which are also visible after painting, emerge during the hot-dip galvanisation process.

That is why the outer skin of the body is electrolytically galvanised to produce a smooth finish.



191/70

# Body

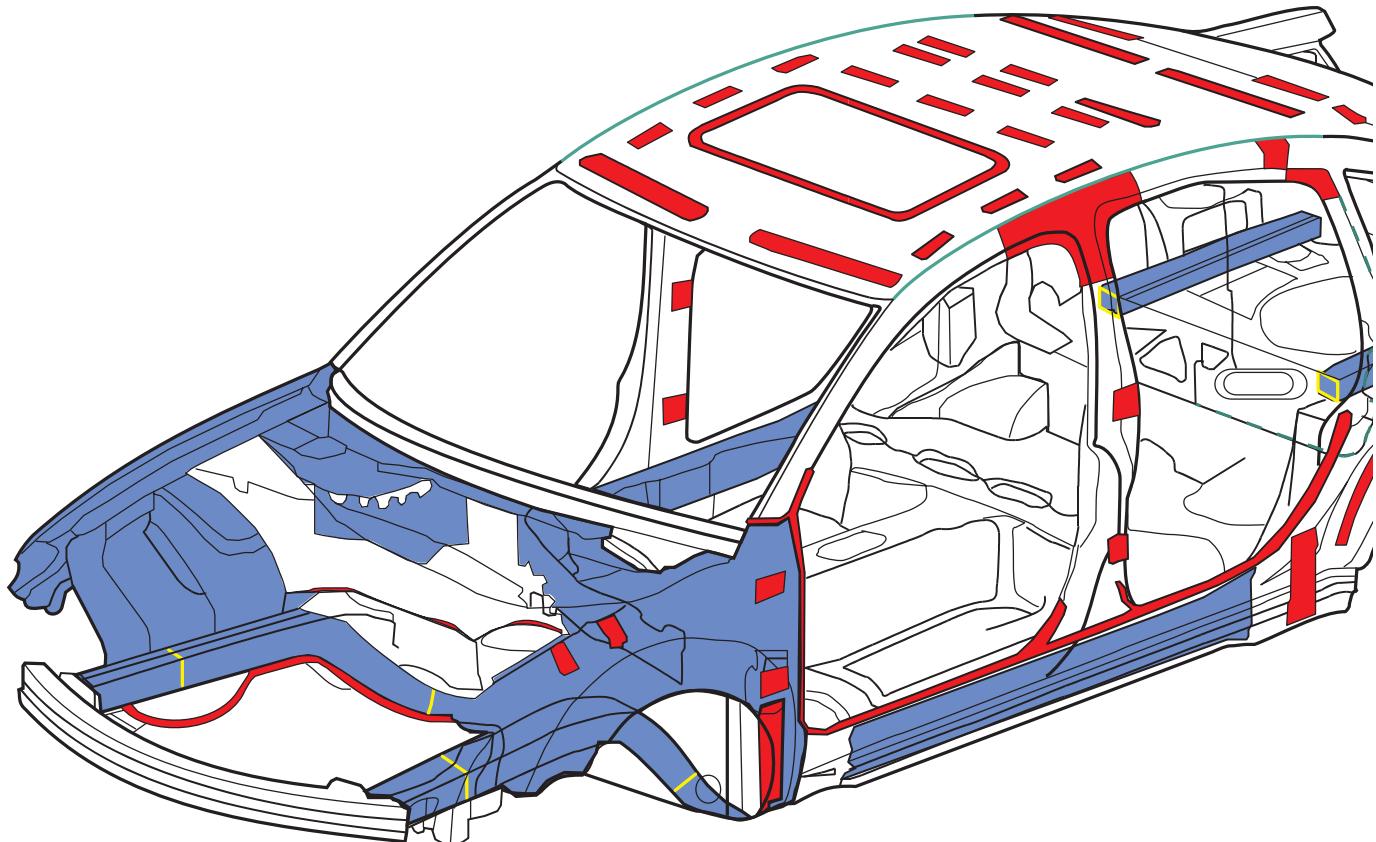
## Stability and Structure

The Passat leads its class in terms of torsional rigidity.

This was achieved by using:

- high-strength panels
- different panel thicknesses
- improved adhesive bonding techniques  
(e.g. adhesive joints)

Adhesive joints increase rigidity and leakproofing while minimising noise levels.



## High-strength Panels

High-strength panels are used to produce a body with greater stability and strength and therefore to provide more safety for the vehicle occupants.

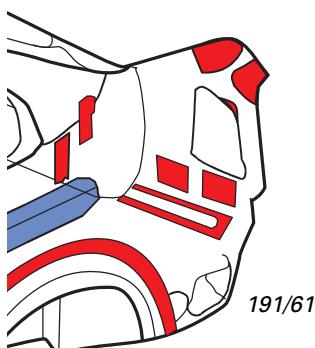
They also substantially reduce the weight of the body-in-white.

As you can see, the high-strength steel components in the front section of the vehicle create a cage-type structure to protect the vehicle occupants.

The wings are also manufactured from high-strength steel.

### Advantages:

- Less weight
- Greater resistance to buckling
- Higher strength



- █ High-strength panels
- █ Adhesive joints
- █ Laser-welded
- █ Mash seam welded

## The Rear Bumpers



Repairing damage to the rear bumpers previously involved expensive repair and welding work, even after minor accidents.



The bumpers on the Passat '97 have the capacity to absorb so much energy during a low-speed rear collision that only plastic parts have to be replaced.

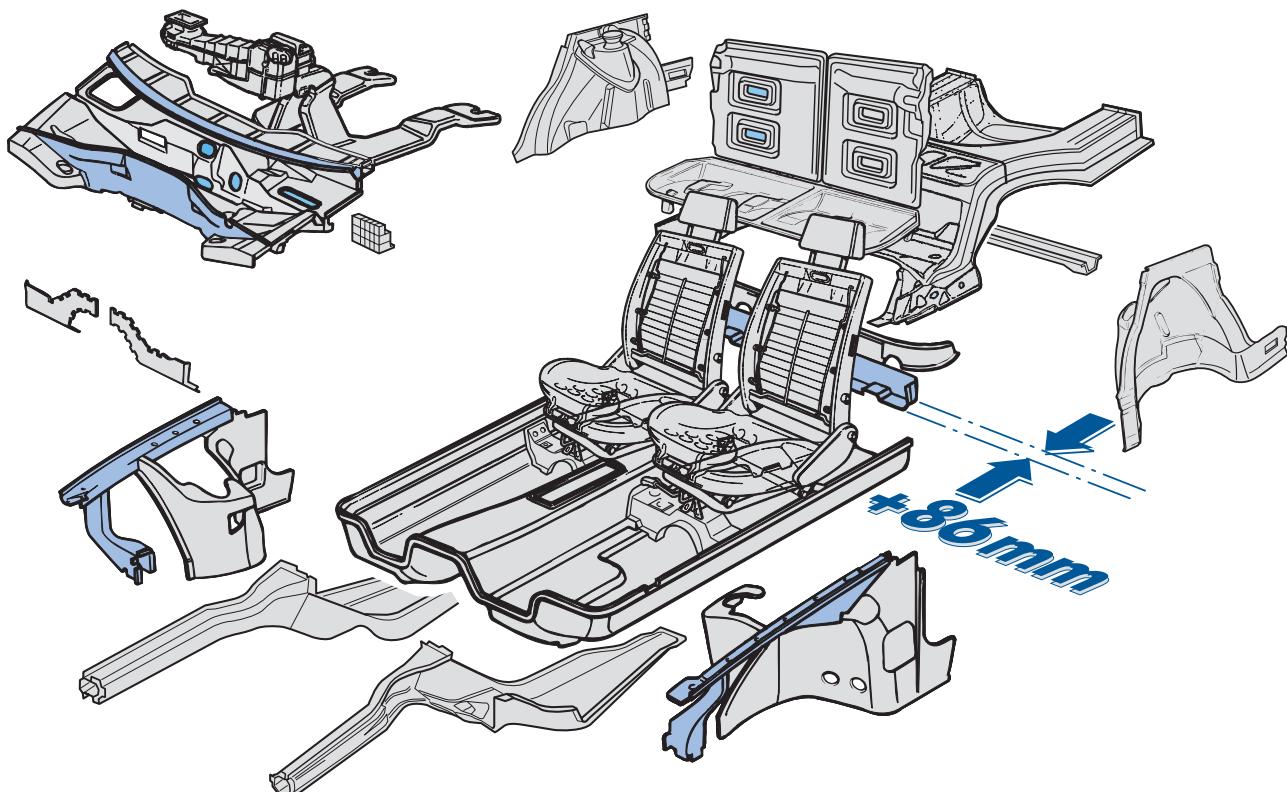
Time-consuming welding work is no longer necessary.

# Body

## Body Platform

The floorpan assembly, side members and luggage compartment floor assembly were adopted from the Audi A4 as a platform.

To enhance ride comfort for rear-seat passengers, a steel floor plate 86 mm wide was inserted.



New parts in Passat '97

191/69

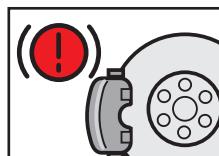
The following features will be of interest to you:

- Active and passive safety
- ABS as standard
- The Passat already complies with the new European standard for crashworthiness
- Door module with enclosed subframe

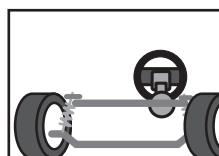
- Driver, front passenger and side airbags as standard
- New seat belt tensioner with force limiter
- Inside door panels with pelvis paddings

As you will no doubt already know, we make a distinction between active and passive safety.

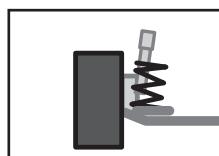
## Active safety



Braking systems

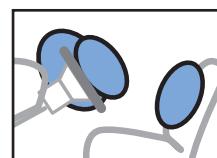


Steering

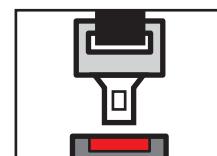


Running gear

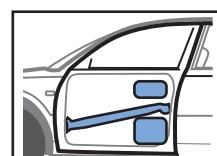
## Passive safety



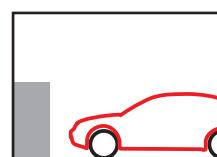
Airbag systems



Restraint systems



Inside door panels and side trims with integral pelvis paddings



Safety body



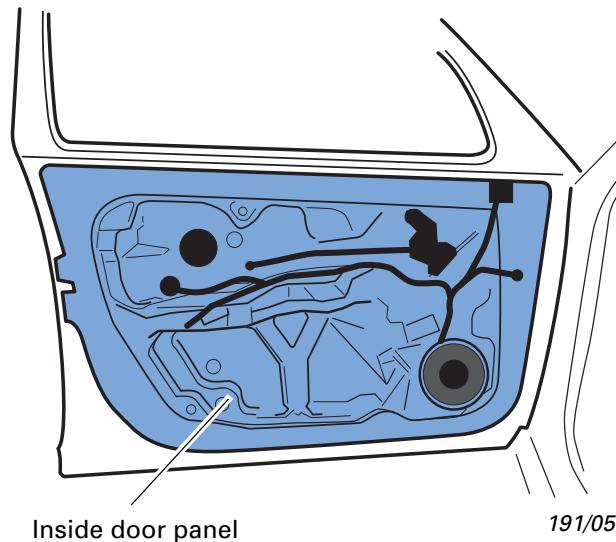
Steering column

# Vehicle Safety

## Crashworthiness

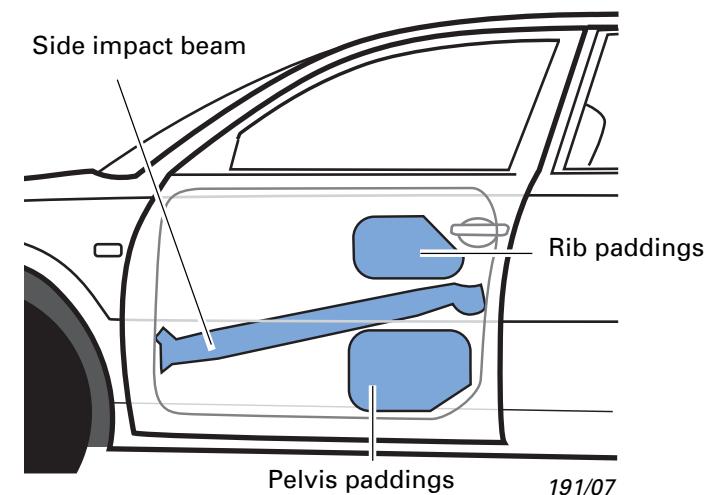
The new Passat offers the driver and front passenger more safety, particularly during a side impact.

The inside door panel, which is fitted complete with built-in door fittings, is bolted to the door. To protect the occupants, the inside door panel has an enclosed surface to prevent intrusion of the built-in door fittings into the interior of the vehicle.



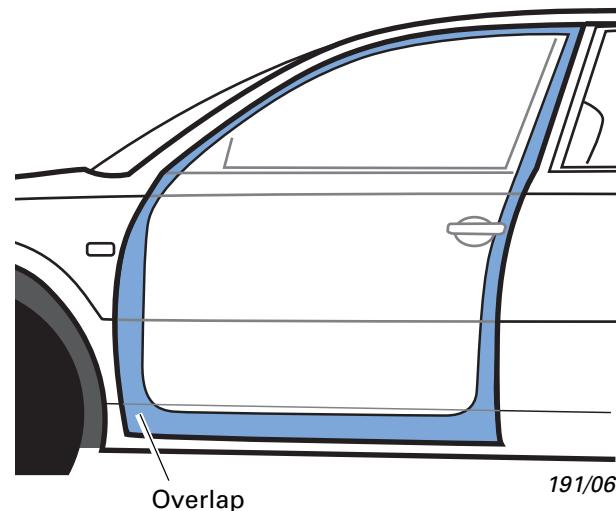
The side impact beams made of pressed sheet metal are arranged diagonally and glued to the outer panel to increase door rigidity.

Impact energy can therefore be better absorbed, distributed and converted. Pelvis and rib paddings give the vehicle occupants added protection.



The size of the overlap between the door and the sill, columns and side section has been increased.

Deformation strength is increased due to the larger contact surface.



## Airbag Systems

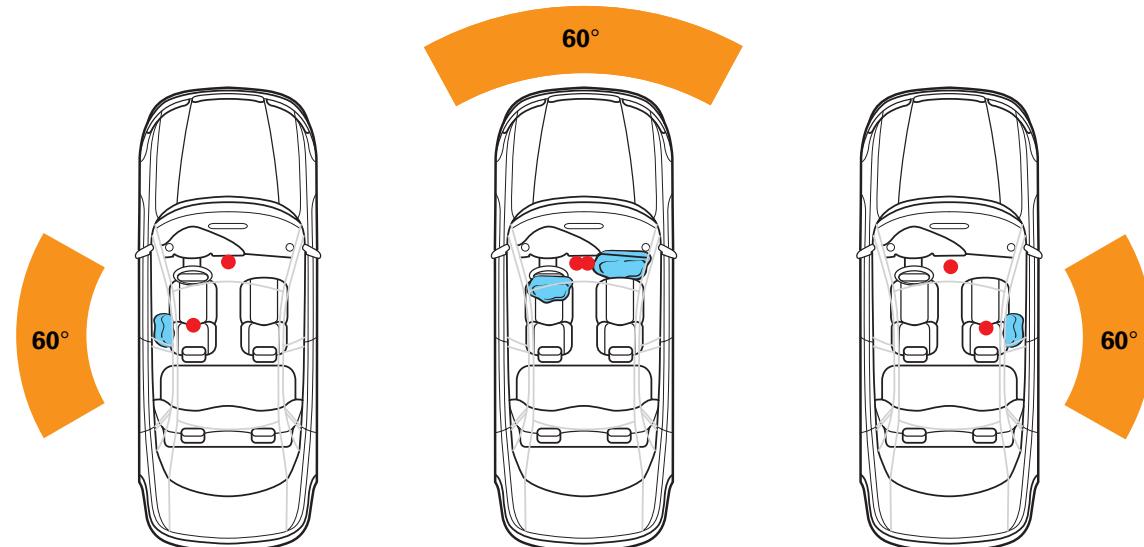
In addition to the driver and front passenger airbags, the Passat is equipped with side airbags as standard.

Depending on the side and angle of impact, only the airbags in the immediate vicinity of the danger zone are inflated.

Therefore, an uninflated airbag on the side facing away from the accident need not necessarily be defective.

The driver and front passenger airbags, which have filling volumes of roughly 65 ltr. and 120 ltr. respectively, conform to the new international-standard airbag sizes.

The volume of the standard side airbag is roughly 12 litres.



191/04

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### Side impact, left-hand side

**Detected by:**  
crash sensor  
located beneath the  
left-hand seat and a  
safety sensor  
integrated in the airbag  
control unit

### Head-on colli- sion

**Detected by:**  
crash sensor and a  
safety sensor  
integrated in the airbag  
control unit

### Side impact, right-hand side

**Detected by:**  
crash sensor  
located beneath the  
right-hand seat and a  
safety sensor  
integrated in the airbag  
control unit

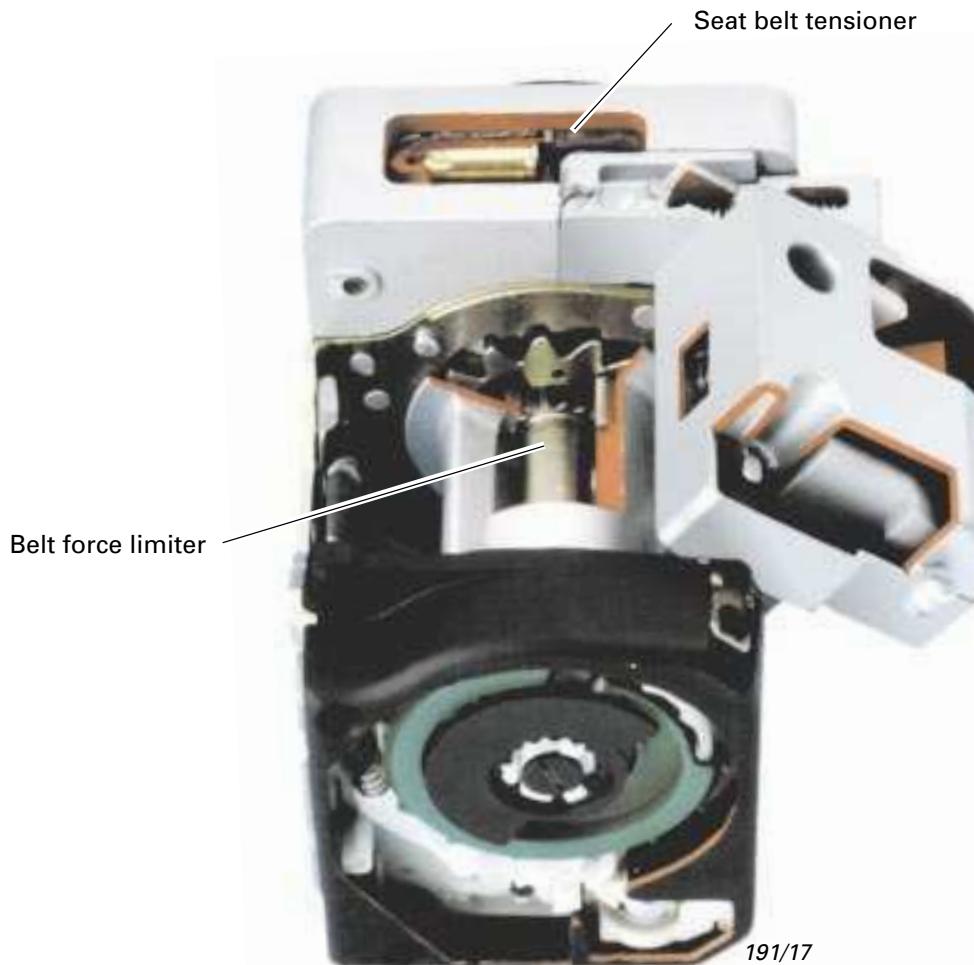
# Vehicle Safety



## The Seat Belt Tensioner

The pyrotechnical seat belt tensioner, together with the “belt fastened” sensor and belt force limiter, are combined in a single assembly. This compact design greatly simplifies replacement.

The “belt fastened” sensor prevents the seat belt tensioner from being activated when the seat belt is not worn.



191/17

# Engines and Gearboxes

In addition to the six tried and tested engines listed below, the new VR5 unit will also be mounted in the Passat.

## 1.6-ltr. Engine AHL

Displacement	1595 cc
Compression ratio	10.3 : 1
Max. torque	140 Nm at 3800 rpm
Max. power output	74 kW at 5300 rpm
Engine management	Simos 2
Fuel	95 RON unleaded premium

This engine is also used in the Audi A3.  
It is mounted in the Passat without a twin-path  
intake manifold.



191/85

## 1.8-ltr. 5V Engine ADR

Displacement	1781 cc
Compression ratio	10.3 : 1
Max. torque	173 Nm at 3950 rpm
Max. power output	92 kW at 5800 rpm
Engine management	Motronic M 3.8.2
Fuel	95 RON unleaded premium

This engine is also used in the Audi A6.



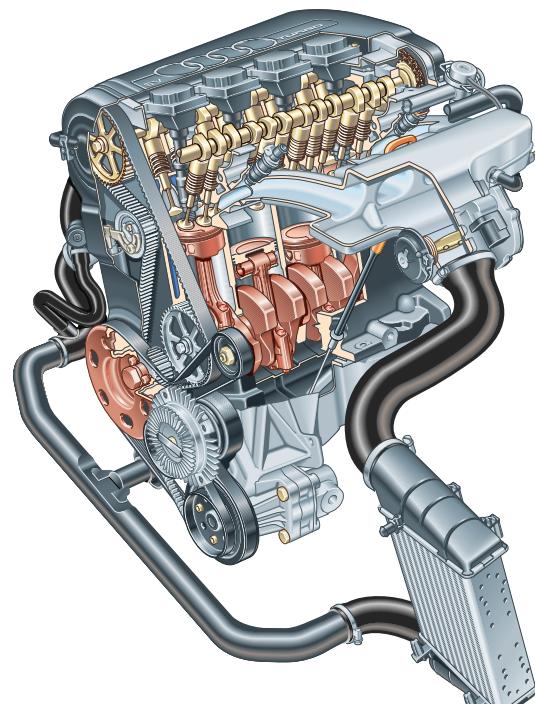
191/77

# Engines and Gearboxes

## 1.8-ltr. 5V Turbo Engine AEB

Displacement	1781cc
Compression ratio	9.3 : 1
Max. torque	210 Nm at 1750-4600 rpm
Max. power output	110 kW at 5700 rpm
Engine management	Motronic M 3.8.2
Fuel	95 RON unleaded premium

This engine is also used in the Audi A4.

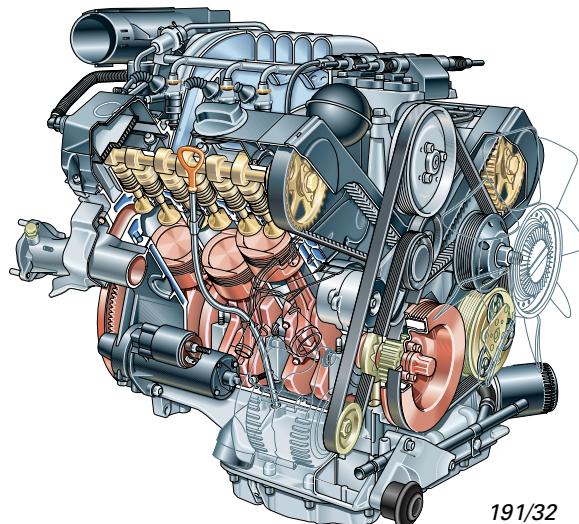


191/31

## 2.8-ltr. V6 Engine ACK

Displacement	2771cc
Compression ratio	10.3 : 1
Max. torque	280 Nm at 3200 rpm
Max. power output	142 kW at 6000 rpm
Engine management	Motronic M 3.8.2
Fuel	98 RON unleaded premium

This engine is also used in the Audi A6.

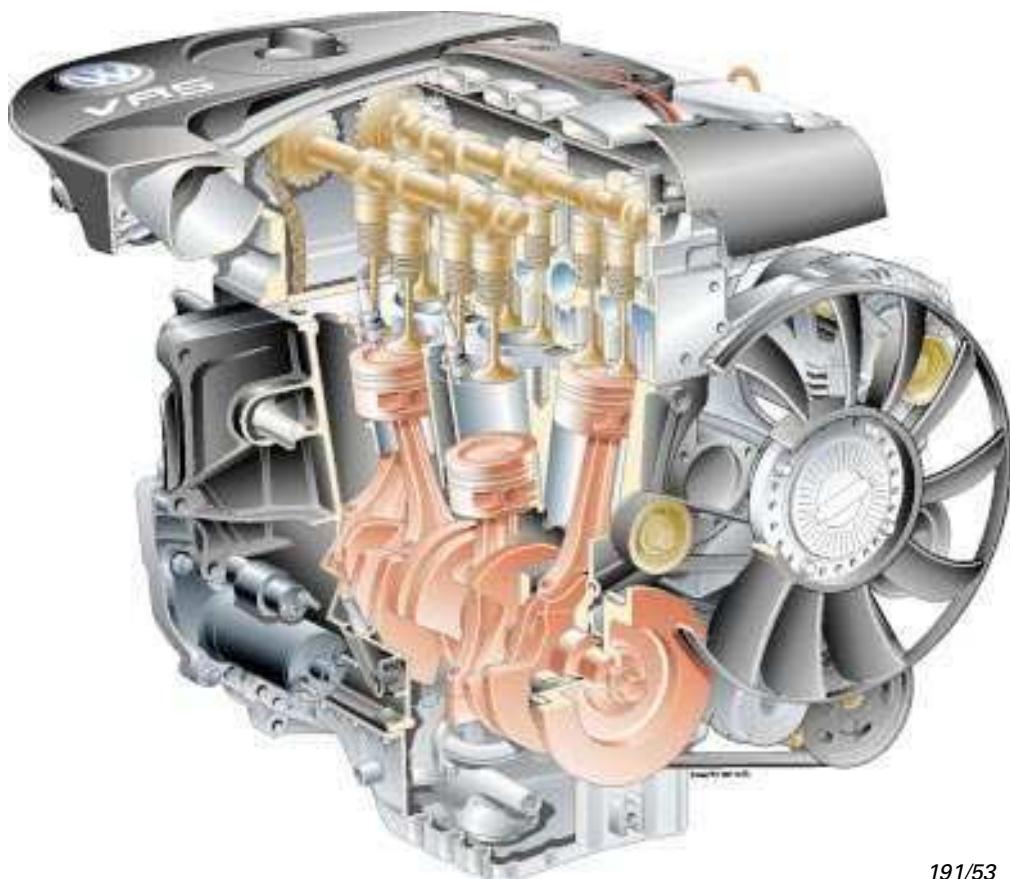


191/32

## 2.3-ltr. VR5 Engine AGZ

The new VR5 engine has a displacement of 2.3 litres. It is derived from the VR6 engine and is designed for in-line or transverse mounting.

Power output is 110 kW.



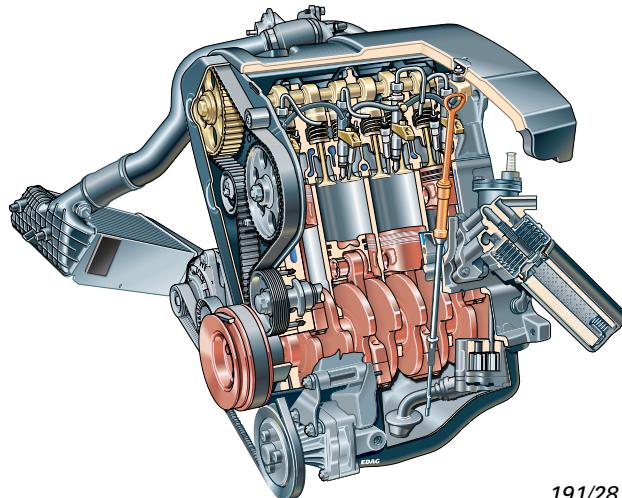
191/53

The engineering of the VR5 engine is explained in a separate Self Study Programme.

# Engines and Gearboxes

## 1.9-ltr. TDI Engine AHU

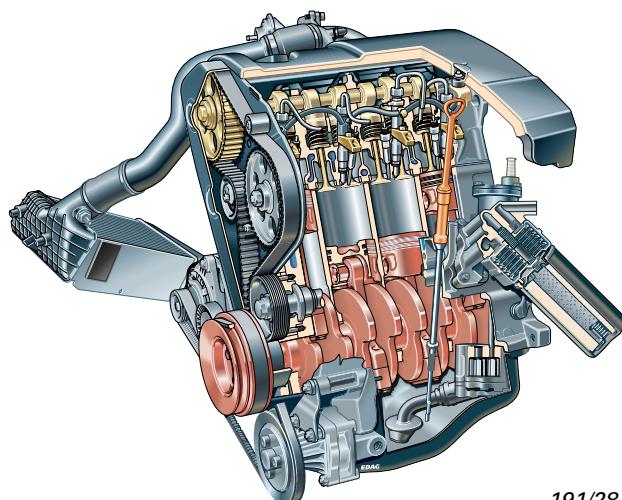
Displacement	1896 cc
Compression ratio	19.5 : 1
Max. torque	202 Nm at 1900 rpm
Max. power output	66 kW at 4000 rpm
Fuel	45 CN diesel
Mixture preparation	Direct injection with electronically controlled distributor injection pump



191/28

## 1.9-ltr. TDI Engine AFN

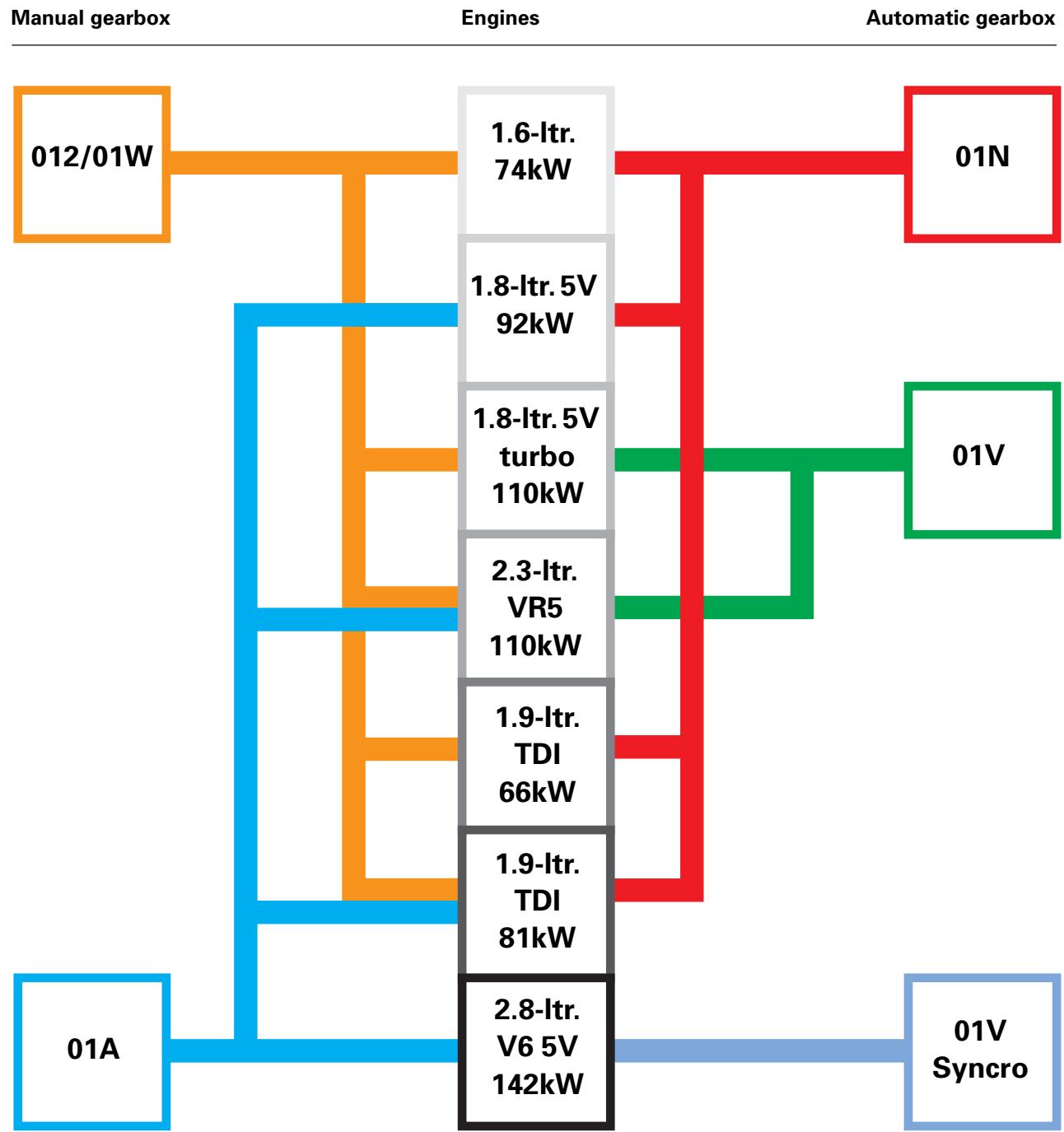
Displacement	1896 cc
Compression ratio	19.5 : 1
Max. torque	235 Nm at 1900 rpm
Max. power output	81 kW at 4150 rpm
Fuel	45 CN diesel
Mixture preparation	Direct injection with electronically controlled distributor injection pump



191/28

This engine features a variable-rate turbocharger. You will find further information on this engine in Self Study Programme SSP190.

## Range of Engines and Gearboxes



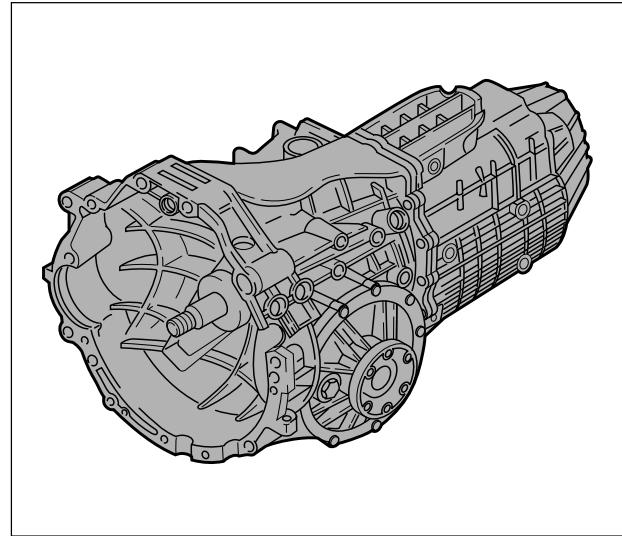
191/64

# Engines and Gearboxes

## 5-speed Manual Gearbox 012/01W

The 012/01W is a manual gearbox as used in the Audi A4.

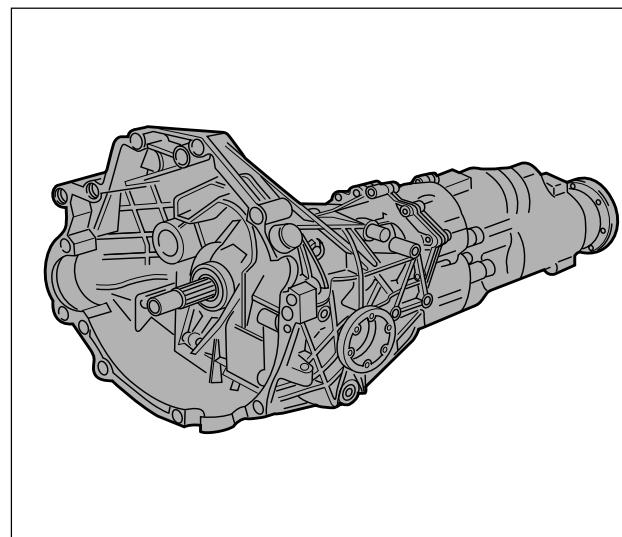
This gearbox has a magnesium housing for installation in the 1.6-ltr./74kW aluminium engine block.



191/34

## 5-speed Manual Gearbox 01A

The 01A is the manual gearbox for four-wheel drive vehicles as used in the Audi A4.

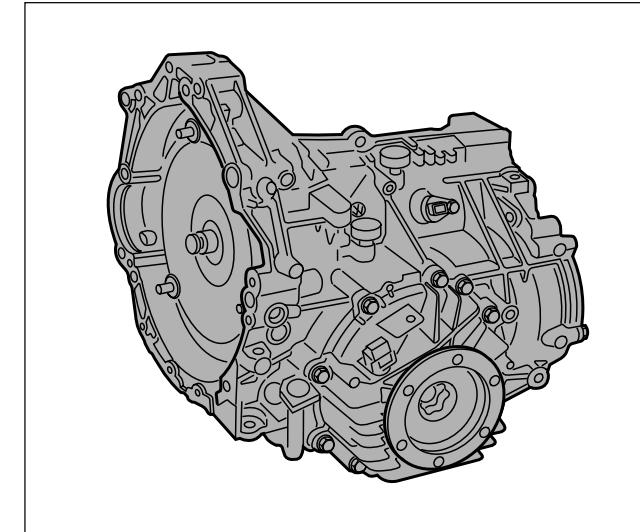


191/35

## **4-speed Automatic Gearbox 01N**

The 01N is also installed in the Audi A6, for example.

You can find detailed information on this gearbox in Self Study Programme No. 172.



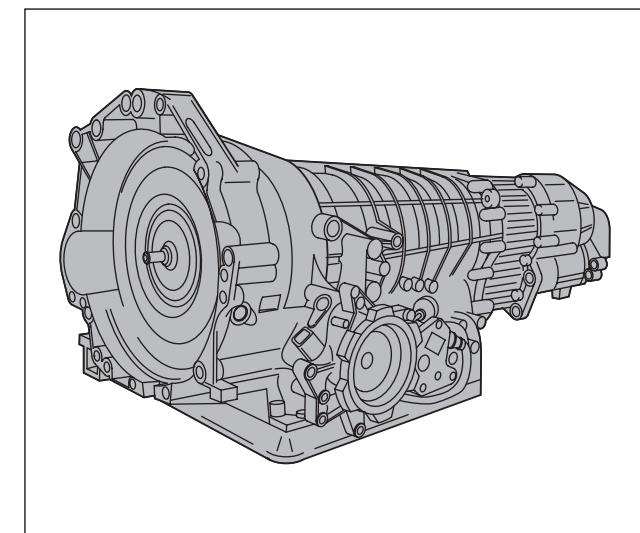
191/36

## **5-speed Automatic Gearbox 01V**

You will also be familiar with the 01V from the Audi A4.

It is equipped with Tiptronic control as standard.

You can find detailed information on this gearbox in Self Study Programme No. 180.



191/78

# Running Gear

In addition to the four-link front suspension, we will show you on the following pages the newly developed torsion beam rear suspension as well as the new double-wishbone rear suspension unique to Syncro models.

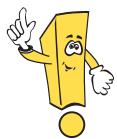
## The Four-link Front Suspension

The four-link front suspension is standard in all front- and four-wheel drive vehicles.

In the case of vehicles with tripoid joints, these joints can be repaired.



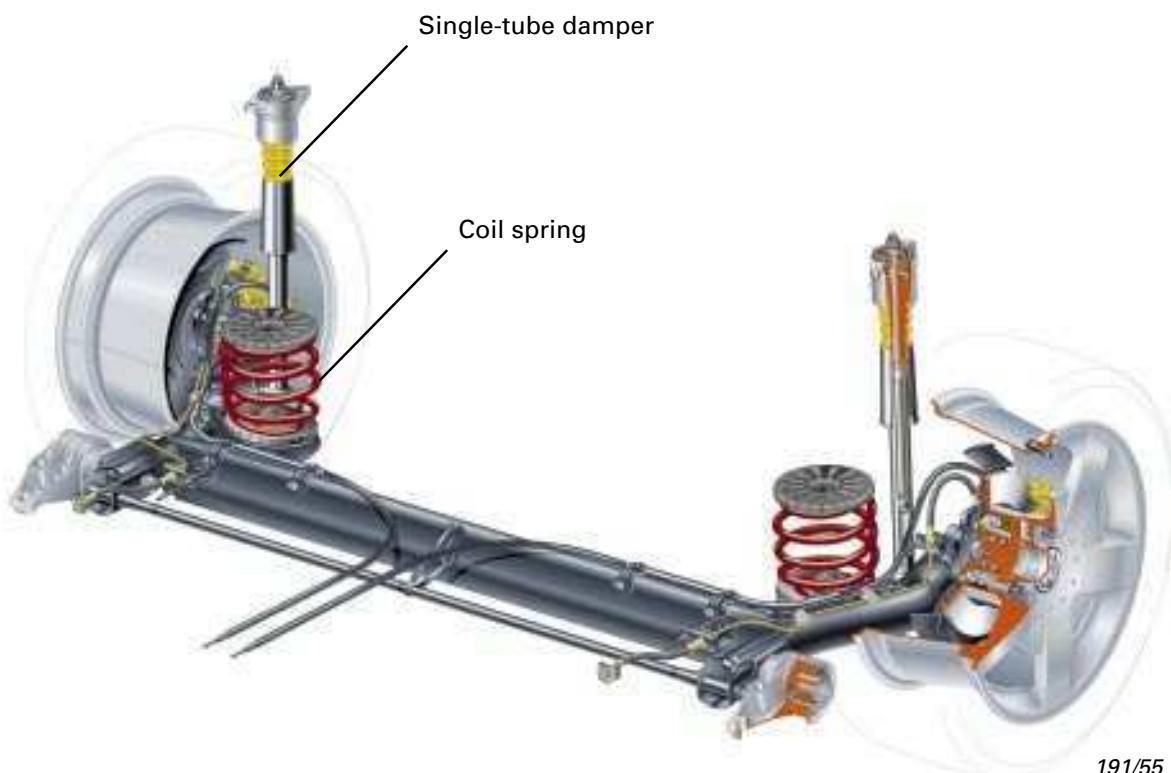
191/37



## The Torsion Beam Rear Suspension

**Advantages of torsion beam rear suspension:**

- Larger through-loading width due to the fact that the coil springs and shock absorbers are kept physically apart
- Use of single-tube dampers
- Downward-facing V-section of axle beam
- Self-aligning twin-grooved oblique ball bearings act as wheel bearings



191/55

# Running Gear



## The Double-wishbone Rear Suspension

The double-wishbone rear suspension was developed in order to provide a through-loading width of over 1000 mm.



191/54



Engine power is transmitted to all four wheels by a Torsen differential.

The Passat is equipped with the Bosch 5.3 anti-lock braking system as standard.

Two different sizes of brake disc are available for the front axle. The rear suspensions also have disc brakes as standard.

**Disc brakes, front**



191/16

**Disc brakes, rear**



191/14

#### **280 x 22 mm brake disc**

The front disc brakes are vented.  
The smaller disc diameter is based on a smaller vehicle mass and lower power output

#### **282.5 x 25 mm brake disc**

This disc brake is vented and larger in size.

#### **Rear brake caliper**

The Passat has rear disc brakes.  
The brake caliper is made of aluminium.

# Steering

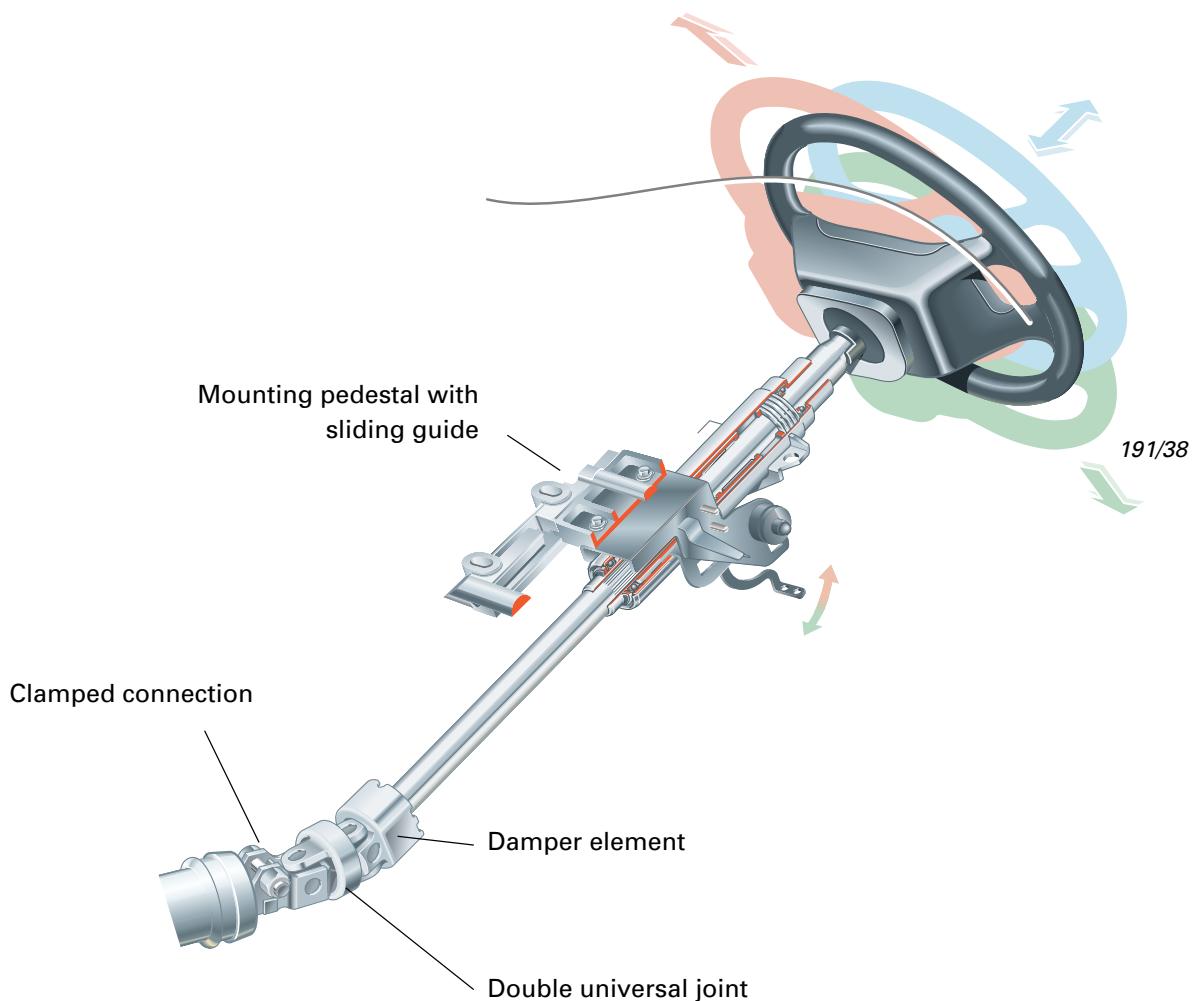
## Height and Reach Adjustment of Steering Column

The Passat is equipped with power steering.

The steering column can be adjusted manually 50 mm fore and aft and 28 mm for height.

The steering column is attached to the body by a mounting pedestal with sliding guide.

A damper element located above the double universal joint prevents vibrations and noise from being transmitted to the body. A clamped connection links the steering column to the power steering gear.



You can find additional information on the steering in Self Study Programme SSP 167.

**The following features will be of interest to you:**

- Decentralised vehicle electrical system
- Dash panel insert
- Gas discharge headlights
- Washer jets

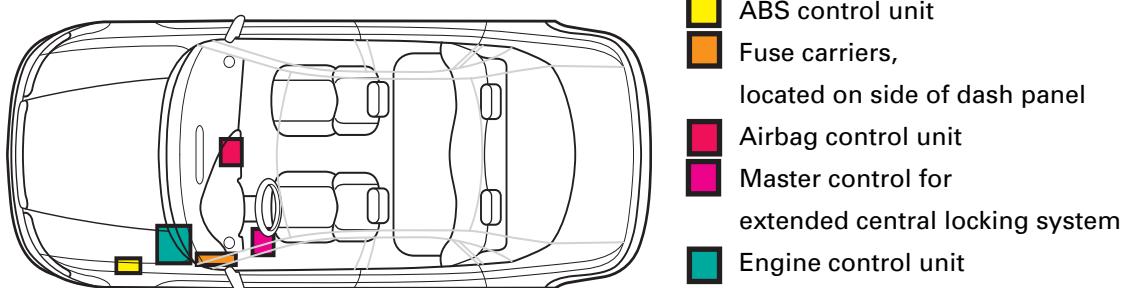
## Decentralised Vehicle Electrical System

The main feature of the decentralised vehicle electrical system is that the central electrics are subdivided into separate connector stations, relay carriers and fuse carriers. These submodules are arranged locally. This means that they are located close to the assemblies and functional units to which they belong. The functions of the "car" as an integrated system are divided up among several control units with specific tasks.

### Advantages:

- Short wiring harnesses make cable connections easier to find and assign.
- The short cables achieve substantial weight savings.
- Test points can be assigned more easily.
- The components of the vehicle electrical system are well protected against moisture.
- The decentralised vehicle electrical system results in easier servicing.

Example of the arrangement of control units



191/43



Repair work on the vehicle electrical system may only be carried out using Wiring Harness Repair Kit VAS1978.

# Electrics

## Dash panel insert

The following features will be of interest to you:

- Electronic immobiliser integrated in dash panel insert
- Capable of diagnosis
- Can be encoded
- Fuel gauge

The dash panel insert is available in two versions which differ from one another in terms of the displays in the centre of the dash panel insert.

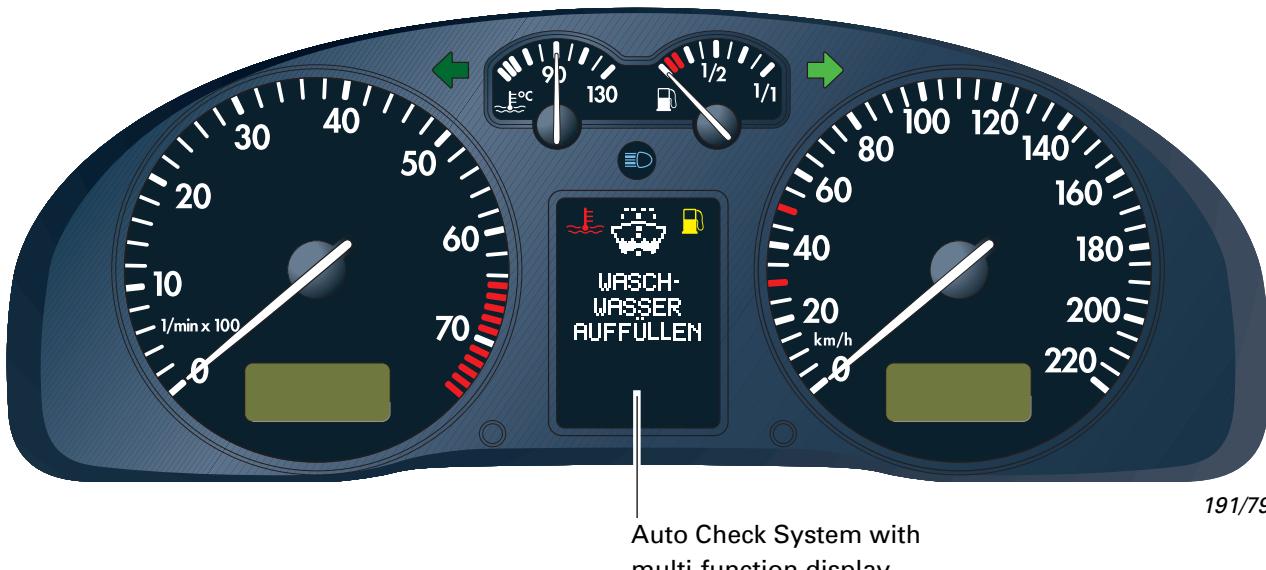
In vehicles equipped with a navigation system, this display is complemented by the Auto Check System with a multi-function display.

The immobiliser is an integral feature of the dash panel insert. However, the matching functions of the immobiliser have been left unchanged.

### Self-diagnosis:

The diagnostic functions can be retrieved using address word "17".

Both instruments can be encoded. This means that the dash panel insert can be encoded depending on country and engine configuration. It is also possible to enter the current mileage when the dash panel insert is replaced.



## Fuel gauge

In previous systems, the fuel gauge tended to fluctuate, e.g. when cornering. To counteract this, damping of the fuel gauge was increased using electronic devices. However, the drawback of this was that the fuel gauge took longer to display the correct fuel level after refueling.

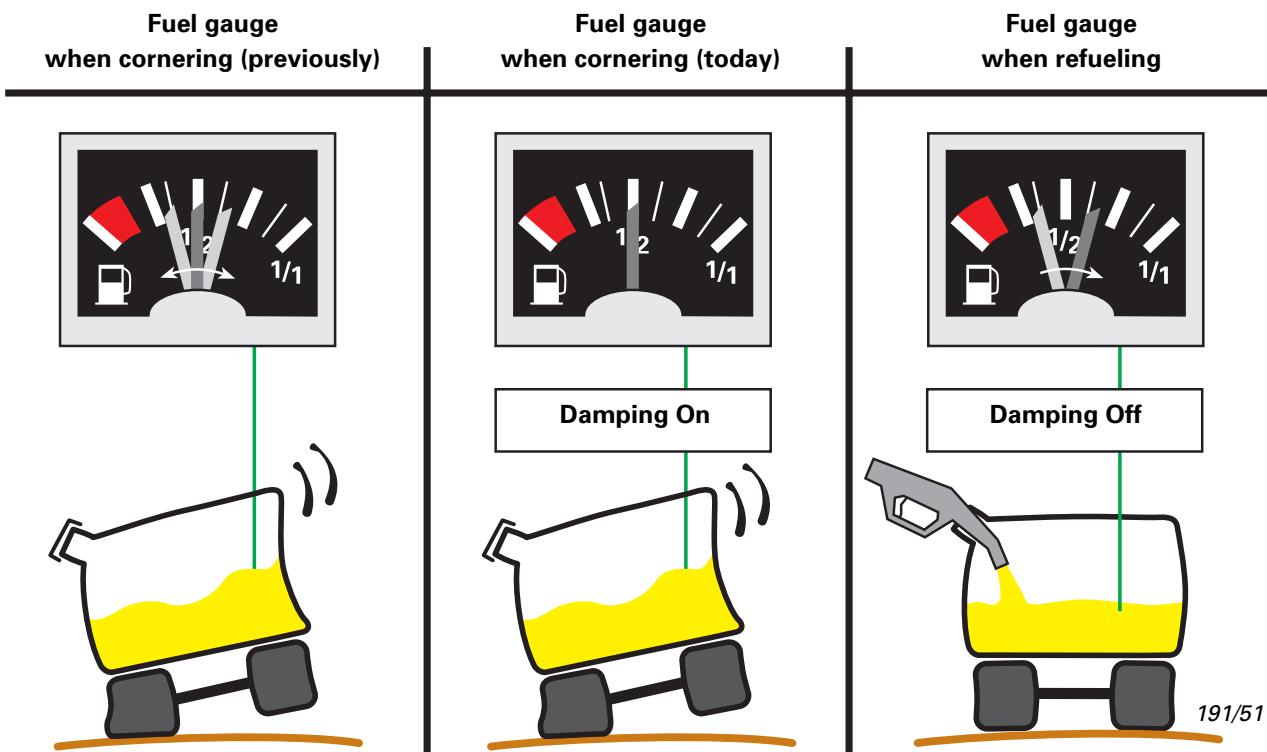
The new fuel gauge eliminates this drawback.

If the **ignition is switched off** and fuel tank capacity increases by four litres or more, the new fuel level is recalculated and displayed straight after the ignition is restarted.

If the **ignition is switched on** and the vehicle is stationary, the damping cuts out and the fuel level is displayed immediately.



Do not refuel the vehicle with the ignition switched on.



## Gas Discharge Headlights

Gas discharge headlights, which are integrated into the headlights, are available for the Passat as an option.

However, the use of gas discharge technology is limited to the dipped beam headlight because it takes up to three seconds to achieve maximum luminous intensity. Therefore, H4 halogen lights will continue to be installed for the main beam headlight.

### Advantage of gas discharge headlights:

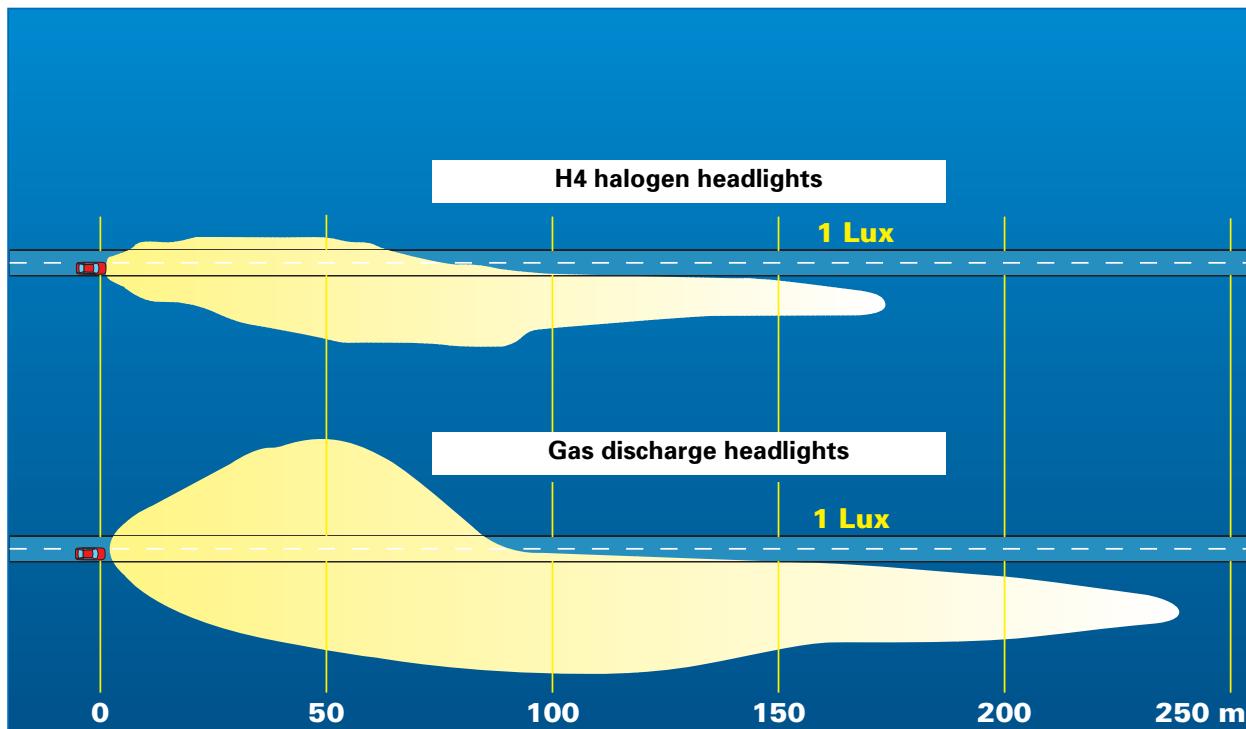
- Greater luminous efficiency than conventional headlights
- Better brightness distribution by virtue of a lens
- Fog light is no longer necessary

On account of the greater danger of dazzling oncoming traffic, vehicles with gas discharge headlights are equipped with dynamic headlight range control.

Consequently, the switch for the manual headlight range control is not required.

### Electronic Headlight Range Control

This function gathers its information on body tilt angle relative to the vehicle axes from two sensors located inside the front and rear wheel housings on the left-hand side of vehicle.

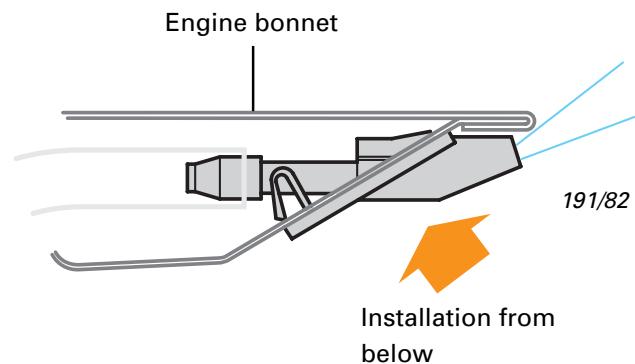


## Fan Jet Nozzle

The Passat features new fan jet nozzles for washing the windscreens.

### Advantages:

- Better fluid distribution over the entire surface of the windscreen
- Lower water consumption
- Better cleansing effect
- No adjustment required



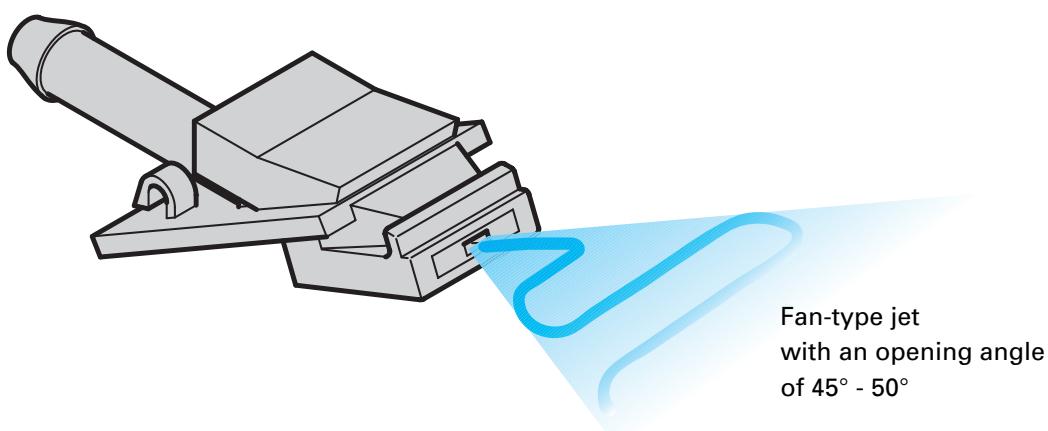
### Mode of operation

For the sake of simplicity, the mode of operation can be compared to that of a garden hose when it is swung from side to side.

Moving the garden hose quickly produces a fan jet.

A nozzle insert for producing the pendulum jet is integrated in the spray nozzle. It ensures a fan jet.

A heated version of the spray nozzle is also available.



# Extended Systems

Various systems cater for ride comfort and ease of operation in the new Passat.

**The following features will be of interest to you:**

- **Extended central locking system**
  - Decentralised system concept
- **Heater/air-conditioning**
  - Innovations in the air-conditioning
- **Navigation + communications**
  - Preparation for mobile cellular phone

## Extended Central Locking System

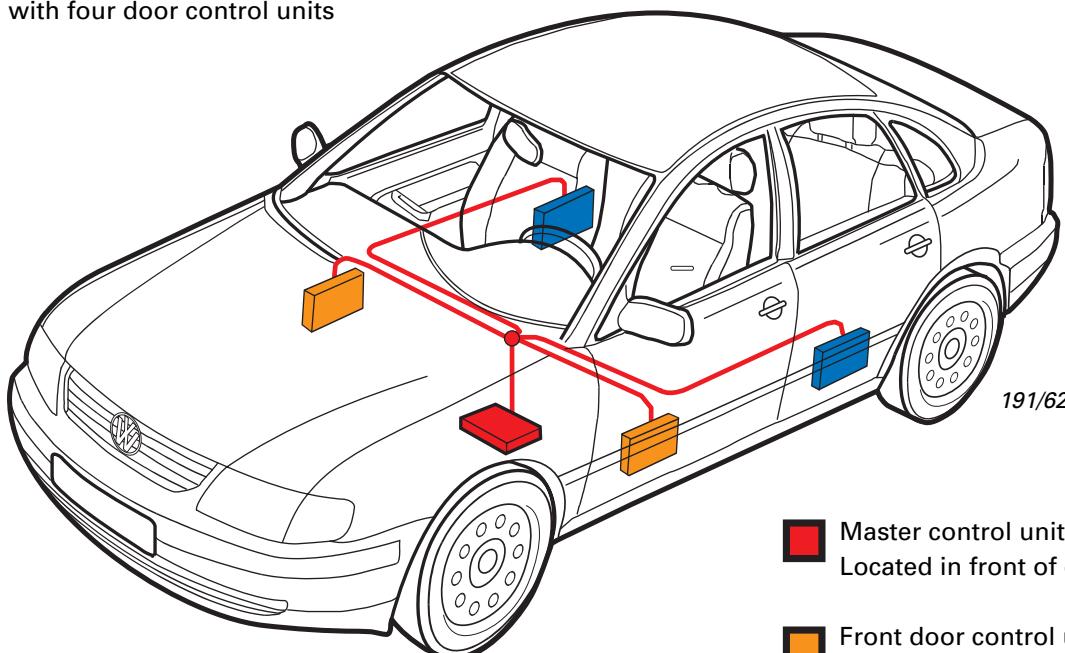
The extended central locking system is based on a decentralised system concept.

It has a central control unit and a separate door control unit with a control panel for every door.

### Self-diagnosis:

Diagnosis is initiated using the address word "46".

Extended central locking system  
with four door control units



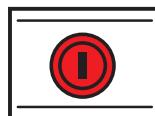
■ Master control units.  
Located in front of driver's seat.

■ Front door control units  
Located on control panel on driver's side  
Located on window lifter motor on front passenger side

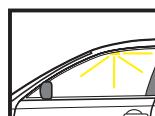
■ Rear door control units  
Located on window lifter motors  
(available only in combination with electric window lifters in rear doors)

## Functions of the Extended Central Locking System

### The master control unit assumes the following functions



Central locking of boot lid



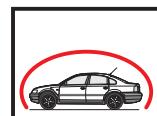
Interior light control



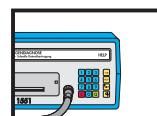
Radio remote control



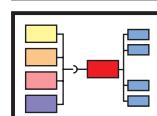
Slide/tilt sunroof



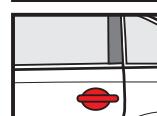
Anti-theft warning system  
with "interior monitor" function



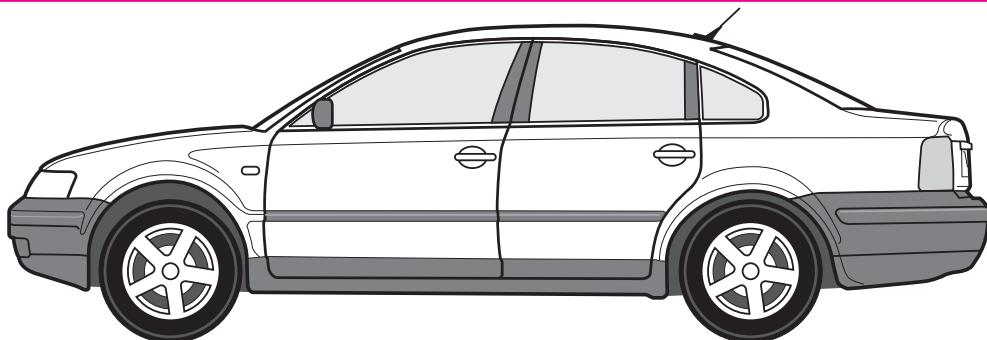
Diagnosis  
Address word „46“



Interface to vehicle electrical system



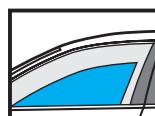
Central locking  
of rear doors (only in combination  
with mech. window lifters at rear)



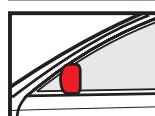
### The door control units assume the following functions



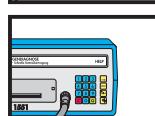
Central locking of  
doors, with Safe mode



Electric window lifters with  
excess power limitation



Electrically adjustable, folding and  
heated door mirrors



Diagnosis  
Address word „46“

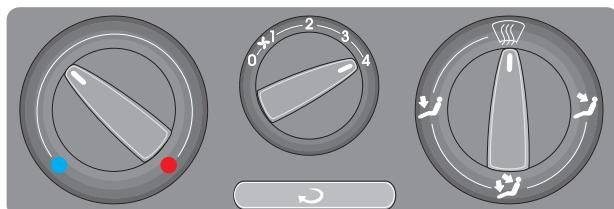
# Extended Systems

## The heater

Unlike predecessor models, the new heater is constructed in one piece.

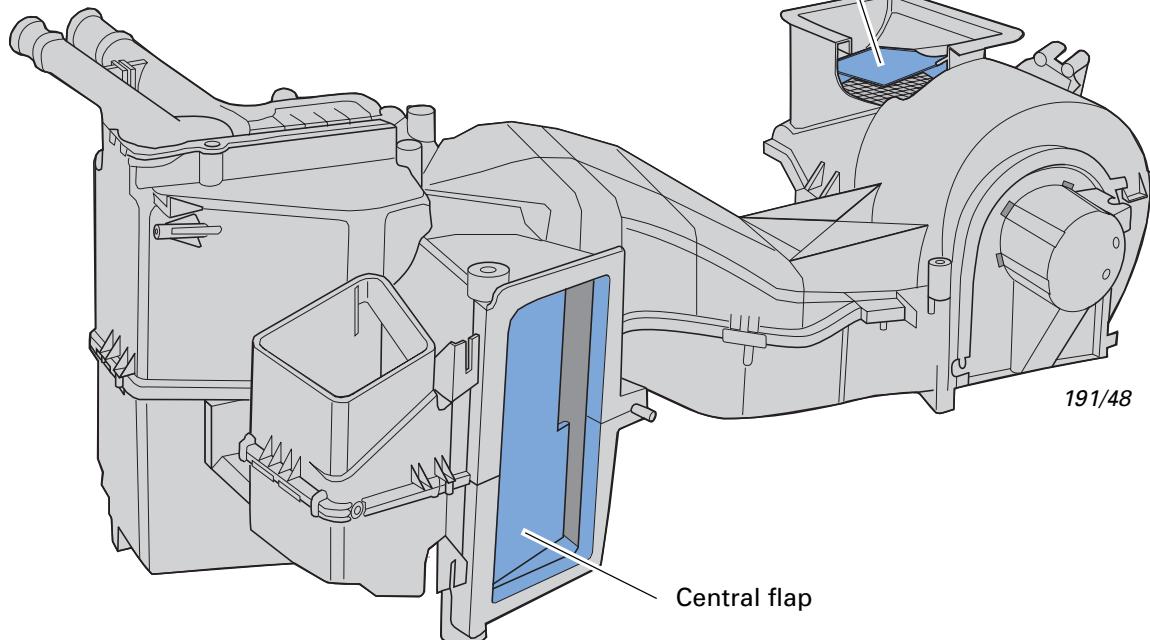
The air distributing housing and the air duct with shutoff flap are combined in a single component.

The heater, which is controlled at the air intake side, permits fresh-air and air-recirculation modes. A main shutoff flap is therefore no longer required.

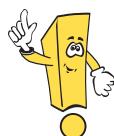


191/27

Fresh-air/air-recirculation flap



191/48



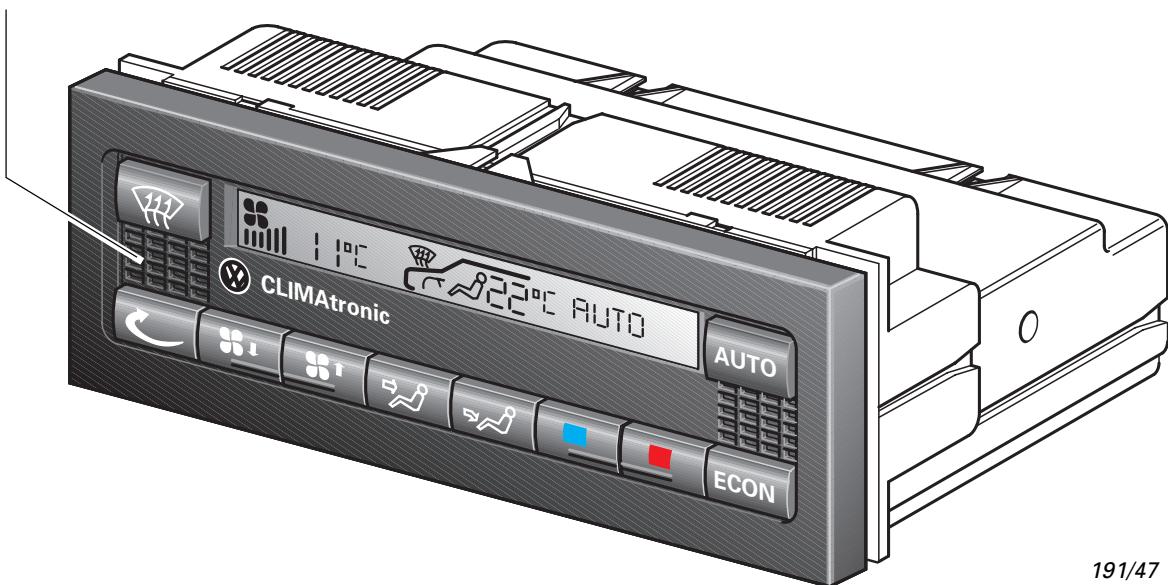
- By virtue of the stepped form of the central flap, the central air vent is closed in defrost mode.
- An electric-motor-operated fresh-air/air-recirculation flap is integrated.
- In defrost mode, the air recycle function is switched off.

Pleasant air-conditioning for comfort and safety in the Passat.

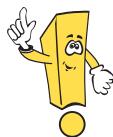
## The CLIMAtronic

### Operating and display unit with control unit

Temperature sensor



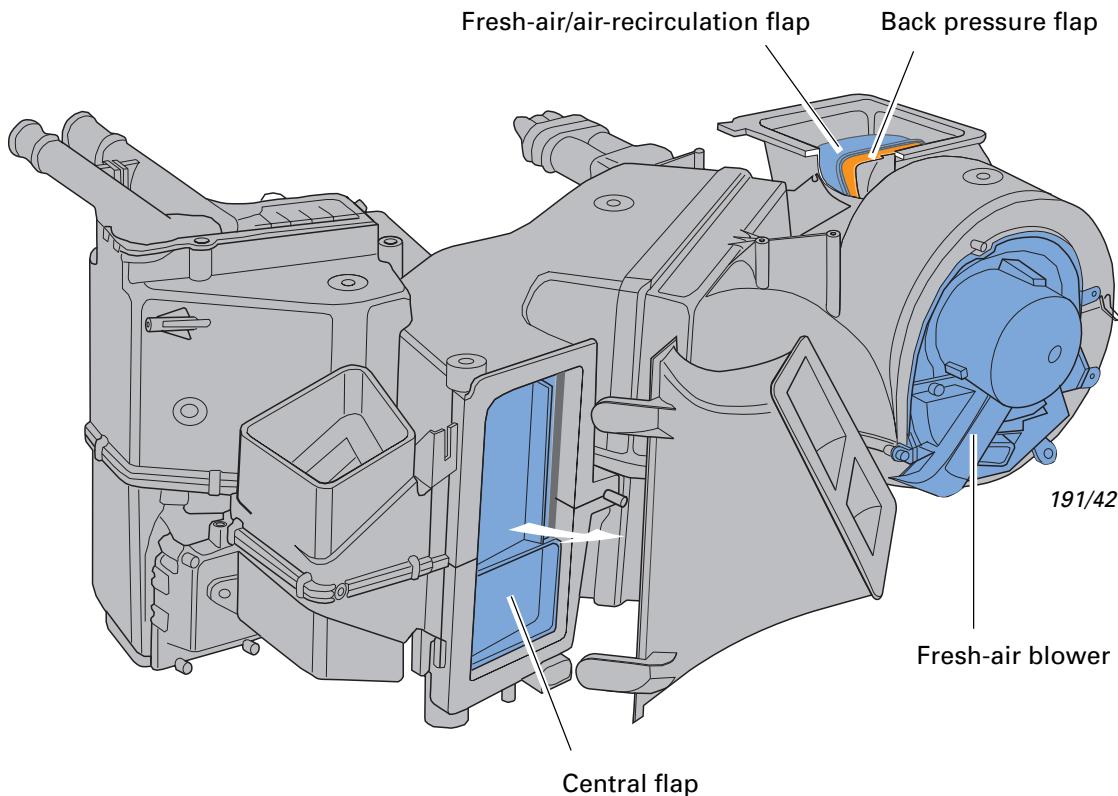
191/47



- The controls have been rearranged.
- The temperature sensor dash panel and blower is integrated in the operating and display unit.
- The photosensor measures incident sunlight over a large area.  
There is greater sensitivity for controlling the interior climate.
- Average outflow temperature is registered by a transmitter.

# Extended Systems

## The Air-conditioning



- The fresh-air/air-recirculation flap is combined with the back pressure flap.
- Fresh-air blower with integrated control unit.
- The shape of the central flap has been modified to allow separate airflow to the central and side vents.
- All flaps are electric-motor-operated.

**The following components are integrated in the refrigeration circuit:**

- Plate evaporator
- Controlled swash plate compressor
- Condenser
- Butterfly valve
- Collecting vessel



Air-conditioning without back pressure flap is installed in right-hand drive vehicles.



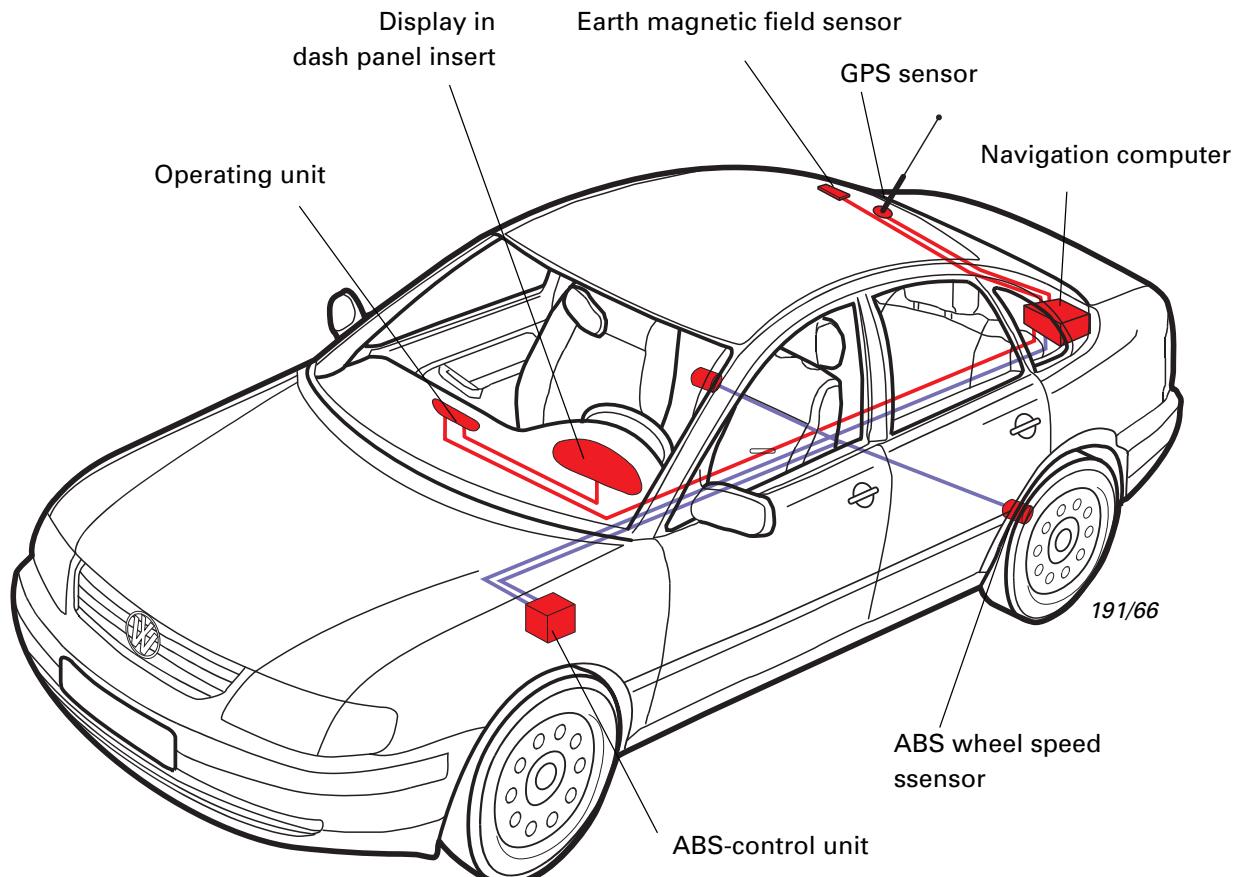
## Navigation

The navigation system enables the driver to reach his (her) destination easily and safely. It replaces the road map and enhances road safety.

This system employs a map stored on a CD-ROM. The driver can select his (her) destination on this map. Directions for the driver are then given on the display in the dash panel insert and via the loudspeaker built into the control unit.

### The system comprises the following elements:

- The navigation computer with integrated CD-ROM drive
- The control unit with control and loudspeaker
- The display integrated in the dash panel insert
- The earth magnetic field sensor
- ABS wheel speed sensor
- The sensor for the global positioning satellite system (GPS)
- The GPS satellite network



# Extended Systems

## Navigation computer with CD-ROM drive

The navigation computer determines the position of the vehicle by means of the above-mentioned sensors. It then compares the calculated position with the map stored on the CD-ROM and the chosen destination.

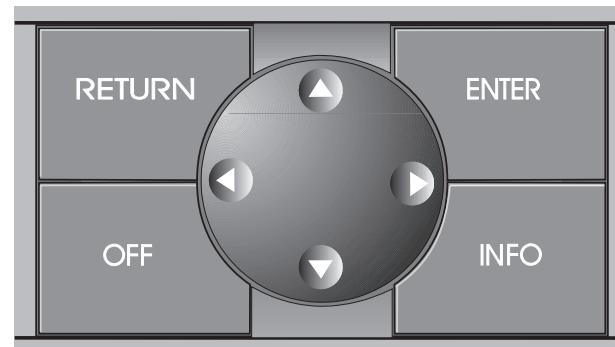
The computer then calculates directions for the driver from this comparison.



191/50

## Control unit with control and loudspeaker

The control unit is the interface to the navigation computer. The system is switched on or off and the destination is entered by operating the control. In addition to the display integrated in the dash panel insert, a voice output can also be provided by means of the built-in loudspeaker.



191/49

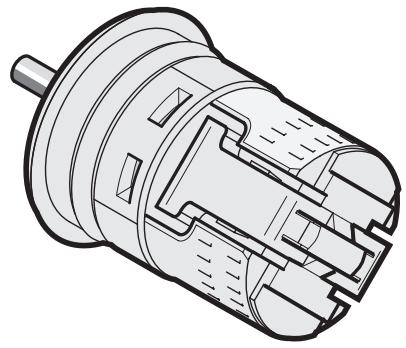
## Display integrated in dash panel insert

The navigation system displays information visually via the display of the Auto Check System with multifunction display integrated in the dash panel insert.

Depending on selected function, the display shows a letter field for entering a destination or pictograms representing directions for the driver .

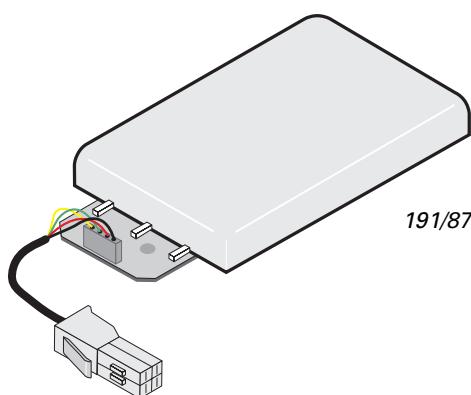


191/83



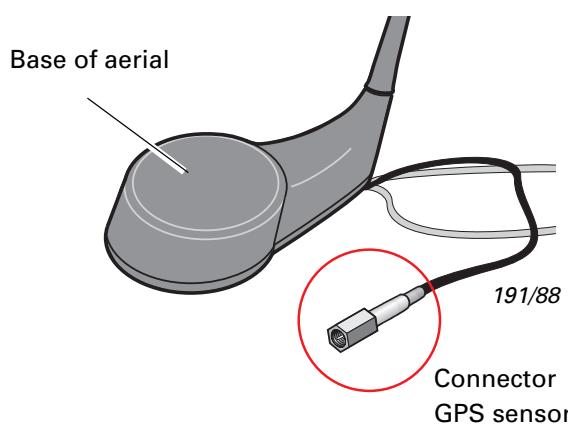
### ABS wheel speed sensor

The wheel speed sensors of the rear suspension are used to provide the navigation computer with information on distance travelled.



### Earth magnetic field sensor

The earth magnetic field sensor determines the direction of travel relative to the north pole for the navigation computer.



### GPS sensor

GPS stands for **G**lobal **P**ositioning **S**ystem, a global navigation system. The sensor is integrated in the roof aerial. The navigation computer uses the data supplied by the GPS sensor as a correction factor or when relocating the vehicle if the computer loses track of the current position (e.g. during rail transport).



However, this particular navigation system is not yet able to make allowance for traffic lights, one-way roads, building sites, traffic jams, etc.

# Extended Systems

The Passat is available with a mobile phone or cellular phone provision as equipment variants.



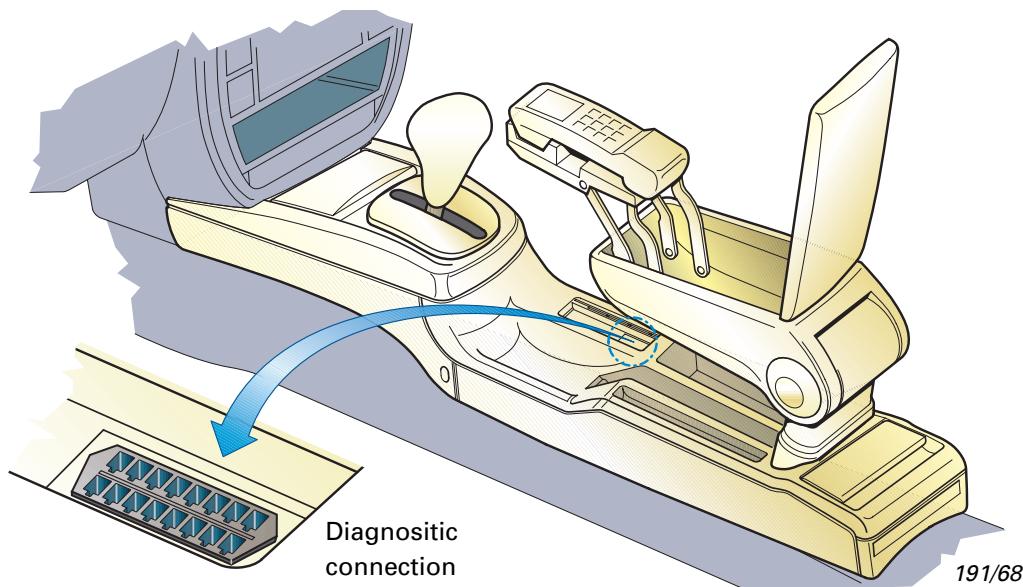
## Cellular Phone Preparation

### Advantage:

- Easy to install
  - No complex cable installation necessary
  - One roof aerial for all functions
- Depending on equipment specification of the vehicle, three types of aerial can be installed:
- Radio only
  - Radio and telephone
  - Radio, telephone and navigation (GPS)

### Scope of cellular phone provision:

- Hands-free microphone integrated in left-hand A pillar
- VDA-standard cable (standard connection for mobile phone)
- Radio mute function
- Change-over relay for left-hand door loudspeaker
- Combined roof aerial with high-frequency line to mobile phone



With the cellular phone provision, only mobile phones with a VDA-standard connection can be operated.



# Notes

# Notes



# The Passat '97

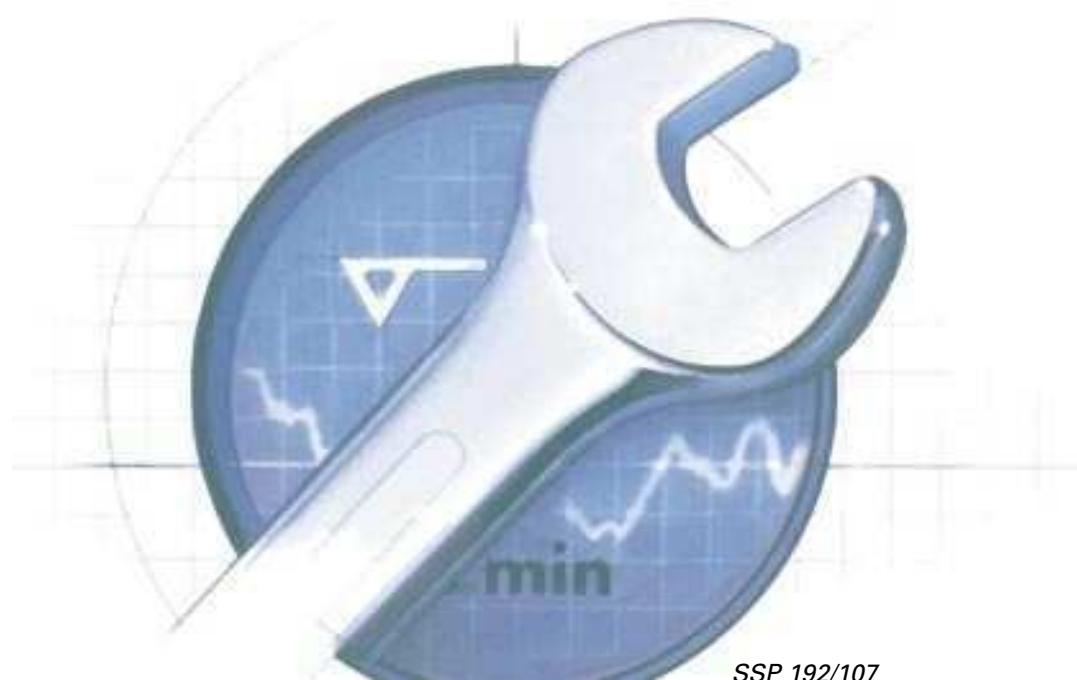
## The Engineering

Design and Function

Self Study Programme



# The Passat '97



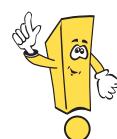
Having provided you with an initial overview of the new Passat in the Self Study Programme entitled "The Passat '97 – The Presentation", we now want to describe in detail how the car's various components are designed and how they function.

The subjects of the VR5 engine, convenience electronics and navigation system are so wide-ranging that it would be beyond the scope of this Self Study Programme. We will therefore deal with them separately.

	Page
<b>Introduction</b>	<b>04</b>
<b>Vehicle Safety</b>	<b>06</b>
<b>1.8-ltr. 5V Engine ADR</b>	<b>20</b>
<b>1.8-ltr. 5V Turbo Engine AEB</b>	<b>22</b>
<b>2.8-ltr. V6 Engine ACK</b>	<b>26</b>
<b>1.9-ltr. TDI Engine AFN</b>	<b>34</b>
<b>Gearbox</b>	<b>38</b>
<b>Drive Shafts</b>	<b>40</b>
<b>Running Gear</b>	<b>43</b>
<b>ABS/EDL</b>	<b>48</b>
<b>Electrics</b>	<b>55</b>
<b>Air-conditioning</b>	<b>60</b>



**Important! / Note!**



**New!**

This Self Study Programme is not a Workshop Manual!  
Please refer to the relevant Service Literature for all inspection, adjustment and repair instructions.

# Introduction

## Overview of topics

### Engines

Given that the engine concepts used in the Passat '97 are tried and tested, we will confine ourselves solely to special innovations such as the variable valve timing featured in the 2.8-ltr. V6 engine.



### Gearbox

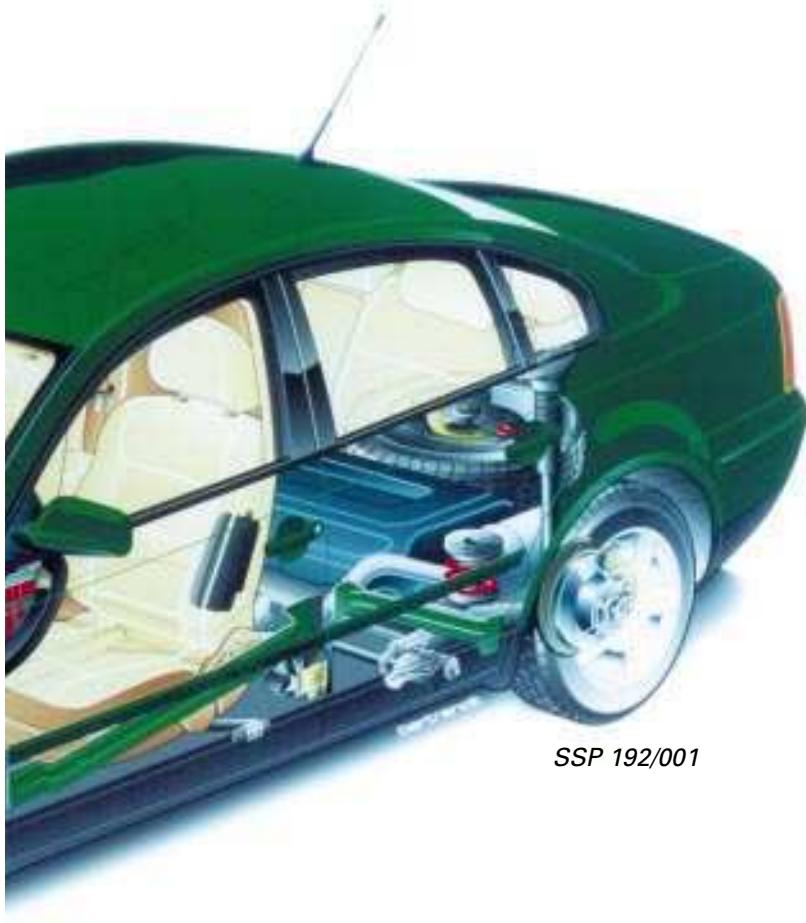
Non-ferrous metals, such as aluminium or magnesium, are being used increasingly in vehicle construction. In this booklet we will explain the advantages and special features of magnesium components.

### Electrics

You will be given information regarding the gas discharge headlights.

### Drive shafts

We will explain how length compensation works in the triple roller drive shafts.



## **ABS/EDL**

As a part of the ABS/EDL system, we will present you the new hydraulic unit with an integrated control unit.

## **Running gear**

In addition to information about the torsion beam rear axle and the double wishbone rear axle, we will show you the new design of the new wheel bearing generation.

## **Air-conditioning**

The latest developments and the special features of the CLIMAtronic will be described.

## **Vehicle safety**

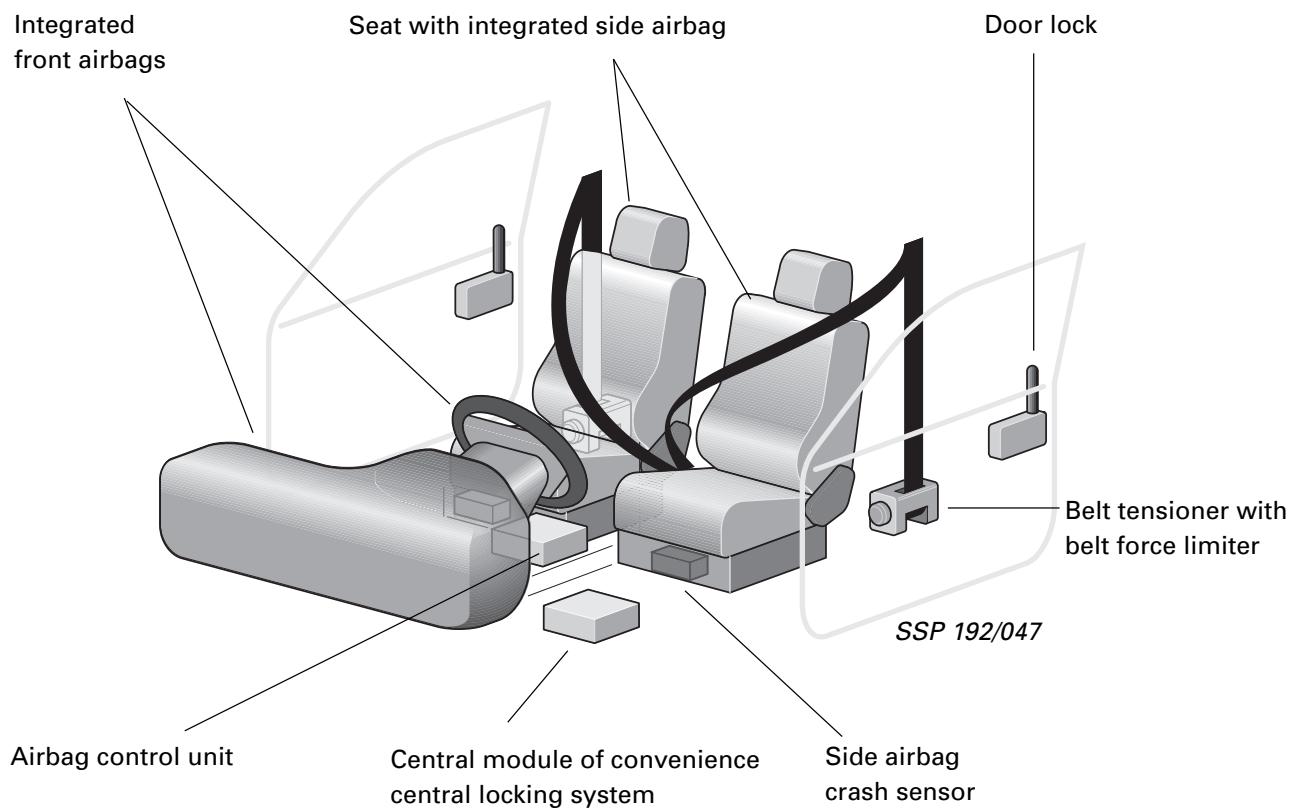
We will describe the gradual action of the side airbag and the belt tensioner with belt force limiter.

# Vehicle Safety

## Mode of operation of the restraint systems

Two different restraint systems are used in the new Passat:

- Seat belts with belt tensioner and belt force limiter, used on all outer seats,
- Front and side airbags for the driver and front passenger.



## Effect of the restraint systems during minor accidents

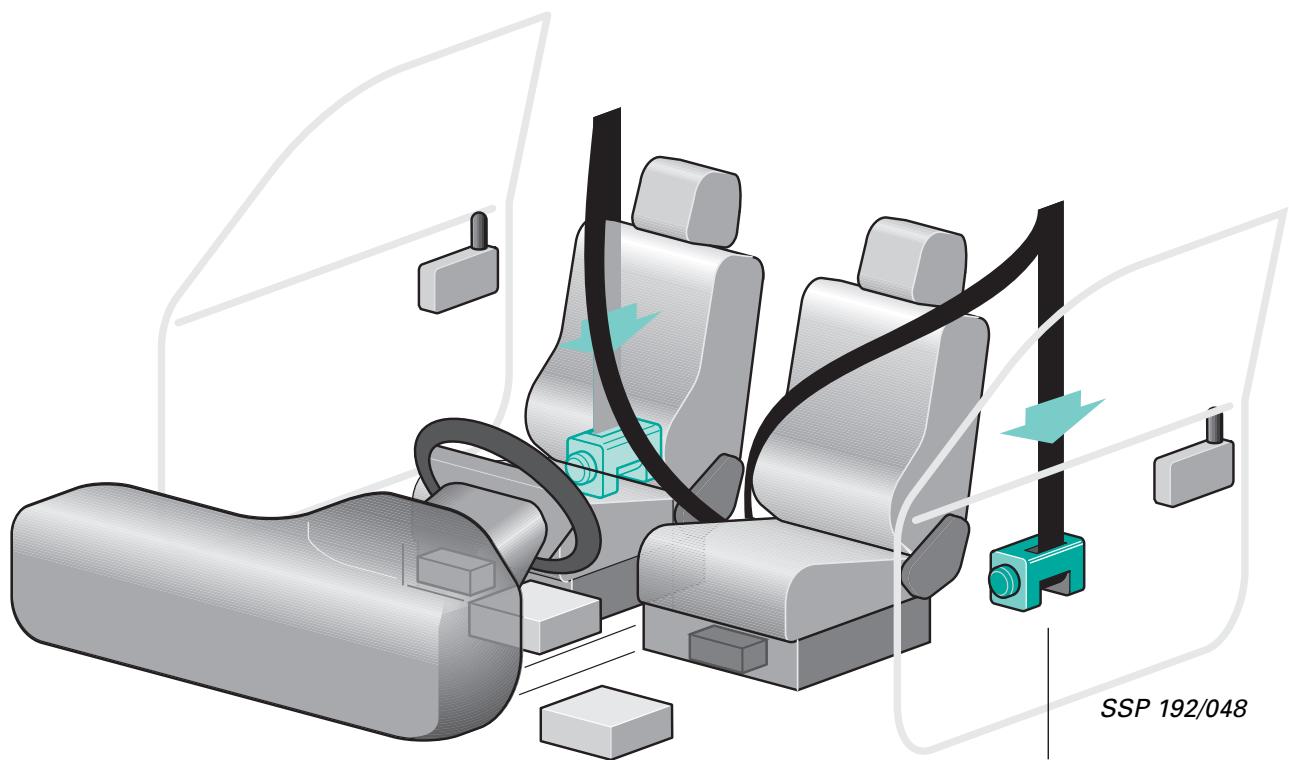
During minor accidents, the body only partially absorbs the impact energy of components such as bumpers and impact absorbers.

The seat belts provide adequate protection; the

belt tensioners restrain the car's occupants in their seats.

The belt force limiter reduces the risk of the belt causing injury.

In this case, the airbags are not triggered.



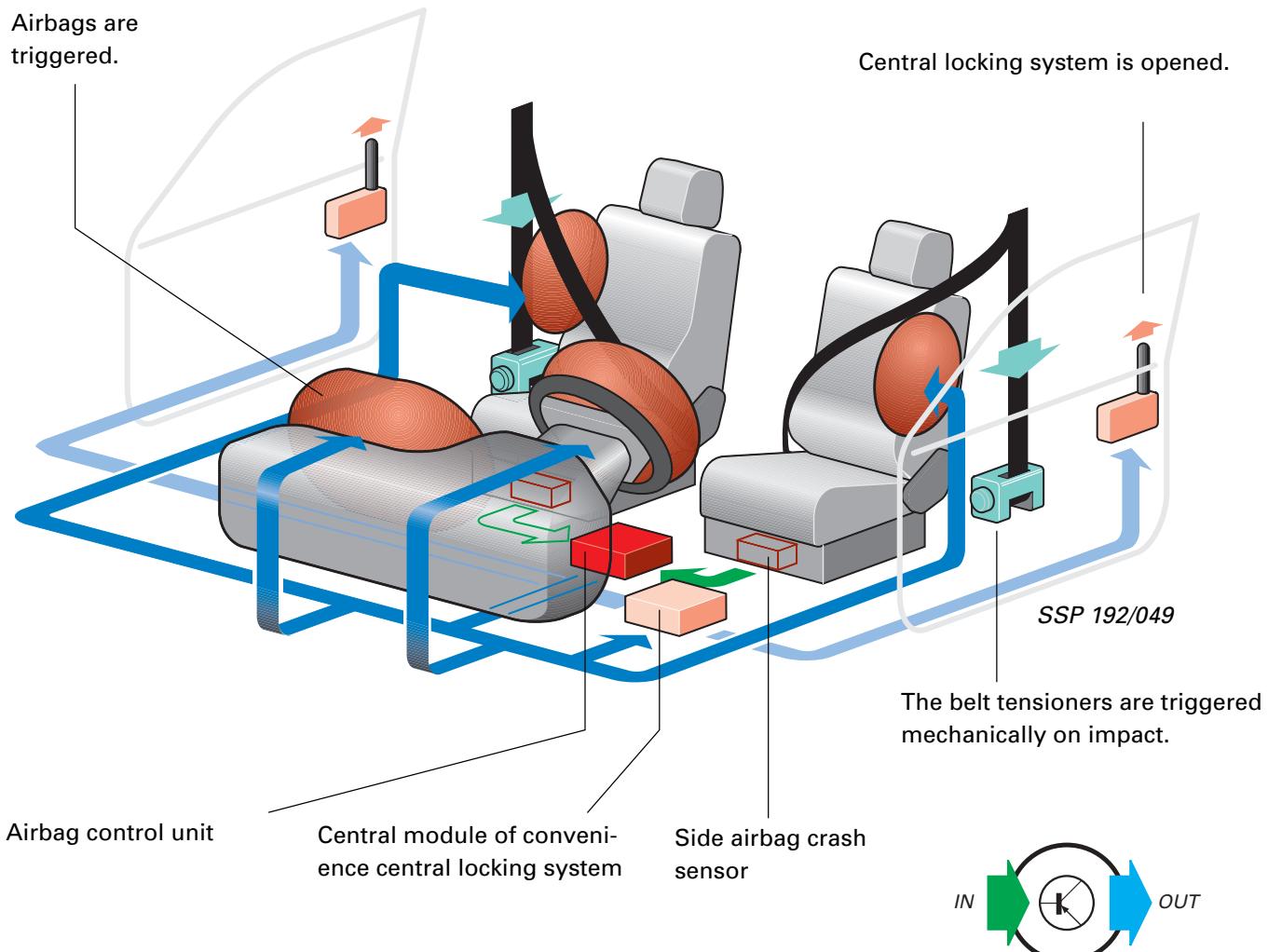
The belt tensioners are triggered mechanically on impact.

# Vehicle safety

## The effect of the restraint systems during serious accidents

During serious accidents, the car body absorbs the impact energy. The passenger compartment remains by and large intact and the airbags are triggered.

In addition to the protection afforded by the seat belts, the restraint systems protect the front passengers from more serious injuries in the upper body and head areas.  
The car's central locking system is opened.





## Side airbag

The new side airbag system is integrated in the driver's and front passenger's seats.

The side airbag is described as a thorax airbag. It mainly protects the thorax, and with it the lungs and pelvis, from lateral bruising.

In terms of its appearance, the new airbag control unit has a different connector housing code to the previous model.

Airbag control unit  
J234

Side airbag  
(illustrated as triggered)

SSP 192/006

Crash-sensor G179



When carrying out work on the airbag systems, always follow the instructions given in the Workshop Manuals.

# Vehicle safety

## Side airbag design

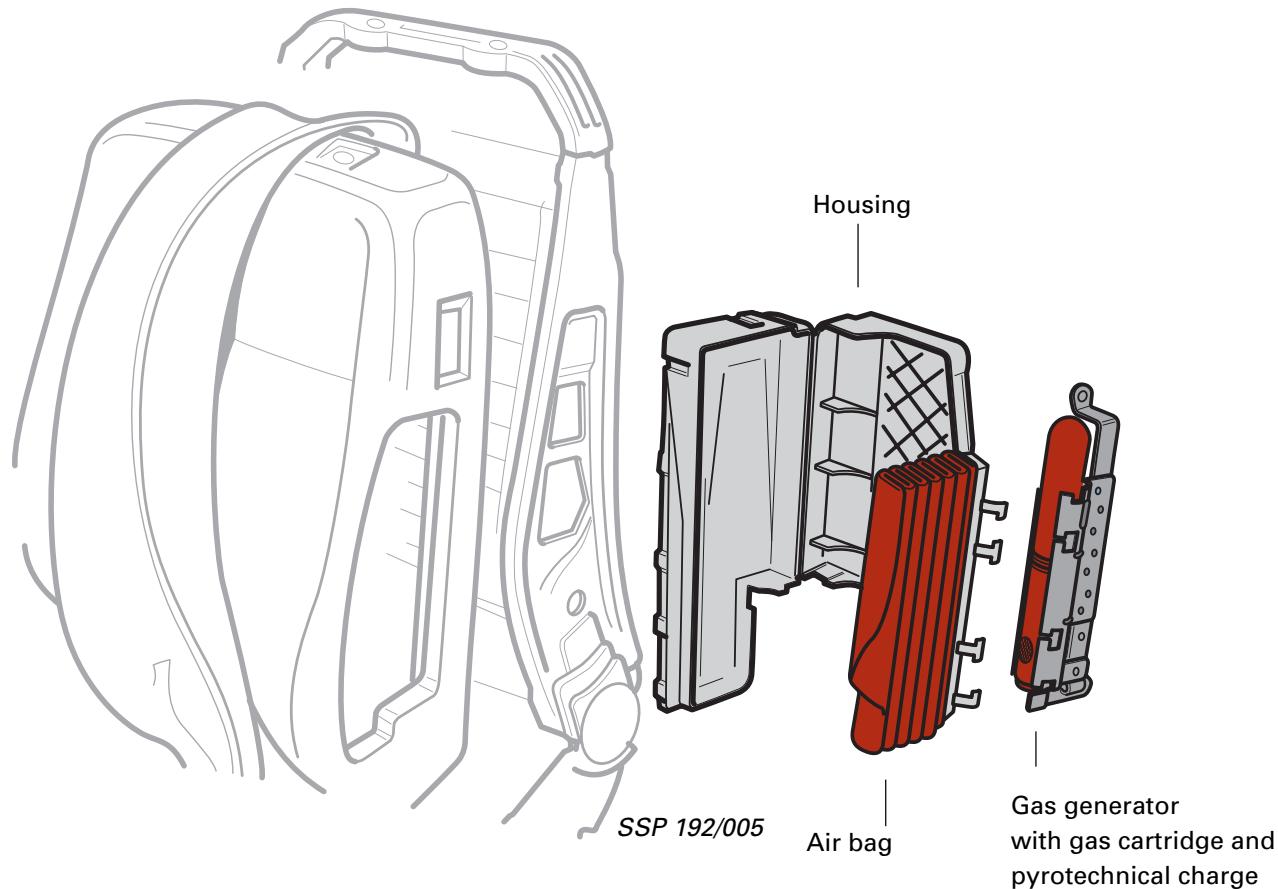
The side airbags are integrated in the front seat backrests.

The folded airbag and gas generator are accommodated inside the plastic housing.

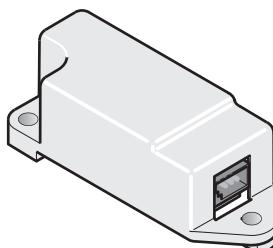
When the side airbag is triggered, the gas cartridges in the gas generator are opened and the pyrotechnical charge ignites. The highly pressurised gas contained inside the cartridge expands instantaneously, inflating the airbag.

While expanding, the gas cools and mixes with the hot gas of the pyrotechnical charge. The temperature of the gas mixture is therefore so low that there is no risk of burning.

The side airbag has a capacity of approx. 12 litres.



A two-stage crash recognition system is used to ensure reliable side airbag activation.



SSP 192/070

### Crash sensors G179/G180

The crash sensors for the side airbags are located below the two front seats on the seat cross members.

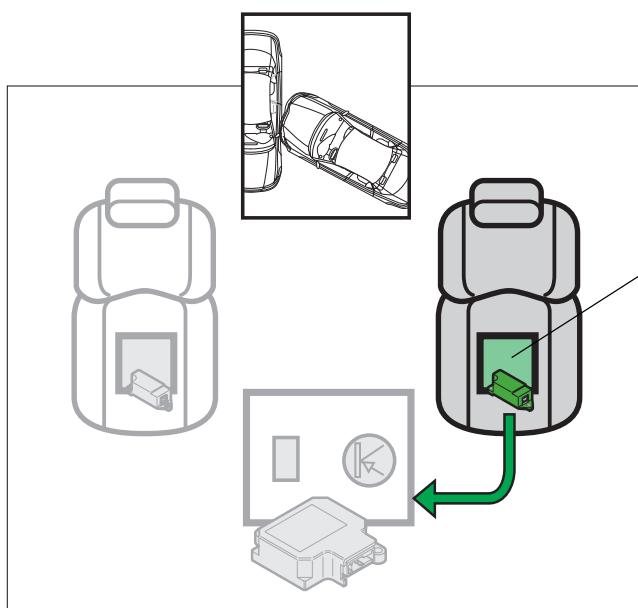
They are conditioned to respond to lateral force application.

The crash sensors are known as intelligent sensors.

They operate independently of each other.

In addition to an electronic acceleration sensor, the entire electronics are integrated in the sensor housing.

When a sensor recognises a crash, it sends a signal to the airbag control unit.



When an impact occurs, the crash sensor G179 informs the airbag control unit that it has recognised a crash.

# Vehicle safety

## Airbag control unit J234

In parallel to the crash sensors, sensors in the airbag control unit evaluate the severity of the crash. The relevant side airbag is not triggered until these sensors have also recognised that an accident has occurred and a crash sensor sends an airbag trigger request.

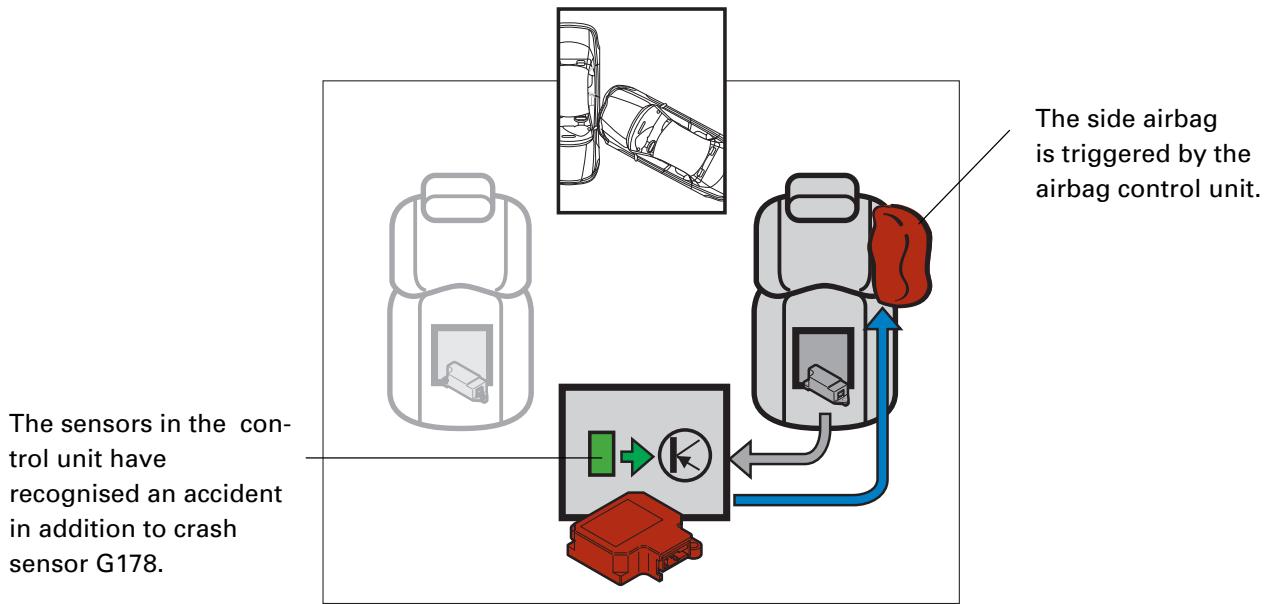
The two crash sensors below the front seats perform a function check at regular intervals, providing feedback to the airbag control unit.

The system status of the side airbags can be displayed via the self-diagnosis. The airbag control unit also indicates when a fault may possibly have occurred in the crash sensors or the side airbags via the airbag warning lamp.

There is an additional energy storage device in the airbag control unit for igniting the side airbags. If the power supply fails during an accident, this energy storage device has sufficient energy to power the control unit and, if necessary, to ignite the airbags.

### Self-diagnosis:

The self-diagnosis is started using address word "15".



SSP 192/120



## Belt tensioner

The pyrotechnical belt tensioner combines with the force limiter and the seat belt recognition device in a single unit. It is only triggered if the mechanical seat belt fastened recognition system recognises an unreeled belt.

Its compact design makes for much easier replacement.

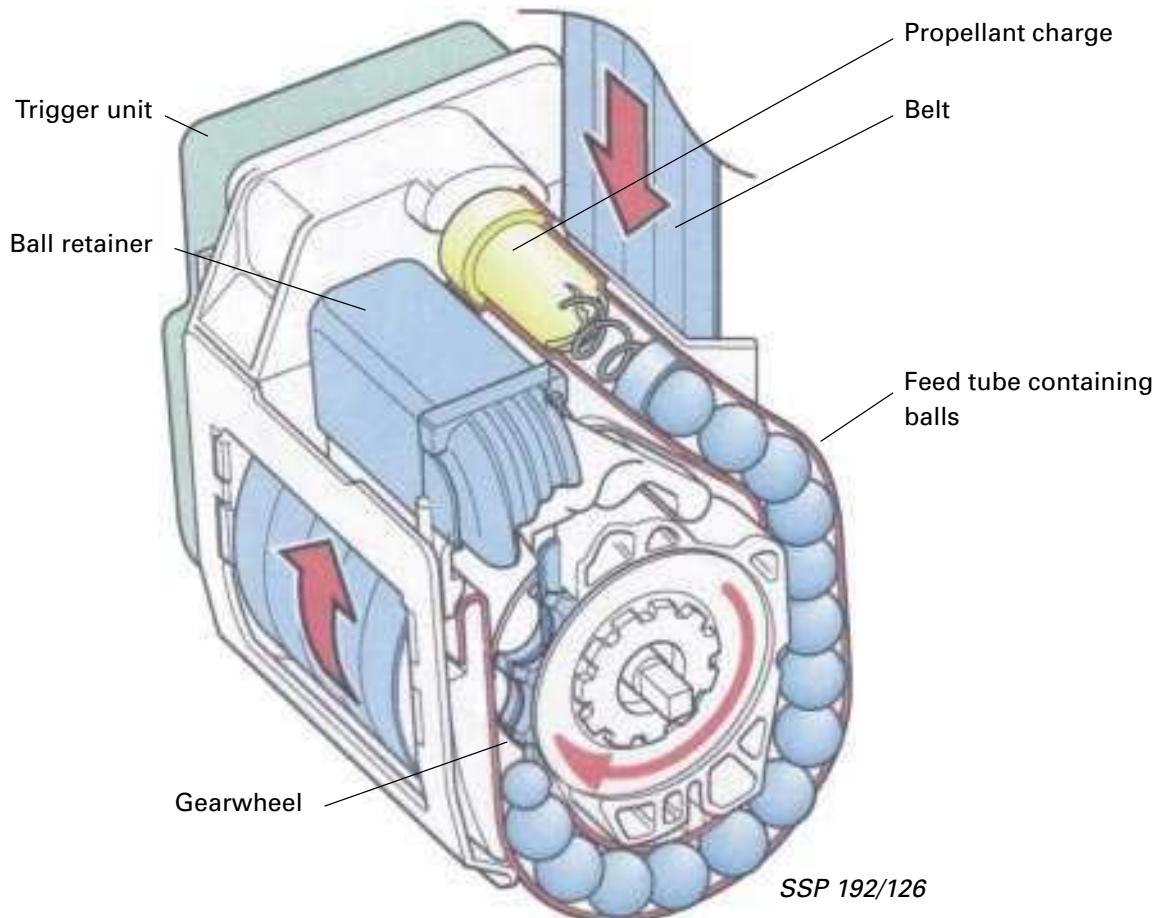
When an impact occurs, the belt tensioners reel in the belt and thus take up any slack (clearance between belt and body).

The mode of operation of the belt tensioner is very different to that of its predecessors.

There are two belt tensioner variants:

- A ball-driven belt tensioner, used on the front seats.
- Belt tensioners operating according to the same principle as the Wankel engine, used on the rear seats.

### Front belt tensioner

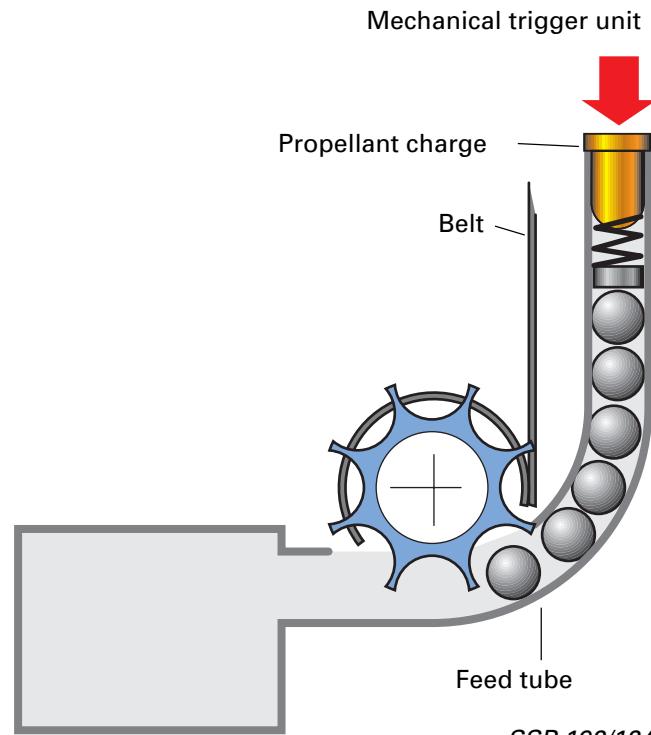


SSP 192/126

# Vehicle safety

## Functional description of front belt tensioner

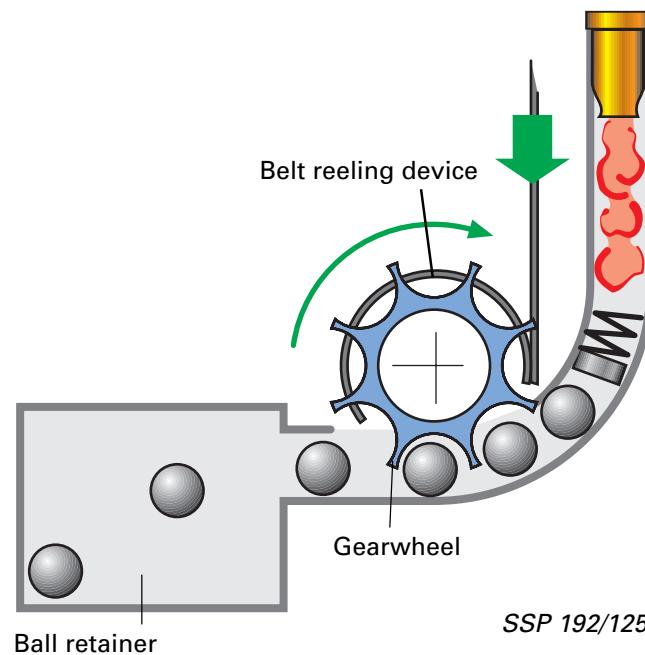
The belt tensioner is activated by balls mounted in a feed tube.



SSP 192/124

When the belt tensioner is triggered, a pyrotechnical propellant charge ignites. It sets the balls in motion and drives them into the ball retainer via a gearwheel.

The belt reeling device is driven by the kinetic energy of the balls, thus reeling in the belt.

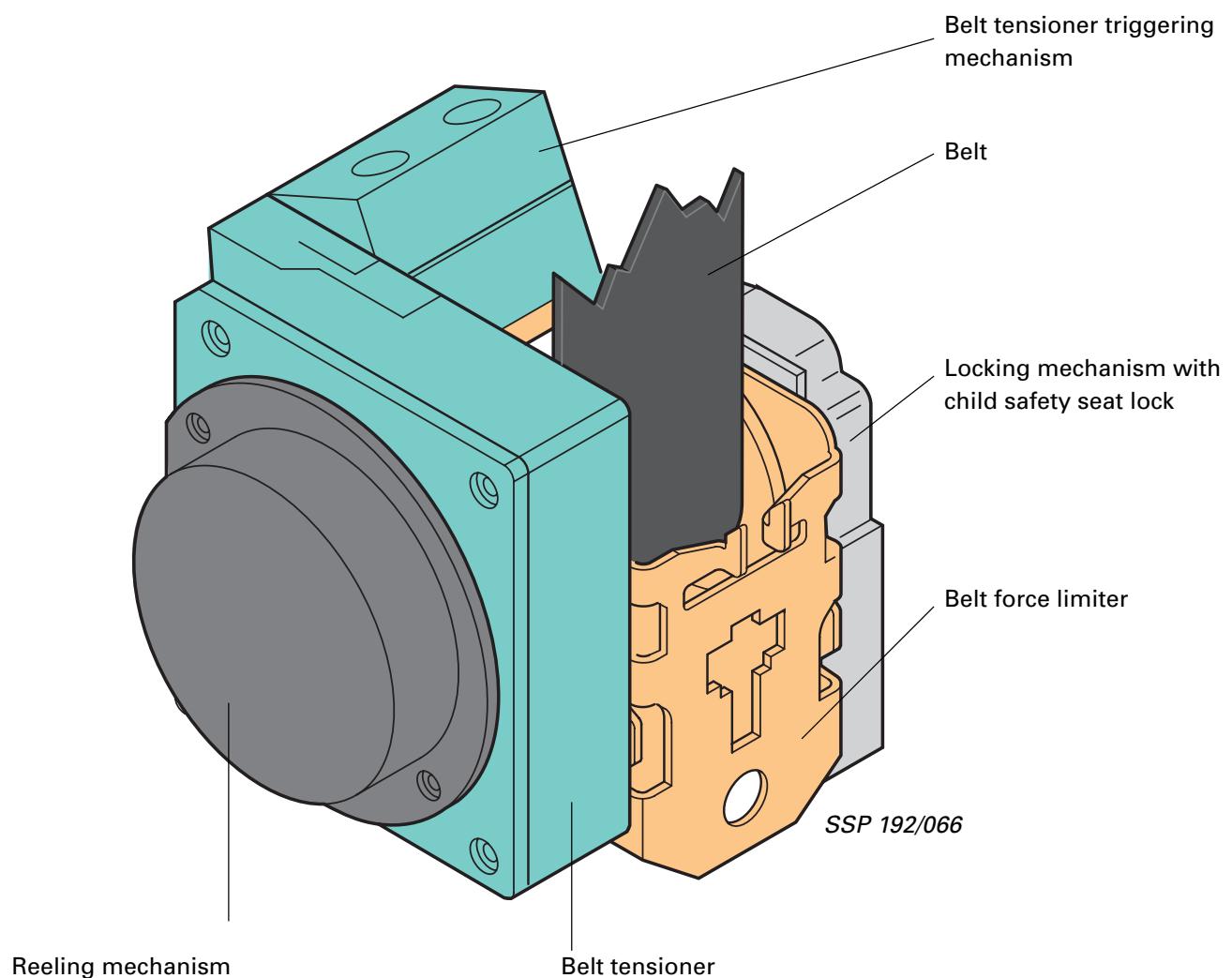


SSP 192/125

## Rear belt tensioner

The belt tensioner can be described in simpler terms as a “pyrotechnical Wankel engine”.

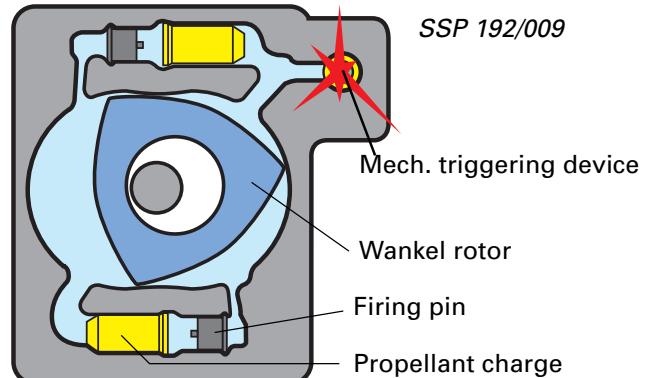
This “Wankel engine” is driven by 3 propellant charges. They are ignited in succession.



# Vehicle safety

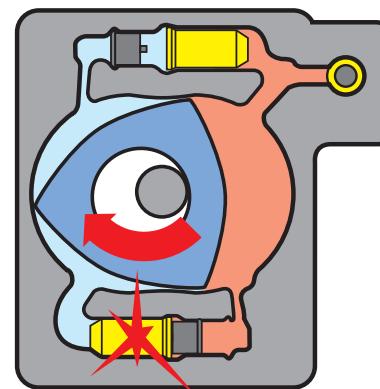
## Functional description of rear belt tensioner.

The first propellant charge is ignited by a mechanical triggering device.

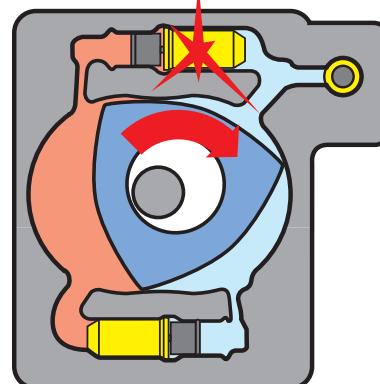


The released gas causes the rotor to rotate.  
The belt is tightened.

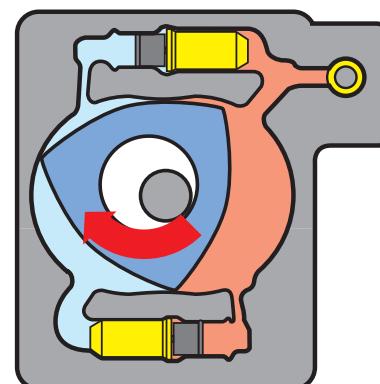
After a certain angle of rotation, the piston opens the inlet port of the second firing pin, thus igniting the second propellant charge.



The released gas makes the rotor rotate until the next inlet channel is opened.  
The third charge ignites.



The belt tensioner is able to perform approximately two full turns in this way.





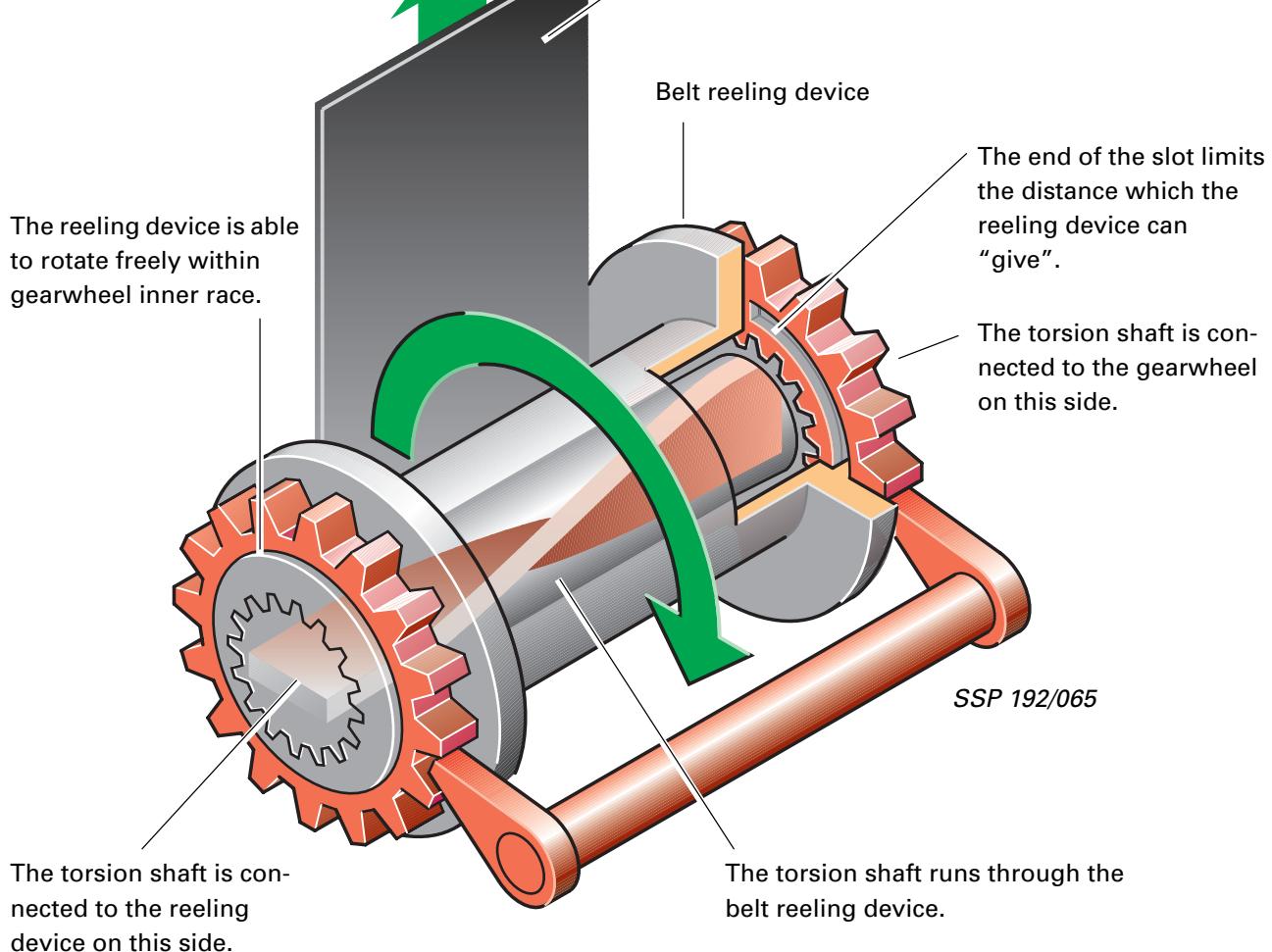
## Belt force limiter

### Functional description of belt force limiter

If, due to acceleration, the tensile force of the belt is so high that bruising or internal injuries can occur, the tensile force of the belt must be limited to a tolerable level.

It is limited by the belt reeling device torsion shaft. The torsion shaft operates in much the same way as a spring. Depending on its tensile force, the belt "gives".

Both types of belt tensioner use the same system



# Test your knowledge

1. Which components belong to the restraint system of the Passat '97?

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2. The side airbag has a capacity of

- a) 8 litres,
- b) 12 litres or
- c) 15 litres.

3. The side airbag crash sensors respond to the application of ..... force.

4. What is the function of the belt force limiter?

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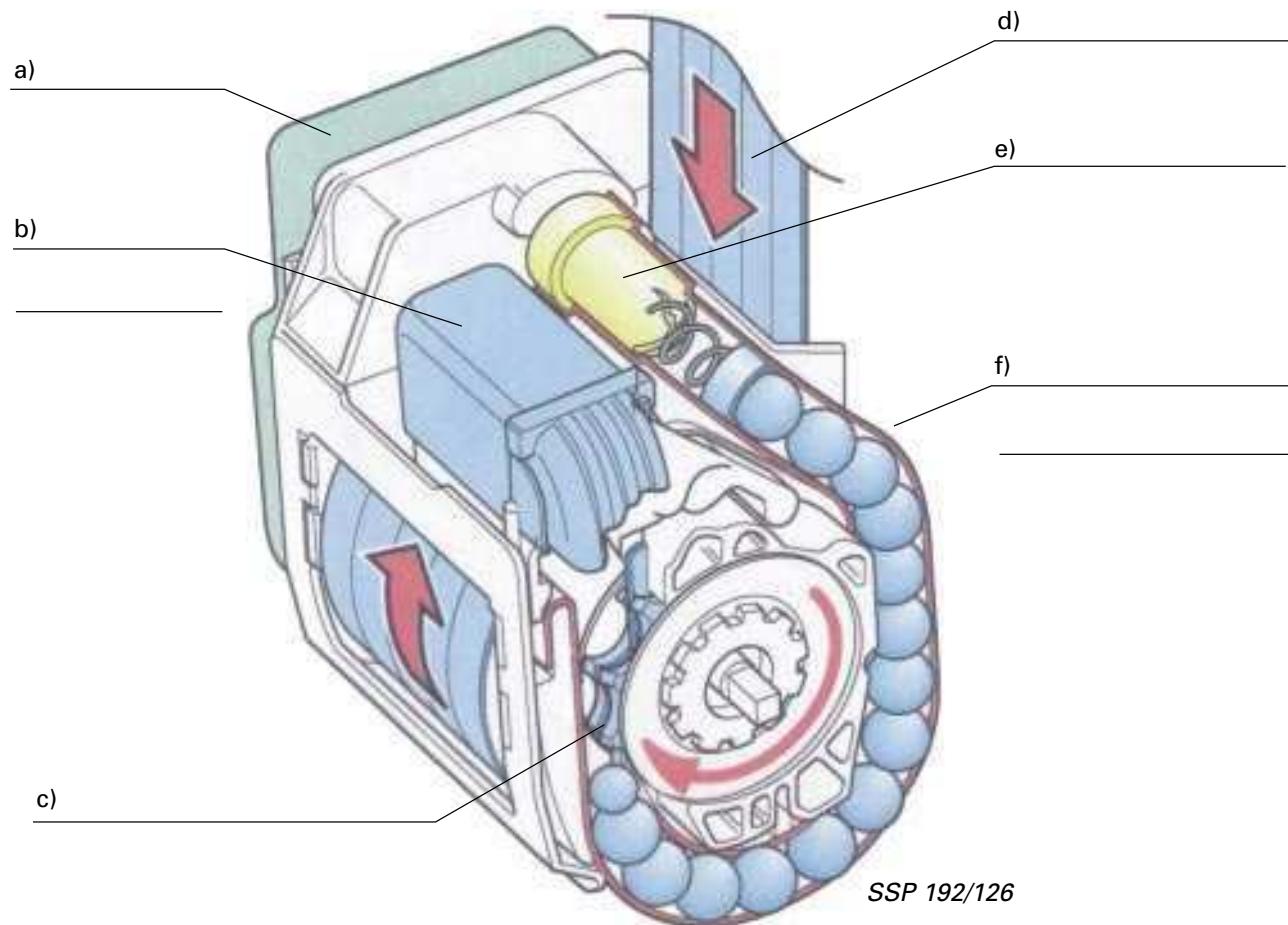
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## 5. The rear belt tensioner

- a) operates according to the Wankel engine principle,
- b) uses a diaphragm pump,
- c) is ball-activated.

## 6. Annotate the following drawing.



SSP 192/126

# 1.8-ltr. 5V Engine ADR

On the following page, we will show you the new technical features of the 1.8-ltr. 5V engine, 1.8-ltr. 5V turbo, 2.8-ltr. V6 and TDI engines.

## Twin path intake manifold

The 1.8-ltr. 5V engine has a twin path intake manifold.

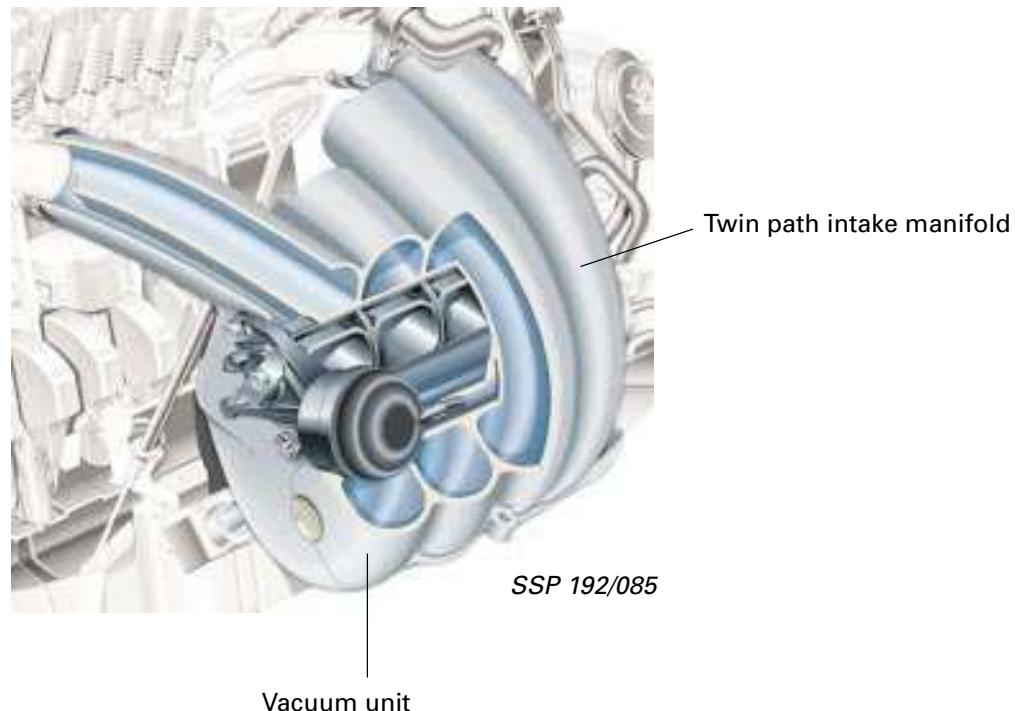
The twin path intake manifold is designed so that it is possible to switch between long and short intake paths.

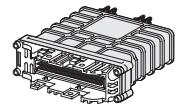
### Long intake path

A long intake path permits optimum charging of the cylinder, and consequently high torque, in the low speed range.

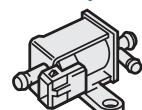
### Short intake path

Switching over to the short intake manifold permits high power output in the upper speed range.





Engine control unit J220



Intake manifold pressure change valve N156



Vacuum unit

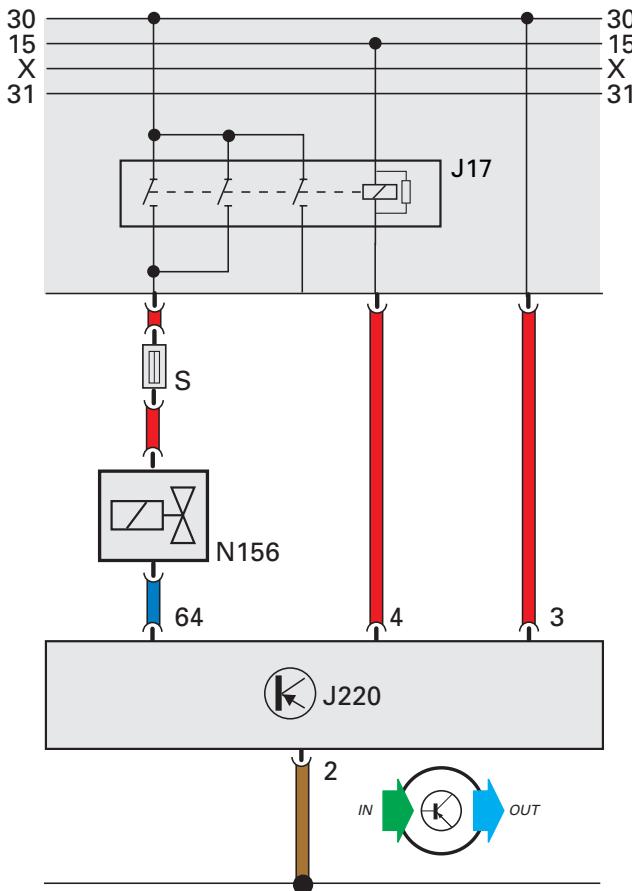
SSP 192/127

The engine control unit sends a signal to the intake manifold pressure change valve. It uses the vacuum unit to change over the intake manifold. Power is supplied via the fuel pump relay.

## Electric circuit

### Components

- J17 Fuel pump relay
- J220 Motronic control unit
- N156 Intake manifold pressure change valve
- S Fuse



SSP 192/106

# 1.8-ltr. 5V Turbo Engine AEB

The 1.8-ltr. 5V turbo engine is equipped with the Motronic M 3.8.2 engine management system.

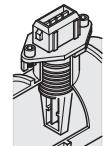
## System overview

### Sensors

Lambda probe  
G39



Air mass meter  
G70



Intake manifold  
temperature sender  
G72



Knock sensors  
G61 + G66



Hall sender  
G40



Engine speed  
sender G28



Coolant tempera-  
ture sender G62



Altitude sender  
F96



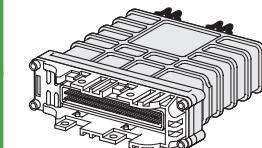
Throttle valve con-  
trol valve J338



Additional signals

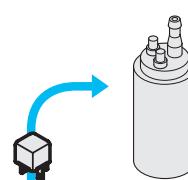


Engine control unit  
J220



### Actuators

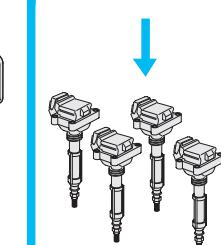
Fuel pump G6  
with fuel pump relay  
J17



Injection valves  
N30, N31, N32, N33



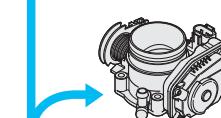
Output stage  
N122



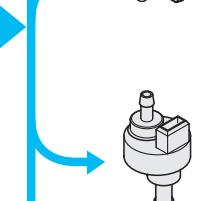
Ignition coils  
N, N128, N158, N163



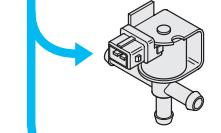
Throttle valve con-  
trol unit J338



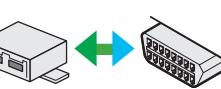
Activated charcoal  
filter system sole-  
noid valve N80



Charge pressure limi-  
tation solenoid valve  
N75



Additional signals



Diagnostic connec-  
tion

Immobiliser control unit  
J362

SSP 192/074

## Function diagram 1.8-ltr. 5V turbo engine AEB

### Components

F96	Altitude sender
G6	Fuel pump
G28	Engine speed sender
G39	Lambda probe
G40	Hall sender
G61	Knock sensor I
G62	Coolant temperature sender
G66	Knock sensor II
G70	Air mass meter
G72	Intake manifold temperature sender
J17	Fuel pump relay
J220	Control unit for Motronic
J338	Throttle valve control unit

N	Ignition coil
N30	Injection valve, cylinder 1
N31	Injection valve, cylinder 2
N32	Injection valve, cylinder 3
N33	Injection valve, cylinder 4
N75	Charge pressure limitation solenoid valve
N80	Activated charcoal system solenoid valve
N122	Output stage
N128	Ignition coil 2
N158	Ignition coil 3
N163	Ignition coil 4

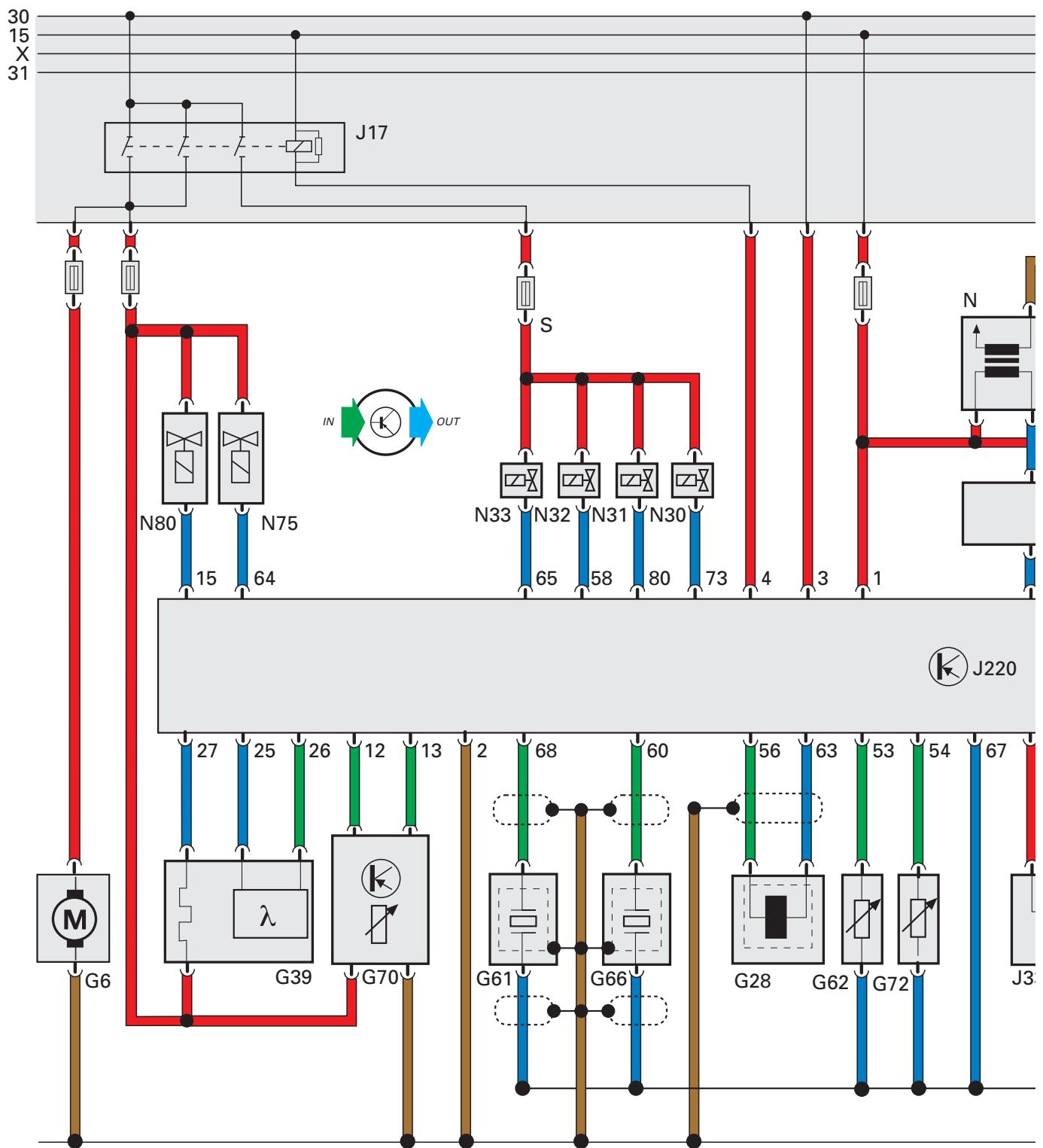
S	Fuse
---	------

### Additional signals

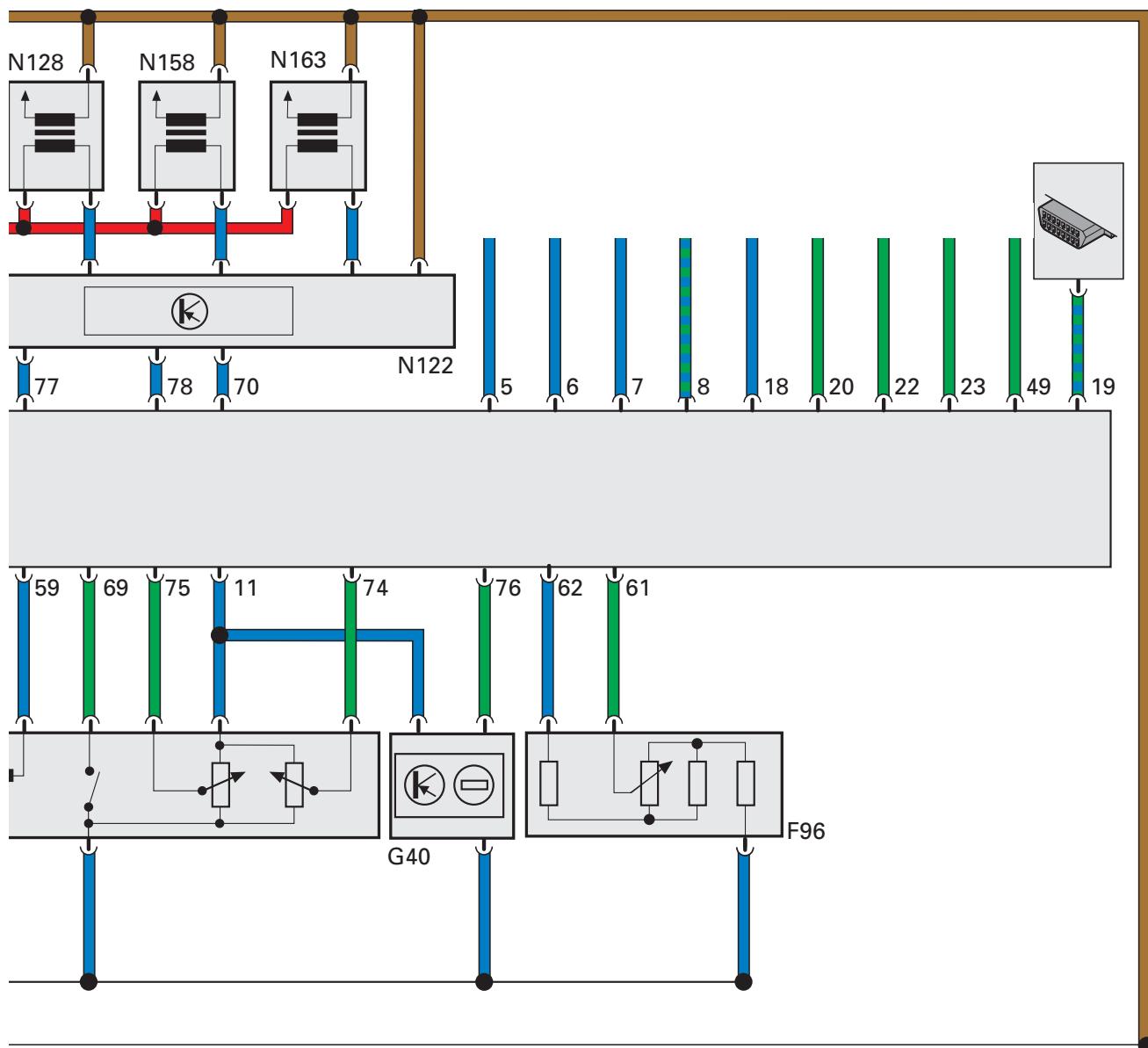
Pin 5	Actual engine torque (out)
Pin 6	Speed signal (out)
Pin 7	Throttle valve potentiometer signal (out)
Pin 8	Air-conditioner compressor signal (in + out)
Pin 18	Fuel consumption signal (out)
Pin 20	Road speed signal (in)
Pin 22	Gear engaged signal for automatic gearbox (in)
Pin 23	Auto. gearbox CU retard signal to engine CU (in)
Pin 49	Upshift/downshift signal for automatic gearbox (in)

### Colour code

	Input signal
	Output signal
	Positive
	Negative



30  
15  
X  
31



SSP 192/076

# 2.8-ltr. V6 Engine ACK



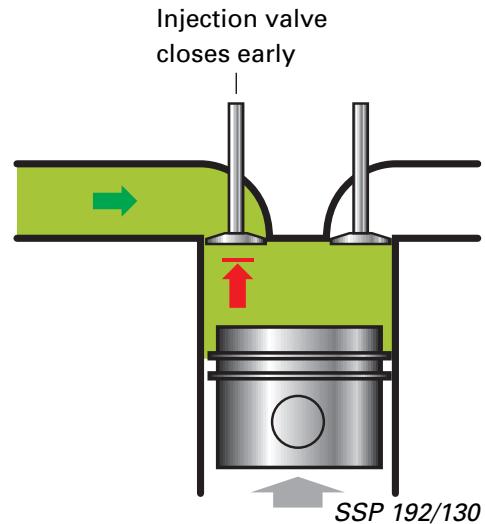
## Variable valve timing

It provides high torque when driving in low gears at low speeds, thus improving fuel economy and reducing exhaust emissions.

High output is needed at high speeds. To achieve both, the cylinder must be well-filled in all speed ranges.

At low speeds, the piston moves so slowly that the gas mixture in the intake manifold follows the movement of the piston.

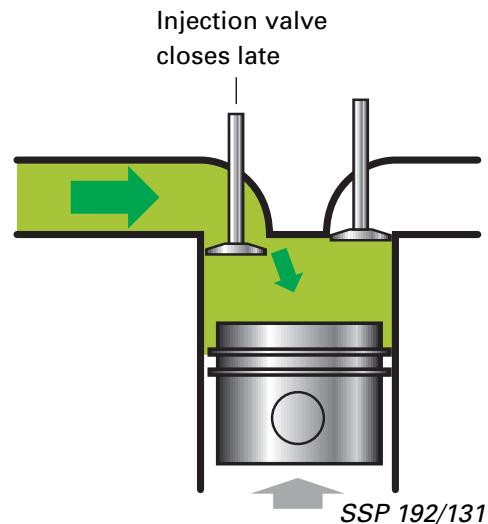
The inlet valve must be closed early so that the fuel-air mixture is not forced back into the intake manifold.



At high speeds, the flow rate inside the intake manifold is so high that the mixture can continue to flow into the cylinder although the piston is moving back up.

The inlet valve is closed when the fuel-air mixture can no longer enter the cylinder.

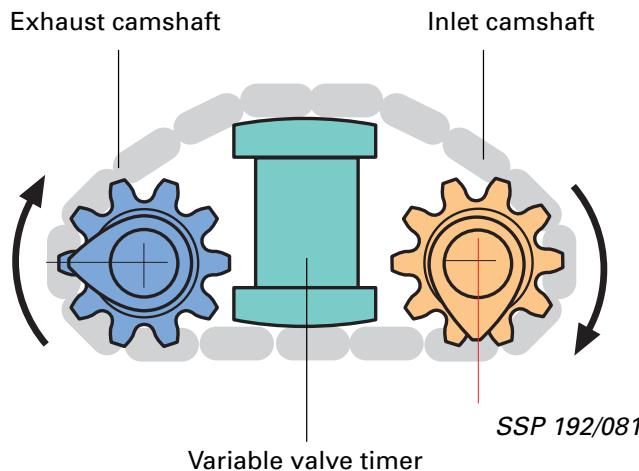
In engines with variable valve timing, the closing times of the inlet valve are adapted to the speed range.



## The principle of variable valve timing:

The exhaust camshaft is driven by the crankshaft by means of a toothed belt. The inlet camshaft is driven by the exhaust camshaft by means of a chain.

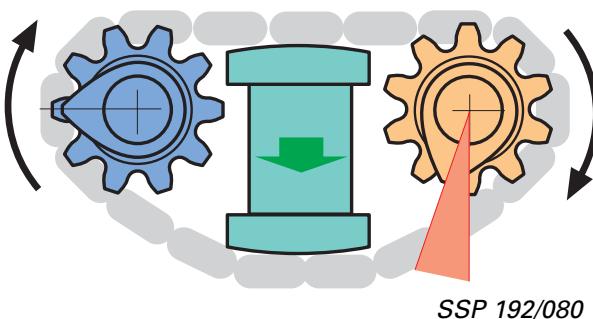
With variable valve timing, the opening times of the inlet valves are adjusted depending on engine speed. The drive chain therefore turns the inlet camshaft.



### Performance position

In the "Performance" position, the lower section of the chain is short while the upper one is long.

The inlet valve closes late. The rapid air flow within the intake manifold ensures that the cylinder charge is high. The engine is thus able to develop high output at high speeds.



### Torque position

Moving the variable valve timer down shortens the upper chain section and lengthens the lower one.

The inlet camshafts therefore rotate in relation to the exhaust camshaft. The exhaust camshaft cannot rotate at the same time, since it is restrained by the toothed belt.

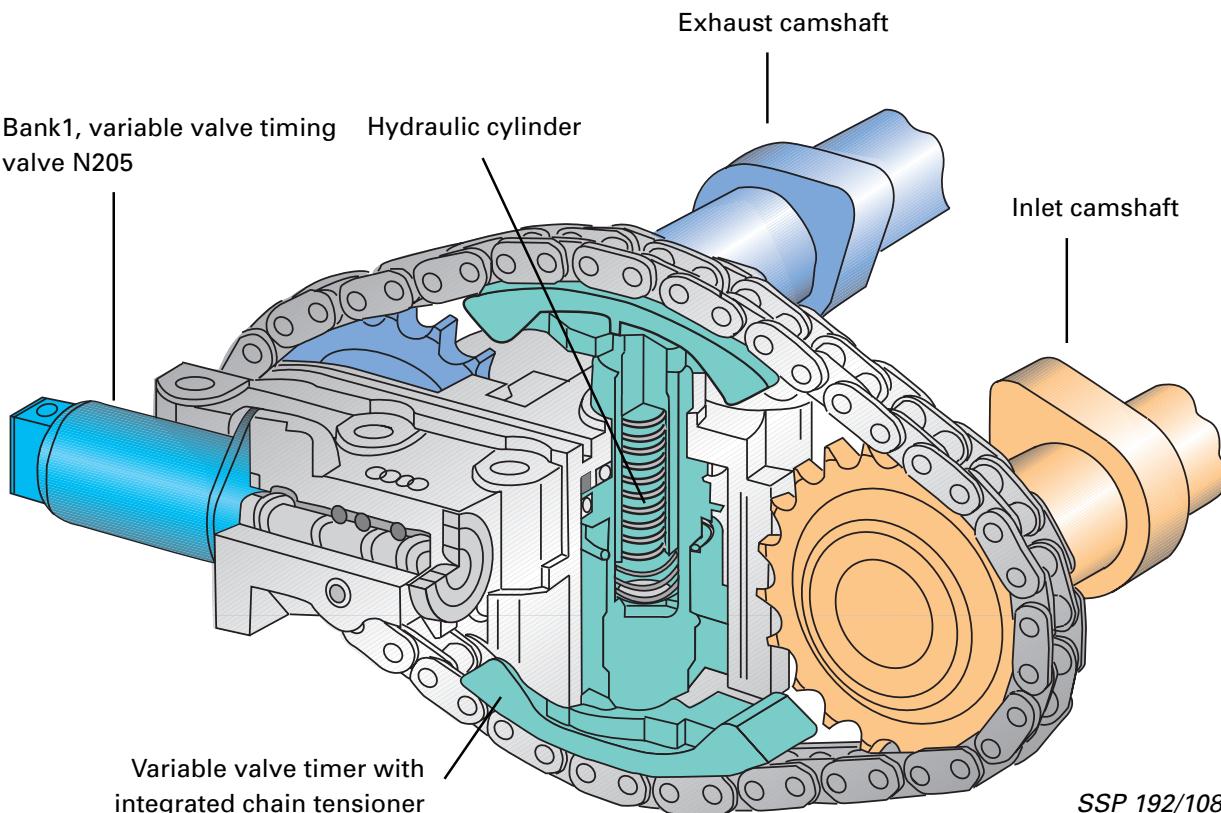
The inlet valve closes early. In this position, high torque is produced in the lower and medium speed ranges.

# 2.8-ltr. V6 Engine ACK

## Variable valve timer

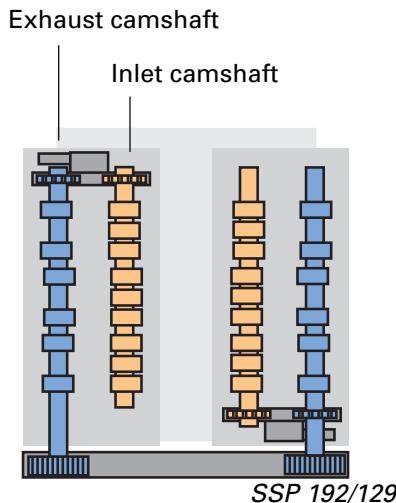
A hydraulic cylinder lifts and lowers the variable valve timer. Oil is supplied to the hydraulic cylinder via the engine oil circuit.

The engine control unit controls the hydraulic cylinder via the variable valve timing valve, which is bolted directly to the variable valve timer housing.

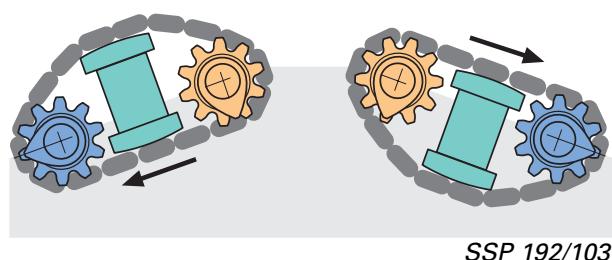


SSP 192/108

## Variable valve timing in the V6 engine

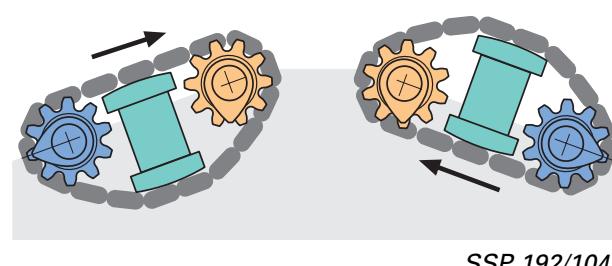


The design of the V6 engine makes particularly heavy demands on variable valve timing. Viewed from above, the exhaust camshafts are arranged on the outside and the inlet cams-hafts on the inside. As a result, the variable valve timers of the left and right bank of cylinders have to operate in opposite directions.



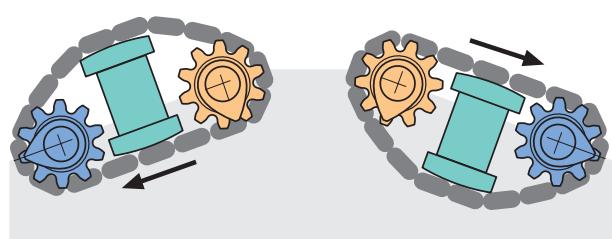
### Idling

When the engine is idling, the inlet valves are closed late.



### Torque position

The inlet valves are closed early above an engine speed of 1000 rpm. The camshaft adjuster of the left bank of cylinders moves down while the right cylinder bank variable valve timer moves up.



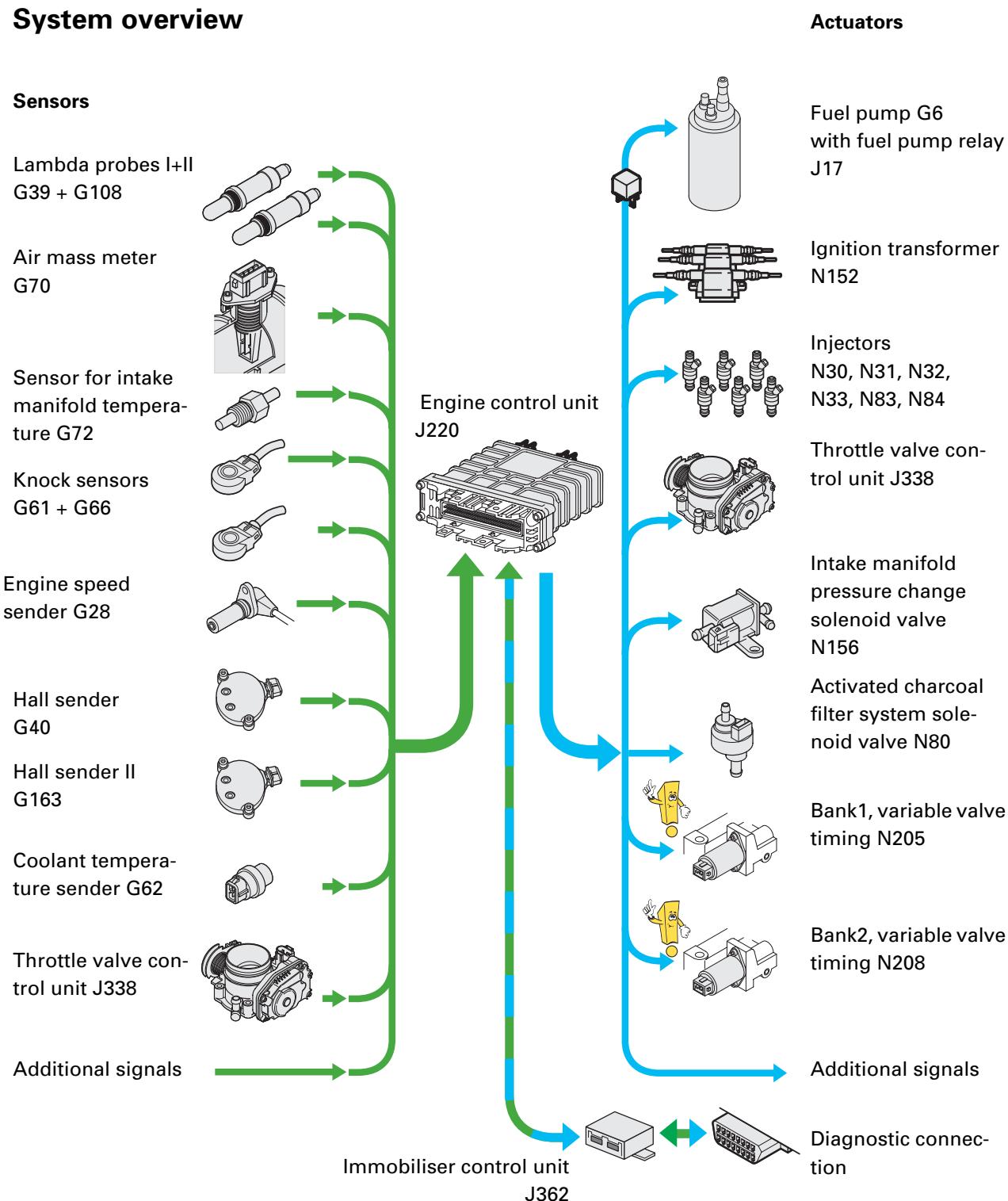
### Performance position

At a speed of 3700 rpm, the inlet valves are closed late.

# 2.8-ltr. V6 Engine ACK

The 2.8-ltr. V6 engine is equipped with variable valve timing and is controlled by the Motronic M 3.8.2 engine control unit.

## System overview



## Function diagram of 2.8-ltr. 6V Engine ACK

### Components

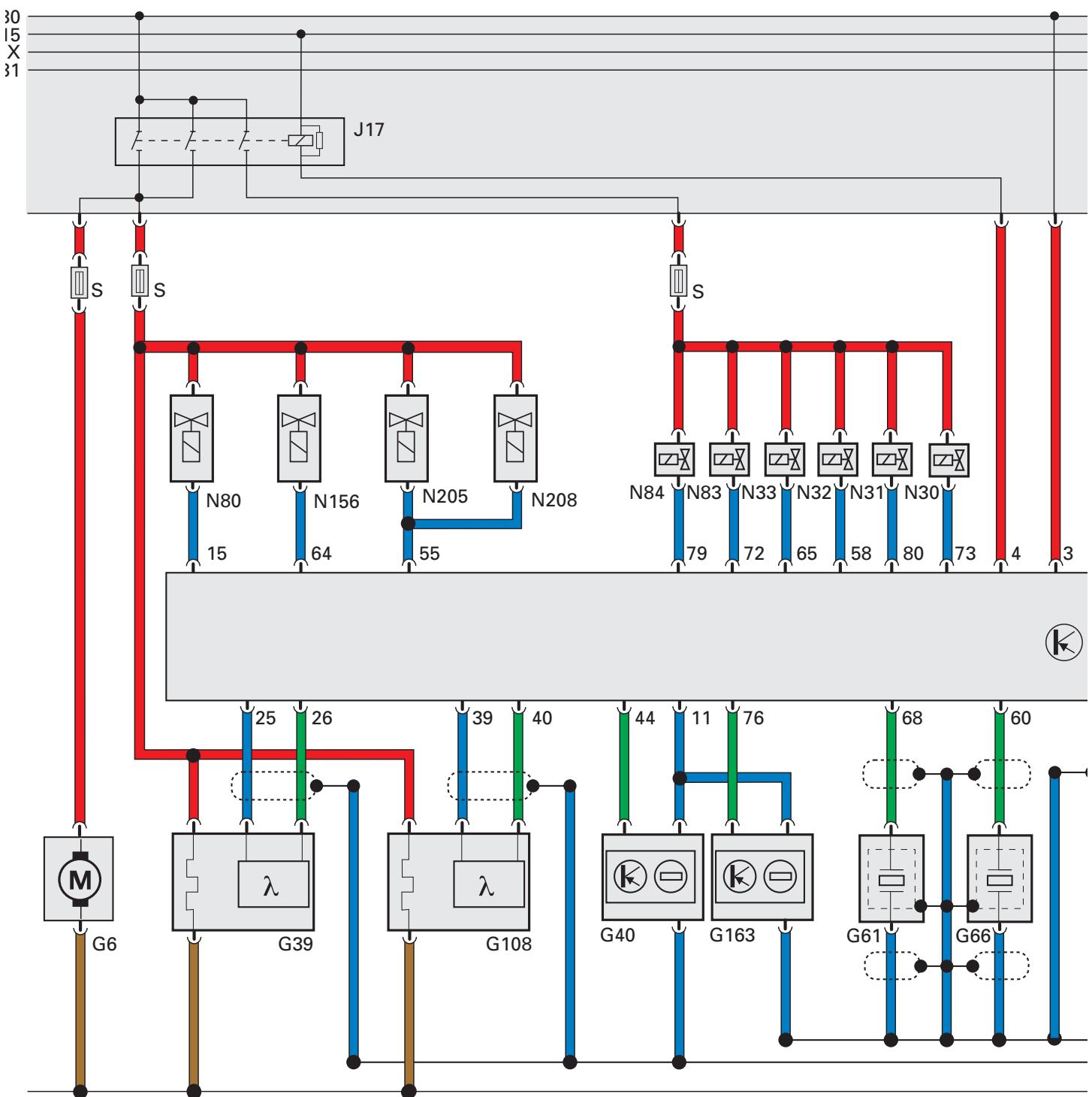
G6	Fuel pump
G28	Engine speed sender
G39	Lambda probe
G40	Hall sender
G61	Knock sensor I
G62	Coolant temperature sender
G66	Knock sensor II
G70	Air mass meter
G72	Intake manifold temperature sender
G108	Lambda probe II
G163	Hall sender II
J17	Fuel pump relay
J220	Motronic control unit
J338	Throttle valve control unit
N	Ignition coil
N30	Injection valve, cylinder 1
N31	Injection valve, cylinder 2
N32	Injection valve, cylinder 3
N33	Injection valve, cylinder 4
N83	Injection valve, cylinder 5
N84	Injection valve, cylinder 6
N75	Charge pressure limitation solenoid valve
N80	Activated charcoal system solenoid valve
N152	Ignition transformer
N156	Twin path intake manifold valve
N205	Camshaft adjustment valve I
N208	Camshaft adjustment valve II
S	Fuse

### Additional signals

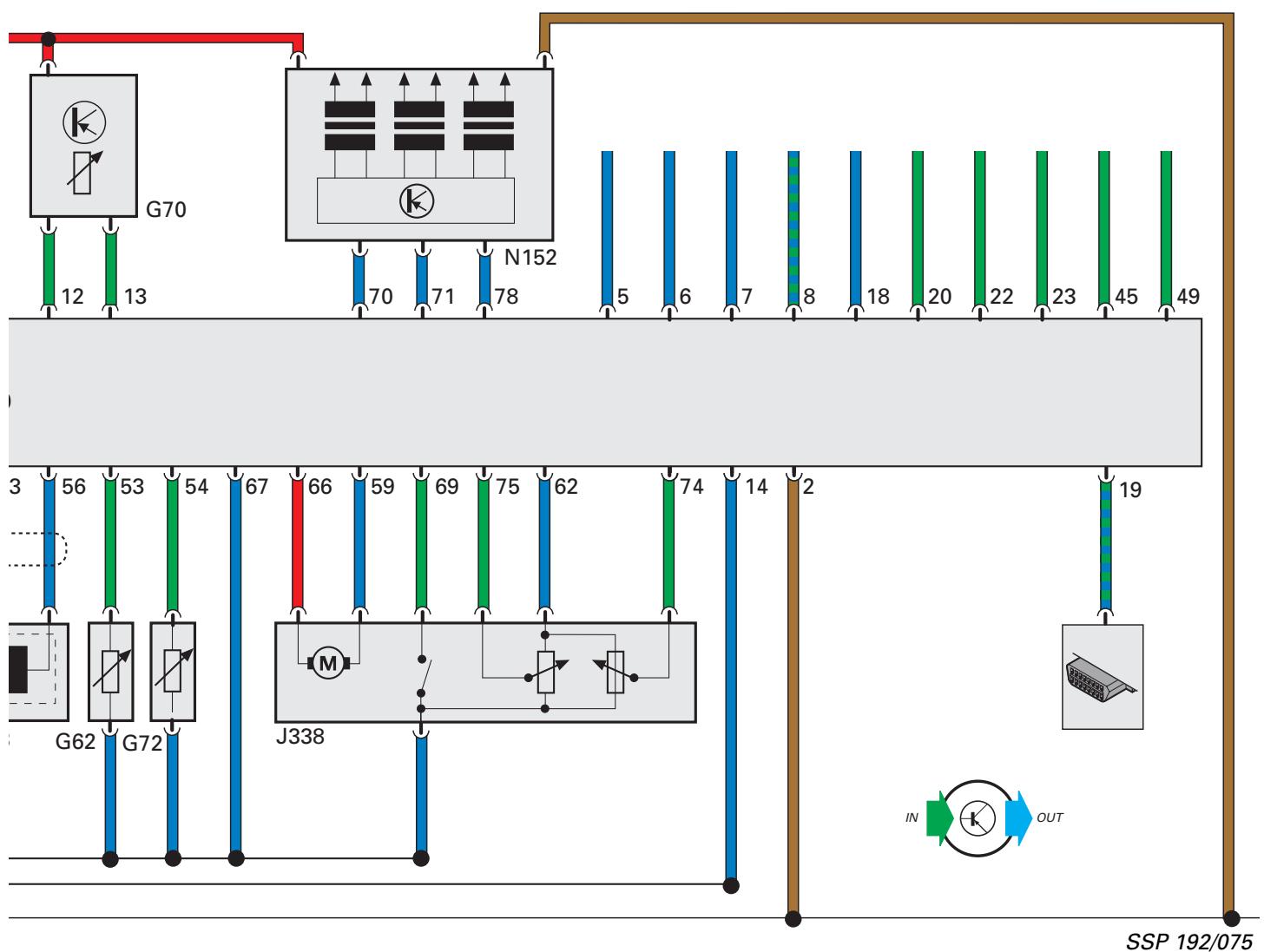
Pin 5	Actual engine torque (out)
Pin 6	Speed signal (out)
Pin 7	Throttle valve potentiometer signal (out)
Pin 8	Air-conditioner compressor signal (in + out)
Pin 18	Fuel consumption signal (out)
Pin 20	Road speed signal (in)
Pin 22	Gear engaged signal for automatic gearbox (in)
Pin 23	Aut. gearbox CU retard signal for engine CU (in)
Pin 45	ABS signal (in)
Pin 49	Upshift/downshift information for automatic gearbox (in)

### Colour code

- █ Input signal
- █ Output signal
- █ Positive
- █ Earth



30  
15  
X  
31



# 1.9-ltr. TDI Engine AFN



## Radiator fan run-on

A radiator fan run-on facility controlled by the engine management system is being used in the 1.9-ltr. 81kW TDI engine for the first time. The advantage of this is that the radiator fan run-on time is variable and can consequently be adapted to the previous operating conditions and load conditions of the engine.

The run-on time is determined by the engine control unit via a characteristic map. Allowance is also made for the coolant temperature and engine load during the final minutes of car operation before the engine is turned off.

### Radiator fan run-on relay J397



The radiator fan run-on relay J397 is designated as blower relay J323 in the self-diagnosis.

### Electric circuit

### Components

J248 Diesel direct injection system control unit

J397 Cooling fan run-on relay

N39 Series resistor for coolant fan

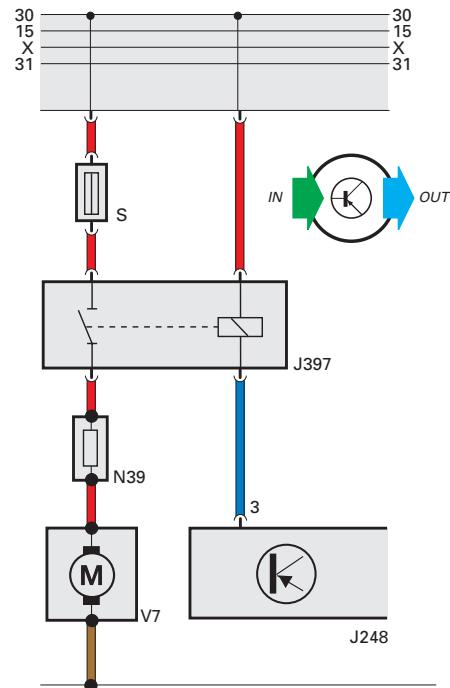
S Fuse

V7 Coolant fan

### Self-diagnosis

Open circuit /short circuit to earth

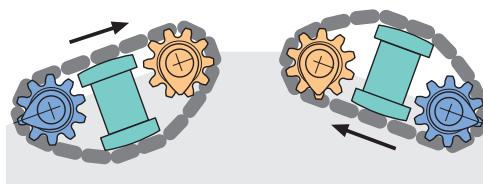
Short circuit to positive



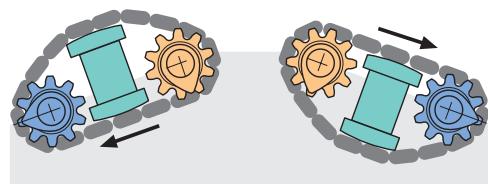
# Test your knowledge

1. Which of the following diagrams represents the “Performance” position and the “Torque” position in the 2.8-ltr. V6 engine?

a) \_\_\_\_\_



b) \_\_\_\_\_



2. Complete the following text.

At low speeds, the piston moves so

a) \_\_\_\_\_,

that the gas mixture in b) \_\_\_\_\_

follows the movement of the piston. The inlet valve c) \_\_\_\_\_

so that the fuel-air mixture is not forced back into the intake manifold.

At high speeds, the flow rate in the intake manifold is so d) \_\_\_\_\_,

that the mixture e) \_\_\_\_\_,

although the piston is moving back up.

The inlet valve is not f) \_\_\_\_\_,

until the fuel-air mixture can no longer enter the cylinder.

# Gearbox

## Magnesium

Lightweight construction now plays a central role in vehicle development, due to the tough demands on performance, safety and fuel economy.

Weighing roughly 34% less than aluminium, magnesium is, as a material, well-suited to meeting these demands.

We will show you the advantages and impacts of magnesium using the 5-speed manual gearbox housing 012/01W.

### Density comparison

Iron:  
7.873 g/cm<sup>3</sup>

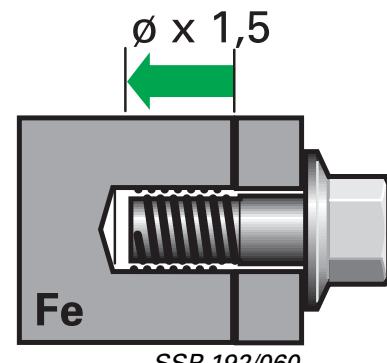
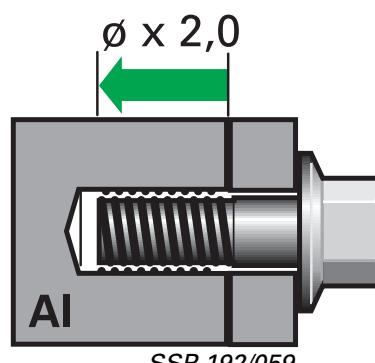
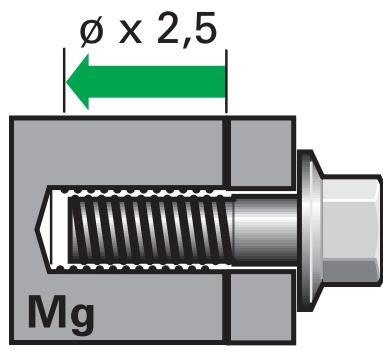
Aluminium:  
2.699 g/cm<sup>3</sup>

Magnesium:  
1.738 g/cm<sup>3</sup>

The strength of a material depends on its density, among other things. Low density goes hand in hand with low strength. This loss of strength has to be compensated for somehow.

The housing is therefore ribbed more intensively and the wall thickness has been increased. As a result, the magnesium housing actually weighs 27% less than the aluminium housing. Bolt insertion depth has also been increased.

### Comparison of insertion depths between magnesium, aluminium and iron



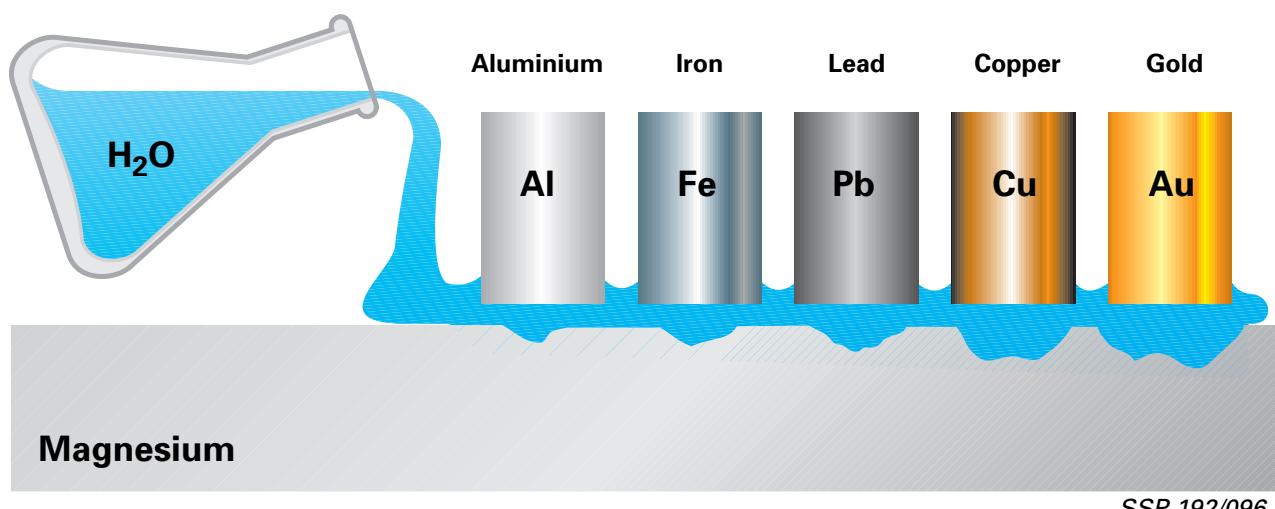
## Electrochemical voltage series

In the presence of water, an electric current develops between two different metals. The car battery operates according to a similar principle.

The electric current causes one of the two metals to decompose. If a metal decomposes easily, it is termed a non-precious metal. If a metal does not decompose easily, it is termed a precious metal.

An electrochemical voltage series is produced by arranging the metals in a series extending from non-precious metal to precious metal. The further the metals in the voltage series are apart from one another, the higher the current and the more readily the less precious metals decompose.

## Excerpt from electrochemical voltage series

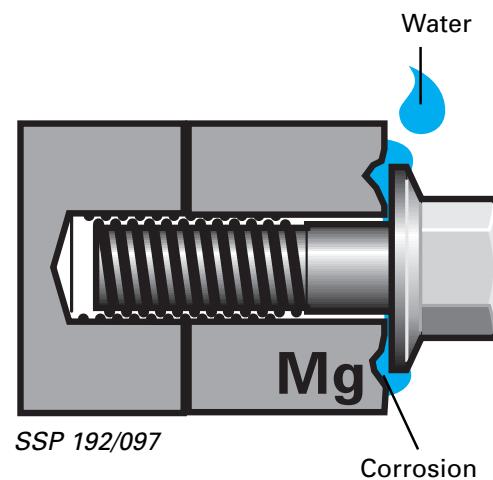


# Gearbox

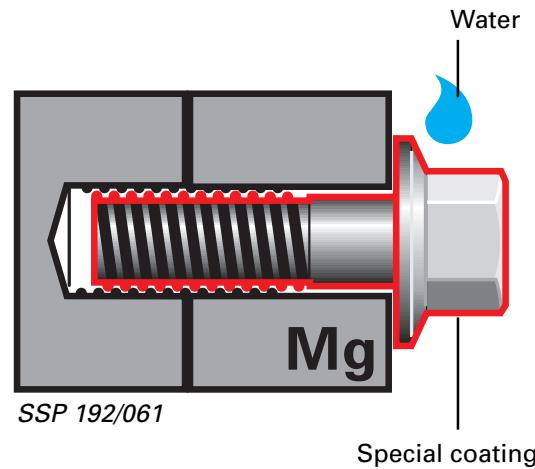
## Magnesium

### Contact corrosion, using a bolted connection as an example

In this example, a magnesium component is attached using a bolt made of an iron alloy. If the contact surface is wetted with water, an electric current occurs between the two metals. This leads to contact corrosion. The magnesium is decomposed at the same time.



Contact corrosion can be prevented by inhibiting the electric current between the two metals by coating the bolt with an insulating layer. This insulating layer is composed of a special non-conductive coating.



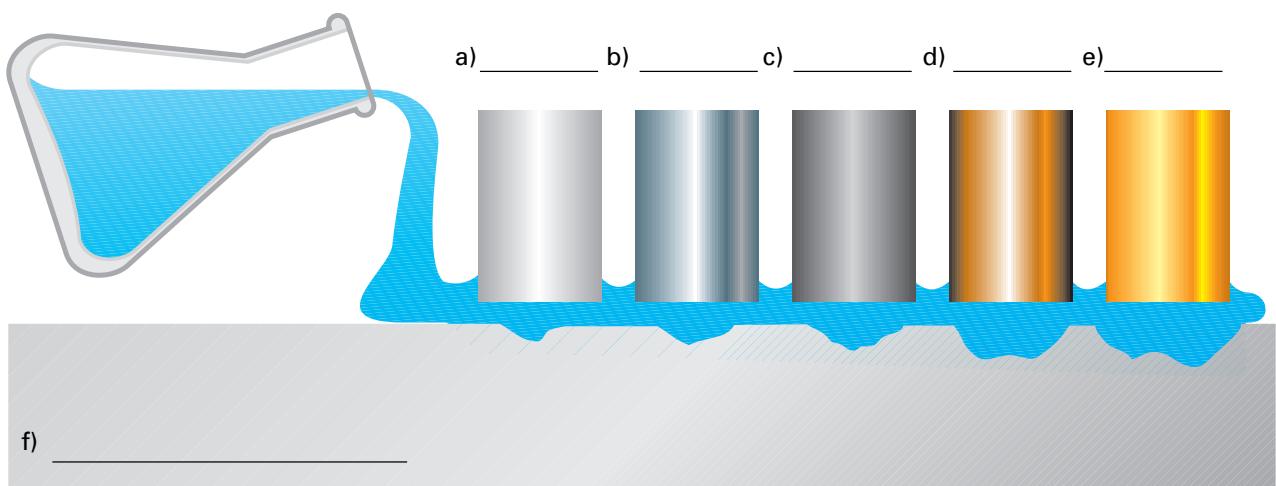
A special coating is applied to all add-on parts which come into direct contact with magnesium. Please follow the instructions given in the Workshop Manual.

# Test your knowledge

**1. What is the insertion depth for magnesium compared to that for iron?**

- a) 2.0 times greater,
- b) 5.2 times greater,
- c) 2.5 times greater.

**2. Assign the metals of gold, iron, magnesium, copper, aluminium and lead to the following drawing.**



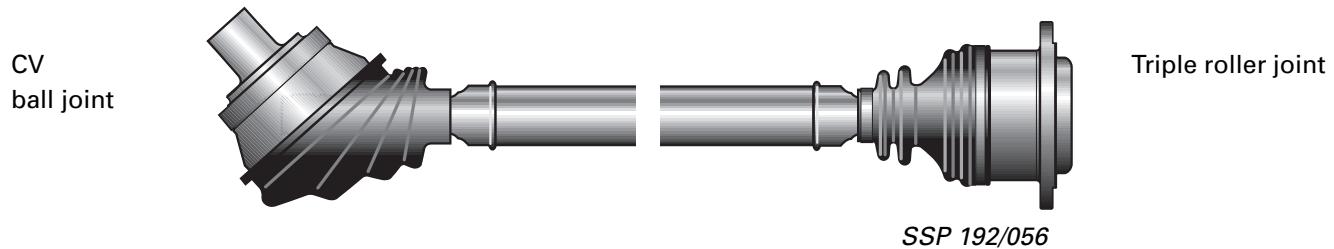
# Drive shafts

## Triple roller constant velocity joint

The triple roller CV joint reduces the transmission of vibrations and noise from the engine/gearbox unit to the body.

Triple roller joints are principally used in diesel and automatic cars.

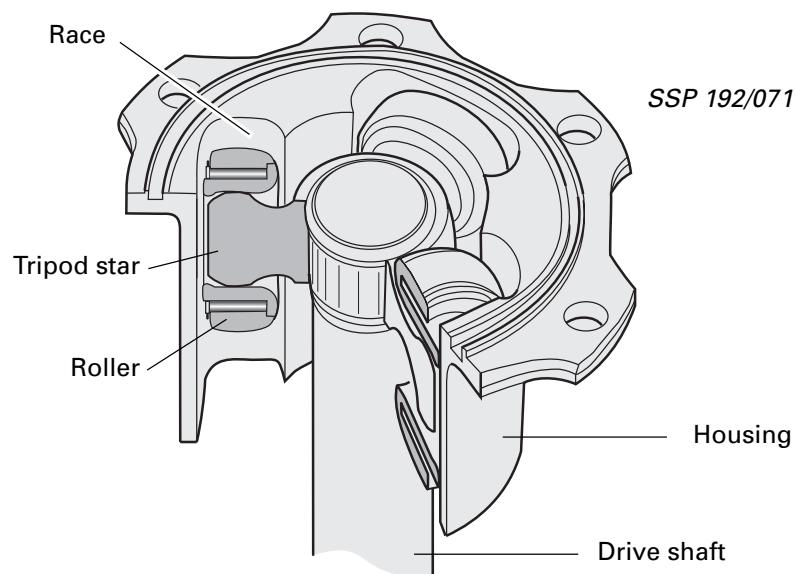
This is necessary due to the high vibrations which occur in diesel engines and the pre-tensioning forces which occur in automatic drive trains.



## Design

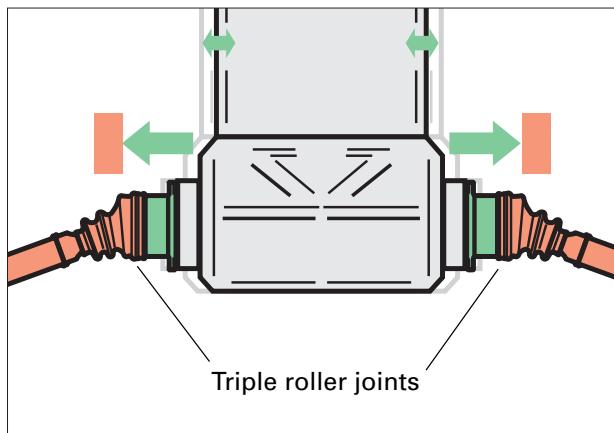
The triple roller joint has three spherical journals with a roller fitted to each of them.

The rollers are located in races and can slide and swivel on the tripod star.



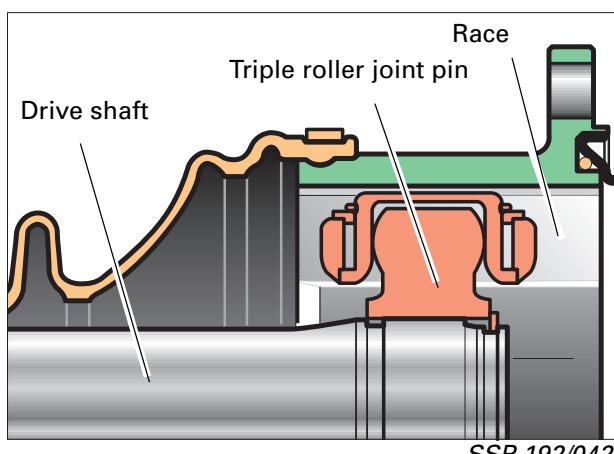
## Function

The principal task of the drive shafts is to transmit power from the gearbox to the wheels. They are also responsible for length compensation.

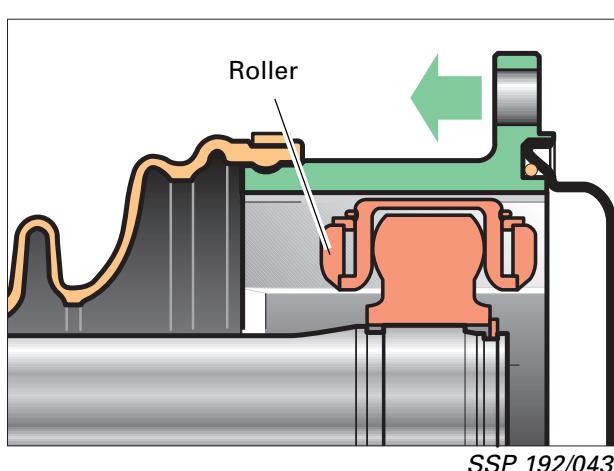


SSP 192/041

The engine/gearbox unit runs in elastic bearings. At certain speeds, the unit begins to oscillate in its mountings.



This movement is compensated by the triple roller joints, whereby the tripod star, together with the rollers, slide within their races.

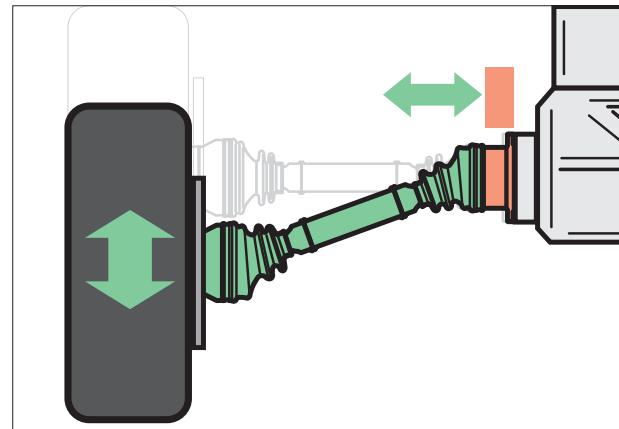


The triple roller joint housing is pushed over the tripod star rollers by the movement of the engine/gearbox unit. The drive shaft remains stationary in the process.

SSP 192/043

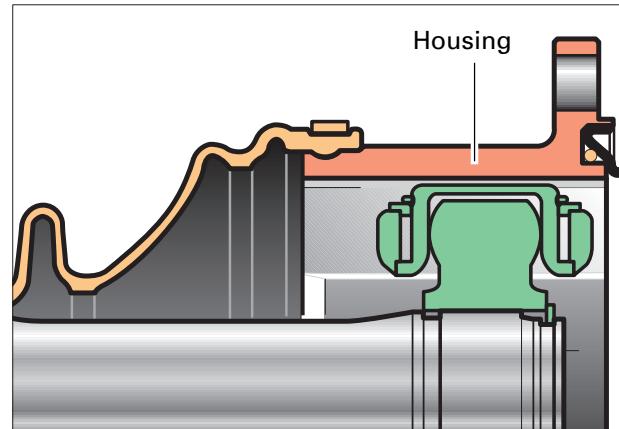
# drive shafts

In addition to the vibrations of the engine/gearbox unit, the triple roller joints have to equalise wheel bump and rebound.



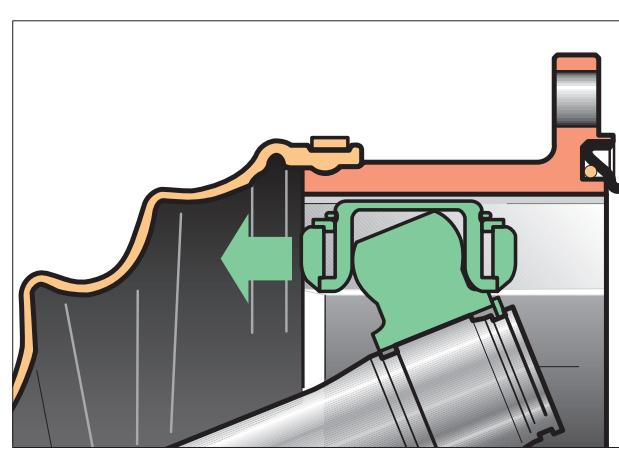
SSP 192/044

The joint housing remains stationary in the process.



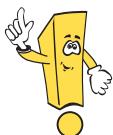
SSP 192/045

The drive shaft is moved away from the gearbox by the rebound action of the wheels. At the same time, the rollers are displaced in only one plane within their races, thereby reducing friction and noise transmission to the body.

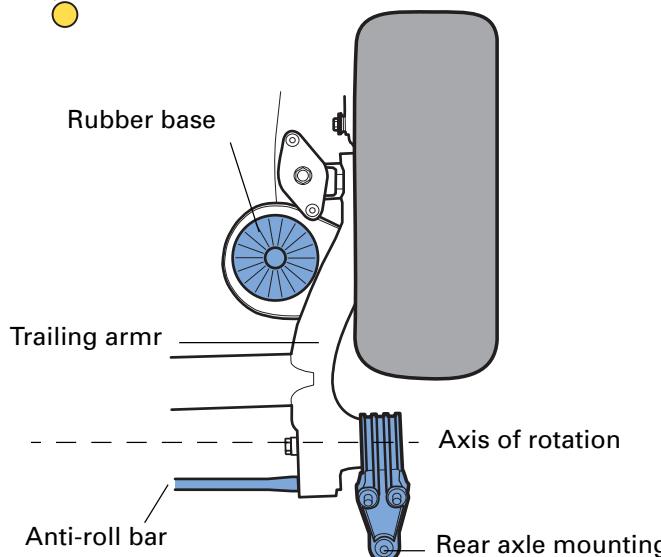


SSP 192/046

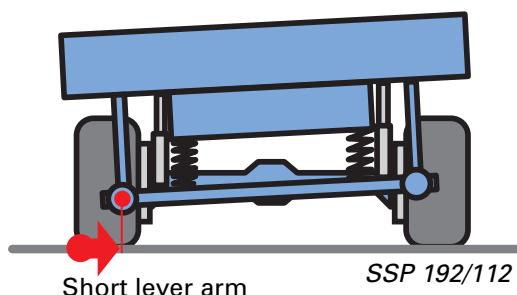
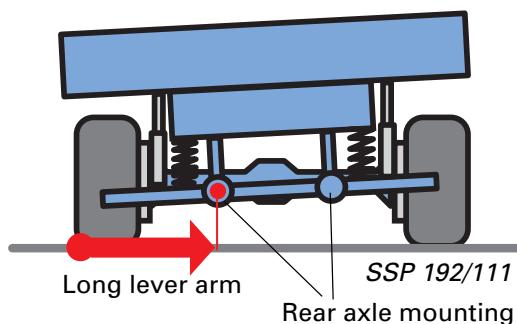
The following pages describe the design modifications to the axles of the Passat '97 as presented to you in Self Study Programme SSP 191.



## Torsion beam rear axle



SSP 192/100



The anti-roll bar used in the new torsion beam rear axle is located in front of the axis of rotation. The rear axle mountings are located on the far outer side of the axle. This considerably reduces the forces acting on the rear axle mountings.

The mounting housing is made of aluminium and bolted to the trailing arms.

When designing the rear axle, comfort was a major consideration. The rear axle mountings and the large rubber bases of the coil springs minimise noise transmission from the axle to the body.

On axles where the rear axle mounting is located on the inside, the mountings have to absorb large forces when cornering.

Locating the rear axle mountings on the outside makes the lever arms shorter, with the result that the mountings only absorb smaller forces. They can therefore be designed with a softer rating.

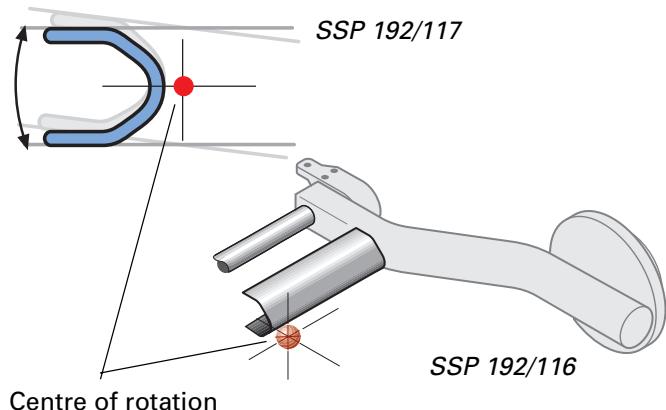
# Running Gear

## V section of torsion beam rear axle

Conventional rear axles have a V section which is open facing forward. In this configuration, the shear centre of the axle is located behind the V section.

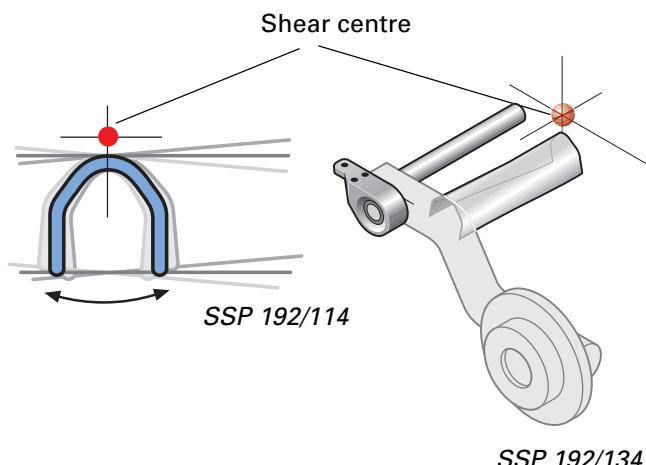
The centre of rotation is an imaginary axis about which the axle rotates when the suspension experiences a bump on one side.

If the shear centre is behind the V section, then diagonally aligned track-correcting mountings have to be used to achieve a self-steering effect.

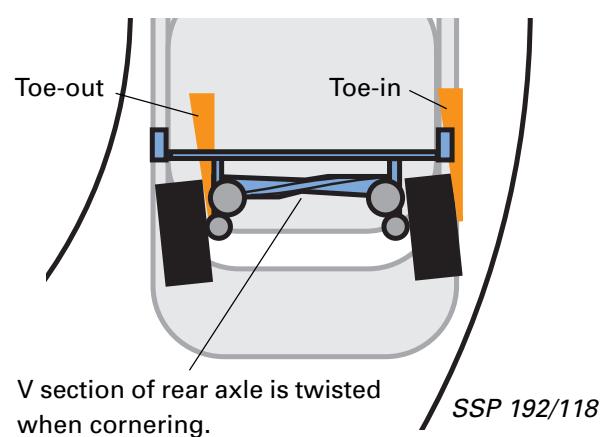


The new torsion beam rear axle has a V section which is open downwards. The shear centre is located above the V section.

The axle has different rotational characteristics as a result.



When cornering, the inside and outside cornering wheels go through rebound and bump respectively, because the car body tilts to the outside. The axle is twisted in itself. The bumped wheel adopts the toe-in position, while the rebound wheel adopts the toe-out position.





## Hub/wheel bearing unit

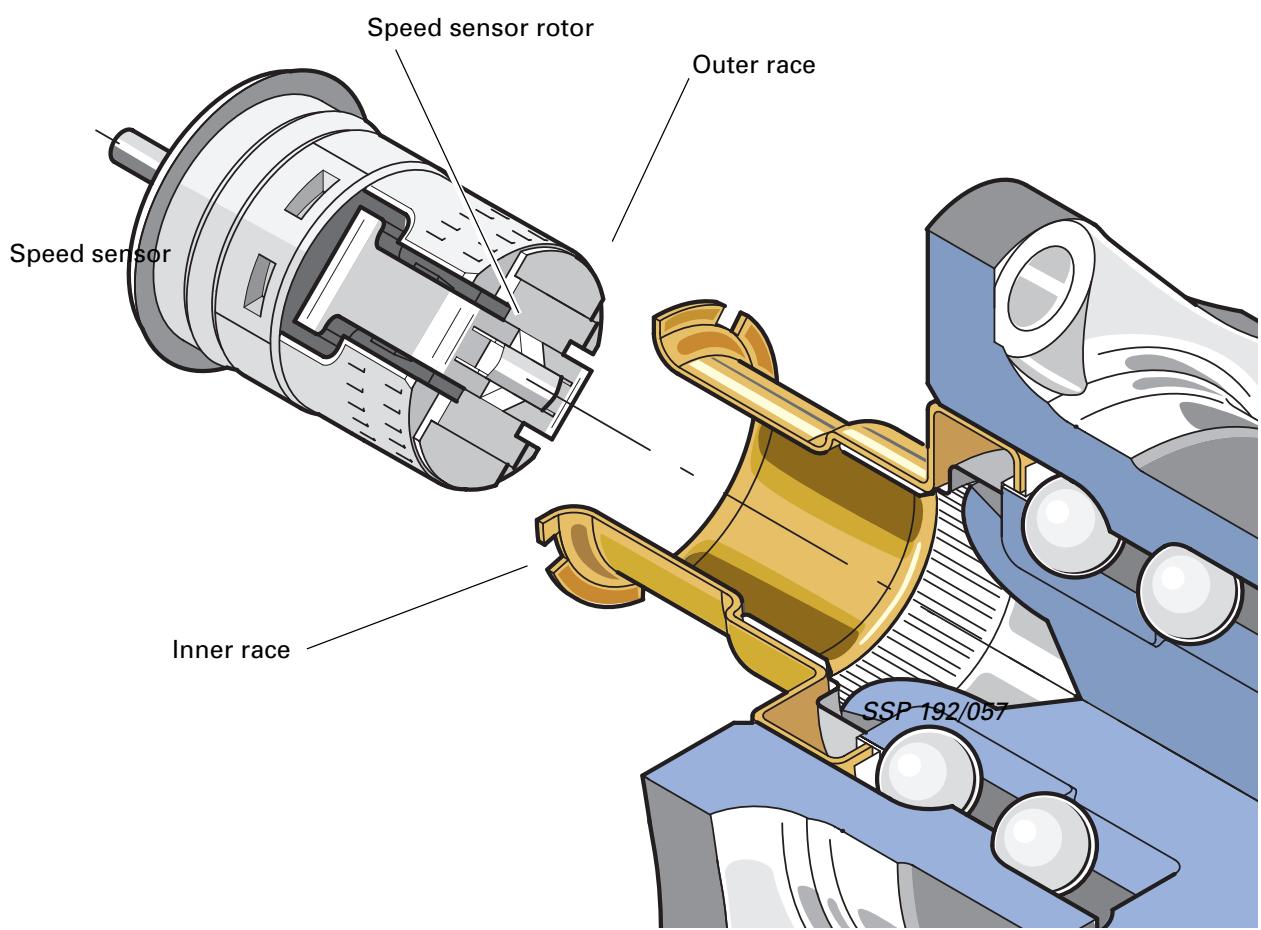
The newly developed wheel bearing generation is used on the rear axle of front-wheel-drive vehicles. The twin-tracked ball bearing has a stationary outer race which is bolted to the rear axle mounting plate.

The bearing inner race serves as the carrier for the brake disc and wheel. This design eliminates the need for an axle pivot.

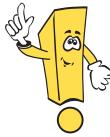
The ABS speed sensor is inserted into the wheel bearing and secured with a clip to prevent it from falling out.

The advantages of the new wheel bearing generation are as follows:

- Minimal wear due to improved sealing.
- The rotor is protected by the inserted speed sensor and cannot be damaged by external influences.
- The wheel bearing does not have to be adjusted any longer because the bearing preload is predetermined by its design.



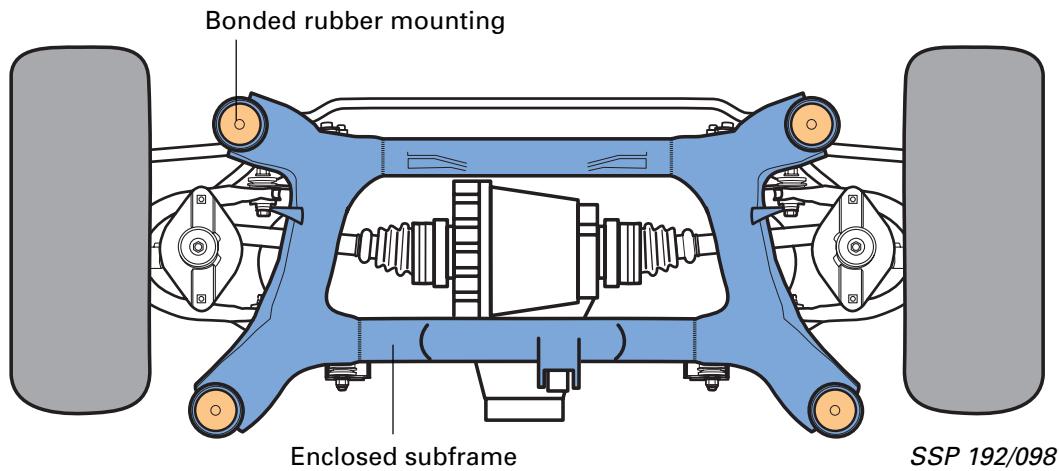
# Running Gear



## Double wishbone rear axle

The newly developed double wishbone rear axle allows the same through-loading width as the torsion beam rear axle. It has an enclosed subframe to which the transverse links are attached.

The subframe is connected to the body by four large bonded rubber mountings.

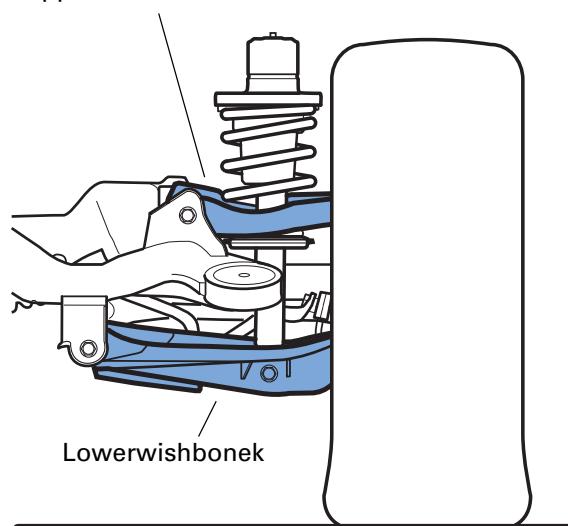


SSP 192/098

Single-tube gas-filled shock absorbers are used on the double wishbone rear axle. Their diameter is smaller than that of twin-tube shock absorbers.

The low-lying position of the upper wishbone and the smaller shock absorber diameter permit a lower loading platform and a larger through-loading width.

Upper wishbone



SSP 192/099

# Test your knowledge

**1. How is the high transverse rigidity of the torsion beam rear axle achieved?**

a) \_\_\_\_\_

b) \_\_\_\_\_

**2. The V section of the new torsion beam rear axle is open \_\_\_\_\_.**

**3. The advantages of the new wheel bearing generation are as follows:**

- a) Minimal wear,
- b) The ABS speed sensor rotor is protected,
- c) It is self-adjusting,
- d) It has to be adjusted using a hexagon nut.

**4. On the double wishbone rear axle, the upper wishbone is located \_\_\_\_\_**

**the wheel. As a result of this, \_\_\_\_\_**

**achieved. \_\_\_\_\_ is**

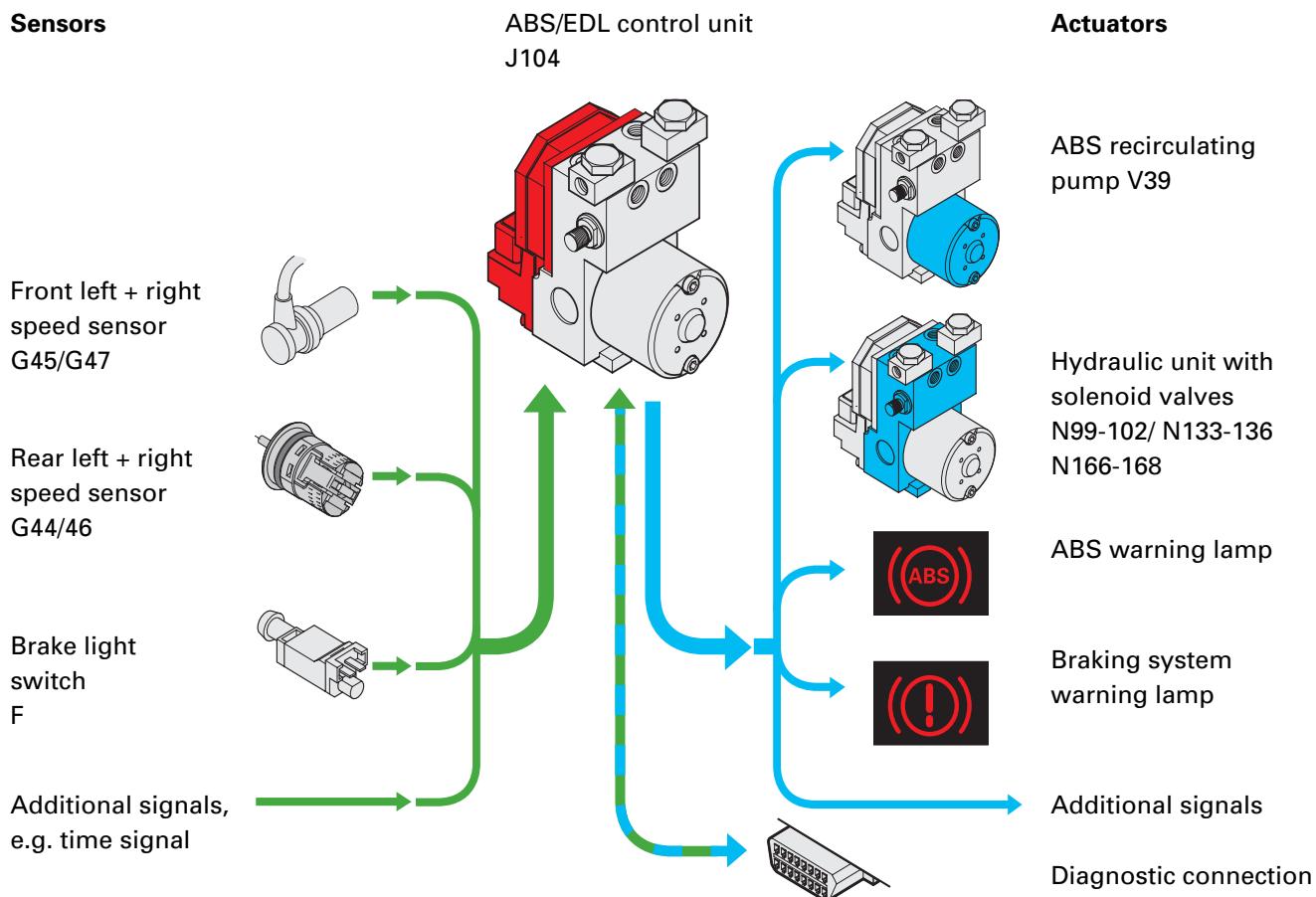
# ABS/EDL

The anti-lock braking system is a 4-channel system. This means that two valves are assigned to each wheel (inlet and outlet valves).

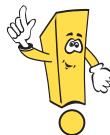
The hydraulic unit and the ABS control unit are combined in a single module and can only be renewed as one unit.

A Self Study Programme relating to the ABS 5.3 system is in preparation.

## System overview

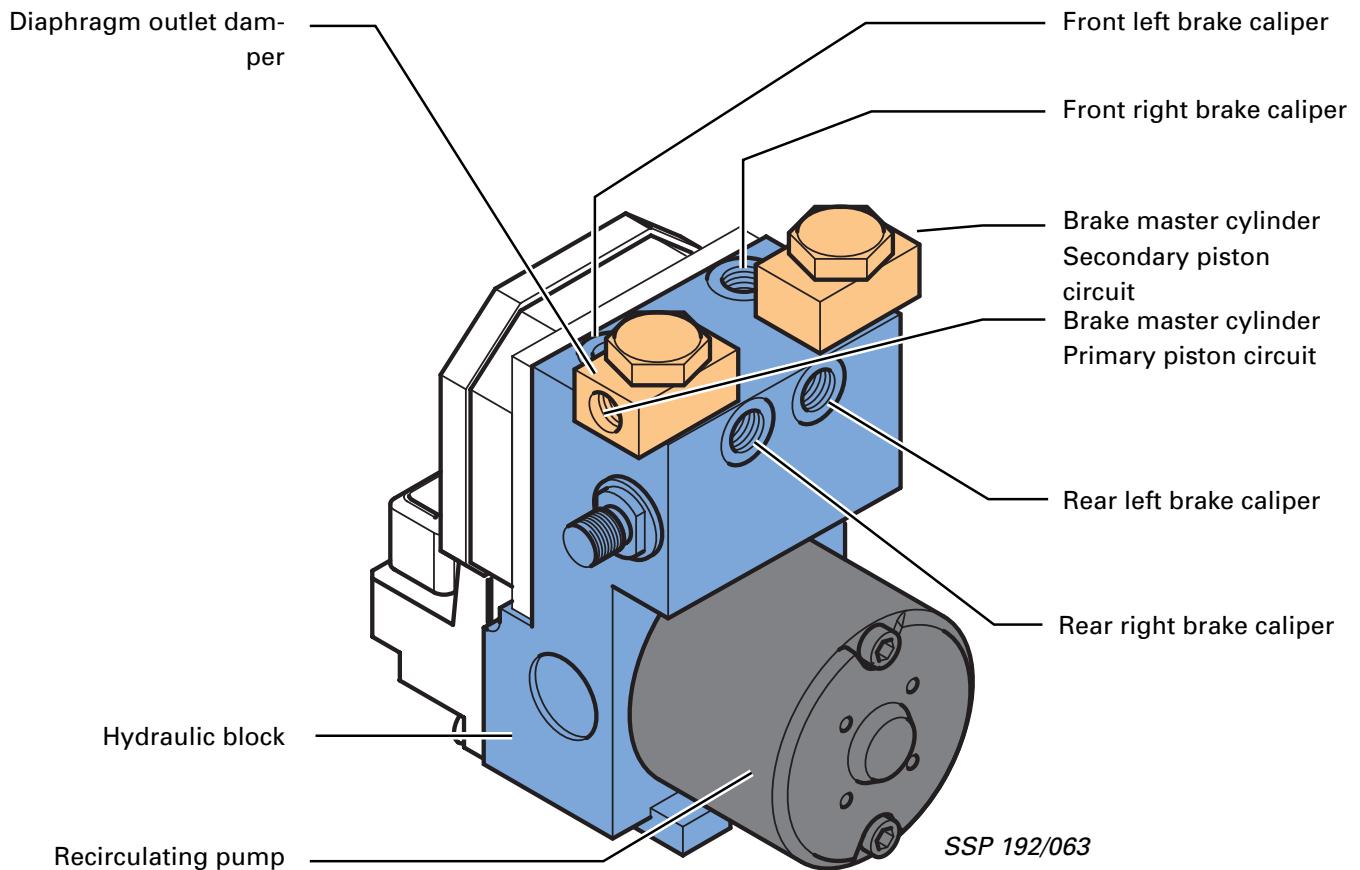


SSP 192/062



## ABS/EDL hydraulic unit

**Connection for:**



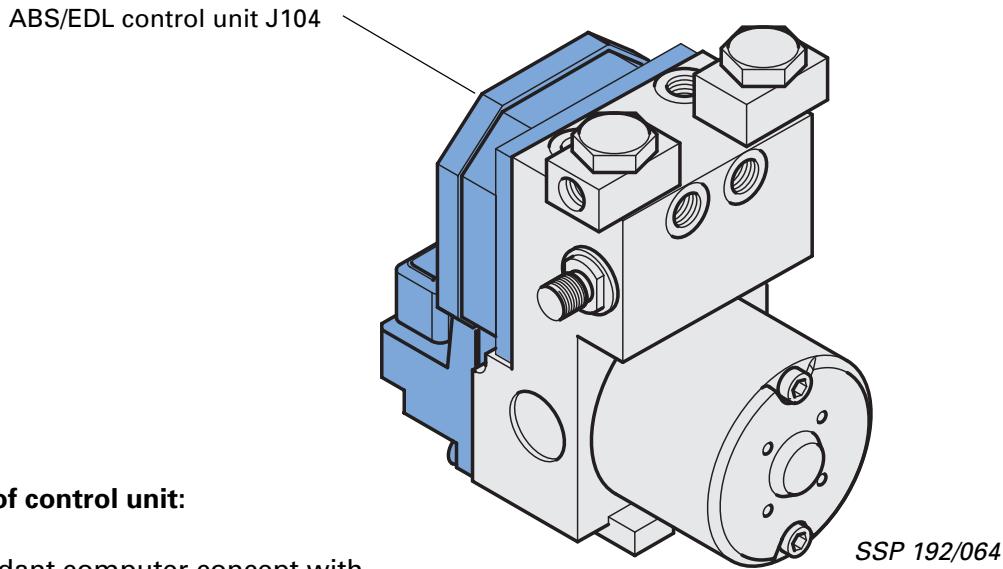
SSP 192/063

### Features of hydraulic unit:

- One-piece cast iron housing.
- ABS/EDL solenoid valves each with two hydraulic connections and operating positions.
- Noise-optimised recirculating pump,
- Accumulator size for each brake circuit: approx. 3 cm<sup>3</sup>,
- Two diaphragm outlet dampers are connected upstream of the EDL hydraulic blocks. They help improve the low-temperature performance of the EDL control system.

# ABS/EDL

## ABS/EDL control unit



### Features of control unit:

- Redundant computer concept with separate watchdog,
- Self-diagnosis capability,
- 26-pin connector contact.

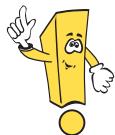
### Redundant computer concept

In this case, redundant stands for a computer concept with several backups.

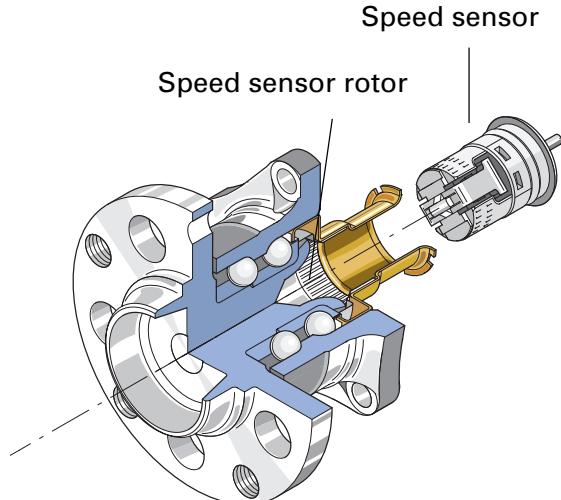
In the control unit there are two computers which work with the same program independently and check one another.

The two computers are, in turn, monitored by a third computer which assumes the task of controlling the solenoid valve relays.

This third computer is known as the watchdog. If it detects a fault, it stores the fault message in a read-only memory and can be read out during the self-diagnosis. The fault is indicated by the ABS warning lamp.



## ABS speed sensor



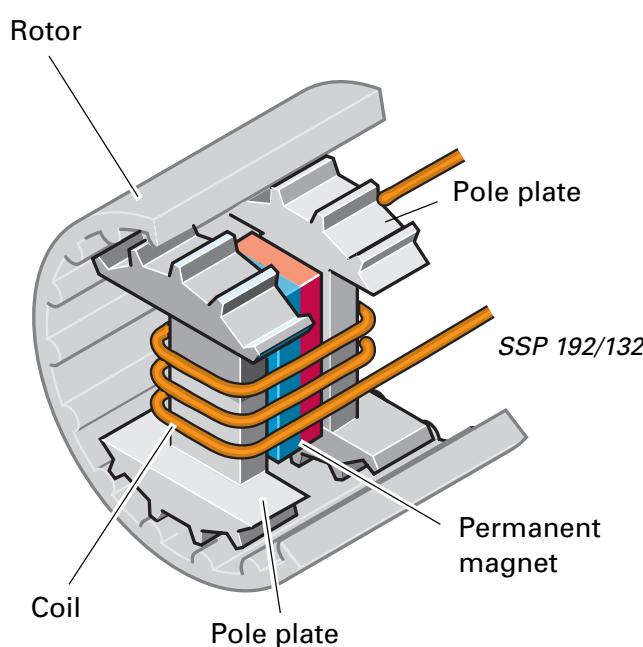
SSP 192/057

### Features of speed sensor:

- It is inserted into the wheel bearing and is thus protected against external influences.
- It generates signals contactlessly.

### Signal utilisation

The signal supplied by the ABS speed sensor is used to control the anti-lock braking system. The navigation system calculates the distance travelled from this signal.



### Effect of signal failure

- The ABS system is switched off and the ABS warning lamp comes on.
- The navigation system is de-energised.
- The brake warning lamp comes on.

### This is how it works:

The rotor is integrated and the speed sensor inserted in the wheel bearing.

The speed sensor comprises a permanent magnet with two pole plates. A coil is wound around the pole plates and the permanent magnet.

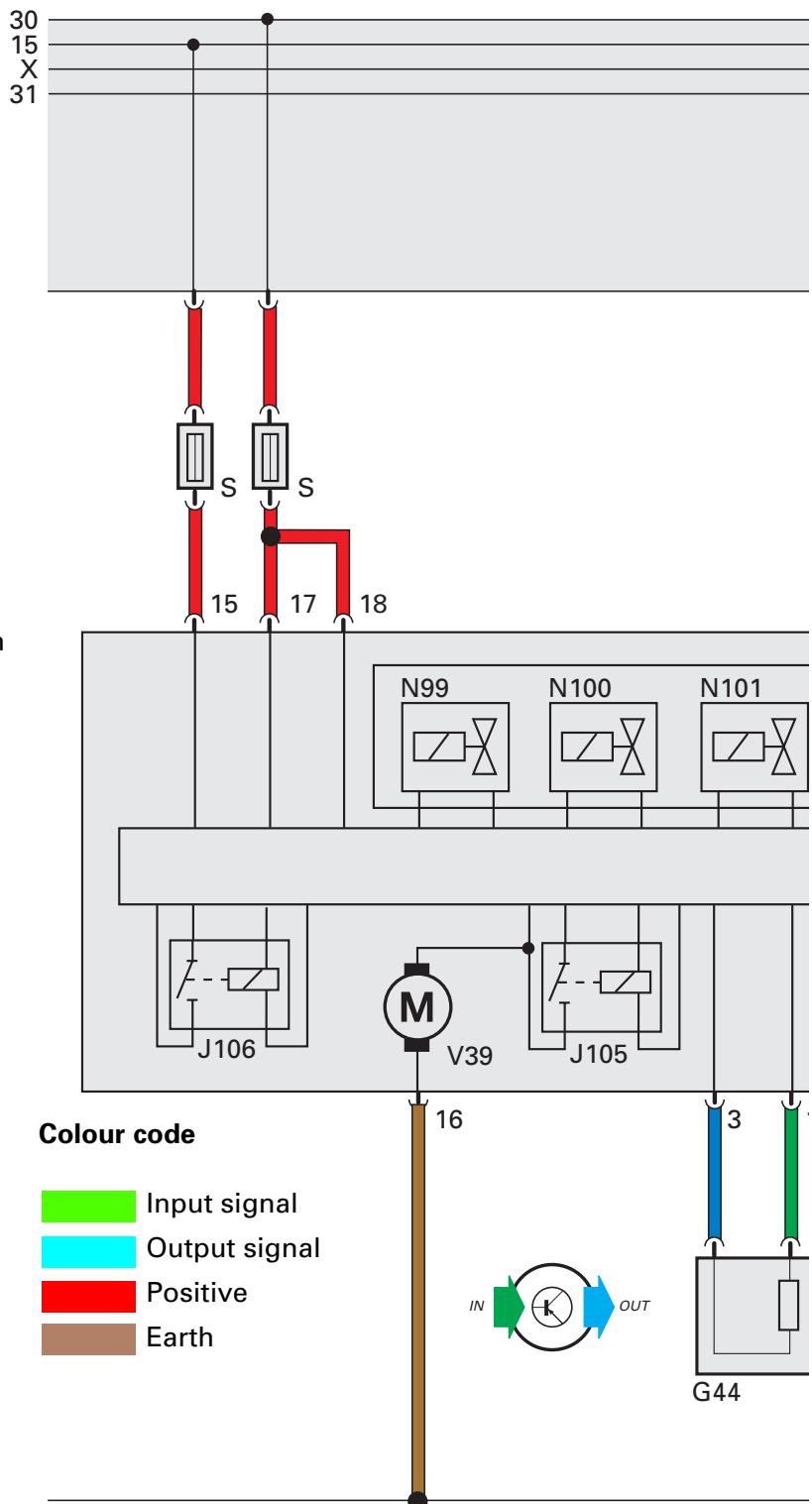
When the wheel moves, the rotor rotates about the speed sensor. In the process, it cuts the field lines of the pole plates, thus inducing a voltage in the coil. This voltage serves as the signal for the ABS control unit and the navigation system.

# ABS/EDL

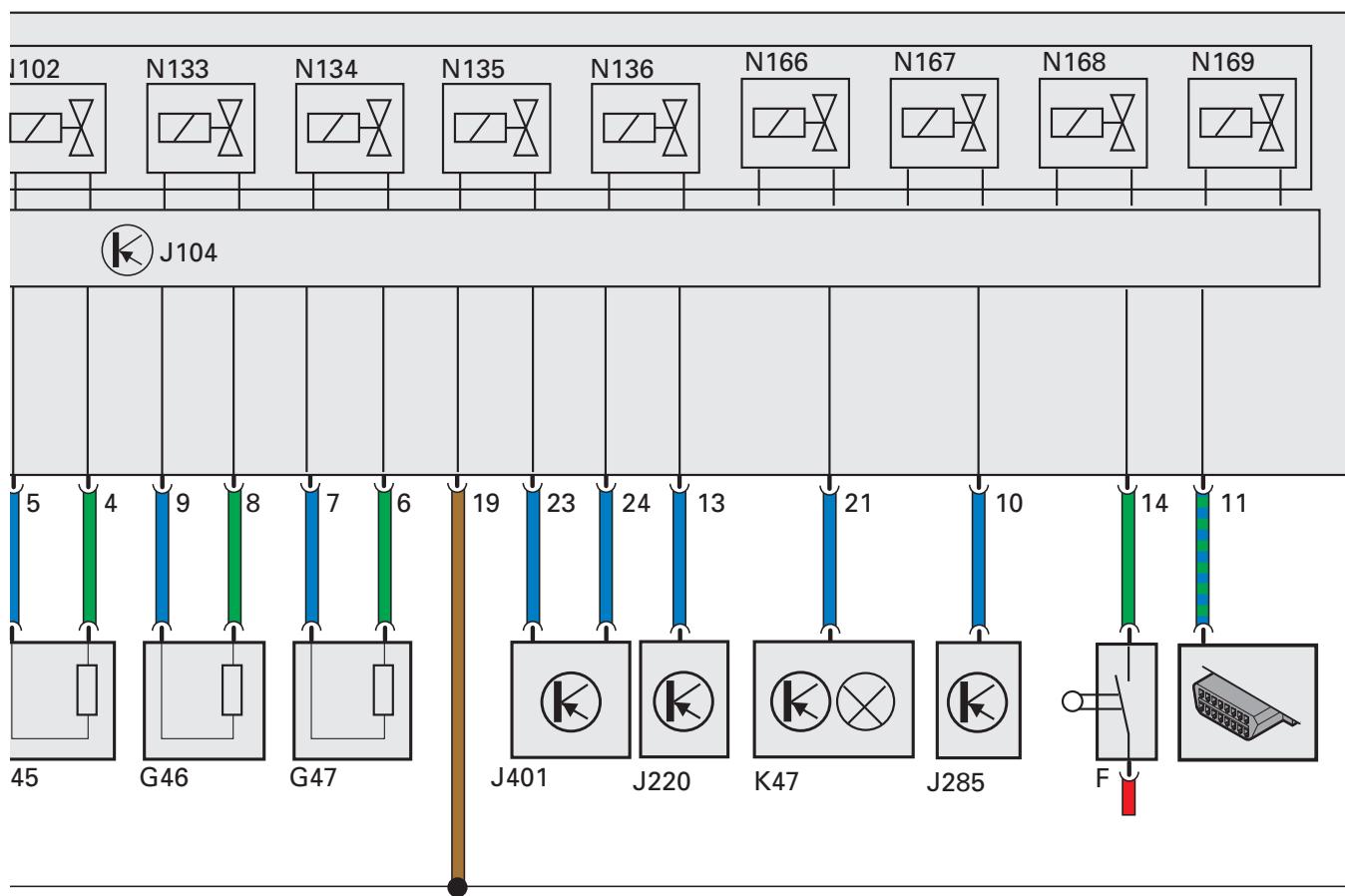
## Function diagram

### Components

- F Brake light switch
- G44 Rear right speed sensor 4  
G45 Front right speed sensor 2  
G46 Rear left speed sensor 3  
G47 Front left speed sensor 1
- J104 Control unit for ABS with EDL  
J105 ABS recirculating pump relay  
J106 Solenoid valve relay  
J220 Control unit for Motronic  
J285 Control unit with display unit in dash panel insert  
J401 Control unit for navigation system with CD-ROM drive
- K 47 ABS warning lamp
- N99 Front right ABS inlet valve  
N100 Front right ABS outlet valve  
N101 Front left ABS inlet valve  
N102 Front left ABS outlet valve  
N133 Rear right ABS inlet valve  
N134 Rear left ABS inlet valve  
N135 Rear right ABS outlet valve  
N136 Rear left ABS outlet valve  
N166 Front right EDL switchover valve  
N167 Front right EDL outlet valve  
N167 Front left EDL switchover valve  
N168 Front left EDL outlet valve
- S Fuse
- V39 ABS recirculating pump



3  
1  
X  
3



SSP 192/087

# Test your knowledge

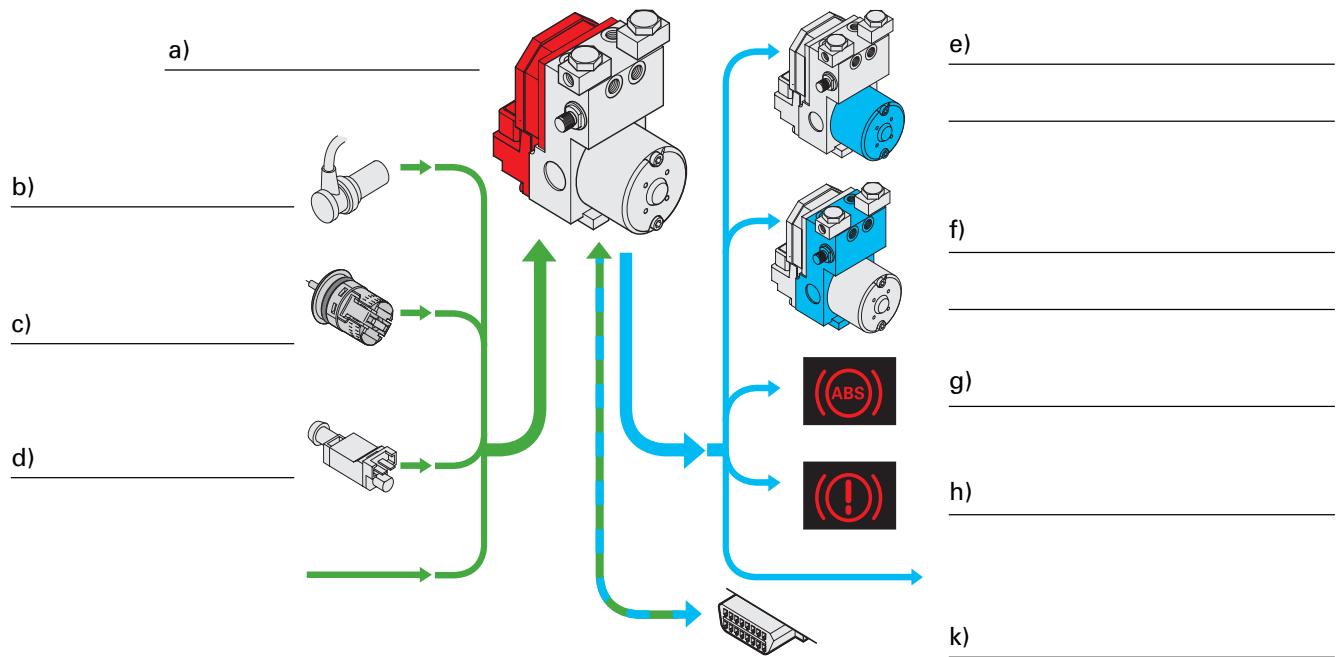
1. How do you distinguish the ABS/EDL hydraulic unit from an ABS hydraulic unit?

- a) By the diaphragm outlet damper,
- b) By the colour of the control unit,
- c) By the threaded holes for the master brake cylinder.

2. Where is the rotor for the speed sensor of the torsion beam rear axle located?

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3. Name the components in this system overview.



## Gas discharge lamp

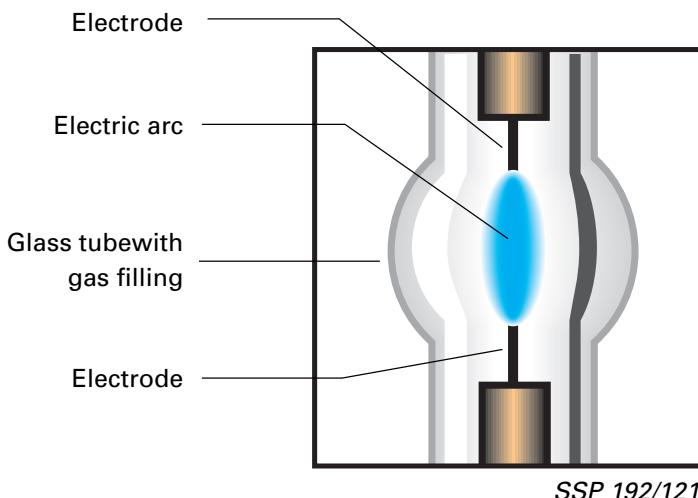
In the case of gas discharge lamps, light is generated by an electric arc between two electrodes in a pea-sized gas-filled glass tube.

The lamp emits light with high green and blue

components due to the composition of the gas in the lamp tube.

This is the external distinguishing feature of gas discharge technology.

The advantages of this new headlight generation over conventional lamp technology are as follows:



- Up to three times higher luminous efficiency, same power consumption.  
A 35W gas discharge lamp is sufficient to provide twice the illumination of a 55W lamp.
- The useful life of approx. 2500 hours is several times that of the halogen lamp.
- The special design of the reflector, aperture and lens provides a much longer range and a wider near-field scatter zone. This illuminates the roadside better, thus reducing driver eye fatigue.
- Fog lights are not needed due to the wide near-field beam.

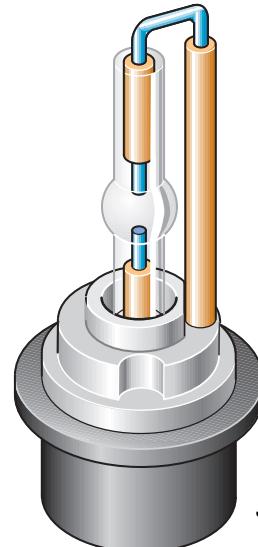
# Electrics

The gas discharge lamp requires a high-voltage pulse of several thousand volts to ignite the electric arc. The voltage is produced in the ballast.

After ignition, an increased electric current is applied to the gas discharge lamp for approx. 3 seconds. As a result, the lamp achieves its maximum brightness with a minimum delay of 0.3 seconds.

This slight delay is also the reason why the main headlight is still equipped with a halogen lamp which is connected to the headlight as required. Once the gas discharge lamp has reached its nominal brightness, the ballast regulates the lamp power output to the lamp.

Gas discharge lamp



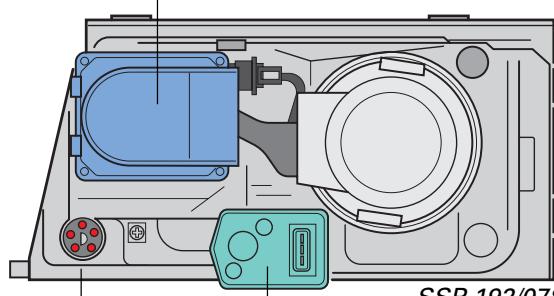
SSP 192/122

## Gas discharge headlight

A gas discharge headlight comprises:

- headlight housing,
- gas discharge lamp ballast J426/J427 and
- headlight range control actuator V48/V49.

Ballast



SSP 192/078

Electrical connection

Headlight range control actuator



A repair solution is available for the headlight housing.

During minor accidents, the securing pin on the headlight housing can shear off. With regard to the gas discharge headlight, this may result in disproportionately high repair costs.

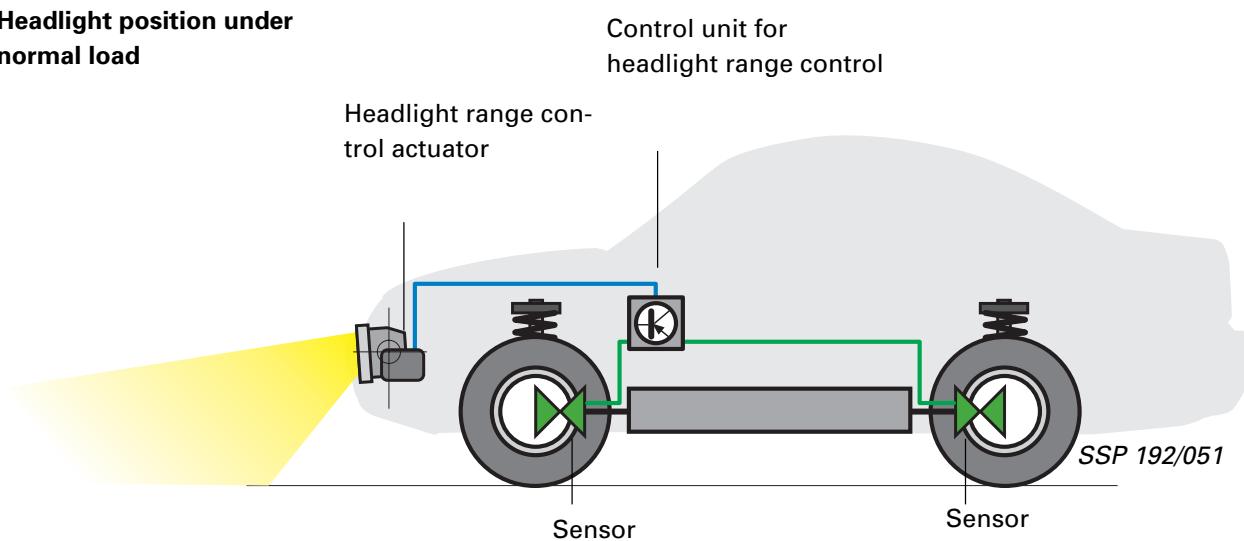
Our repair solution, which involves renewing the securing pin and eccentric, allows all headlight housings to be renewed inexpensively.

## Automatic headlight range control

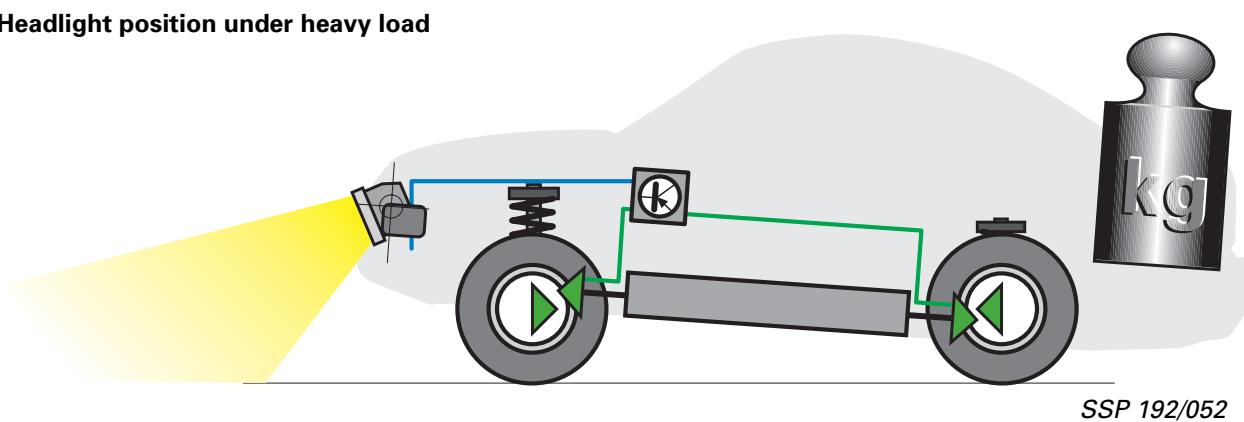
To prevent dazzling oncoming traffic, the gas discharge headlights have to be equipped with an automatic headlight range control.

The control unit for automatic headlight range control determines the car's load condition by two sensors located on the front and rear axles on the left of the car. It continuously adjusts the headlight via the actuator to ensure that the road is always illuminated optimally. Manual adjustment is no longer provided.

**Headlight position under normal load**



**Headlight position under heavy load**



# Electrics

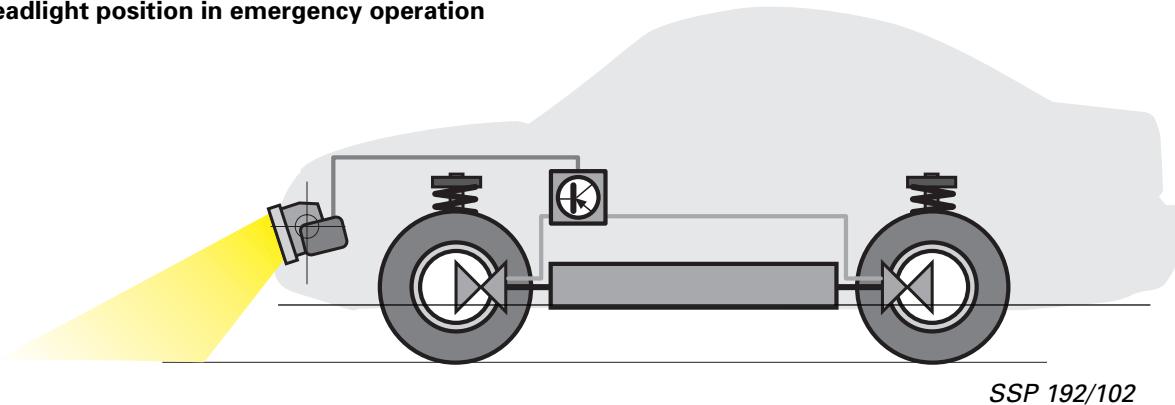
## Emergency operation:

If an electrical fault occurs in the automatic headlight range control, the headlight range control actuator automatically sets the headlight to its lowest position. The driver is alerted to the malfunction.

## Self-diagnosis:

The self-diagnosis is started using address word "55".

### Headlight position in emergency operation



SSP 192/102

 The high voltage applied to the gas discharge lamps can endanger life.  
When carrying out repairs, the headlight must always be disconnected from the power supply.

# Test your knowledge

1. In the case of gas discharge lamps, light is produced by \_\_\_\_\_

between two \_\_\_\_\_ in a gas-filled glass tube.

2. The luminous efficiency with the same power consumption is:

- a) approx. ten times higher,
- b) approx. five times higher,
- c) approx. three times higher.

3. A gas discharge headlight comprises:

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4. The voltage applied to the gas discharge lamp is:

- a) very low and therefore absolutely safe,
- b) dangerous when performing work with wet or moist fingers,
- c) a high voltage and can endanger life if handled improperly.

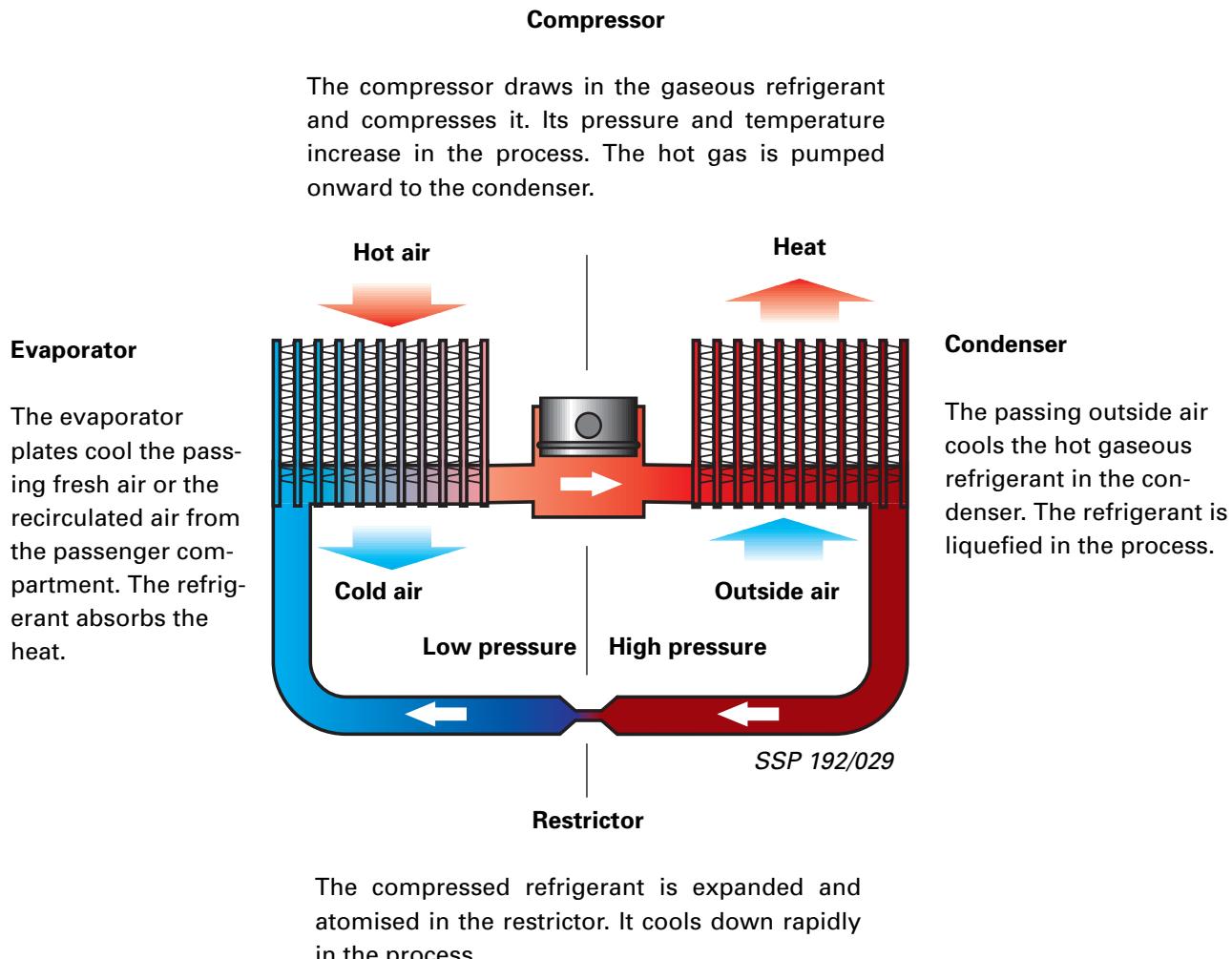
# Air-conditioning

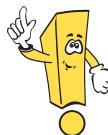
The Passat has an improved air-conditioning system.  
You can find out about its features and innovations on the following pages.

## Refrigerant circuit

The refrigerant in the evaporator absorbs heat and dissipates it into the ambient air to cool the passenger compartment.

The refrigerant is circulated in a closed circuit. The refrigerant circuit contains the refrigerant R134a.



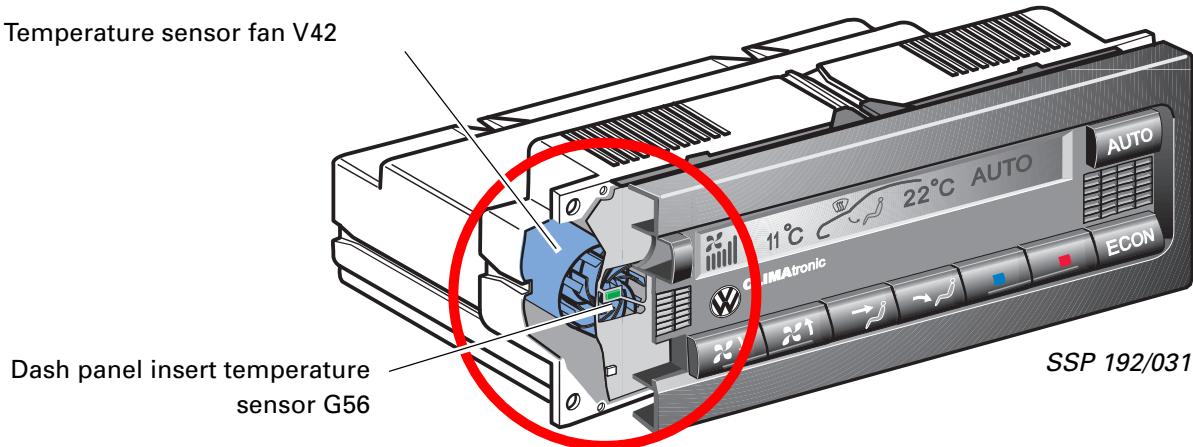


## CLIMAtronic

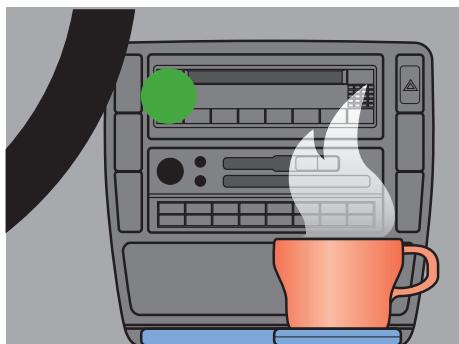
The operating and display unit is combined with the CLIMAtronic control unit as a single module.

The dash panel insert temperature sensor and the temperature sensor fan are integrated in the control unit.

Temperature sensor fan V42



Dash panel insert temperature sensor G56



SSP 192/039

Temperature sensor for left-hand drive cars



SSP 192/040

Temperature sensor for right-hand drive cars

The installation location of the temperature sensor in the CLIMAtronic control unit is different in left- and right-hand drive cars. In left-hand drive vehicles, the temperature sensor is located behind the cover grille on the left.

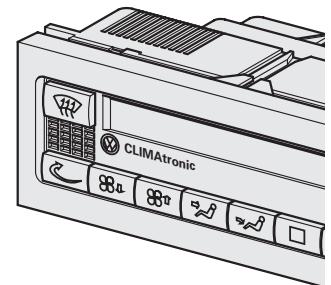
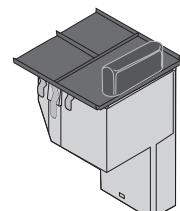
For right-hand drive cars, the temperature sensor is installed on the right. Using this layout, drinks in the can holder have less effect on the temperature sensor.

# Air-conditioning

## System overview

### Sensors

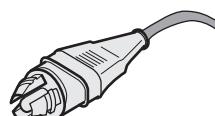
Sunshine penetration photosensor G107



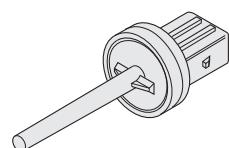
Dash panel insert temperature sensor G56 with temperature sensor fan V42



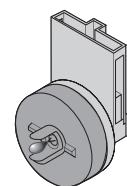
Outside temperature sensor G17



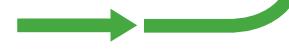
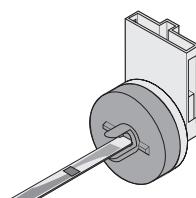
Temperature sensor for fresh air intake duct G89



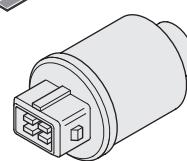
Sender for footwell air outlet temperature G192



Sender for central air outlet temperature G191



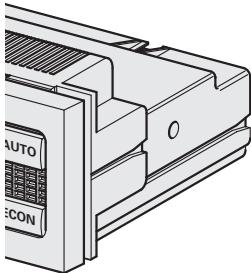
Air-conditioning pressure switch F129



Additional signals

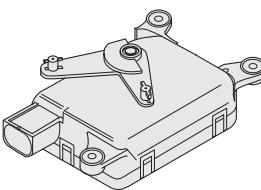


Control unit  
for CLIMATronic J255

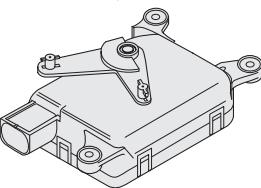


## Actuators

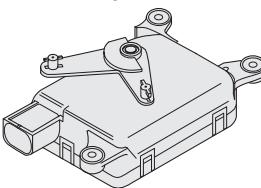
Footwell/defrost flap actuator  
V85  
with potentiometer



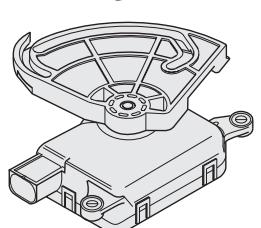
Central flap actuator  
V70  
with potentiometer



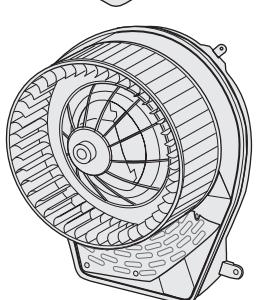
Temperature flap actuator  
V68  
with potentiometer



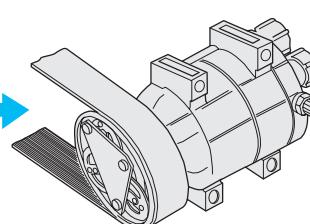
Ventilation flap actuator  
V71  
with potentiometer



Fresh air blower V2  
with blower control unit  
J126



Magnetic coupling N25



Additional signals



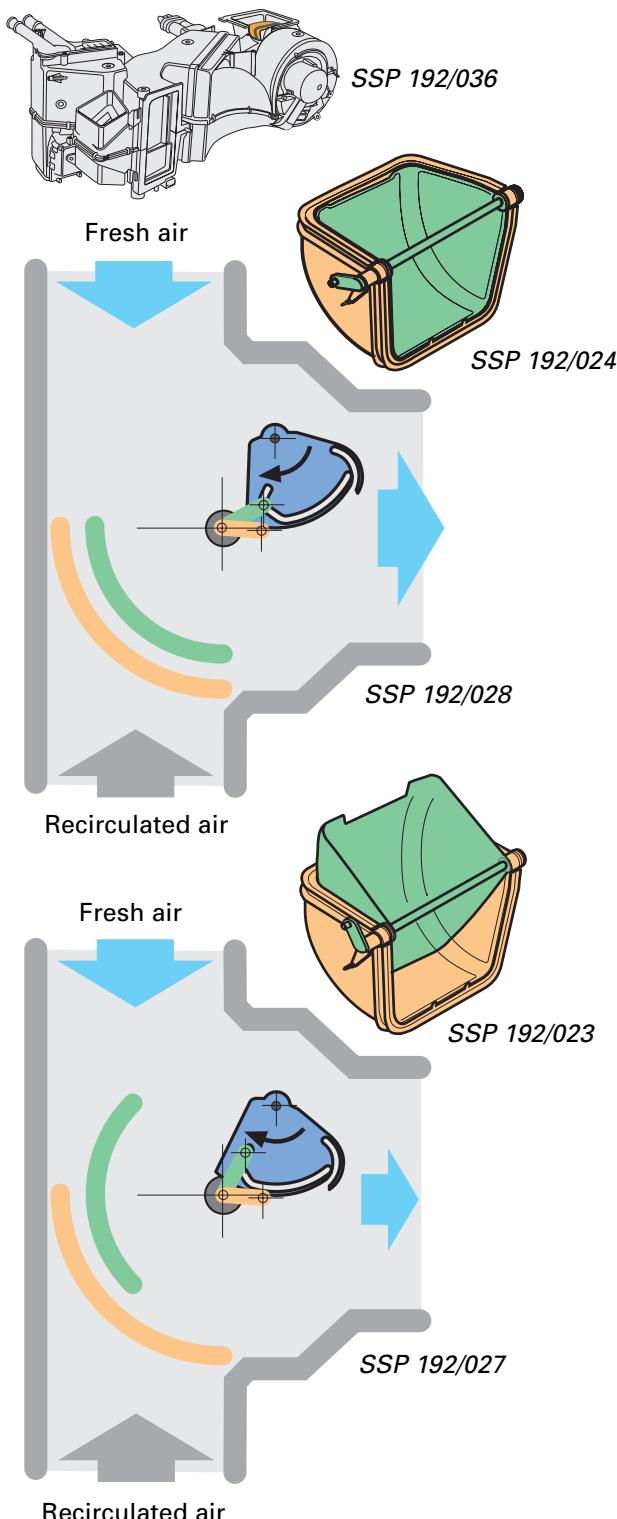
Diagnostic connection

SSP 192/030

# Air-conditioning



## Ventilation flap and the fresh/air recirculation flap



The ventilation flap and the fresh/air recirculation flap are activated by a common motor. The flaps are adjusted separately by a drive disc with two guide paths. The vacuum unit and two-way valve previously used are no longer required.

### Fresh air mode

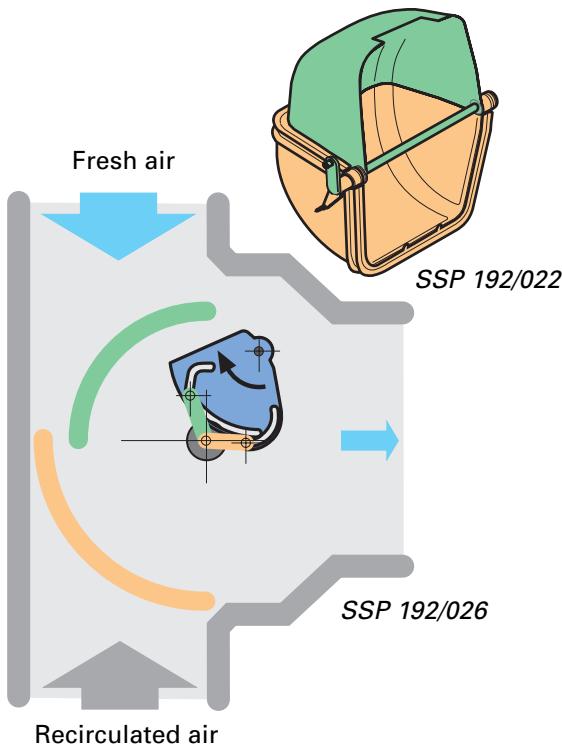
In the fresh air mode, the ventilation flap and the fresh/air recirculation flap are fully open at speeds of below 20 kph. Fresh air is able to flow into the car unobstructed.

### Ventilation mode

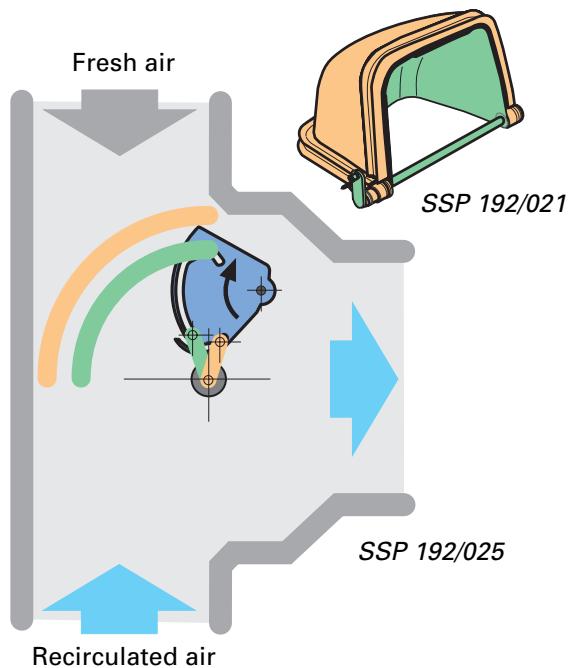
At high speeds, the ventilation flap prevents too much fresh air from entering the passenger compartment. Opening and closing are dependent on road speed. The position of the ventilation flap is also affected by the difference between the nominal and actual temperature in the passenger compartment. If the temperature difference is very large, the port cross-section stays open at increasing speed so that the desired temperature is achieved more quickly.

### Colour code

- Ventilation flap
- Fresh/air recirculation flap
- Drive disc



Above a speed of 160 kph, the ventilation flap is closed. A small amount of fresh air trickles into the passenger compartment through a narrow opening in the ventilation flap.



#### Air recirculation mode

In the air recirculation mode, the two flaps are in their upper positions. The fresh air supply is blocked. Air-conditioning only takes in air from the passenger compartment.

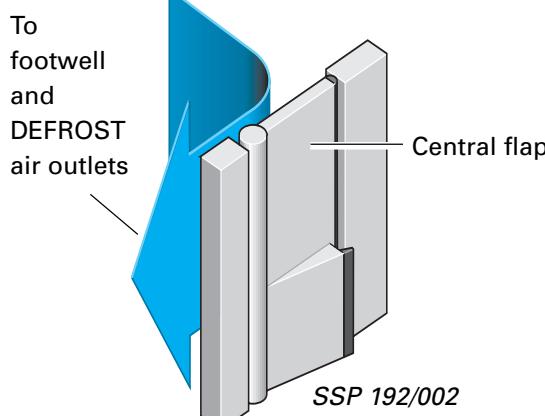
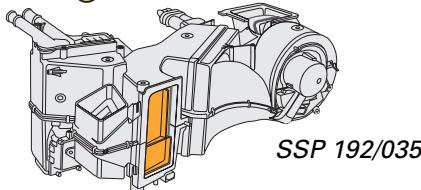


An air-conditioner without a ventilation flap is installed in right-hand drive vehicles.

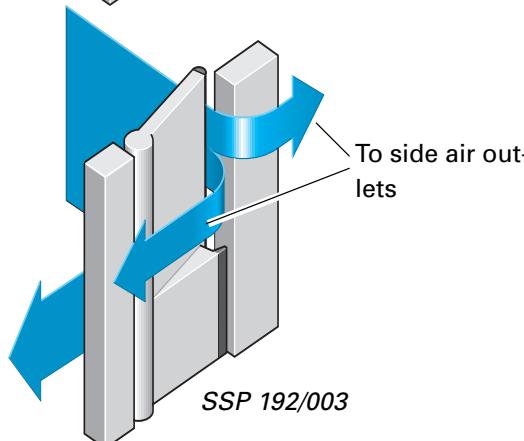
# Air-conditioning



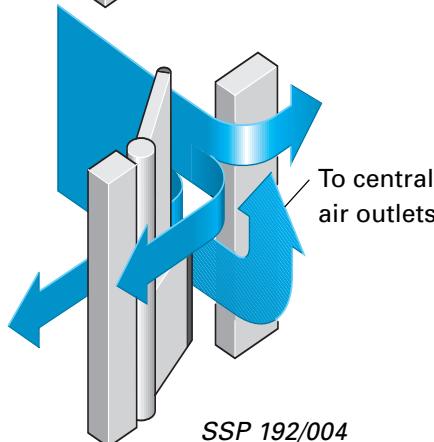
**Central flap**



The central flap controls the air flow to the central, side, footwell and DEFROST air outlets. Its new shape allows it to be fully closed. It is also driven by an electric motor.



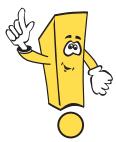
At low outside temperatures and when the engine is cold, the central flap is fully closed. This prevents ice-cold air from being blown into the passenger compartment.



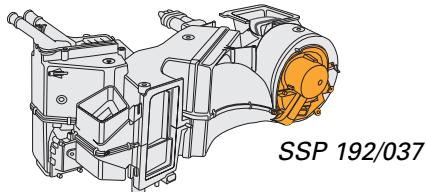
If the central flap is fully opened, air is evenly distributed to the central and side air outlets.



The vacuum unit and the shutoff flap for the central air outlets are not required.



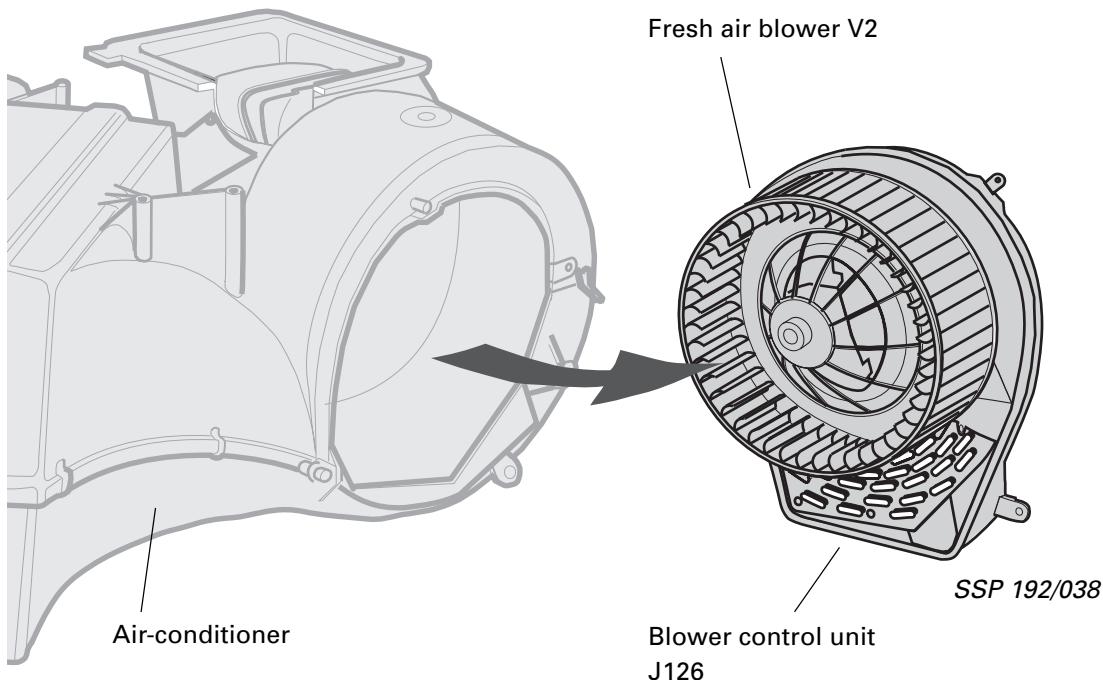
## Fresh air blower V2



SSP 192/037

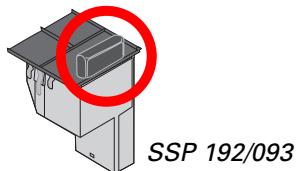
The blower control unit is integrated in the fresh air blower.

The control unit cooling ribs are cooled by the blower airstream.

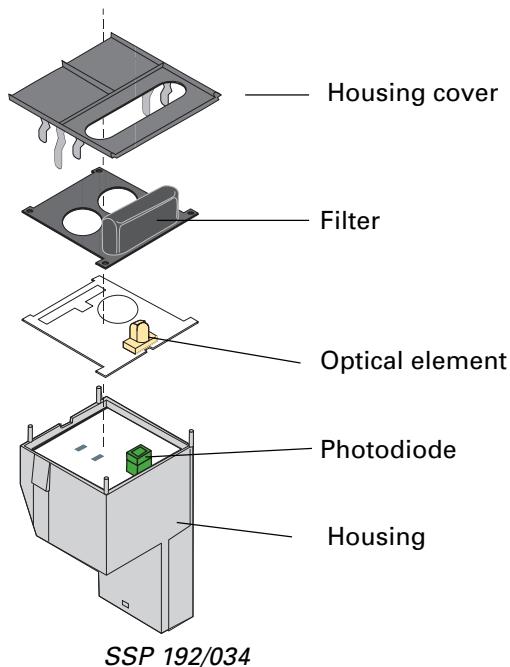


# Air-conditioning

## Sunshine penetration photosensor G107



The air-conditioning temperature control is affected by the sunshine penetration photosensor. It measures the sunlight falling directly on the car's occupants.

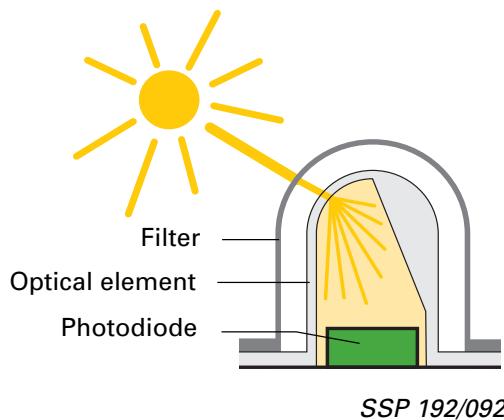


### How it works:

The sunlight impinges on a photodiode through a filter and an optical element. The filter has the same effect as sunglasses and prevents sublight from damaging the photodiode.

The photodiode is a light-sensitive semiconductor element. When it is not illuminated, only a small electric current can flow through the diode. When it is illuminated, the electric current increases. The stronger the light, the higher the current.

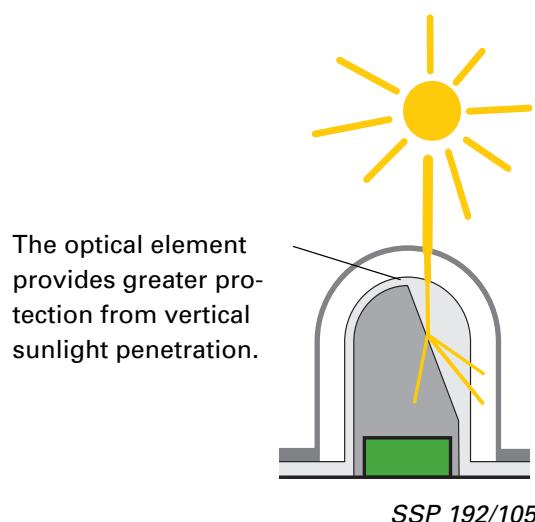
To the control unit, an increase in electric current indicates higher sunshine penetration. It regulates the interior temperature accordingly.



### Diagonal sunlight penetration

Particularly sunlight incident on the car's occupants diagonally from the front, i.e. directly, increases the feeling of warmth.

The optical element deflects a large proportion of diagonally penetrating sunlight onto the photodiode. Cooling is increased to equalise the effect of heat radiation on the body.



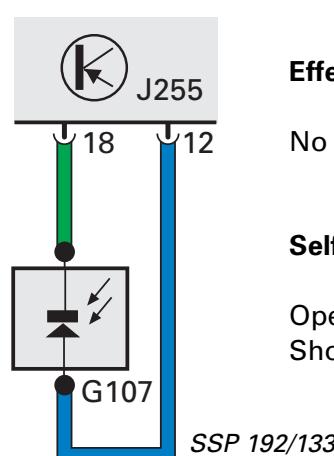
### Vertical sunlight penetration

Vertically incident sunlight is screened by the car's roof.

The optical element deflects less light onto the photodiode. Cooling can be reduced as the car's occupants are not directly exposed to heat radiation.

### Electric circuit

- J225 Control unit for CLIMAtronic
- G107 Sunshine penetration photosensor
- Pin 12 Signal earth
- Pin 18 Signal



### Effects of signal failure

No replacement function.

### Self-diagnosis fault message

Open circuit/short circuit to positive.  
Short circuit to earth.

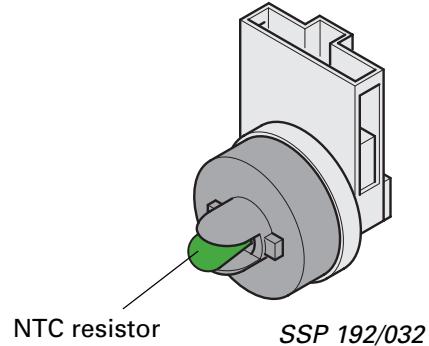
# Air-conditioning

The temperature of the air streaming into the vehicle is now measured by two separate temperature sensors.

## Footwell outlet temperature sender G192

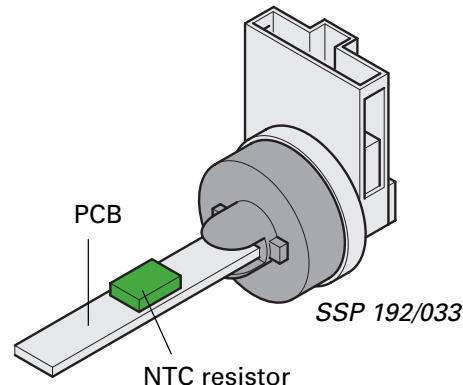
The temperature is measured by a temperature-dependent resistor.

As temperature decreases, the electrical resistance increases.



## Central outlet temperature sender G191

With this sender, the temperature-dependent resistor is glued and soldered to the surface of a printed circuit board. By designing the sender in this way, the temperature is not determined at a measuring point, but along a measuring section. The central air outlet temperature is measured in this way.



## Signal utilisation

The control unit calculates a value from the signals provided by the two sensors.

## Effects of signal failure

In the event of signal failure, the control unit calculates a substitute value on the basis of the outside temperature.

## Self-diagnosis fault message

Open circuit/short circuit to positive.  
Short circuit to earth.

# Test your knowledge

## 1. Which statements are true?

- a) The ventilation flap and the fresh/air recirculation flap are activated by a common electric motor drive.
- b) In the air recirculation mode, the ventilation flap is in its upper limit position and the fresh/air recirculation flap is in its lower limit position.
- c) The central flap controls the air flow to the central, side, footwell and DEFROST air outlets.
- d) The new shape of the central flap makes it possible to fully close the central and side air outlets.

## 2. What is the task of sunshine penetration photosensor G107 and how does it work?

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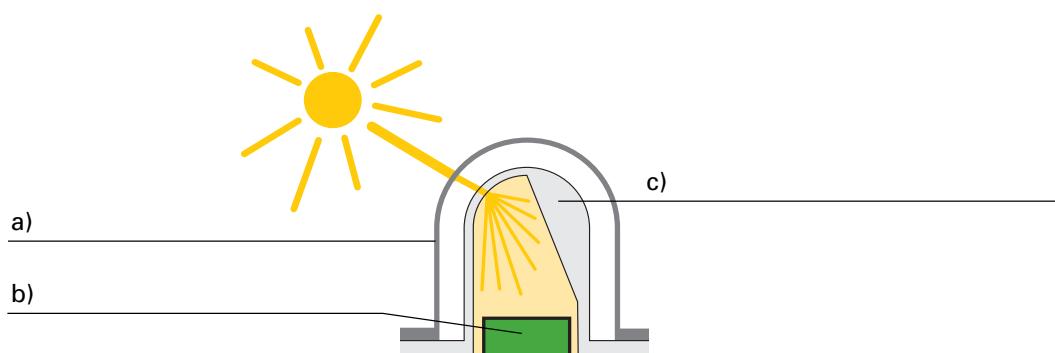
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## 3. Name the components.



**Solutions:****Page 18/19**

Re. 1.

Driver airbag, Front passenger airbag, Side airbags, Front + rear belt tensioners, Belt force limiter

Re. 2.

b)

Re. 3.

side

Re. 4.

Its purpose is to reduce the tensile force of the belt to an acceptable level so that persons wearing a seatbelt are not injured by the belt during an accident.

Re. 5.

a)

Re. 6.

a) Tripping device, b) Ball retainer, c) Gear, d) Belt , e) Propellant charge,

f) Feed tube containing balls

**Page 35**

Re. 1.

a) Torque position, b) Performance position

Re. 2.

a) slowly, b) intake manifold , c) be closed early, d) high,

e) can continue to control the cylinder, f) closed late

**Page 39**

Re. 1.

c)

Re. 2.

a) Aluminium, b) Iron, c) Lead, d) Copper, e) Gold, f) Magnesium

**Page 47**

Re. 1.

a) The rear axle mountings are attached on the far outer side.

b) The anti-roll bar is in front of the axis of rotation.

Re. 2.

downward

Re. 3.

a), b), c)

Re. 4.

a) within, b) a low load floor and large through-loading width

**Page 54**

Re. 1.

a)

Re. 2.

Er is inserted into the wheel bearing and secured by a clip.

Re. 3.

a) ABS/EDL control unit, b) Front speed sensor, c) Rear speed sensor, d) Brake light switch

e) ABS recirculating pump, f) Hydraulic unit with solenoid valves, g) ABS warning lamp,

h) Brake warning light system, k) Diagnostic connection

**Page 59**

Re. 1.

a) Electric arc, b) Electrodes

Re. 2.

c)

Re. 3.

Headlight housing, Ballast, Headlight range control actuator

Re. 4.

c)

**Page 71**

Re. 1.

a), c), d)

Re. 2.

The photosensor controls the air-conditioning temperature control when sunlight impinges directly incident on the car's occupants. A filter and an optical element deflect the sunlight onto a photodiode. The photodiode is a light-sensitive semiconductor element. The stronger the sunlight directly incident, the higher the current which can flow through the diode.

Re. 3.

a) Filter, b) Photodiode, c) Optical element



# Notes

