SCANIA

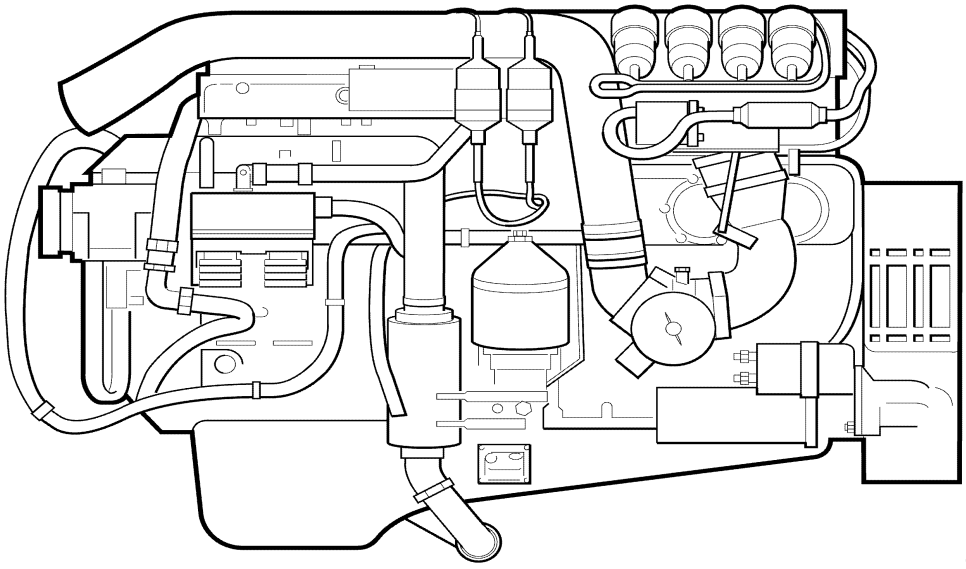
01:02-04

Issue 6 **en-GB**

Gas engines

OSC9 G01 and OSC11 G03

Function and work description



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Contents

Function description

General

Refer to the work description for each basic engine if engine work is not described in this booklet. Basic engine specifications apply unless otherwise stated.

Gas engines OSC9 G01 and OSC11 G03 are both Otto engines with mechanical gas supply control. The engines operate according to the lean burn principle.

Basically, they are diesel engines (DSC9 11 and DSC11 74) that have been fitted with new cylinder heads and spark plugs, new valves and new pistons. OSC11 G03 also has a different camshaft in comparison to the diesel variant plus a water-cooled turbocharger.

The ignition system comprises a magnetic trigger disc, a control unit and separate ignition coils for each spark plug.

The gas engines are equipped with a relief valve that reduces the high charge air pressure that can arise when the throttle valve closes rapidly. The engine is also fitted with an electric throttle. The function of the electric throttle is described in booklet 14:02-55.

The lambda value, i.e. the ratio between air and gas, must be adjusted for the gas specification in question. Attaining the correct power output and emission level is dependent on a correct setting.

Gas engines can be adjusted to suit gas grades with a class H Wobbe index in accordance with the European standard ISO/FDIS 15 403. Wobbe index = 46.1-56.5 MJ/m^3 at a temperature of 288.15 Kelvin and at a pressure of 101.325 kPa. If the gas quality deviates from this specification, an adjustment must be made so that the engine provides the correct performance and emission level. An adjustment must also be made if the vehicle is refuelled with gas of another grade than the one used for the latest setting. Natural gas must be processed and cleaned.

Engines are factory-set to the following typical natural gas specifications.

These values apply at 288.15 Kelvin and 101.325 kPa.

Upper calorific value	41.0 MJ/m^3
Effective calorific value	37.0 MJ/m^3
Upper Wobbe index	52.0 MJ/m^3
Relative density	0.62
Methane CH_4	91.1 percent by volume
Ethane C_2H_6	4.7 percent by volume
Propane C_3H_8	1.7 percent by volume
Butane C_4H_{10}	1.4 percent by volume
Nitrogen N_2	0.6 percent by volume
Carbon dioxide CO_2	0.5 percent by volume

IMPORTANT!

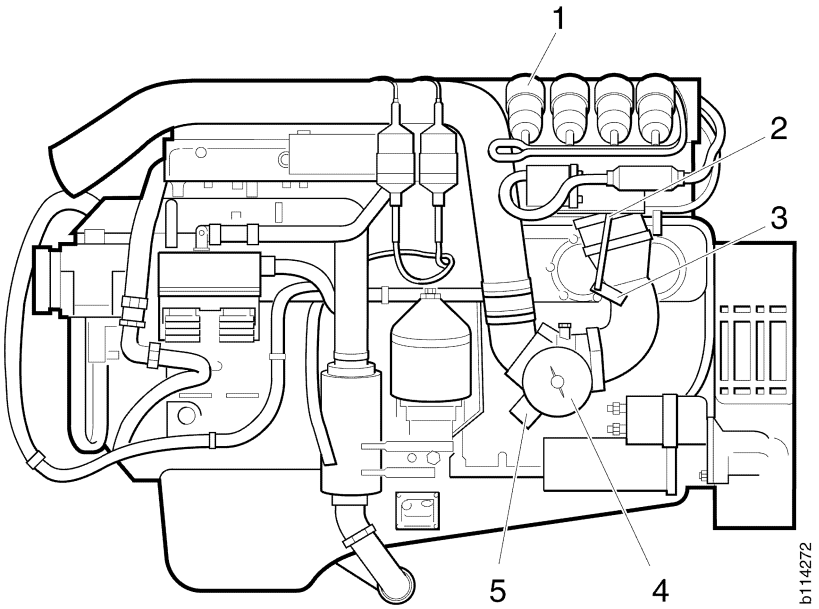
The engine oil must be intended for use in heavy duty engines with spark plugs. Engine oils intended for use in petrol or diesel engines must not be used.

The engine oil must comply with the following specifications:

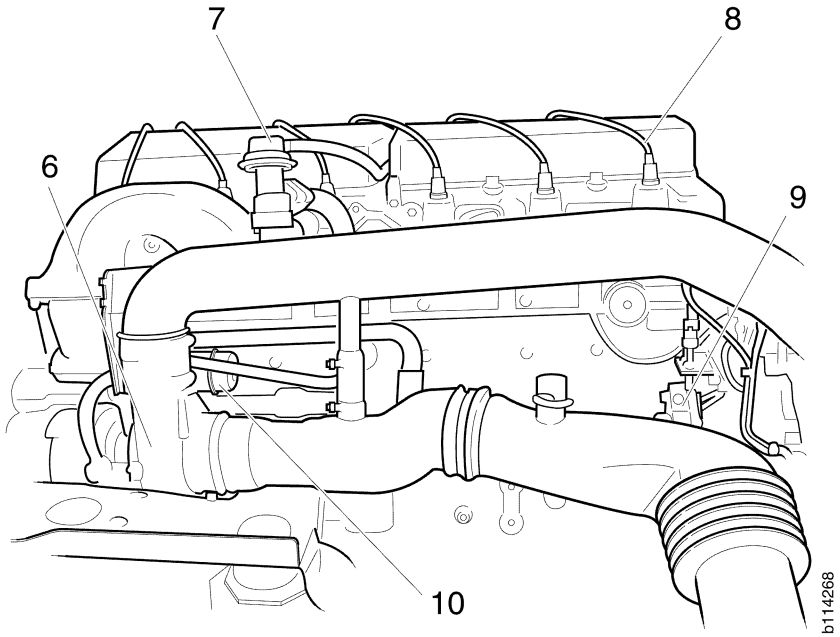
- Viscosity according to booklet 00:03-09, Fuels, lubricants and fluids.
- Max. ash content 1.0 percent by weight.
- Max. sulphur content 0.4 percent by weight.

Gas engines are factory-filled with Mobil Pegasus 1 15w-40.

Overview, left-hand side



Overview, right-hand side

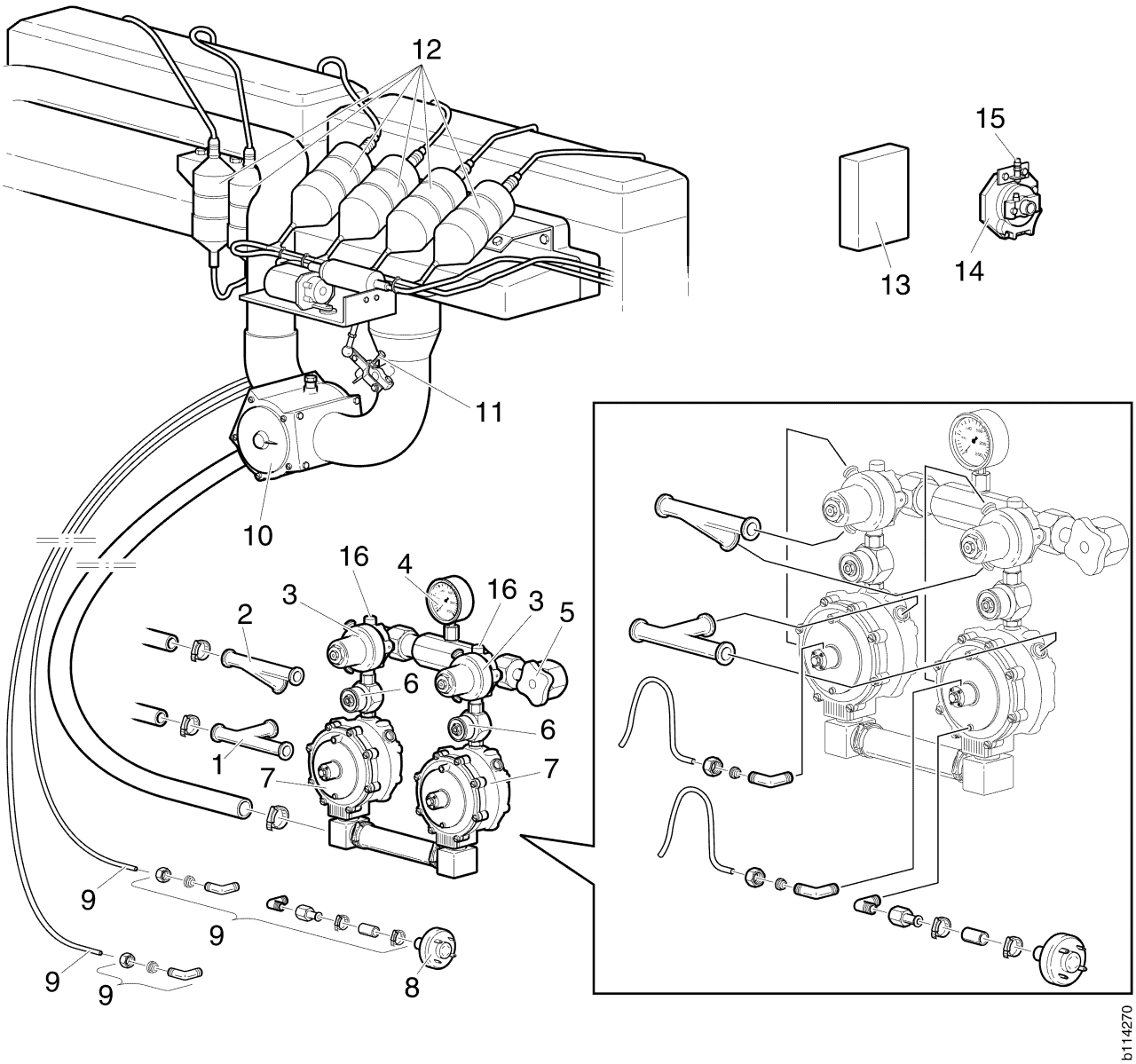


The OSC11 GO3 is shown in the illustrations

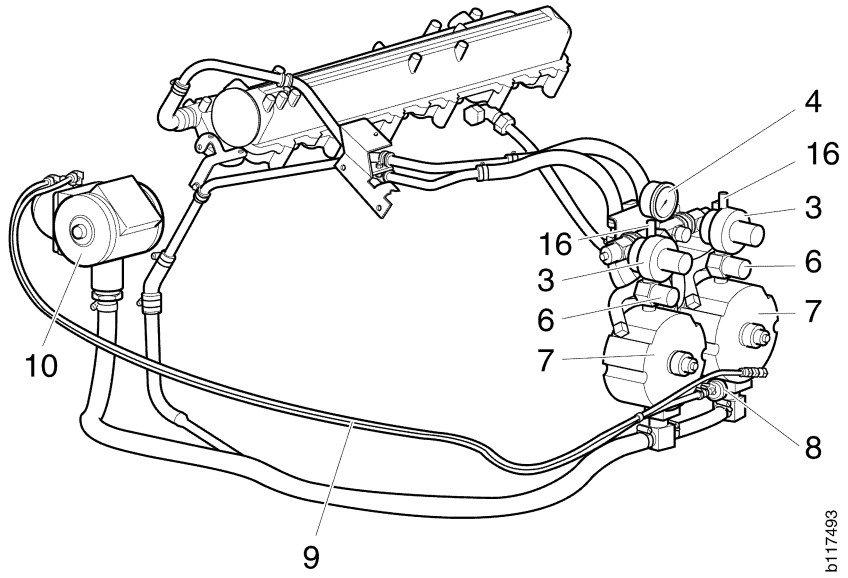
1 *Ignition coil*
2 *Electric throttle*
3 *Throttle valve*
4 *Gas mixer*
5 *Gas inlet*
6 *Turbocharger*
7 *Relief valve*
8 *Ignition cable*
9 *Magnetic trigger disc*
10 *Wastegate valve*

Overview of gas and ignition systems

OSC11 G03



OSC9 G01



1 Coolant line from engine
2 Coolant pipe to engine
3 High pressure regulators
4 Manometer
5 Manual shut-off valve
6 Solenoid valves
7 Low pressure regulators
8 Pressure switch
9 Reference pressure lines
10 Gas mixer
11 Idling speed adjusting screw
12 Ignition coils
13 Ignition system control unit
14 Magnetic trigger disc
15 Ignition pulse sensor, Hall sensor
16 Safety valve, high pressure section

Gas equipment

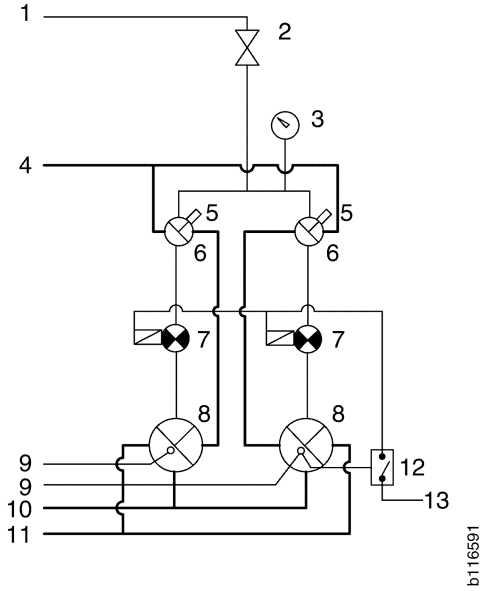
The gas equipment comprises tanks, mechanical shut-off valves, electric solenoid valves, manometer, high and low pressure regulators, gas mixer and pressure switch.

The gas pressure from the tanks on the high pressure side is reduced across the high pressure regulators in the gas panel to approx. 10 bar. The pressure is then further reduced in two steps across the low pressure regulators to just above the current charge air pressure from the turbocharger. The low pressure regulators are coupled to the gas mixer air intake via the reference pressure lines.

The reference value is used to induce the regulators to maintain the gas pressure at approx. 2-12 mbar above the charge air pressure. The gas then leaves the gas panel and passes to the gas mixer, where it is mixed with air.

All of the regulators are connected to the engine cooling system. The gas is cooled drastically when it expands and must therefore be heated by the cooling system.

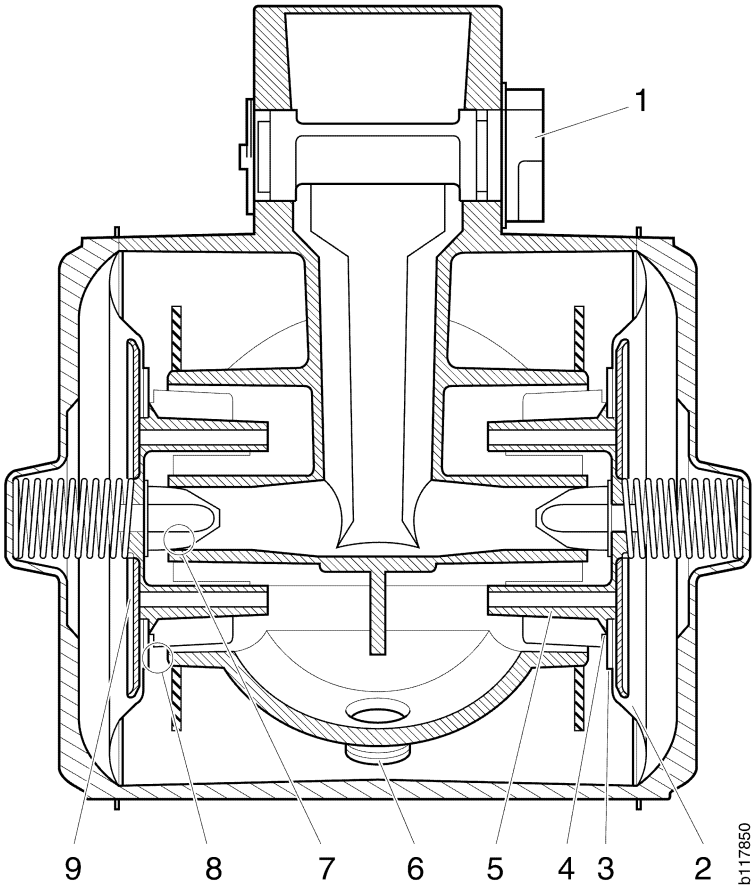
Principle drawing of gas panel



1 Gas inlet 0-200 bar
2 Manual high pressure shut-off valve
3 High pressure manometer
4 Coolant outlet
5 Safety valves, high pressure regulators
6 High pressure regulators
7 Solenoid valves
8 Low pressure regulators
9 Charge air reference pressure line
10 Gas outlet to gas mixer
11 Coolant inlet
12 Pressure switch
13 24V power supply

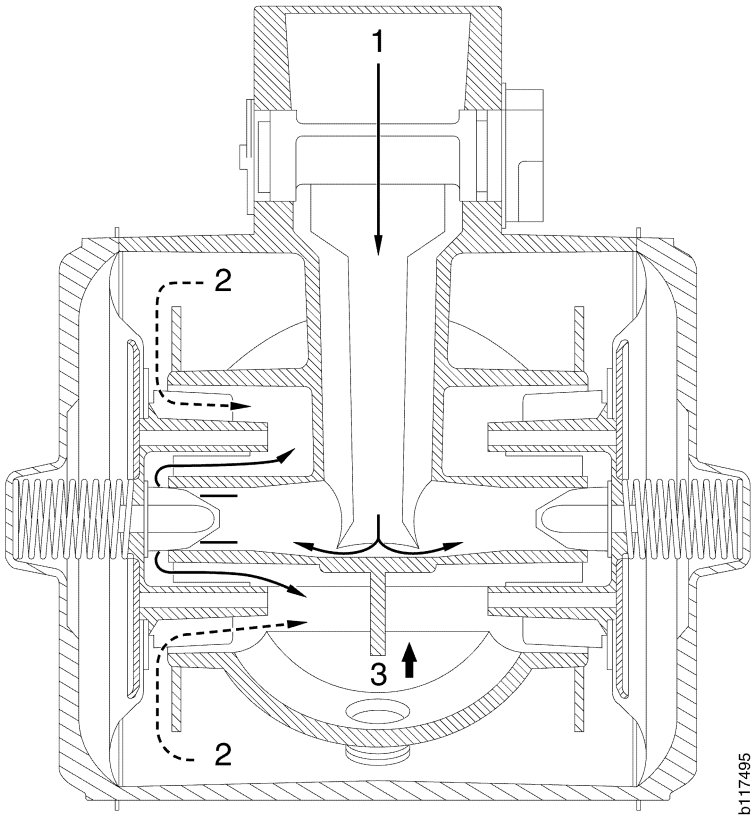
The solenoid valves are used to open and close the flow of gas when starting or stopping the engine or when the pressure in the intake manifold is too high. The high pressure side has one manual valve after the tanks and one at the inlet to the high pressure regulator. After the high pressure regulators, there are solenoid valves that open when the starter key is turned to start position and the starter motor begins to rotate. The solenoid valves are then kept open by the voltage from the alternator output for charge control.

If the pressure in the intake manifold is higher than 1.5 bar, e.g. due to a defective wastegate valve, the pressure switch will cut the electrical connection to the solenoid valves and the flow of gas to the engine will be stopped. The connection will be made again once the pressure has dropped.



Gas mixer, component parts

1 *Adjustable gas flow restriction valve*
2 *Diaphragm*
3 *Support washer*
4 *Shim for idling mixture*
5 *Air/gas valve*
6 *Idling mixture screw*
7 *Variable gas passage*
8 *Variable air passage*
9 *Pressure connection to diaphragm chamber*

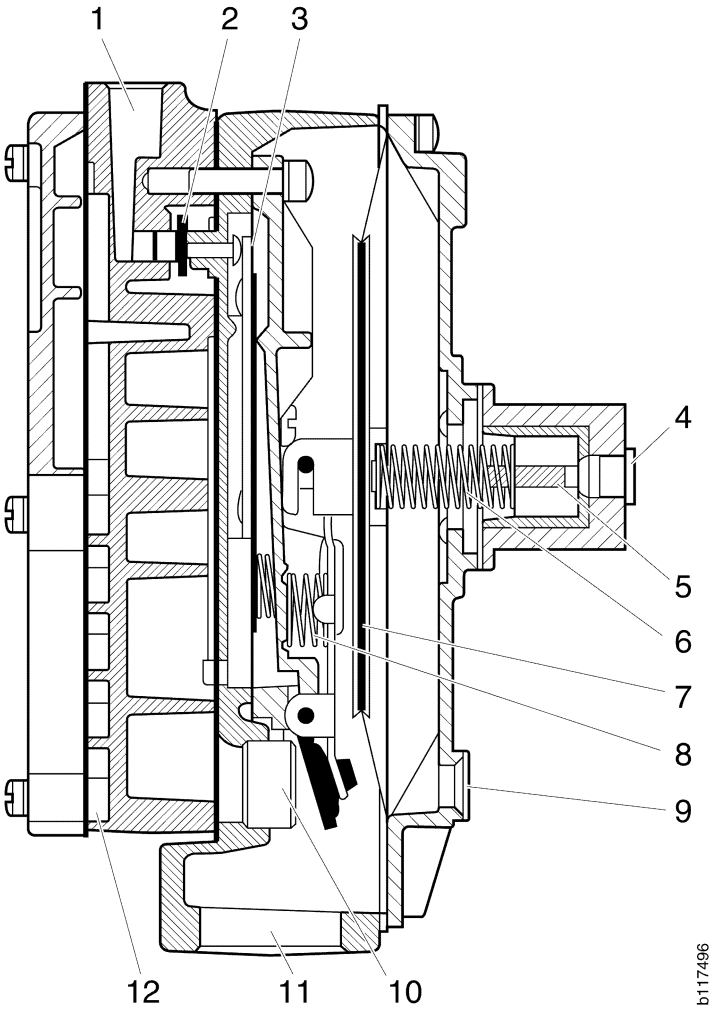


Gas mixer, gas flow

1 Gas in

2 Air in

3 Gas/air mixture out



Low pressure regulator

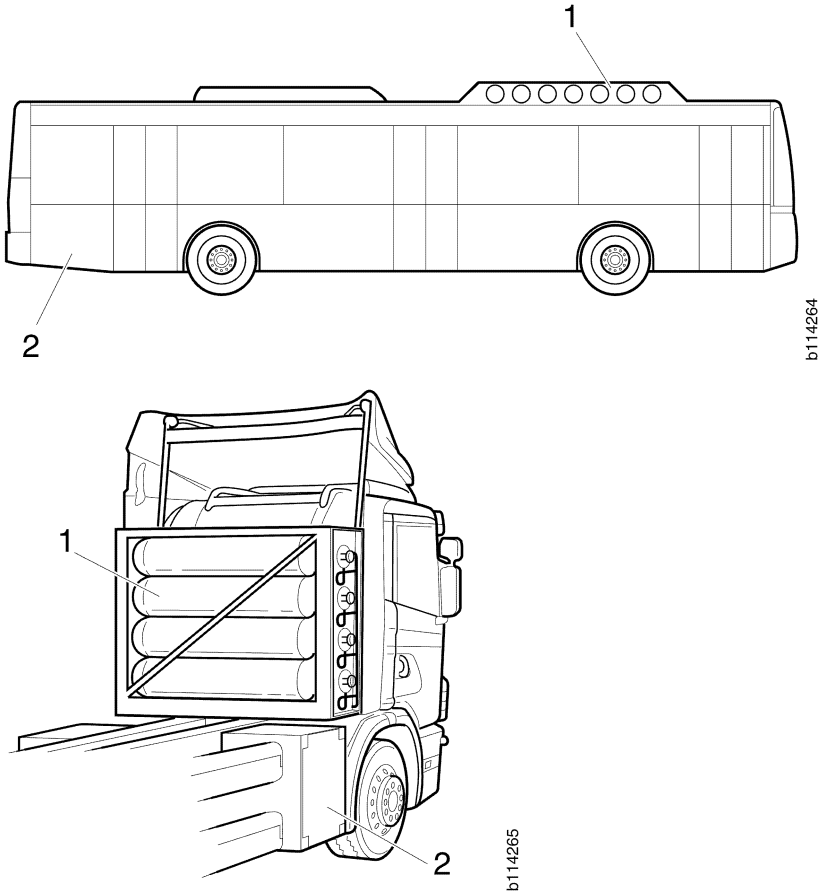
1 *Gas inlet*
2 *Valve, stage 1*
3 *Diaphragm*
4 *Plug*
5 *Outer spring adjusting screw*
6 *Outer spring*
7 *Diaphragm*
8 *Spring*
9 *Reference value*
10 *Valve, stage 2*
11 *Gas outlet*
12 *Coolant line*

The gas package for buses comprises six composite tanks. Each tank holds 185 litres. The tank package has room for seven tanks.

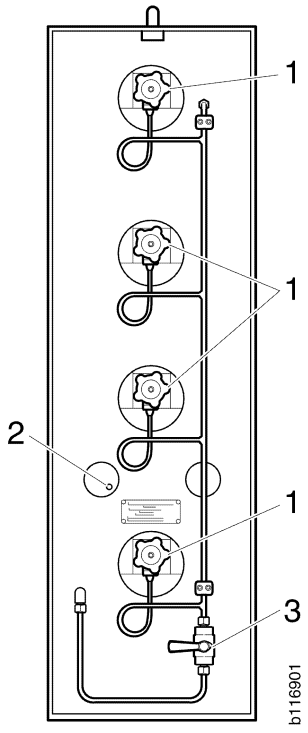
The gas package for trucks is mounted in a frame and comprises four 4,140-litre steel tanks bound with composite material. The tanks are located on stands which are certified according to regulations governing their attachment and for possible acceleration forces, e.g. in the case of a collision.

The tanks have a shut-off cock at one end and a blind plug at the other. The shut-off cock and blind plug contain fusible links that will be triggered at temperatures above 110°C. The shut-off cock is a combined shut-off valve and flow limiter. The flow limiter is activated in the event of e.g. a break in a high pressure pipe and limits the velocity of the leaking gas.

A certificate from the manufacturer of the tank equipment must accompany the vehicle on delivery.



1 Gas tanks
2 Gas panel



Tank package in truck
1 Tank shut-off cocks
2 Gas filling point
3 Main tap

Minimum load valve

There is a minimum load valve located on the intake manifold by the throttle valve. It limits the vacuum after the throttle valve in the intake manifold during engine braking to ensure correct combustion. The minimum load valve also helps to reduce HCs (hydrocarbons), as too high an HC content in relation to the air could destroy the catalytic converter.

Ignition system

The ignition system is of the capacitive discharge type. A control unit receives data concerning engine crankshaft position from a magnetic trigger disc via a Hall sensor. Each spark plug has its own ignition coil.

The ignition system has integrated engine overspeed protection that cuts the power at 2,400 rpm. The overspeed protection also cuts the supply of gas via the solenoid valves on the gas low pressure side. The power and the gas are restored once the engine speed drops below 2,200 rpm.

The control unit provides a basic supply of approx. 350V to each ignition coil. The ignition coils then provide an output of up to 40,000 V to the spark plugs. The control unit is located below the central electric unit inside the cab.

WARNING!

The spark plugs are supplied with 350 V. Carelessness can cause lethal injuries.

Work description

General

These instructions describe how to perform repairs on the gas system and not who is approved to carry them out.

IMPORTANT!

Before starting work: Read the safety precautions for vehicle gas in 00:01-02, Safety and fire protection in service workshops.

Lambda value, checking and adjusting

IMPORTANT!

If the vehicle is equipped with a catalytic converter, the gas pressure must not be left so low that it causes misfiring. Misfiring can damage the catalytic converter.

Settings for gas/air mixture using Scania-recommended tools

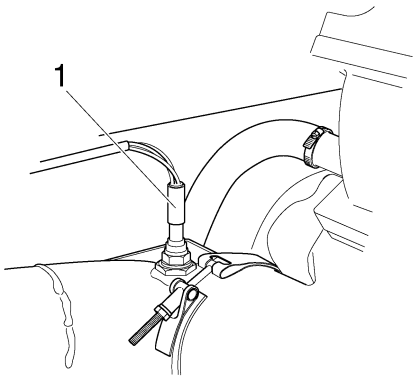
	OSC9 G01	OSC11 G03
Sensor voltage at idling speed	1.6 V-1.9 V	1.6 V-1.9 V
Sensor voltage at 1,200 rpm and 50 bar tank pressure	2.81 V-2.99 V	2.81 V-2.99 V
Sensor voltage at 2,000 rpm and 50 bar tank pressure	2.92 V-3.17 V	2.92 V-3.17 V
Sensor voltage at 1,200 rpm and 150 bar tank pressure	2.75 V-2.91 V	2.75 V-2.91 V
Sensor voltage at 2,000 rpm and 150 bar tank pressure	2.88 V-3.1 V	2.88 V-3.1 V
Maximum charge air pressure at 1,200 rpm	approx. 1.0 bar	approx. 0.7 bar

The sensor voltage can be read using a measuring instrument.

Special tools

Number	Designation
588 460	Lambda sensor
588 462	Cable harness
588 461	Test control unit
588 094	Multimeter (included in kit 588 093)

Fitting the test equipment

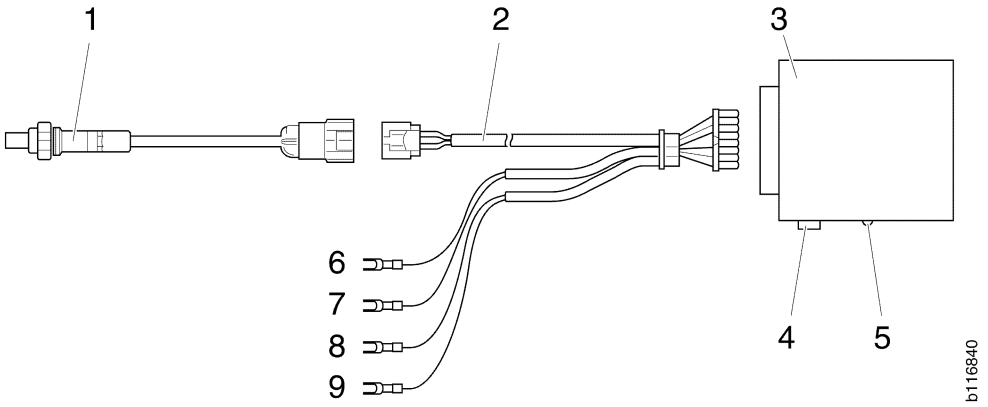


1 Screw the lambda sensor (1) into the outlet on the exhaust system.

Note: Use heat-resistant lubricating grease, Scania 561 205, when fitting the lambda sensor.

2 Connect the lambda sensor to the cable harness.

3 Run the cable harness to the vehicle, connect it to the test control unit and secure the electrical cables so they are not damaged during the test drive. Connect a power supply via either a 12V socket or a voltage converter. The test control unit will turn off if the supply exceeds 28 V. During the warm-up phase, the test control unit LED will flash for 4 X 2.5 seconds and subsequently for 10 seconds at a frequency of 10 Hz. The LED will be lit constantly in normal test mode.



Connecting the test equipment

1 *Lambda sensor 588 460*
2 *Cable harness 588 462*
3 *Test control unit 588 461*
4 *Switches*
5 *Light-emitting diode*
6 *Orange electrical cable, 12 V positive voltage input*
7 *Yellow electrical cable, negative voltage input, ground*
8 *Green electrical cable, positive voltage to multimeter*
9 *Black electrical cable, negative voltage to multimeter*

Fault codes for test control unit 588 461

Number of flashes at 2.5-second intervals	**Fault**
1	Sensor not connected or incorrectly connected
2	Power supply too low, i.e. below 11 V
3	Power supply too high, i.e. above 28 V
4	Temperature in sensor element too low
5	Impaired sensor element or gas/air mixture too rich
6	Impaired sensor element or gas/air mixture too lean
7	Damaged sensor element

Checking and adjusting when engine under load

IMPORTANT!

All checks and adjustments must be carried out with the engine at a temperature of at least 80°C. Misfiring must not occur, as this will cause the lambda sensor to give an incorrect reading.

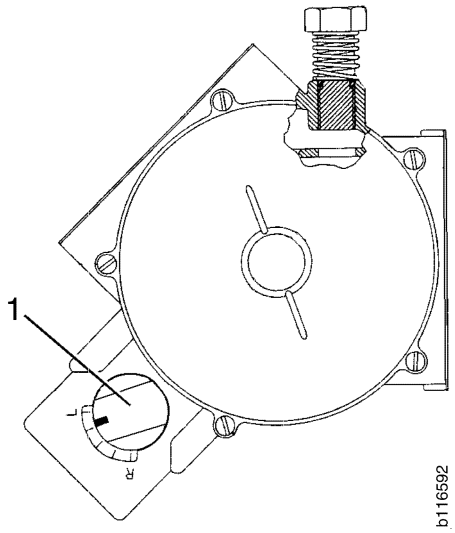
1 Attach the test equipment as described in Fitting the test equipment.

2 If the engine has not been adjusted before, set the restriction valve to 1 on the gas mixer inlet halfway between the L and R marks.

3 Measuring

Vehicles with automatic gearbox

Measure with the drive mode selector in position D and the vehicle brakes applied. Press the accelerator pedal to the floor and take a reading of the sensor voltage when the engine speed is stable.



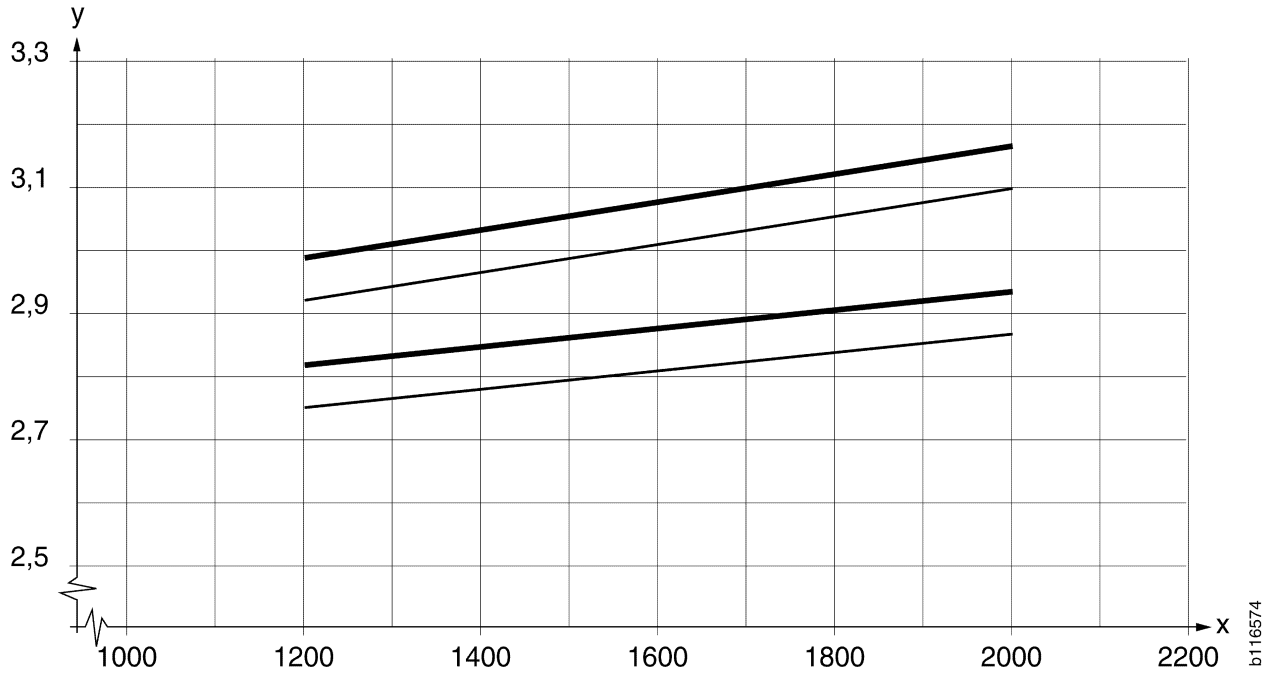
Note: Max. stalling speed time with stable value should not exceed 10 seconds per measurement.

Vehicles with manual gearbox

Measure at full acceleration in high gear from approx. 1,200 rpm to 2,000 rpm and take readings of the sensor voltage at intervals of 200 rpm or so.

4 Make a copy of the chart and plot the readings. The existing curves indicate the permitted minimum and maximum values.

Sensor voltage with engine under load



The thin-line curves indicate limits at 150 bar gas pressure and the bold ones at 50 bar gas pressure.
The X axis shows the engine speed in rpm
The Y axis shows the sensor voltage in volts

5 Adjust the gas pressure if the sensor voltage is too high or too low across the whole engine speed range.

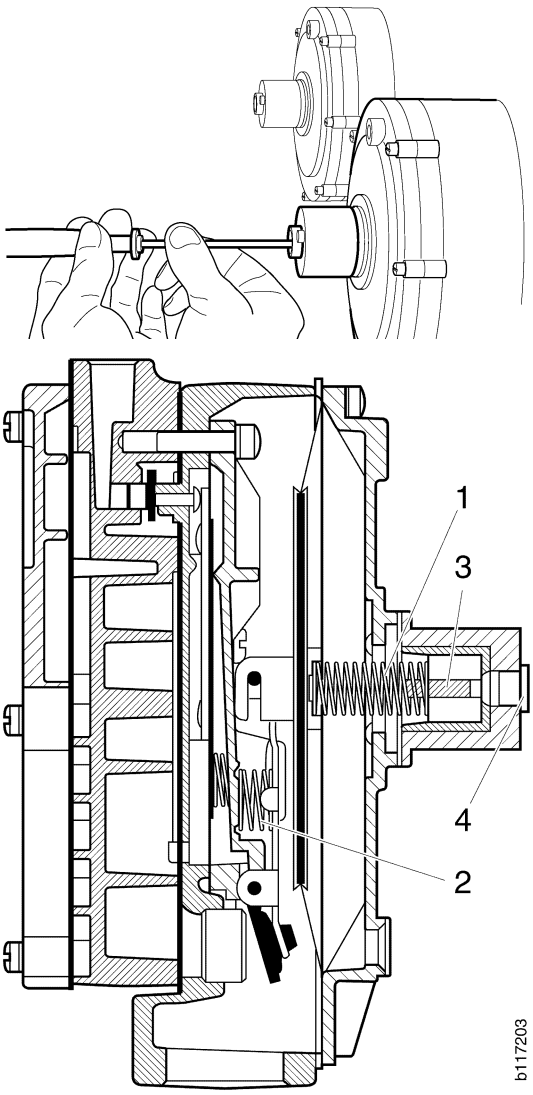
6 Unscrew the plugs and adjust the gas pressure with the adjusting screws on the low pressure regulators. Adjust both regulators the same amount. Turning clockwise will increase the gas pressure and lower the sensor voltage. Do not screw in the adjusting screw more than 16 turns from the fully unscrewed position.

Note: Screwing in the adjusting screw more than 16 turns will cause the spring disc to come loose from the screw.

IMPORTANT!

Refit the plugs in the low pressure regulators before test driving. Leaks can affect the lambda value.

7 Renew one of the regulator springs if the adjustment range of the screw is insufficient.



Location of springs in low pressure regulator

1 Outer regulator spring
2 Inner regulator spring
3 Outer regulator spring adjusting screw
4 Plug

The affect of the different regulator springs on gas pressure:

Outer regulator spring

Gas pressure	Part number	Spring colour
Lowest	1 440 142	Unpainted metal
Higher	1 440 143	White
Highest	1 440 144	Brown

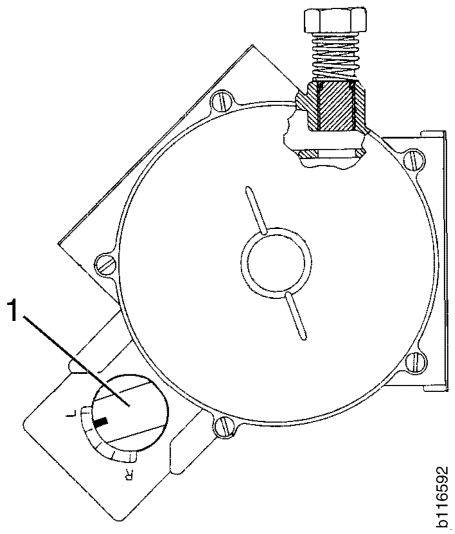
Spring 1 446 574 or 1 446 575 is located behind the low pressure diaphragm lever. Remove it as necessary to attain a higher gas pressure.

Inner regulator spring

Gas pressure	Part number	Spring colour
Higher	1 446 574	Orange
Lower	1 446 575	Blue

8 Change the setting of the restriction valve to 1 on the gas mixer inlet if the sensor voltage is too high or too low across part of the engine speed range, i.e. if the curve is completely or partially outside the specified limit values. The restriction valve acts most at high engine speeds. For example, adjusting towards R will give a richer gas mixture and lower sensor voltage, mainly at high engine speeds. Since a certain change in level also takes place at low engine speeds, the gas pressure must normally also be changed to compensate.

9 The lambda value must also be checked at idling speed if the gas pressure has been changed. Changing only the mixer restriction valve will not affect the lambda value at idling speed.



Checking and adjusting when engine is idling

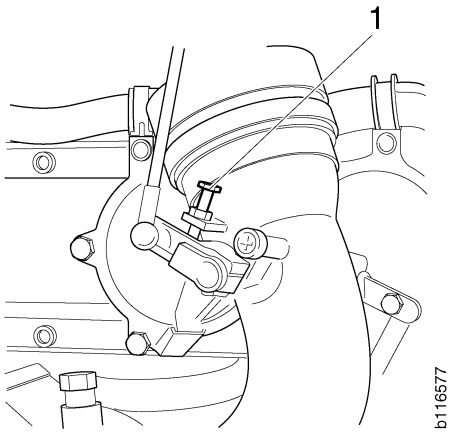
IMPORTANT!

All checks and adjustments must be carried out at an engine temperature at least 80°C. Misfiring must not occur, as this will cause the lambda sensor to give an incorrect reading.

1 Run the engine until it reaches normal operating temperature.

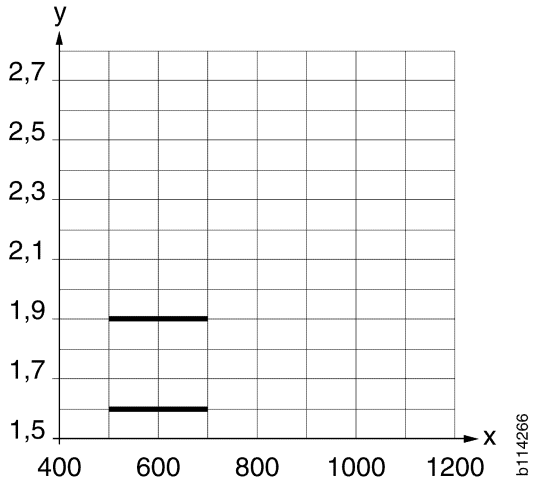
2 Check that the idling speed is approx. 550 rpm.

3 Adjust screw 1 when necessary so that it is against the arm when the engine is warm. Adjust the electric throttle if the engine speed is not correct. See Electric throttle linkage, adjustment.



4 Take a sensor voltage reading with the multimeter. It should read between 1.6 V and 1.9 V at 550 rpm.

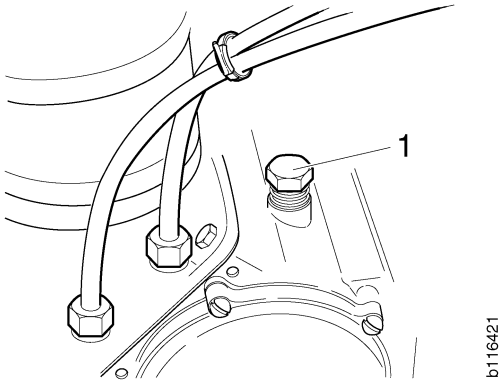
Sensor voltage at idling speed



The X axis shows the engine speed in rpm
The Y axis shows the sensor voltage in volts

5 Adjust the lambda value if necessary by turning the mixture screw 1 on the gas mixer. Turning clockwise will lower the sensor voltage.

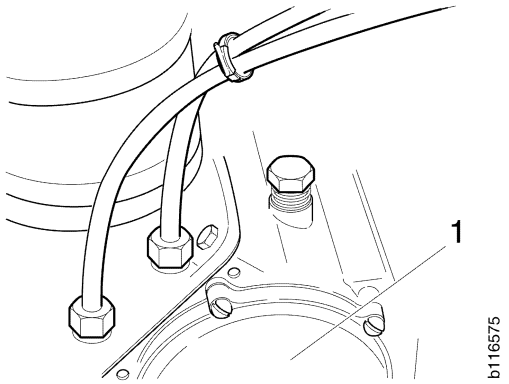
6 If the correct lambda value cannot be set, take off the outer diaphragm of the gas mixer and remove or add shims at the gas valve.



Adjusting with shims in the gas mixer

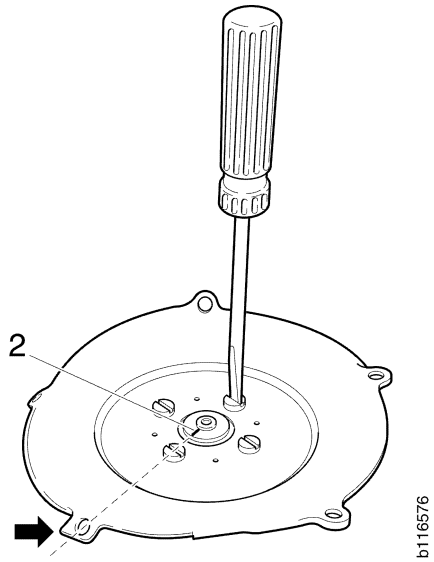
1 Note: Mark all the parts in the gas mixer so that they can be refitted in the same position.

Remove the outer blanking piece (1) from the gas mixer.



2 Carefully remove the outer diaphragm unit without damaging the diaphragm.

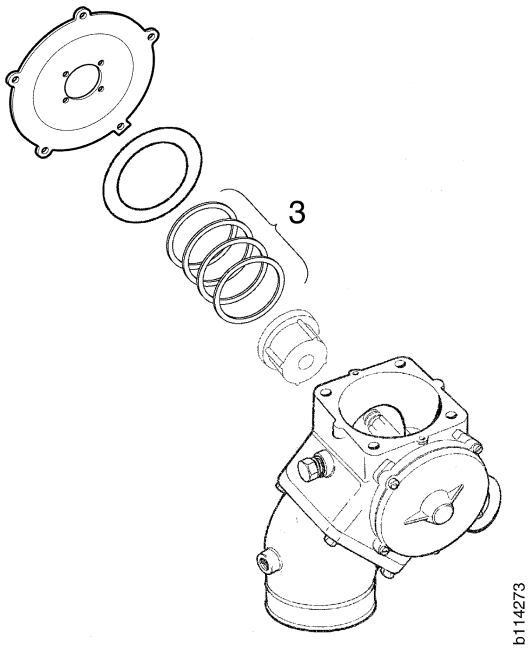
3 Remove the air/gas valve and the washer from the diaphragm. The mark (2) must point towards the square lug on the diaphragm.



4 Add or remove shims (3) as necessary. More shims will increase the sensor voltage and less will reduce it.

5 Refit everything to its original position.

6 Repeat the check/adjustment according to Checking and adjusting when engine is idling.



Electric throttle linkage, adjustment

For other work descriptions concerning the electric throttle, see 14:02-56.

1 Run the engine until it reaches normal operating temperature.

2 Disconnect the throttle linkage.

3 Set the idling speed to 550 rpm using the idling screw.

4 Switch off the power with the starter key.

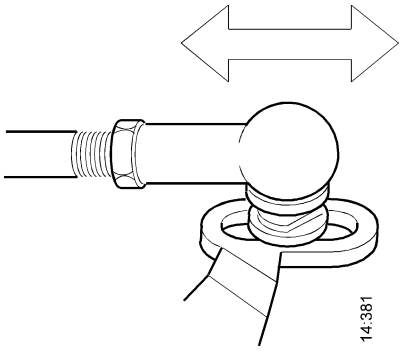
5 Start the engine and keep the accelerator pedal depressed for at least 2 seconds.

Note: The throttle linkage must be disconnected.

6 Stop the engine by shutting off the supply of gas. Leave the power on.

7 Adjust the length of the linkage so that it fits onto the ball when the lever is in the idling position.

8 Depress the accelerator pedal all the way and adjust the linkage so that it travels 2-4 mm further than the full throttle position on the throttle lever. If necessary, move the upper ball pin in the slot on the electric throttle motor. Adjustment in this slot will not affect the idling position.



9 Check that the ball still fits onto the linkage at the idling position.

10 Delete any fault codes.

Solenoid valves, checking for leaks

The solenoid valves are located between the high and low pressure regulators on the gas panel.

1 Allow the engine to idle. Unplug the contact housings for both solenoid valves. The engine should stop immediately when the current to the last valve is cut.

2 Connect the first valve again and repeat the test with only this valve.

Charge air pressure switch, checking

Special tools

99 405	Bleeding tool

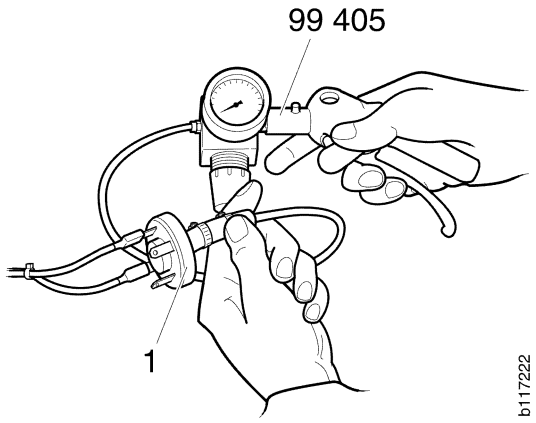
The pressure switch detects the charge air pressure via the reference pressure line at one of the low pressure regulators.

1 Remove the pressure switch (1) from the low pressure regulator.

2 Attach the hose from tool 99 405.

3 Start the engine and run it at idling.

4 Slowly increase the pressure from zero. The engine should stop when the pressure is between 1.1 and 1.5 bar.



1 Pressure switch

Gas panel, complete renewal

Removal

1 Empty the gas system by turning off all the taps to the tanks and leaving the engine idling until it stops.

2 Make sure that all the taps are closed.

3 Clamp the coolant hoses so that they can be removed without leaking coolant.

4 Remove the coolant hoses from the gas panel.

5 Unplug all the contact housings.

6 Remove the reference pressure line between the low pressure regulators.

7 Undo the connection for the gas inlet.

8 Undo the connection for the gas outlet.

9 Remove all the fastening bolts and take away the gas panel as one unit.

Fitting

Fit in reverse order and perform a leak test.

Solenoid valve for high or low pressure regulator, renewal

1 Remove the gas hose between the regulators.

2 Unscrew the relevant regulator section from the upper manifold pipe and renew the solenoid valve.

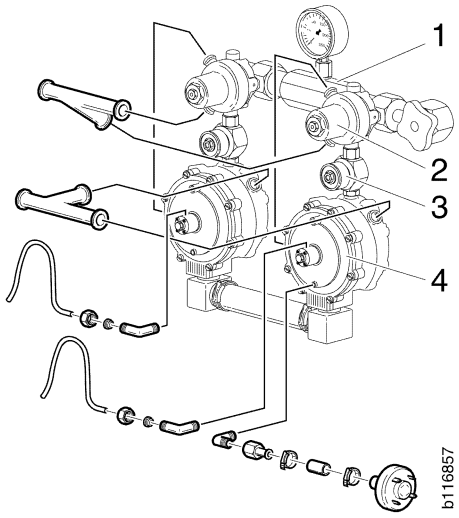
Fitting

Fit in reverse order and perform a leak test.

IMPORTANT!

All unions have **tapered threads**. The regulator housing can crack if tightened too hard. Seal all threads with thread sealing compound.

Thread sealing compound	Loctite 577



1 Manifold pipe
2 High pressure regulator
3 Solenoid valve
4 Low pressure regulator

Gas tanks, renewal

Tightening torque	Tap side	Plug side
Nuts	22 Nm	10 Nm

WARNING!

It is highly dangerous to work on the tanks as the pressure in them is very high.

When the tanks have been lifted off, it is important to follow the instructions in the booklet before doing anything with the tanks.

Removal

1 Empty the gas system by turning off all the shut-off cocks to the tanks and leaving the engine idling until it stops.

2 Make sure that all the shut-off cocks are closed.

3 Remove all pipes and pipe unions on the tap side as one unit.

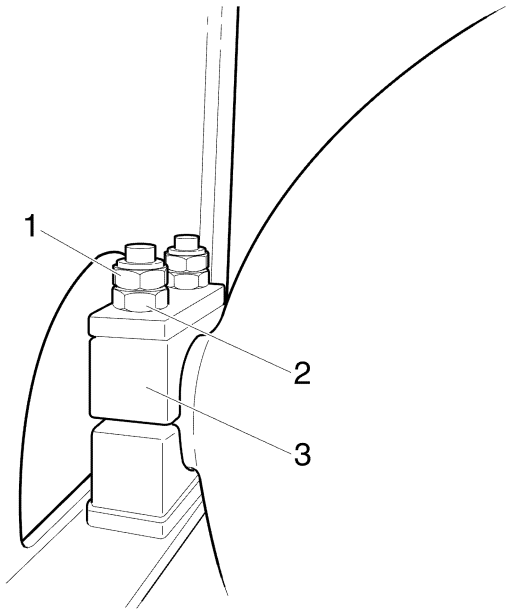
4 Remove the caps holding the tanks in place.

5 Lift off the tanks.

Fitting

1 Lift the tanks into position.

2 Position them and attach the pipe connections.



Tank mounting

1 Lock nut
2 Nut
3 Cap

3 Tighten the pipe unions.

First stage of tightening new union

1. Insert the pipe until it bottoms.

2. Tighten the union nut by hand as hard as possible.

3. Tighten the union nut another 1 1/4 turns with a spanner.

Refitting an old union

1. Insert the pipe until it bottoms.

2. Tighten the union nut by hand as hard as possible.

3. Tighten the union nut another 1/4 turn with a spanner.

4 Fit the caps securing the tanks in place and torque tighten the nuts as specified in the table.

Note: Fit a gasket between the cap and the tank on the tap side.

5 Tighten the lock nuts without disturbing the nuts.

6 Test for leaks.

Gas system, leak test

Check for leaks in the gas system after each repair or adjustment during which a part of the gas system has been dismantled.

Make sure that all the taps are open. Check for leaks using Scania leak detection spray 584 018 or soapy water. Any leaks will appear as bubbles.

Ignition, checking and adjusting

IMPORTANT!

Close the main tap before all engine repairs and empty the gas system by leaving the engine idling until it stops.

IMPORTANT!

The positive terminals on the ignition coils are connected to the chassis ground via ignition coils 1 and 6.

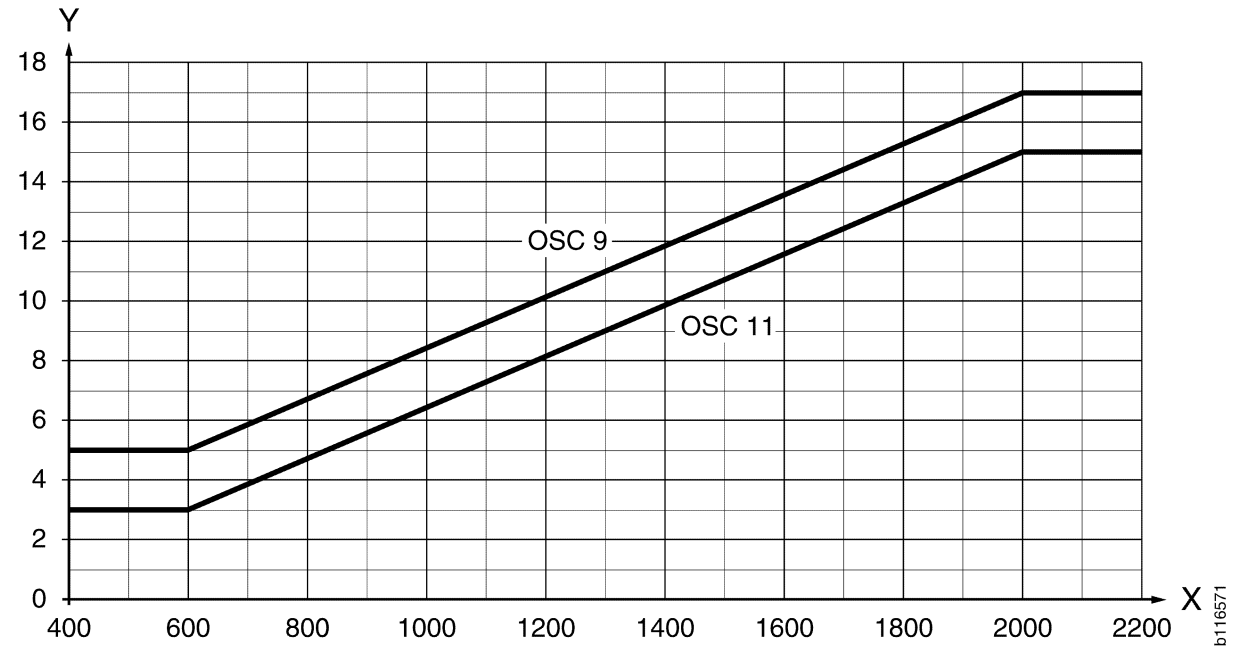
Spark plugs and spark plug gaps

	OSC9 G01 and OSC11 G03
Type	Champion RN 79G (spark gap 0.38 mm, 0.015")
Spark plug gap	0.35-0.5 mm
Tightening torque	35-40 Nm
Distance between magnetic trigger disc and ignition pulse sensor	0.8-1.0 mm (0.5-0.7 turns back from contact)

Other tools

Number	**Designation**
588 463	Ignition timing tool
	Stroboscope lamp

Ignition timing diagram



The X axis shows the engine speed in rpm

The Y axis shows the ignition timing in degrees BTDC (before top dead centre).

Adjusting using the ignition timing tool 588 463

	OSC9 G01	OSC11 G03
Engine speed	0 rpm	0 rpm
Ignition timing, BTDC	24°	22°

The ignition timing tool indicates the angle of the crankshaft when the ignition pulse sensor gives a signal. The control unit changes the ignition timing to the engine speed by displacing the ignition pulse in varying amounts. A certain distance must therefore be present between the sensor signal and the earliest ignition. The distance for the Altronic control unit is 7 engine degrees.

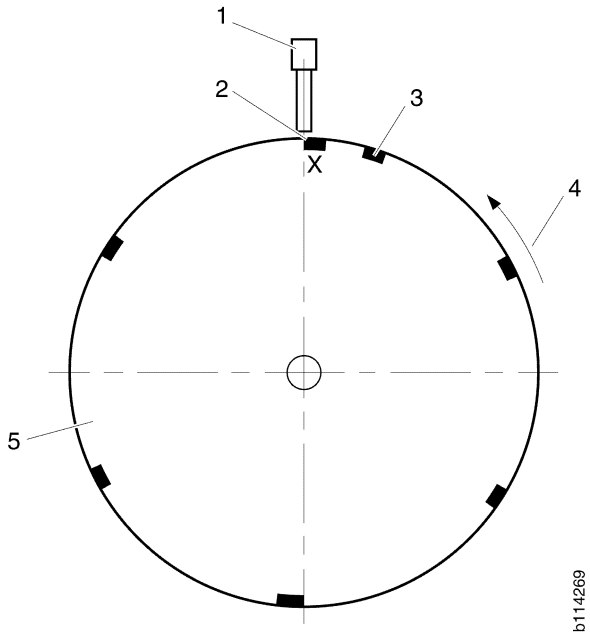
Example:

Since the most advanced ignition timing for the OSC11 G03 is 15° BTDC (before top dead centre), the sensor signal must arrive at 15° + 7° = 22° BTDC. This applies to the piston position in cylinder 1 in compression and the corresponding magnet in the magnetic trigger disc.

Setting

1 Fit the tool at the ignition system control unit under the central electric unit. Put the toggle switch in the Input position.

2 Rotate the engine until piston 1 is in ignition position according to the flywheel graduation in its compression stroke. See table.



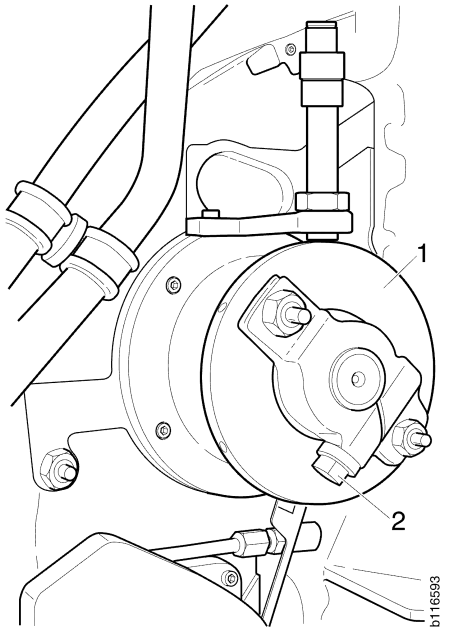
1 Ignition pulse sensor, Hall sensor
2 Magnet for cylinder 1, marked X
3 Index for magnetic trigger disc position
4 Direction of rotation
5 Magnetic trigger disc

3 Undo the clamp bolt (2) for the magnetic trigger disc.

4 Carefully tap the magnetic trigger disc (1) in its direction of rotation until the magnet for cylinder 1 turns on the indicator lamp in the instrument.

5 Tighten the clamp bolt (2) for the magnetic trigger disc.

6 Check the setting by rotating the engine in the opposite direction and then slowly rotating it in its direction of rotation until the lamp just starts to come on. Check the graduation on the flywheel and compare it with the table.



1 Magnetic trigger disc
2 Clamp screw

Adjusting using a stroboscope lamp

	OSC9 G01	OSC11 G03
Engine speed/angle	550 rpm/5° BTDC	550 rpm/3° BTDC
Engine speed/angle	2,000 rpm/17° BTDC	2,000 rpm/15° BTDC

1 Connect the stroboscope lamp to the ignition cable for cylinder 1.

2 Start the engine and run it at idling speed.

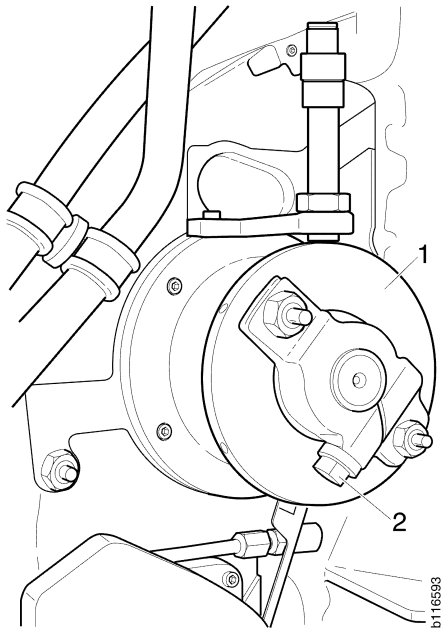
3 Read off the current ignition timing on the flywheel.

4 Switch off the engine.

5 Undo the clamp bolt (2) for the magnetic trigger disc.

6 Rotate the magnetic trigger disc to the correct timing.

7 Check the ignition timing again after adjusting the magnetic trigger disc and readjust if it is still not correct.

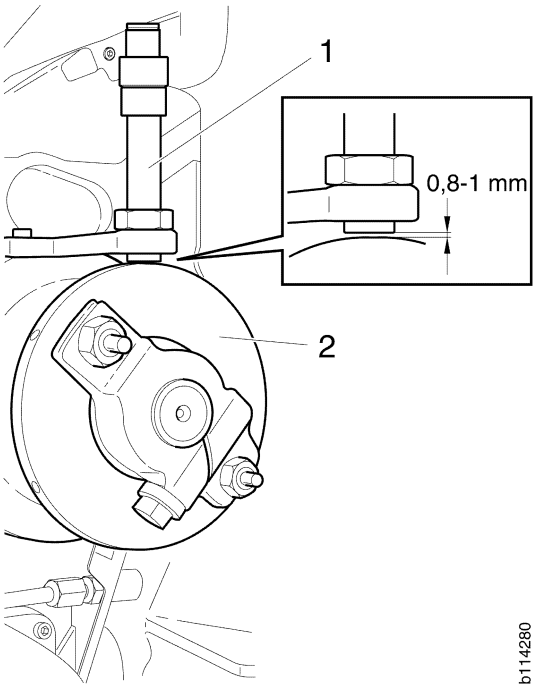


1 Magnetic trigger disc
2 Clamp screw

Ignition pulse sensor, renewal

Distance between magnetic trigger disc and ignition pulse sensor	0.8-1.0 mm

Remove the old ignition pulse sensor. Fit the new one and adjust it to the correct distance from the magnetic trigger disc.



1 Ignition pulse sensor
2 Magnetic trigger disc