The Passat ‘97

The Engineering

Design and Function

Self Study Programme

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Service Department

The Passat ‘97

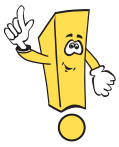
SSP 192/107

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

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

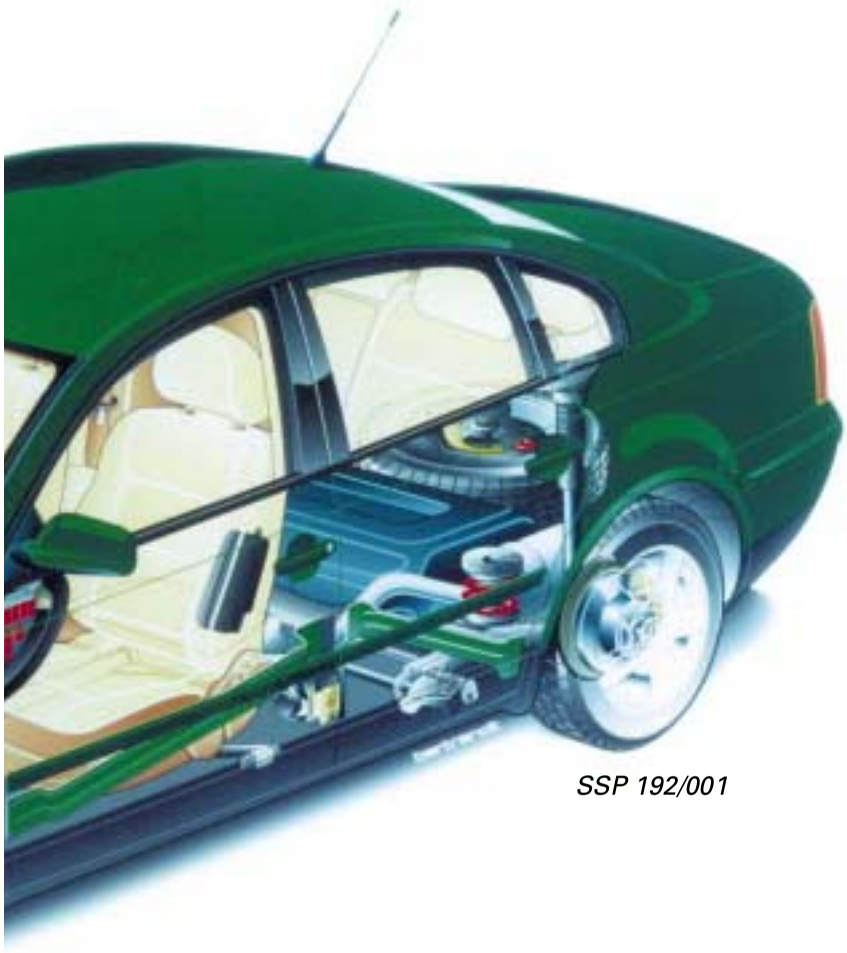
Non-ferrous metals, such as aluminium or magnesium, are being used increasingly in vehicle construction. In this booklet we will explain the advantages and special features of magnesium components.

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.



SSP 192/001

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.

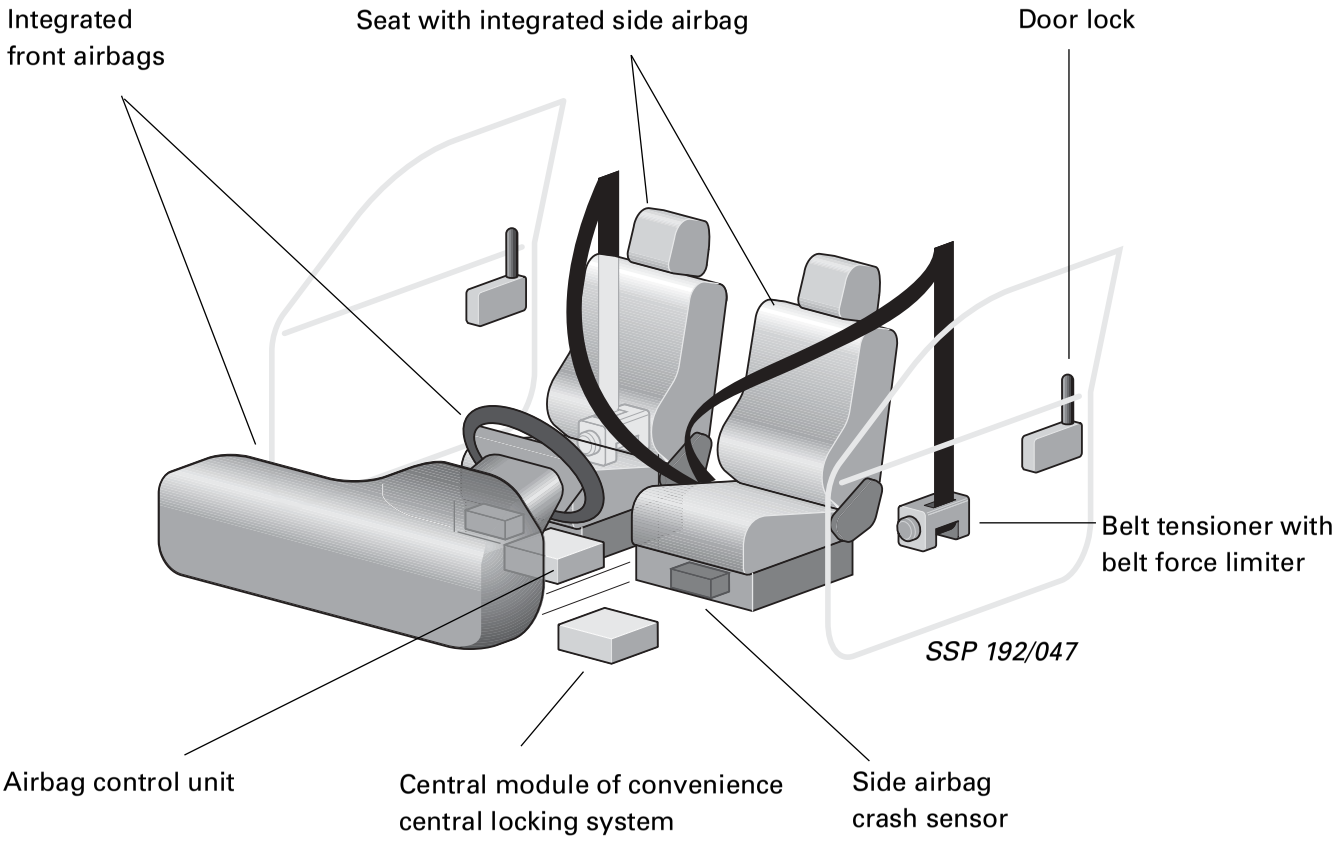
Vehicle safety

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

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.

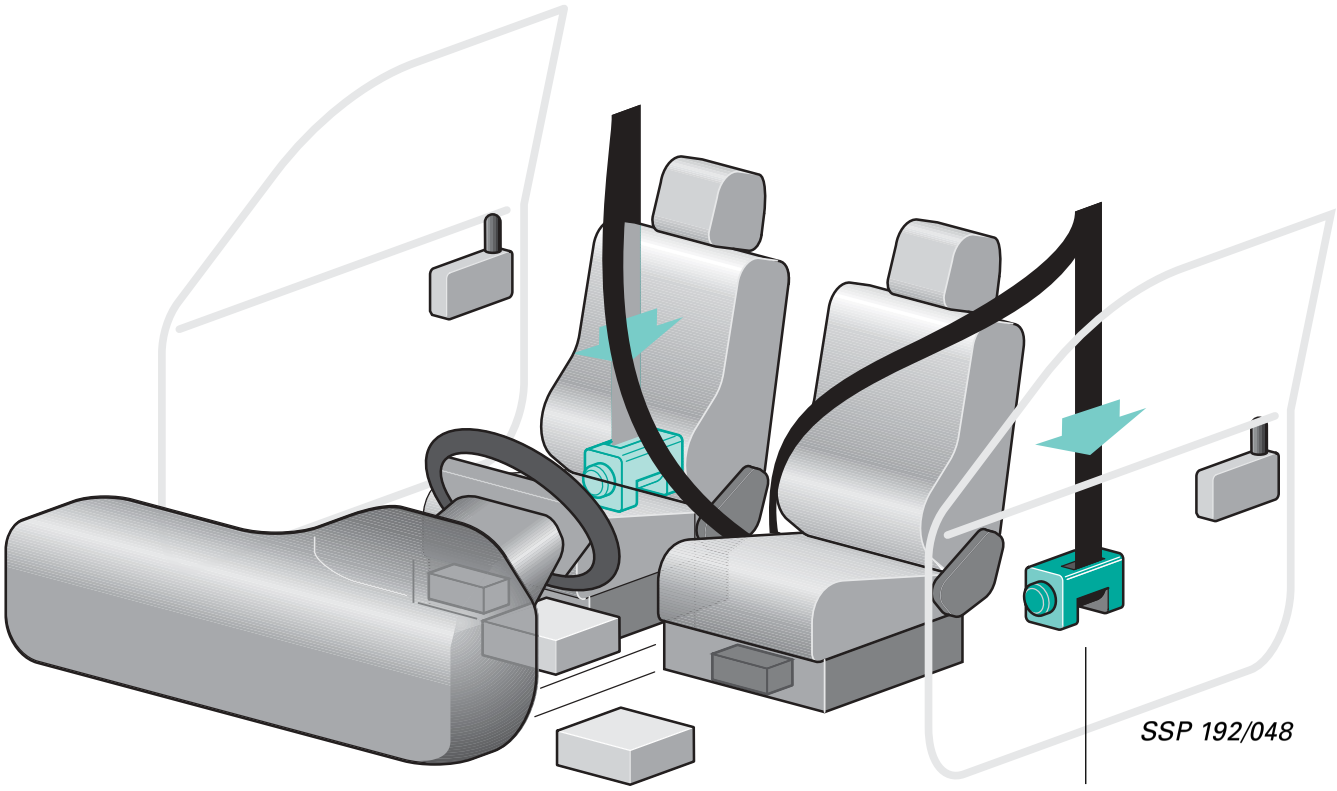


Effect of the restraint systems during minor accidents

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.



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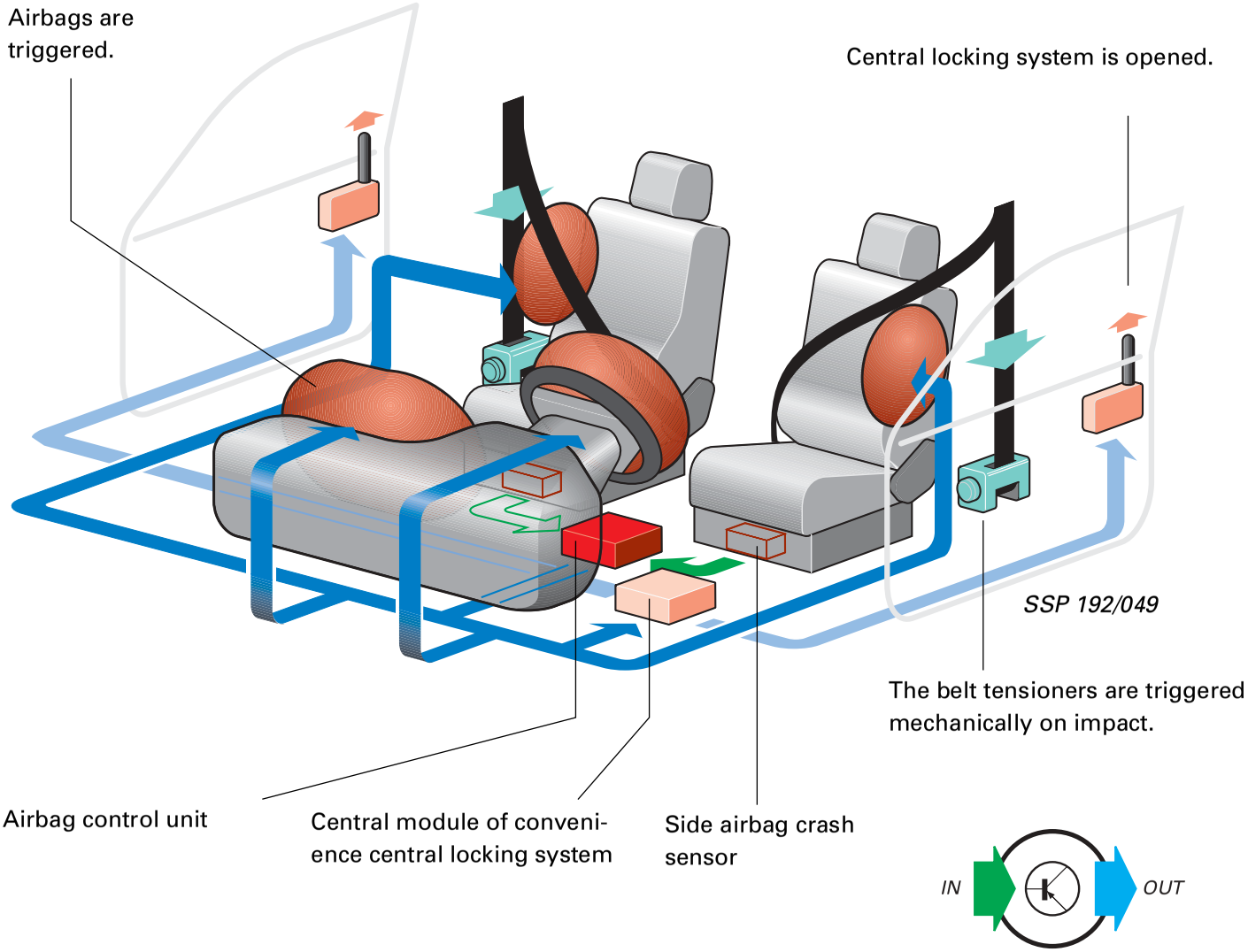
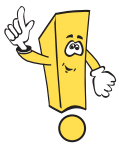
The belt tensioners are triggered mechanically on impact.

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.



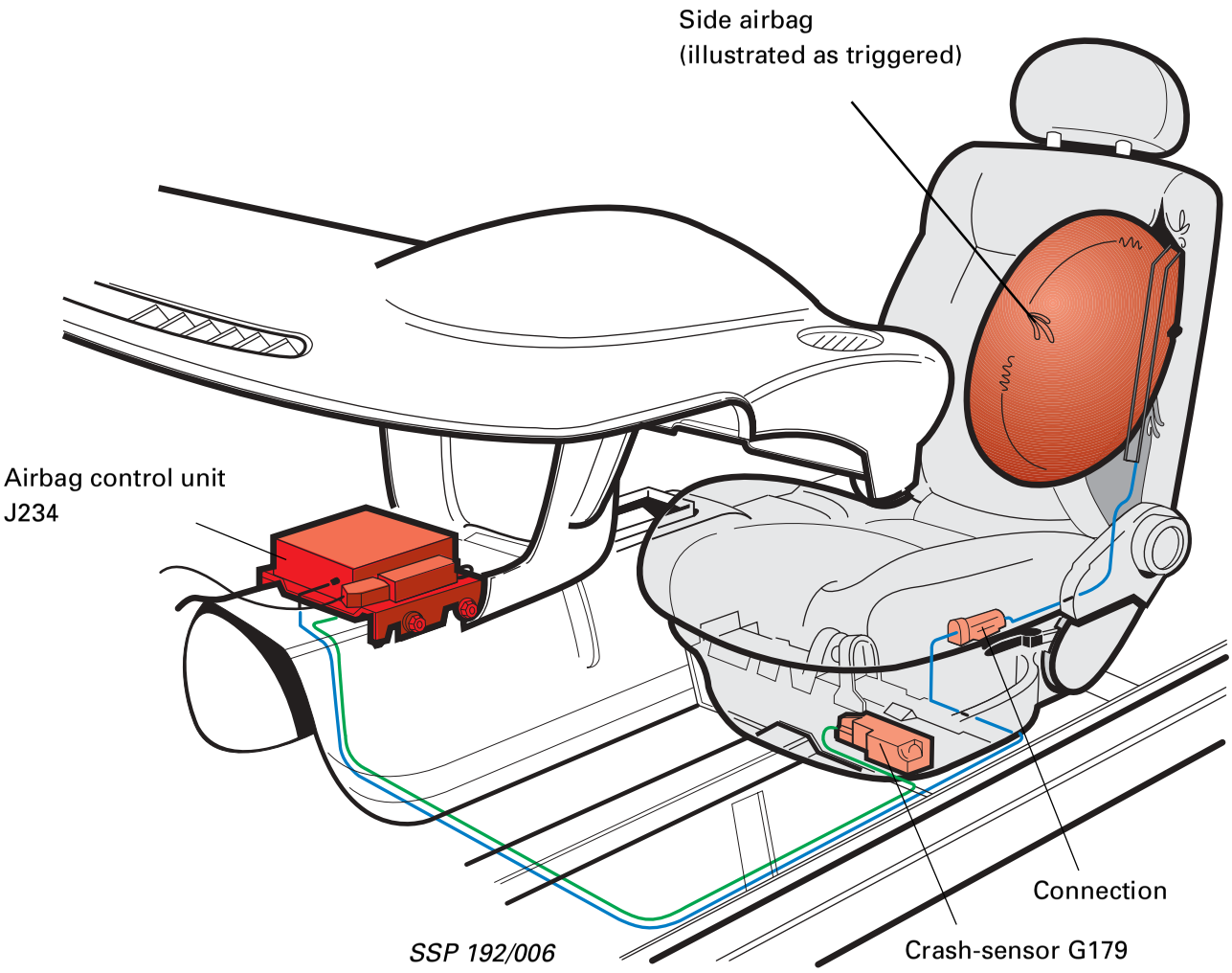


Side airbag

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.



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

Vehicle safety

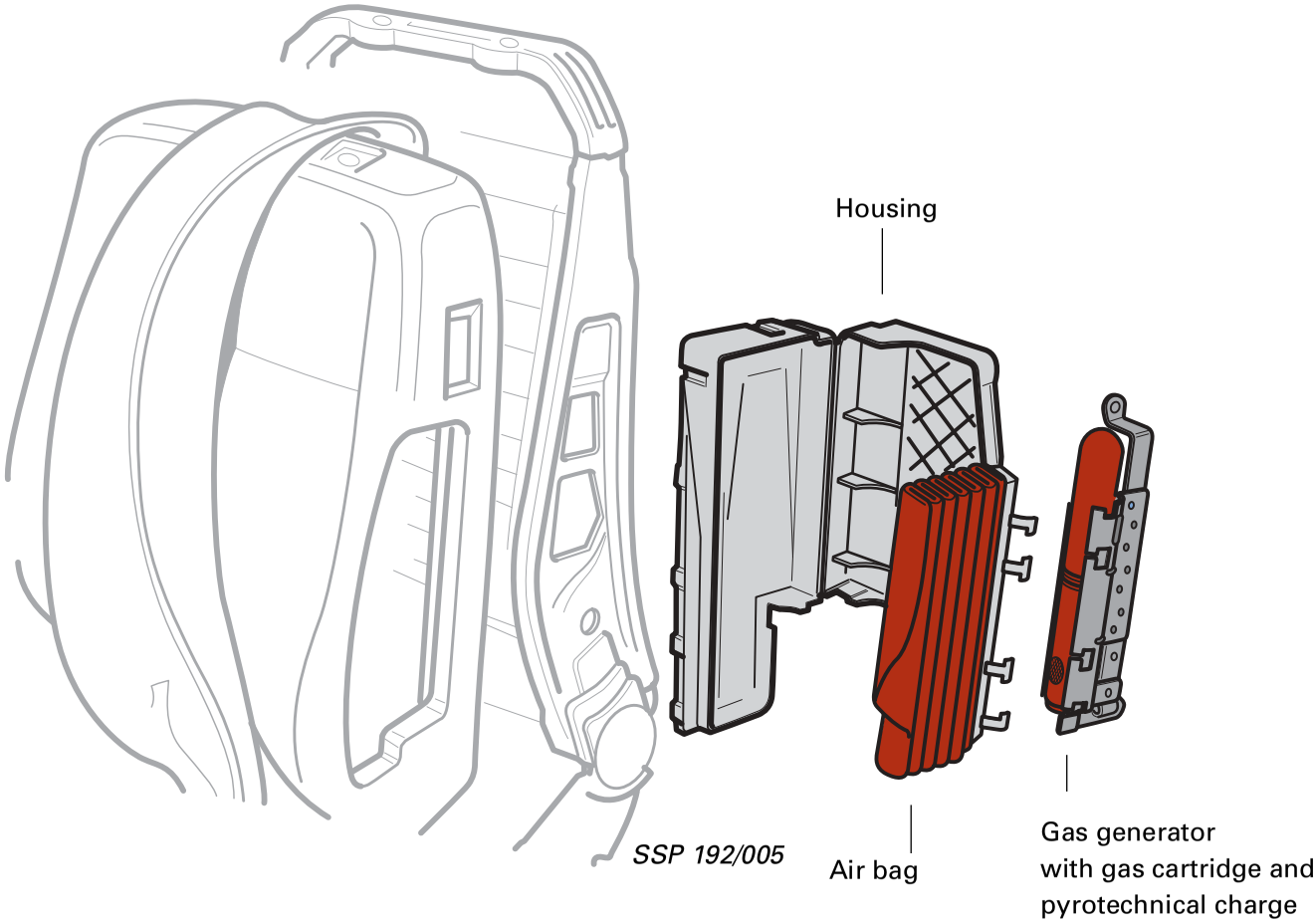
Side airbag design

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.



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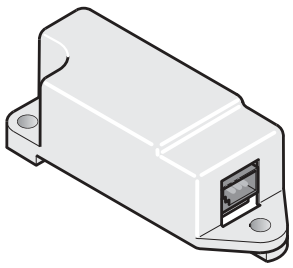
A two-stage crash recognition system is used to ensure reliable side airbag activation.



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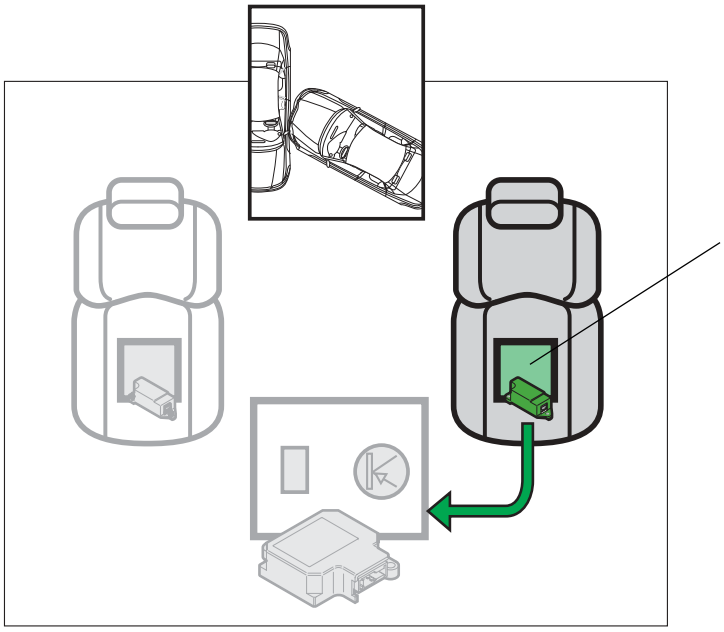
Crash sensors G179/G180

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.



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

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 rcognised that an accident has occurred and a crash sensor sends an airbag trigger request.

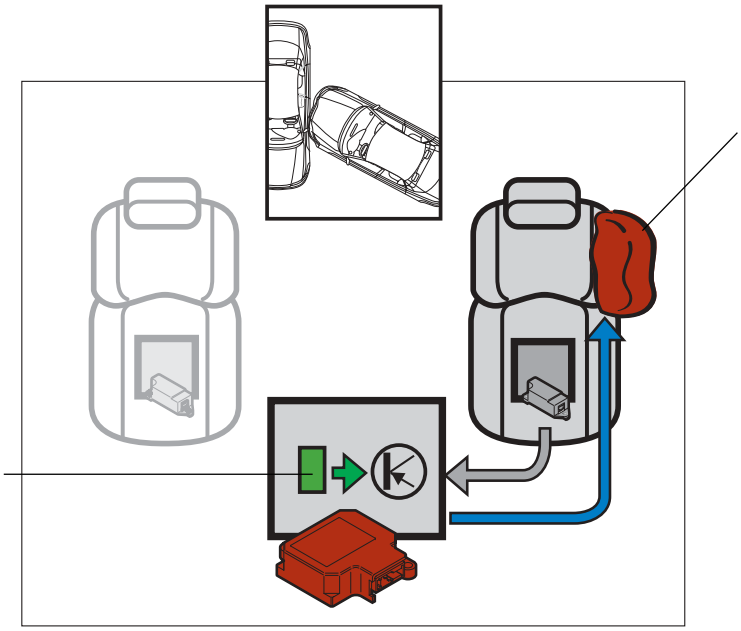
The two crash sensors below the front seats perform a function check at regular intervals, providing feedback to the airbag control unit.

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”.



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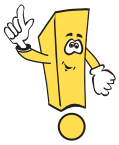


Belt tensioner

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.

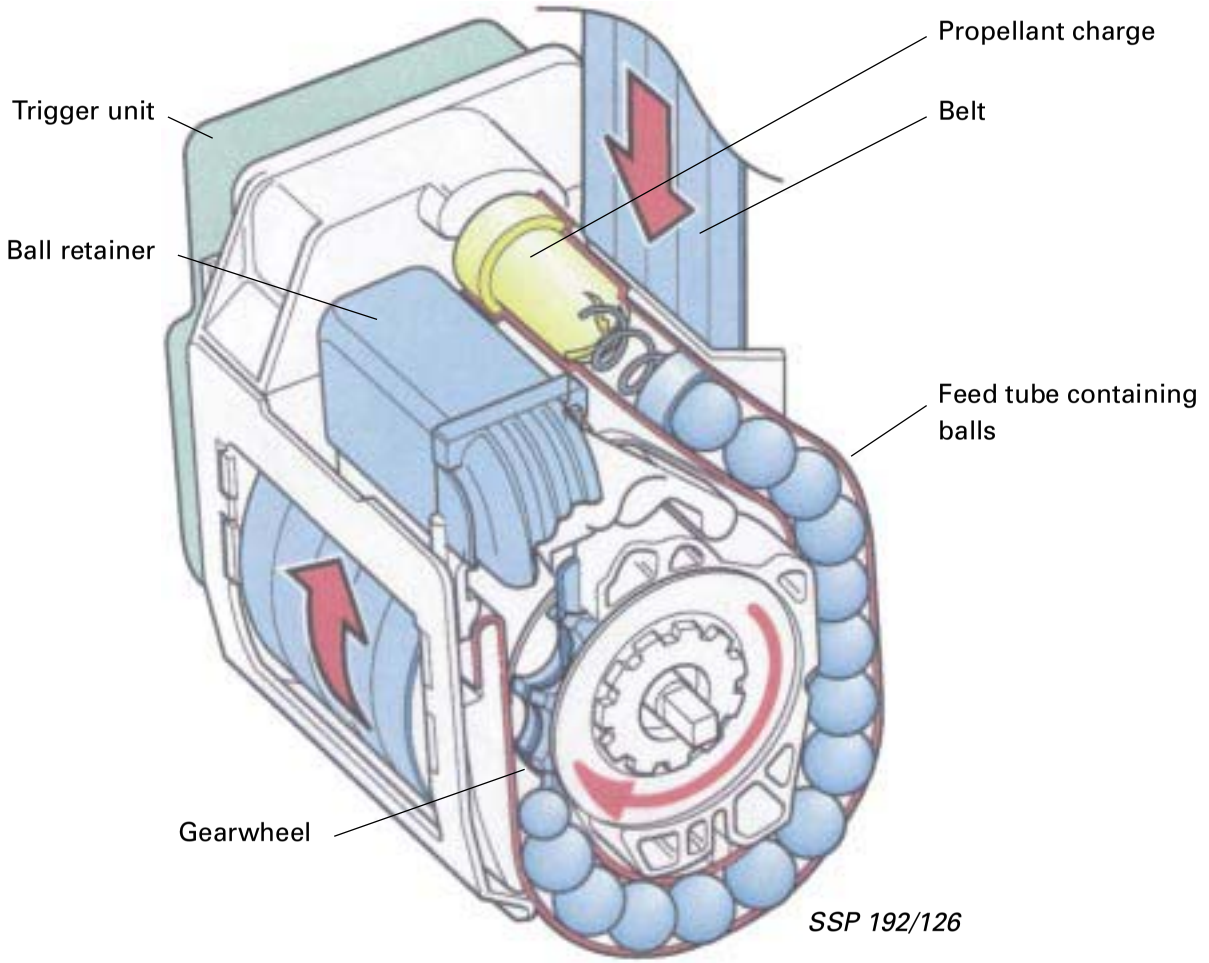
When an impact occurs, the belt tensioners reel in the belt and thus take up any slack (clearance between belt and body).

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



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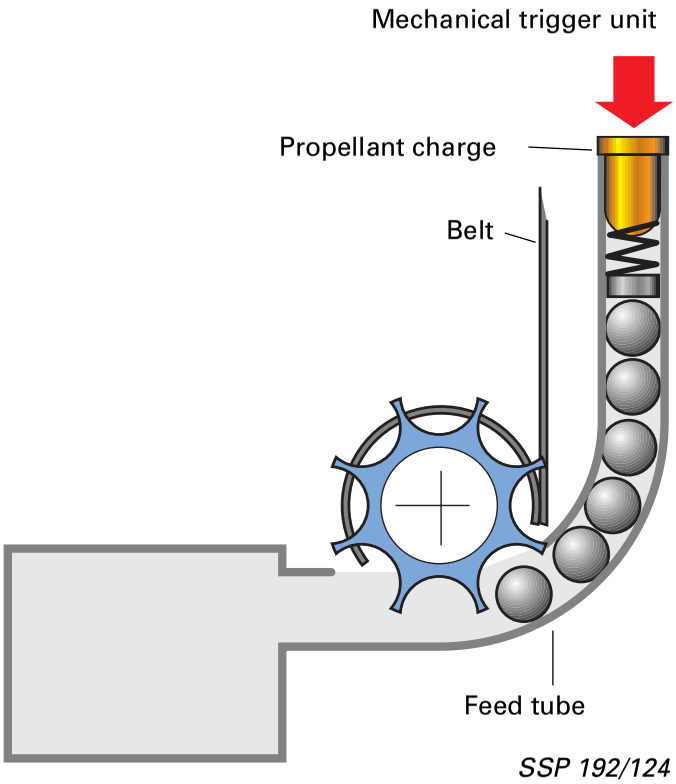
Functional description of front belt tensioner

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



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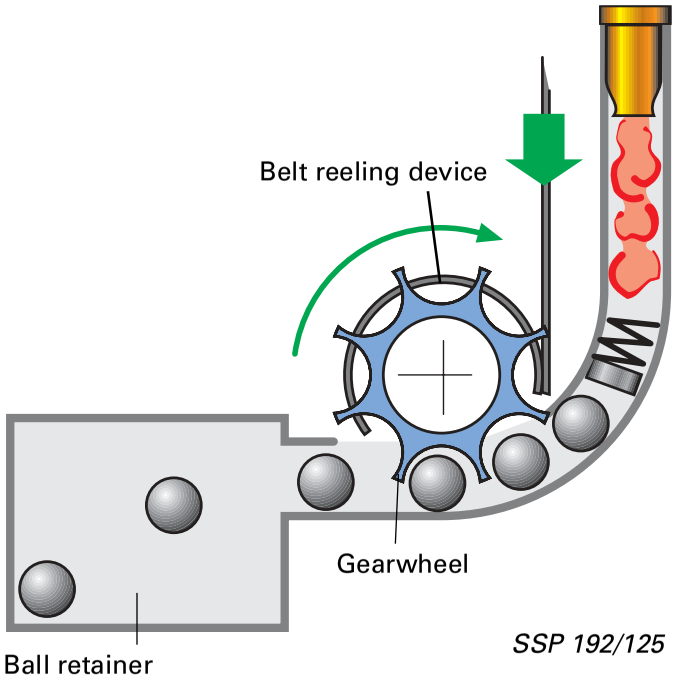
When the belt tensioner is triggered, a pyrotechnical propellant charge ignites. It sets the balls in motion and drives them into the ball retainer via a gearwheel.

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



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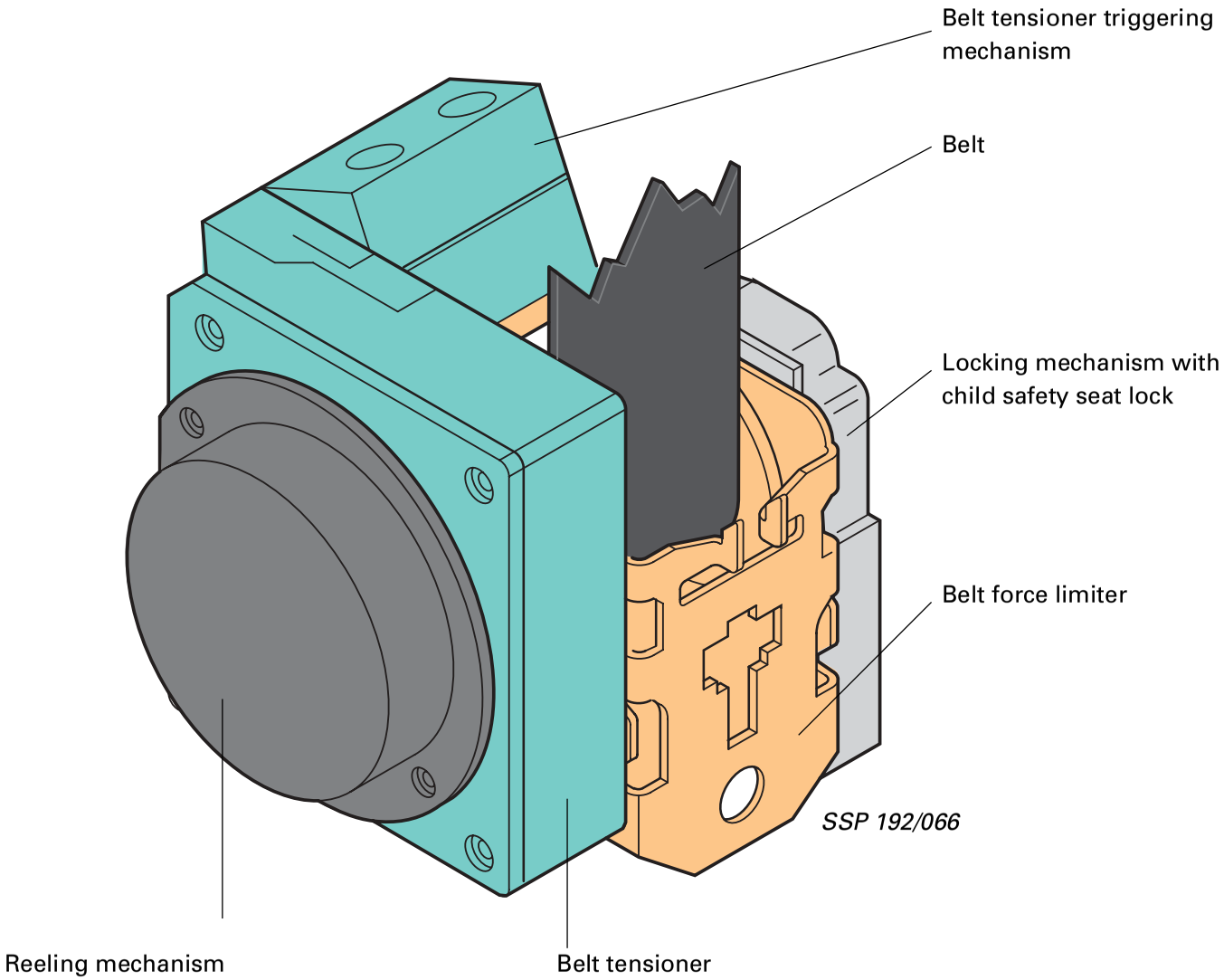
Rear belt tensioner

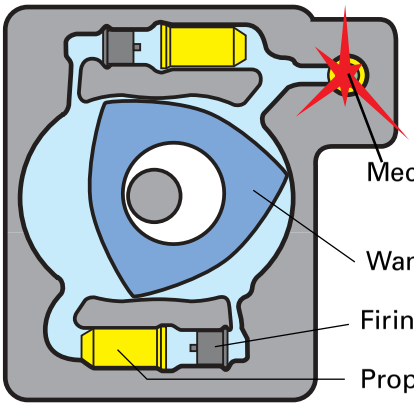
The belt tensioner can be described in simpler terms as a “pyrotechnical Wankel engine”.

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



Functional description of rear belt tensioner.

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



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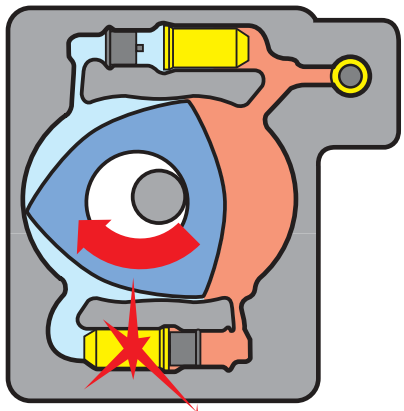
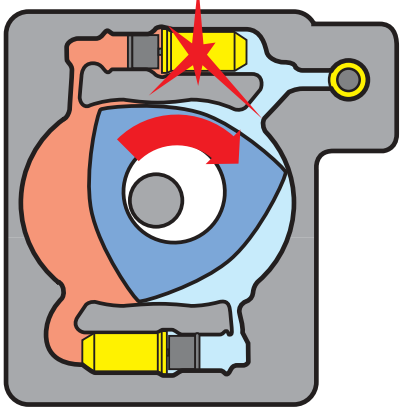
The released gas causes the rotor to rotate.
The belt is tightened.
After a certain angle of rotation, the piston opens the inlet port of the second firing pin, thus igniting the second propellant charge.



SSP 192/010

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



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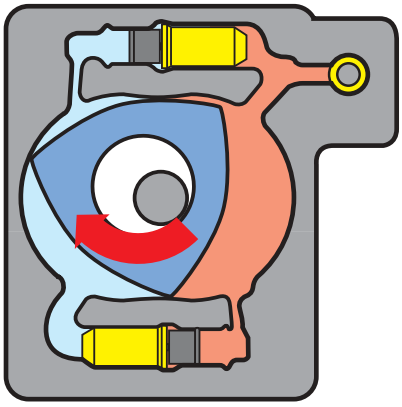
The belt tensioner is able to perform approximately two full turns in this way.



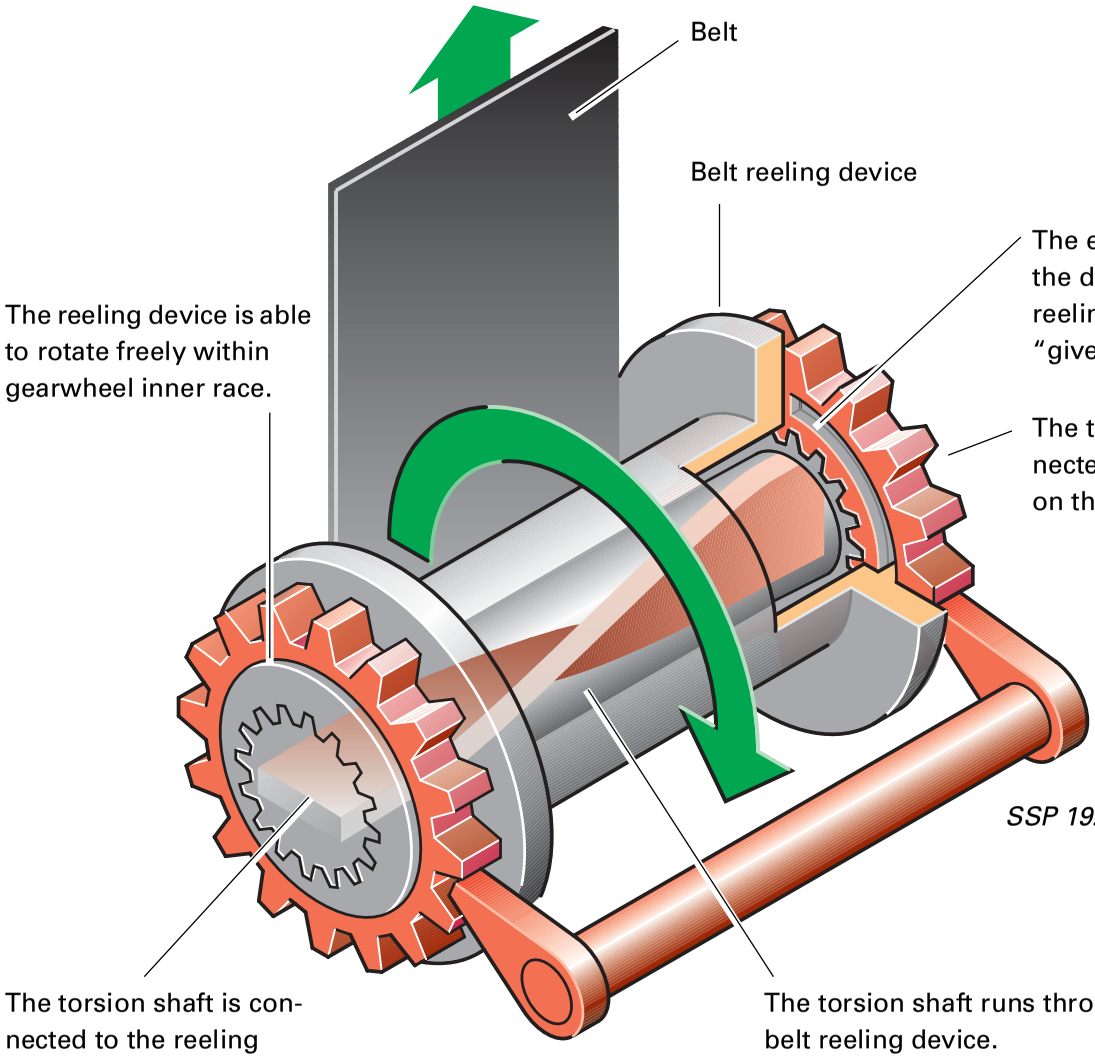
SSP 192/012

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?

_____

_____

_____

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?

_____

_____

_____

_____

_____

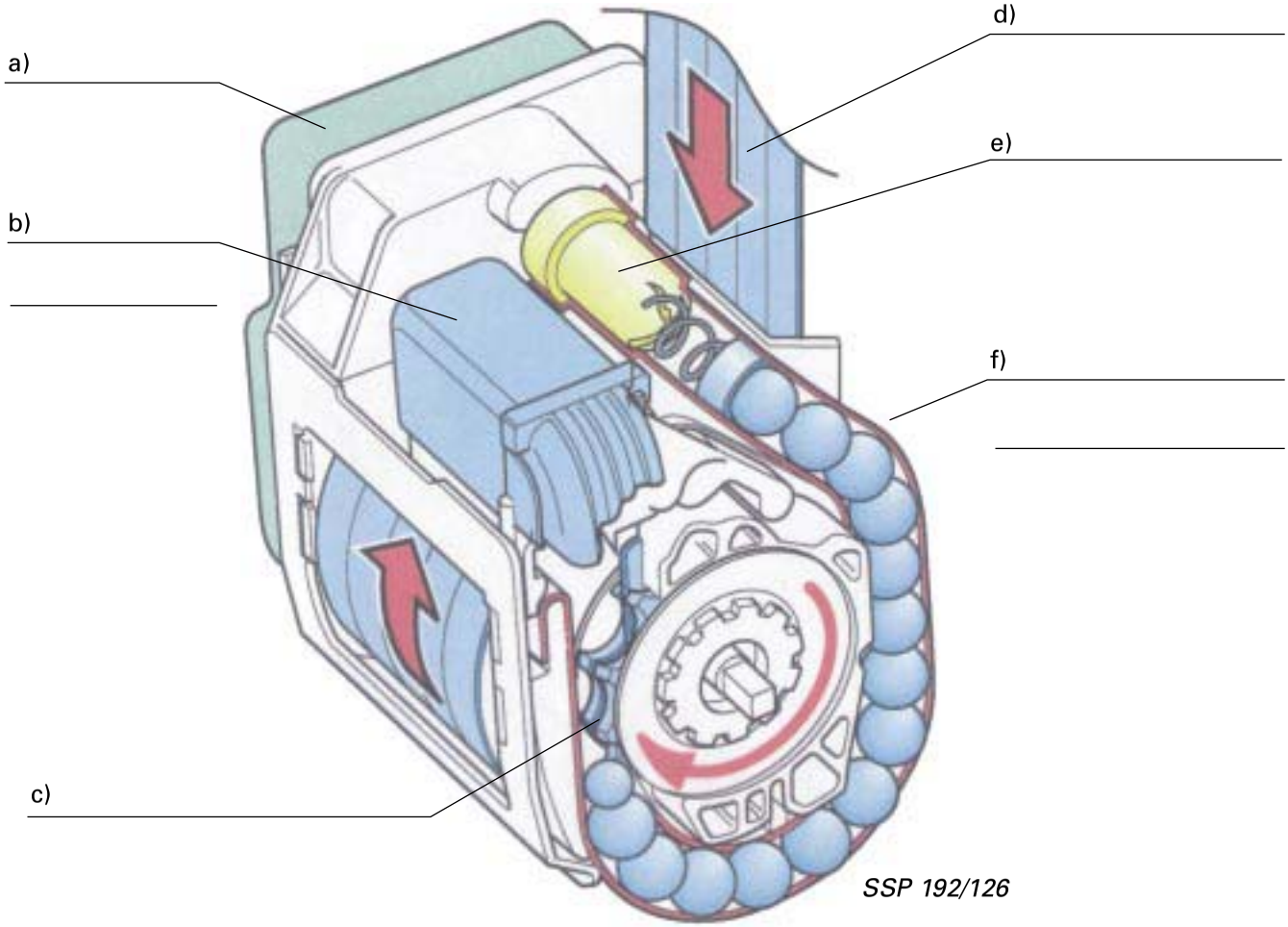
5. The rear belt tensioner

a) operates according to the Wankel engine principle,

b) uses a diaphragm pump,

c) is ball-activated.

6. Annotate the following drawing.



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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.

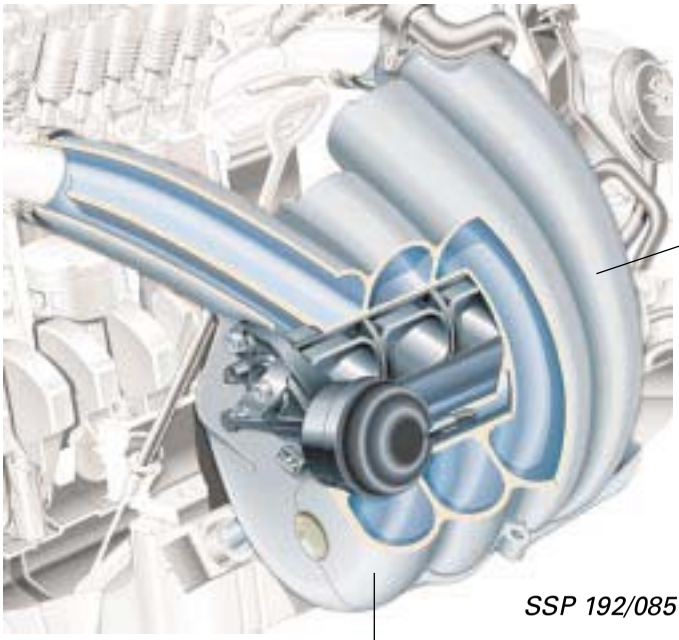
Twin path intake manifold

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 permite 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.



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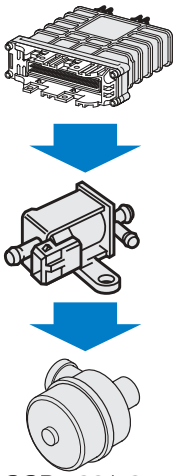


Engine control unit J220

IIntake manifold pressure change valve N156

Vacuum unit

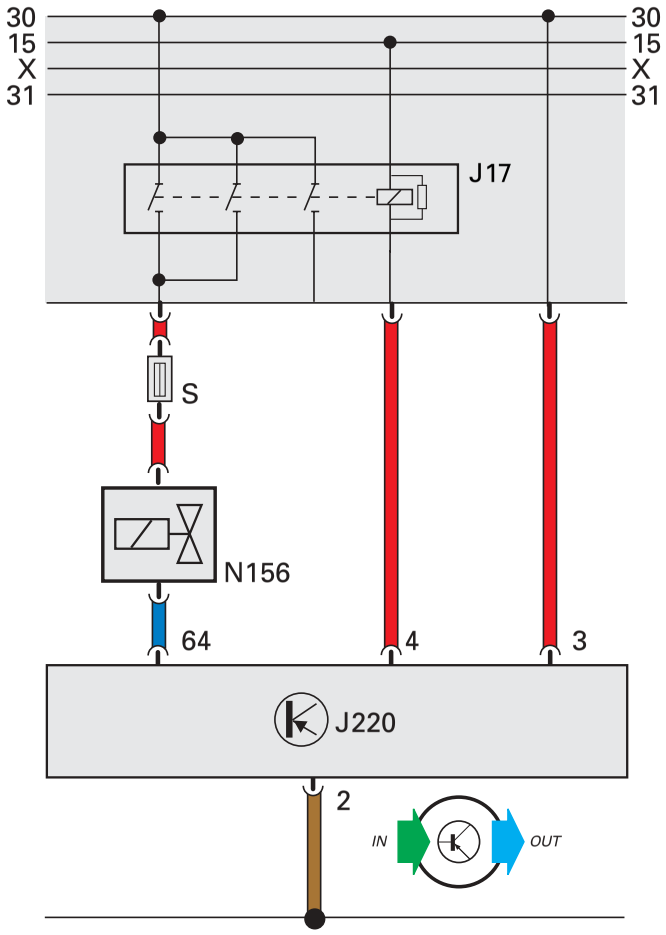
SSP 192/127

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



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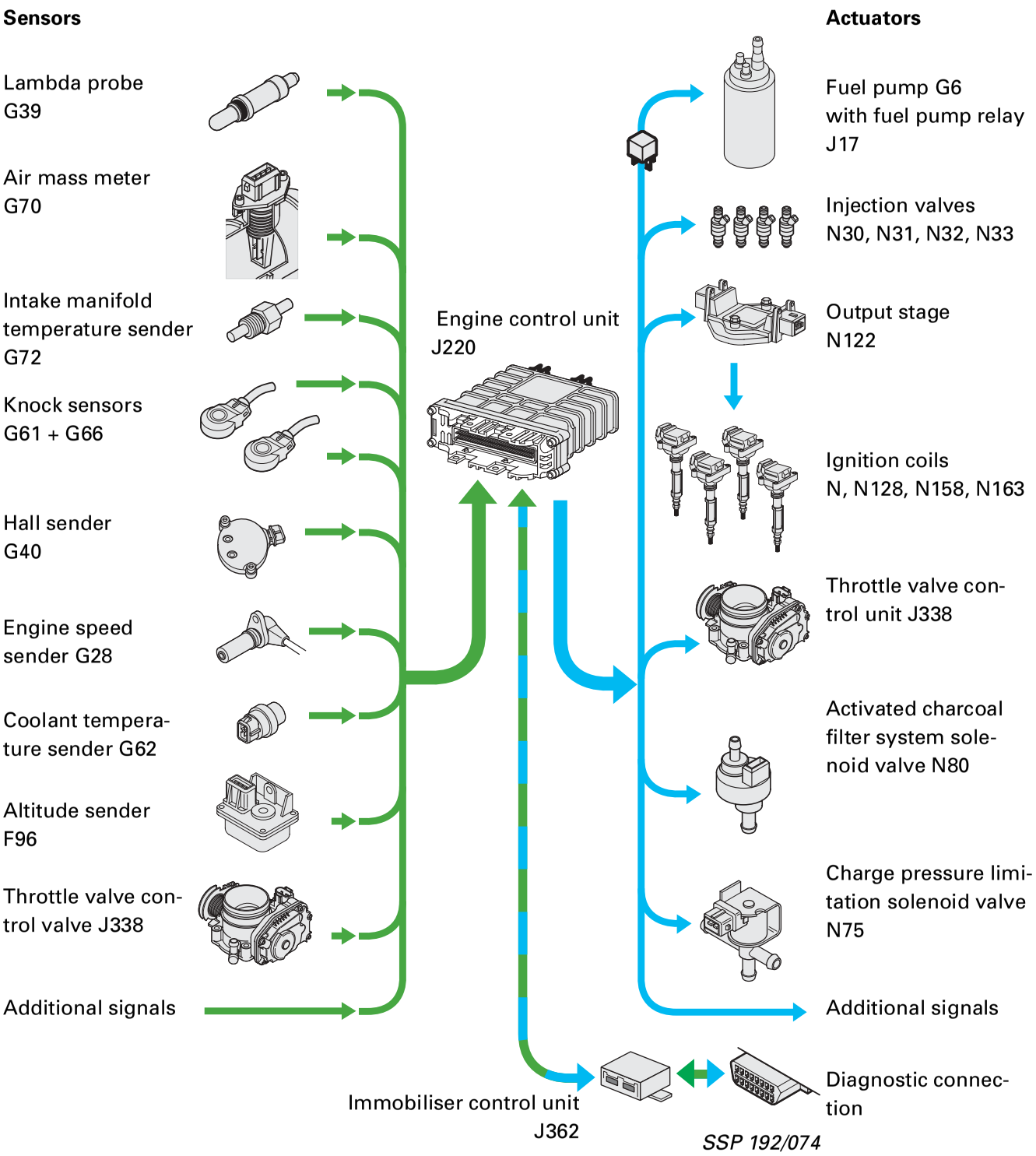
1.8-ltr. 5V Turbo Engine AEB

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

System overview



Function diagram 1.8-ltr. 5V turbo engine AEB

Components

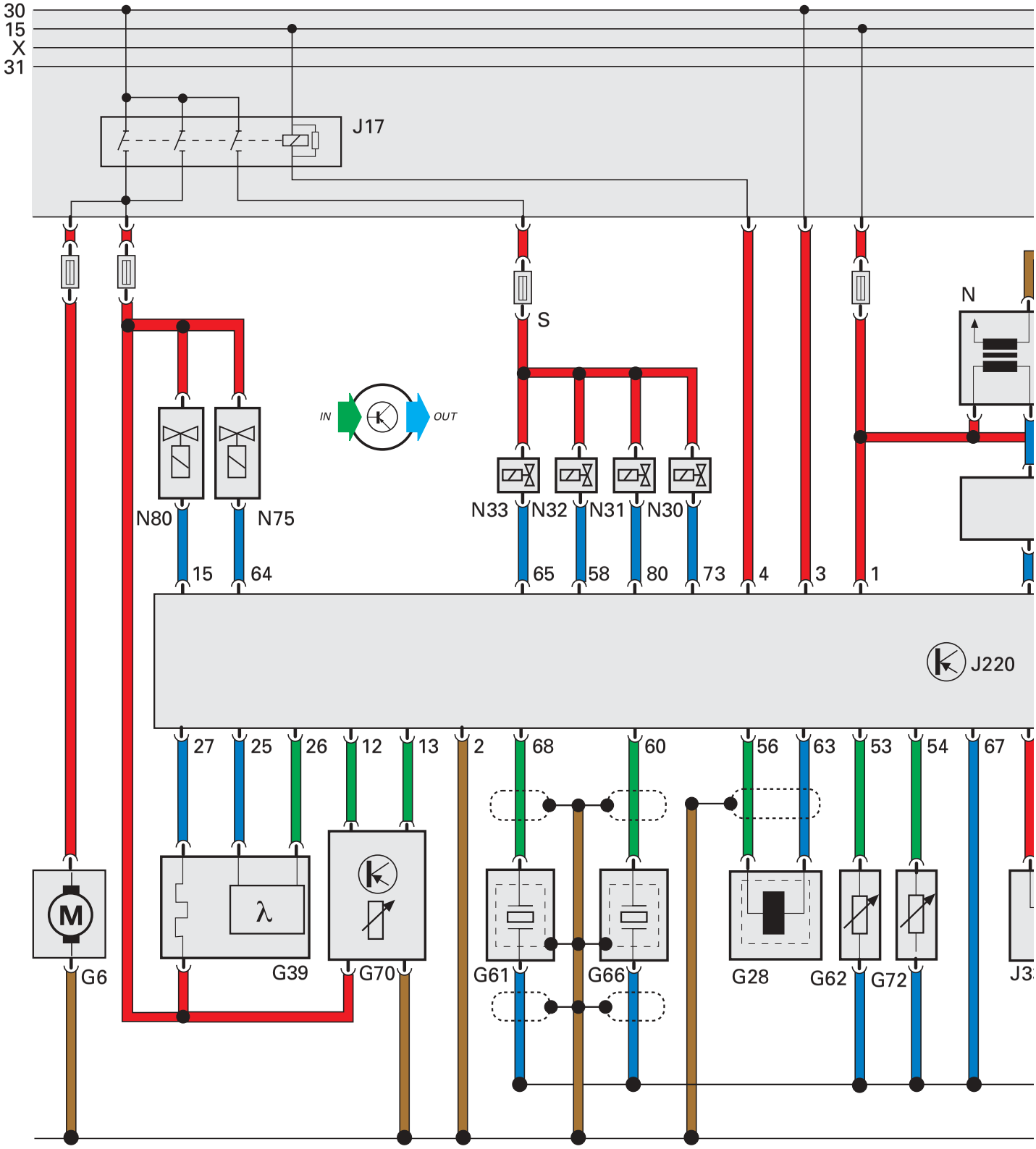
F96	Altitude sender
G6	Fuel pump
G28	Engine speed sender
G39	Lambda probe
G40	Hall sender
G61	Knock sensor I
G62	Coolant temperature sender
G66	Knock sensor II
G70	Air mass meter
G72	Intake manifold temperature sender
J17	Fuel pump relay
J220	Control unit for Motronic
J338	Throttle valve control unit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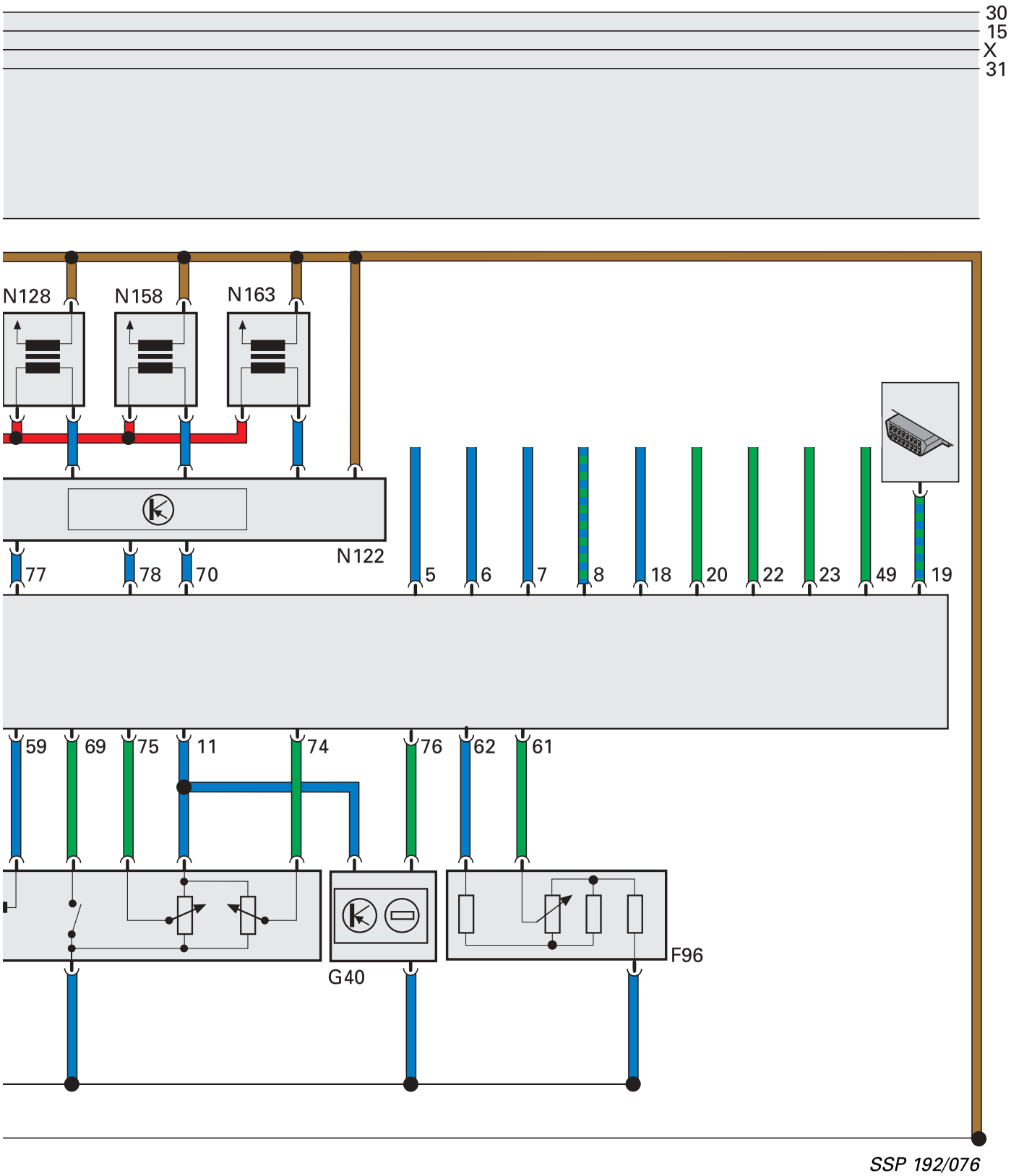
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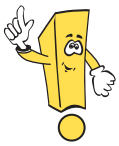
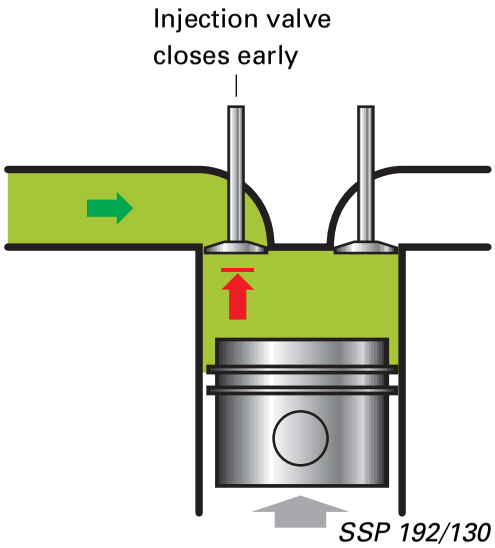


Variable valve timing

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.



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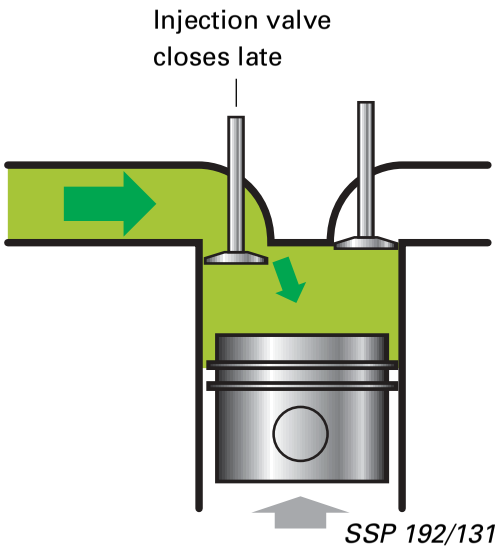
At high speeds, the flow rate inside the intake manifold is so high that the mixture can continue to flow into the cylinder although the piston is moving back up.
The inlet valve is closed when the fuel-air mixture can no longer enter the cylinder.

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

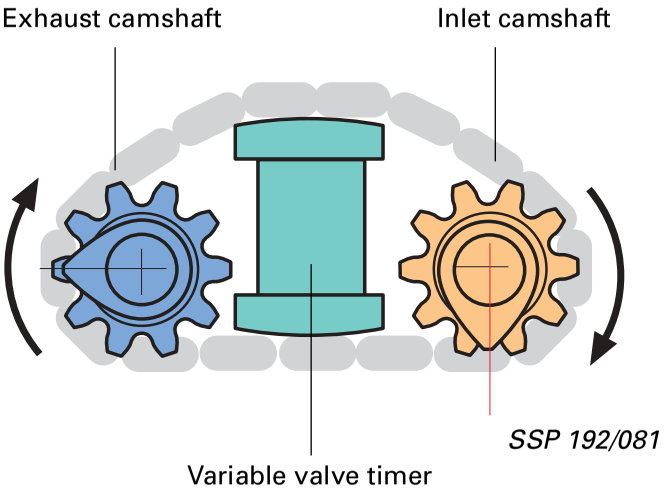


SSP 192/131

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.

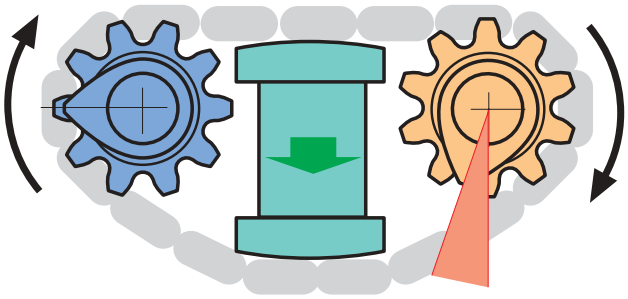


SSP 192/081

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.



SSP 192/080

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.

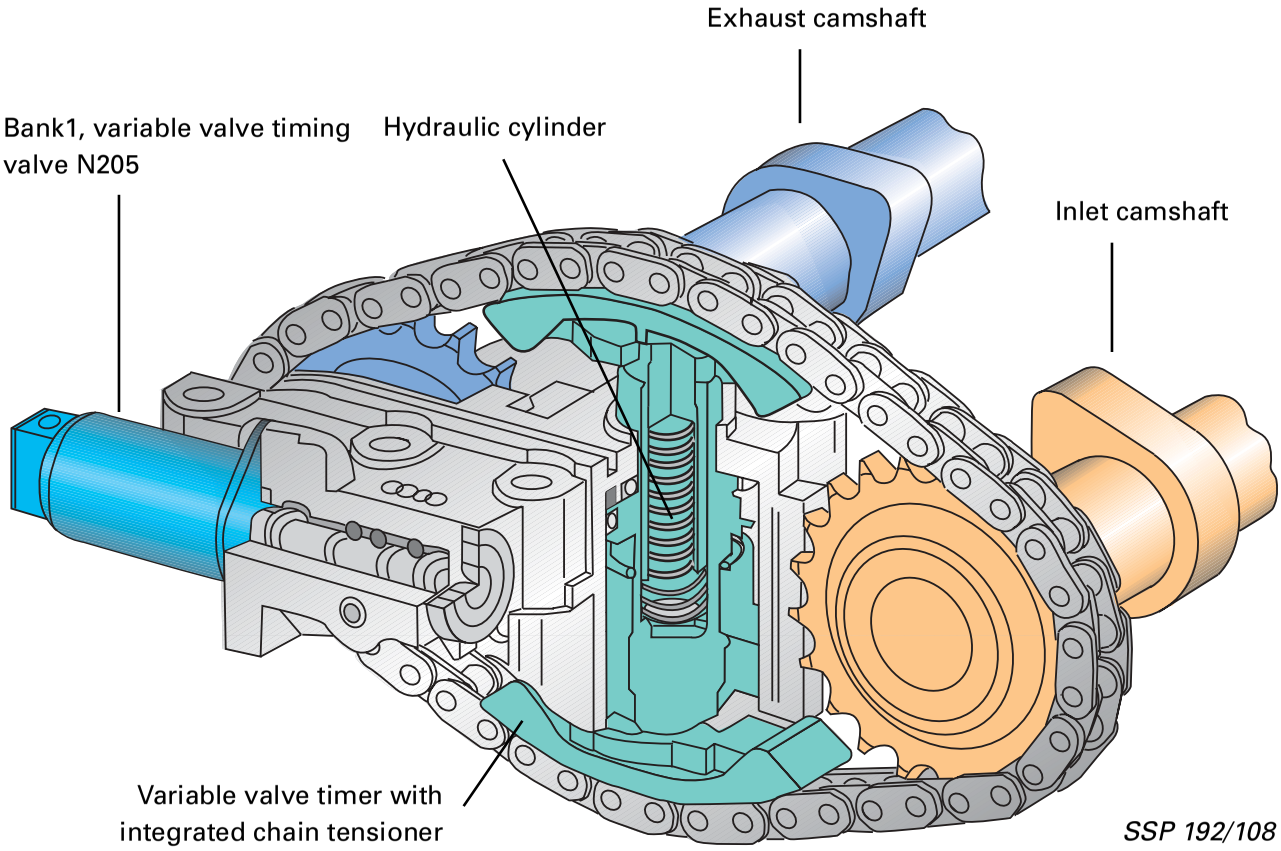
The inlet valve closes early.
In this position, high torque is produced in the lower and medium speed ranges.

2.8-ltr. V6 Engine ACK

Variable valve timer

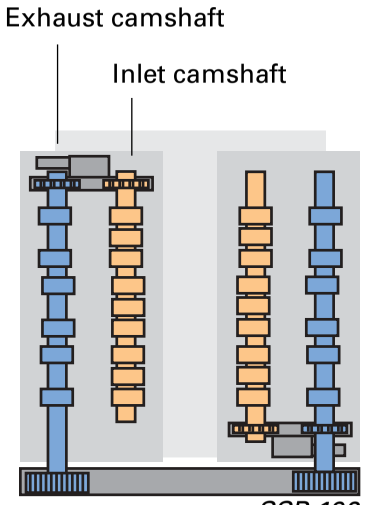
A hydraulic cylinder lifts and lowers the variable valve timer. Oil is supplied to the hydraulic cylinder via the engine oil circuit.

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



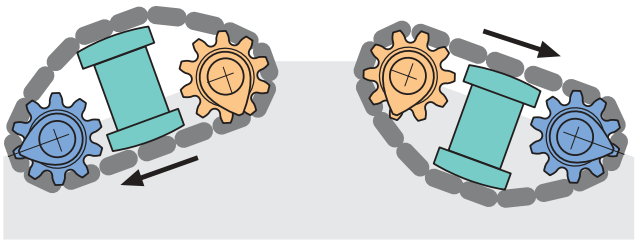
SSP 192/108

Variable valve timing in the V6 engine



SSP 192/129

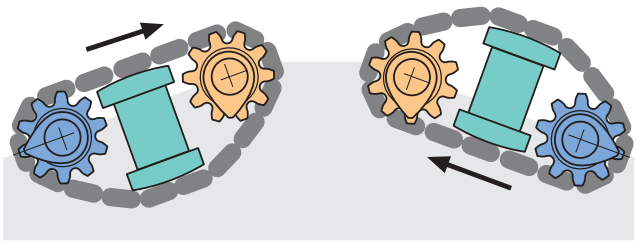
The design of the V6 engine makes particularly heavy demands on variable valve timing. Viewed from above, the exhaust camshafts are arranged on the outside and the inlet camshafts on the inside.
As a result, the variable valve timers of the left and right bank of cylinders have to operate in opposite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



SSP 192/103

Idling

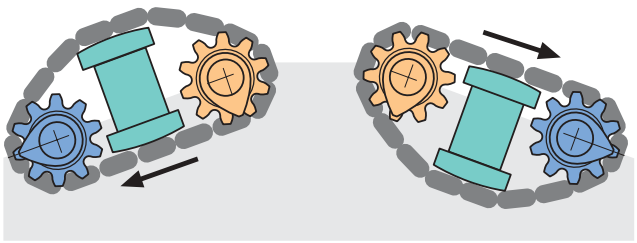
When the engine is idling, the inlet valves are closed late.



SSP 192/104

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.



SSP 192/103

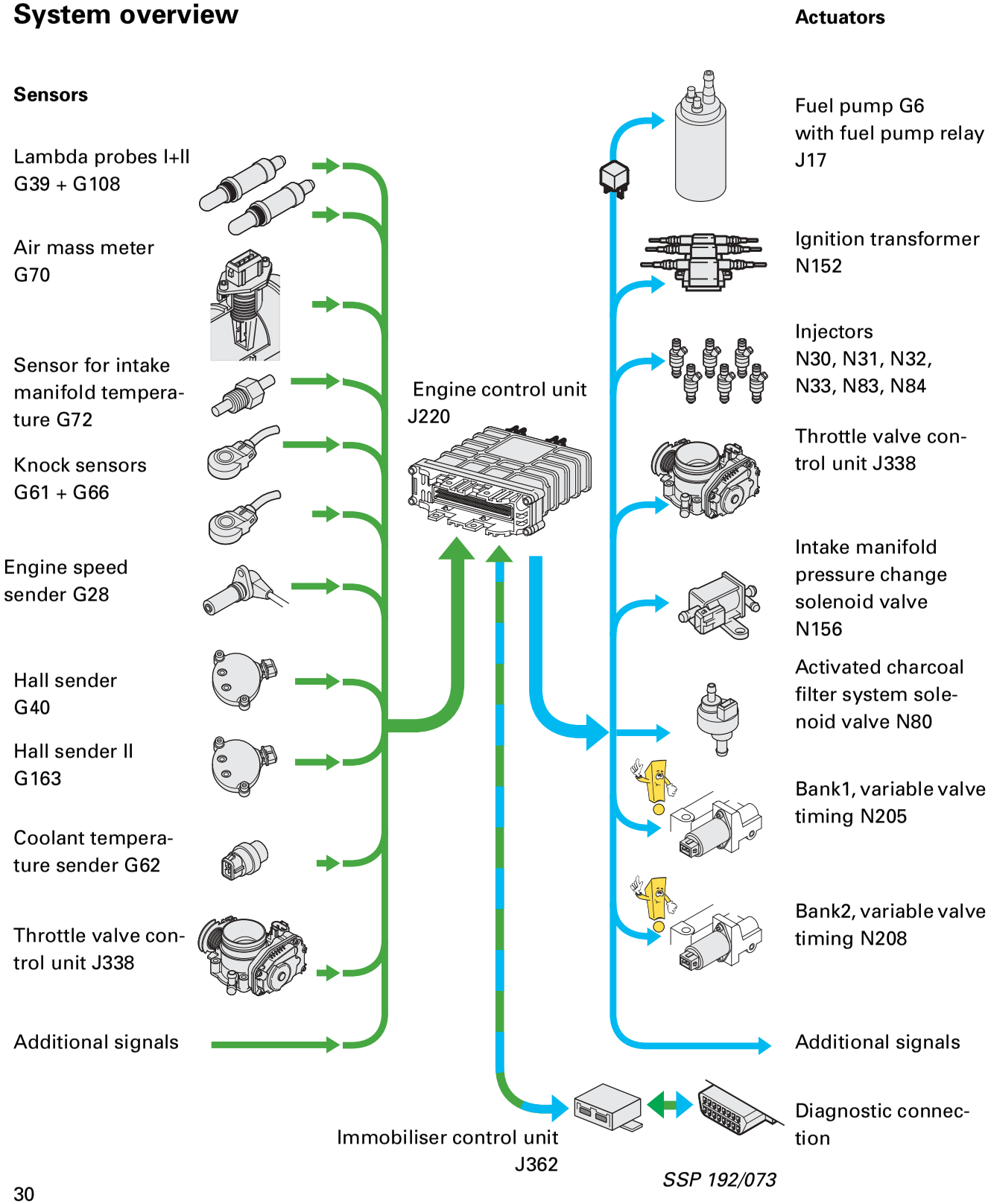
Performance position

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



SSP 192/073

Function diagram of 2.8-ltr. 6V Engine ACK

Components

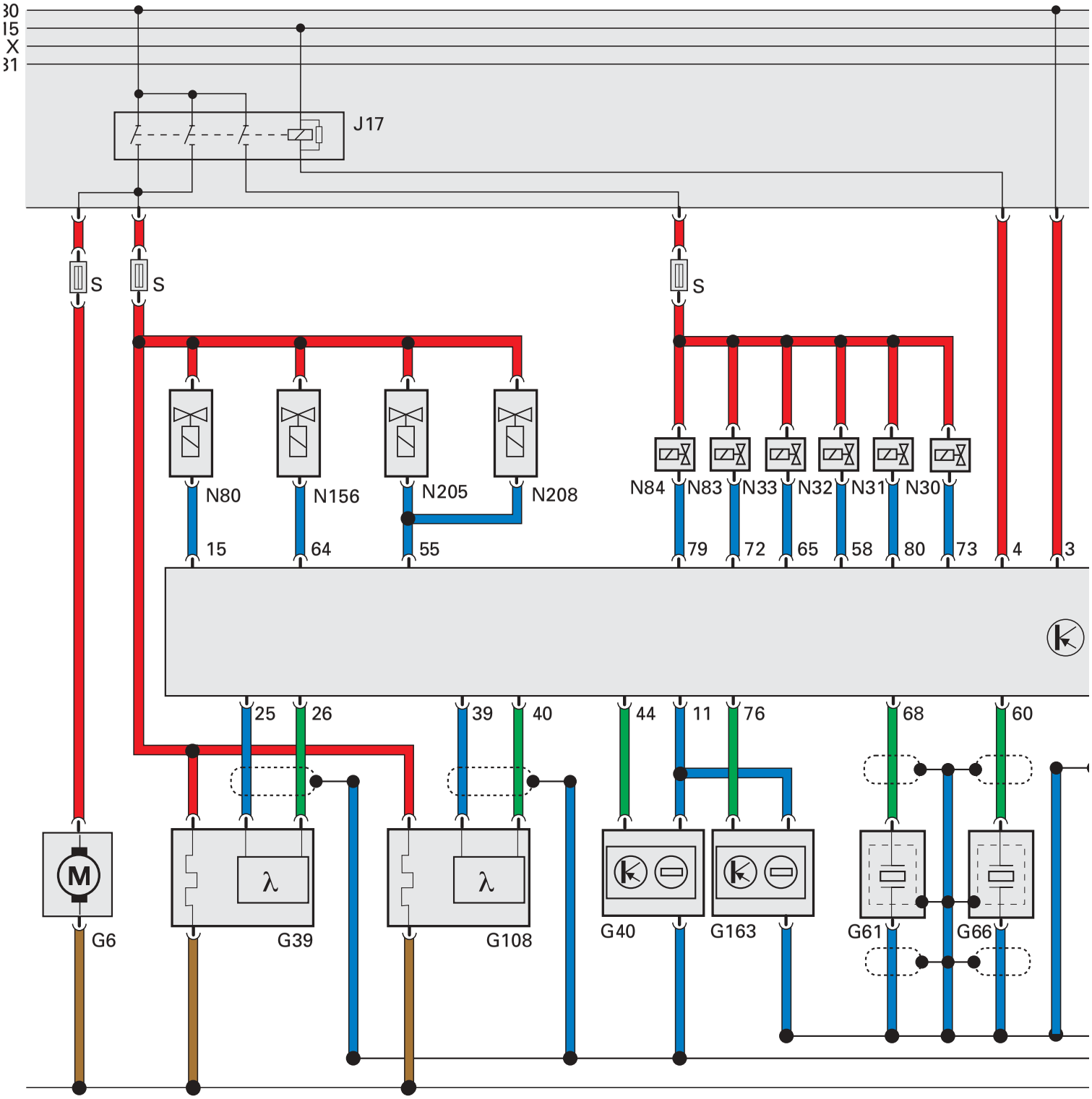
G6	Fuel pump
G28	Engine speed sender
G39	Lambda probe
G40	Hall sender
G61	Knock sensor I
G62	Coolant temperature sender
G66	Knock sensor II
G70	Air mass meter
G72	Intake manifold temperature sender
G108	Lambda probe II
G163	Hall sender II
J17	Fuel pump relay
J220	Motronic control unit
J338	Throttle valve 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

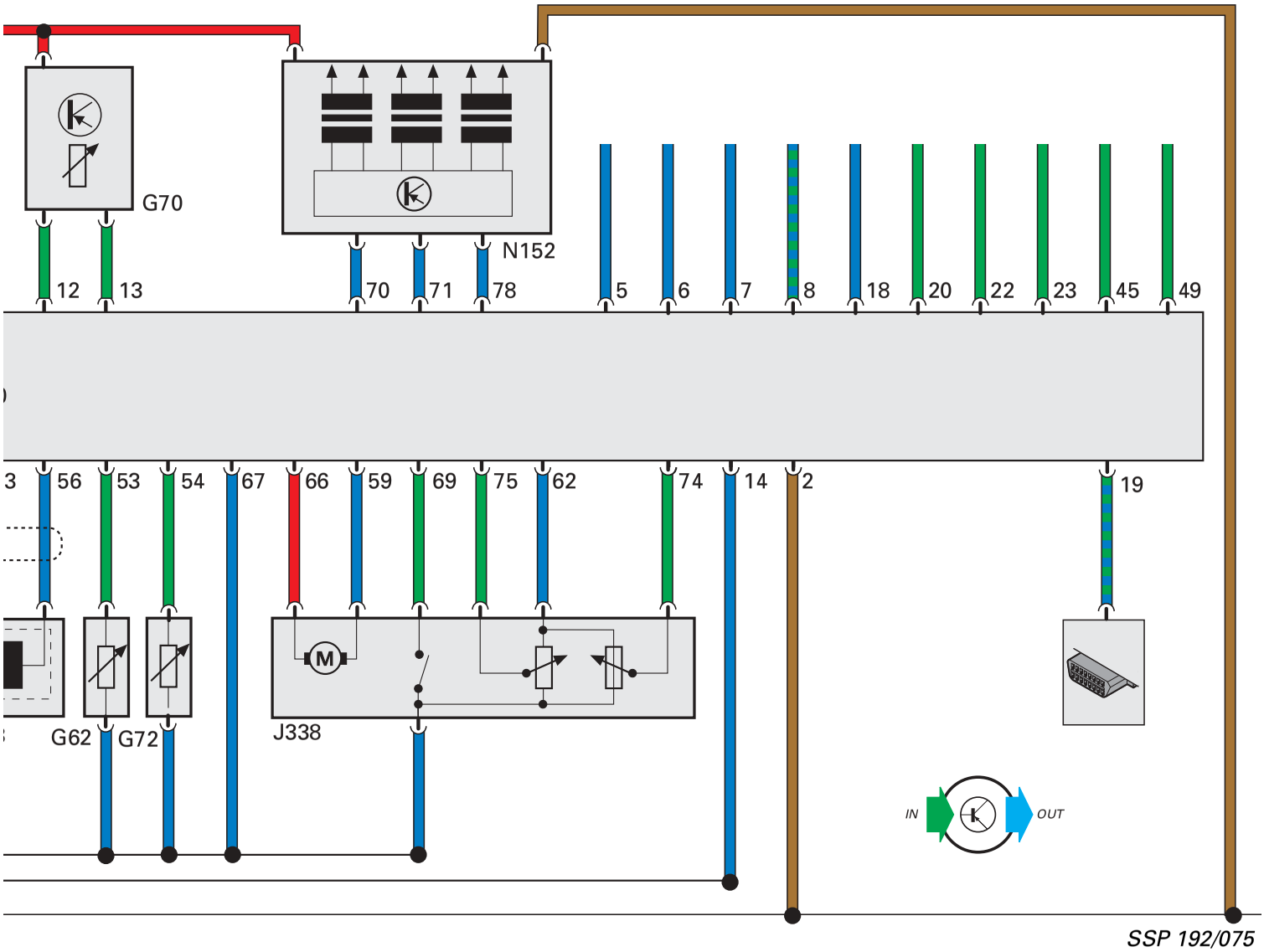
Pin 5	Actual engine torque (out)
Pin 6	Speed signal (out)
Pin 7	Throttle valve potentiometer signal (out)
Pin 8	Air-conditioner compressor signal (in + out)
Pin 18	Fuel consumption signal (out)
Pin 20	Road speed signal (in)
Pin 22	Gear engaged signal for automatic gearbox (in)
Pin 23	Aut. gearbox CU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

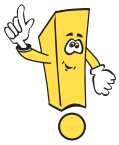

30
15
X
31
J17
S
S
S
N80
N156
N205
N208
N84
N83
N33
N32
N31
N30
15
64
55
79
72
65
58
80
73
4
3
25
26
39
40
44
11
76
68
60
M
G6
λ
G39
λ
G108
G40
G163
G61
G66

30
15
X
31



SSP 192/075

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

Self-diagnosis

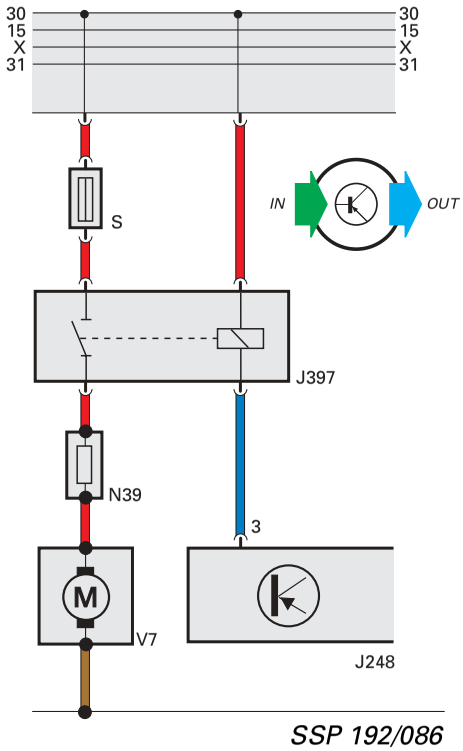
Open circuit /short circuit to earth
Short circuit to positive

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

Electric circuit

Components

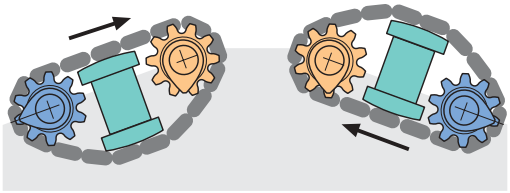
J248	Diesel direct injection system control unit
J397	Cooling fan run-on relay
N39	Series resistor for coolant fan
S	Fuse
V7	Coolant fan

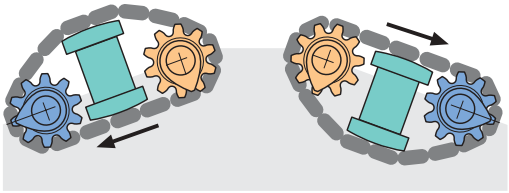


SSP 192/086

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.

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/cm3

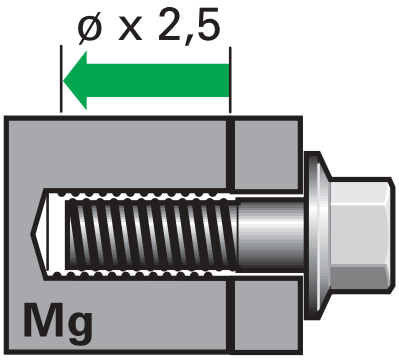
Aluminium:
2.699 g/cm3

Magnesium:
1.738 g/cm3

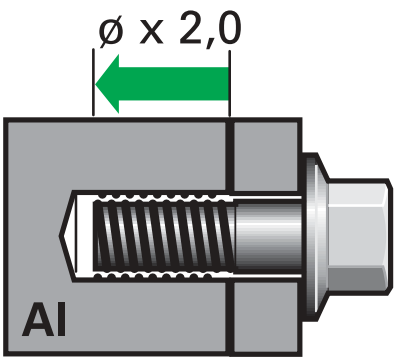
The strength of a material depends on its density, among other things. Low density goes hand in hand with low strength. This loss of strength has to be compensated for somehow.

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.

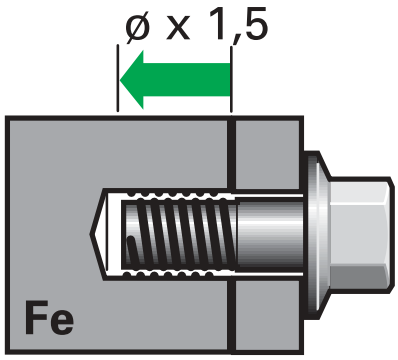
Comparison of insertion depths between magnesium, aluminium and iron



SSP 192/058



SSP 192/059



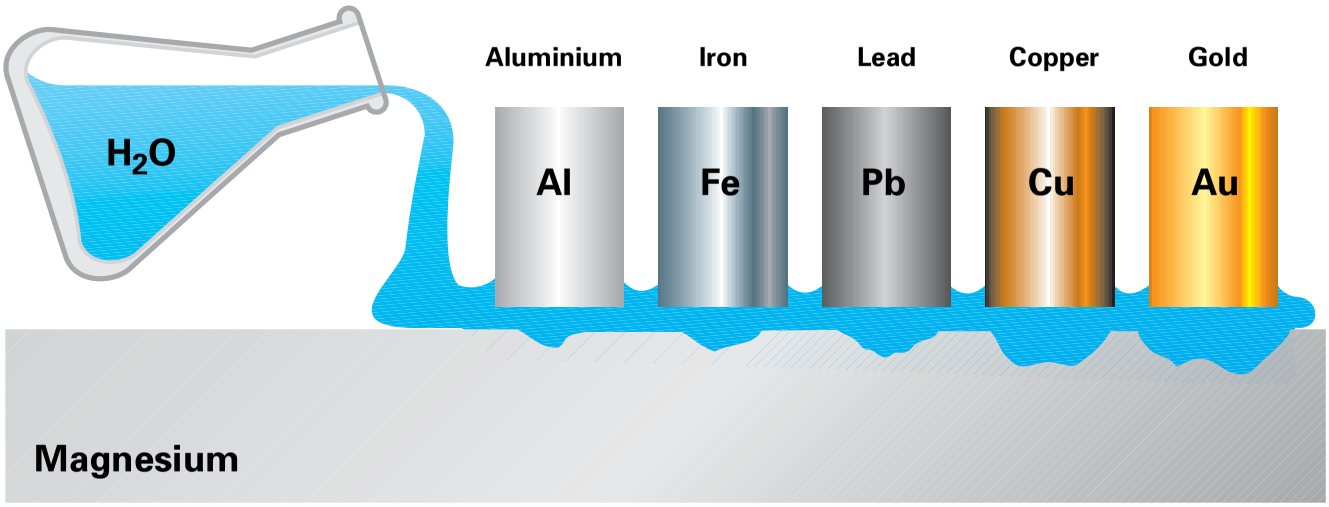
SSP 192/060

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

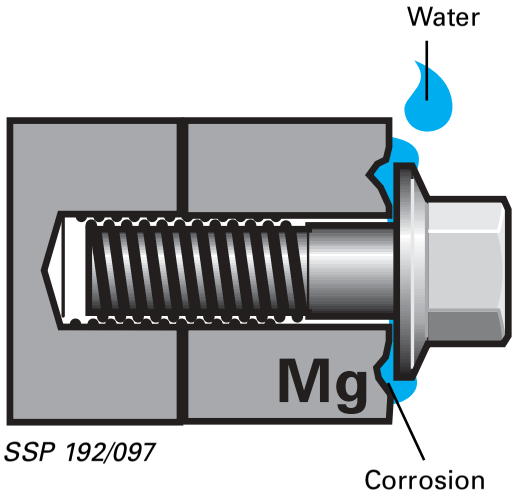


SSP 192/096

Magnesium

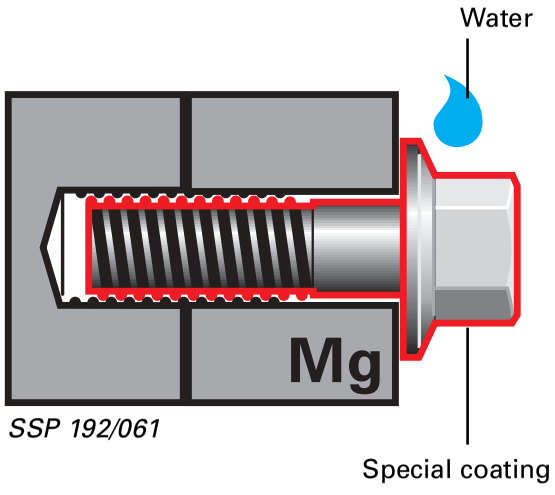
Contact corrosion, using a bolted connection as an example

In this example, a magnesium component is attached using a bolt made is 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.



SSP 192/097

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.



SSP 192/061

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.

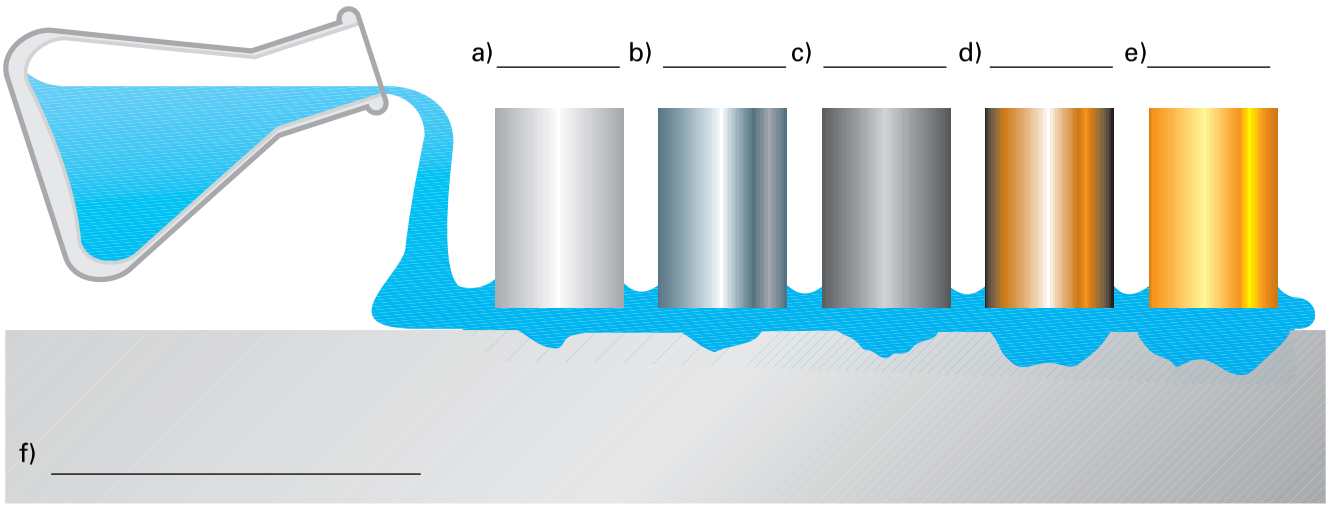
1. What is the insertion depth for magnesium compared to that for iron?

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.

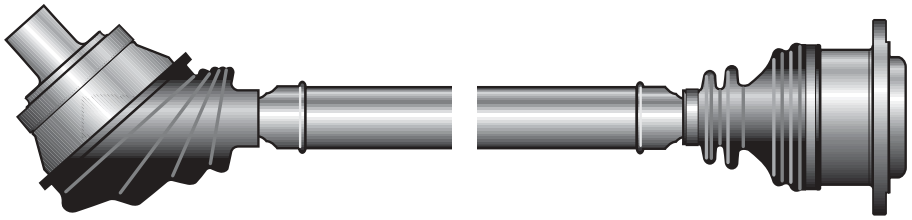


Triple roller constant velocity joint

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 pretensioning forces which occur in automatic drive trains.

CV
ball joint

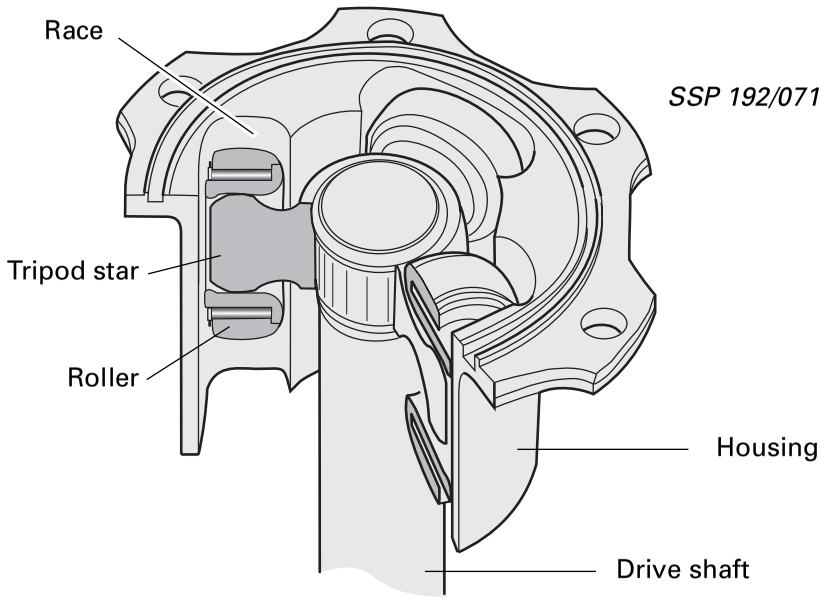


Triple roller joint

SSP 192/056

Design

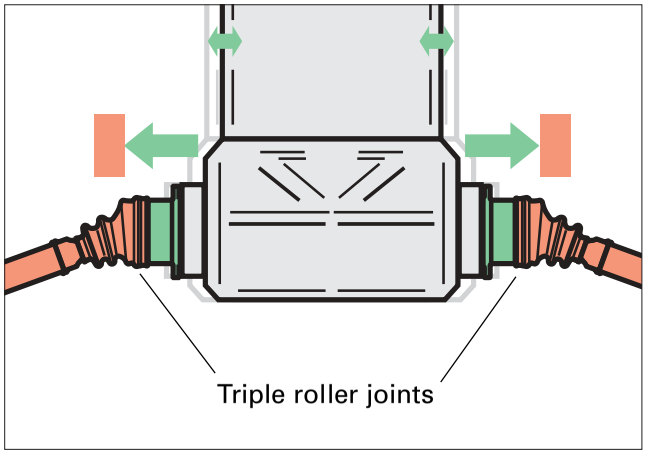
The triple roller joint has three spherical journals with a roller fitted to each of them.
The rollers are located in races and can slide and swivel on the tripod star.



SSP 192/071

Function

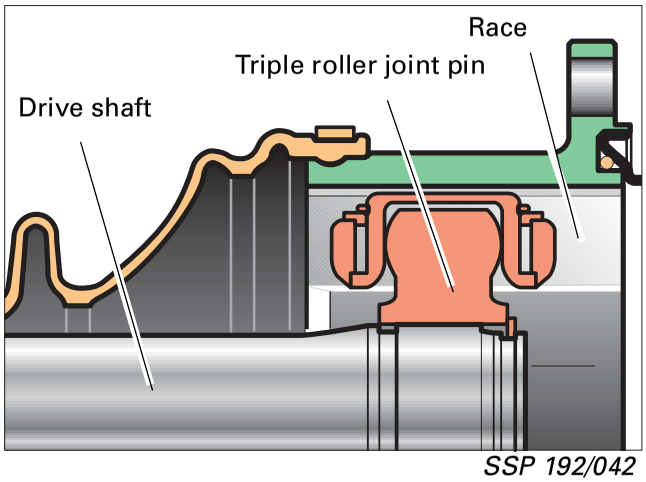
The principal task of the drive shafts is to transmit power from the gearbox to the wheels.
They are also responsible for length compensation.



SSP 192/041

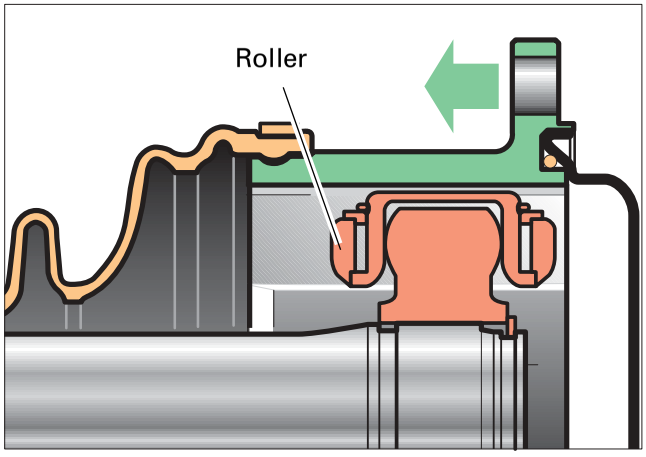
The engine/gearbox unit runs in elastic bearings. At certain speeds, the unit begins to oscillate in its mountings.

Moving parts
Stationary parts



SSP 192/042

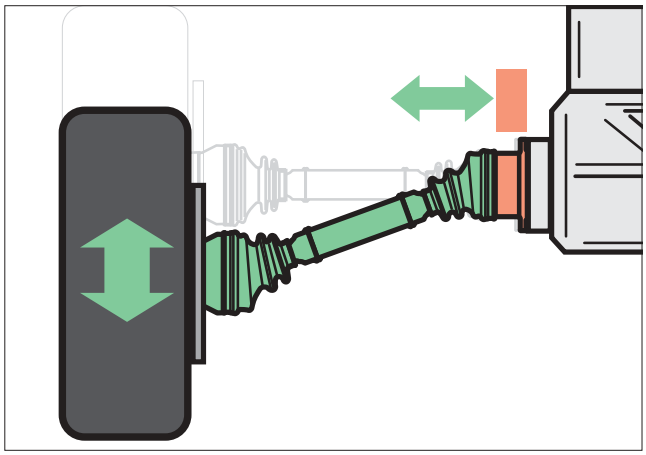
This movement is compensated by the triple roller joints, whereby the tripod star, together with the rollers, slide within their races.



SSP 192/043

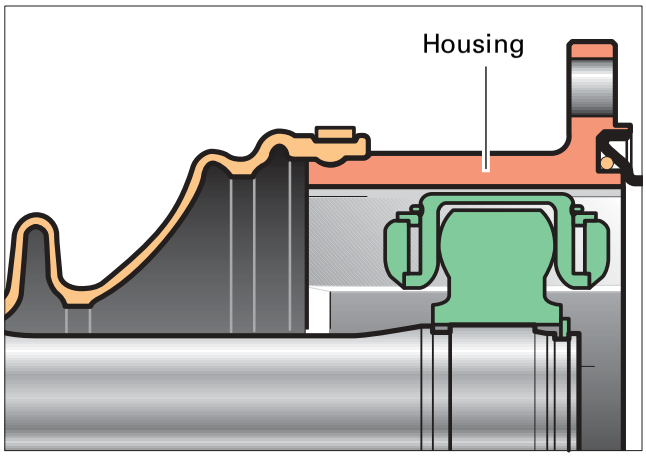
The triple roller joint housing is pushed over the tripod star rollers by the movement of the engine/gearbox unit.
The drive shaft remains stationary in the process.

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



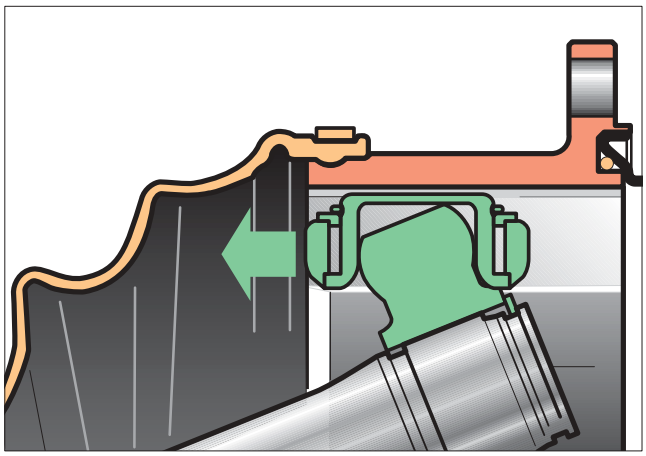
SSP 192/044

The joint housing remains stationary in the process.



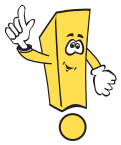
SSP 192/045

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.

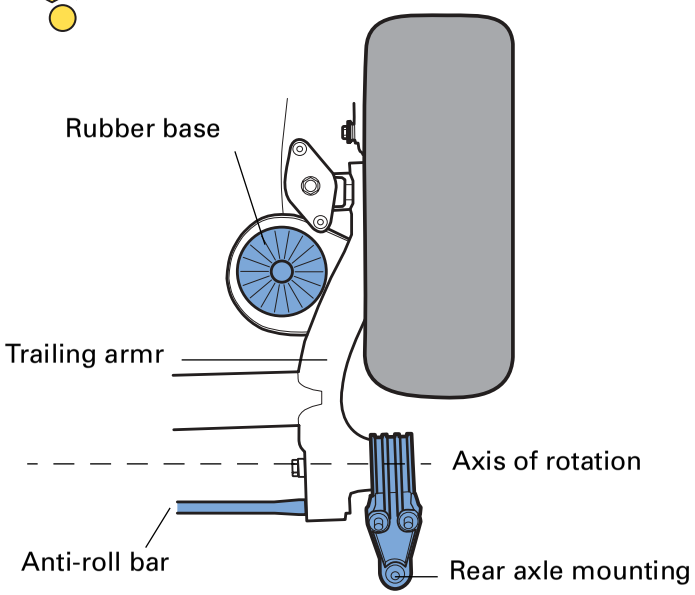


SSP 192/046

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



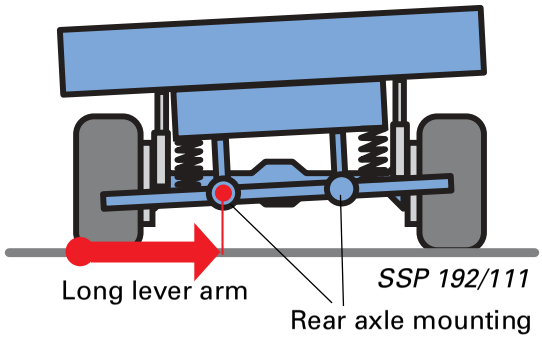
Torsion beam rear axle



SSP 192/100

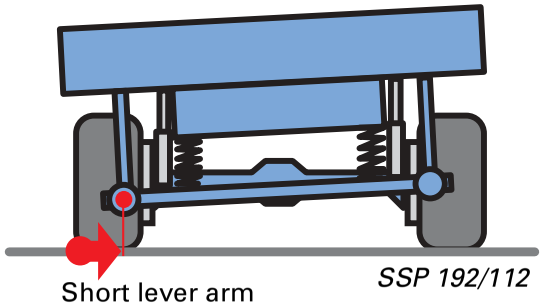
The anti-roll bar used in the new torsion beam rear axle is located in front of the axis of rotation. The rear axle mountings are located on the far outer side of the axle. This considerably reduces the forces acting on the rear axle mountings.
The mounting housing is made of aluminium and bolted to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



SSP 192/111

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

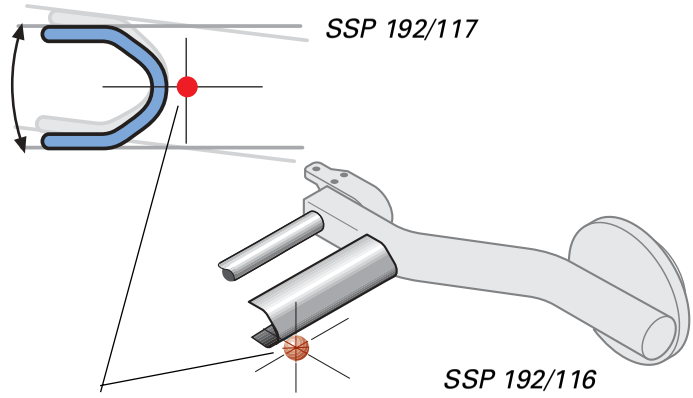


SSP 192/112

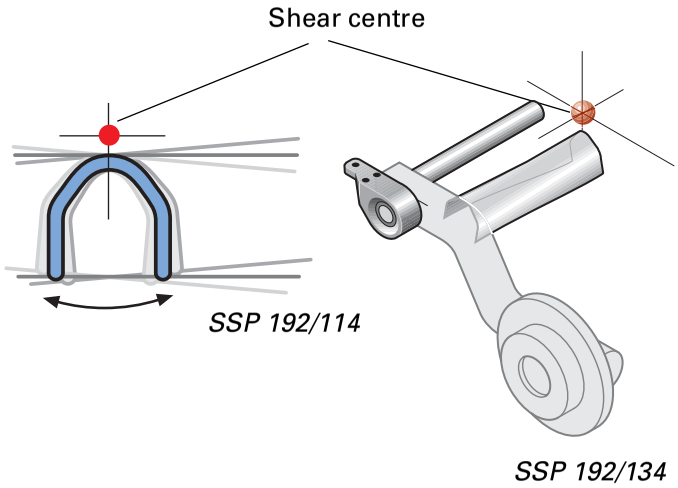
Locating the rear axle mountings on the outside makes the lever arms shorter, with the result that the mountings only absorb smaller forces. They can therefore be designed with a softer rating.

V section of torsion beam rear axle

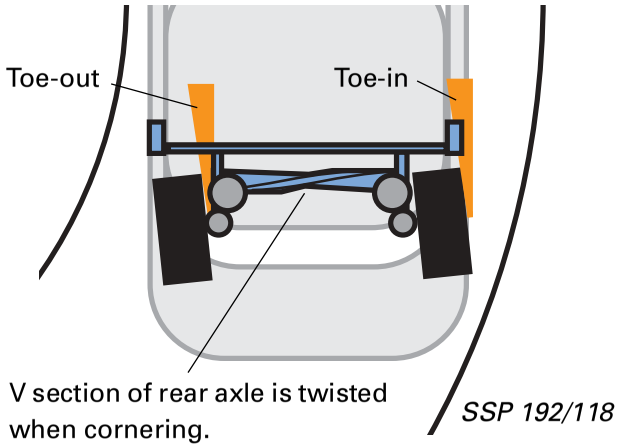
Conventional rear axles have a V section which is open facing forward. In this configuration, the shear centre of the axle is located behind the V section.
The centre of rotation is an imaginary axis about which the axle rotates when the suspension experiences a bump on one side.
If the shear centre is behind the V section, then diagonally aligned track-correcting mountings have to be used to achieve a self-steering effect.

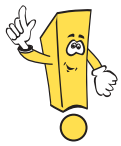


The new torsion beam rear axle has a V section which is open downwards. The shear centre is located above the V section.
The axle has different rotational characteristics as a result.



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.





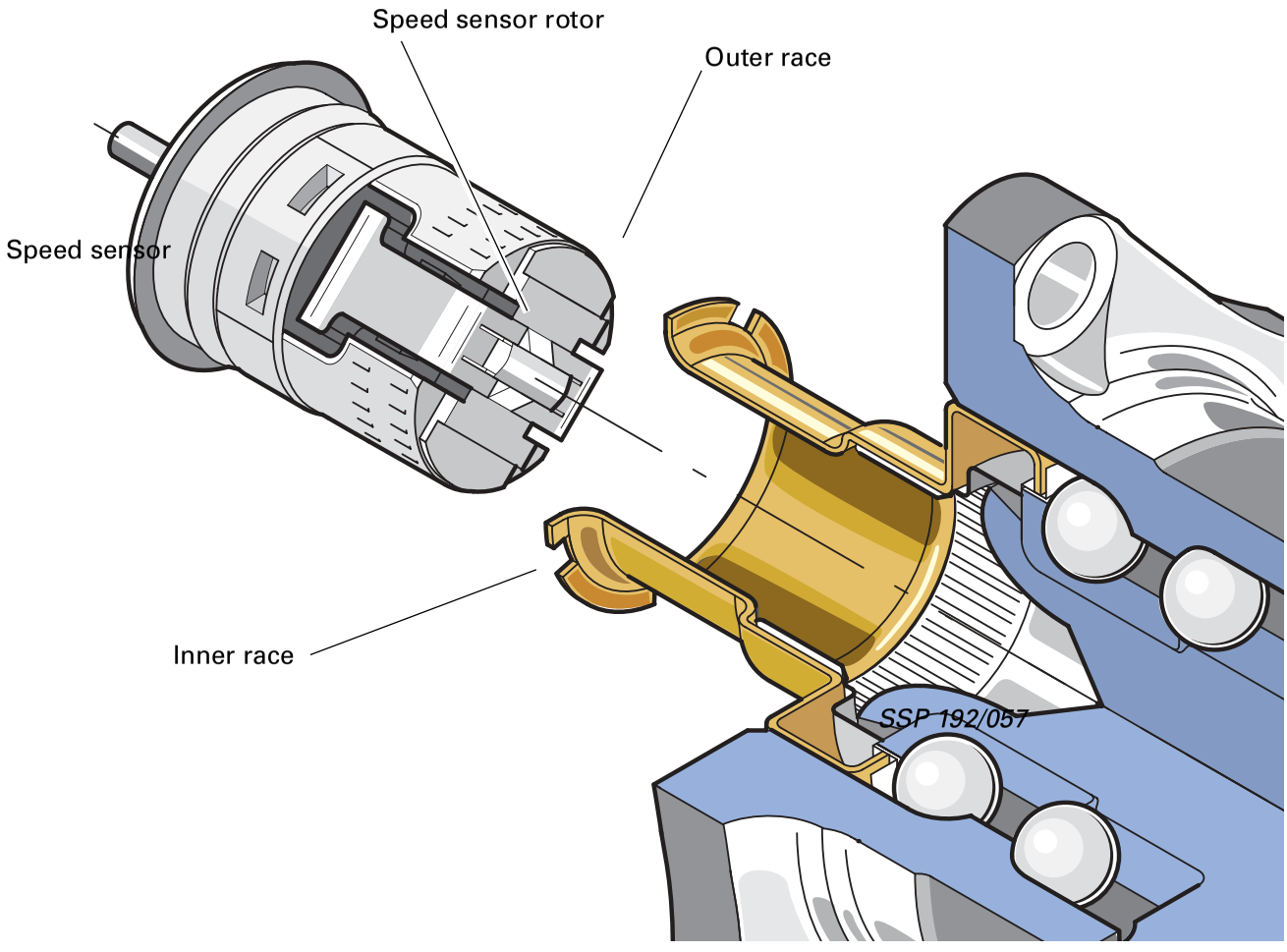
Hub/wheel bearing unit

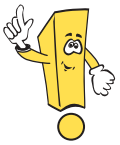
The newly developed wheel bearing generation is used on the rear axle of front-wheel-drive vehicles. The twin-tracked ball bearing has a stationary outer race which is bolted to the rear axle mounting plate.

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.

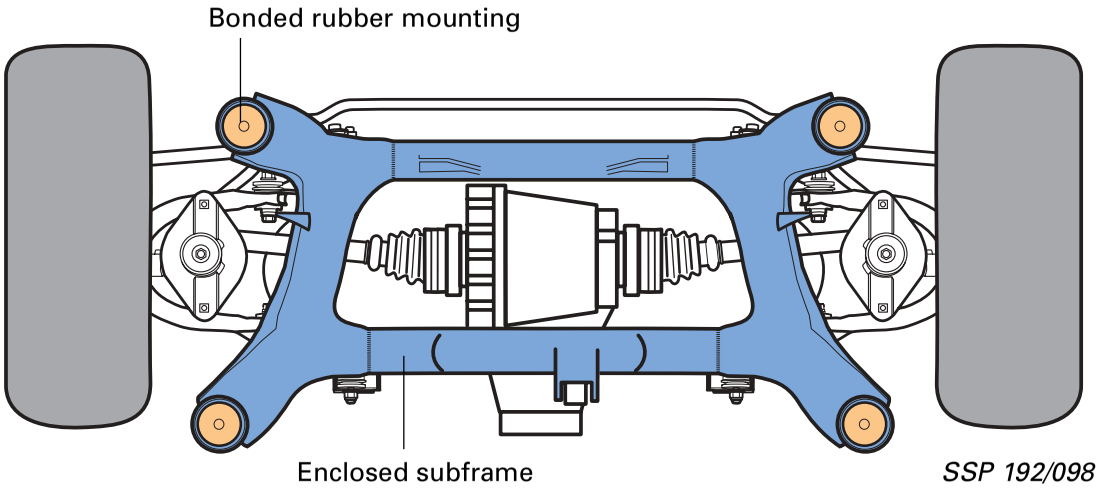




Double wishbone rear axle

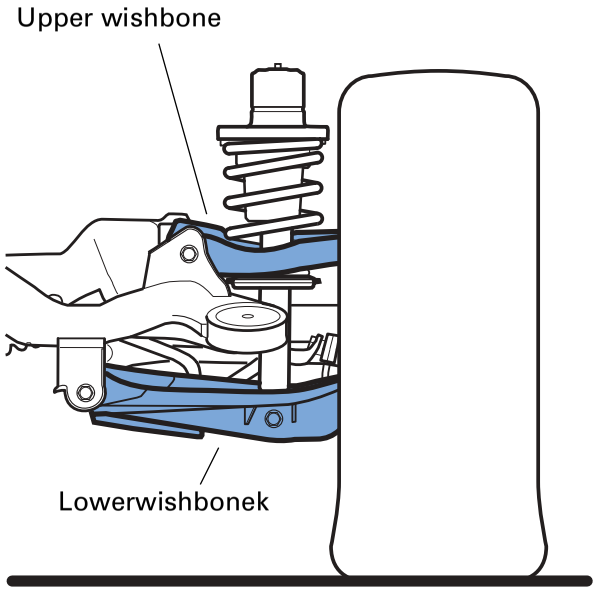
The newly developed double wishbone rear axle allows the same through-loading width as the torsion beam rear axle. It has an enclosed subframe to which the transverse links are attached.

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.



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.

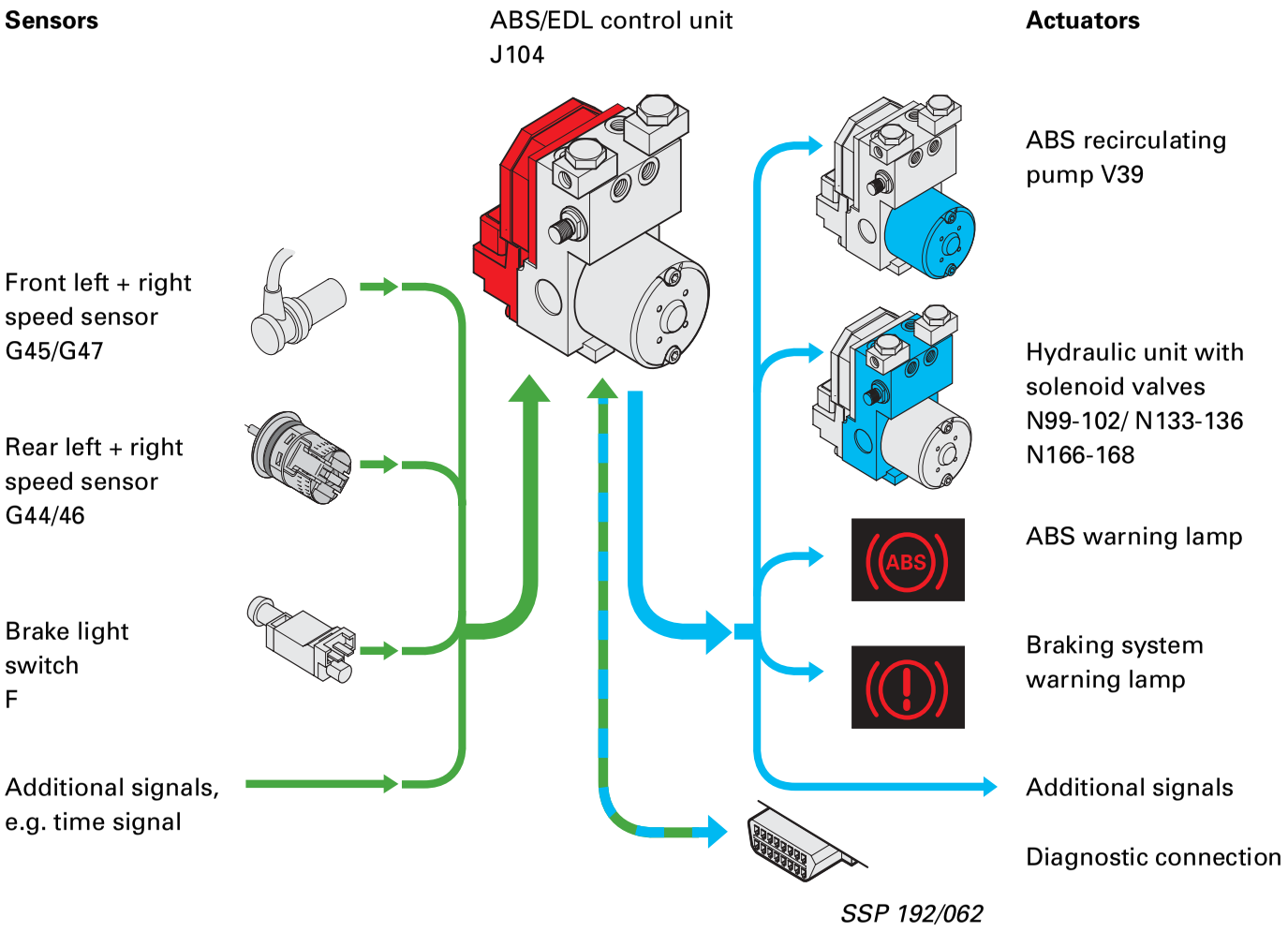
4. On the double wishbone rear axle, the upper wishbone is located _____ the wheel. As a result of this, _____ _____ is achieved.

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.

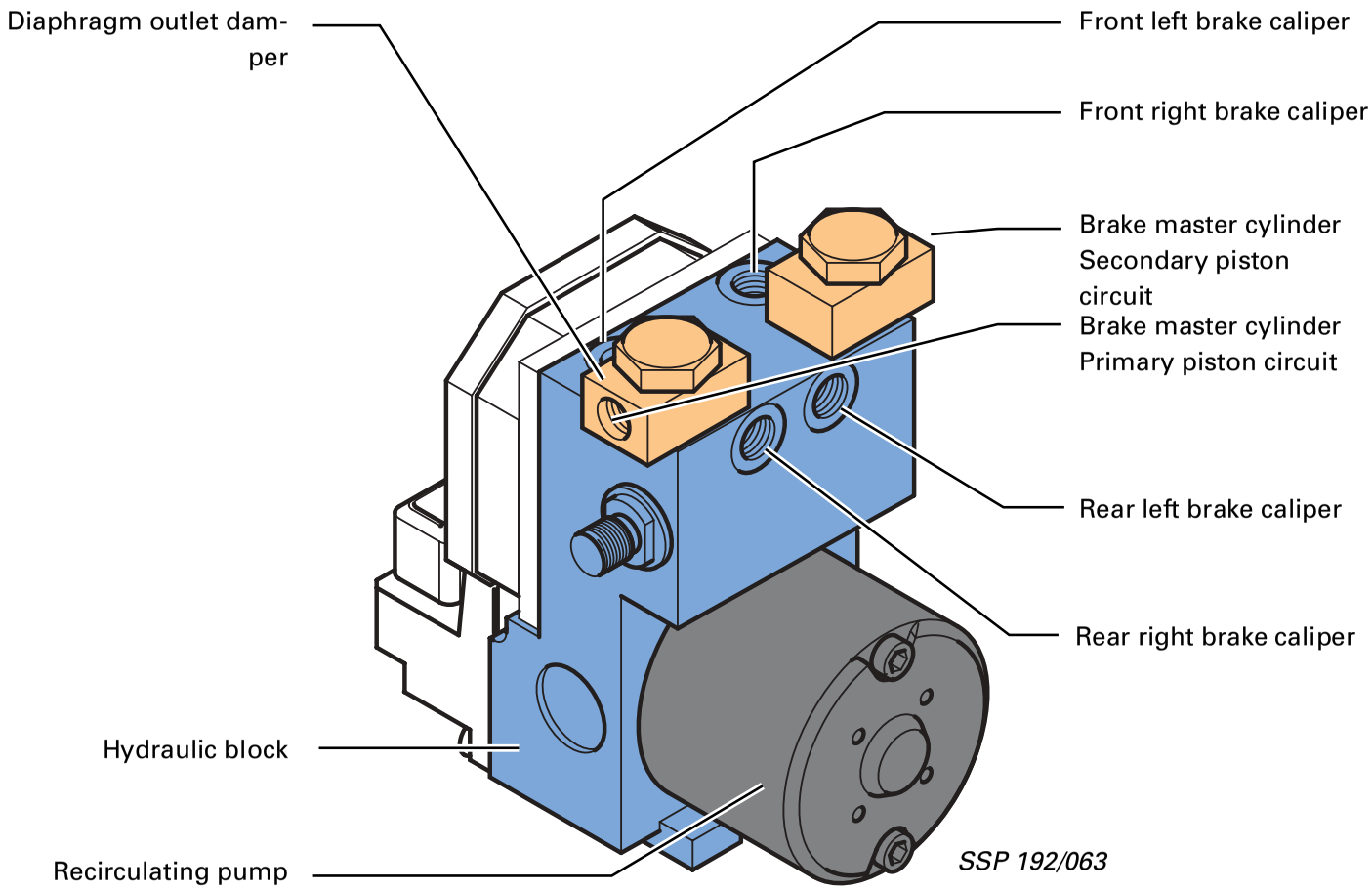
A Self Study Programme relating to the ABS 5.3 system is in preparation.

System overview



SSP 192/062

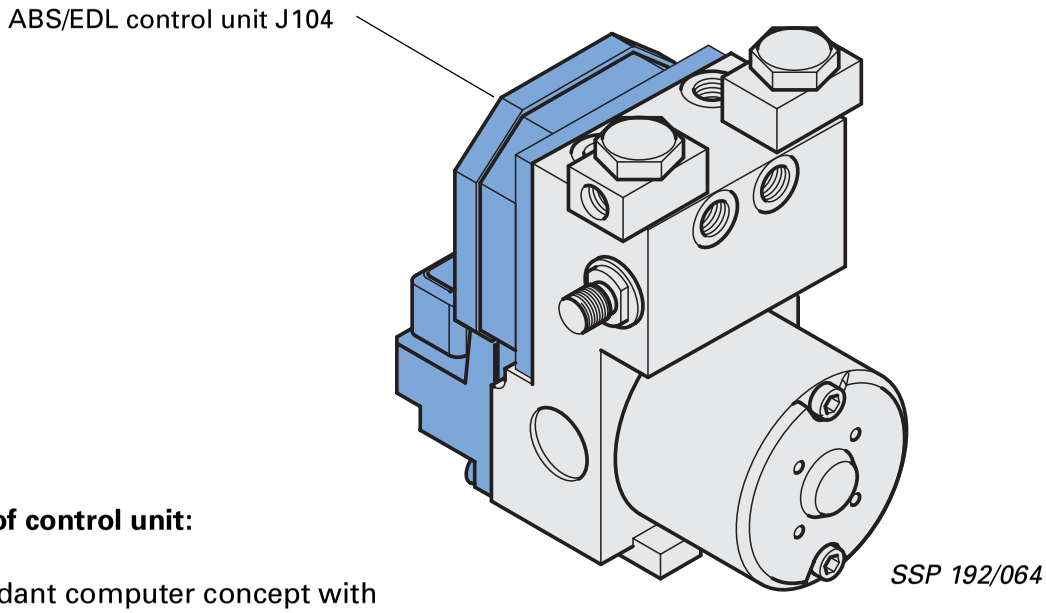
ABS/EDL hydraulic unit



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^3,
- 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 control unit



SSP 192/064

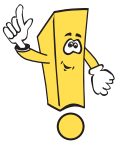
Features of control unit:

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

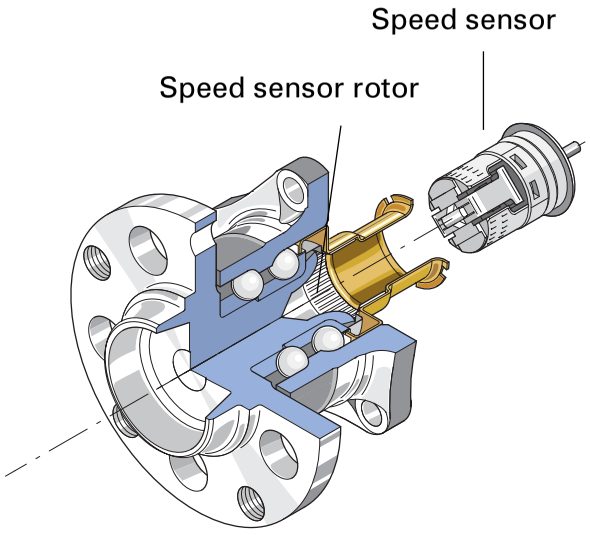
Redundant computer concept

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:

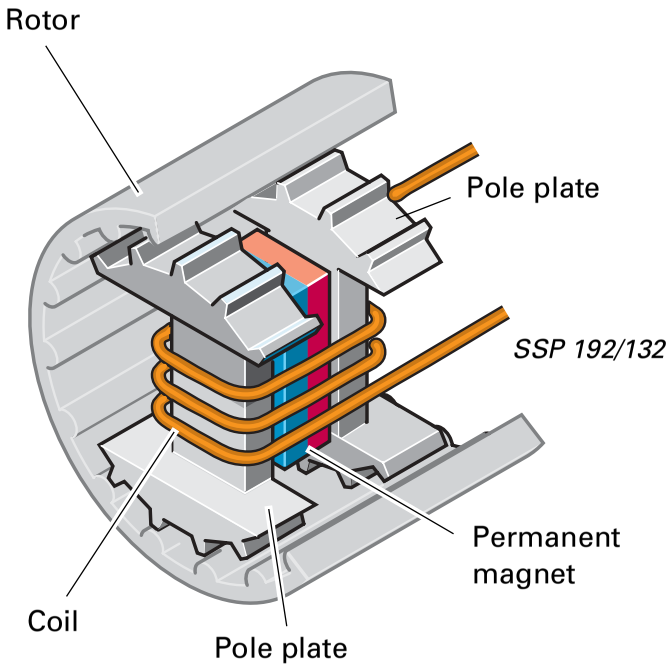
- It is inserted into the wheel bearing and is thus protected against external influences.
- It generates signals contactlessly.

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.



SSP 192/132

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 platesand 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.

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

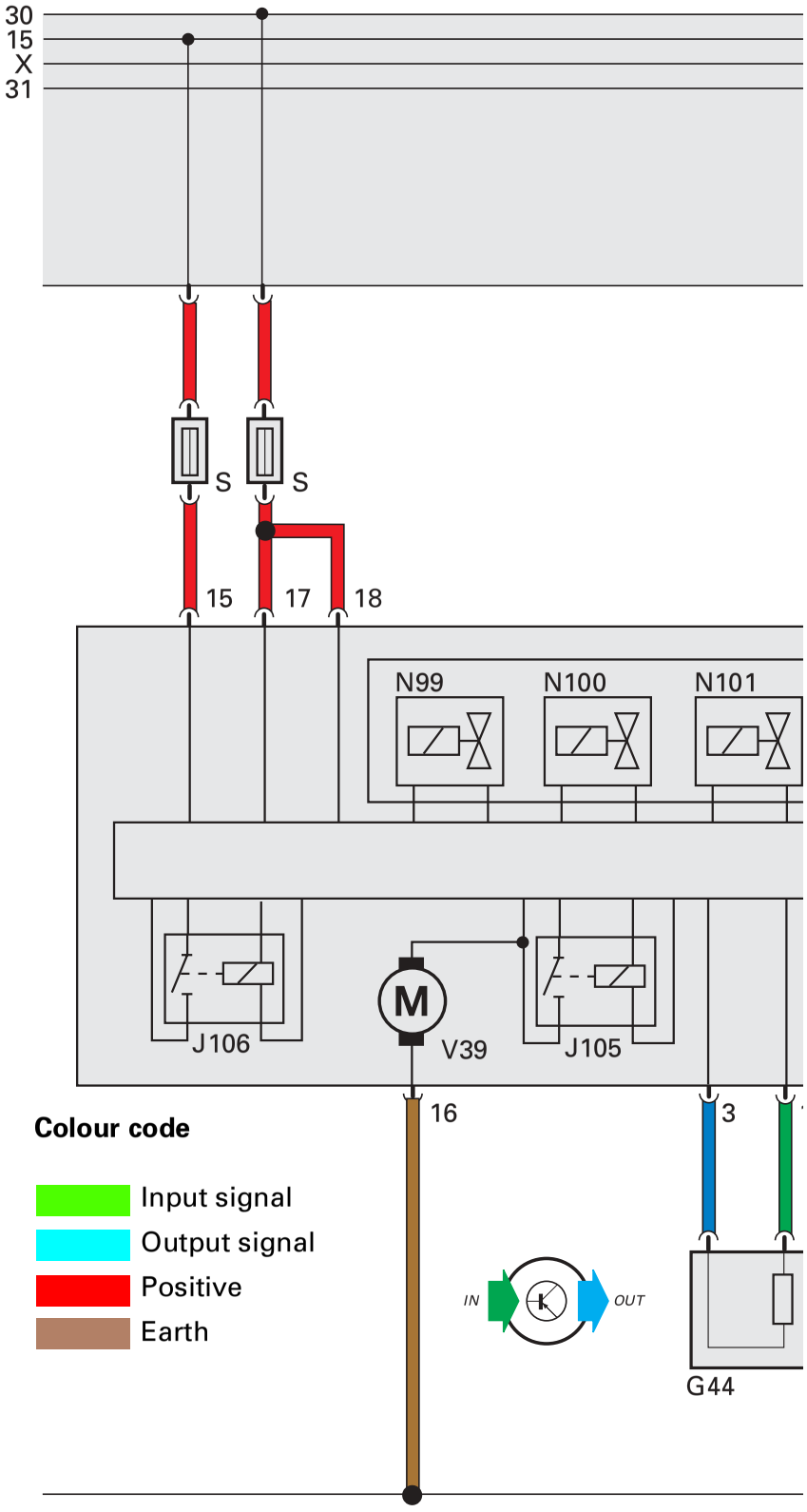
J104 Control unit for ABS with EDL
J105 ABS recirculating pump relay
J106 Solenoid valve relay
J220 Control unit for Motronic
J285 Control unit with display unit in dash panel insert
J401 Control unit for navigation system with CD-ROM drive

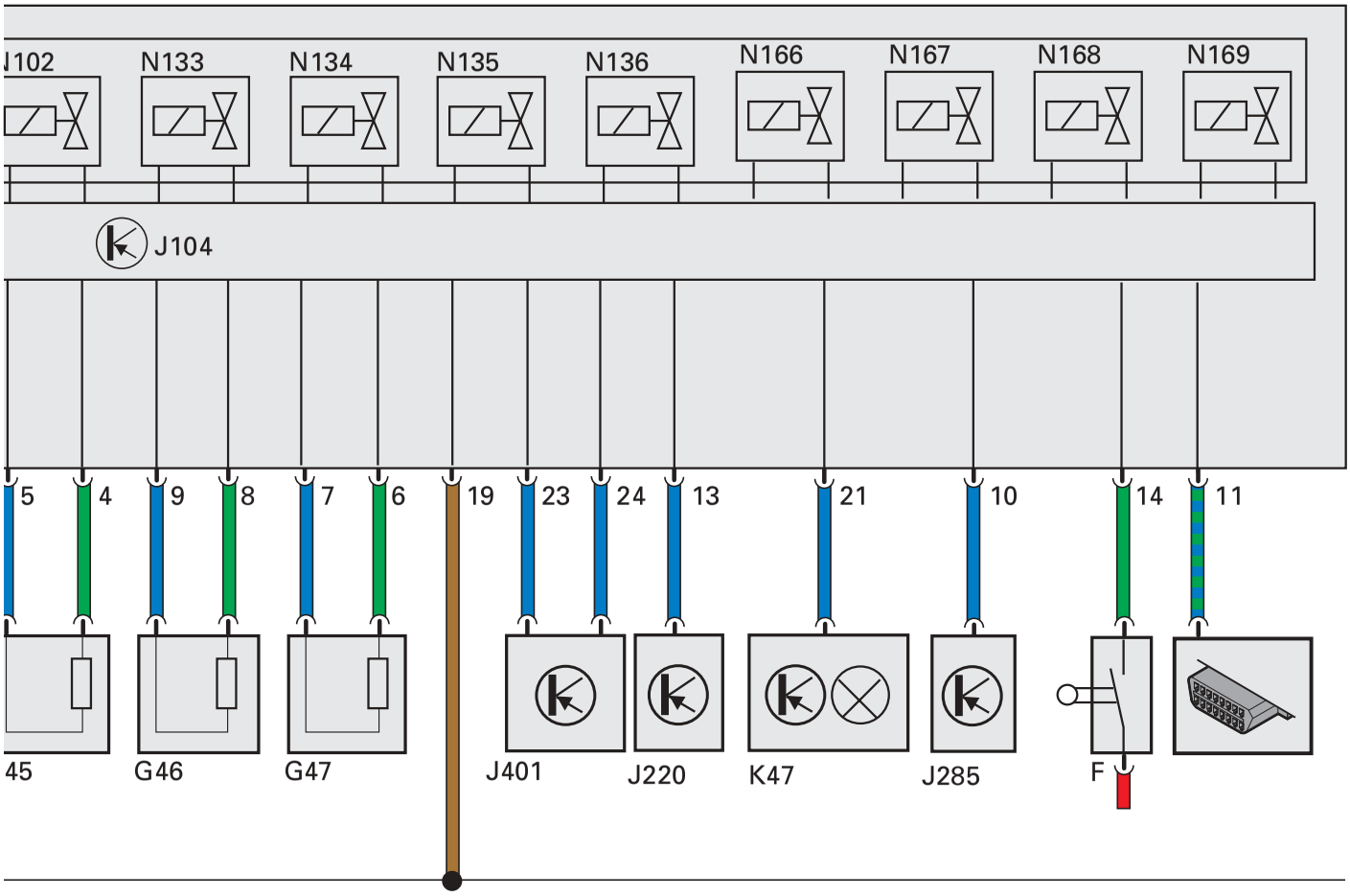
K 47 ABS warning lamp

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




J102
N133
N134
N135
N136
N166
N167
N168
N169
J104
5
4
9
8
7
6
19
23
24
13
21
10
14
11
45
G46
G47
J401
J220
K47
J285
F

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,

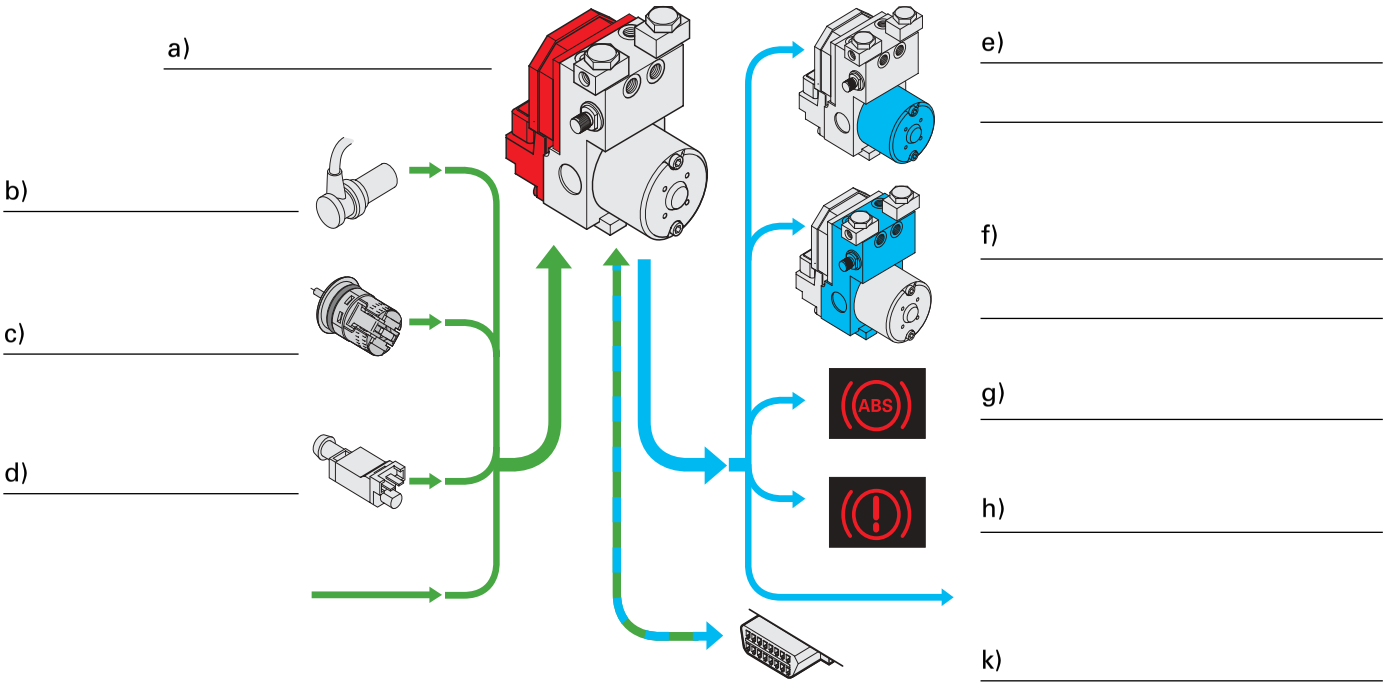
b) By the colour of the control unit,

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?

_____

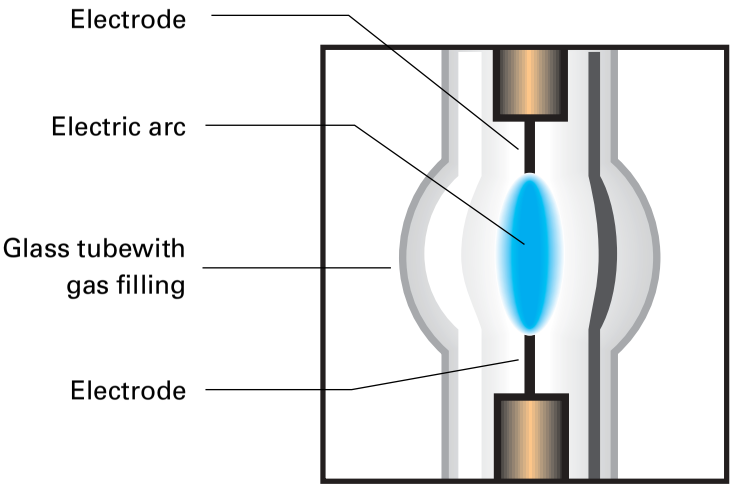
3. Name the components in this system overview.



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:



SSP 192/121

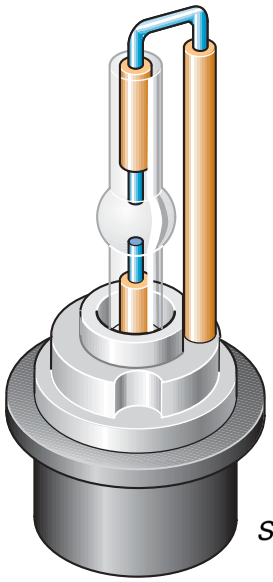
- Up to three times higher luminous efficiency, same power consumption.
  A 35W gas discharge lamp is sufficient to provide twice the illumination of a 55W lamp.
- The useful life of approx. 2500 hours is several times that of the halogen lamp.
- The special design of the reflector, aperture and lens 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.

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 tio the lamp.

Gas discharge lamp

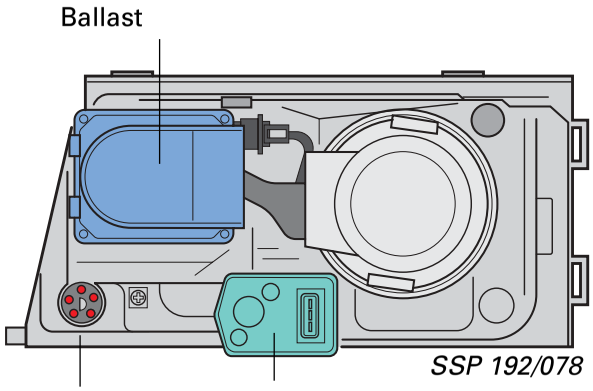


SSP 192/122

Gas discharge headlight

A gas discharge headlight comprises:

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



SSP 192/078

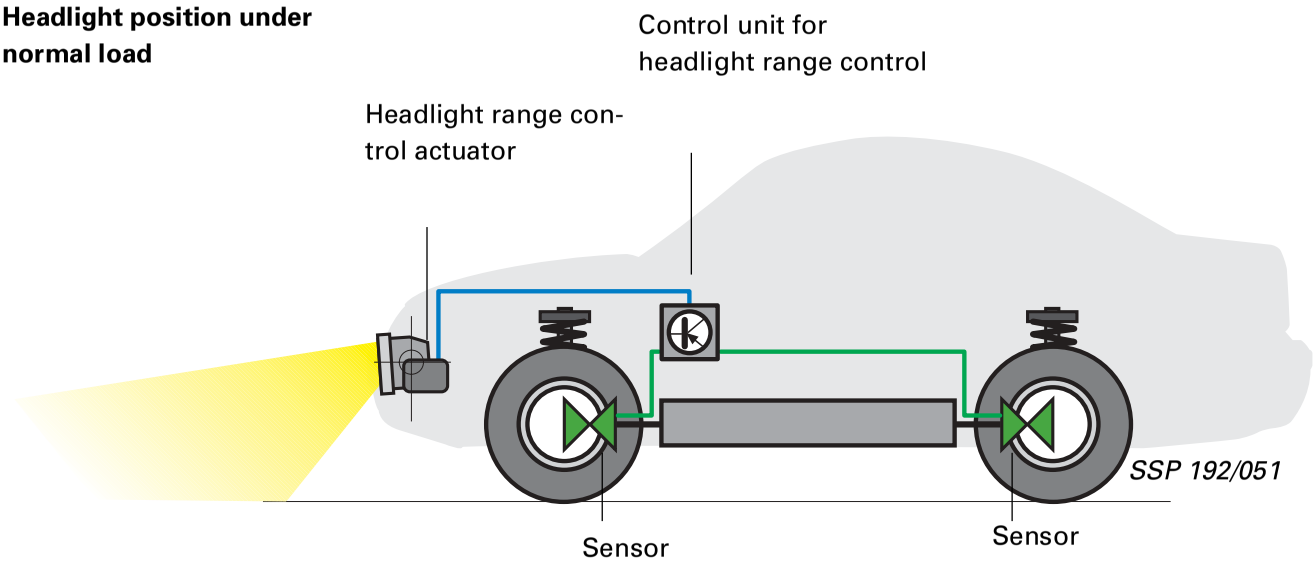
A repair solution is available for the headlight housing.
During minor accidents, the securing pin on the headlight housing can shear off. With regard to the gas discharge headlight, this may result in disproportionately high repair costs.
Our repair solution, which involves renewing the securing pin and eccentric, allows all headlight housings to be renewed inexpensively.

Automatic headlight range control

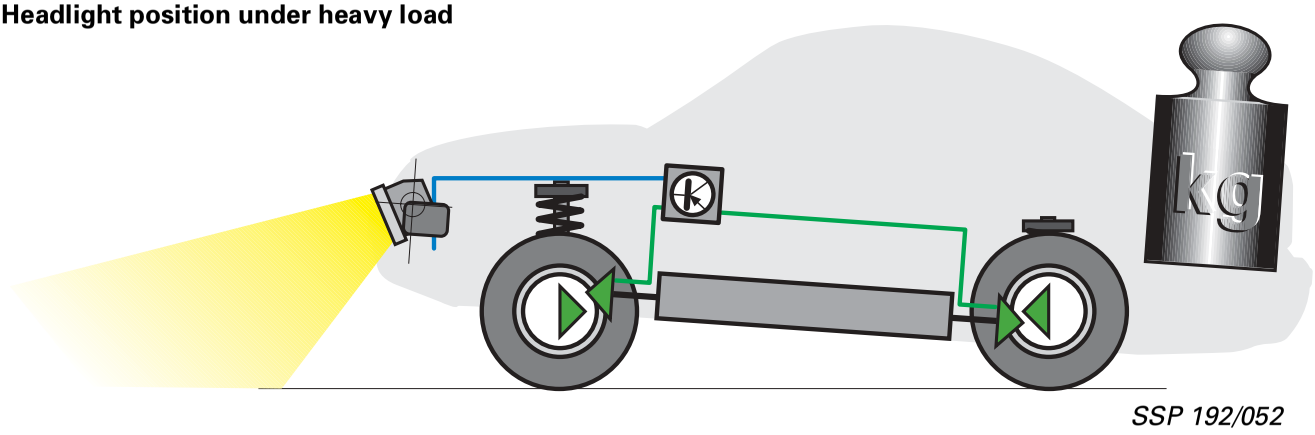
To prevent dazzling oncoming traffic, the gas discharge headlights have to be equipped with an automatic headlight range control.

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



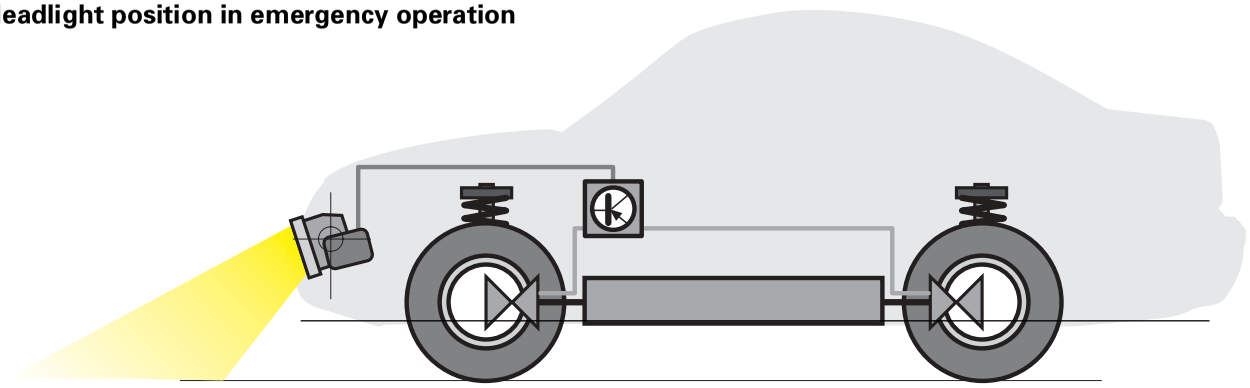
Emergency operation:

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:

_____

_____

_____

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.

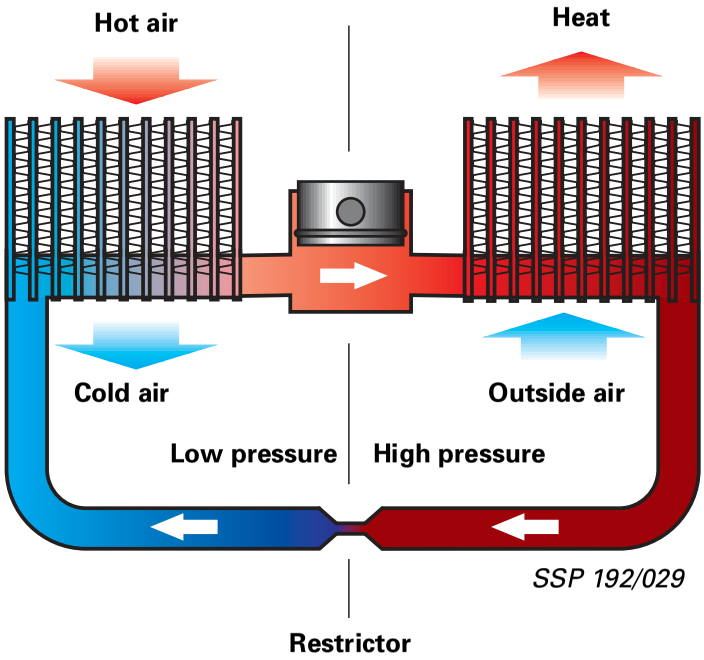
The refrigerant is circulated in a closed circuit. The refrigerant circuit contains the refrigerant R134a.

Compressor

The compressor draws in the gaseous refrigerant and compresses it. Its pressure and temperature increase in the process. The hot gas is pumped onward to the condenser.

Evaporator

The evaporator plates cool the passing fresh air or the recirculated air from the passenger compartment. The refrigerant absorbs the heat.



Condenser

The passing outside air cools the hot gaseous refrigerant in the condenser. The refrigerant is liquefied in the process.

Restrictor

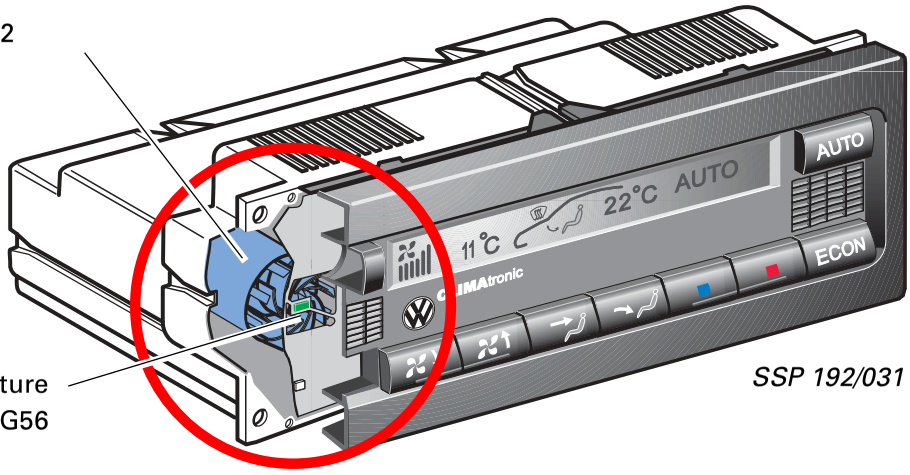
The compressed refrigerant is expanded and atomised in the restrictor. It cools down rapidly in the process.

CLIMAtronic

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

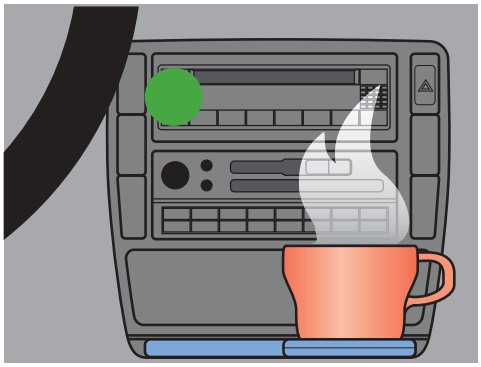
The dash panel insert temperature sensor and the temperature sensor fan are integrated in the control unit.

Temperature sensor fan V42



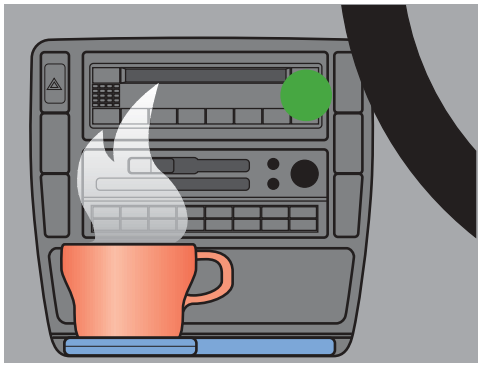
Dash panel insert temperature sensor G56

SSP 192/031



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.

System overview

Sensors

Sunshine penetration photosensor G107

Dash panel insert temperature sensor G56 with temperature sensor fan V42

Outside temperature sensor G17

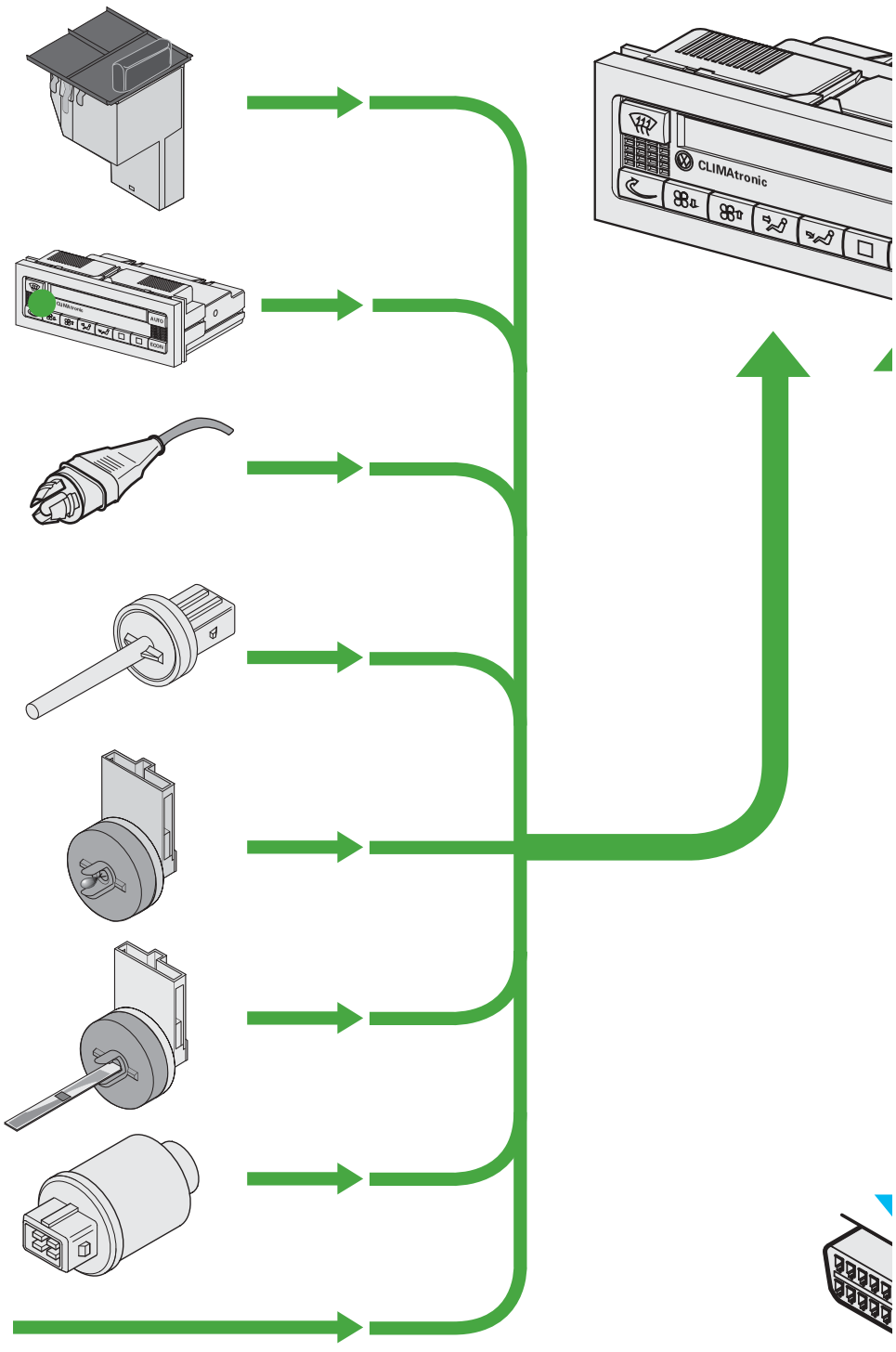
Temperature sensor for fresh air intake duct G89

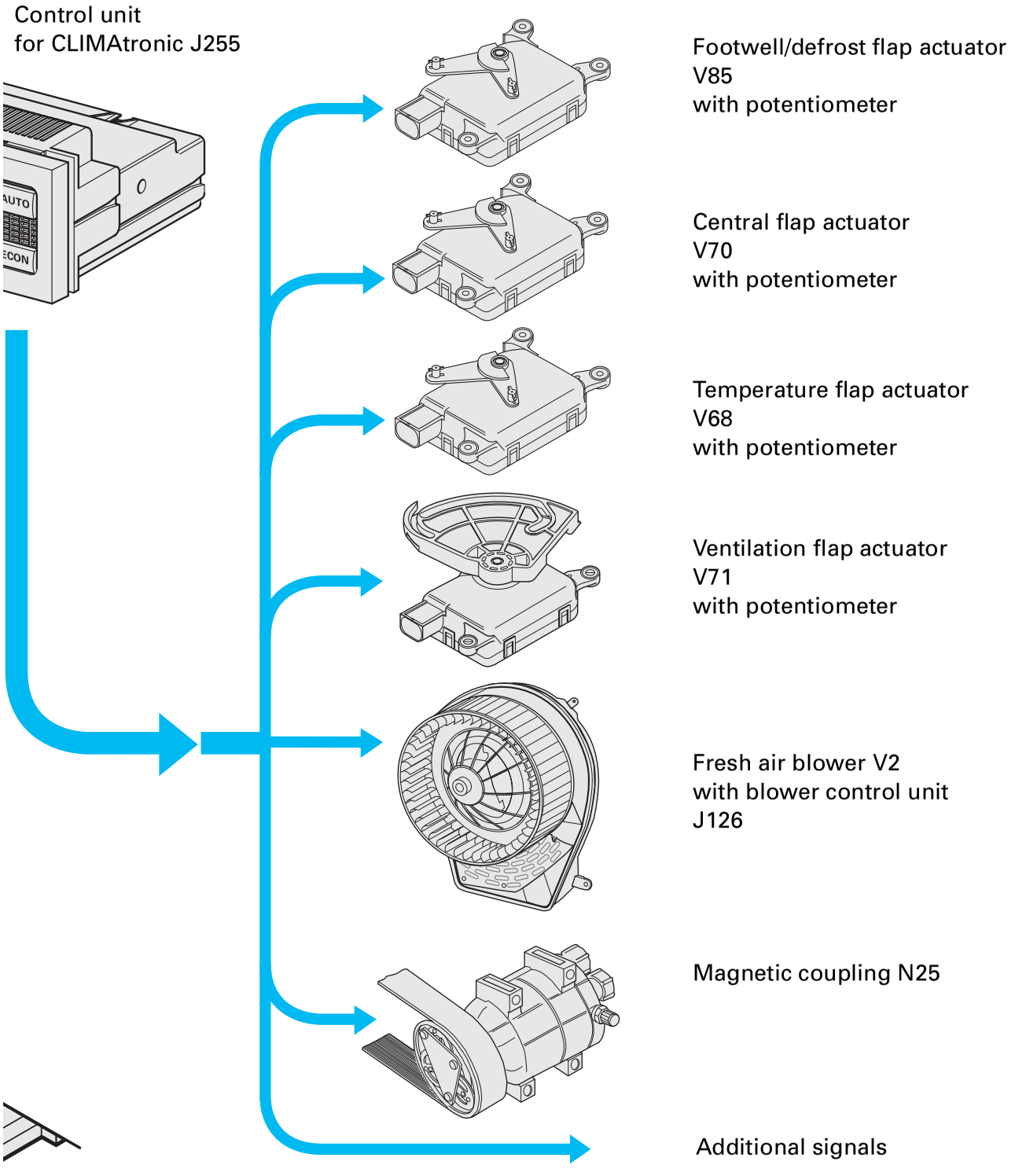
Sender for footwell air outlet temperature G192

Sender for central air outlet temperature G191

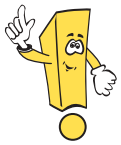
Air-conditioning pressure switch F129

Additional signals

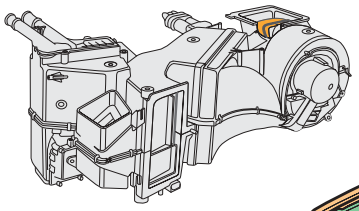



Control unit
for CLIMAtronic J255
Actuators
Footwell/defrost flap actuator
V85
with potentiometer
Central flap actuator
V70
with potentiometer
Temperature flap actuator
V68
with potentiometer
Ventilation flap actuator
V71
with potentiometer
Fresh air blower V2
with blower control unit
J126
Magnetic coupling N25
Additional signals
Diagnostic connection

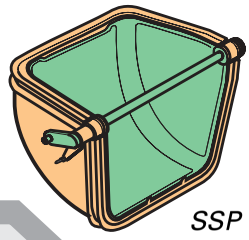
SSP 192/030



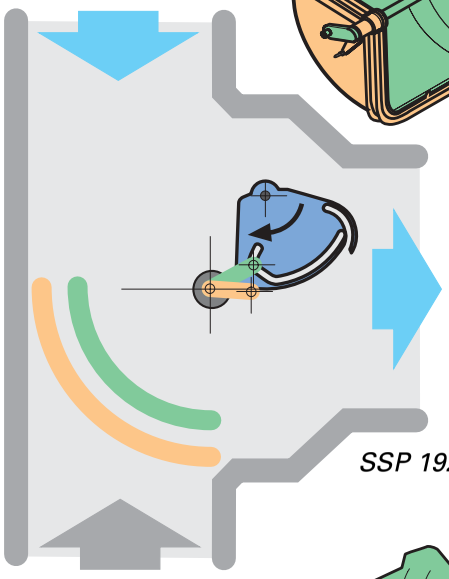
Ventilation flap and the fresh/air recirculation flap



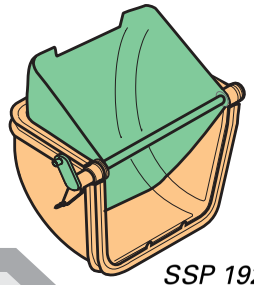
SSP 192/036



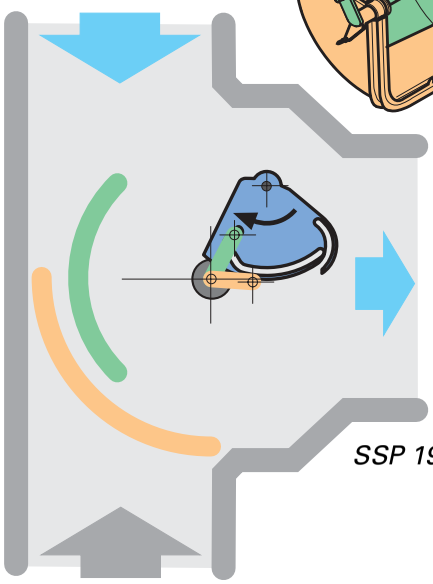
SSP 192/024



SSP 192/028



SSP 192/023



SSP 192/027

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

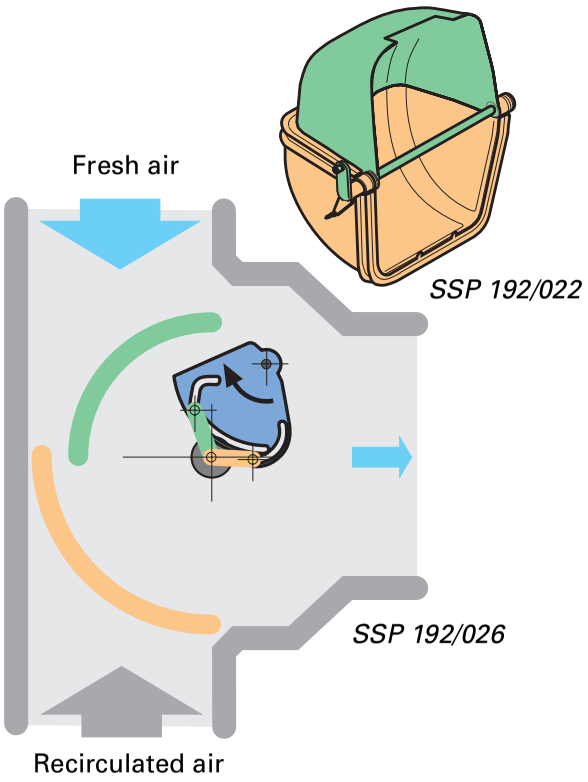
In the fresh air mode, the ventilation flap and the fresh/air recirculation flap are fully open at speeds of below 20 kph. Fresh air is able to flow into the car unobstructed.

Ventilation mode

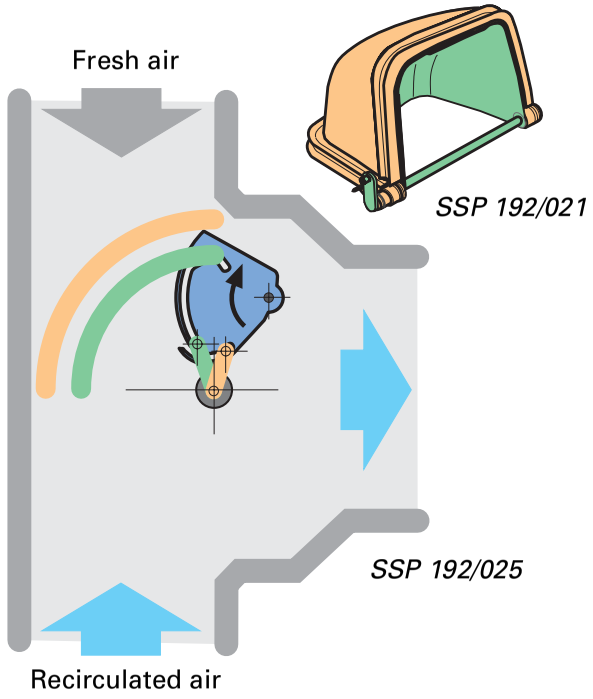
At high speeds, the ventilation flap prevents too much fresh air from entering the passenger compartment. Opening and closing are dependent on road speed.
The position of the ventilation flap is also affected by the difference between the nominal and actual temperature in the passenger compartment. If 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



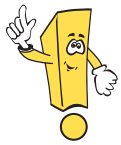
Above a speed of 160 kph, the ventilation flap is closed. A small amount of fresh air trickles into the passenger compartment through a narrow opening in the ventilation flap.



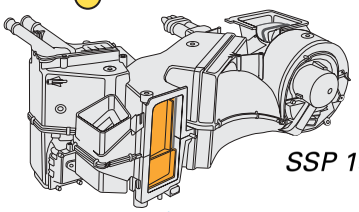
Air recirculation mode

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.

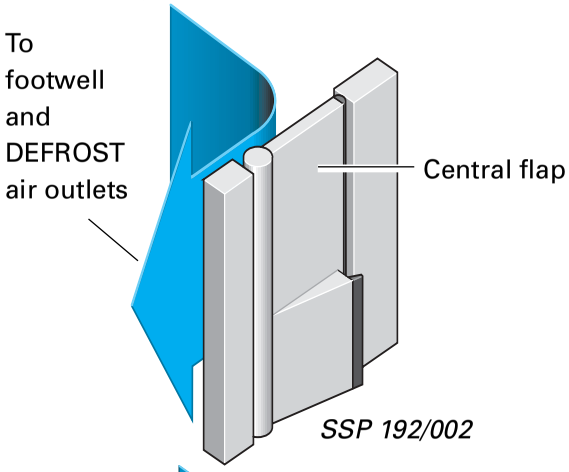


Central flap



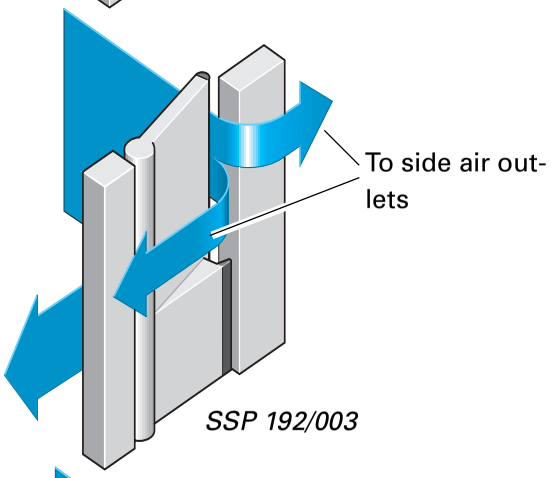
SSP 192/035

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.



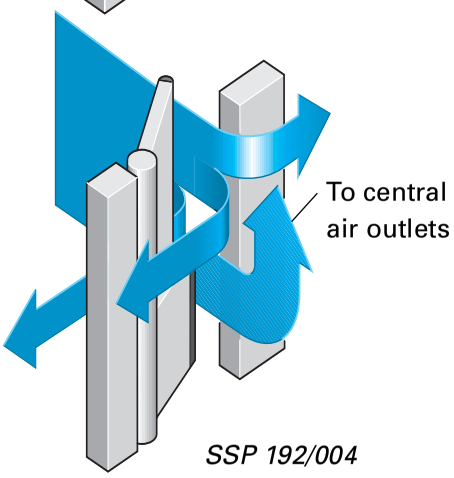
SSP 192/002

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.



SSP 192/003

As coolant temperature increases, the flap opens and air reaches the side air outlets. The air duct leading to the central air outlets is still closed.

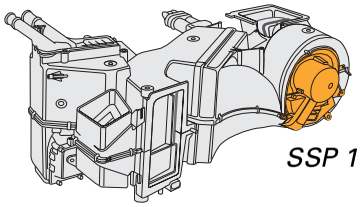


SSP 192/004

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.

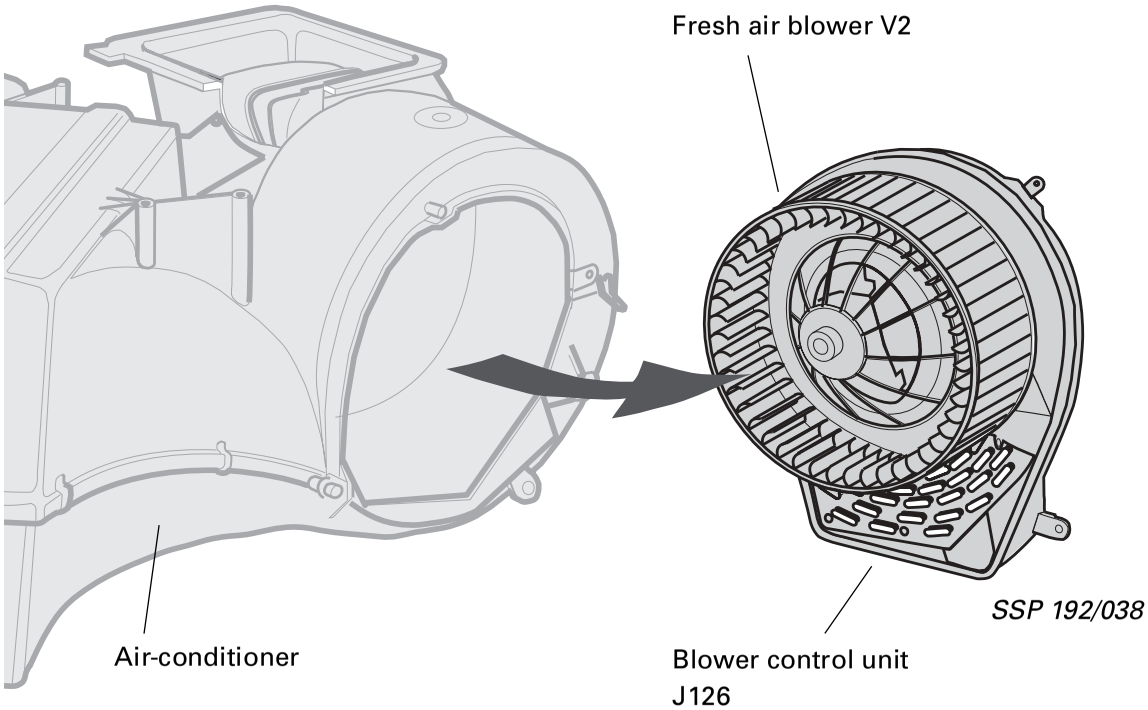
Fresh air blower V2



SSP 192/037

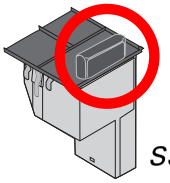
The blower control unit is integrated in the fresh air blower.

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



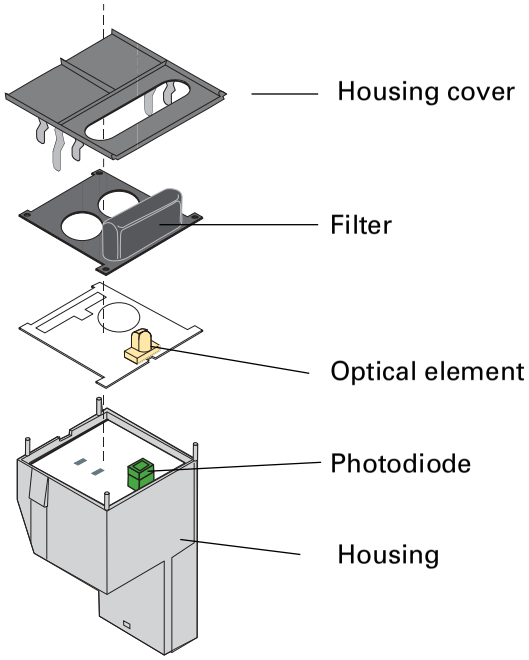
SSP 192/038

Sunshine penetration photosensor G107



SSP 192/093

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



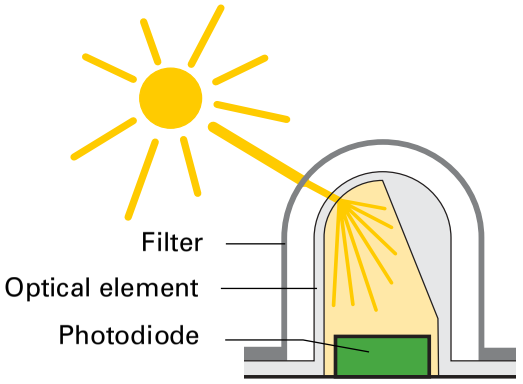
SSP 192/034

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.



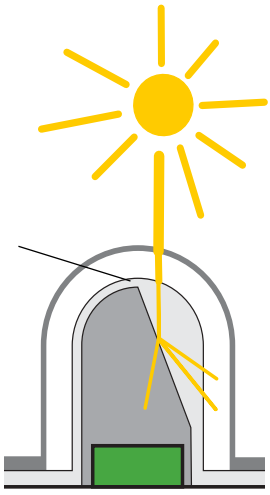
SSP 192/092

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.

The optical element provides greater protection from vertical sunlight penetration.



SSP 192/105

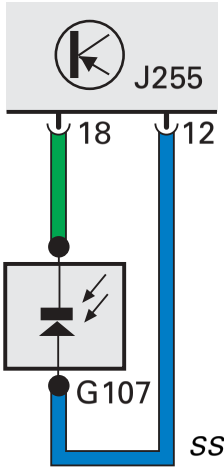
Vertical sunlight penetration

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



SSP 192/133

Effects of signal failure

No replacement function.

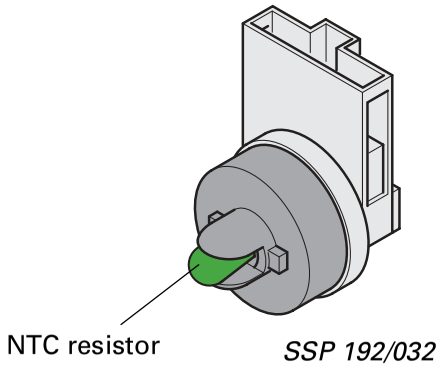
Self-diagnosis fault message

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

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

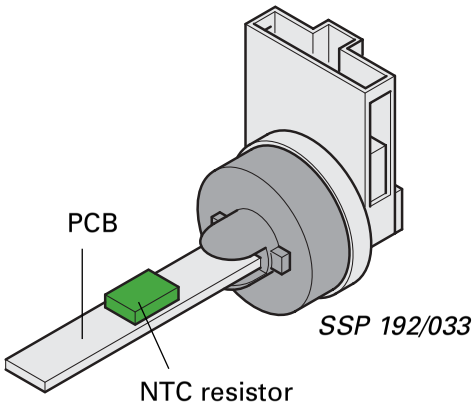
Footwell outlet temperature sender G192

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.

1. Which statements are true?

a) The ventilation flap and the fresh/air recirculation flap are activated by a common electric motor drive.

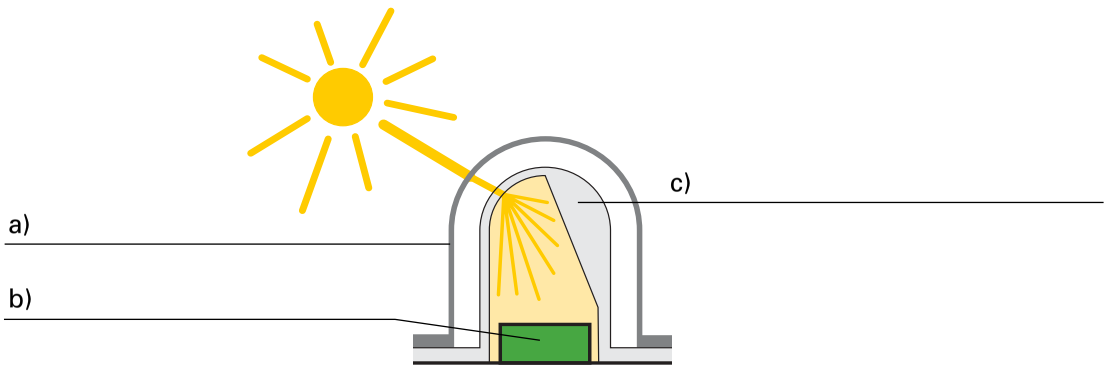
b) In the air recirculation mode, the ventilation flap is in its upper limit position and the fresh/air recirculation flap is in its lower limit position.

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?

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

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