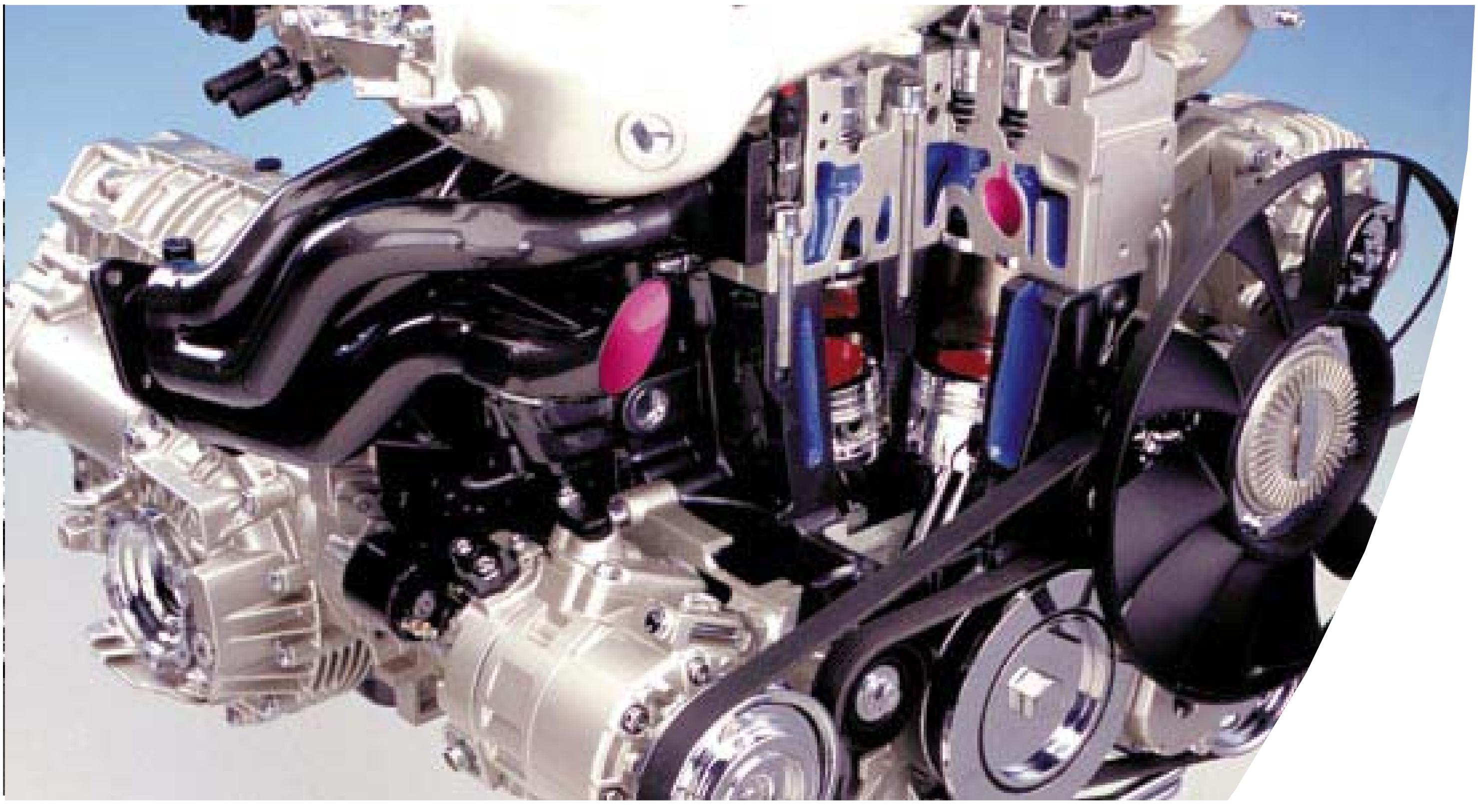
The 2.3-ltr. V5 Engine

Design and Function

Self-Study Programme No. 195



195_118

The new 2.3-ltr. V5 engine is related to the VR6 engine as regards design. For this reason this Self-Study Programme will be largely confined to the modifications to the VR6 engine.

You will find more detailed information about the design of the engine mechanicals or the cooling system and the oil circuit in SSP 127 “The VR6 engine” and SSP 174 “Modifications to the VR6 engine”.

New

Important Note

The Self-Study Programme is not a Workshop Manual!

Please always refer to the Service Literature for all inspection, adjustment and repair instructions.

The contents of this SSP at a glance

Introduction

Why do V-engines exist?

Front-wheel drive, in combination with a transversely mounted four-cylinder inline engine, is now part and parcel of many motor vehicle concepts. Installing the engine transversely has promoted the development of more compact vehicles.
But the vehicle width is not sufficient to accommodate inline engines with more than four cylinders.
This is why the V-engine came into being.
Al-though V-engines have a very short overall length, they are rather wide - with a V-angle of 60° or 90° - and hence cannot be used in smaller mid-range vehicles.

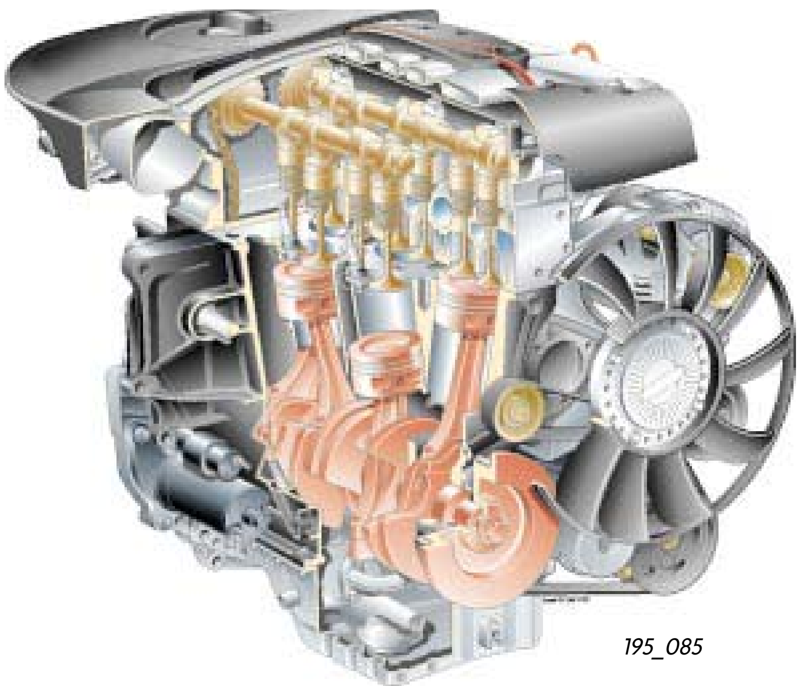
V-engine with an angle of 15°

The VR engines and the new V5 engine combine the advantages of the V-concept with the advantages of the inline engine.

These are:

- short overall length thanks to V-angle,
- small overall width thanks to the V-angle of 15°,
- only one cylinder head is required,

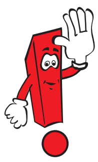
The V5 was derived from the VR6 by removing the 1st cylinder from the latter.
The resulting, even more compact design makes it possible to use this powerful unit in all vehicle classes.



195_085

Technical specifications

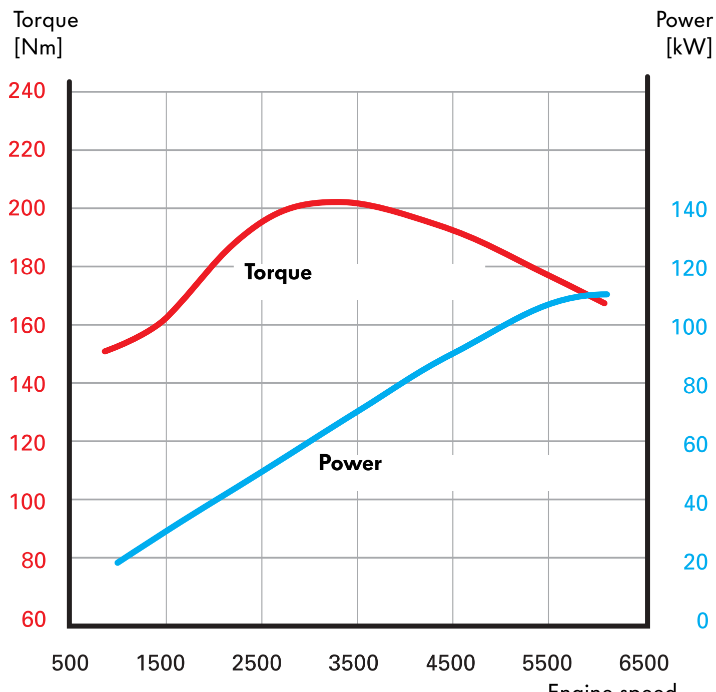
Engine code	AGZ
V-angle	15°
Displacement	2324 cm^3
Bore	81.0 mm
Stroke	90.2 mm
Compression ratio	10.0 : 1
Firing order	1 - 2 - 4 - 5 - 3
Mixture preparation and ignition	Bosch Motronic M3.8.3
Fuel	95 RON unleaded premium
Exhaust gas aftertreatment	Three-way catalytic converter with lambda control



The V5 engine conforms to exhaust gas level D3.

As the power vs. torque curve shows, the remarkable features of this engine are its immense low-end torque and high power output in the upper rpm range.

Max. torque is 220 Nm at 3600 rpm and max. power output is 110 kW at 6000 rpm.



195_084

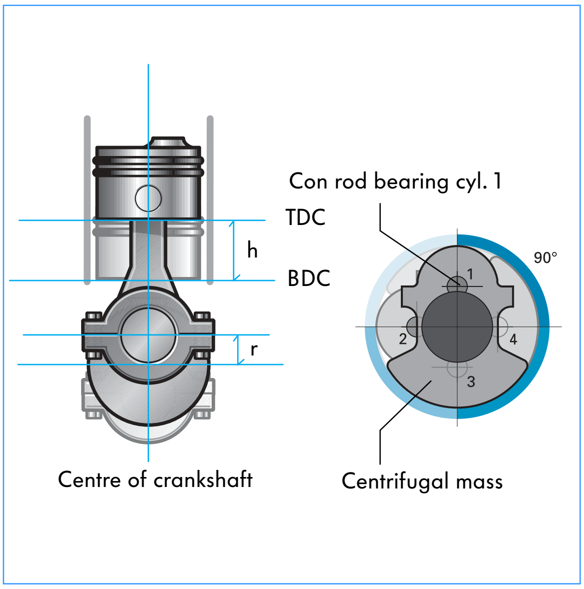
Engine mechanicals

Offsetting

To give you a better understanding of the design features of the V5 engine and to clarify several technical concepts, we will begin by looking at the design features of the inline engine.

Inline engine

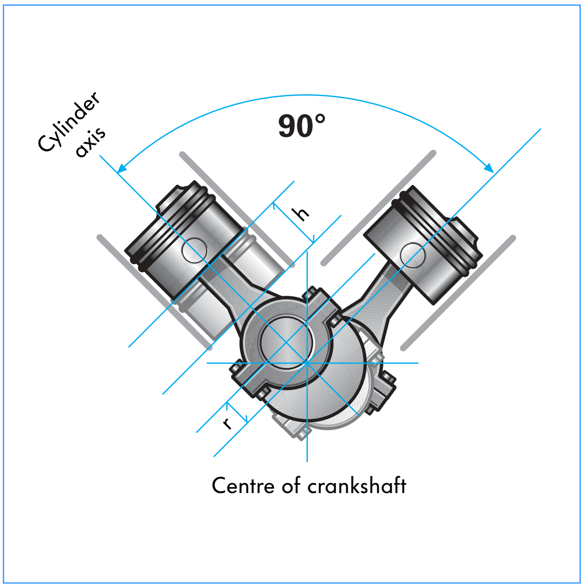
In the inline engine the piston is located directly above the centre of the crankshaft. The piston stroke (h) is therefore twice the crank radius (2xr). TDC and BDC are exactly 180° apart.



195_074 195_079

V-engine with an angle of 90°

In conventional V-engines the pistons in both banks of cylinders are aligned at 60° or 90° to one another. The centre lines of the cylinders nevertheless project through the centre of the crankshaft. The piston stroke is then twice the crank radius in this case, too. But the large V-angle also means the engine has a large overall width.

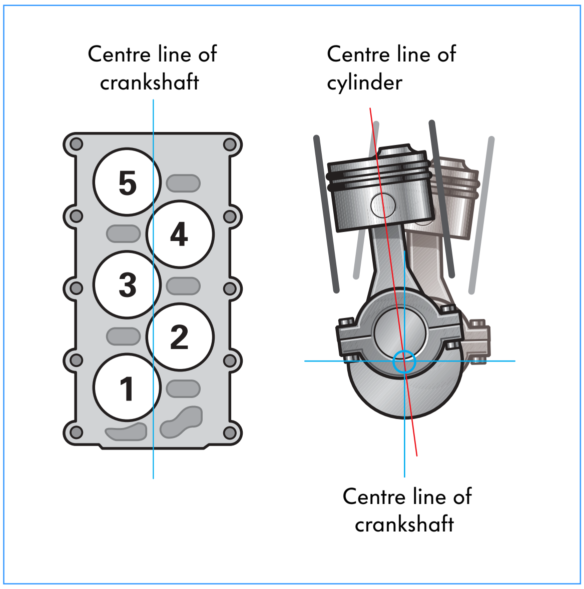


195_075

V5 engine with an angle of 15°

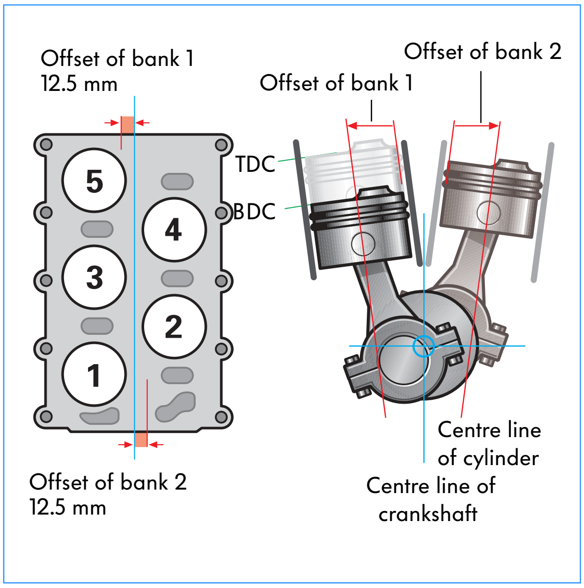
As a result of the V-angle of 15°, the V5 engine is not as wide as engines with an angle of 60° or 90°. The V5 engine can be mounted both longitudinally and transversely because it is shorter than an inline engine.

Several difficulties had to be overcome during the design process, since the 15° V-angle causes the cylinders to overlap at the bottom.



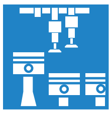
195_109 195_076

To avoid these overlaps, it was necessary to shift the cylinders slightly further outwards so as to increase the clearance between the cylinders. This process is known as "offsetting". In the V5 engine the offset of each bank of cylinders is 12.5 mm.
By offsetting the cylinders, their centrelines no longer project through the centre of the cranks-haft. As a result, the pistons travel i na different line from TDC to BDC than from BDC to TDC. Allowance has to be made for this difference when designing the crankpin throw to ensure that all cylinders have the same ignition point.



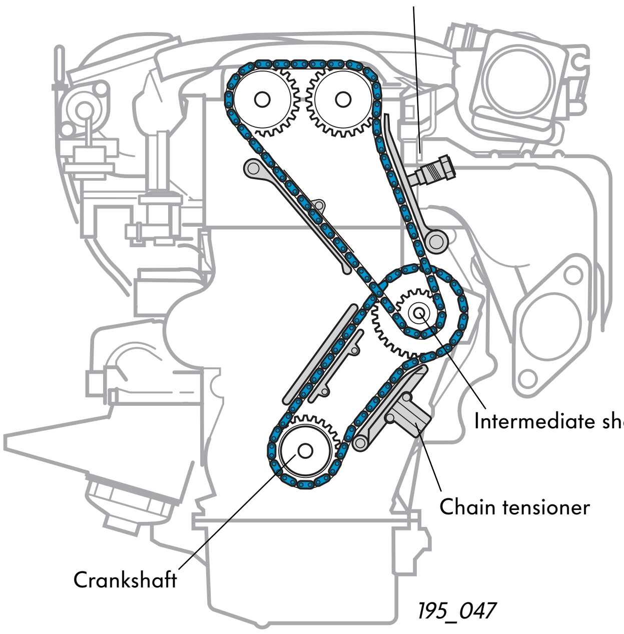
195_110 195_077

Engine mechanicals



The engine control unit

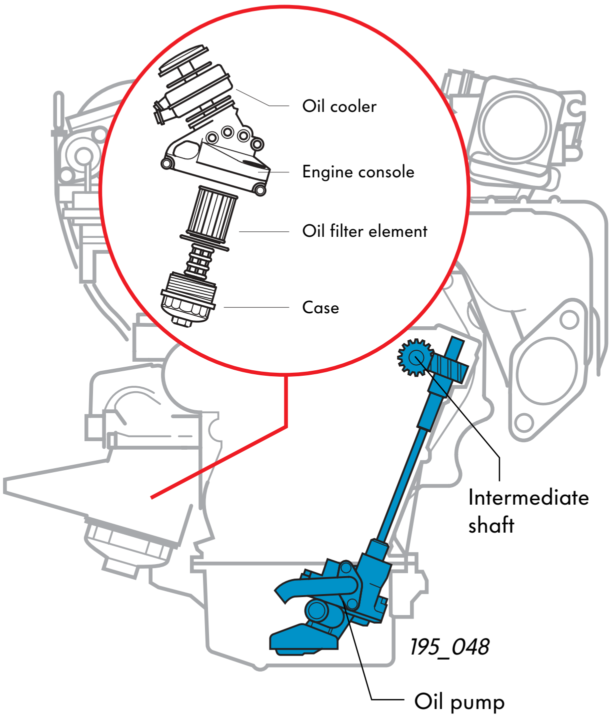
Running in 6 bearings, the crankshaft drives the intake camshaft by means of an intermediate shaft. The two chains are designed as single chains. Each chain has a tensioner actuated by the oil circuit.



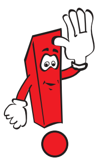
195_047

Engine lubrication

The oil pump is driven by the intermediate shaft. The oil cooler and oil filter are located in the engine console. When the oil filter is changed, only the paper filter element needs to be replaced.



195_048

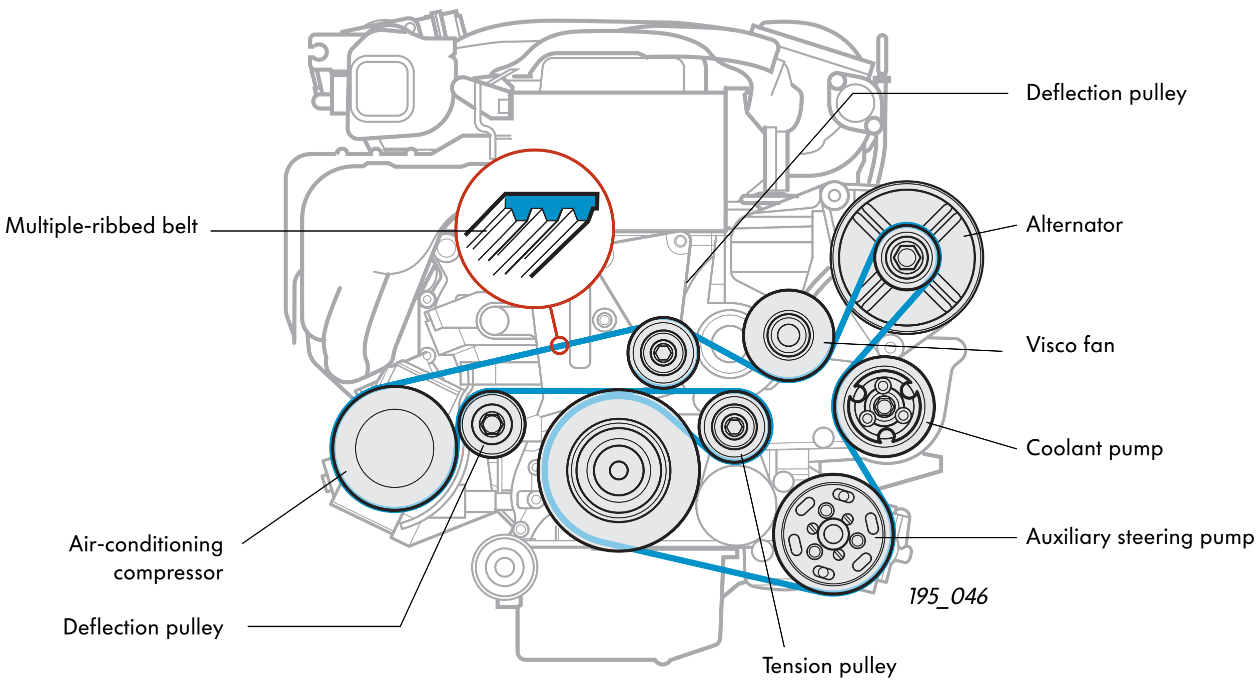


A different oil filter type is used for longitudinally and transversely mountinged engines (see page 34, Service).

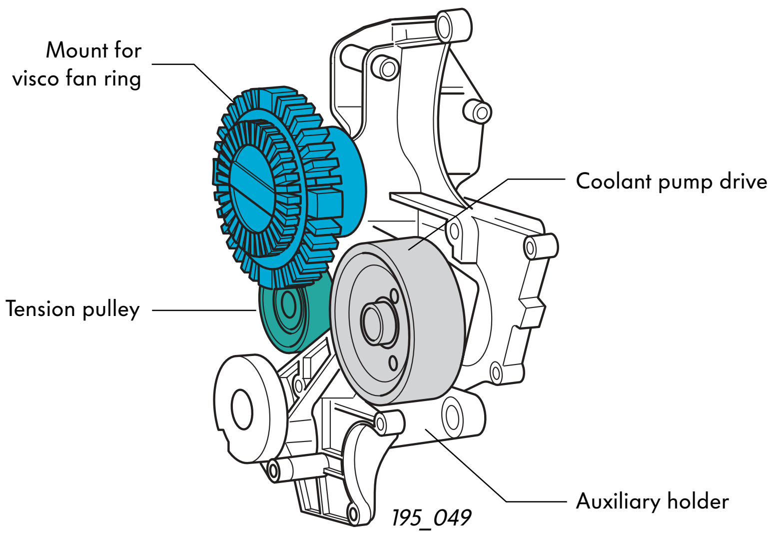
Drive for auxiliaries

The longitudinally and transversely mounted V5 engines have different drives for auxiliaries.

Belt routing of longitudinally mounted V5 with air-conditioning compressor

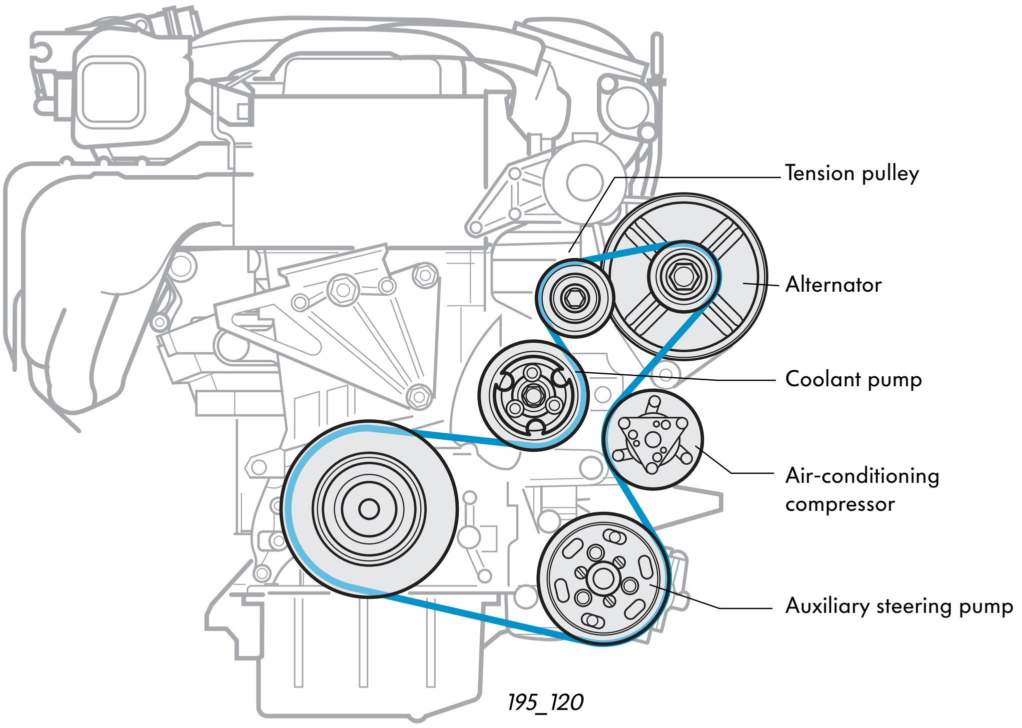


In the longitudinally mounted engine the coolant pump is located on the auxiliary holder.
As a result, this engine is slightly shorter than the transversely mounted engine.



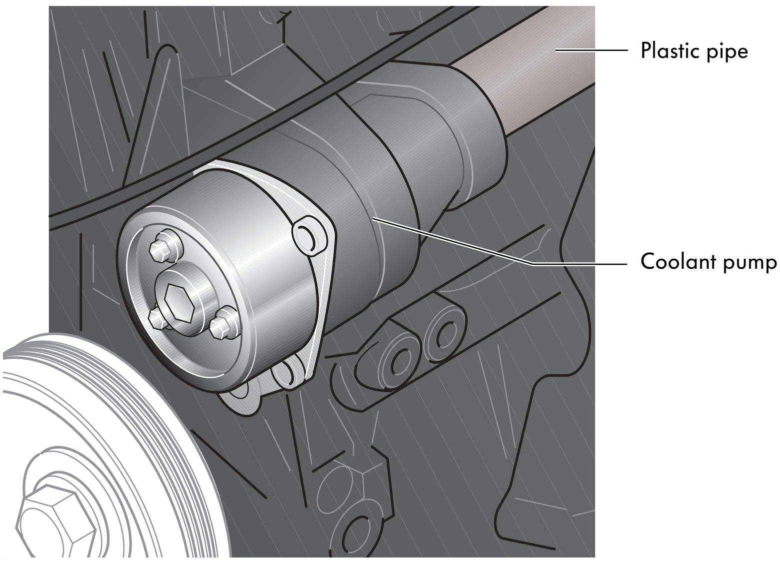
Engine design

Belt routing in the transversely mounted V5 engine with air-conditioning compressor



195_120

In the transversely mounted engine the coolant pump is integrated in the cylinder crankcase.



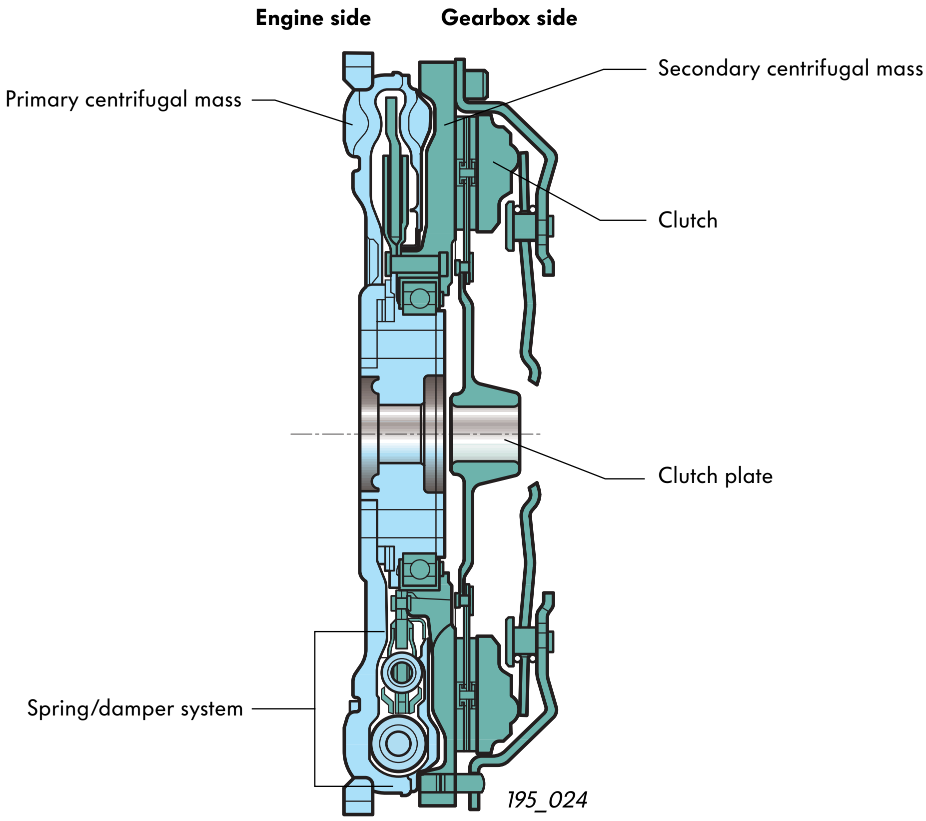
195_122

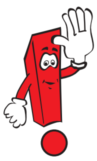
The flywheel

enables the crankshaft to rotate evenly due to its mass. It also acts as a clutch support. The clutch transmits engine torque to the gearbox.
The torsional oscillations of the engine in the low speed range in particular are transferred to the gearbox in the process.
This induces vibrations and consequently "gearbox rattle".

The dual-mass-flywheel

prevents torsional oscillations of the engine from being transmitted to the gearbox. As the name suggests, the dual-mass flywheel consists of two flywheel masses, a primary centrifugal mass and a secondary centrifugal mass.
They are interconnected by means of a spring/damping system.





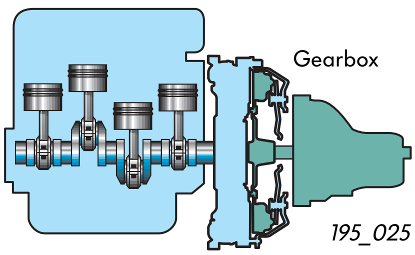
The dual-mass-flywheels for mounting the engines in the longitudinal and transverse positions differ from one another, since an intermediate plate is required to locate the gearbox for longitudinal mounting.

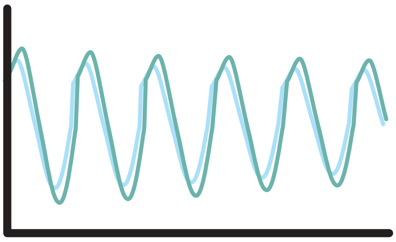
Engines with dual-mass flywheels have an engine oscillation system which is tuned differently to engines with conventional flywheels.
Therefore, never replace single-mass flywheels with dual-mass flywheels.

Power transmission

Engine and gearbox with conventional flywheel-clutch layout

Put simply, it can be said that a conventional fly-wheel is better at absorbing oscillations which an engine produces. But the remaining oscillations are transmitted fully to the gearbox, and this manifests itself as vibrations and noise in the low speed range.

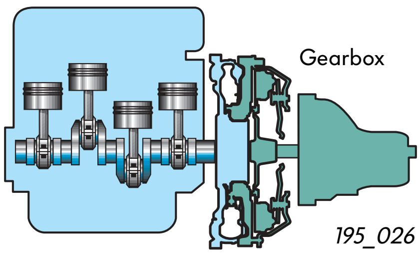


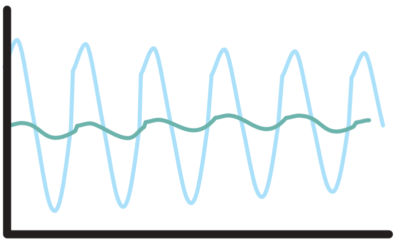


Oscillatory behaviour of the engine and gearbox at idling speed

Engine and gearbox with dual-mass flywheel

The dual-mass flywheel allows slightly more engine oscillation, due to its smaller centrifugal mass. In fact, the spring/damping system and the higher gearbox moment of inertia prevent these oscillations from being transmitted to the gearbox. This results not only in a much higher level of ride comfort, but also in less wear and higher fuel efficiency at low engine speeds.



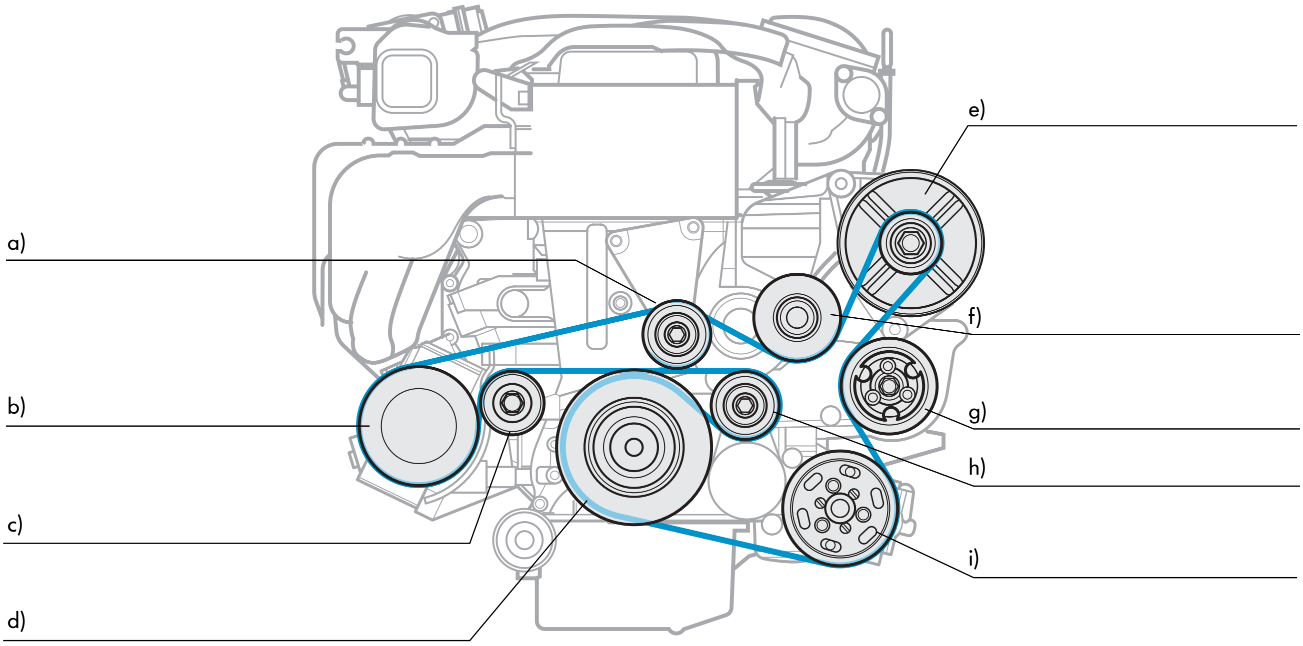


Oscillatory behaviour of the engine and gearbox at idling speed

1. The V5 engine has a V-angle of

☐ a) 15°,
☐ b) 60° or
☐ c) 90°.

2. Annotate the drawing.
What belt pulleys drive what units?



3. State the advantages of the dual-mass flywheel

☐ a) Higher ride comfort,
☐ b) Higher engine power,
☐ c) Less wear,
☐ d) Higher fuel efficiency at low engine speeds

Reasons:

Motronic injection and ignition system

Overview of Motronic M3.8.3 system

Sensors

G70 Air mass meter

G28 Engine speed sender

G40 Hall sender

G39 Lambda probe

G61 Knock sensor I

G66 Knock sensor II

G62 Coolant temperature sender

G72 Intake manifold temperature sender

J338 Throttle valve control unit with
F60 Idling switch
G69 Throttle valve potentiometer
G88 Throttle valve positioner potentiometer

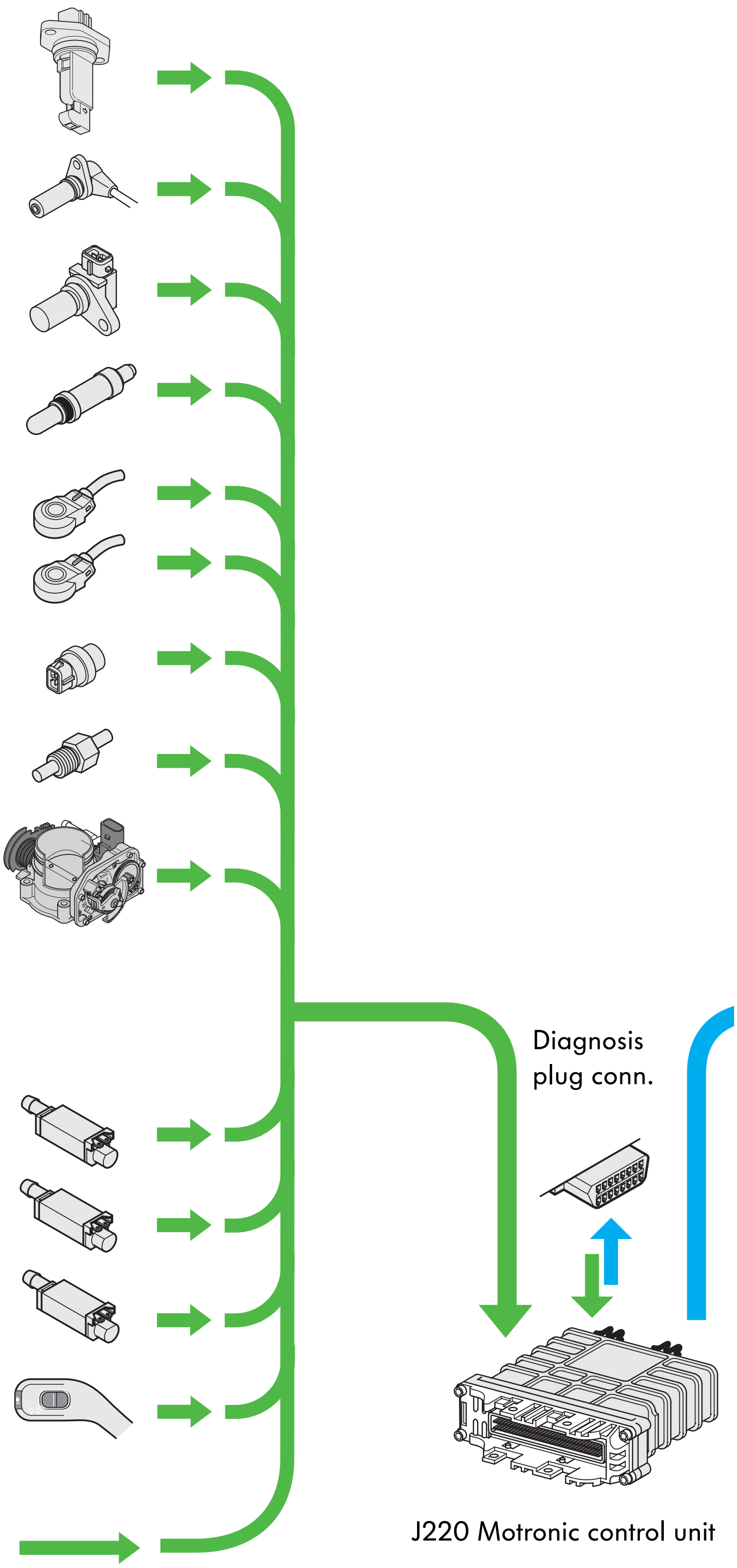
F Brake light switch

F36 Clutch switch

F63 Brake pedal switch

E45 Cruise control system switch
E227 Cruise control system button

Additional input signals
e.g. road speed signal



Actuators

G6 Fuel pump with
J17 Fuel pump relay

N30 Injector, cylinder 1
N31 Injector, cylinder 2
N32 Injector, cylinder 3
N33 Injector, cylinder 4
N83 Injector, cylinder 5

N122 Power end stage

N Ignition coil
N128 Ignition coil 2
N158 Ignition coil 3
N163 Ignition coil 4
N164 Ignition coil 5

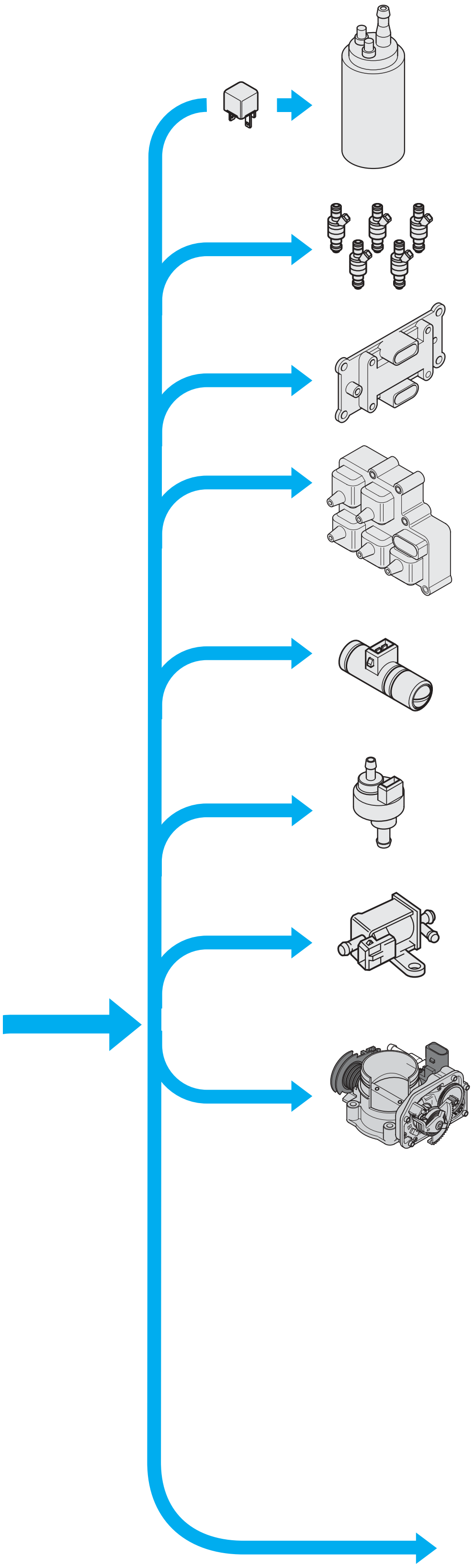
N79 Heater element
(crankcase breather valve)

N80 Solenoid valve 1 for
activated charcoal filter system

N156 Twin-path intake manifold change-over valve

J338 Throttle valve control unit with
V60 throttle valve positioner

Additional output signals,
e.g. to air-conditioning compressor

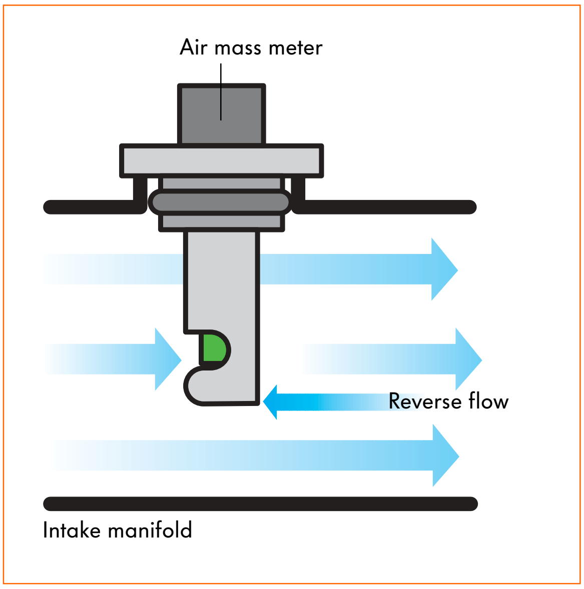


195_105

The air mass meter with reverse flow recognition

To guarantee optimal mixture composition and low fuel consumption, the engine management system needs to know exactly how much air the engine intakes.
The air mass meter supplies this information.

The opening and closing actions of the valves cause the air mass inside the intake manifold to flow in reverse.
The hot-film air mass meter with reverse flow recognition detects reverse flow of the air mass and makes allowance for this in the signal it sends to the engine control unit. Thus, the air mass is metered very accurately.

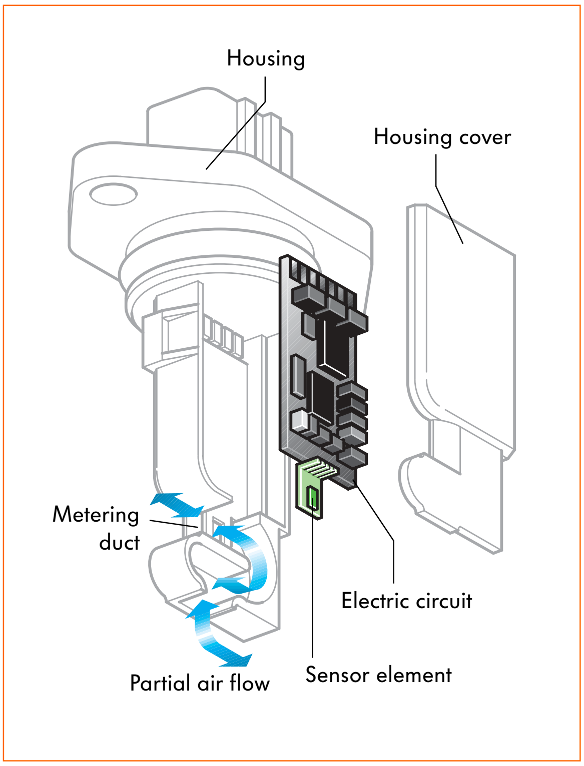


195_094

Design

The electronic circuit and the sensor element of the air mass meter are accommodated in a compact plastic housing.

Located at the lower end of the housing is a meter-ing duct into which the sensor element projects.
The metering duct extracts a partial flow from the air stream inside the intake manifold and guides this partial flow past the sensor element.
The sensor element measures the intake and reverse air mass flows in the partial air flow.
The resulting signal for the air mass measurement is processed in the electronic circuit and sent to the engine control unit.

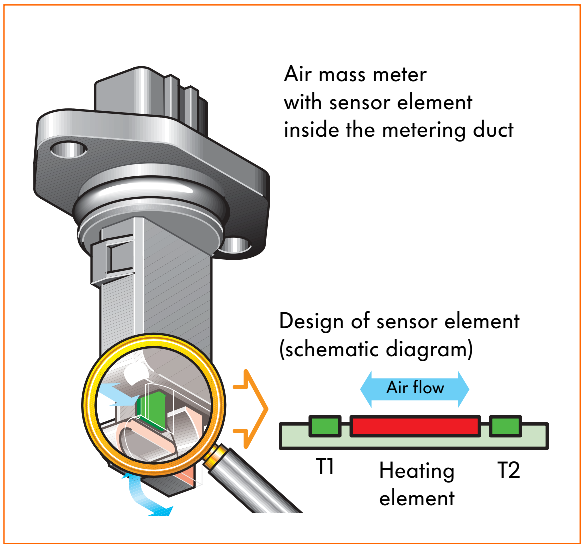


195_092

Functional principle

Mounted on the sensor element are two temperature sensors (T1 + T2) and a heating element.

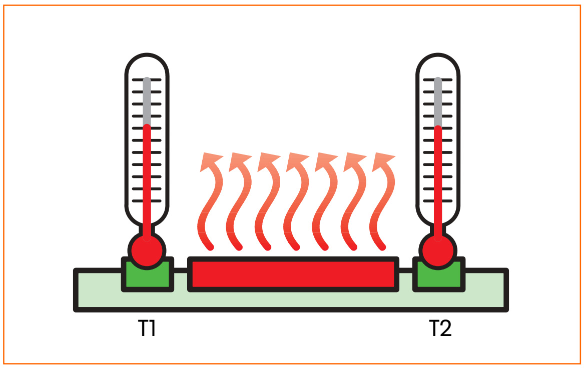
The substrate to which the sensors and heating element are attached is composed of a glass membrane. Glass is used because of its poor thermal conductivity. This prevents heat which the heating element radiates from reaching the sensors through the glass membrane. This can result in measurement errors.



195_041

The heating element warms up the air above the glass membrane.

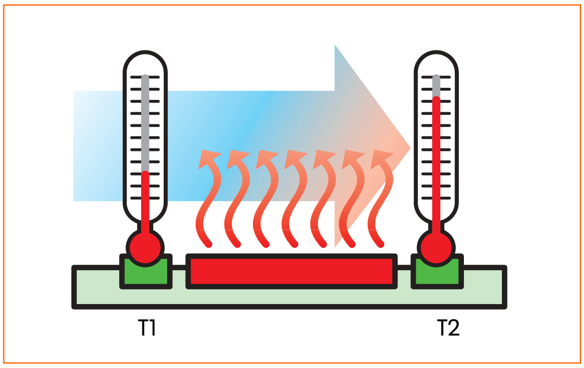
The two sensors register the same air temperature, since the heat radiates uniformly without air flow and the sensors are equidistant from the heating element.



195_042

Induced air mass recognition

In the intake cycle, an air stream is ducted from T1 to T2 via the sensor element.
The air cools sensor T1 down and warms up when it passes over the heating element, with the result that sensor T2 does not cool down to as great an extent as T1.
The temperature of T1 is therefore lower than that of T2. This temperature difference sends a signal to the electronic circuit that air induction has occurred.



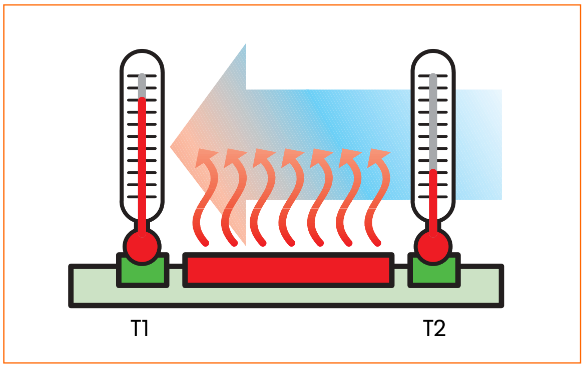
195_043

Motronic injection and ignition system

Reverse air mass flow recognition

If the air flows over the sensor element in the opposite direction, T2 will be cooled down to a greater extent than T1. From this the electric circuit recognises reverse flow of the air mass. It subtracts the reverse air mass flow from the intake air mass and signals the result to the engine control unit.

The engine control unit therefore obtains an electrical signal: it indicates the actual induced air mass and is able to meter the injected fuel quantity more accurately.



195_044

Signal utilisation

The signal which the air mass meter sends is used to calculate all speed- and load-dependent functions, e.g. injection time, ignition timing or tank venting.

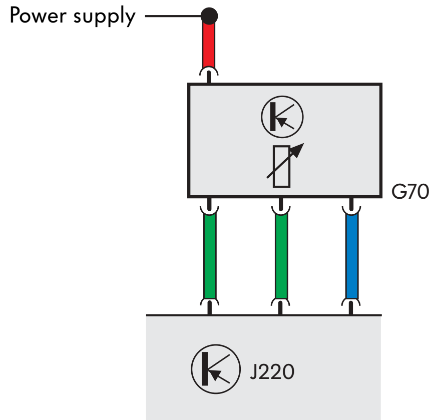
Electric circuit

The air mass meter is connected to the engine control unit via two signal lines and one earth line and is supplied with power via connection 87a in the engine wiring harness.

Effects of signal failure

In the event of failure of the air mass meter, the engine management system computes a substitute value. This emergency function is so well adapted that the fitter cannot tell from the running behaviour of the engine whether the air mass meter is defective. This can only be done by reading out the fault memory.

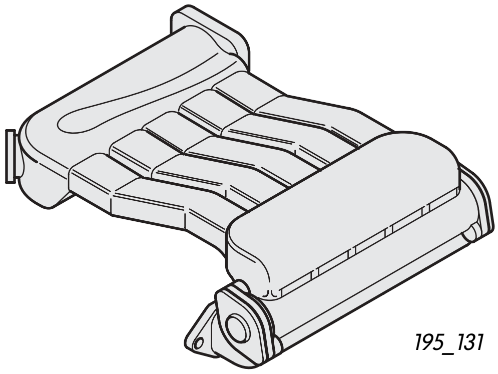
This means that the defect will be detected at the latest during the exhaust emission test which takes place every two years if not during the routine service checks.



195_111

The twin-path intake manifold

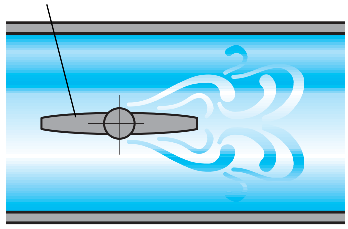
Twin-path intake manifolds are a new development. Their task is to develop high low-end torque by means of the long port in the intake manifold and deliver high top-end power by means of the short port in the intake manifold. In contrast to previous systems, change-over of the intake manifold paths in the V5 engine is performed by a rotary valve instead of change-over valves.



195_131

Air flow when using change-over valve

The change-over valves are housed in the intake port. As a result, they change the flow cross-section and the flow behaviour of the intake air inside the port. Turbulence occurs even if the valves are fully open.



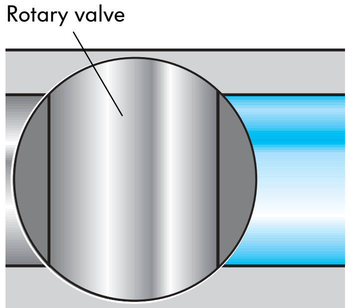
195_022

Turbulence during valve control

Advantage of using a rotary valve

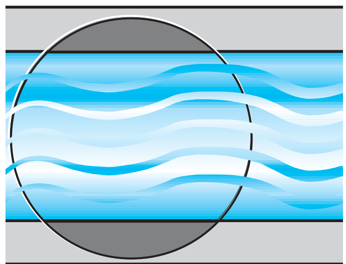
The advantage of using a rotary valve instead of a valve actuator is it ensures optimal flow behaviour of the air drawn into the intake manifold.

The shape of the rotary valve replicates the cross-section of the intake duct.
Air-flow behaviour is not impaired when the rotary valve is open.
As opposed to the valve actuator, turbulence does not occur.



195_108

Closed rotary valve



195_023

An optimal flow characteristic is achieved when the rotary valve is open

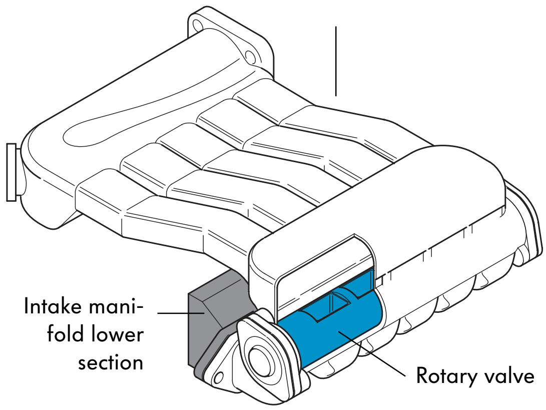
Motronic injection and ignition system

On closer examination it can be seen that the processes taking place inside the twin-path intake manifold are more complex than at first meet the eye. We will therefore devote this section to explaining the functional principle of the intake manifold, beginning with its design.

Design

The intake manifold comprises an intake manifold upper section together with the torque ports, performance ports and rotary valves, and the intake manifold lower section.

In longitudinally and transversely mounted engines the intake manifold is made of aluminium or plastic respectively.
Plastic is the preferred material for transversely mounted engines. This is because the intake manifold shatters when it collides with the engine compartment bulkhead in a crash and prevents the engine from intruding into the passenger compartment.



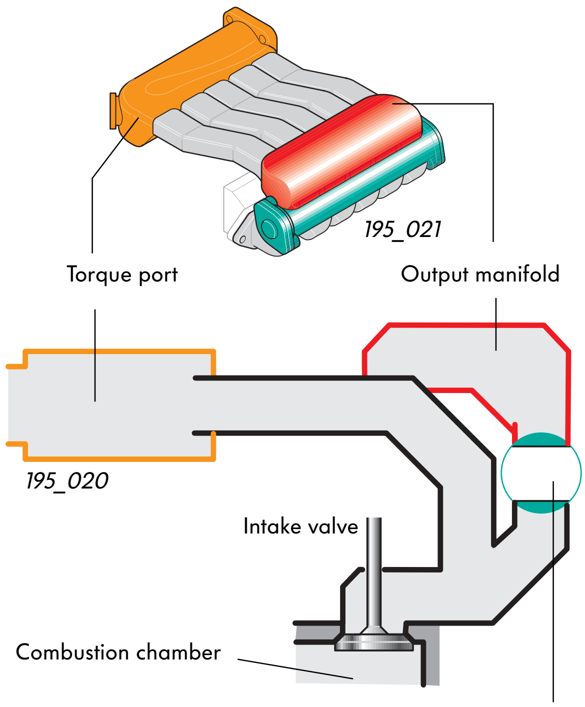
195_089

The intake manifold of the V5 engine is based on the ram pipe charge principle.

Was does this mean?

The key components of the twin-path intake manifold are the torque ports and the performance ports. As their name already suggests, the ports are designed to collect something.
Indeed, they collect air and produce what is known as the "self-charging effect".

This effect arises from the propagation of pressure waves or oscillations inside the intake manifold. The name "ram pipe charging" is derived from this.



195_021

195_020

Actuation

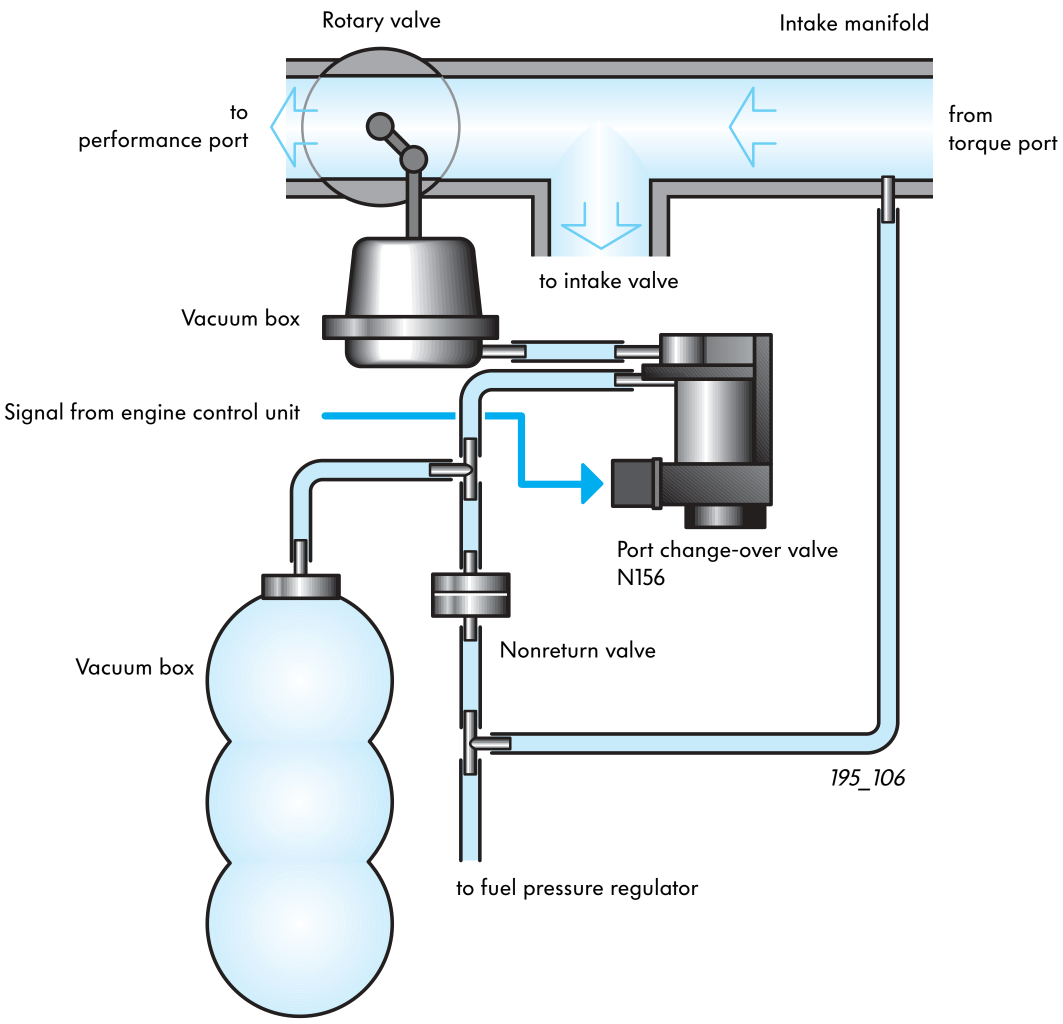
Change-over is speed- and load-dependent. The engine control unit activates the solenoid valve for changing over the ports in the intake manifold.
This valve admits a partial pressure into the vacuum box. The vacuum box in turn actuates the rotary valve and ensures smooth change-overs even at high revs. The non-return valve prevents the vacuum box from being vented if pressure fluctuations occur inside the intake manifold.

Position of the twin-path intake manifold

Change-over takes place:
up to approx. 900 rpm
Idling/performance position = short intake manifold

as of approx. 900 rpm
Torque position = long intake manifold

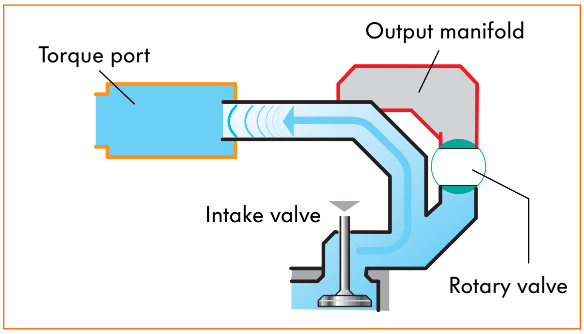
above approx. 4300 rpm
Performance position = short intake manifold



195_106

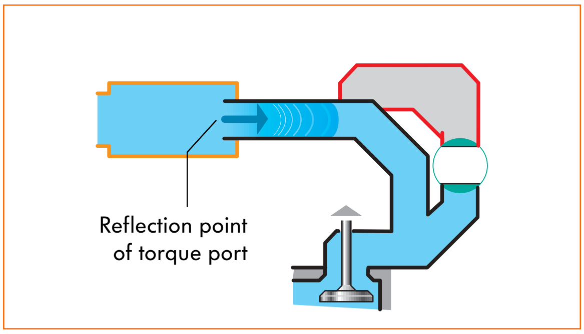
Functional principle

After combustion has taken place, there is a pressure differential between the cylinder and intake manifold.
When the intake valve opens, an intake wave forms inside the intake manifold and propagates from the inlet port towards the torque port at the speed of sound.



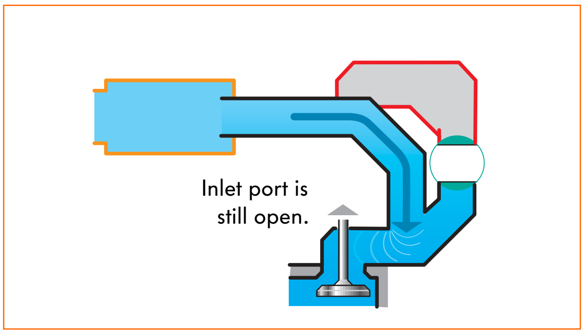
195_011

The open end of the pipe in the torque port has the same effect on the intake wave as a solid wall has on a ball. The wave is reflected and propagates back to the inlet port in the form of a pressure wave.



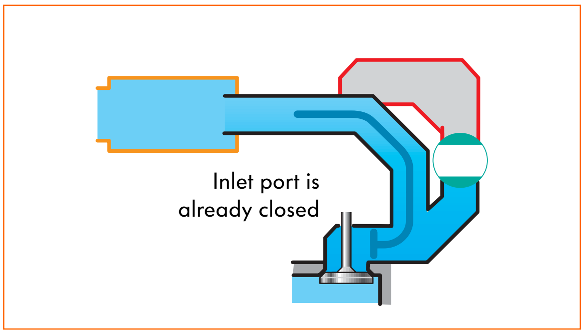
195_012

At an optimal intake manifold length, the max. pressure reaches the inlet port shortly before it closes.
The pressure wave enables more air to be admitted into the cylinder, and improves the amount of fuel-air mixture in the cylinder.
This is what's called the self-charging effect.



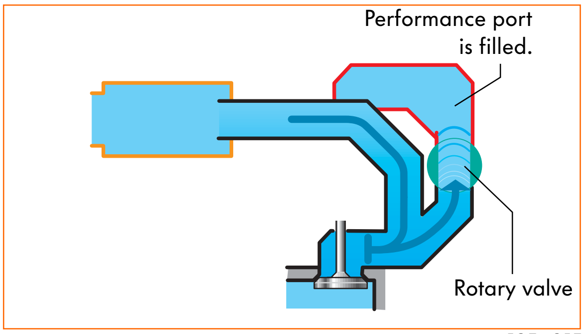
195_013

As engine speed increases, the pressure wave has less time to reach the inlet port. Because the pressure wave is only able to propagate at the speed of sound, it reaches the inlet port too late. It is already closed.
Self-charging does not take place.
This problem can be solved by shortening the intake manifold.



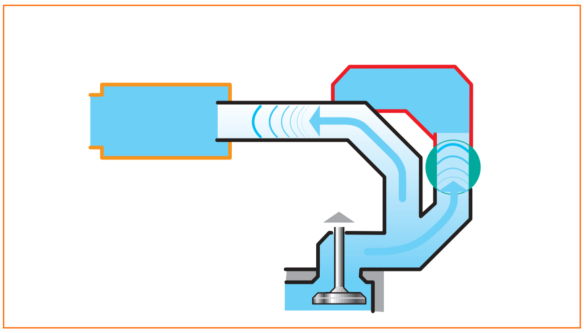
195_014

In the V5 engine, the rotary valve turns to the performance position at an engine speed of 4300 rpm. This opens up the path to the performance port. The performance port is designed so that the intake and pressure waves follow a shorter path to the inlet port.
The performance port is filled with air when the inlet ports are closed.



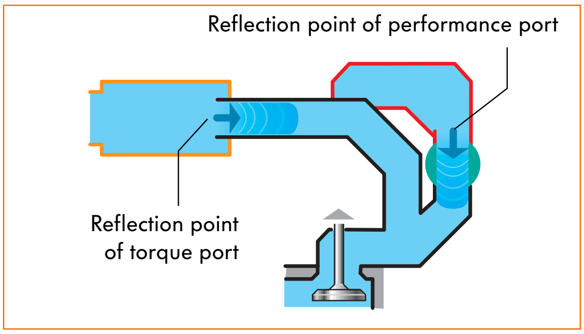
195_015

When the inlet port opens, an intake wave propagates uniformly inside the intake manifold.



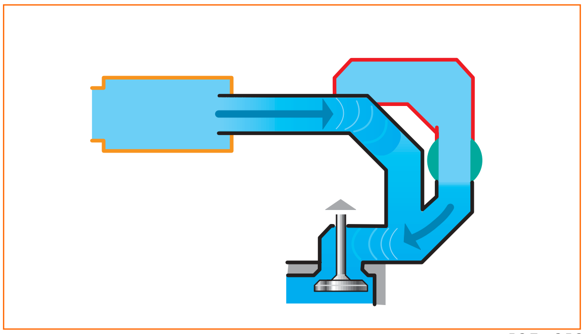
195_016

The intake wave reaches the pipe end in the performance port before it does in the torque port. There it is reflected and returns to the inlet port.



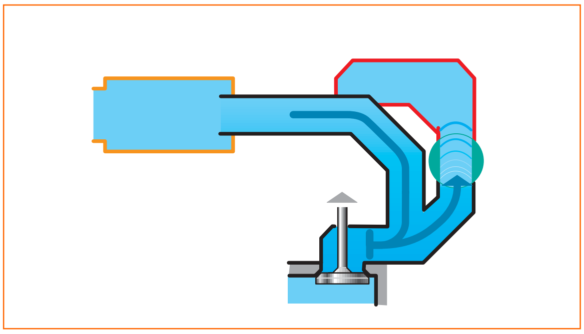
195_017

Unlike the pressure wave which propagates back from the torque port, the intake wave arrives before the inlet port closes. It therefore has a self-charging effect.



195_019

The wave arriving too late from the torque port is reflected by the closed injectors and fills the performance port.



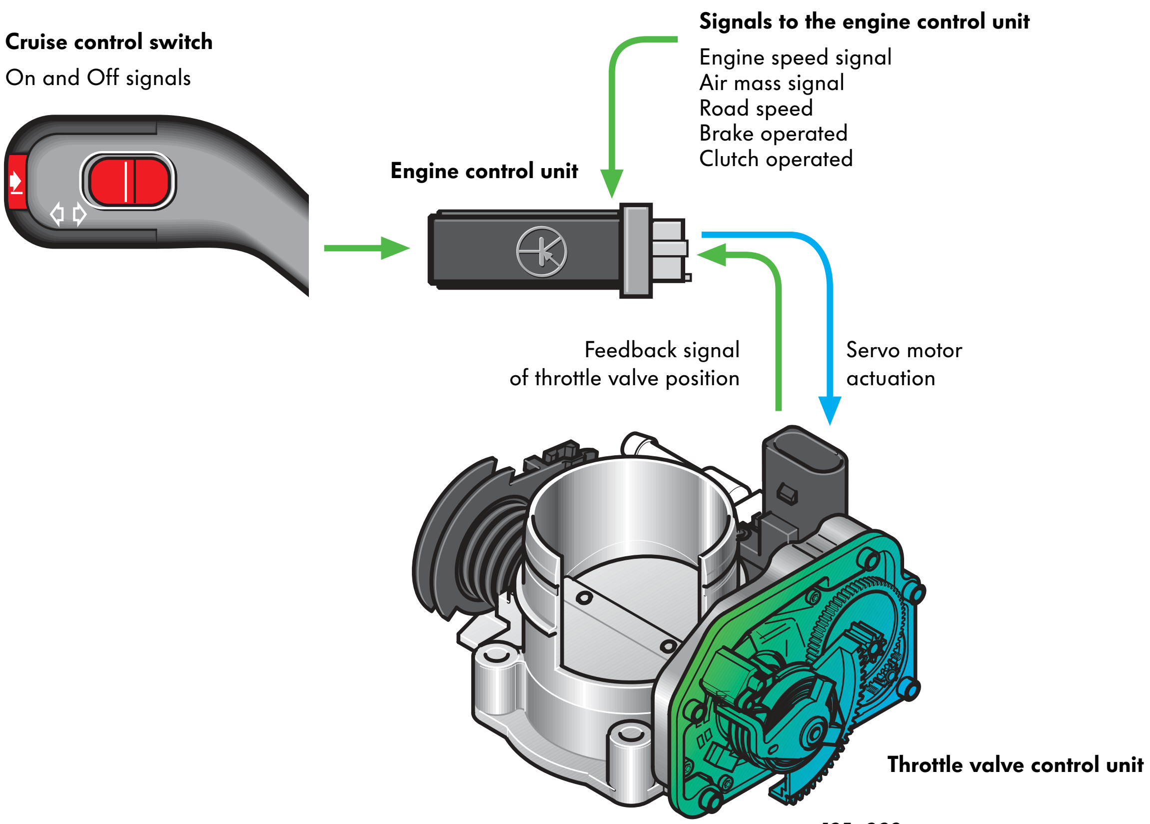
Motronic injection and ignition system

Cruise control

Cruise control enables the driver to set a constant road speed of 45 kph and above. Once activated, cruise control maintains the set speed regardless of topography without the driver having to press the accelerator pedal.

In the previous system the throttle valve was opened electro-pneumatically depending on the set road speed.

The signal which the cruise control switch generates is transmitted to the engine control unit, which in turn activates the throttle valve control unit. A control unit for cruise control is no longer needed.
The throttle valve positioner opens the throttle valve depending on the road speed setting.



195_093

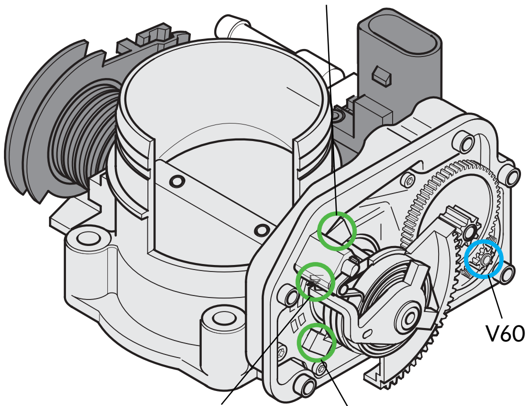
Cruise control only operates at a road speed of 45 kph or above.

The throttle valve control unit

Volkswagen has been fitting the throttle valve control unit to its engines since early 1995. After it is activated by the engine control unit, the throttle valve control unit regulates idling speed. You will find further information on this in SSP 173.

The component parts are:

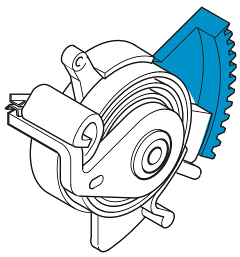
- Idling switch F60,
- Throttle valve potentiometer G69,
- Throttle valve positioner potentiometer G88,
- Throttle valve positioner V60.



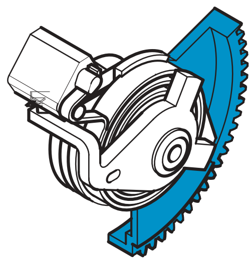
195_054

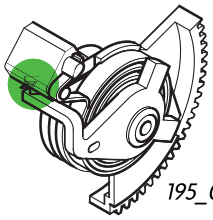
The throttle valve control unit also actuates the throttle valve while the cruise control is switched on.
Apart from minor differences, the new throttle valve control unit has the same design as the old one.
The main difference is that the gearwheel segment is larger. This enables the servo motor to operate the throttle valve across the full adjustment range.

Gearwheel segment without cruise control


195_055

Gearwheel segment with cruise control


195_056

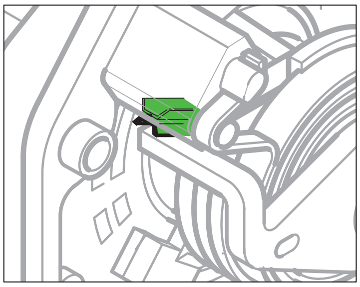


195_057

Idling switch F60

Signal utilisation

When the idling switch is closed, the engine management system knows that the engine is idling.

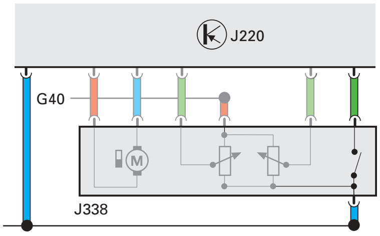


195_061

Effects of signal failure

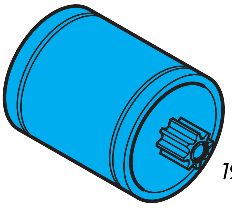
In the event of signal failure, the values of the engine management potentiometer are used to detect when the engine is idling.

Electric circuit



195_073

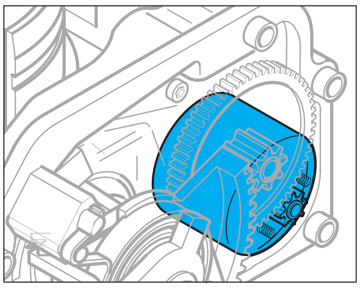
The idling switch utilises the sensor earth of the engine control unit.



195_060

Throttle valve positioner V60

The throttle valve positioner is an electric motor and has the capability to actuate the throttle valve over the full throttle valve operating range.



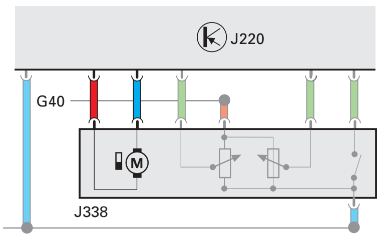
195_064

Effects of failure

To control idling, the emergency running spring draws the throttle valve into the emergency running position.

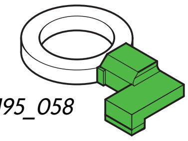
The cruise control fails.

Electric circuit



195_070

V60 is activated by the engine control unit.



195_058

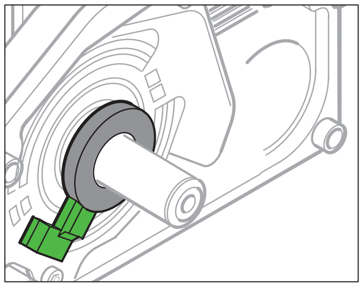
Throttle valve potentiometer G69

Signal utilisation

This potentiometer enables the engine control unit to recognise the position of the throttle valve.

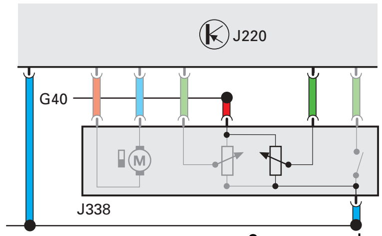
Effect of signal failure

If the engine control unit does not receive a signal from this potentiometer, it will compute a substitute value based on engine speed and the signal which the air mass meter sends.



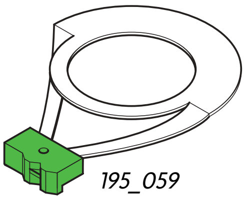
195_062

Electric circuit



195_072

G69 utilises the sensor earth of the engine control unit. The voltage supply is identical to that of G88.



195_059

Throttle valve positioner potentiometer G88

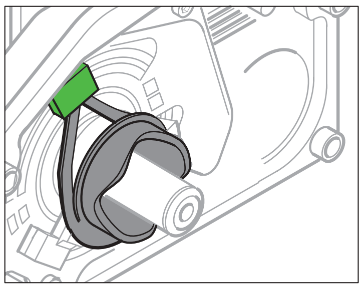
Signal utilisation

This potentiometer signals the position of the throttle valve drive to the engine control unit.

Effect of signal failure

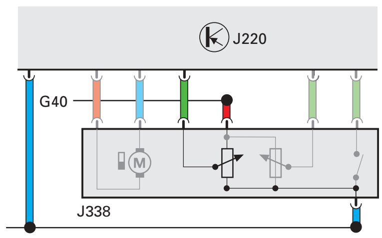
If this signal is not received, the idling control goes into an emergency mode. A higher idling speed indicates this.

The cruise control fails.



195_063

Electric circuit



195_071

Motronic injection and ignition system

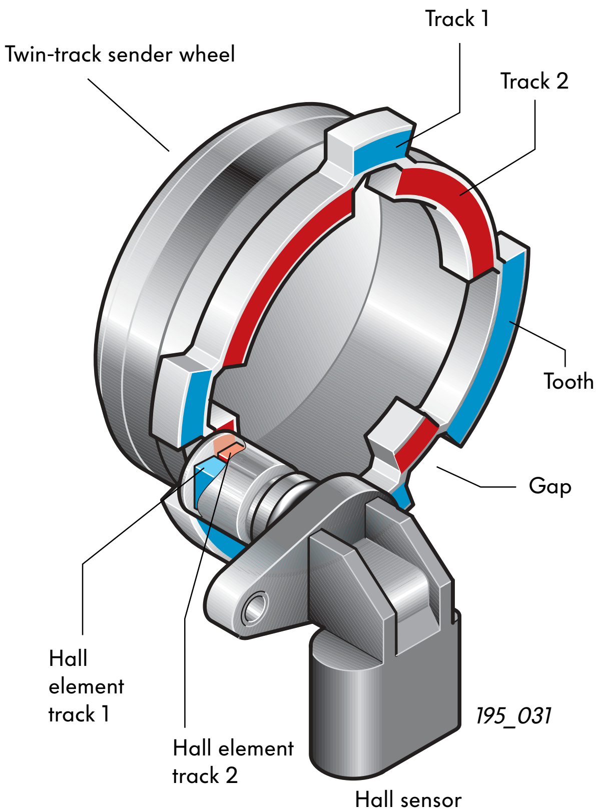
The quick-start sender wheel

is secured to the camshaft. The signal it sends enables the engine control unit to recognise more quickly the position of the camshaft in relation to the crankshaft and, in conjunction with the signal which the engine speed sender generates, to start the engine more quickly.

In previous systems the first combustion cycle was initiated after a crank angle of approx. 600-900°. The quick-start sender wheel enables the engine control unit to recognise the position of the crank-shaft in relation to the camshaft after a crank angle of only 400-480°.
As a result, the first combustion cycle can be initiated sooner and the engine starts more quickly.

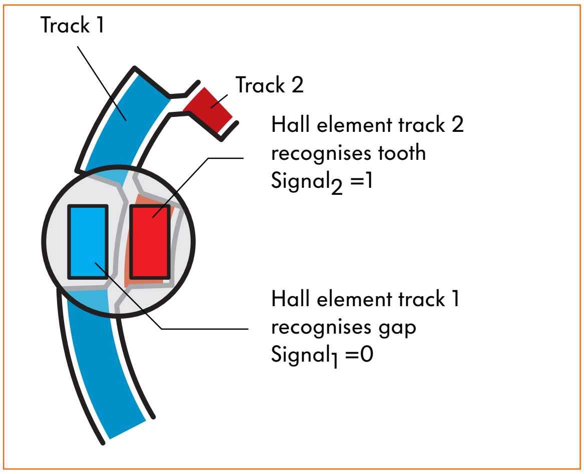
The quick-start sender wheel consists of a twin-track sender wheel and a Hall sensor.
The sender wheel is designed with two tracks located side by side. Where one track has a gap, the other track has a tooth.

The Hall sensor comprises two Hall elements located side by side.
Each Hall element scans a single track. This device is known as a differential Hall sensor because the engine management system compares the signals of the two elements.

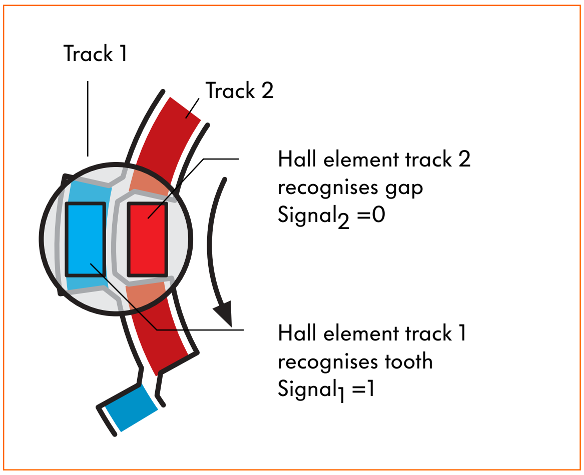


Function

The sender wheel is designed so that the two Hall elements never generate the same signal. When Hall element 1 is facing a gap, Hall element 2 is always facing a tooth.
Hall element 1 therefore always generates a different signal to Hall element 2.
The control unit compares the two signals and is thus is able to recognise the cylinder at which the camshaft is located.
Using the signal which the engine speed sender G28 generates, the injection cycle can be initiated after a crank angle of approx. 440°.



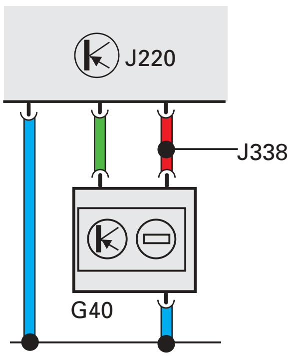
195_032



195_033

Electric circuit

The Hall sender G40 is connected to sensor earth of the engine control unit. If the Hall sender fails, the engine cannot be restarted.

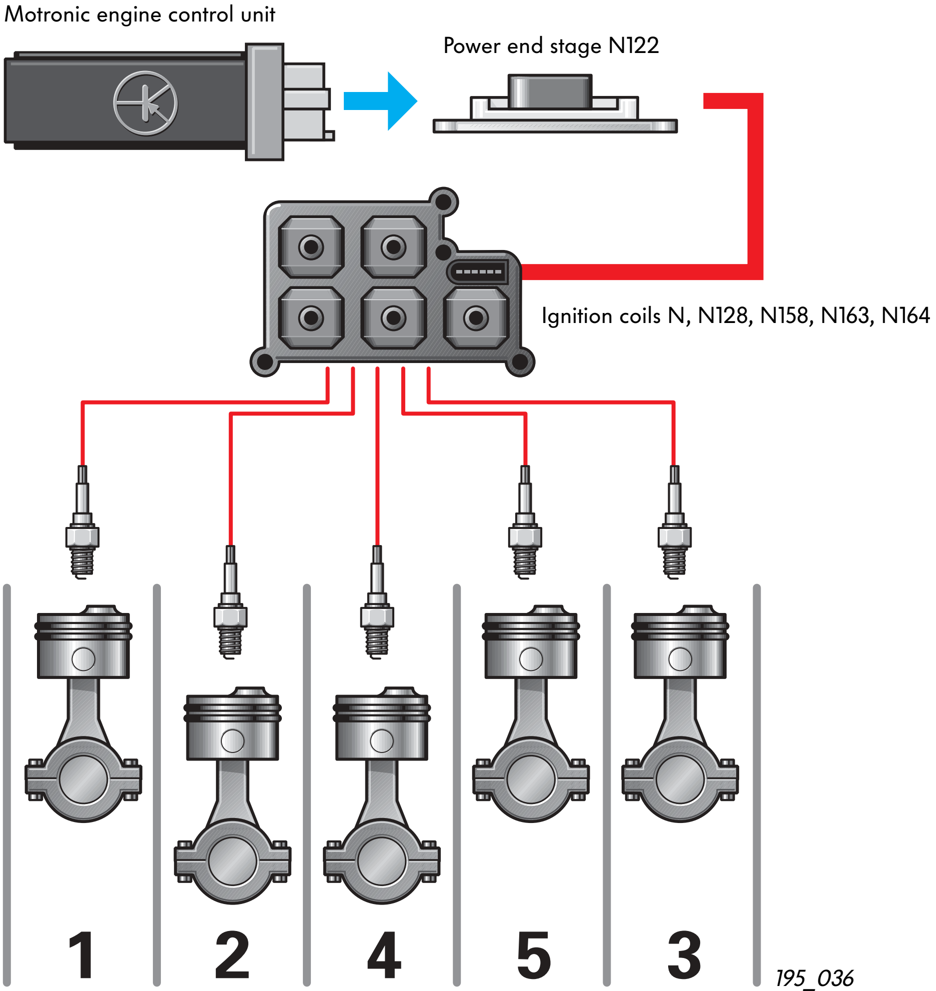


195_069

Motronic injection and ignition system

The ignition system

The V5 engine is equipped with a static high voltage distributor.
Due to the uneven number of cylinders, the V5 utilises a power end stage with a single ignition coil for each cylinder. The ignition coils are grouped together in a single module.



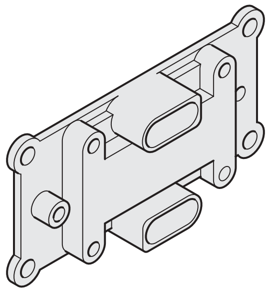
195_036

Advantages:

- No wear
- High reliability

Power end stage N122

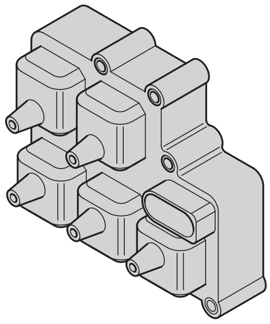
Each of the five ignition output stages "pumps" a high amperage into the ignition coils to ensure that there is enough power to produce the ignition spark.



195_090

Ignition coils N, N128, N158, N163, N164

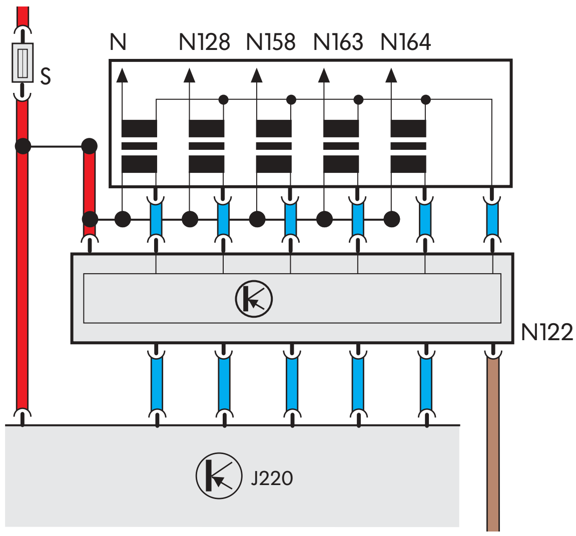
Due to the uneven number of cylinders, it was not possible to use twin ignition coils for the ignition system as in the case of the VR6 engine.



195_097

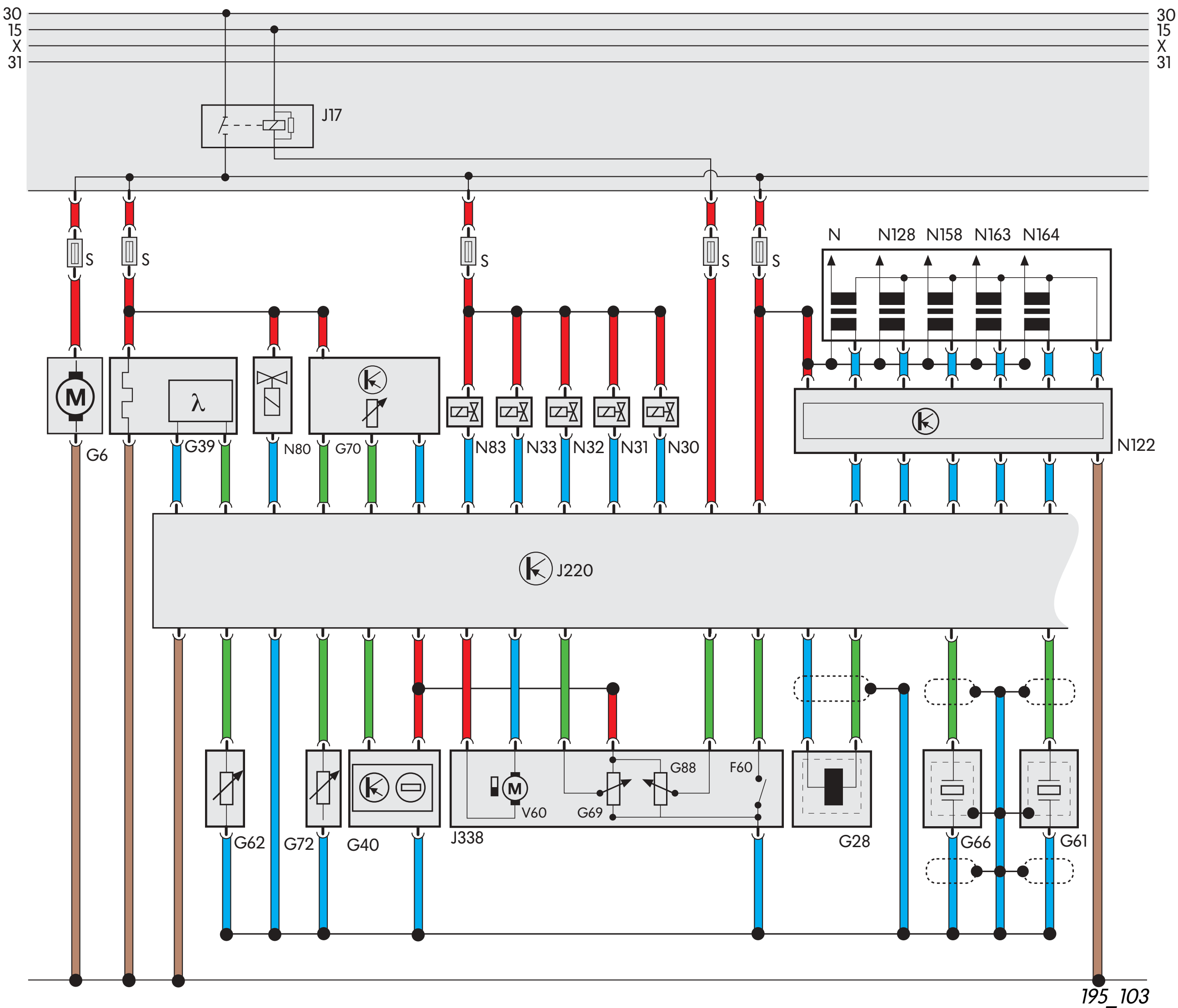
Electric circuit

The power end stage, together with the ignition coils and the engine control unit, are supplied with power via the fuel pump relay J17. Each cylinder has its own ignition output stage and therefore also has an output wire from the engine control unit.



195_116

Function diagram



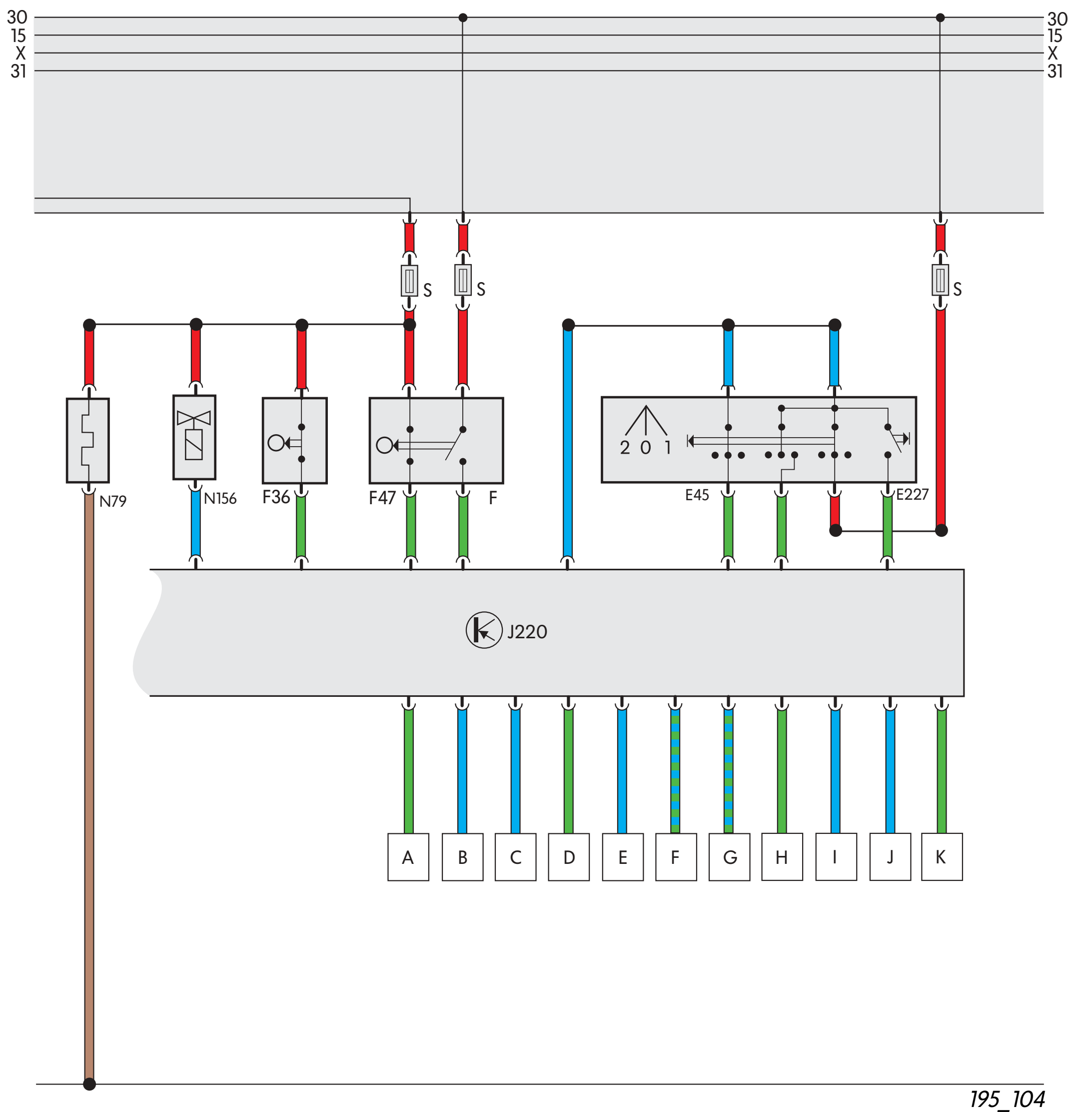
Components

F60 Idling switch

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
G69 Throttle valve potentiometer
G70 Air mass meter
G72 Intake manifold temperature sender
G88 Throttle valve positioner potentiometer

J17 Fuel pump relay
J220 Motronic control unit
J338 Throttle valve control unit

N30 Injector, cylinder 1
N31 Injector, cylinder 2
N32 Injector, cylinder 3
N33 Injector, cylinder 4
N80 Solenoid valve 1 for activated charcoal filter system
N83 Injector, cylinder 5
N Ignition coil 1
N122 Power end stage
N128 Ignition coil 2
N158 Ignition coil 3
N163 Ignition coil 4
N164 Ignition coil 5
V60 Throttle valve positioner



195_104

Components

E45 Cruise control system switch
E227 Cruise control system button (set)

F Brake light switch
F36 Clutch switch
F47 Brake pedal switch for cruise control

G70 Air mass meter

J220 Motronic control unit

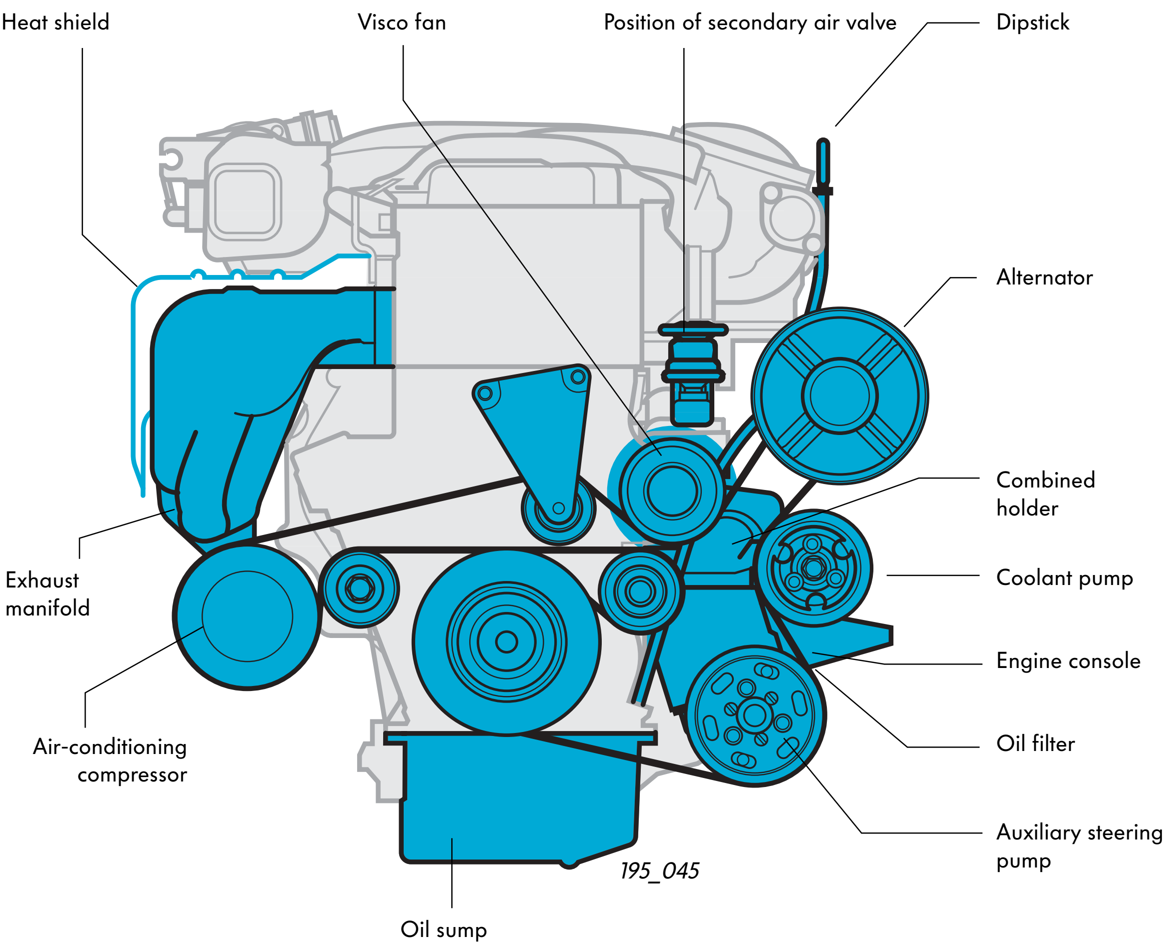
N79 Heater element (crankcase breather)
N156 Intake manifold change-over valve

A Road speed signal
B Fuel consumption indicator signal
C Engine speed signal
D Air conditioning on standby
E Throttle valve position signal
F Diagnostics/immobiliser data wire
G Air-conditioning compressor
H Automatic gearbox signal
I ABS/EDL data line
J ABS/EDL data line
K Automatic gearbox signal

Longitudinal and transverse mounting

Please note that the add-on parts of the V5 engine for longitudinal and transverse mounting are very different.

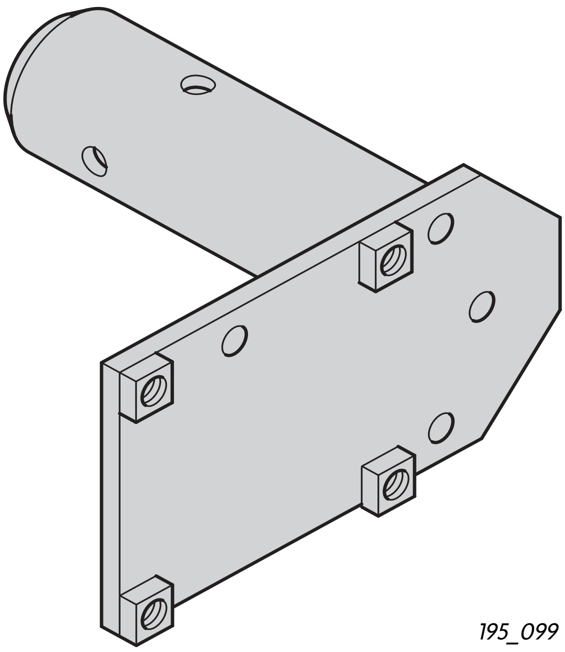
The parts highlighted in blue indicate where the V5 engine intended for longitudinal mounting shown below differs from the engine intended for transverse mounting.



Special tools

For the V5 engine, additional holes must be drilled in special tools Engine Holder 3269 and Counter-holder 3406.

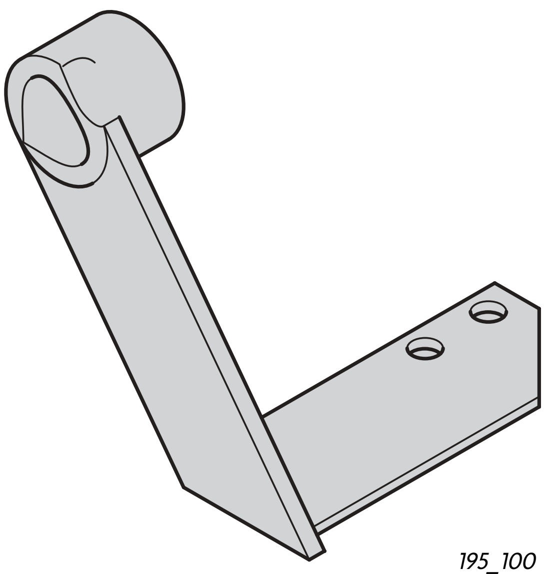
For Engine Holder 3269, mark three drill-holes from the centre outwards. Please note that holes may only be drilled for the engine which has code AGZ, i.e. the longitudinally mounted engine.



195_099

For Counter-holder 3406, position the drill-holes in parallel with the existing drill-hole.

Then seal the surface of the special tool with corrosion inhibitor.



195_100

Self-diagnosis

You can select the following functions in the self-diagnosis:

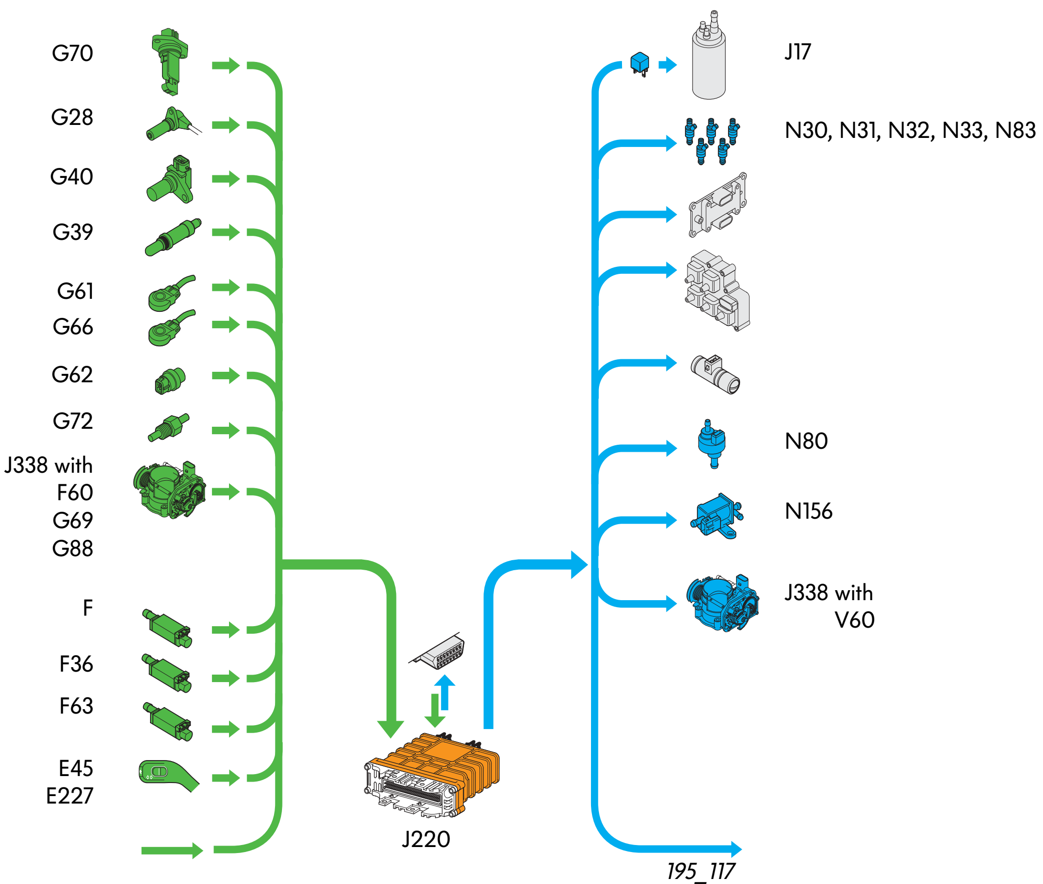
01 Interrogate control unit version
02 Interrogate fault memory
03 Actuator diagnosis
04 Basic adjustment
05 Erase fault memory
06 End of output
07 Encode control unit
08 Read measured value block
10 Adaptation

Basic adjustment must be performed after completing the following work:

- Engine control unit,
- Throttle valve control unit,
- replace engine or
- disconnect battery terminals

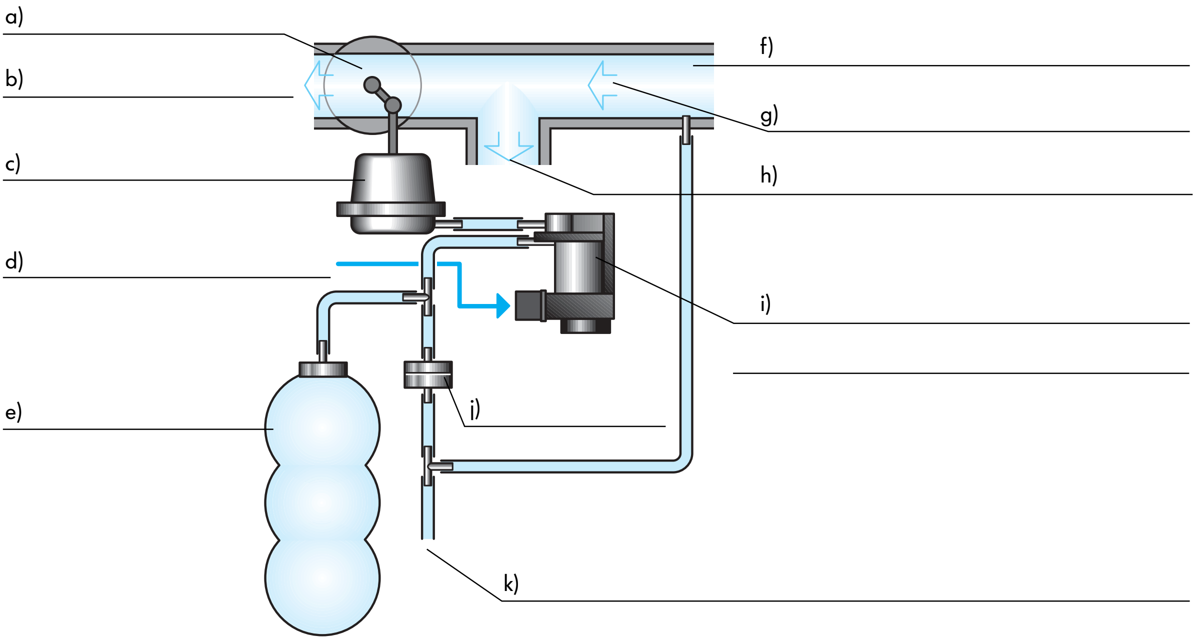
Function 02 Interrogate fault memory

The self-diagnosis stores faults in the components highlighted below in the fault memory. These faults can be read using fault reader V.A.G. 1551 or V.A.G. 1552.



1. What is the special feature of the new hot-film air mass meter?

2. Annotate the following drawing.



3. Why does the engine start more quickly with a quick-start sender wheel?

4. What is a performance port and what purpose does it serve?

Notes

Solutions:

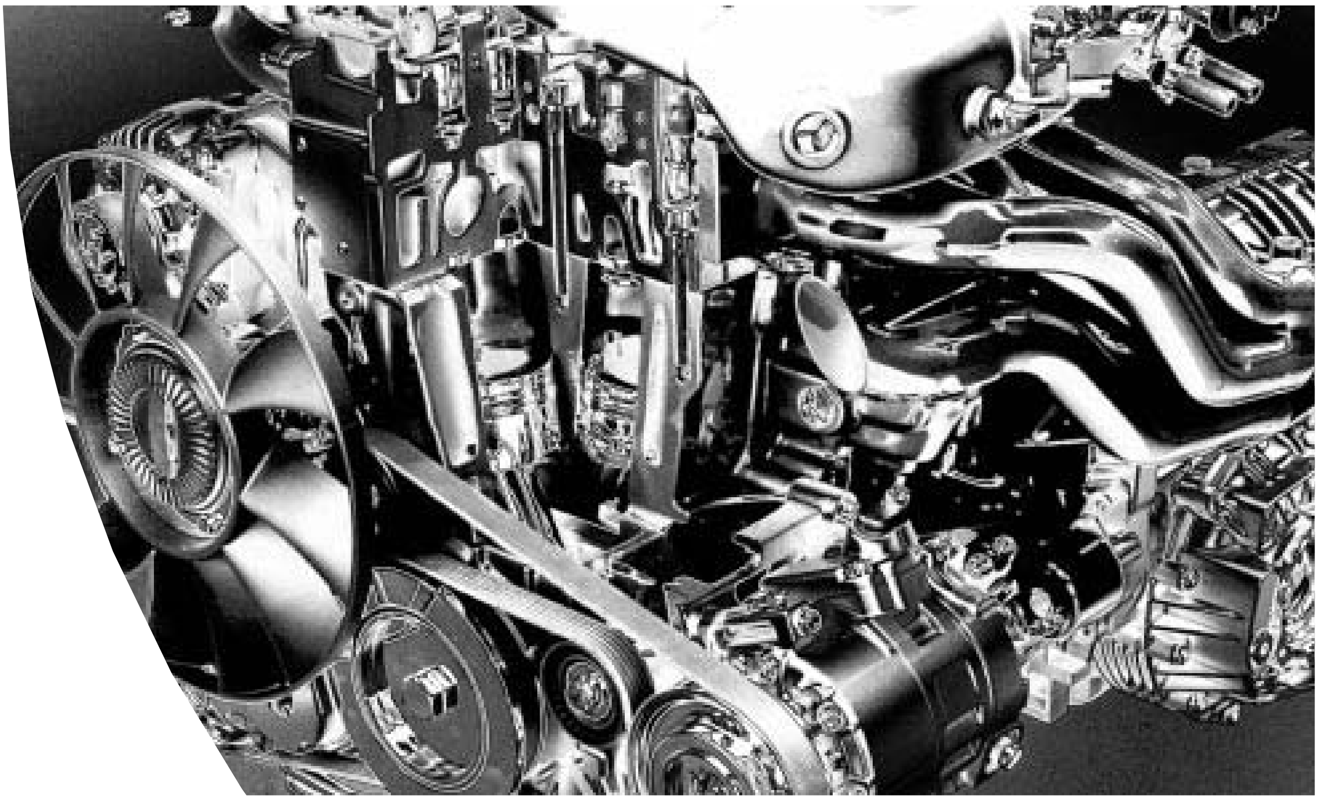
Page 13

1. a)
2. a) Deflection pulley, b) Air-conditioning compressor, c) Deflection pulley, d) Crankshaft, e) Alternator, f) Visco van, g) Coolant lpump, h) Tension pulley, i) Auxiliary steering pump
3. a), c), d)
4. Fewer oscillations are transmitted from the engine to the gearbox.

Page 37

1. The air mass meter has reverse flow recognition.
2. a) Rotary valve, b) to output manifold, c) Vacuum box, d) Signal from engine control unit, e) Vacuum box, f) Intake manifold , g) from torque port, h) to intake valve, i) Register intake manifold change-over valve, j) Nonreturn valve, k) to fuel-pressure regulator
3. Thanks to the configuration of the gear teeth and gaps on the two-track sender wheel and the Hall sensor with two Hall elements, the engine control unit receives a signal which enables it to determine the position of the camshaft in relation to the crankshaft more quickly.
4. The performance port is a component part of the twin-path intake manifold.
   It serves to improve volumetric efficiency in the upper speed range and thus to increase power output.

Service.



For internal use only © VOLKSWAGEN AG, Wolfsburg
All rights reserved. Subject to change.

740.2810.13.20 Technical status: 12/97

❀ This paper was made from chlorine-free bleached cellulose.