INDEX

Mercedes-Benz

Service

Service Manual

V-8 Engines 1971-1980
M116.98 3.5 (ltr.) & M117.98 4.5 (ltr.)

Mercedes-Benz of North America Inc.

Match group index number on right to beginning of numbers in bookmarks panel on left

Instructions for use of service manual 00

Complete Service Manual coverage for late model year Mercedes-Benz vehicles requires three individual manuals:

Service Manual, Engine
Service Manual, Transmission
Service Manual, Chassis and Body

Throughout these manuals, the vehicles are identified by their chassis and engine numbers. These numbers are made up of the first six digits of the respective serial number. For the actual location of Chassis number and Engine number, see page 00–015/1. In cases where the repair instructions apply to all versions of the engine, only the first three digits of the respective number are referenced.

For example, engine 117 applies to all 4.5 liter cast iron block V-8 engines.

See the **engine and vehicle identification** table on page 00–010/1 for the engine installed in your vehicle.

Location of specific repair instructions

First locate the major component group in the Group Index. Individual groups are separated by an easily visible dividing page, which is followed by the job index page. Then check the job index for the exact job required. The first page of a typical job description looks like this:

07.3–135 Checking Injection valves

Job Title appears on same line as Group No.

Major component group
Sub component group
Unit version
Revision status of microfiche
Job No.
Page No.

07.3.1 I-135/1

Technical data, tightening torques and tools are listed at the beginning of each Job.

All the dimensions are in metric units, unless otherwise indicated. The indicated part numbers serve exclusively for identification and differentiation of individual versions. When ordering spare parts, always use part numbers from the latest parts microfiche.

00 Engine and vehicle identification

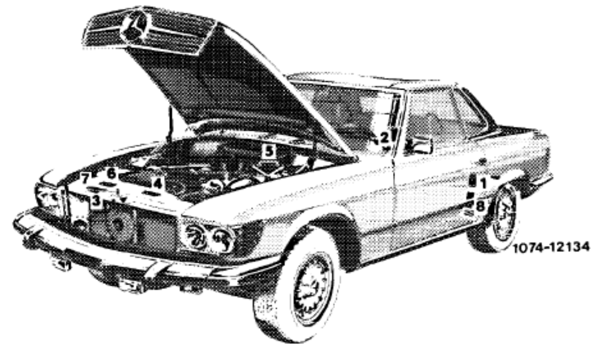
This manual applies to all engines M 116 (3.5 liter displacement) and M 117 (4.5 liter displacement) with cast iron blocks installed in the following vehicles, starting in 1971.

Model	Model Year from	to	Chassis	Engine
300 SEL 3.5	1971	1971	109.056	116.981
280 SE 3.5 Cp.	1971	1971	111.026	116.980
280 SE 3.5 Conv.	1971	1971	111.027	116.980
280 SE 4.5	1972	1973	108.067	117.984
280 SEL 4.5	1972	1973	108.068	117.984
300 SEL 4.5	1972	1973	109.057	117.981
450 SE	1973	1975	116.032	117.983
	1976	1976	116.032	117.986
450 SEL	1973	1975	116.033	117.983
	1976	1980	116.033	117.986
450 SL	1972	1975	107.044	117.982
	1976	1980	107.044	117.985
450 SLC	1973	1975	107.024	117.982
	1976	1980	107.024	117.985

Vehicle identification number locations 00

When ordering engine parts, please quote engine number (5), for example:
117.985-12-000 000. For body parts quote chassis no. (3) for example:
107.044-12-000 000.

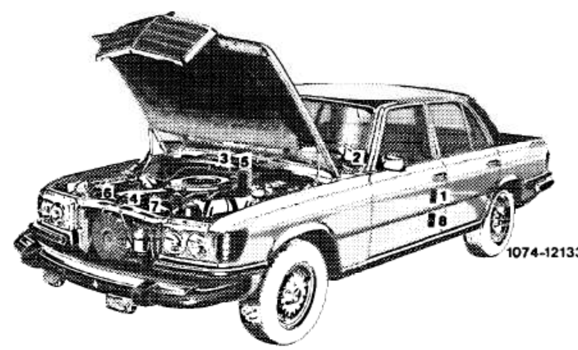
The illustration depicts model 450 SL. On model 450 SLC identification numbers are in similar locations.



1 Certification Tag (left door pillar)
2 Identification Tag (left window post)
3 Chassis No.
4 Body No. and Paintwork No.
5 Engine No. is stamped on engine block behind left cylinder head (drivers side)
6 Information Tag California version Vacuum line routing for emission control system
7 Emission Control Tag
8 Emission Control Tag Catalyst Information

When ordering engine parts, please quote engine number (5), for example:
117.986-12-000 000. For body parts quote chassis no. (3), for example:
116.033-12-000 000.

The illustration depicts model 450 SEL. On models 280 SEL, 300 SEL and 280 SEC the identification numbers are arranged in similar locations.



1 Certification Tag (left door pillar)
2 Identification Tag (left window post)
On the following models this tag shows the chassis number:

Model	Chassis No.
280 SEL	108
300 SEL	109
280 SEC	111

3 Chassis No.
4 Body No. and Paintwork No.
5 Engine No. is stamped on engine block behind left cylinder head (driver's side)
6 Information Tag Californien version Vacuum line routing for emission control system
7 Emission Control Tag
8 Emission Control Tag Catalyst Information

Engine Data

Model		300 SEL 3.5	280 SE 3.5 Cp.	280 SE 3.5 Conv.
Chassis Type		109.056	111.026	111.027
Engine		116.981	116.980	116.980
Operation		4-stroke gasoline engine with electronic fuel injection (EFI)		
Number of cylinders		8		
Cylinder arrangement		V-shaped 90°		
Bore/stroke	mm	92/65.8		
Total displacement	cm^3	3499		
Compression ratio		9.5 : 1		
Firing order		1-5-4-8-6-3-7-2		
Max. speed	rpm	6500		
Engine output	DIN net hp/rpm SAE gross hp/rpm	200/5800 230/6050		
Max. torque	SAE net mkp/rpm SAE net lb.ft./rpm	210/4000 230/4200		
Crankshaft bearings		5		
Valve arrangement		Overhead		
Camshaft arrangement		OHC, one per cylinder bank		
Oil cooling		Air-oil cooler		
Cooling		Coolant circulation pump, thermostat with bypass line, fan with viscous coupling (viscofan), finned tube radiator.		
Lubrication		Forced oil circulation via gear-type oil pump		
Oil filter		Main flow filter		
Air filter		Dry air filter with paper cartridge		

00 Technical data

Filling Capacities

Model				300 SEL 3.5	280 SE 3.5 Cp.	280 SE 3.5 Conv.
Chassis Type				109.056	111.026	111.027
Engine				116.981	116.980	116.980
Fuel tank/reserve			apprx. ltr.	82/11	82/11.5	
Engine	crankcase w/o oil filter	engine oil	max/min ltr.	7.5/5.5		
	oil filter change	engine oil	apprx. ltr.	0.75		
	air oil cooler	engine oil	apprx. ltr.	0.4		
Cooling system with heater		coolant	apprx. ltr.	13.2		
Coolant pump				Maintenance-free		
Brake system		brake fluid	apprx. ltr.	0.5		
Automatic transmission		ATF	apprx. ltr.	5.8		
Rear axle hypoid gear oil SAE 90			apprx. ltr.	2.5		
Power steering		ATF	apprx. ltr.	1.5		

Electrical System

Battery	Voltage Capacity	12 V 66 Ah
Starter		GF 12 V 1.4 H.P.
Alternator		KI (RL) 14 V 55 A 20

Engine Data

Model		280 SE 4.5	280 SEL 4.5	300 SEL 4.5
Chassis Type		108.067	108.068	109.057
Engine		117.984	117.984	117.981
Operation		4-stroke gasoline engine with electronic fuel injection (EFI)		
Number of cylinders		8		
Cylinder arrangement		V-shaped 90°		
Bore/stroke	mm	92/85		
Total displacement	cm^3	4520		
Compression ratio		8.0 : 1		
Firing order		1-5-4-8-6-3-7-2		
Max. speed	rpm	5800		
Engine output	SAE net bhp/rpm	190/4750		
Max. torque	SAE net lb. ft./rpm	240/3000		
Crankshaft bearings		5		
Valve arrangement		Overhead		
Camshaft arrangement		OHC, one per cylinder bank		
Oil cooling		Air-oil cooler		
Cooling		Coolant circulation pump, thermostat with bypass line, fan with viscous coupling (viscofan), finned tube radiator.		
Lubrication		Forced oil circulation via gear-type oil pump		
Oil filter		Main flow filter		
Air filter		Dry air filter with paper cartridge		

00 Technical data

Filling capacities

Model				280 SE 4.5	280 SEL 4.5	300 SEL 4.5
Chassis Type				108.067	108.068	109.057
Engine				117.984	117.984	117.981
Fuel tank/reserve			apprx. ltr.	82/11		
Engine	full capacity	engine oil	max/min apprx. ltr.	8.5/6.5		
	crankcase w/o oil filter	engine oil	max/min ltr.	7.5/5.5		
	oil filter change	engine oil	apprx. ltr.	0.75		
	air oil filter	engine oil	apprx. ltr.	0.4		
Cooling system with heater		coolant	apprx. ltr.	13.5		
Coolant pump				Maintenance-free		
Brake system		brake fluid	apprx. ltr.	0.5		
Automatic transmission		ATF	apprx. ltr.	7.9		
Rear axle hypoid gear oil SAE 90			apprx. ltr.	2.5		
Power steering		ATF	apprx. ltr.	1.4		

Electrical System

Battery	Voltage Capacity	12 V 66 Ah
Starter		GF 12 V 1.4 H.P.
Alternator		KI (RL) 14 V 55 A 20

Engine Data

Model		450 SE	450 SEL	450 SL	450 SLC
Chassis Type		116.032	116.033	107.024	107.044
Engine		117.983	117.986	117.982	117.985
Operation		4-stroke gasoline engine with EFI[1]) or CIS[2]) fuel injection system			
Number of cylinders		8			
Cylinder arrangement		V-shaped 90°			
Bore/stroke	mm	92/85			
Total displacement	cm^3	4520			
Compression ratio		8 : 1			
Firing order		1-5-4-8-6-3-7-2			
Max. speed	rpm	5800			
Engine output	SAE net bhp/rpm	180/4750			
Max. torque	SAE net lb. ft./rpm	220/3000			
Crankshaft bearings		5			
Valve arrangement		Overhead/Hydraulic tappets[2])			
Camshaft arrangement		OHC, one per cylinder bank			
Oil cooling		Air-oil cooler			
Cooling		Coolant circulation pump, thermostat with bypass line, fan with viscous coupling (viscofan), finned tube radiator.			
Lubrication		Forced oil circulation via gear-type oil pump			
Oil filter		Main flow filter			
Air filter		Dry air filter with paper cartridge			

[1]) Engine 117.982/983 up to model year 1976 with Electronic Fuel Injection (EFI)
[2]) Engine 117.985/986 from model year 1976 with Continuous Injection System (CIS)

00 Technical data

Filling Capacities

Model				450 SE	450 SEL	450 SL	450 SLC
Chassis Type				116.032	116.033	107.044	107.024
Engine				117.983	117.986	117.982	117.985
Fuel tank/reserve			apprx. ltr.	96/13			
Engine	full capacity	engine oil	apprx. ltr.	9			
Engine	during oil and filter change	engine oil	apprx. ltr.	8			
Engine	oil pan up to marks on oil dipstick	engine oil	max/min ltr.	7.5/5.5			
Engine	oil filter	engine oil	apprx. ltr.	0.75			
Cooling system with heater		coolant	apprx. ltr.	15			
Coolant pump				Maintenance-free			
Brake system		brake fluid Dot 4	apprx. ltr.	0.5			
Automatic transmission		ATF	apprx. ltr.	7.9			
Rear axle hypoid gear oil SAE 90			apprx. ltr.	1.3			
Power steering		ATF	apprx. ltr.	1.4			

Electrical System

Battery	Voltage Capacity	12 66 Ah	
Starter		GF 12 V 1.5 kW	
Alternator		Kl (RL) 14 V 55 A 20[1] Kl 14 V 65 A 21[3]	Kl 14 V 55 A 20[2] Kl 14 V 70 A 20[4]

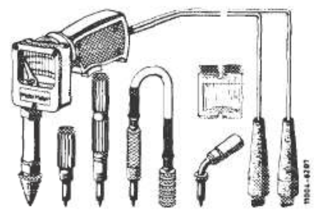
1) Up to August 1974
2) Since August 1974
3) 1979
4) 1980

01–010 Checking compression pressure

Test values with engine at operating temperature		Gauge pressure in bar
Minimum compression pressure[1]) at	Normal compression	approx. 8.5
	Low compression	approx. 7.5
Permissible difference between individual cylinders		max. 1.5

[1]) Check cylinders for leaks if compression pressure is below minimum.

Special tool

Compression pressure recorder with accessories and contact handle		001 589 46 21 00

Note

Check compression pressure at operating temperature.

Check cylinders for leaks if compression pressure is below specified minimum (00–015).

For checking, unscrew all spark plugs.

Rotating of engines

Rotate engines with starter motor. For this purpose, connect respective terminals.

Engines with electronic injection system

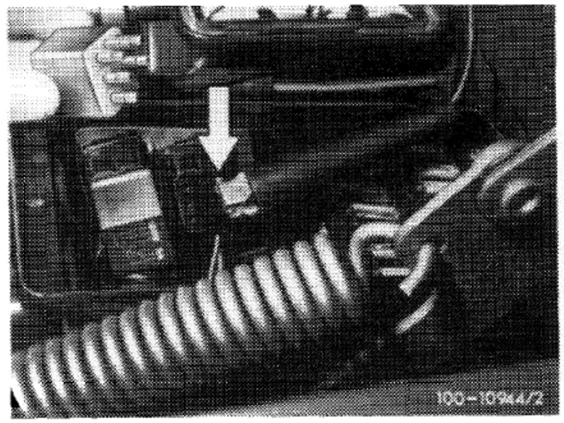
Connect contact handle to battery + and to starter terminal 50.

Disconnect cable 1 on ignition coil.

Engines with continuous injection system (CIS)

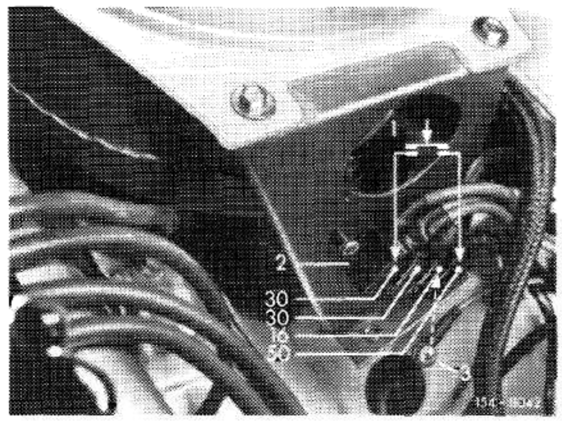
Model 116

Pull out fuel pump relay code No. 21 in fuse box. Connect contact handle to battery + and with the assistance of a pin to contact bushing 1 of coupling (arrow).



Model 107

Disconnect cable terminal 16 (cable color red/violet) on 4-point cable connector. Connect contact handle to terminal 30 (cable color red) and terminal 50 (cable color violet).



Testing

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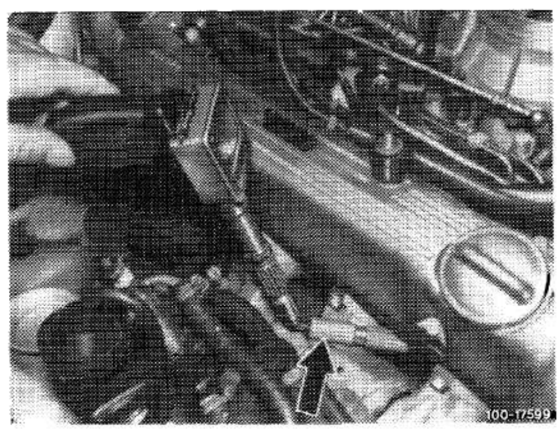
1 Unscrew all spark plugs.

2 Rotate engine several times to throw out residue and soot (selector lever in position "N" or "P").

3 Push compression pressure recorder into spark plug bore of respective cylinder.

4 For testing, rotate engine for approx. 8 turns with throttle valve open.



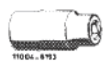
Check all cylinders likewise. First move respective data sheet in compression pressure recorder into new working position.

01–015 Checking cylinders for leaks

Data

Total pressure loss	max. 25 %
On valves and cylinder head gasket	max. 10 %
On pistons and piston rings	max. 20 %

Special tools

Socket 27 mm, 1/2" square for rotating for engine		001 589 65 09 00
Square drive socket 1/2", 80 mm long for rotating engine	 11004-10282	617 589 00 16 00

Conventional tool

Cylinder leak tester	e.g. made by Bosch, EFAW 210 A and SUN, CLT 228–1

Checking

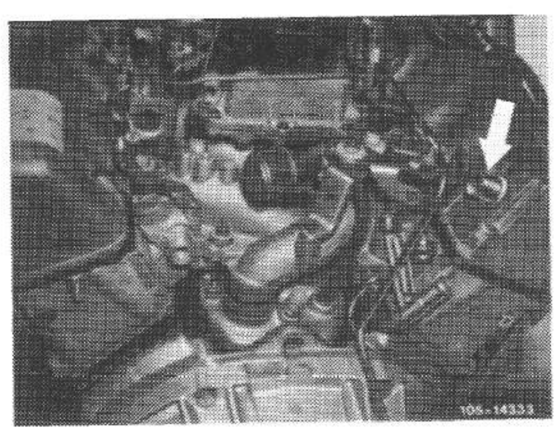
1 Run engine up to operating temperature.

2 Remove air filter.

3 Set throttle valve to full opening.

4 Unscrew spark plugs.

5 Pull off venting valve at valve cover (arrow).



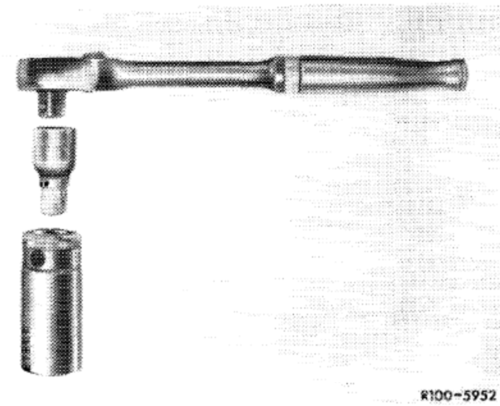
6 Top up coolant and leave lock open.

7 Connect cylinder leak tester with hose to a compressed air system.

Calibrate tester.

8 Set piston of cylinder to be tested to ignition TDC. For this purpose, rotate engine with tool combination at crankshaft.

For rotating engine on model 107, unscrew radiator shell element and fan.

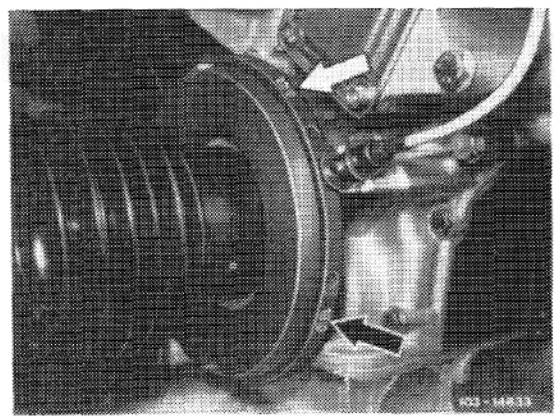


R100-5952

Note: Marking numbers 0, 90, 180 and 270 (arrows) are punched into vibration damper.

The pistons named below are at TDC in the following positions of the marking in relation to indicator:

Marking number:	Piston at TDC
0	1 and 6
90	5 and 3
180	4 and 7
270	8 and 2



9 Screw connecting hose into spark plug bore and attach to connecting hose of tester.

Crankshaft should not rotate.

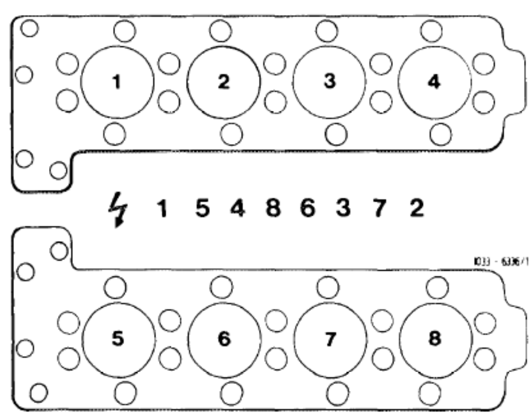
10 Read pressure loss on cylinder leak tester.

11 Check by listening whether pressure escapes via intake pipe, exhaust, engine breather, spark plug bore of adjacent cylinder or coolant filler hole.

12 Check all cylinders in ignition sequence.

Note: It is possible that on individual pistons the piston ring gaps are directly one above the other, so that the test results will be misrepresented.

When in doubt, continue running vehicle and check cylinder for leaks once again later on.



01–020 Evaluation of cylinder bores

Conventional tool

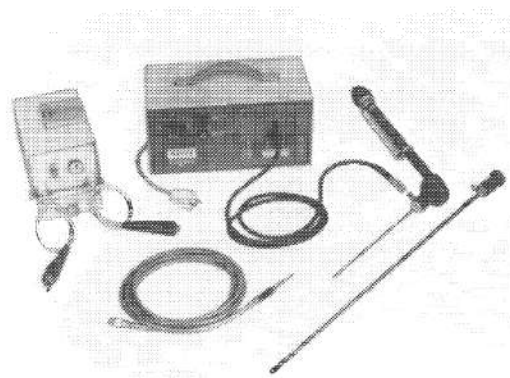
Cylinder illuminating lamp	e. g. Karl Storz GmbH, D-7200 Tuttlingen Motoskop TV (cold light) and lens probe 103 26 CW (570 mm) and lens probe 103 26 CT (210 mm)[1]

[1]) Required for 3rd cylinder.

Note

A visual checkup can be made with cylinder head in place by means of a cylinder illuminating lamp.

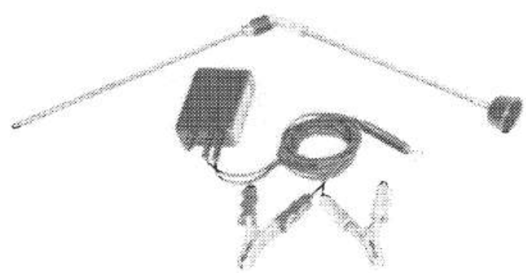
To evaluate cylinder bore, introduce lens probe through spark plug bore.



Motoskop
12 Volts and 220 Volts

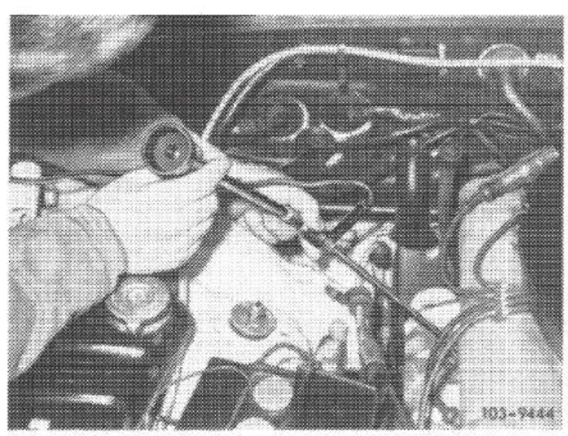
103-15713

When evaluating scored or streaky cylinder walls, it is often difficult for a workshop to decide whether the damage is already extensive and requires removal or repair of the engine, or whether the evidence is harmless. The following instructions will help in making an expert and correct decision.



103-9443

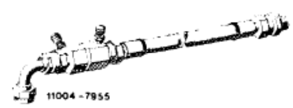
Note: With streaks in direction of "land" (in direction of piston pin), shaft streaks or seizures are not possible since there is no contact between piston skirt and cylinder liner. With regard to marks on cylinder walls (liners), the first difference is between "optical streaks" or "seizure streaks". As a rule "optical streaks" are about 3 mm wide, they are produced by the piston ring gaps, with the honing structure still visible; with "seizure streaks", however, the honing structure is obliterated.



103-9444

01–025 Measuring oil consumption

Special tools

Oil dip stick with millimeter scale for engine **with** oil suction		115 589 15 21 00
Oil dip stick with millimeter scale for engine **without** oil suction		110 589 11 21 00
Oil telethermometer		116 589 27 21 00
Valve for interrupting oil return flow		110 589 00 91 00

Note

Measure oil consumption by means of oil dip stick with millimeter scale in combination with pertinent data sheet.

The oil measuring procedure is shown on front page of data sheet.

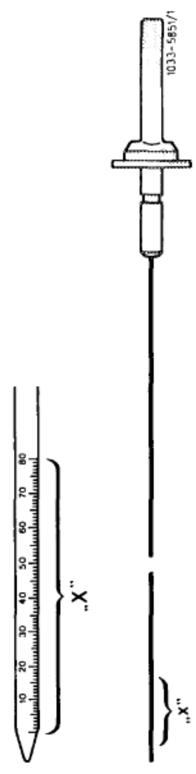
Read oil consumption, indicated in mm on dip stick, on basis of diagram on back page of data sheet in cc.

Data sheets

Engines	Print No.
115.982/983 116.992/993 117.982/983 117.992/993	800.99.228.00/B German/English 800.99.228.01/B French/Spanish
116.984/985 117.985/986	800.99.406.00B German/English 800.99.406.01B French/Spanish

Attention!

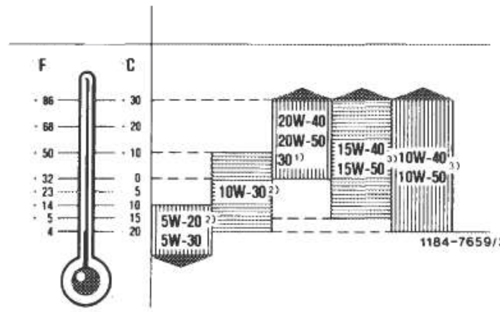
To eliminate faulty measurements, check engine oil for dilution by fuel prior to measuring consumption.



01–030 Removal and installation of engine (oil capacity)

Specified viscosity classes according to SAE during constant ambient temperatures

[1]) During constant ambient temperatures above +30 °C (+86 °F), SAE 40 may be used.
[2]) For engine oils identified by footnote[1]) on sheets 226.1 and 227.1 of Specs. for service products the following applies: SAE 5 W–20 below + 10 °C
SAE 10 W–30 in moderate zones all year
[3]) All year oil.



Oil capacity in liters (for approved engine oils, refer to specifications for service products)

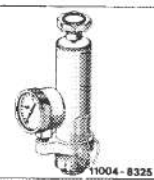
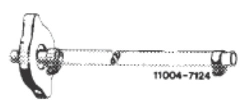
Engine (total filling capacity)	Full capacity (dry engine)	8.5[1])
	During oil and filter change	8.0

[1]) On vehicles with air oil cooler additionally 0.5 liter.

Tightening torques

		Nm
Oil drain plug to oil pan	M 26	50
	M 12	40
Fastening screw for filter lower half (or filter cover)		40

Special tools

Tester for cooling system and radiator cap	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak test	 11004-7124	605 589 00 25 00
Double connection for radiator cap test in combination with tester	 11004-8326	000 589 73 63 00
Open end wrench 46 mm for clamping nut of propeller shaft	 11004-7082	126 589 00 01 00
Torque wrench handle 25–130 Nm for 126 589 00 01 00	 11004-10056	001 589 66 21 00

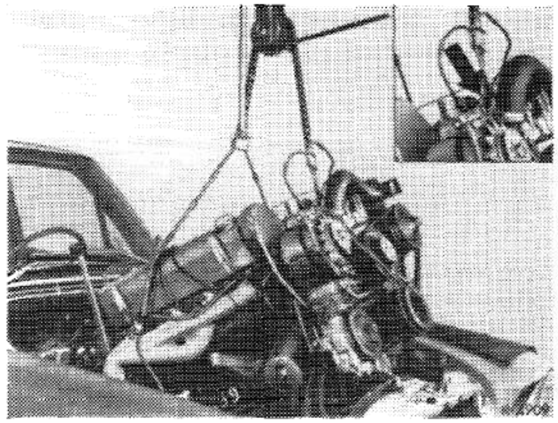
Conventional tool

Engine hoist size 1.5	Bäcker, D-5630 Remscheid order No. 3178

Note

Remove and install engine with transmission at approx. 45° tilt.

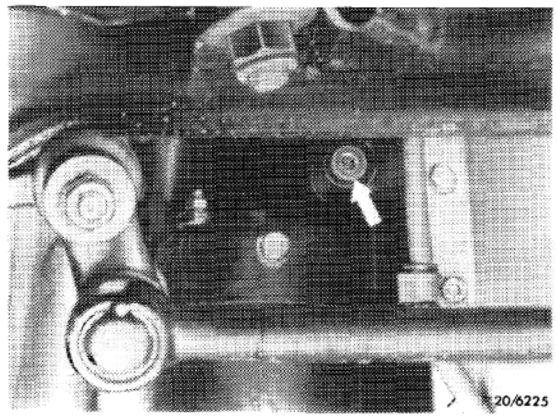
Remove engine hood for above purpose.



Removal

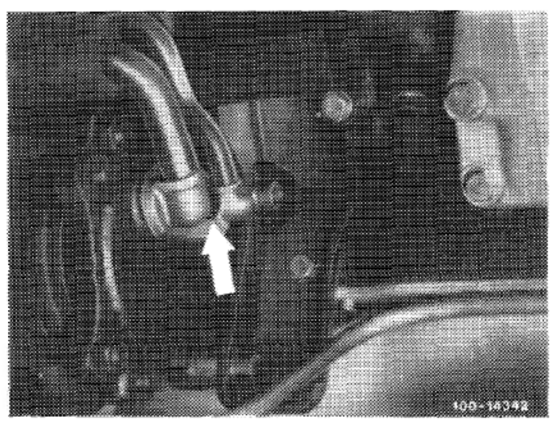
1 Drain coolant.

Attention!
Drain plugs (arrow) are located at the right and left on engine block.

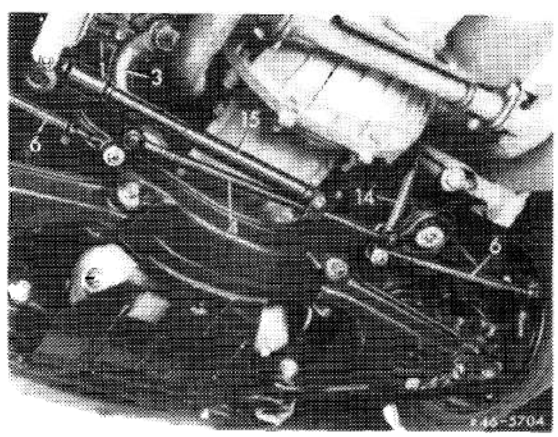


2 On vehicles with air conditioning system, drain system and disconnect hose lines on pipe set (arrow) (83–516).

3 Completely remove exhaust system (except model 116).



4 **Model 107:** Force off drag link (4) on righthand ball head.



5 **Model 116:** Remove battery frame.

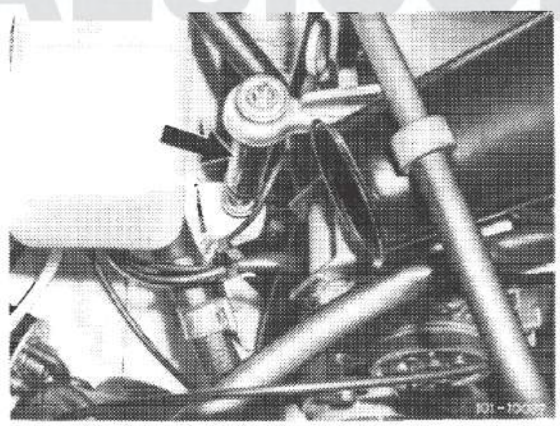
6 Suck reservoir of power steering pump empty.

7 Disconnect pressure oil hoses on power steering.

8 Disconnect all coolant hoses, vacuum, oil, fuel and electric lines leading to engine.

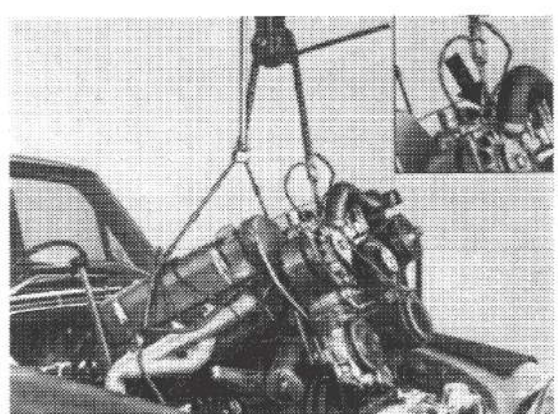
9 Pull cable for TDC transmitter from diagnosis socket. For this purpose, unscrew diagnosis socket.

10 Remove engine shock absorber left and right.

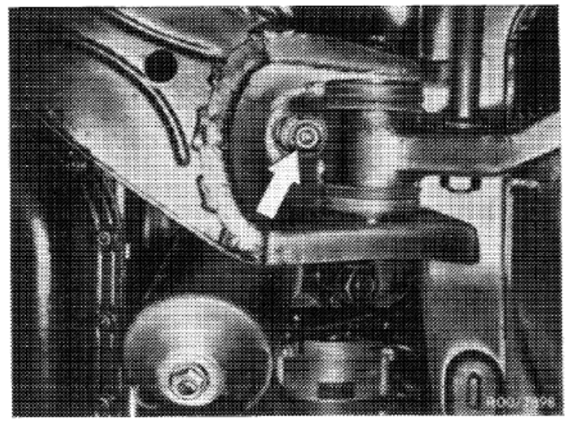


Model 107

11 Suspend engine at suspension eyes.



12 Unscrew fastening bolts on engine mounts left and right.



Model 116

13 Remove rear engine carrier with engine mount.

14 Loosen clamping nut of universal shaft.

15 Disconnect universal shaft on transmission.

16 Loosen connections on transmission.

17 Lift out engine.

Installation

Attention!
When installing a new engine following previous bearing damage, carefully flush oil hoses and oil cooler, disassemble and clean oil damper.

18 Check engine mounts, coolant, vacuum, oil and fuel hoses and renew, if required.

19 Install engine and connect.

20 Install rear engine mount free of tension.

21 Adjust universal shaft (41–020).

22 Check all drain plugs for tight seat.

23 Add oil, coolant and refrigerant.

24 Check cooling system for leaks with leak tester.

Check coolant for presence of anti-freeze.

25 Clean air filter and renew, if required.

26 Check timing angle (dwell angle) and firing point (15–501).

27 Adjust idle speed and emission value (07.3–100).

01–040 Engine breather – Functional description

The engine has a closed, service-free crankcase breathing system. The engine blow-by gases and cylinder crankcase vapors flow through connection (1) in lefthand cylinder head cover (in driving direction) to idle air distributor (4). The idle air distributor is provided with a bleeder throttle (3) of 2 mm dia.

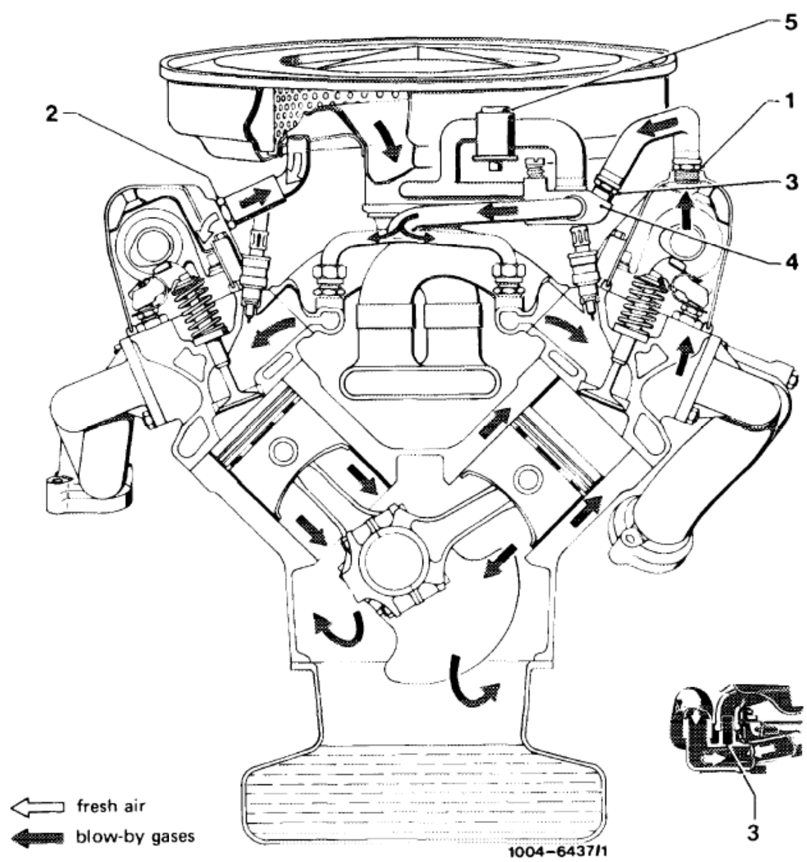
From the bleeder throttle the flow-by gases and crankcase vapors are flowing with the idle air through a distributing pipe to the two idle air ducts (one duct per cylinder bank) cast onto intake pipe. From here, they are guided directly into the intake ducts and from there to the combustion chambers.

From the breather connection (2) of the righthand cylinder head cover the breather line extends directly to the clean air end in air filter.

In the lower and medium driving range the intake pipe vacuum, which is transmitted via the lefthand venting line to the cylinder crankcase, supplies the engine with fresh air via the righthand cylinder bank. This means that the air filter draws clean air through the breather line.

The upper driving range will also be bled. The blow-by gases and crankcase vapors are flowing into air filter and through throttle valve housing into intake pipes and combustion chambers.

To prevent freezing of condensate in bleeder throttle at low ambient temperatures, the idle air distributor is heated by the refrigerant.



1,2 Connection 13 mm ID
3 Bleeder throttle 2 mm dia.
4 Idle air distributor

01–110 Measuring, boring and honing cylinder bores

Data

Standard dimension		92.00 / 92.02
Repair stages		92.50 / 92.52
		93.00 / 93.02
Max. wear limits of cylinder bores in forward or transverse direction at upper reversing point of 1st piston ring		0.10
Piston clearance	when new	0.02–0.03
	wear limit	0.08

Machining tolerances

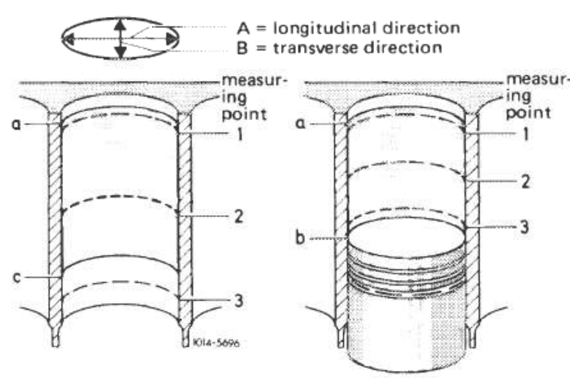
Permissible deviation from cylinder shape	when new	0.013
	wear limit	0.05
Permissible deviation from square with reference to cylinder height		0.05
Mean roughness (Rz)		0.003–0.005
Permissible waviness		50 % of roughness
Chamfer of cylinder bores		refer to Fig., item 2

Note

In addition to a visual checkup, in particular in the event of complaints about "high oil consumption", measuring of cylinder bores is unavoidable.

1 Measure cleaned cylinder bores with an internal measuring instrument at measuring points 1, 2 and 3 in longitudinal direction A (piston pin center line) and in transverse direction B.

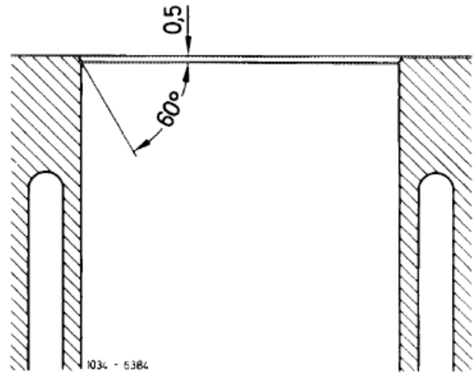
On the installed piston, the measuring point 3 is just above the piston, which should be at TDC.



a upper reversing point of 1st piston ring
b BDC of piston
c lower reversing point of oil wiper ring

2 Chamfer cylinder bores after boring.

For honing, the material allowance should not exceed 0.05 mm.

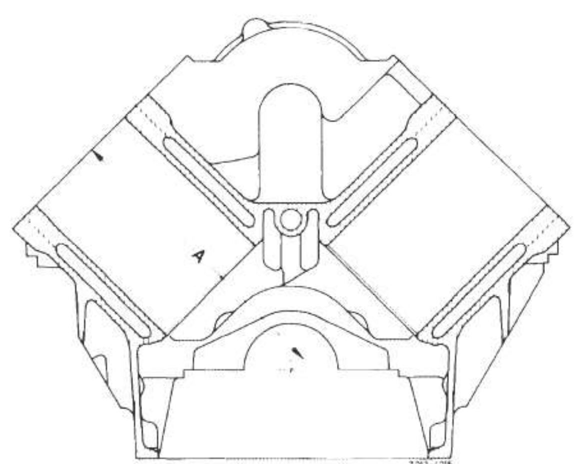


01–120 Facing cylinder crankcase parting surface

Data

Engine		116	117
Height "A" of cylinder crankcase when new		215.85–216.0	244.85–245.0
Minimum height following required removal of material[1])		215.65	244.65
Permissible deviation from parallel of upper parting surfaces in relation to crankshaft center	in longitudinal direction	0.08	
	in transverse direction	0.05	
Permissible deviation from flat of upper parting surface		0.02	
Mean roughness (Rz) of upper parting surface		0.02	
Test pressure in coolant chamber with air under water in bar gauge pressure		3	
Distance from piston crown to parting surface of crankcase		refer to 03–316	
Chamfer of cylinder bores		refer to note	

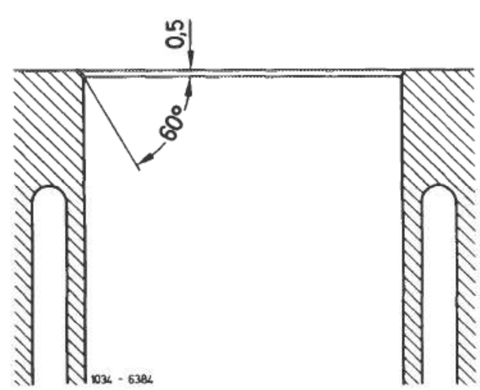
[1]) Material removal on cylinder crankcase and on cylinder head of an engine should together not exceed max. 0.5 mm (refer to 01–418).

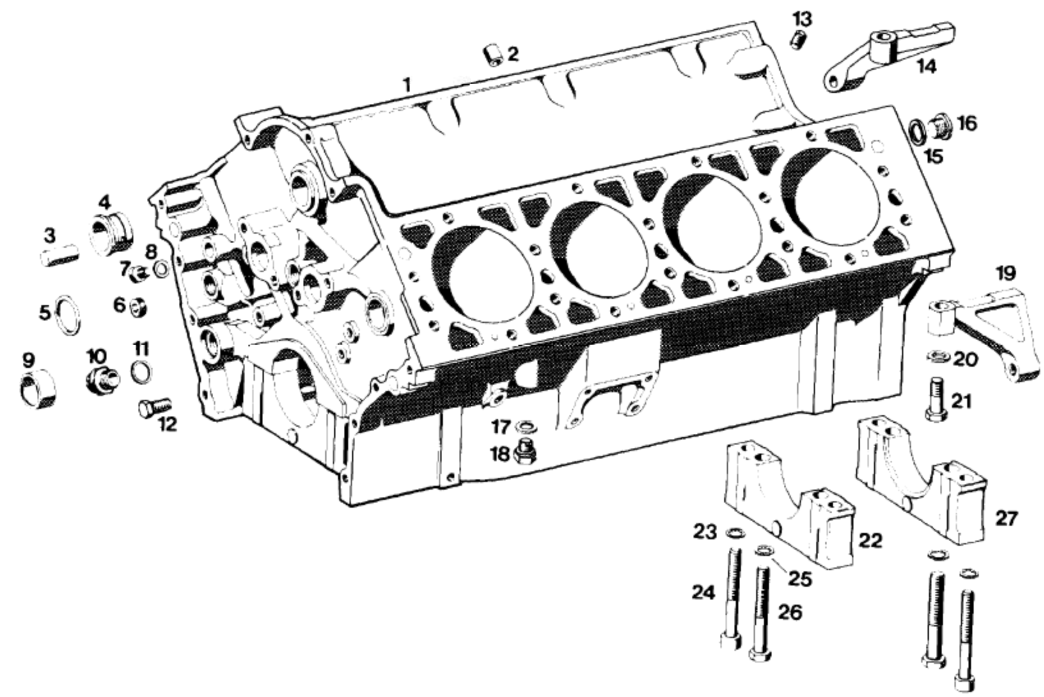


Note

Chamfer cylinder bores after facing.

If the cylinder crankcase parting surface has been reconditioned, reset the timing (05–215).





1 Cylinder crankcase
2 Set sleeves (4 each)
3 Cyl. pin 12h 8 x 14
4 Bearing bushing guide wheel
5 Sealing ring
6 Tapered plug
7 Closing plug M 8 x 1
8 Sealing ring
9 Bearing bushing intermediate gear shaft
10 Screw connection
11 Sealing ring
13 Closing plug
14 Supporting angle right
15 Sealing ring
16 Screw plug
17 Sealing ring
18 Plug AM 14 x 1.5
19 Supporting angle left
20 Washer A 10.5
21 Screw M 10 x 40
22 Crankshaft bearing cap
23 Washer
24 Hex. socket screw M 10 x 75
25 Washer
26 Hex. screw M 12 x 80
27 Crankshaft bearing cap (fitted bearing)

01–210 Removal and installation of timing housing cover

Tightening torques	Nm
Screw to crankshaft	270–330
Screws of pulley to hub	30

Special tools		
Detent (starter removed)		116 589 01 40 00
Torque wrench 3/4" square, 150–500 Nm		001 589 31 21 00
Socket 1/2" square, 27 mm		001 589 65 09 00
Allen wrench 6 mm, 440 mm long		116 589 03 07 00
Inserted bushing for radial sealing ring		110 589 07 61 00
Knocking-in tool for oil dipstick guide tube		117 589 00 31 00

Conventional tool	
Connection 3/4" square socket to 1/2" square head	e.g. made by Hazet, D-5630 Remscheid order No. 1058 RI

Note

Timing housing covers differ by the number on casting and by their height.

The timing housing cover can be removed with cylinder heads mounted.

Removal

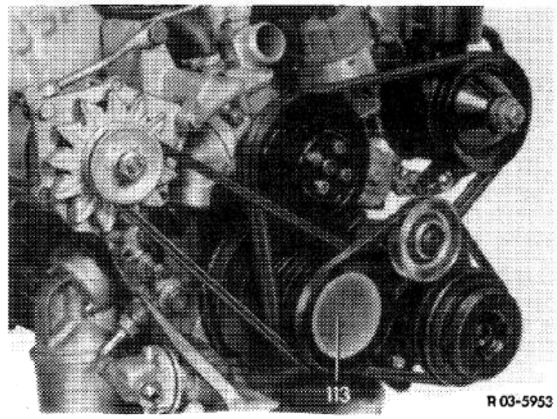
1 Disconnect grounding line on battery.

2 Drain engine oil and coolant.

3 Remove radiator and fan (without viscofan coupling).

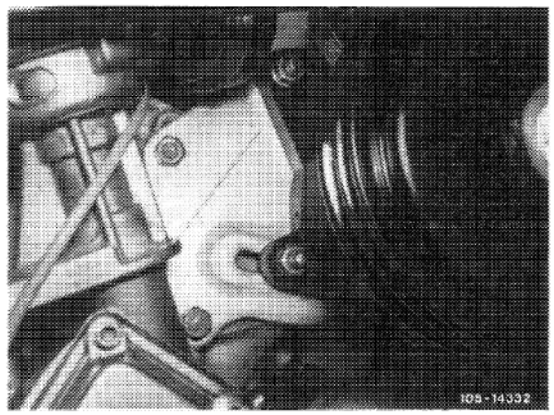
4 Remove alternator with mounting bracket and ignition distributor.

5 Remove air compressor, refrigerant compressor and vacuum pump (USA).

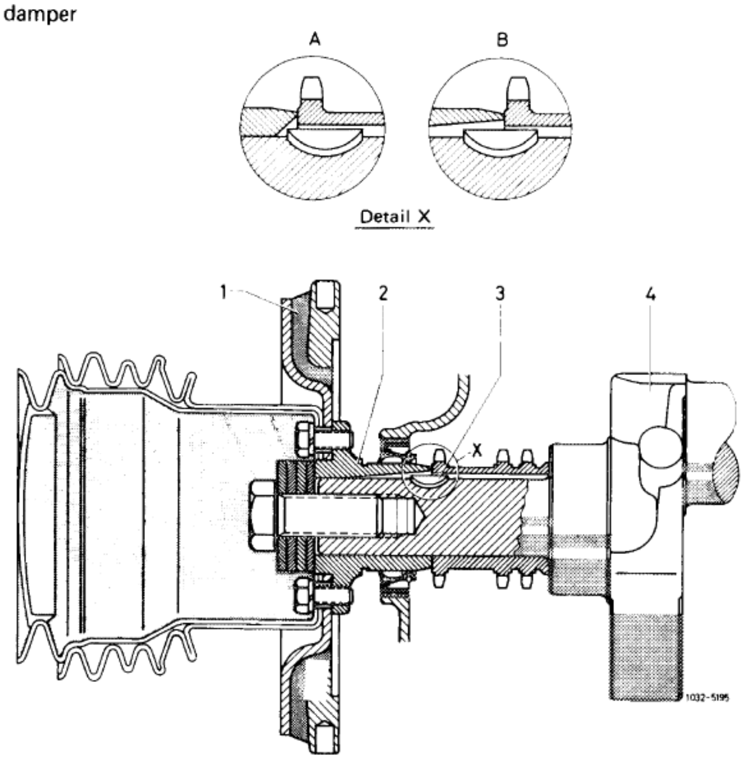


6 Remove power steering pump at connected lines and put aside.

7 Unscrew mounting bracket of power steering pump.



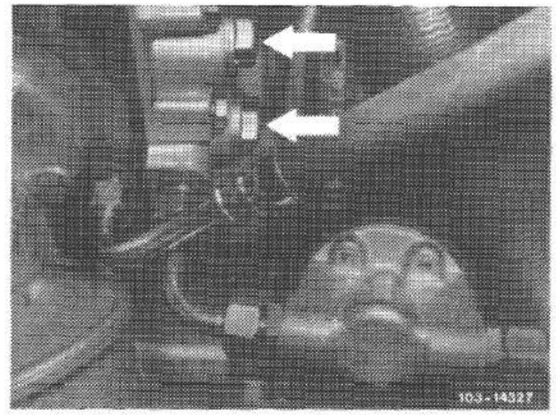
8 Remove pulley together with vibration damper and hub (03–340).



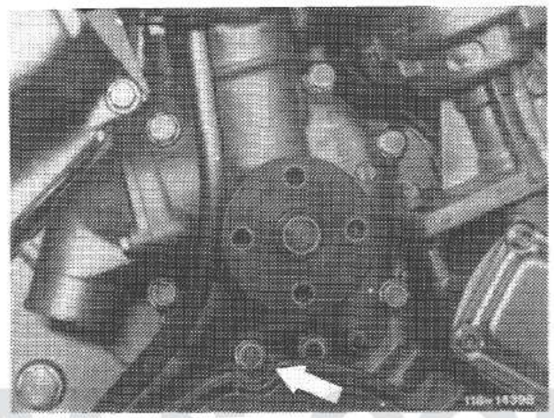
9 Remove oil damper with holder.

Do not unscrew closing plugs (arrows).

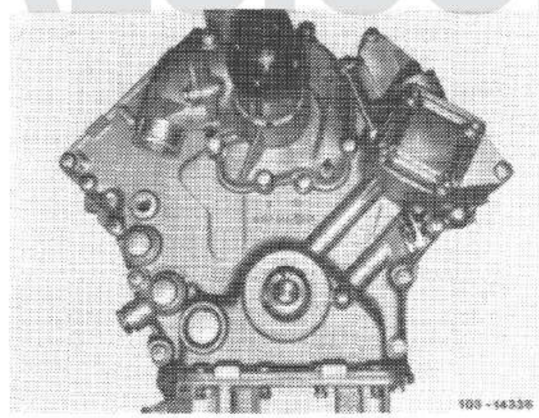
On engines with oil suction, remove oil dip stick guide tube.



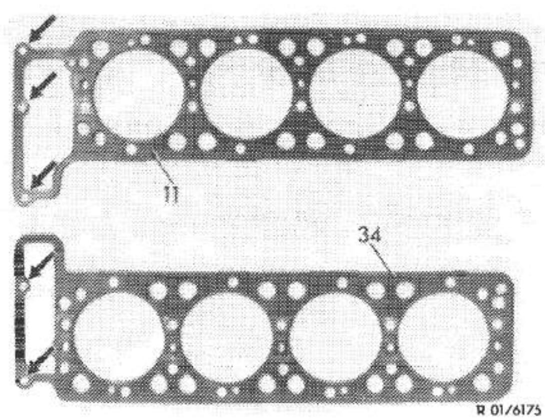
10 Remove coolant pump with housing (20–210).



11 Remove oil pump (18–210). Loosen oil pan upper half on two-piece oil pan on crankcase, that is, loosen screws for approx. 3–4 turns.

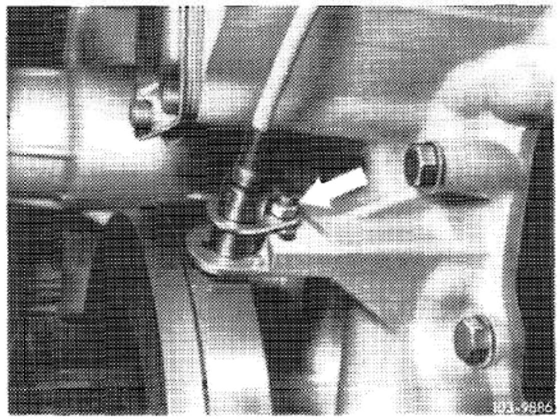


12 Unscrew cylinder head bolts M 8 (arrows).



13 Disconnect TDC transmitter and pull out.

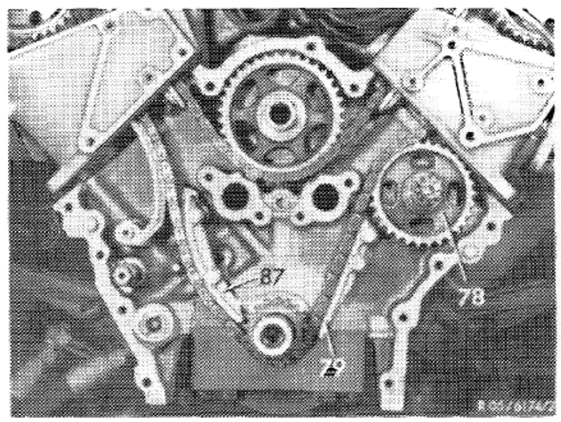
14 Unscrew all screws for timing housing cover.



15 Push out radial sealing ring for crankshaft.

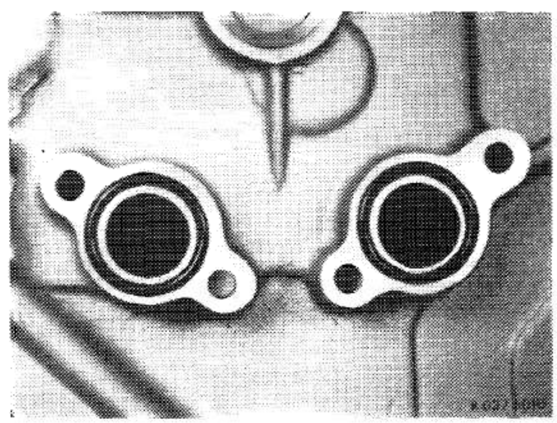
16 Remove timing housing cover while disconnecting oil pump chain on crankshaft sprocket.

Attention!
Do not damage cylinder head gasket.
Renew damaged cylinder head gaskets.



Installation

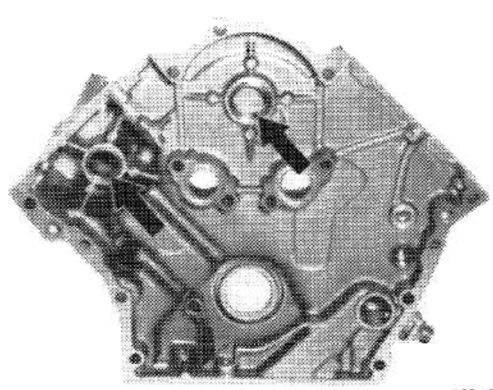
17 Renew O-rings for sealing coolant ducts.



Attention!
If the bearing bushings are renewed, pay attention to position of bottom oil groove (arrows).

18 Coat sealing surface of timing housing cover with sealing compound.

19 Grease cylinder head gaskets.



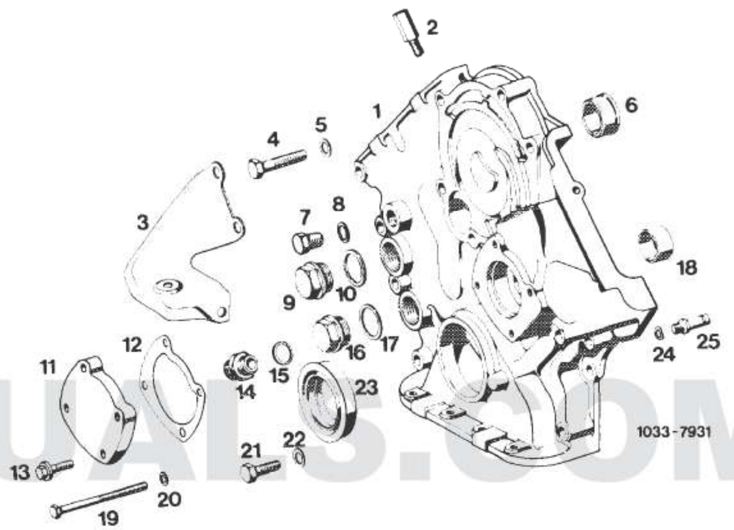
103–9559

20 When mounting timing housing cover, place oil pump chain with a curved panel on crankshaft sprocket.

21 Screw-on cylinder head bolts M 8 first.

22 For further installation proceed vice versa.

1 Timing housing cover
2 Threaded bolts for adjusting lever of ignition distributor
3 Holder for engine shock absorber
4 Screw M 8 x 45 (10 each)
5 Washer A 8.4
6 Bearing bushing guide wheel
7 Closing plug
8 Sealing ring
9 Closing plug M 26 x 1.5
10 Sealing ring
11 End cover
12 Gasket
13 Combination screw 6 x 15
14 Screw connection
15 Sealing ring
16 Closing plug M 26 x 1.5
17 Sealing ring
18 Bearing bushing for intermediate sprocket shaft
19 Screw M 8 x 105
20 Washer
21 Screw M 8 x 25
22 Washer
23 Radial sealing ring
24 Spring washer
25 Bearing bolt



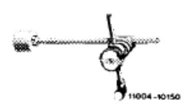
01–220 Installation and centering of intermediate flange

Data

Permissible radial runout at fitted shoulder of intermediate flange during one full turn		0.10
Permissible axial runout at fitted shoulder of intermediate flange during one full turn		0.10
Fitted bore in intermediate flange for centering pins		12.016 to 12.043

Tightening torques		Nm
Fastening screws for intermediate flange		50
Fastening screws M 8 for supporting angle on cylinder crankcase		30
Fastening screws M 10 for supporting angle on intermediate flange		50
Necked-down screw for driven plate or flywheel	initial torque	30–40
	angle of rotaton torque	90–100°

Special tool

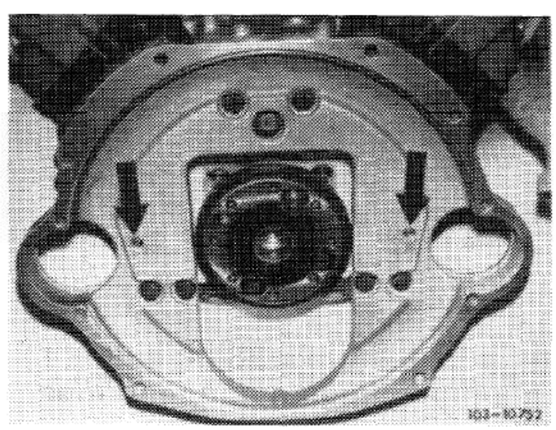
Dial gauge holder		363 589 02 21 00

Self-made tool

Threaded bolt	refer to Fig., item 3

Note

A new intermediate flange must be centered.

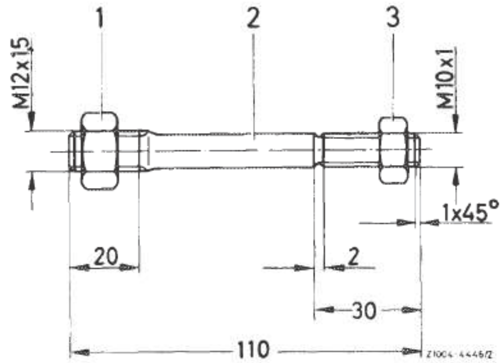


Installing and centering

1 Insert intermediate flange into fitted pins (arrows) into crankcase.

2 Slightly tighten the four fastening screws.

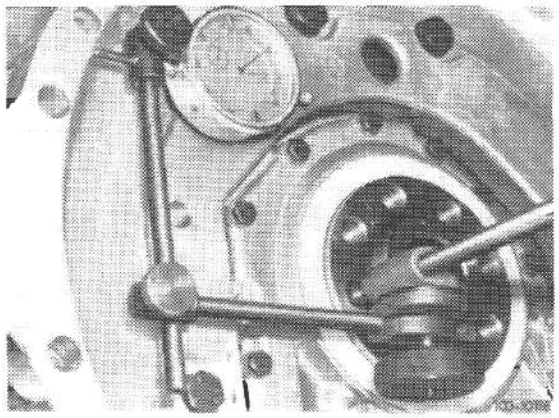
3 Screw threaded bolts into crankshaft and counterlock.



1 Hex. nut M 12 x 1.5
2 Threaded bolt 10 mm dia.
3 Hex. nut M 10 x 1

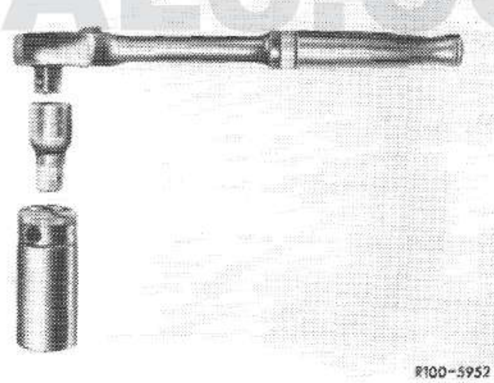
4 Attach dial gauge holder with dial gauge to threaded bolt.

5 Position feeler pin against fitted OD of intermediate flange for measuring axial or radial runout. Set dial gauge to 0.



6 Turn crankshaft with tool combination in direction of rotation for one complete revolution. Radial or axial runout should not exceed max. 0.10 mm. This means that the total deflection may amount to max. 0.10 mm. If the axial runout exceeds 0.10 mm, renew intermediate flange.

Note: When rotating crankshaft, make sure that feeler pin of dial gauge is not getting stuck.



7 Correct radial runout by means of light blows against intermediate flange.

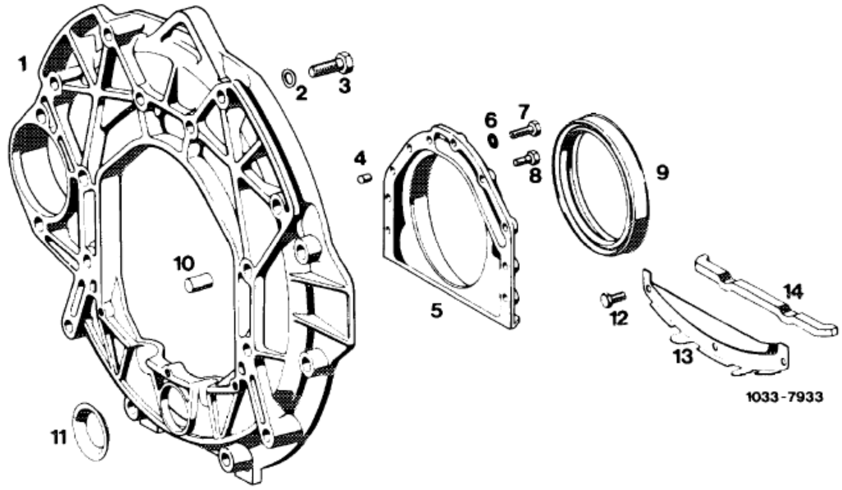
8 Tighten fastening screws.

Note: If the radial runout is higher than 0.10 mm, remove intermediate flange.

9 Drill both fitted bores in intermediate flange to 12.1 mm.

10 Repeat item 1–8.

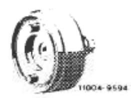
11 Mount supporting angle only after the intermediate flange has been attached to cylinder crankcase.



1 Intermediate flange
2 Spring washer B 10
3 Screw M 10 x 28
4 Cyl. pin 6h 8 x 10
5 End cover
6 Washer A 6.4
7 Screws M 6 x 25 (5 each)
8 Screws M 6 x 20 (3 each)
9 Radial sealing ring
10 Cyl. pin 6h 8 x 10
11 Cover
12 Screw M 6 x 15
13 Cover plate
14 Sealing strip

01–222 Removal and installation of end cover

Tightening torques		Nm
Screws for end cover		25
Necked-down screws for driven plates and flywheel	Initial torque	30–40
	Angle of rotation torque	90–100°

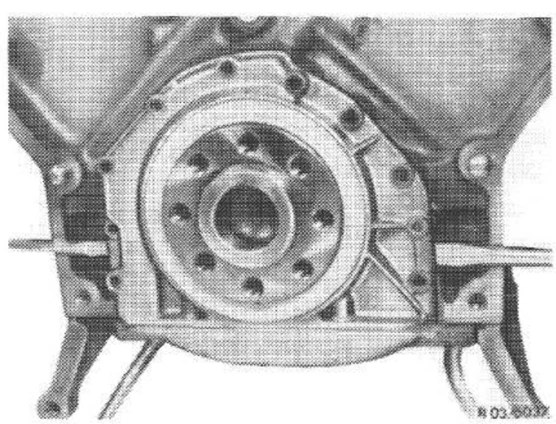
Special tool		
Installer for radial sealing ring for mounting end cover with pressed-in radial sealing ring		117 589 00 43 00

Removal

1 Remove transmission (27–600).

2 Remove flywheel or driven plate (03–410).

3 Force-off cover at recesses.



Installation

4 Carefully clean sealing surface on cylinder crankcase and on end cover.

5 Coat end cover at sealing surface uniformly with sealing compound Hylomar, part no. 001 989 25 20.

6 Fill radial sealing ring between dust and sealing lip with longterm grease according to sheet 266.2 of Specifications for service products.

7 Slip end cover with radial sealing ring over screwed-on installer for radial sealing ring and screw-on.

01–310 Removal and installation of complete oil pan

Oil filling capacity in liters

Model	107	116
Oil pan max./min.	7.5/5.5	
Oil filter	0.5	
Air oil cooler	0.5	0.4
Oil dipstick color code	gentian blue	light blue

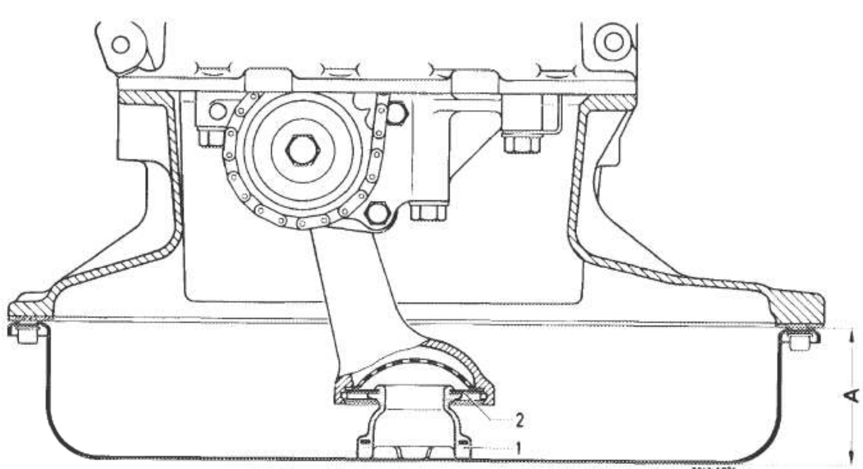
Tightening torques		Nm
Oil drain plug to oil pan	M 26	50
	M 12	40
Oil drain plug to oil air cooler		35

Special tools

Allen-box wrench 13 x 14 mm		117 589 02 07 00
Support for knocking-in oil dipstick guide tube		117 589 00 31 00

Note

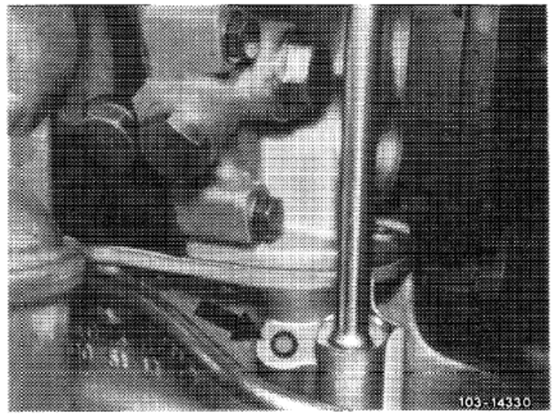
Since March 1972, the oil pan lower half of two-piece oil pans is installed with dimension A = 58.5 mm.



As a spare part, oil pans are supplied with 2 bores for oil dip stick guide tube. Close bore which is not required with a closing plug (arrow).

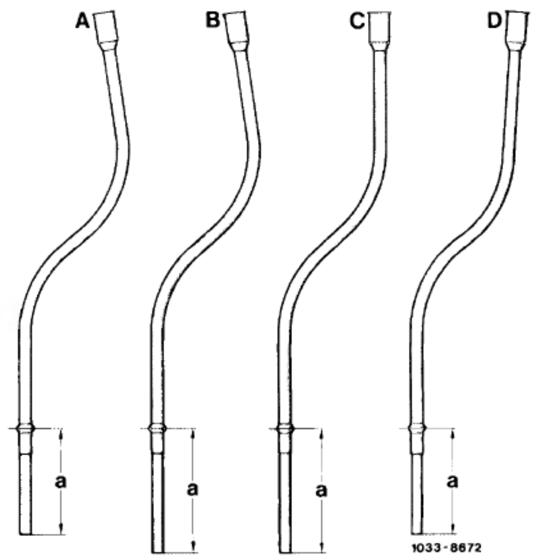
Aluminum closing plug 11.8 dia. x 10 mm
116 997 03 35

Aluminum closing plug 9.8 dia. x 10 mm
116 997 04 35



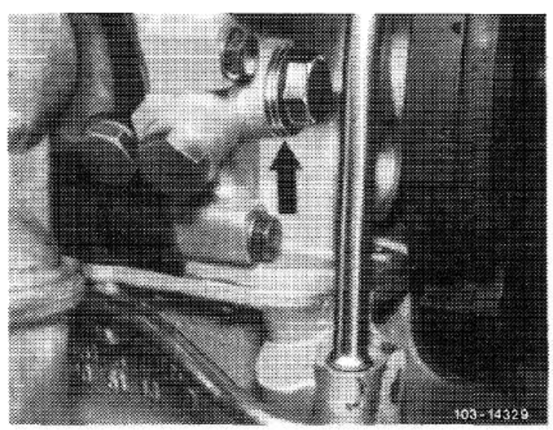
Do not mix up oil dipstick guide tubes during assembly jobs, since otherwise wrong oil levels will be indicated.

Differences are shown on drawing and in table.

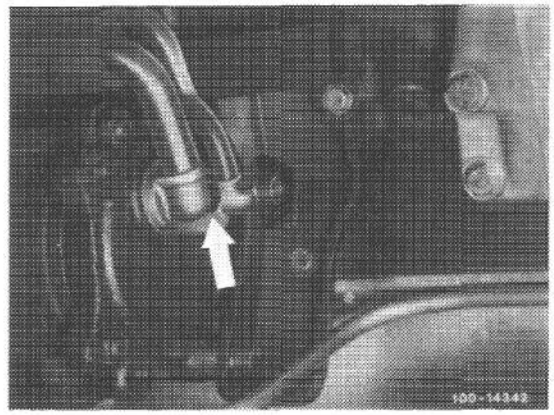


A	engine 116.985,	117.986	a = 125,5 mm
B	engine 116.984,	117.985	a = 135,5 mm
C	engine 116.960/962,	117.960/962	a = 135,5 mm
D	engine 116.961/963,	117.961/963	a = 125,5 mm

An oil pan with an oil dipstick guide tube for oil suction can be installed only with a timing housing cover with offset closing plug (arrow) for oil cooler bypass valve.



A. Model 107



Removal

1 Remove radiator shell and breather.

2 Remove front axle.

3 Remove refrigerant compressor with mounting bracket and tensioning roller (83–522).

4 Remove supporting angle bracket on transmission.

5 Unscrew holder for oil dipstick guide tube.

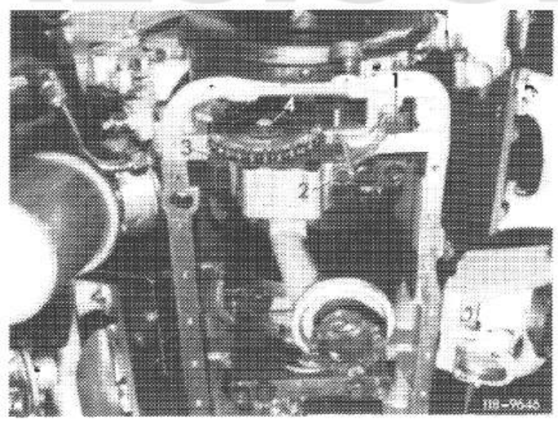
6 Unscrew oil pan and remove together with oil dipstick guide tube in downward direction.

Installation

7 Prior to installation, glue new oil pan gasket with grease on oil pan.

8 For further installation proceed vice versa.

B. Model 116



Removal

1 Remove refrigerant compressor with mounting bracket and tensioning roller (83–522).

2 Remove regulating linkage.

3 Remove oil pan lower half.

4 Remove oil dipstick guide tube.

5 Remove oil pump.

6 Remove pulley for viscofan.

7 Remove thermostat housing cover.

8 Disconnect oil lines for automatic transmission

9 Remove supporting angle bracket on transmission.

10 Unscrew oil pan, turn crankshaft in such a manner that oil pan can be removed in downward forward direction.

Installation

11 Prior to installation, glue new oil pan gasket with grease on oil pan.

12 For further installation proceed vice versa.

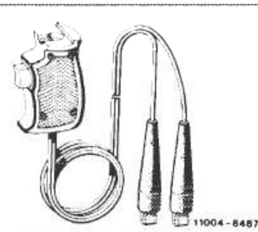
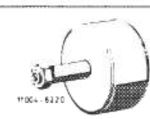
01–415 Removal and installation of cylinder head

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1)]	0.15[1)]
Exhaust	0.20	0.25

[1)] 0.05 mm higher during lasting outside temperatures below –20 °C.

Tightening torques			Nm
Cylinder head bolts	with engine cold	step 1	30
		step 2	60
	check at approx. 80 °C		60
Bolts for cylinder head cover			5
Fastening bolts for camshaft sprockets			100
Injection valves on cylinder head			10

Special tools

Screw driver socket 8 mm, 130 mm long		000 589 33 07 00
Screw driver socket 8 mm, 105 mm long, offset		000 589 34 07 00
Screw driver socket 8 mm, 1/2" square		116 589 00 13 00
Screw driver socket 8 mm, with hinged joint and extension		117 589 01 07 00
Screw driver 6 mm, 440 mm long		116 589 03 07 00
Valve adjusting wrench 17 mm		116 589 02 01 00
Contact handle for rotating engine		001 589 46 21 08
Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt 6 x 50 mm		116 589 01 34 00

Note

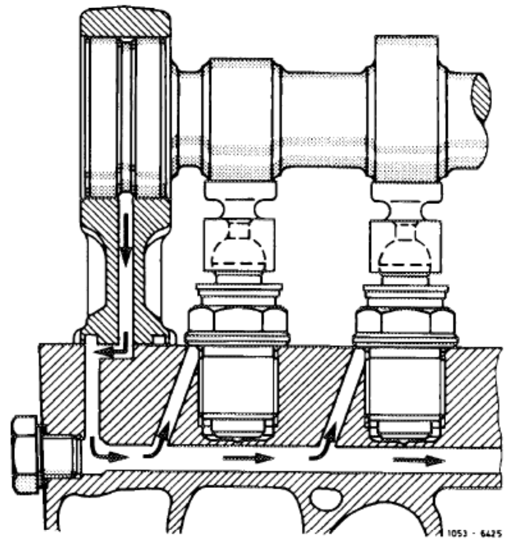
The cylinder heads cannot be used for light alloy engines, since the 5 center cylinder head screw holes are not uniform.

Remove cylinder head only from cooled-down engine.

Face cylinder head parting surface only in the event of porous or damaged spots. A slightly warped parting surface will adapt itself again when cylinder head is tightened.

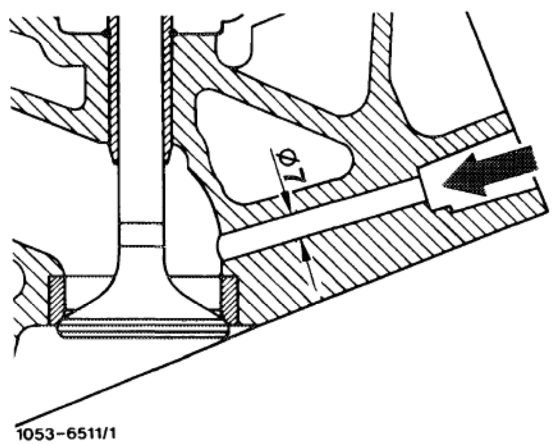
Each cylinder head is located in relation to cylinder crankcase by means of 2 fitted sleeves and is fastened to cylinder crankcase by means of 18 cylinder head screws, 6 each per cylinder bore.

Note: Cylinder heads with longitudinal oil duct and feed bores for hydraulic valve clearance compensating elements can be provided with valve adjusting screws for manual valve adjustment when used as spare parts.

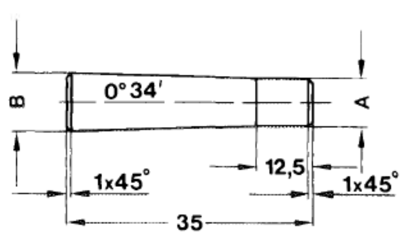


In a cylinder head with air duct and 4 bores, the 4 bores must be closed with tapered plugs (6 mm dia.) 116 997 00 05 when the cylinder head is used for an engine without air injection.

Starting model year 1980, the 4 bores in air duct have been enlarged from 6 to 7 mm dia. They must be closed with tapered plugs (7 mm dia.) 116 997 01 05 if the cylinder head is used for an engine without air injection.



Provide tapered plugs made of aluminum for closing bores in air duct with Loctite AVX 86, part no. 002 989 87 71 and knock in.



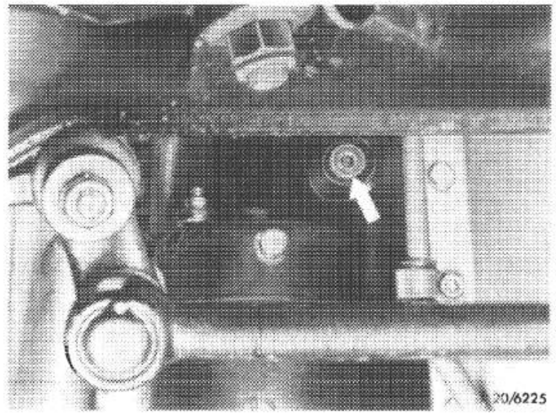
Bore 6 mm: Dimension A = 5.9 mm dia., B = 6.33 mm dia.
Bore 7 mm: Dimension A = 6.9 mm dia., B = 7.33 mm dia.

Removal

RZ = righthand cylinder head
LZ = lefthand cylinder head

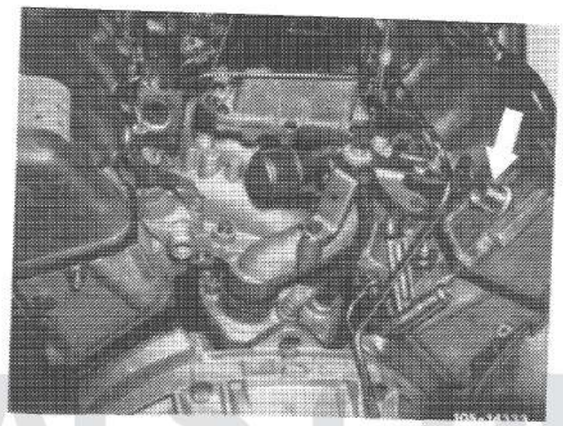
1 Drain coolant.

The drain plugs on crankcase are at the left and right.

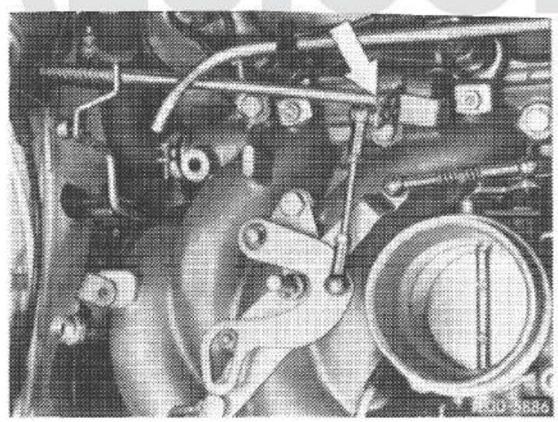


2 Righthand cylinder head: Remove battery.

3 Remove fuel line and injection valves.



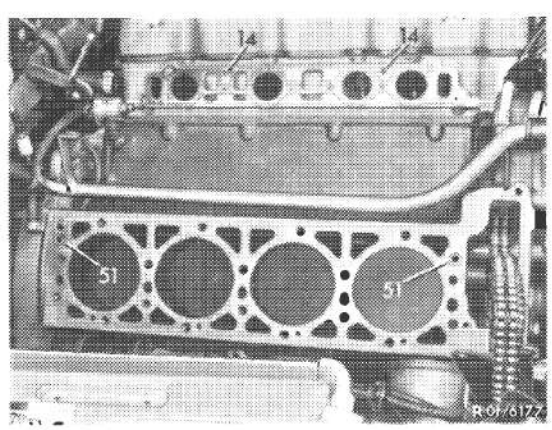
4 Push longitudinal regulating shaft in direction of front wall and remove or unscrew bearing bracket.



5 Remove intake pipe.

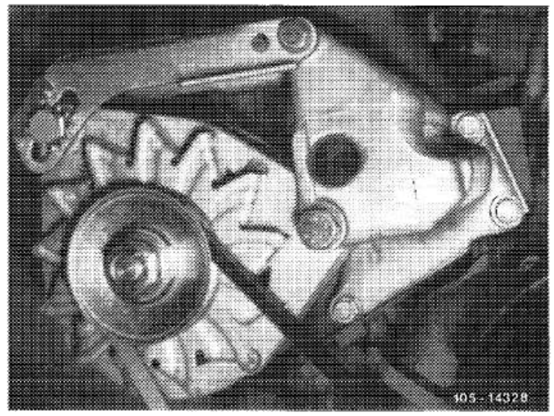
On engines with CIS injection system, remove intake pipe with mixture controller and air guide housing.

The intake pipe is guided by four set sleeves (14).



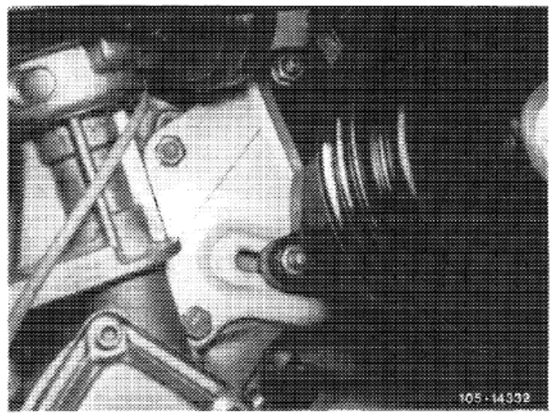
6 Righthand cylinder head: Remove alternator with mounting bracket.

7 Righthand cylinder head: Loosen oil dipstick guide tube for automatic transmission on cylinder head.

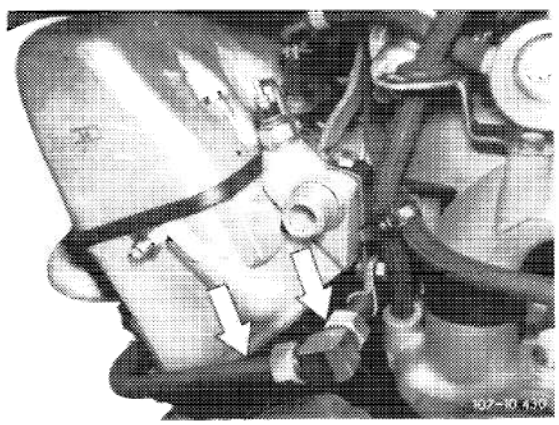


8 Lefthand cylinder head: Remove power steering pump with mounting bracket. For this purpose, remove ignition distributor.

9 Unscrew exhaust pipe on respective exhaust manifold.



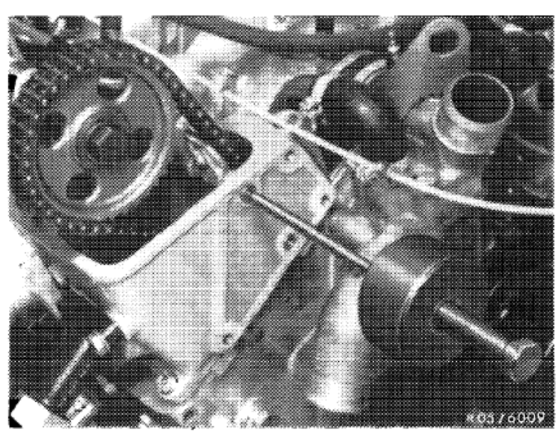
10 On USA verhicles, disconnect exhaust gas return line (arrows).



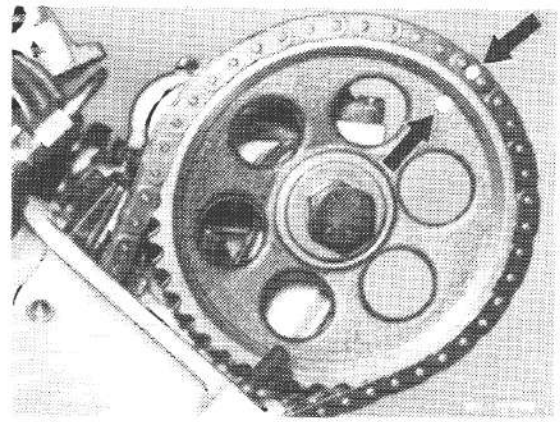
11 Remove chain tensioner (05–312).

12 Righthand cylinder head: Remove slide rail.

13 Lefthand cylinder head: Remove slide rail.

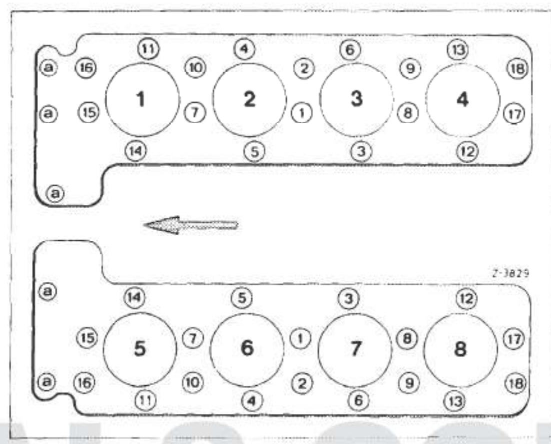


14 Mark camshaft sprocket and timing chain in relation to each other (arrows).



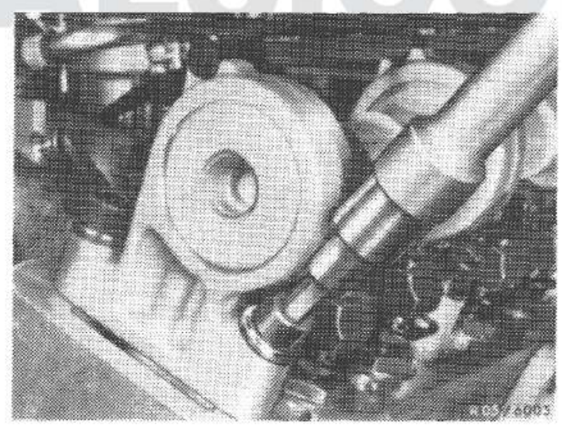
15 Unscrew cylinder head bolts vice versa to tightening diagram.

Loosen the M 8 bolts (a) with hex. socket wrench 116 589 03 07 00.

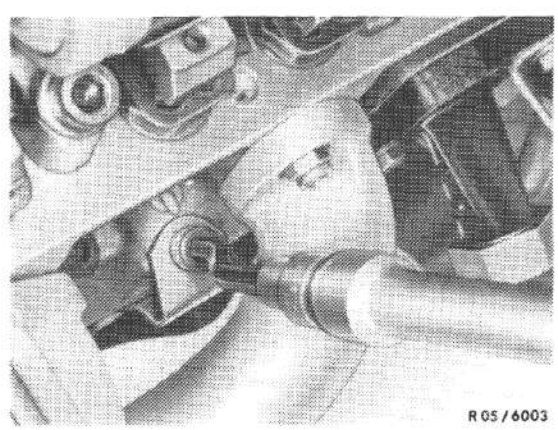


a Bolts M 8

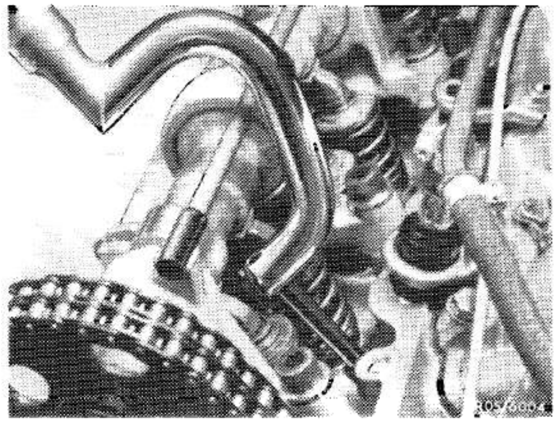
Notes: Loosening and tightening of cylinder head bolts require various types of screw driver sockets.



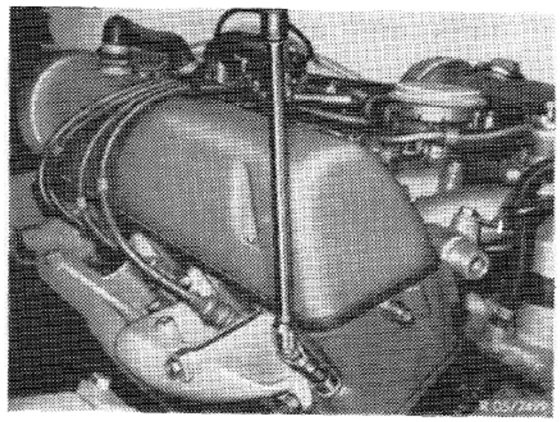
Screw driver socket 000 589 33 07 00



Screw driver socket 000 589 34 07 00

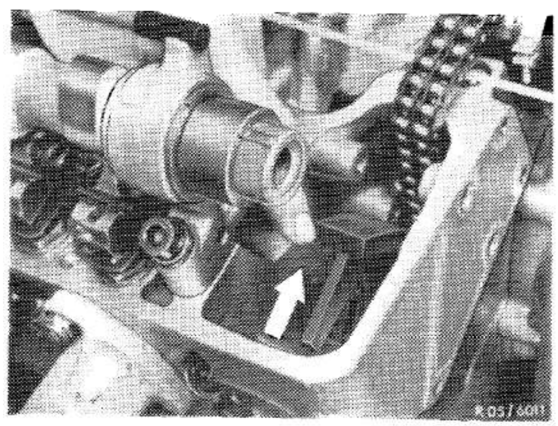


Screw driver socket 116 589 00 13 00



Screw driver socket 117 589 01 07 00

16 For removing righthand cylinder head, push tensioning rail with timing chain toward center of engine so that tensioning rail is not getting stuck.

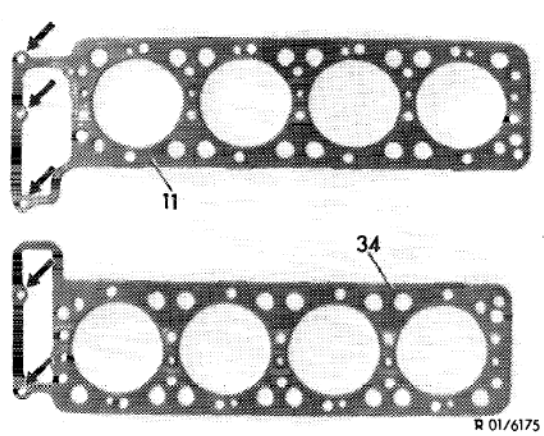


Installation

17 Clean cylinder head and cylinder crankcase parting surface.

18 Mount new cylinder head gasket.

Cylinder head gaskets of engines 116.96 and 117.96 to 116.98 and 117.98 differ by the hole pattern of the 5 central cylinder head bolt holes.



11 Righthand cylinder head gasket
34 Lefthand cylinder head gasket

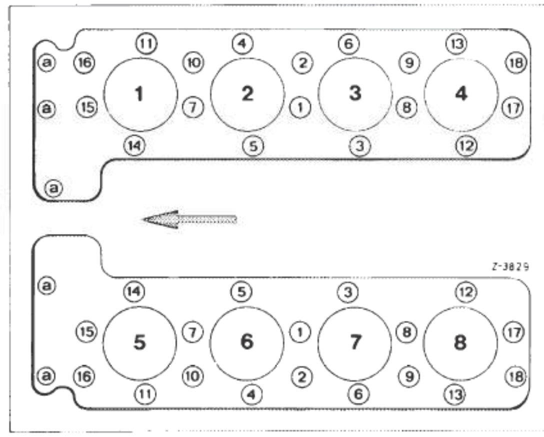
19 Mount cylinder head.

Prior to screwing-in cylinder head bolts, provide threads and mounting surface as well as washers with oil.

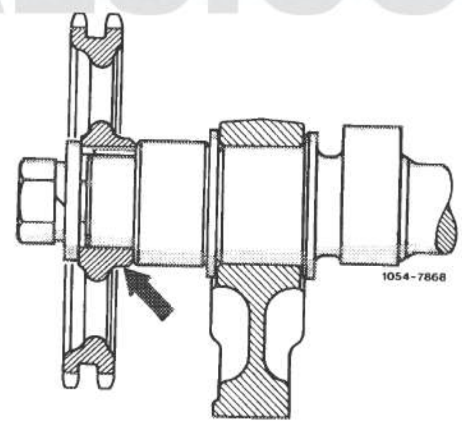
20 Tighten cylinder head bolts in steps in sequence of tightening diagram, starting with 1, first to 30 Nm and then to 60 Nm.

21 Tighten the M 8 bolts (a) to 25 Nm.

Attention!
Cylinder head bolts M 10x165, M 10x90 and M 10x65 are 10 mm shorter than on light alloy engine.

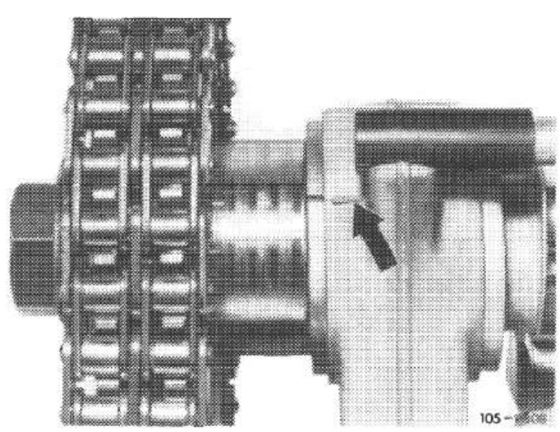


22 Mount camshaft sprocket.
The wide collar (arrow) on camshaft sprocket should face camshaft.

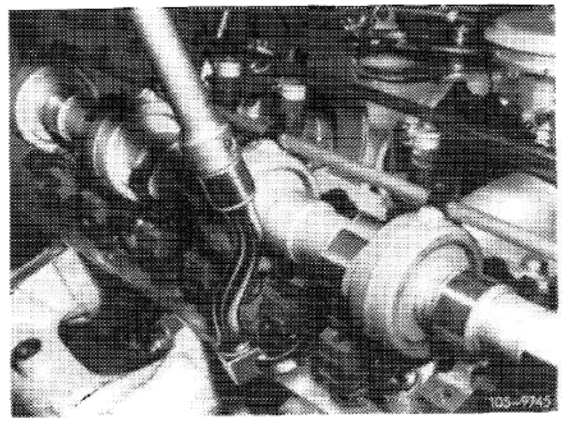


23 Markings on camshaft should be in alignment at ignition TDC position of 1st cylinder.

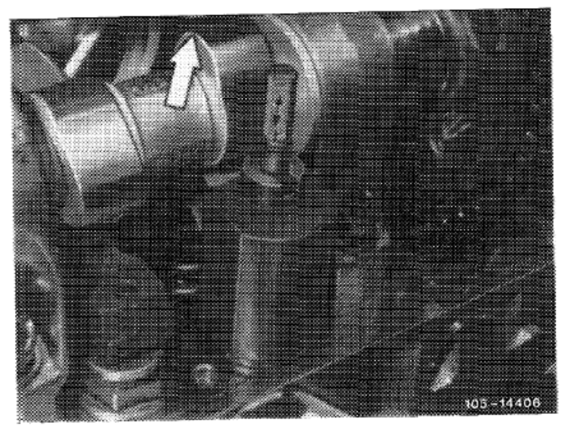
If the markings are not in alignment, check timing and adjust, if required.



24 Check valve clearance and adjust, if required (05–210).



25 Check basic position of hydraulic valve clearance compensating elements with test gauge and adjust, if required (05–213).

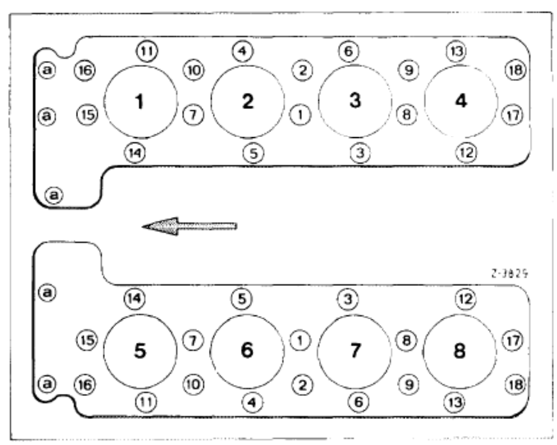


26 For further installation proceed vice versa.

27 Warm up engine.

28 Slightly loosen cylinder head bolts individually and retighten in sequence of tightening diagram, starting with 1, to 60 Nm.

Note: Retighten cylinder head bolts after 500–1000 km is not required with self-adjusting cylinder head gasket installed.



01–418 Facing cylinder head parting surface

Data

Reference dimension H when new		60
Minimum dimension after removing material allowance		59.75[1])
Permissible deviation from flat of parting surface when new or after machining[2])	in longitudinal direction	0.08
	in transverse direction	0.0
Roughness		0.006–0.014
Pressuretest with air under water in bar gauge pressure		2

[1]) The material allowance on cylinder head and on cylinder crankcase of one engine should together not exceed max. 0.5 mm (refer to 01–120).
[2]) Face cylinder head parting surface only in the event of porous or damaged spots. A slightly distorted parting surface will adapt again to cylinder head when tightened.

Conventional tools

Service grinder with milling attachment for light alloy surface	e. g. Scledum, Typ RTY Foaro u. Fi. Schio, Italy
Straightedge approx. 500 mm long	

Note

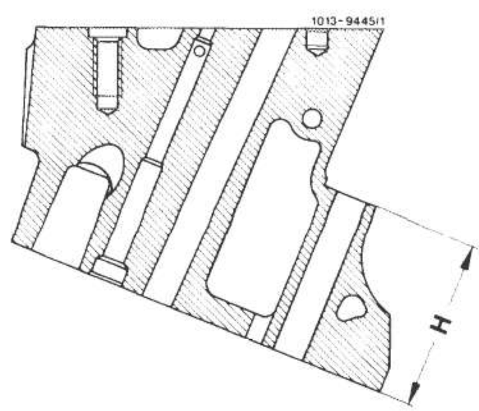
Face cylinder head parting surface only in the event of porous or damaged spots.

Facing

1 Measure reference dimension H and note.

2 Face cylinder head parting surface.

3 Measure again, determine material removal (allowance) and note.



4 Introduce valve, measure distance between valve stem end and cylinder head and note.

5 Refinish valve seats according to material removal on cylinder head.

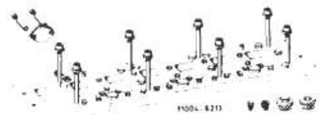
6 Check timing (05–215).

01–420 Pressure-testing cylinder head

Data

Test pressure with air under water in bar gauge pressure	2

Special tools

Pressure plate		117 589 00 25 00
Suspension device		115 589 34 63 00

Conventional tool

Electrically heated water basin	e.g. made by Otto Dürr, D-7123 Sachsenheim-Ochsenbach

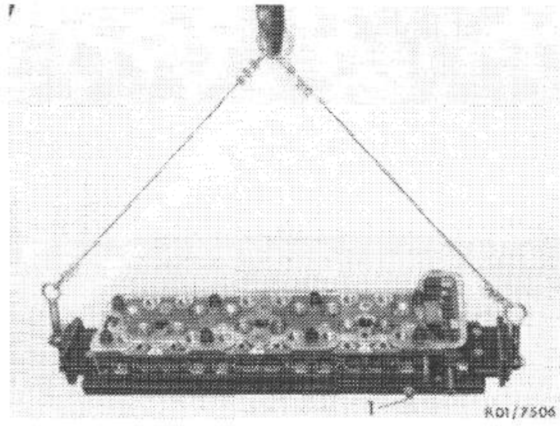
Pressure test

If cylinder head seems to have cracks (water loss), a pressure test is required.

1 Screw pressure plate on cleaned cylinder head.

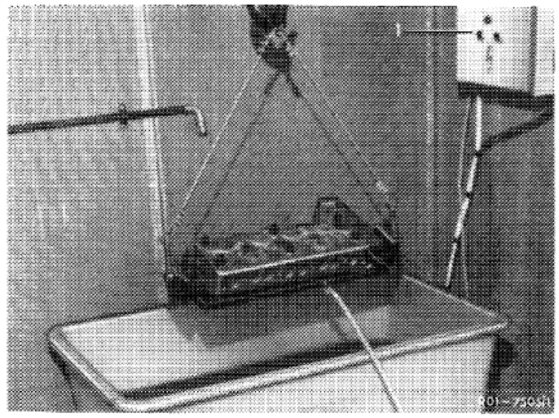
2 Close bores and connections.

3 Connect compressed air hose and set compressed air to 2 bar gauge pressure.



4 Attach cylinder head to supension device and lower into heated water (approx. 80 °C).

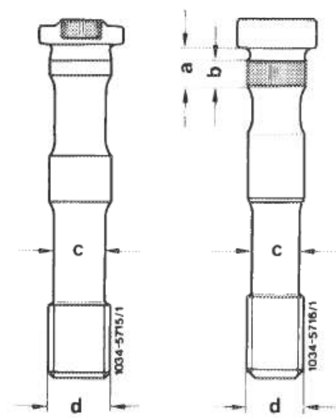
5 If air bubbles are rising, find leaks and mark.



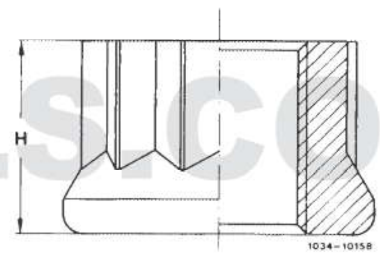
03–310 Checking, renewing and tightening connecting rod bolts

Dimensions of connecting rod bolt and connecting rod nut

		1st version 2nd version	3rd version
Part no.		116 038 01 71 116 038 02 71	116 038 04 71
Thread dia. d		M 11 x 1	M 10 x 1
Necked-down shaft dia c when new		9,5–0,1	8,4–0,1
Minimum necked-down shaft dia. c		8,5	8,0
Dimension	a	–	6,6
	b	–	4,5
	c		4,2
Length L		57,7–58,5	58,2–58,5
Connecting rod nut height H		11	



1st and 2nd version   3rd version



Tightening torque

Connecting rod nuts	initial torque	40–50 Nm
	angle of rotation torque	90–100°

Self-made tool

Steel plate	refer to Fig., item 3

Note

Prior to assembly, lubricate connecting rod bolt threads and nut contact surface with engine oil.

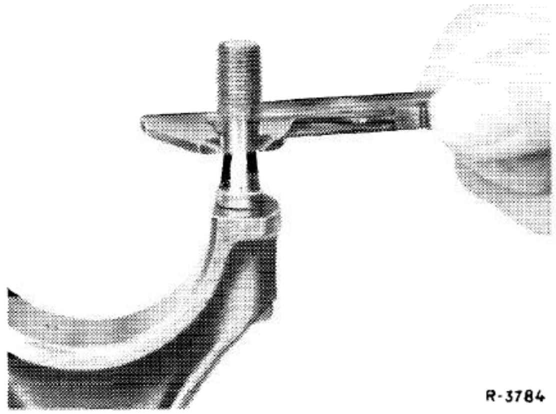
Connecting rod bolt 3rd version may be used only in connecting rods with 10 mm bolt bore.

Knock-out connecting rod bolts only if they are to be replaced.

Checking

1 Measure minimum necked-down shaft dia. c prior to re-use.

If the minimum necked-down shaft dia. c shown in table is attained, replace connecting rod bolt.

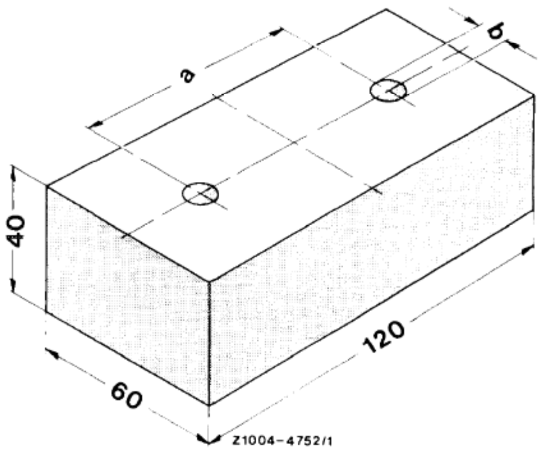


R-3784

Replacement

2 Knock-out connecting rod bolts.

3 Press new connecting rod bolts into connecting rod at approx. 45 000 N, or knock in with hammer and mandrel. When knocking or pressing in connecting rod bolts, set connecting rod on a ground steel plate.



Z1004-4752/1

Hole spacing a = 68 mm
Bore b = 11.5 mm

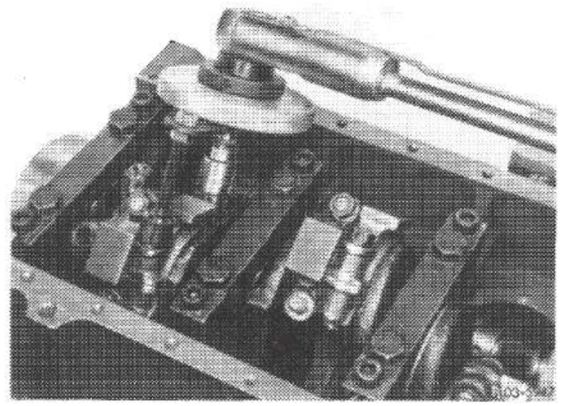
Attention!
Connecting rod bearing caps mounted with **hex. nuts** may **not subsequently** be converted to **double hex. nuts.** Since hex. nuts have a smaller dia. than double hex. nuts, the double hex. nuts would rest on the burr created when tightening hex. nuts.

Tightening

4 Lubricate nuts and thread faces.

5 Tighten connecting rod nuts with 40–50 Nm initial torque and then to 90–100° angle of rotation torque.

Attention!
Tighten connecting rod bolts knocked in with a **hammer the first time** to **60–70 Nm** initial torque and then to 90–100° angle of rotation torque.



Make sure that these instructions are observed, since otherwise the nuts of the connecting rod bolts may become loose.

Note: If no angle of rotation torque wrench is available, the nuts can also be tightened with a normal socket wrench with a tommy bar **in one step** to the specified angle. The angle should be estimated as accurately as possible. **To eliminate angle of rotation errors, do not use torque wrench** for tightening angle of rotation.

03–313 Reconditioning and squaring connecting rod

Data

Engine	116.98	117.98
Center of connecting rod big end bore up to center of connecting rod small end bore (L in Fig. item 5)	138,050 137,950	154,550 154,450
Width of connecting rod at big end bore	24,890 24,857	
Width of connecting rod at small end bore	28,000 27,900	
Basic bore for connecting rod bearing shells (A in Fig. item 5)	55,619 55,600	
Basic bore for connecting rod bushing (a in Fig. item 5)	29,021 29,000	
Connecting rod bushing ID	26,013 26,007	
Roughness of connecting rod bushing, inside	0,004	
Permissible offset of big end bore in relation to small end bore	0,13	0,15
Permissible deviation from parallel alignment of axis: Big end bore in relation to small end bore	0,06	0,07
Permissible deviation of big end bore from concentricity	0,01	
Permissible difference in weight of complete connecting rod within one engine	4 g	

Tightening torque

Connecting rod nuts	Initial torque	40–50 NM
	Angle of rotation torque	90–100°

Conventional tool

Connecting rod testing and aligning tool	e. g. Walter Krupp GmbH D-5309 Meckenheim Model CL 6

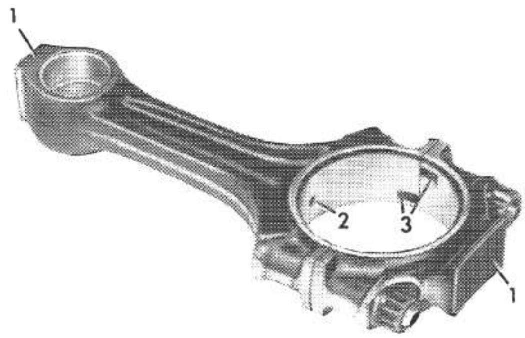
Note

Connecting rods which were overheated as a result of bearing damage (blue discoloration) should no longer be used.

Connecting rod and connecting rod cap are marked together. The connecting rod shaft should have no transverse score marks and notches.

Connecting rods with machined connecting rod bushing are supplied as spare parts.

When renewing connecting rods, pay attention to difference in weight of connecting rods.

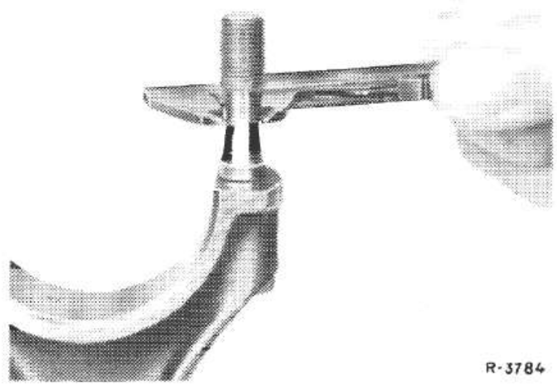


1 Weight compensation
2 Oil bore
3 Locking grooves

103–9495

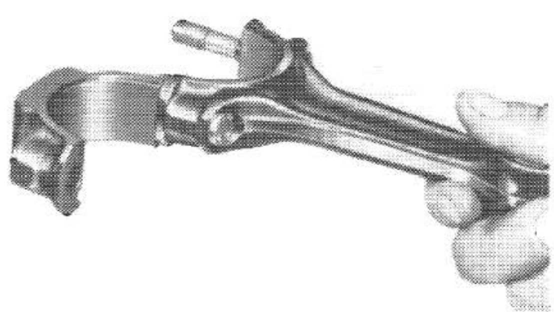
Reconditioning

1 Check connecting rod bolts and replace, if required (03–310).



R-3784

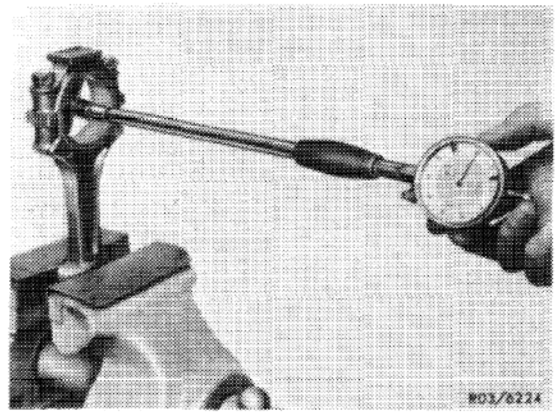
2 Check bores for connecting rod bolts. Mount connecting rod bearing cap on a connecting rod bolt. If the connecting rod bearing cap is moving downwards under its own weight, the connecting rod must be replaced.



103–9232

3 Mount connecting rod bearing cap and tighten connecting rod nuts to 40–50 Nm.

4 Measure connecting rod bearing bores. If basic bore exceeds a value of 55,62 mm or is conical in shape, refinish bearing cap supporting surface on a face plate up to max. 0.02 mm.



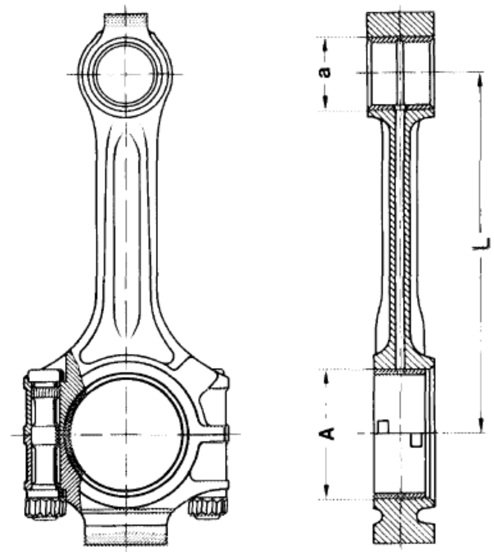
103/6224

5 Press-in new connecting rod bushing in such a manner that the oil bores are in alignment. Pressing-in pressure at least 2500.

6 Machine or ream connecting rod bushing.

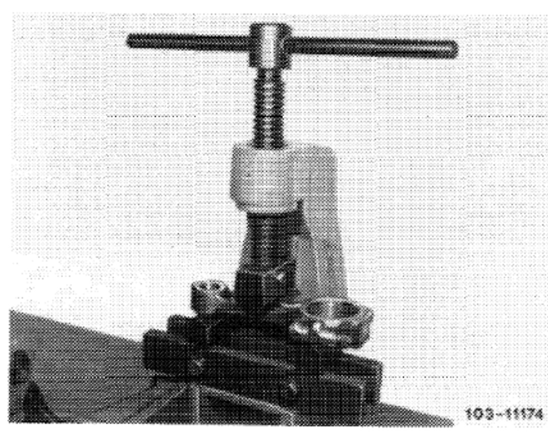
7 Refinish lateral contact surface of connecting rod on the face plate.

8 Square connecting rod by means of a connecting rod tester.



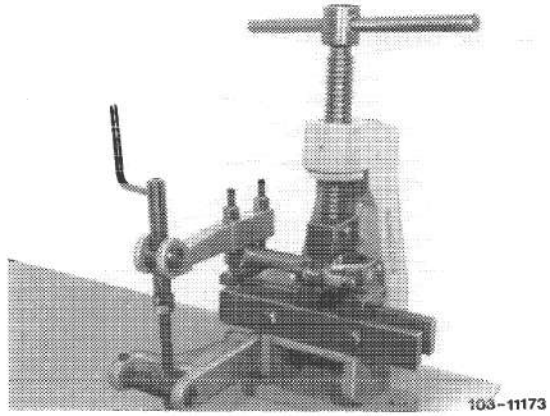
1033-8002/2

9 Align connecting rod bore in relation to connecting bushing bore (parallel alignment).



103-11174

10 Check setoff of connecting rod bearing bore in relation to connecting rod bushing bore.



03–316 Removal and installation of pistons

Association piston-cylinder

Group No.		0	1	2
Standard dimension Std	piston dia. cylinder dia.	91.98 92.00	91.99 92.01	92.00 92.02
1st repair stage + 0.5	piston dia. cylinder dia.	92.48 92.50	92.49 92.51	92.50 92.52
2nd repair stage + 1.0	piston dia. cylinder dia.	92.98 93.00	92.99 93.01	93.00 93.02

Engine	Piston code No. Std	+ 0.5	+ 1.0	Piston crown refer to illustration	Spacing between piston crown and parting surface of cylinder crankcase Std	+ 0.5 and + 0.1	Compression ε : 1
116.980 116.981 116.982 116.983 116.980 (USA) 116.981 (USA)	51 54	52 55	53 56	cavity 1 mm deep d = 52 mm 2 valve niches	projection max. 0.75 min. 0.30	projection max. 0.10 recess max. 0.35	9.3 9.5
116.984 116.985	66 69	67 70	68 71	without cavity 4 valve niches	projection max. 0.75 min. 0.6	projection max. 0.55 min. 0.1	9
116.990 NV 116.991 NV 116.992 NV 116.993 NV	57 60	58 61	59 62	cavity 4 mm deep 56 x 84 mm oval without valve niches	projection max. 0.85 min. 0.30	projection max. 0.40 min. 010	8 7.5
116.984 NV 116.985 NV	72	73	74	cavity 5.1 mm deep d = 66 mm 4 valve niches	projection max. 1.05 min. 0.6	projection max. 1.05 min. 0.6	7.5
117.982 117.983	19 25	20 26	21 27	cavity 5.9 mm deep d = 66 mm 2 valve niches	projection max. 0.75 min. 0.30	projection max. 0.25 recess max. 0.20	8.8
117.985 117.986	31 37	32 38	33 39	cavity 5.9 mm deep d = 66 mm 4 valve niches	projection max. 0.75 min. 0.30	projection max. 0.25 recess max. 0.20	8.8
117.981 (USA) 117.982 (USA) 117.983 (USA) 117.984 (USA)	10 13	11 14	12 15	without cavity without valve niches	recess max. 3.60 min. 3.15	recess max. 4.1 min. 3.65	8.0
117.985 (AUS) (J) (S) (USA) 117.986 (AUS) (J) (S) (USA)	40 50[1]) 53 56 60	41 51 54 57 61	42 52 55 58 62	cavity 8.8 mm deep d = 66 mm 4 valve niches	projection max. 0.75 min. 0.30	projection max. 0.25 recess max. 0.20	8.0
117.992 NV 117.993 NV 117.985 NV 117.986 NV	22[2]) 43[3])	23 44	24 45	cavity 9 mm deep d = 80 mm 4 valve niches	projection max. 0.75 min. 0.30	projection max. 0.25 recess max. 0.20	7.5

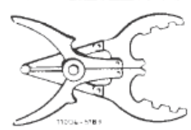
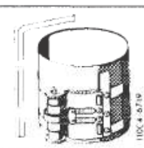
[1]) Piston with reduced friction capacity (oil ring 008 037 30 18) for (USA) entering production 1979 starting engine No. 117.985–12–043649 and 117.986–12–049507.
[2]) 2 valve niches.
[3]) 117.985 NV starting engine end No. 009 551, 117.986 NV starting engine end No. 013 041.

Test values			when new	wear limit
Piston clearance			0.02–0.03	0.08
Max. wear limit of cylinder bores in driving or transverse direction at upper reversing point of 1st piston ring			0.10	
Weight difference of pistons in one engine			4 g	10 g
Piston pin dia.			25.99 to 26.00	
Piston pin clearance in connecting rod bushing			0.007 to 0.018	
Piston pin clearance in piston			0.002 to 0.012	
Gap clearance of piston rings	groove 1	engine 116	0.30 to 0.45	1.0
		engine 117	0.35 to 0.55	
	groove 2		0.35 to 0.55	0.8
	groove 3		0.25 to 0.40	0.8
Side clearance of piston rings	groove 1	engine 116	0.05 to 0.8	0.15
		engine 117	0.06 to 0.9	
	groove 2		0.04 to 0.07	0.08
	groove 3		0.03 to 0.06	0.08

Tightening torque

Connecting rod nuts	initial torque	40–50 Nm
	angle of rotation torque	90–100°

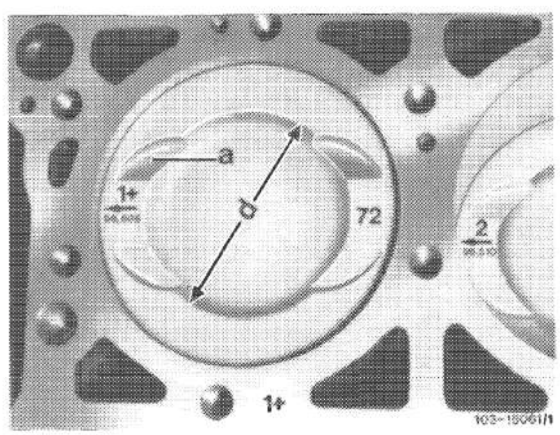
Special tools

Expanding pliers for piston rings		000 589 51 37 00
Clamping strap for piston rings		000 589 04 14 00

Note

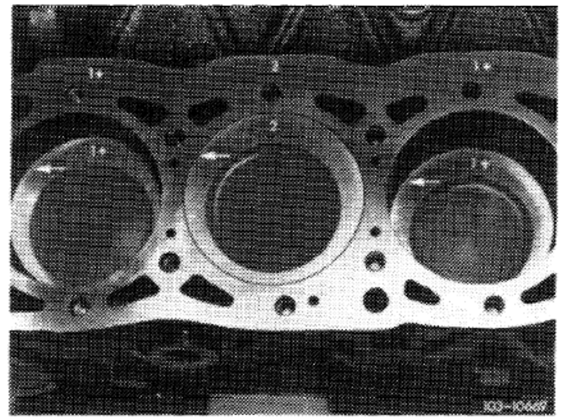
Standard pistons are subdivided in three tolerance groups (group numbers). They are punched into piston crown as follows:

1. Piston dia. e. g. 92.00
2. Piston code number e. g. 72
3. Group number e. g. 2
4. Direction indicating arrow



a Valve depression
b Cavity dia.

The group number is also punched into cylinder crankcase parting surface.


103-10669

The group number of pistons (e.g. 2) must be in accord with group number of cylinder bores (series production).

The specified piston clearance will then be maintained.

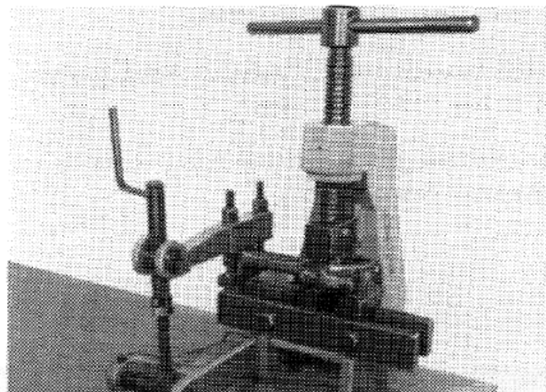
In the event of repairs, hone all cylinder bores to dimensions of existing pistons plus piston clearance (refer to table).

Removal

1 Remove connecting rod with piston in upward direction.

2 Remove piston pin lock and force out piston pin.

3 Recondition and square connecting rod (03–313).


103-11173

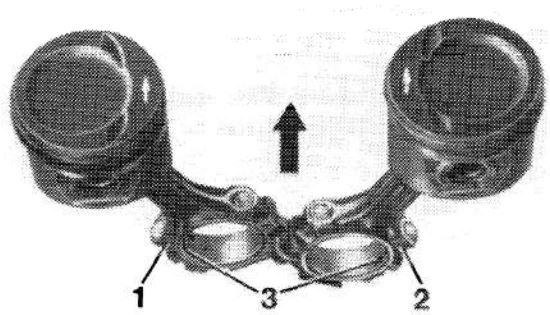
Installation

4 Check piston rings of used pistons for gap and end clearance.

5 Lubricate piston pins and connecting rod bushings.


103-10956

6 Mount pistons on connecting rod in such a manner that the arrow points in driving direction and the locking grooves (3) in connecting rod to outer sides of engine.

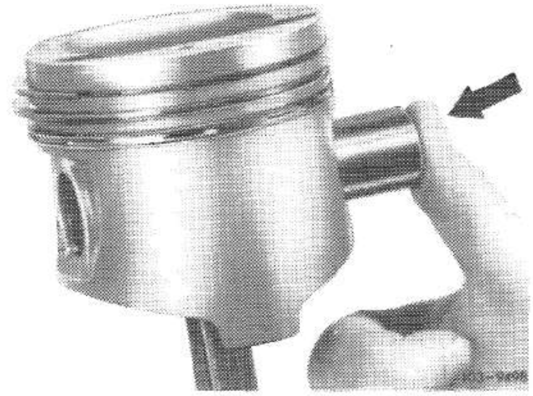


103-9556/1

1 Connecting rod thrust end
3 Locking grooves

7 Push-in piston pin manually.

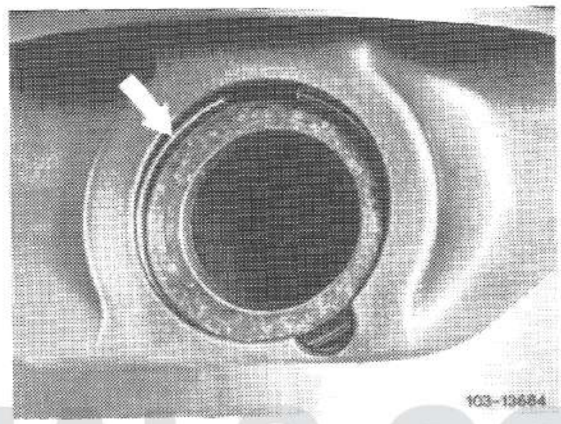
Attention!
Do not heat piston.



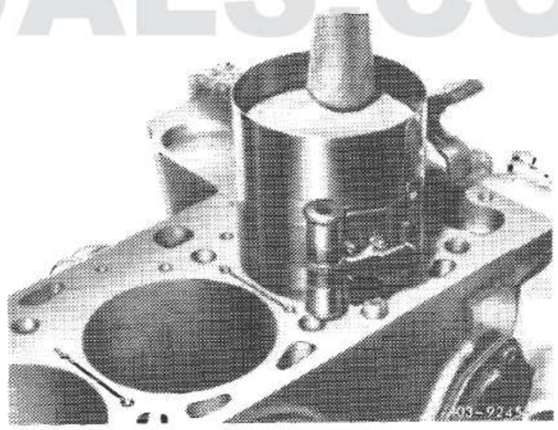
8 Insert piston pin lock into groove.

9 Lubricate clean cylinder bores, crankpins, connecting rod bearing shells and pistons.

10 Distribute gap ends of piston rings uniformly along piston circumference.

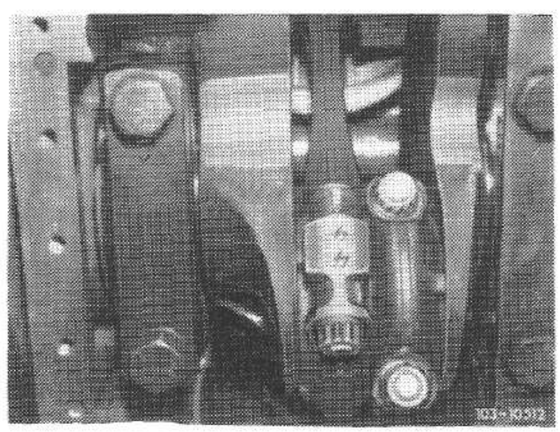


11 Mount clamping strap for piston rings and introduce piston with arrow in driving direction.

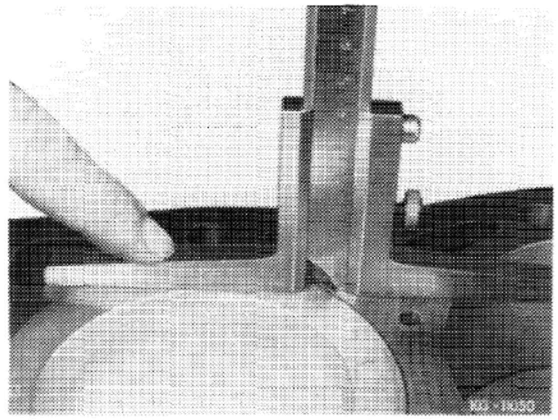


12 Position connecting rod bearing cap with code numbers in relation to each other on connecting rod and tighten connecting rod nuts to 40–50 Nm initial torque and 90–100° angle of rotation torque.

13 Rotate crankshaft and check clearance between piston pin eye and connecting rod.



14 In TDC position of pistons, measure distance between piston crown and cylinder crankcase parting surface (refer to table).



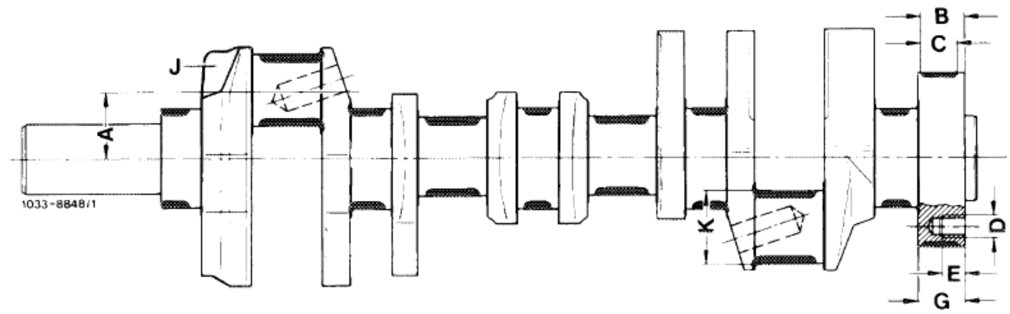
03–318 Checking and reconditioning of crankshaft

Data

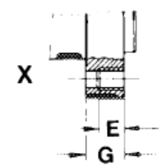
Crankshaft standard dimension and repair stages	Crankshaft bearing journal dia.	Width of journal at fitted bearing	Crankpin dia.	Width of pins
Standard dimension	63.96 63.95	27.00 27.02	51.96 51.95	50.00 50.12
1st repair stage	63.71 63.70	up to 27.50	51.71 51.70	up to 50.30
2nd repair stage	63.46 63.45		51.46 51.45	
3rd repair stage	63.21 63.20		51.21 51.20	
4th repair stage	62.96 62.95		50.96 50.95	

Permissible radial runout of crankshaft journals and crankpins		0.0025
Permissible deviation of surface line of crankpins in relation to reference axis of crankshaft journals I and V, from parallel		0.01
Permissible radial runout of rear crankshaft flange[3]		0.02
Permissible axial runout of rear crankshaft flange[3]		0.012
Permissible radial runout of crankshaft journals[3]	journal II, IV	0.07
	journal III	0.10
Permissible deviation of front crankshaft journal[2]	from cylindrical shape	0.05
	radial runout[3]	0.03
Permissible deviation of running surfaces of thrust bearing	axial runout[3]	0.02
Fillets on crankshaft journals and crankpins		2.5–3
Crankshaft journal dia. front		31.984–32.000
Running surface dia. for radial sealing ring rear, ground free of twist		99.928 99.874
Scleroscope hardness of crankshaft journals and crankpins	value when new	71–81
	limit value	61[1]

1) The limit value should be available at least at 2/3 of journal and crankpin circumference.
2) When measuring in installed condition, eliminate radial bearing play by pushing against crankshaft journal.
3) With crankshaft resting on outer crankshaft bearing journal I and V and at one full turn.



The differenciating characteristics of crankshafts of engines 116 and 117 are shown on drawing and in table.



Starting with installation of transmission 722.3 (W 4 A 040) into model 107.026 the crankshaft of engine 117.960 is standardized with that of engine 117.961.

Crankshafts engines 116 and 117

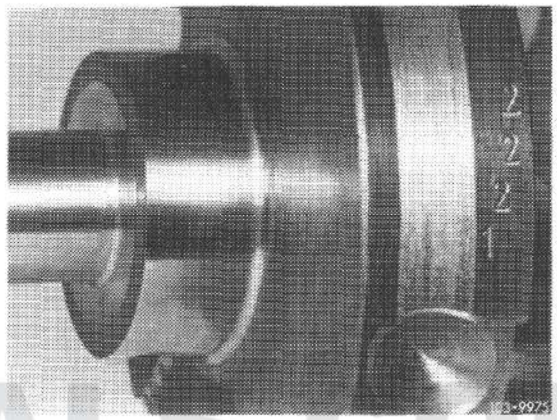
<table>
<tr><th>Engine</th><th>A (stroke)</th><th>C</th><th>E</th><th>G</th><th>J</th><th>K</th><th>Part no. of crankshaft</th><th>Interchange-able with</th></tr>
<tr><td>116.960/961</td><td>35,9 (71,8)</td><td rowspan="2">13</td><td rowspan="2">13[1])</td><td rowspan="2">19</td><td rowspan="2">with-out</td><td>52</td><td>116 031 16 01</td><td>–</td></tr>
<tr><td>116.960
116.961
116.962/963</td><td>39,45 (78,9)</td><td>48</td><td>116 031 22 01</td><td>–</td></tr>
<tr><td>116.98
1st version</td><td rowspan="2">32,9 (65,8)</td><td>21</td><td rowspan="3">13[2])</td><td rowspan="3">26</td><td rowspan="2">with</td><td rowspan="4">52</td><td>116 031 14 01</td><td>116 031 20 01</td></tr>
<tr><td>116.98
2nd version</td><td rowspan="4">13</td><td>116 031 20 10</td><td>116 031 14 01</td></tr>
<tr><td>117.960
1st version[3])</td><td rowspan="5">42,5 (85)</td><td rowspan="3">with-out</td><td>117 031 12 01[3])</td><td>–</td></tr>
<tr><td>117.960
2nd version
117.961</td><td rowspan="2">13[1])</td><td rowspan="2">19</td><td>117 031 14 01</td><td>–</td></tr>
<tr><td>117.962
117.963</td><td>48</td><td>117 031 21 01</td><td>–</td></tr>
<tr><td>117.98
1st version</td><td>21</td><td rowspan="2">13[2])</td><td rowspan="2">26</td><td rowspan="2">with</td><td rowspan="2">52</td><td>117 031 10 01</td><td>117 031 18 01</td></tr>
<tr><td>117.98
2nd version</td><td>13</td><td>117 031 18 01</td><td>117 031 10 01</td></tr>
</table>

1) Throughbore.
2) Blind hole bore.
3) In the event of repairs, the shorter crankshaft 117 031 14 01 can be installed instead of crankshaft 117 031 13 01, together with a length compensating washer, part no. 116 032 03 76, (10.5 mm thick) and the longer (29 mm, up to now 23 mm) necked-down screws, part no. 116 032 04 71.

Special tool

Hardness tester (Scleroscope)		000 589 20 21 00

Note



Following repairs, no balancing of crankshaft is required.

When checking and reconditioning crankshaft, proceed in sequence of diagram below.

Group number for crankpin dia. (standard dimension)

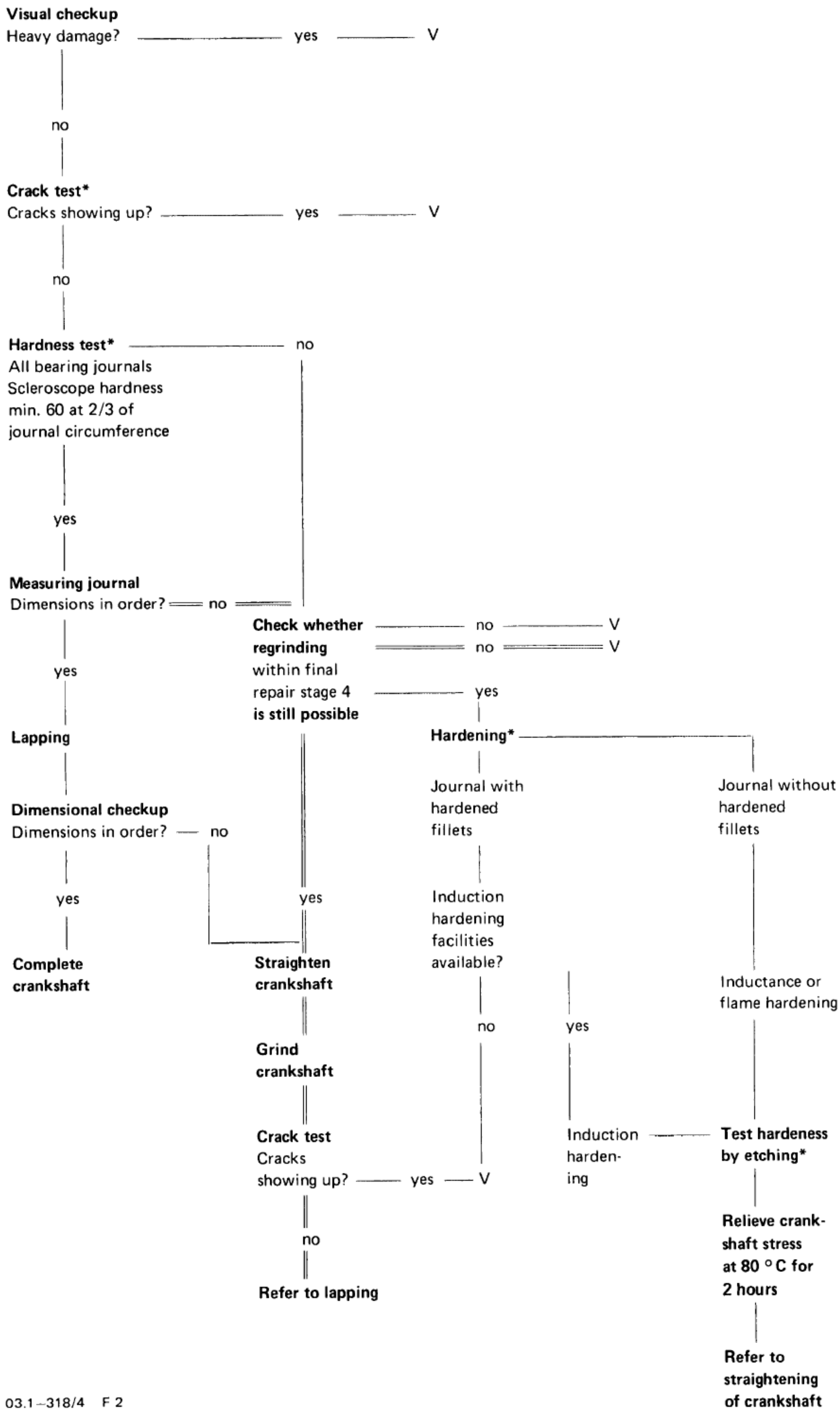
1 = 51.945–51.954 mm or 47.945–47.954 mm
2 = 51.995–51.965 mm or 47.955–47.965 mm

The number punched in at bottom applies to 1st crankpin.

Diagram

* Refer to section "Explanations concerning diagram".

V = scrap.


Visual checkup
Heavy damage?
yes
V
no
Crack test*
Cracks showing up?
yes
V
no
Hardness test*
All bearing journals
Scleroscope hardness
min. 60 at 2/3 of
journal circumference
no
yes
Measuring journal
Dimensions in order?
no
Check whether
regrinding
within final
repair stage 4
is still possible
no
V
no
V
yes
yes
Lapping
Dimensional checkup
Dimensions in order?
no
yes
Complete
crankshaft
yes
Straighten
crankshaft
Grind
crankshaft
Crack test
Cracks
showing up?
yes
V
no
Refer to lapping
Hardening*
Journal with
hardened
fillets
Induction
hardening
facilities
available?
no
yes
Induction
harden-
ing
Journal without
hardened
fillets
Inductance or
flame hardening
Test hardeness
by etching*
Relieve crank-
shaft stress
at 80 °C for
2 hours
Refer to
straightening
of crankshaft

Explanations concerning diagram

Crack test

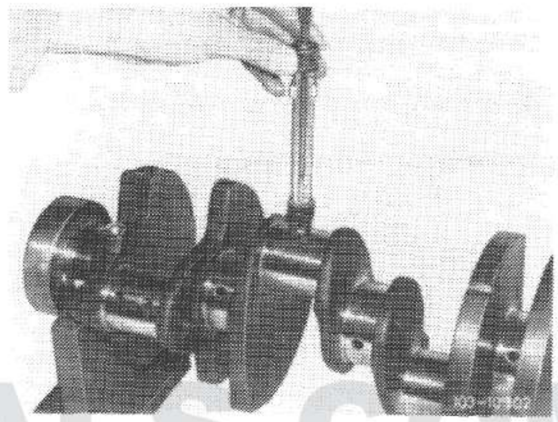
Clean crankshaft. Journals should be free of oil and grease. Magnetize crankshaft and apply fluorescent powder (fluxing). A color penetration test (immersion in bath or using spray can) can also be applied.

Aids: Paint or UV-oil,
cleaning agent,
developer

Hardness test

Check hardness with Scleroscope.

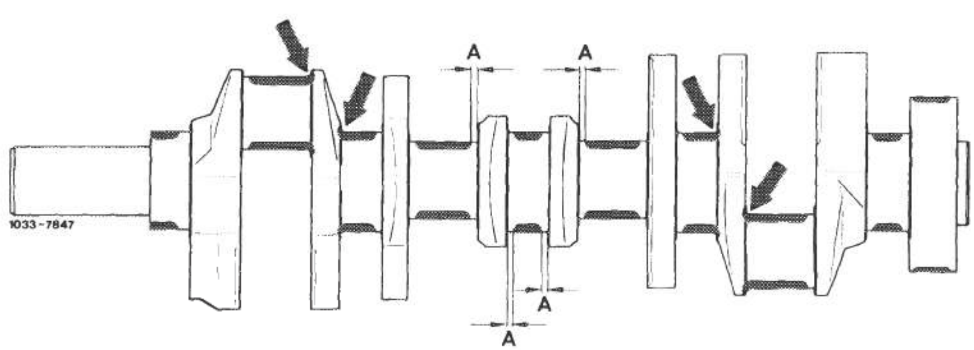
The minimum hardness should prevail at 2/3 of journal circumference.



Hardening

Journals without hardened fillets can be induction-hardened or flame-hardened. Journals with hardened fillets (arrow) should be induction-hardened on principle. If this is not possible, scrap crankshaft.

When hardening journals without hardened fillets, the distance A between runout of hardened surface and fillet (4—5 mm) must be maintained.



Checking the hardening

For perfect hardening, check adjustment of hardening equipment by metallographic grinding.

Pertinent tests can be made on scrapped crankshafts.

Check hardening by etching the journal surface with a 2% alcoholic nitric acid (HNO_3) solution.

No dark spots should show up at surface of journal.

Non-hardened fillets will become dark.

The hardened fillets, on the other hand, should be as bright as the journal surface.

For comparison, we recommend an etching test on a metallographically inspected journal.

Then, carefully wash off nitric acid by means of alcohol.

Corrosion protection

Coat crankshafts which are not immediately installed again with engine initial operation oil (SAE 30).

03–320 Mounting of crankshaft

Data

Crankshaft standard dimension and repair stages	Crankshaft bearing journal dia.	Width of journal at fitted bearing	Crankpin dia.	Width of pins
Standard dimension	63.96 / 63.95	27.00 / 27.02	51.96 / 51.95	50.00 / 50.12
1st repair stage	63.71 / 63.70	up to 27.50	51.71 / 51.70	up to 50.30
2nd repair stage	63.46 / 63.45		51.46 / 51.45	
3rd repair stage	63.21 / 63.20		51.21 / 51.20	
4th repair stage	62.96 / 62.95		50.96 / 50.95	

Basic bore and bearing play		Crankshaft bearing	Connecting rod bearing
Basic bore dia.		68.50 / 68.52	55.60 / 55.62
Permissible out-of-round and conicity of basic bore		0.01	0.01
Seat width for fitted bearing shell		22.379 / 22.400	
Bearing play, radial	when new	0.03–0.07[1]	0.03–0.06[1]
	wear limit	0.09	0.08
Bearing play, axial	when new	0.10–0.24	0.22–0.38
	wear limit	0.30	0.50

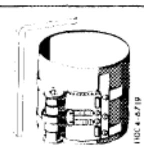
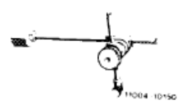
[1]) For radial play, try for mean value.

Bearing shells	Wall thickness crankshaft bearing	Width of fitted bearing shells	Wall thickness connecting rod bearing
Standard dimension	2.25	26.80–26.90	1.81
1st repair stage	2.37	27.40–27.60[1]	1.94
2nd repair stage	2.50		2.06
3rd repair stage	2.62		2.18
4th repair stage	2.75		2.31

[1]) The fitted bearing shells for 1st to 4th repair stage are supplied at oversize width and must be finished to fit ground crankshaft bearing journal.

Tightening torques		Nm
Crankshaft bearing bolts	M 10	65
	M 12	80
Connecting rod nuts	initial torque	40–50
	angle of rotation torque	90–100°
Screw on crankshaft front		270–330
Necked-down screws for flywheel or driven plates	initial torque	30–40
	angle of rotation torque	90–100°

Special tools

Clamping strap for piston rings		000 589 04 14 00
Dial gauge holder for measuring end play		363 589 02 21 00

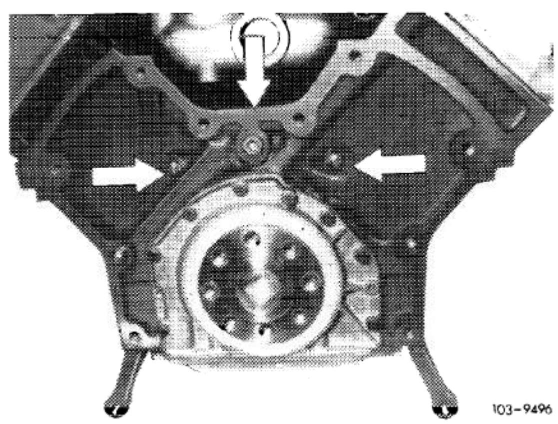
Note

Mount crankshaft with engine removed and disassembled.

Following a bearing defect, remove connecting rods and also remove any chips and the like from connecting rod bores.

Carefully clean oil ducts in cylinder crankcase, crankshaft, timing housing cover, oil filter housing, end cover, oil pump etc.

Check crankshaft for cracks, dimensional accuracy and hardness (03–318).



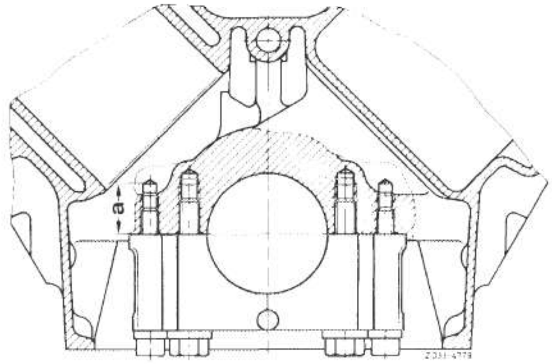
103–9496

Association of crankshaft bearings, installation of crankshaft

1 Measure depth "a" of threads in crankcase. Use appropriate hex. socket screws.

Hex. socket screws M 10 x 80 with threads 34 mm deep.

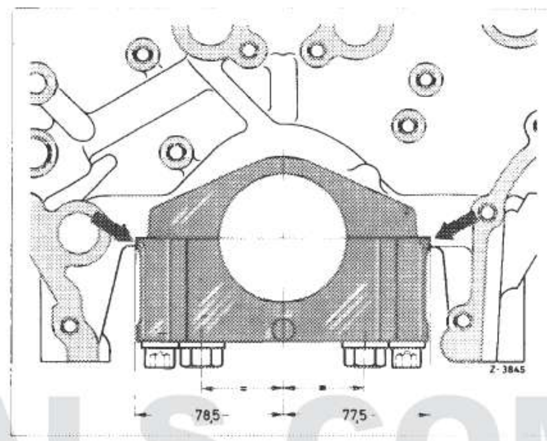
Hex. socket screws M 10 x 75 with threads 29 mm deep.



2 Install crankshaft bearing cap. Pay attention to identification, 1 is at front.

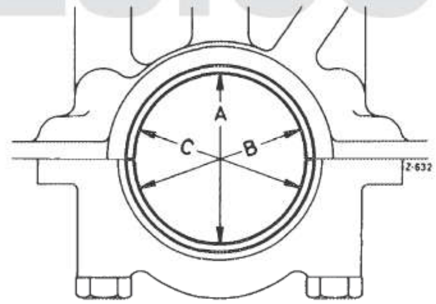
Note: The fitting point is offset from center by 0.5 mm.

Tighten screws to specified torque.



3 Measure basic bore in direction A, B and C along two planes (conicity). Note measured values.

If basic bore exceeds specified value or if bore is conical, touch up bearing cap contact surface on a face plate up to max. 0.02 mm.

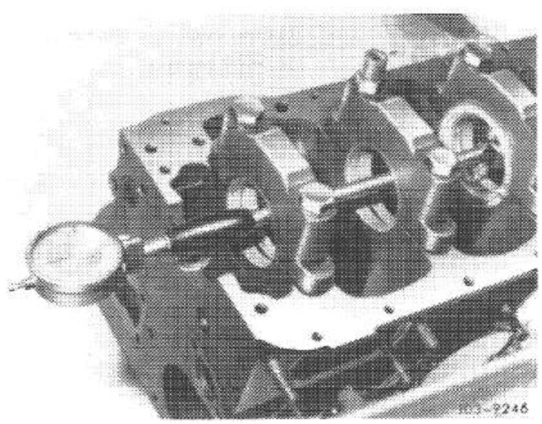


4 Mount crankshaft bearing shells and bearing cap. Tighten bolts to specified torque.

5 Measure bearing dia. and note measured values.

6 Measure crankpins, determine radial crankshaft bearing plate.

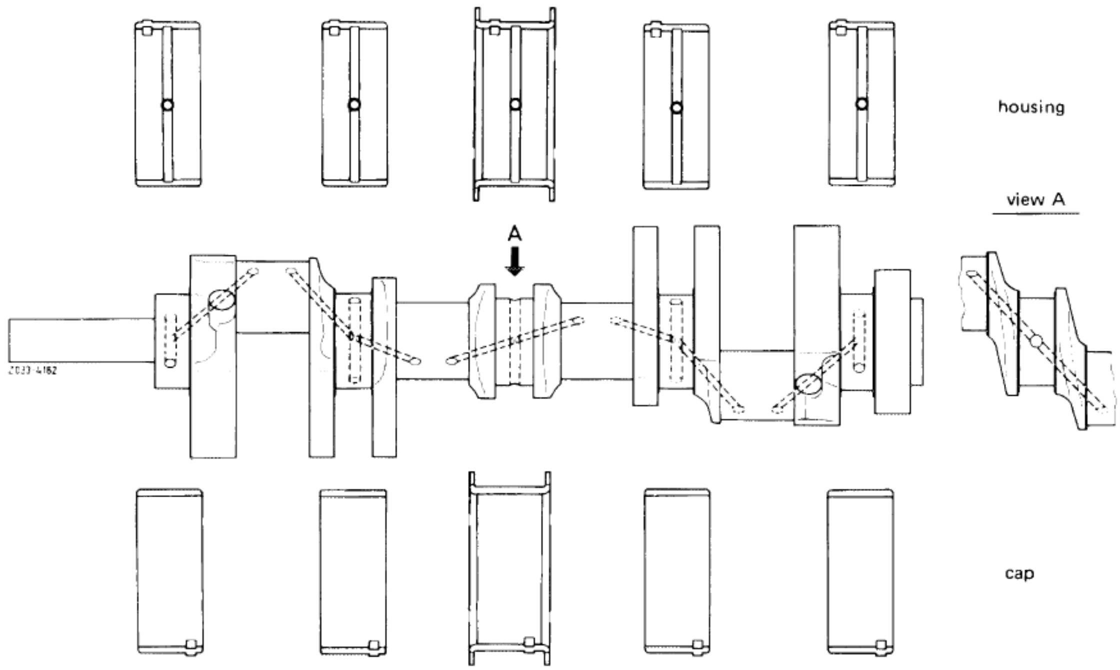
Note: The bearing play can by corrected by exchanging bearing shells, while trying for mean value of specified bearing play. Crankshaft bearing shells without color code are thicker than those with blue color code, while taking into consideration that the wall thicknesses without and with color code may overlap.



7 Measure width of fitted bearing journal and fitted bearing, determine axial crankshaft bearing play.

The fitted bearing shells of the repair stages are supplied at oversize.

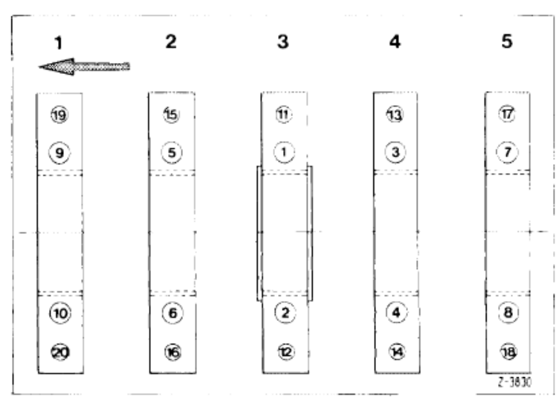
Machine both fitted bearing shells together on both sides to width of fitted bearing journal minus end play.



8 Provide bearing shells with crankshaft with engine oil SAE 30 and insert crankshaft.

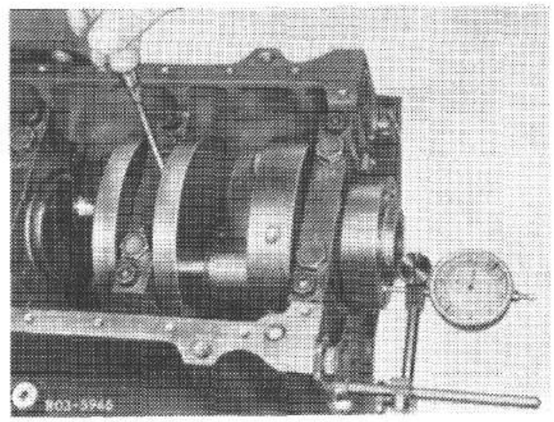
Attention!
Do not use bearing shells without oil bore in cylinder crankcase, but in cover only.

9 Tighten crankshaft bearing caps in sequence of tightening diagram to specified torque.



10 Measure axial crankshaft bearing play.

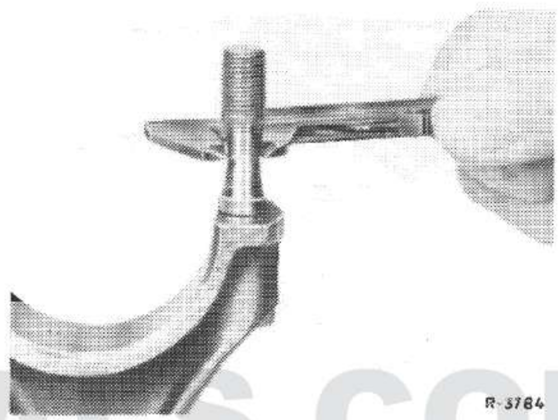
11 Rotate crankshaft manually and check for unobstructed rotation.



Association of connecting rod bearing and installation of connecting rod

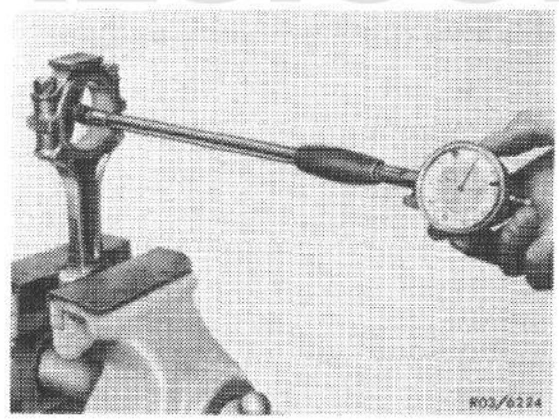
12 Check connecting rod bolts (03–310).

13 Recondition connecting rod and square (03–313).



14 Mount connecting rod bearing cap, pay attention to identification. Tighten connecting rod nuts to 40–50 Nm.

15 Measure basic bore in two directions. If a basic bore exceeds the specified value or is conical, touch up bearing cap contact surface on a face plate up to max. 0.02 mm.

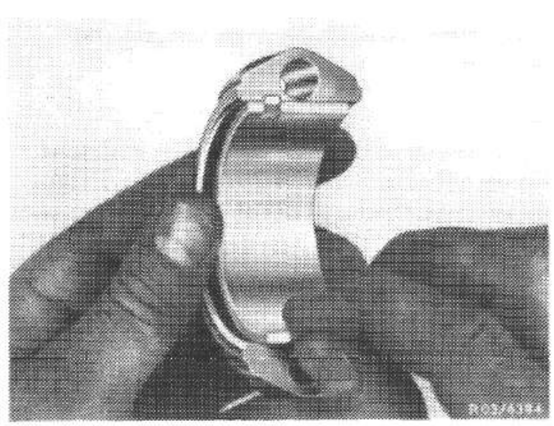


16 Insert connecting rod bearing shells, assemble connecting rod bearing cap and bearing shells and tighten connecting rod nuts to 40–50 Nm.

17 Measure bearing dia. and note.

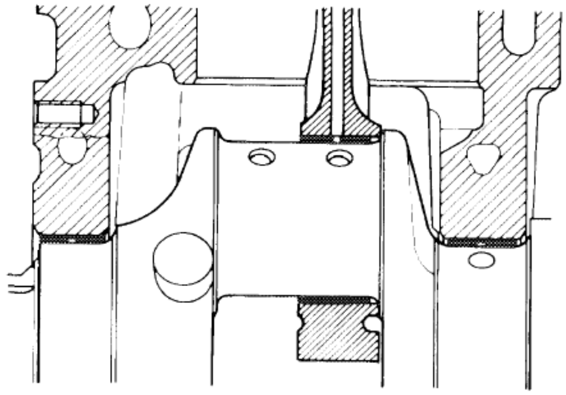
18 Measure connecting rod bearing journals. Determine connecting rod bearing radial play.

Note: The bearing play can be corrected by exchanging bearing shells, while trying for mean value of specified bearing play. Crankshaft bearing shells without color code are thicker than those with blue color code, while taking into consideration that the wall thicknesses without and with color code may overlap.



19 Mount piston and connecting rod (03–316).

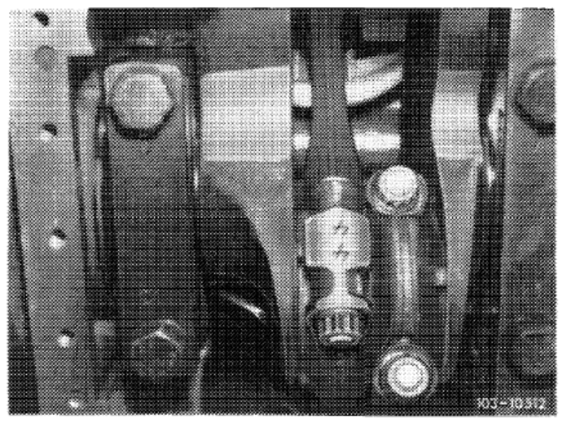
Attention!
Connecting rods are unsymmetrical.



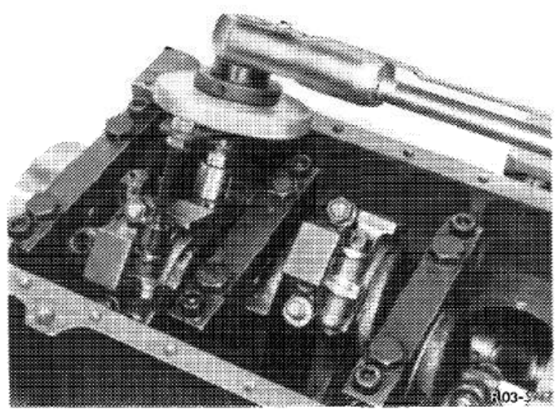
1034-11148

20 Provide bearing shells, crankshaft, piston and cylinder with engine oil SAE 30. Install connecting rod with piston (03–316).

Pay attention to identification!



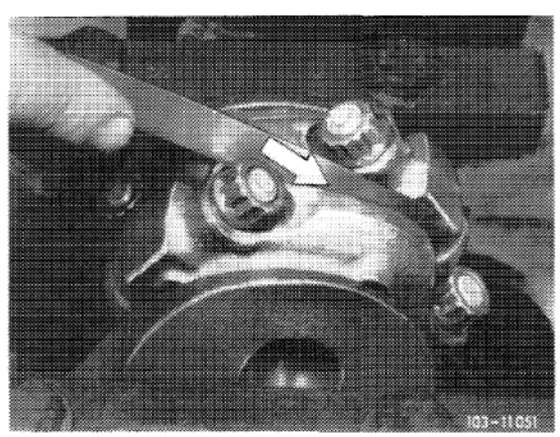
21 Tighten connecting rod nuts to 40–50 Nm **initial torque** and 90–100° **angle of rotation torque.**

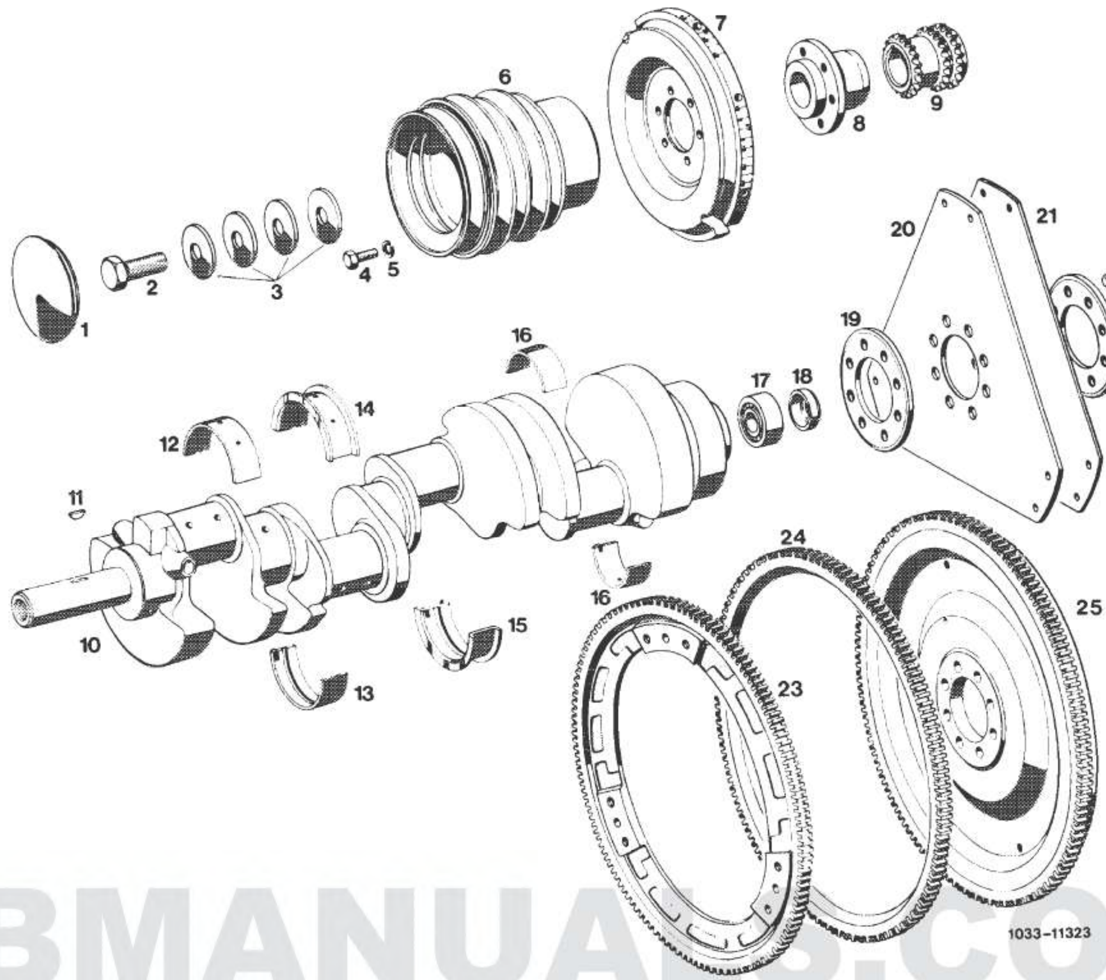


22 Measure connecting rod bearing play axially. Check connecting rod in piston for unobstructed operation.

Attention!
Disassemble oil pump, clean and replace, if required. Replace oil pressure relief valve. Disassemble oil filter top and clean. Carefully clean air-oil cooler. Unscrew oil overflow valve for oil filter element and oil filter bypass valve and clean. Disassemble oil damper and clean.

Install initial operation oil filter element. Change engine oil and oil filter element after 1000–1500 km.



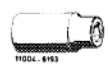
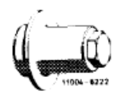


1 Cap for pulley (no longer installed starting November 1979)
2 Screw M 18 x 1.5 x 45
3 Disc springs (4 each)
4 Screw M 8 x 22 (6 each)
5 Snap ring A 8 (6 each)
6 Pulley
7 Vibration damper
8 Hub
9 Crankshaft sprocket
10 Crankshaft
11 Woodruff key
12 Crankshaft bearing shell crankcase (4 each)
13 Crankshaft bearing shell bearing cap (4 each)
14 Fitted bearing shell crankcase
15 Fitted bearing shell bearing cap
16 Connecting rod bearing shell (16 each)
17 Ball bearing 6202 DIN 625 (manual transmission)
18 Closing ring (manual transmission)
19 Spacing washers
20 Driven plate 1.5 mm thick
21 Driven plate 1 mm thick
22 Necked-down screw for flywheel or driven plates (8 each)
23 Ring gear (automatic transmission)
24 Ring gear (manual transmission)
25 Flywheel with ring gear

03–324 Renewing front crankshaft radial sealing ring

Tightening torques	Nm
Bolt on crankshaft	270–330
Bolts pulley to hub	35

Special tools

Detent (starter flange left or right)		116 589 01 40 00
Torque wrench 3/4" square, 150–500 Nm		001 589 31 21 00
Socket 27 mm, 1/2 " square		001 589 65 09 00
Bushing for radial sealing ring		110 589 07 61 00

Conventional tool

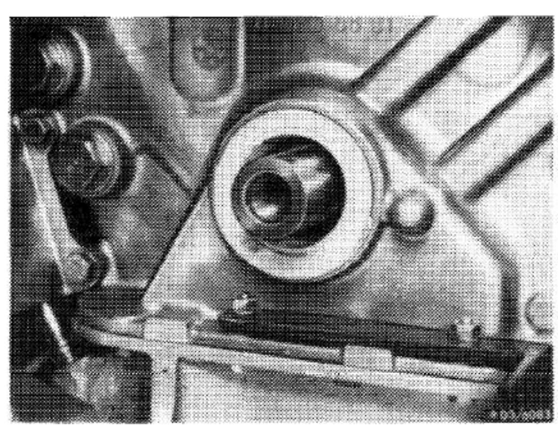
Connection 3/4" square socket to 1/2" socket head	e. g. Hazet, D-5630 Remscheid order No. 1058 RI

Note

Fill radial sealing ring prior to assembly between sealing and dust lip with longterm grease according to sheet 266.2 of Specifications for service products.

Renewing

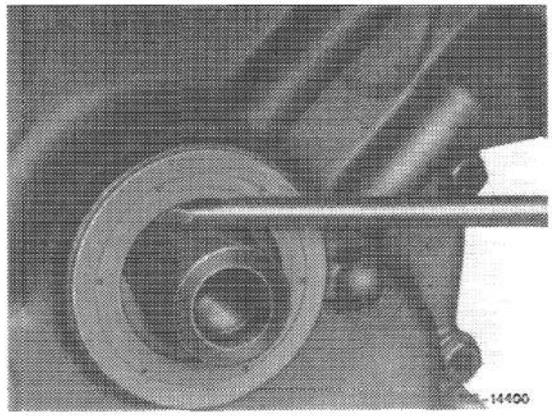
1 Remove hub, vibration damper and pulley (03–342).



2 Push out radial sealing ring by means of a screw driver.

Attention!
Do not damage crankshaft and receiving bore for radial sealing ring.

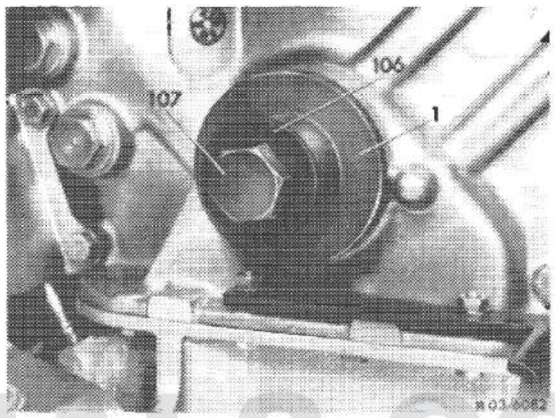
3 Deburr edge of receiving bore for radial sealing ring.



4 Install radial sealing ring with insertion bushing (1). For installation, use hex. screw (107) for attaching hub to crankshaft and a disc spring (106).

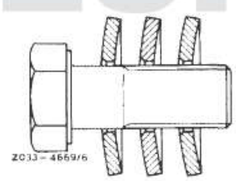
The radial sealing ring should be at right angles with crankshaft journal.

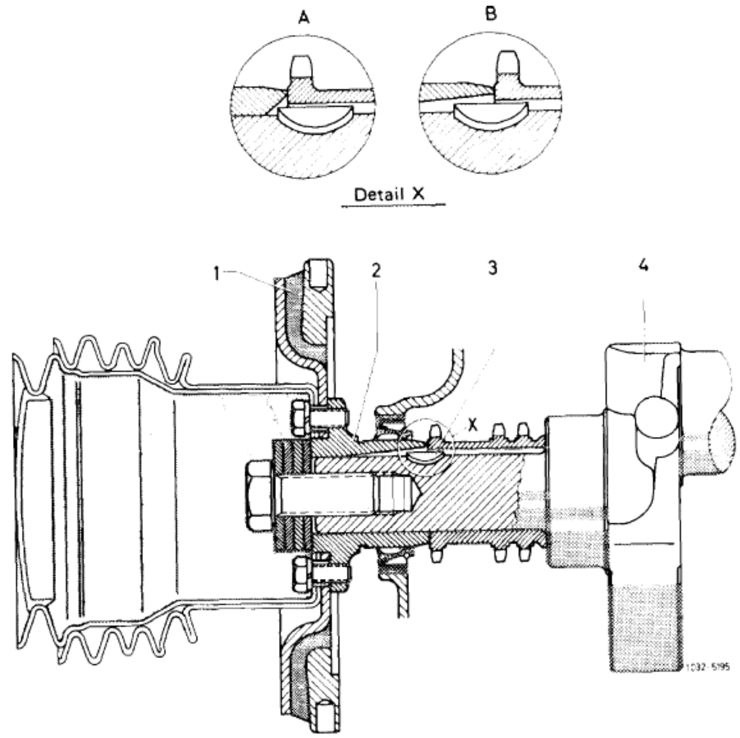
Note: Hubs with scrore marks caused by radial sealing ring must be replaced.



5 Install hub, vibration damper and pulley (03–342).

Mount screw M 18 x 1.5 x 45 with 4 disc washers (on light alloy engines with 3 disc washers).



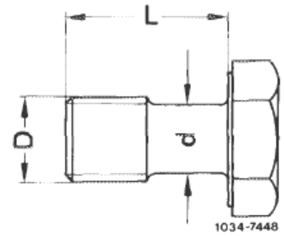


A 1st version
B 2nd version

03–327 Renewing rear crankshaft radial sealing ring

Necked-down bolts for flywheel and driven plates on crankshaft

Necked-down bolts, part no.		116 032 02 71
Threads D		M 12 x 1.5
Necked-down bolt dia. d	when new	9.8–0.2
	minimum dia.	9.3
Length L		23



Tightening torque

Flywheel or driven plate on crankshaft	initial torque	30–40 Nm
	angle of rotation torque	90–100°

Special tool

Installer for radial sealing ring with end cover mounted		117 589 00 43 00

Note

On a crankshaft with scored running surface, install a radial sealing ring of pertinent repair stage with sealing lip offset in inward direction.

Radial sealing ring	standard	width = 15 mm
Radial sealing ring	repair stage	width = 10.5 mm

The running surface for rear radial sealing ring on crankshaft is hardened and ground.

Renewing

1 Push-out radial sealing ring by means of a screw driver.

Attention!
Do not damage crankshaft and mounting bore for radial sealing ring.

2 Check running surface on crankshaft.

3 Screw insertion bushing to crankshaft.

4 Fill radial sealing ring between dust lip and sealing lip with longterm grease according to sheet 266.2 of Specifications for service products.

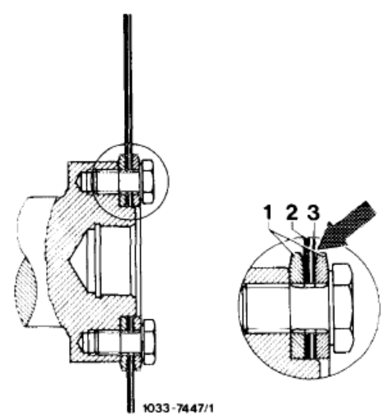
5 Slip radial sealing ring on insertion bushing.

6 Push radial sealing ring up to stop into cover by means of installer.

7 Measure necked-down shaft of necked-down bolts.

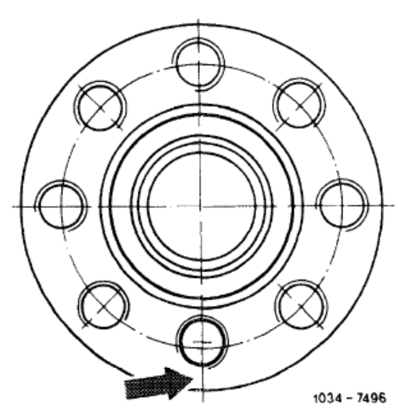
8 Mount driven plates in correct sequence or flywheel.

9 Tighten necked-down bolts to 30–40 Nm and 90–100° angle of rotation.



1 Washer
2 Driven plate 1.5 mm
3 Driven plate 1.0 mm

Attention!
One of the eight fastening bores is off center on pitch circle dia. (arrow). For this reason, the flywheel or driven plates can be mounted in a given position only. The hole patterns should be accurately aligned.



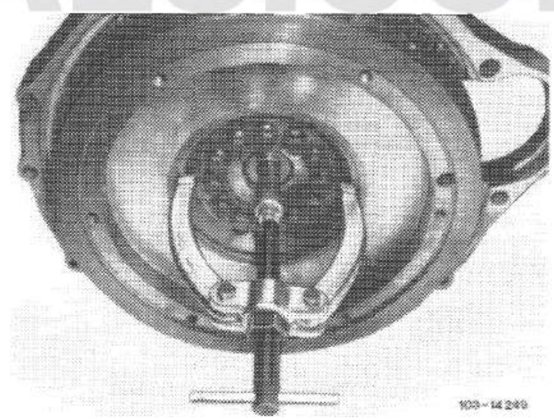
03–330 Removal and installation of radial ball bearing and closing ring in crankshaft

Special tools

Internal puller 14.5–18.5 mm	 11004-7247	000 589 25 33 00
Countersupport	 11004-7724	000 589 33 33 00

Removal

1 Pull ball bearing and closing ring together out of crankshaft by means of puller.

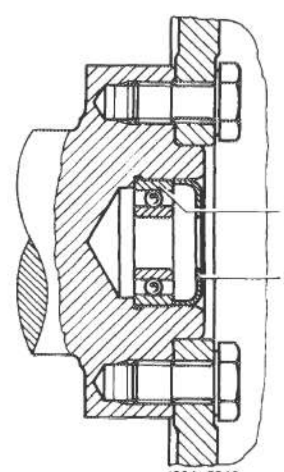


103-14249

Installation

2 Provide new ball bearing (1) with high-temperature grease and knock into crankshaft by means of a suitable mandrel.

3 Knock-in closing ring (2).



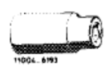
1034-7548

03–342 Removal and installation of hub, vibration damper and pulley

Data

Permissible deviation on vibration damper	radial runout	0.3
	axial runout	0.5

Tightening torques	Nm
Bolt to crankshaft	270–330
Bolts pulley to hub	35

Special tool		
Detent		116 589 01 40 00
Torque wrench 3/4" square, 150–500 Nm		001 589 31 21 00
Socket 27 mm, 1/2" square		001 589 65 09 00

Conventional tool	
Connection 3/4" square socket to 1/2" square head	e. g. Hazet, D-5630 Remscheid order no. 1058 RI

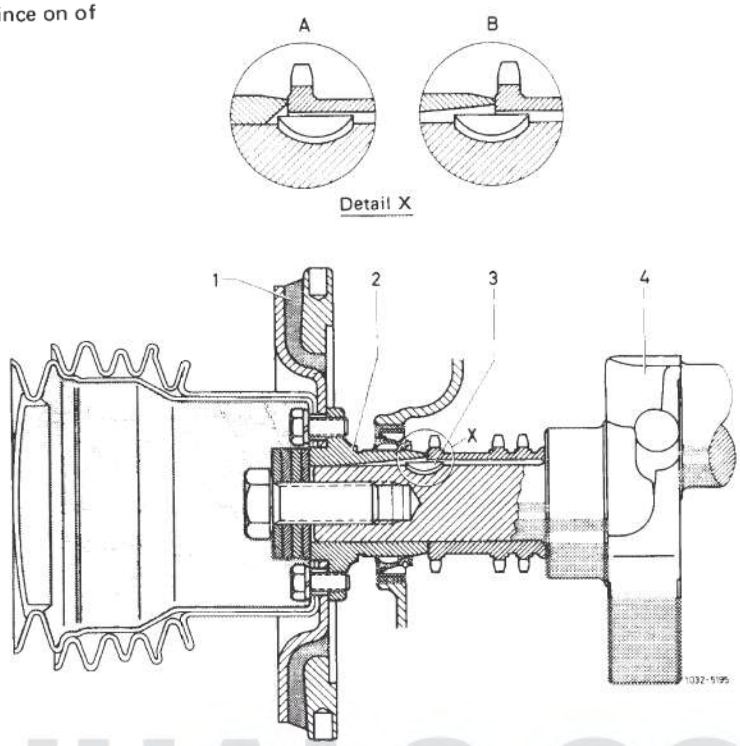
Note

Hub, vibration damper and pulley can be exchanged without balancing.

The vibration dampers of the different engines 116.98 and 117.98 are different in OD and in assigned frequency.

Pulleys of the different engines 116.98 and 117.98 are also different.

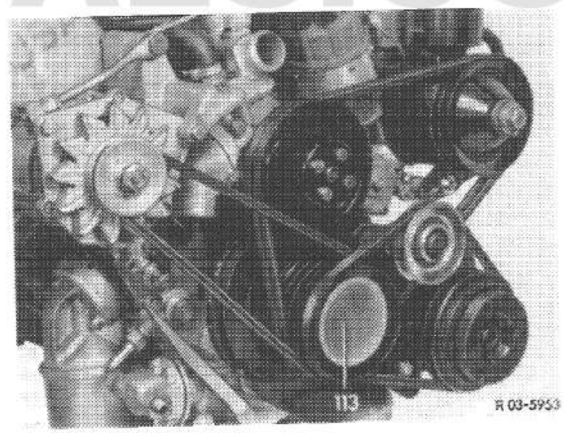
The crankshaft gear and hub (2) are located on front crankshaft journal, aligned by key (3). This assembly is pressed against crankshaft by the screw and the four disc springs. Vibration damper (1) and the pulley are screwed to hub (2) in a given position, since on of the six tapped holes is located off center.



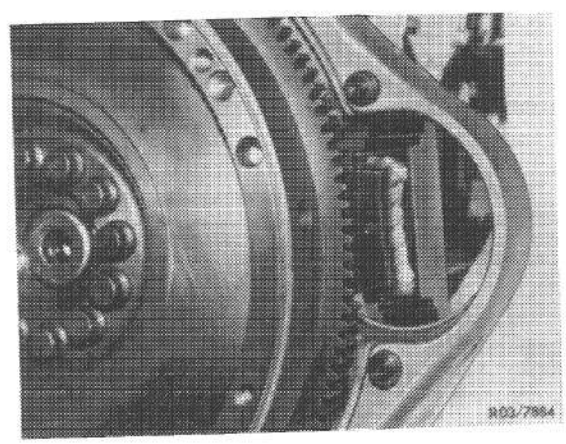
1 Vibration damper
2 Hub
3 Disc spring
4 Crankshaft
A 1st version
B 2nd version

Removal

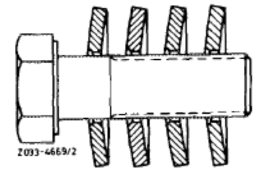
1 Remove radiator, fan and V-belt.



2 Lock crankshaft with detent against rotation.

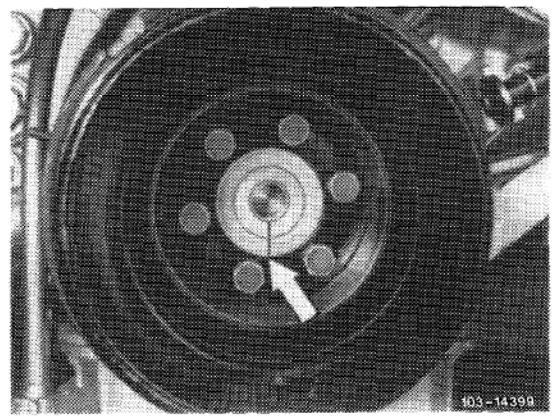


3 Unscrew crankshaft bolt.



4 Mark crankshaft and hub in relation to each other with a chisel (arrow), so that the groove of the hub will be in alignment with Woodruff key during assembly.

5 Pull off manually vibration damper (1) together with pulley and hub (2 , if necessary knock from crankshaft by means of a plastic hammer.



Installation

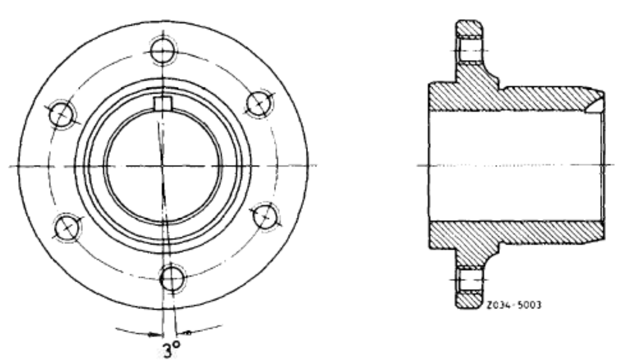
6 Mount vibration damper (1), pulley and hub (2) in screwed-together condition.

7 For this purpose, heat hub to approx. 50° C for easy sliding on crankshaft. When sliding on crankshaft, check whether groove of hub is in alignment with Woodruff key by light turning motions.

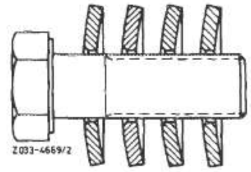
Attention!
The vibration damper, the pulley and the hub must be screwed together in a given position.

One of the 6 bores is located off center. The hole patterns must be accurately in alignment.

Different from light alloy engine, the 6 screws M 8 x 22 for fastening pulley and vibration damper are mounted with snap rings.



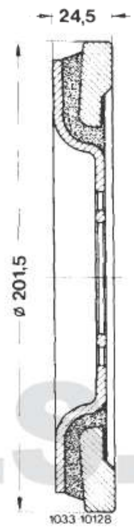
8 Mount the four disc springs with convex surface (crown) toward screw head.



Mount screw M 18 x 1.5 x 45 with 4 disc springs (on light alloy engines with 3 disc springs) and tighten to 270–330 Nm.

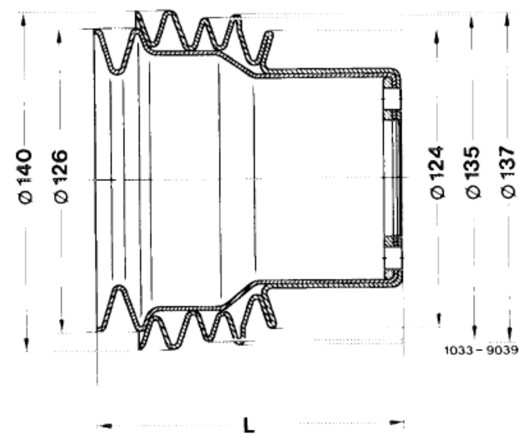
Attention!
If the vibration damper has been replaced, the TDC transmitter must be newly set (03–345).

The difference between pulleys and vibration dampers is shown by the following drawings.

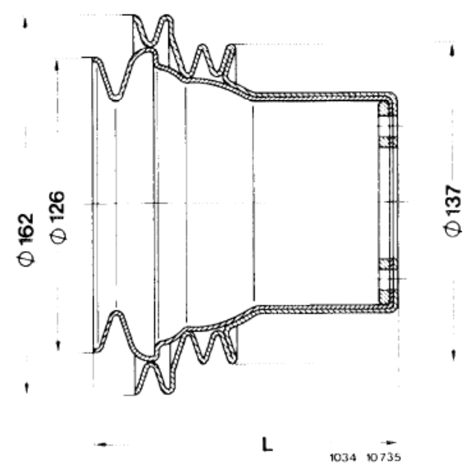


Vibration damper engine 116.98

Vibration damper engine 117.98



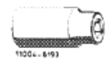
Engine 116.98, 117.982, 117.983
L = 128.5 mm

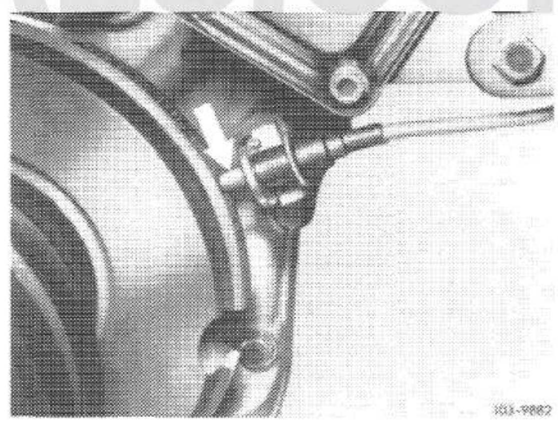


Engine 117.985, 117.986
L = 128.5 mm

03–345 Checking and correcting adjustment of TDC transmitter

Special tools

Measuring pin for TDC and 20° after TDC position of engine on 1st cylinder		115 589 17 21 00
Locating tool for adjusting tool		102 589 03 21 00
Socket 27 mm, 1/2" square		001 589 65 09 00
Square drive socket 1/2", 80 mm long for rotating engine		617 589 00 16 00



Note

At crankshaft position 20° after TDC, the TDC indicator should be accurately above pin in vibration damper (arrow).

Check or adjust adjustment of TDC transmitter:

a) when renewing TDC transmitter adjusting slide;

b) when renewing hub and vibration damper of crankshaft;

c) when renewing timing housing cover;

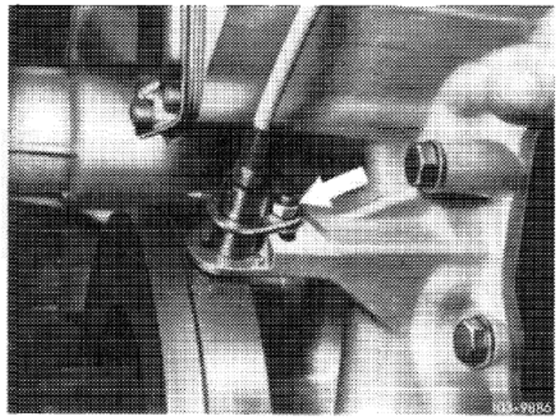
d) when completing basic engines.

Checking

1 Remove radiator.

2 On vehicles with air conditioning system, screw on refrigerant compressor with mounting bracket after having adjusted TDC transmitter.

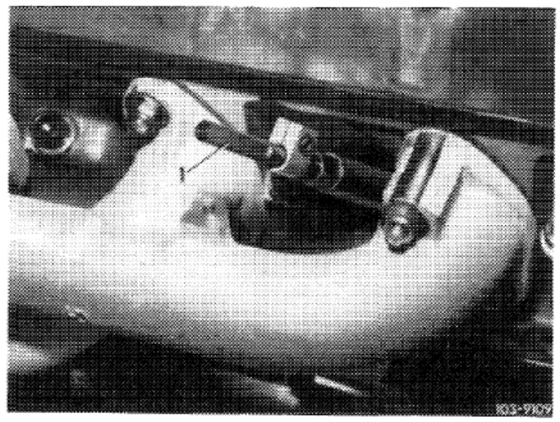
3 Unscrew hex. nut (arrow) and pull out TDC transmitter.



4 Screw tester into spark plug bore of 1st cylinder.

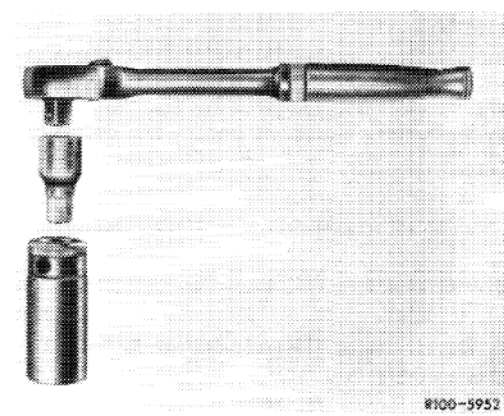
Insert adjusting pin (1) into tester and push down until seated.

Note: With cylinder head removed, attach a dial gauge holder to cylinder crankcase and place dial gauge pin on piston crown.



5 Turn crankshaft with tool combination until adjusting pin is at its highest point.

Piston is then at TDC.

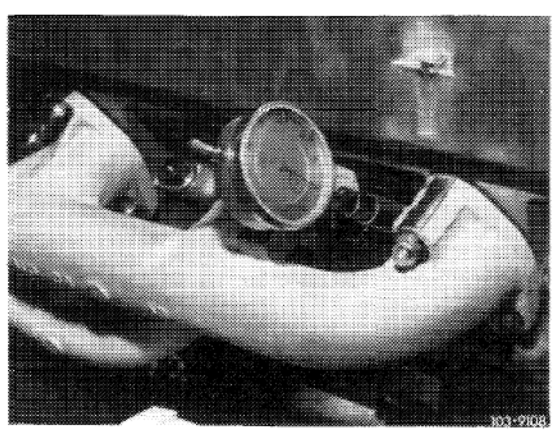


6 Remove adjusting pin.

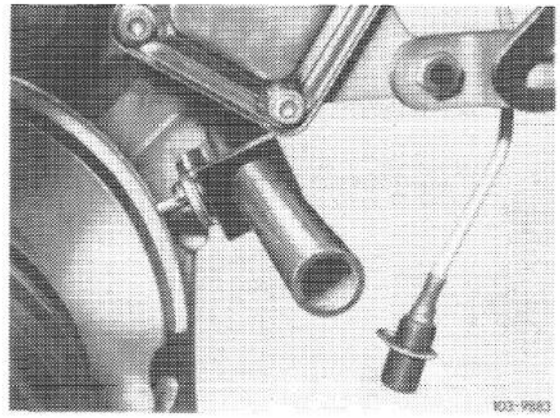
Tighten dial gauge with approx. 5 mm preload.

Turn crankshaft and set TDC accurately by means of dial gauge.

Turn dial gauge scale until needle points to 0.



7 Keep turning crankshaft in rotating direction until dial gauge shows the respective value according to table.



8 Insert positioning device into adjusting tool. Pin of vibration damper should engage in groove of positioning device.

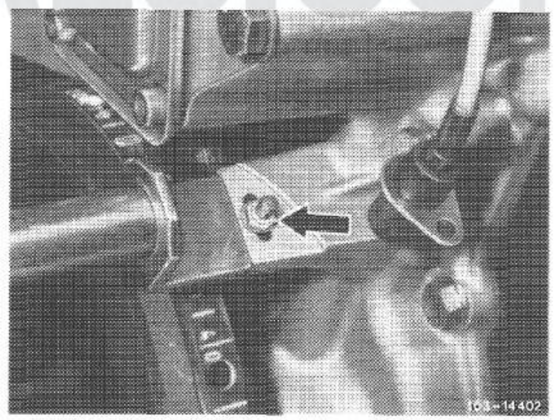
Note: With righthand cylinder head removed, place dial gauge pin vertically on piston of 1st cylinder. Keep turning crankshaft in rotating direction until dial gauge shows the respective value according to table.

Engine	Measured through spark plug bore	Vertically on piston
116.98	2.69	2.44
117.98	3.58	3.25

Corrections

9 Loosen adjusting slide (arrow) and displace until pin engages in positioning device.

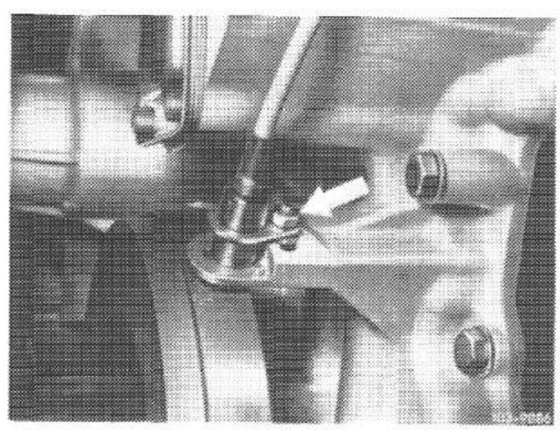
10 Screw-on adjusting slide (arrow) and remove positioning device.



11 Insert TDC transmitter and screw-on (arrow).

12 Remove dial gauge.

13 Turn crankshaft in rotating direction for a short distance, then unscrew tester from spark plug bore.



03–350 Removal and installation of crankshaft sprocket

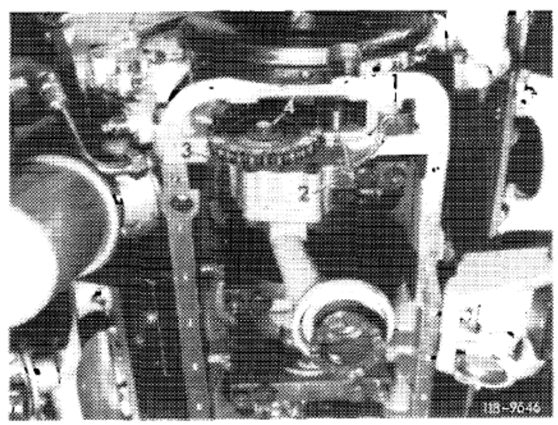
Tightening torques	Nm
Screw to crankshaft front	270–330
Fastening screw for camshaft sprocket	80

Special tools		
Detent (starter flange)		116 589 01 40 00
Torque wrench, 3/4" square, 150–500 Nm		001 589 31 21 00
Socket 27 mm 1/2" square		001 589 65 09 00

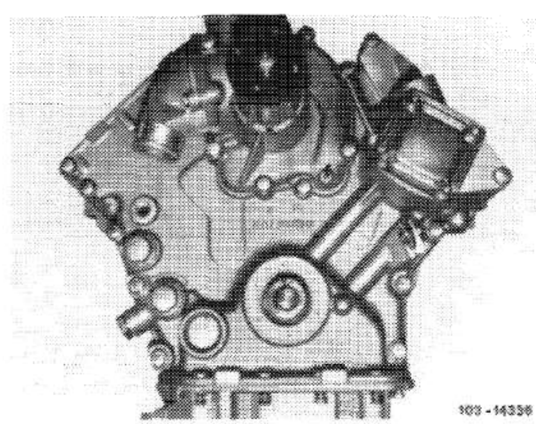
Conventional tool	
Connection 3/4" square socket to 1/2" square head	e.g. made by Hazet, D-5630 Remscheid order No. 1058 RI

Removal

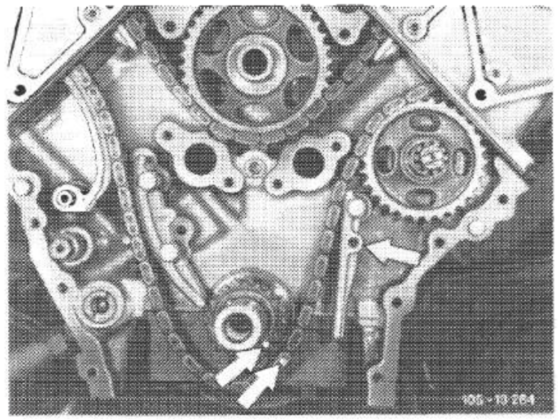
1 Remove oil pump (18–210).



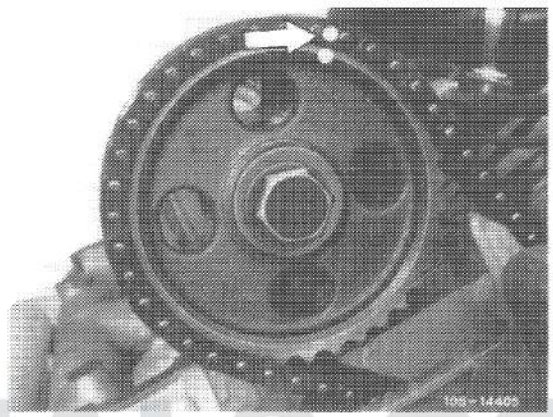
2 Remove timing housing over (01–210).



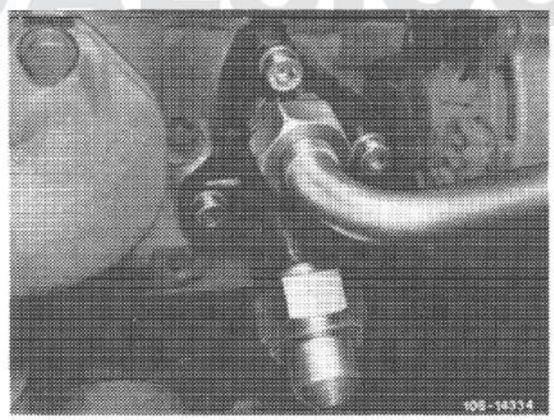
3 Mark crankshaft sprocket together with timing chain (arrows).



4 Mark righthand camshaft sprocket together with timing chain and remove.



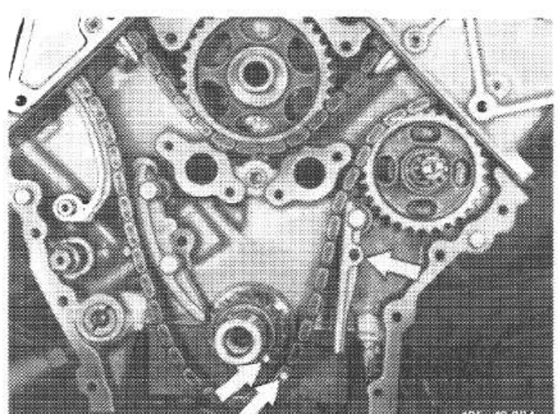
5 Remove chain tensioner (05–312).



Exhaus gas version

6 Loosen lefthand slide rail (arrow).

7 Pull off crankshaft sprocket manually or with two-arm puller.

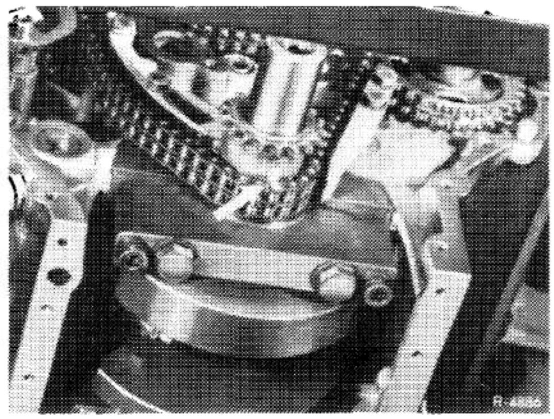


Installation

8 Transfer marking from old to new crankshaft sprocket.

9 Slip crankshaft sprocket on crankshaft.

10 Place timing chain on crankshaft sprocket in such a manner that the markings are in alignment (also refer to 05–434).



11 For further installation proceed vice versa.

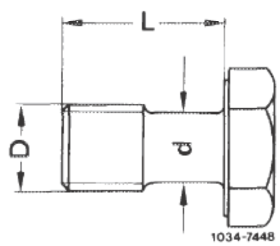
03–410 Removing and installing flywheel and driven plate

Flywheel-crankshaft group

Group Code No.	Color code	Crankshaft dia. on mounting pin	Bore in flywheel or in driven plates
1	red	54.99–55.00	55.00–55.01
2	yellow	55.00–55.01	55.01–55.02
3	green	55.01–55.02	55.02–55.03

Necked-down screw for flywheel or driven plates on crankshaft

Necked-down screws, part No.		116 032 02 71
Thread D		M 12 x 1.5
Shaft dia. d	when new	9.8--0.2
	minimum dia.	9.3
Length L		23



1034-7448

Tightening torque

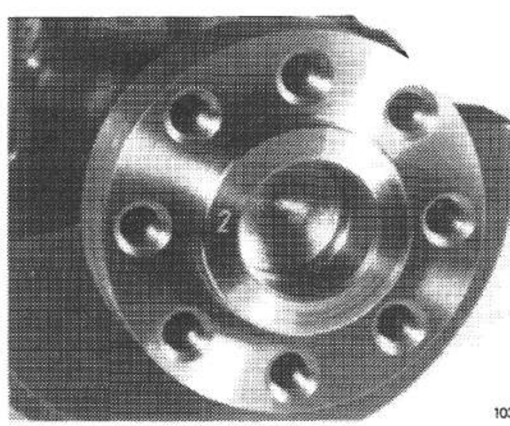
Initial torque	30–40 Nm
Angle of rotation torque	90–100°

Note

When installing a new flywheel, the latter need not be balanced again, since the flywheel, the crankshaft and the vibration damper are individually balanced.

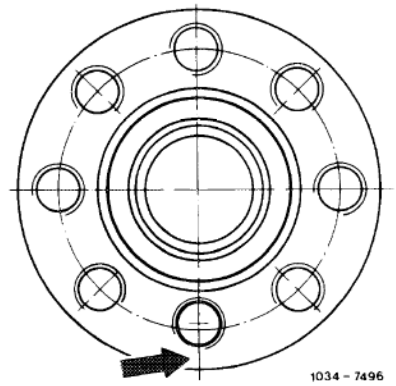
Due to installation tolerances, crankshaft and flywheel are combined in three groups.

During assembly, pay attention to color code or group code number on crankshaft (illustration) and flywheel.



103-9976

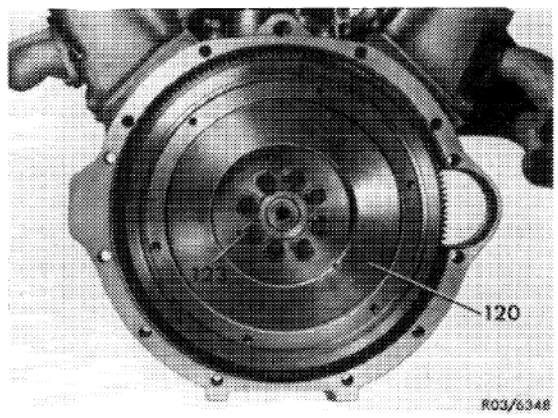
One of the eight fastening bores is located off center in pitch circle dia. (arrow). As a result, the flywheel or driven plates must be mounted in a given position. The whole pattern should be accurately aligned.



Removal

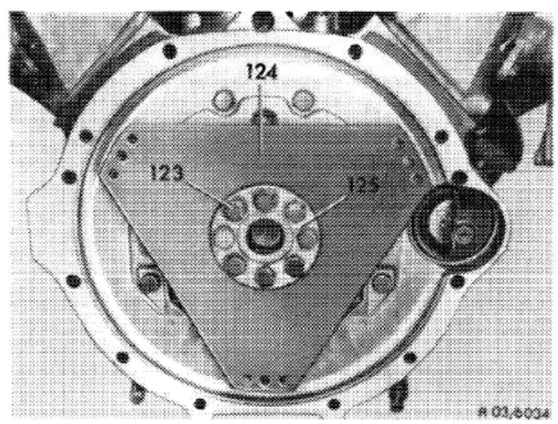
1 Remove transmission.

2 Unscrew necked-down screws and remove flywheel (manual transmission).



120 Flywheel
123 Necked-down screws

Unscrew necked-down screws and remove spacing washers and driven plates (automatic transmission).

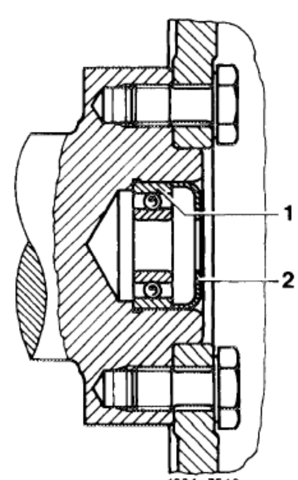


123 Necked-down screws
124 Driven plates
125 Spacing washers

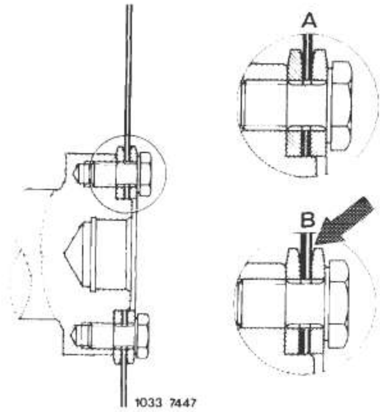
Installation

3 Measure necked-down shaft. If the specified minimum dia. "d" on shaft is attained, renew necked-down screws.

4 Mount flywheel or driven plates.



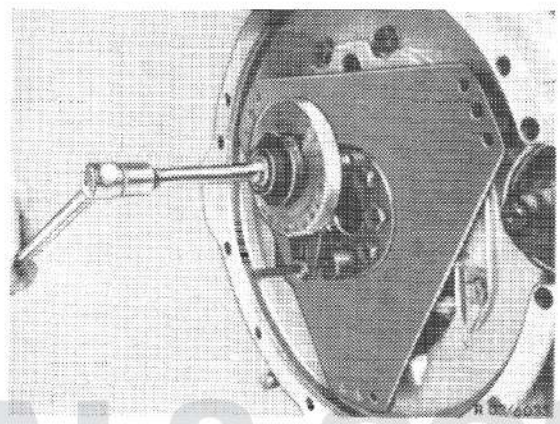
Note: In the event of repairs, the driven plates version "B" may be installed instead of version "A".



Cutout A
1st version: 2 driven plates 1 mm thick

Cutout B
2nd version: 1 driven plate 1.5 mm thick and 1 driven plate 1 mm thick (arrow)

5 Screw-in necked-down screws and tighten to 30–40 Nm initial torque and 90–100° angle of rotation torque.



03–420 Refinishing flywheel

Data

Distance "a" between clutch surface and flywheel contact surface		3.8–3.9
Distance "b" between clutch surface and fastening flange of flywheel	when new	27.4–27.5
	during repairs min.	26.4
Permissible lateral runout		0.05

Note

Refinish flywheel for manual transmission showing score marks, cracks or burnt surfaces by surface grinding or position turning.

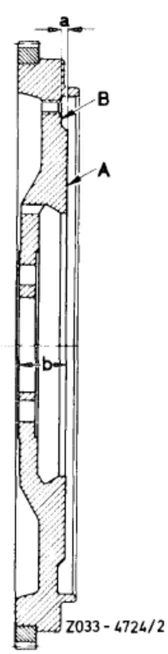
If the score marks or cracks are deeper than the max. permissible material allowance, replace flywheel.

If clutch surface A is refinished, also refinish fastening surface B to maintain distance a.

Do not refinish below dimension b during repairs.

For refinishing, clamp flywheel carefully so that the permissible lateral runout of 0.05 mm is not exceeded.

Upon refinishing, the clutch surface should not show any evidence of porosity and chatter.



03–430 Renewing ring gear

Data

Permissible axial runout on ring gear	max. 0.40
Centering flange dia. for ring gear	324.39–324.46 mm
Shrinking temperature	max. 200° C
Annealing color	red-brown

Conventional accessories

Temperature measuring chalk for 220 °C	e. g. AW Faber-Castell D-8504 Stein bei Nürnberg color No. 2815/220 (white), Thermochrome

Note

The ring gear is hardened. To protect hardened surface, the max. temperature of 200° C should not be exceeded at any point when heating ring gear. This can be done reliably only by means of a hot plate or a heating furnace. An open flame may be used in exceptional cases only. The flame should only wipe along inside of ring gear.

No balancing of flywheel is required after renewing ring gear.

Renewing

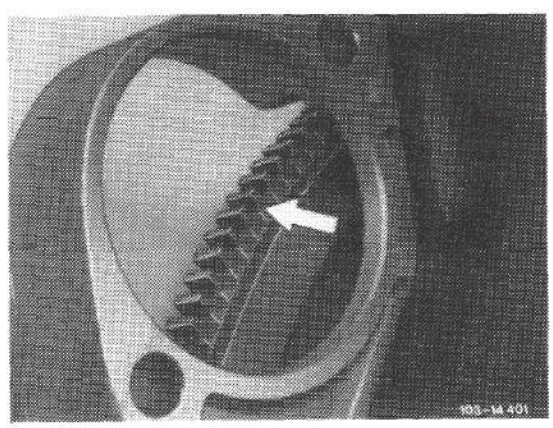
1 Drill into old ring gear and cut up with a chisel, or heat quickly and then remove immediately.

2 Clean mounting surface of ring gear on flywheel.

3 Heat new ring gear uniformly on a hot plate or in a heating furnace. For this purpose, use temperature measuring chalk according to instructions.

4 Mount heated ring gear immediately on flywheel.

Attention!
The teeth (arrow) should face starter.



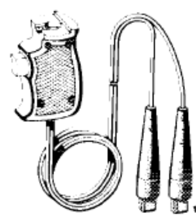
05–210 Inspection and adjustment of valve clearance

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1]	0.15[1]
Exhaust	0.20	0.25

[1] 0.05 mm higher during lasting outside temperatures below –20 °C.

Tightening torques	Nm
Valve adjusting screws	20–40
Bolts for cylinder head cover	3

Special tools

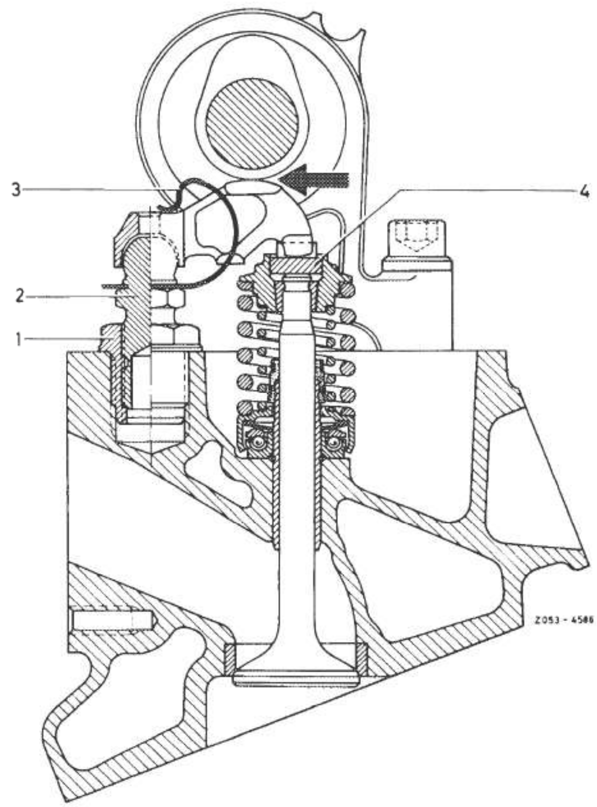
Valve adjusting wrench			116 589 02 01 00
Contact handle for rotating engine (component of compression meter 001 589 46 21 00)		 11004-8487	001 589 46 21 08
Slip gauge holder		 11004-6364	617 589 00 40 00
Slip gauge blades (20 each)	0.10 mm thick 0.15 mm thick 0.20 mm thick 0.25 mm thick	11004-6359	617 589 00 23 00 617 589 01 23 00 117 589 00 23 00 117 589 01 23 00

Note

Check valve clearance with engine cold or warm and adjust, if required.

If adjustment is no longer possible, install thinner thrust piece (4). Thrust pieces are available 2.5, 3.5 and 4.5 mm thick.

Attention!
Check torque on easily turning valve adjusting screws (2). For this purpose, remove old tensioning spring (3) with a screw driver and check torque with valve adjusting wrench part No. 116 589 02 01 00 and a torque wrench. If the torque of the valve adjusting screw is below 20 Nm (2 kpm), renew valve adjusting screw (2) or threaded bushing (1) with valve adjusting screw (2).

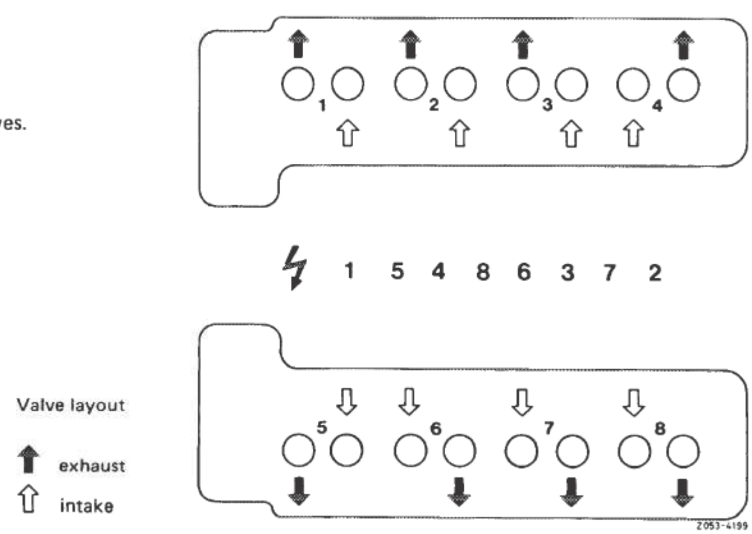


Adjusting valve clearance

1 Check valve clearance between rocker arm and camshaft, cam tip should point in upward direction.

Valve clearance is correctly set, when pulling of slip gauge blade requires some effort.

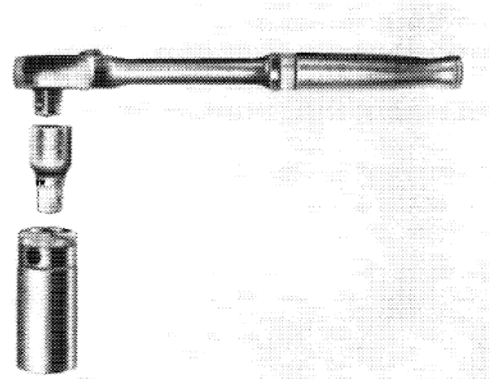
Observe layout of intake and exhaust valves.



The engine can be rotated as follows:

a) With tool combination at crankshaft front.

Attention!
Do not rotate engine at fastening bolt of **camshaft sprocket.**



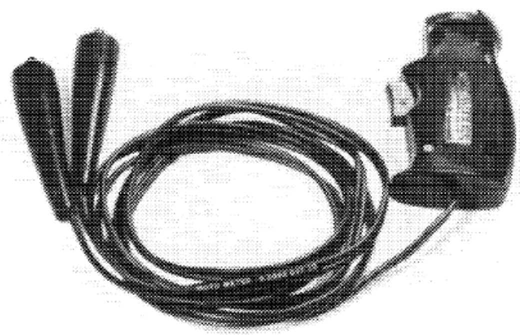
R100-5952

b) With starter and contact handle

Engines with electronic injection system

2 Connect contact handle to battery + and to starter terminal 50.

3 Disconnect cable 1 on ignition coil.

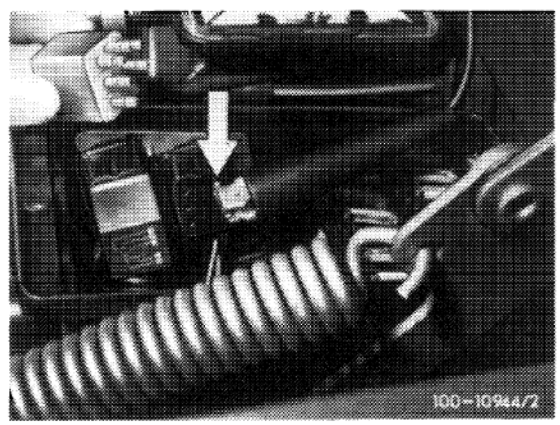


105-9061

Engines with CIS injection system

Type 116

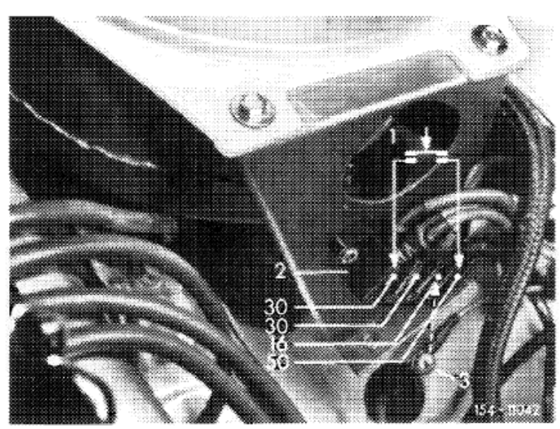
4 Pull out fuel pump relay code No. 21 in fuse box. Connect contact handle to battery + and with the assistance of a pin to contact bushing 1 of coupling (arrow).



100-10944/2

Type 107

5 Disconnect cable terminal 16 (cable color red/violet) on 4-point cable connector. Connect contact handle to terminal 30 (cable color red) and terminal 50 (cable color violet).

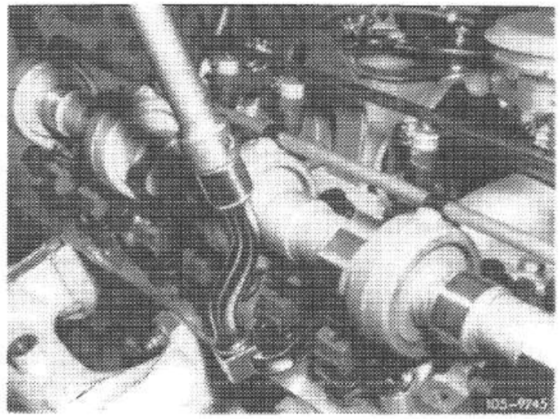


154-11042

6 Adjust valve clearance by turning valve adjusting screw with valve adjusting wrench.

7 Check tensioning springs for perfect seat.

8 Check gasket, renew according to condition.

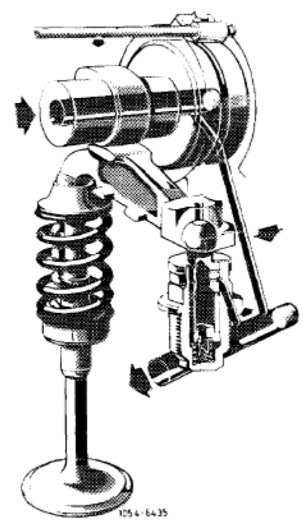


05–211 Inspection and renewal of hydraulic valve clearance compensating elements

Tightening torques	Nm
Bolts for cylinder head cover	3
Compensating element in cylinder head	60

Special tool

Valve spring depressor		123 589 03 61 00



Note

Store compensating elements in upright position only and do not disassemble.

Reinstall rocker arm and compensating elements again in the same place.

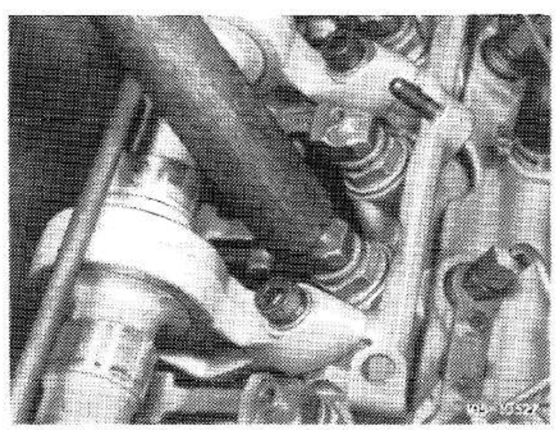
In the event of complaints about noise, check compensating elements as follows:

Checkup

1 Set cam tip in upward direction in relation to rocker arm.

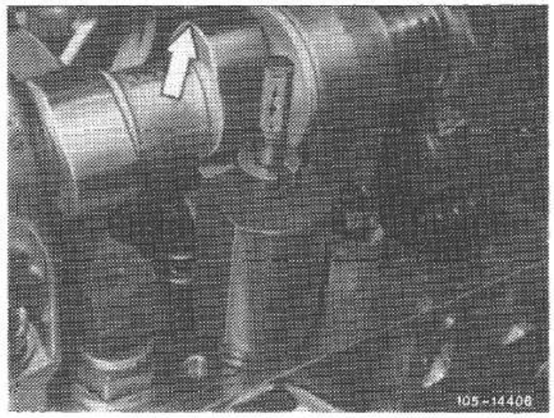
2 Push against rocker arm with a hammer handle.

If the ball pressure pin drops too fast compared with other ball pressure pins, renew hydraulic valve clearance compensating element.



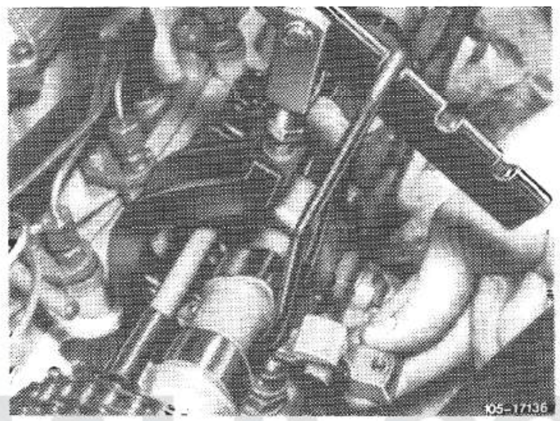
3 Try to move rocker arm manually.

In the event of play, check basic position of compensating elements (05–213).



Renewal

4 Remove rocker arm (05–230).

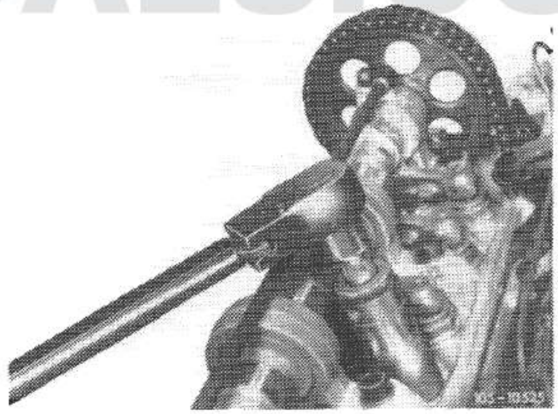


5 Unscrew compensating element with wrench socket 24 mm.

6 Lubricate new compensating element on threads, screw-in and tighten to 60 Nm.

7 Install rocker arm (05–230).

8 Check basic position (05–213).



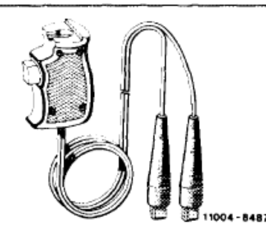
05–212 Renewal of threaded bushing with valve adjusting screw

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1]	0.15[1]
Exhaust	0.20	0.25

[1] 0.05 mm higher during lasting outside temperatures below –20 °C.

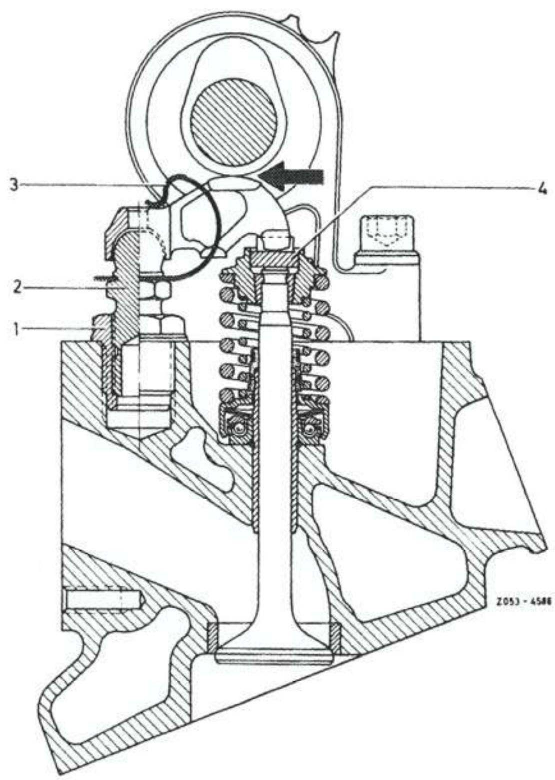
Tightening torques	Nm
Bolts for cylinder head cover	3
Threaded bushing in cylinder head	80
Valve adjusting screw	20–40

Special tools

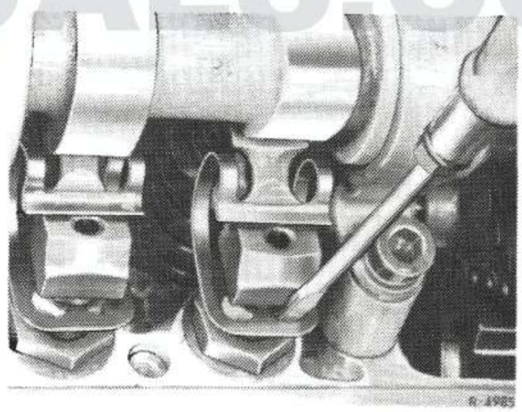
Remover and installer for rocker arms		123 589 03 61 00
Valve adjusting wrench 17 mm		116 589 02 01 00
Contact handle for rotating engine (component of compression meter 001 589 46 21 00)		001 589 46 21 08

Note

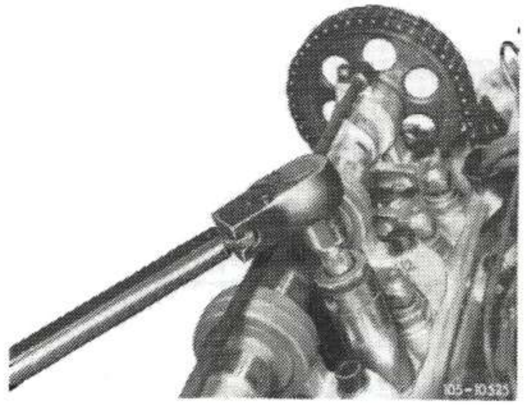
If the torque of the valve adjusting screw is below 20 Nm, renew valve adjusting screw (2) or threaded bushing (1) with valve adjusting screw (2).



1 Remove tensioning springs.



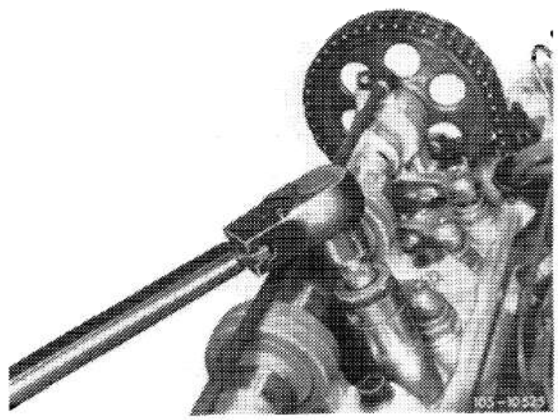
2 Remove rocker arm (05–230).



3 Unscrew threaded bushing.

4 Coat new threaded bushing with valve adjusting screw on threads with tallow, screw-in and tighten to 80 Nm.

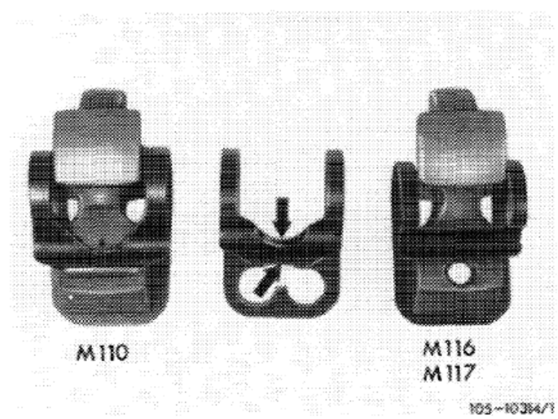
5 Coat bearing surface of rocker arm with oil and install rocker arm.



6 Push tensioning spring into ring groove of valve adjusting screw.

Attention!
Rocker arms and tensioning springs of engines 116 and 117 and rocker arms and tensioning springs of engine 110 may not be interchanged.

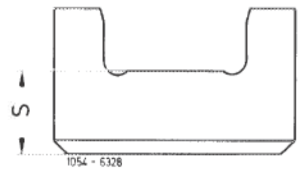
The center tensioning spring (arrows) can be used for engines 116, 117 and 110.



7 Adjust valve clearance (05–210).

05–213 Inspection and correction of basic position of hydraulic valve clearance compensating elements

Thickness of thrust piece "S" in mm	Part No.
6.15	117 053 07 53
5.8	117 053 06 53
5.45	117 053 05 53
5.1	117 053 04 53
4.75	117 053 03 53
4.4	117 053 02 53
4.05	117 053 01 53
3.7	117 053 00 53



Tightening torque	Nm
Nuts for cylinder head cover	3

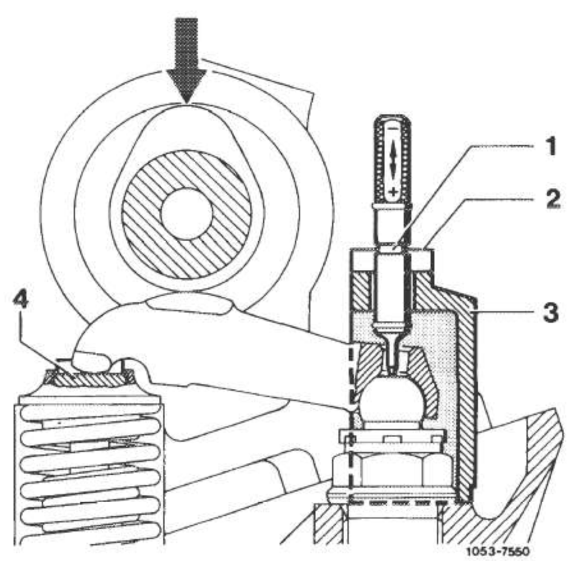
Special tools

Test gauge for hydraulic compensating elements		117 589 06 23 00
Valve spring depressor		123 589 03 61 00

Note

The test gauge serves to determine the basic position or a plus deviation (+) or minus deviation (–) of hydraulic element.

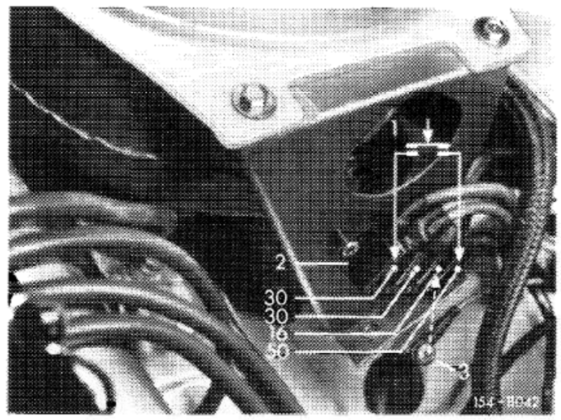
In the event of a plus deviation (+) or a minus deviation (–), the installation of a thinner or thicker thrust piece (4) will regain the basic position.



Checkup

1 When a **new** compensating element is installed, **rotate** engine with starting motor for approx. **30 seconds prior to checkup.**

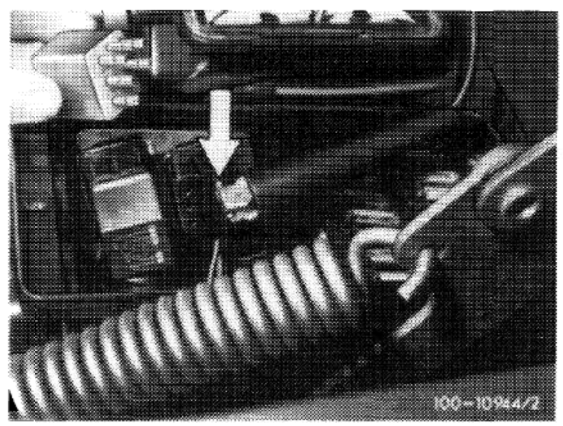
2 Rotate engine:



Model 107

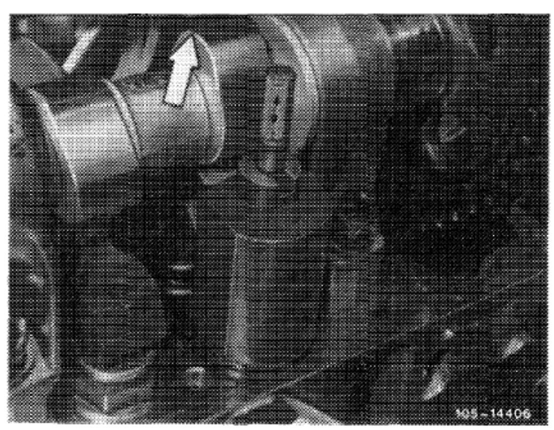
On 4-pole cable connector disconnect cable terminal 16 (cable color red/purple), so that the ignition coil and the fuel pump are not activated. Connect terminal 30 (cable color red) and terminal 50 (cable color purple).

Model 116



Switch off ignition. Pull out fuel pump relay code No. 21 in fuse box. Connect contact handle to battery + and with the assistance of a pin to contact bushing 1 of coupling (arrow).

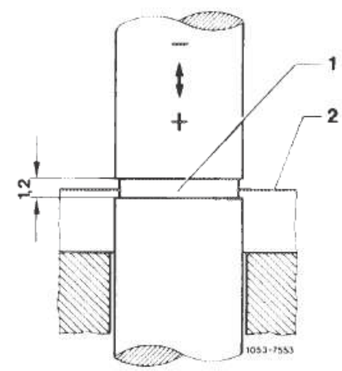
3 Take load from hydraulic element to be checked, that is, the cam tip should point in upward direction (arrow).



4 Place test gauge over hydraulic element to be tested and set measuring pin on ball pin.

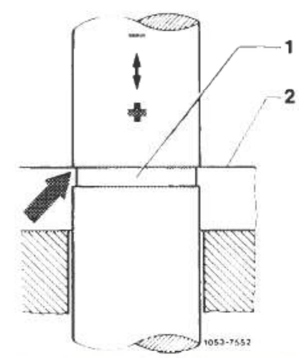
5 Check position of measuring groove (1) in relation to measuring gauge (2):

a) The basic position is correct when the measuring edge (2) is within the 1.2 mm wide, red measuring groove (1).



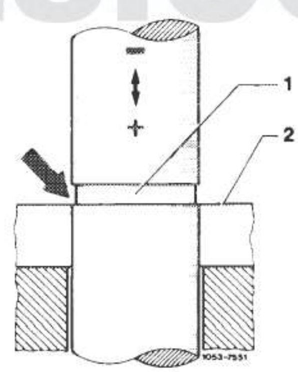
b) Plus deviation (+) is indicated when the measuring edge (2) is above the red measuring groove (1).

Remedy: In the event of a plus deviation (+), install thinner thrust piece.



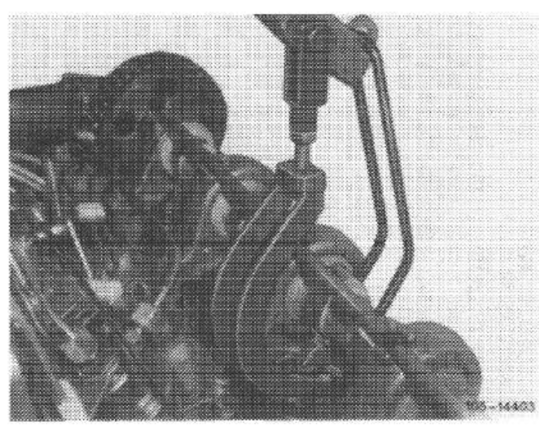
c) Minus deviation (–) is indicated when the measuring edge (2) is below the red measuring groove (1).

Remedy: In the event of a minus deviation (–), install thicker thrust piece.

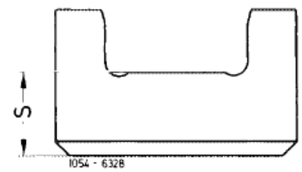


Correction

6 Remove rocker arm with lever-type pusher, remove thrust piece.



7 Measure thickness of thrust piece "S".



Thickness of thrust piece "S" in mm	Part No.
6.15	117 053 07 53
5.8	117 053 06 53
5.45	117 053 05 53
5.1	117 053 04 53
4.75	117 053 03 53
4.4	117 053 02 53
4.05	117 053 01 53
3.7	117 053 00 53

8 In the event of a plus deviation (+), install thinner thrust piece, in the event of a minus deviation (–), install thicker thrust piece.

Note: During new adjustment, try for center position on measuring groove.

9 Install rocker arm and repeat checkup.

05–215 Checking and adjusting of camshaft timing

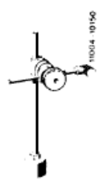
Timing at 2 mm valve lift

Engine	Camshaft code number left/right	Intake valve opens after TDC 1)	Intake valve closes after BDC	Exhaust valve opens before BDC	Exhaust valve closes before TDC
116.980 116.981 116.982 116.983 116.990 2) 116.991 2) 116.992 2) 116.993 2)	30/31 4) 42/43 4) 46/47 4) **52/53** 5)	4° (2°)	14°	30°	16°
116.984 3) 116.985 3)	58/59 6)	4° (2°)	14°	26.5°	11.5°
117.981 (USA) 117.984 (USA)	46/47 4) **52/53** 5)	4° (2°)	14°	30°	16°
117.982 117.983 117.992 2) 117.993 2)	54/55 7) **56/57** 5) 9)	5° (3°)	21°	25°	5°
117.982 117.983 117.992 2) 117.993 2)	00/01 6) 9)	6.5° (4.5°)	18.5°	23°	8°
117.985 3) 117.986 3)	00/01 6)	6.5° (4.5°)	18.5°	23°	8°
117.985 (USA) 117.986 (USA)	06/07 6)	22° (20°)	6°	2° 10)	14°

1) With new timing chains and after driving 20 000 km, change timing of **righthand** camshaft by 2° in direction of advance. Refer to data in brackets.
2) Low compression.
3) Same engine designation for low compression.
4) Replaced by **52/53.**
5) Use with mechanical valve clearance adjustment only.
6) Use with hydraulic valve clearance adjustment only.
7) Replaced by **56/57.**
8) 117.982/992 up to engine end no. 035995 and starting engine end no. 036326 with mechanical valve clearance compensating elements.
117.983/993 up to engine end no. 039155 and starting engine end no. 039612 with mechanical valve clearance compensating elements.
9) 117.982/992 starting engine end no. 035996 to 036325 with hydraulic valve clearance compensating elements.
117.983/993 starting engine end no. 039156 to 039611 with hydraulic valve clearance compensating elements.
10) Opens after BDC.

Tightening torques		Nm
Bolts for cylinder head cover		3
Screw M 14 x 1.5 x 40 for camshaft sprocket		100
Cylinder head bolts with engine cold	step 1	30
	step 2	60
Camshaft bearing bolts on cylinder head		50
Hydraulic valve clearance compensating element in cylinder head		60

Special tools

Valve spring depressor		123 589 03 61 00
Dial gauge holder		363 589 02 21 00
Valve adjusting wrench 17 mm		116 589 02 01 00

Conventional tool

Dial gauge A 1 DIN 878	e.g. Mahr, D-7300 Esslingen order No. 810

Note

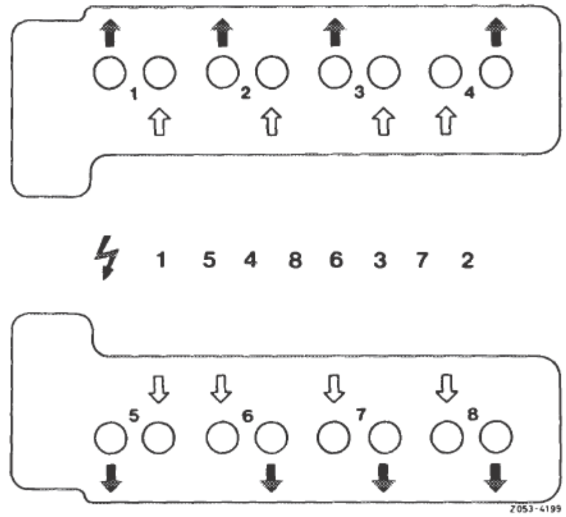
During assembly jobs, alignment of the markings on camshaft at ignition TDC position of 1st cylinder will be sufficient.

Check "intake valve opens" on 1st and 6th cylinder at 2 mm valve lift.

Checkup

1 Check camshaft code number at rear end of camshafts.

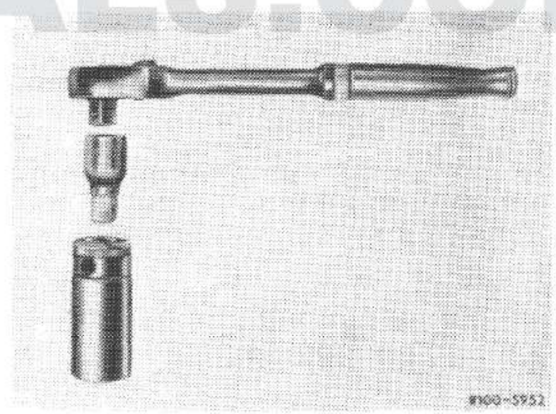
2 On engines with hydraulic valve clearance compensating elements remove rocker arms and valve clearance compensating elements on intake valve of 1st and 6th cylinder. Install valve adjusting screw, part No. 116 050 11 20, on intake valve of 1st and 6th cylinder.



Install rocker arms.

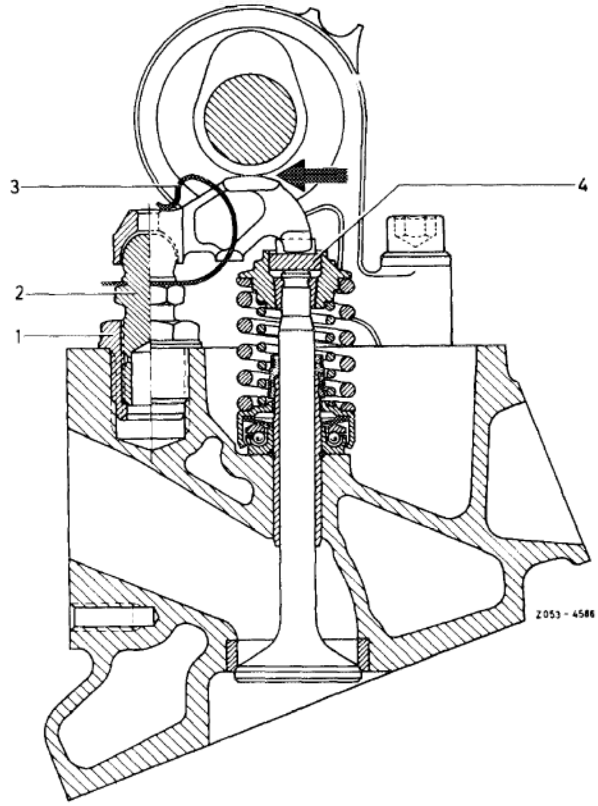
Attention!
Rocker arms and valve clearance compensating elements should always be installed in the same place.

3 Rotate crankshaft (socket 27 mm) until cam tip on intake valve of 1st cylinder is pointing in upward direction.



Rotate crankshaft in engine direction of rotation only.

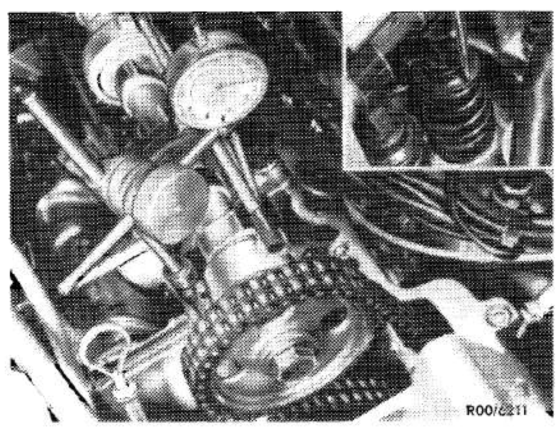
4 Turn valve adjusting screw until rocker arm rests free of play against camshaft base circle.



5 Attach dial gauge holder to cylinder head.

6 Clamp dial gauge with extension pin in dial gauge holder at 3 mm preload.

The feeler pin should rest on valve spring retainer in accurately vertical position.



7 Set large needle to 0.

8 Rotate crankshaft in direction of engine rotation until the needles of the dial gauge are moving back by 2 mm to 1 mm preload. The valve lift will then amount to 2 mm.

9 In this engine position, the value on vibration damper should be in accord with value "intake valve opens" on table.

10 Complete test procedure on intake valve of 6th cylinder and repeat item 4 to 9 for this purpose.

Adjustment

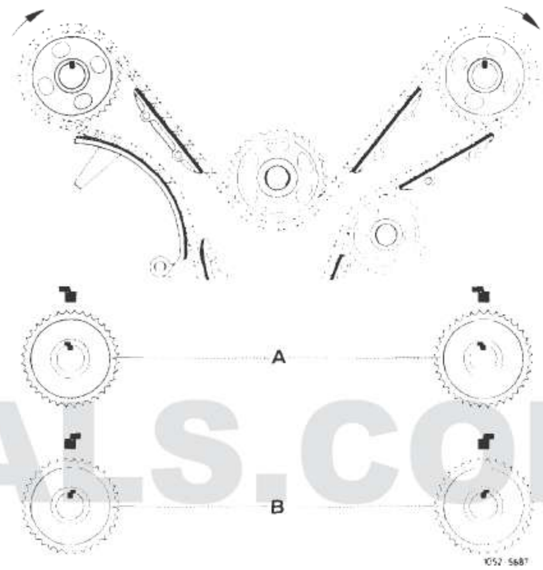
If the timing requires corrections, an offset Woodruff key or in the event of excessive elongation, a new timing chain must be installed.

Woodruff keys are available with the following offset:

Offset mm	Part No.	for a correction of approx.	
0.7	621 991 04 67	4°	KW
0.9	621 991 02 67	6 1/2°	KW
1.1	621 991 01 67	8°	KW
1.3	621 991 00 67	10°	KW

An offset by one tooth on camshaft sprocket results in approx. 18° on crankshaft.

An offset of Woodruff key to the right (in driving direction) results in an earlier (advanced) begin of opening, and an offset to the left in a later (retarded) begin of opening.



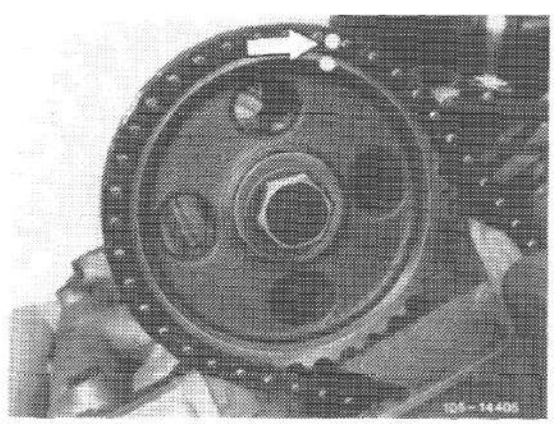
Installation position A results in an earlier (advanced) begin of opening
Installation position B results in a later (retarded) begin of opening

11 Mark camshaft sprockets and timing chain in relation to each other (arrow).

12 Remove respective camshaft sprocket.

13 Place cleaning rag under camshaft and remove Woodruff key.

14 Insert selected Woodruff key.



15 Mount camshaft sprocket while paying attention to color code.

The wide collar on camshaft sprocket should face camshaft (arrow).

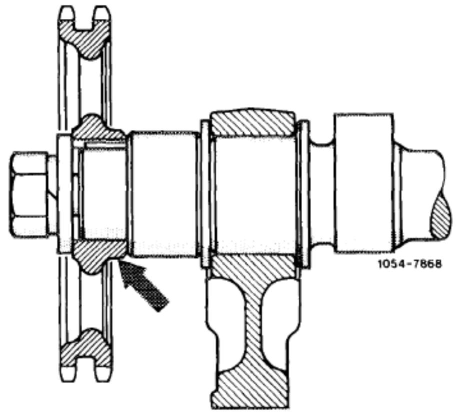
Do not tighten screw.

16 Repeat item 4 to 9.

17 Tighten screw to 100 Nm.

18 Adjust valve clearance (05–210) or check and correct basic position of hydraulic valve clearance compensating elements (05–213).

19 Complete engine assembly.

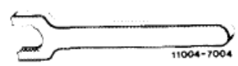


Timing at 2 mm valve lift

Engine	Camshaft code number left/right	Intake valve opens after TDC [1]	Intake valve closes after BDC	Exhaust valve opens before BDC	Exhaust valve closes before TDC
116.980 116.981 116.982 116.983 116.990 [2] 116.991 [2] 116.992 [2] 116.993 [2]	30/31 [4] 42/43 [4] 46/47 [4] **52/53** [5]	4° (2°)	14°	30°	16°
116.984 [3] 116.985 [3]	58/59 [6]	4° (2°)	14°	26.5°	11.5°
117.981 USA 117.984 USA	46/47 [4] **52/53** [5]	4° (2°)	14°	30°	16°
117.982 117.983 117.992 [2] 117.993 [2]	54/55 [7] **56/57** [5] [8]	5° (3°)	21°	25°	5°
117.982 117.983 117.992 [2] 117.993 [2]	00/01 [6] [9]	6.5° (4.5°)	18.5°	23°	8°
117.985 [3] 117.986 [3]	00/01 [6]	6.5° (4.5°)	18.5°	23°	8°
117.985 USA 117.986 USA	06/07 [6]	22° (20°)	6°	2° [10]	14°

1) With new timing chains and after driving 20 000 km, change timing of **righthand** camshaft by 2° in direction of advance. Refer to data in brackets.
2) Low compression.
3) Same engine designation for low compression.
4) Replaced by **52/53.**
5) Use with mechanical valve clearance adjustment only.
6) Use with hydraulic valve clearance adjustment only.
7) Replaced by **56/57.**
8) 117.982/992 up to engine end no. 035995 and starting engine end no. 036326 with mechanical valve clearance compensating elements.
117.983/993 up to engine end no. 039155 and starting engine end no. 039612 with mechanical valve clearance compensating elements.
9) 117.982/992 starting engine end no. 035996 to 036325 with hydraulic valve clearance compensating elements.
117.983/993 starting engine end no. 039156 to 039611 with hydraulic valve clearance compensating elements.
10) Opens after BDC.

Tightening torques		Nm
Bolts for cylinder head covers		3
Bolts for camshaft sprockets		100
Cylinder head bolts with engine cold	1st step	30
	2nd	60
Fastening bolts for camshaft bearing on cylinder head		50

Special tools		
Valve spring depressor		123 589 03 61 00
Holding wrench for camshafts		116 589 01 01 00
Screwdriver element 8 mm, 1/2″ square, 130 mm long		000 589 33 07 00
Valve adjusting wrench		116 589 02 01 00

Note

Camshafts for engines with hydraulic valve clearance compensating elements have no initial cams of the type required for engines with mechanical valve clearance adjustment for smooth compensation of valve clearance.

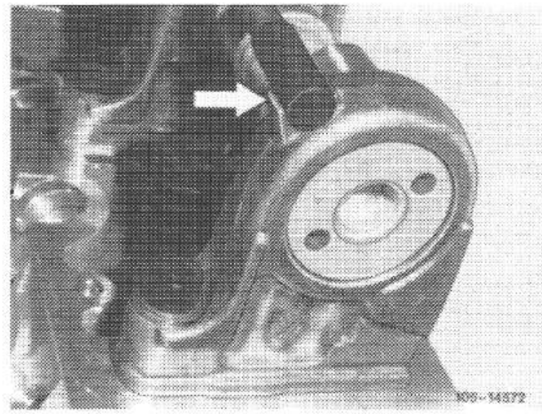
Always pay attention to association of camshaft code number in relation to respective engine (refer to table).

Camshaft bearing journals can be ground, the required camshaft bearings with repair stages are available (05–225).

When replacing a camshaft, also replace the respective rocker arms.

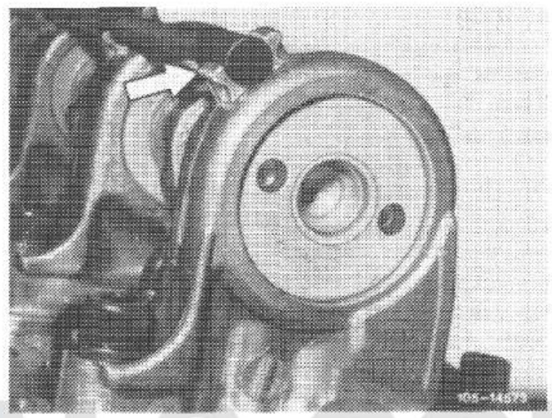
Since October 1977, an oil pipe of 10 mm OD, larger connections and modified camshaft bearings (arrow) are installed.

Do not install an oil pipe of 8 mm OD together with modified camshaft bearing (arrow).



Version with oil pipe 10 mm dia.

Renew connections following each removal from camshaft bearings, since otherwise the oil pressure in oil pipe is not assured.

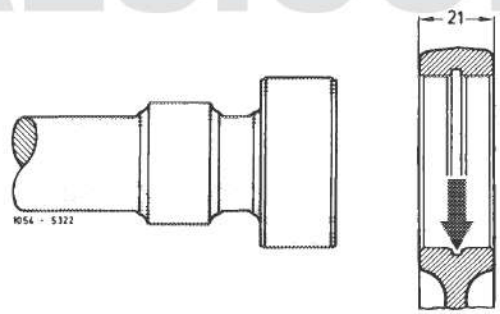


Version with oil pipe 8 mm dia.

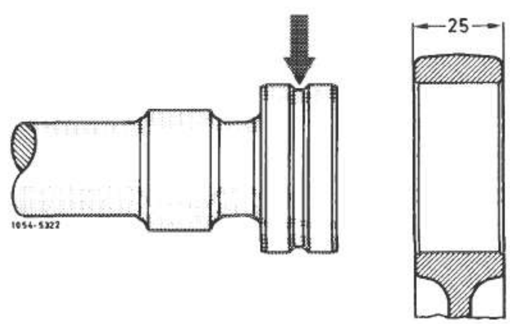
Install camshaft without oil groove only in camshaft bearings with oil groove (arrow).

Code numbers (left/right) of camshafts

without oil groove:	30/31, 42/43, 46/47, 48/49, 52/53, 54/55
with oil groove:	00/01, 06/07, 56/57, 58/59.

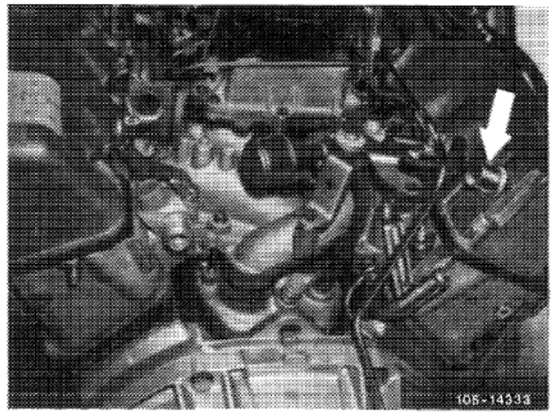


Install camshaft with oil groove (arrow) only in camshaft bearings without oil groove.



In combination with new camshaft bearings, use only cylinder head covers which are not resting inside against camshaft bearings.

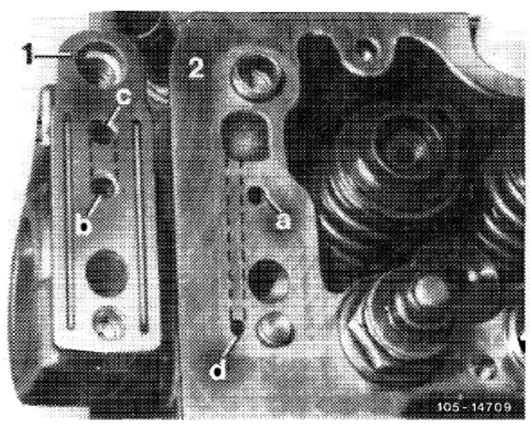
Identification: Cast neck for engine breather, formerly threaded bore (arrow).



Attention!
On engines with hydraulic valve clearance compensating elements, the 5th camshaft bearing bracket (1) has an oil feed duct (c), which is connected to longitudinal duct in cylinder head.

If the camshaft bearing bracket (1) is mounted on cylinder heads with mechanical valve clearance adjustment, the oil duct (c) must be closed. For this purpose, cut threads M 7 x 13 into oil bore (c) on camshaft bearing bracket and close with an aluminum plug 5 x M 7 AL 99 F x 11 x 12 N 150 14, part no. 915014 007100.

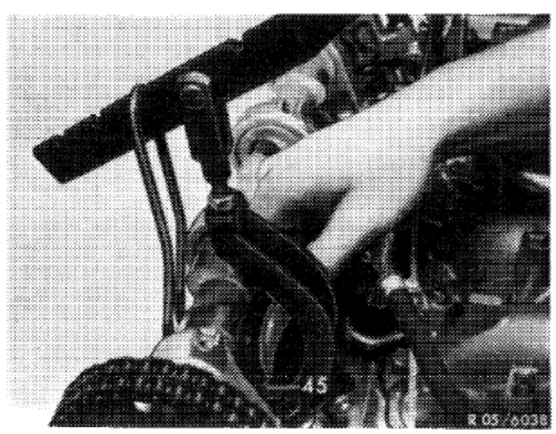
1 Camshaft bearing bottom
2 Cylinder head right rear
a Oil feed from main oil duct
b Oil duct to oil pipe and to camshaft bearings
c Oil duct from rear camshaft bearing to feed bore (d) for oil longitudinal duct in cylinder head
d Feed bore for oil longitudinal duct with hydraulic valve clearance compensating elements



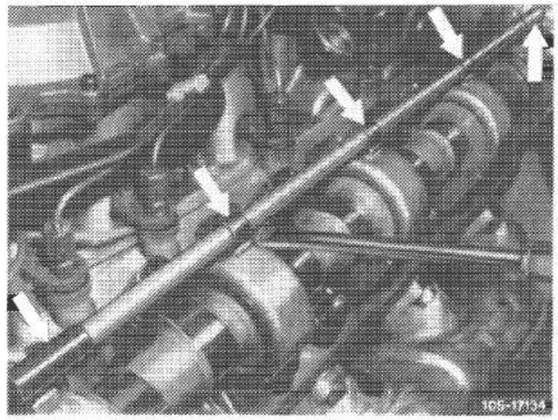
Removal

1 Set piston of 1st cylinder to ignition TDC, so that woodruff key in camshaft (arrow) points in upward direction.

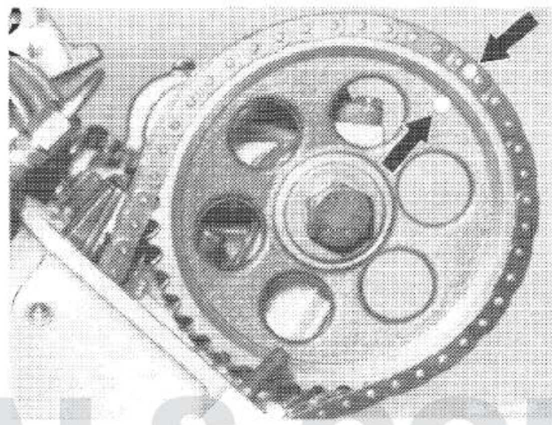
Note: Do not rotate engine on fastening bolt of camshaft sprockets.



2 Force off oil pipe together with connections (arrows) and remove.


105-17134

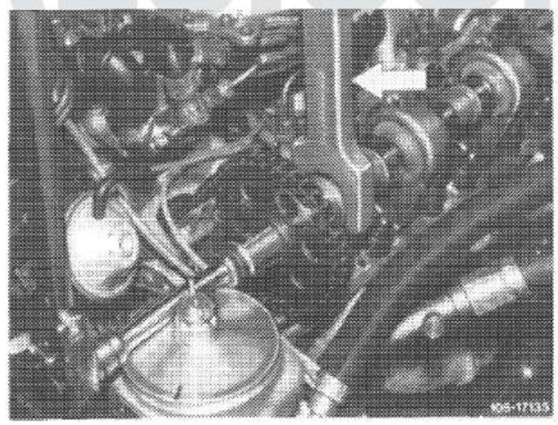
3 Mark both timimg chain and camshaft sprocket with locking fluid (arrows).



4 Loosen necked-down screw on camshaft sprocket while applying counterhold with holding wrench.

5 Remove camshaft sprocket.

6 Unscrew camshaft bearing and remove camshaft together with camshaft bearing and oil pipe.


105-17135

Installation

7 Lubricate camshaft bearings, slip camshaft into camshaft bearings and mount.

Note: On lefthand camshaft insert outer fastening screw of rear camshaft bearing (owing to brake unit) into camshaft bearings prior to positioning camshaft.

8 Lubricate cylinder head screws on threads and on screw head contact surface.

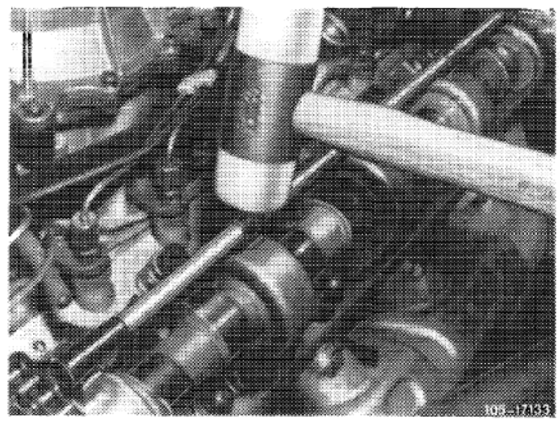
9 Retighten cylinder head screws M 10 x 155 for camshaft bearing from inside out first to 30 Nm and then tighten to 60 Nm.

10 Tighten fastening screws M 8 to 50 Nm.

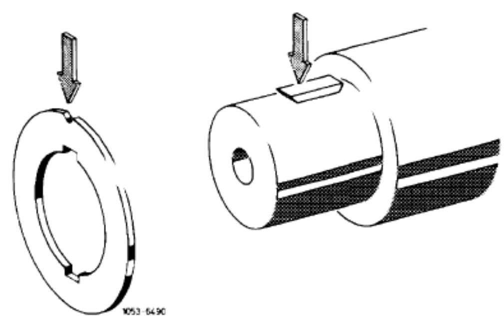
Attention!
Manual turning of camshaft should still be possible.

11 When mounting oil pipes, move connections into assembly position and check the three inner connections for free passage of oil bores prior to knocking on camshaft bearings. **Renew oil pipe if oil bores are concealed.**

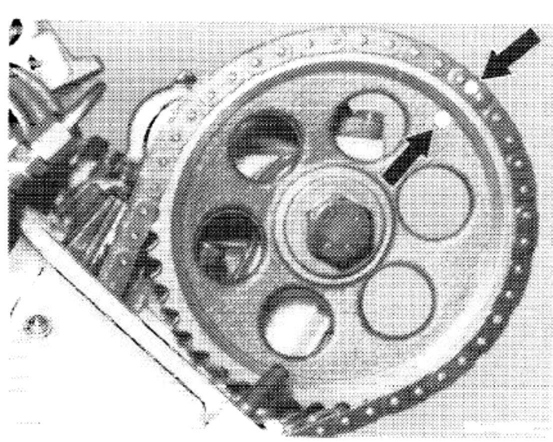
Attention!
Renew connections each time after removing camshaft bearings, since otherwise the oil pressure in oil pipe is not assured.



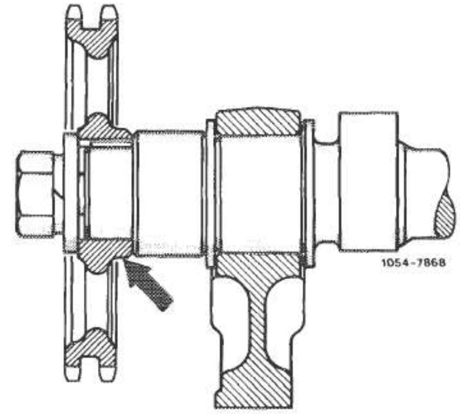
12 Mount compensating washer in such a manner that the keyway and the notch are properly aligned in relation to Woodruff key of camshaft (refer to arrows).



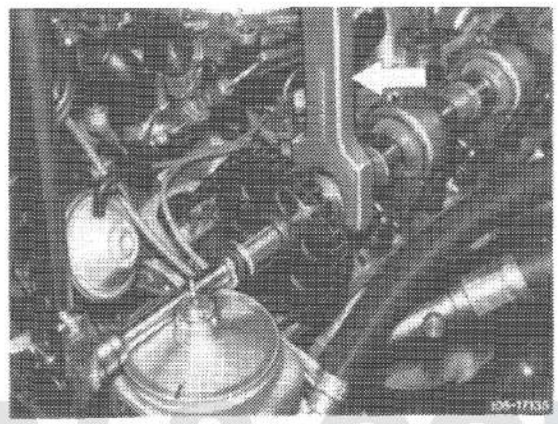
13 Mount camshaft sprocket while paying attention to color coding (arrow).



Attention!
The white color on camshaft sprocket (arrow) should face camshaft.



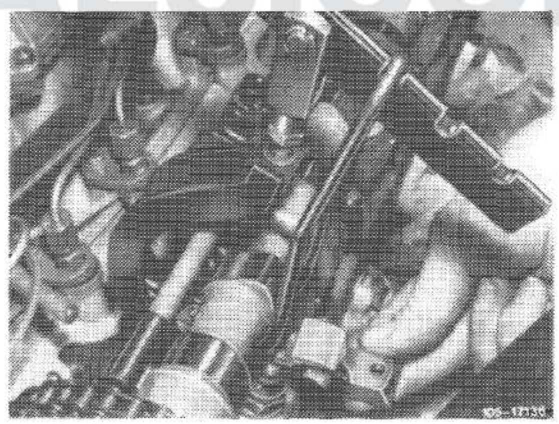
14 Tighten necked-down screw to 100 Nm, while counterholding camshafts with holding wrench.



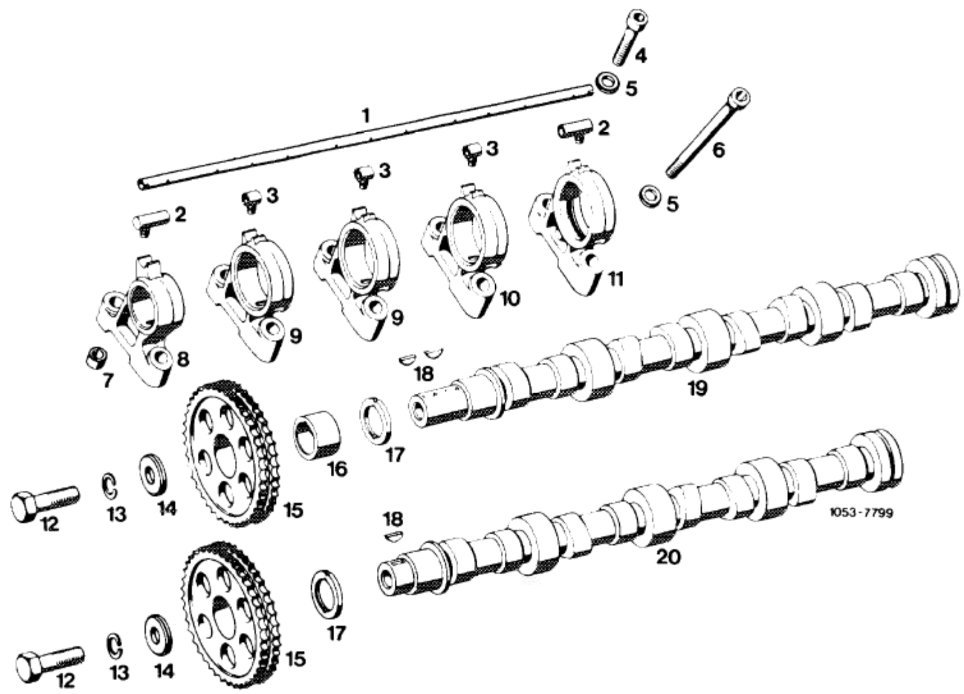
15 Install rocker arm again at the same place.

Attention!
If the rocker arms or the camshaft were renewed, check basic position of hydraulic valve clearance compensating elements (05–213).

16 Adjust valve clearance (05–210).



17 Complete assembly of engine.



1 Oil pipe
2 Connection, end
3 Connection, center
4 Cyl. head screw M 8 x 50
5 Washer
6 Cyl. head screw M 10 x 150
7 Set sleeves
8 Camshaft bearing sprocket end
9 Camshaft bearing 2 and 3
10 Camshaft bearing 5
11 Camshaft bearing flywheel end
12 Screw M 14 x 1.5 x 40
13 Spring washer B 14
14 Washer
15 Camshaft sprocket
16 Spacing ring right
17 Compensating washer
18 Woodruff key
19 Camshaft right
20 Camshaft left

05–225 Grinding camshaft bearing journals

Data

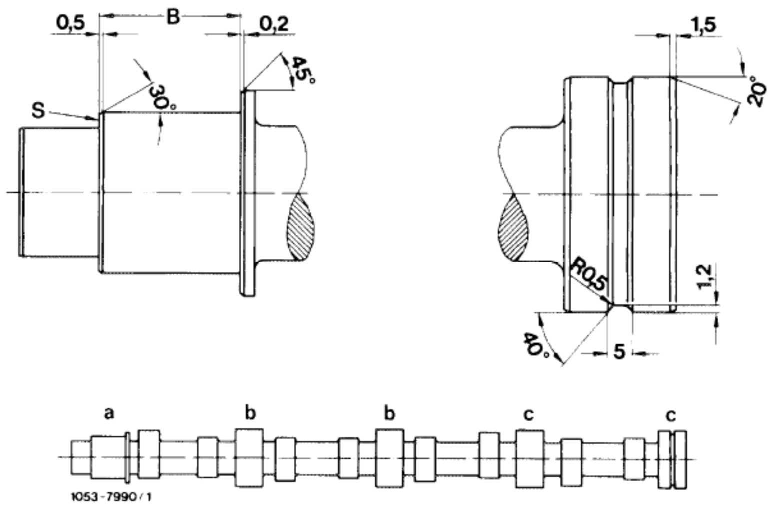
Mean roughness of camshaft bearing journals				0.005
Permissible radial runout of camshaft bearing journals b and c and of camshaft sprocket seat when mounting camshaft at bearing journal a and rear bearing journal c				0.025
Permissible radial runout of cam base circle when mounting camshaft at bearing journal a and rear bearing journal c				0.03
Bearing points (Fig.)		a	b	c
Normal dimension	bearing dia	35.000 / 35.016	49.200 / 49.216	49.400 / 49.416
	journal dia	34.975 / 34.959	49.175 / 49.159	49.375 / 49.359
Repair stage 1	bearing dia	34.900 / 34.916	49.100 / 49.116	49.300 / 49.316
	journal dia	34.875 / 34.859	49.075 / 49.059	49.275 / 49.259
Repair stage 2	bearing dia	34.750 / 34.766	48.950 / 48.996	49.150 / 49.166
	journal dia	34.725 / 34.709	48.925 / 48.909	49.125 / 49.109
Thrust bearing	width of bearing bracket	25.430 / 25.390		
	journal width B	25.500 / 25.533		
Camshaft bearing play	radial	0.025–0.057	0.025–0.057	0.025–0.057
	axial	0.070–0.143		

Note

When grinding thrust surface of bearing journal "a" always regrind face "S" to the extent that the journal width "B" and thereby the end play will be maintained.

Bearing journals are not hardened.

Camshaft bearing journals can be ground; for this purpose, camshaft bearings with repair stages are available.

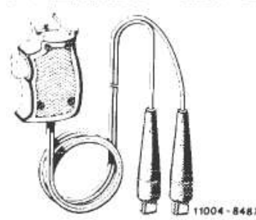


05–230 Removal and installation of rocker arms

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.20	0.25

[1]) 0.05 mm higher during lasting outside temperatures below –20 °C.

Tightening torques	Nm
Bolts for cylinder head cover	3
Valve adjusting screws	20–40

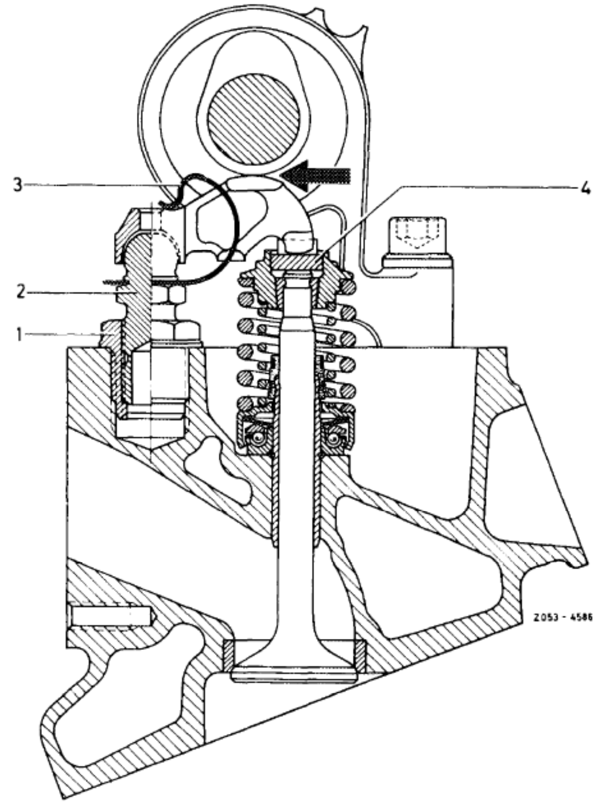
Special tools		
Valve spring depressor		123 589 03 61 00
Valve adjusting wrench 17 mm		116 589 02 01 00
Contact handle for rotating engine (component of compression meter 001 589 46 21 00)		001 589 46 21 08

Note

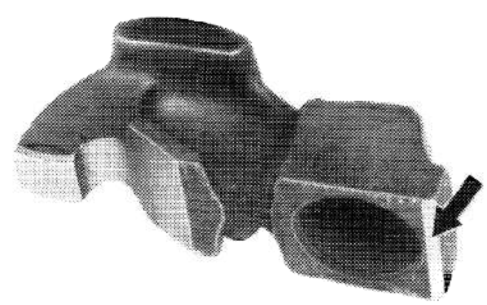
Always install rocker arms at the same spot.

If the rocker arms are exchanged or renewed, check basic position of hydraulic valve clearance adjusting elements (05–213).

When installing new rocker arms, also renew pertinent camshaft.



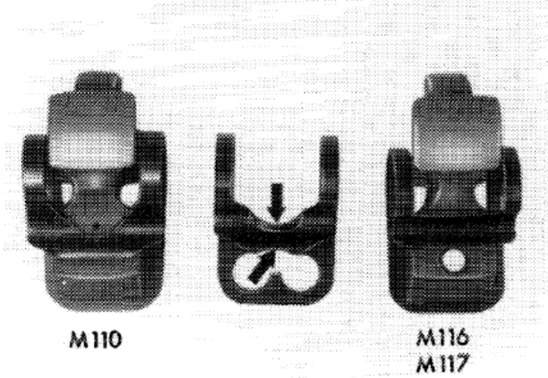
Attention!
With hydraulic valve clearance compensating elements use only rocker arms with chamfer (arrow).



105–10604

Attention!
Do not interchange rocker arms and tensioning springs of engines 116 and 117 with rocker arms and tensioning springs of enginge 110.

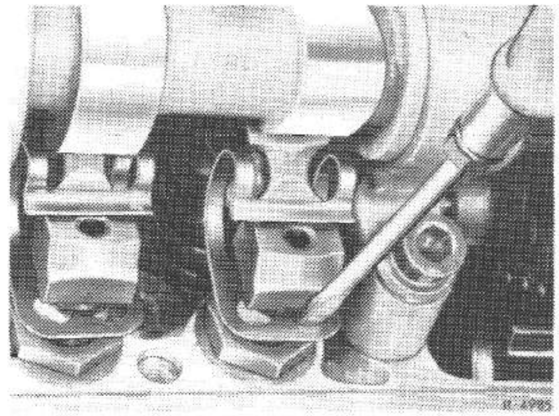
The center tensioning spring (arrow) can be used for engines 116, 117 and 110.



105–10314/1

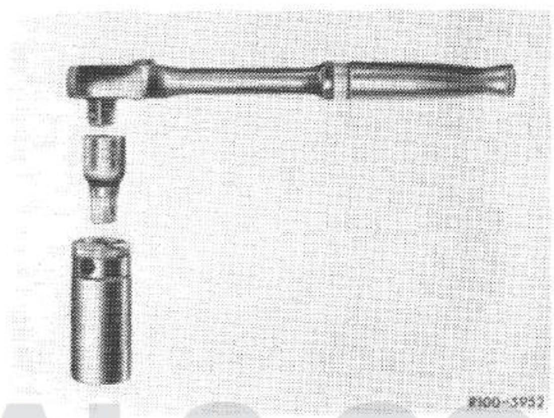
Removal

1 Remove tensioning springs with a screw driver.

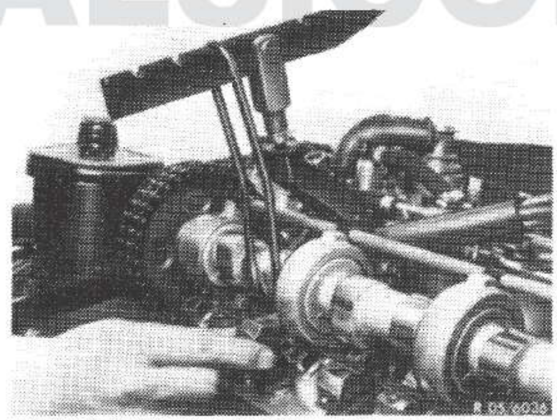


2 Rotate crankshaft with tool combination until cam tip is pointing upwards.

Do not rotate engine on camshaft.



3 Remove rocker arm with remover and installer.



Installation

4 Lubricate sliding and bearing surface of rocker arm.

5 Install rocker arm, push tensioning spring into ring grooves of adjusting screw.

6 Adjust valve clearance (05–210).

Attention!
If a camshaft or a rocker arm has been renewed, check basic position of hydraulic valve clearance compensation elements (05–213).

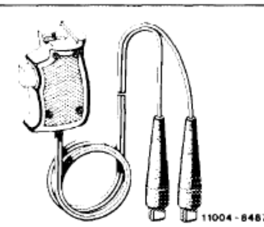
05–250 Removal and installation of valve springs

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1])	0.15[1])
Exhaust	0.20	0.25

[1]) 0.05 mm higher during lasting outside temperatures below −20 °C.

Tightening torques	Nm
Bolts for cylinder head cover	3
Valve adjusting screw	20–40

Special tools

Valve spring depressor		123 589 03 61 00
Magnetic lifter for valve cone halves		116 589 06 63 00
Contact handle for rotating engine (component of compression meter 001 589 46 21 00		001 589 46 21 08
Valve adjusting wrench 17 mm		116 589 02 01 00

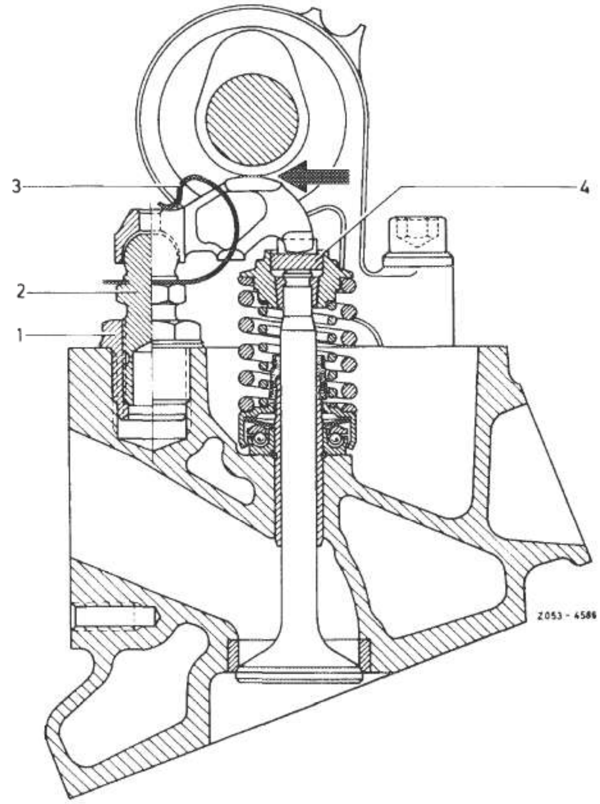
Conventional tool

Cylinder leak tester	e. g. made by Bosch, EFAW 210 A made by SUN, CLT 228–1

Removal

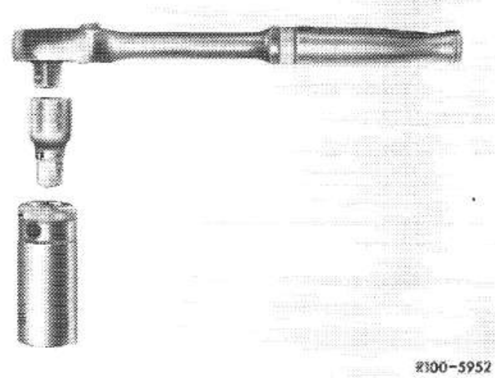
1 Remove rocker arm (05–230).

Attention!
Install rocker arm at the same spot as before.



2 Unscrew spark plugs.

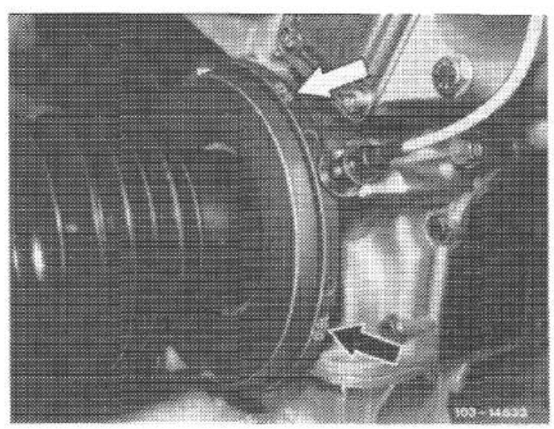
3 Set piston of respective cylinder to ignition TDC. For this purpose, rotate engine with tool combination and crankshaft.



Note: The markings 0, 90, 180 and 270 (arrows) are punched into vibration damper.

At the positions shown below in relation to needle the following pistons are at TDC:

Marking number	Piston at TDC
0	1 and 6
90	5 and 3
180	4 and 7
270	8 and 2



4 Support valve by compressed air (cylinder leak test).

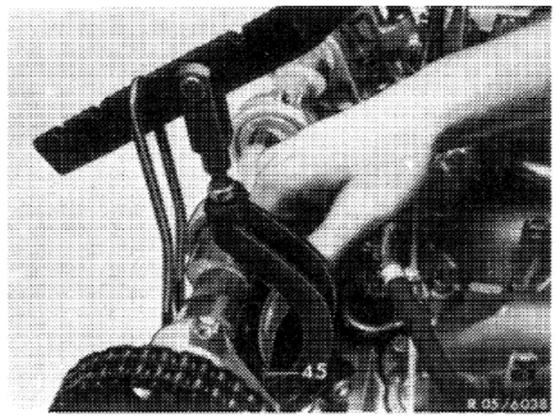
Attention!
Valves should not rest on piston crown to prevent bending of valves.

5 Push valve spring retainer down by means of lever-type pusher.

6 Remove valve cone halves with magnetic lifter.

7 Remove valve spring retainer and valve spring.

8 Check valve spring, renew according to condition (05–260).

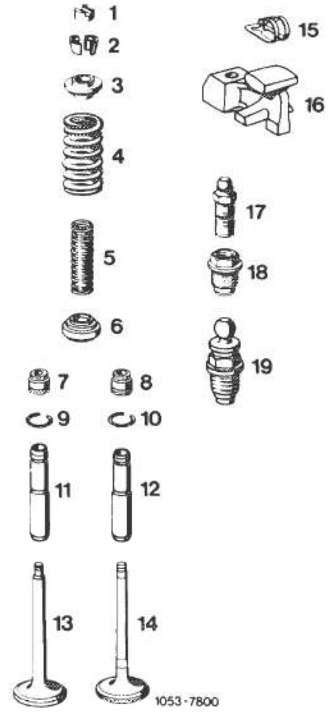


Installation

9 Insert valve spring with close coils toward cylinder head.

10 For further installation proceed vice versa to removal.

11 Adjust valve clearance (05–210).



1 Thrust pieces
2 Valve cone
3 Valve spring retainer
4 Valve spring, outer
5 Valve spring, inner
6 Rotocap
7 Valve seal intake
8 Valve seal exhaust
9 Locking ring intake
10 Locking ring exhaust
11 Valve guide intake
12 Valve guide exhaust
13 Intake valve
14 Exhaust valve
15 Tensioning spring
16 Rocker arm
17 Adjusting screw
18 Threaded bushing
19 Hydraulic valve clearance compensating element

05–260 Checking valve springs

Data

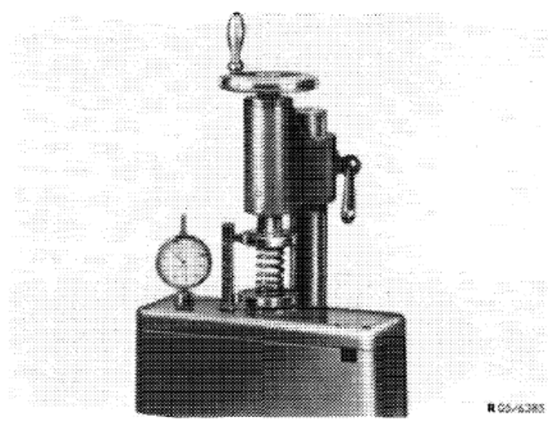
Engine	Valve springs part No. optional	Color code	OD mm	Wire dia. mm	Length un-loaded mm	Spring force at preloaded length mm	when new N (kp)	limit value N (kp)
116 117	inside spring 108 053 00 22[1]	yellow/brown or	22.2	2.5	45	21	228–252	205
	130 053 00 22	purple/brown	22.0–22.4			21.5	235	224–246
	outside spring 100 053 01 20	yellow/red or purple/red	34.1–34.5	4.75	49	30.5	863	843–902

[1] Engine 116.980/981, 982, 983, 990, 991, 992 and 993 only.

Checkup

In the event of repairs, check valve springs prior to re-use for corrosion.

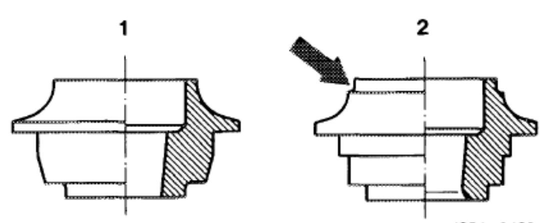
In addition, check spring force at specified length by means of a spring test scale. If values are less than the lower limit value, renew valve springs.



R 05/6385

Attention!
Be sure to maintain limit values on engines with hydraulic valve clearance compensating elements. To make sure that this value is not less than specified on valves with a by now lower level (machined valve seats), use valve spring retainer, part no. 130 053 06 25.

This valve spring retainer (2) is identified by a machined groove (arrow).



1 Valve spring retainer, series
2 Valve spring retainer for increased spring force with machined groove

1054 - 9492

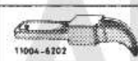
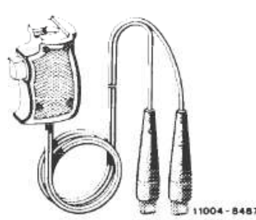
05–270 Replacement of valve stem seals

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1)]	0.15[1)]
Exhaust	0.20	0.25

[1)] 0.05 mm higher during lasting outside temperatures below –20 °C.

Tightening torques	Nm
Bolts for cylinder head	3
Valve adjusting screws	20–40

Special tools

Valve spring depressor		123 589 03 61 00
Magnetic lifter for valve cone halves		116 589 06 63 00
Assembly mandrel 9 mm dia. for valve stem seal		116 589 00 43 00
Assembly mandrel 11 mm dia. for valve stem seal		116 589 01 43 00
Valve adjusting wrench 17 mm		116 589 02 01 00
Contact handle for rotating engine (component of compression meter 001 589 46 21 00)		001 589 46 21 08

Conventional tool

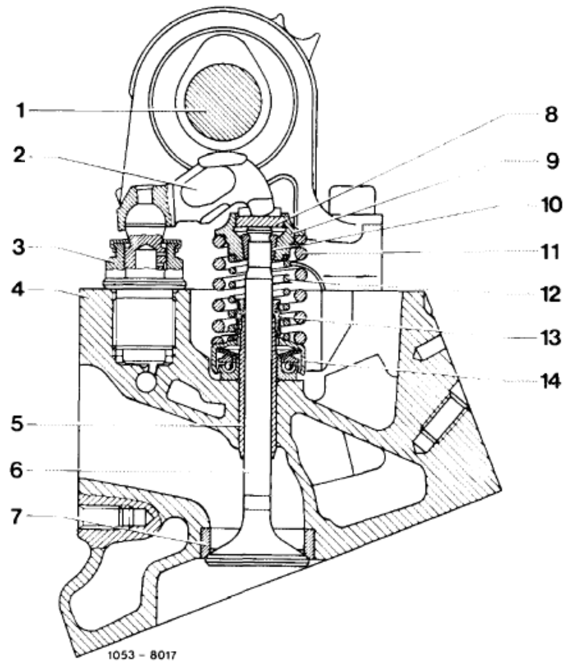
Cylinder leak tester	e.g. Bosch, EFAW 210 A made by SUN, CLT 228–1

Note

Valve stem seals including assembly sleeves are supplied in repair kit.

Valve guides which are worn out at holding groove for valve stem seal must be replaced.

Attention!
Reinstall rocker arms, thrust piece, valve spring retainers, valve springs, valve cone halves and rotocap always at the same point, if the basic position of the hydraulic compensating elements is not to be changed.



1 Camshaft
2 Rocker arm
3 Hydraulic valve clearance compensating element
4 Cylinder head
5 Valve guide
6 Exhaust valve
7 Valve seat ring
8 Thrust piece
9 Valve spring retainer
10 Valve cone half
11 Outer valve spring
12 Inner valve spring
13 Valve stem seal
14 Rotocap

Renewing

1 Remove valve springs (05–250).

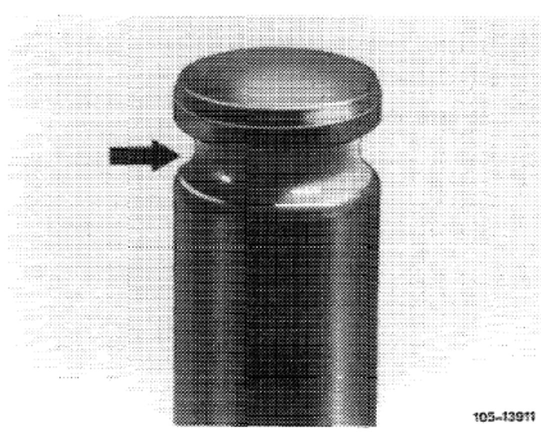
2 Press off valve stem seals by means of a screw driver or pull off by means of pliers.

Attention!
Do not damage valve stem and valve guide.

3 Debur valve stem on groove.

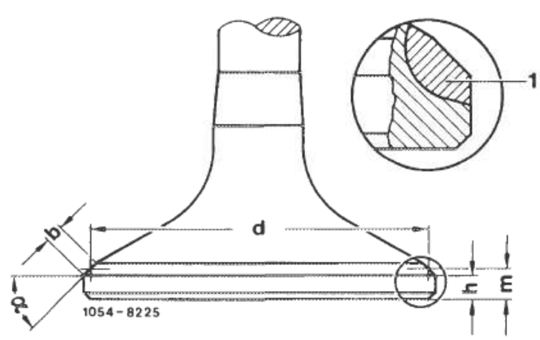
Renew worn out valve cone halves and spring retainers.

4 Check rotocap and renew, if required.



05–280 Checking and machining valves

Data		Intake valve	Exhaust valve
Valve retainer dia.		44.10–44.30	37.00–37.20
Valve stem dia.		8.95–8.97	10.94–10.96
Valve length		116.8–117.2	117.8–118.2
Code No. at shaft end		E 116 01 or E 116 02	A 110 00 or 110 00 C
Filled-in sodium		without	with
Valve seat plating		with	with
Height of valve reatiner	when new	1.5	2.5
	limit value	1.0	2.0
Width "b" of valve seat		1.8–2.5	1.5–2.5
Diameter "d" at valve seat center		43.2	36.1
Height "m" up to valve	when new	2.1–2.3	3.1–3.3
	limit value	1.6–1.8	2.6–2.8
Adjusting angle for machining valves			45°
Permissible radial runout vertically in relation to valve seat and on valve stem when mounted at valve stem			0.03
Permissible axial runout at end of valve stem when mounted at valve stem.			0.015



1 Valve seat plating

Conventional tools

Valve cone grinder or Valve cone machining tools	e.g. Krupp, D-5320 Bad Meckenheim model VS e.g. Hunger, D-8000 München 55, type VKDR 1, order No. 203.00.200

Note

Exhaust valves are filled with sodium!

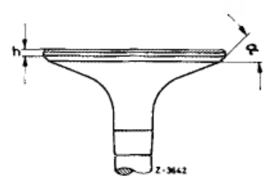
When scrapping valves, pay attention to safety rules. Do not melt valves filled with sodium since there is a risk of explosion and do not use such valves for making tools (punch etc.) without first removing filled-in sodium.

Be careful when removing sodium from valves, since sodium mixed with water and watery solutions reacts heavily-explosive, while the resulting hydrogen gas may cause fires.

Sodium from cut up or broken up valves can be neutralized in a mixture comprising 2 liters of spirit of alcohol and 1 liter of water put into a vessel and placed in the open air.

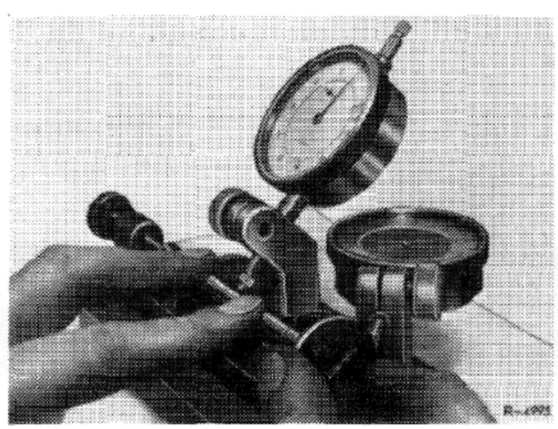
Valves filled with sodium can be collected and shipped for neutralizing to: Garantieprüfstelle Werk Stuttgart-Untertürkheim.

Checking and machining



1 Clean valves and check visually.

Valves with a burnt valve retainer, with insufficient height "h" of valve retainer and valves with worn-out or score valve stem should be replaced.



2 Permissible radial runout at valve stem, check valve seat.

3 Check axial runout at end of valve stem.

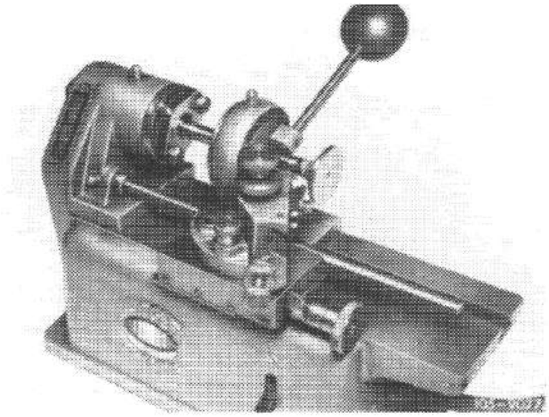
Replace valve, if a limit value is attained.

4 Machine valve seat and face of valve stem.

Refer to operating instructions of machining tool.

5 Measure runout on valve seat and height "h" of valve disc.

When the limit values are attained, replace valve.



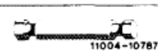
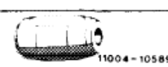
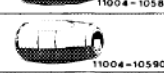
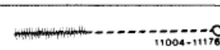
05–285 Inspection and renewal of valve guides

Valve guides

	Step adjustment and part no.	OD	Color code	Basic bore in cylinder head	Overlap[1])	Valve guide ID
Intake	Standard dimension 116 050 36 24	14.043–14.050	grey-brown	14.030–14.035	0.008–0.020	9.000–9.015
	Repair stage 116 050 37 24	14.214–14.222	red	14.198–14.203	0.011–0.024	
Exhaust	Normal dimension 116 050 41 24	15.043–15.050	grey-brown	15.030–15.035	0.008–0.020	11.000–11.018
	Repair stage 116 050 42 24	15.214–15.222	red	15.193–15.203	0.011–0.024	

[1]) Overlap should be between 0.007 and 0.025 mm.

Special tools

Plug gauge 9 mm dia. intake valve guide		117 589 03 23 00
Plug gauge 11 mm dia. exhaust valve guide		117 589 04 23 00
Drive-out punch 9 mm dia. intake		110 589 02 15 00
Drive-out punch 11 mm dia. exhaust		110 589 03 15 00
Plug gauge for valve guide basic bore		117 589 05 23 00
Reamer 14.035 mm dia. intake		110 589 03 53 00
Reamer 15.035 mm exhaust		110 589 02 53 00
Broach 14.2 mm dia. intake		115 589 00 53 00
Broach 15.2 mm dia. exhaust		110 589 00 53 00
Guide sleeve for broach intake 14.2 mm dia.		102 589 01 63 00
Guide sleeve for broach exhaust 15.2 mm dia.		117 589 00 63 00
Drive-in punch 9 mm dia intake		110 589 00 15 00
Drive-in punch 11 mm dia. exhaust		110 589 01 15 00
Reamer 8.99 mm dia. H 7 intake		000 589 10 53 00
Reamer 10.99 mm dia. H 7 exhaust		000 589 15 53 00
Cylinder brush 20 mm dia.		000 589 10 68 00

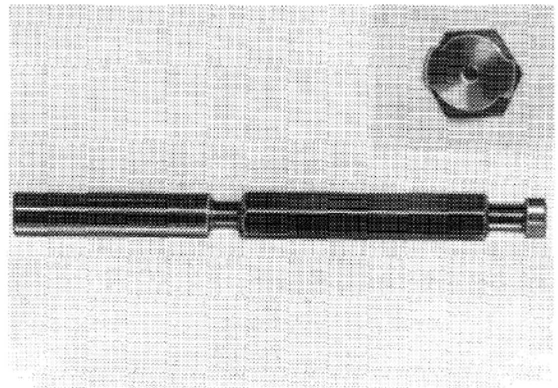
Association engines — guide sleeve — broaches

Engine	Valve	Valve guide basic bore mm	Guide sleeve part no.	Page	Broach part no.
116, 117	Intake	14.2	102 589 01 63 00	A	115 589 00 53 00
116, 117	Exhaust	15.2	117 589 00 63 00	B	110 589 00 53 00

Note

In the event of repairs, insert valve guides of normal dimension (gray-brown) into cylinder heads with standard normal dimension valve guides. First ream basic bores with reamers 14.035 mm dia. (intake) or 15.035 mm dia. (exhaust), so that the overlap will not be too high.
Basic bores in which no adequate force fit is attained with standard dimension valve guide (gray-brown) (minimum overlap 0.007 mm) must be reamed with reamers for repair stage valve guides (red).
Knock broaches through basic bores by means of a plastic hammer and with the aid of guide sleeves.

Checking valve guides



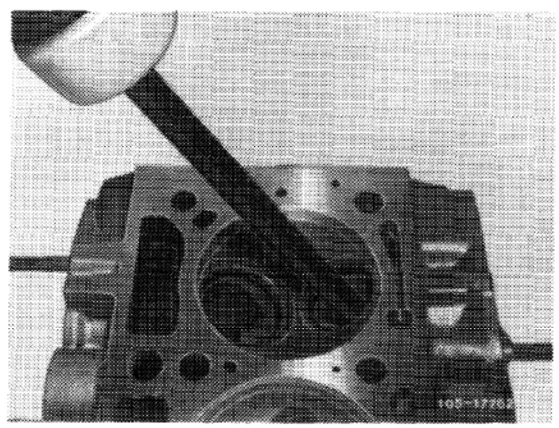
105-22768

On disassembled cylinder head check both sides of valve guide by means of plug gauge, each time in longitudinal and transverse direction (4 measuring points). First clean bores of valve guides by means of cylinder brush.

Valve guides, into which the not-go plug with the limit wear dimension (+220) can be inserted at one point with its full height (5 mm) must be replaced.

Valve guides, which are worn outside at seat of valve stem seal, in such a manner that the valve stem seal is no longer firmly seated, should also be replaced.

Renewing valve guides

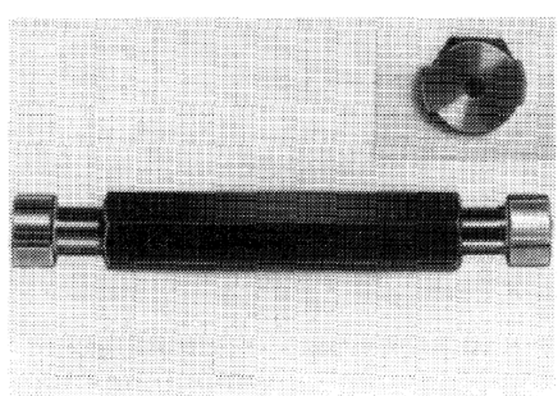


1 Knock-out valve guide by means of knocking-out punch from direction of combustion chamber.

2 Check valve guide basic bore by means of plug gauge in lengthwise and transverse direction at both bore ends.

Machine basic bores into which the measuring plug can be introduced at one point with its full height (8 mm) to repair stage.

If the plug gauge cannot be inserted fully or not completely, the basic bore may be reamed to normal valve guide dimension.



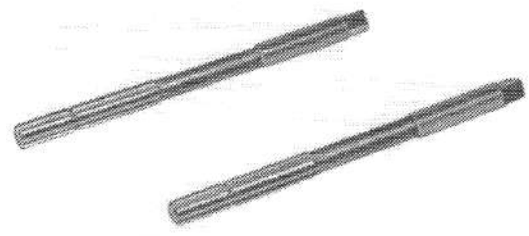
105-22767

Machining basic bore

Normal dimension

3 Ream basic bore with reamer 14.035 mm dia. or 15.035 mm dia. while lubricating with kerosene. Ream at low pressure and do not cant reamer. Always turn reamer in forward direction **(never backward)** and take out of bore below.

Note:
Handle reamers carefully and store in protective sleeve, so that the cutting edges are not damaged.



105-21802

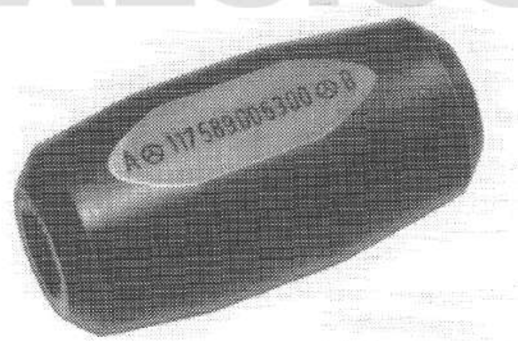
Machining basic bore

Repair stage

4 De-soot and clean cylinder head perfectly, in particular inside of valve seat rings.

5 Clean cutting edges of broach from metal chips prior to each broaching step (use stiff plastic brush or the like).

6 Select correct guide sleeve (refer to table). Make sure that the guide sleeve is always centered at ID of respective valve seat ring only and is not coming into contact with residue soot, casting lubs, walls of intake and exhaust ducts etc.

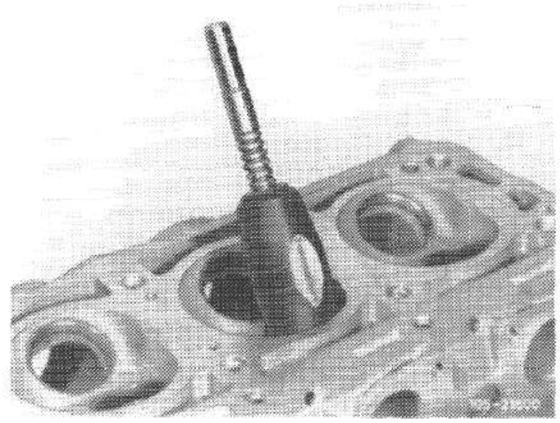


105-21801

7 Provide guide sleeve, basic bore and complete broach generously with engine oil.

8 Introduce broach in broaching direction into guide sleeve in such a manner that upon subsequent insertion of guide sleeve into cylinder head the broach enters into the bore to be broached up to first cutting edge. Center sleeve by rotating motions in valve seat ring.

9 Knock broach through bore by means of an aluminium mandrel approx. 130 mm long and a plastic hammer weighing approx. 250 g.



Inserting valve guide

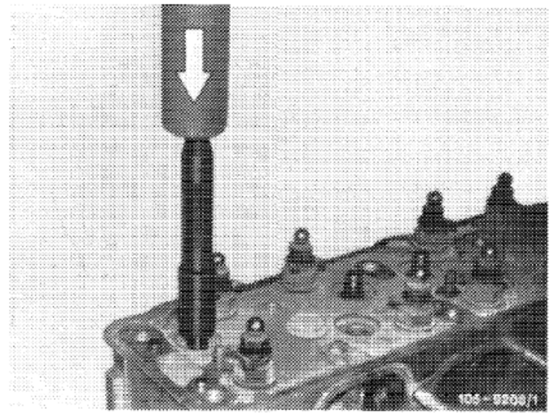
10 Undercool valve guide in liquid nitrogen (approx. 3 minutes) and insert.

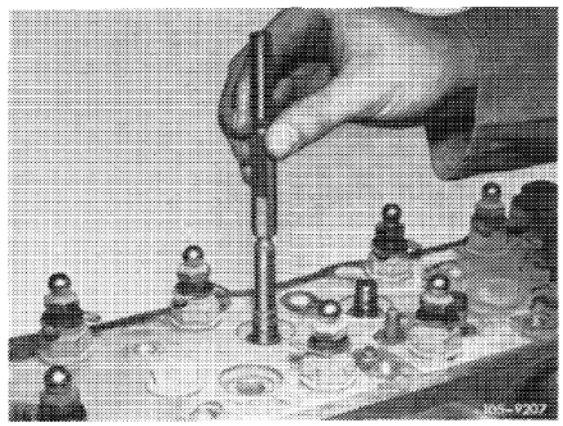
If no liquid nitrogen is available, heat cylinder head in a water bath to approx. 80 °C. Coat valve guide with tallow or oil and knock-in with knocking-in mandrel until the circlip rests against cylinder head.

11 Check valve guide for firm seat with cylinder head cooled down.

12 Check ID of valve guide by means of plug gauge.

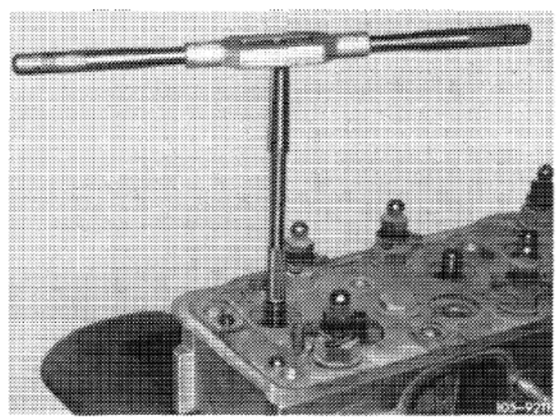
The "go" end should completely slip in.





13 If required, ream ID with reamer.

14 Check valve seats for runout and refinish, if required.

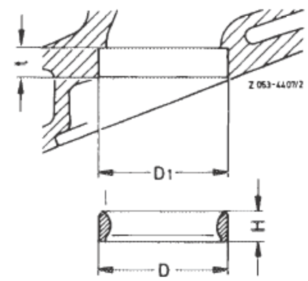


05–290 Renewal of valve seat rings

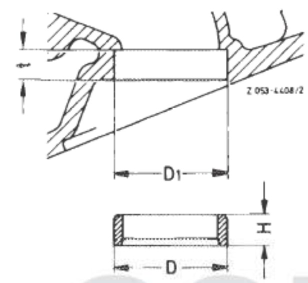
Engine 116.98, 117.98

Normal dimension D 1	intake	46.000–46.016
	exhaust	40.000–40.016
Normal dimension D	intake	46.090–46.100
	exhaust	40.090–40.100
Repair stage intake	D 1 max. up to	47.016
	D rough turning dimension	47.300
Repair stage exhaust	D 1 max. up to	40.016
	D rough turning dimension	40.300
t		10.300–10.800
H		10.390–10.500
Overlap of valve seat rings in cylinder head		0.074–0.100

intake



exhaust



Special tools

Plug gauge 9 mm dia. for intake valve guide	117 589 03 23 00
Plug gauge 11 mm dia. for exhaust valve guide	117 589 04 23 00

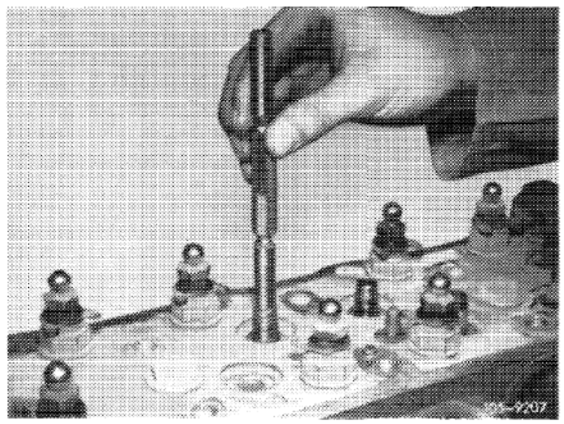
Conventional tools

Cylinder head clamping device	e.g. Rothenberger, D–6233 Kelkheim, order no. 29900
Ring seat machining tool	e.g. Hunger, D–8000 München, size 2, order no. 220.03.110
Valve seat machining tool	e.g. Hunger, D–8000 München, type VDSNL 1/45/30, order no. 236.03.308
Test set for valve seats	e.g. Hunger, D–8000 München, order no. 216.93.300
Internal measuring instrument (measuring range 25–60 mm)	e.g. Mahr, D–7300 Esslingen, order no. 844
External micrometer (measuring range 25–50 mm)	e.g. Mahr, D–7300 Esslingen, order no. 40 S

Renewal

1 Remove old valve seat ring by means of ring seat machining tool.

2 Check valve guides and replace, if required (05–285).



3 Measure basic bore D 1.

A new valve seat ring **standard dimension** can be used when the specified overlap is available.

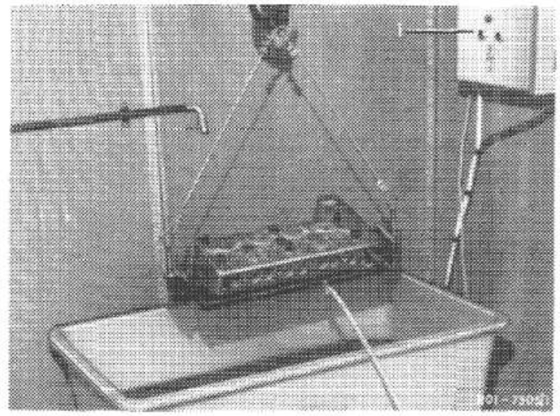
4 Machine basic bore repair stage D 1 with ring seat machining tool to the extent that the bore is just clean.

5 Measure machined basic bore.

6 Machine valve seat ring repair stage in such a manner that the specified overlap is established.

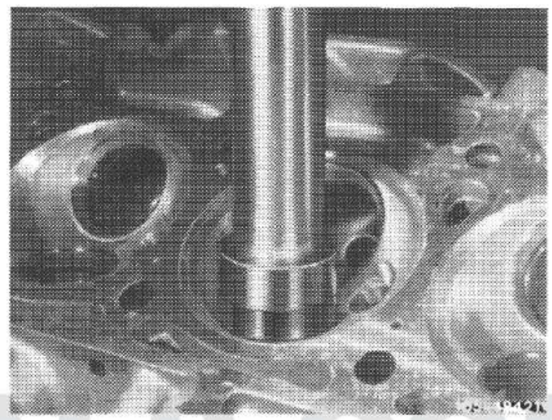
7 Heat cylinder head in water bath.

8 Undercool valve seat ring with liquid nitrogen.



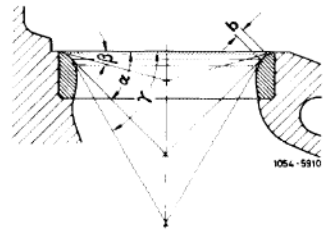
9 Nock-in valve seat ring with suitable punch.

10 Machine valve seat (05–291).



05–291 Machining valve seat

Data	Intake		Exhaust
Valve seat width b	1.3–2.0		1.5–2.0
Valve seat angle α		45°	
Correction angle top β		15°	
Correction angle bottom γ		60°	
Permissible runout of valve seat		0.04	



Special tools

Magnetic lift for valve cone half		116 589 06 63 00
Plug gauge 9 mm dia. for intake valve guides		117 589 03 23 00
Plug gauge 11 mm dia. for exhaust valve guides		117 589 04 23 00

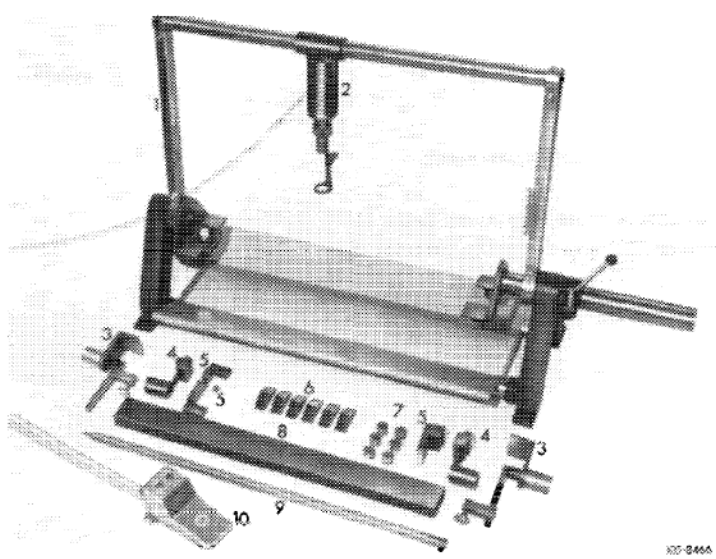
Conventional tools

Cylinder head clamping device	e.g. Rothenberger, D–6233 Kelkheim order No. 29900
Valve seat machining tool	e.g. Hunger, D–8000 München type VDSNL 1/45/30 order No. 236.03.308
Test set for valve seats	e.g. Hunger, D–8000 München order No. 216.93.300
60° correction tool bit No. 13 for correction angle, bottom	e.g. Hunger, D–8000 München order No. 216.64.622

Note

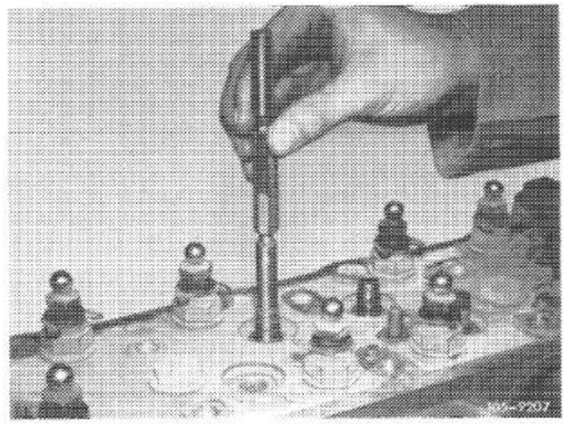
Clamp cylinder head for disassembly and machining into clamping device.

Refinish valve seats with valve seat machining tool, valve seat grinder or valve seat milling tool.



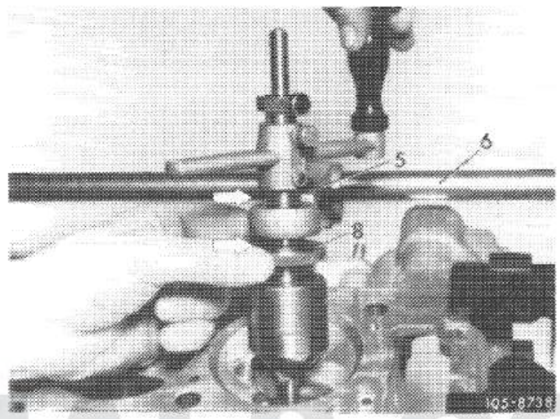
Machining valve seat

1 Check valve guides and renew, if required (05–285).

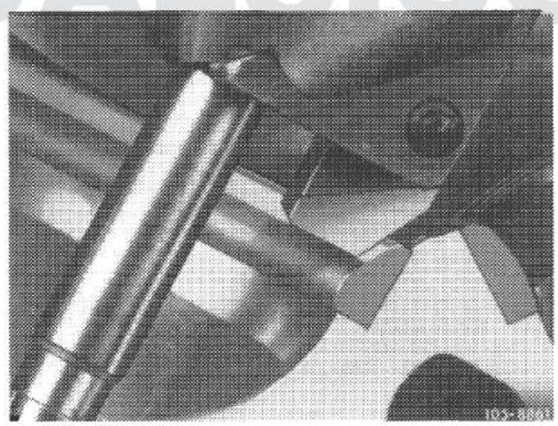


2 Machine valve seats (refer to operating instructions of tool manufacturer).

Attention!
Loosen pilot only after the runout of the valve seat has been checked (item 3).

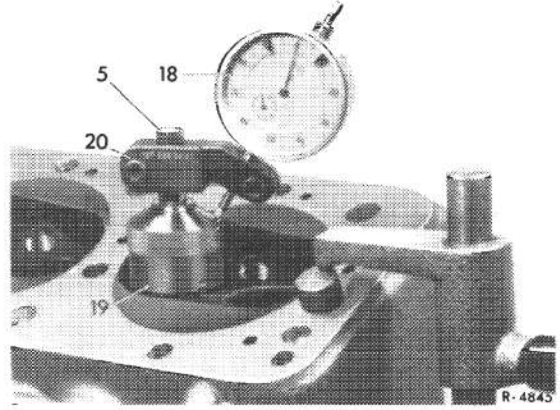


Attention!
Do not machine bead on lower portion of valve seat.



3 Check runout of valve seat.

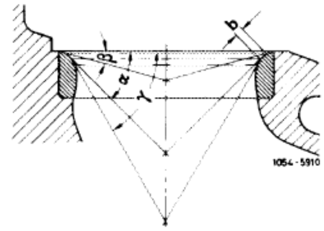
For this purpose, slip check sleeve (19) with dial gauge holder (20) and dial gauge on pilot (5).



5 Pilot
10 Dial gauge
19 Check sleeve
20 Dial gauge holder

4 Measure valve seat width "b" and correct to 15° at top and 60° at bottom, if required.

When machining with machining tool made by Hunger, use correction tool bit No. 13 for 60° bottom valve seat correction.

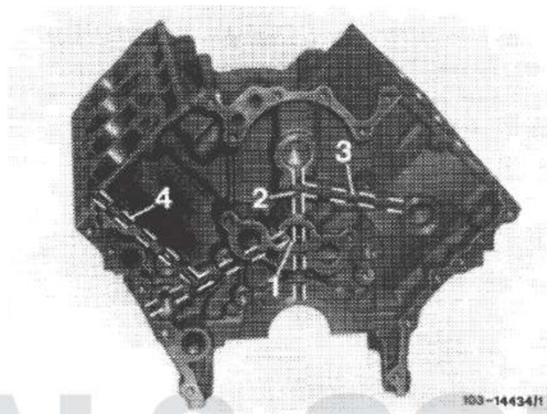


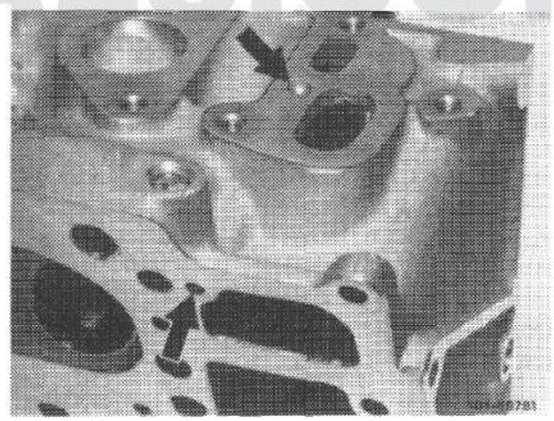
05–310 Removal and installation, inspection of chain tensioner

Tightening torques	Nm
Screws for chain tensioner on cylinder head	25
Coupling nut chain tensioner	90

Note

The hydraulic chain tensioner is provided with pressure oil by way of an oil duct (4) in cylinder crankcase front and in cylinder head (arrows).

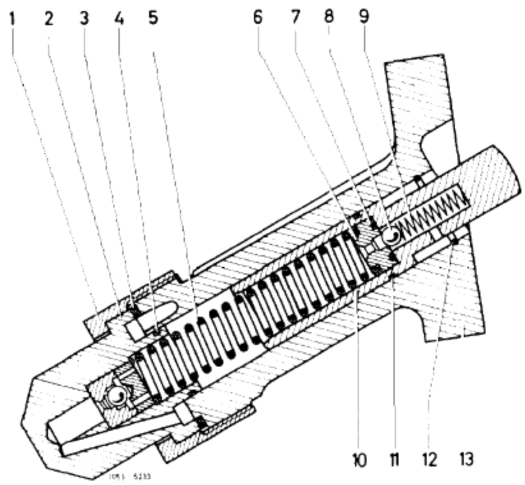




Since December 1974, the installed chain tensioner is provided with a venting bore for defoaming of the oil.

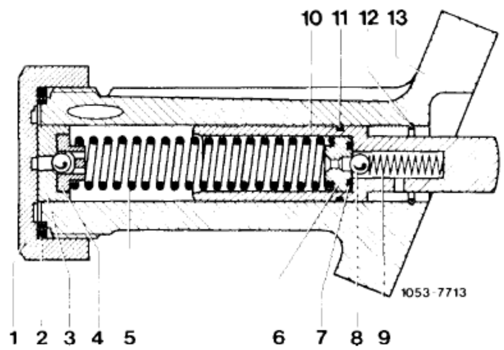
Venting proceeds when the oil pressure in engine oil circuit has been established and the chain tensioner is getting filled inside with oil.

If this chain tensioner is used in engines 116.980/981/990/991 and 117.981/984, the upper mounting bracket of the righthand engine shock absorber must be changed to the extent that it will not rest against closing cap (2) of chain tensioner.



1 Closing nut
2 Closing cap
3 Sealing ring
4 Sealing ring
5 Compression spring
6 Valve disc
7 Sealing ring
8 Ball
9 Compression spring
10 Pressure bolt
11 Sealing ring
12 Circlip
13 Housing

Since June 1977, a chain tensioner with aluminum housing has been occasionally installed. This chain tensioner can be exchanged for chain tensioner used up to now, but cannot be disassembled.



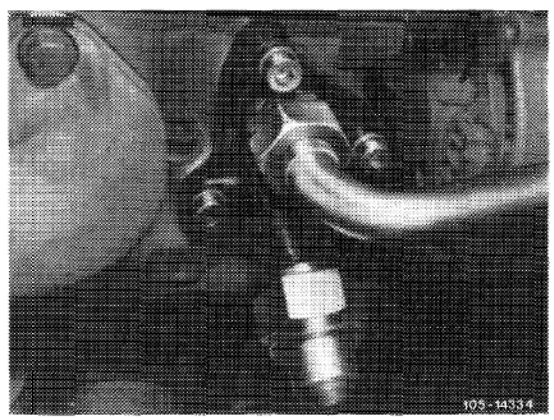
1 Closing cap
2 Sealing ring
3 Valve seat
4 Valve disc and ball
5 Compression spring
6 Valve disc
7 Sealing ring
8 Ball
9 Compression spring
10 Thrust bolt
11 Sealing ring
12 Circlip
13 Housing

Removal

1 Unscrew two fastening screws and remove chain tensioner.

Chain tensioners for engines with air injection for exhaust emission control are screwed-on with 3 fastening screws. In addition, the pipeline must be disconnected.

On engine 117.985 (USA) remove exhaust manifold and catalyst at the right.



Checking and installing

Place chain tensioner into a vessel filled with engine oil. The chain tensioner should be positioned vertically in downward direction, and should rest in oil at least up to flange. By actuating pressure pin (10), the chain tensioner will be filled with oil and simultaneously vented.

After filling and venting, the chain tensioner should permit compression only very slowly, uniformly and at considerable force.

2 Mount chain tensioner with new gasket and tighten screws uniformly.

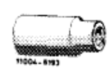
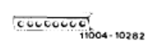
Pressure pin of chain tensioner should rest against lug of tensioning rail.

05–320 Renewing timing chain

Valve clearance	with engine cold (approx. 20 °C)	with engine warm (60 °C ± 15 °C)
Intake	0.10[1)]	0.15[1)]
Exhaust	0.20	0.25

1) 0.05 mm higher during lasting outside temperatures below −20 °C.

Tightening torques	Nm
Fastening screw for camshaft sprocket	100
Bolts for cylinder head cover	3
Valve adjusting screws	20–40

Special tools		
Valve spring depressor		123 589 03 61 00
Socket 27 mm, 1/2" square for rotating engine		001 589 65 09 00
Square drive socket 1/2", 80 mm long for rotating engine		617 589 00 16 00
Valve adjusting wrench 17 mm		116 589 02 01 00

Note

For repairs, a repair chain with plug link is available.

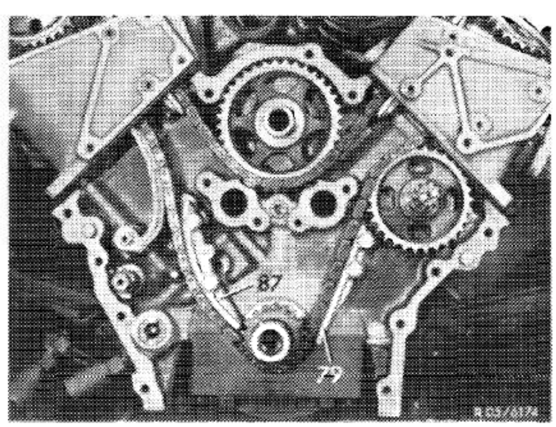
If only an endless timing chain is available, chain can be split by cutting **both bolts of one link** with a grinding wheel and mounting chain with a plug link.

An endless timing chain can be mounted with timing housing cover removed.

Check sprockets for score marks and pitting.

Repair chain with plug link.

Engine 116: 186 links, part No. 000 997 75 94
Engine 117: 198 links, part No. 000 997 76 94



Renewal

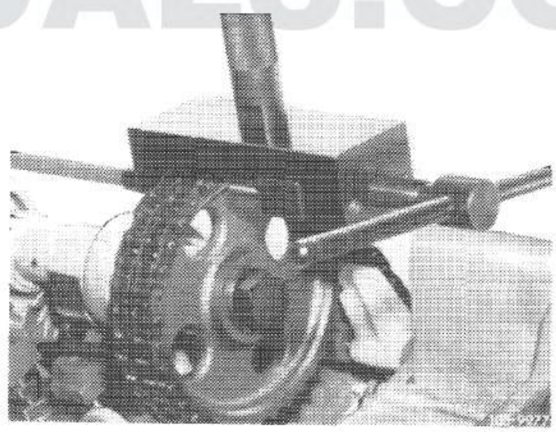
1 Remove spark plugs.

2 Remove rocker arms on righthand camshaft (05–230).

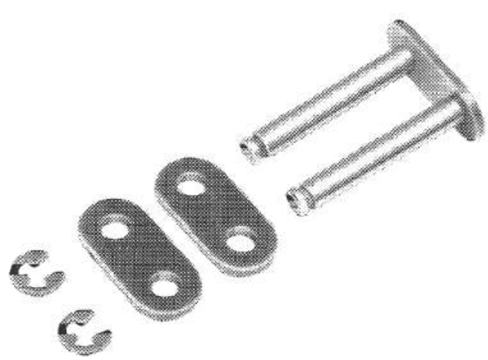
Attention!
Install rocker arms again at the same spot.

3 Remove chain tensioner (05–310).

4 Cover chain box with rags and cut timing chain with a chain cutter or grind up both bolts of one link.

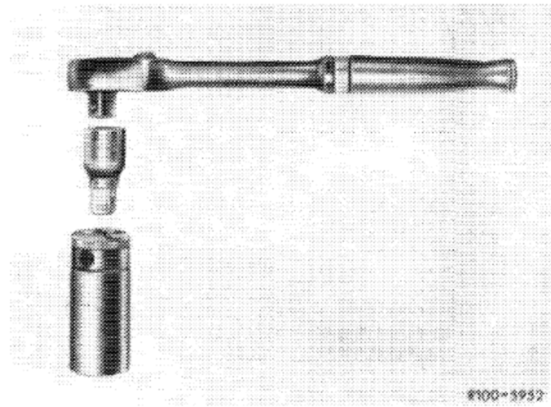


5 Attach new timing chain with a plug link to old timing chain while removing cut-up link.



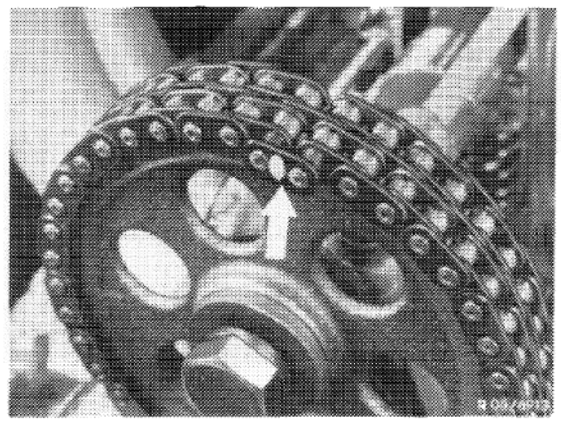
105-9259

6 Rotate crankshaft with tool combination slowly in direction of rotation of engine while simultaneously pulling up the old chain until the plug link comes to rest against top spot of righthand camshaft sprocket.



Attention!
While turning on both camshaft sprockets, the timing chain should always remain in mesh.

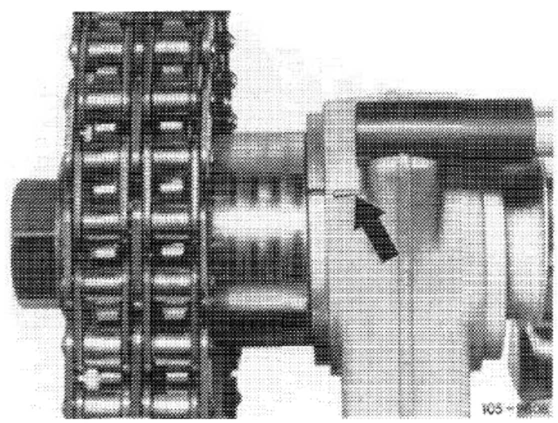
7 Disconnect old timing chain and connect the ends of the new timing chain with a plug link.



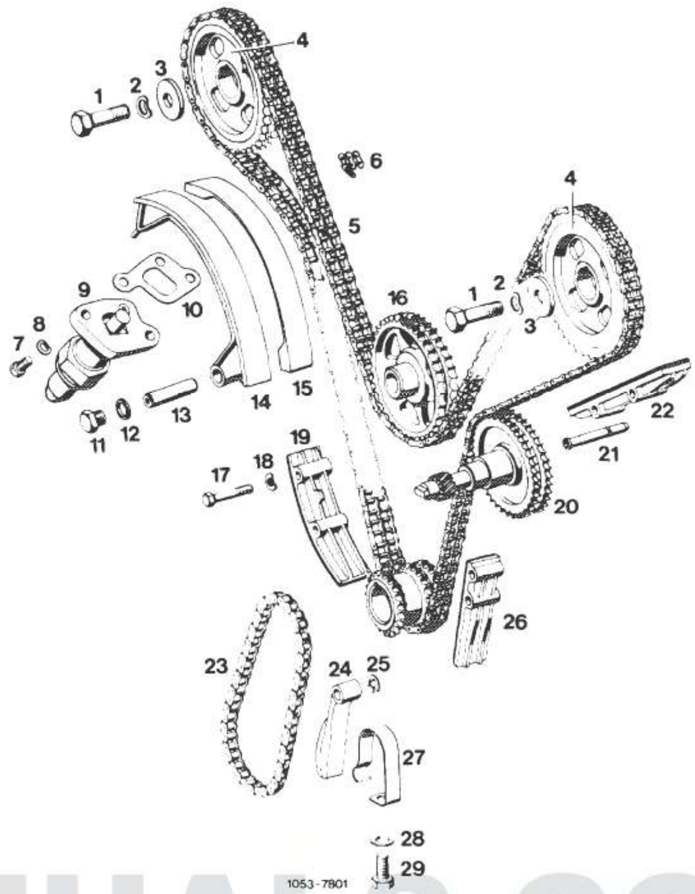
8 Place engine on ignition TDC of 1st cylinder.

Check timing, if the markings (arrow) are not accurately in alignment (05–215).

9 Complete engine assembly.



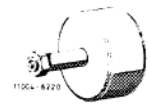
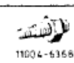
1 Screw M 14 x 1.5 x 40
2 Spring washer B 14
3 Washer
4 Camshaft sprocket
5 Double roller chain
6 Plug link for repairs
7 Screw M 8
8 Spring washer
9 Chain tensioner
10 Gasket
11 Closing plug M 14 x 1.5
12 Sealing ring
13 Bearing pin
14 Tensioning rail
15 Lining
16 Guide wheel
17 Screw M 8 x 38
18 Spring washer
19 Slide rail, curved
20 Drive sprocket ignition distributor
21 Bearing pin
22 Slide rail
23 Single roller chain oil pump
24 Clamp
25 Lock washer
26 Slide rail in cylinder crankcase
27 Tensioning spring
28 Washer
29 Screw M 8 x 30



05–330 Removal and installation of tensioning rail

Tightening torques	Nm
Bolts for cylinder head cover	3
Screw for camshaft sprocket	100

Special tools

Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt M 6 x 50		116 589 01 34 00

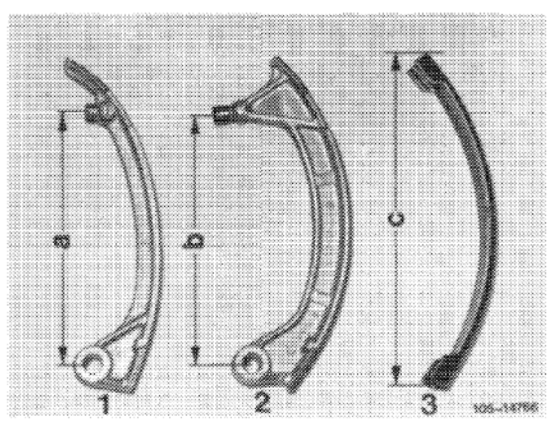
Note

The timing chain is guided in cylinder crankcase by 2 slide rails and tensioned by means of chain tensioner and a tensioning rail.

The tensioning rail is guided by a bolt which is floatingly supported in cylinder crankcase and in timing housing cover.

The tensioning rails of engines 116.98 and 117.98 are of different length and differ in shape from those of light alloy engines.

Coating (3) of tensioning rails of all engines 116 and 117 can be replaced in the event of repairs.



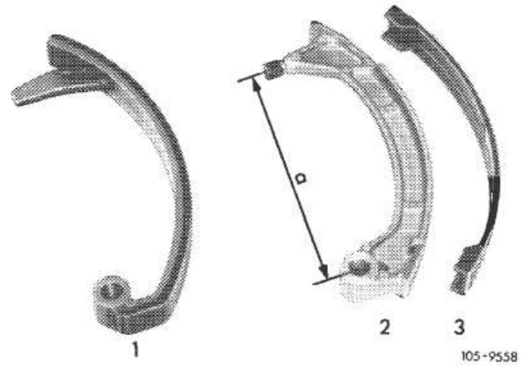
1 Tensioning rail
engine 116.96 117.96
a = 133 mm 160 mm
2 Tensioning rail
engine 116.98 117.98
b = 133 mm 161.5 mm
3 Coating
engine 116 117
c = 184 mm 208 mm

Note

The steel tensioning rail (1) can be exchanged for aluminum tensioning rail (2).

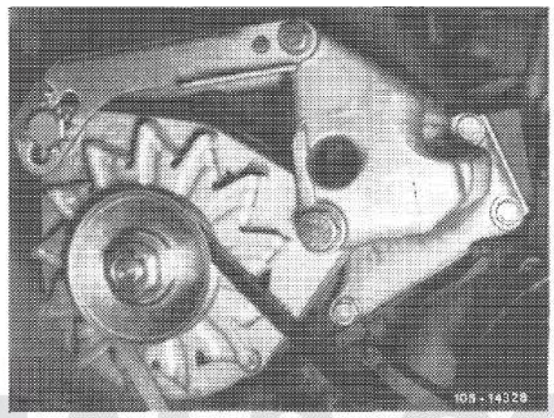
The plastic lining (3) on aluminum tensioning rail (2) is replaceable.

Engine 116 dimension a = 133 mm
Engine 117 dimension a = 161.5 mm



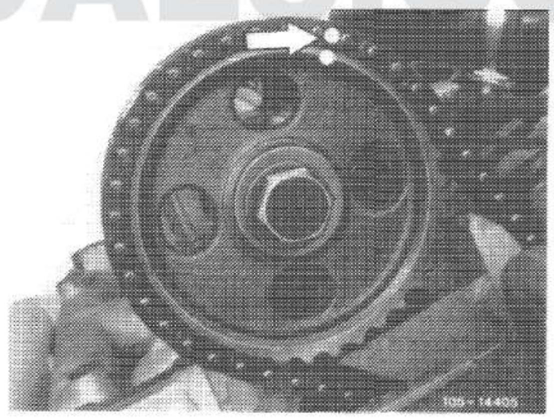
Removal

1 On engines with aluminum tensioning rail, remove alternator with mounting bracket and remove slide rail in righthand cylinder head.

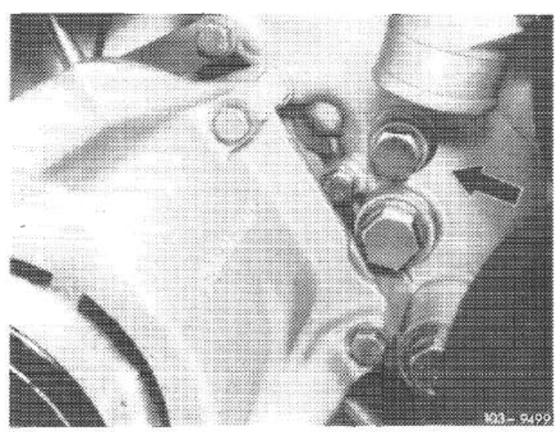


2 Mark righthand camshaft sprocket and timing chain together with paint.

3 Remove righthand camshaft gear.

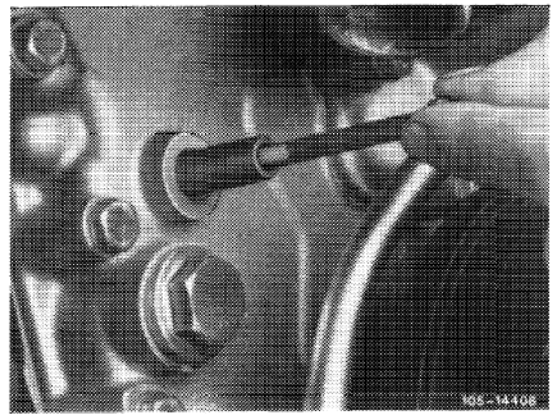


4 Unscrew closing plug (arrow).

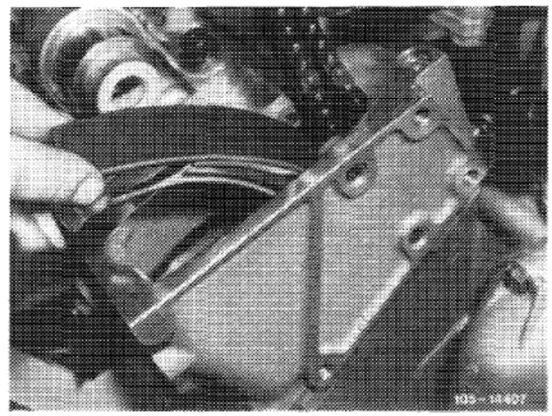


Engine 117 (USA)

5 Pull out bearing bolt of tensioning rail with M 6 screw.



6 Remove tensioning rail.

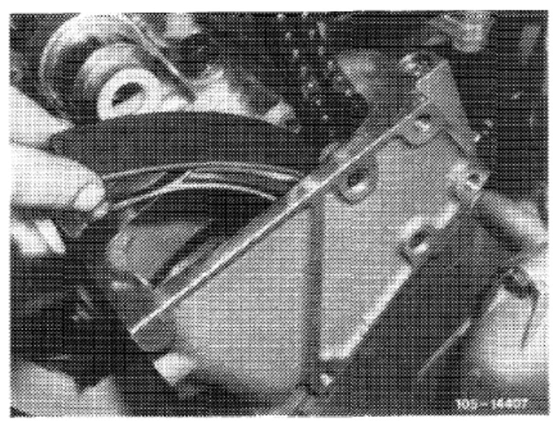


Installation

7 Introduce tensioning rails between timing housing cover and timing chain.

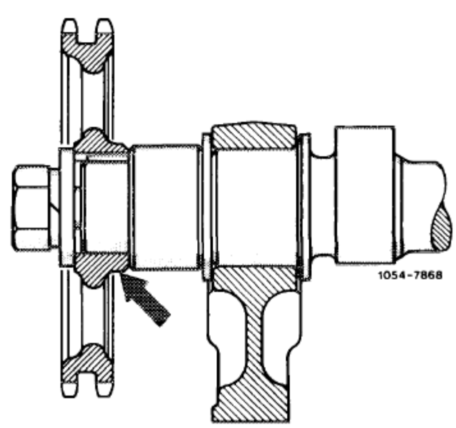
8 Introduce bearing bolt and knock-in up to stop.

9 Mount closing plug with sealing ring.



8 Mount camshaft sprocket in such a manner that the collar on camshaft sprocket (arrow) points in direction of camshaft.

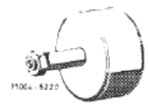
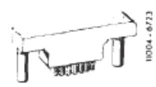
9 For further installation proceed vice versa.



05–340 Removal and installation of slide rails

Tightening torques	Nm	(kpm)
Bolts for cylinder head cover	3	(0.3)
Necked-down screw on crankshaft front	270–330	(27–33)
Fastening screw for camshaft sprocket	100	(10)

Special tools

Impact puller for bearing bolt (basic unit)		116 589 20 33 00
Threaded bolt 6 x 50 mm		116 589 01 34 00
Detent (starter flange)		116 589 01 40 00
Torque wrench 150–500 Nm		001 589 31 21 00
Socket 27 mm, 1/2'' square		001 589 65 09 00

Conventional tool

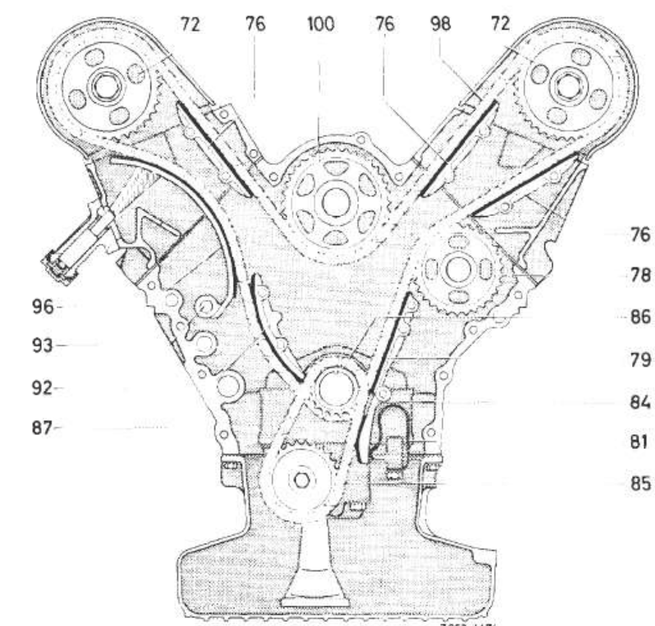
Connection 3/4'' square socket to 1/2'' square head	e.g. Hazet, D–5630 Remscheid order No. 1058 RI

Note

All slide rails in cylinder heads of all engines 116 are similar in design.

Slide rails in cylinder heads of all engines 117 are likewise identical.

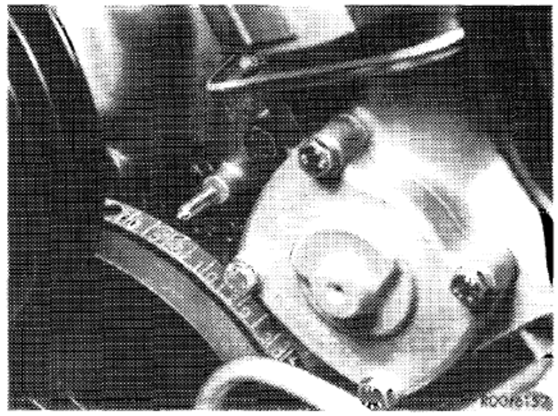
On the other hand, the pertinent bearing bolts of light alloy engines differ from those of gray iron engines in length.



Slide rails in cylinder head left inside and outside

1 Set piston of 1st cylinder to ignition TDC.

2 Remove ignition distributor (07.5–510).

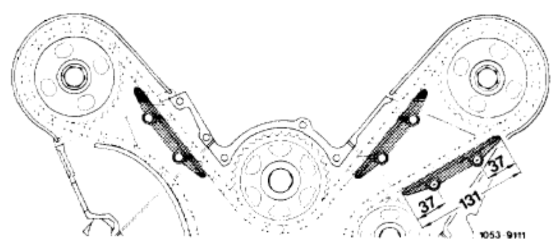


3 Remove power steering pump with mounting bracket.

4 Knock out bearing bolt with impact puller and remove slide rail.

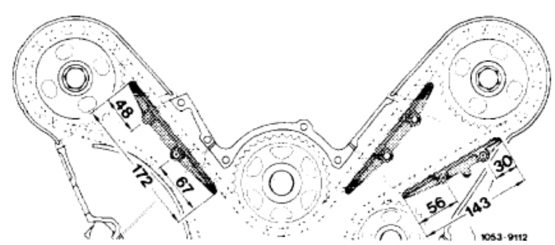
5 When installing slide rail, note the following:

Bearing bolts differ from those of gray iron engines.



Slide rail layout engine 116

Light alloy engines L = 46 mm
Gray iron engines L = 56 mm

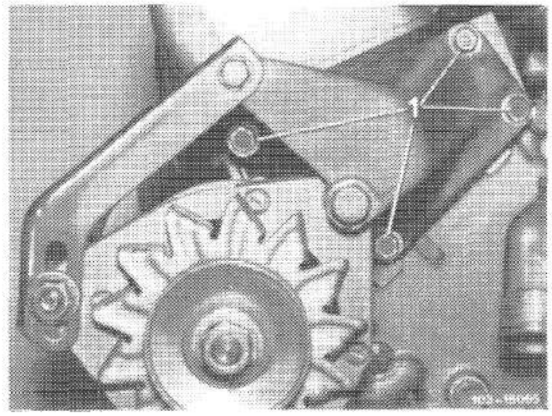


Slide rail layout engine 117

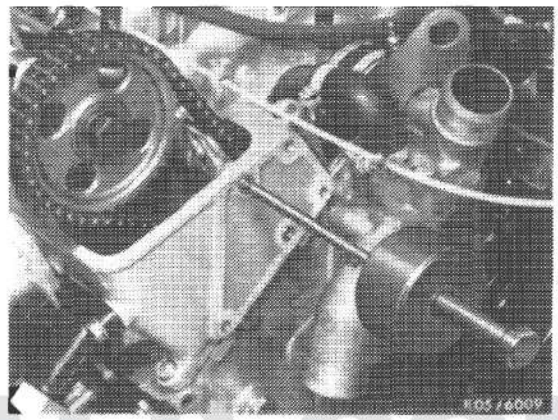
Light alloy engines L = 46 mm
Gray iron engines L = 56 mm

Slide rail in cylinder head right

1 Remove alternator with mounting bracket.



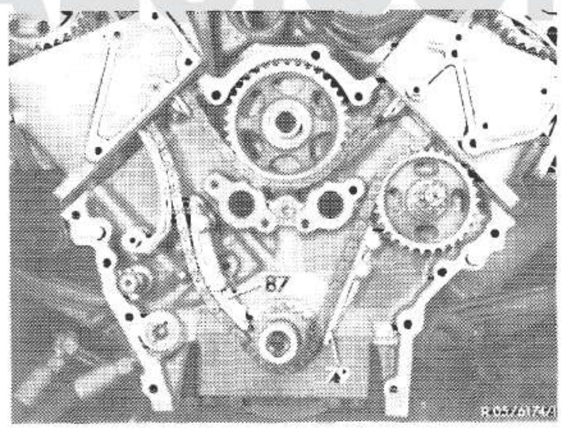
2 Knock out bearing bolt with impact puller and remove slide rail.



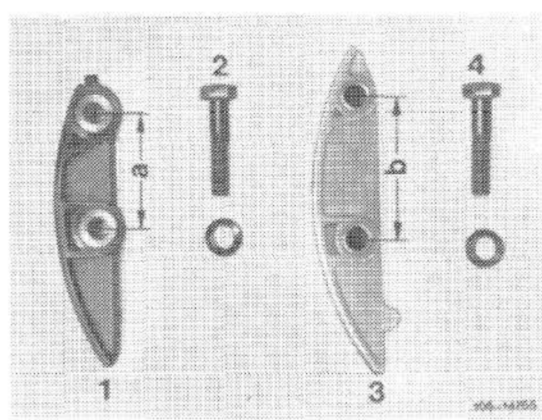
Slide rails in cylinder crankcase

1 Remove timing housing cover.

2 Unscrew slide rail (87 or 79).

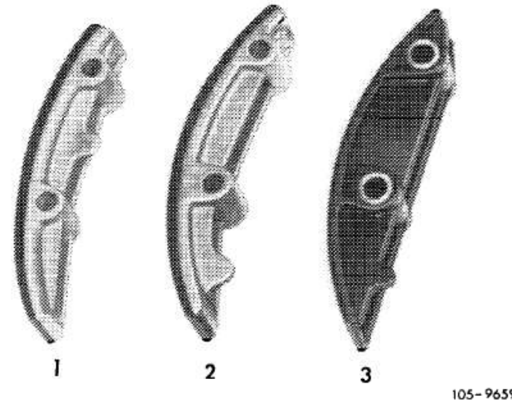


The two slide rails in cylinder crankcase differ from those of gray iron engines.



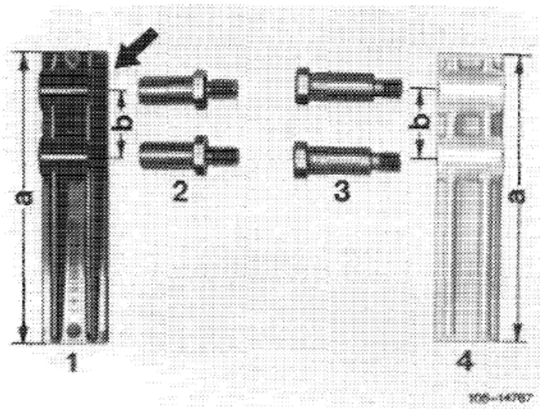
Engine 116.96, 117.96	Engine 116.98, 117.98
1 Slide rail	3 Slide rail
2 Screw M 8 x 40	4 Screw M 8 x 38
a 43.8 mm	b 55 mm

Attention!
If on engine 116.98 version 1 is exchanged for version 2 or 3, remove stop sleeve from chain tensioner 116 05 10 11.



1 Invalid slide rail
2 Former slide rail
3 New slide rail

The straight slide rail (1) in cylinder crankcase is unsymmetrical (arrow) and is plugged on bolts (2) screwed into cylinder crankcase.

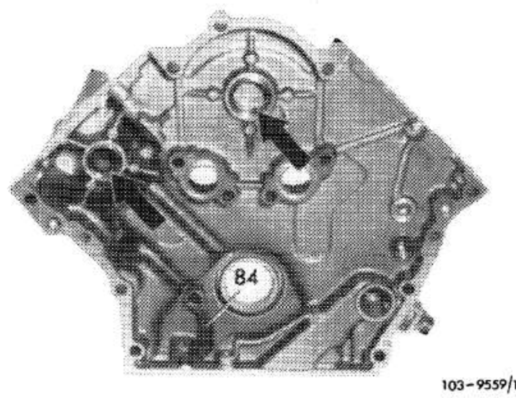


1, 2 Engine 116.96 and 117.96
3, 4 Engine 116.98 and 117.98
a 114 mm
b 26 mm

Tensioning clamp for oil pump chain

1 Remove timing housing cover.

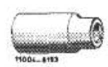
2 Remove lock and remove tensioning clamp (84).



05–434 Removal and installation of intermediate sprocket ignition distributor drive

Tightening torques	Nm
Screw on crankshaft front	270–330
Front screw for camshaft sprocket	100

Special tools

Torque wrench single arm, 3/4" square, 150–500 Nm		001 589 31 21 00
Socket 27 mm, 1/2" square		001 589 65 09 00
Detent (starter removed)		116 589 01 40 00
Screw driver with tommy handle 6 mm, 440 mm long		116 589 03 07 00
Sleeve for radial sealing ring front		110 589 07 61 00

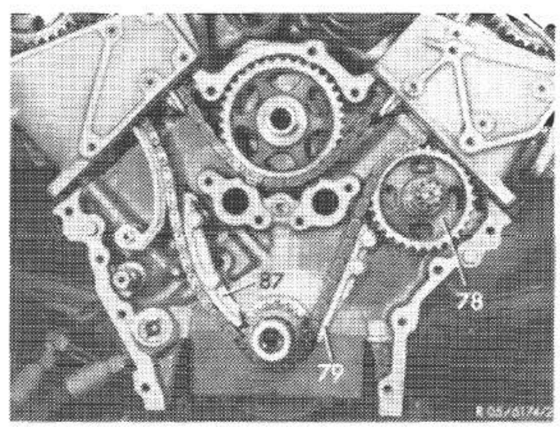
Conventional tool

Connection 3/4" square socket to 1/2" square head	e. g. made by Hazet, D–5630 Remscheid order No. 1058 Rl

Removal

1 Remove timing housing cover (01–210).

2 Remove slide rail (87).



78 Intermediate sprocket for ignition distributor drive

3 Slacken timing chain on intermediate sprocket by turning on lefthand camshaft.

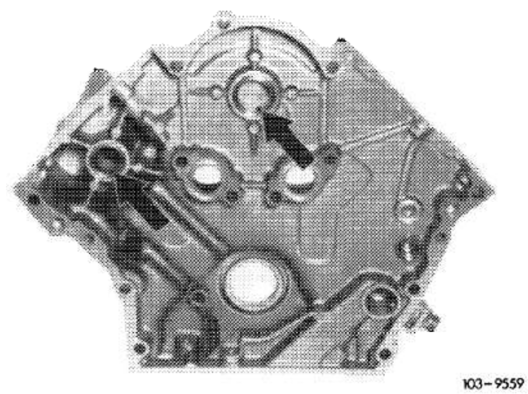
4 Remove intermediate sprocket.

5 Pull out bearing bushing in cylinder crankcase and in timing housing cover by means of internal puller.

Installation

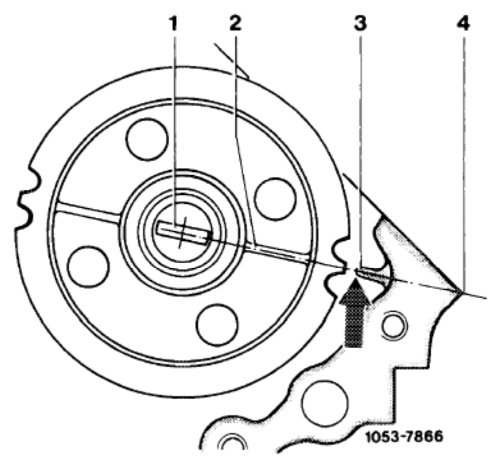
6 Press bearing bushing into cylinder crankcase and into timing housing cover so that the lubricating groove (arrow) comes to rest in downward position.

7 Provide bearing bushing with oil and introduce intermediate sprocket.



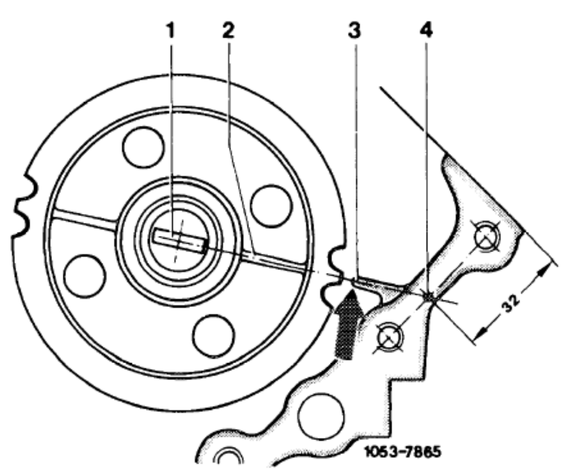
8 Set crankshaft to ignition TDC.

Attention!
At ignition TDC position of 1st cylinder, the intermediate sprocket should be positioned in such a manner that the applied markings on intermediate sprocket and on cylinder crankcase are in alignment (arrow).



Engine 116

1 Driver
2 Mark on intermediate sprocket
3 Mark on crankcase
4 Reference point for crankcase without mark



Engine 117

9 Check position of intermediate sprocket and correct, if required.

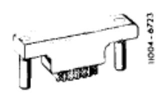
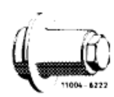
Marks (arrows) should be in alignment, if not, the ignition distributor on engines with breakerless controlled ignition system cannot be installed with the required adjustability.

10 For further installation proceed vice versa.

05–440 Removal and installation of guide sprocket

Tightening torque	Nm
Bolt on crankcase front	270–330

Special tools

Torque wrench single arm, 3/4" square, 150–500 Nm		001 589 31 21 00
Socket 27 mm, 1/2" square		001 589 65 09 00
Detent (starter flange left or right)		116 589 01 40 00
Allen wrench 6 mm		116 589 03 07 00
Insertion bushing for radial sealing ring front		110 589 07 61 00

Conventional tool

Connection 3/4" square socket to 1/2" square head	e.g. Hazet, D-5630 Remscheid order No. 1058 RI

Removal

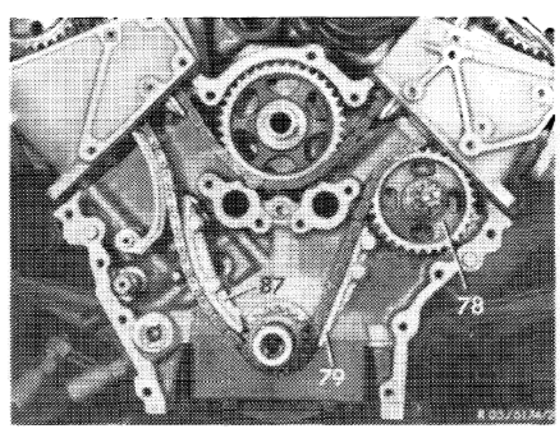
1 Remove timing housing cover (01–210).

2 Remove slide rail (87).

3 Slacken timing chain on intermediate sprocket (78) by turning on lefthand camshaft.

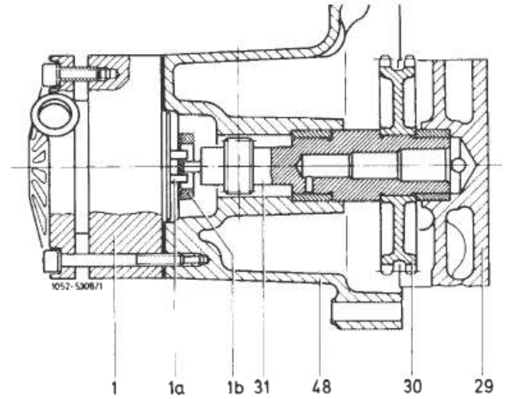
4 Remove intermediate sprocket (78).

5 Remove guide sprocket.



6 Pull off bearing bushing in cylinder crankcase by means of internal puller, if required.

7 Pull out guide bushing in timing housing cover by means of internal puller.



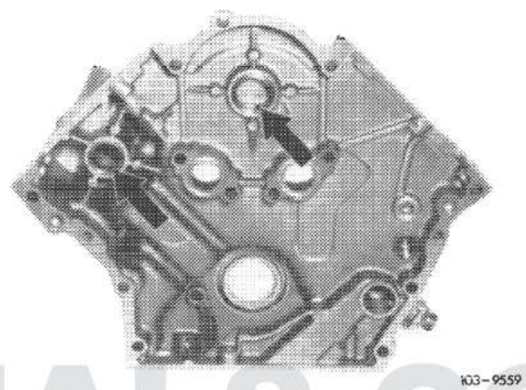
Installation

8 Press bearing bushing into cylinder crankcase and timing housing cover in such a manner that the lubrication groove is at bottom (arrow).

9 Provide bearing bushing in cylinder crankcase with oil and introduce guide sprocket.

10 Install intermediate sprocket (05–434).

11 For further installation proceed vice versa.



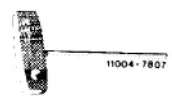
07.3–100 Adjustment of idle speed

A. Standard version

Testing and adjusting data

Idle speed	700–750/min
Idle speed emission value	0.5–1.5 % CO

Special tools

Screwdriver 3 mm with tommy handle for regulating idle speed emission value		000 589 14 11 00
Oil telethermometer		116 589 27 21 00

Conventional tools

CO-measuring instrument, revolution counter (speedometer)	
Digital tester	e.g. Bosch, MOT 001.03

Note

Do not adjust idle speed when engine is too hot, e.g. immediately following a fast ride or after measuring output on output dynamometer.

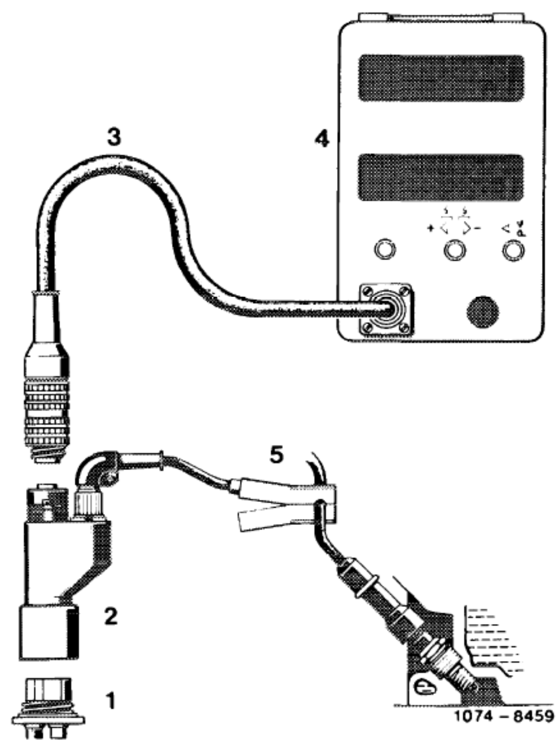
Adjustment

1 Switch off air-conditioner or automatic climate control. Move selector lever into position "P".

2 Remove air filter.

3 Connect test instruments: Revolution counter, CO-measuring instrument, digital tester, oil telethermometer.

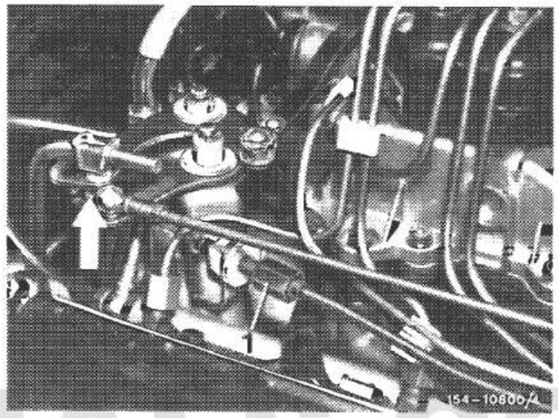
4 Run engine to operating temperature (75–85 °C engine oil temperature).



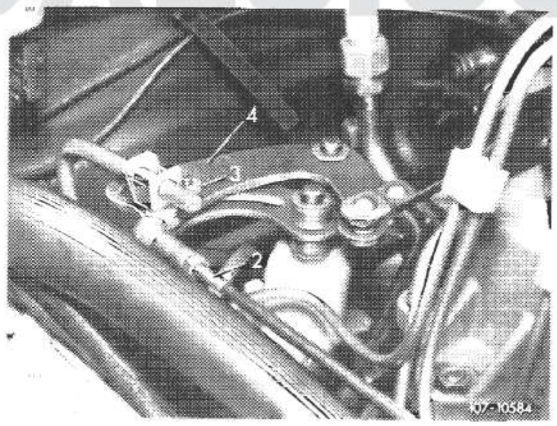
5 Check intake system for leaks. For this purpose, spray all seal points with Iso-Oktan DIN 51756 or benzine.

Attention!
Do not use conventional fuel for spraying (vapors dangerous to health), note inflammability and do not spray on red hot components or parts of ignition system.

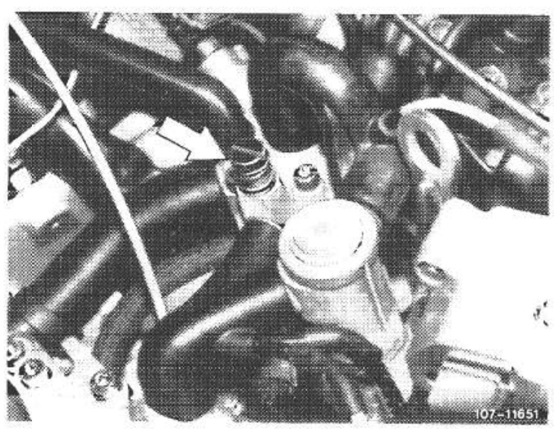
6 Check whether bowden wire for tempomat/cruise control rests free of tension against regulating lever (arrow). Set with adjusting nut (1), if required.



7 Check whether roller (3) in gate lever (4) rests free of tension against end stop. Adjust by means of connecting rod (2), if required.

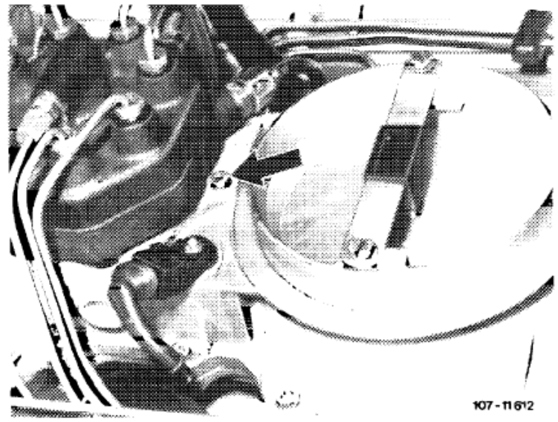


8 Adjust specified speed by means of idle speed air screw (arrow).



9 Adjust idle speed emission value. For this purpose, unscrew closing plug (arrow).

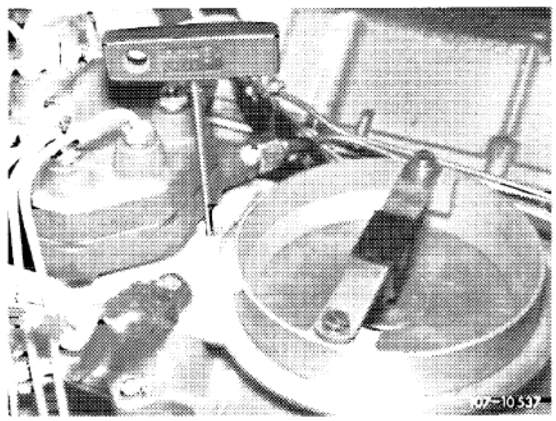
Attention!
On vehicles manufactured after October 1, 1976, remove safety plug first.



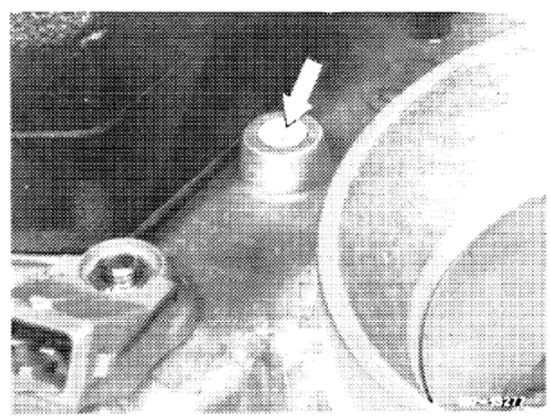
Insert screw driver through bore into socket on idle speed mixture control screw and adjust emission value by turning.

Turning counterclockwise = leaner
Turning clockwise = richer

Hold bore for closing plug closed. Accelerate for a short moment, check idle speed emission value and adjust, if required. Put back closing plug.



Following adjustment, on vehicles manufactured after October 1, 1976, install a blue safety plug (arrow) MB-part no. 000 997 56 86.



10 Mount air filter. Check idle speed and idle speed emission value once again, and adjust, if required.

11 Place selector lever into driving position, switch on air-conditioner, turn power steering to full lock with engine smoothly running. Adjust speed, if required.

B. National version (AUS) (J) (S) (USA)

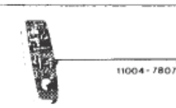
Identification: Information plate in respective language on cross member in front of radiator. Adjust engines according to data of respective emission control information plate.

Testing and adjusting data engine 117

Model year		Information plate	Idle speed 1/min	Idle speed emission value % CO without air injection	Idle speed emission value % CO with air injection
(AUS)					
1977		silver	750	0.2–2.0	–
1978–1980				1.0–2.5	–
(J)					
1976–1980		in Japanese language	700–800	0.2–1.5	–
(S)					
1976		blue	700–800	0.2–1.5	–
1977/78			750	0.2–2.0	–
1979/80				1.0–2.5	–
(USA)					
1976	Federal	black	700–800	0.2–1.5	–
	California	green			
1977	Federal	black	750	–	0.2–2.0
	California	yellow		0.2–2.0	–
	Federal high altitudes	red		–	0.2–1.2
1978/79	Federal	black		–	0.5–2.0
	California	yellow		0.5–2.0	–
1980[1)]	Federal and California	black	650 ± 50	–	0.5–1.5

[1)] Tourist version model 107 only. These vehicles are provided without catalysts and without O_2 probe ex factory.

Special tools

Screw driver with tommy handle for adjsuting idle speed emission value		000 589 14 11 00

Oil telethermometer		116 589 27 21 00

Conventional tools

CO-measuring instrument, revolution counter (speedometer)	
Digital tester	e.g. Bosch, MOT 001.03

Note

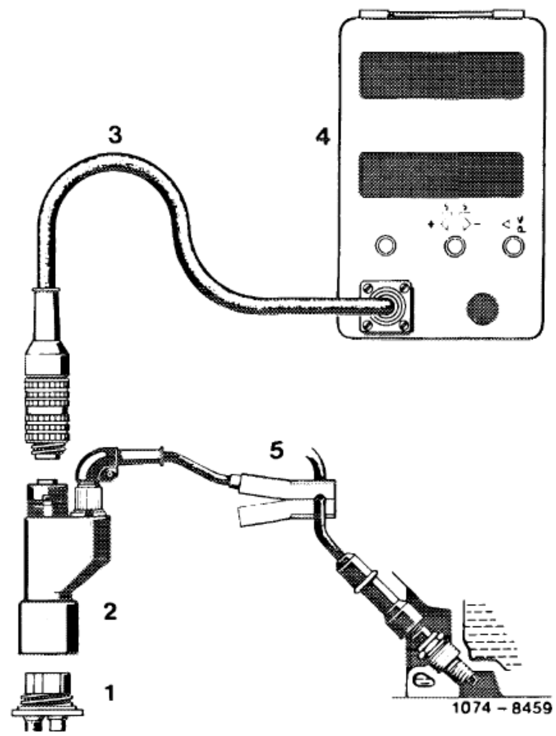
Do not adjust idle speed when engine is too hot, e. g. immediately after a fast drive or after measuring output on output dynamometer.

Adjustment

1 Switch off air-conditioner or automatic climate control. Move selector lever into position "P".

2 Remove air cleaner.

3 Connect test instruments: Revolution counter CO-measuring instrument, digital tester, oil telethermometer.

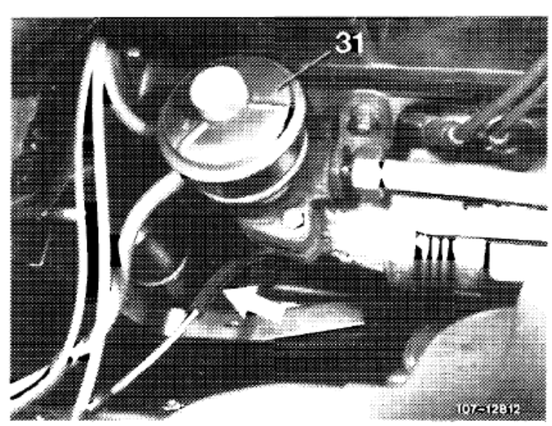


Connecting CO-measuring instrument

For this purpose, on (J) (USA) starting 1977, pull off connecting hose (arrow) at measuring point (exhaust backpressure line).

Connect CO-measuring instrument and exhaust backpressure line by means of a hose.

USA tourist vehicles outside the USA have no catalyst installed, the emission value can therefore be measured at exhaust end pipe.

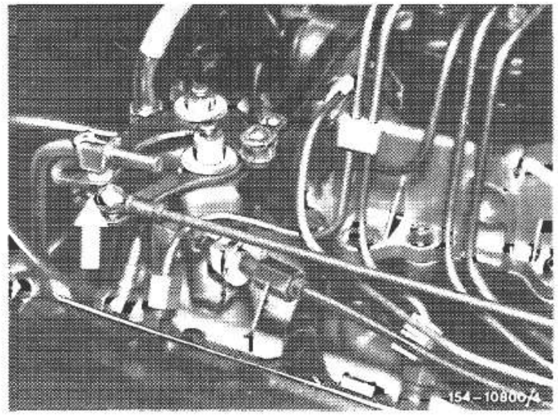


4 Run engine to operating temperature (75–85 °C engine oil temperature).

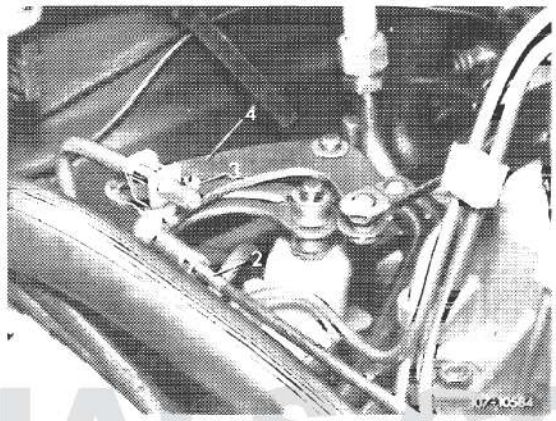
5 Check intake system for leaks. For this purpose, spray all sealed points with Iso-Oktan DIN 51756 or benzine.

Attention!
For spraying, do not use conventional fuel (unhealthy vapors). Pay attention to inflammability and do not spray on red hot components or parts of ignition system.

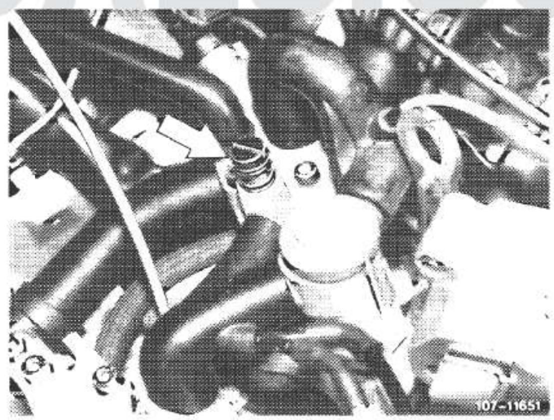
6 Check whether bowden wire for tempomat/cruise control rests free of tension against regulating lever (arrow). Adjust with adjusting screw (1), if required.



7 Check whether roller (3) in gate lever (4) rests free of tension against end stop. Adjust with connecting rod (2), if required.



8 Set to specified speed by means of idle speed adjusting screw (arrow).

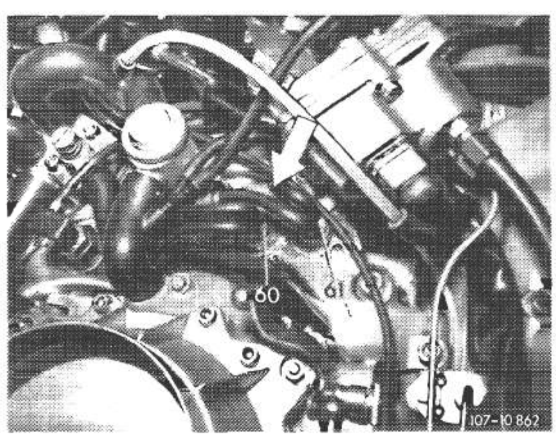


9 Check idle speed emission value.

(AUS) 1977, (J) starting 1976, (S) 1976/77, (USA) starting 1976

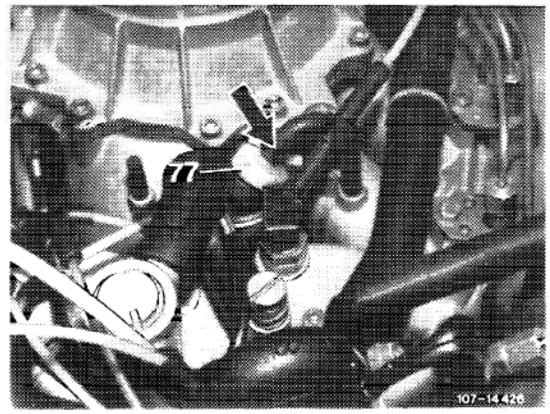
Check idle speed emission value **without air injection.** For this purpose, pull blue/violet vacuum line (arrow) from blue thermovalve (61) and close connection on thermovalve. Thus the air injection is switched off.

(USA) Federal and Federal high altitudes, check idle speed emission value **with** air injection (self-aspirating).

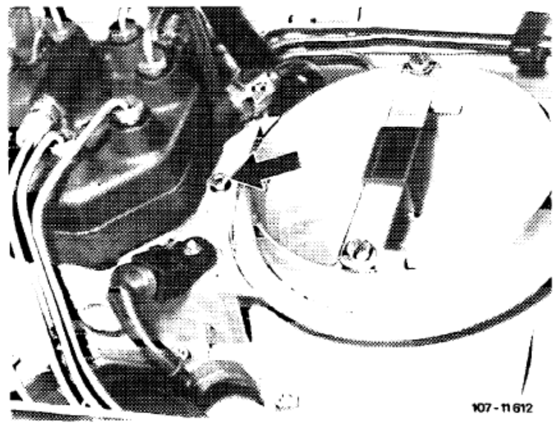


(AUS) starting 1978, (S) starting 1978

Check idle speed emission value **without** air injection. For this purpose, pull vacuum hose (arrow) from retarder valve (77) and close hose. This will shut off the air injection.



10 **Adjust idle speed emission value.** For this purpose, unscrew closing plug (arrow).



Insert allen wrench through bore into socket of idle speed mixture regulating screw and set emission value by turning screw.

Turning counterclockwise = leaner
Turning clockwise = richer

Close bore for closing plug. Accelerate for a short moment and check idle speed emission value once again or adjust, if required. Put back closing plug.

Plug back vacuum lines with (USA) version on thermo-valve, with (AUS) version at time-delay valve.

Check idle speed emission value once again (air injection in operation). The idle speed emission value should be **below** previously set value.

11 Mount air cleaner. Check idle speed and idle speed emission value once again and adjust, if required.

12 Place selector lever into driving position, switch on air-conditioner, turn power steering to full lock, engine should run smoothly. Adjust speed, if required.

07.3–105 Checking, adjusting on-off ratio

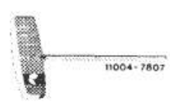
National version (USA)

Identification: Information label in national language on cross member in front of radiator. Adjust engines according to data of respective emission information label.

Testing and adjusting values

Engine	Idle speed 1/min	On-off ratio in % Adjusting value	controlled	fixed
(USA) 1980 Identification: Black information label.				
117	650 ± 50	50 ± 10	40–60	50/50

Special tools

Oil telethermomenter		116 589 27 21 00
Puller for safety plug		123 589 05 33 00
Installer for safety plug		123 589 00 15 00
Screwdriver 3 mm with tommy handle for adjusting idle speed emisssion value		000 589 14 11 00

Conventional testers

Revolution counter	
Digital tester	e.g. Bosch, MOT 001.03
Lambda control tester KDJE–P 600	e.g. Bosch

Adjusting

1 Connect digital tester or revolution counter, oil telethermometer and lambda control tester.

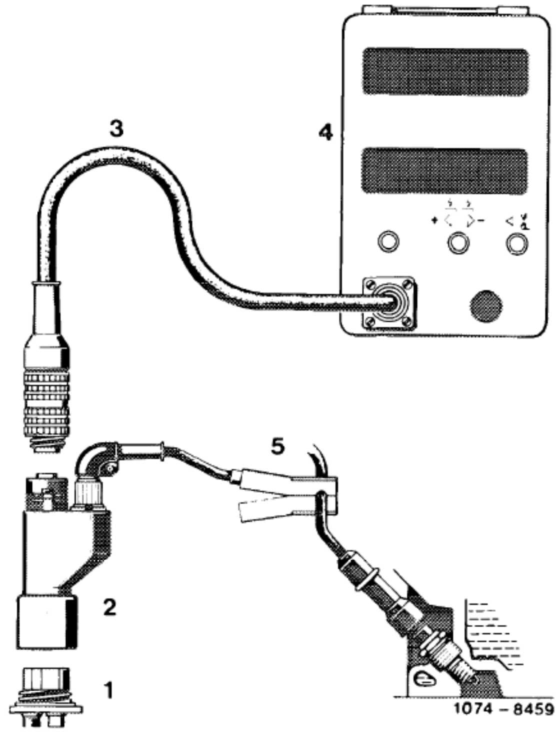
2 Switch off air conditioning or automatic climate control. Move selector lever into position "P".

3 Run engine to 75–85 °C oil temperature.

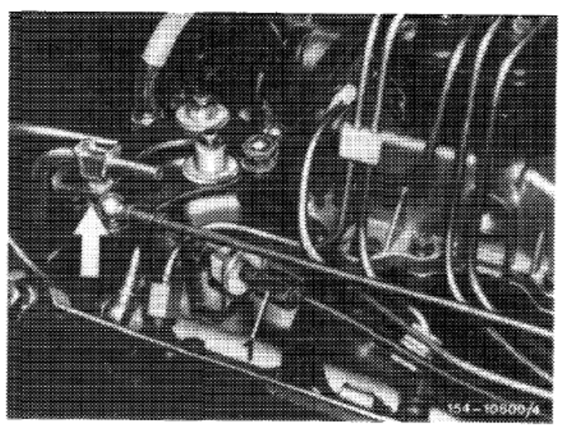
4 Check whether throttle valve lever rests against idle speed stop.

5 Check intake system f›r leaks. For this purpose, spray all sealing points with Iso-Oktan DIN 51756 or benzine.

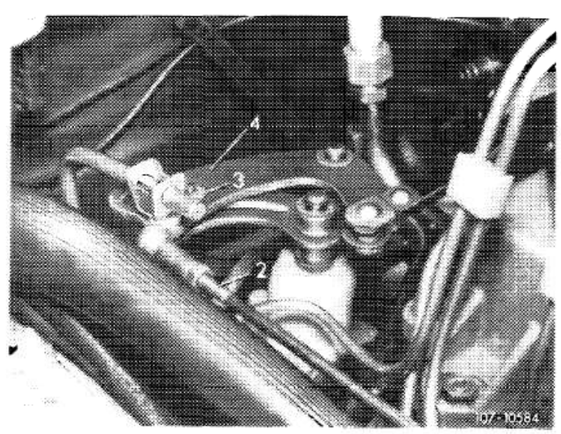
Attention!
Do not use conventional fuel for spraying (unhealthy vapors). Pay attention to fire hazard and do not spray on red-hot parts or parts of ignition system.



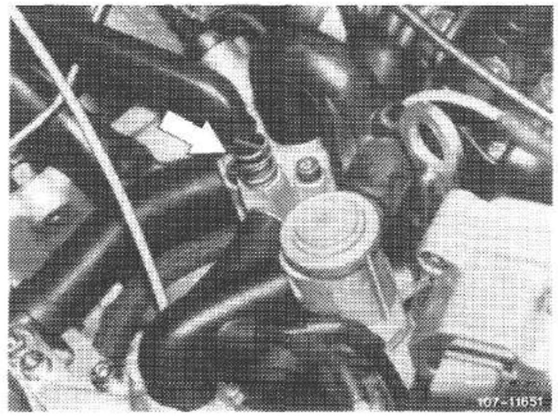
Check whether Bowden wire for cruise control/Tempomat rests free of tension against regulating lever (arrow). Adjust by means of adjusting nut (1), if required.



7 Check whether roller (3) in slotted lever (4) rests free of tension against end stop. Adjust by means of connecting rod (2), if required.



8 Run engine at idle, switch off all electric additional consumers. Adjust an idle speed of 650 ± 50/min by means of idle speed air screw (arrow).



9 Check on-off ratio and adjust, if required.

Note: For adjusting on-off ratio at idle the air cleaner need not be removed.

Read on-off ratio at tester, if value is between 40–60 the on-off ratio is in order. If not, pull out safety plug (4) with puller.

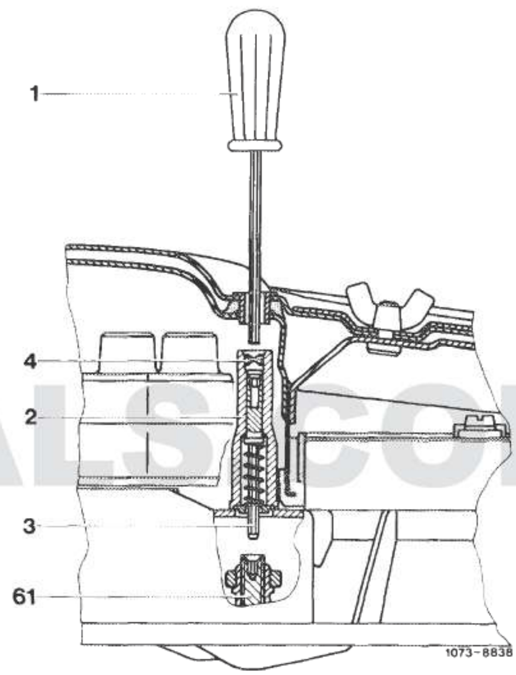
Push with screwdriver (1) through cutout in air cleaner top against adjuster (2). Push adjuster down with screwdriver against spring force, turn slightly until hexagon (3) engages in mixture control screw (61).

Turning counterclockwise	=	60 % (leaner)
Turning clockwise	=	40 % (richer)

Release screwdriver, compression spring will release adjusting device from mixture control screw.

Accelerate shortly and check on-off ratio, readjust if required.

Following adjustment, install a blue safety plug (4), part No. 000 997 56 86 by means of installer.



10 Engage selector lever in driving position, switch on air conditioning, turn power steering to full lock, engine should run smoothly. Readjust engine speed, if required.

07.3–110 Checking, regulating engine

A. Standard version

Testing and adjusting data

Idle speed	700–750/min
Idle speed emission value	0.5–1.5 % CO

Battery voltages

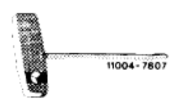
Rest potential	12.2 volts
Starting voltage min.	10 volts

Voltages at ignition coil (with engine stopped and ignition switched on)

Transistorized ignition system TSZ 4

Voltage on terminal 15	approx. 4.5 volts
Voltage on terminal 1	0.5–2.0 volts
Series resistor bypass (when starting)	10 volts

Special tools

Screwdriver 3 mm with tommy handle for adjusting idle speed emission value		000 589 14 11 00
Oil telethermometer		116 589 27 21 00

Conventional tools

CO-measuring instrument, revolution counter (speedometer), stroboscope, oscilloscope	
Digital tester	e.g. Bosch, MOT 001.03

Note

Do not regulate when engine is too hot, e. g. immediately following a fast ride or after measuring output on output dynamometer.

Regulation

1 Switch off air-conditioner or automatic climate control. Move selector lever into position "P".

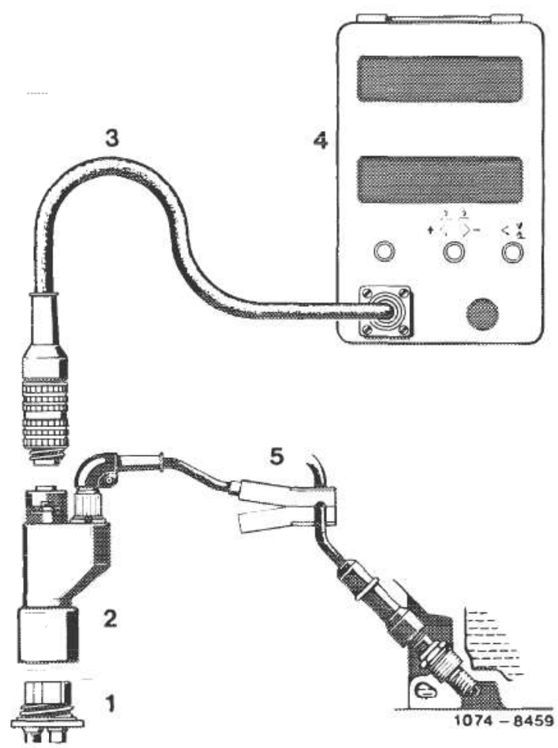
2 Remove air cleaner.

3 Check engine regulating linkage for easy operation and wear. Lubricate all bearing points and ball sockets.

4 Perform full throttle checkup from inside vehicle (30–300).

5 Connect test instruments: CO-measuring instrument, revolution counter (speedometer), stroboscope, oscilloscope, digital tester.

6 Evaluate oscilloscope display.



7 Check firing point and adjust, if required. Check centrifugal and vacuum ignition adjustment (15–500).

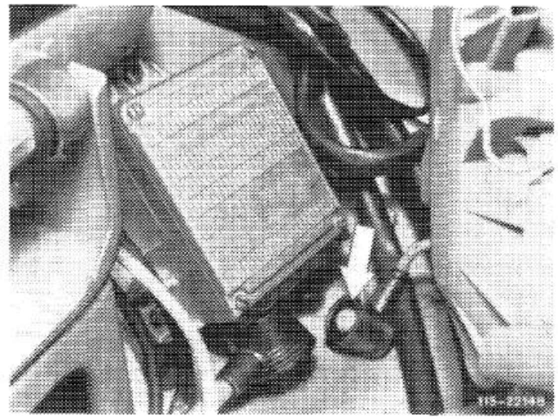
8 Check battery voltages.

Note: Voltmeter connection remains unchanged during tests a) and b).

a) Rest potential

Connect voltmeter to battery while paying attention to polarity and read voltage. Nominal value 12.2 volts.

b) Starting voltage



Pull plug for transmitter of ignition distributor from switching unit (green cable) or plug protective plug, part No. 102 589 02 21 00 on diagnosis socket.

Actuate starter for a short moment while reading voltage. Nominal value min. 10 volts. If nominal value is not attained, check battery, charge or renew, if required.

9 Voltages on ignition coil.

Transistorized ignition system TSZ 4

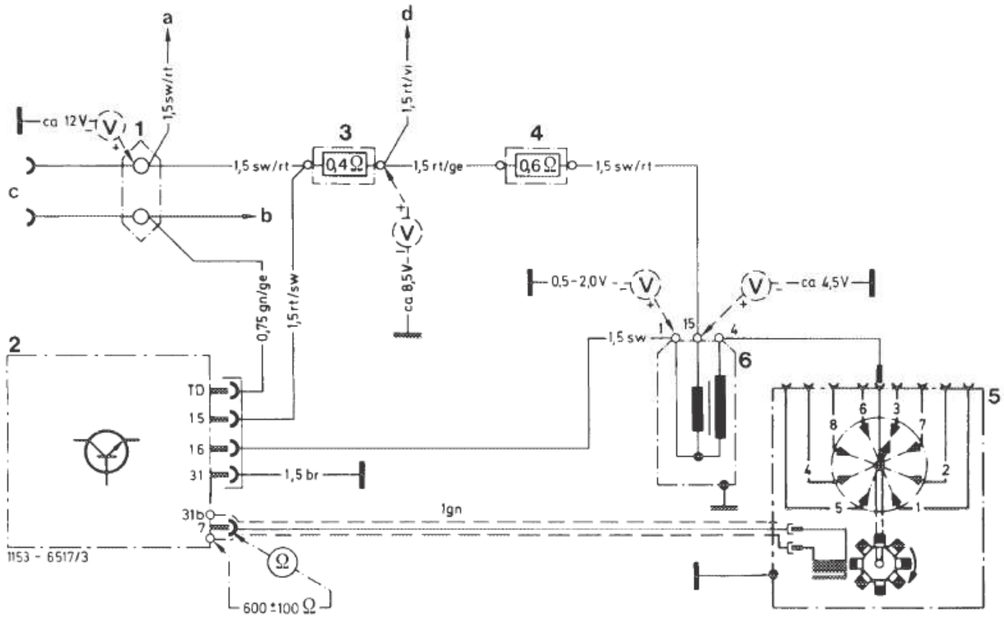
Check voltage on terminal 15 of ignition coil. For this purpose, disconnect positive cable of voltmeter from battery and connect to terminal 15 of ignition coil.

Switch on ignition and read voltage. Nominal value approx. 4.5 volts.

Disconnect positive cable of voltmeter from terminal 15 and connect to terminal 1 of ignition coil.

Switch on ignition and read voltage. Nominal value 0.5–2.0 volts.

Check series resistor bypass by starting engine while reading voltage during start. Nominal value 10 volts.



Wiring diagram breakerless transistorized ignition with test values TSZ 4

1 Two-point cable connector
2 Switching unit
3 Series resistor 0.4 ohm
4 Series resistor 0.6 ohm
5 Ignition distributor with transmitter top
6 Ignition coil

a Ignition starting switch
b Instrument cluster, revolution counter
c Diagnosis socket
d Terminal 16 starter

Color code
br = brown
ge = yellow
gn = green
rt = red
sw = black

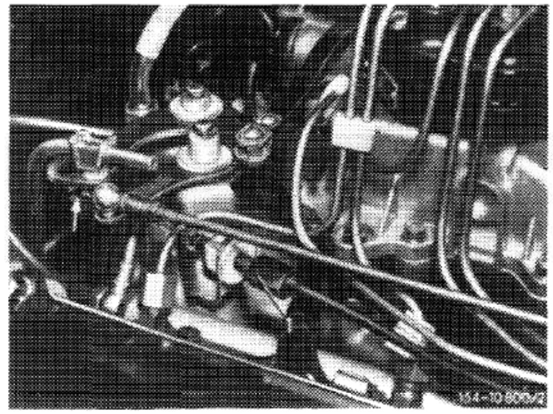
10 Check intake system for leaks. For this purpose, spray all sealing points with Iso-Oktan DIN 51756 or benzine.

Attention!
Do not use conventional fuel for spraying (unhealthy vapors). Pay attention to fire hazard and do not spray on red-hot parts or parts of ignition system.

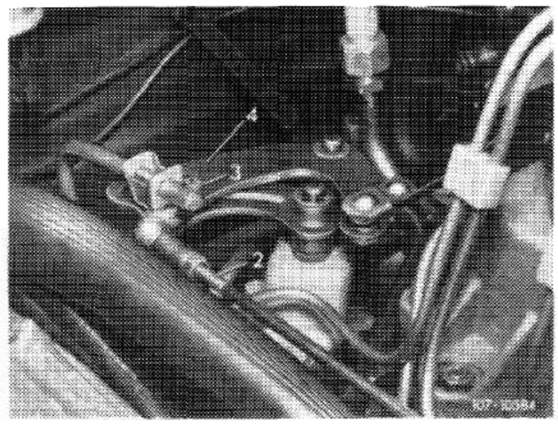
11 Run engine to 75–85 °C oil temperature.

12 Check whether bowden wire for tempomat/cruise control rests free of tension against regulating lever (arrow). Adjust by means of adjusting nut (1), if required.

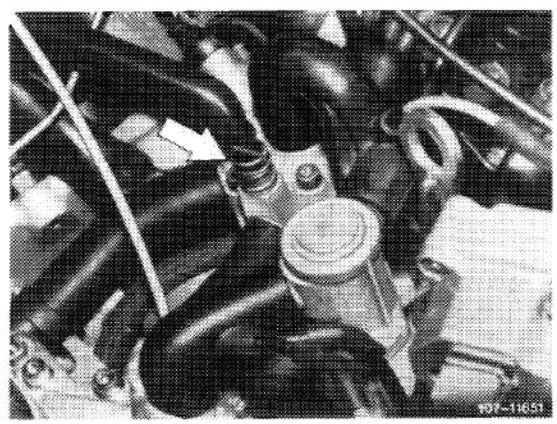
13 Check whether throttle valve rests against idle speed adjusting screw. For this purpose, disconnect connecting rod.



14 Check whether roller (3) in gate lever (4) rests free of tension against end stop. Adjust by means of connecting rod (2), if required.

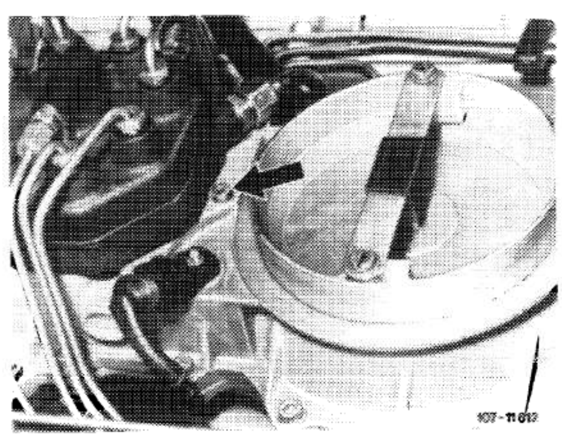


15 Set to specified speed by means of idle speed air screw (arrow).



16 Adjust idle speed emission value. For this purpose, unscrew closing plug (arrow).

Attention!
On vehicles manufactured after October 1, 1976 remove safety plug first.



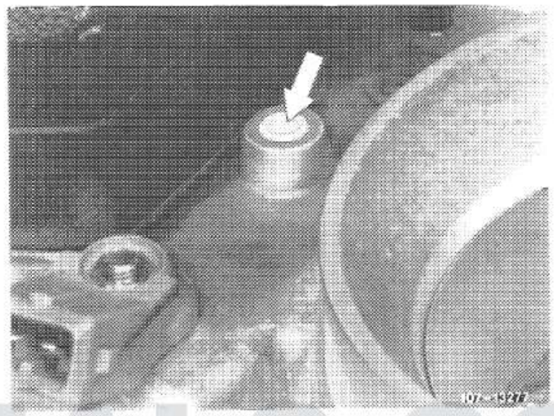
Insert screwdriver through bore into socket of idle speed mixture regulating screw and adjust emission value by turning screw.

Turning counterclockwise = leaner
Turning clockwise = richer

Close bore for closing plug. Accelerate for a short moment, check idle speed emission value and adjust, if required.

Put back closing plug.

Following adjustment, on vehicles manufactured after October 1, 1976, install a blue safety plug (arrow) MB-part No. 000 997 59 86.



17 Mount air filter. Check idle speed and idle speed emission value once again and adjust, if required.

18 Place selector lever into driving position, switch on air-conditioner, turn power steering to full lock with engine running smoothly. Readjust speed, if required.

B. National version (AUS) (J) (S) (USA)

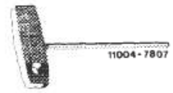
Identification: Information plate in respective language on cross member in front of radiator.
Adjust engines according to data of respective emission control information plate.

Testing and adjusting data engine 117

Model year		Information plate	Idle speed 1/min	Idle speed emission value % CO without air injection	Idle speed emission value % CO with air injection
(AUS)					
1977		silver	750	0.2–2.0	–
1978–1980				1.0–2.5	–
(J)					
1976–1980		in Japanese language	700–800	0.2–1.5	–
(S)					
1976		blue	700–800	0.2–1.5	–
1977/80			750	0.2–2.0	–
1979/80				1.0–2.5	–
(USA)					
1976	Federal	black	700–800	0.2–1.5	–
	California	green			
1977	Federal	black	750	–	0.2–2.0
	California	yellow		0.2–2.0	–
	Federal high altitudes	red		–	0.2–1.2
1978/79	Federal	black		–	0.5–2.0
	California	yellow		0.5–2.0	–
1980[1]	Federal and California	black	650 ± 50	–	0.5–1.5

[1]) Tourist version model 107 only. These vehicles are not provided with catalysts and O_2 probe ex factory.

Special tools

Screwdriver 3 mm with tommy handle for adjusting idle speed emission value		000 589 14 11 00
Oil telethermometer		116 589 27 21 00

Conventional tools

CO-measuring instrument, revolution counter (speedometer), stroboscope, oscilloscope	
Digital tester	e.g. Bosch, Mot 001.03

Note

Do not regulate when engine is too hot, e. g. immediately following a fast ride or after measuring output on output dynamometer.

Adjustment

1 Switch off air-conditioner or automatic climate control. Move selector lever into position "P".

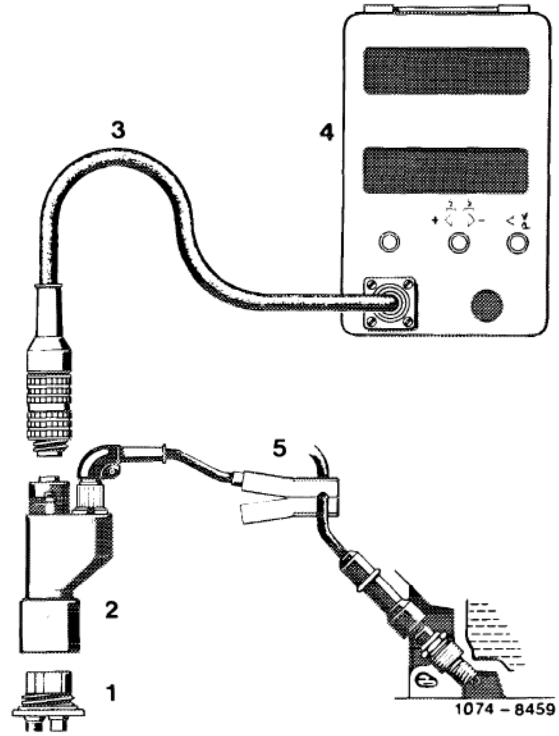
2 Remove air cleaner.

3 Check engine regulating linkage for easy operation and wear. Grease all bearing points and ball sockets.

4 Perform full throttle checkup from inside vehicle (30–300).

5 Connect testers: CO measuring instrument, revolution counter, stroboscope, oscilloscope, digital tester, oil telethermometer.

6 Evaluate oscilloscope display.



7 Check firing point and adjust ignition timing, if required. Check centrifugal and vacuum ignition adjustment (15–500).

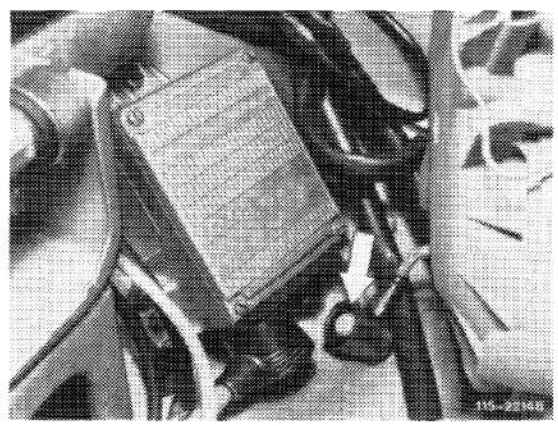
8 Check battery voltages.

Note: The voltmeter connection remains unchanged during tests a) and b).

a) Rest potential

Connect voltmeter to battery while paying attention to polarity and read voltage. Nominal value 12.2 volts.

b) Starting voltages



Pull plug of transmitter for ignition distributor on switching unit (green cable) or plug protective plug, part No. 102 589 02 21 00 on diagnosis socket.

Actuate starter for a short moment while reading voltage. Nominal value min. 10 volts. If nominal value is not attained, test battery, change or renew, if required.

9 Voltages on ignition coil.

Transistorized ignition system TSZ 4

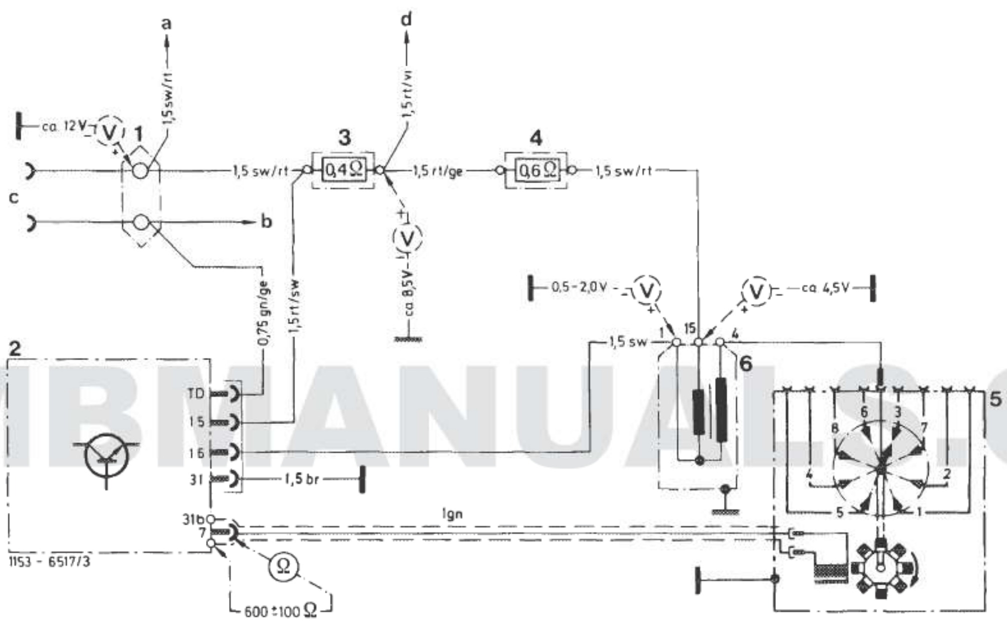
Voltage test on terminal 15 of ignition coil. For this purpose, disconnect positive cable of voltmeter from battery and connect to terminal 15 of ignition.

Switch on ignition and read voltage. Nominal value approx. 4.5 volts.

Disconnect positive cable of voltmeter from terminal 15 and connect terminal 1 of ignition coil.

Switch on ignition and read voltage. Nominal value 0.5–2.0 volts.

Check series resistor bypass, for this purpose start engine while simultaneously reading voltage while starting. Nominal value 10 volts.



Wiring diagram breakerless transistorized ignition with test values TSZ 4

1 Two-point cable connector
2 Switching unit
3 Series resistor 0.4 ohm
4 Series resistor 0.6 ohm
5 Ignition distributor and transmitter top
6 Ignition coil

a Ignition starting switch
b Instrument cluster, revolution counter
c Diagnosis socket
d Terminal 16 starter

Color code
br = brown
ge = yellow
gn = green
rt = red
sw = black

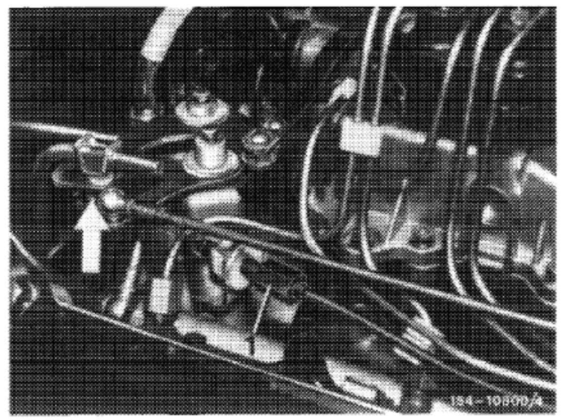
10 Check intake system for leaks. For this purpose, spray all sealing points with Iso-Oktan DIN 51 756 or benzine.

Attention!
Do not use conventional fuel for spraying (unhealthy vapors). Pay attention to inflammability and do not spray on red hot components or parts of ignition system.

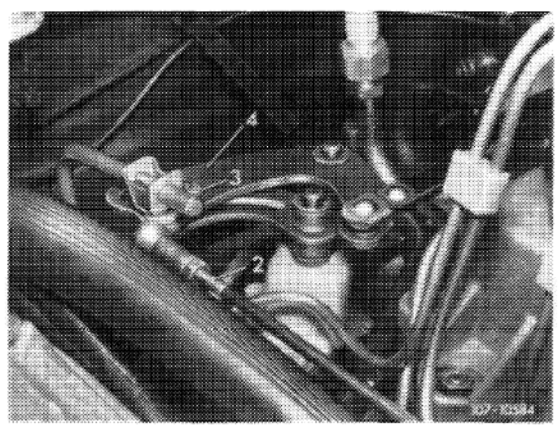
11 Run engine to 75–85 °C oil temperature.

12 Check whether bowden wire for tempomat/cruise control rests free of tension against regulating lever (arrow). Adjust with adjusting nut (1), if required.

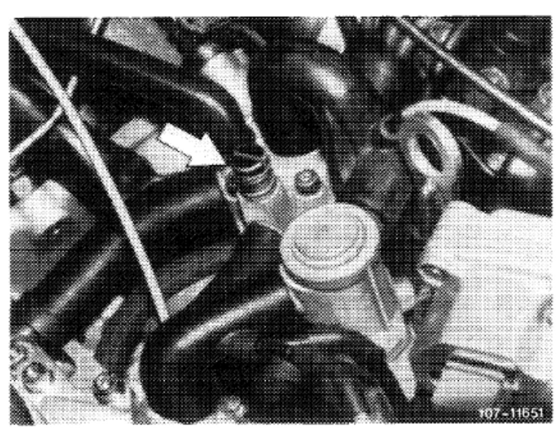
13 Check, whether throttle valve rests against idle speed stop. For this purpose, disconnect connecting rod.



14 Check, whether roller (3) in gate lever (4) rests free of tension against end stop. Adjust with connecting rod (2), if required.



15 Set to specified speed with idle speed air screw (arrow).

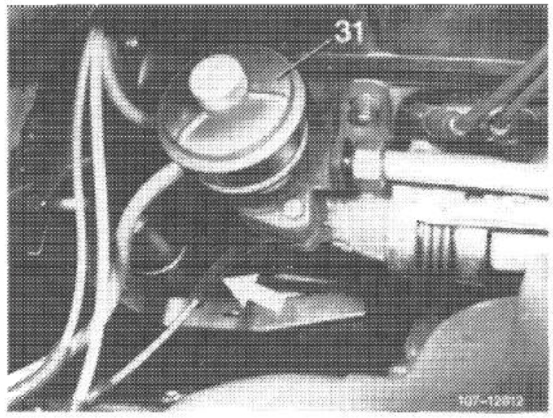


16 Connect CO measuring instrument.

For this purpose, for (J) (USA) starting 1977, pull off connecting hose (arrow) of measuring point (exhaust backpressure line).

Connect CO-measuring instrument and exhaust backpressure line with a hose.

USA tourist vehicles are not provided with a catalyst, for this reason, the emission value can be measured at exhaust end pipe.

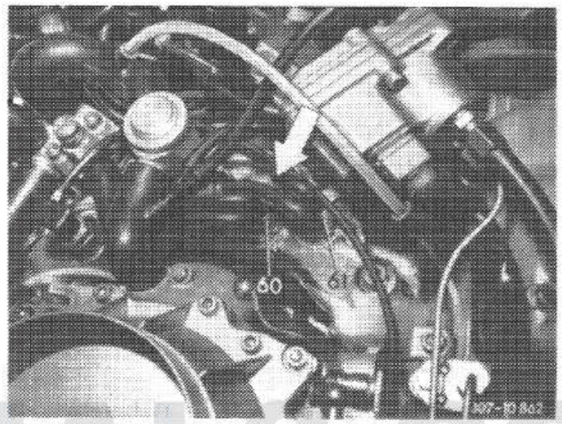


17 Check idle speed emission value.

(AUS) 1977, (J) starting 1976, (S) 1976/77, (USA) starting 1976

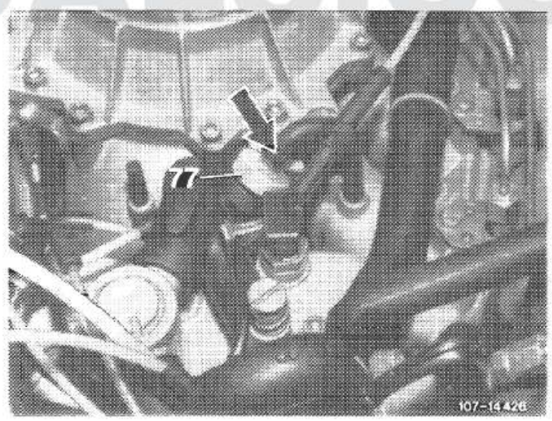
Check idle speed emission value **without air injection.** For this purpose, pull blue/violet vacuum line (arrow) from blue thermovalve (61) and close connection on thermovalve. This will disconnect air injection.

On (USA) Federal and Federal higher altitudes, check idle speed emission value **with** air injection (self-aspirating).



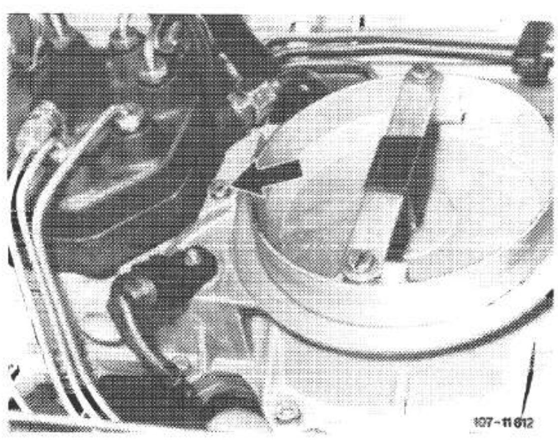
(AUS) starting 1978, (S) starting 1978

Check idle speed emission value **without** air injection. For this purpose, pull vacuum hose (arrow) from retarding valve (77) and close hose. This will disconnect air injection.



(AUS) (S)

18 **Adjust idle speed emission value.** For this purpose, unscrew closing plug (arrow).



Insert screwdriver through bore into socket of idle speed mixture regulating screw and adjust emission value by turning screw.

Turning counterclockwise = leaner
Turning clockwise = richer

Hold bore for closing plug closed. Accelerate for a short moment, check idle speed emission value once again and adjust, if required. Put back closing plug.

Plug back vacuum line with (USA) version on thermo-valve, with (AUS) version on time-delay valve.

Check idle speed emission value once again (air injection in operation). The idle speed emission value should be **below** previously set value.

19 Mount air cleaner. Check idle speed and idle speed emission value once again and adjust, if required.

20 Move selector lever into driving position, switch on air-conditioning, turn power steering to full lock with engine running smoothly. Adjust speed, if required.

07.3–120 Checking fuel pressures and for internal leaks

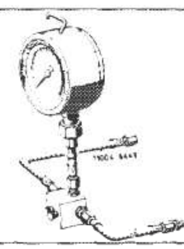
A. Standard version

Test values

System pressure at idle with engine cold or at operating temperature			5.0–5.6 bar gauge pressure
Control pressure at idle with engine at operating temperature	Warm-up compensator cycle completed		3.5–3.8 bar gauge pressure at 530 mbar[1])
	Full load enrichment at idle speed (vacuum hose pulled off)	Engine 116 with warm-up compensator with Bosch end no.028	2.5–2.9 bar gauge pressure
		Engine 116 and 117 with warm-up compensator with Bosch end no. 010 and 056	2.8–3.2 bar gauge pressure
Control pressure according to ambient teperature at idle speed with engine cold			min. 0.5 bar gauge pressure (refer to diagram)

[1]) If the control pressure is not attained, check intake pipe vacuum (refer to section "Checking control pressure at idle with engine at operating temperature").

Special tool

Pressure tester		102 589 00 21 00
Clamp for hose lines		000 589 40 37 00

Conventional tools

Voltmeter, ohmmeter	
Screwdriver element 992–T 30	e.g. Hazet, D–5630 Remscheid

Note

Prior to working on injection system, check firing point, spark plugs and idle speed adjustment.

Perform leak test only in the event of complaints about hot starting.

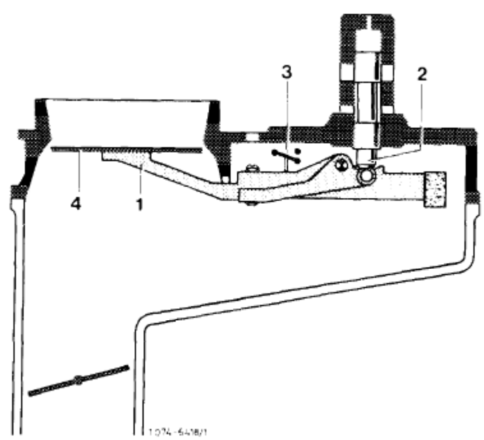
After stopping the engine, the fuel pressure after 30 minutes should still amount to 2.5 bar gauge pressure.

Visual checkup

1 Remove air filter.

2 Check all fuel connections for leaks.

3 Check adjusting lever (1) in air flow sensor and control piston (2) in fuel distributor for easy operation. For this purpose, pull plug from safety switch (3). Switch on ignition for a short moment to establish control pressure. Push air flow sensor plate (4) manually downwards. A uniform resistance should be felt along entire path. When moving up fast, no resistance should be felt, since the slowly following control piston lifts off from adjusting lever. During the slow upward movement, the control piston should smoothly follow.



4 Check control piston in fuel distributor visually for leaks.

Push air flow sensor plate for a short moment down and hold in this position, during which no fuel should be seen in air guide housing.

If fuel emerges, renew fuel distributor (07.3–205).

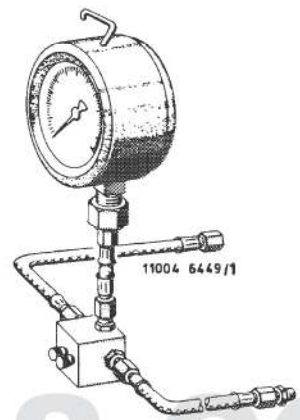
Connecting pressure measuring device

The pressure measuring device remains connected for **all** pressure measurements.

The pressure measuring device can be connected to warm-up compensator or to fuel distributor.

The pressure measuring device 102 589 00 21 00 is now provided with only one valve screw on three-way valve.

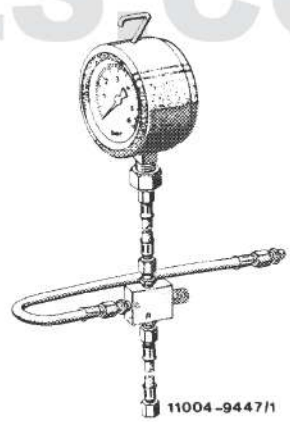
To relieve sealing rings, keep valve screw or valve screws always opened. Connections of three-way valve are numbered.



11004 6449/1

Pressure measuring device 1st version

Connection 1 = Hose line on fuel distributor
Connection 2 = Hose line on pressure gauge
Connection 3 = Hose line on released control pressure line



11004-9447/1

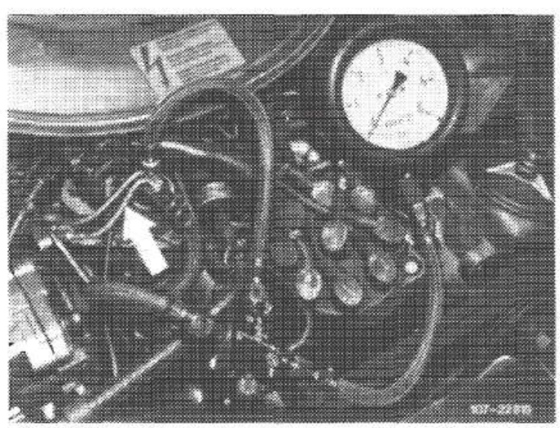
Pressure measuring device 2nd version

Connection A = Hose line on fuel distributor
Connection B = Hose line on released control pressure line

a) Connect pressure measuring device to warm-up compensator (air cleaner mounted).

Unscrew control pressure line (arrow) from warm-up compensator, while catching fuel with a rag.

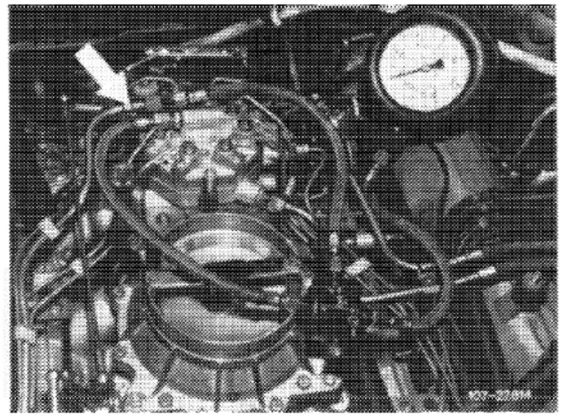
Connect hose line with double-thread connection from connection "1 or A" to control pressure line. Screw connecting line from connection "3 or B" to warm-up compensator.



b) Connect pressure measuring device to fuel distributor (air cleaner removed).

Unscrew control pressure line (arrow) from fuel distributor, while catching fuel with a rag.

Connect hose line from connection "1 or A" to fuel distributor and connect hose line from connection "3 or B" to control pressure line (arrow).



Checking control pressure at idle with engine cold

1 Open valve screw or valve screws on pressure measuring device.

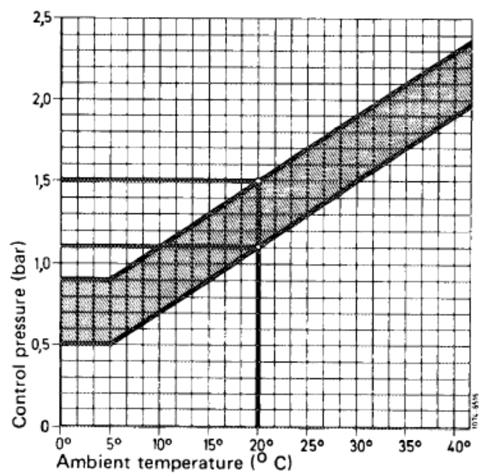
2 Run engine at idle and immediately read control pressure.

The nominal pressure is taken from control pressure diagram in accordance with ambient temperature.
If the nominal value is not attained, recondition system pressure regulator (07.3–210) or check input screen in warm-up compensator. Renew warm-up compensator, if required.

Example engine 117:

Warm-up compensator with Bosch end No. 010
Ambient temperature + 20 °C = 1.1–1.5 bar gauge pressure.
Breakaway time at + 20 °C 3–6 minutes.

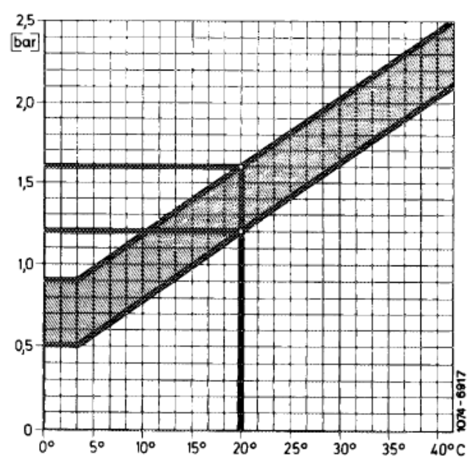
Note: Check breakaway time of warm-up compensator. All additional electrical consumers switched off and a minimum voltage of 12 volts. Read initial control pressure at + 20 °C. Breakaway time should be at 3.4 bar gauge pressure within tolerance.



Example engine 116, 117:

Warm-up compensator with Bosch end No. 028 and 056
Ambient temperature + 20 °C = 1.2–1.6 bar gauge pressure.

Breakaway time at + 20 °C:
Warm-up compensator with Bosch end No. 028 = 3–6 minutes.
Warm-up compensator with Bosch end No. 056 = 2–4 minutes.



Checking system pressure at idle with engine cold or at operating temperature

3 Close valve screw on pressure measuring device. On pressure measuring device with 2 valve screws, close valve screw on connection 3.

4 The system pressure should be 5.0–5.6 bar gauge pressure.

5 If the system pressure of 5.0–5.6 bar gauge pressure is not attained, check up as follows:

a) Check delivery of fuel pump (07.3–130).

b) Recondition system pressure governor (07.3–210).

c) Check fuel return line for unobstructed passage.

6 Open valve screw again.

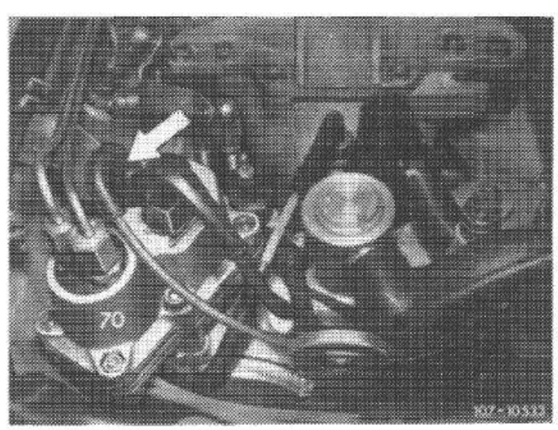
Checking control pressure at idle with engine at operating temperature

7 Open both valve screws or valve screw at pressure measuring device.

8 Control pressure should rise to 3.4–3.8 bar gauge pressure (warm-up compensator cycle completed).

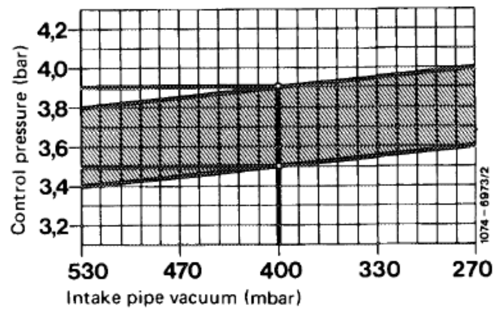
If the control pressure of 3.4–3.8 bar gauge pressure is not attained, check up as follows:

a) Check intake pipe vacuum. For this purpose, pull vaccum hose from warm-up compensator and fit a T-piece for pressure gauge.



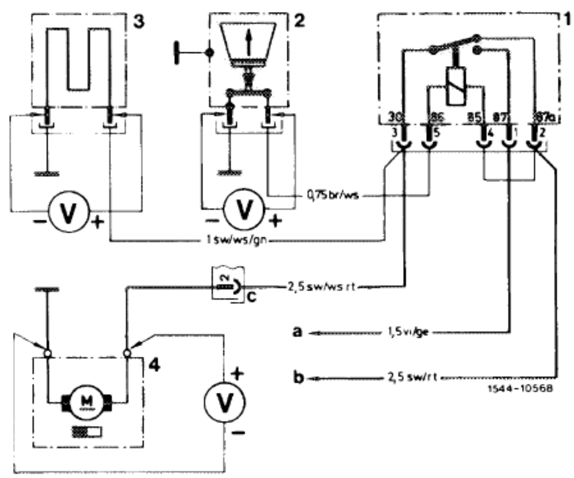
Read intake pipe vacuum and transfer to vacuum diagram.

Example:
Intake pipe vacuum 400 mbar = 3.5–3.9 bar gauge pressure.



b) Check voltage on warm-up compensator with engine running. Pull electrical connection from warm-up compensator and check voltage. Minimum voltage 12 volts (without electrical consumers).

c) Check heater coil with an ohmmeter. If interrupted, renew warm-up compensator.

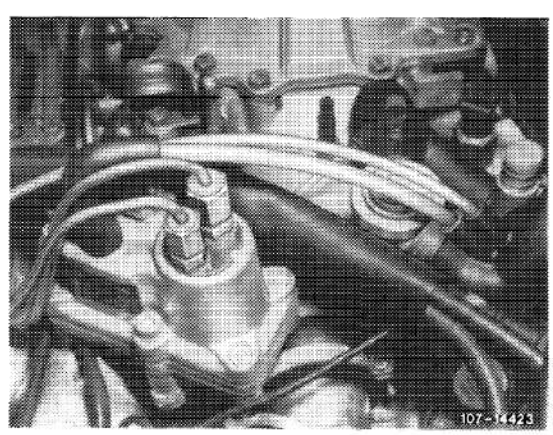


1 Fuel pump relay
2 Safety switch air flow sensor plate
3 Warm-up compensator
4 Fuel pump
a Terminal 50 (starting)
b Terminal 15/54 (ignition)
c Plug connection 14-point
Tail lamp harness

d) If control pressure is above 3.8 bar gauge pressure, recondition system pressure regulator (07.3–210).

9 Check full load enrichment. For this purpose, pull vacuum hose from warm-up compensator, control pressure should then drop to 2.8–3.2 bar gauge pressure.

If the control pressure of 2.8–3.2 bar gauge pressure is not attained, replace warm-up compensator.



Checking fuel distributor and fuel pump for leaks

10 Shut off engine. The control pressure will drop below opening pressure of injection valves (approx. 2.8 bar gauge pressure).

11 If the control pressure drops immediately to 0 bar gauge pressure, renew check valve on fuel pump or subsequently install.

12 If the pressure drops slowly, unscrew fuel return line on fuel distributor. With a leak on control piston or pressure compensation valve, fuel will emerge. If there is more than 1 drop in 5 seconds, recondition system pressure regulator or pressure compensating valve (07.3–210).

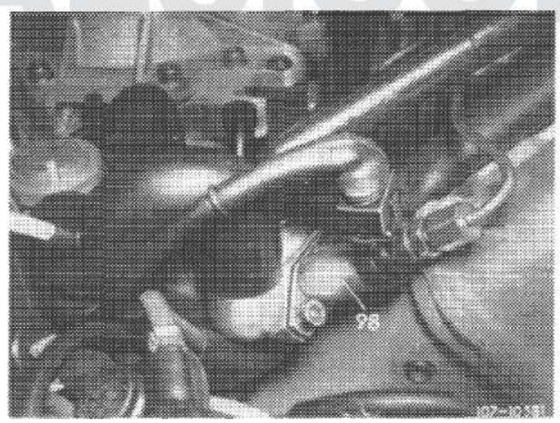
Note: There may also be a leak on fuel reservoir or cold starting valve.

To check for leaks on fuel reservoir, pinch the leak line between the fuel reservoir and the intake damper. Then loosen leak line on intake damper and pull off. Loosen clamp, a pressureless amount of leaking fuel is allowed. Renew fuel reservoir, if required (07.3–270).

Remove cold starting valve (98) for leak test (07.3–125 section "Checking for leaks").

13 Disconnect pressure measuring device, while catching fuel with a rag.

14 Connect fuel lines, run engine once again and check all fuel connections for leaks.



B. National version (AUS) (J) (S) (USA)

Fuel pressures in bar gauge pressure engine 117

Warm-up compensator Bosch end No. model year	System pressure at idle with engine cold or at operating temperature	Control pressure at idle with engine at operating temperature		
		Warm-up compensator stabilized at 530 mbar intake manifold vacuum[1]	Full load enrichment at idle (vacuum hose pulled off)	Acceleration enrichment with engine stopped and 0.5 bar vacuum at warm-up compensator

(AUS) starting 1977
Information plate: color code silver
(J) starting 1976
Information plate: in Japanese language
(S) starting 1976
Information plate: color code blue

015 starting 1976	5.0–5.6	3.4–3.8	3.0–3.4	–

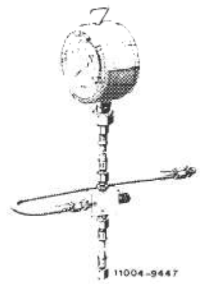
(USA) 1976–1980
Information plate: color code black Federal 1976–1980
green California 1976
yellow California 1977–1979
red Federal high altitudes 1977

<table>
<tr><td>015
1976–1978</td><td rowspan="4">5.0–5.6</td><td rowspan="2">3.4–3.8</td><td rowspan="2">3.0–3.4</td><td rowspan="3">–</td></tr>
<tr><td>061
1979</td></tr>
<tr><td>043
Federal only
High altitudes
1977</td><td>3.6–4.0</td><td>3.2–3.6</td></tr>
<tr><td>068
1980</td><td>3.4–3.8</td><td>–</td><td>1.4–1.8</td></tr>
</table>

[1]) On warm engine the control pressure values depend on intake manifold vacuum, on cold engine on ambient temperature. For this reason, in the event of deviations from nominal value, check intake manifold vacuum or ambient temperature and transfer to respective diagrams.

Transfer control pressure at idle on cold engine according to ambient temperature on diagram.

Special tools

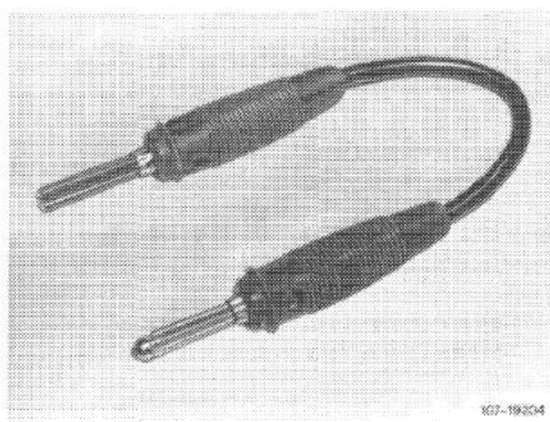
Pressure measuring device		102 589 00 21 00
Clamp for hose lines		000 589 40 37 00

Conventional tools

Voltmeter, ohmmeter	
Screwdriver element 992–T 30	e.g. Hazet, D–5630 Remscheid
Vacuum pump	e.g. Mityvac

Self-made tool

Contact bridge



Note

Perform leak test only in the event of complaints about hot starting.

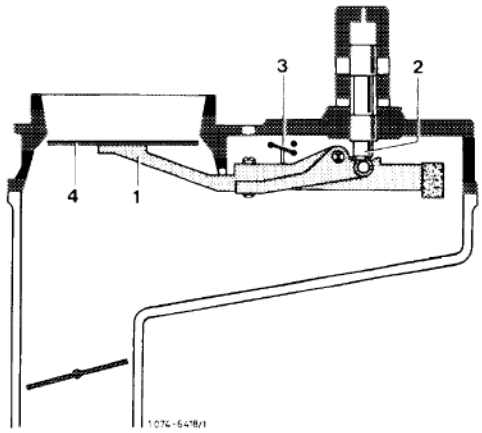
After stopping engine, the fuel pressure should amount to 2.5 bar gauge pressure after 30 minutes.

Visual checkup

1 Remove air cleaner.

2 Check all fuel connections on fuel distributor for leaks.

3 Check adjusting lever (1) in air flow sensor and control piston (2) in fuel distributor for easy operation. For this purpose, pull plug from safety switch (3). Switch on ignition for a short moment to establish control pressure. Push flow rate sensor plate (4) manually downwards. A uniform resistance should be felt along entire path. When moving up fast, no resistance should be felt, since the slowly following control piston lifts off from adjusting lever. During the slow upward movement, the control piston should smoothly follow.



4 Check control piston in fuel distributor visually for leaks.

Push flow rate sensor plate for a short moment completely down and hold in this position, no fuel should show up in air guide housing.

If fuel emerges, renew fuel distributor (07.3–205).

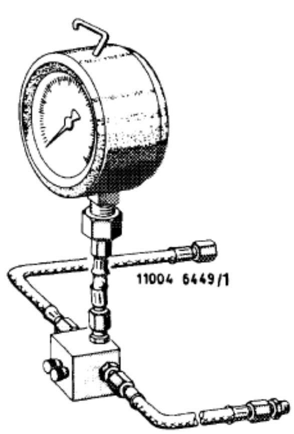
Connecting pressure measuring device

Leave pressure measuring device connected for all pressure measurements.

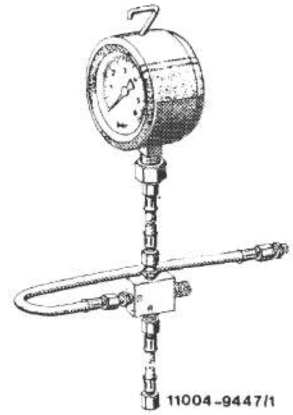
The pressure measuring device can be connected to warm-up compensator or to fuel distributor.

Pressure measuring device 102 589 00 21 00 is now provided with only one valve screw on three-way valve.

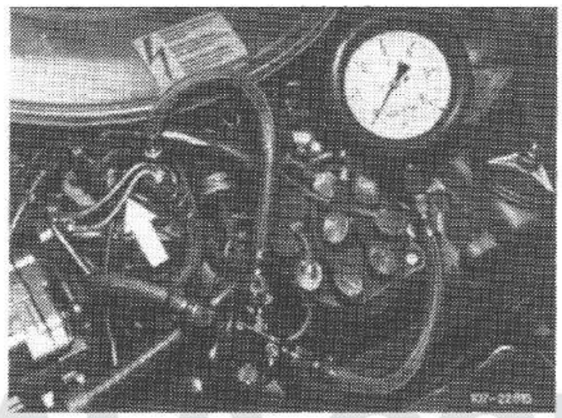
To relieve sealing rings, keep valve screw or valve screws always opened. Connections of three-way valve are numbered.



Pressure measuring device 1st version
Connection 1 = Hose line on fuel distributor
Connection 2 = Hose line on pressure gauge
Connection 3 = Hose line on released control pressure line



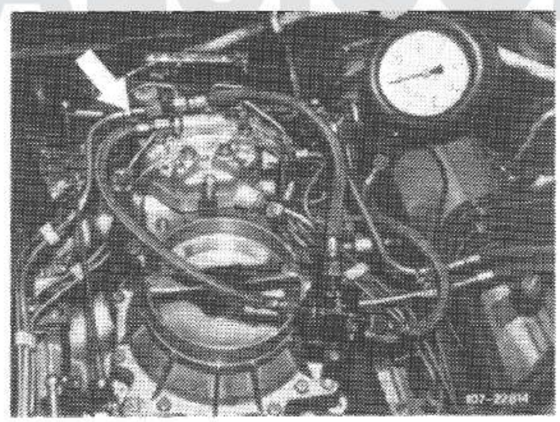
Pressure measuring device 2nd version
Connection A = Hose line on fuel distributor
Connection B = Hose line on released control pressure line



a) Connect pressure measuring device to warm-up compensator (air cleaner mounted).

Unscrew control pressure line (arrow) on warm-up compensator, while catching fuel with a rag.

Connect hose line with double-thread connection of connection "1 or A" to control pressure line. Screw connecting line of connection "3 or B" to warm-up compensator.



b) Connect pressure measuring device to fuel distributor (air cleaner removed).

Unscrew control pressure line (arrow) on fuel distributor, while catching fuel with a rag.

Connect hose line of connection "1 or A" to fuel distributor and connect hose line of connection "3 or B" to control pressure line (arrow).

Checking control pressure at idle on cold engine

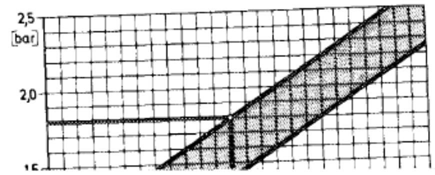
1 Open valve screws or valve screw on pressure measuring device.

2 Run engine at idle and immediately read control pressure.

Take nominal pressure according to ambient temperature from control pressure diagram. If the nominal value is not attained, recondition system pressure regulator (07.3–210), or check input screen in warm-up compensator. Renew warm-up compensator, if required.

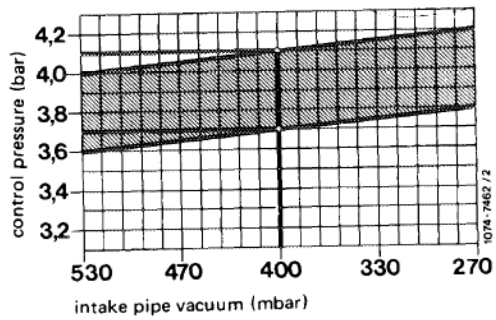
(AUS) (J) (S) 1976–1980
(USA) 1976–1978

Warm-up compensator Bosch end No. 015.



(USA) Federal higher altitudes 1977

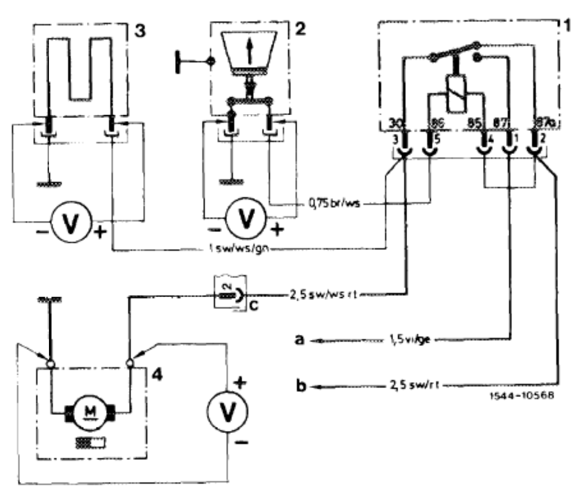
Example:
Intake pipe vacuum 400 mbar = control pressure 3.7–4.1 bar gauge pressure



b) Check voltage on warm-up compensator with engine running. Pull electrical connection from warm-up compensator and check for voltage. Minimum voltage 12 Volts (without consumers).

c) Check haeter winding with an ohmmeter.

If interrupted, replace warm-up governor.

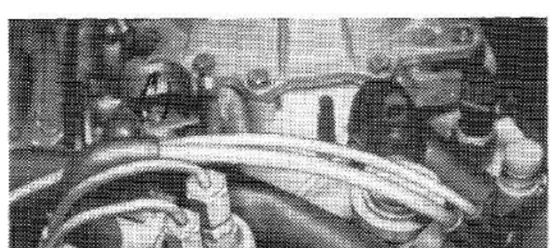


1 Fuel pump relay
2 Safety switch air flow sensor plate
3 Warm-up compensator
4 Fuel pump
a Terminal 50 (starting)
b Terminal 15/54 (ignition)
c Plug connection 14-point Tail lamp harness

d) If control pressure is above nominal value, recondition system pressure regulator (07.3–210).

9 Check full load enrichment. For this purpose, pull vacuum hose from warm-up compensator, control pressure should drop to specified value.

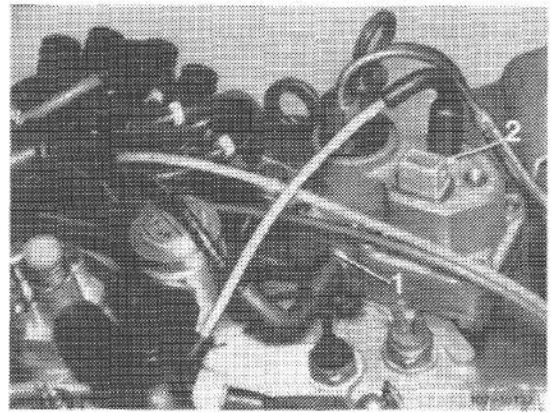
If the control pressure is not attained, replace warm-



USA 1979

Connection (1) for full load enrichment has been placed on intermediate plate. Connection (2) is for venting. For this reason, pull vacuum hose from connection (1) for checking full load enrichment.

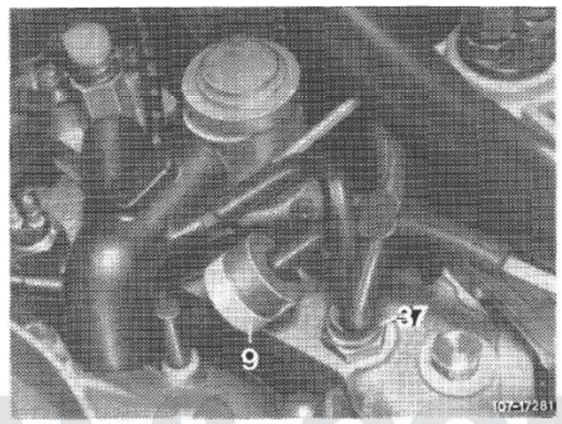
If full load enrichment is not attained, renew warm-up compensator.



USA 1980

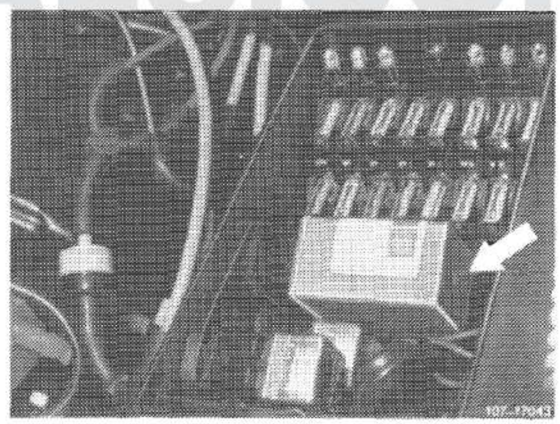
Checking acceleratiop enrichment

10 Check thermovalve 50 °C (37) for passage. For this purpose, pull off vacuum hose (arrow), thermovalve is closed below approx. 50 °C, passage must be available above approx. 50 °C coolant temperature. If not, renew thermovalve (37).



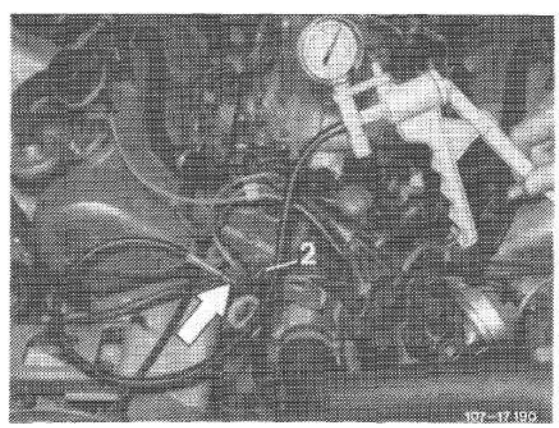
11 Run engine until warm-up compensator is stabilized (3.4–3.8 bar gauge pressure).

12 Stop engine, pull off fuel pump relay (arrow).

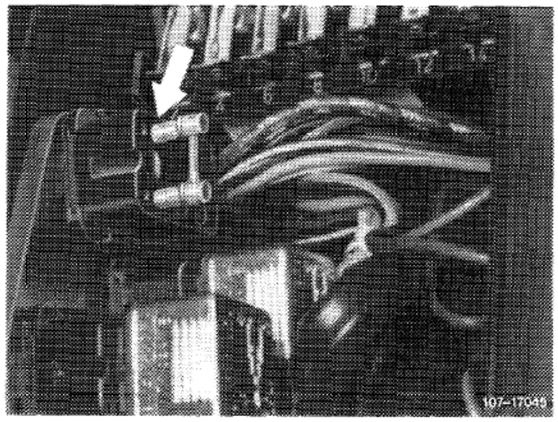


13 Pull vacuum line of vacuum chamber from warm-up compensator (2).

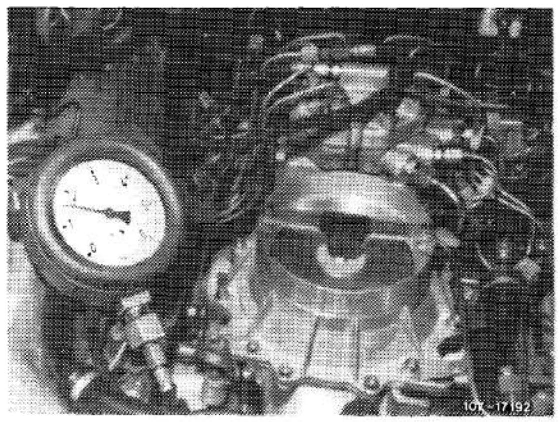
14 Plug vacuum pump on contour hose (arrow) and energize warm-up compensator with 0.5 bar vacuum.



15 Bridge jacks 1 and 2 (arrow).



16 Control pressure should then amount to 1.4–1.8 bar gauge pressure. If control pressure deviates from nominal value. renew warm-up compensator.



Checking fuel distributor and fuel pump for leaks

17 Stop engine. Control pressure will then drop below opening pressure of injection valves (approx. 2.8 bar gauge pressure).

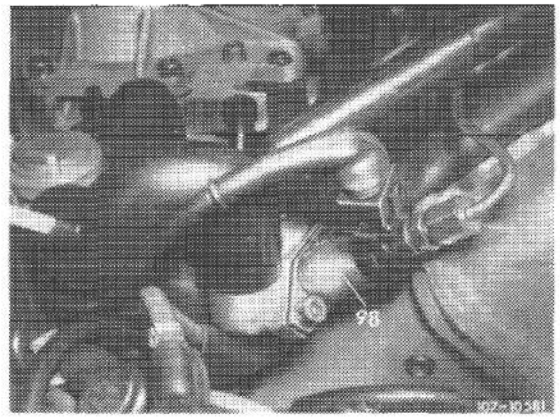
18 If the control pressure drops immediately to 0 bar gauge pressure, renew check valve on fuel pump or subsequently install.

19 If the pressure drops slowly, unscrew fuel return line on fuel distributor. Fuel will emerge with a leak on control piston or pressure compensating valve. If there is more than 1 drop in 5 seconds, recondition system pressure regulator or pressure compensating valve (07.3–210).

Note: Another leak may be located on fuel reservoir or cold starting valve.

To check fuel reservoir for leaks, pinch leak line between fuel reservoir and intake damper. Then loosen leak line on intake damper and pull off. Loosen clamp, a pressureless quantity of leaking fuel is allowed. Renew fuel reservoir, if required (07.3–270).

Remove cold starting valve (98) for leak test (07.3–125 section "Checking for leaks").



20 Disconnect pressure measuring device, while catching fuel with a rag.

21 Connect fuel lines, run engine once again and check all fuel connections for leaks.

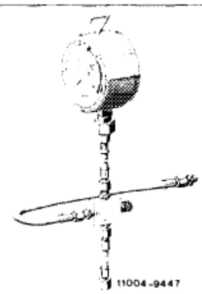
07.3–125 Checking choke system

Test values

System pressure at idle with engine cold or at operating temperature		5.0–5.6 bar gauge pressure
Control pressure at idle with engine at operating temperature	Warm-up compensator stabilized	3.4–3.8 bar gauge pressure at 530 mbar [1])
	Full load enrichment at idle (vacuum hose pulled off)	2.8–3.2 bar gauge pressure
Control pressure according to ambient temperature at idle with engine cold		min. 0.5 bar gauge pressure (refer to diagram)
Starting voltage		10 volts

[1]) If control pressure is not attained, check intake manifold vacuum (refer to section "Checking control pressure at idle with engine at operating temperature").

Special tool

Pressure measuring device	 11004-9447	102 589 00 21 00

Conventional tools

Voltmeter and ohmmeter
Revolution counter

Checking

1 Pull off cable plug on warm-up compensator and on cold starting valve.

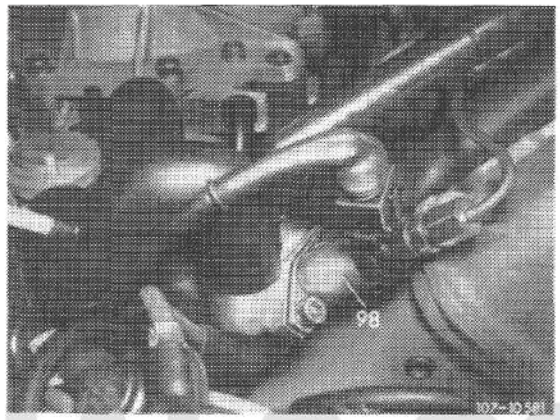
2 Starting voltage

Check voltmeter while paying attention to polarity on battery.

Pull cable 4 from ignition coil. Actuate starter for a short moment while reading voltage. Nominal value 10 Volts. If the nominal value is not attained, check battery, charge or renew, if required.

3 Check air flow sensor plate and control piston for easy operation, fuel pressures and for internal leaks, as well as breakaway time of warm-up compensator (07.3–120).

Checking cold-starting valve for function and leaks



5 Remove cold-starting valve (98) with fuel line connected.

6 Hold cold-starting valve into a container.

Checking function

7 Switch-on ignition.

8 Connect cold-starting valve with separate cable to B+ and ground. Cold-starting valve should eject in cone shape.

Attention!
Connect cable first to cold-starting valve to avoid sparking.

No separate cable is required below + 15° C, attach cable plug instead and pull cable plug from safety switch.

Checking for leaks

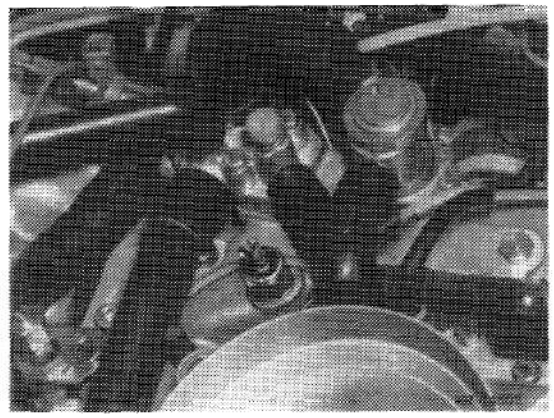
9 Loosen separate cable connection on cold-starting valve. Dry cold-starting valve at nozzle. No drops should show up.

10 Switch-off ignition.

11 Mount cold-starting valve with new seal.

12 Return cable plug to safety switch and cold-starting valve.

Checking thermo-time switch



The cold-starting valve is actuated only at coolant termperatures below +15° C by means of closed thermotime switch.

The actuating time increases with decreasing temperature and attains approx. 12 seconds at –20° C.

Testing below + 15° C coolant temperature

13 Connect voltmeter to connection of cold-starting valve.

14 Actuate starter. Voltmeter should then indicate 10 Volts for a given time, depending on coolant temperature.

The switching time increases with decreasing temperature by approx. 1.5 seconds per 5° C.

e. g. + 15° = 0 seconds
+ 10° = 1.5 seconds

During this test, it is recommended to check thermo-time switch also with an ohmmeter.

Test value **below** + 15° C:

Connection G-ground = approx. 48 Ω
Connection W-ground = approx. 0 Ω
(Contacts in switch closed).

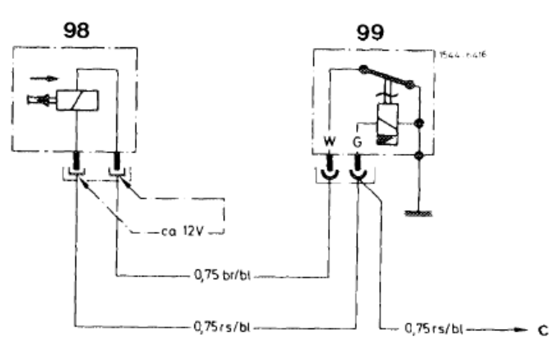
Test above + 15° C coolant temperature

Above + 15° C coolant temperature, the thermo-time switch can be tested with an ohmmeter only. For this purpose, pull plug from thermo-time switch.

Test value **above** + 15 °C:

Connection G-ground = approx. 62 Ω
Connection W-ground = approx. 270 Ω
(Contacts in switch opened).

Put back plug.



98 Cold starting valve
99 Thermo time switch
C To terminal 50

Checking switch-off point of supplementary air valve

19 The engine speed should be 800–1000/min immediately upon cold start. The speed will then increase to approx. 1200–1300/min and will return to normal idling speed at approx. 70 °C coolant temperature.

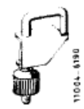
20 Connect fuel lines, run engine once again and check all fuel connections for leaks.

07.3–130 Checking delivery of fuel pump

Test data

Voltage at fuel pump min.	11.5 Volts
Delivery min.	1 liter/40 seconds

Special tool

Clamp for fuel hose		000 589 40 37 00

Conventional tools

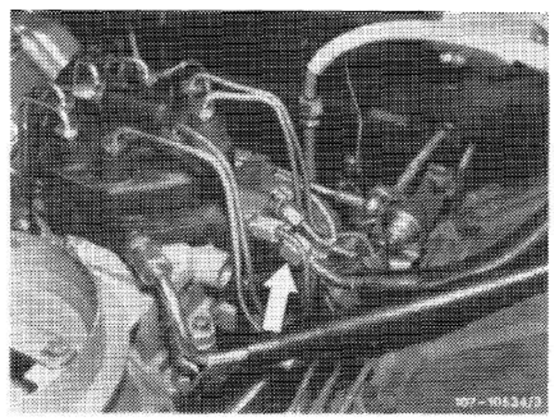
Voltmeter, measuring glass or measuring cup (min. 1 liter), stop watch

Self-made fuel hose

Fuel hose	500 mm long
Pipe with sealing cone	
Coupling nut	M 14 x 1.5

Checkup

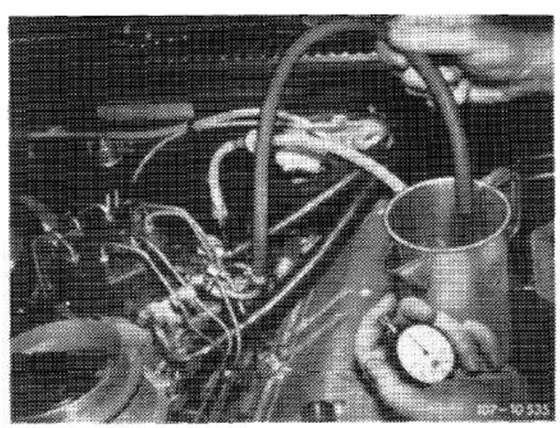
1 Unscrew fuel return hose (arrow) on fuel distributor.



2 Screw self-made fuel hose to fuel distributor and hold into measuring glass or measuring cup.

3 Switch-on ignition.

4 Pull cable plug from safety switch on mixture regulator and plug-in again after 30 seconds.



5 If the delivery volume is less than 1 liter/40 seconds, check up as follows:

a) Check voltage on fuel pump.
Nominal value = min. 11.5 volts (with engine stopped).

b) Check screen in inflow connection of fuel distributor for passage.

c) Check fuel lines for squeeze marks.

d) Pinch-off leak line between fuel storage reservoir and intake damper. Check delivery volume once again. If the specified volume is not attained, replace fuel storage reservoir.

e) Replace fuel filter.

6 If the delivery volume is still too low, replace fuel pump.

7 Connect fuel return hose.

07.3–135 Checking injection valves

Test data

Injection valves		Bosch no. 0 437 502 010
Opening pressure	with new injection valves	3.5–4.1 bar gauge pressure
	with used injection valves min.	3.0 bar gauge pressure

Tightening torques	Nm
Injection lines to fuel distributor (reference value)	10–12
Injection lines to injection valves (reference value)	10–15

Conventional tools

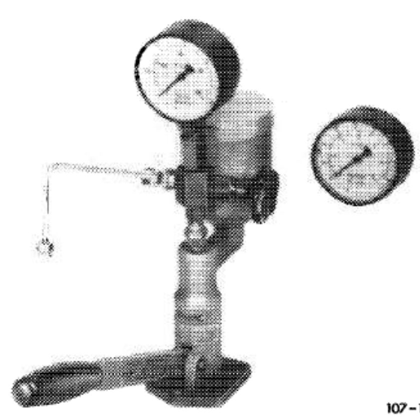
Valve tester Bosch KD-JE 7452	Bosch order designation KD-JE 7452
Nozzle tester EFEP 60 H[1])	Bosch no. 0 684 200 700
Pressure gauge 0–6 bar gauge pressure Quality class 1.0 housing dia. = 100 mm	Bosch no. 1 687 231 00
Pipe line	Bosch no. 1 680 750 001

[1]) Corresponds to nozzle testers used up to now. To check injection valves, the pressure gauge named above or the pressure gauge of pressure measuring device 100 589 13 21 00 will be required.

Note

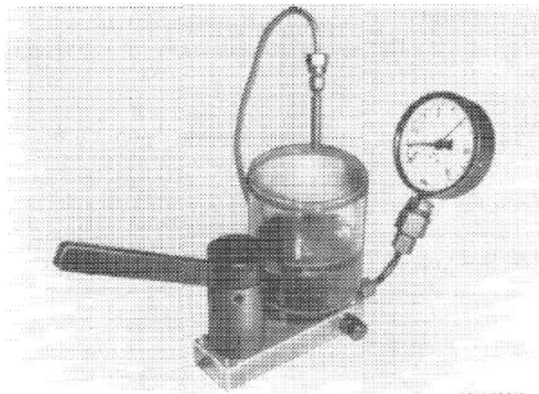
The nozzle or valve tester serves to check the opening pressure, the buzzing test and the fuel jet, and also for checking the injection valves for leaks.

Prior to checking injection valves, fill container of tester and bleed. For testing, use kerosene only.



107–10592

Injection valves, beyond tolerance must be renewed. Injection valves can be individually interchanged within one set.



107–14 212

For checking, remove injection valves (07.3–215).

1 Coarse leak test:

a) Connect removed injection valves to tester. Bleed pressure line with shutoff valve open and coupling nut released by actuating lever slowly several times. Then tighten coupling nut.

b) With shutoff valve open, **slowly** actuate hand lever (4 s/stroke) and build up pressure up to max. 1.5 bar gauge pressure. If injection valve shows a leak, replace.

2 Check opening pressure.

Close shutoff valve. Operate hand lever quickly several times to flush injection valve.

Open shutoff valve and check opening pressure while moving lever slowly.

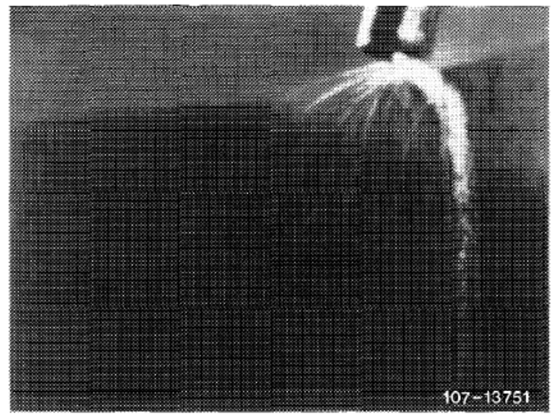
3 Fine leak test:

Close shutoff valve. Operate hand lever fast several times to flush injection valve, open shutoff valve and increase pressure slowly up to 0.5 bar gauge pressure at previously determined opening pressure and hold. No drops should show up at injection valve within 15 seconds.

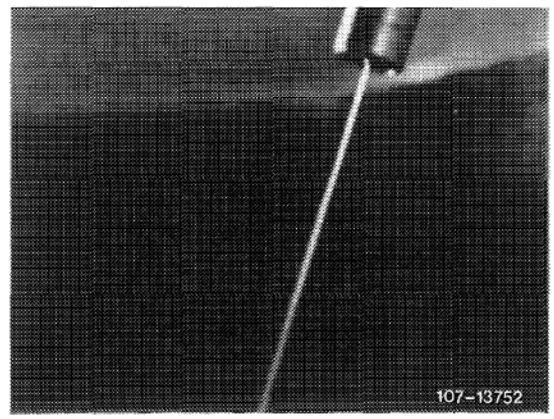
4 Buzzing test, evaluation of jet:

Close shutoff valve and flush valve by operating lever several times (0.5 s/stroke). Then reduce lever speed to approx. 1 s/stroke. Valve should then buzz. No drops should show up at valve mouth. There should be no cord-type jet. One-sided, atomized jet formations within a total spray angle of approx. 35° is permitted.

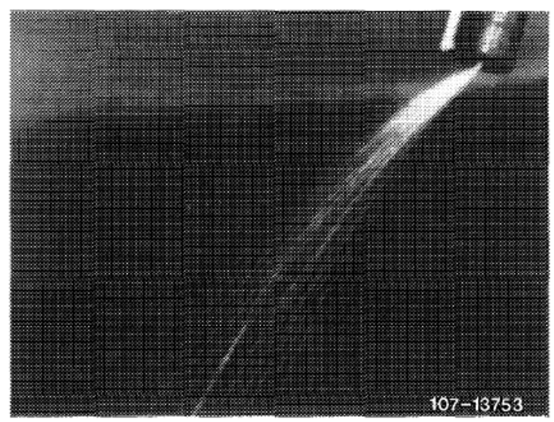
Damaged injection valves



Formation of drops

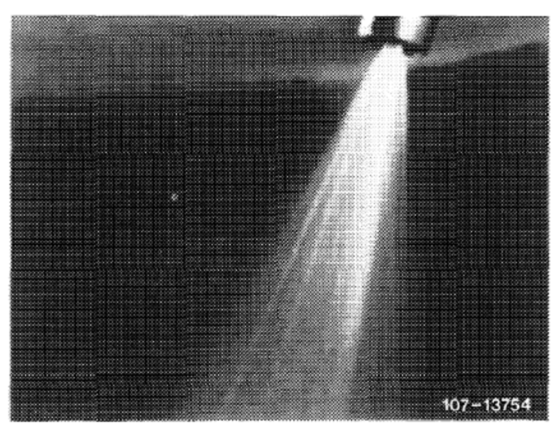


Cord-type jet

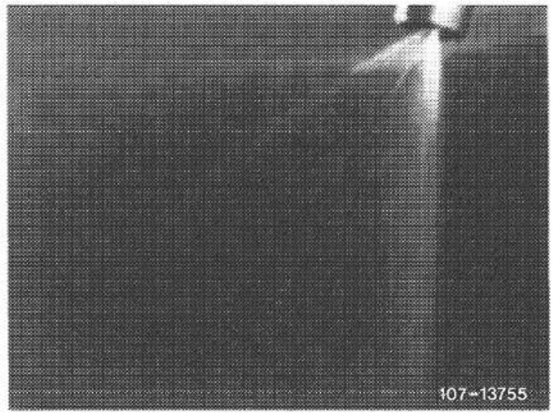


Poorly proportioned jet

Good injection valves



Well proportioned jet



Slightly one-sided atomization

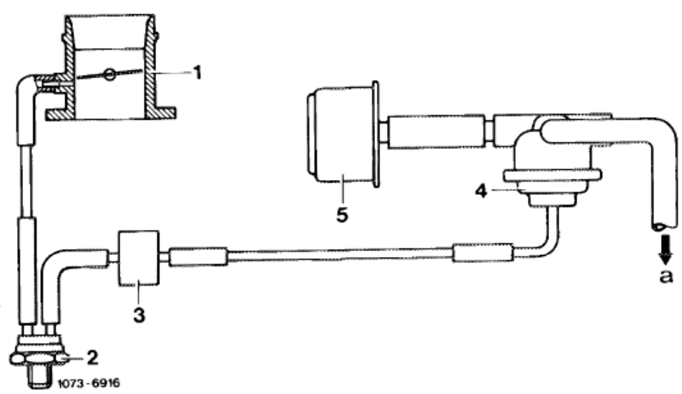
07.3–146 Checking speed stabilization at idle, engine 116.98 (3.5)

A. Function

1st version

For speed stabilization at idle, additional air will be taken into intake pipe at coolant temperatures above 40° C while bypassing throttle valve and air distributor.

Above approx. 40° C coolant temperature and an intake pipe vacuum above approx. 470 mbar the vacuum moves via delaying valve (3) to ambient air valve (4). The ambient air valve opens, so that the engine can suck up air via filter (5).

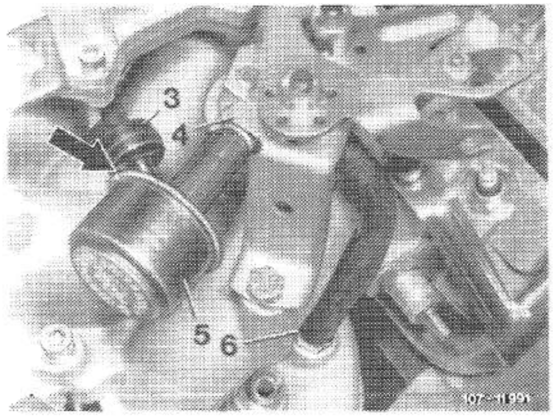


1 Valve housing
2 Thermovalve 40 °C
3 Delaying valve
4 Ambient air valve
5 Filter
a To intake pipe

When intake pipe vacuum drops below 470 mbar the vacuum will act on ambient air valve after approx. 4 seconds due to the delaying valve connected inbetween, so that the engine will continue to draw in unmeasured air.

By adding air, the fuel – air mixture will become leaner at idle for a short period and the engine speed will be stabilized.

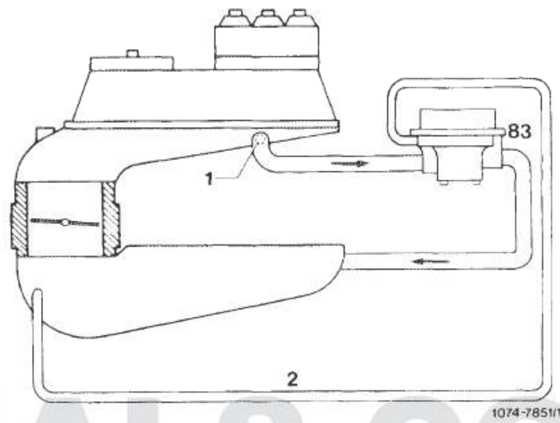
The delaying valve (3) is installed in 2 different versions. In the event of repairs, make sure that on the version shown in the illustration, the green dot (arrow) and on the second version the black side are pointing toward ambient air valve (4).



3 Delaying valve
4 Ambient air valve
5 Filter
6 Intake pipe connection

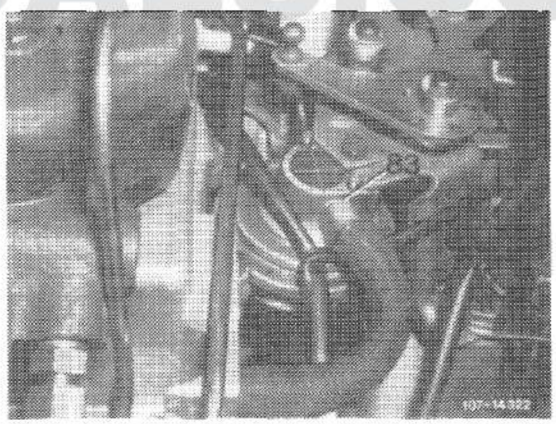
2nd version

Air measured by CIS injection system is added into intake pipe by way of ambient coasting air valve (83) via connection (1) on air guide housing. The ambient coasting air valve (83) is actuated by vacuum line (2). The ambient coasting air valve serves to increase speed after starting and to improve combustion under coasting (deceleration) conditions.



1 Connection air guide housing
2 Vacuum line
83 Ambient coasting air valve

The ambient coasting air valve is mounted behind mixture regulator on holder of regulating linkage.



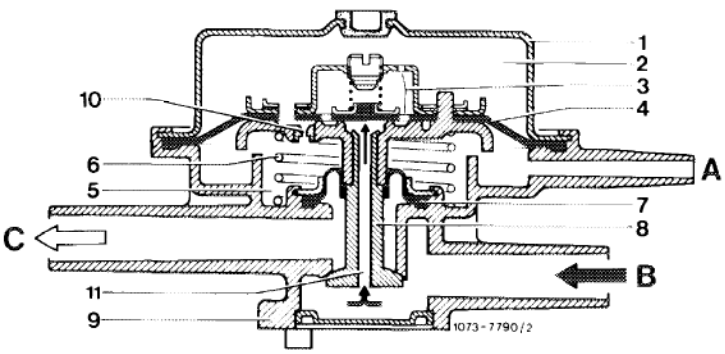
Increasing speed following start

With the engine stopped a uniform atmospheric pressure prevails in upper and lower diaphragm chamber. After starting the engine, a high vacuum will be established for a short period in lower diaphragm chamber (5), which overcomes the pressure of compression spring (6). The valve (8) is pushed down and the path for the bypass air from air guide housing to intake pipe is clean.

The addition of bypass air will increase the idling speed for a short period, which in turn will serve to stabilize operation at idle.

As soon as the vacuum in the two diaphragm chambers has been balanced under the influence of the throttle bore (10), compression spring (6) will push valve (8) in upward direction and thereby close valve.

1 Housing top
2 Upper diaphragm chamber
3 Compensating bores
4 Diaphragm
5 Lower diaphragm chamber
6 Compression spring
7 Sealing diaphragm
8 Valve
9 Housing bottom
10 Throttle bore
11 Compensating bore
A Vacuum connection intake pipe
B Connection air guide housing
C Connection intake pipe

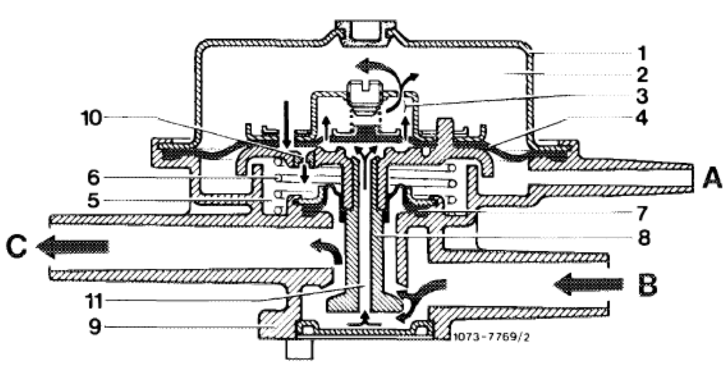


Air feed under coasting (decelerating) conditions

Through the balanced pressure ratio in upper and lower diaphragm chamber during constant driving, the compression spring will close valve (8).

Under coasting (decelerating) conditions the vacuum in lower diaphragm chamber (5) will increase faster than any balancing in relation to upper diaphragm chamber attempted by means of throttle bore (10). The adjusting force of the high vacuum will overcome the pressure of compression spring (6). Valve (8) is pushed down and the bypass air can flow from air guide housing into intake pipe.

1 Housing top
2 Upper diaphragm chamber
3 Bypass bores
4 Diaphragm
5 Lower diaphragm chamber
6 Compression spring
7 Sealing diaphragm
8 Valve
9 Housing bottom
10 Throttle bore
11 Compensating bore
A Vacuum connection intake pipe
B Connection air guide housing
C Connection intake pipe

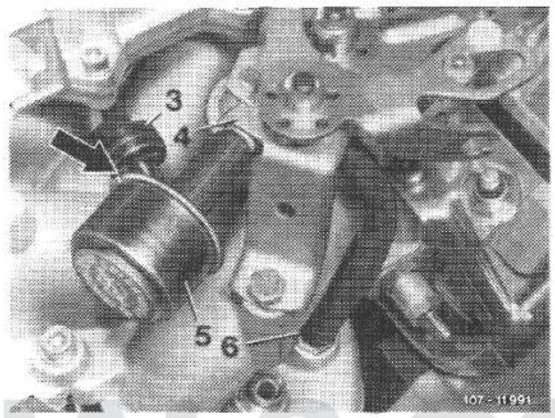


Introduction into series: approx. December 1977

Model	starting chassis en No.
107.023	012024
107.043	013199
116.028/029	044654

B. Checking

1st version



a) Testing ambient air valve

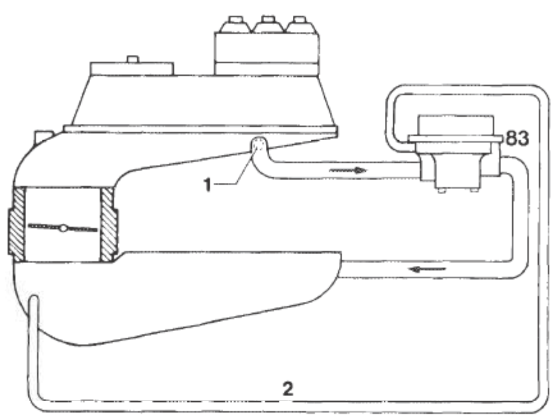
Run engine at idle and operating temperature. Pull off filter (5), with no vacuum present at ambient air valve (4). If vacuum is in evidence, replace ambient air valve.

b) Checking thermovalve

Run engine under + 40 °C coolant temperature with engine cold. Pull off filter (5), increase engine speed to approx. 3000/min and permit to drop to idling speed. There should be no vacuum at ambient air valve (4). Replace thermovalve, if required.

2nd version

With the engine running, pull vacuum line (2) from decel air valve (83). Return line after a short moment, which should result in a short speed increase for 2–3 seconds. If no speed increase shows up, replace decel air valve.



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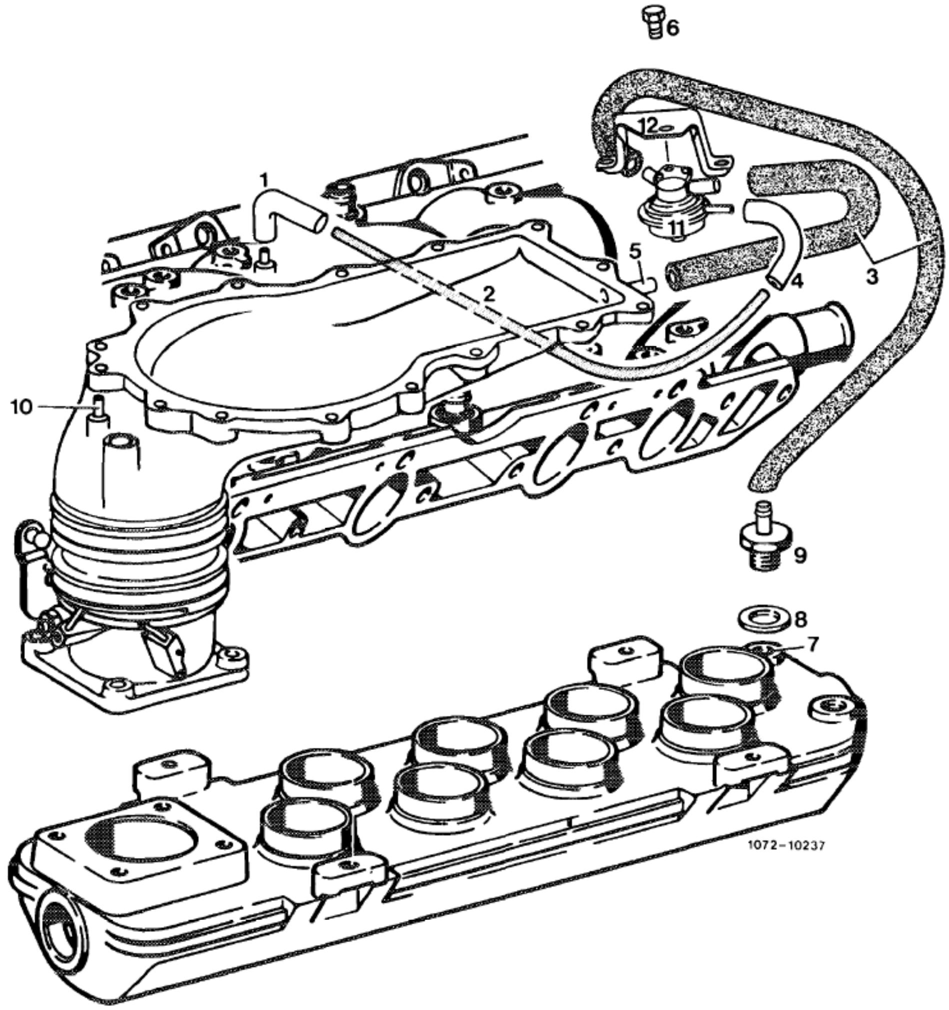
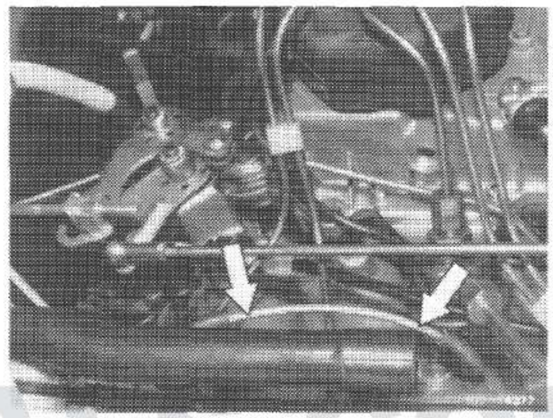
Installation survey decel air valve



1 Contour hose
2 Vacuum line
3 Hose
4 Contour hose
5 Connection
6 Hex. head screw M 5 x 10
7 Bore
8 Sealing ring
9 Connection
10 Vacuum connection
11 Decel air valve
12 Bearing bracket

07.3–151 Converting leak line for pressure damper

Starting approx. October 1977, the leak line for the pressure damper is connected to the contoured hose for engine breathing.



On previously manufactured vehicles, the contoured hose for engine breathing on cylinder head cover should also be replaced when renewing the pressure damper. Connect leak line to contoured hose and make shorter. Close connection for leak line used up to now with rubber cap part no. 000 987 11 45. When renewing contoured hose, also connect leak line of pressure damper to new hose.

Introduction into series

Model	starting chassis end No.
107.023	012024
107.024	019375
107.043	013199
107.044	042800
116.028/029	044654
116.032/033	076606

07.3–152 Adjusting throttle valve switch (USA) 1980

Conventional tool

Ohmmeter

Note

Remove throttle valve housing for renewing throttle valve switch (07.3–230).

Adjusting

1 Set ohmmeter to measuring range 0—∞ ohm.

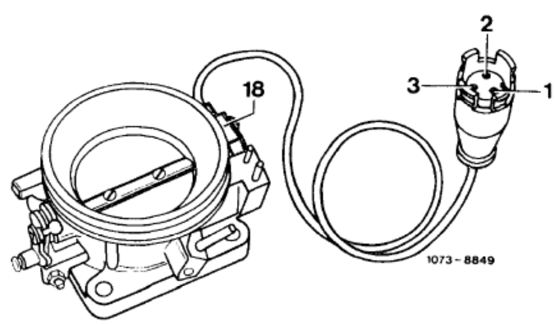
2 Check idle speed stop. For this purpose, push throttle valve to idle speed stop. Connect ohmmeter to jack 1 and 2.

3 Turn throttle valve switch until indication reads 0 ohm.

4 Slightly raise throttle valve, readout should move to ∞ ohm.

5 Check full load stop. For this purpose, push throttle valve to full load stop and connect jacks 2 and 3. Readout should then be 0 ohm.

6 Turn throttle valve slightly in direction of idle, readout should move to ∞ ohm.



07.3–160 Checking for constant delivery of fuel distributor

Test values

Load range	Air flow sensor plate fixed at approx. . . . . cc/min	Max. dissipation in cc/min
Grey-iron fuel distributor		
Idle	6	1.2
Partial load	30	6.0
Full load	100	10.0
Light-alloy fuel distributor		
Idle	6	0.8
Partial load	30	4.0
Full load	100	10.0

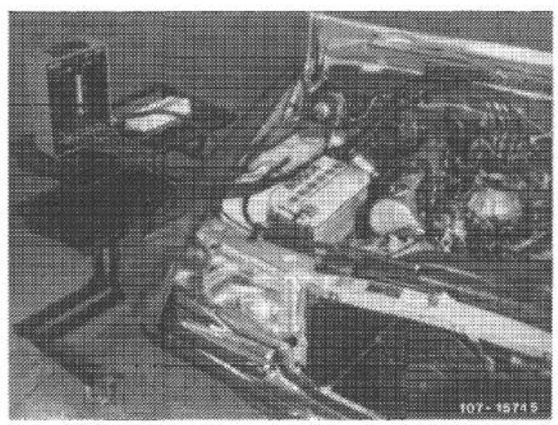
Conventional Bosch testers and accessories

Designation	Order designation
Quantity reference measuring unit	KDJE–P 300
Tester carriage [1])	M 200/2 or KDJE–W 100

[1]) If the tester carriage is used for quantity reference measuring unit, an additional angle plate is required. The plate can be self-made or obtained from Bosch agency.

Note

A quantity reference measuring unit is available for checking fuel distributor in vehicle. The unit serves to measure the individual fuel quantities which are distributed by the fuel distributor to the injection valves. Measurements are on stopped engine. The operating condition (idle, partial or full load) is simulated and adjusted on air flow sensor plate by means of an adjusting device.

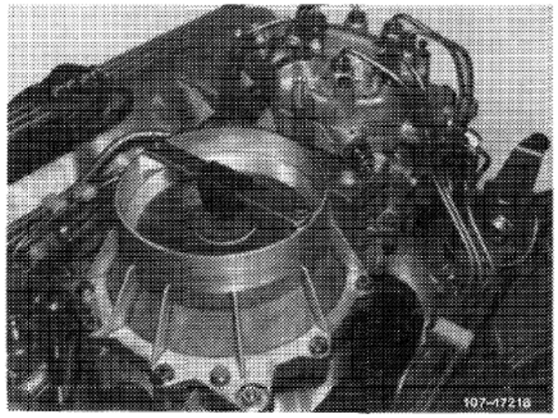


Checking

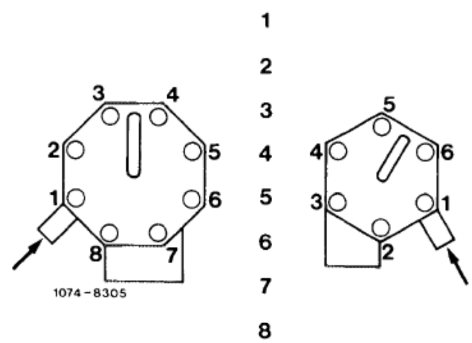
1 Set up quantity reference measuring unit horizontally adjacent to vehicle (tool or tester carriage).

2 Remove air cleaner.

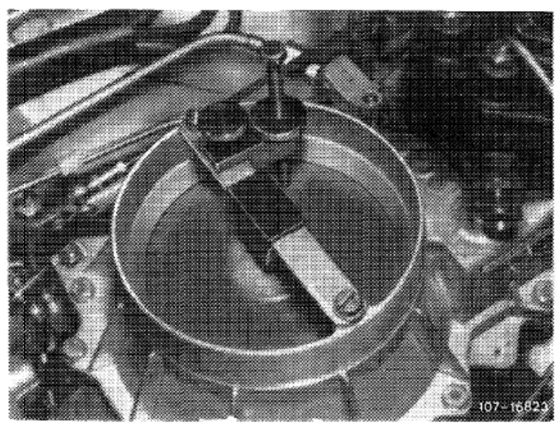
3 Unscrew injection lines on fuel distributor and loosen on injection valves, unscrew if required.



4 Connect connecting lines of quantity reference measuring unit to fuel distributor (sequence according to Fig.) and plug fuel return line into filler neck of fuel tank.



5 Clamp adjusting device for fixing air flow sensor plate to stop bracket of air funnel (cone).



6 Switch on ignition.

7 Deflect air flow sensor plate and push individually and for a short moment buttons 1 to 8 for venting unit.

8 Keep one button pushed, deflect air flow sensor plate with adjusting device and fix at a flow rate of 6 cc/min (idle).

9 Push remaining buttons, read individual flow rates and enter on data sheet.

Note: Service establishments and major representatives in the Federal Republic of Germany should address orders for data sheets, print No. 800.99.472.00 to the Drucksachen-Zentrallager in Stuttgart-Untertürkheim, and general representatives in export countries to ZKD/F 2, Stuttgart-Untertürkheim. Data sheets are available in blocks of 50 sheets each.

10 Calculate difference between smallest and largest flow rate and compare with tolerance value (refer to test values.

11 For partial and full load fix air flow sensor plate as described under item 8 at a flow rate of 30 cc/min or 100 cc/min. Then also calculate difference between smallest and largest flow rate and compare with tolerance value.

12 If dissipation is outside tolerance, exchange fuel distributor.

13 Run engine and check all fuel connections for leaks.

14 Adjust idle (07.3–100).

07.3–165 Checking fuel pump relay

Function

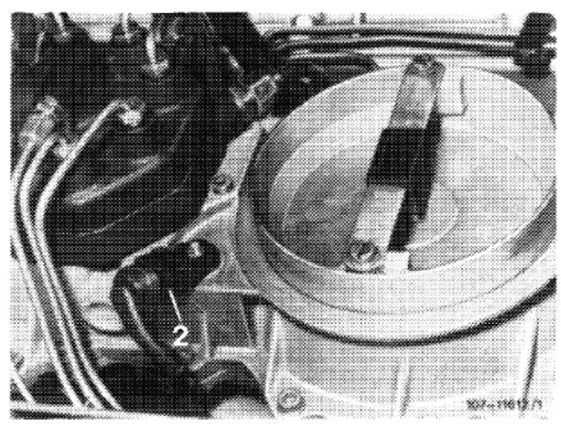
The fuel pump relay for voltage supply of fuel pump has two functions:

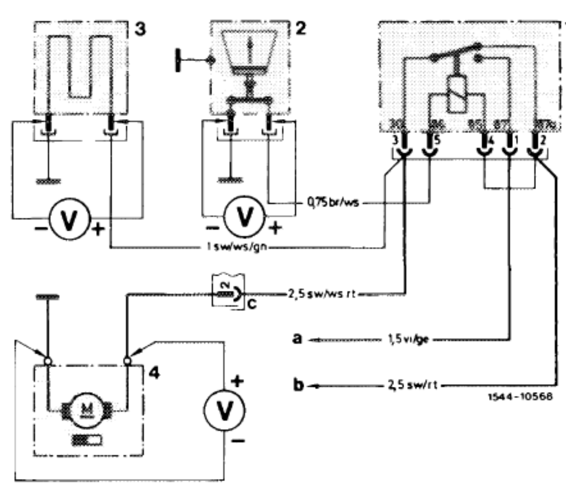
1. Activation of fuel pump while starting and with engine running.

   Parallel to fuel pump, the warm-up compensator will also be activated.

2. Switching off fuel pump upon activation of fuel pump relay by safety switch.

With air flow sensor plate closed, the safety switch (2) connects ground to jack 5 (terminal 86) of fuel pump relay (1). As a result, the relay will be switched in such a manner that the fuel pump (4) can be activated only via terminal 50 (starting voltage). As soon as the air flow sensor plate is lifted, the safety switch will open and the fuel pump relay will switch over. The fuel pump is now supplied with voltage via terminal 15/54.

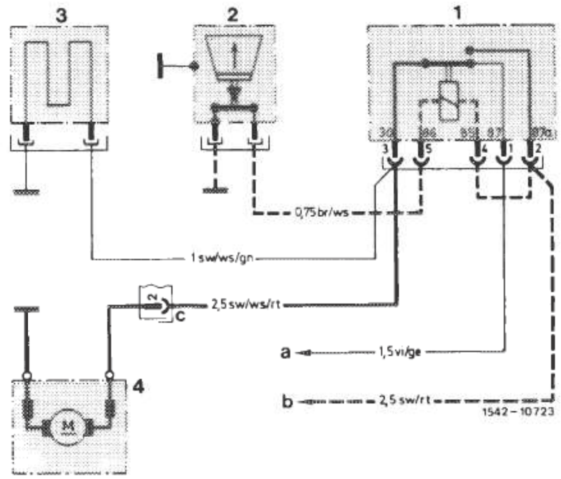




1 Fuel pump relay
2 Safety switch air flow sensor plate
3 Warm-up compensator
4 Fuel pump
a Terminal 50 (starting)
b Terminal 15/54 (ignition)
c Plug connection 14-point Tail lamp harness

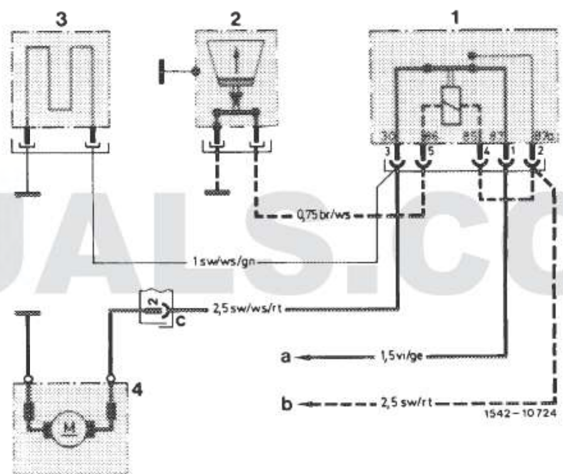
Activation of fuel pump when starting and with engine running

a) Ignition switched on.
Fuel pump not running.

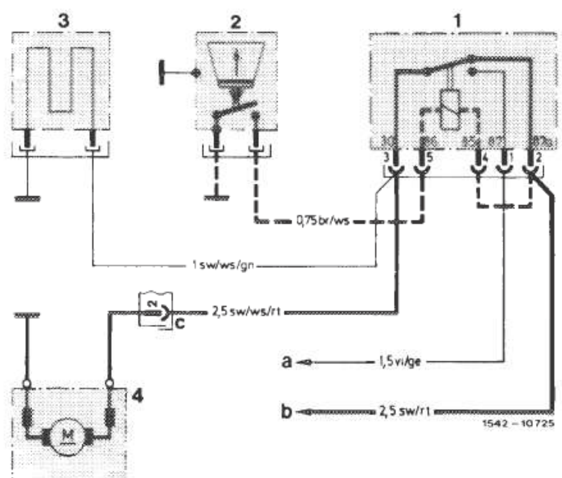


1 Fuel pump relay
2 Safety switch air flow sensor plate
3 Warm-up compensator
4 Fuel pump
a Terminal 50 (starting)
b Terminal 15/54 (ignition)
c Plug connection 14-point
Tail lamp harness
——— Working current circuit
- - - - Control circuit

b) Starting procedure.
Fuel pump running.



c) Engine and fuel pump running.



Checking

Conventional tester

Voltmeter

1 Remove air cleaner.

2 Switch on ignition and push air flow sensor plate for a short moment down. Fuel should audibly inject when air flow sensor plate is actuated.

If yes, the fuel pump and the safety switch are in order.

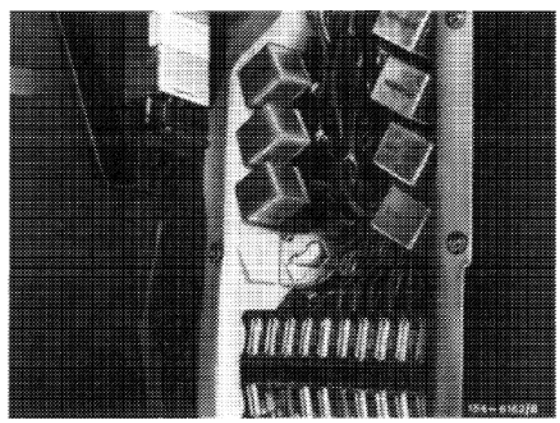
If no, check through test program.

Attention!
If air flow sensor plate is activated several times or for a longer period, there is the risk that too much fuel may enter combustion chamber. This may lead to a "fuel knock" during start.

Layout fuel pump relay:

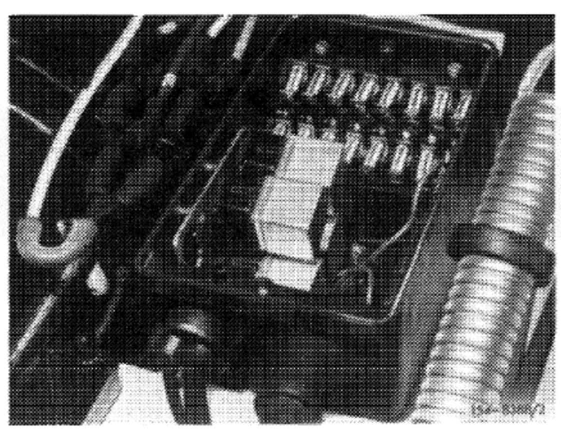
Model 107: In fuse box under glove box.

The cable harness for fuel pump relay is identified with 21.



Model 116: In fuse box in lefthand wheel house.

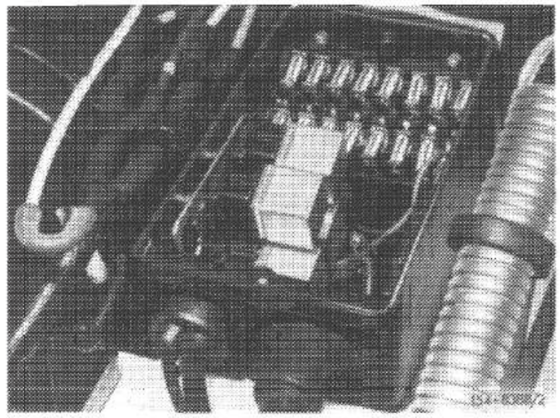
The cable harness for fuel pump relay is identified with 21.



Checking activation of fuel pump relay

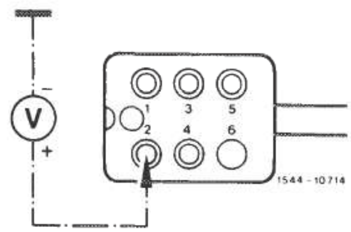
Remove fuel pump relay. Switch on ignition. Connect negative cable of voltmeter to vehicle ground. Measure voltage with positive cable of voltmeter on jack 2 (terminal 87a) and jack 4 (terminal 85) of coupler.

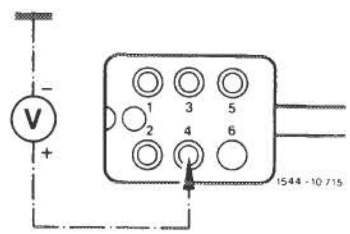
approx. 12 volts	0 volt



Check line (terminal 15/54 black/red) for interruption.

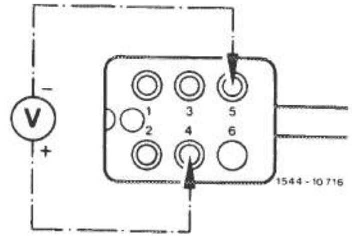
Repair interruption.





Check zero position of air flow sensor plate. Measure voltage with voltmeter between jack 4 (terminal 85) and jack 5 (terminal 86) of coupler.

approx. 12 volts	0 volt

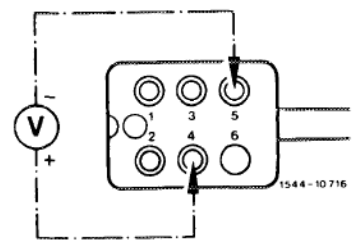


1 Test line between jack 4 and 2, as well as line brown/white to safety switch for interruption.

Repair interruption.

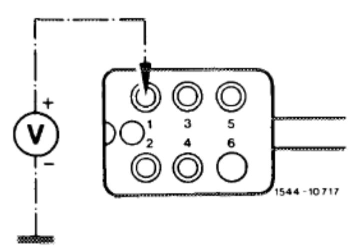
2 Test safety switch.

Air flow sensor plate opened. Measure voltage between jack 4 (terminal 85) and jack 5 (terminal 86) of coupler.	
0 volt	approx. 12 volts



Test safety switch and renew, if required.

Actuate starter. Measure voltage with positive cable of voltmeter on jack 1 (terminal 87).	
approx. 12 volts	0 volt



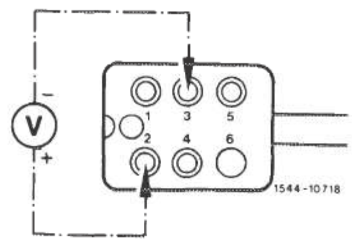
Test line purple/yellow for interruption.

Repair interruption.

Checking activation of fuel pump

Measure voltage with voltmeter between jack 2 (terminal 87a) and jack 3 (terminal 30).

approx. 12 volts, fuel pump running.	0 volt

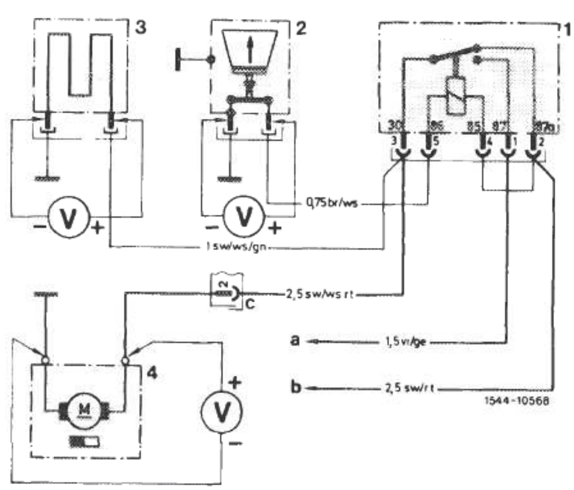


Test line black/white/red and ground connecting line for interruption (wiring diagram).

Repair interruption.

Line in order and fuel pump not running, renew pump.

End of test

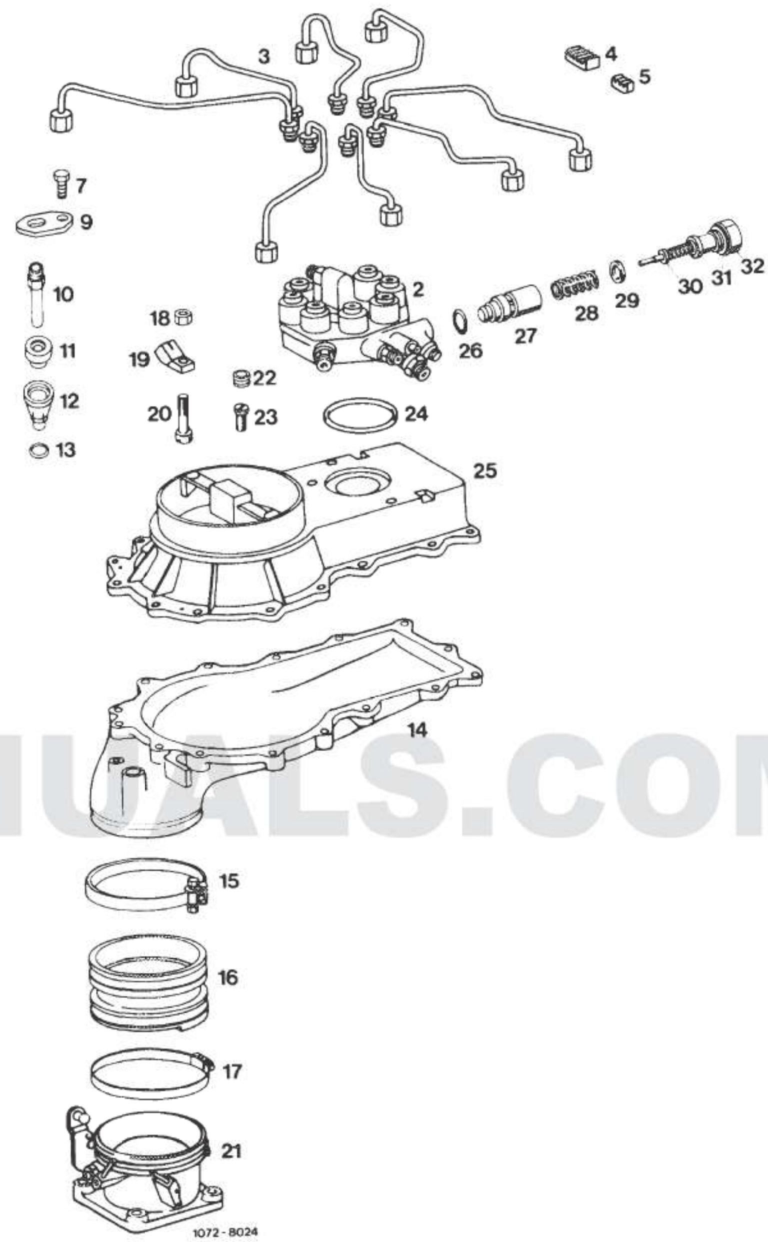


1 Fuel pump relay
2 Safety switch air flow sensor plate
3 Warm-up compensator
4 Fuel pump
a Terminal 50 (starting)
b Terminal 15/54 (ignition)
c Plug connection 14-point
 Tail lamp harness

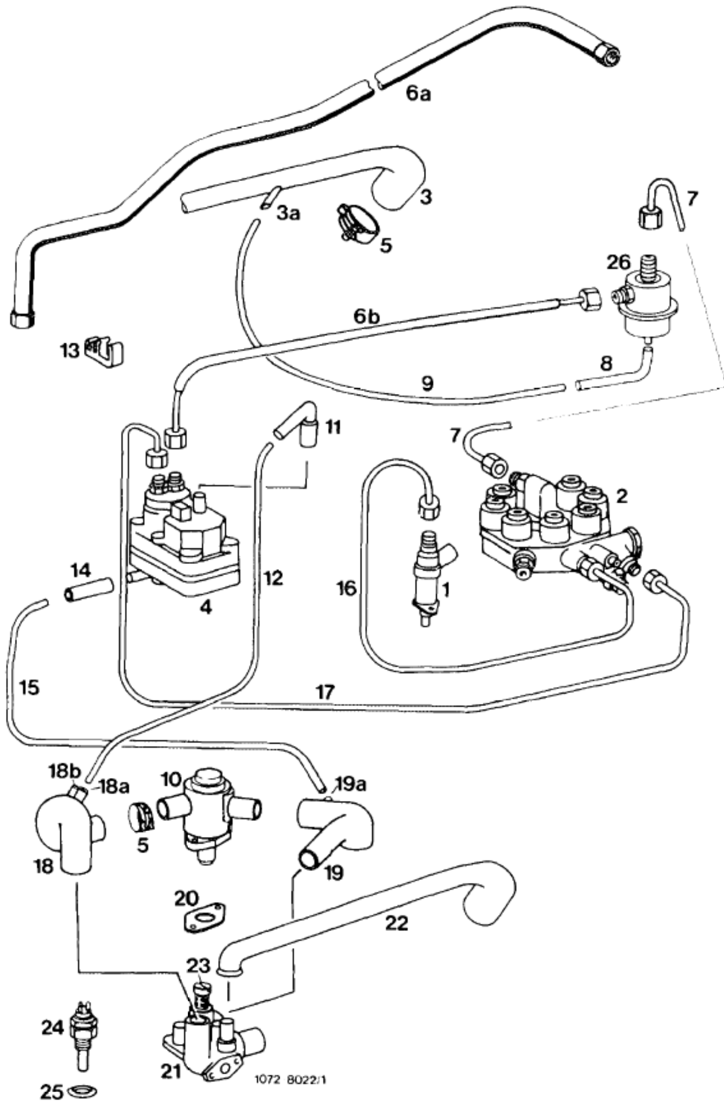
Run engine at idle.	
Running.	Not running.
↓	↓
In order.	Renew relay.

End of test.

07.3–199 Mixture preparation



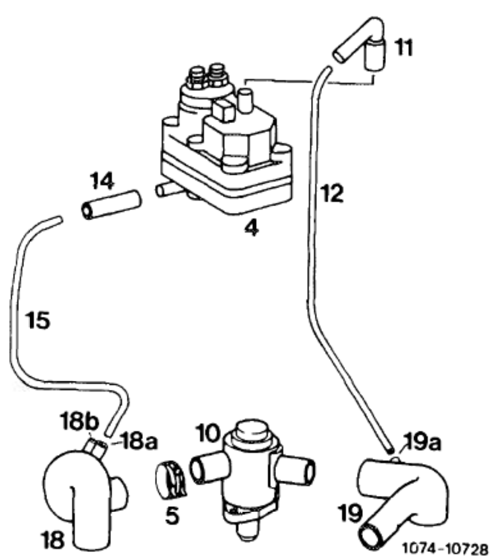
2 Fuel distributor
3 Injection lines
4 Plastic clip
5 Plastic clip
7 Hex. screw
9 Fastening plate
10 Injection valve
11 Rubber ring
12 Plastic sleeve
13 O-ring
14 Air guide housing
15 Hose clip
16 Rubber sleeve
17 Hose clip
18 Polystop nut
19 Safety switch
20 Screw
21 Throttle valve housing
22 Closing plug
23 Closing plug
24 O-ring
25 Air flow sensor
26 O-ring
27 Control piston
28 Compression spring
29 Adjusting washers
30 O-ring
31 Copper sealing ring
32 Closing plug



1 Cold-starting valve
2 Fuel distributor
3 Contoured hose for breather at righthand cylinder head cover
3a Leak connection
4 Warm-up compensator
5 Hose clip
6a Control pressure line of Tecalan – 1st version
6b Control pressure line with Tecalan insert – 2nd version
7 Control pressure line
8 Connecting hose
9 Leak line
10 Supplementary air valve
11 Contoured hose
12 Vacuum line
13 Plastic clip
14 Connecting hose
15 Leak line
16 Fuel line
17 Fuel line
18 Contoured hose
18a Connection for full load enrichment
18b Connection for ignition retard adjustment
19 Contoured hose
19a Connection for leak line
20 Gasket
21 Idle speed air distributor
22 Contoured hose
23 Idle speed air screw
24 Thermo-time switch
25 Sealing ring
26 Pressure damper

(USA) **1979**

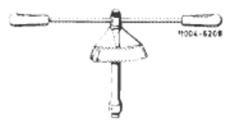
Connection for full load enrichment modified.



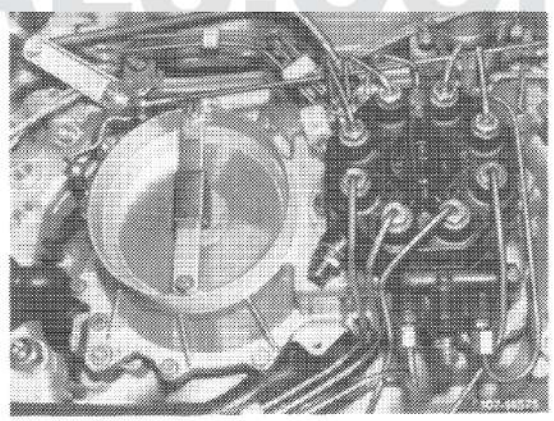
07.3–200 Removal and installation of mixture controller

Tightening torques	Nm
Hex. screw with mixture controller to air guide housing	9–10
Hex. nuts mixture controller to intake pipe (rubber buffer)	9–10
Injection lines and fuel lines to fuel distributor (reference value)	10–12
Injection lines to injection valves (reference value)	10–15

Special tool

Torque wrench 1/4" square, 4–16 Nm		000 589 67 21 00

Removal



1 Remove air cleaner.

2 Unscrew all fuel and injection lines on fuel distributor and on injection valves. Catch fuel with a rag.

Deactivate fuel feed and return line.

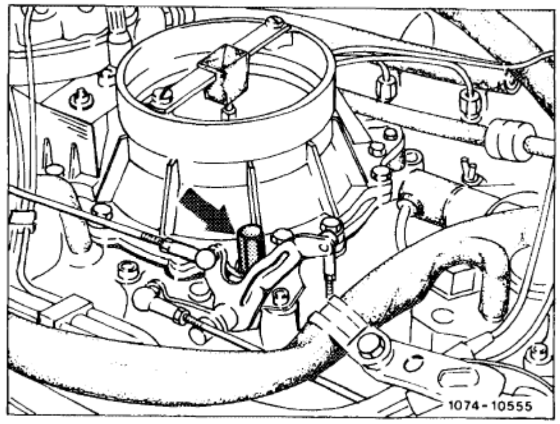
3 Pull electric connecting cable from safety switch.

4 Unscrew all hex. screws and both hex. nuts on mixture controller.

5 Remove mixture controller with gasket.

6 Renew air guide housing according to condition. For this purpose, loosen hose clip on rubber sleeve and on contoured hose for idle speed air.

Installation



7 Mount air guide housing.

8 Install mixture controller with Curil K 2 or Hylomar in vice versa sequence.

For better location of air cleaner install a stop nut (arrow), part No. 117 070 00 41, at front right instead of hex. nut.

9 Tighten hex. screws and hex. nuts to 9–10 Nm.

10 Connect injection lines and fuel lines. Pay attention to tightening torques as reference values.

Attention!
When tightening injection lines and fuel lines, apply counterhold to injection valves as well as to double thread connections on fuel distributor.

11 Keep engine running and check all fuel connections for leaks.

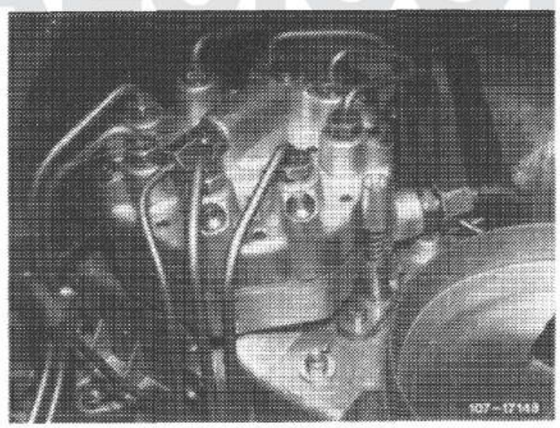
12 Adjust idle speed (07.3–100).

07.3–205 Renewing fuel distributor

Tightening torques (reference values)	Nm
Injection lines to fuel distributor	
Fuel line for cold-starting valve to fuel distributor	
Fuel return line from warm-up compensator to fuel distributor	10–12
Control pressure line to fuel distributor	
Control pressure line to pressure damper	
Injection lines to injection valves	10–15

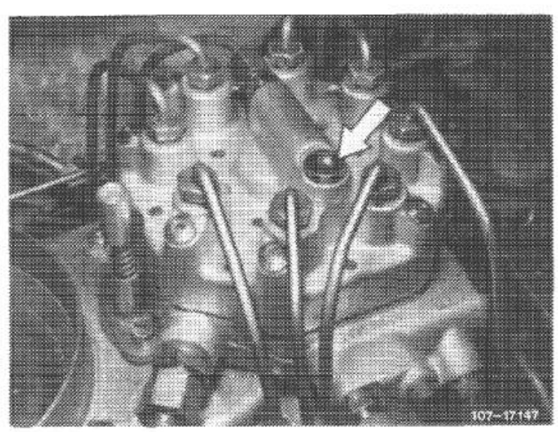
Note

After fuel distributors made of grey iron have been used up, only fuel distributors made of light alloy will be available as spare parts. This fuel distributor is provided with a fabric diaphragm between upper and lower half. The fuel distributor top has 8 closing plugs with adjusting screws underneath for differential pressure valves. The differential pressure valves are set by manufacturer, adjustments are not permitted.



In addition, the fuel distributor top has a pressure compensating valve (arrow), as well as a compression spring which is integrated above control piston.

The compression spring is installed on grey-iron fuel distributor since February 1979, the light-alloy fuel distributor since start of series.

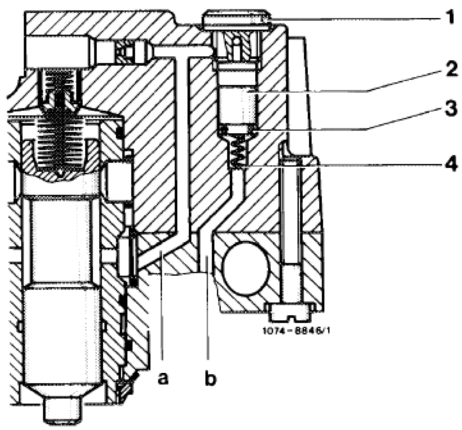


The pressure compensating valve is closed as long as fuel system is under pressure.

In the event of a pressure drop "following an extended stationary period and cooling down of fuel" below 0.3—0.5 bar gauge pressure, the pressure compensating valve will open.

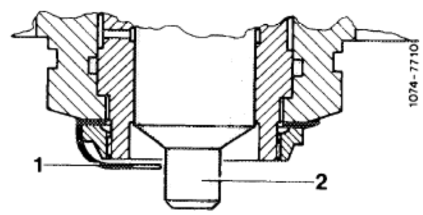
Piston (2) is lifted and the pressure between system pressure and return pressure is compensated.

This will prevent that the control piston in fuel distributor is lifted in direction of full load when the engine is stopped, and will also prevent heavy enrichment of mixture during cold start.



1 Closing plug
2 Piston
3 O-ring
4 Compression spring
a System pressure
b Return flow

Starting with Bosch production no. 724, the fuel distributor is provided with a sheet-metal lock (1). which prevents control piston (2) from dropping out. The **sheet-metal lock** serves to facilitate assembly and as a transportation lock **and should not be removed.**

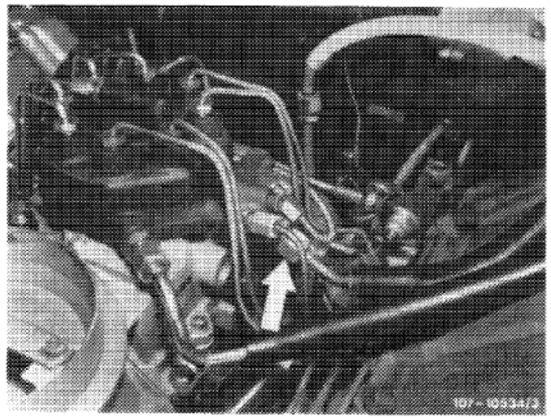


Removal

1 Remove air filter.

2 Unscrew all fuel and injection lines on fuel distributor and on injection valves. Catch fuel with a rag.

Deactivate fuel forward and return flow line.



3 Unscrew the three fastening screws on fuel distributor.

4 Remove fuel distributor by turning back and forth.

Attention!
On fuel distributor without sheet-metal lock make sure during removal of fuel distributor that the control piston will not fall out.

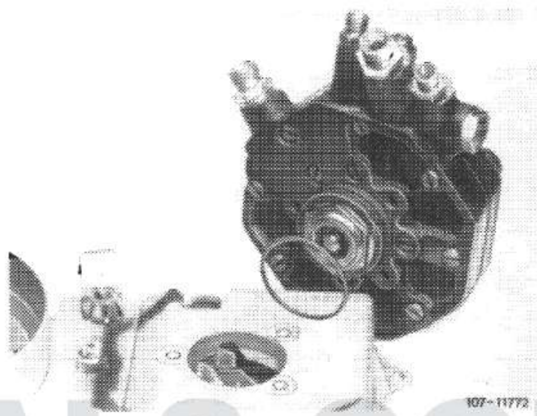
Installation

5 Mount fuel distributor in vice versa sequence.

6 Slip new rubber ring on fuel distributor.

7 Slightly lubricate rubber ring and carefully mount fuel distributor.

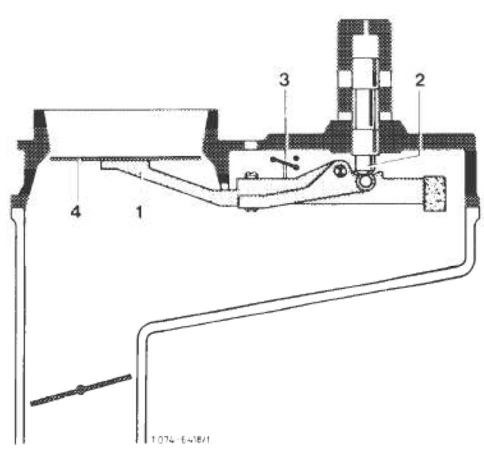
Attention!
Do not damage rubber ring during assembly, so that no false air will be drawn in.



8 Connect all fuel lines except injection lines.

9 Check adjusting lever (1) in air flow sensor and control piston (2) in fuel distributor for easy operation.

For this purpose, pull plug from safety switch (3). Switch on ignition for a short period to establish control pressure. Push air flow sensor plate (4) manually downwards. A uniform resistance should be felt along entire path. When moving up fast, no resistance should be felt, since the slowly following control piston lifts off from adjusting lever. During the slow upward movement, the control piston should smoothly follow.



10 Check association of control piston in relation to air flow sensor plate and adjust, if required. For this purpose, switch on ignition and pull cable plug from safety switch. The fuel should now just stop to flow at outlet connection for injection lines. Adjust association by means of idle speed mixture control screw, if required.

11 Mount injection lines.

12 Keep engine running and check all fuel connections, as well as rubber ring on fuel distributor for leaks by means of spray test.

13 Adjust idle speed (07.3–100).

07.3–210 Reconditioning system pressure regulator and pressure compensating valve

Test data

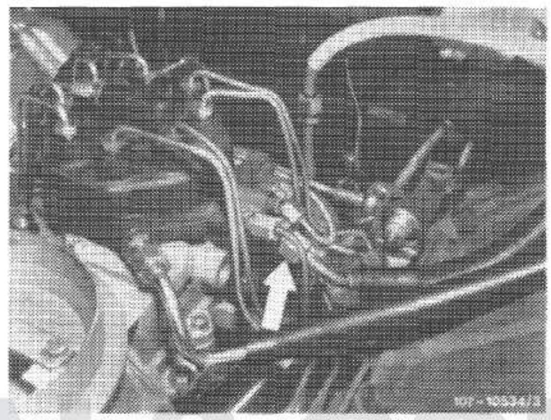
System pressure (engine cold or warm) at idle	5.0–5.6 bar gauge pressure

Note

O-ring (1) and contour ring (1) of control piston (2) are available as individual components.

Reconditioning

1 Reduce fuel pressure. For this purpose, unscrew fuel return hose (arrow) on fuel distributor. Catch fuel with a rag. Close fuel return hose blind.

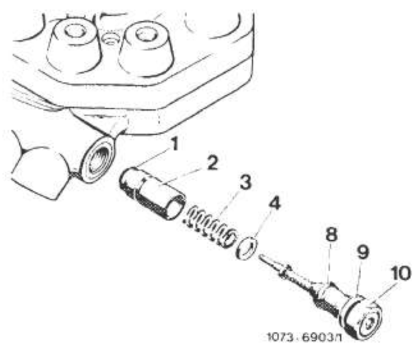


System pressure regulator

2 Unscrew closing plug (10). When screwing out, make make sure that the compression spring (3) and the adjusting washers (4) are not dropping out.

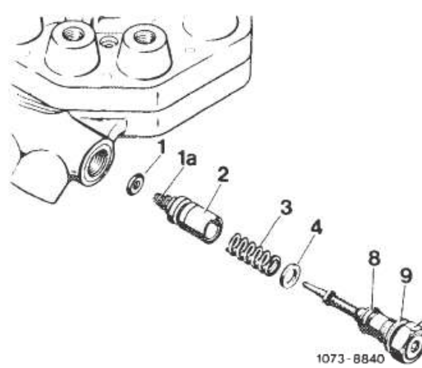
3 Remove control piston (2) with a magnet or a wooden stick (pencil).

Remove O-ring (1) on 1st version.



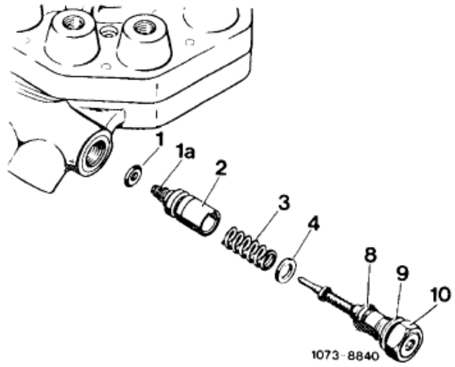
1st version

4 On 2nd version, cut through contour ring (1) of control piston and remove.



2nd version

5 Install components from repair kit.



Attention!
The control piston (2) is fitted into fuel distributor and should not be replaced. If required, renew complete fuel distributor.

On 2nd version, carefully slide new contour ring (1) over lock (1a), lubricate slightly and mount control piston with compression spring (3).

Mount assembly group with removed adjusting washers (4) and supplied copper sealing ring (9).

6 Check system pressure (07.3–120). If the system pressure deviates from nominal value, remove system pressure regulator once again and adjust system pressure by adding or removing adjusting washers (4).

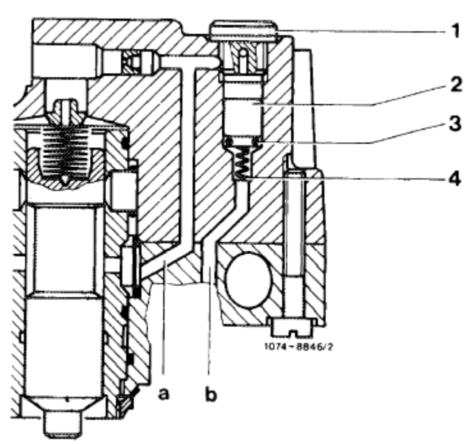
The adjusting washers are contained in repair set and are available at the following thickness:

0.1 mm
0.15 mm
0.3 mm
0.4 mm
0.5 mm

0.1 mm provides approx. 0.2 bar system gauge pressure.

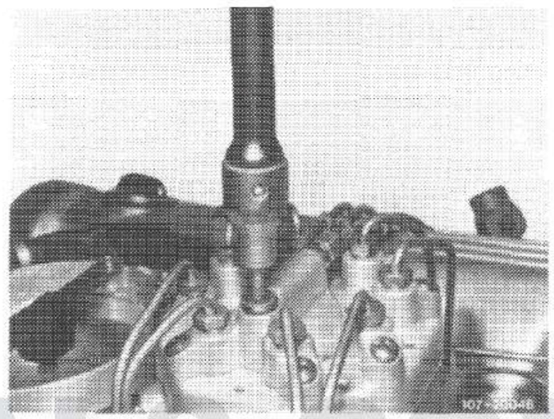
Pressure compensating valve

7 Unscrew closing plug (1). Remove piston (2) with contour ring (3).



8 Install components of repair set.

To loosen closing plug (1), use screwdriver element, e.g. Hazet, D-5630 Remscheid, order No. 992–T 30.



07.3–215 Removal and installation of injection valves

Tightening torques (reference values)	Nm
Injection lines to fuel distributor	10–12
Injection lines to injection valves	10–15

Removal

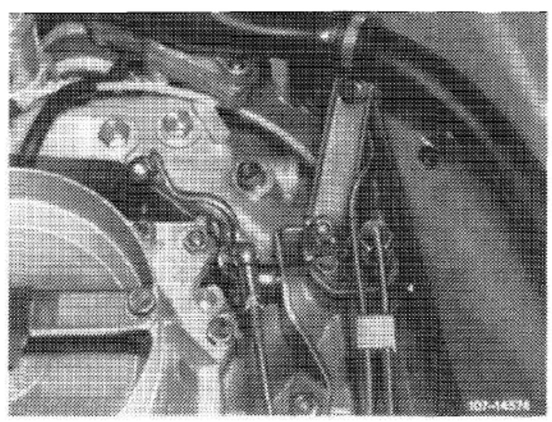
1 Remove air filter.

2 Unscrew injection lines on injection valves and on fuel distributor. Apply counterhold to injection valves when loosening injection lines.

Attention!
When unscrewing injection line of cylinder 2, avoid kinks in Tecalan line (if installed), unscrew Tecalan line, if required.

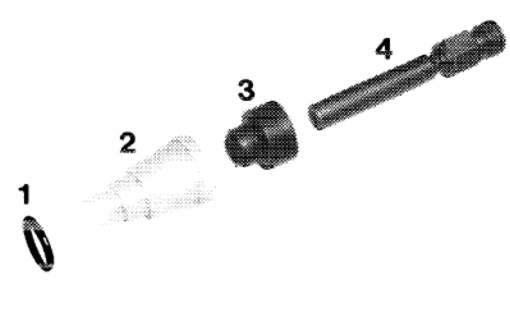
3 Unscrew fuel line for cold-starting valve.

4 Loosen fastening screws and remove fastening bridges. When loosening 8th injection valve, unscrew bearing bracket for longitudinal regulating shaft, if required.



Attention!
When removing fastening bridges, apply counterhold to injection valves, so that the injection valves and the insulating sleeves are not following along.

5 Pull out injection valves. While applying counterhold to insulating sleeve (2). If the insulating sleeves are pulled out, install new O-rings (1).



Installation

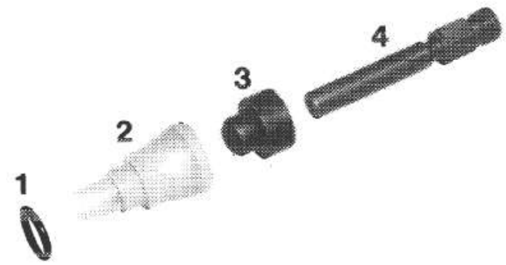
6 Install injection valves in vice versa sequence. For this purpose, displace or renew rubber sealing rings (3).

Note: Mount pulled out insulating sleeves with new O-rings.

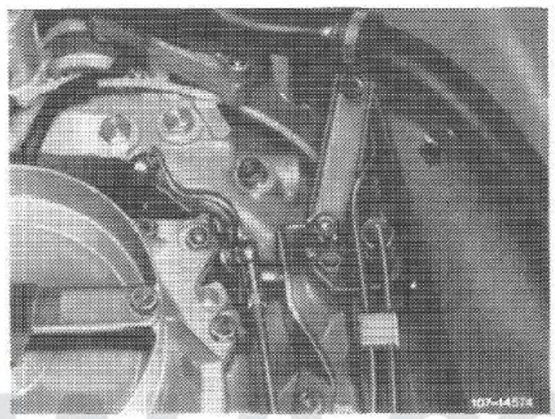
7 Connect injection lines and fuel line for cold-starting valve while paying attention to tightening torques as reference values.

Attention!
Apply counterhold to injection valves when tightening injection lines.

8 Keep engine running and check all fuel connections for leaks.



107–11773

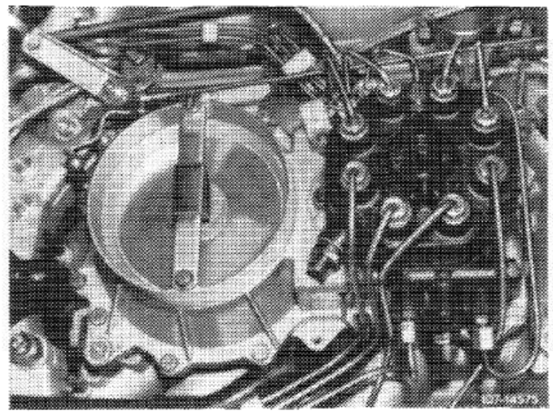


07.3–220 Renewing air flow sensor

Renewal

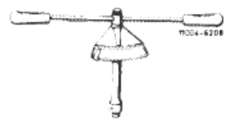
1 Remove and install mixture controller (07.3–200).

2 Remove and install fuel distributor (07.3–205).

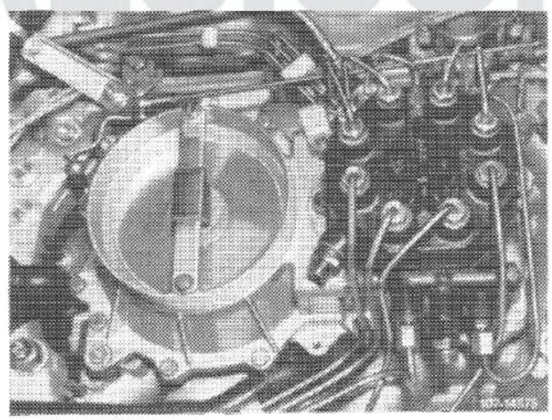


07.3–225 Removal and installation of mixture controller with air guide housing

Tightening torques	Nm
Hex. nuts mixture controller to intake pipe (rubber buffer)	9–10
Injection lines and fuel lines to fuel distributor (reference value)	10–12
Injection lines to injection valves (reference value)	10–15

Special tool		
Torque wrench 1/4" square, 4–16 Nm		000 589 67 21 00

Removal



1 Remove air cleaner.

2 Unscrew all fuel and injection lines on fuel distributor and on injection valves. Catch fuel with a rag.

3 Unscrew holder for fuel feed and return line and close lines blind.

4 Pull electric connecting cable from safety switch.

5 Loosen hose clip on rubber sleeve between air guide housing and valve housing.

6 Pull contour hose from air guide housing to supplementary air valve.

7 Unscrew hex. nuts from rubber buffers.

8 Remove mixture controller with air guide housing.

Note: On Teclan line, make sure that there are no kinks.

Installation

9 For installation proceed vice versa.

10 Tighten hex. nuts to specified torque by means of torque wrench.

11 Connect injection lines and fuel lines. Pay attention to reference value for tightening torques.

Attention!
When tightening injection lines and fuel lines, apply counterhold to injection valves as well as to double thread connections on fuel distributor.

12 Keep engine running and check all fuel connections for leaks.

13 Adjust idling speed (07.3–100).

07.3–230 Removal and installation of throttle valve housing

Note

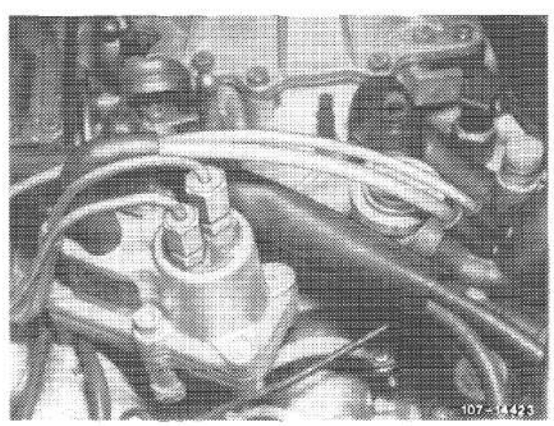
Starting approx. April 1978 the throttle valve housing has no longer a connection for ignition retard adjustment.

Start of series

Model	starting chassis end No.
107.023	012024
107.024	019375
107.043	013199
107.044	042800
116.028/029	044654
116.032/033	076606

As of this date the ignition retard adjustment is connected to contour hose between auxiliary air valve and idle speed air distributor (15–525).

In the event of repairs, only the throttle valve housing is now installed without connection for ignition retard adjustment, or the connection for ignition retard adjustment must be closed with rubber cap part no. 000 987 11 45. In this connection, also renew contour hose between supplementary air valve and idle speed distributor, since the ignition retard adjustment is made there.



Removal

1 Remove mixture controller with air guide housing (07.3–225).

2 Remove ignition distributor (15–510)

3 Loosen and remove rubber sleeve.

4 Disconnect regulating linkage and return spring.

5 Pull off vacuum connections.

6 Loosen fastening screws and remove throttle valve housing.

Installation

7 For installation proceed vice versa using new gasket.

8 Adjust regulating linkage (30–300).

9 Adjust firing point (15–500).

10 Adjust idle speed (07.3–100).

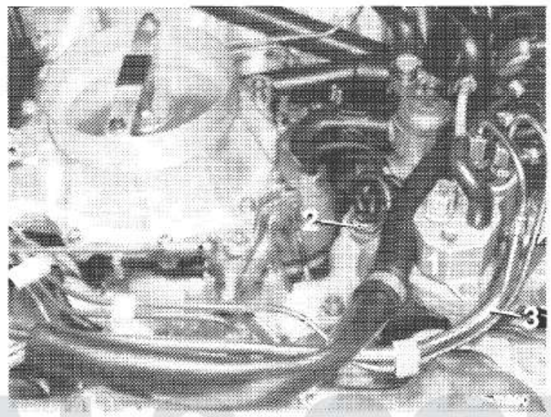
07.3–240 Renewing warm-up compensator

Note

Engine 116

On engine 116 the warm-up compensator is screwed directly to intake pipe from start of production.

The control pressure line (3) from pressure damper to warm-up compensator (1) is made of steel. To compensate for pressure vibrations, a hollow plastic body (float) is inserted in pressure control line.



Engine 116

1 Warm-up compensator
2 Thermovalve 40 °C
3 Control pressure line

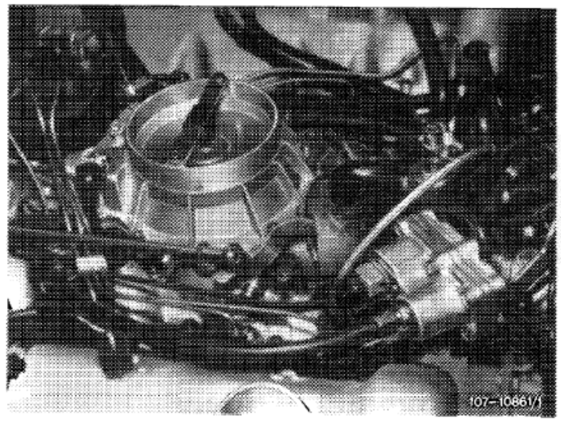
Engine 117

The fastening method for warm-up compensator on engine 117 has been changed. Starting approx. April 1976 the warm-up compensator is fastened directly to intake manifold and is in addition provided with a steel control pressure line with internal plastic hollow body (float) between warm-up compensator and diaphragm damper (formerly Tecalan control pressure line).

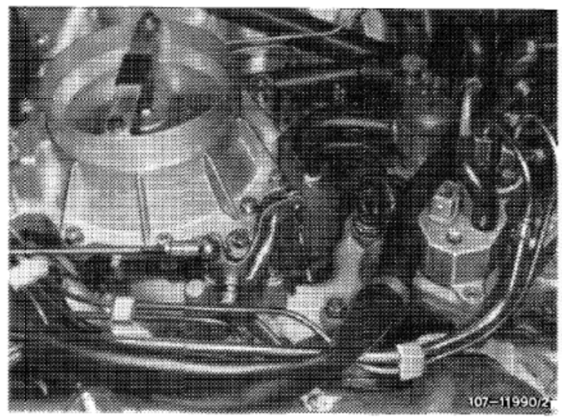
The control pressure line, the return line and the diaphragm damper with holder were modified due to the different installation position of the warm-up compensator.

Start of series: approx. April 1976

Model	starting chassis end no.
107.024	013543
107.044	032743
116.032/033	052125



Engine 117
1st version



Engine 117
2nd version

When renewing the pressure control line and the return line, and also the diaphragm damper, the fastening on vehicles with lower chassis end no. must be changed, since the following parts are no longer available as a spare part:

Fastening plate for warm-up compensator
Rubber washers
Tecalan-control pressure line
Return line
Diaphragm damper with fastening plate

Renewing

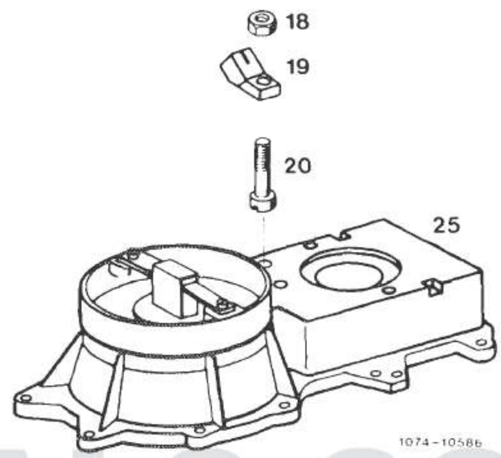
1 Remove all connections on warm-up compensator and unscrew warm-up compensator at fastening plate.

2 Unscrew fastening plate together with rubber washers on intake pipe.

3 Unscrew diaphragm damper with fastening plate.

07.3.1–242 Subsequent installation of safety switch on air flow sensor

When installing a new engine or an exchange engine without safety switch (19) on air flow sensor and rpm-limited distributor rotor into vehicles, in which these components had been installed until then, transfer safety switch and rpm-limited distributor rotor from old engine.



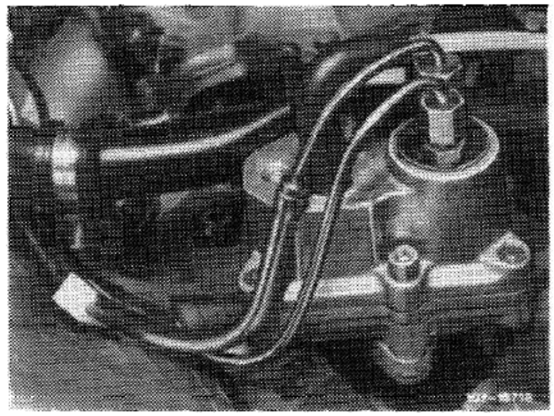
1 Remove mixture controller from new engine.

2 Install safety switch (19) as shown in Fig. Leave out removed disk.

Attention!
When mounting safety switch, make sure that the insulating disk is correctly mounted under leaf spring.

3 Install rpm-limited distributor rotor into new engine.

4 Mount warm-up compensator without fastening plate directly to intake pipe.



5 Mount new diaphragm damper and new fastening plate.

6 Screw new steel control pressure line to diaphragm damper and new return line (do not yet tighten).

7 Install control pressure line and return line free of tension and chafing. For this purpose, pull off spark plug connection of cylinders 1—4.

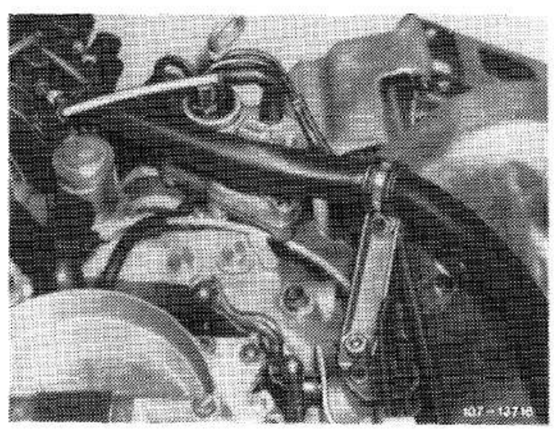
8 Tighten control pressure and return line and secure with plastic clips.

9 Attach regulating linkage, check for easy operation and adjustment and change adjustment, if required.

10 Plug electric connection as well as vacuum connections to warm-up compensator and install free of tension. Shorten vacuum lines, if required.

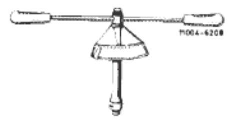
11 Install ignition cable harness and attach with new holder.

12 Keep engine running and check for leaks.



07.3–245 Renewing air flow sensor plate, centering, checking zero position of air flow sensor plate and adjusting

Tightening torque	Nm
Hex. head screw	5.0–5.5

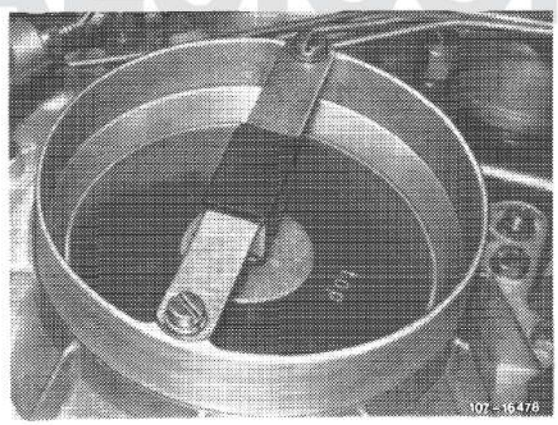
Special tool		
Torque wrench 1/4'' square, 4–16 Nm		000 589 67 21 00

Conventional equipment and tools
Hot air blower, tap M 6

Removal

1 Remove air cleaner.

2 Unscrew stop bracket.



3 Heat fastening screw with a hot air blower and screw out carefully (risk of tearing).

Attention!
The fastening screw is micro-encapsulated.

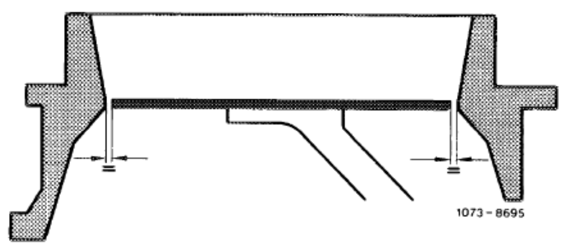
4 Clean bore for fastening air flow sensor plate by means of tap M 6.

Installation

5 Install components of repair set. Insert air flow sensor plate with letters "TOP" in upward direction and insert top. Lightly screw in micro-encapsulated fastening screw (self-locking).

6 Center air flow sensor plate. For this purpose, pull plug from safety switch. Switch on ignition for a short moment to establish control pressure.

Apply feeler gauge 0.10–0.20 mm to make sure that the air flow sensor plate is accurately centered. Air flow sensor plate should not bind even under light lateral pressure (bearing play cancelled).

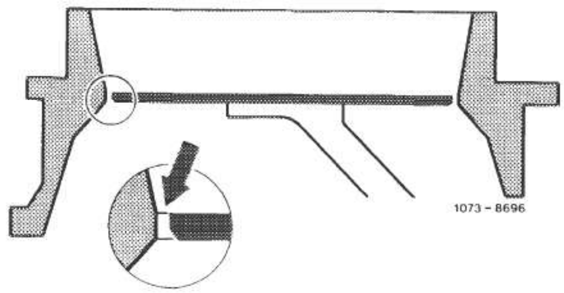


7 Tighten fastening screws to 5.0–5.5 Nm.

8 Check air flow sensor plate for easy operation. For this purpose, push air flow sensor plate down manually. Plate should not bind. Release air flow sensor plate, plate should also not bind during return and should audibly knock against resilient stop. Center air flow sensor plate once again, if required.

9 Check zero position (rest position) of air flow sensor plate. Upper edge of air flow sensor plate should be accurately flush with cylindrical portion of air funnel (arrow) along entire circumference. A higher position up to max. 0.5 mm is permitted.

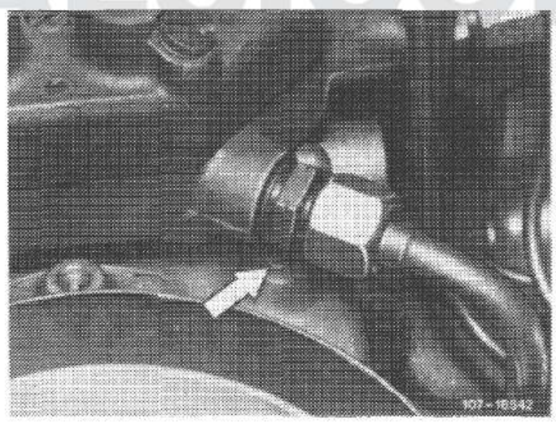
Note: To check zero position, pull off plug on safety switch and switch on ignition for a short moment. This will energize control piston with control pressure.



10 Adjust zero position of air flow sensor plate.

a) If too high, unscrew fuel inlet connection, knock in guide pin (arrow) by means of a mandrel (punch) deeper as required.

b) If too low, remove mixture controller and knock in guide pin from below (07.3–200).



Attention!
Knock in guide pin very carefully, so that pin is not knocked in too deep.

Avoid adjusting several times in both directions, since this will reduce press fit of pin too much.

11 Mount fuel inlet connection and stop bracket, plug on safety switch.

12 Adjust idle speed (07.3–100).

07.3–270 Removal and installation of fuel storage reservoir

Special tool

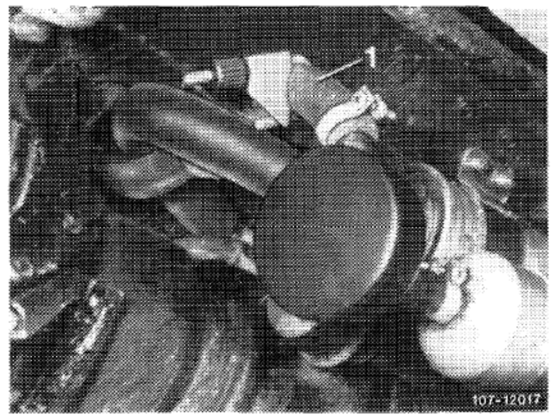
Clamp for fuel hose		000 589 40 37 00

Removal

1 Unscrew protective box.

2 Pinch off fuel suction hose (1) with a clamp.

3 Pinch off fuel feed hose.

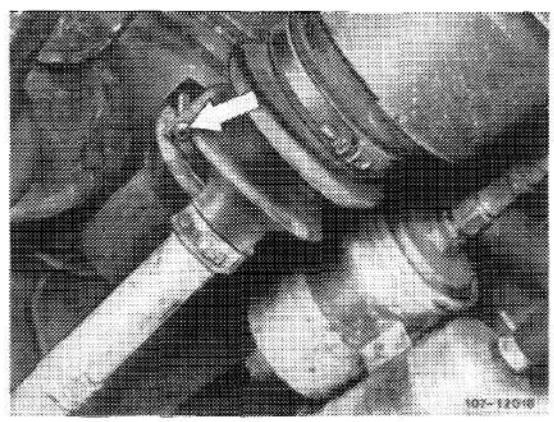


1st version

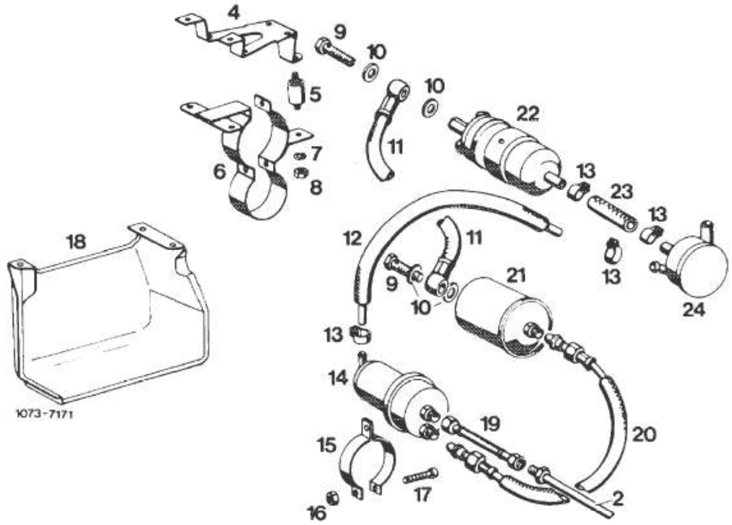
4 Unscrew both fuel hoses on fuel storage reservoir, pinch off leak hose, loosen and pull off.

5 Loosen fastening screws (arrow) for clamp and remove fuel storage reservoir.

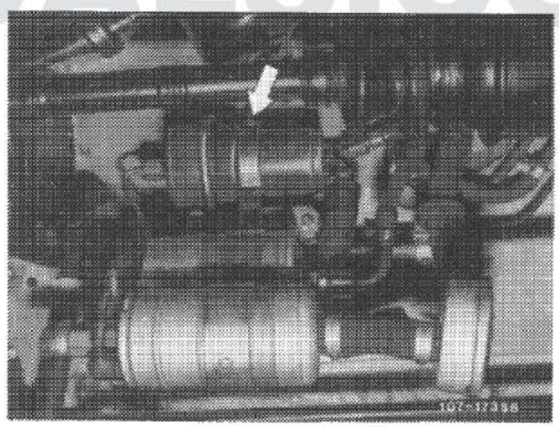
6 For installation proceed vice versa. Make sure of correct connection of fuel hoses. Mount fuel feed hose to center connection of fuel storage reservoir.



2 Fuel feed line
4 Holder
5 Vibration damper
6 Holder
7 Circlip
8 Nut
9 Hollow screw
10 Sealing ring
11 Fuel hose
12 Fuel hose
13 Hose clip
14 Fuel storage reservoir
15 Holder
16 Nut
17 Screw
18 Protective box
19 Fuel hose
20 Fuel hose
21 Fuel filter
22 Fuel pump
23 Fuel hose
24 Damper



2nd version



7 Unscrew fuel line on fuel reservoir, also pinch leak hose, loosen and pull off.

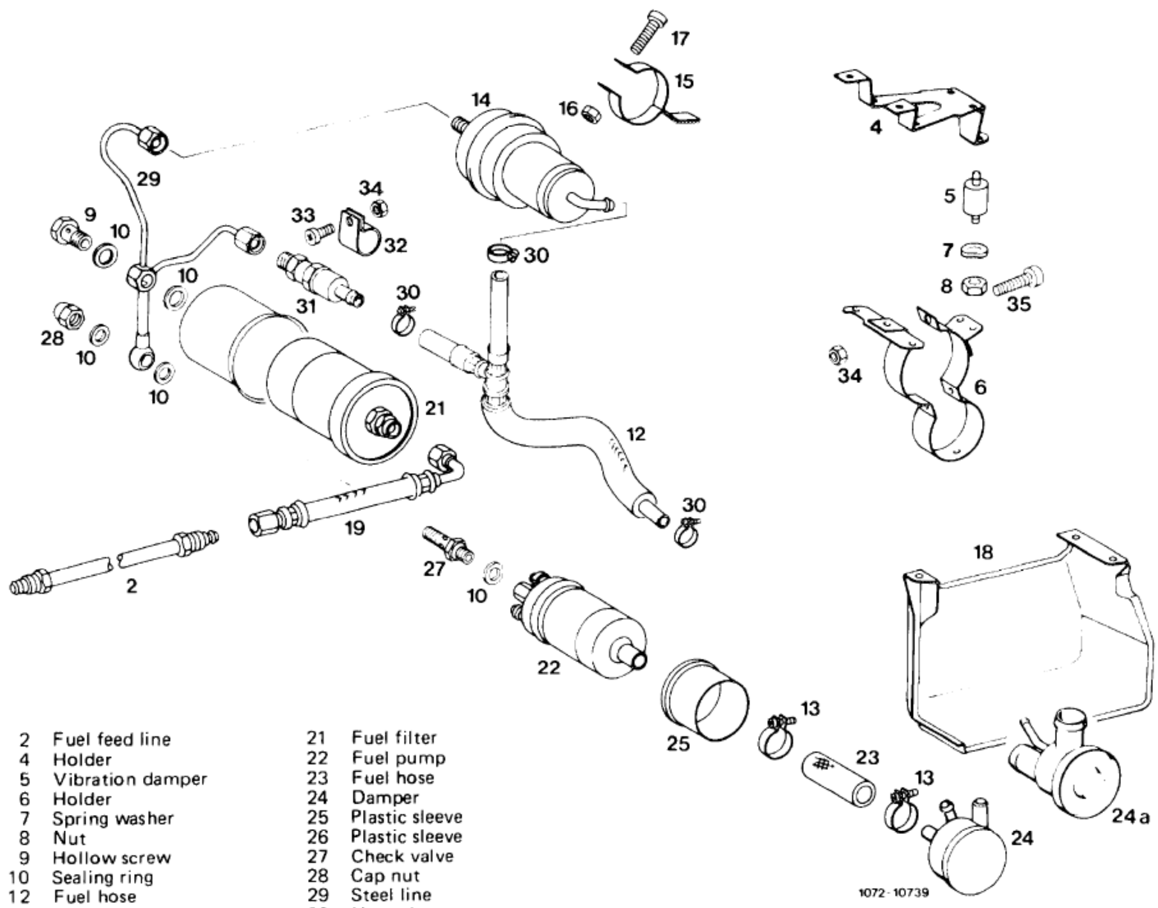
8 Loosen fastening screw (arrow) for clamp and remove fuel reservoir.

9 For installation proceed vice versa.

10 Remove clamp on fuel suction hose.

11 Run engine and check for leaks.

12 Mount protective box.



2	Fuel feed line	21	Fuel filter
4	Holder	22	Fuel pump
5	Vibration damper	23	Fuel hose
6	Holder	24	Damper
7	Spring washer	25	Plastic sleeve
8	Nut	26	Plastic sleeve
9	Hollow screw	27	Check valve
10	Sealing ring	28	Cap nut
12	Fuel hose	29	Steel line
13	Hose clamp	30	Hose clamp
14	Fuel reservoir	31	Pressure relief valve
15	Holder	32	Clamp
16	Nut	33	Screw
17	Screw	34	Nut
18	Protective box	35	Screw
19	Fuel hose		

07.3–275 Removal and installation of fuel filter

Special tool

Clamp for fuel hose		000 589 40 37 00

Note

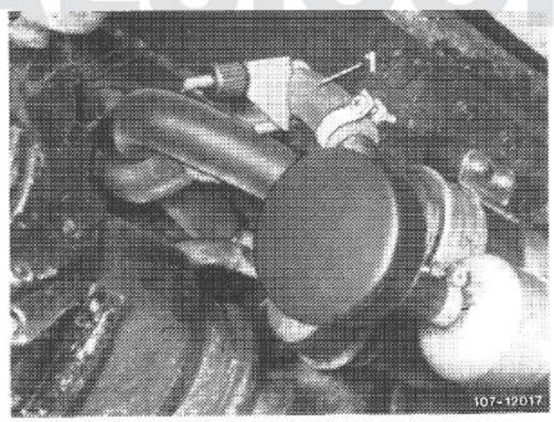
The fuel filter is additionally provided with an integrated damper for reducing noise. To prevent contact corrosion, the fuel filter carries a plastic sleeve.

When changing fuel filter, be sure that the plastic sleeve is mounted between fuel filter and holder. Sleeve should project on both sides of holder, since direct contact of fuel filter with holder may lead to contact corrosion.

Removal

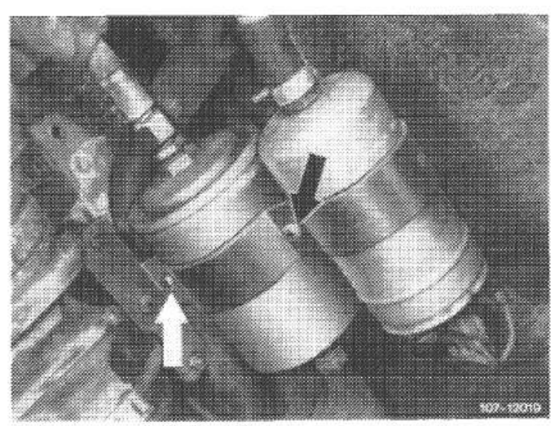
1 Unscrew protective box.

2 Pinch off fuel suction hose (1) with clamp.

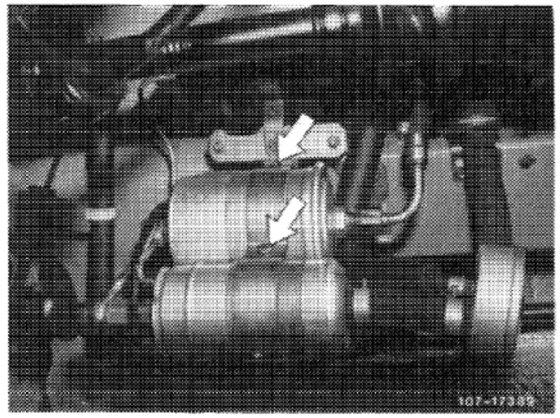


3 Unscrew both fuel hoses or fuel line and fuel hose on fuel filter.

4 Loosen both fastening screws (arrow) and remove fuel filter.



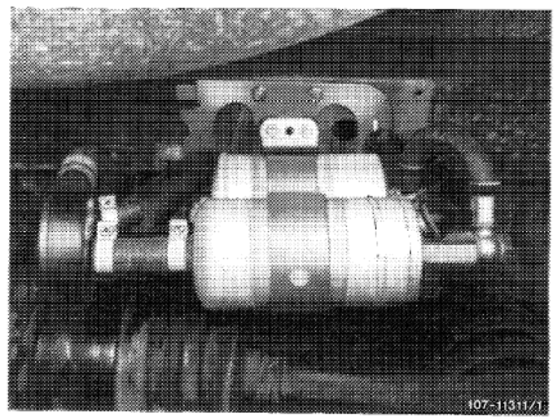
1st version



2nd version

5 For installation proceed vice versa, using new sealing rings.

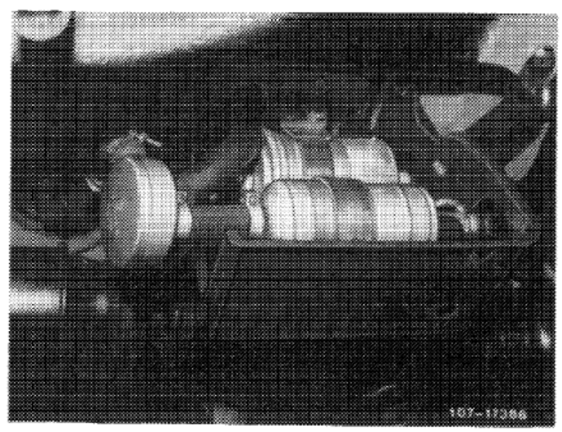
6 Locate fuel filter with plastic sleeve in holder. Plastic sleeve should project on both sides of holder, since direct contact of fuel filter with holder may result in contact corrosion.



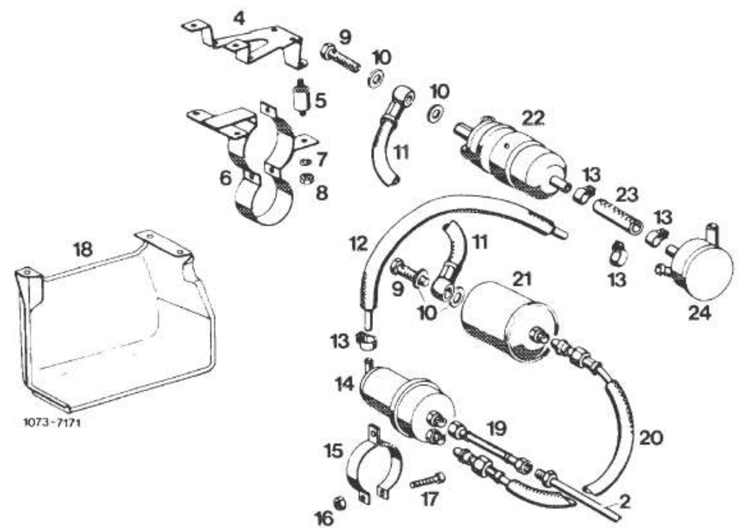
7 Remove clamp on fuel suction hose.

8 Run engine and check for leaks.

9 Mount protective box.

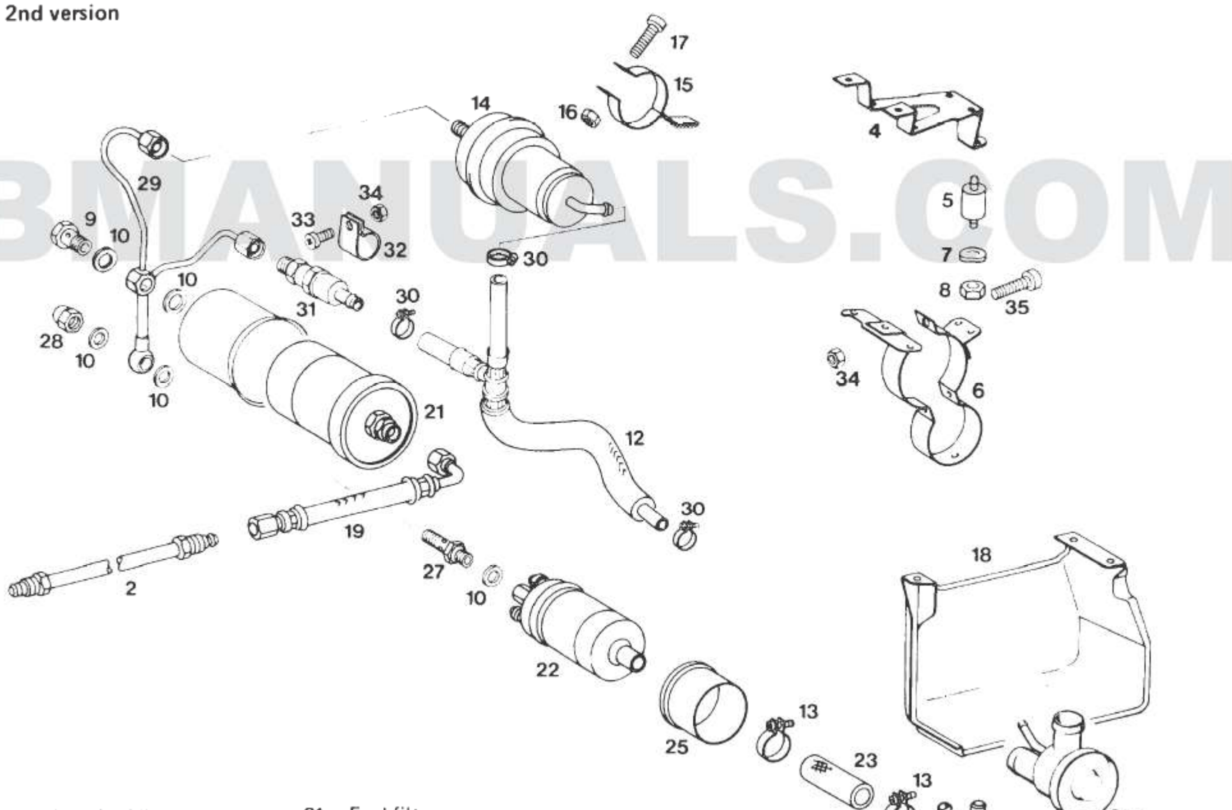


1st version



2 Fuel feed line
4 Holder
5 Vibration damper
6 Holder
7 Circlip
8 Nut
9 Hollow screw
10 Sealing ring
11 Fuel hose
12 Fuel hose
13 Hose clip
14 Fuel storage reservoir
15 Holder
16 Nut
17 Screw
18 Protective box
19 Fuel hose
20 Fuel hose
21 Fuel filter
22 Fuel pump
23 Fuel hose
24 Damper

2nd version



2 Fuel feed line
4 Holder
5 Vibration damper
6 Holder
7 Circlip
8 Nut
9 Hollow screw
10 Sealing ring
12 Fuel hose
13 Hose clamp
14 Fuel reservoir
15 Holder
16 Nut
17 Screw
18 Protective box
19 Fuel hose
21 Fuel filter
22 Fuel pump
23 Fuel hose
24 Damper 1st version
24a Diaphragm damper 2nd version
25 Plastic sleeve
26 Plastic sleeve
27 Check valve
28 Cap nut
29 Steel line
30 Hose clamp
31 Pressure relief valve
32 Clamp
33 Screw
34 Nut
35 Screw

07.3–280 Removal and installation of fuel pump

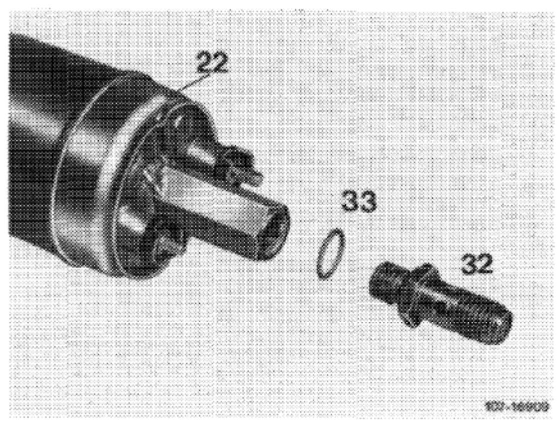
Special tool

Clamp for hose lines		000 589 40 37 00

Note

Since April 1980 the fuel pump is provided with a special coating on roller running surface, an exchangeable check valve, and with a plastic sleeve to prevent contact corrosion.

The check valve has been moved outwards and can be separately replaced in case of a breakdown.



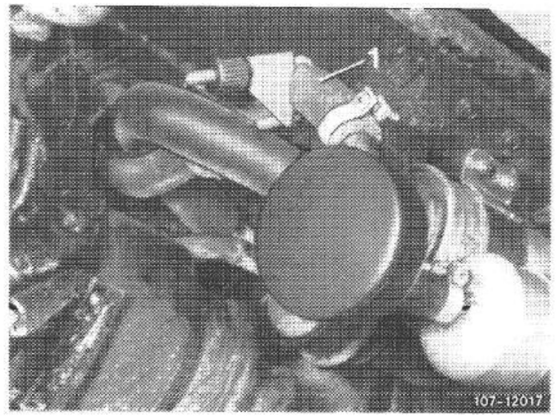
22 Fuel pump
32 Check valve
33 Sealing ring

When changing fuel pump, make sure that the plastic sleeve is mounted between fuel pump and holder. Sleeve should project on both sides of holder, since direct contact between fuel pump and holder may lead to contact corrosion.

Removal

1 Unscrew protective box.

2 Pinch fuel suction hose (1) with a clamp.

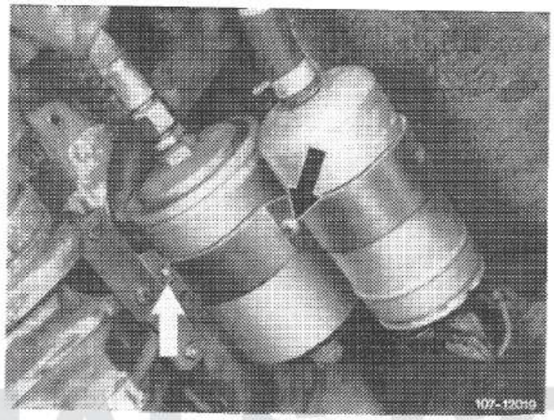


1st version

3 Loosen fuel hoses, pull off and unscrew.

4 Disconnect electric connecting cables.

5 Loosen fastening screw (arrow) and remove fuel pump.

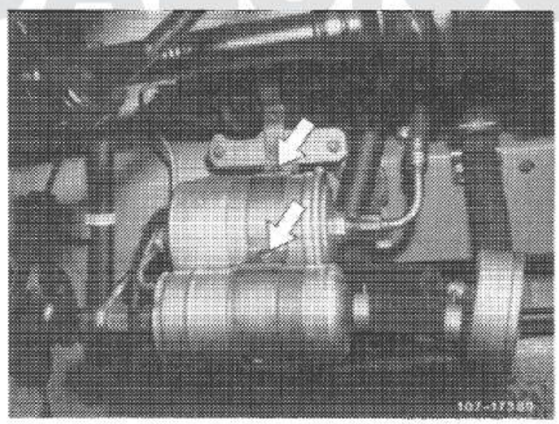


2nd version

6 Loosen fuel line on fuel filter and fuel reservoir. Loosen fuel line on fuel pump, pull off and unscrew.

7 Disconnect electric connecting cable.

8 Loosen fastening screw (arrow) and remove fuel pump.



Installation

9 For installation proceed vice versa using new sealing rings.

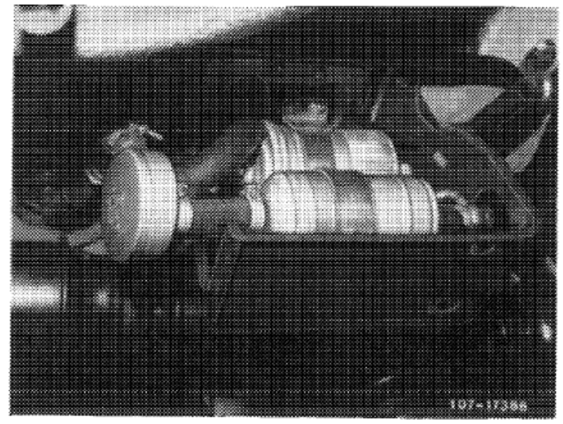
Pay attention to perfect installation of fuel hoses, as well as to correct polarity. Terminals should be horizontal in installation position.

10 Locate fuel pump with plastic sleeve in holder. Plastic sleeve should project on both sides of holder, since direct contact between fuel pump and holder may lead to contact corrosion.

11 Remove clamp on fuel suction hose.

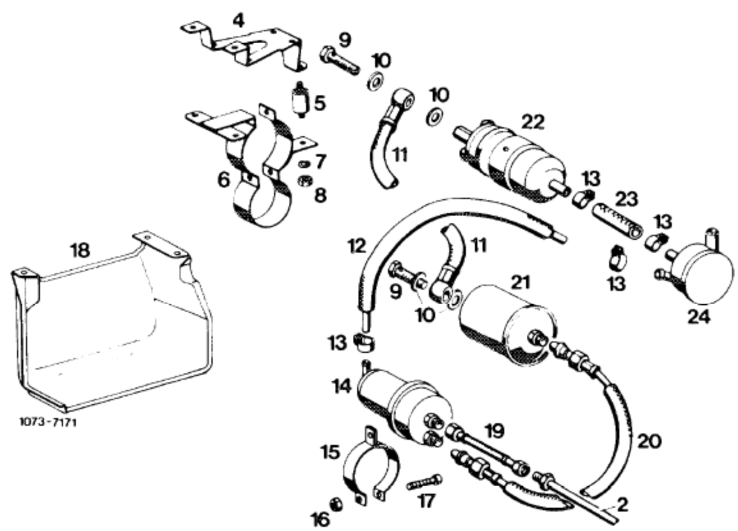
12 Run engine and check for leaks.

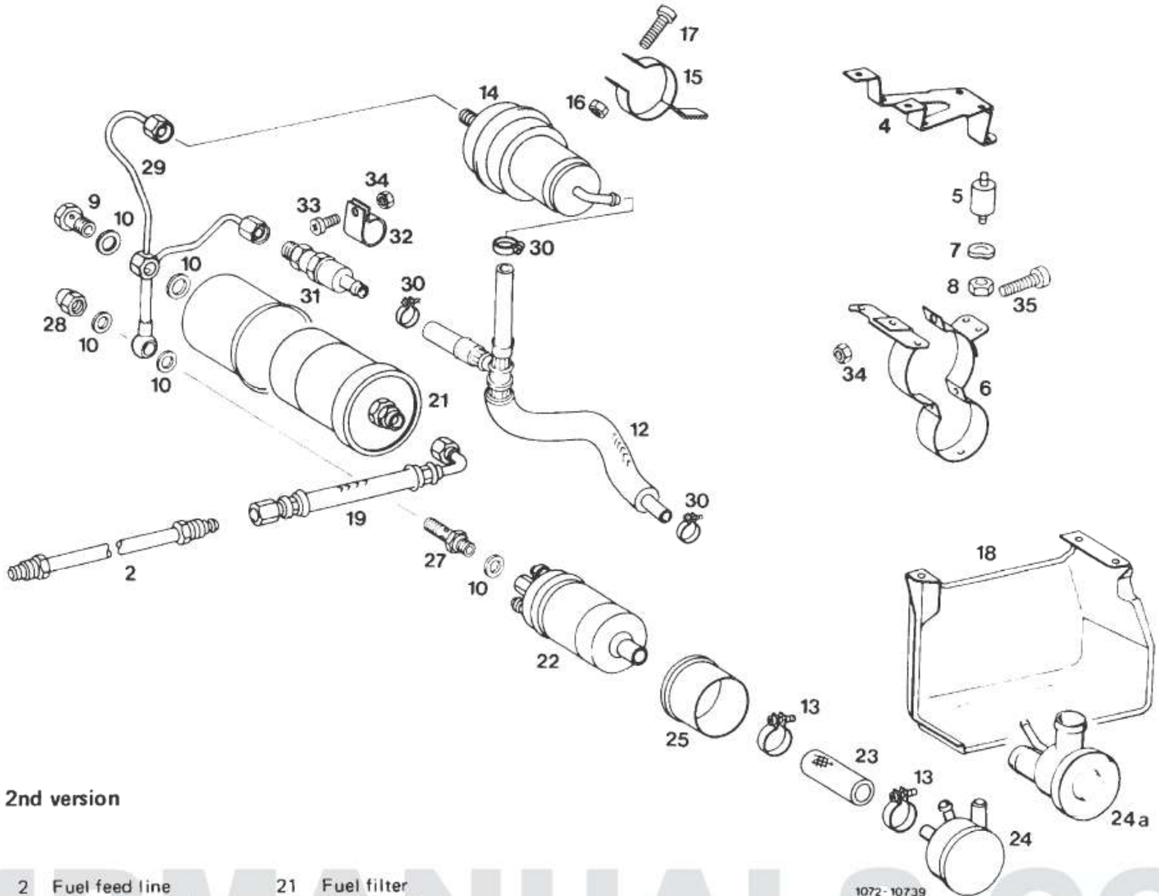
13 Mount protective box.



1st version

2 Fuel feed line
4 Holder
5 Vibration damper
6 Holder
7 Circlip
8 Nut
9 Hollow screw
10 Sealing ring
11 Fuel hose
12 Fuel hose
13 Hose clamp
14 Fuel reservoir
15 Holder
16 Nut
17 Screw
18 Protective box
19 Fuel hose
20 Fuel hose
21 Fuel filter
22 Fuel pump
23 Fuel hose
24 Damper





2nd version

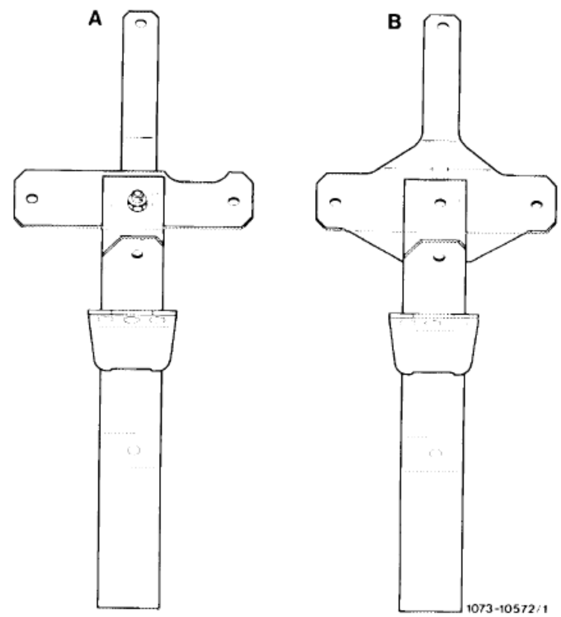
2	Fuel feed line	21	Fuel filter
4	Holder	22	Fuel pump
5	Vibration damper	23	Fuel hose
6	Holder	24	Damper
7	Circlip	25	Plastic sleeve
8	Nut	26	Plastic sleeve
9	Hollow screw	27	Check valve
10	Sealing ring	28	Cap nut
12	Fuel hose	29	Steel line
13	Hose clamp	30	Hose clamp
14	Fuel reservoir	31	Pressure relief valve
15	Holder	32	Clamp
16	Nut	33	Screw
17	Screw	34	Nut
18	Protective box	35	Screw
19	Fuel hose		

07.3–281 Renewing holder for fuel pump, fuel filter and fuel reservoir

Renewing

For renewing holder, remove
fuel reservoir (07.3–270),
fuel filter (07.3–275),
fuel pump (07.3–280).

The holder has been modified to improve installation position and to increase rigidity.



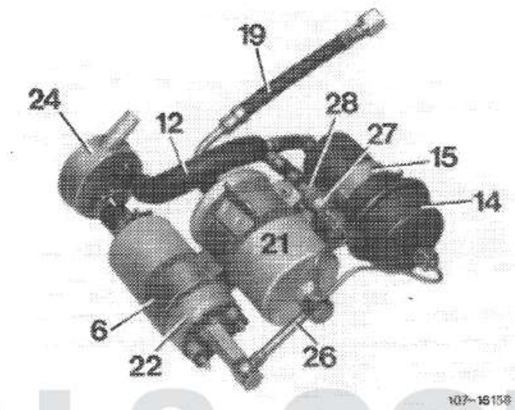
A 1st version
B 2nd version

07.3–282 Converting fuel pump assembly

A. General

Since February 1979 the pressure reservoir (14) is installed in front of fuel filter, an additional pressure compensating valve (27) is also installed. As a result, the engine will fire easier when cold and smooth running directly upon cold start is improved.

With light-alloy fuel distributors the pressure compensating valve is integrated in fuel distributor.



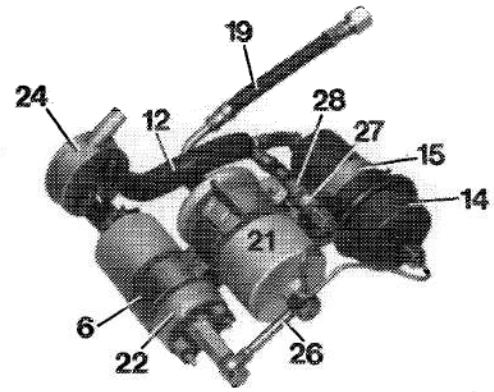
Start of series: February 1979

Model	starting chassis end No.
107.023	013146
107.024	025530
107.043	014194
107.044	053366
116.028/029	050944
116.032/033	089514

Functional description

The pressure reservoir (14) has now only one connection and is filled only slowly with fuel owing to throttle (orifice). From fuel filter the fuel flows directly into feed line to engine. As a result, the fuel pressure on injection valves will be built up faster.

In front of fuel filter (21) is an additional pressure compensating valve (27), which will close in the presence of pressure in system. If the fuel volume is reduced in system when the fuel is cooling down, the pressure compensating valve will open. This will prevent a vacuum to pull the control piston in fuel distributor to full load, otherwise, the full fuel quantity might be injected for a short period during a cold start and the engine might be provided with overrich fuel.



107–16156

B. Converting fuel pump assembly

Special tool

Clamp for hose lines		000 589 40 37 00

Spare parts

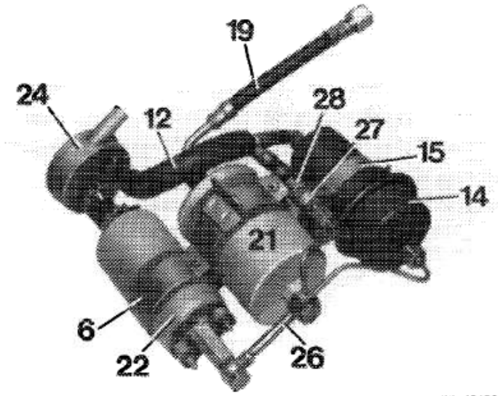
Designation	Part No.
Conversion set	123 470 05 93
Steel line for engines with light-alloy fuel distributor	126 470 01 64

Responsible for delivery: Werk 50 (PEW Sindelfingen)

Note

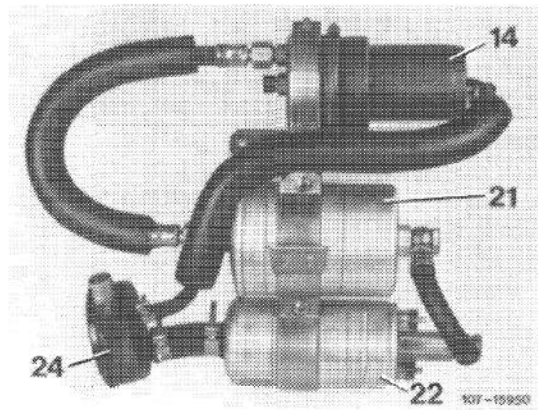
When exchanging fuel filter (21), fuel pump (22) or pressure compensating valve (27) be sure that a new plastic film or plastic sleeve is placed between these components and the holder (6, 15, 28). Plastic member should project on both sides of holder, since direct contact of components with holder might lead to contact corrosion.

Do not subsequently install pressure compensating valve in vehicles of Australia and Japan version.



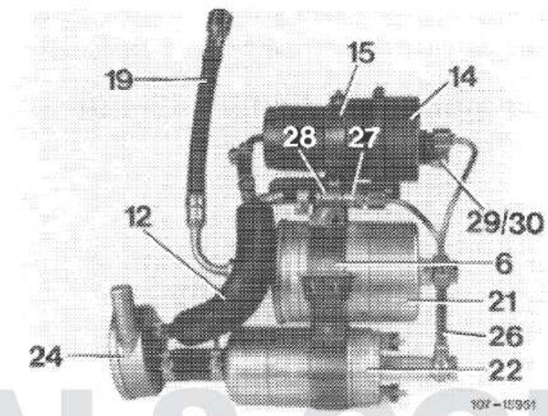
107–16156

Layout fuel pump assembly



2nd version

14 Pressure reservoir
21 Filter
22 Fuel pump
24 Suction damper



3rd version

6 Holder for fuel pump and filter
12 Leak line
14 Pressure reservoir
15 Holder for pressure reservoir
19 Fuel hose
21 Filter
22 Fuel pump
24 Suction damper
26 Fuel pressure line
27 Pressure compensating valve
28 Clamp for pressure compensating valve
29 Closing cone
30 Coupling nut

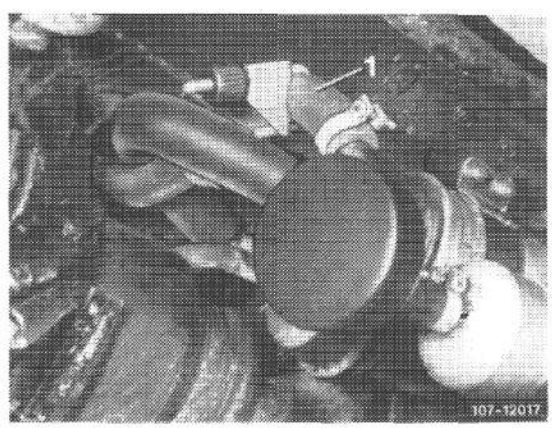
During convension, the following parts can be used again:

Fuel pump,
suction damper,
pressure reservoir,
fuel filter.

1 Unscrew protective box.

2 Disconnect electric connections.

3 Pinch fuel suction hose (1) between fuel tank and suction damper by means of a clamp.

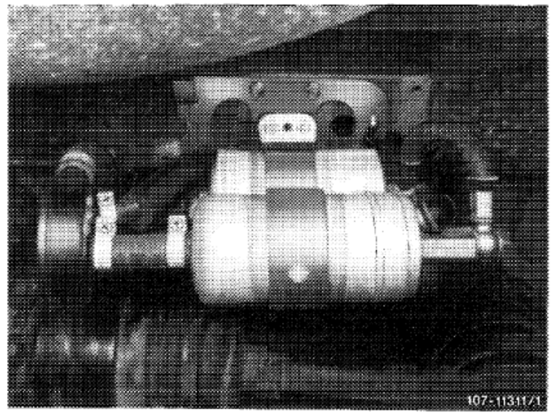


4 Loosen suction hose on suction damper and pull off.

5 Unscrew fuel pressure hose from feed line to engine compartment. Clean screw connection first.

6 Unscrew fastening nuts of vibration dampers and remove "fuel pump assembly".

7 Disassemble fuel pump assembly.

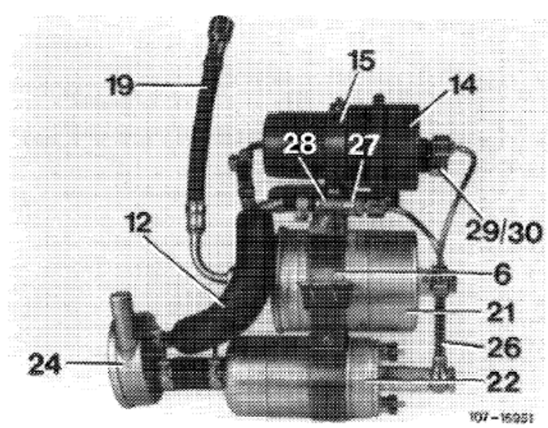


8 Clean fuel pump and fuel filter externally and mount with additional plastic sleeve (slip up to bead of pump).

As an exception, a film (e.g. Tesafilm) may be glued-on.

Fasten plastic sleeve or film on principle in such a manner that the material projects on both sides of holder. Direct contact between holder and pump or filter may lead to contact corrosion.

9 Assemble pump assembly with parts of conversion set as shown in Fig. Slip fuel pump (22) up to bead into holder (6) and mount clamp (28) for pressure compensating valve (27) under holder of pressure reservoir. Prior to tightening screws of holder, position fuel pressure line (26) against pump, filter and pressure reservoir. On pressure reservoir, close off-center connection with a closing cone (29) and a coupling nut (30).

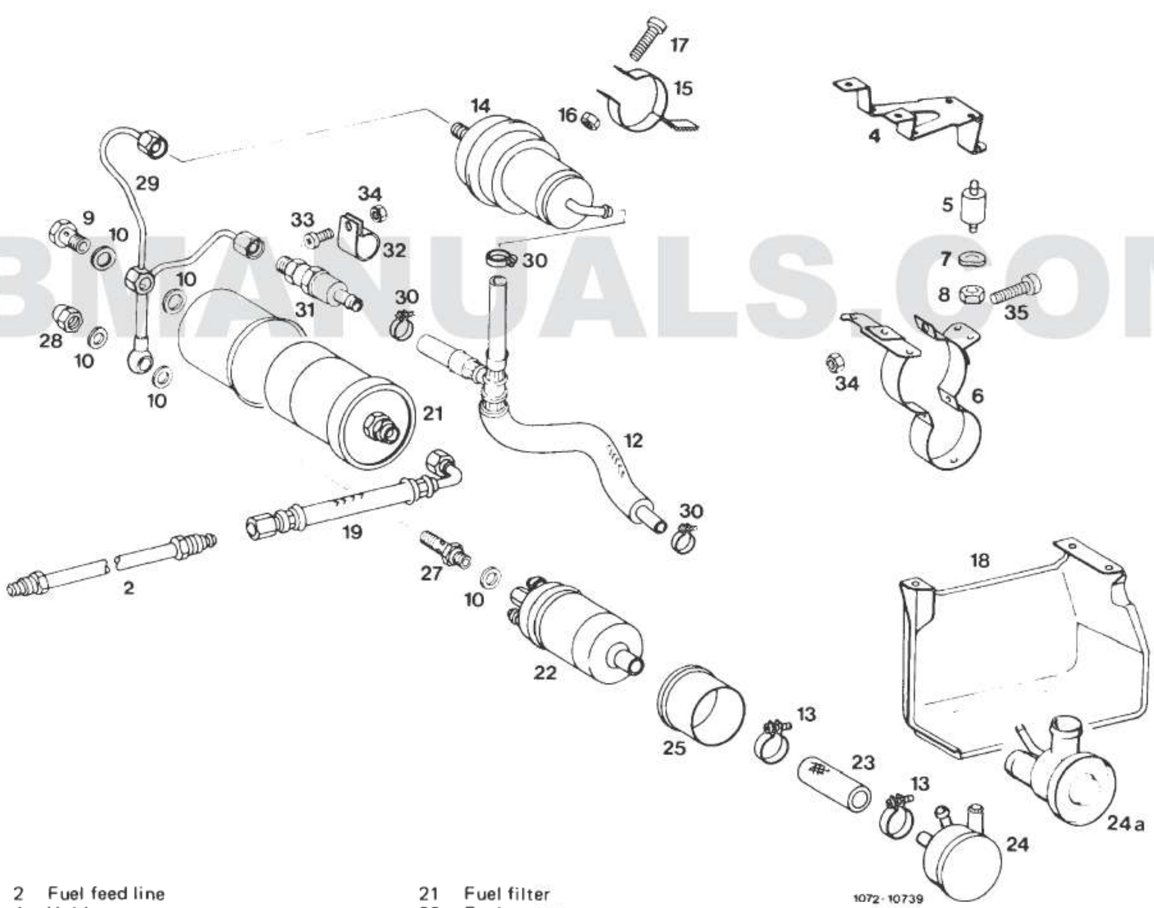


10 Install pump assembly and connect fuel hoses, as well as electric connections.

11 Remove clamp from suction hose, run engine and check system for leaks.

12 Mount protective box. Then check whether fuel hoses are installed free of chafing.

Note: On vehicles with auxiliary heater, insert a T-member into leak line, approx. 500 mm from suction damper. Shorten anti-chafing hose at this point.



2 Fuel feed line
4 Holder
5 Vibration damper
6 Holder
7 Circlip
8 Nut
9 Hollow screw
10 Sealing ring
12 Fuel hose
13 Hose clamp
14 Fuel reservoir
15 Holder
16 Nut
17 Screw
18 Protective box
19 Fuel hose
21 Fuel filter
22 Fuel pump
23 Fuel hose
24 Damper
25 Plastic sleeve
26 Plastic sleeve
27 Check valve
28 Cap nut
29 Steel line
30 Hose clamp
31 Pressure relief valve
32 Clamp
33 Screw
34 Nut
35 Screw

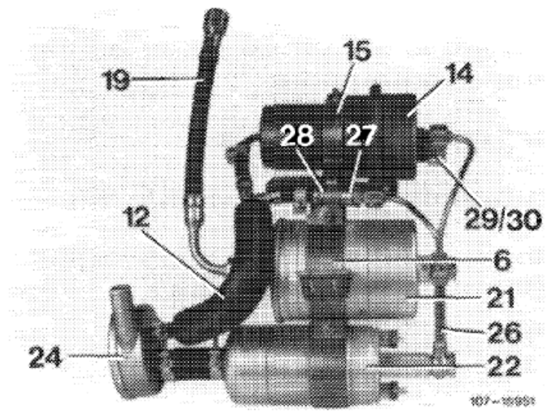
07.3–283 Subsequent installation of separate check valve on fuel pump

Fuel pump assembly with steel line between fuel pump and filter

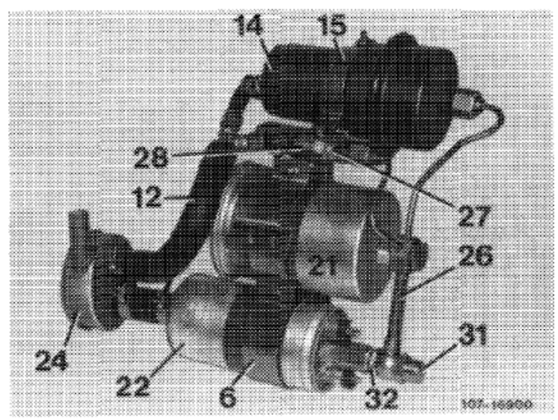
1 Unscrew protective box.

2 Pinch fuel hoses (from fuel tank and line to engine) with one clamp each.

3 Unscrew fuel pump assembly on both front vibration dampers.

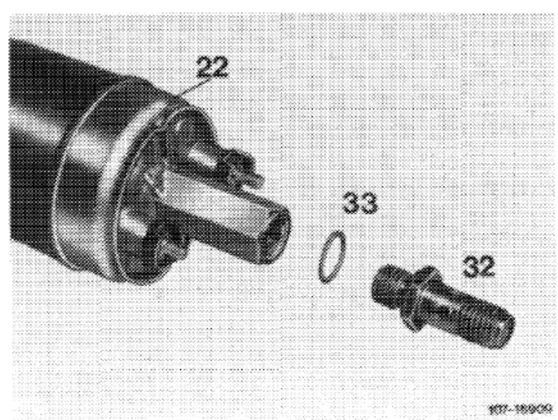


6 Holder for fuel pump and filter
12 Leak line
14 Pressure reservoir
15 Holder for pressure reservoir
19 Fuel hose
21 Filter
22 Fuel pump
24 Suction damper
26 Fuel pressure line
27 Pressure compensating valve
28 Clamp for pressure compensating valve
29 Closing cone
30 Coupling nut
31 Closing nut
32 Check valve
33 Sealing ring



4 Unscrew steel line (26) on fuel pump, filter, reservoir and pressure compensating valve.

5 Screw check valve (32) with new copper sealing ring (33) to fuel pump.



6 Mount steel lines. For this purpose, slip fuel pump up to bead into holder. Connect steel line with new copper sealing rings and closing nut (screw on closing nut lightly only). Hollow screw is no longer installed.

Note: Plastic film or plastic sleeve of pump and filter should project on holder on both sides and must be renewed, if damaged. For this purpose, remove pump and filter.

7 Mount fuel filter in holder in such a manner that the steel line is in alignment with fuel pump.

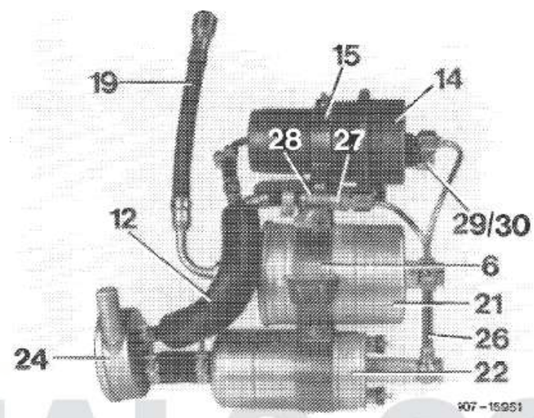
8 Mount steel line on reservoir and pressure compensating valve and tighten connections (apply counterhold to check valve).

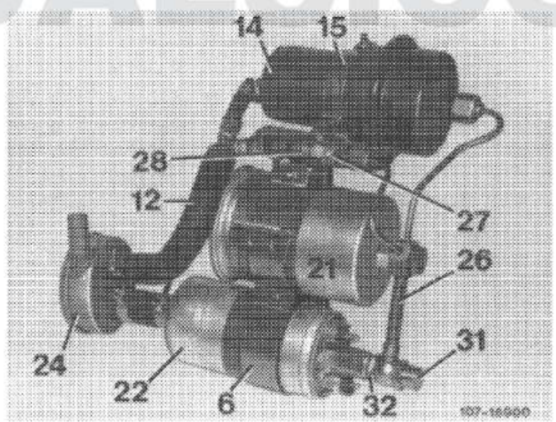
9 Tighten fuel pump and filter in holder and screw holder to vibration dampers.

10 Remove clamps on fuel hoses.

11 Run engine and check connections for leaks.

12 Mount protective box. Make sure that the steel line is not chafing against protective box.

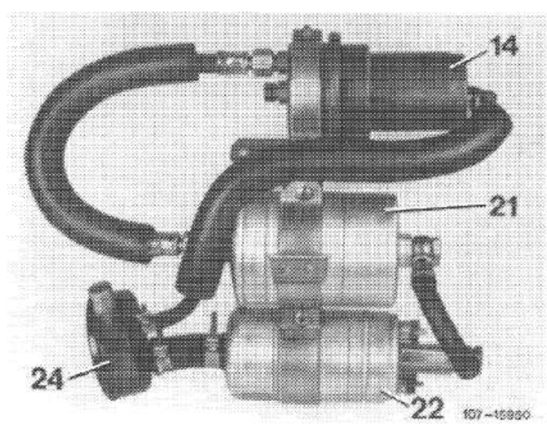




Fuel pump assembly with hose between pump and filter

1 Unscrew protective box.

2 Pinch fuel hoses with clamps.

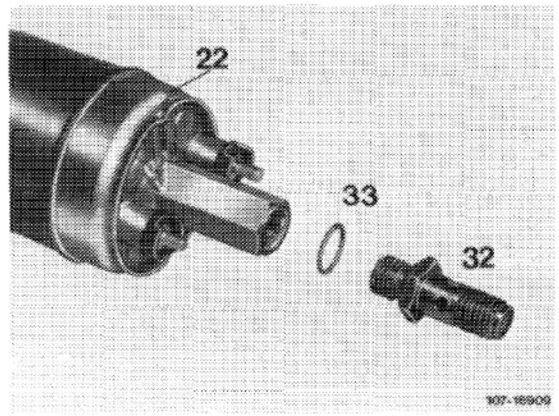


14 Pressure reservoir
21 Filter
22 Fuel pump
24 Suction damper

3 Unscrew fuel pump assembly on both front vibration dampers.

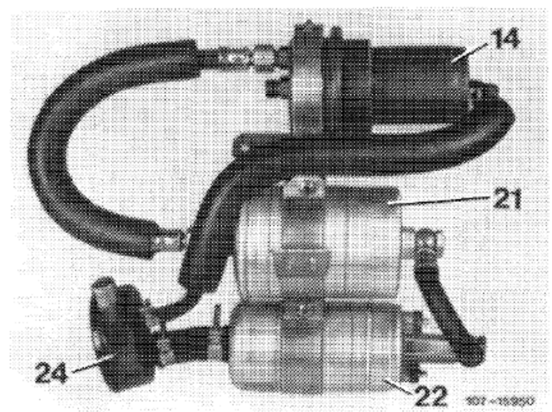
4 Unscrew fuel hose on pump.

5 Screw check valve (32) with new copper sealing ring (33) on fuel pump.



6 Slip fuel pump in holder approx. 15 mm to the left (so that closing nut is not chafing against protective box) and mount fuel hose with 2 new copper sealing rings and closing nut to check valve (applying counterhold to check valve). Hollow screw is no longer installed.

Note: Plastic film or plastic sleeve of pump and filter should project on holder on both sides and must be renewed if damaged. For this purpose, remove pump and filter.



7 Tighten fuel pump and filter in holder and mount holder on vibration dampers.

8 Remove clamps on fuel hoses.

9 Run engine and check system for leaks.

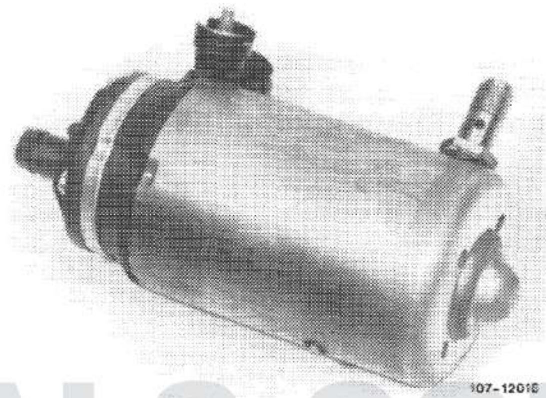
10 Mount protective box. Make sure that the fuel hose is not chafing against protective box.

07.3–285 Survey fuel pump

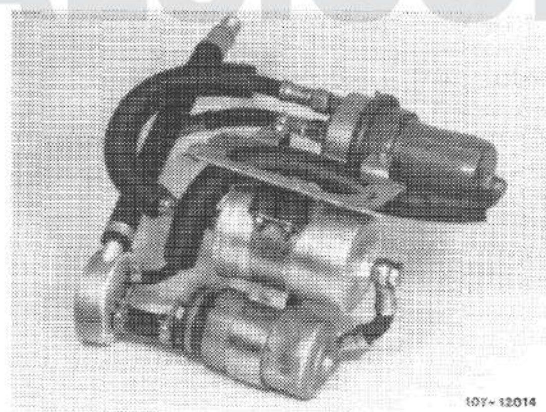
Note

When renewing fuel pump make sure that a fuel pump of latest design is installed. For conversion jobs refer to job number 07.3–282 "Section B".

Fuel pump 1st version



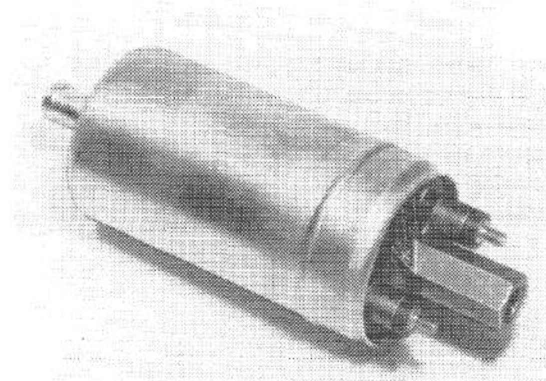
107-12018



107-12014

Fuel pump 2nd version

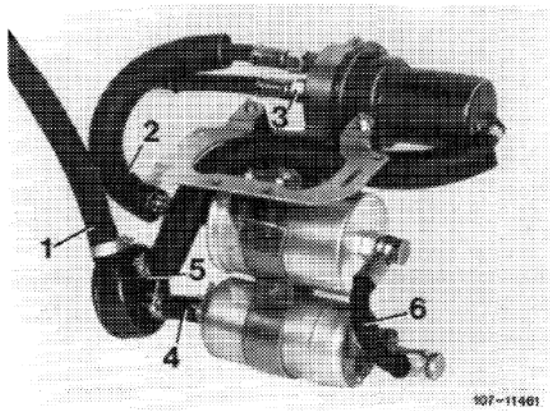
On this fuel pump the fuel connections and the electrical connections have been modified. Except for location of fuel hose (pressure end) between fuel pump and fuel filter and electrical connections, the installation position is the same.



107-12015

Start of series: October 1975

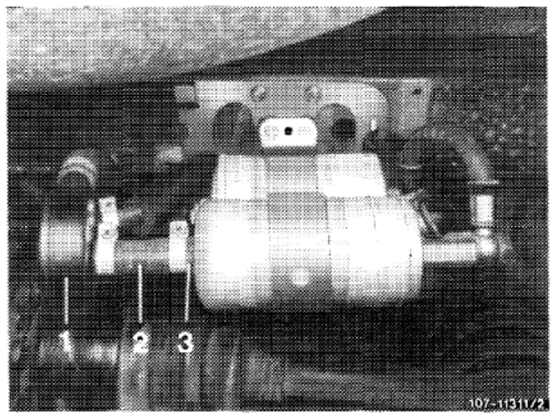
Model	starting chassis end No.
107.024	012079 (USA 012041)
107.044	029876 (USA 029796)
116.032/033	046201



3rd version

To keep intake characteristics constant under all climatic conditions, the intake connection has been increased to a diameter of 13 mm (formerly 10 mm).

As a result, the diameter of the connection on damper container (1) and that of fuel hose (2) had also to be changed.



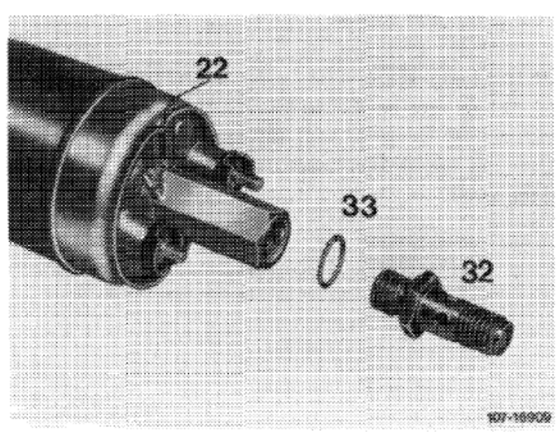
1 Damper container
2 Fuel hose
3 Intake connection (concealed)

Start of series: May 1977

Model	starting chassis end No.
107.023	011748
107.024	017936
107.043	012986
107.044	040364
116.028/029	040868
116.032/033	067850

4th version

Since April 1980 a fuel pump with plastic-coated roller running surface (Glycodur) and separately exchangeable check valve is installed. In addition, a plastic sleeve is mounted between fuel pump and fastening holder as a protection against contact corrosion.



22 Fuel pump
32 Check valve
33 Sealing ring

Start of series: April 1980

Model	starting chassis end No.
107.024	030199
107.044	062340

Repair note

If in connection with complaint "Engine firing poorly when warm" an internal leak of fuel pump is found, a check valve can be subsequently mounted on former fuel pump (07.3–283).

07.3–500 Functional description CIS A (USA) model year 1980 (engine 117)

General

To meet emisssion limits, the CIS A system has been amended and extended by lambda control which, however, does not change the basic principle of CIS A.

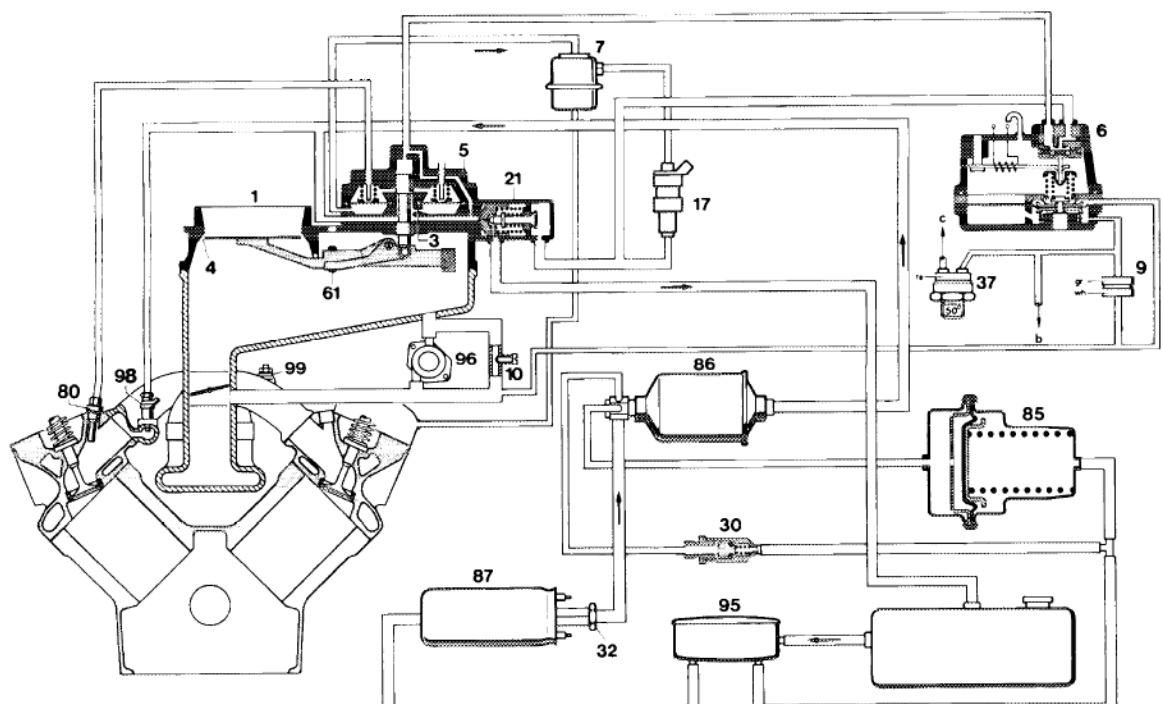
Lambda control keeps weight ratio air-fuel constant at approx. 14.5 : 1.

Lambda control results in the following modifications:

1. Shape of injection lines has been changed.

2. Diaphragm damper between warm-up compensator and fuel distributor is no longer installed.

In addition, the fuel distributor (5) is provided with an additional connection and a throttle (3) for timing valve (17).



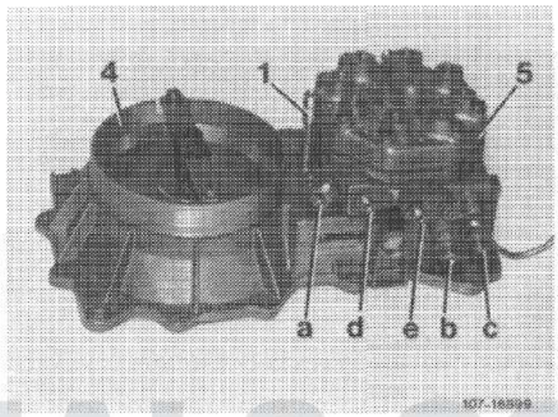
1072-6406/6

1 Mixture controller
3 Throttle (orifice)
4 Air flow sensor
5 Fuel distributor
6 Warm-up compensator
7 Pressure damper
9 Throttle (orifice)
10 Idle speed air screw
17 Timing valve
21 System pressure regulator
30 Pressure relief valve
32 Check valve
37 Thermovalve 50° C
61 Idle mixture regulating screw
80 Injection valve
85 Fuel reservoir
86 Fuel filter
87 Fuel pump
95 Intake damper
96 Auxiliary air valve
98 Cold starting valve
99 Thermo time switch
b To ignition distributor
c To intake manifold

Color code
gr = green
re = red
wh = white

Mixture controller

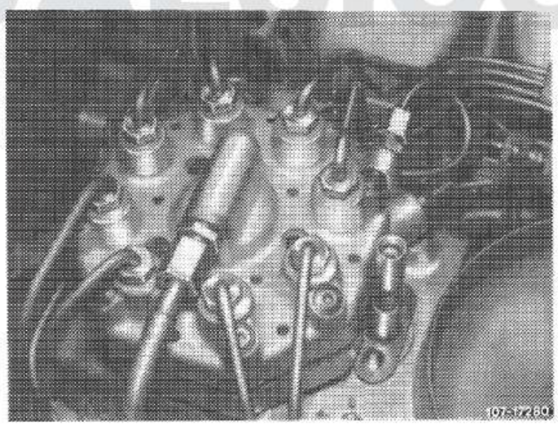
The characteristic of the fuel distributor and the air funnel (cone) in air flow sensor has not been changed. The idle mixture adjusting device (1) has been attached for adjusting on-off ratio.



1 Idle mixture adjusting device
4 Air flow meter
5 Fuel distributor
a Fuel forward flow
b Fuel return flow
c Connection timing valve return flow
d Connection timing valve pressure side
e Connection cold starting valve

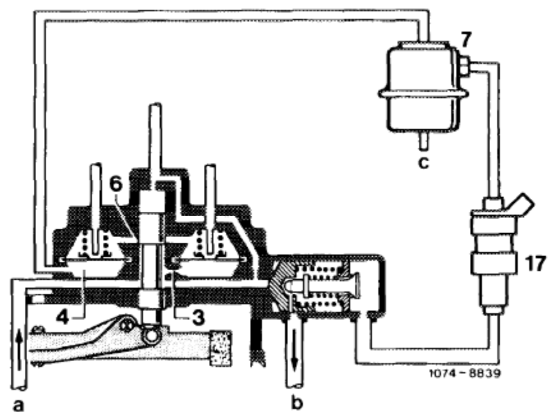
Fuel distributor

The fuel distributor is made of light alloy. A fabric diaphragm is installed between upper and lower half. The upper half of fuel distributor has 8 closing plugs with adjusting screws for differential pressure valves underneath. The differential pressure valves have been set by manufacturer to correct value and may not be adjusted during repair jobs.



To adapt the injected fuel quantity to desired air-fuel ratio of $\lambda = 1$, the pressure in lower chambers (4) of fuel distributor is varied. If the pressure in lower chambers is reduced, the differential pressure on control slots (6) increases, which in turn increases the flow rate. To control the pressure in the lower chambers, they are uncoupled from system pressure, as compared with fuel distributor installed up to now, by way of a throttle (3), which is firmly integrated in fuel distributor. The timing valve (17) establishes the connection between the lower chambers and the fuel return flow.

When the timing valve is opened, the pressure in lower chambers can go down. If it is closed, the system pressure in lower chambers will return. When the timing valve is opened and closed in a fast rhythm, the pressure in lower chambers can be controlled according to ratio between closing time and opening time. The valve is controlled by electrical impulses from control unit.



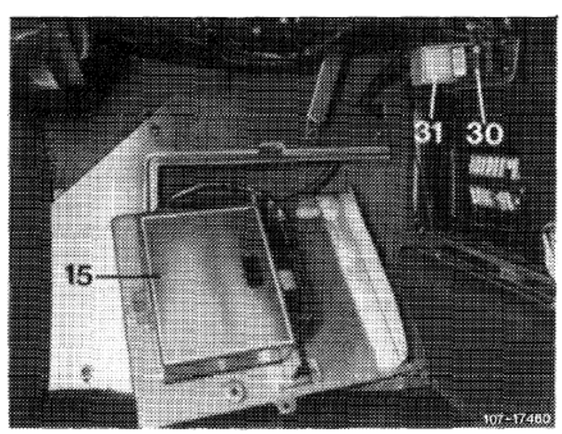
3 Throttle (orifice)
4 Lower chamber
6 Control slots
17 Timing valve

a Fuel forward flow
b Fuel return flow
c Leak connection

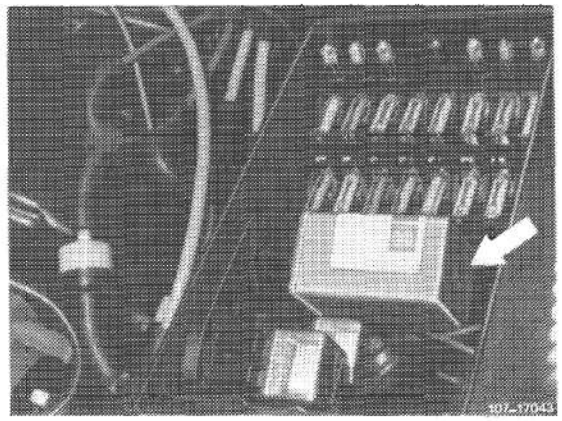
Air flow sensor

An electronic fuel pump relay handles activation of fuel pump, of warm-up compensator as well as rpm limitation of the engine and thereby replaces the safety switch on air flow meter (refer to electric wiring diagrams 07.3–165).

On model 107 the relay is located in righthand leg-room behind lateral lining in fuse box.

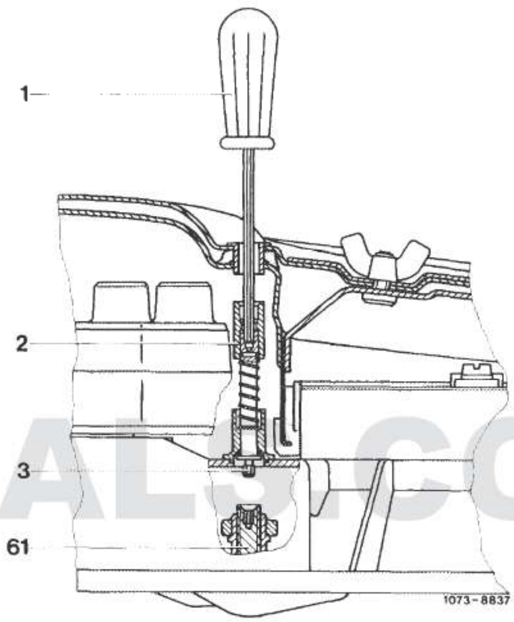


Model 107



Model 116

For idle speed mixture adjustment the air flow meter is provided with an adjusting device. As a result, adjustments can be made with air cleaner mounted. The idle air mixture is no longer controlled as before by way of a CO measuring instrument, but by way of the on-off ratio of lambda control.

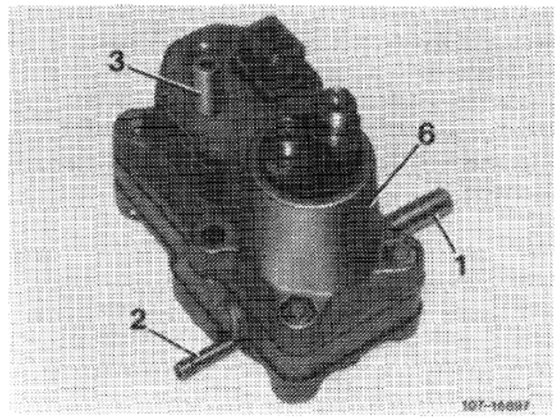


1 Allen wrench
2 Adjusting device
3 Hexagon
61 Mixture control screw

Warm-up compensator

To obtain an additional mixture enrichment in warm-up stage during acceleration, the warm-up compensator has been provided with acceleration enrichment.

Full load enrichment by way of warm-up compensator is no longer applied and is now activated via throttle valve switch.

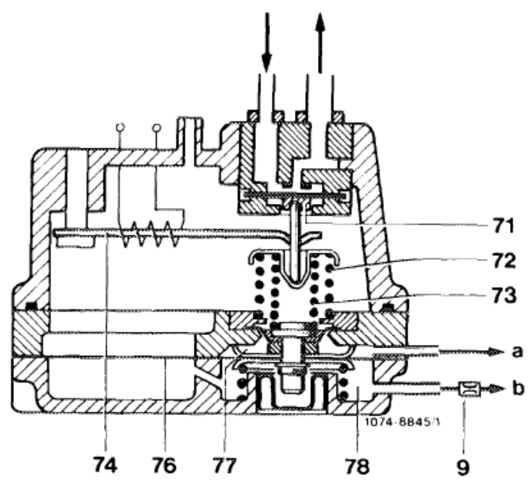


1 Connection upper chamber
2 Connection lower chamber
3 Vent into atmosphere
6 Warm-up compensator

Acceleration enrichment is controlled in dependence of vacuum below a coolant temperature of 50° C.

Two springs are pressing on control diaphragm (71) in warm-up compensator, the outer spring (72) is firmly supported in housing and the inner spring (73) is loaded or unloaded in dependence of vacuum.

The warm-up compensator lower half has a chamber which is divided into an upper chamber (77) and a lower chamber (78) by a diaphragm. Both chambers are connected to intake manifold vacuum, with a throttle (9) located in vacuum line to lower chamber.



9	Throttle (orifice)	76	Vacuum diaphragm
71	Diaphragm valve	77	Upper chamber
72	Outer valve spring	78	Lower chamber
73	Inner valve spring	a	Connection upper chamber
74	Bimetallic spring	b	Connection lower chamber

At constant speed, diaphragm (76) rests against upper stop. As a result, the vacuum in upper chamber and lower chamber is the same.

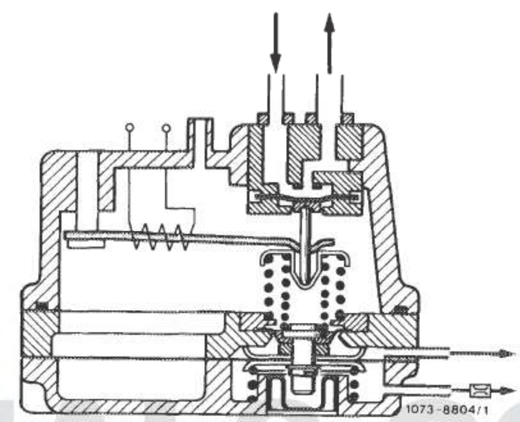
Upon acceleration, the vacuum in the upper chamber will be reduced faster than that in the lower chamber under influence of throttle (9).

The inner spring will be relieved until the pressure in the two chambers is the same, and the pressure on control diaphragm will therefore be less.

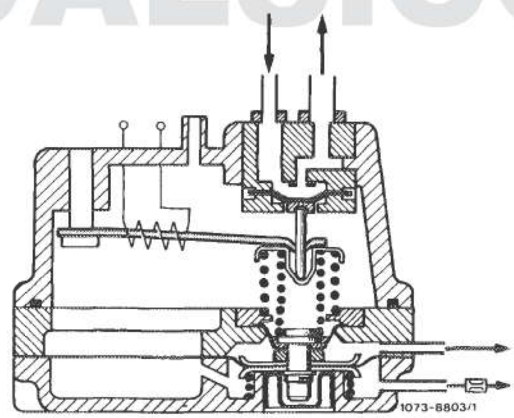
Owing to the resulting lower control pressure (enlargement of outflow cross section) the control piston in fuel distributor is subject to a lower force, as a result, the air flow sensor plate will be further deflected under influence of the same air flow rate, so that a larger fuel quantity will be distributed (mixture enrichment).

Starting at a coolant temperature of 50° C the thermovalve (37) opens. The lower diaphragm chamber of warm-up compensator is vented and the acceleration enrichment is cancelled. Both springs are pressing against control diaphragm and the control pressure goes back to its normal value.

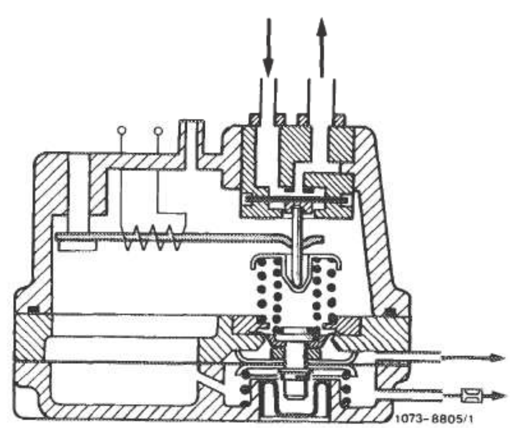
The three functions of the warm-up compensator:



Warm-up stage



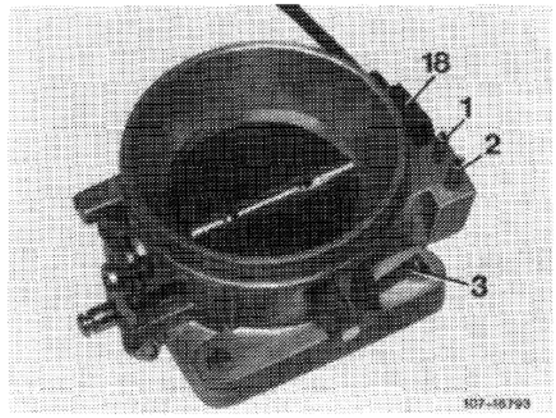
Warm-up and acceleration stage



Warm-up compensator stabilized

Throttle valve housing

The throttle valve housing is provided with a throttle valve switch, a vacuum connection for ignition advance, a retard bore for shutoff valve (SLS), as well as a draw-off connection for fuel evaporation.



1 Advance adjustment
2 Draw-off connection for charcoal canister
3 Retard bore for shutoff valve (SLS)
18 Throttle valve switch

Throttle valve switch

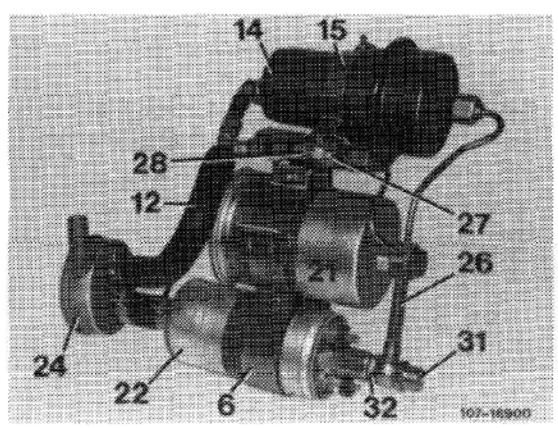
The throttle valve switch (18) transmits a signal during idle and full load operation.

At idle, the throttle valve switch in control unit narrows the control range of lambda control to prevent rpm fluctuations at idle.

At full throttle, the throttle valve switch transmits a signal to control unit. As a result, lambda control will be switched off and the mixture will be simultaneously enriched via timing valve.

Fuel pump assembly

Layout of fuel assembly has been modified starting February 1978. A pressure compensating valve (27) has been installed at that time. The pressure reservoir and the pressure compensating valve were located in parallel with fuel filter.



6 Holder for fuel pump and filter
12 Leak line
14 Pressure reservoir
15 Holder for pressure reservoir
21 Filter
22 Fuel pump
24 Suction damper
26 Fuel pressure line
27 Pressure compensating valve
28 Clamp for pressure compensating valve
31 Coupling nut
32 Check valve

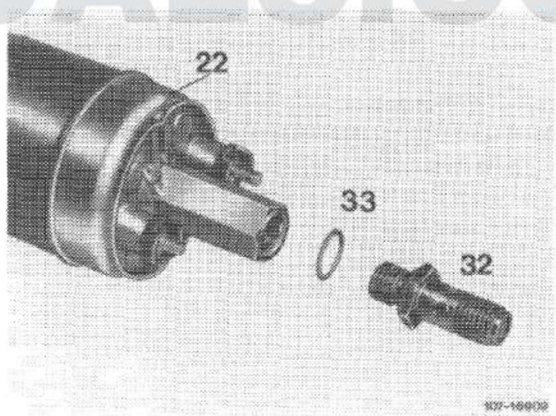
The pressure reservoir has now only one connection and is filled only slowly with fuel owing to throttle (orifice). From fuel filter the fuel flows directly into feed line to engine. As a result, the fuel pressure on injection valves will be built up faster.

In front of fuel filter is an additional pressure compensating valve, which will close in the presence of pressure in system. If the fuel volume is reduced in system when the fuel is cooling down, the pressure compensating valve will open. This will prevent a vacuum to pull the control piston in fuel distributor to full load, otherwise, the full fuel quantity might be injected for a short period during a cold start and the engine might be provided with overrich fuel.

Fuel pump

The fuel pump has a special coating on roller running surface, an exchangeable check valve (32) and a plastic sleeve to prevent contact corrosion.

The check valve has been moved outwards and can separately be replaced in the event of a breakdown.



22 Fuel pump
32 Check valve
33 Sealing ring

Fuel filter

A damper is additionally integrated in fuel filter to reduce noise. To prevent contact corrosion, the fuel filter is provided with a plastic sleeve.

Repair note

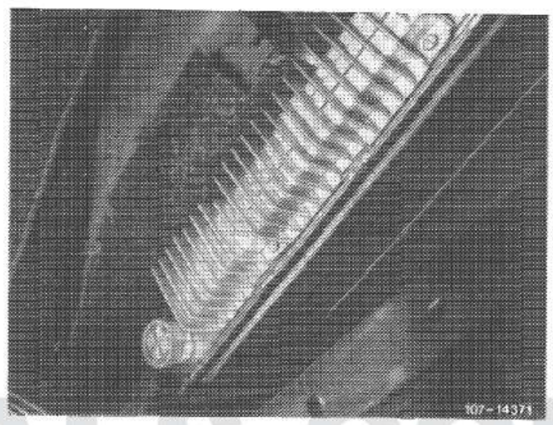
When exchanging fuel filter or fuel pump make absolutely sure that the plastic sleeve is mounted between these parts and the holder. The sleeve must project on both sides of holder, since direct contact of parts with holder may lead to contact corrosion.

07.4–035 Initial jobs for testing electronically controlled gasoline injection system

Prior to checkup, check dwell angle, firing point, compression, spark plugs and valve clearance.

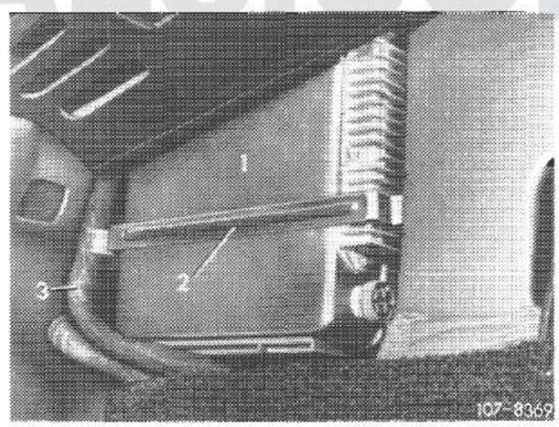
1 Switch off ignition to de-energize control unit.

2 Remove control unit. For this purpose, on model 107, remove cover at right under glove box. Take control unit out of holding bracket while disengaging spring clip (1).
On vehicles with right-hand steering, the control unit is mounted at the left.



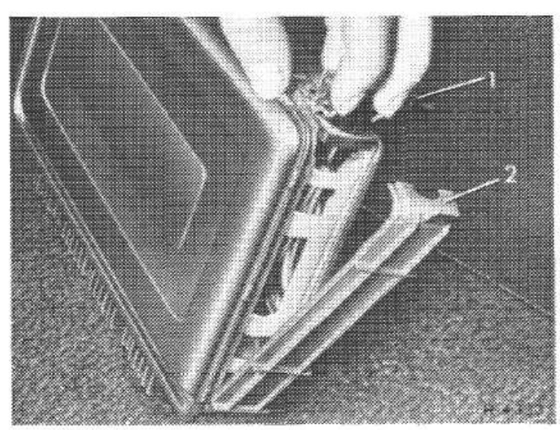
Model 107

On model 116, remove side panelling in right-hand legroom. Loosen spring clip (2) and pull control unit downward out of holding bracket. Make sure that the line harness is not damaged.
On vehicles with right-hand steering the control unit is mounted at the left.



Model 116

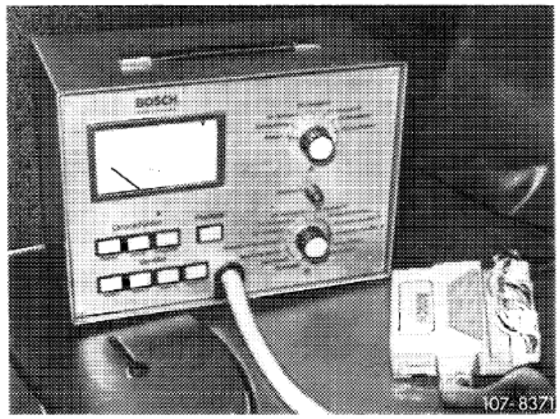
3 Remove closing cover (2) on control unit. Open strain relieving clip (1) on electronic harness.



4 Pull multiple plug from control unit.

5 Connect Bosch tester EFAW 228 to pulled-off multiple plug.

6 For testing with volt-ohmmeter connection, refer to 07.4–040.



107-8371

07.4–040 Testing electronically controlled gasoline injection

A. With Bosch tester EFAW 228

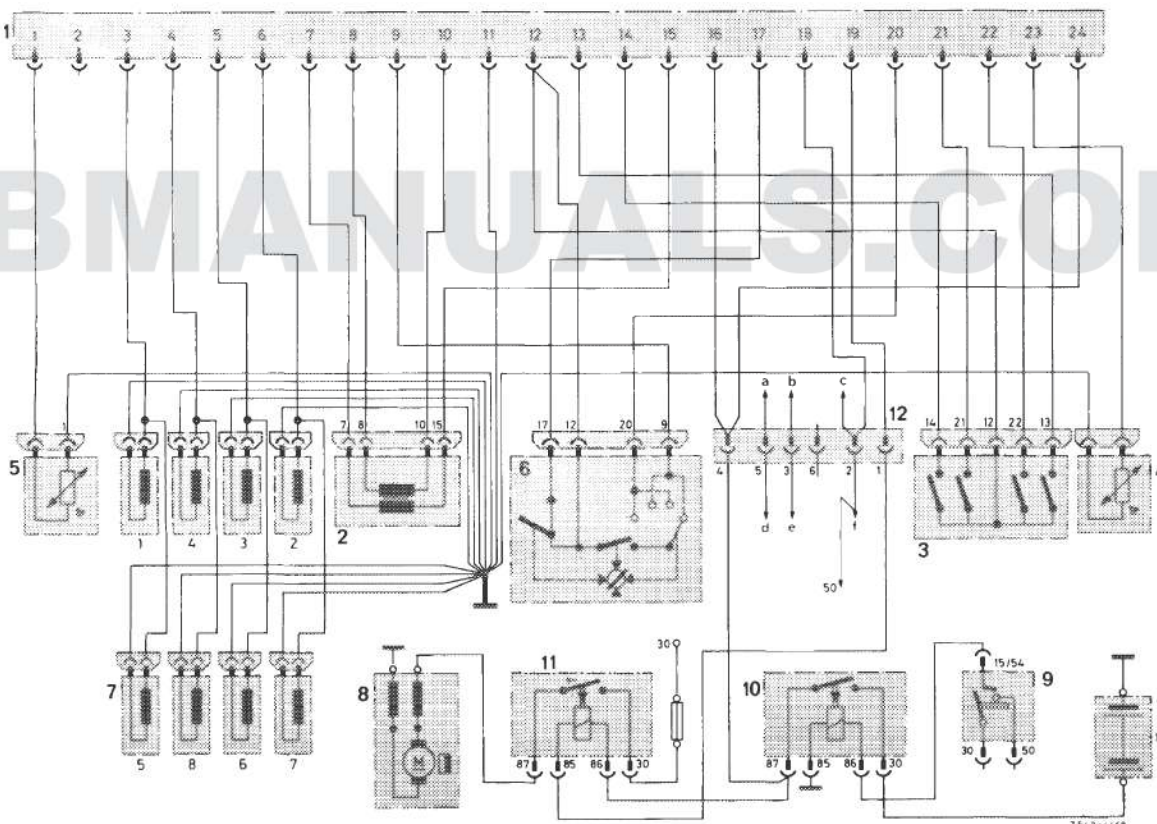
Conventional tool

Bosch tester EFAW 228	made by Bosch GmbH D-7000 Stuttgart 30

Connection diagram for control unit

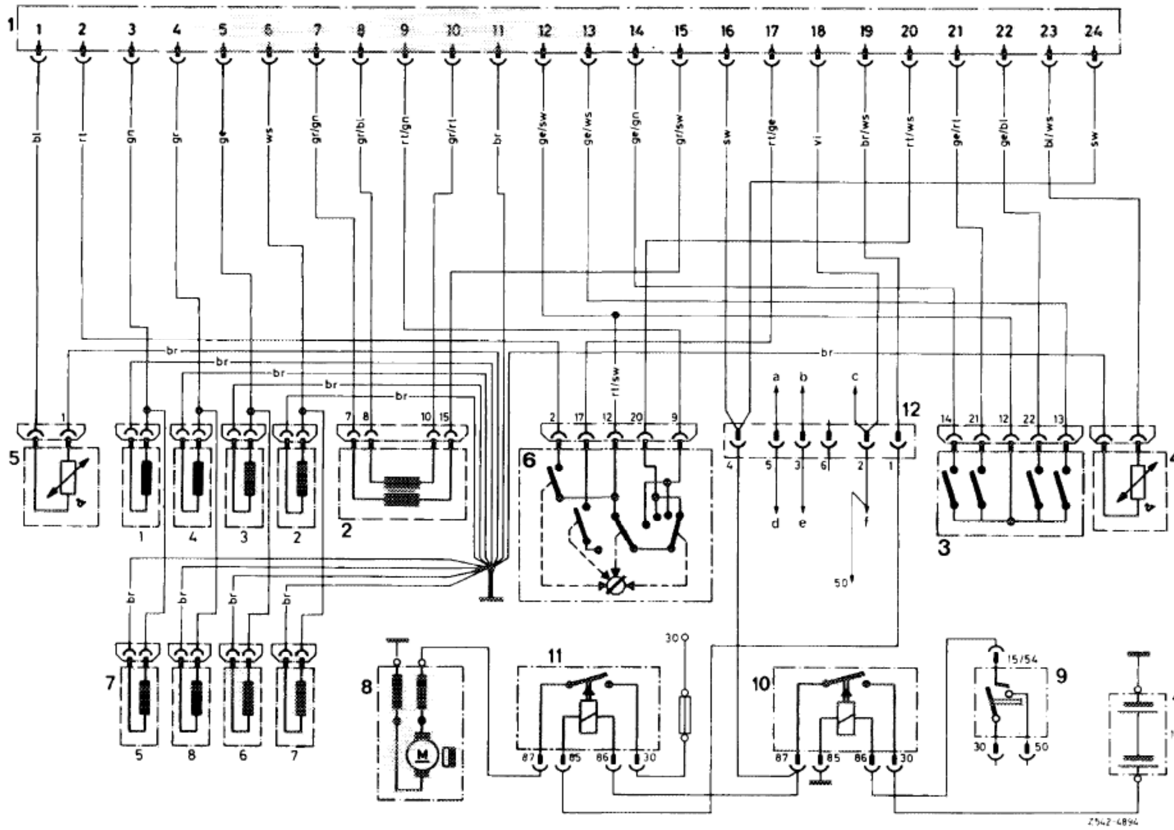
The following wiring diagram shows the individual components of the electronically controlled gasoline injection system and its connection to the control unit.

Engine 116



1 Multi-point connector control unit
2 Pressure sensor
3 Release contacts in ignition distributor
4 Temperature sensor cooling water
5 Temperature sensor air
6 Throttle valve switch
Terminal 9 transition enrichment
Terminal 20 transition enrichment
Terminal 12 ground
Terminal 17 idle speed contact
7 Injection valves
8 Fuel pump
9 Ignition starting switch
10 Main relay electronic system
11 Pump relay
12 Plug connection to vehicle harness
a To cold starting valve
b To thermo-time switch terminal W
c To thermo-time switch terminal G
d To cold starting relay terminal 87
e To cold starting relay terminal 85
f To cold starting relay terminal 86
13 Vehicle battery

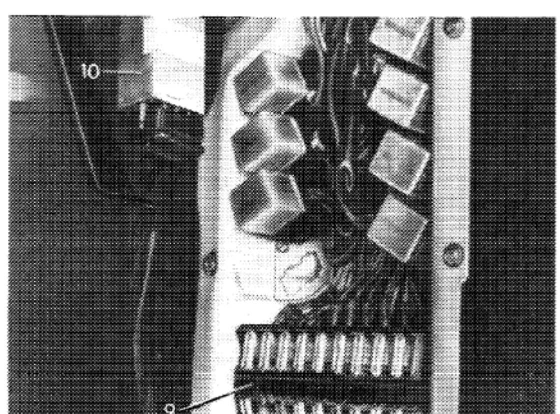
Engine 117



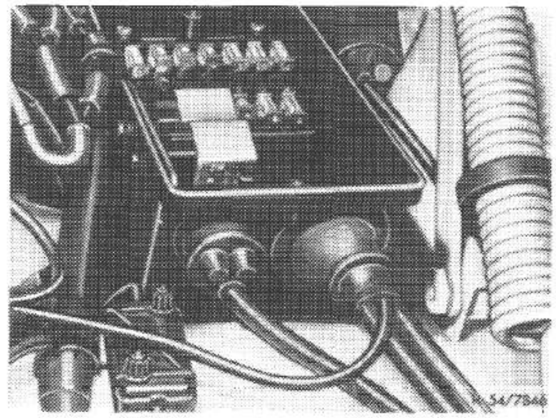
1 Multi-point connector (control unit)
2 Pressure sensor
3 Release contacts (ignition distributor)
4 Temperature sensor (coolant)
5 Temperature sensor (air)
6 Throttle valve switch
Terminal 9 transition enrichment
Terminal 20 transition enrichment
Terminal 2 full-load contact
Terminal 17 idle speed-contact
Terminal 12 ground
7 Injection valves cylinder 1–8
8 Fuel pump
9 Ignition starting switch
10 Main relay (power supply control unit)
11 Pump relay
12 Intermediate plug (connection to vehicle harness)
a Starting valve
b Thermo-time switch terminal W
c Thermo-time switch terminal G
d Relay for starting valve terminal 87
e Relay for starting valve terminal 85
f Relay for starting valve terminal 86
13 Vehicle battery

Relay layout

Code number	Relay function
1	Relay fuel pump
2	Relay starting valve
3	Main relay electronic injection



Model 107



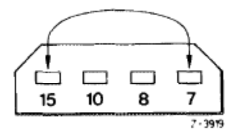
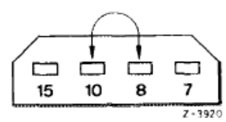
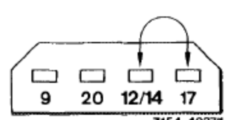
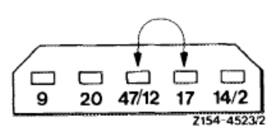
Model 116

Initial jobs for testing refer to 07.4–035.

I. With control unit not connected

Turn switch ,,A'' on tester to position ,,measuring'', switch on ignition and complete all functions according to the following check list.

Switch ,,B'' in position . . .	Actuate	Measure	Indication (nominal value volt-ohmmeter)	Nominal value not attained. Possible causes and remedy
Voltage I	Switch-on ignition and leave switched on throughout entire test sequence described below	Voltage supply for control unit	11 . . . 12.5 (11 . . . 12.5 V)	**Voltmeter indicates no voltage:** Interruption: Plug connection from main relay (10) to control unit (line 16). Main relay not attracting: Check voltage on terminal 86 of main relay, if there is no voltage, check fuse in fuse box. Terminal 85 should be connected to ground. Measure voltage on terminal 87 of relay. If voltage is ,,0'', check terminal 30 of relay. **Under load, voltage is below 11 V:** Transfer-resistance on line 16 or on relay contact. Exchange main relay. Check cable from battery terminal plus to relay terminal 30.
Voltage II				Similar to voltage I, but check line 24.
Voltage starter	Actuate starter for a moment	Voltage on terminal 50 of starter	9.0. . . 12.0 (9.0 . . . 12.0 V)	**Voltmeter shows no voltage, but starter rotates:** Line interruption from starter terminal 50 to control unit. Check line to control unit terminal 18. **Voltmeter indicates no voltage and starter is not rotating:** Ignition starting switch defective, line interrupted. **Voltage below 9.5 V:** Battery discharged, voltage drop in line from ignition starter switch to terminal 50 of starter relay too high. Measure line with voltmeter for voltage drop.
Alignment ∞ pressure sensor	Adjust instrument by turning aligning knob to ,, ∞ ''			If no full deflection is attained on instrument, battery voltage in vehicle is too low. Also refer to test step: Voltage I.
	Push button ,,ground''	Resistance between pressure sensor windings and ground (ground connection)	Resistance ,,∞'' (∞)	**Resistance ,,0'':** Ground connection in supply line or on pressure sensor. Pull plug from pressure sensor, if indication is ,,∞'', exchange pressure sensor; if indication remains unchanged at ,,0'', lines 7, 8, 10 or 15 may have a short circuit, replace cable harness. **Resistance below ,,∞'', but not ,,0'':** Insulation damage, remedy see above.

Switch „B" in in position . . .	Actuate	Measure	Indication (nominal value volt-ohmmeter)	Nominal value not attained. Possible causes and remedy
Alignment ∞, pressure sensor	Push „primary" button	Resistance of primary winding of pressure sensor	0.8 . . . 1.2 on ohm scale (approx. 90 ohms)	**Resistance essentially lower than nominal:** Insulation damage: Pull plug from pressure sensor, if indication then is „∞", exchange pressure sensor. **Resistance „0":** Short circuit in winding. Pull plug from pressure sensor, if indication then is „∞", exchange pressure sensor. **Resistance considerably higher than nominal:** High transfer resistance. Check plug and lines for corrosion or interruption. **Resistance „∞":** Interruption. Bridge terminal 7 and 15 on plug. If indication is „0", exchange pressure sensor. If indication is „∞", check lines. Top view on plug 
	Push „secondary" button	Resistance of secondary winding of pressure sensor	3 . . . 4 on ohm scale (approx. 350 ohms)	Similar to „primary". If resistance is „∞", bridge terminals 8 and 10. 
ZV contact I **ZV contact II** **ZV contact III** **ZV contact IV**	Rotate ignition distributor by brief actuation of starter	Function of release contact in ignition distributor	Alternately resistance „0" and „∞" (0/∞ ohms)	If the pointer of the instrument is not swinging back and forth while starting or stops in position ∞ or 0, check connections 12, 13, 14, 21 and 22 on contact slide-in. If connections and cable harness to control unit are in order, renew release contacts, adjustment is not possible.
Throttle valve switch I then throttle valve switch II	Step down slowly on accelerator pedal	Function of transfer enrichment	Pointer of instrument swings approx. 10 times between „0" and „∞" (alternately 0/∞ ohms)	When the floored gas pedal is moving back, the pointer of the instrument should remain in position „∞". **Indication „0":** Throttle valve switch defective, exchange.
Throttle valve switch III	a) Throttle valve in idle position (closed)	Function of contact in throttle valve switch	a) 0 (0 ohm)	**a) Resistance „∞":** Throttle valve switch wrongly set or interruption in supply line. Check adjustment. Pull-off plug, bridge terminals 12 and 17. If then still „∞", exchange cable line, otherwise exchange throttle valve switch.
			 Engine 116	 Engine 117
	b) Throttle valve slightly opened approx. $1^{\circ} = 0.4$ mm		b) ∞ (∞ ohm)	**b) Resistance „0":** Throttle valve switch wrongly adjusted or short circuit in supply line. Pull-off plug, if indication is still „0", exchange cable line, otherwise adjust or exchange throttle valve switch.

(ZV = ignition distributor)

Checking throttle valve switch — full-load contact (refer to section II, item Pressure switch).

Switch „B" in position . . .	Actuate	Measure	Indication (nominal value voltohmmeter)	Nominal value not attained. Possible causes and remedy.
Temperature sensor I (intake air)		Resistance of temperature sensor	2 . . . 5 at 20°C heavily dependent on temperature: 640 Ω at 0°C 400 Ω at 10°C 300 Ω at 20°C 210 Ω at 30°C 150 Ω at 40°C	Nominal value applies to 20°C. Resistance becomes lower at higher temperature. If measurements are not 0 or ∞, sensor is in order. **Indication „∞":** Interruption. Pull-off plug and bridge, if indication is „0", exchange temperature sensor, otherwise cable line. **Indication „0":** Short circuit. Pull-off plug, if indication remains unchanged. Cable is defective. If indication then is „∞", exchange temperature sensor.
Temperature sensor II (cooling water)		Resistance of temperature sensor	0.2. . . 0.4 at 80°C heavily dependent on temperature: 5.9 kΩ at 0°C 2.5 kΩ at 20°C 1.2 kΩ at 40°C 600 Ω at 60°C 325 Ω at 80°C 190 Ω at 100°C	Refer to temperature sensor I. Nominal value applies to 80°C cooling water temperature.
Valves if required, balance instrument once again to „∞" (switch position „valves")	Button 1 = valves cyl. 1 and 5 Button 2 = valves cyl. 3 and 6 Button 3 = valves cyl. 2 and 7 Button 4 = valves cyl. 4 and 8 **Attention!** Prior to actuating buttons always pull one valve plug on injection valve, so that only one valve is measured, e.g. cylinder 1 or 5, or 2 or 7.	Resistance of valve winding with supply line	2 . . . 3 (2.4 Ω at 20°C)	**Resistance „0":** Short circuit in supply line or on valve. Pull plug from respective valve, if indication then is „∞", exchange valve, otherwise exchange cable line. **Resistance „∞":** Interruption in supply line or in valve coil. Bridge contacts in valve plug, if indication then is „0", valve is defective. **Resistance above „3":** Ground line of valves poorly connected to engine.

Switch ,,A" in position . . . (switch ,,B" has no influece)	Actuate	Measure	Indication (nominal value volt-ohmmeter)	Nominal value not attained. Possible causes and remedy.
Valve test	Push ,,pump" button	Connect pressure gauge. Pressure in fuel line	Nominal value 2.0 + 0.1 bar gauge pressure	**No pressure buildup** (pump not starting). Disconnect cable connections on pump, push ,,pump" button and measure voltage with voltmeter at cable ends. 12 volts readout indicates defective pump, exchange. If indication is ,,0", check audibly whether pump relay attracts. **If yes,** line interrupted from pump relay 87 to pump connections or from there to ground. Fuse in fuse box defective. If connecting line is in order, pump relay is defective. **If no,** line interrupted from main relay terminal 87 to pump relay terminal 86 or from pump relay terminal 85 to control unit terminal 19 (ground for pump relay). If line is in order, check wehether pump relay attracts when ground is connected directly to terminal 85, if yes, exchange control unit, if no, exchange pump relay. **Pressure not corresponding to nominal value.** Pressure regulator maladjusted, adjust pressure regulator and exchange, if required.
	Briefly push ,,pump" button	Leak test of fuel system (Pressure end)	Pressure may drop to 1.5 bar gauge pressure, then pressure should continue to drop only slightly	**Pressure drops immediately upon release of ,,pump" button below 1.5 bar gauge pressure** 1. Leaks in pressure line system, check visually whether hose connections are leaking. 2. Leaking valve of delivery pump, of pressure regulator, of injection valves or of cold starting valve. To check which of the 4 components is leaking: Pinch pressure hose between fine filter and injection valves with delivery pump running by means of a clamp, switch off delivery pump. If the pressure is no longer dropping, valve in delivery pump is defective, exchange delivery pump. But if pressure still drops: Check pressure regulator. Pull return flow hose from pressure regulator immediately after stopping delivery pump. If fuel emerges, replace pressure regulator. If no fuel emerges and pressure is still dropping: Determine by means of spark plug patterns whether individual injection valves or cold-starting valve are leaking. Deviations among plug patterns point to leaking injection valves, while uniformly dark plug patterns point to a leaking starting valve. Check accurately upon removal of valves, connected to pressure system, with delivery pump engaged. Valve opening may become wet. But there should be no more than two drops per minute.

Switch „A" in position . . . (switch „B" has no influece)	Actuate	Measure	Indication (nominal value volt-ohmmeter)	Nominal value not attained. Possible causes and remedy.
Attention! Perform the following test only if a fault is suspected on injection valve. **Valves removed.**	Pressure buildup: Push „pump" button. Push buttons 1 to 4 one after the other. When pushing buttons, pull-off respective plug of valve in valve group not tested at the moment.	Visual checkup. Valve spray test. Catch fuel.		Push „pump" button and check visually for leaks. Valve opening may become wet, but there should be no more than 2 drops per minute on one valve. If no leak is found, exchange pressure regulator.
Starting valve cooling water temperature above +35°C	a) Push „pump" button, actuate starter for one second.	Function of thermo-time switch and starting valve	a) Pressure gauge should not visibly drop.	a) **Pressure drops steadily when starter is actuated.** Thermo-time switch defective, exchange.
	b) Connect connection „W" of thermo-time switch to ground.		b) Starting valve injects, pressure gauge indication drops.	b) **Pressure not dropping when starter is actuated** Check lines from starting valve to connection 87 of relay or to ground. If connecting lines are in order, check starting valve. **Note:** Starting approx. September 1975, relays are no longer installed.
Cooling water temperature below +35°C	Push „pump" button, actuate starter for one second (thermo-time switch again normally connected)		Pressure should drop.	If pressure is not dropping, renew thermo-time switch or check starting valve as described under b). Interturn resistance 4.2 ohms at 20°C.

Switch off ignition, remove pressure gauge.

II. With control unit connected

Connect multiple plug of tester to control unit. The position of switch ,,B" on tester has no influence on test sequence.

Switch ,,A" in position	Actuate	Measure	Indication (nominal value volt-ohmmeter)	Nominal value is not attained. Possible causes and remedy.
ZV contact I **ZV contact II** **ZV contact III** **ZV contact IV**	Rotate ignition distributor by operating starter for a short moment	Function of release contacts in ignition distributor	Alternately resistance ,,10" and ,,∞" (0/∞ ohm)	If the needle of the instrument is not swinging while starting or remains in position ∞ or 0, check connections 12, 13, 14, 21 and 22 on contact slide-in. If connections and cable harness for control unit are in order, renew release contacts. Adjustment is not possible.
Pressure switch engine 117 only	Switch on ignition step down on accelerator pedal (full throttle)	Function of full throttle contact in throttle valve switch	2-5 on volt scale. Indication should come 5° **before** completely opened throttle valve.	Throttle valve switch defective, exchange.

B. With volt-ohmmeter

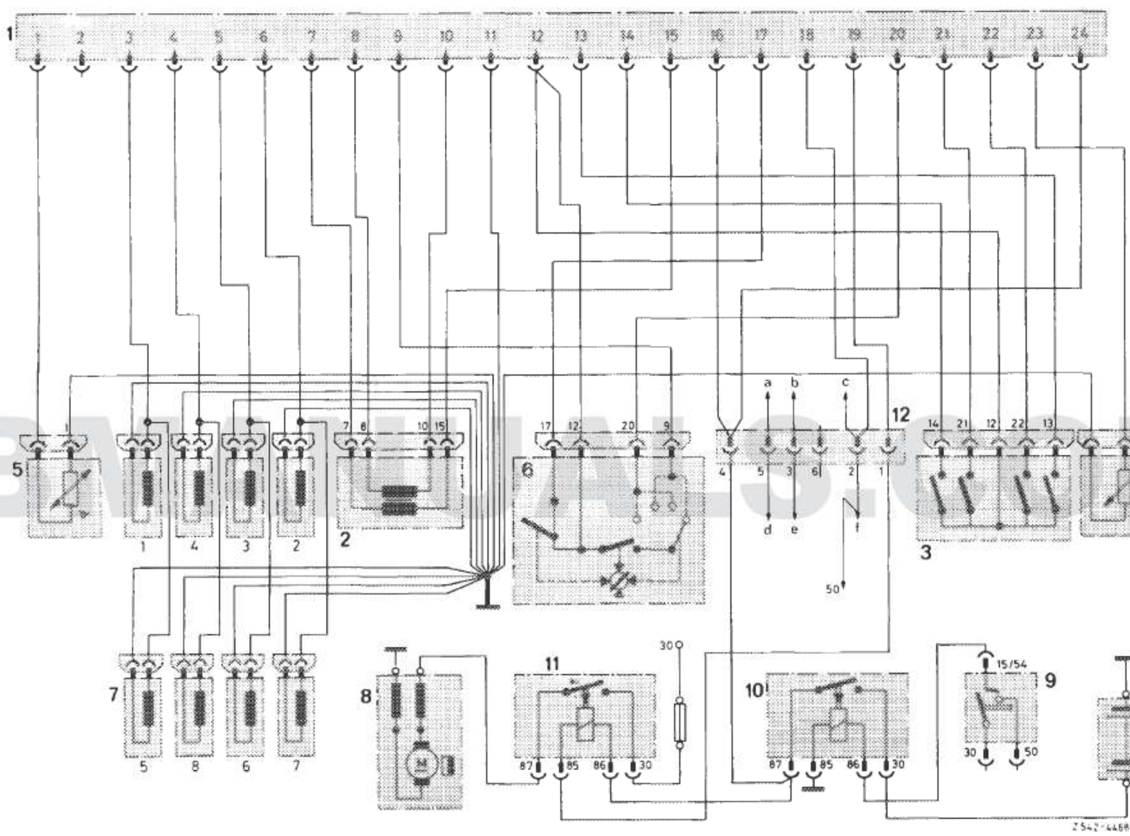
Conventional tools

Ohmmeter 0–10 000 ohm, voltmeter 0–16 volt

Connection diagram for control unit

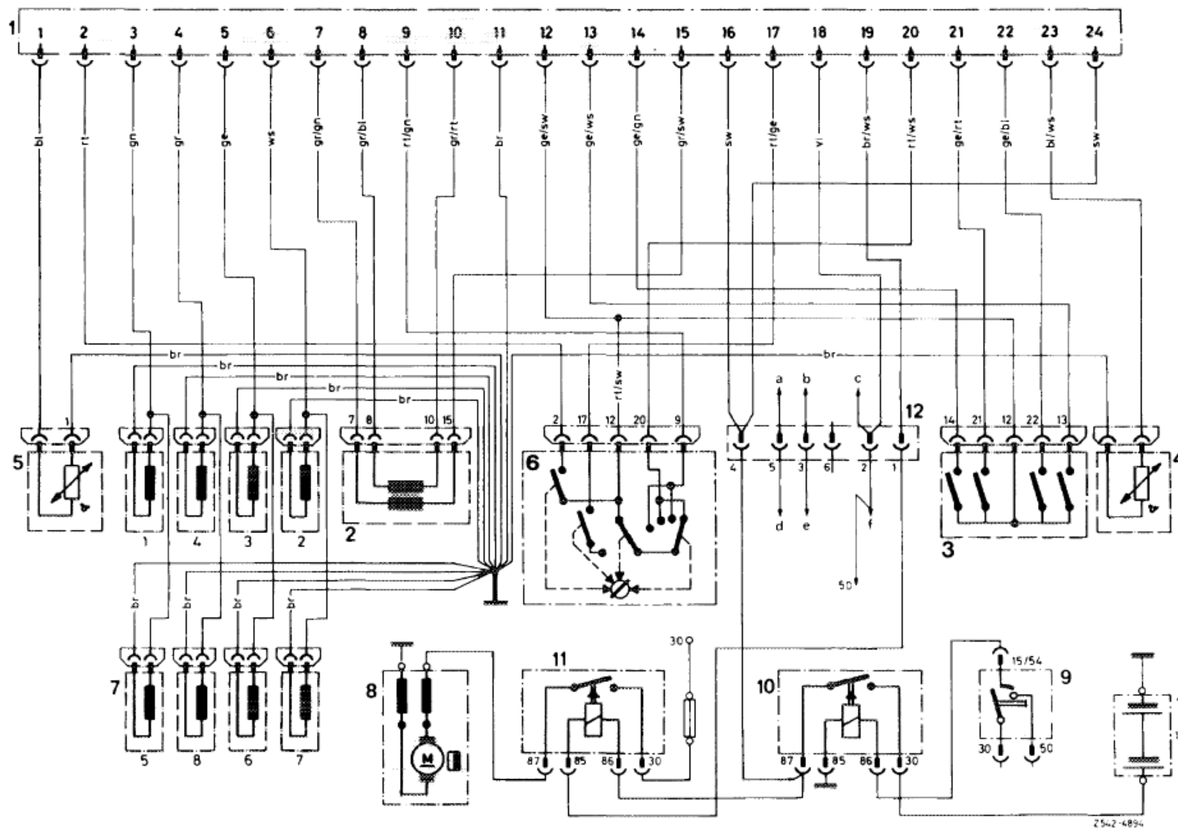
The following circuit diagram shows the individual components of the electronically controlled gasoline injection system and its connection to control unit.

Engine 116



1 Multi-point connector, control unit
2 Pressure sensor
3 Release contact in ignition distributor
4 Temperature sensor coolant
5 Temperature sensor air
6 Throttle valve switch
Terminal 9 transmition enrichment
Terminal 20 transition enrichment
Terminal 12 ground
Terminal 17 idle speed contact
7 Injection valves
8 Fuel pump
9 Ignition starting switch
10 Main relay electronics
11 Pump relay
12 Plug connection to vehicle harness
a To cold starting valve
b To thermo-time switch terminal W
c To thermo-time switch terminal G
d To cold starting relay terminal 87
e To cold starting relay terminal 85
f To cold starting relay terminal 86
13 Vehicle battery

Engine 117

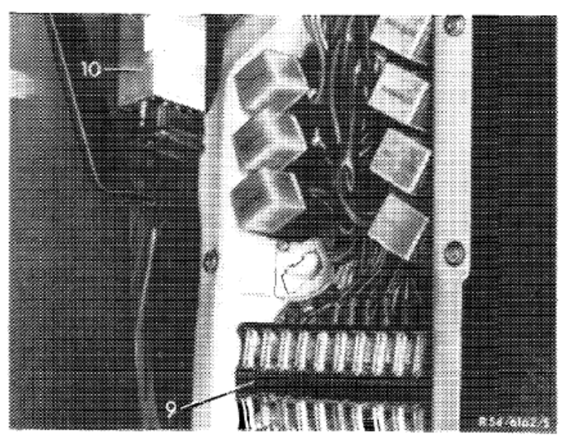


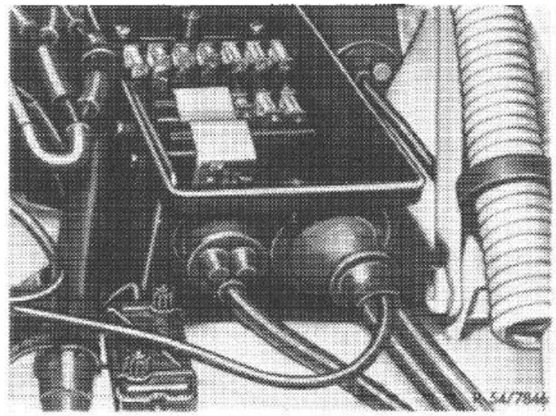
1 Multi-point connector (control unit)
2 Pressure sensor
3 Release contacts (ignition distributor)
4 Temperature sensor (coolant)
5 Temperature sensor (air)
6 Throttle valve switch
Terminal 9 transition enrichment
Terminal 20 transition enrichment
Terminal 2 full-load contact
Terminal 17 idle speed contact
Terminal 12 ground
7 Injection valves cylinders 1–8
8 Fuel pump
9 Ignition starting switch
10 Main relay (power supply control unit)
11 Pump relay
12 Intermediate plug (connection to vehicle harness)
a Starting valve
b Thermo-time switch terminal W
c Thermo-time switch terminal G
d Relay for starting valve terminal 87
e Relay for starting valve terminal 85
f Relay for starting valve terminal 86
13 Vehicle battery

Relay layout

Code number	Relay function
1	Relay fuel pump
2	Relay starting valve
3	Main relay electronic injection

Model 107





Model 116

Initial jobs for testing (refer to 07.4--035)

Testing

Voltage at multi-point connector of control unit

Actuate:	Switch-on ignition and leave switched on throughout entire test sequence described below.
Measure:	Voltage supply for control unit.
Connection electronic control unit multi-point contactor:	Voltage I terminal 11 and terminal 16 Voltage II terminal 11 and terminal 24
Nominal value:	11 V
Nominal value not attained.	
Possible causes and remedy:	**Voltmeter indicates no voltage:** Interruption: Plug connection from main relay (10) to control unit (line 16). Main relay not attracting: Check voltage on terminal 86 of main relay, if there is no voltage, check fuse in fuse box. Terminal 85 should be connected to ground. Measure voltage on terminal 87 of relay. If connection is ,,0'', check terminal 30 of relay. **Under load, voltage is below 11 V:** Transfer resistance on line 16 or on relay contact. Exchange main relay. Check cable from battery terminal plus to relay terminal 30.

Voltage starter terminal 50

Actuate:	Starter
Measure:	Voltage on terminal 50
Connection electronic control unit multi-point contactor:	Terminal 11 and terminal 18
Nominal value:	9.5 V
Nominal value not attained.	
Possible causes and remedy:	**Voltmeter shows no voltage, but starter rotates:** Line interruption from starter terminal 50 to control unit terminal 18. **Voltmeter indicates no voltage and starter is not rotating:** Ignition starting switch defective, line interrupted terminal 50. **Voltage below 9.5 V:** Battery discharged, voltage drop in line from ignition starter switch to terminal 50 of starter relay too high. Measure line with voltmeter for voltage drop.

Pressure sensor

Measure:	Pressure sensor connected to ground.
Connection electronic control unit multi-point contactor:	Terminal 7 and terminal 11 Terminal 8 and terminal 11
Nominal value:	Resistance „∞"
Nominal value not attained.	
Possible causes and remedy:	**Resistance „0":** Ground connection in supply line or on pressure sensor. Pull plug from pressure sensor, if indication is „∞", exchange pressure sensor; if indication remains unchanged at „0", lines 7 and 8 may have a short circuit, replace cable harness. Resistance below „∞", but not „0": Insulation damage, remedy see above.

Measure: Primary winding of pressure sensor.

Connection electronic control unit multi-point contactor: Terminal 7 and terminal 15

Nominal value: approx. 90 ohms

Nominal value not attained.

Possible causes and remedy:

Resistance essentially lower than nominal:

Insulation damage: Pull plug from pressure sensor if indication then is ,,∞'', exchange pressure sensor.

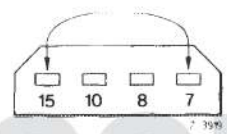
Resistance ,,0'':

Short circuit in winding. Pull plug from pressure sensor, if indication is then ,,∞'', exchange pressure sensor. **Resistance considerably higher than nominal:** High transfer resistance. Check plug and lines for corrosion or interruption.

Resistance ,,∞'':

Interruption. Bridge terminal 7 and 15 on plug. If indication is ,,0'', exchange pressure sensor. If indication is ,,∞'', check lines.

Top view on plug



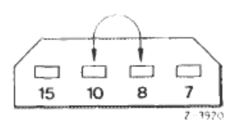
Measure: Secondary winding of pressure sensor.

Connection electronic control unit multi-point contactor: Terminal 8 and terminal 10

Nominal value: approx. 350 ohms

Nominal value not attained.

Possible causes and remedy: Similar to ,,primary''. If resistance is ,,∞'', bridge terminals 8 and 10.



Function of release contacts in ignition distributor

Actuate: Rotate ignition distributor by brief actuation of starter.

Measure: Function of release contact in ignition distributor.

Connection electronic control unit multi-point contactor:
ZV contact I terminal 12 and 21
ZV contact II terminal 12 and 22
ZV contact III terminal 12 and 13
ZV contact IV terminal 12 and 14

Nominal value: Alternately resistance ,,0'' and ,,∞''

Nominal value not attained.

Possible causes and remedy: If the pointer of the instrument is not swinging back and forth while starting or stops in position ∞ or 0, check connections 12, 21, 22, 13 and 14 on contact slide-in. If connections to control unit are in order, renew release contact, adjustment is not possible.

Throttle valve switch conductor path I and II

Actuate: Step down slowly on accelerator pedal.

Measure: Function of transfer enrichment.

Connection electronic control unit multi-point contactor: I terminal 9 and terminal 12
II terminal 20 and terminal 12

Nominal value: Pointer of instrument swings approx. 10 times between „0" and „∞"

Nominal value not attained.

Possible causes and remedy: When the floored pedal is moving back, the pointer of the instrument should remain in position „∞".

Indication „0":

Throttle valve switch defective, exchange.

Throttle valve switch III

Actuate: 1. Throttle valve switch at idle (closed).
2. Throttle valve switch slightly opened (approx. 1° = 0.4 mm).

Measure: Function of contacts in throttle valve switch.

Connection electronic control unit multi-point contactor: Terminal 12 and terminal 17

Nominal value: 1. „0"
2. „∞"

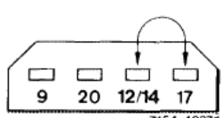
Nominal value not attained.

Possible causes and remedy:

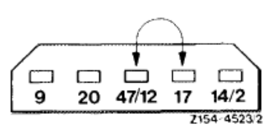
a) Resistance „∞":

Throttle valve switch wrongly set or interruption in supply line. Check adjustment. Pull-off plug, bridge terminals 12 and 17.

If then still „∞", exchange cable line,
otherwise exchange throttle valve switch.



Engine 116



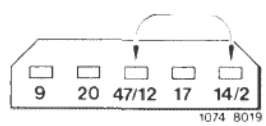
Engine 117

b) Resistance „0":

Throttle valve switch wrongly adjusted or short circuit in supply line. Pull-off plug, if indication is still „0", exchange cable line, otherwise adjust or exchange throttle valve switch.

Full-load contact in throttle valve switch (engine 117 only)

Check:	Full-throttle checkup of accelerator pedal.
Actuate:	Step down fully on accelerator pedal.
Measure:	Full-load contact of throttle valve switch.
Connection electronic control unit multi-point contactor:	Terminal 12 and terminal 2
Nominal value:	,,0"
Nominal value not attained.	
Possible causes and remedy:	**Resistance ,,∞":** Throttle valve switch wrongly adjusted or interruption in supply line. Check adjustment. Pull plug, bridge terminal 12 and 2. If then still ,,∞", exchange cable line, otherwise exchange throttle valve switch.



Temperature sensor I (air)

Measure:	Resistance of temperature sensor.
Connection electronic control unit multi-point contactor:	Terminal 1 and terminal 11
Nominal value:	Heavily dependent on temperature: 640 Ω at 0°C 400 Ω at 10°C 300 Ω at 20°C 210 Ω at 30°C 150 Ω at 40°C
Nominal value not attained.	
Possible causes and remedy:	Resistance decreasing at increasing temperature. Sensor is in order, unless 0 or ∞ is measured. **Indication ,,∞":** Interruption. Pull-off plug and bridge, if indication is ,,0", exchange temperature sensor, otherwise cable line. **Indication ,,0":** Short circuit. Pull-off plug, if indication remains unchanged, cable is defective. If indication is then ,,∞", exchange temperature sensor.

Temperature sensor II (coolant)

Measure:	Resistance of temperature sensor
Connection electronic control unit multi-point contactor:	Terminal 11 and terminal 23
Nominal value:	Heavily dependent on temperature: 5.9 kΩ at 0°C 2.5 kΩ at 20°C 1.2 kΩ at 40°C 600 Ω at 60°C 325 Ω at 80°C 190 Ω at 100°C
Nominal value not attained.	
Possible causes and remedy:	Refer to temperature sensor I

Injection valves (1-8)

Actuate:	During measurements always pull-off one valve plug on electric injection valve, so that only one valve is measured at a time, e.g. cylinder 1 or 5, or 3 or 6.
Measure:	Resistance of valve winding with supply line.
Connection electronic control unit multi-point contactor:	1. Terminal 3 and terminal 11 injection valve 1 and 5 2. Terminal 5 and terminal 11 injection valve 3 and 6 3. Terminal 4 and terminal 11 injection valve 4 and 8 4. Terminal 6 and terminal 11 injection valve 2 and 7
Nominal value:	2.5 – 3 ohms each injection valve
Nominal value not attained.	
Possible causes and remedy:	**Resistance „0":** Short circuit in supply line or on valve. Pull plug from respective valve, if indication is then „∞", exchange valve, otherwise exchange cable line. **Resistance „∞":** Interruption in supply line or in valve coil. Bridge contacts in valve plug, if indication is then „∞", cable line is defective. If indication is „0", valve is defective. **Resistance at terminal 11:** Ground line of valves poorly connected to engine.

Electric fuel pump and electric lines

Actuate:	Switch-on ignition.
Measure:	Electric fuel pump and electric lines.
Connection electronic control unit multi-point contactor:	Connect terminal 11 and terminal 19.
Nominal value:	11.5 V on cable connections fuel pump.
Nominal value not attained.	
Possible causes and remedy:	Fuel pump not starting.

Disconnect cable connections on pump, measure voltage with voltmeter at cable ends. 12 volts readout indicates defective pump, exchange. If indication is ,,0'', check audibly whether pump relay attracts.

If yes,

line interrupted from pump relay 87 to pump connections or from there to ground.

Fuse in fuse box defective.

If connecting lines are in order, pump relay is defective.

If no,

line interrupted from main relay terminal 87 to pump relay terminal 86 or from pump relay terminal 85 to control unit terminal 19 (ground for pump relay). If lines are in order, check whether pump relay attracts when ground is connected directly to terminal 85, if yes, exchange control unit. If no, exchange pump relay.

Checking fuel pressure and leaks in ring line

Refer to 07.4–120

Starting device

Actuate:	Actuate starter.
Measure:	Function of thermo-time switch (+35°C)
Connection:	To coupling plug of cold starting valve.
Nominal value:	10 volts below +35°C coolant temperature.
Nominal value not attained.	
Possible causes and remedy:	If there is no voltage, check fuse, also check line from cold starting valve to relay and to thermo-time switch.

If fuse and line are in order:
Connect terminal ,,W'' of thermo-time switch to ground.
If line is now carrying voltage, the thermo-time switch is defective, exchange thermo-time switch.

If there is no voltage, replace relay.

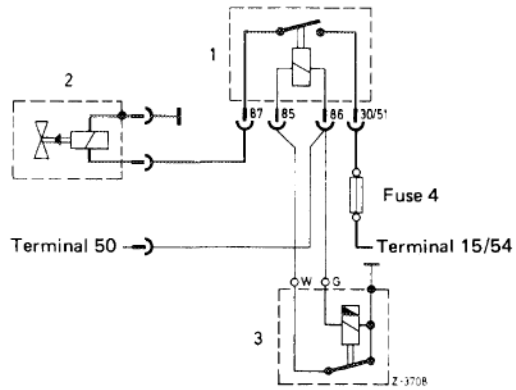
Testing thermo-time switch with ohmmeter:

Test values above +35°C

Connection W – ground = approx. 100 ohms
Connection G – ground = approx. 60 ohms
Connection G – W = approx. 40 ohms

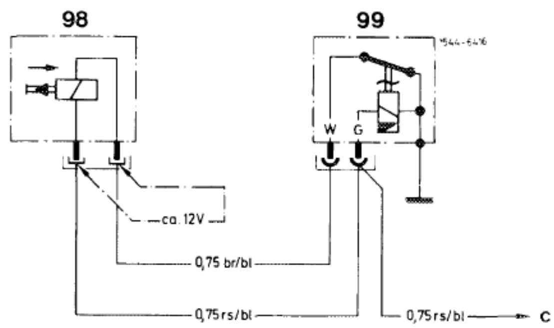
Test values below +35°C

Connection G – ground = approx. 20 ohms
Connection W – ground = approx. 0 ohms
(contacts in switch closed)



Wiring diagram of starting device with relay

1 Relay
2 Starting valve
3 Thermo-time switch



Wiring diagram of staring device without relay starting September 1975

98 Cold starting valve
99 Thermo-time switch
c To terminal 50

Offset of release contacts in ignition distributor

Actuate:	Connect control unit, run engine at approx. 2000/min.
Measure:	Offset of release contacts in ignition distributor.
Connection electronic control unit multi-point contactor:	1. Terminal 12 and terminal 21 2. Terminal 12 and terminal 22 3. Terminal 12 and terminal 13 4. Terminal 12 and terminal 14
Nominal value:	Pointer of voltmeter swings to a mean value. When changing connections, the deviation may amount to max 0.4 V of mean value.
Nominal value not attained.	
Possible causes and remedy:	If deviations are higher, renew release contact slide-in in ignition distributor.

C. With Bosch tester KD-JED 7500

The test jobs are shown in test list of unit.

07.4–100 Adjustment of idle speed

A. Standard version

Testing and adjusting data

Engine	Idle speed 1/min	Idle speed emission value % CO
116,117	700–750	1.5–2.5

B. National version J USA

Identification: Information plate in national language on cross member in front of radiator or on cylinder head cover.

Adjust engines according to data of respective emission control information plate.

<table>
<tr><th>Engine</th><th>Model</th><th>Idle speed 1/min</th><th>Idle speed emission value % CO</th></tr>
<tr><td colspan="4">J
Information plate: yellow imprint „Japan".</td></tr>
<tr><td>116, 117</td><td>up to 1976</td><td>760–800</td><td>max. 1.5</td></tr>
<tr><td colspan="4">USA
Information plate: color code black/green</td></tr>
<tr><td>116</td><td>1970/71</td><td>750–800</td><td>1.0–2.0</td></tr>
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<tr><td>117
Federal emission control (black information plate)</td><td>1974</td></tr>
<tr><td>117
California emission control (green information plate)</td><td>1974</td><td>max. 1.0 with air injection</td></tr>
<tr><td>117</td><td>1975</td><td>max 1.5 without air injection</td></tr>
</table>

Special tool

Oil telethermometer		116 589 27 21 00

Conventional tools

CO measuring instrument, revolution counter

Note

Do not adjust idle speed when engine is too hot, e.g. immediately following a fast ride or after measuring output on output dynamometer.

Adjustment

1 Switch off air conditioner or automatic climate control. Move selector lever into position „P".

2 Connect test instruments: revolution counter, CO measuring instrument.

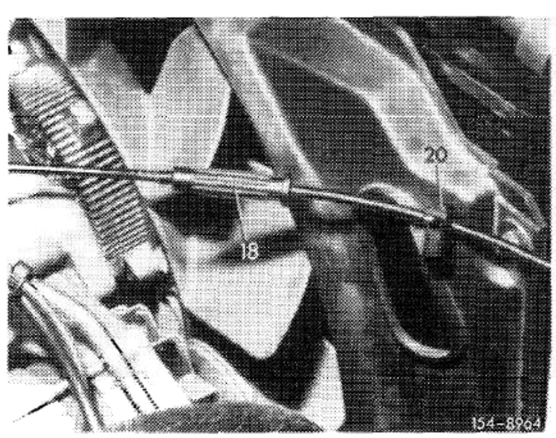
3 Run engine to operating temperature (60–80°C engine oil temperature).

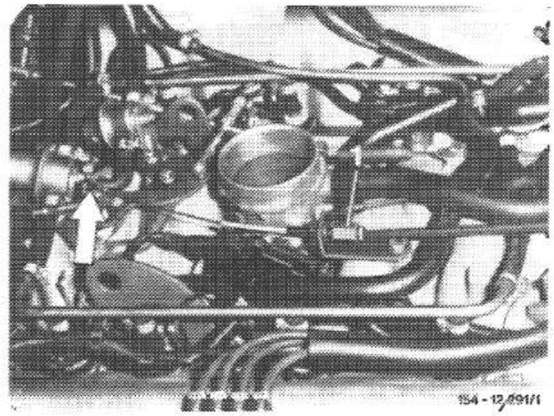
4 Check intake system for leaks. For this purpose, spray all sealed points with Iso-Oktan DIN 51756 or bezine.

Attention!
Do not use conventional fuel for spraying (vapours dangerous to health). Note inflammability and do not spray on red-hot components or parts of ignition system.

5 Check whether Bowden wire for Tempomat/Cruise Control rests free of tension against regulating lever (arrow). Set with adjusting nut (1 or 18), if required.

1st version



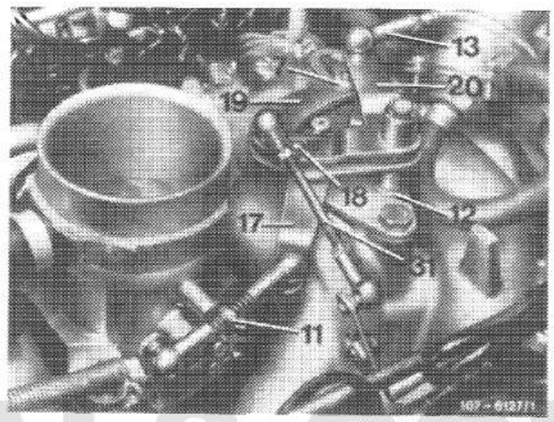


2nd version

6 Check regulating linkage.

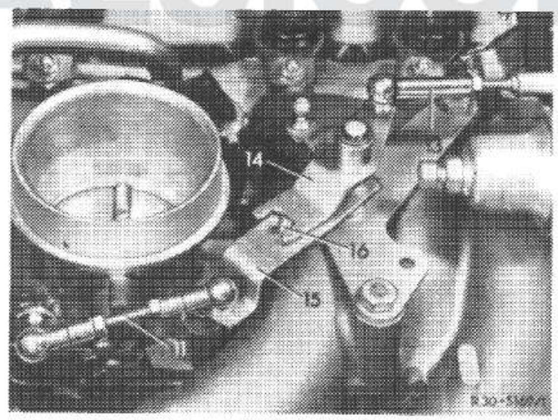
a) On vehicles with gate lever

Check whether roller (7) in gate lever (19) rests free of tension against end stop. Adjust by means of connecting rod (11).

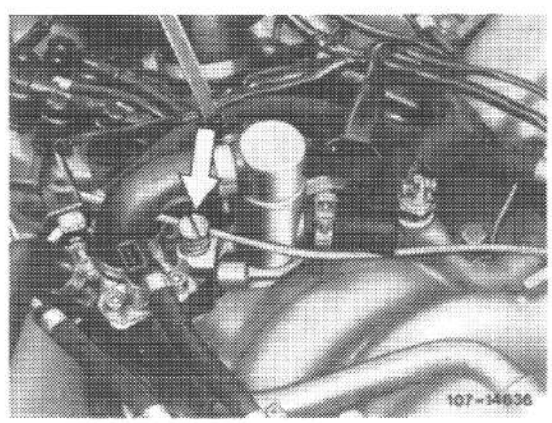


b) On vehicles without gate lever

Check whether regulating lever (14) rests against stop pin (16). Adjust connecting rod (11) if required.



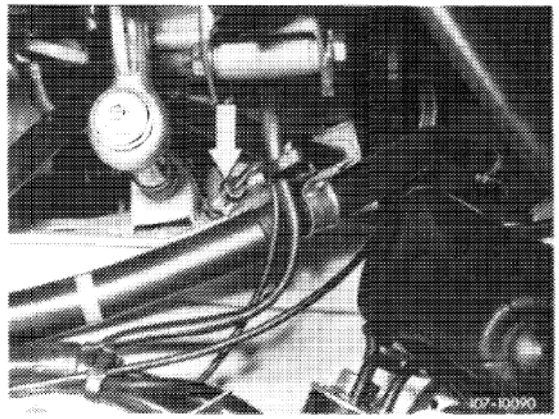
7 Adjust to specified idle speed by means of idle speed air screw (arrow).



8 Test idle speed emission value.

On vehicles USA version model year 1975, test emission value **without** air injection and adjust, if required.

For this purpose, pull plug connection (arrow) of oil temperature switch 17°C at right-hand wheel house and connect to ground. This will switch off the air injection.



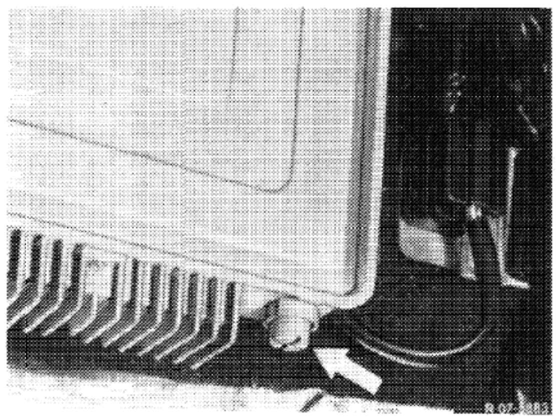
9 Adjust idle speed emission value.

Adjust idle speed emission value on control unit by means of adjusting screw (arrows).

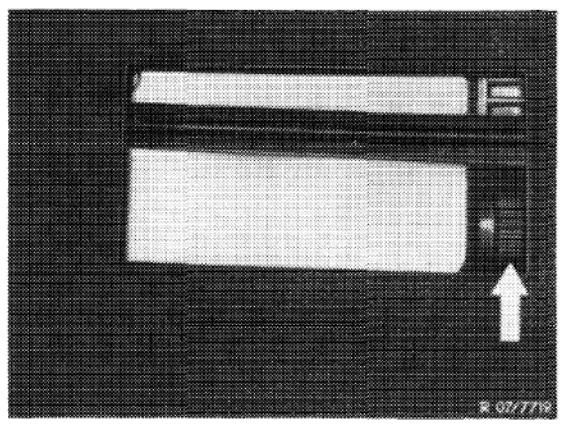
Turning counterclockwise	=	leaner
Turning clockwise	=	richer

On model 107 the control unit is accessible after releasing internal lining under glove box. On vehicles with right-hand steering, control unit is mounted at the left.

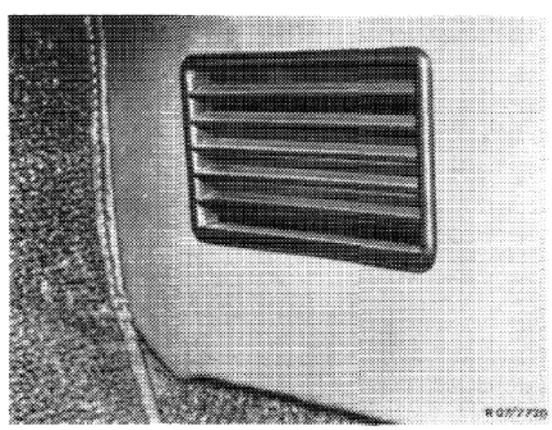
Model 107



Model 116

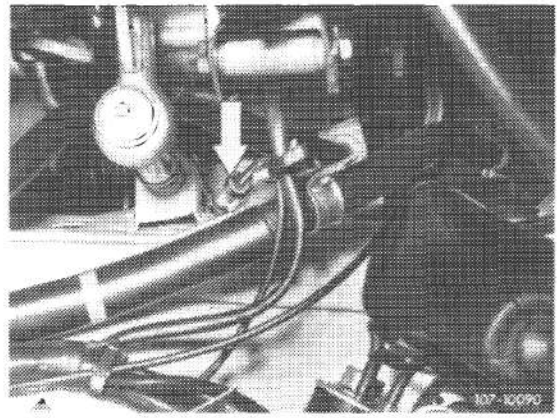


On model 116 the control unit is mounted in legroom at front right. Remove ornamental moulding to adjust emission value.
On vehicles with right-hand steering the control unit is mounted at the left.



Accelerate for a short moment and test idle speed emission value, adjust if required.

On vehicles USA version model year 1975 connect plug connection of temperature switch 17°C. Check idle speed emission value once again (air injection operating). Idle speed emission value should be below the value previously set.



10 Mount air filter. Check idle speed and idle speed emission value once again and adjust, if required.

11 Set selector lever to driving position. Switch-on air conditioner or automatic climate control, turn power steering completely against lock, engine should continue running. Adjust speed, if required.

07.4–110 Regulating engine

A. Standard version

Testing and adjusting data

Engine	Idle speed 1/min	Idle speed emission value % CO
116, 117	700–750	1.5–2.5

B. National version J USA

Identification: Information plate in national language on cross member in front of radiator or on cylinder head cover.

Adjust engines according to data of respective emission control information plate.

<table>
<tr><th>Engine</th><th>Model year</th><th>Idle speed 1/min</th><th>Idle speed emission value % CO</th></tr>
<tr><td colspan="4">J
Information plate: yellow imprint „Japan"</td></tr>
<tr><td>116, 117</td><td>up to 1976</td><td>760–800</td><td>max 1.5</td></tr>
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<tr><td>117
Federal emission control
(black information plate)</td><td>1974</td></tr>
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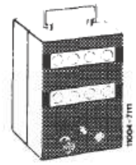
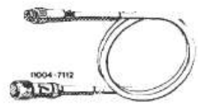
California emission control
(green information plate)</td><td>1974</td><td>max 1.0 with air injection</td></tr>
<tr><td>117</td><td>1975</td><td>max 1.5 without air injection</td></tr>
</table>

Special tools

Digital tester		001 589 54 21 00
Connecting cable		000 589 04 90 00
Oil telethermometer		116 589 27 21 00

Conventional tools

CO measuring instrument, revolution counter, stroboscope, oscilloscope

Note

Do not regulate engine when it is too hot, e.g. immediately following a fast ride or after measuring output on output dynamometer.

Regulation

1 Switch off air conditioner or automatic climate control. Move selector lever into position „P".

2 Connect test instruments: CO measuring instrument, revolution counter, stroboscope, oscilloscope, digital tester.

3 Evaluate oscilloscope display.

4 Check firing point and adjust, if required. Check centrifugal and vacuum ignition adjustment (07.5–500).

5 Check intake system for leaks. For this purpose, spray all sealed points with Iso-Oktan DIN 51756 or benzine.

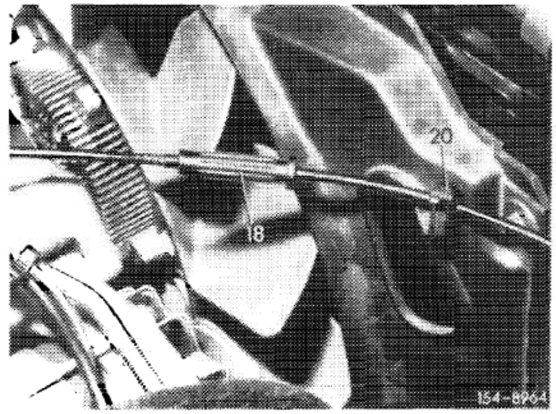
Attention!
Do not use conventional tools for spraying (vapours are dangerous to health). Note inflammability and do not spray on red-hot components or parts of ignition system.

6 Run engine up to operating speed (60–80°C engine oil temperature).

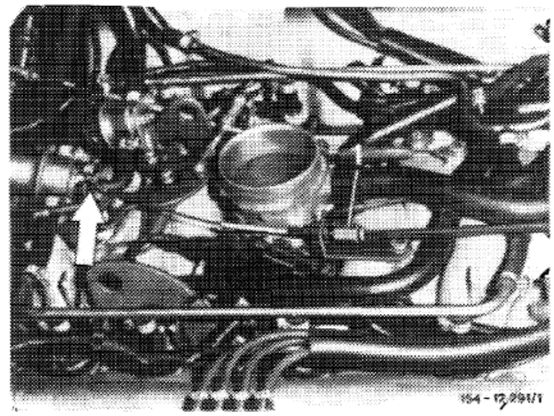
7 Check engine regulating linkage for easy operation and wear. Lubricate all bearing points and ball sockets.

8 Check whether Bowden wire for Tempomat/Cruise Control rests free of tension against regulating lever (arrow). Set with adjusting nut (1 or 18), if required.

1st version



2nd version

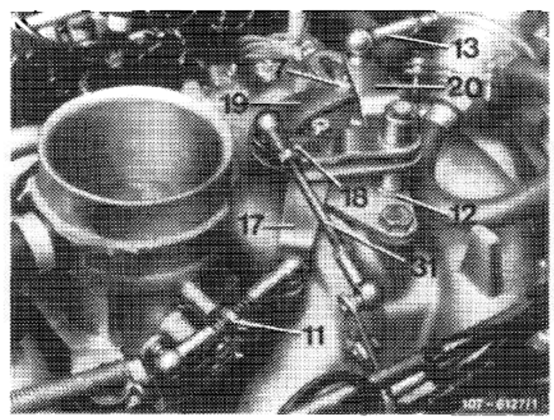


9 Check whether throttle valve rests against idle speed stop. For this purpose, disconnect connecting rod.

10 Check regulating linkage.

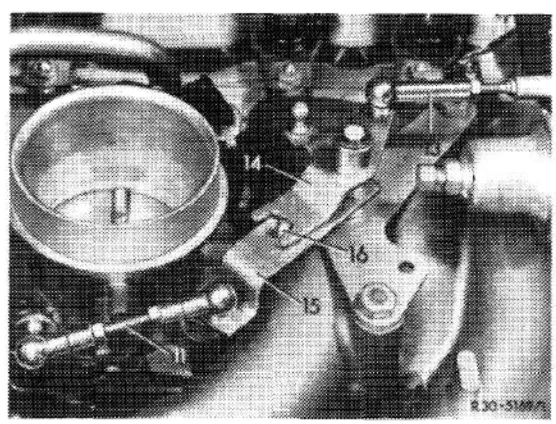
a) On vehicles with gate lever

Check whether roller (7) in gate lever (19) rests free of tension against end stop. Adjust with connecting rod (11), if required.

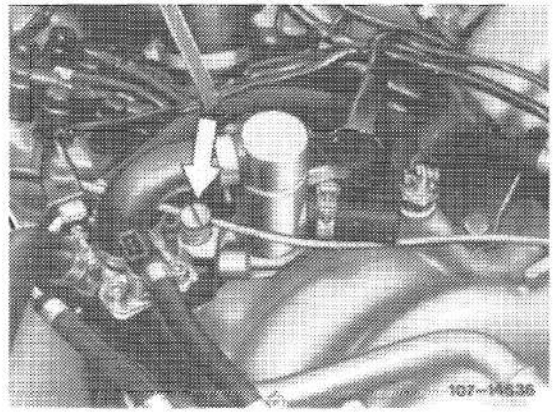


b) On vehicles without gate lever

Check whether regulating lever (14) rests against stop pin (16). Adjust connecting rod (11), if required.



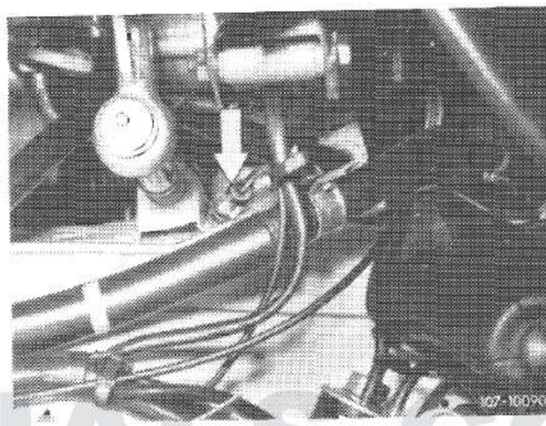
11 Set to specified idle speed by means of idle speed air screw (arrow).



12 Check idle speed emission value.

On vehicles USA version model year 1975 check emission value **without** air injection and adjust, if required.

For this purpose, pull-off plug connection (arrow) of oil temperature switch 17°C at right-hand wheel house and connect to ground. This will cut out the air injection.



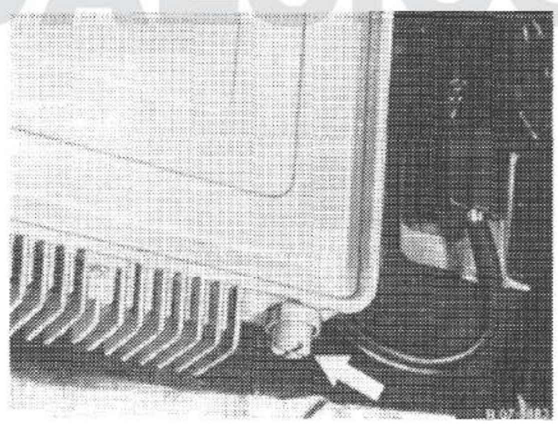
13 Adjust idle speed emission value.

Adjust idle speed emission value by means of adjusting screw (arrow) on control unit.

Turning counterclockwise = leaner
Turning clockwise = richer

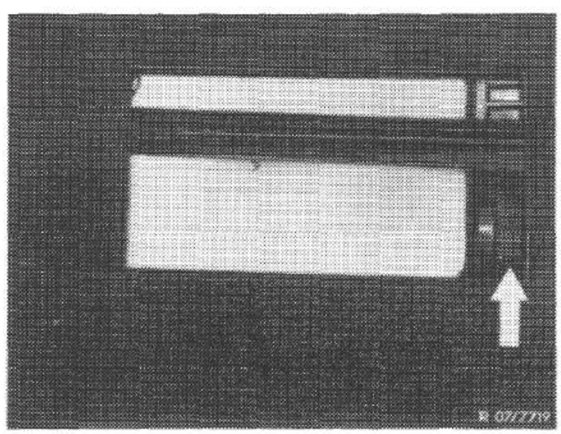
On model 107 the control unit is accessible after loosening inside panelling under glove box. On vehicles with right-hand steering the control unit is mounted at the left.

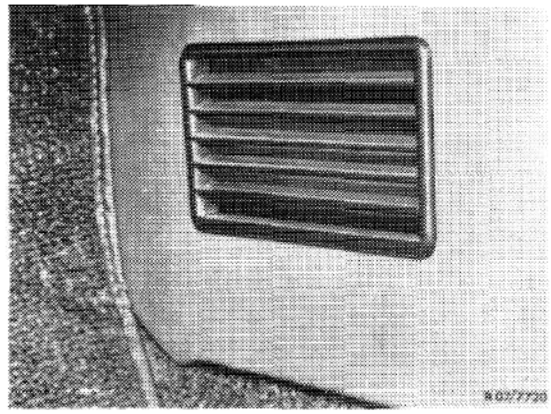
Model 107

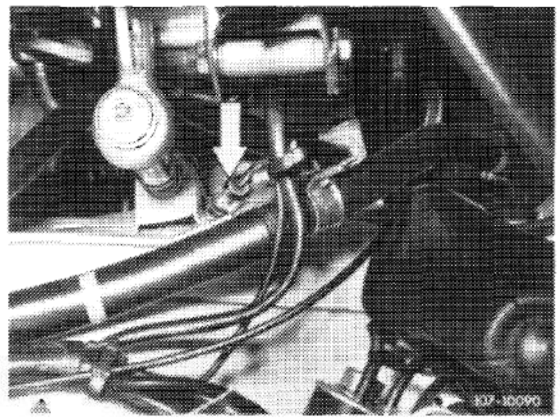


On model 116 the control unit is mounted in legroom at front right. Remove ornamental moulding for adjusting emission value.
On vehicles with right-hand steering the control unit is mounted at the left.

Model 116







Accelerate for a short moment, check idle speed and idle speed emission value once again and readjust, if required.

On vehicles USA version model year 1975, join plug connection of temperature switch 17°C. Check idle speed emission value once again (air injection operating). The idle speed emission value should be below the value previously adjusted.

14 Mount air filter. Check idle speed and idle speed emission value once again and adjust, if required.

15 Set selector lever to driving position, switch-on air conditioner or automatic climate control, turn power steering to full lock with engine running. Adjust speed, if required.

07.4–120 Checking fuel pressure and for leaks in ring line

Test values

Measuring specifications at idle with delivery pump energized		min 11.5 V
Delivery pressure in ring line	Measuring point	in front of cold starting valve in ring line
	bar gauge pressure	2.0 + 0.1
Capacity[1])	Measuring point	following pressure regulator in return line
	1 litre	in max 30 seconds

[1]) When measuring delivery capacity, the fuel tank should be filled to at least 50%.

Special tool

Clamp		000 589 40 37 00

Conventional tools

Pressure gauge with calibrated measuring range of 0–2.5 bar gauge pressure

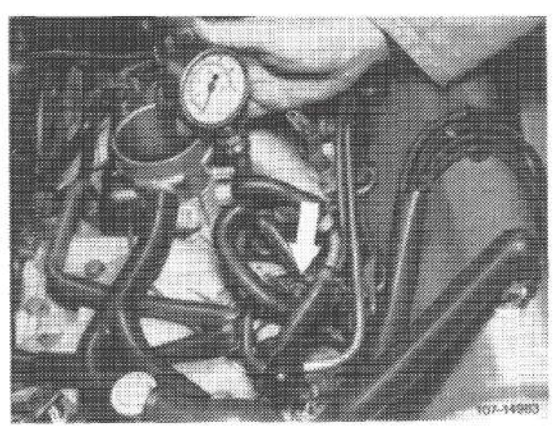
Checking fuel pressure

1 Remove air filter.

2 Remove fuel pressure for **safety reasons.** Pull electric plug connection from cold starting valve. Connect cold starting valve with separate cable to B + and ground for approx. 20 seconds.

Then return plug connection to cold starting valve.

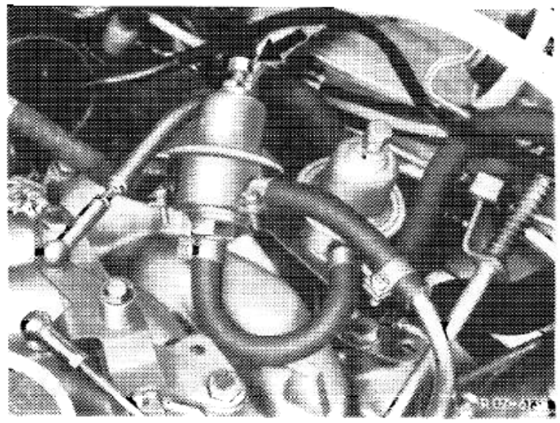
3 Connect pressure gauge in front of cold starting valve to ring line. For this purpose, pull fuel hose from ring line (arrow) and place pressure gauge in-between by means of a T-fitting.



4 Run engine at idle speed, check fuel pressure.

Nominal pressure 2.0 + 0.1 bar gauge pressure. Adjust by means of adjusting screw (arrow) on pressure regulator, if required.

If following a slight turn of adjusting screw no difference in pressure results, replace pressure regulator.

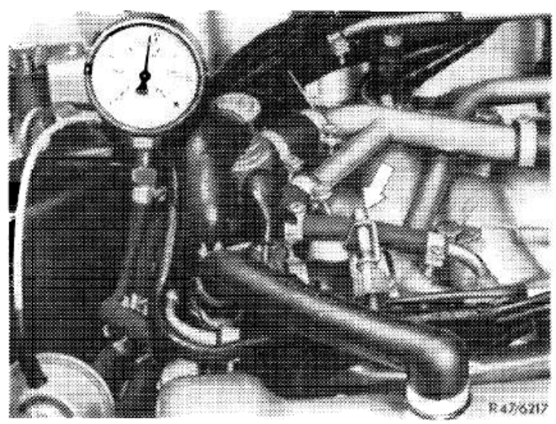


Checking for leaks

5 Disconnect engine. Fuel pressure may drop to 1.7 bar gauge pressure. After another approx. 5 minutes, a pressure drop to 1.5 bar gauge pressure is permitted. On fuel pumps with Bosch designation 0 580 970 002 the fuel pressure drops to 1.2 bar gauge pressure. If the fuel pressure drops uniformly to 0 bar gauge pressure, **an internal leak may be present at the following points.**

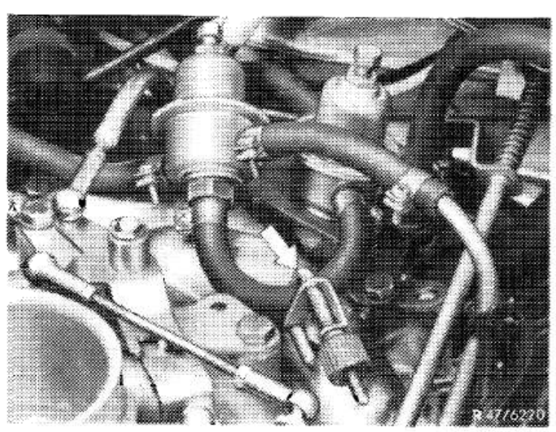
a) Check cold starting valve while switching-on ignition and disconnecting (pinching) fuel hose at cold starting valve (arrow).

If pressure gauge shows no reduction of fuel pressure, the cold starting valve is leaking and should be replaced.



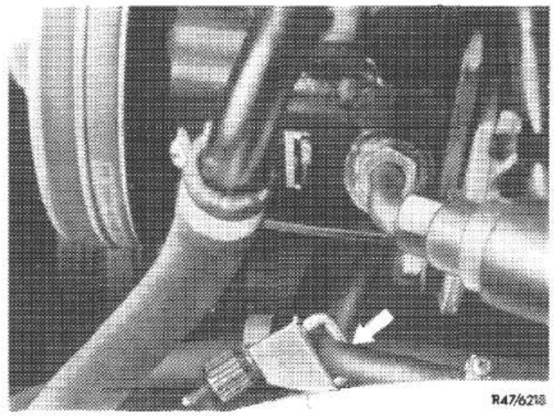
b) Check with pressure regulator by switching-on ignition and disconnecting (pinching) fuel return hose, behind pressure regulator (arrow) the moment the fuel pump stops.

If the pressure gauge shows no reduction of fuel pressure, the pressure regulator is leaking and should be replaced.

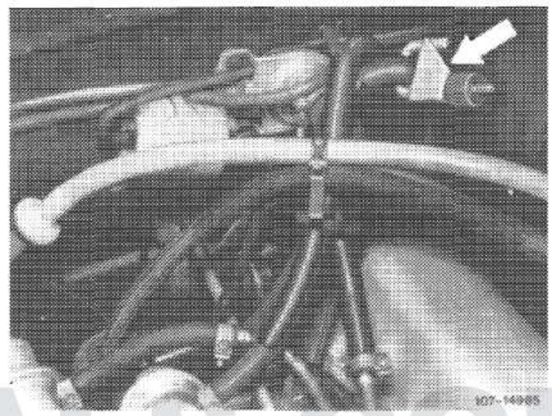


c) Check ball valve in pressure connection of fuel pump by switching-on ignition while disconnecting (pinching) fuel hose of fuel feed line in front of ring line (arrow) the moment the fuel pump stops.

If the fuel pressure at pressure gauge is not reduced, renew fuel pump.



1st version



2nd version

d) Check injection valves (07.4–135).

6 Check injection valves for electric function. For this purpose, switch-on ignition. Floor accelerator pedal slowly, the injection valves of the first group (cylinders 1 and 5) should then audibly eject. Rotate engine for approx. one additional revolution. Repeat procedure, now the injection valves of the second group (cylinders 4 and 8) should audibly eject. Repeat procedure, during which the injection valves of the third group (cylinders 6 and 3) should audibly eject. Continue rotating engine for approx. one more revolution. Repeat procedure, during which the injection valves of the fourth group (cylinders 7 and 2) should audibly eject.

7 Disconnect pressure gauge while slowly reducing fuel pressure as described under item 2.

8 Run engine and check for external leaks.

07.4–125 Checking starting device

Test values

Delivery pressure in ring line	Measuring point	in front of cold starting valve in ring line
	bar gauge pressure	2.0 + 0.1

Battery voltages

Rest potential	12.2 volts
Starting voltage	10 volts
Alternator regulating voltage	13.9–14.8 volts with contact regulator 13.7–14.5 volts with transistorized regulator

Voltages at ignition coil

Voltage at terminal 15	approx. 4.5 volts
Voltage at terminal 1	0.5–2.0 volts
Series resistance bridge (when starting)	10 volts

Conventional tools

Voltmeter and ohmmeter
Revolution counter
Pressure gauge with calibrated measuring range from 0–2.5 bar gauge pressure

Testing

1 Check battery for external condition (visual checkup).

Pay attention to contamination, in particular to battery pole oxidation.

2 Test battery voltages.

Note: During checkups a) and b), the voltmeter connection remains unchanged.

a) **Rest potential**

Connect voltmeter to battery at correct polarity and read voltage. Nominal value 12.2 volts.

b) **Starting voltage**

Pull cable 4 from ignition coil. Actuate starter for a short moment while reading voltage. Nominal value 10 volts. If the nominal value is not attained, check battery, charge or renew, if required.

c) **Alternator regulating voltage**

Connect voltmeter to alternator B +. Return cable 4 to ignition coil. Start engine, increase speed to 2000/min and keep constant. Load alternator by switching-on dimmer, fog lamp and windshield wiper.

Read regulating voltage within 30 seconds. Nominal value 13.9–14.8 volts with contact regulator or 13.7–14.5 volts with transistorized regulator. If the nominal value is not attained, check alternator and regulator and renew, if required.

3 Check voltage at terminal 15 of ignition coil. For this purpose, disconnect plus cable of voltmeter from battery and connect to terminal 15 of ignition coil.

Switch-on ignition and read voltage, nominal value approx. 4.5 volts.

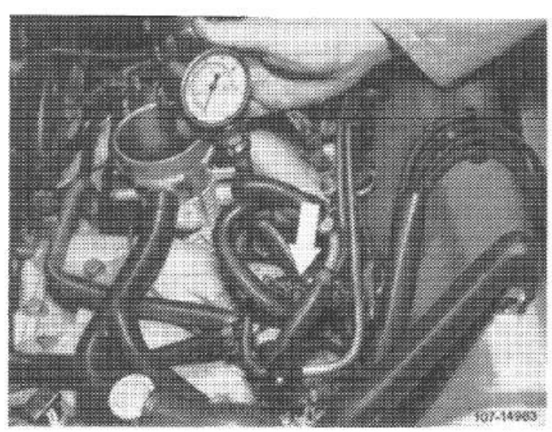
Check voltage at terminal 1 of ignition coil. For this purpose, disconnect plus cable of voltmeter from terminal 15 and connect to terminal 1 of ignition coil. Switch-on ignition and read voltage. Nominal value 0.5–2.0 volts.

4 Check series resistance bridge while starting engine and read voltage during starting sequence. Nominal value 10 volts.

Checking fuel pressure in ring line

5 Connect pressure gauge in front of cold starting valve to ring line. For this purpose, reduce fuel pressure for **safety reasons.** Pull electric plug from cold starting valve. Connect cold starting valve with separate cable to B+ and ground for approx. 20 seconds.

Then return plug connection to cold starting valve.



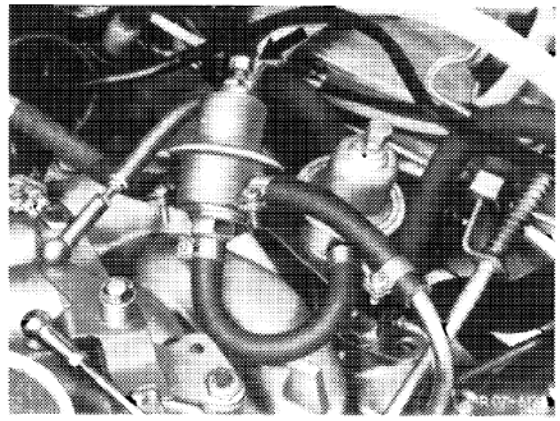
107-14983

6 Switch ignition on and off several times to establish fuel pressure.

7 Read fuel pressure.

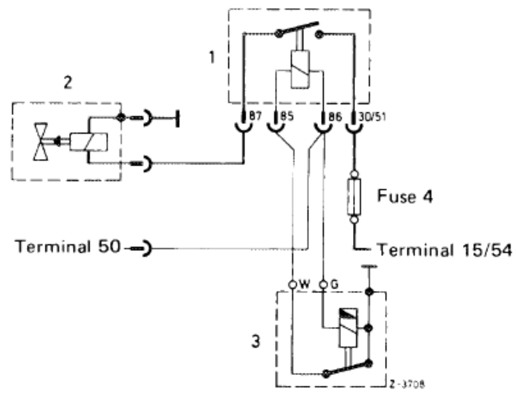
Nominal value = 2.0 + 0.1 bar gauge pressure.

Adjust by means of adjusting screw (arrow) on pressure regulator, if required.



Checking cold starting valve for function and leaks

8 Remove cold starting valve with fuel hose connected and hold into a container.



Circuit diagrm of starting device with relay

1 Relay
2 Starting valve
3 Thermo-time switch

Checking function

9 Switch-on ignition.

10 Connect cold starting valve with separate cable to B+ and ground. Cold starting valve should eject in cone shape.

Attention!
Connect cable first to cold starting valve to avoid sparking. No separate cable is required below +35°C, attach cable plug instead.

Checking for leaks

11 Release separate cable connection on cold starting valve. Dry cold starting valve at nozzle. No drops should show up.

12 Switch off ignition.

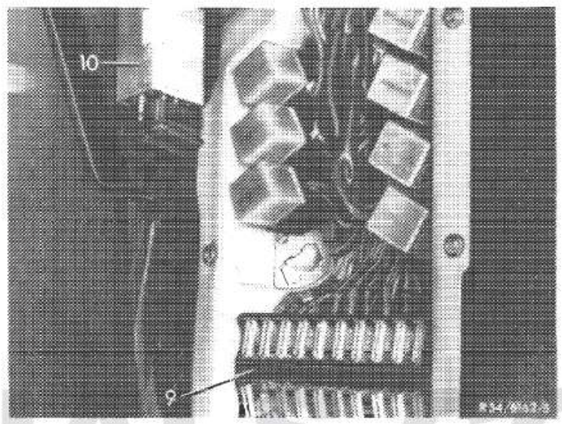
13 Mount cold starting valve with new seal.

14 Return cable plug to cold starting valve.

Checking thermo-time switch

The cold starting valve is actuated only at coolant temperatures below +35°C by means of closed thermo-time switch via relay (9).

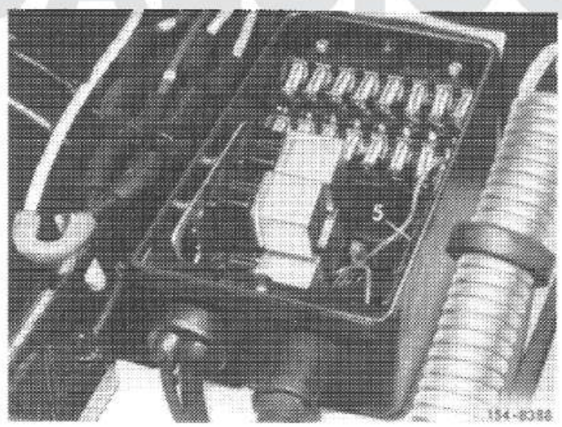
The actuating time increases with decreasing temperature and attains approx. 12 seconds at – 20°C.



Relay layout model 107

Code number	1	Relay fuel pump
Code number	2	Relay cold starting valve
Code number	3	Relay electronic injection system
Code number	4	Relay starter/air conditioner
Code number	5	Relay changeover valve ignition (19)
Code number	8	Relay separation temperature switch 62°C from 100°C
Code number	19	Relay exhaust gas return flow/advance ignition (58)

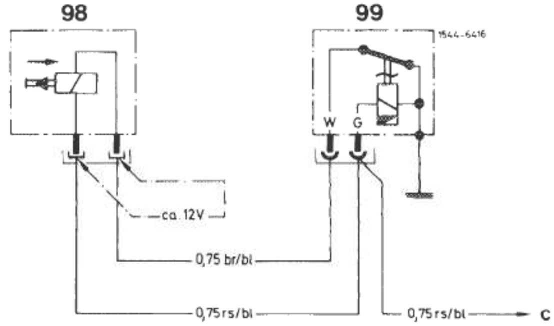
9 Fuses
10 Time switch heated rear window



Relay layout model 116

Code number 1 Relay fuel pump
Code number 2 Relay cold starting valve

Note: Starting approx. September 1975 the relay (9) for cold starting valve is no longer installed. The cold starting valve is directly contacted by thermo-time switch (refer to circuit diagram).



Circuit diagram of starting device without relay starting September 1975

98 Cold starting valve
99 Thermo-time switch
c To terminal 50

Testing below + 35°C coolant temperature

15 Connect voltmeter to connection of cold starting valve.

16 Actuate starter. Voltmeter should then indicate 10 volts for a given time (depending on coolant temperature).

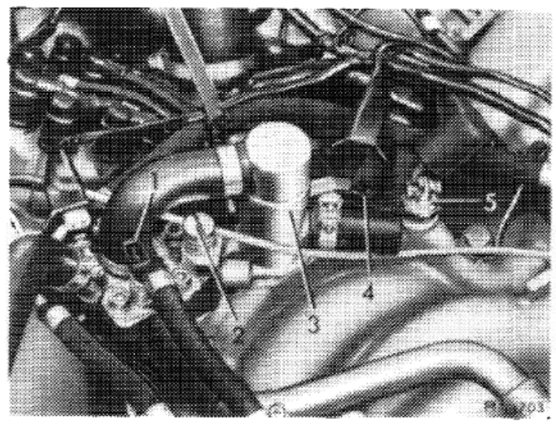
The switching time increases with decreasing temperature by approx. 1 second per 5°C.

e.g. +35°C = 0 seconds
+20°C = 3 seconds

During this test, it is recommended to check thermo-time switch (5) also with an ohmmeter.

Test value **below** +35° C:

Connection G-ground = approx. 20 ohms
Connection W-ground = approx. 0 ohm
(contacts in switch closed).



4 Cooling water temperature sensor
5 Thermo-time switch

Testing above +35°C coolant temperature

17 Above +35°C coolant temperature the thermo-time switch can be tested with an ohmmeter only. For this purpose, pull plug from thermo-time switch.

Test values **above** +35°C:

Connection G-ground = approx. 60 ohms
Connection W-ground = approx. 100 ohms
(contacts in switch opened).

Return plug.

Checking switch-off point of supplementary air valve

18 Pull contour hose from supplementary air valve. At approx. 70°C coolant temperature, the supplementary air valve should switch off (no more suction).

19 Check air and coolant temperature sensors in installed condition.

a) Without ohmmeter

Pull-off cable plugs one after the other, start engine and pay attention to speed change.

b) With ohmmeter

Pull-off connection cable and check resistance with ohmmeter.

Nominal values:

Air temperature sensor	= 640 Ω at 0°C
	= 400 Ω at 10°C
	= 300 Ω at 20°C
	= 210 Ω at 30°C
	= 150 Ω at 40°C
Coolant temperature sensor	= 5.9 k Ω at 0°C
	= 2.5 k Ω at 20°C
	= 1.2 k Ω at 40°C
	= 600 Ω at 60°C
	= 325 Ω at 80°C
	= 190 Ω at 100°C

07.4–130 Checking delivery pressure and delivery capacity of fuel pump

Test values

Measuring specification at idle and with delivery pump energized		min 11.5 volts
Delivery pressure in ring line	Measuring point	in front of cold starting valve in ring line
	bar gauge pressure	2.0 + 0.1
Delivery capacity[1])	Measuring point	following pressure regulator in return line
	1 litre	in max 30 seconds

[1]) When measuring delivery capacity, the fuel tank should be filled to at least 50%.

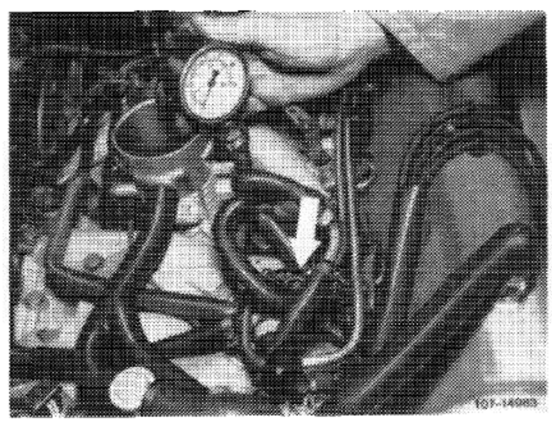
Conventional tools

Voltmeter, measuring glass or measuring cup 1 litre, stop watch

Checking delivery pressure

1 Connect pressure gauge in front of cold starting valve in ring line. For this purpose, reduce fuel pressure for **safety reasons.** Pull electrical plug connection from cold starting valve. Connect cold starting valve with separate cable to B+ and ground for approx. 20 seconds.

Then return plug connection to cold starting valve.

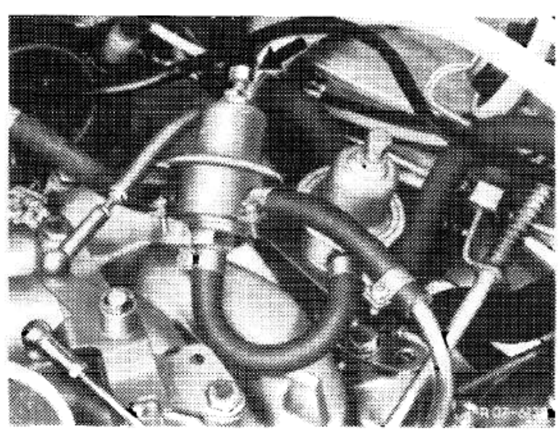


2 Run engine at idle. Check fuel pressure.

Nominal value 2.0 + 0.1 bar gauge pressure. Set pressure with adjusting screw (arrow) on pressure regulator, if required.

If, after a slight turning of adjusting screw, no difference in pressure is observed, renew pressure regulator.

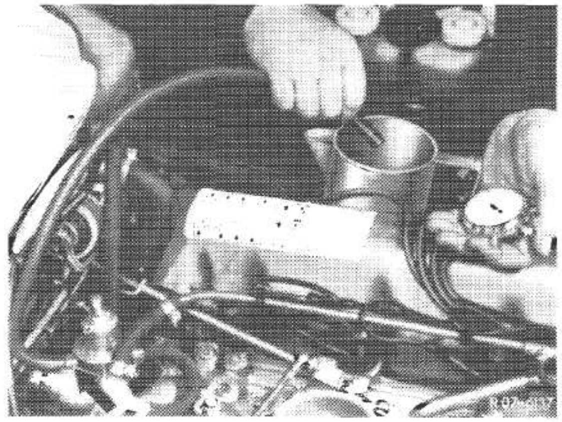
3 Prior to removing pressure gauge, reduce fuel pressure as described under item 1.



Checking delivery capacity

4 Disconnect fuel return hose after damper reservoir.

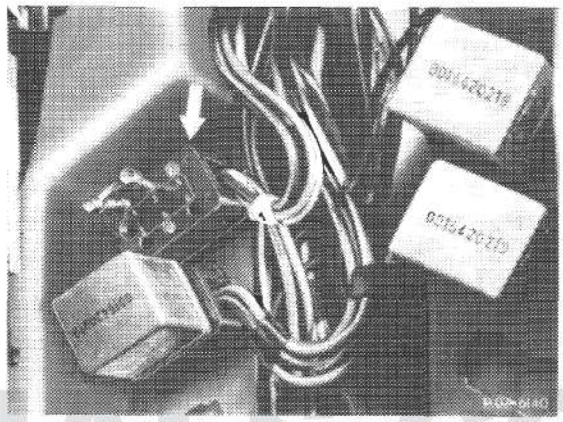
5 When measuring, connect fuel return hose (arrow) to damper reservoir.



6 Pull-off fuel pump relay (arrow) and bridge the two poles 1 and 3. This will energize the fuel pump which will then run when the ignition is switched on.

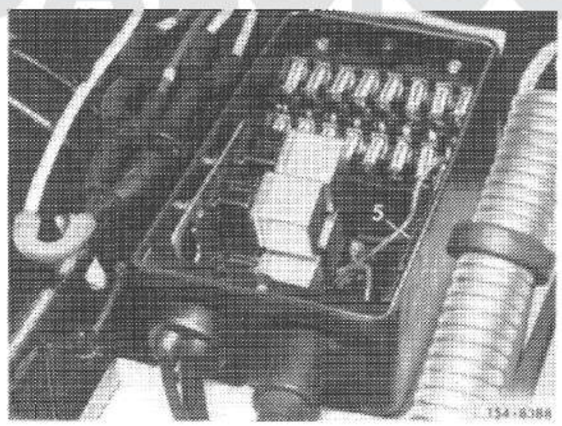
For this purpose, on model 107, remove cover and control unit underneath glove box. On model 116, the fuel pump relay is mounted in fuse box.

Model 107

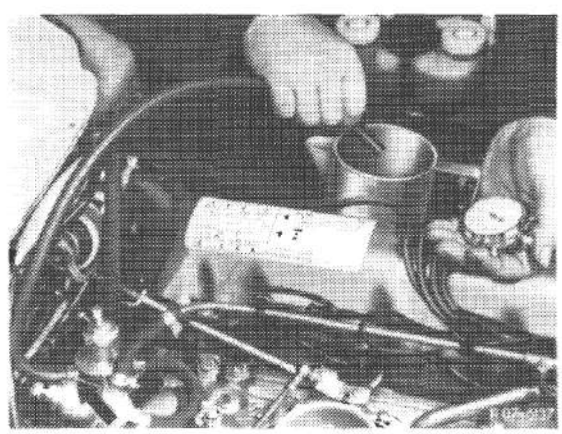


Note: The cable harness for fuel pump relay is marked with an 1.

Model 116

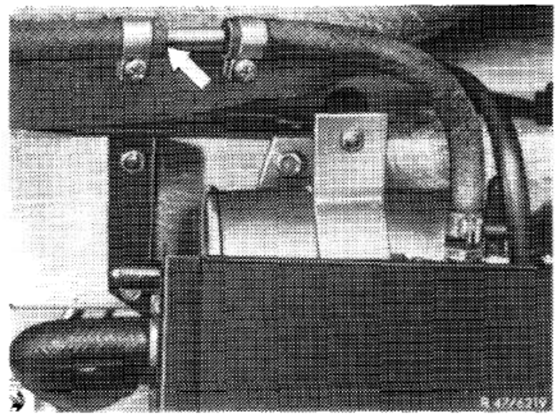


7 Hold hose end into measuring cup and switch-on ignition for 30 seconds.



8 If the delivery volume is below 1 litre/30 seconds, check fuel lines for restrictions (squeezed lines) and fuel filter for passage first. For this purpose loosen pressure hose on fuel filter and connect directly to fuel feed line (arrow).

If the delivery volume is still not enough, renew fuel pump.



9 Put back relay, mount control unit and cover in vehicle.

10 Mount fuel hoses, run engine and check for leaks.

07.4–135 Checking injection valves

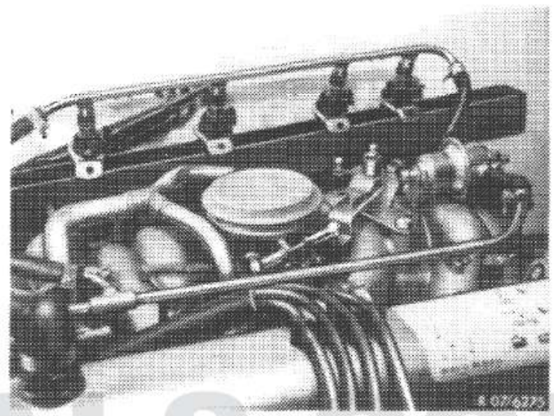
Checking

1 Remove and install injection valves with ring line (07.4–215).

2 Insert fuel collecting vessel.

3 Disconnect cable 1 on ignition coil (risk of fire)

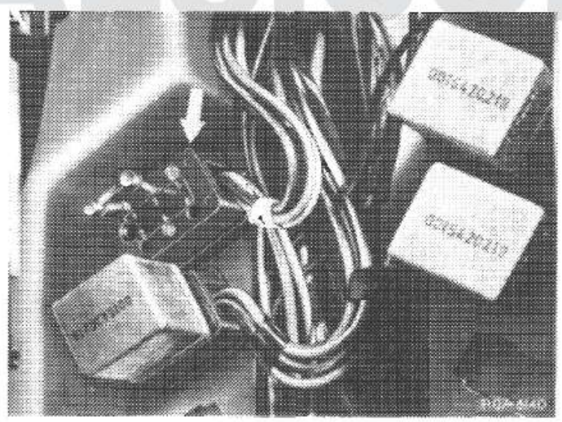
4 Crank engine with starting motor, injection valves should eject in firing sequence of 1–5–4–8–6–3–7–2.



5 Check injection valves for leaks.

a) Without Bosch tester

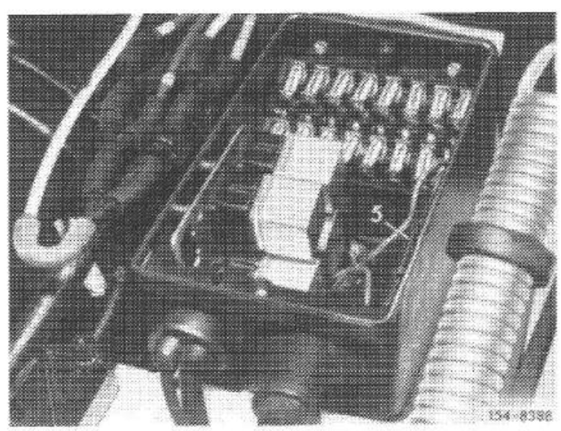
For this purpose, pull-off fuel pump relay (arrow) and bridge the two poles 1 and 3. The fuel pump will then be energized and will run with the engine stopped and the ignition switched on.



Model 107

On model 107, remove cover and control unit under glove box.

On model 116, the fuel pump relay is mounted in fuse box. The cable harness of relay is marked with an 1.



Model 116

Switch-on ignition, paying attention to leaks, if any, in injection valves. Renew leaking injection valves. Permissible leak volume max 2 drops per minute.

b) With Bosch tester EFAW 228

Remove control unit. Connect Bosch tester EFAW 228 and check injection valves for ejection and leaks (07.4–040).

6 Return injection valves with ring line. Run engine and check for external leaks.

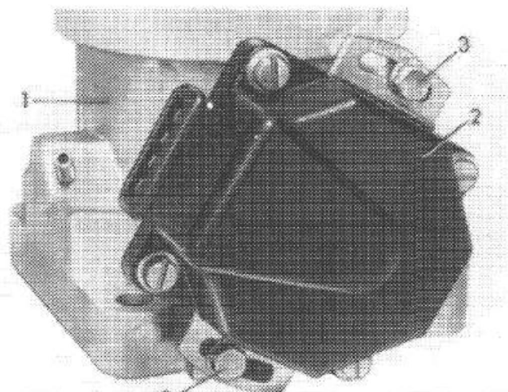
07.4–140 Adjustment of throttle valve switch

a) With Bosch tester EFAW 228

1 Connect Bosch tester EFAW 228 (07.4–040). Move switch ,,A'' to position ,,measuring'', switch ,,B'' to position ,,throttle valve switch III''.

2 Loosen switch (1) and the two fastening screws (2 and 3).

3 Switch-on ignition and turn switch until pointer of test instrument moves from ,,∞'' to ,,0''. From this position move switch by 1/2 graduation mark (1^{o}) counterclockwise and tighten. Then check adjustment by actuating throttle valve.



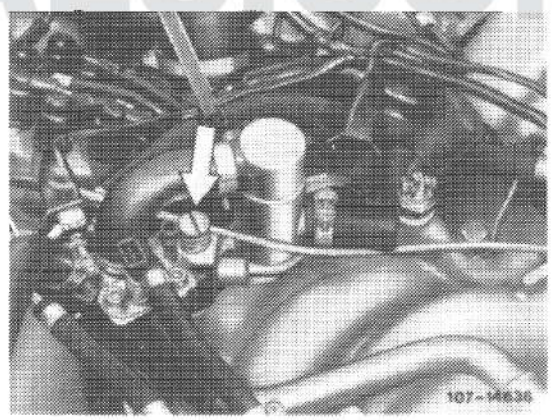
R 07/6160

b) Without Bosch tester

1 Run engine at idle.

2 Pull-off supplementary air hose between supplementary air valve and idle speed air distributor.

3 Insert a 0.4 mm measuring gauge at idle stop of throttle valve housing, with engine running. Adjust throttle valve switch, if required.



107–14636

Note: To check, insert a 0.35 mm measuring gauge at idle speed stop.

Adjustment is in order, if engine is hunting. Repeat adjustment, if required.

Remove measuring gauge and reattach supplementary air hose.

07.4–215 Removal and installation of injection valves

Installation survey of injection valves

Injection valves without protective sleeve

Engine	116	117
Bosch no.	0 280 150 013	0 280 150 015
Color code	black	blue

[1]) On engine 116 the injection valves can be provided with yellow protective sleeves starting production date 025.

Injection valves with protective sleeves

Engine	116	117
Bosch no.	0 280 150 022	0 280 150 024
Color code	yellow	blue

Injection valves with protective sleeve and double sealing edge connection

Engine	116	117
Bosch no.	0 280 150 034	0 280 150 036
Color code	yellow	blue

Protective sleeve

Engine	116	117
Part no.	000 987 18 45	000 987 19 45
Color code	yellow	blue

Note

To avoid damaging fuel hoses when mounting injection valves, remove the 4 injection valves of each cylinder bank **together with ring line.** Only then remove injection valves from ring line.

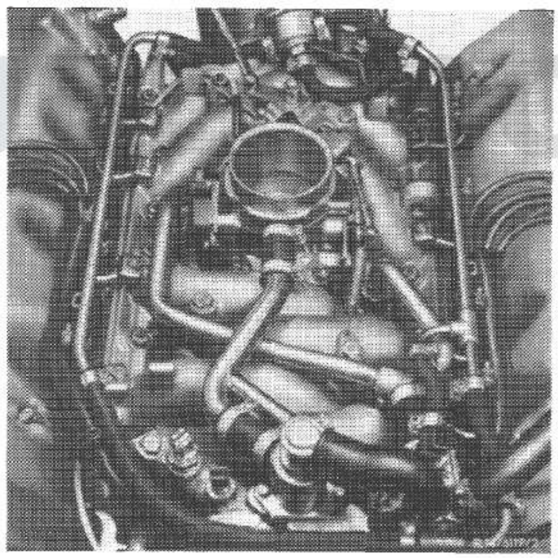
Removal

1 For **safety reasons,** reduce fuel pressure in ring line. For this purpose, pull electric plug connection from cold starting valve. Connect cold starting valve with separate cable to B+ and ground for approx. 20 seconds. Then return plug connection to cold starting valve.

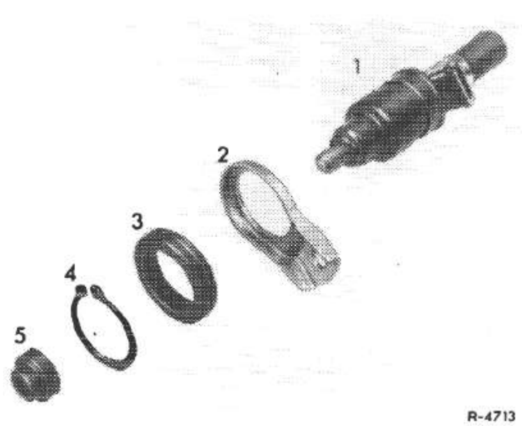
2 Loosen all electric connecting cables and fuel connections.

3 Loosen fastening nuts on fasteners and **remove** injection valves **together with ring line.**

4 Test injection valves (07.4–135).



5 Renew defective injection valves. For this purpose, loosen hose clip on ring line and remove locking ring (4) from fastener (2).



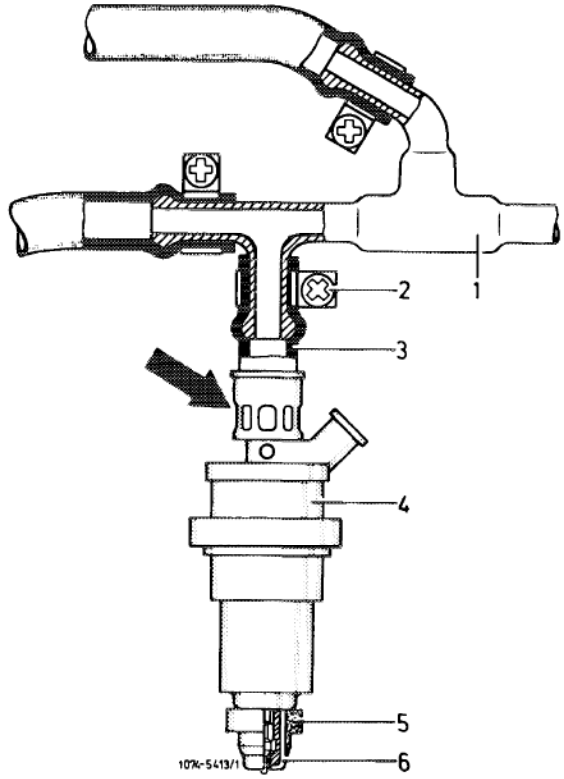
Injection valve removed

1 Injection valve
2 Holder
3 Rubber ring
4 Locking ring
5 Rubber sealing ring

Installation

For installation proceed vice versa. Observe the following points:

6 Slip fuel hoses as far as possible on ring line and attach hose clips each time behind bead on ring line. Keep turning injection valves in such a manner that the electric connections on cylinders 1–7 are pointing toward the rear and on cylinder 8 to the front. Mount hose clips with screw head pointing toward cylinder head end. Do not tighten hose clips to limit. Distance approx. 2 mm.



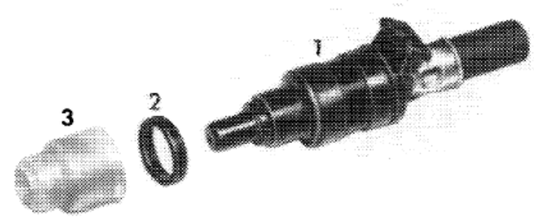
Injection valve with ring line ready for installation

1 Ring line
2 Hose clip
3 Fuel hose
4 Injection valve
5 Rubber sealing ring
6 Sleeve (color code engine 116 yellow, engine 117 blue)

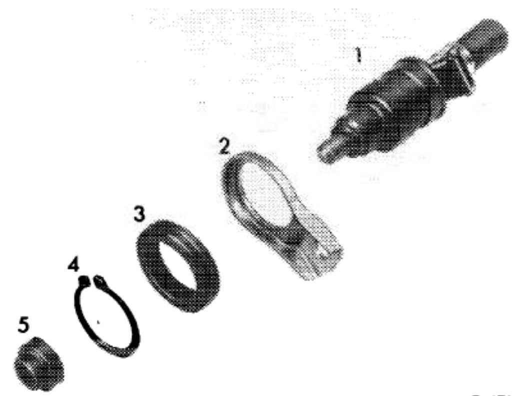
107-5413/1

7 On injection valves which are not yet provided with a protective sleeve, subsequently install protective sleeve with pertinent color code for respective injection valve. Slip-on protective sleeve manually up to stop.

8 Renew rubber sealing ring (2 or 5) and insert into cylinder head.



107–9098



R-4713

9 Mount injection valves together with ring line. Make sure that the valve needles of the injection valves are not breaking off.

10 Plug-on all electric connection cables and pull rubber caps over plug housing.

11 Slip fuel hoses as far as possible on ring line and position hose clips each time behind bead on ring line. Do not tighten hose clips to limit. Distance approx. 2 mm.

12 Run engine. Perform leak test **immediately** upon starting. Check hose connections for leaks, correct assembly and chafing by moving connecting points manually.

07.4–220 Renewing fuel hoses on injection valves

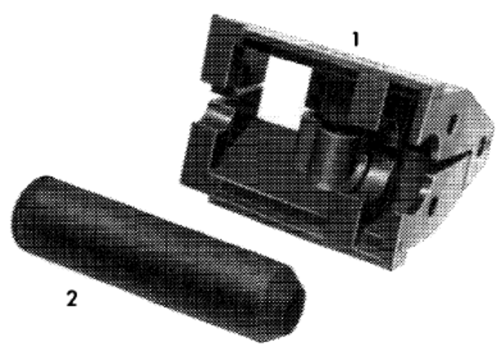
Special tool

Clamping device with assembly mandrel		116 589 07 31 00

Conventional tools

Side-cutting pliers, soldering gun

When replacing fuel hose, put injection valve into clamping device and clamp together with clamping device in a vise.



107–10048

a) Injection valves former version (hose sleeve 17 mm burnished black)

1 Remove injection valves together with ring line (07.4–215). For easier disassembly, cut fuel hoses of ring line.

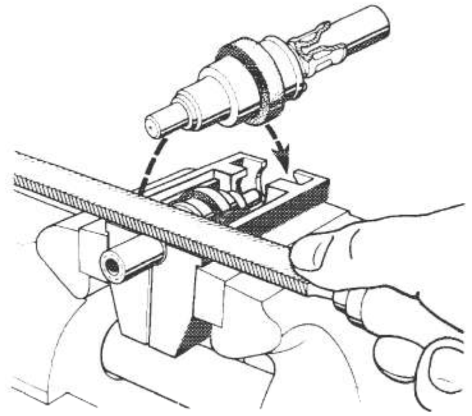
Once released, fuel hoses cannot be used again. Always install new fuel hoses.

2 Remove injection valves from ring line.

3 Place injection valve into clamping device and clamp into a vise. Electrical connection should point downwards. Close hose with closing cap.

4 Cut through hose sleeve with a flat file.

5 Insert injection valve into opposite end of clamping device and clamp into vise. Cut hose sleeve with side-cutting pliers and pull-off hose.



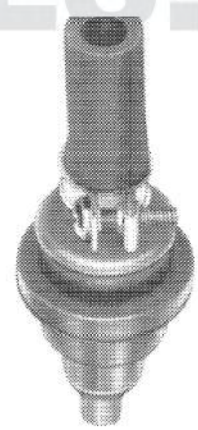
1074 – 5990/1

6 Clean connection. No dirt should enter connection, so that the fuel strainer inside connection is not clogged or damaged.

7 Push new fuel hose from repair kit part no. 000 586 99 07 with assembly mandrel up to stop on injection valve.

For easier assembly, immerse fuel hose into fuel; **do not use oil, grease or other sliding compounds!**

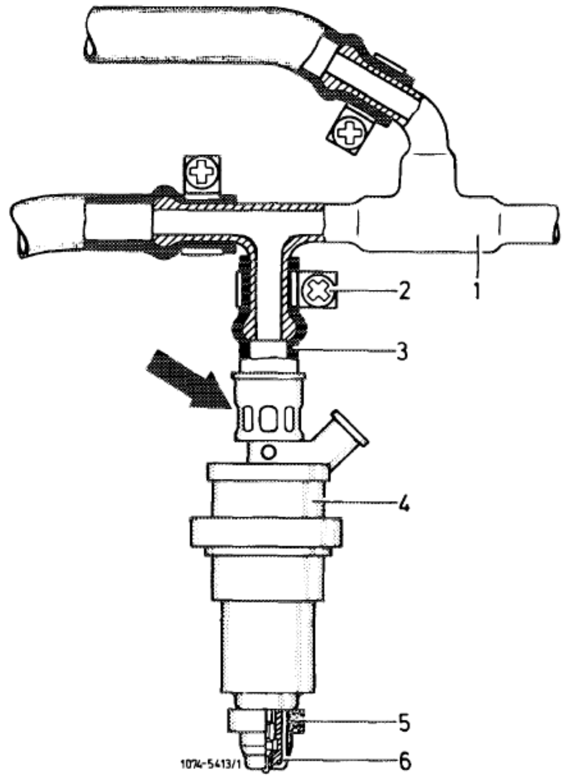
8 Slip one of the beaded hose clips of repair kit over fuel hose up to stop on injection valve and attach. Do not tighten hose clip to limit (distance approx. 2 mm).



107-9725

9 Slip injection valves with other beaded hose clips from repair kit up to stop on ring line connections and turn in such a manner that the electric connections of the injection valves in installed condition are pointing toward the rear on cylinders 1—7, and toward the front on cylinder 8.

Attention!
Do not use hose clips other than those in repair kit. Mount hose clips behind bead and with screw head pointing toward cylinder head cover (distance between ring line and hose clip approx. 3mm). Do not tighten hose clips to limit. Distance approx. 2 mm.

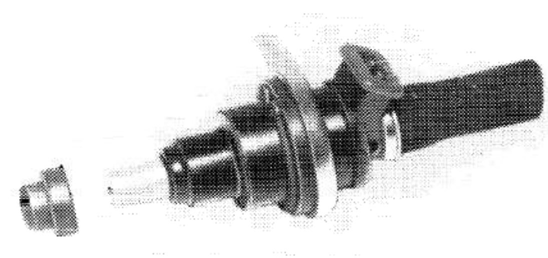


Injection valve with ring line ready for installation

1 Ring line
2 Hose clip
3 Fuel hose
4 Injection valve
5 Rubber sealing ring
6 *Sleeve (color code engine 116 yellow, engine 117 blue)*

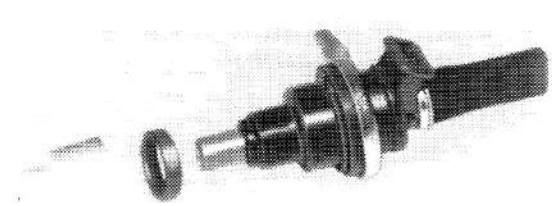
10 Install ring line with injection valves, use new rubber sealing rings part no. 116 078 04 73 or 07 73.

11 Perform leak test immediately upon starting. Check hose connections for leaks, correct assembly and chafing marks with the engine running by moving connecting points manually.



Rubber seal
Part no. 116 078 04 73

107-9711

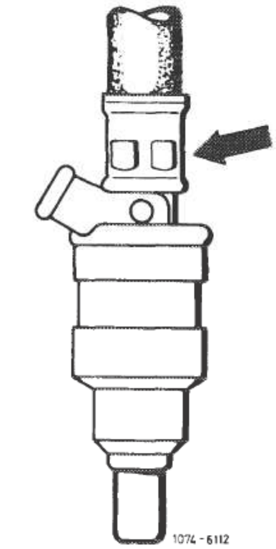


Rubber seal
Part no. 116 078 07 73

107-9710

Attention!
On the following injection valves the repair method cannot be applied:

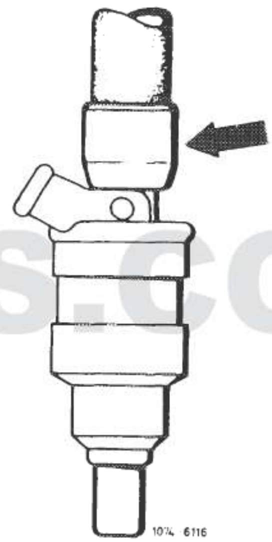
Injection valves of the old version, identified by the **hose sleeve 17 mm high and chromatised yellow.** Installed on engine 116.



Arrow: hose sleeve chromatised yellow

1074-6112

Injection valves with smooth hose sleeves 17 mm high burnished black – Temporarily on engines 116 and 117.



Arrow: smooth hose sleeve burnished black

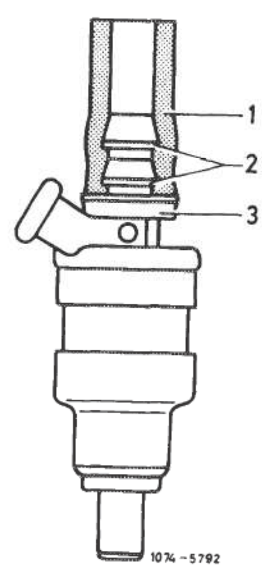
1074 6116

b) Injection valves with double sealing edge connection (hose sleeve approx. 5 mm)

1 Remove injection valves together with ring line (07.4–215).

For easier disassembly, cut through fuel hoses of ring line.

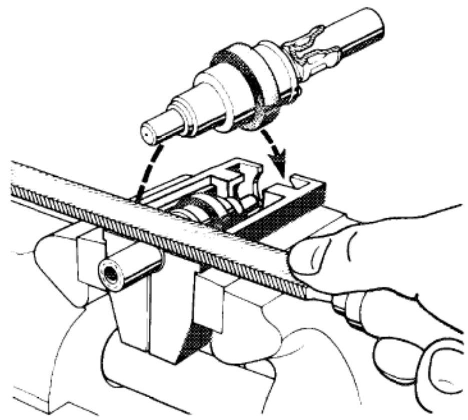
Once released, fuel hoses may not be used again. Use new fuel hoses during installation.



1074-5792

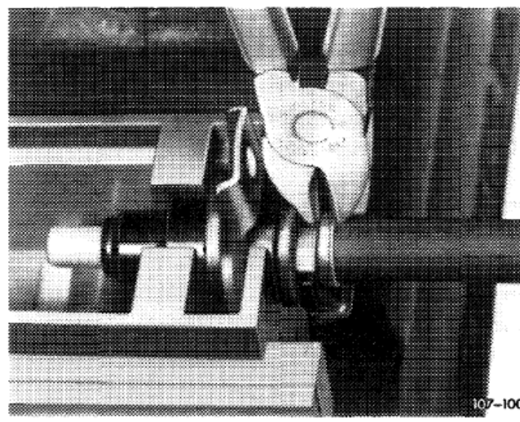
2 Remove injection valves from ring line.

3 Place injection valve into clamping device and clamp into a vise. Electrical connection should point downwards.



1074 – 5990/1

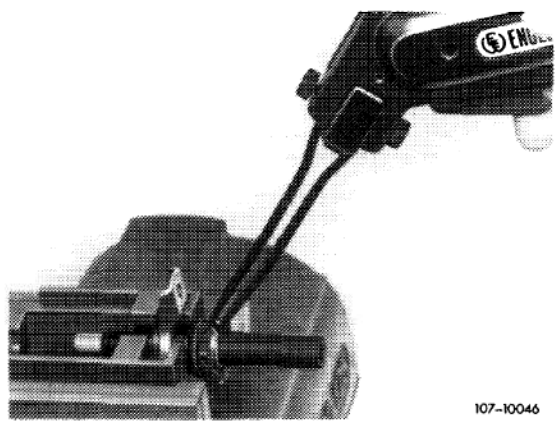
4 Cut hose sleeve with side-cutting pliers and bend open. Grind side-cutting pliers accordingly.



107–10047

5 Loosen fuel hose on injection valve with an electric soldering gun. Cut fuel hose opposite connecting point of electric plug. Move soldering gun back and forth along entire length of connection until fuel hose can be pulled off with pliers.

Attention!
Do not damage plastic insulating body on injection valve with soldering gun. To avoid damaging double sealing edge connection, never cut fuel hose with a cutting tool (e.g. a knife). Even minor damage may result in leaks.



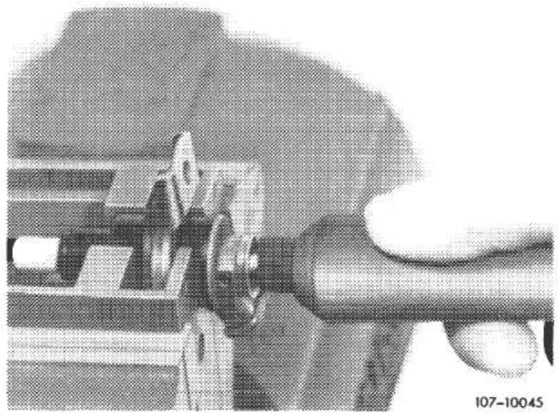
107–10046

6 Clean connection. No dirt should enter connection, so that the fuel strainer in connection is not clogged or damaged.

7 Mount new hose sleeve from repair kit part no. 001 586 00 07 on connection.

8 Push new fuel hose completely on connection by means of an assembly mandrel until hose is perfectly seated in hose sleeve and can no longer be moved.

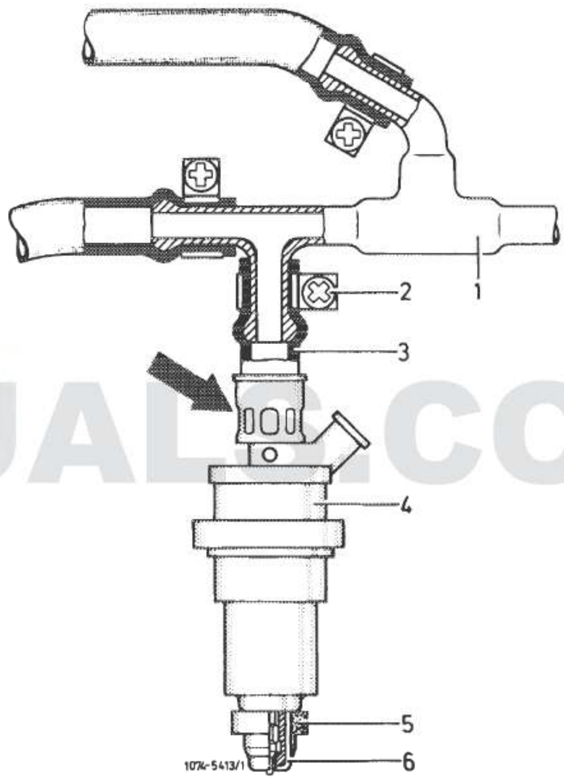
Attention!
On injection valves with double sealing edge connection, no hose clip should be mounted at injection valve. Mount hose clip at ring line end of fuel hose only. Use hose clips from repair kit only.



107–10045

9 Slip injection valves with hose clips (for ring line connections only) on ring line and turn in such a manner that the electric connections of the injection valves are pointing toward the rear on cylinders 1–7 and toward the front on cylinder 8.

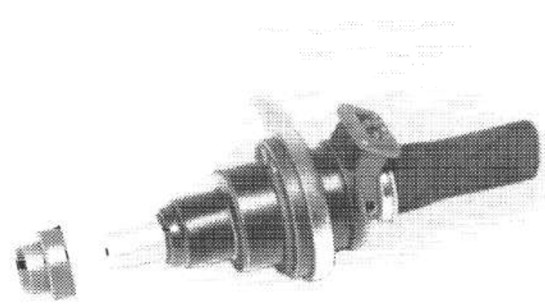
Attention!
Mount hose clips behind bead and with screw head pointing toward cylinder head cover (distance between ring line and hose clip approx. 3mm). Do not tighten hose clips to limit. Distance approx. 2 mm.



Injection valve with ring line ready for installation

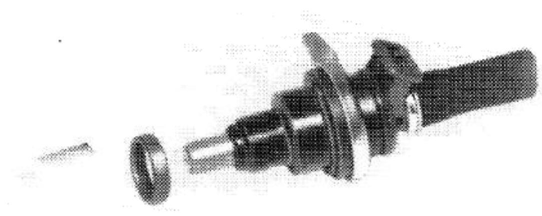
1 Ring line
2 Hose clip
3 Fuel hose
4 Injection valve
5 Rubber sealing ring
6 Sleeve (color code engine 116 yellow, engine 117 blue)

10 Insert new rubber sealing rings and install injection valves with ring line.



Rubber sealing ring
Part no. 116 078 04 73

107–9711



Rubber sealing ring
Part No. 116 078 07 73

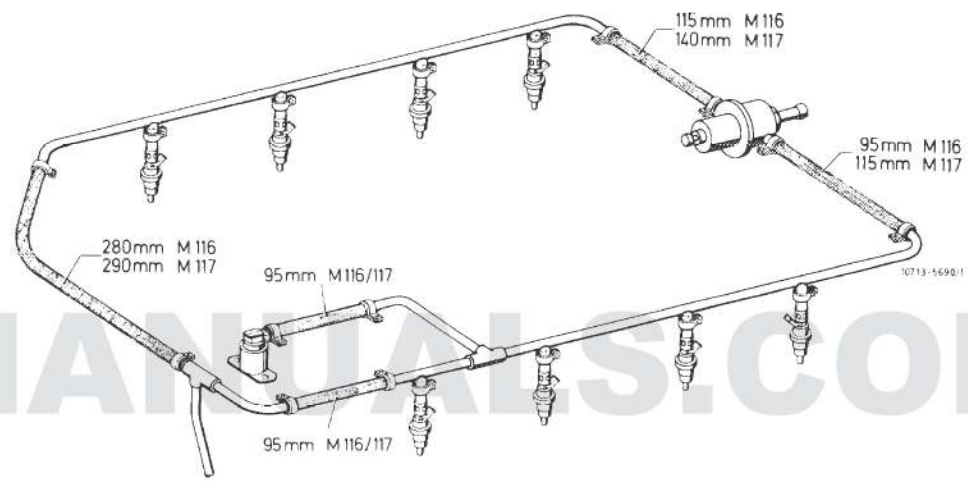
107-9710

11 Perform leak test immediately upon starting. Check hose connections for leaks, correct assembly and chafing marks with the engine running by moving connecting points manually.

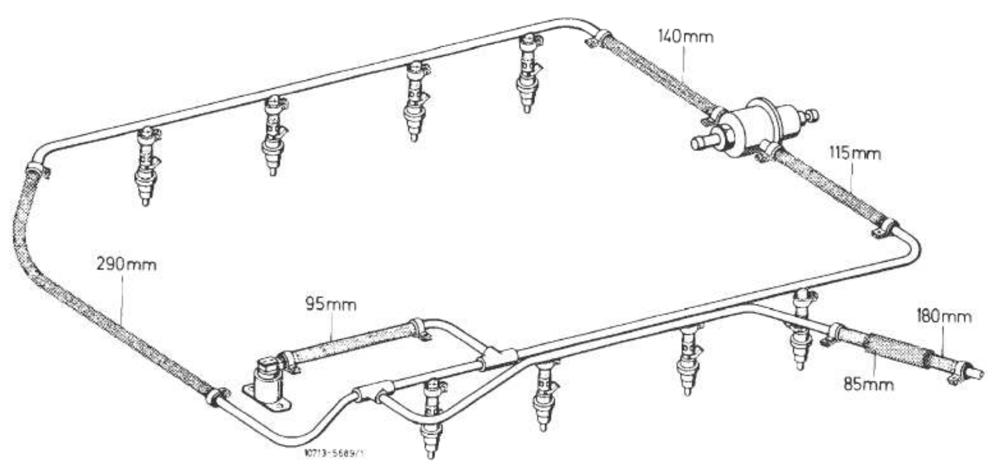
07.4–221 Replacing fuel hoses on ring line

Replace fuel hoses according to specified dimensions or according to removed fuel hoses. For assembly instructions refer to 07.4–220.

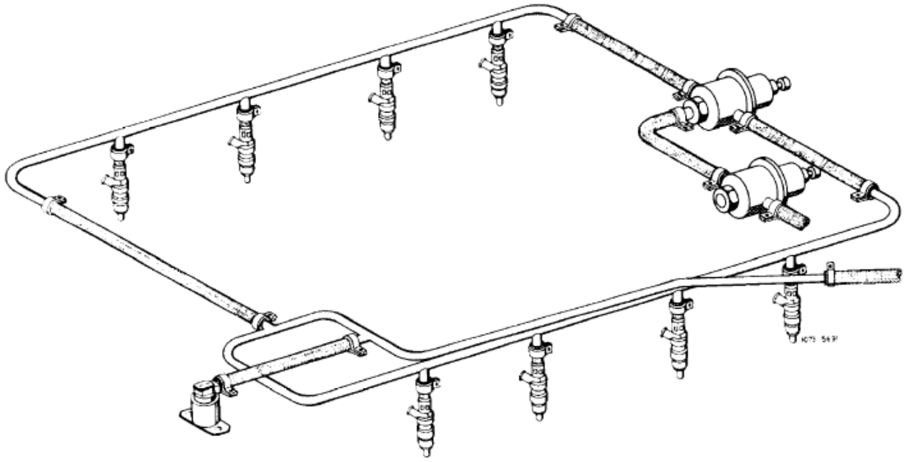
1st version



2nd version



3rd version



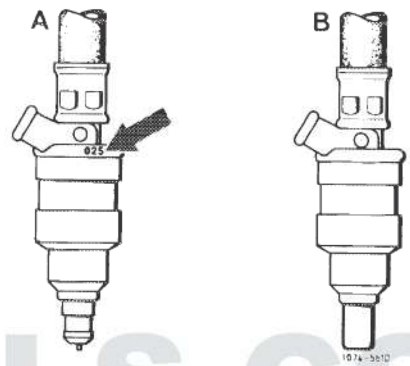
07.4–223 Renewing protective sleeves on injection valves

Installation survey (07.4–215).

The injection valves are provided with a protective sleeve to prevent deposits on valve needle.
The color code of the protective sleeve corresponds to the respective injection valve.
On engine 116, the color code has been changed from black to yellow.

Injection valves starting with production date 025 (arrow) can be subsequently provided with protective sleeves.

Due to the larger OD of the protective sleeve the ID of the rubber sealing ring has been increased. The modified rubber sealing ring can also be used on injection valves without protective sleeve.



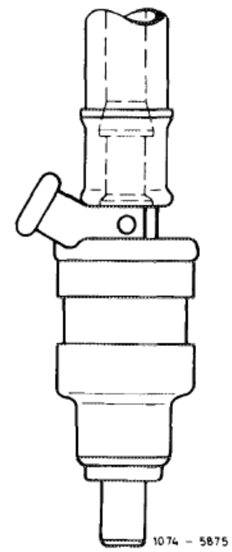
A Injection valve **without** protective sleeve
B Injection valve **with** protective sleeve

Starting June 1973

Model	Starting chassis end no.
107.023/043	008248/010636
107.024/044	002810/013560
116.020/029	011650
116.032/033	008612

07.4–225 Injection valves with double sealing edge connection

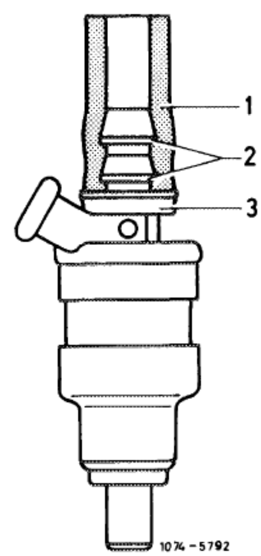
Since February 1974 injection valves are installed with double sealing edge connection:



Former injection valve
Hose sleeve: height 17 mm

For manufacturing reasons, only the injection valve with double sealing edge connection is installed.

The fuel hose of the injection valve is attached to ring line by means of hose clip part no. 001 997 69 20.
There is no hose clip on injection valve itself.



Modified injection valve

1 Fuel hose
2 Double sealing edge connection
3 Hose sleeve (yellow):
height approx. 5 mm

Installation on production vehicles

Model	Starting chassis end no.
107.043	011376
107.023	009603
107.044	019640
107.024	006980
116.028/029	021345
116.032/033	024450

Spare parts

Designation	Engine	Color code	Part no.
Injection valve	116	yellow	000 078 31 23
	117	blue	000 078 34 23

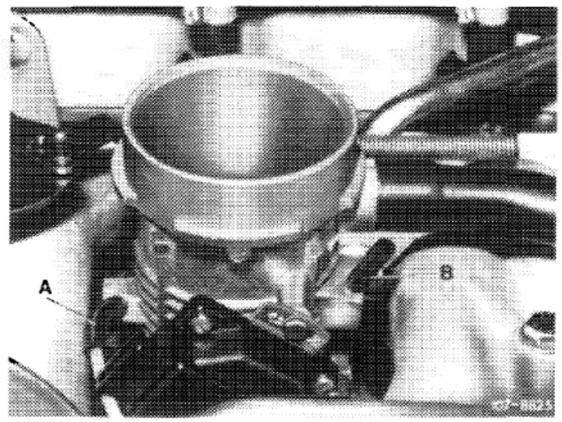
07.4–230 Removal and installation of throttle valve housing

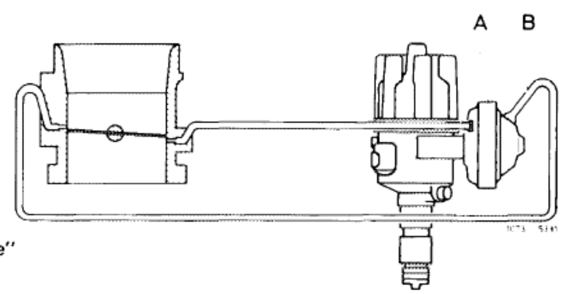
Note

When installing a throttle valve housing with 2 vacuum connections in vehicles with engine 116 licenced prior to April 1973, close vacuum connection ,,B'' for advance ignition by means of rubber cap part no. 000 987 11 45.

When installing an ignition distributor with two vacuum connections, close connection for advance ignition (connection ,,B'') with rubber cap part no. 000 987 11 45.

The firing point should then be adjusted to 30° before TDC at 3000/min without vacuum.





A Vacuum connection ,,retard''
B Vacuum connection ,,advance''

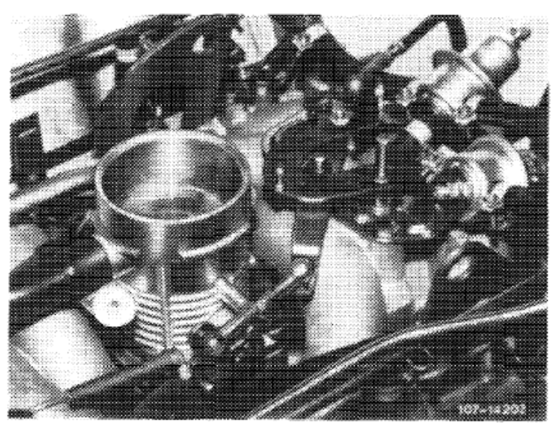
Removal

1 Remove air filter.

2 Remove vacuum lines for ignition adjustment, supplementary air line and regulating rod.

3 Unscrew fastening nuts and remove throttle valve housing.

4 Remove throttle valve switch according to condition.



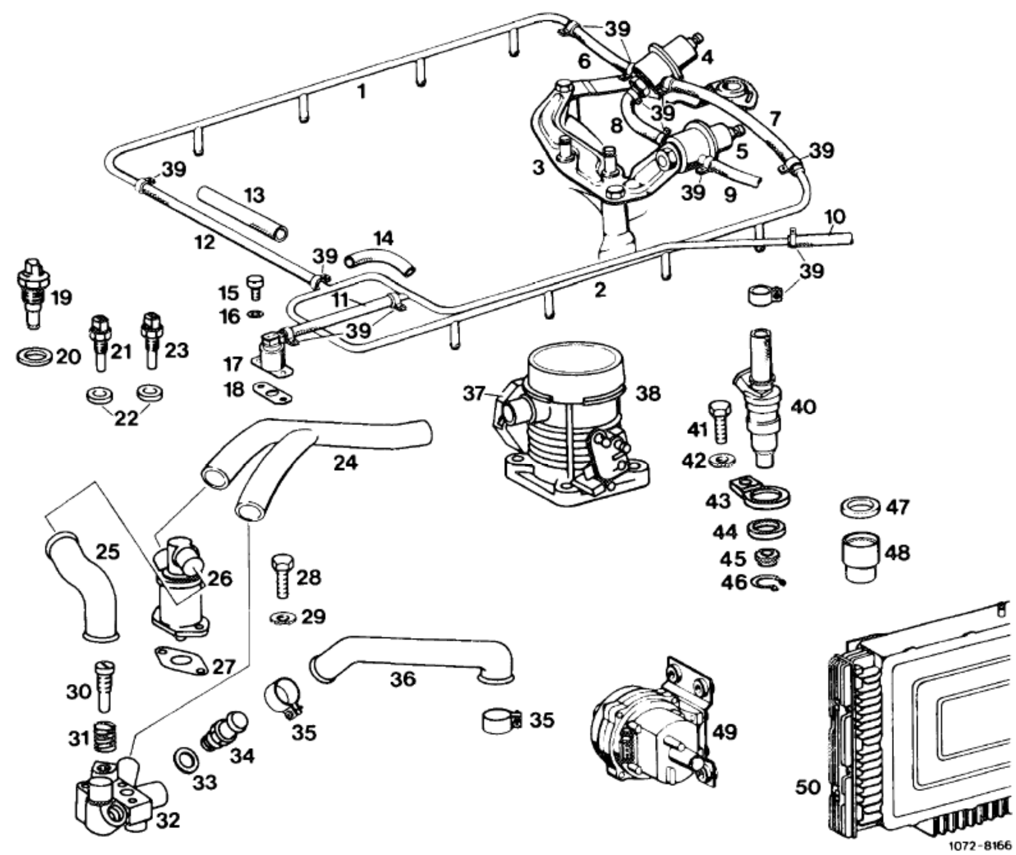
Installation

5 For installation proceed vice versa using new seal.

6 Adjust throttle valve switch (07.4–140).

7 Complete full-throttle checkup by means of accelerator pedal.

07.4–235 Illustrated table mixture preparation



1 Ring line right-hand engine side
2 Ring line left-hand engine side
3 Holder
4 Pressure regulator
5 Diaphragm damper
6 Fuel hose
7 Fuel hose
8 Fuel hose
9 Fuel hose for return line
10 Fuel hose for feed line
11 Fuel hose
12 Fuel hose
13 Protective hose
14 Protective hose
15 Screw
16 Corrugated washer
17 Cold starting valve
18 Gasket
19 Thermo-time switch
20 Sealing ring
21 Coolant temperature sensor
22 Sealing ring
23 Air temperature sensor
24 Contour hose
25 Contour hose
26 Supplementary air valve
27 Gasket
28 Screw
29 Corrugated washer
30 Idle speed adjusting screw
31 Compression spring
32 Idle speed air distributor
33 Sealing ring
34 Connection
35 Hose clip
36 Contour hose
37 Throttle valve switch
38 Throttle valve housing
39 Hose clip
40 Injection valve
41 Screw
42 Corrugated washer
43 Holder
44 Rubber ring
45 Rubber ring
46 Fuse
47 Rubber ring
48 Insulating sleeve
49 Intake pipe pressure sensor
50 Control unit

07.4–270 Removal and installation of fuel filter and fuel pump

Special tool

Clamp		000 589 40 37 00

Attention!
Check whether transparent sheeting on fuel pump or on fuel filter is not damaged. During assembly, make sure that the holder is in center of transparent sheeting If holder is directly resting against fuel filter or fuel pump, contact corrosion may result. Repair damaged transparent sheeting e.g. with Tesa film.

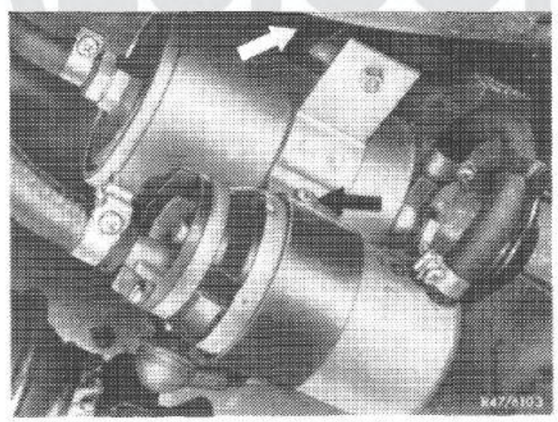
Removing fuel filter

1 Unscrew protective box.

2 Disconnect pressure hoses and release.

3 Loosen both fastening screws (arrows) and remove fuel filter.

4 Unscrew angle bracket (9).



Removing fuel pump

5 Disconnect pressure and suction hose and loosen.

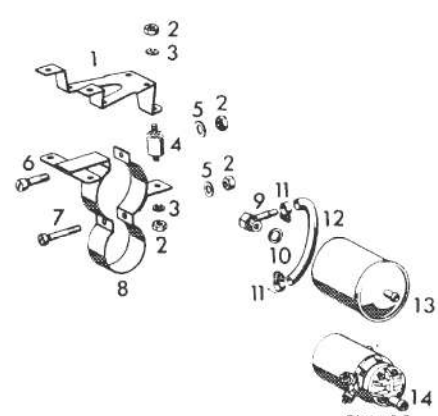
6 Unscrew electric connecting cable and pressure connection on fuel pump.

7 Loosen both fastening screws (arrows) and remove fuel pump.

Installation

For installation proceed vice versa using new sealing rings. Make sure of correct polarity of connecting cables on fuel pump. Terminals are identified with positive (+) and negative (–).

8 Run engine and check for leaks.



1 Holder	8 Holder
2 Nut	9 Angle bracket
3 Snap ring	10 Sealing ring
4 Vibration damping buffer	11 Hose clip
5 Washer	12 Fuel hose
6 Cyl. head screw	13 Fuel filter
7 Cyl. head screw	14 Fuel pump

07.4–275 Subsequent installation of modified fuel hose to prevent compressional vibrations at fuel pump (model 107.023/043)

Special tool

Clamp		000 589 40 37 00

Starting June 1972 a fuel hose 500 mm long (formerly 250 mm) with a protective anti-rub jacket will be installed between the fuel filter and the delivery line. In addition, the fuel delivery line has been shortened and its layout changed.

Start of production

Model	Starting chassis end no.
107.023	001496
107.043	007858
107.044 USA	003486

The longer fuel hose serves to dampen the compressional vibrations starting at fuel pump. These compressional vibrations were formerly mistakingly considered to be fuel pump noises which resulted quite often in unjustified pump replacement.

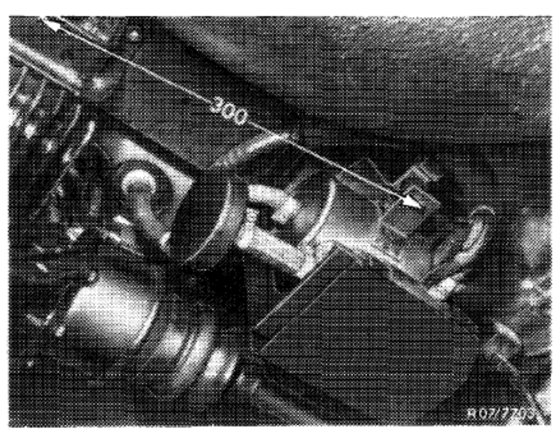
In the event of complaints about noise, the longer fuel hose with protective anti-rub jacket should be installed from now on.

Attention!
During such repairs the fuel line should not be changed with regard to its location and length. Consequently, the fuel hose should now be longer than the standard hose.

Scope

1 Displace fuel pump by approx. 55 mm to the right.

Note: Do **not** perform job no. 1.1–1.8 if the distance between the bore for axle measurement (at bearing of rear axle suspension) and attachment of fuel filter to vibration damping buffer amounts to 300 mm.



1.1 Unscrew protective box.

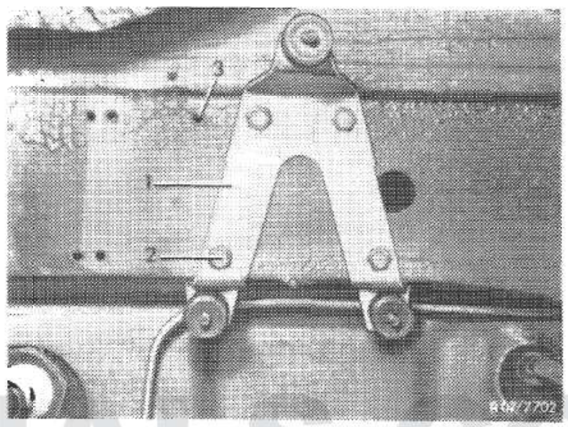
1.2 Disconnect (pinch) fuel suction hose in front of damper by means of a clamp.

1.3 Loosen fuel pressure hose between fuel filter and fuel delivery line, as well as fuel hose between damper and fuel pump, and pull-off.

1.4 Unscrew fuel pump with filter at vibration damping buffers.

1.5 Loosen holder (1) and move to the right (approx. 55 mm) until holder can be attached to fastening point (2) by means of a screw.

1.6 Drill the remaining 3 bores – using holder as a template – with a twist drill (5.2 mm dia) and attach holder.

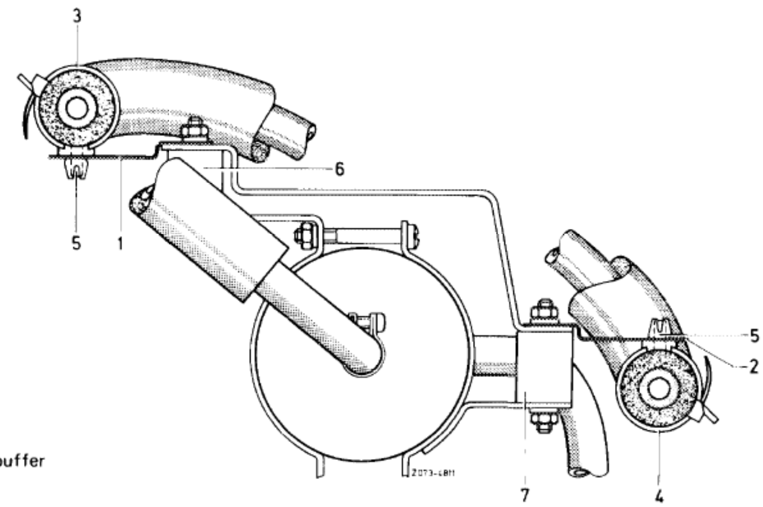


1 Holder
2 Fastening point for holder
3 Bore for protective box

1.7 Mount fuel pump with filter.

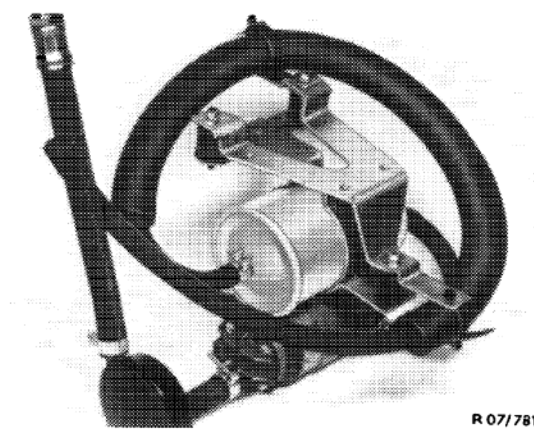
1.8 Tighten protective box with a screw at bore (3). Drill the remaining 2 bores and attach protective box.

2 Clip one cable strap (3 and 4) each into holder (1 and 2) and secure with locking pins (5).



1 Holder
2 Holder
3 Cable strap
4 Cable strap
5 Locking pin
6 Rear right-hand vibration damping buffer
7 Front vibration damping buffer

3 Mount the two holders at rear right-hand and front vibration damping buffer. Pay attention to offset (torsion lock) (refer to illustration item 2 and 3).



R 07/7810

4 Slip protective anti-rub jacket 107 997 14 82, 600 mm long, on fuel hose 114 997 18 82, 900 mm long. To facilitate sliding, jacket may be cut into two pieces each 300 mm long.

5 Slip-on jacket until distance to one end of fuel hose amounts to 95 mm. Attach this end to fuel filter (refer to illustration item 3).

6 Install fuel hose along protective box in direction of rear right-hand vibration damping buffer. Fasten fuel hose above holder by means of cable strap (illustration item 3).

7 Lead fuel hose further along and clamp to respective holder by means of cable strap. Fuel hose should be clamped underneath holder (illustration item 3).

8 Attach fuel hose to fuel delivery line.

9 Install fuel hose 112 476 12 26, 65 mm long, between damper and fuel pump.

10 Check distance between fuel suction hose and rear axle shaft and shorten fuel suction hose, if required.

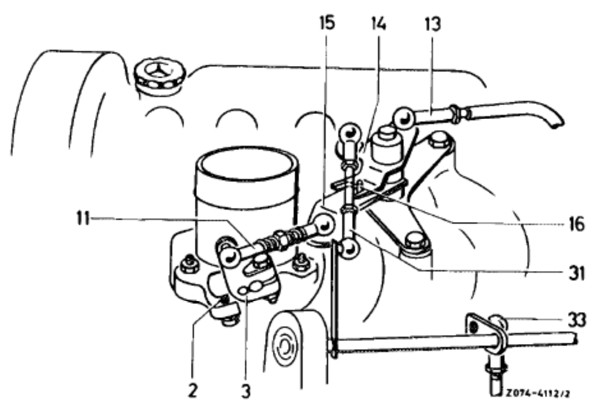
11 Remove clamp.

12 Tighten all hose straps, run engine and check for leaks.

07.4–300 Adjusting regulating linkage

Adjusting data in mm

Length of connecting rod (31) on vehicles with manual transmission **with** gate lever (2nd version with bore adjacent to ball head)	engine 116	90
Length of connecting rod (31) on vehicles with automatic transmission **without** gate lever	engine 116	114
Length of connecting rod (31) on vehicles with automatic transmission **with** gate lever	engine 116 engine 117	90 107
Length of push rod (33)	model 107 model 116 1st and 2nd version	105 68
Length of push rod (24) (illustration item 9)	model 116	122



2 Idle speed stop
3 Throttle valve lever
11 Connecting rod
13 Control pressure rod
14 Regulating lever
15 Regulating lever
16 Stop pin
31 Connecting rod
33 Push rod

Adjustment

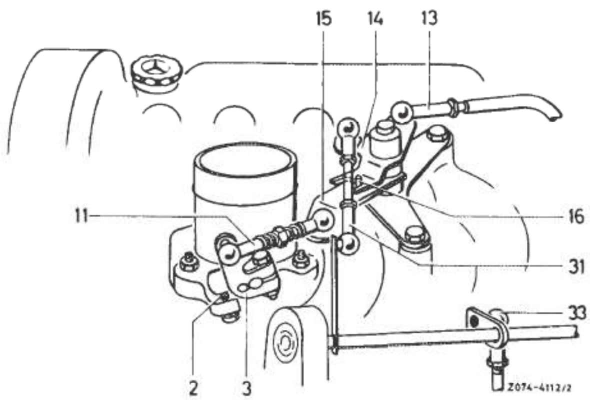
1 Check regulating linkage for easy operation and distortion. Renew linkage, if required.

2 Disconnect all regulating rods.

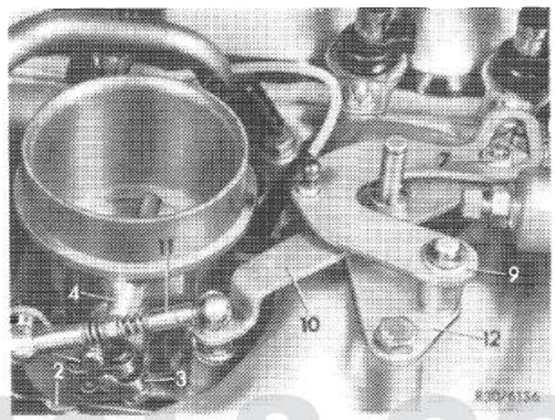
3 Check whether throttle valve closes completely without binding.

Vehicles with manual transmission

4 Adjust connecting rod (31) to a length of 90 mm and attach.



Push throttle valve lever (3) against idle speed stop (2). Adjust connecting rod (11) in such a manner that the regulating lever (10) rests with its roller (7) against end stop of gate lever (9).



2 Idle speed stop
3 Throttle valve lever
4 Full-throttle stop
7 Roller
9 Gate lever
10 Regulating lever
11 Connecting rod
12 Bearing bracket

Vehicles with automatic transmission

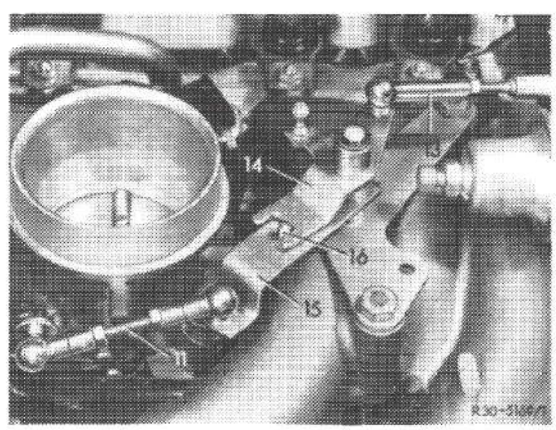
a) Version without gate lever

5 Adjust connecting rod (31) to a length of 114 mm, connecting rod (11) to 69 mm and attach (illustration item 4).

Push throttle valve lever against idle speed stop and regulating lever (14) toward the rear against stop pin (16).

Push control pressure rod (13) completely to the rear against stop, adjust to length free of stress in relation to ball head of regulating lever (14) and attach.

When checking length of control pressure rod, **hold ball socket adjacent to and not above** ball head due to circular motion of linkage.



11 Connecting rod
13 Control pressure rod
14 Regulating lever
15 Regulating lever
16 Stop pin

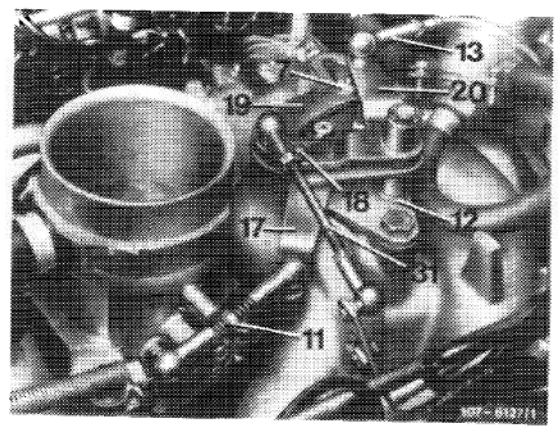
b) Version with gate lever

6 Set connecting rod (31) to specified length and attach. Engine 116 = 90 mm, engine 117 = 107 mm.

Push throttle valve lever against idle speed stop. Adjust connecting rod (11) in such a manner that the regulating lever (17) rests with roller (7) against end stop of gate lever (19). Push regulating lever (20) to the rear up to stop pin (18).

Push control pressure rod (13) completely to the rear against stop and adjust to length free of tension in relation to ball head of regulating lever (20) and attach.

When checking length of control pressure rod, **hold ball socket adjacent to and not above** ball head due to circular motion of linkage.



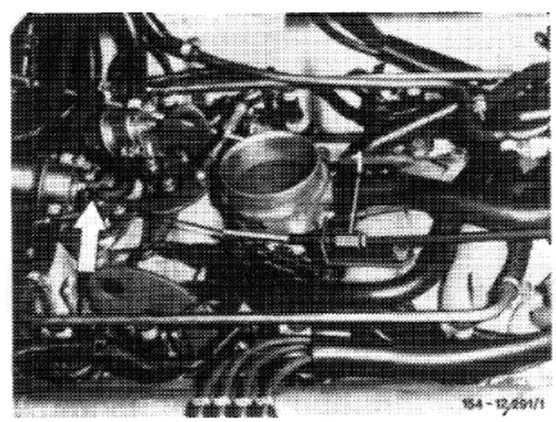
7 Roller
11 Connecting rod
12 Bearing bracket
13 Control pressure rod
17 Regulating lever
18 Stop pin
19 Gate lever
20 Regulating lever
31 Connecting rod

c) Version with Tempomat/Cruise Control

7 On vehicles with Tempomat/Cruise Control, the regulating lever (20) and the stop pin (18) are no longer installed (illustration item 6).

Adjust as described in section b.

Make sure that the plastic clip (arrow) of Bowden wire rests free of tension against regulating lever. Adjust Bowden wire by means of adjusting nut (1), if required.

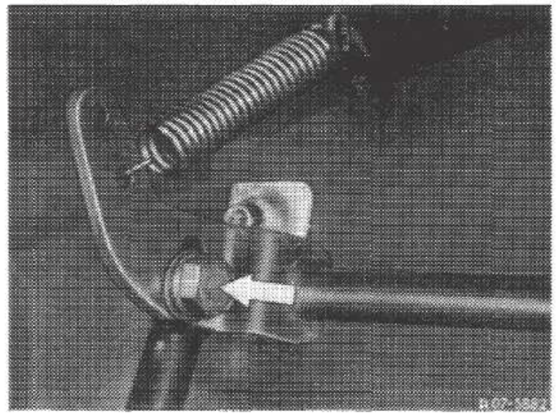


8 Check full throttle stop. With the engine stopped, floor accelerator pedal from inside vehicle. Accelerator pedal and throttle valve lever should rest against full-throttle stop. Adjust regulating shaft, if required.

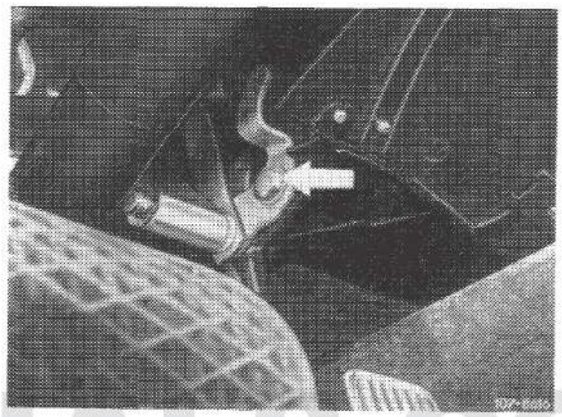
1st version

Model 107, 116

Loosen hex screw (arrow), permit accelerator pedal to move up slightly and tighten hex screw again.



Model 107

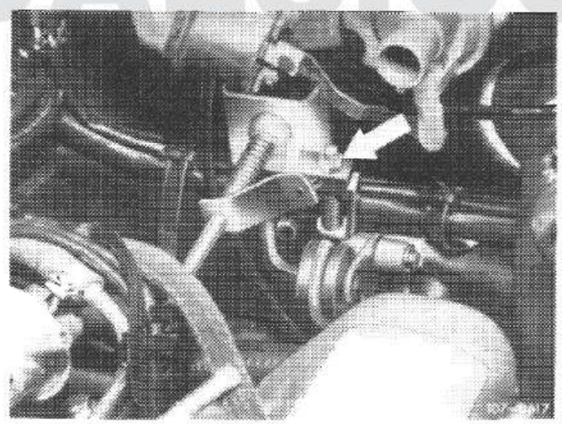


Model 116

2nd version

Model 116

Adjust regulating linkage by means of hex nut (arrow) in such a manner that the throttle valve lever rests against full-throttle stop.



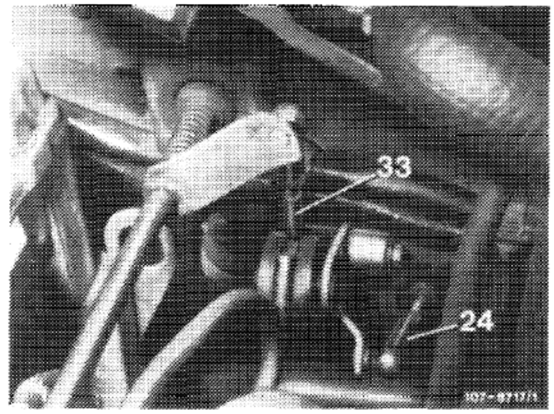
Model 116

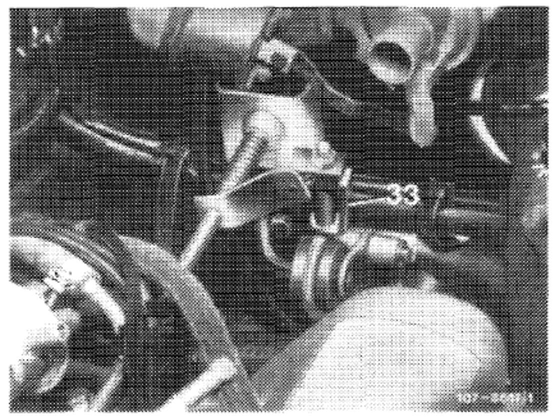
If the full-throttle stop is not attained with this adjustment, set regulating lever inside vehicle as required after loosening fastening screw (arrow) (refer to 1st version).

9 If the regulating linkage cannot be adjusted, check regulating rods (24 and 33) for basic adjustment (refer to adjusting data).

10 Adjust push rod (33) to a length of 105 mm on model 107, or 68 mm on model 116, measured from center of ball socket to center of damping ring and attach.

11 Adjust connecting rod (24) on model 116 for a length of 122 mm and attach (illustration item 9).

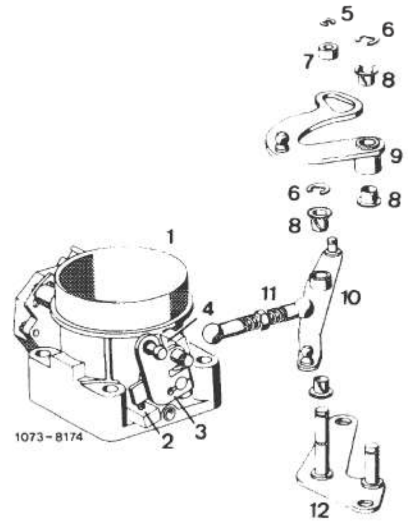




Engine regulation

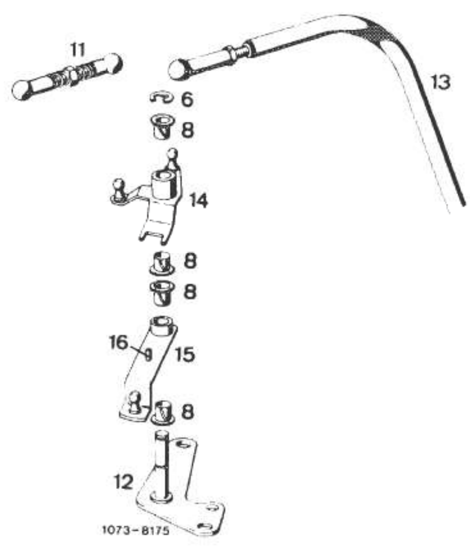
Engine 116 with manual transmission

1 Throttle valve housing
2 Idle speed stop
3 Throttle valve lever
4 Full-throttle stop
5 Locking ring
6 Locking ring
7 Roller
8 Plastic bushing
9 Gate lever
10 Regulating lever
11 Connecting rod
12 Bearing bracket

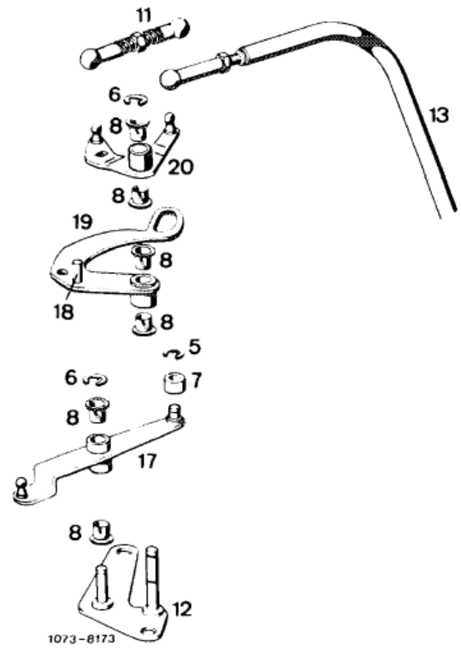


Engine 116 with automatic transmission 1st version

6 Locking ring
8 Plastic bushing
11 Connecting rod
12 Bearing bracket
13 Control pressure rod
14 Regulating lever
15 Regulating lever
16 Stop pin

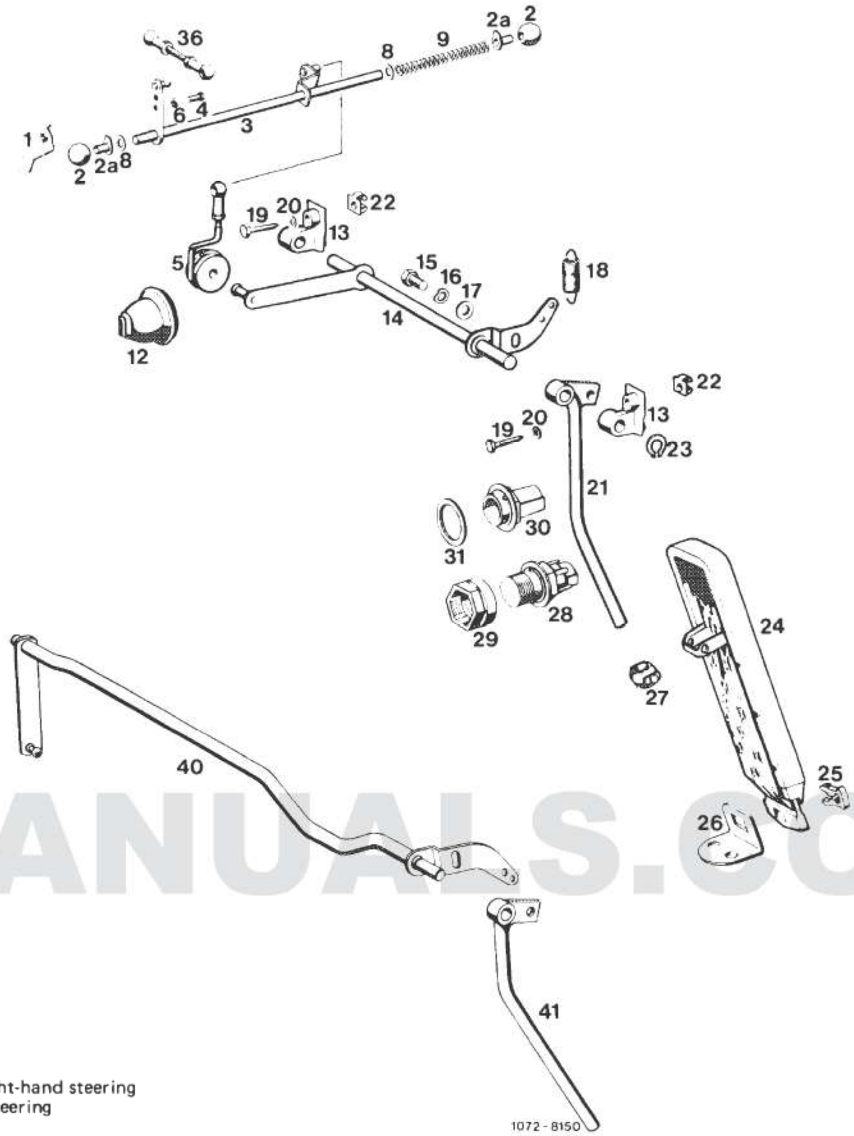


Engine 116 with automatic transmission 2nd version
Engine 117



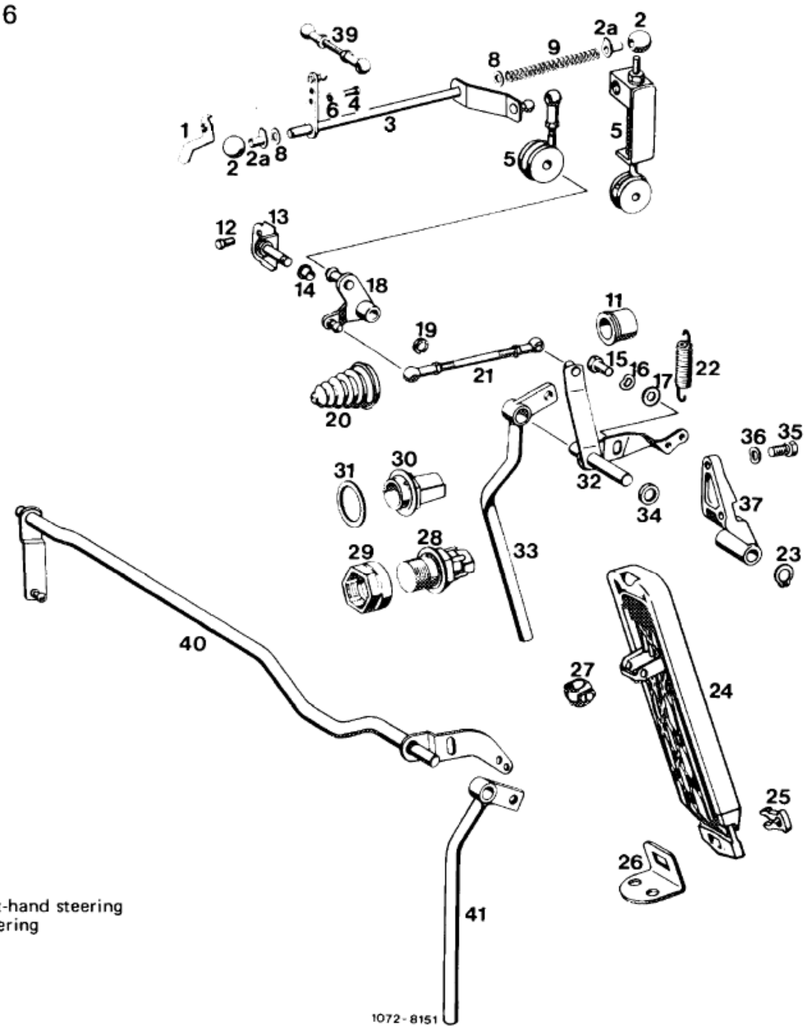
5 Locking ring
6 Locking ring
7 Roller
8 Plastic bushing
11 Connecting rod
12 Bearing bracket
13 Control pressure rod
17 Regulating lever
18 Stop pin
19 Gate lever
20 Regulating lever

Chassis regulation model 107



1 Lock
2 Ball for joint
2a Bearing bushing
3 Longitudinal regulating shaft
4 Hex screw
5 Push rod
6 Washer
8 Plastic spacing ring
9 Compression spring
12 Rubber grommet
13 Bearing
14 Front wall regulating shaft
15 Hex screw
16 Spring washer
17 Washer
18 Return spring
19 Screw
20 Washer
21 Accelerator lever
22 Cage nut
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kick-down switch
29 Adjusting nut
30 Full-throttle stop
31 Washer
36 Connecting rod
40 Front wall regulating shaft right-hand steering
41 Accelerator lever right-hand steering

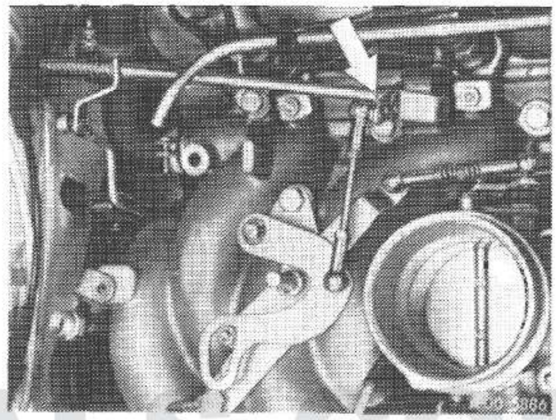
Chassis regulation model 116



1 Lock
2 Ball for joint
2a Bearing bushing
3 Longitudinal regulating shaft
4 Hex screw
5 Push rod
6 Washer
8 Plastic spacing ring
9 Compression spring
12 Hex screw
13 Bearing
14 Plastic bushing
15 Hex screw
16 Spring washer
17 Washer
18 Guide lever
19 Lock
20 Rubber grommet
21 Connecting rod
22 Return spring
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kick-down switch
29 Adjusting nut
30 Full-throttle stop
31 Washer
32 Guide lever
33 Accelerator lever
34 Plastic spacing ring
35 Hex screw
36 Spring washer
37 Bearing
39 Connecting rod
40 Front wall regulating shaft right-hand steering
41 Accelerator lever right-hand steering

07.4–310 Removal and installation of engine longitudinal regulating shaft

Removal



1 Loosen hex screw (arrow) and remove lock.

2 Disconnect connecting rod and push rod, push longitudinal regulating shaft to the rear and remove. Pay attention to compression spring, plastic bushings and balls for joint.

Installation

For installation proceed vice versa. Grease bearing points as well as ball sockets of regulation with Molykote-Longterm 2.

Adjust regulating linkage (07.4–443).

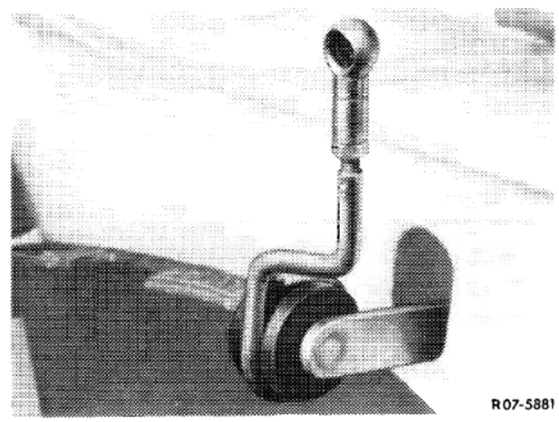
07.4–320 Removal, installation and adjustment of front wall regulating shaft

Removal

1 Remove accelerator pedal (07.4–330).

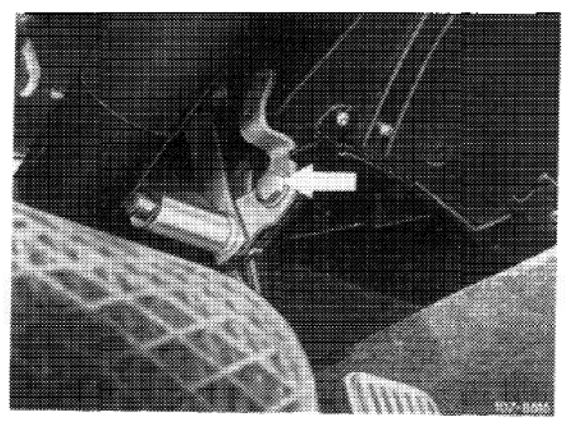
2 On model 107, push regulating linkage with damping ring from lever of regulating shaft.

Model 107



3 On model 116, disconnect connecting rod and return spring inside vehicle.

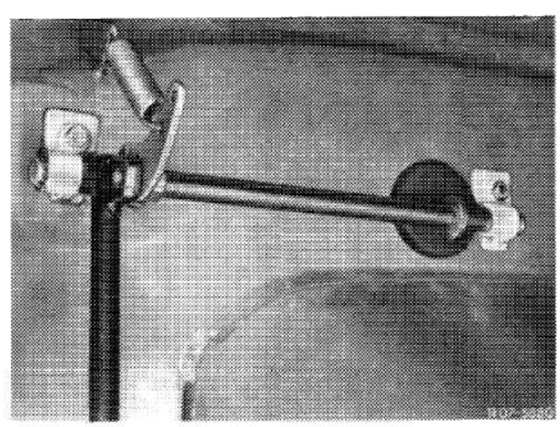
Model 116

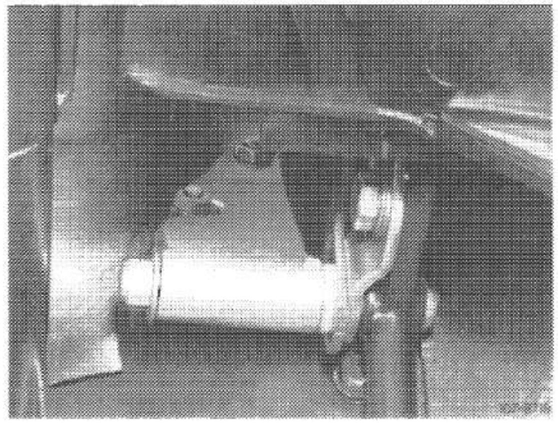


4 Unscrew fastening screws or nuts from bearings.

On model 107, remove heater box (83–100).

Model 107





Model 116

5 Remove regulating shaft with bearing.

On model 107, push out plastic bearing in upward direction.

Installation

For installation proceed vice versa. Grease bearing points as well as ball sockets of regulation with Molykote-Longterm 2.

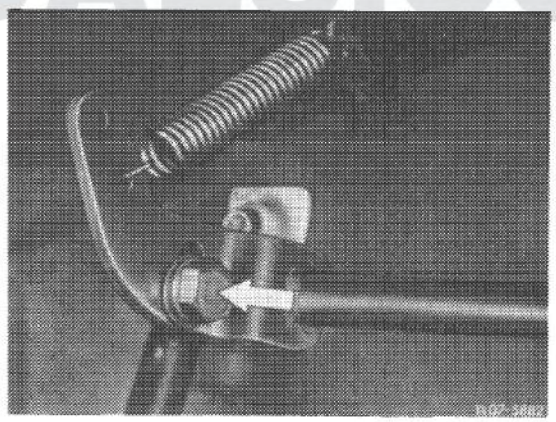
Attach return spring to inside hole.

Adjustment

6 With engine stopped, floor accelerator pedal from inside vehicle.
Accelerator pedal and throttle valve lever should rest against full-throttle stop. Adjust regulating shaft, if required.

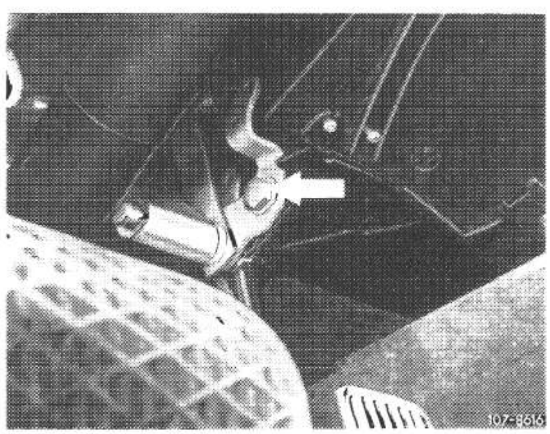
1st version

Model 107, 116



Model 107

Loosen hex screw (arrow), permit accelerator pedal to move slightly upwards and tighten hex screw again.



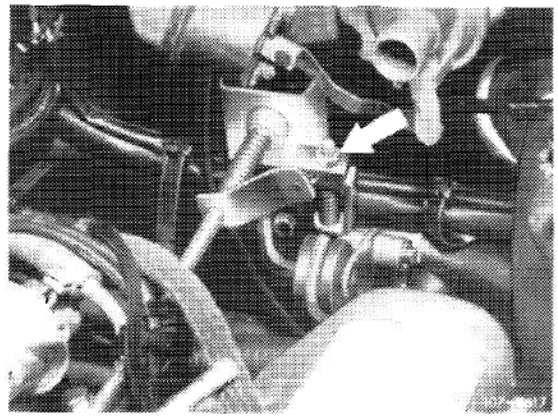
Model 116

2nd version

Model 116

Adjust regulating linkage by means of hex nut (arrow) in such a manner that the throttle valve lever rests against full-throttle stop.

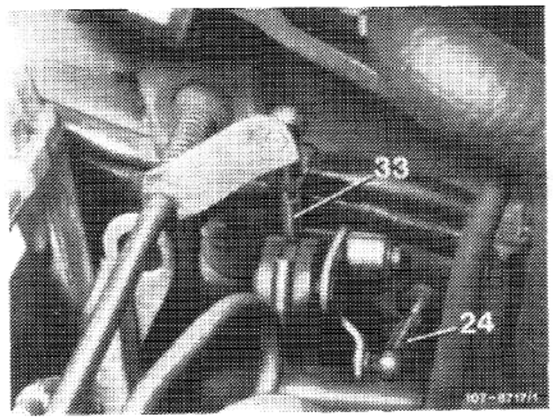
If the full-throttle stop is not attained with this adjustment, set regulating lever inside vehicle (illustration item 6 1st version) after loosening fastening screw.

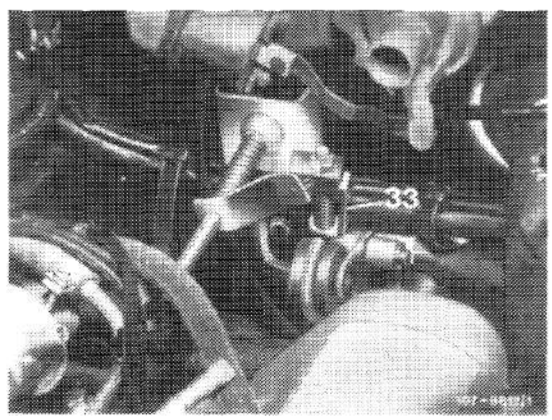


7 If the regulating linkage cannot be adjusted, check regulating rods (24 and 33) for basic adjustment.

8 Set push rod (33) to a length of 105 mm on model 107, or 68 mm on model 116, measured from center of ball socket to center of damping ring, and connect.

9 Adjust connecting rod (24) on model 116 to a length of 122 mm and connect (illustration item 7).

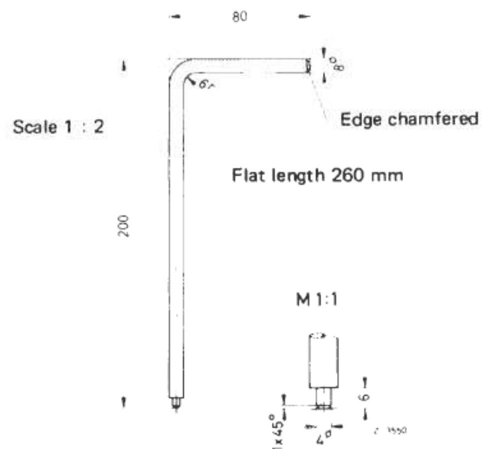




07.4–330 Removal and installation of accelerator pedal

Self-made tool

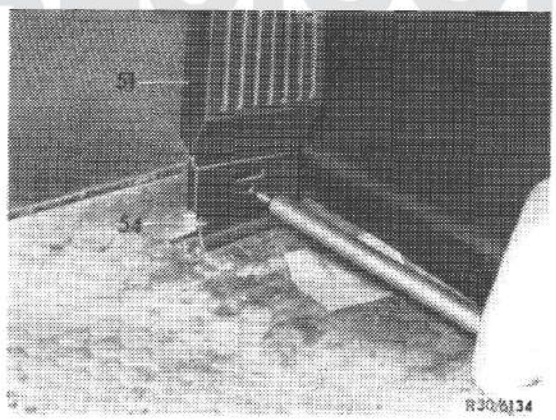
Removing mandrel for accelerator pedal



1st version

Removal

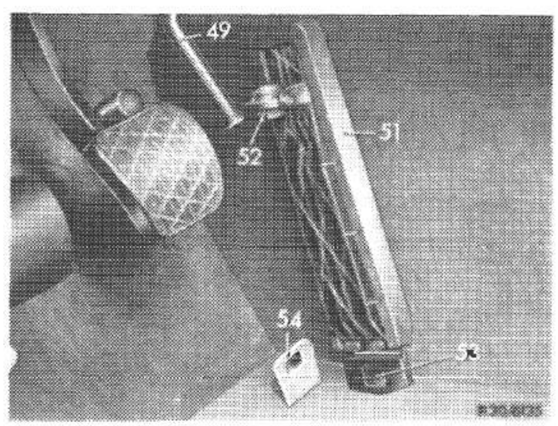
1 Remove accelerator pedal (51) from bearing plate (54). For this purpose, remove clip from bearing plate with removing mandrel. **Be sure to use removing mandrel,** so that clip (53) will not be damaged or stretched.



2 Pull accelerator pedal (51) in upward direction out of accelerator lever (49).

Installation

3 Slip accelerator pedal (51) with joint (52) into accelerator lever (49) and push tightly against bearing plate for reliable engagement of clip (53).



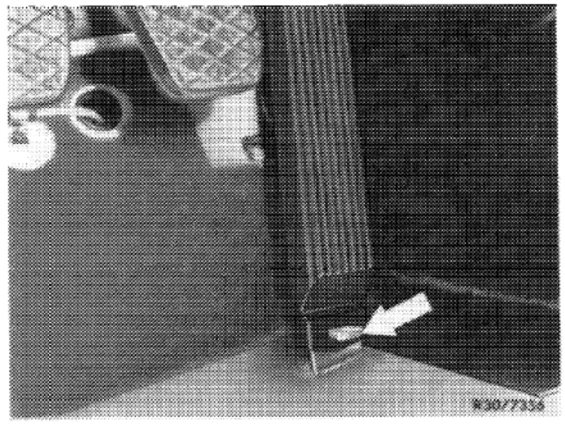
2nd version

Removal

Compress expanding clip (arrow) behind accelerator pedal and pull out.

Installation

During installation, make sure that expanding clip is reliably engaged.



07.5–500 Checking and adjusting closing angle (dwell angle) and firing point

Closing angle (dwell angle) (transistorized ignition system)

Identification: blue ignition coil, two series resistances and transistorized switchgear.

Engine	Closing angle (dwell angle) testing and **adjusting value** at idle[1])	Change between idle and 3000/min
116, 117	30–34°	max ± 3°

[1]) When installing new or adjusting used breaker points, adjust closing angle (dwell angle) according to bold-face value ± 1°.

A. Standard version

Firing point (for normal and low compression engines)

<table>
<tr><th rowspan="2">Engine</th><th rowspan="2">Ignition distributor Bosch order no.</th><th rowspan="2">Adjusting value[1]) of firing point without vacuum at 3000/min</th><th colspan="3">Test values ignition adjustment with/without vacuum</th><th colspan="2">Vacuum adjustment after</th><th rowspan="2">Installation value of ignition distributor at starting speed without vacuum</th></tr>
<tr><th>idle [2])</th><th>1500/min</th><th>3000/min</th><th>„retard" at idle</th><th>„advance" at 3000/min</th></tr>
<tr><td rowspan="3">116</td><td rowspan="2">0 231 302 001
0 231 401 001
0 231 402 001
0 231 402 004
0 231 402 006</td><td rowspan="2">34° [3])</td><td>TDC ± 2°</td><td>16–20°</td><td>34°</td><td rowspan="4">8–12°</td><td rowspan="2"></td><td rowspan="4">10° before TDC</td></tr>
<tr><td colspan="3">with vacuum</td></tr>
<tr><td>0 231 403 001
0 231 403 005
0 231 403 009</td><td>30° [4])</td><td rowspan="2">TDC ± 2° with</td><td rowspan="2">15–19° without</td><td rowspan="2">30° without</td><td rowspan="2">8–12°</td></tr>
<tr><td>117</td><td>0 231 403 003
0 231 403 004
0 231 403 008</td><td>30° [4])</td></tr>
</table>

[1]) If normally compressed engines are operated with fuel under 98 RON (min 88 MON), adjust firing point in direction of „retard" and match to octane rating of fuel used. A reference value for this adjustment is: set firing point back by 1–2° crank angle per 1 RON. Max setback should not exceed 6° crank angle.
Attention!
Taking firing point back is considered an **„emergency measure"**. Reduced input and increased fuel consuption will result. In addition, the engine cannot be fully loaded. **As soon as fuel with specified octane number is available, set again to full advance.**

[2]) Switch off air conditioner.

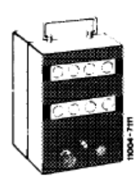
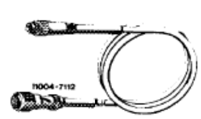
[3]) On engines with retard adjustment, check specified idle speed with vacuum after adjusting firing point.

[4]) Pull-off both vacuum lines for ignition adjustment when setting firing point. After setting firing point, test specified firing point at idle with vacuum.

B. National version (J) (USA)

Engine	Ignition distributor Bosch order no.	**Adjusting** value of firing point **with vacuum** at idle	**Test values** ignition adjustment **with vacuum** 1500/min	3000/min	Vacuum adjustment after „retard" at idle	„advance" at 3000/min	**Installation value** of ignition distributor at starting speed **without** vacuum
(J) Identification: Information plate with yellow printing on cylinder head cover. **Up to introduction of model year 1976**							
116	0 231 403 001 0 231 403 005	**TDC**	16–20°	28–32°	8–12°	8–12°	10° before TDC
117	0 231 403 003 0 231 403 004						
(USA) Identification: green/black information plate in English on cross member in front of radiator.							
Model year 1970/71							
116	0 231 302 002 0 231 401 002	6° after TDC	TDC±1°	30–38°	12–18°	–	10° before TDC
Model year 1972							
117	0 231 401 003 0 231 402 002	5° after TDC	11–15°	18–22°	10–14°	–	7° before TDC
Model year 1973							
117	0 231 402 007 0 231 402 002 0 231 402 005	5° after TDC	10–14°	18–22°	10–14°	–	7° before TDC
Model year 1974							
117	0 231 403 006 0 231 403 007	5° after TDC	10–14°	18–22°	10–14°	–	7° before TDC
Model year 1975							
117	0 231 404 002	TDC	10–16° **without** vacuum	18–23°	6–10°	8–12°	8° before TDC

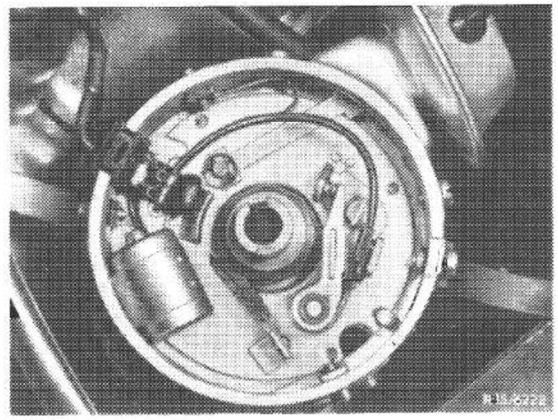
Special tools

Digital tester		001 589 54 21 00
Connecting cable		000 589 04 90 00

Conventional tools

CO measuring instrument, revolution counter, stroboscope, oscilloscope

Checking and adjusting closing angle (dwell angle)



1 Measure closing angle at idle.

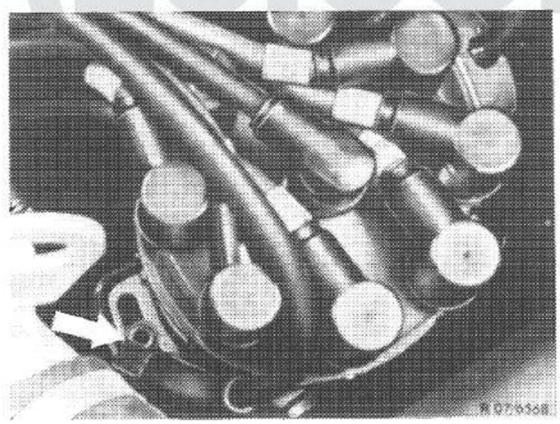
2 Measure closing angle change between idle and 3000/min, max change ± 3°.

3 Adjust closing angle, if required, or renew breaker points (07.5–505).

Closing angle can be adjusted for used contacts.

Large closing angle – small contact gap.
Small closing angle – large contact gap.

Checking and adjusting firing point



4 Measure firing point with stroboscope or digital tester at specified speed with or without vacuum.

5 Loosen ignition distributor attachment (arrow) and set adjusting value of firing point by turning ignition distributor.

Clockwise	=	retard
Counterclockwise	=	advance

Screw down ignition distributor and check firing point.

6 Check centrifugal and vacuum adjustment of ignition distributor. For this purpose, run through specified test values with or without vacuum adjustment.

07.5–503 Removing and preventing coating on breaker points

Conventional tool

Voltmeter with measuring range 0–3 volts.

A blue or dark grey coating on breaker points of transistorized ignition systems may result in misfiring when in a progressive stage due to the insulating characteristics of the coating – no matter whether a GE or a SI switchgear is installed. Pertinent complaints have resulted in unjustified exchange of switchgear.

A formation of a coating on breaker points may be due to the various influences explained in short below:

Blue coating

The blue coating (tungsten oxide) is formed by the arc generated during the closing phase and above all by the discharge of the suppressor contact installed in ignition distributor.

A large closing angle (small contact gap) favours the intensity of the arc and thereby of the coating.

Dark grey coating

The dark grey coating is caused by burnt grease, oil or dirt particles formed between the breaker points.

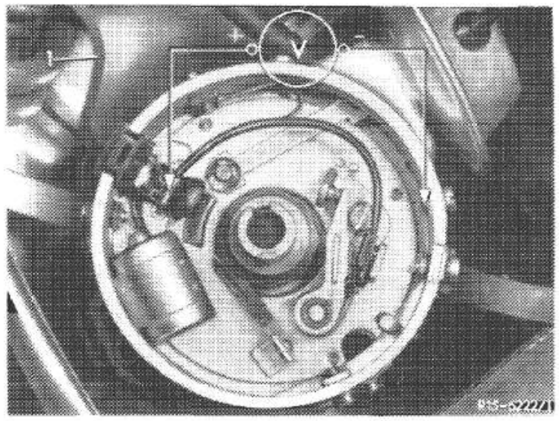
The remedy for complaints about the formation of such coatings requires the following jobs:

1 Check on ignition distributor whether:

a) A coating has been formed on breaker point.
b) The felt lubricator has been destroyed by the cams.
c) The cams are showing score marks (check with finger nail).

2 If the visual checkup shows no clear-cut faults, check function of contacts by measuring voltage drop. Use voltmeter with 0–3 V measuring range.

With contact closed, the voltage drop may amount to **0.5 volts.** A larger voltage drop indicates the beginning of a coating.



1 Control line with capacitor

Remedies

1 Coating on breaker points:

a) Exchange breaker points (refer to repair instructions).

b) Remove control line with capacitor (1) and replace by **shielded control line without capacitor.**

2 Score marks in distributor cam or rubbed-through lubricating felt:

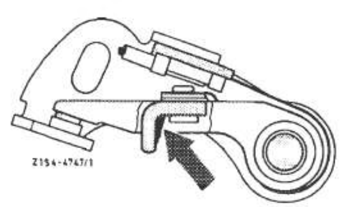
Exchange ignition distributor. Prior to installation, mount shielded control line without capacitor on new ignition distributor.

Repair instructions

Breaker points

In the event of complaints, the ignition distributor must be provided with new breaker points including an improved slide piece (polyimide). These breaker points are identified by a connecting cable with black/white stripes.

When renewing breaker points, be sure to coat slide piece (arrow) with a selected grease wedge (special grease Bosch Ft 1 v 4). If no grease is applied, the increased wear of the slide piece will increase the closing angle (smaller contact gap). This in turn will favour the formation of a coating and may result in misfiring.



Arrow: spot to be greased

Closing angle (dwell angle)

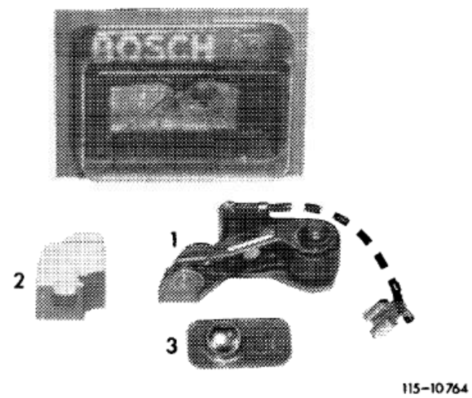
Adjust closing angle (dwell angle) to lower tolerance limit (07.5–500) to make sure that the closing angle will not change beyond specified value after run-in time of slide piece.

Adjusting value (lower tolerance) 30°.

Protective breaker point cap

Mount breaker point cap to protect contact against grease, oil or dirt particles.

To guarantee that the slide piece is greased and the protective cap is mounted when the breaker points are installed, breaker points are supplied from now on together with a grease capsule and a protective cap.



1 Breaker point
2 Protective cap
3 Grease capsule

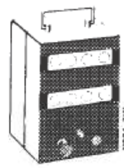
07.5–505 Renewing breaker points

Closing angle (dwell angle) (transistorized ignition system)
Identification: blue ignition coil, two series resistances and transistorized switchgear.

Engine	Closing angle (dwell angle) testing and **adjusting value** at idle[1])	Change between idle and 3000/min
116, 117	**30–34°**	max ± 3°

[1]) When installing new or adjusting used breaker points, adjust closing angle (dwell angle) according to boldfaced value ± 1°.

Special tools

Digital tester		001 589 54 21 00
Connecting cable		000 589 04 90 00

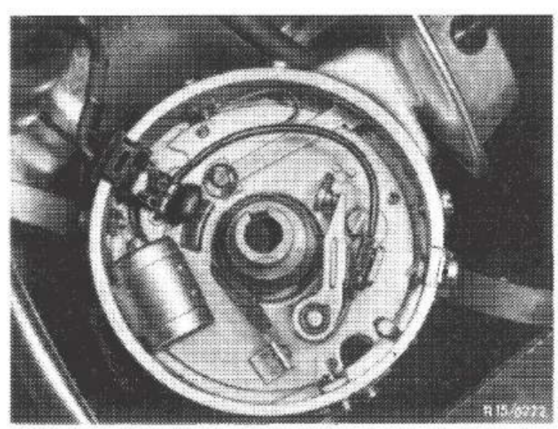
Conventional tool

Closing angle (dwell angle) measuring instrument

Installation

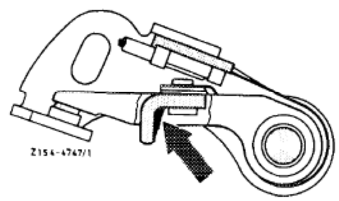
When renewing breaker points, proceed as follows:

1 Wipe points prior to installation with a lint-free cloth to remove moisture or grease.



2 Coat slide piece of breaker point, its bearing and the cams of the distributor shaft with some Bosch special grease Ft 1 v 4.

3 When closed, points should be in parallel and at similar level in relation to each other.

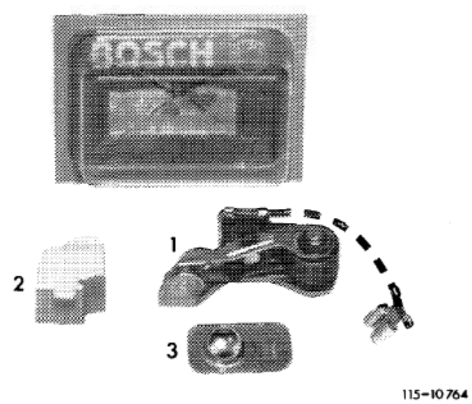


Arrow: spot to be greased

4 Adjust closing angle (dwell angle) to specified value.

Mount protective breaker point cap. Cap will protect point against grease, oil or dirt.

To guarantee that the slide piece is greased and the protective cap is mounted when the breaker points are installed, breaker points are supplied from now on together with a grease capsule and a protective cap.

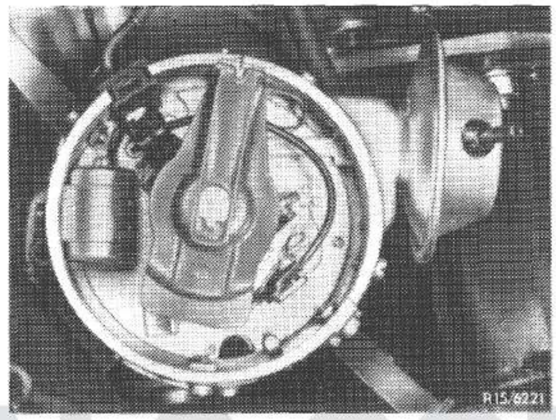


1 Breaker point
2 Protective cap
3 Grease capsule

5 Check firing point and adjust (07.5–500).

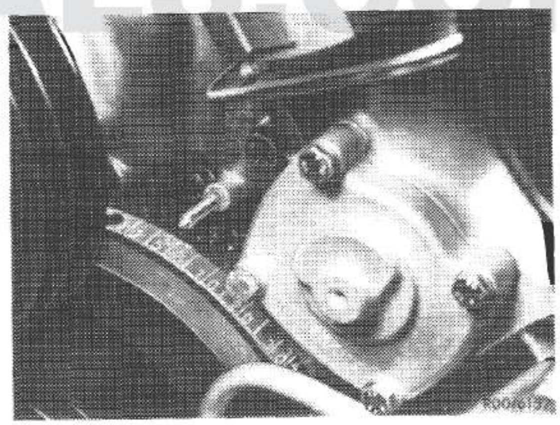
07.5–510 Removal and installation of ignition distributor

Removal



1 Remove protective cap, distributor cover, cable plug connections and vacuum line.

2 Set engine to ignition TDC of 1st cylinder. For this purpose, the markings on the distributor rotor and on distributor housing must be in alignment.



In addition, the pointer on crankcase should be above TDC mark of vibration damper.

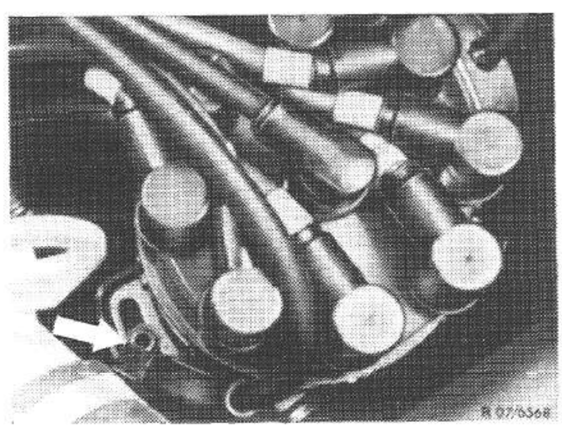
Attention!
On engines where the vibration damper carries a „0IO" mark also for BDC in addition to mark for TDC, the TDC mark is adjacent to the pin in vibration damper.

Rotate engine with combination tool.

Attention!
Do **not** rotate engine at fastening bolts of **camshaft gears.** Do **not** rotate engine **in reverse.**

3 Loosen hex socket screw of distributor attachment and remove ignition distributor.

Installation

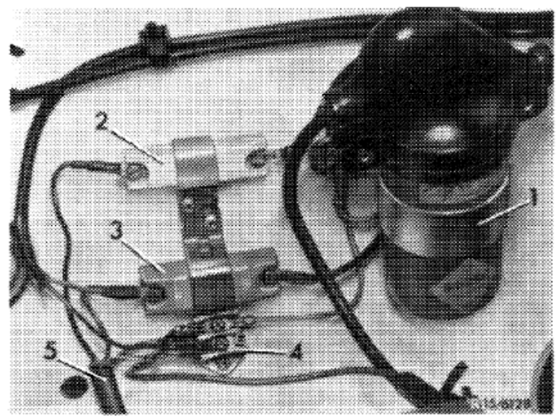


4 For installation proceed vice versa. Pay special attention to markings (refer to item 2).

5 Check closing angle (dwell angle) and firing point and adjust (07.5–500).

07.5–519 General description of breaker-controlled transistorized ignition

Layout of transistorized ignition



The system comprises:

Switchgear
Ignition coil (1)
Series resistance 0.4 ohm (3)
Series resistance 0.6 ohm (2)

Operation

The ignition coil current is switched on by a transistorized system instead of the contact breaker point. The contact breaker point serves to control this transistorized system.

The switching transistor is energized when the contact breaker point is closed. When the contact breaker point opens, the transistor locks and the ignition coil current is interrupted. The interruption of the circuit in the primary winding induces the ignition voltage in the secondary winding similar to the conventional coil ignition.

To increase the ignition voltage when starting, the 0.4 ohm series resistance is bridged by contact 16 on starter.

Switchgear (1)

The switchgear comprises several transistors, resistors and other electronic components in a metal housing, depending on type. The housing protects these components against mechanical damage and splash water and serves simultaneously to dissipate electric heat. Contact on switchgear is made by means of a 3-point flat plug connection or a 4-point round plug connection with separate coaxial connection for establishing contact.

Switchgears for model 107 (wheel house units) are provided with a firmly attached connecting line.

In the event of repairs, only the entire switch-gear can be exchanged.

Ignition coil (2)

The ignition coil design and its external dimensions are similar to a normal heavy-duty ignition coil. But the winding system is different. The interturn ratio is approx. 1 : 185 as compared with 1 : 100 on conventional ignition coils.

External identification: blue paintwork.

Series resistances

Resistances 0.4 ohm and 0.6 ohm are similar to ignition coil resistances used up to now: a ceramic body encloses the resistance winding with its extended connections.

For attachment, the ceramic body is provided with a sheet-metal clamp. The color of this clamp indicates the resistance value, which is additionally punched in as a number.

Color	Code number	Resistance
anodized, blue	0.4	0.4 ohm
anodized, metallic	0.6	0.6 ohm

General information

On vehicles with transistorized ignition systems do not operate engine when battery is not connected.

When using rapid chargers for charging the vehicle battery, separate battery from other vehicle circuits.

Starting assistance with rapid chargers is not permitted.

When installing battery, pay attention to correct polarity.

Do not interchange line connections on switchgear (e.g. when switchgear is tested in removed condition).

Switchgear may suffer damage, if these instructions are not observed.

Instructions for test jobs

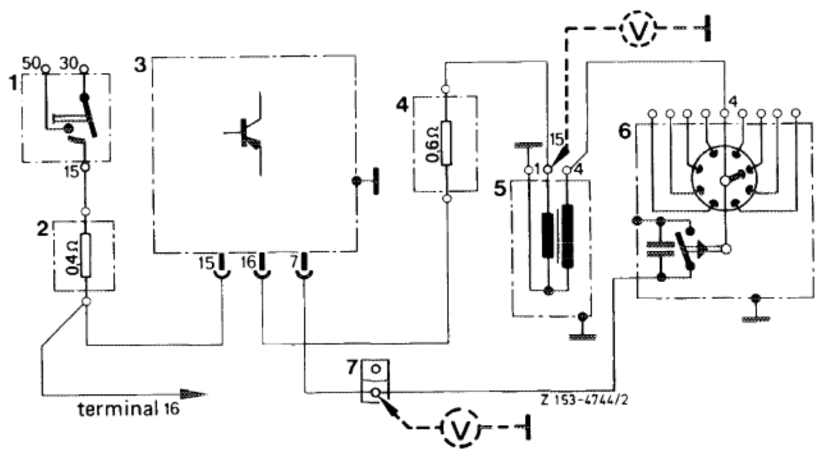
On engines with transistorized coil ignition, speed and closing angle (dwell angle) cannot always be measured in the usual manner.

Depending on type of tester used, connection must be made at varying points of ignition system. In each case, the operating instructions of test instrument apply. To facilitate connection of speed and dwell angle test instruments, an empty, offset cable shoe is screwed on under cable connector 7.

TSZ (transistorized) switchgear with Ge transistor

Bosch no.	installed in model
0 227 051 006*	108.057/058
0 227 051 008*	
0 227 051 011*	109.056
0 227 057 015	111.026/027

* Install 0 227 051 015 as a replacement.

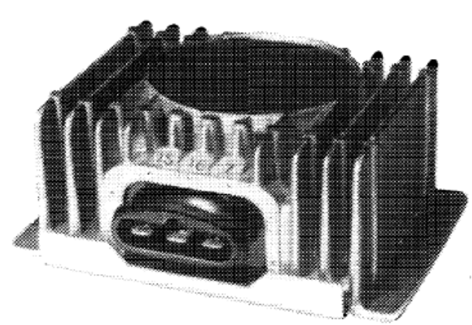


Wiring diagram

1 Ignition starting switch
2 Series resistance 0.4 ohm
3 Switchgear
4 Series resistance 0.6 ohm
5 Ignition coil
6 Ignition distributor
7 Cable connector terminal 7 (TD)

Designation of 3-core connecting line on switchgear (3):

black	terminal 16 (to series resistance 0.6 ohm)
red/black	terminal 15 (to series resistance 0.4 ohm)
green/yellow	terminal 7 (to cable connector terminal 1 ignition distributor)



Switchgear 0 227 051 015

107 – 8814

TSZ switchgear (wheel house units) with Ge transistor or Si transistor

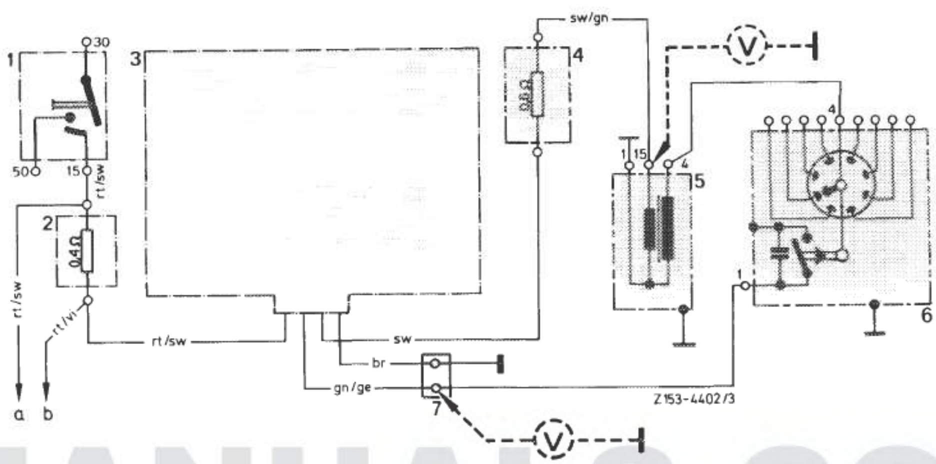
Bosch no.	Installed in model
0 227 051 012* 0 227 051 017*	107.023 107.024 107.043 107.044 } up to December 1974 107.024/044 (USA) up to including model year 1974

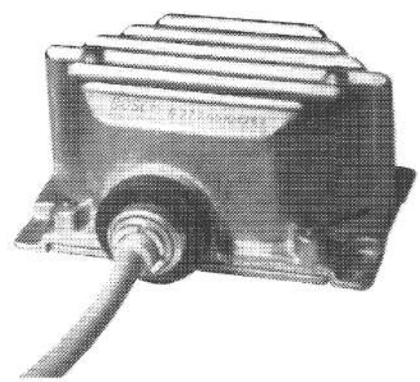
*Replaced by Si wheel house unit 0 227 051 022.

Wiring diagram

1 Ignition starting switch
2 Series resistance 0.4 ohm
3 Switchgear
4 Series resistance 0.6 ohm
5 Ignition coil
6 Ignition distributor
7 Cable connector Terminal 7
a To diagnosis plug
b Starter Terminal 16

br = brown
ge = yellow
gn = green
rt = red
sw = black
vi = purple





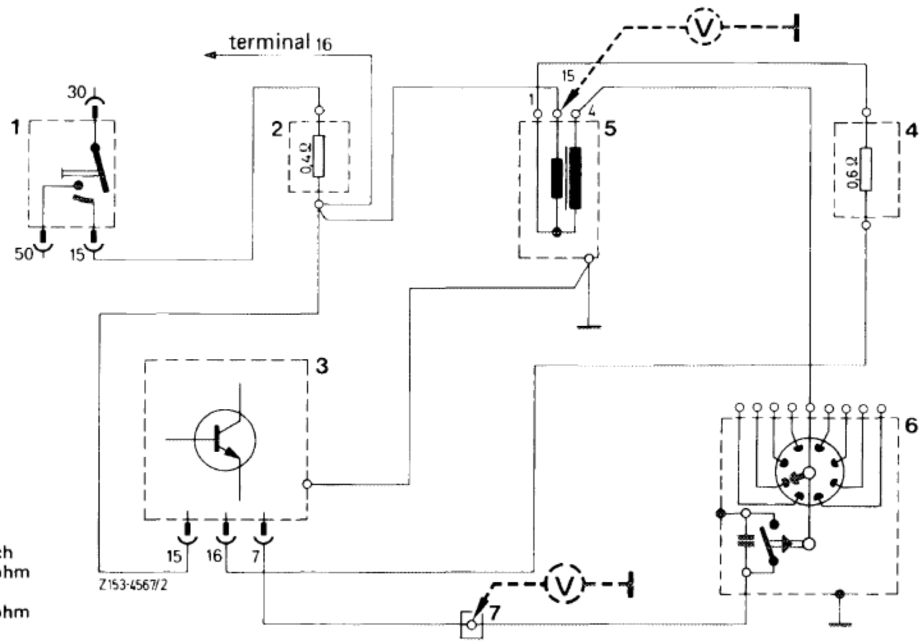
Switchgear 0 227 051 017

107-8815

TSZ switchgear with Si transistor

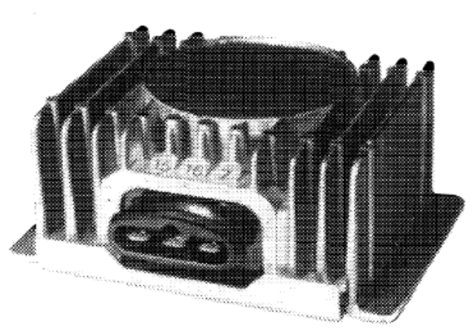
Bosch no.	Installed in model
0 227 051 013*	108.067/068
0 227 051 016	109.057

* Install 0 227 051 016 as a replacement.



Wiring diagram

1 Ignition starting switch
2 Series resistance 0.4 ohm
3 Switchgear
4 Series resistance 0.6 ohm
5 Ignition coil
6 Ignition distributor
7 Cable connector, terminal 7

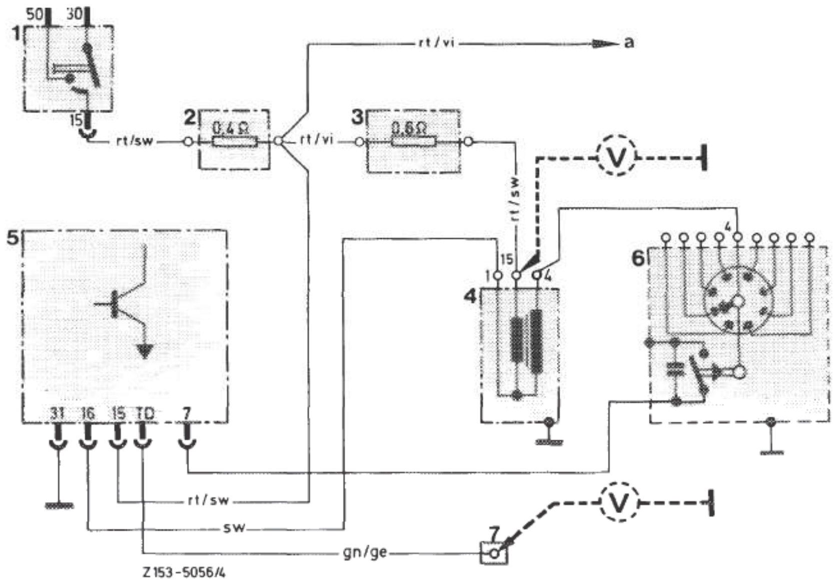


Switchgear 0 227 051 016

107 – 8814

TSZ switchgear – standard switchgear – with Si transistor

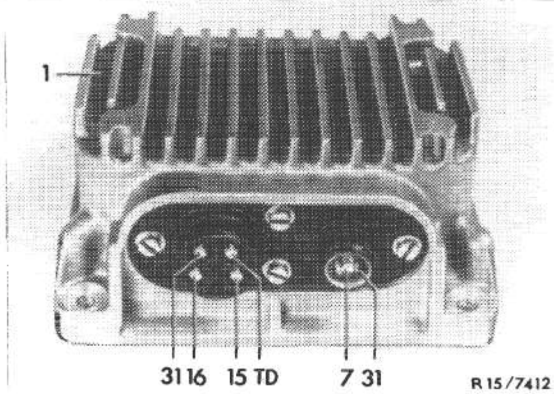
Bosch no.	Installed in model
0 227 051 014	116.028/029, 116.032/033 } up to November 1974 116.032/033 (USA) up to including model year 1974
0 227 051 024	107.023/024, 107.043/044, 116.028/029, 116.032/033 } starting December 1974 107.024/044, 116.032/033 (USA) starting model year 1975



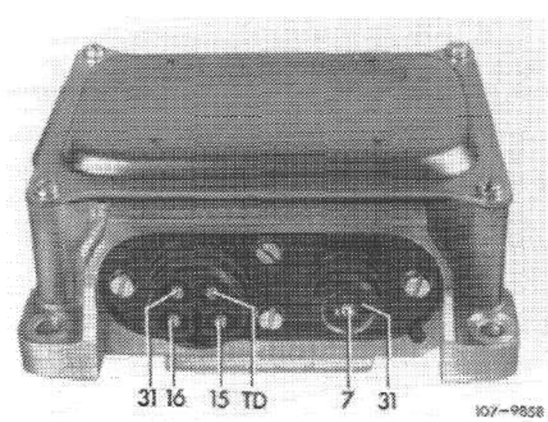
Wiring diagram

1 Ignition starting switch
2 Series resistance 0.4 ohm
3 Series resistance 0.6 ohm
4 Ignition coil
5 Switchgear
6 Ignition distributor
7 Cable connector with test terminal TD
a To terminal 16 starter

ge = yellow
gn = green
rt = red
sw = black
vi = purple



Switchgear 0 227 051 014



Switchgear 0 227 051 024

07.5–520 Testing contact (breaker) controlled transistorized ignition

Conventional tools

1 voltmeter; measuring range 0–3 V, 0–15 V with 0.1 V scale graduation
1 ohmmeter, measuring range starting 0.1 ohm

1. Testing series resistances

Loosen line connection on one connection of resistance to be tested.

Measure resistance with ohmmeter.

Series resistance	Resistance nominal value at + 20°C
0.4 ohm	0.4 ± 0.05 ohm
0.6 ohm	0.6 ± 0.05 ohm

For warmer series resistances, the measured values are slightly higher.

2. Testing ignition coil

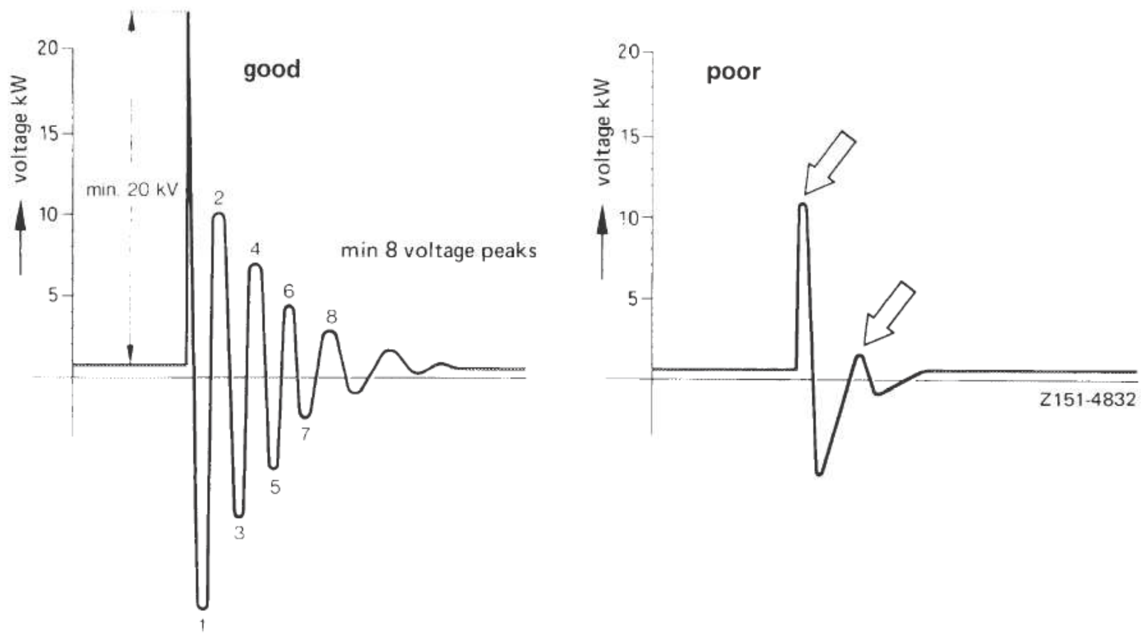
Insulation test

Separate ignition coil by removing terminals 1, 15, 4 from vehicle supply system.

Connect engine tester to ignition coil. Test according to operating instructions.

Whenever possible, test ignition coil with a suitable engine tester (e.g. SUN 745 or 1130) under operating conditions. The discovered faults are above all insulation damage, grounding and interturn shorts.

Evaluate voltage flow on scope according to subsequent illustration.



Display	Line-up
Fault	Voltage below 20 kV, less than 8 voltage peaks
Cause	Interturn interruption, interturn short or insulation damage against ground
Remedy	Renew ignition coil

Display evaluation

The ignition is perfect when the first oscillation attains 20 kV and at least 8 voltage peaks will follow. If this value is not attained, replace ignition coil.

Resistance test

Resistance nominal value at + 20°C	
Primary winding measured between terminal 1 and 15	0.38–0.45 ohm
Secondary winding measured between terminal 1 and 4	8–11 kΩ

Measurements will be slightly higher when ignition coil is warmer.

3. Testing contact breaker point

For perfect function of transistorized systems the transfer resistance on contact breaker point should not be too high. To check, measure voltage drop on closed contact breaker point.

Connect voltmeter: + to cable connector (= terminal 7 or TD on switchgear)
— to ground

Voltage indication **max 0.3 volt.**

If this value is exceeded, install a new contact breaker.

4. Testing switchgear and line connections

Check whether switchgear is connected to voltage or whether, if pertinently contacted, the switching transistor will lock the primary current of the ignition coil or let it pass. The primary current is not directly measured but, for the sake of simplicity, the voltage drop caused by this current.

Test with engine stopped and ignition switched on.

Test voltage drop at input of 0.4 ohm resistance with contact braker point closed.

Connect voltmeter: + to input series resistance 0.4 ohm
— to ground

The voltage drop may amount to **max 0.4 volt.**

When voltage drop is too high, check cable and cable connections.

4.1 Ge switchgear

Check connections on series resistances, on cable connector and on ignition coil for perfect condition.

Voltage with breaker point opened

This will check the locking conduct of transistor.

Connect voltmeter: + to terminal 15 ignition coil
— to ground

No voltage should be available at terminal 15 ignition coil, i.e. **readout = 0 volt.**

If readout is not 0 volt, the transistor in switchgear is no longer locking. Replace switchgear.

Voltage with breaker point closed

Voltmeter connected as before.

Voltage at terminal 15 ignition coil = 2.6–3.5 volts.

If not, transistor is no longer switching through. Replace switchgear.

With breaker point closed or opened, the voltage measured at terminal 1 of ignition coil amounts to **0 volt.**

If these values are above or below 0 volt, test series resistances, ignition coil and cables.

4.2 Ge or Si switchgear – wheel house unit – in model 107

Designation of 4-core connecting line on switchgear

brown	ground	
black	terminal 16	to series resistance 0.6 ohm
red/black . . .	terminal 15	to series resistance 0.4 ohm
green/yellow .	terminal 7	to cable connector terminal 1 – ignition distributor

Check connections on series resistances, on cable connector and on ignition coil for perfect condition.

Voltages with breaker points opened

This will check the locking conduct of transistor.

Connect voltmeter: + to terminal 15 ignition coil
– to ground

There should be no voltage at terminal 15 ignition coil, i.e. **readout = 0 volt.**

If readout is not 0 volt, the transistor in switchgear is no longer locking. Replace switchgear.

Voltage with breaker point closed

Voltmeter connected as before.

Voltage on terminal 15 ignition coil = 2.6--3.5 volts.

If not, the transistor in switchgear is no longer switching through. Replace switchgear.

Voltage on terminal 1 of ignition coil with breaker point closed or opened amounts to **0 volt.**

If these values are below or above specifications, check series resistances, ignition coil and cables.

4.3 Si switchgear

Checking line connections

Check connections on series resistances, on cable connector and on ignition coil for perfect condition. With the ignition switched on, the pulled off 3-pole plug of switchgear plug connection should be connected to battery voltage at terminals 15 and 16.

Connect voltmeter: + to terminal 15 or 16
— to ground

Voltage with breaker point opened

This will check the locking conduct of the transistor.

Connect voltmeter: + to terminal 15 ignition coil
— to ground

Terminal 15 ignition coil should carry **battery voltage.** If not, transistors in switchgear are no longer locking. Replace switchgear.

Voltages with breaker point closed

Voltmeter connected as before.

Voltage on terminal 15 ignition coil = 8.2—9.6 volts.

With breaker point closed, voltage on terminal 1 of ignition coil is **4.8--6.3 volts;** with breaker point opened, battery voltage.

If not, transistors are no longer switching through. Replace switchgear.

4.4 Standard switchgear (Si)

Inspection of line connections

Pull 4-pole connecting plug from switchgear and test with voltmeter for battery voltage at 4-point round plug terminal 15 and terminal 16 with ignition switched on.

Connect voltmeter: + 1 x to terminal 15 and
1 x to terminal 16
– to ground

If there is no voltage, test all connections from input 0.4 ohm resistance to switchgear.

Then put back 4-point round plug on switchgear.

Voltage with breaker point opened

This will check the locking conduct of the transistor.

Connect voltmeter: + to terminal 1 ignition coil
– to ground

Terminal 1 should carry battery voltage.

If not, replace switchgear.

Voltage with breaker point closed

Voltmeter connected as before.

Voltage on terminal 1 ignition coil = **0.7--1.5 volts.**

With breaker point closed, **3.6--4.6** volts are measured on terminal 15 of ignition coil; with breaker point opened, battery voltage.

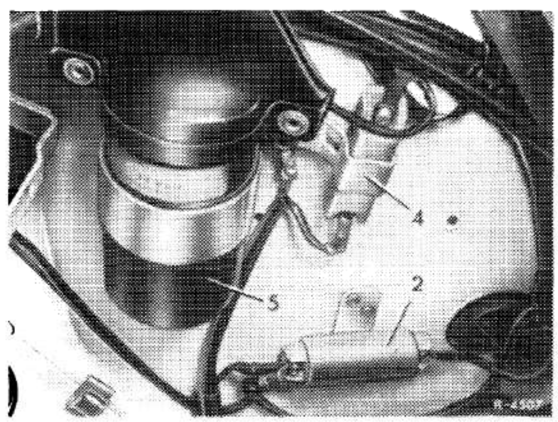
If not, replace switchgear.

Values for testing switchgear

Measuring points and associated voltages for transistorized (TSZ) systems

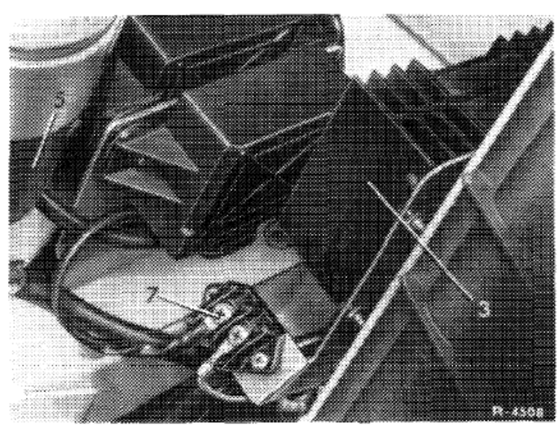
Voltmeter		Breaker point	Nominal voltages			Voltages outside nominal range: causes, remedies
Plus to	Minus to		Wheel house TSZ	Si-TSZ	Si standard TSZ	
Series resistance 0.4 ohm input	ground	closed	max 0.4 V below battery voltage			With correct battery voltage: Excessive voltage drop battery – 0.4 ohm series resistance caused by transfer resistances (corrosion), line interruption etc.
Pulled-off switchgear plug terminal 15		without significance	11.8–13.0 V	battery voltage		With correct voltage at 0.4 ohm series resistance: parallel resistance or circuit interruption between 0.4 ohm series resistance input and terminal 15 or terminal 16
terminal 16			0 V			
Cable connector terminal 7 or TD		closed	0–0.3 V			Higher voltage: transfer resistance on breaker point too high. Renew breaker point.
Ignition coil terminal 15		closed	2.6–3.5 V	8.2–9.6 V	3.6–4.6 V	With correct voltage at switchgear and terminal 7 or TD:
		opened	0 V	battery voltage		Switchgear defective
Ignition coil terminal 1		closed	0 V	4.8–6.3 V	0.7–1.5 V	Renew switchgear
		opened		battery voltage		

Layout of individual components

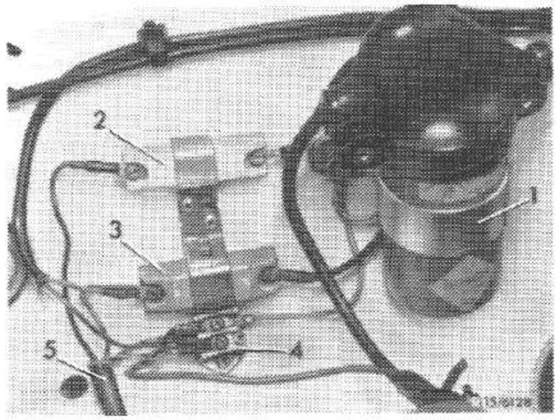


Model 108.057/058, 109.056, 111.026/027

2 Series resistance 0.4 ohm
4 Series resistance 0.6 ohm
5 Ignition coil

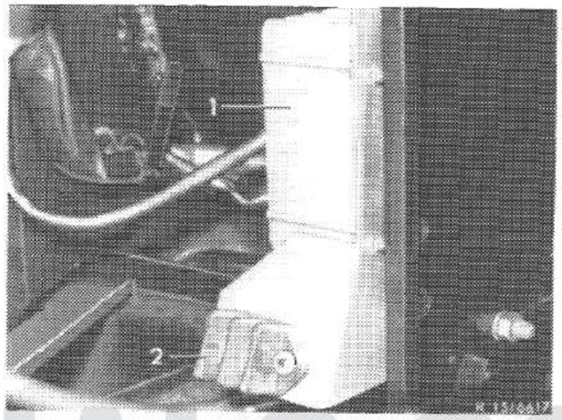


3 Switchgear
5 Ignition coil
7 Cable connector



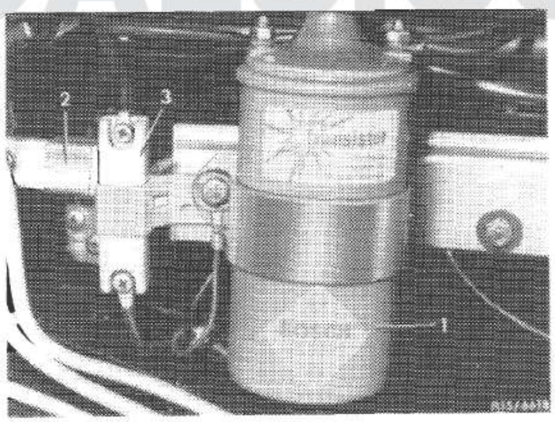
Model 107

1 Ignition coil
2 Series resistance 0.6 ohm
3 Series resistance 0.4 ohm
4 Cable connector
5 Line from switchgear

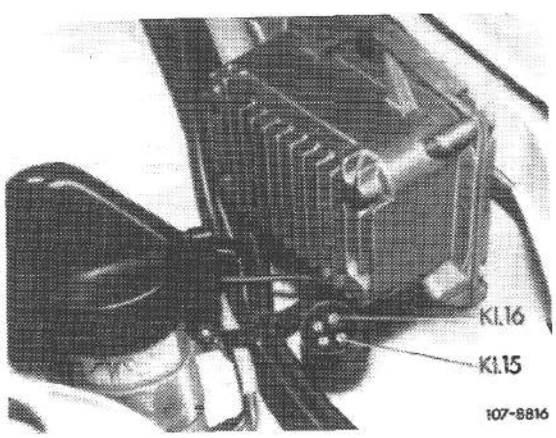


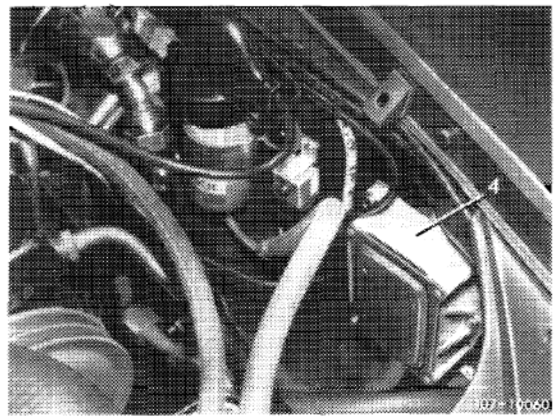
Model 108.067/068 (USA), 109.057 (USA)

1 Switchgear 2 Cable connector



1 Ignition coil
2 Series resistance 0.4 ohm
3 Series resistance 0.6 ohm





Switchgear layout model 107

09–400 Removal and installation of intake pipe, renewing gasket

Removal

1 Disconnect battery.

2 Partially drain coolant.

3 Remove air filter.

4 Disconnect regulating linkage and remove longitudinal regulating shaft (07.4–310).

5 Pull-off cable plug connections.

6 Loosen fuel hoses on pressure regulator and on cold starting valve.

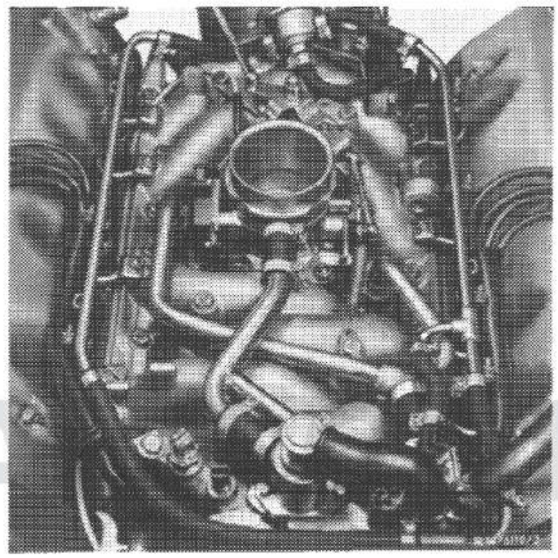
7 Unscrew fastening nuts of injection valves and put injection valves aside.

8 Unscrew the 16 fastening screws of intake pipe.

9 Loosen hose clip on thermostat.

10 Lift intake pipe and splash wall and remove toward the rear.

11 Clean intake pipe and check flange surfaces with straightedge and finish on surface plate, if required.



Installation

12 Mount intake pipe in vice versa sequence using new gaskets.

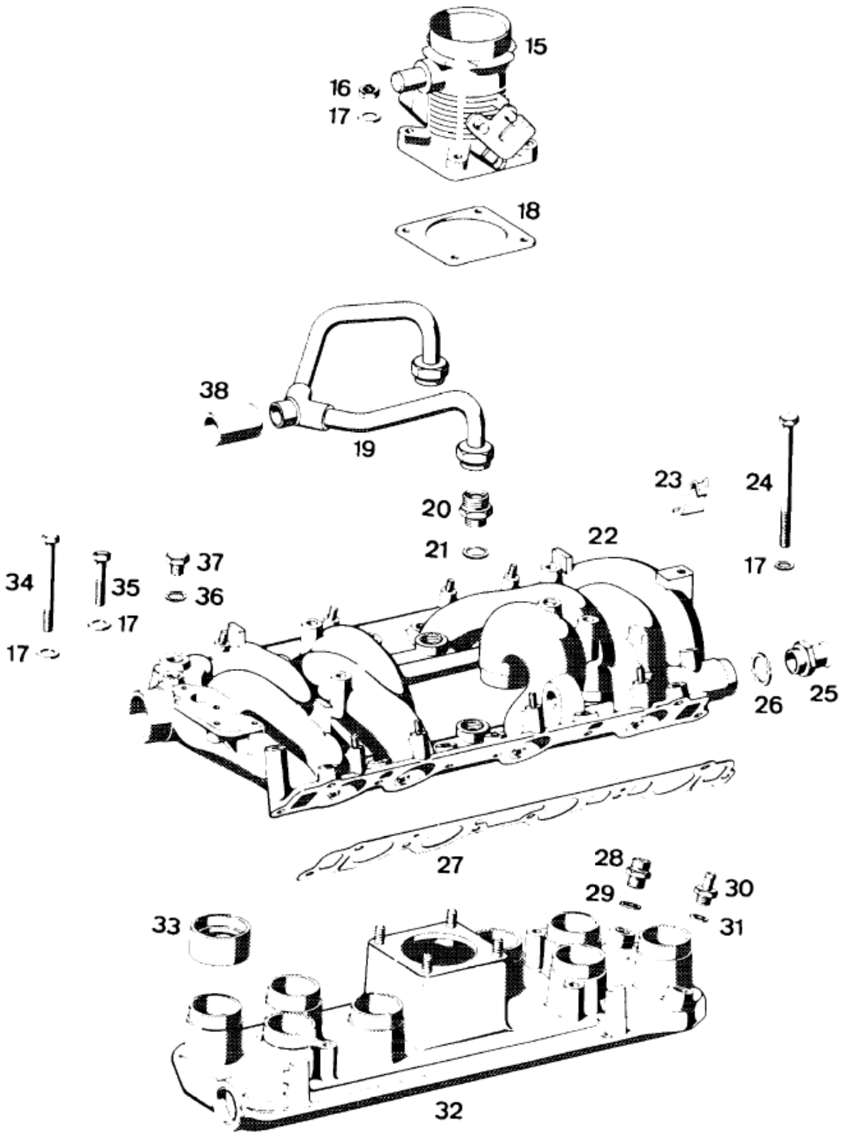
13 Adjust regulating linkage (07.4–300).

14 Connect battery.

15 Add coolant.

16 Run engine, test intake system for leaks by spraying with Iso-Oktan DIN 51756 or benzine.

17 Adjust idle speed (07.4–100).



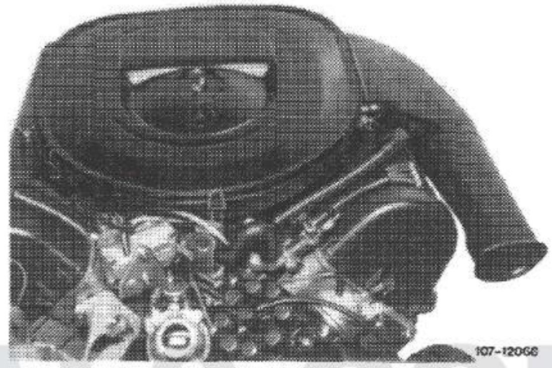
15	Throttle valve housing	27	Gasket
16	Nut	28	Screw connection
17	Washer	29	Sealing ring
18	Gasket	30	Screw connection
19	Idle speed air line	31	Sealing ring
20	Screw connection	32	Intake pipe lower half
21	Sealing ring	33	Rubber connection
22	Intake pipe upper half	34	Hex screw
23	Holder	35	Hex screw
24	Hex screw	36	Sealing ring
25	Connection	37	Closing plug
26	Sealing ring	38	Hose member

09–400 Removal and installation of air cleaner

Removal

1 Unscrew both ring nuts from vibration mounts.

2 Remove air cleaner, while pulling off contoured hose for crankshaft breather.



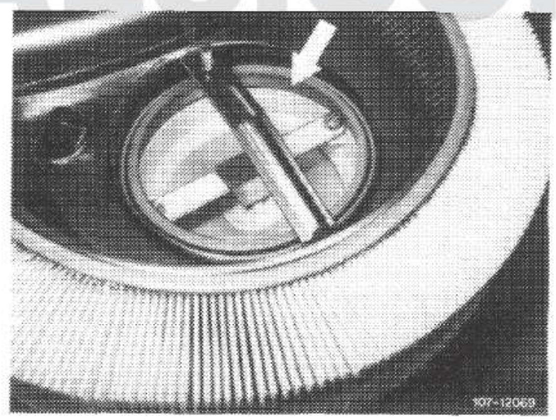
107-12066

Installation

3 Remove air cleaner cover.

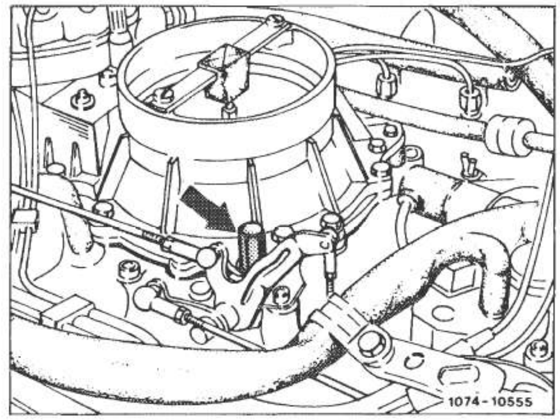
4 Mount air cleaner. Pay attention to correct seat of sealing ring (arrow) between air flow sensor and air cleaner.

5 Mount air cleaner cover.



107-12069

Note: For better location of air cleaner, mount a stop nut (arrow), part no. 117 070 00 41, on mixture controller at front right (up to now hex. nut).

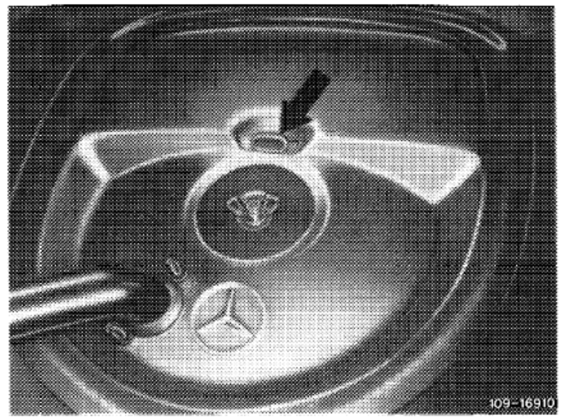


1074-10555

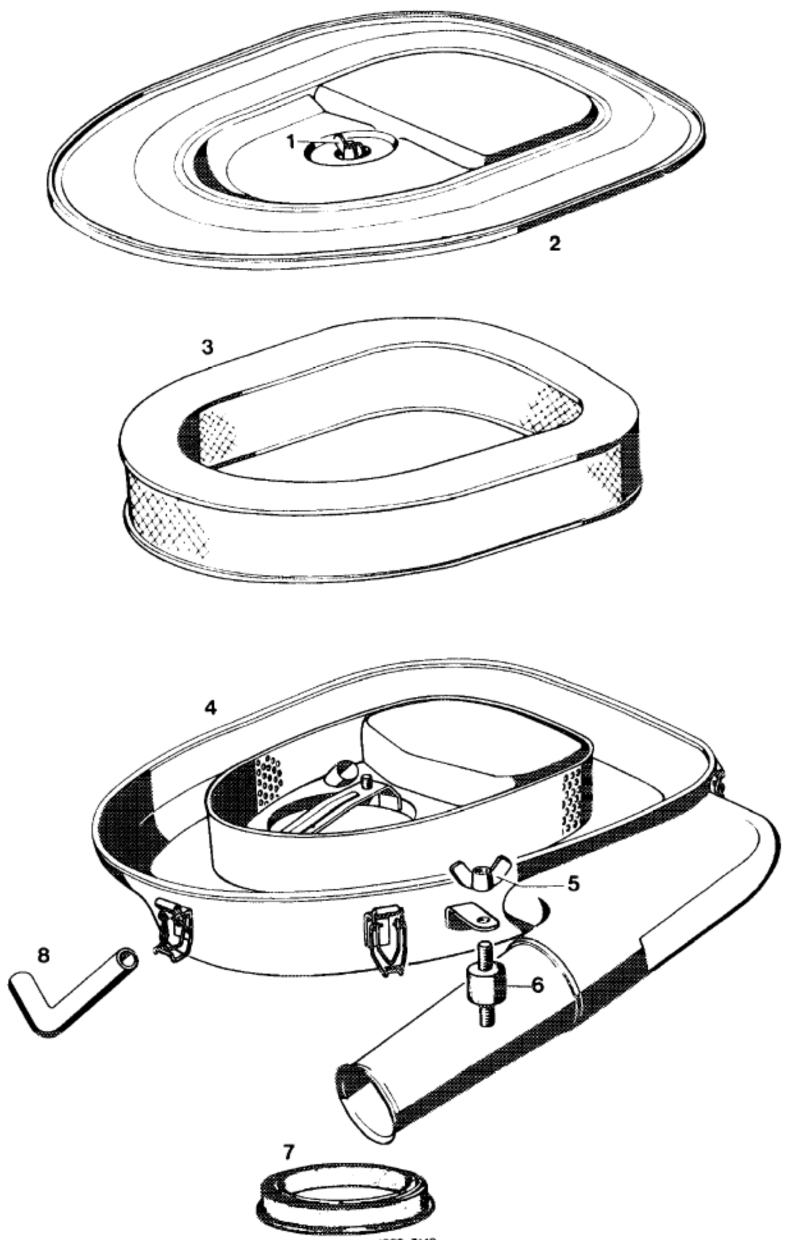
(USA) 1980 (engine 117)

The air cleaner is made of light alloy, the air cleaner top has a recess (arrow) for adjusting idle mixture (on-off ratio).

As a result, the air cleaner need no longer be removed for adjusting idle speed mixture (on-off ratio).



Air cleaner



1 Wing nut
2 Air cleaner cover
3 Air cleaner element
4 Air cleaner lower half
5 Ring nut
6 Vibration mount
7 Rubber sealing ring
8 Contoured hose for crankcase breather

09–410 Renewing intake pipe (intake pipe removed)

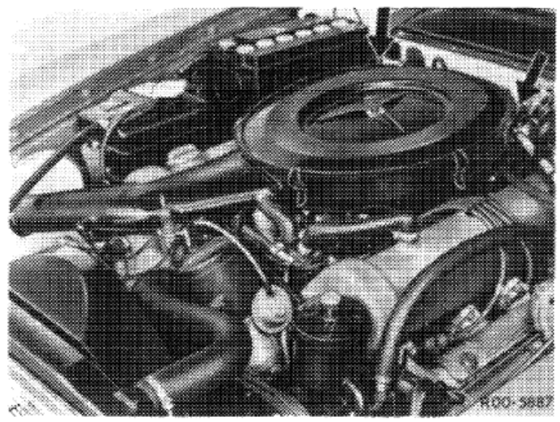
Renewing

1 Remove and install intake pipe (09–400).

2 Remove and install throttle valve housing (07.4–230).

3 Unscrew all unscrewable parts on removed intake pipe and mount on new intake pipe using new seals and gaskets.

09–420 Removal and installation of air filter



Removal

1 Pull-off electric connection for temperature sensor.

2 Disconnect two rubber straps (arrows).

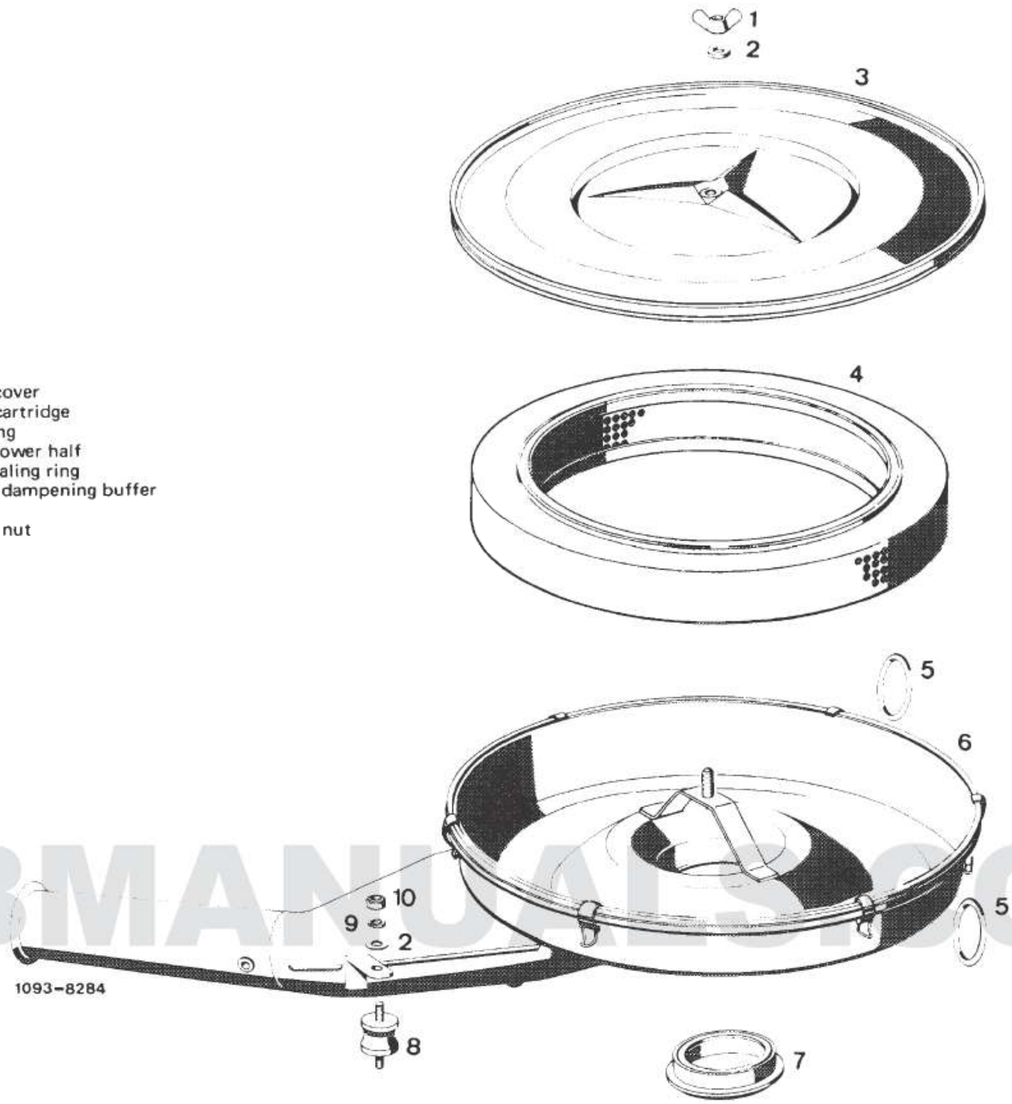
3 Unscrew fastening nut on vibration dampening buffer.

4 Lift off air filter while pulling off contour hose for crankcase breather.

Installation

5 Install air filter in vice versa sequence. Remove air filter cover and pay attention to correct seat of sealing ring between throttle valve housing and air filter.

1 Wing nut
2 Washer
3 Air filter cover
4 Air filter cartridge
5 Rubber ring
6 Air filter lower half
7 Rubber sealing ring
8 Vibration dampening buffer
9 Snap ring
10 Fastening nut



13–335 Notes concerning renewing and tensioning of V-belts

Adjusting values

V-belts (profile width in mm)	New V-belts (KG-scale on measuring instrument)	Used V-belts (KG-scale on measuring instrument)
9.5	30	20–25
12.5	50	40–45

Special tool

Measuring instrument (Krikit) for measuring V-belt tension		001 589 69 21 00

Checking condition of V-belt

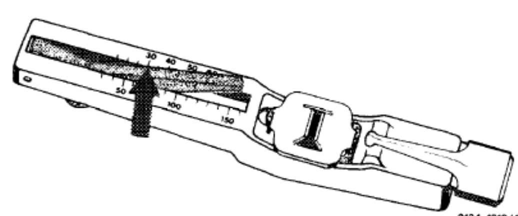
Renew cracked, burnt or worn out V-belts.

Attention!
If on double belt drive for coolant pump and power steering pump one of the two V-belts fails due to wear, be sure to renew both V-belts.

Checking tension

For handling of instrument refer to operating instructions, renew V-belts and tension (13–340).

The specified adjusting values refer to KG-scale of measuring instrument (arrow).



2134-1218/1

Used V-belts

Check tension of V-belts and compare with values named in table for used V-belts (e.g. V-belt, profile width 9.5 mm, 9.5 mm = adjusting value 20–25). If required, re-tension V-belt.

Mounting and tensioning new V-belts

Perfect mounting of a V-belt requires releasing of respective auxiliary unit or of V-belt tensioning device to the extent that the belt can be easily mounted. In addition, the running surfaces for V-belt on pulleys must be free of burr, rust and dirt.

Keep free of oil, grease, chemicals. Do not use belt wax or the like. Subsequent optimal adjustment of belt tension (for adjusting data refer to table) serves to eliminate complaints such as squealing V-belts and low service life.

Within scope of maintenance jobs, mount V-belts prior to checking engine and tension to value named on table for new V-belts (e.g. V-belt, profile width 9.5 mm = adjusting value 30).

If the V-belt tension is checked at final inspection or following a test drive, the value measured at that time should be the same as the value named in table for used V-belts (e.g. V-belts, profile width 9.5 mm = adjusting value 20–25). If required, re-tension V-belt to match this value.

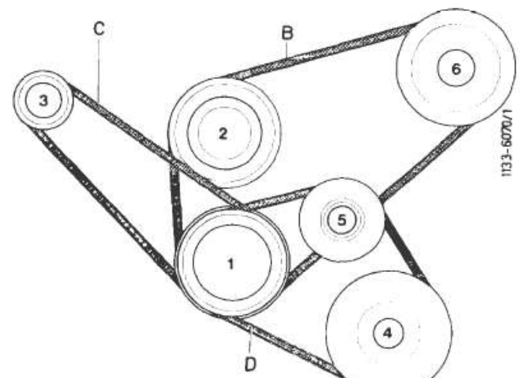
13–340 Replacing and tensioning V-belts

V-belt		A	B				C					D		E	
		Air compressor (air suspension)	Coolant pump – power steering pump				Alternator					Refrigerant compressor		Air pump	
Dimensions		9,5 X 838	9,5 X 1160	9,5 X 1184	9,5 X 1200	9,5 X 1225	9,5 X 913	9,5 X 950	9,5 X 980	9,5 X 1000	9,5 X 1025	12,5 X 850	12,5 X 825	9,5 X 935	9,5 X 875
Installed in			Double V-belts may be replaced in sets only								USA and California 1974			1974 California	AUS J S USA 12)
Type	Engine														
107.023/043	116.982/929			X	X[9]		X[7]	X				X			
	116.984				X		X					X	X[13]		
107.024/044	117.982/992		X[2]	X[1]	X[9]				X[7,10]	X	X[8]	X		X	X
	117.985				X					X		X[11]	X		X
108.057/058	116.980/990			X[4]		X[3]		X				X			
108.067/068	117.984		X							X		X			
109.056	116.981/991	X		X[6]		X[5]		X				X			
109.057	117.981	X	X							X		X			
111.026/027	116.980					X		X				X			
116.028/029	116.983/993			X	X[9]		X[7]	X				X			
	116.985				X		X					X	X[14]		
116.023/033	117.983/993		X		X[9]				X[7,10]	X	X[8]	X		X	X
	117.986				X					X		X[11]	X		X

1) Up to chassis end No. 002614.
2) Starting chassis end No. 002615.
3) Up to chassis end No. 003369.
4) Starting chassis end No. 003370.
5) Up to chassis end No. 007234.
6) Starting chassis end No. 007235.
7) Starting alternator mounting bracket with toothed disc adjust with toothed disc adjustment.
8) Type 107.024 starting chassis end No. 007725 up to chassis end No. 008175. Type 107.044 starting chassis end No. 020995 up to chassis end No. 021704. Type 116.032/033 starting chassis end No. 028710 up to chassis end No. 029558.
9) Starting power steering pump 2nd version (VT 49).
10) In vehicles with the following chassis numbers, V-belt 9.5 x 1000 has been installed: Type 107.024 starting chassis end No. 008589 up to chassis end No. 009425, 107.044 starting chassis end No. 022627 up to chassis end No. 024745, 116.032/033 starting chassis end No. 032886 up to chassis end No. 036799.
11) USA starting 1976 (with pulley 148 mm OD on crankshaft) and AUS J S starting 1977.
12) AUS starting 1977.
J starting 1976.
S starting 1976.
USA 1975 and 1976
USA 1977 California only.
13) Type 107.023 starting chassis end No. 011722, 107.043 starting chassis end No. 012964.
14) Starting chassis end No. 040535.

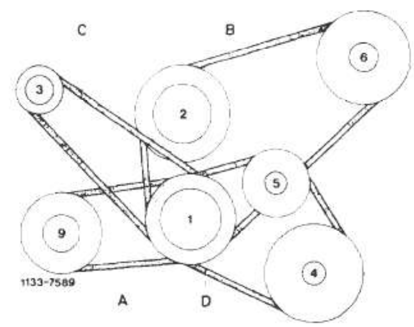
Engine 116.980/984
116.982/992
116.983/993
116.984
116.985
117.982/992
117.983/993
117.984
117.985
117.986

1 Crankshaft
2 Coolant pump
3 Alternator
4 Refrigerant compressor
5 Tensioning roller
6 Power steering pump



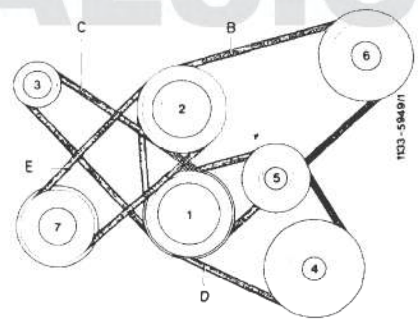
Engine 116.981/991
117.981

1 Crankshaft
2 Coolant pump
3 Alternator
4 Refrigerant compressor
5 Tensioning roller
6 Power steering pump
9 Air compressor – air suspension



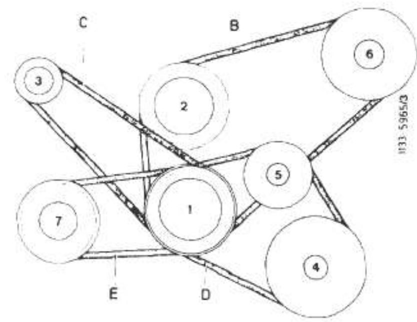
USA 1974 California

1 Crankshaft
2 Coolant pump
3 Alternator
4 Refrigerant compressor
5 Tensioning roller
6 Power steering pump
7 Air pump



USA starting 1977
J starting 1976
S starting 1976
USA 1975 and 1976
USA 1977 California only

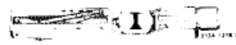
1 Crankshaft
2 Coolant pump
3 Alternator
4 Refrigerant compressor
5 Tensioning roller
6 Power steering pump
7 Air pump



V-belt adjusting values

V-belt width		9.5	12.5
Adjusting value KG-scale on measuring instrument	new	30	50
	used	20–25	40–45

Special tool

Krikit measuring instrument for measuring V-belt tension		001 589 69 21 00

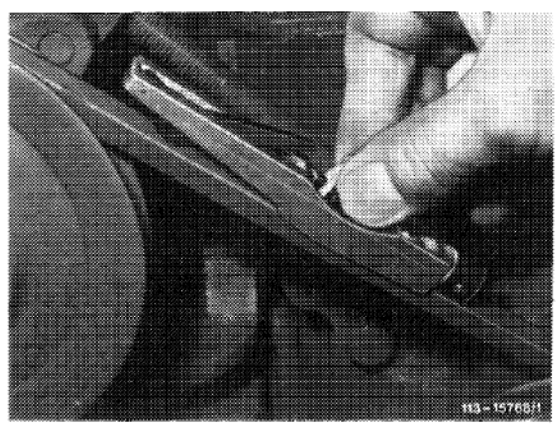
Note

Measuring instrument "Krikit" is recommended for testing V-belt tension.

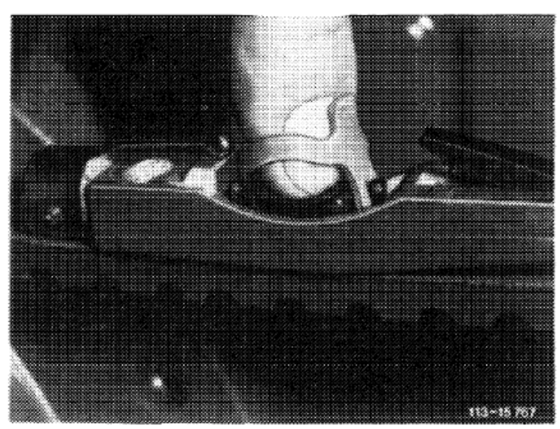
Handling of measuring instrument

For checking V-belt tension, the measuring instrument can be held in different ways:

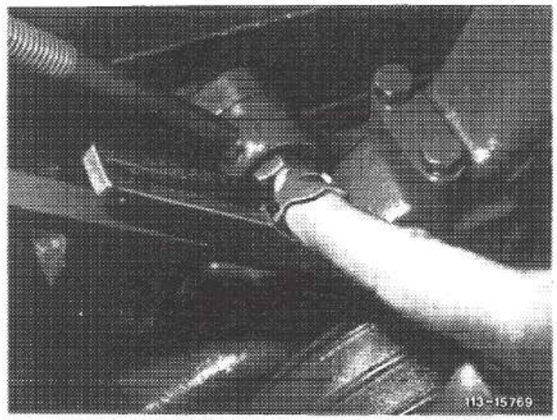
a) With thumb and forefinger at rubber loop, with finger tips resting on pushbutton.



b) With forefinger from above in rubber loop.



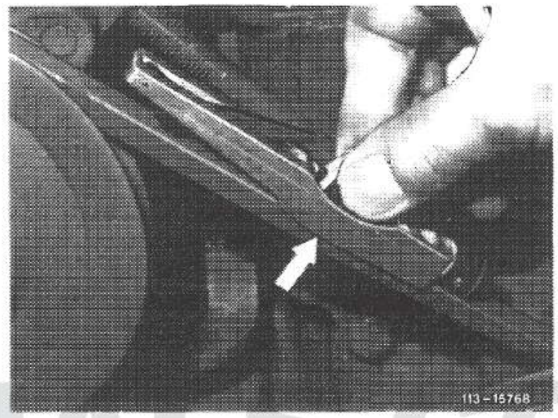
c) With forefinger laterally between rubber loop and pushbutton.



Checkup

1 Lower indicator arm on measuring instrument.

2 Place measuring instrument on V-belt in center between pulleys. Lateral stop of measuring instrument should rest laterally against V-belt (arrow).



Attention!
On double belt drive, make sure that the measuring instrument rests on one V-belt only.

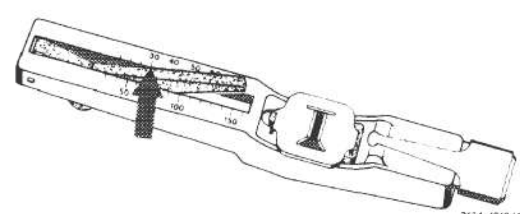
3 Exert a uniform, vertical pressure with pushbutton against V-belt top, until click spring audibly or noticeably disengages.

Note: Following disengagement of click spring, do not continue pushing measuring instrument, since otherwise a wrong measuring value will be indicated.

4 **Carefully** lift measuring instrument from V-belt. Avoid knocks and do not change position of indicator arm.

5 Read adjusting value on point of intersection of indicator arm and upper scale (KG-scale, arrow).

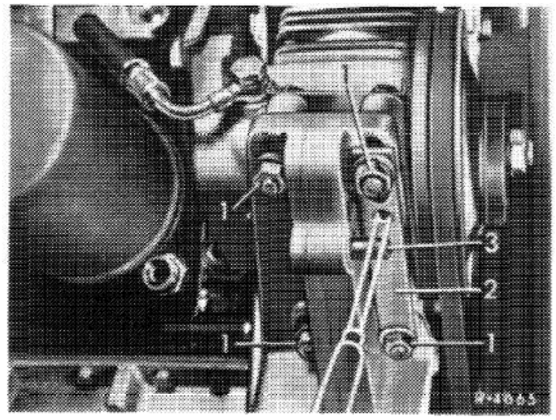
The specified adjusting values refer to KG-scale of measuring instrument.



2134-1218/1

Tensioning

V-belt A Compressor for air suspension
Engine 116.981/991, 117.981

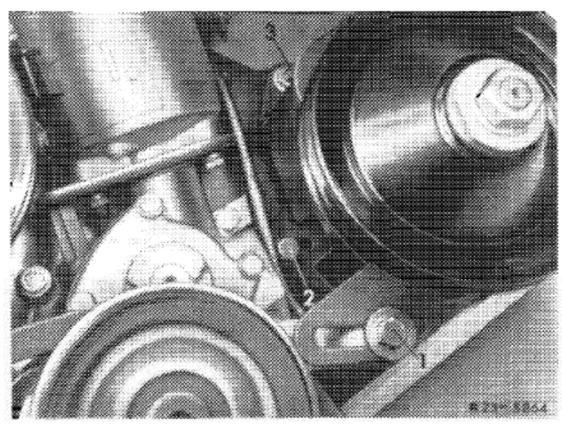


1 Loosen nuts of the four fastening screws (1) and clamp for holding air lines.

2 Place a screw driver or mandrel into hole plate (2); push compressor outwards by using bolt (3) as a support and tension V-belts.

3 Tighten nuts of fastening screws (1) and clamp for air lines.

V-belt B coolant pump -- power steering pump
(with power steering pump VT 27)

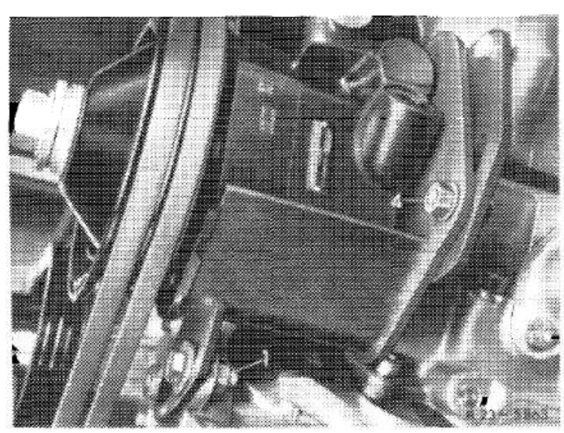


1 Loosen fastening screws (1, 2 and 4).

2 Loosen fastening screw (3) at swivel point only slightly.

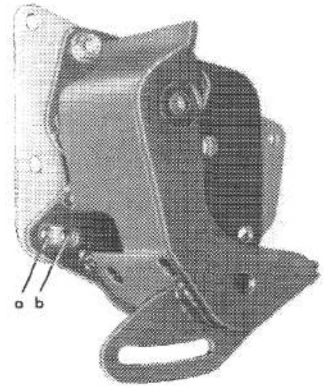
3 Tension V-belt by swivelling power steering pump in outward direction.

4 Tighten fastening screws.



Attention!
If adjustments can no longer be made at fastening screw (1), move fastening screw (2) from threaded bore "a" into threaded bore "b".

When renewing V-belts, set fastening screw (2) back into bore "a".



R 13/7228

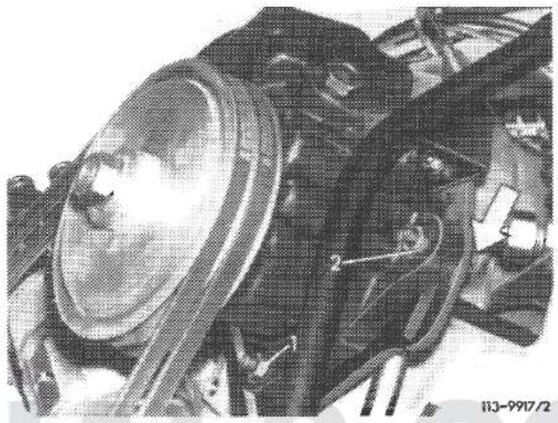
V-belt B coolant pump — power steering pump
(with power steering pump VT 49 or ZF)

1 Loosen fastening screws (1) and (2).

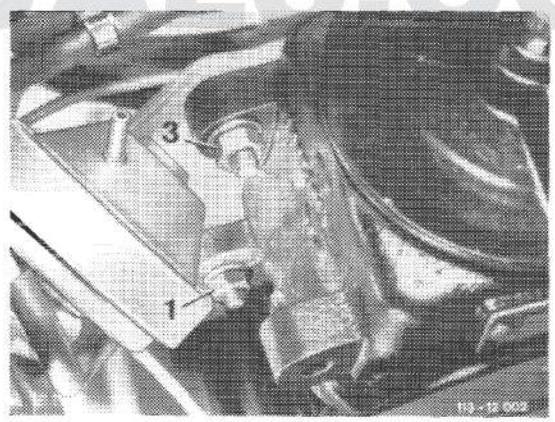
2 Loosen fastening screw (3) at swivel point only slightly.

Tension V-belt with toothed disc (arrow).

3 Tighten fastening screws (1–3).



113-9917/2

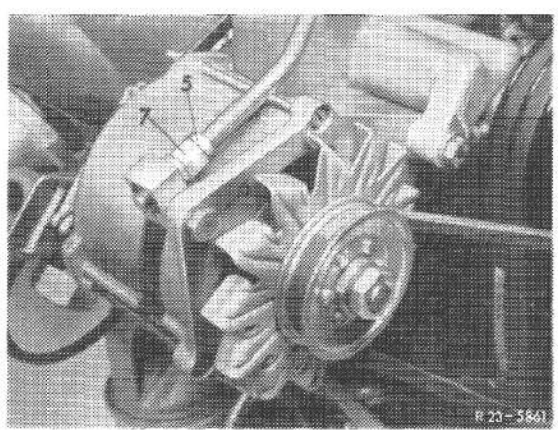


V-belt C Alternator 1st version

1 Loosen counter nut (5) and fastening screws (6 and 8).

2 Tension V-belt with tensioning nut (7).

3 Counter-lock tensioning nut and tighten fastening screws (6 and 8).

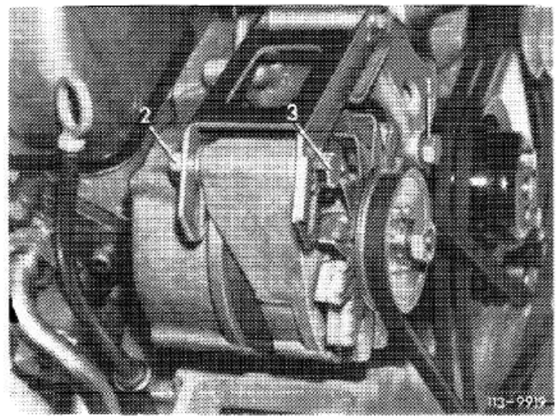


V-belt C Alternator 2nd version

1 Loosen fastening screw (1) and nut (2).

2 Tension V-belt at tensioning screw (3).

3 Tighten nut and fastening screw.



V-belt D Refrigerant compressor

1 Loosen fastening screw (9) of tensioning roller (8).

2 Tension V-belt by swivelling tensioning roller.

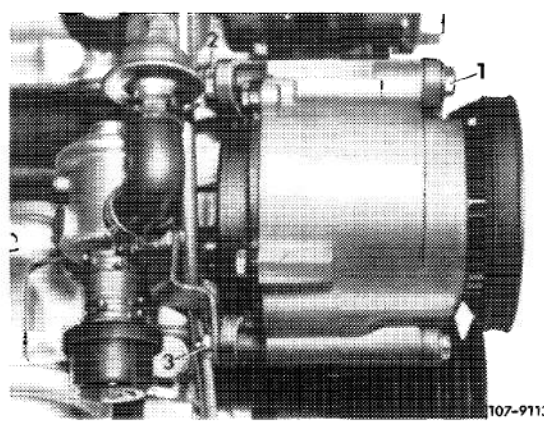
3 Tighten fastening screw.

V-belt E Air pump model year 1974

1 Loosen fastening screw (1) and (2) as well as nut of fastening screw (3) at swivel point.

2 Push air pump outwards until V-belt is tight.

3 Tighten fastening screws.

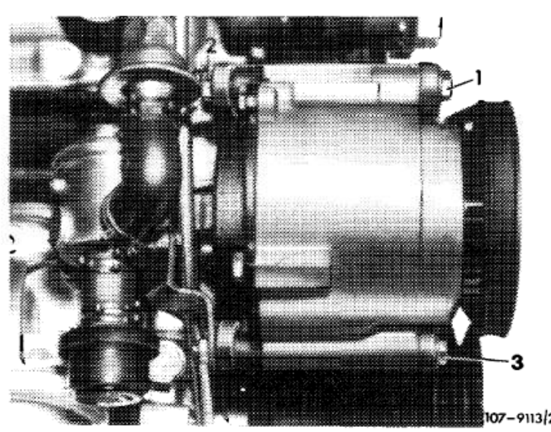


V-belt E Air pump starting model year 1975

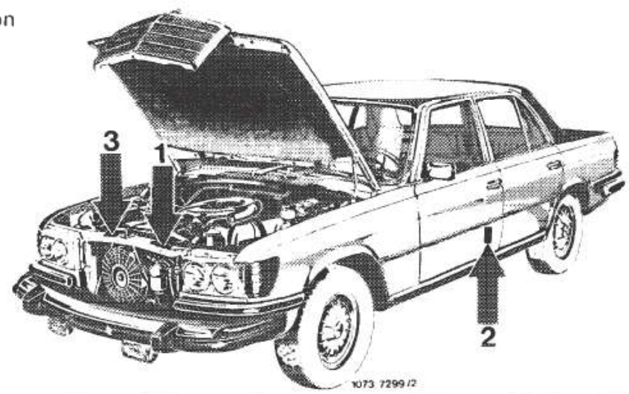
1 Loosen fastening screws (1, 2 and 3).

2 Push air pump outwards until V-belt is tight.

3 Tighten fastening screws.



The various emission control systems of USA version vehicles are identified by respective information plates (arrows 1, 2 and 3).



1. Information plate on cross member in front of radiator

This plate shows the identification data as well as all the important engine adjustment data.

Recognizing emission control system from color of information plate – basic color/lettering

Model year	Federal version	California version	Federal version high altitudes	Federal version tourist vehicles	California version tourist vehicles
1971			–	–	–
1972		black/silver	–	–	–
1973			–	–	–
1974	black/silver		–	–	–
1975		green/silver	–		
1976			–	yellow/silver	yellow/silver
1977			red/black		
1978		yellow/black	–		yellow/black
1979	black/white		–	black/white	
1980		black/white	–		black/white

The information plate shows:

1. MODEL YEAR

2. IDLE . . . RPM

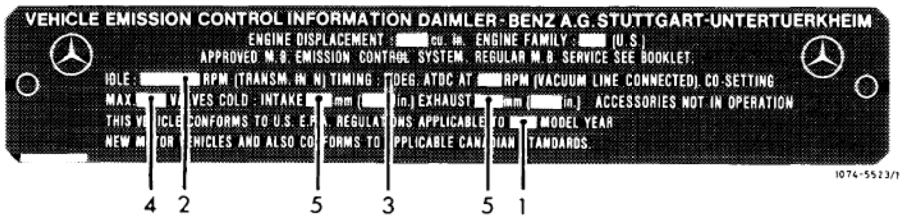
3. TIMING . . . DEG. AT . . . RPM

4. Emission value at idle without air injection max . . .

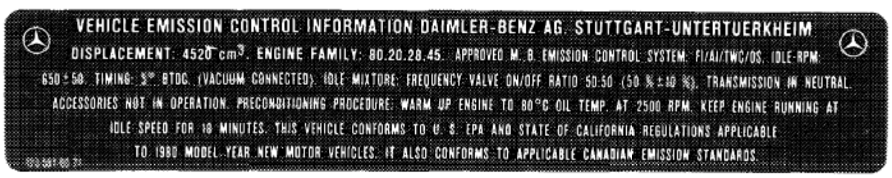
   CO–SETTING MAX. . . . AIR INJECTION DISCONNECTED

5. Valve clearance: INTAKE (. . . in)
   EXHAUST (. . . in)

Information plate up to model year 1979



Information plate model year 1980



1144-9543

Identification data are encoded in an 8-digit code no.

Example: Engine family 80. 20. 28. 45

80 20 2 8 45

Model year — 80

National code no. — 20

20 = Federal and California
21 = Federal
22 = California

Combustion system — 2

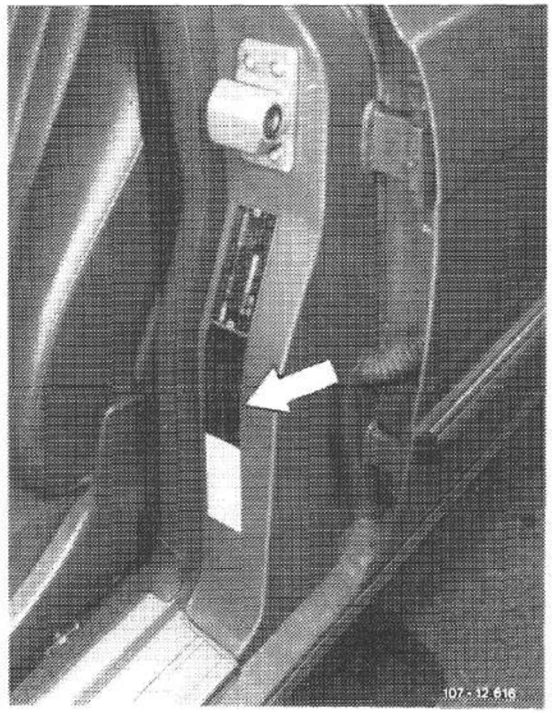
1 = Carburetor
2 = Injection, gasoline
3 = Diesel
4 = Diesel, turbo

Number of cylinders — 8

Displacement
approx. 4500 cc — 45

2. Information plate on door pillar of driver's door

This plate shows whether vehicle is provided with catalysts or not.



Recognizing catalysts from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1976</td><td rowspan="4">black/silver</td><td>black/silver</td><td>–</td><td rowspan="4">red/silver</td><td>red/silver</td></tr>
<tr><td>1977</td><td>green/silver</td><td>black/silver</td><td>blue/silver</td></tr>
<tr><td>1978</td><td rowspan="2">black/silver</td><td>–</td><td rowspan="2">red/silver</td></tr>
<tr><td>1979</td><td>–</td></tr>
</table>

Information plates

This vehicle is provided with catalysts.

1074 – 8259

Tourist vehicles

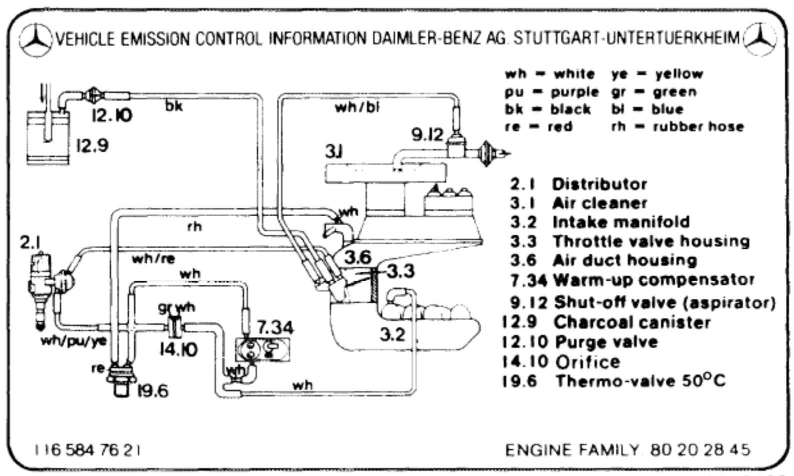
This vehicle is not provided with catalysts by manufacturer.

Catalysts must be installed prior to import into USA.

1074 – 8260

3. Information plate for vacuum line installation located on cross member in front of radiator (California only)

This plate shows the vacuum line layout for all emission system components in engine compartment.



1144–9406

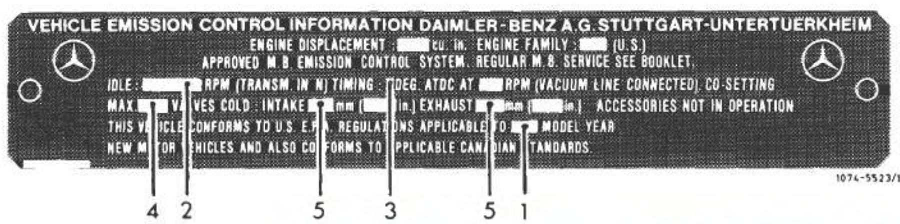
14–050 Operation

Model year 1972/73 (engine 117)

A. General

Information plate

Vehicles are identified by information plate basic color black.



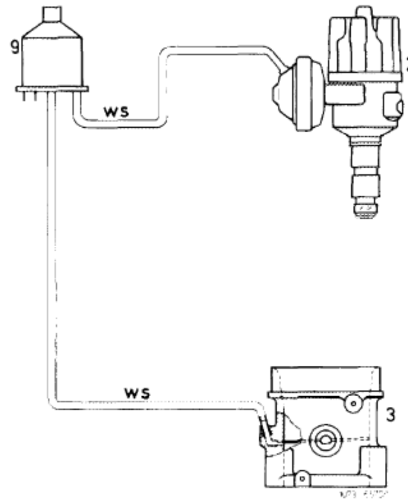
1 Model year
2 Idle . . . rpm
3 Timing at . . . rpm
4 Emission value at idle
5 Valve clearance

B. Ignition timing

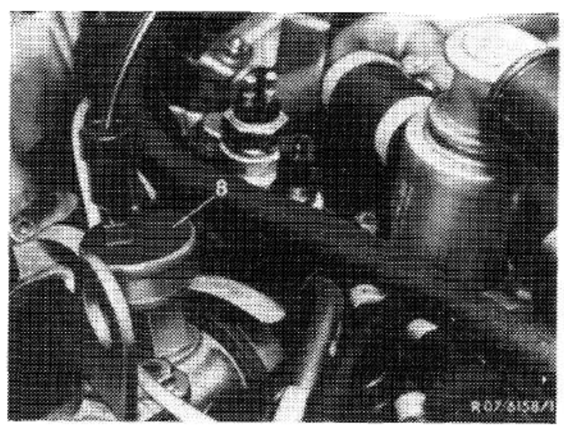
The ignition timing influences the running characteristics of the engine.

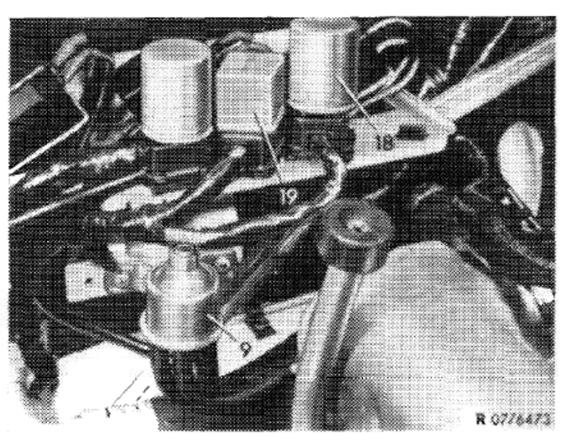
Ignition timing in direction of "retard" results in a higher engine temperature, longer periods of dwell and thereby in a reduction of CH and CO values.

Function diagram



2 Ignition distributor
3 Throttle valve housing
9 Switchover valve





Vacuum adjustment in direction of "retard" becomes effective at the following operating conditions:

- Below 100 °C coolant temperature.
- Engine at idle.
- Engine decelerating (coasting) (throttle valve at idle speed stop).
- Air conditioning system switched off.

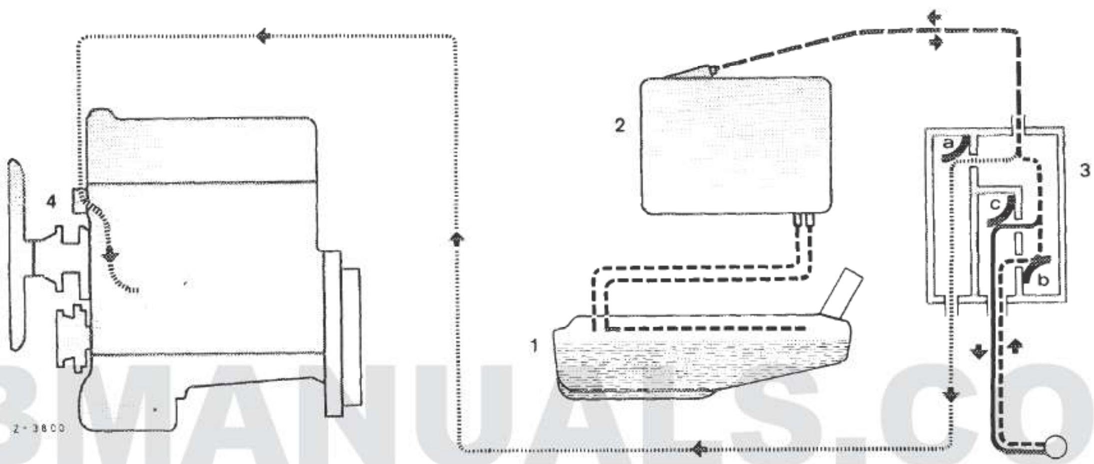
Switching vacuum adjustment on or off in direction of "retard" is effected by means of switchover valve (9), which is contacted by the temperature switch 100 °C (8) via relay (19).

Below 100 °C coolant temperature, the temperature switch 100 °C (8) is opened, the switchover valve (9) is de-energized. Vacuum flows from throttle valve housing (3) via switchover valve (9) to diaphragm of vacuum unit of ignition distributor.

C. Fuel evaporation control system

A fuel evaporation control system has been installed to improve emission characteristics which have nothing to do with engine combustion.

Function diagram model year 1972

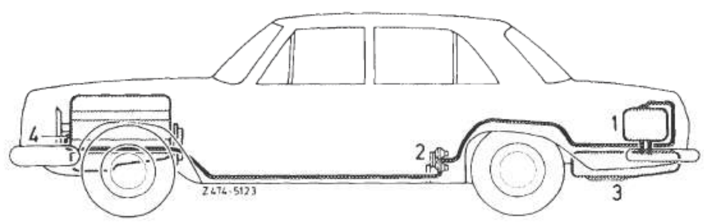


- - - - Positive ventilation to expansion tank
— — — Positive and negative venting line
········· Negative ventilation to engine
——— Negative ventilation to atmosphere

1 Fuel tank
2 Expansion tank
3 Valve system
4 Connection on crankcase
a Negative vent valve
b Positive vent valve
c Pressure relief valve

Function diagram model year 1973

1 Expansion tank
2 Valve system
3 Fuel tank
4 Connection on crankcase

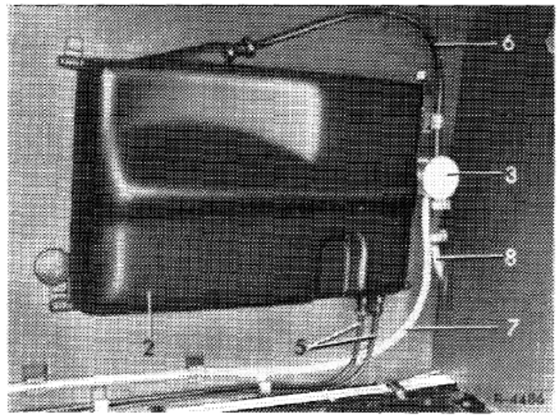


Components of fuel evaporation system:

Valve system model year 1972

The valve system (3) is mounted in trunk adjacent to expansion tank.
The valve system comprise three valves:

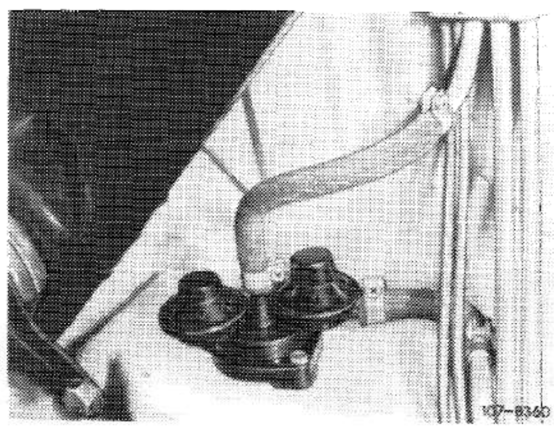
a) Negative vent valve
b) Positive vent valve
c) Pressure relief valve



Valve system model year 1973

The valve system if mounted under vehicle at level of rear legroom. The system comprises three valves:

1. Negative vent valve
2. Pressure relief valve
3. Positive vent valve

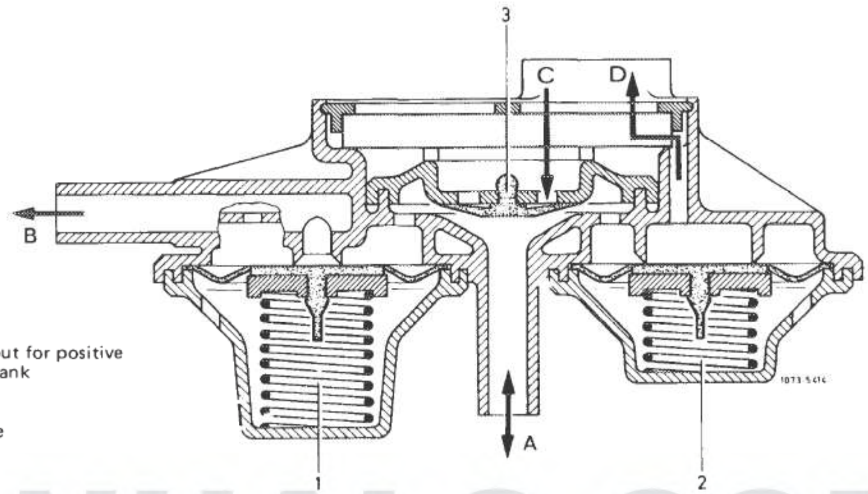


Function and operation of both valve systems are identical.

The negative vent valve opens at a slight overpressure. The evaporation vapors will flow through a line which is connected to cylinder crankcase into cylinder crankcase.

The pressure relief valve is a safety valve and opens in the event of an overpressure in fuel evaporation system. The fuel vapors are vented directly into the open air.

The positive vent valve opens in the event of a vacuum caused when the fuel tank is cooling down.



1 Negative vent valve
2 Pressure relief valve
3 Positive vent valve
A Input to valve system/output for positive venting of fuel expansion tank
B To crankcase
C Fresh air input
D Output pressure relief valve

Draw-off connection on crankcase

The negative vent line which leads to engine is attached to draw-off connection by means of a hollow screw.

Operation

The fuel evaporation vapors from compensating tank are routed via valve system into crankcase and stored. When the engine is running, they are drawn off into the combustion chambers by means of the crankcase venting system.

14–100 Test program

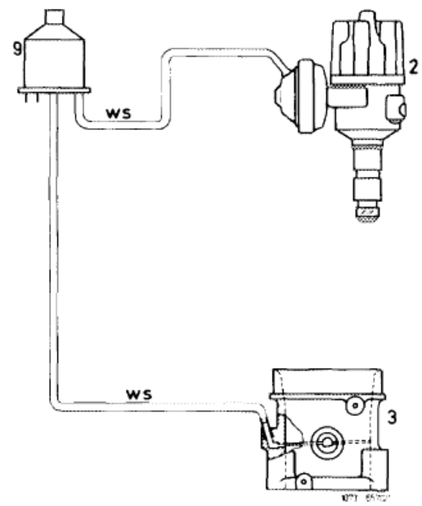
Model year 1972/73 (engine 117)

For complaints such as: Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.

Test conditions: Engine at operating temperature, run engine at idle speed.

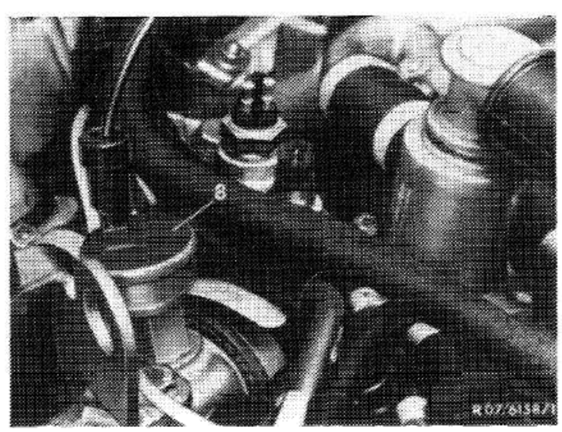
Test the following: Ignition switchover.

Function diagram



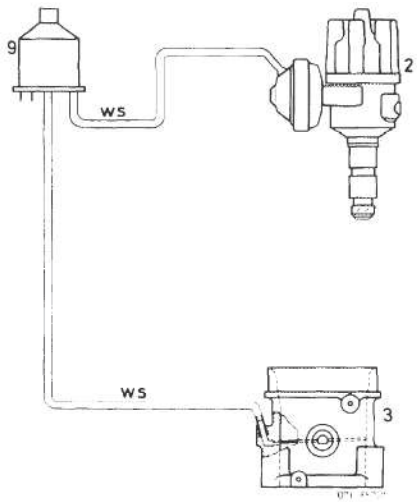
2 Ignition distributor
3 Throttle valve housing
9 Switchover valve

Testing ignition switchover Pull plug from temperature switch 100 °C (8) and connect to ground.	
Engine speed increasing.	Engine speed not increasing.



Testing vacuum lines

The vacuum line from throttle housing (3) leads to center connection of switchover valve (9), that of vacuum control unit of ignition distributor (2) to outer connection of switchover valve (9).



Checking vacuum

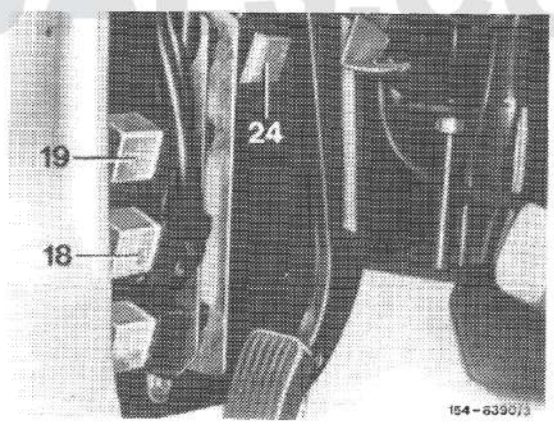
Pull vacuum line from center connection of switchover valve (9) and keep closed with finger. If vacuum is evident, plug vacuum line in again. If no vacuum is evident, blow out vacuum draw-off connection on throttle valve housing with compressed air.

Testing relay (19) for switchover valve

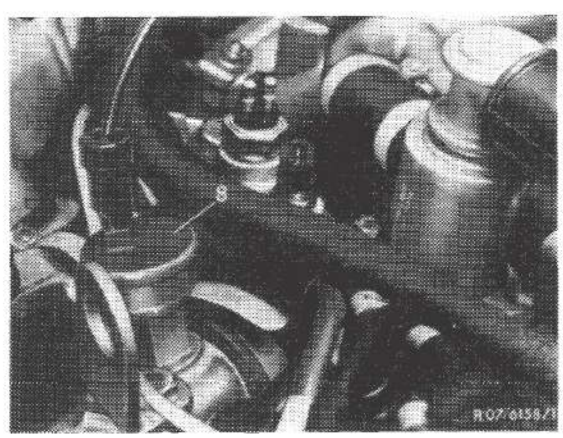
Connect test lamp to connecting plug of switchover valve (9) and plug of temperature switch (8) to ground. Relay (19) is in order if test lamp lights up.

Replace switchover valve (9).

If test lamp is not lighting up, replace relay (19).



End of test.



Model year 1972/73

Model 107.024/044

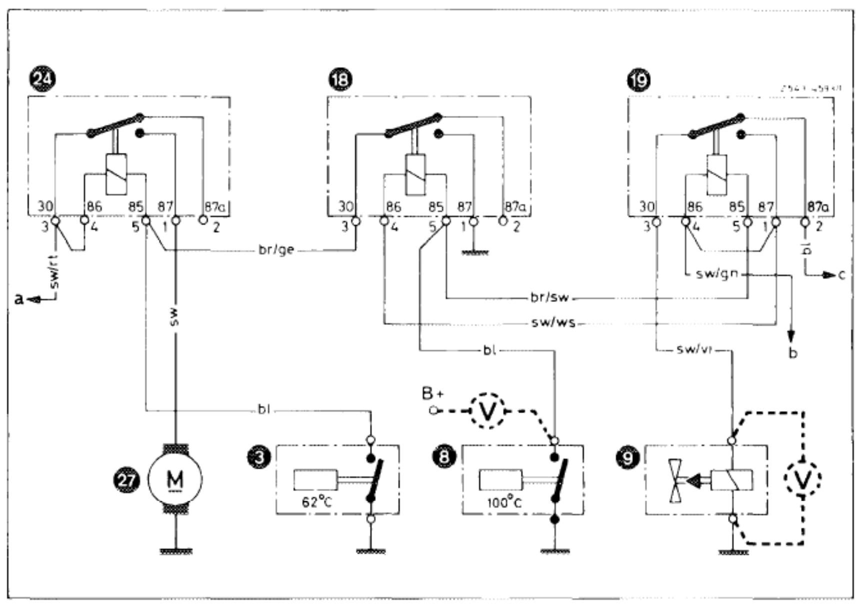
Drawn with ignition switched off.

Connection of test instruments is drawn in dashed lines.

Color code

bl = blue	gn = green	sw = black
br = brown	rs = pink	vi = purple
ge = yellow	rt = red	ws = white

Circuit diagram and test

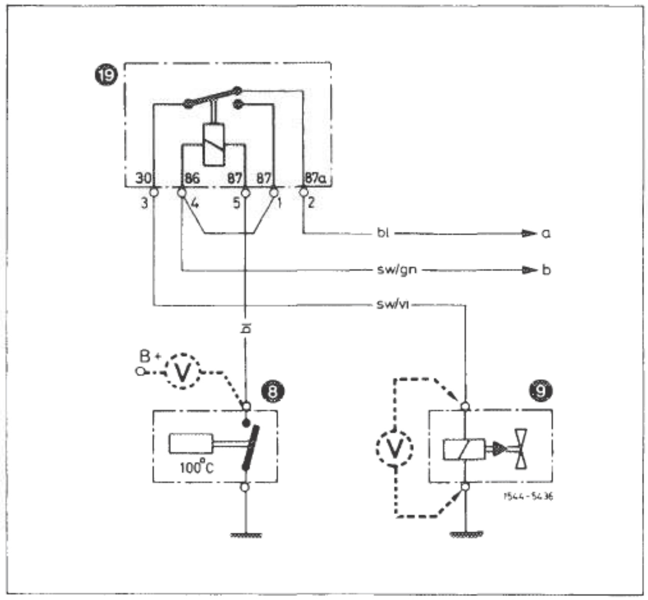


3 Temperature switch 62 °C
8 Temperature switch 100 °C
9 Switchover valve
18 Relay air conditioning system
19 Relay switchover valve
24 Relay supplementary fan

a Fuse no. 9 (15/54)
b Fuse no. 8 (15/54)
c Switch air conditioning system

Model 107.024/044

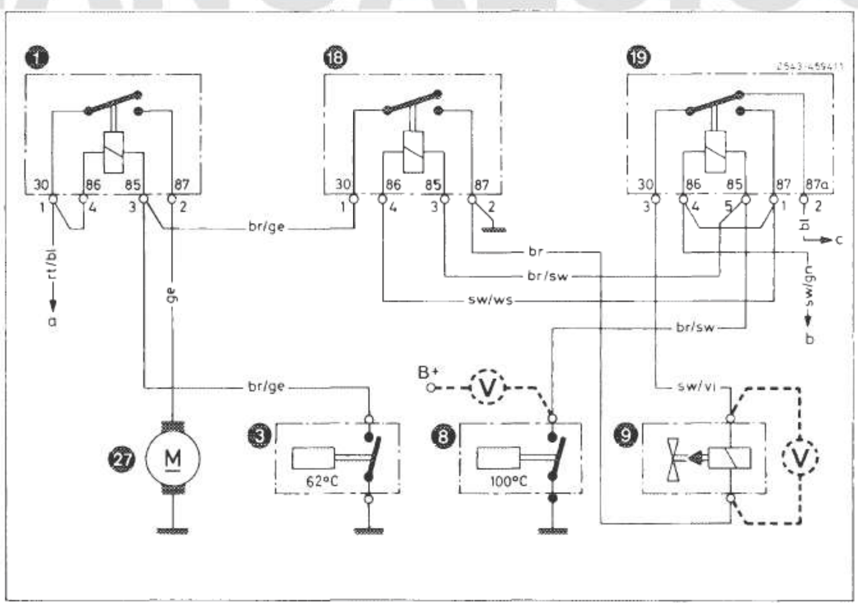
Ignition switchover



8 Temperature switch 100 °C
9 Switchover valve ignition
19 Relay switchover valve
a Switch air conditioning system
b Fuse no. 12 (15/54)

Model 108.067/068, 109.057

Circuit diagram and test



1 Relay supplementary fan
3 Temperature switch 62 °C
8 Temperature switch 100 °C
9 Switchover valve
18 Relay air conditioning system
19 Relay switchover valve
27 Supplementary fan

a Supplementary fuse box fan (15/54)
b Fuse no. 6 (15/54)
c Switch air conditioning system

Model 116.032/033

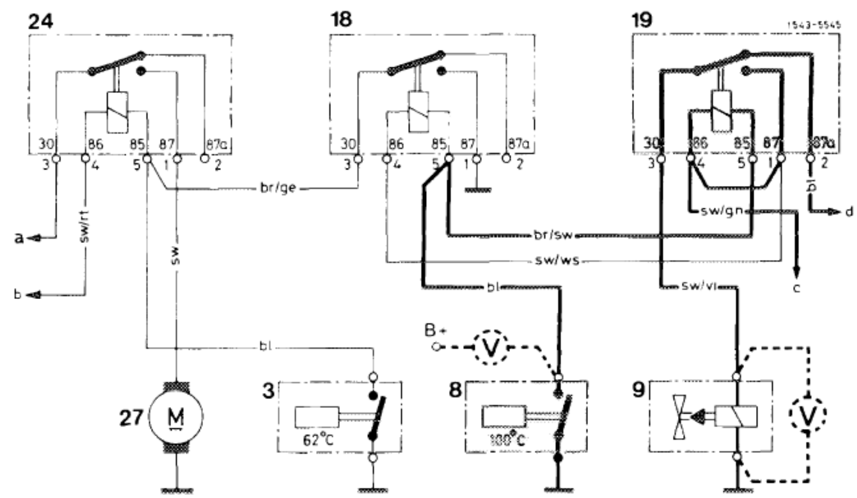
Drawn with ignition switched off.

Connection of test instruments is drawn in dashed lines.

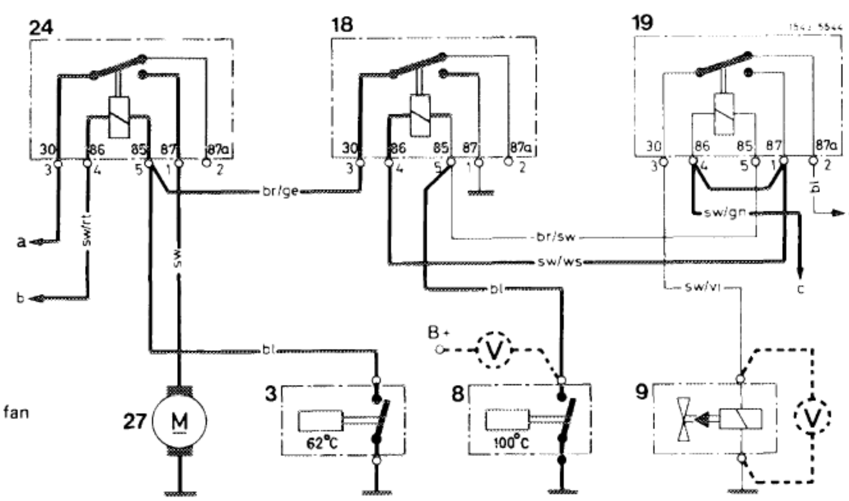
Color code

bl = blue	gn = green	sw = black	a Fuse no. 2 (15/54)
br = brown	rs = pink	vi = purple	b Fuse no. 4 (15/54)
ge = yellow	rt = red	ws = white	c Fuse no. 4 (15/54)
			d Switch air conditioning system

Ignition switchover



Supplementary fan



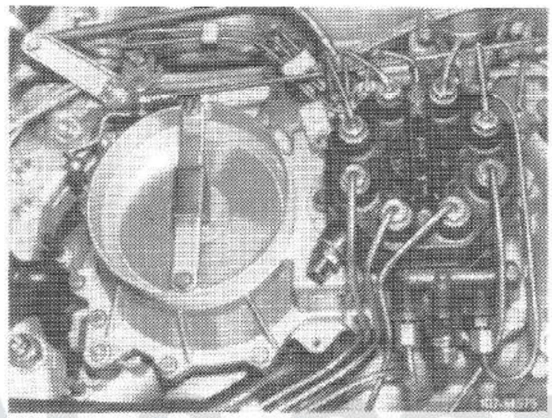
3 Temperature switch 62 °C
8 Temperature switch 100 °C
9 Switchover valve ignition
18 Cut-off relay supplementary fan of ignition switchover
19 Relay switchover valve
24 Relay supplementary fan
27 Supplementary fan

09–450 Removal and installation of intake manifold upper and lower half, renewing gaskets

Note

During removal and installation of intake manifold the mixture regulator with air guide housing need not be removed.

Removal



1 Disconnect battery.

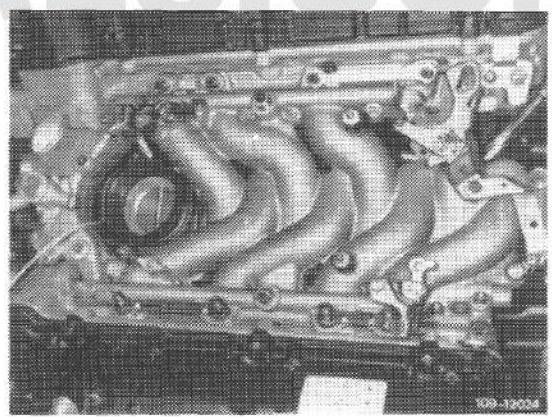
2 Partially drain coolant.

3 Unscrew injection lines and fuel lines. Catch fuel with a cloth.

Deactivate fuel lines.

4 Pull off supplementary air lines.

5 Remove control pressure rod for automatic transmission.



6 Unscrew bearing bracket for gate regulation.

7 Unscrew bearing bracket for longitudinal regulating shaft.

8 Pull off all connecting cables and plug connections.

9 Unscrew vacuum line for automatic transmission and for brake unit.

10 Unscrew idle speed air distributor.

11 Loosen coolant hoses and pull off.

12 Unscrew all fastening screws and remove intake pipe toward the rear.

13 Clean intake manifold and check flange surfaces with straightedge or touch up on surface plate.

Installation

14 Mount intake manifold with new gaskets in vice versa sequence.

Use only graphited intake manifold gaskets.
Do not install non-graphited intake manifold gaskets similar to engine 117.96 (5.0).

15 Adjust regulating linkage (30–300).

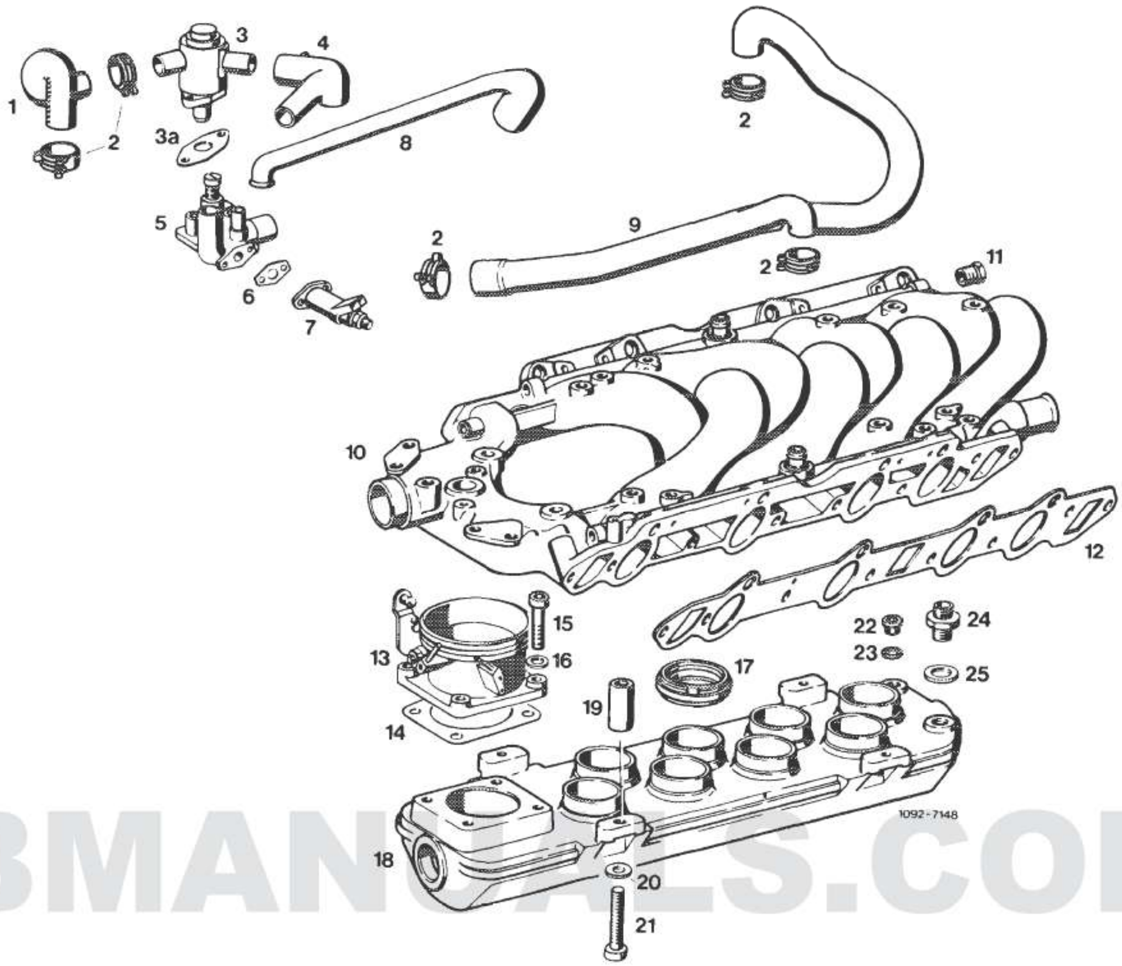
16 Connect battery.

17 Add coolant.

18 Keep engine running, check fuel lines for leaks. Check intake system, fuel distributor and injection valves by spraying with Iso-Oktan or benzine for leaks.

19 Adjust idle speed (07.3–100).

Intake manifold



1 Contoured hose
2 Coiled hose clips
3 Supplementary air valve
3a Gasket
4 Contoured hose
5 Idle speed air distributor
6 Gasket
7 Cold-starting valve
8 Contoured hose
9 Supplementary air line
10 Intake manifold upper half
11 Closing plug
12 Gasket
13 Throttle valve housing
14 Gasket
15 Hex. socket screw
16 Washer
17 Rubber connection
18 Intake manifold lower half
19 Spacing sleeve
20 Washer
21 Hex. socket screw
22 Closing plug
23 Sealing ring
24 Double thread connection
25 Sealing ring

14–455 Renewing intake manifold (intake manifold removed)

1 Remove and install intake manifold (14–450).

2 Remove and install injection valves and insulating sleeves (07.3–215).

3 Remove and install mixture regulator with air guide housing (07.3–225).

4 Unscrew all unscrewable parts on removed intake manifold and mount on new intake manifold with new gaskets.

5 Unscrew intake manifold upper half from intake manifold lower half. For this purpose, loosen vacuum line for brake unit on intake manifold lower half, then unscrew fastening screws and pull from rubber adaptors.

6 Mount intake manifold lower half with new rubber adaptors to intake manifold upper half.

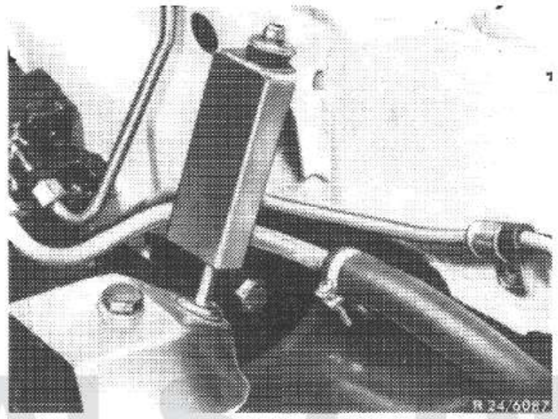
Attention!
The intake manifold lower half has a different shape as that of engine 117.960 (5.0) and can therefore not be installed in this engine.

49–470 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm
Bolt for engine mount	75

Removal



1 Remove exhaust system (49–100).

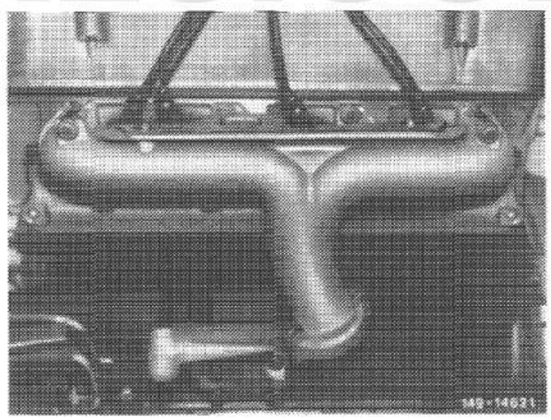
Note: Survey exhaust manifold (14–472).

2 Pull off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with fastener and shielding plates. For this purpose, unscrew bolt for engine mount.

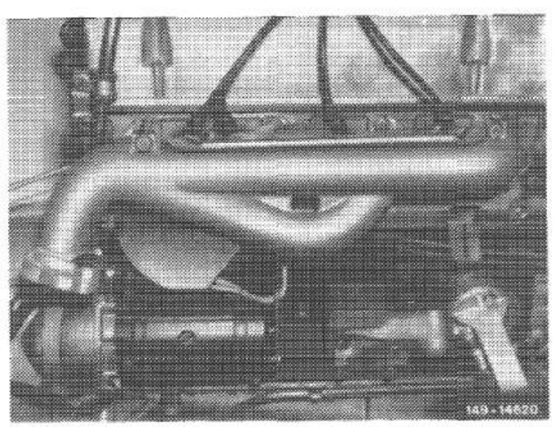
Exhaust manifold left



5 Remove air cleaner.

6 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right



7 Remove windshield washer tank.

8 Unscrew coolant supply tank. Unscrew fastening clamp for coolant hose, loosen cable band for electric line and put supply tank aside.

9 Remove battery, battery holder and shielding plate.

10 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Installation

11 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

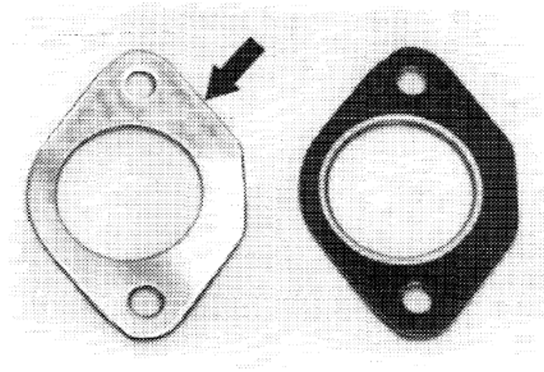
12 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

13 Tighten bolts for engine mount to 75 Nm.

14 Mount exhaust system.

15 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

16 Keep engine running and check exhaust system lor leaks.



107-12067

B. Model 116

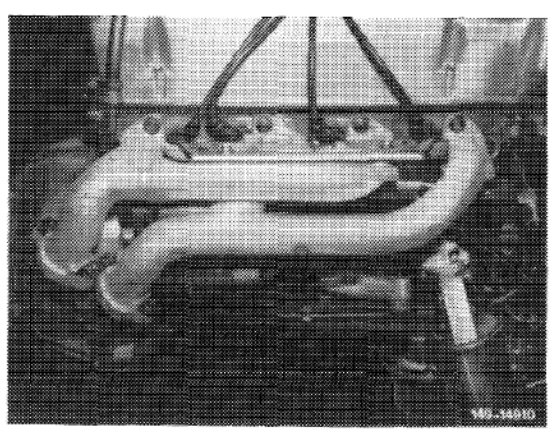
Note

Starting with the following chassis end no. a two-fluted **righthand** exhaust manifold is installed.

Start of production: December 1977

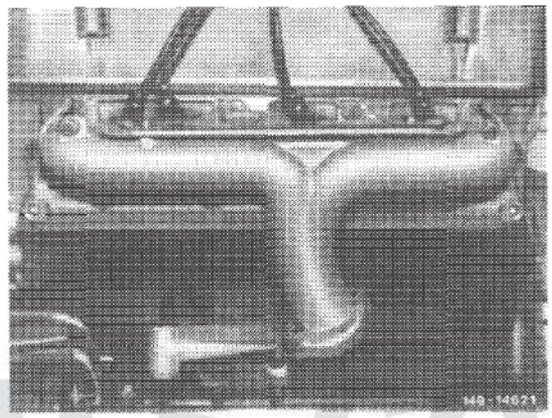
Model	starting chassis end no.
116.028/029	044654
116.032/033	076606

On previously manufactured vehicles the former exhaust manifold remains installed.

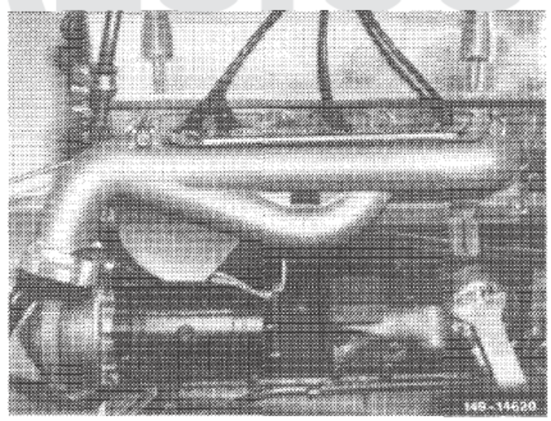


A. Standard version

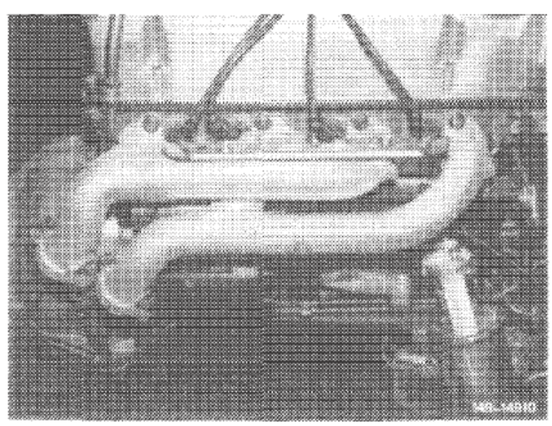
Lefthand steering



Exhaust manifold left

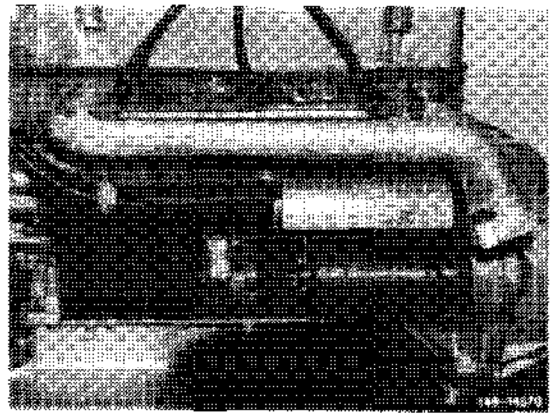


Exhaust manifold right

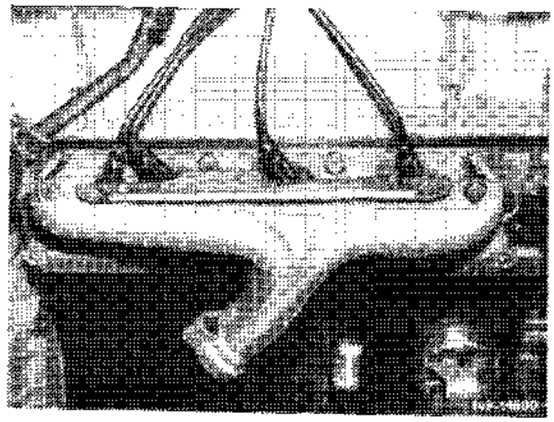


Exhaust manifold right
two-fluted model 116

Righthand steering



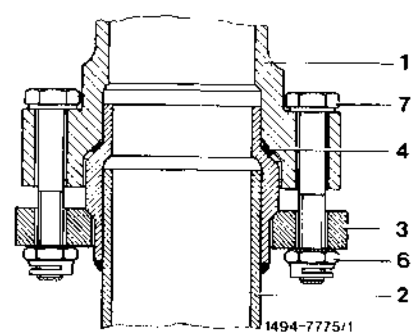
Exhaust manifold left



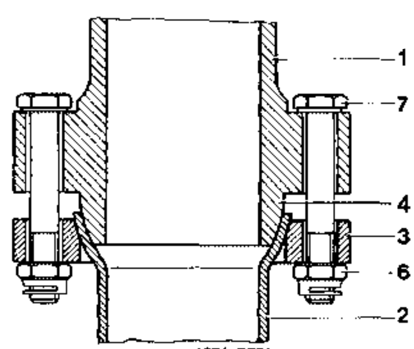
Exhaust manifold right

Repair versions

Starting approx. November 1977, the exhaust manifolds are provided with an external ball connection (up to now trapezoid connection). As a result, when installing exhaust manifolds with external ball connection, replace front exhaust pipe with trapezoid connection against an exhaust pipe with external ball connection.



Trapezoid connection
(past version)



External ball connection

Removal

1 Remove exhaust system (49–100).

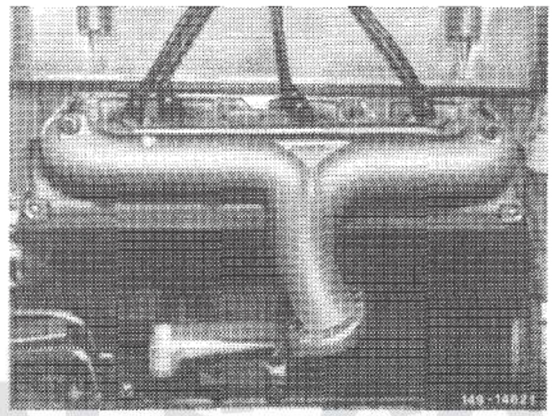
2 Pull off ignition cable.

3 Unscrew shielding plate on exhaust manifold.

Exhaust manifold left

4 Remove air cleaner.

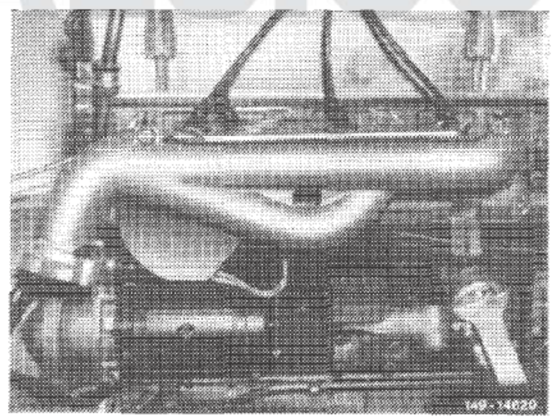
5 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Exhaust manifold right

6 Remove battery and battery holder.

7 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Installation

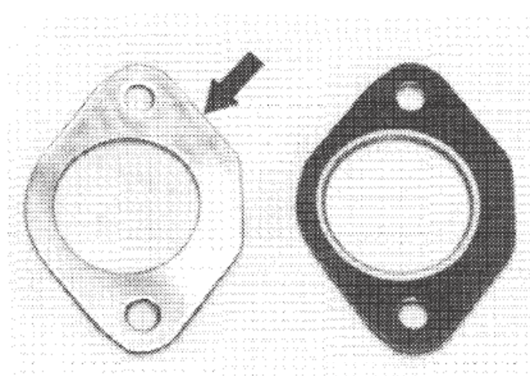
8 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

9 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

10 Mount exhaust system.

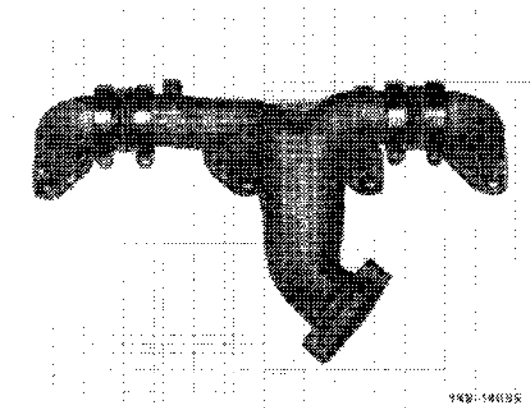
11 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

12 Keep engine running and check exhaust system for leaks.

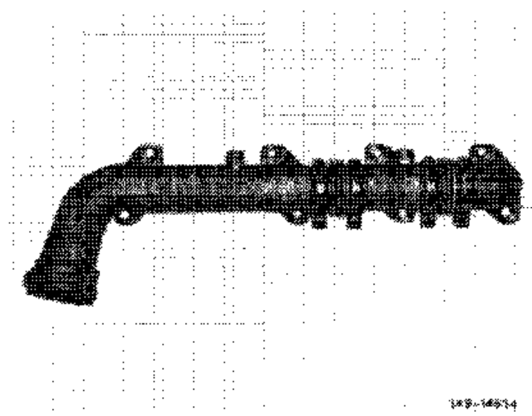


107-12067

Lefthand steering



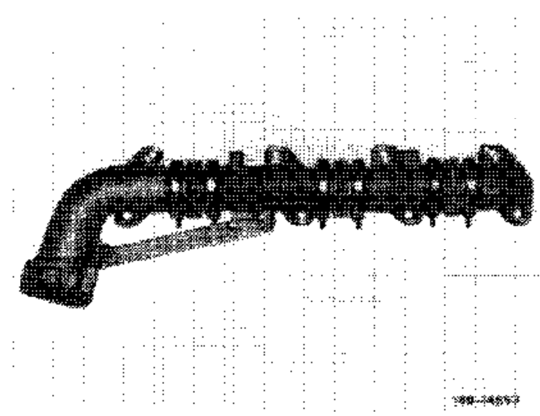
Exhaust manifold left



Exhaust manifold right

In the event of damage on exhaust manifolds with 2 bellows as a result of extremely sharp driving, the exhaust manifold can be subsequently provided with 3 bellows at righthand engine side on model 116.

This exhaust manifold has a trapezoid connection. Consequently, on vehicles manufactered after approx. November 1977, the front exhaust pipe with external ball connection must be replaced by an exhaust pipe with trapezoid connection.



Exhaust manifold right
model 116

Righthand steering

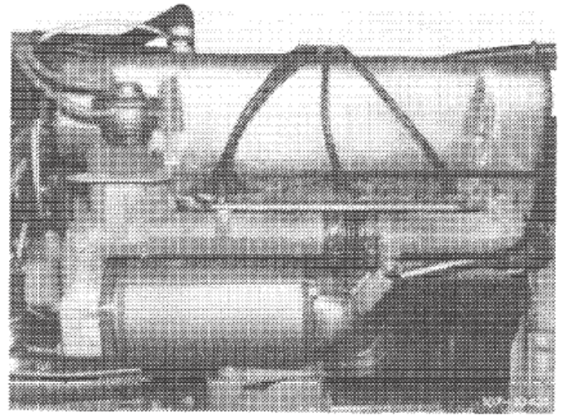
On righthand steering vehicles the exhaust manifolds must be replaced like for like.

B. National version (AUS) (J) (S) (USA)

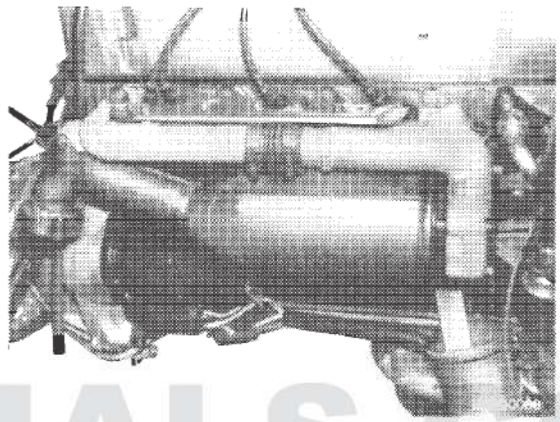
(J) (S) (USA) **Model year 1976**

Exhaust manifold with internal ball

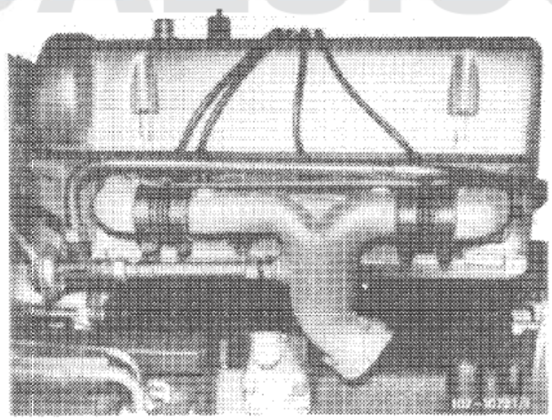
(J) (USA)
Exhaust manifold left



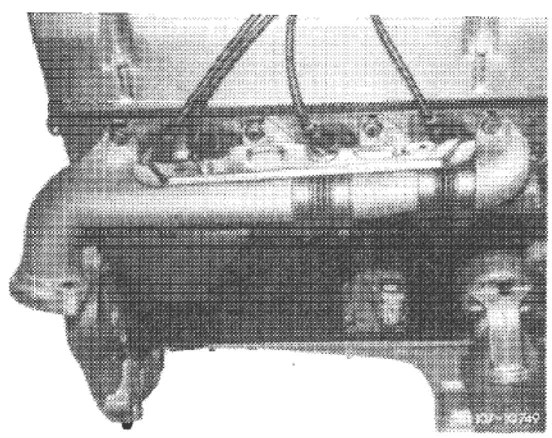
Exhaust manifold right



(S)
Exhaust manifold left



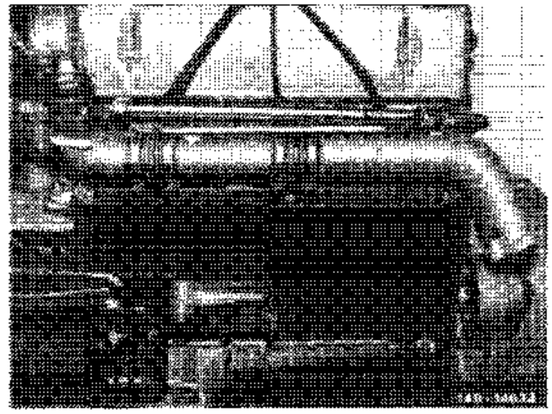
Exhaust manifold right



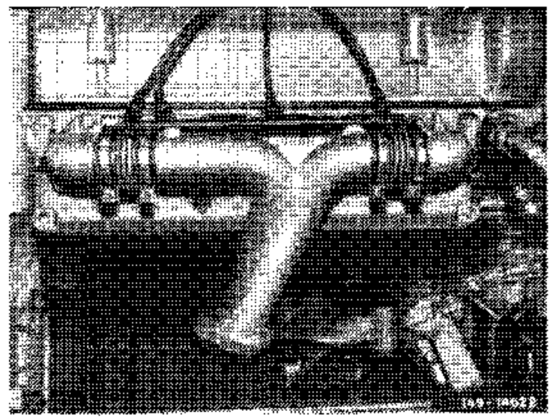
AUS J S model year 1977–1980
USA model year 1977–1979

1977 exhaust manifold with internal ball,
starting 1978 exhaust manifold with external ball

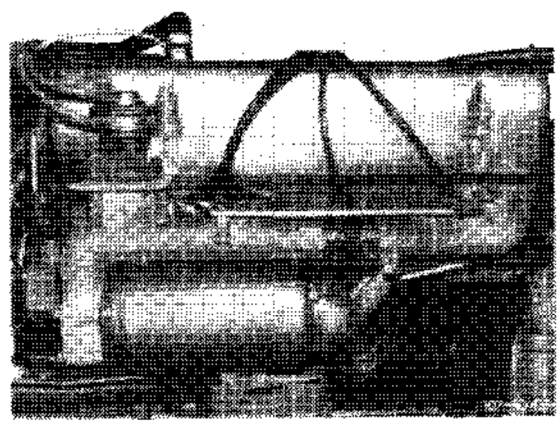
Note: If on vehicles model year 1977 an exhaust manifold with external ball connection is installed, the front exhaust pipe must be replaced.



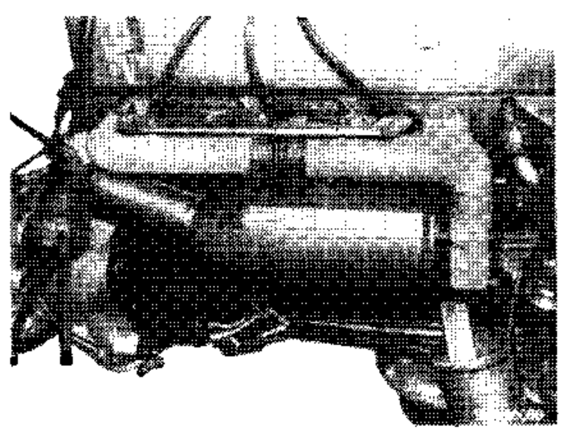
AUS
Exhaust manifold left



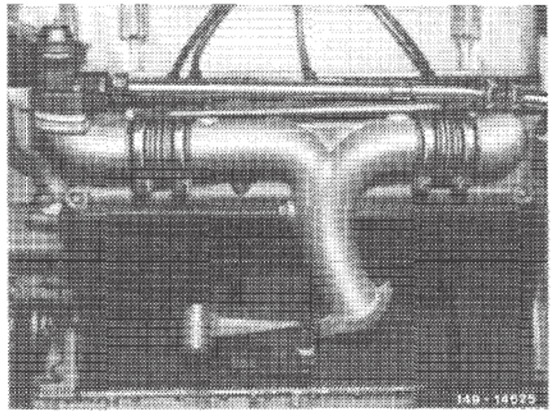
Exhaust manifold right



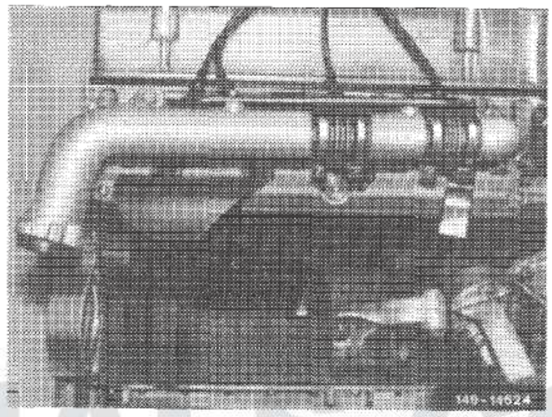
J
Exhaust manifold left



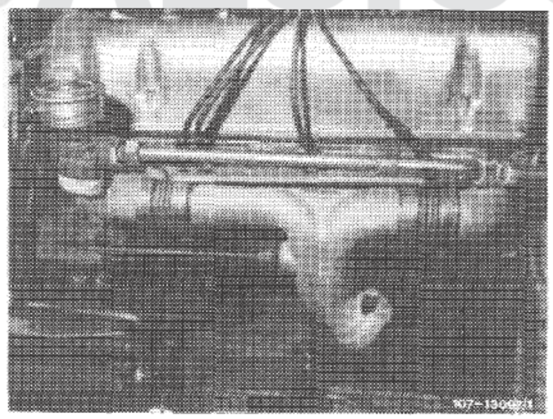
Exhaust manifold right



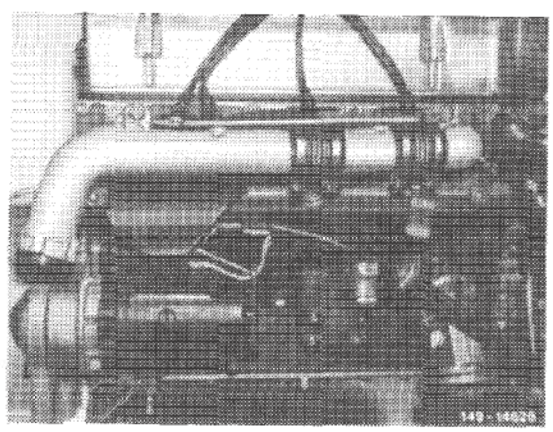
S
Exhaust manifold left



Exhaust manifold right



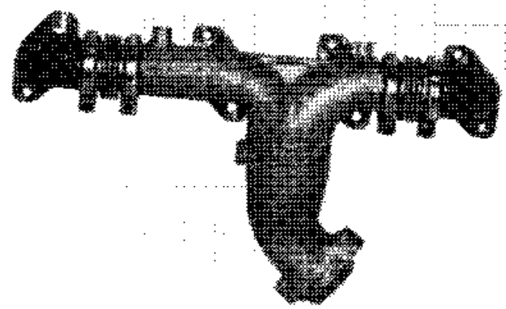
USA
Exhaust manifold left



Exhaust manifold right

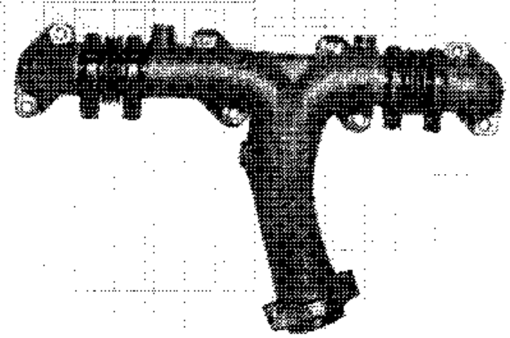
(USA) model year 1980

Without EGR



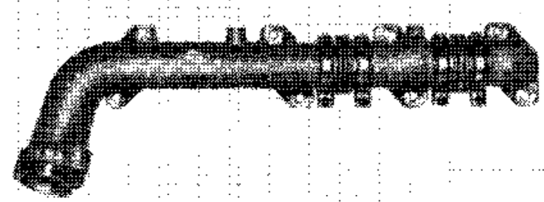
Exhaust manifold left
Model 107

114 – 18851



Exhaust manifold left
Model 116

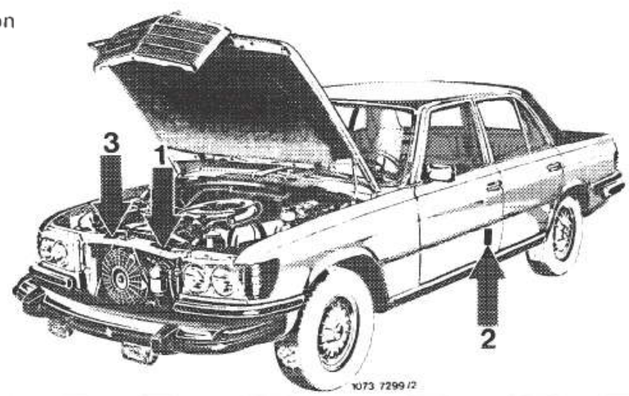
114 – 18852



Exhaust manifold right
Model 107 and 116

114 – 18854

The various emission control systems of USA version vehicles are identified by respective information plates (arrows 1, 2 and 3).



1. Information plate on cross member in front of radiator

This plate shows the identification data as well as all the important engine adjustment data.

Recognizing emission control system from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1971</td><td rowspan="6">black/silver</td><td rowspan="3">black/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1972</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1973</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1974</td><td rowspan="3">green/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1975</td><td>–</td><td rowspan="2">yellow/silver</td><td rowspan="2">yellow/silver</td></tr>
<tr><td>1976</td><td>–</td></tr>
<tr><td>1977</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td><td>red/black</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td></tr>
<tr><td>1978</td><td>–</td></tr>
<tr><td>1979</td><td>–</td></tr>
<tr><td>1980</td><td>black/white</td><td>–</td><td>black/white</td></tr>
</table>

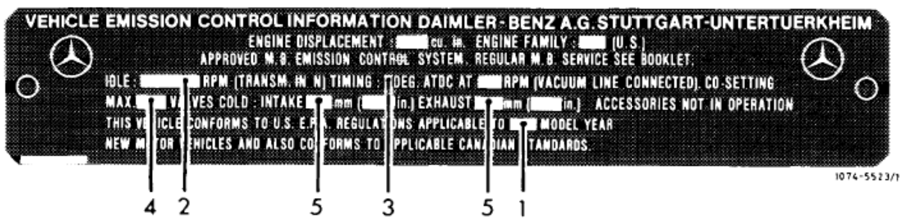
The information plate shows:

1. MODEL YEAR
2. IDLE . . . RPM
3. TIMING . . . DEG. AT . . . RPM
4. Emission value at idle without air injection max . . .

   CO–SETTING MAX. . . . AIR INJECTION DISCONNECTED

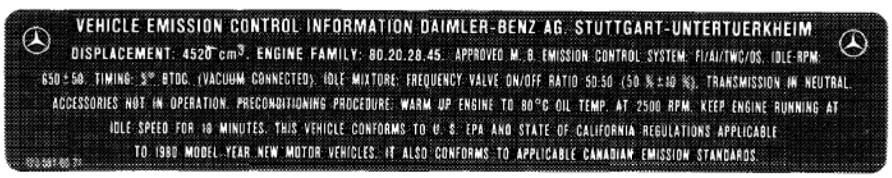
5. Valve clearance: INTAKE (. . . in)
   EXHAUST (. . . in)

Information plate up to model year 1979



1074-5523/1

Information plate model year 1980



1144-9543

Identification data are encoded in an 8-digit code no.

Example: Engine family 80. 20. 28. 45

80 20 2 8 45

Model year

National code no.

20 = Federal and California
21 = Federal
22 = California

Combustion system

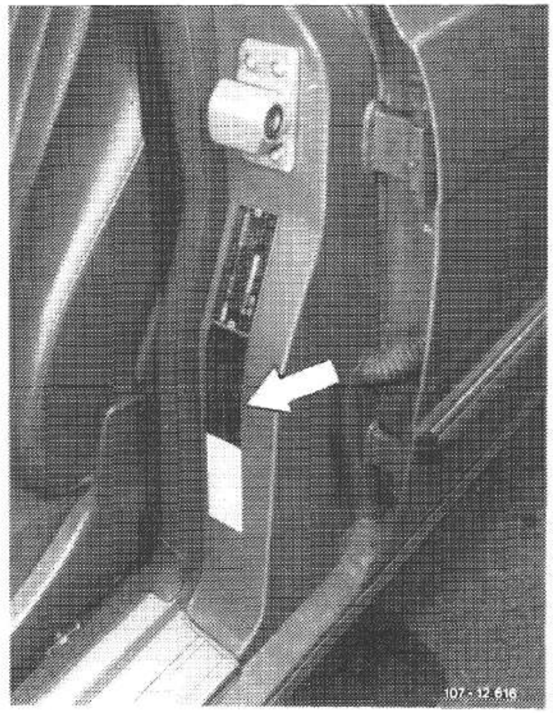
1 = Carburetor
2 = Injection, gasoline
3 = Diesel
4 = Diesel, turbo

Number of cylinders

Displacement
approx. 4500 cc

2. Information plate on door pillar of driver's door

This plate shows whether vehicle is provided with catalysts or not.



Recognizing catalysts from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1976</td><td rowspan="4">black/silver</td><td>black/silver</td><td>–</td><td rowspan="4">red/silver</td><td>red/silver</td></tr>
<tr><td>1977</td><td>green/silver</td><td>black/silver</td><td>blue/silver</td></tr>
<tr><td>1978</td><td rowspan="2">black/silver</td><td>–</td><td rowspan="2">red/silver</td></tr>
<tr><td>1979</td><td>–</td></tr>
</table>

Information plates

This vehicle is provided with catalysts.

1074 – 8259

Tourist vehicles

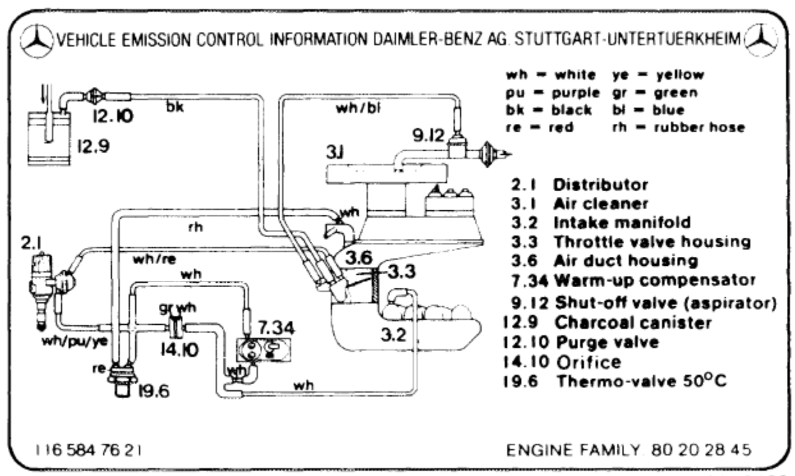
This vehicle is not provided with catalysts by manufacturer.

Catalysts must be installed prior to import into USA.

1074 – 8260

3. Information plate for vacuum line installation located on cross member in front of radiator (California only)

This plate shows the vacuum line layout for all emission system components in engine compartment.



1144–9406

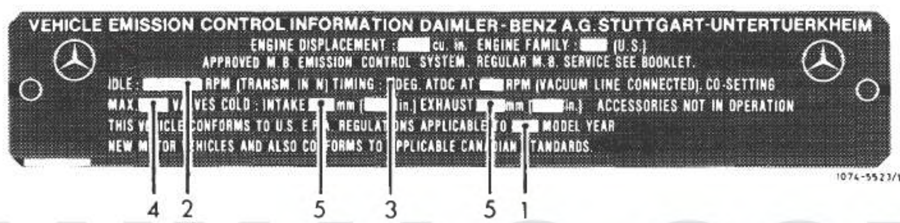
14–050 Operation

Federal version model year 1974

A. General

Information plate

Vehicles are identified by information plate basic color black.



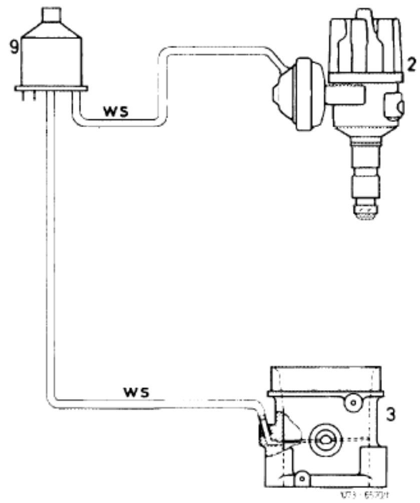
1 Model year
2 Idle . . . rpm
3 Timing at . . . rpm
4 Emission value at idle
5 Valve clearance

B. Ignition timing

The ignition timing influences the running characteristics of the engine.

Ignition timing in direction of "retard" results in a higher engine temperature, longer periods of dwell and thereby in a reduction of CH and CO values.

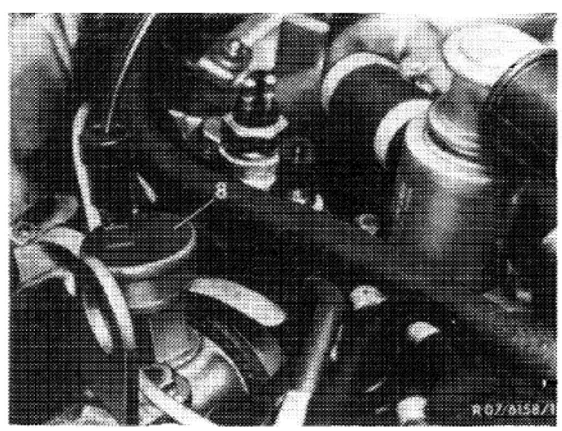
Function diagram



2 Ignition distributor
3 Throttle valve housing
9 Switchover valve

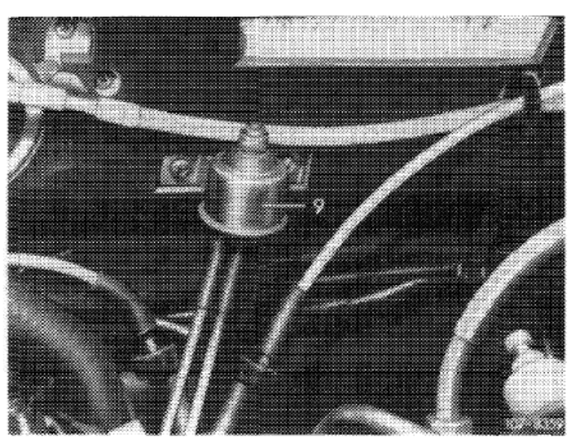
Vacuum adjustment in direction of "retard" becomes effective at the following operating conditions:

- Below 100 °C coolant temperature.
- Engine at idle.
- Engine decelerating (coasting) (throttle valve at idle speed stop).
- Air conditioning system switched off.



Switching vacuum adjustment on or off in direction of "retard" is effected by means of switchover valve (9), which is contacted by temperature switch 100 °C (8) via relay (19).

Below 100 °C coolant temperature, the temperature switch 100 °C (8) is opened, the switchover valve (9) is de-energized. Vacuum flows from throttle valve housing (3) via switchover valve (9) to diaphragm of vacuum unit of ignition distributor.

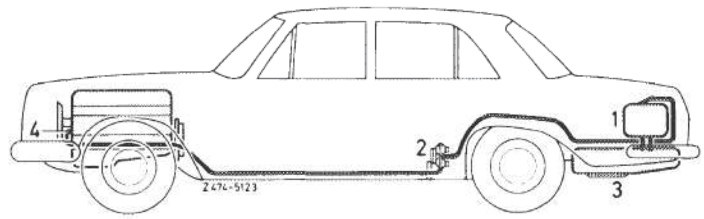


C. Fuel evaporation control system

A fuel evaporation control system has been installed to improve emission characteristics which have nothing to do with engine combustion.

Function diagram

1 Expansion tank
2 Valve system
3 Fuel tank
4 Connection on crankcase

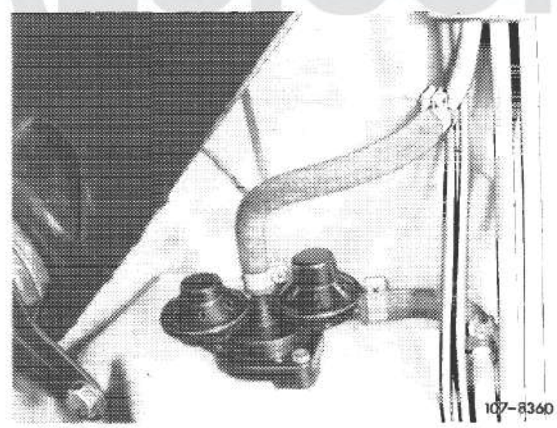


Components of fuel evaporation system:

Valve system

The valve system is mounted under vehicle at level of rear legroom. The system comprises three valves:

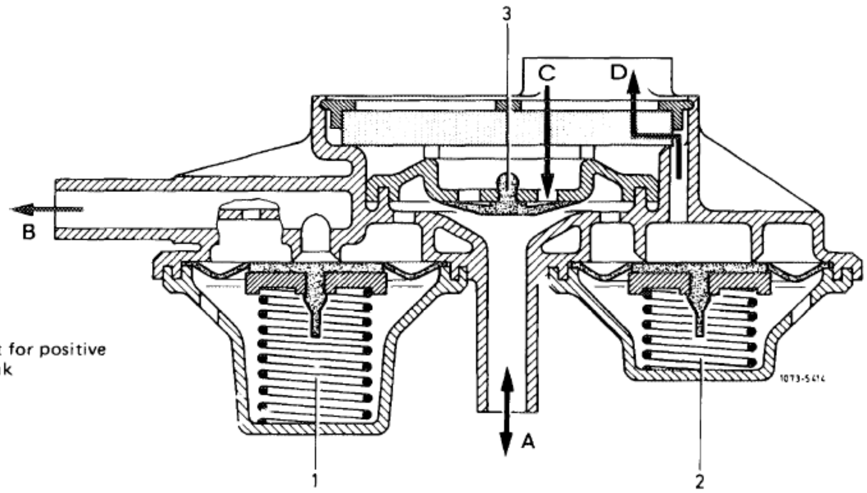
1. Negative vent valve
2. Pressure relief valve
3. Positive vent valve



The negative vent valve opensat a slight overpressure. The evaporation vapors will flow through a line which is connected to cylinder crankcase into cylinder crankcase.

The pressure relief valve is a safety valve and opens in the event of an overpressure in fuel evaporation system. The fuel vapors are vented directly into the open air.

The positive vent valve opens in the event of a vacuum caused when the fuel tank is cooling down or loss of contents.



1 Negative vent valve
2 Pressure relief valve
3 Positive vent valve
A Input to valve system/output for positive venting of fuel expansion tank
B To crankcase
C Fresh air input
D Output pressure relief valve

Draw-off connection on crankcase

The negative vent line which leads to engine is attached to draw-off connection by means of a hollow screw.

Operation

The fuel evaporation vapors from compensating tank are routed via valve system into crankcase and stored. When the engine is running, they are drawn off into the combustion chambers by means of the crankcase venting system.

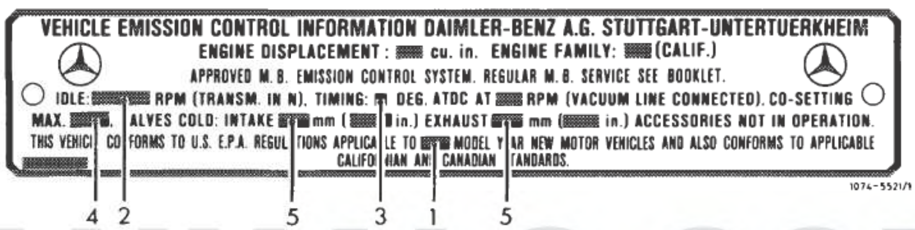
14–050 Operation

California version model year 1974

A. General

Information plate

Vehicles are identified by information plate basic color green.



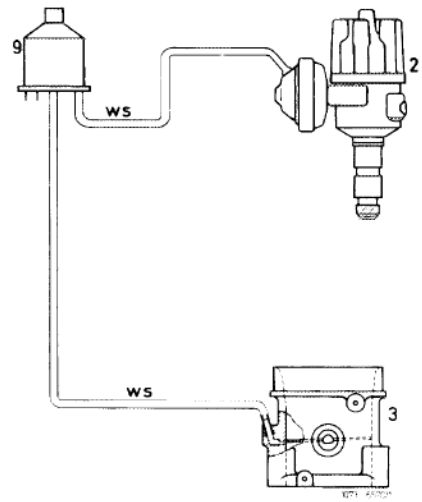
1 Model year
2 Idle . . . rpm
3 Timing at . . . rpm
4 Emission value at idle
5 Valve clearance

B. Ignition timing

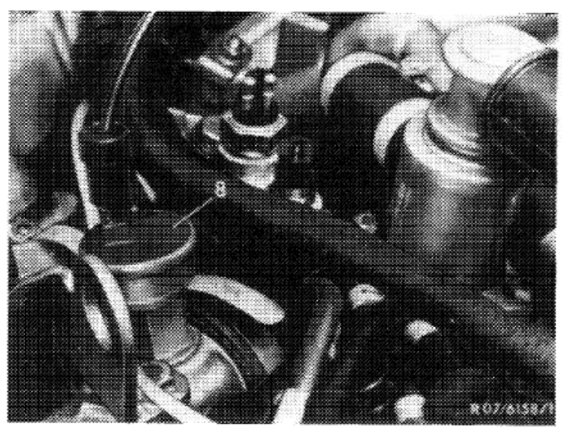
The ignition timing influences the running characteristics of the engine.

Ignition timing in direction of "retard" results in a higher engine temperature, longer periods of dwell and thereby in a reduction of CH and CO values.

Function diagram



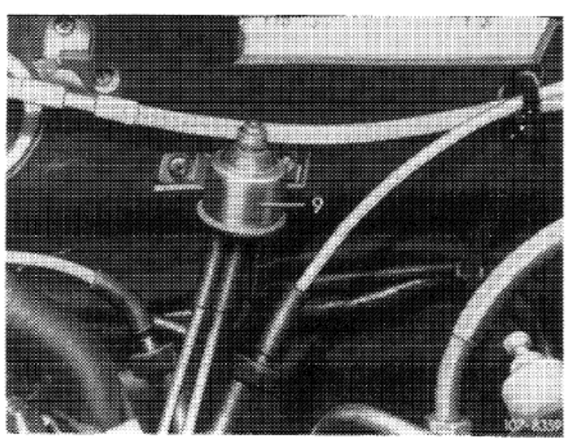
2 Ignition distributor
3 Throttle valve housing
9 Switchover valve



Vacuum adjustment in direction of "retard" becomes effective at the following operating conditions:

- Below 100 °C coolant temperature.
- Engine at idle.
- Engine decelerating (coasting) (throttle valve at idle speed stop).
- Air conditioning system switched off.

Switching vacuum adjustment on or off in direction of "retard" is effected by means of switchover valve (9), which is contacted by temperature switch 100 °C (8) via relay (19).



Below 100 °C coolant temperature, the temperature switch 100 °C (8) is opened, the switchover valve (9) is de-energized. Vacuum flows from throttle valve housing (3) via switchover valve (9) to diaphragm of vacuum unit of ignition distributor.

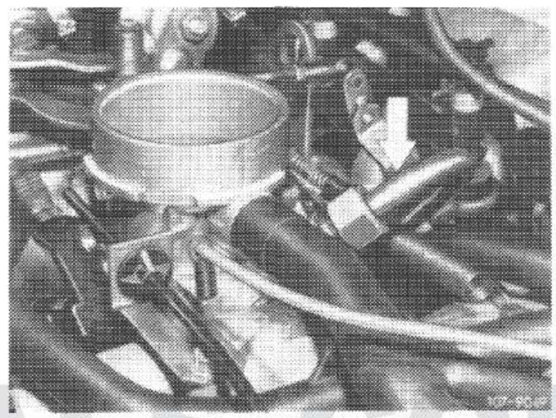
C. EGR (exhaust gas recirculation)

To reduce nitrogen oxides in exhaust gases, a portion of the gases from the exhaust manifold is returned to throttle valve housing in front of throttle valve.
The quantity of the returned exhaust gas is controlled in dependence of the throttle valve position and the intake pipe vacuum.

EGR components:

Throttle valve housing with connection

EGR line (arrow)



EGR is activated:

- During acceleration.
- During partial load operation.
- During idle.
- During deceleration (coasting).

Note: At idle and while decelerating (coasting) only a slight quantity of exhaust gas is recirculated and drawn off via idle speed system.

Operation

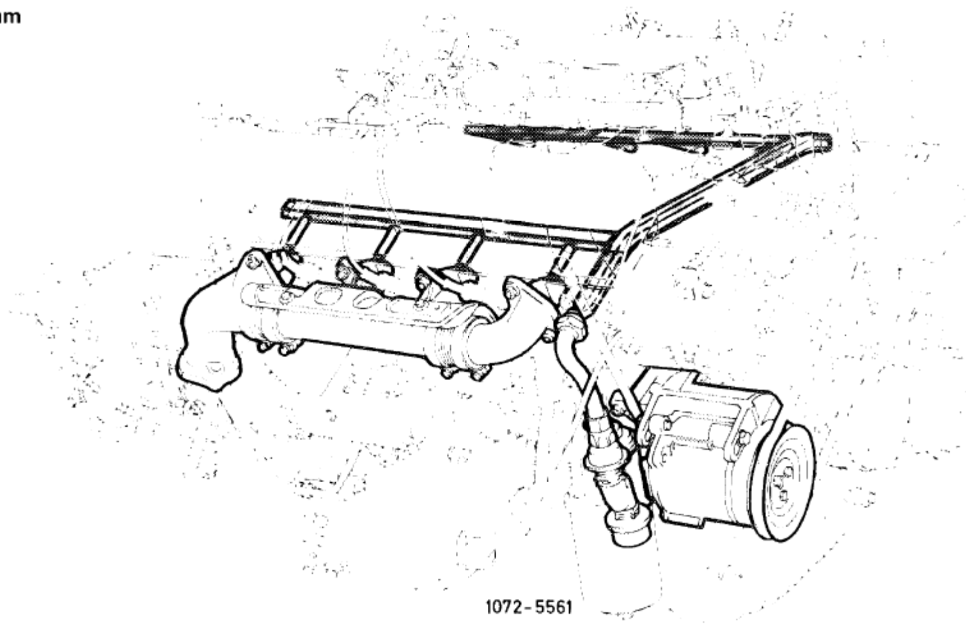
With the engine running and depending on throttle valve position and intake pipe vacuum, exhaust gases are recirculated from front exhaust pipe via EGR line into throttle valve housing. From there, the gases flow through intake pipe and intake valves back into combustion chamber.

D. Air injection

To reduce the incompletely burnt components in exhaust gas, air is injected into hot zone behind exhaust valves.

To prevent backfiring in exhaust the air injection is controlled via vacuum control valve (44).

Function diagram



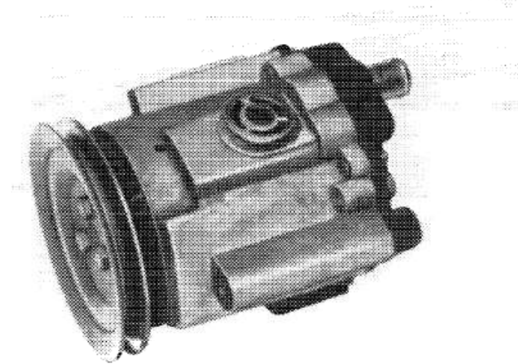
1072-5561

Components of air injection:

Air pump (Saginaw pump)

The air pump is an impeller pump with a maintenance-free centrifugal filter which cleans the drawn in air.

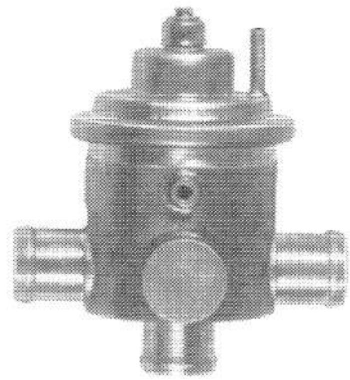
A safety valve on pump housing blows off the delivered air at a given overpressure to protect the pump vanes against overloads.



107-8959

Diverter valve

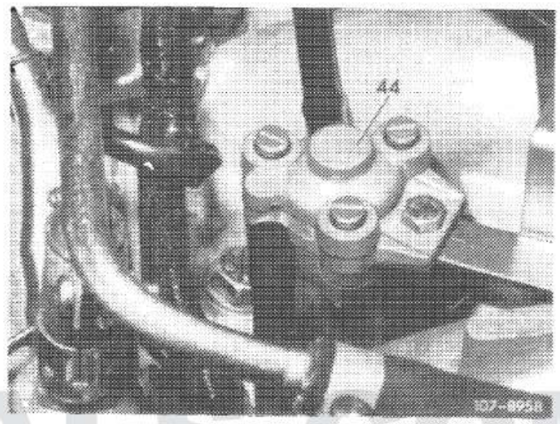
The diverter valve serves the purpose of controlling the air volume during deceleration (coasting) at vacuum values above 533 mbar (400 mm Hg) through an air filter (silencer).



107-9139

Vacuum control valve (44)

Air injection or air discharge is controlled by means of the vacuum control valve which is directly connected to intake pipe vacuum.

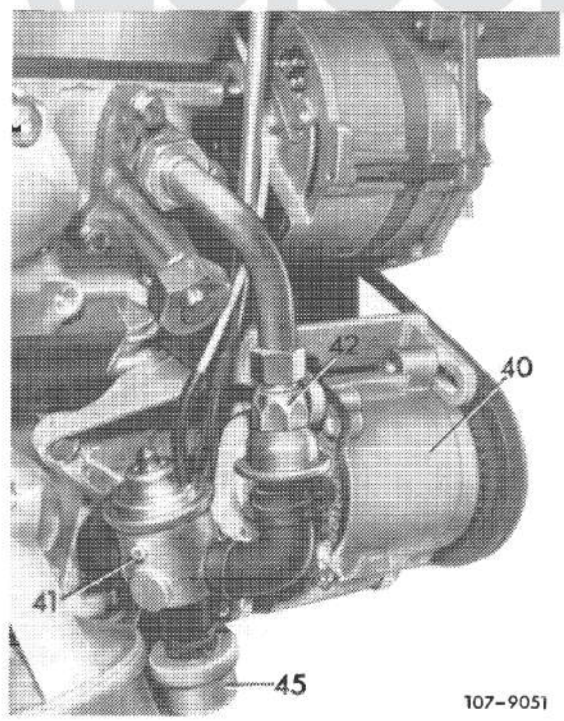


Check valve (42)

The check valve prevents hot exhaust gases from flowing into air line.

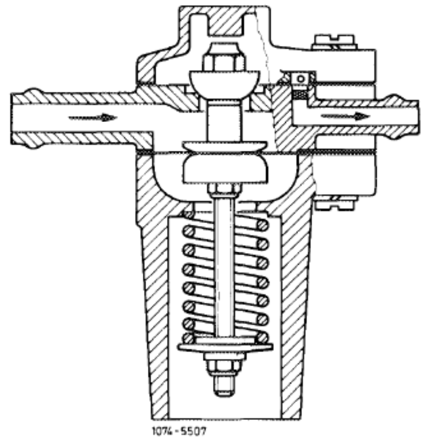
Operation

The air pump (40) is driven by the crankshaft via a V-belt and delivers constantly air when the engine is running. The air flows into cylinder heads via the diverter valve (41) and the check valve (42), or into the open air via the air filter (45).



107-9051

The air injection or air discharge is controlled by the vacuum control valve (44) which is directly connected to the intake pipe vacuum.



Operation of vacuum control valve

The annular space of the valve above the diaphragm is negatively vented by the intake pipe vacuum.

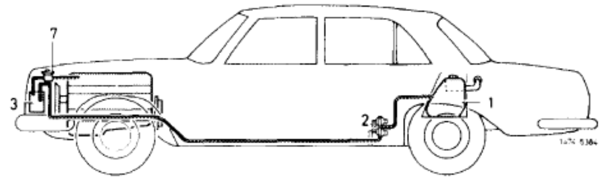
At a vacuum of approx. 533 mbar (400 mm Hg) caused by the permanently set spring, the diaphragm is pushed upwards by atmospheric air. This opens the passage in direction of arrow and the diverter valve (41) is provided with a vacuum.

E. Fuel evaporation control system

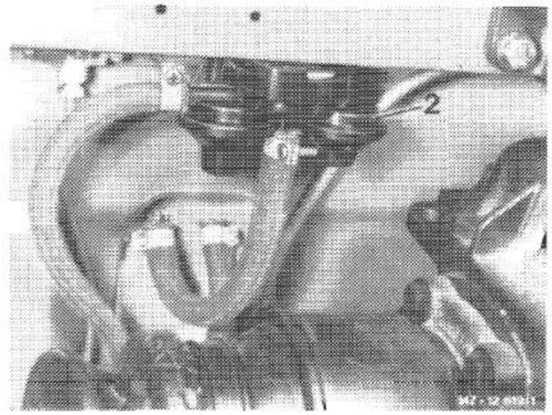
A fuel evaporation control system has been installed to improve emission characteristics which have nothing to do with engine combustion.

Function diagram

1 Fuel tank with expansion tank
2 Valve system
3 Charcoal canister
7 Purge valve



Components of fuel evaporation control system:



Valve system

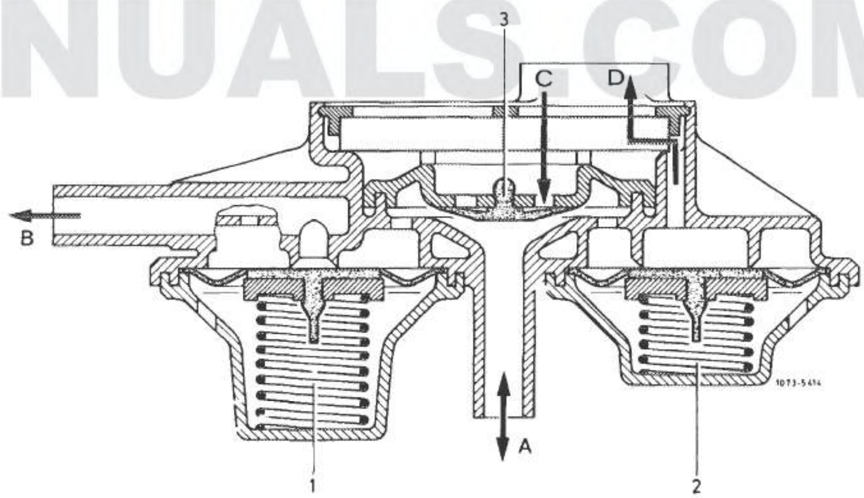
The valve system is mounted under vehicle at level of rear legroom. The system comprises three valves:

1. Negative vent valve
2. Pressure relief valve
3. Positive vent valve

The **negative vent valve** opens at a slight overpressure. The evaporation vapors will flow through negative vent valve (1) (direction B) into a line to charcoal canister.

The **pressure relief valve** is a safety valve and opens in the event of an overpressure in fuel evaporation control system. The fuel vapors are vented directly into the open air.

The **positive vent valve** opens in the event of a vacuum caused when the fuel tank is cooling down.



1 Negative vent valve
2 Pressure relief valve
3 Positive vent valve
A To valve/to expansion tank
B To charcoal canister
C Fresh air inlet
D Outlet pressure relief valve

Charcoal canister

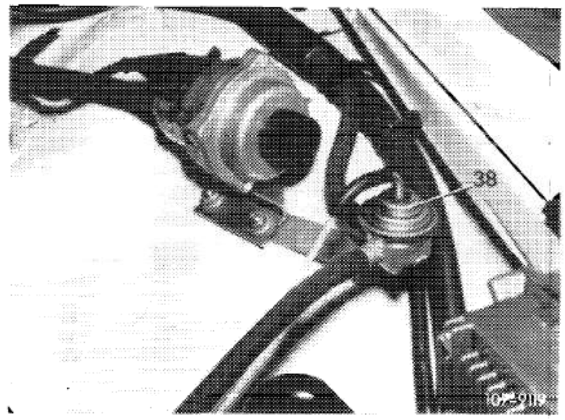
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn off again when driving.

A Connection tank vent
B Connection purge valve

107-9128

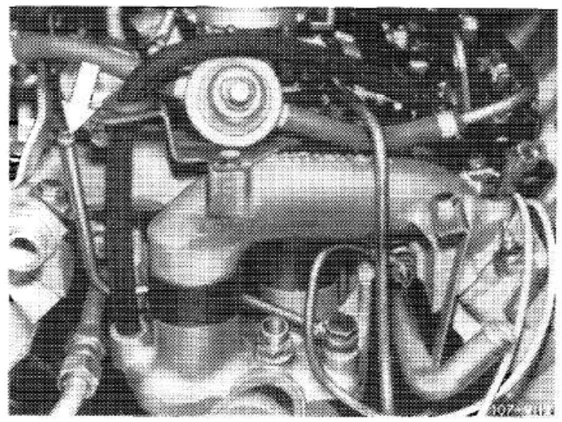
Purge valve

The purge valve is controlled by the vacuum of the throttle valve. If the diaphragm is activated by a vacuum, the valve opens and the gases can be drawn off from charcoal canister.



Intake pipe connection

The intake pipe is provided with a connection (arrow) to draw off the fuel evaporation vapors from charcoal canister.



Operation

The fuel evaporation vapors from fuel tank are stored in charcoal canister when the engine is stopped, and are drawn off when the engine is running in dependence of the intake pipe vacuum.

When the throttle valve is opened, the diaphragm of the purge valve is activated by a vacuum and the valve is opened.

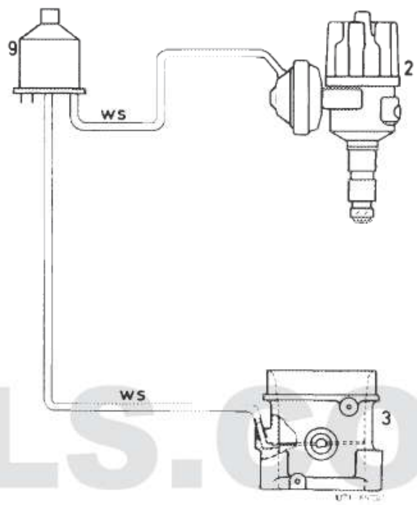
The intake pipe vacuum will draw the stored gases from charcoal canister.

14–100 Test program

Federal version model year 1974

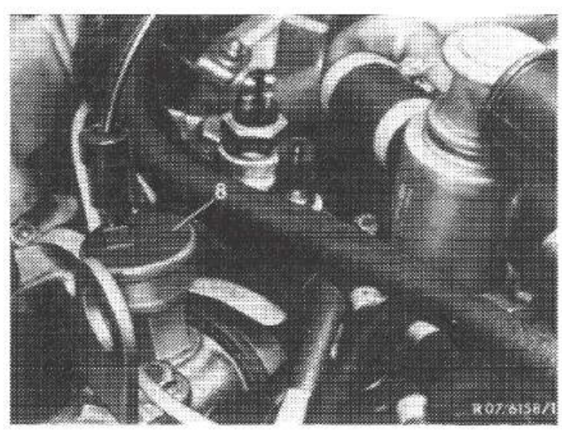
For complaints such as:	Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.
Test conditions:	All fuses in order, engine at operating temperature, run engine at idle speed.
Test the following:	Ignition switchover.

Function diagram



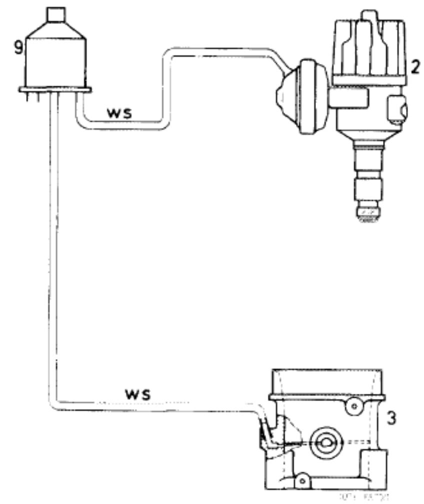
2 Ignition distributor
3 Throttle valve housing
9 Switchover valve

Testing ignition switchover Pull plug from temperature switch 100 °C (8) and connect to ground.	
Engine speed increasing.	Engine speed not increasing.



Testing vacuum lines

The vacuum line from throttle valve housing (3) leads to center connection of switchover valve (9), that of vacuum control unit of ignition distributor (2) to outer connection of switchover valve (9).



Checking vacuum

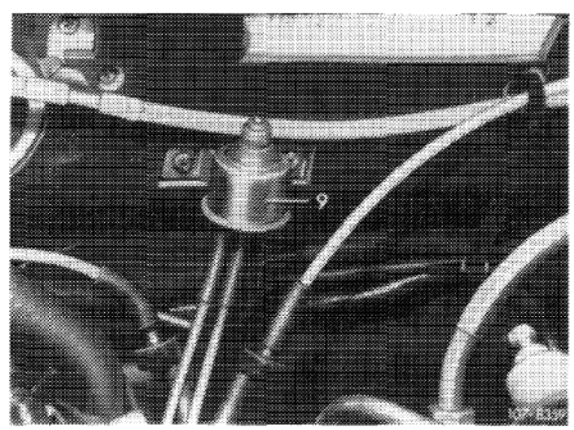
Pull vacuum line from center connection of switchover valve (9) and keep closed with finger. If vacuum is evident, plug vacuum line in again. If no vacuum is evident, blow out vacuum draw-off connection on throttle valve housing with compressed air.

Testing relay (code number 5) for switchover valve

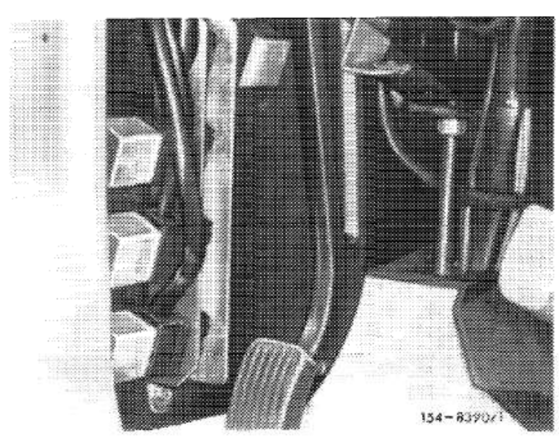
Connect test lamp to connecting plug of switchover valve (9) and plug of temperature switch (8) to ground. Relay is in order if test lamp lights up.

Replace switchover valve (9).

If test lamp is not lighting up, replace relay.



End of test.

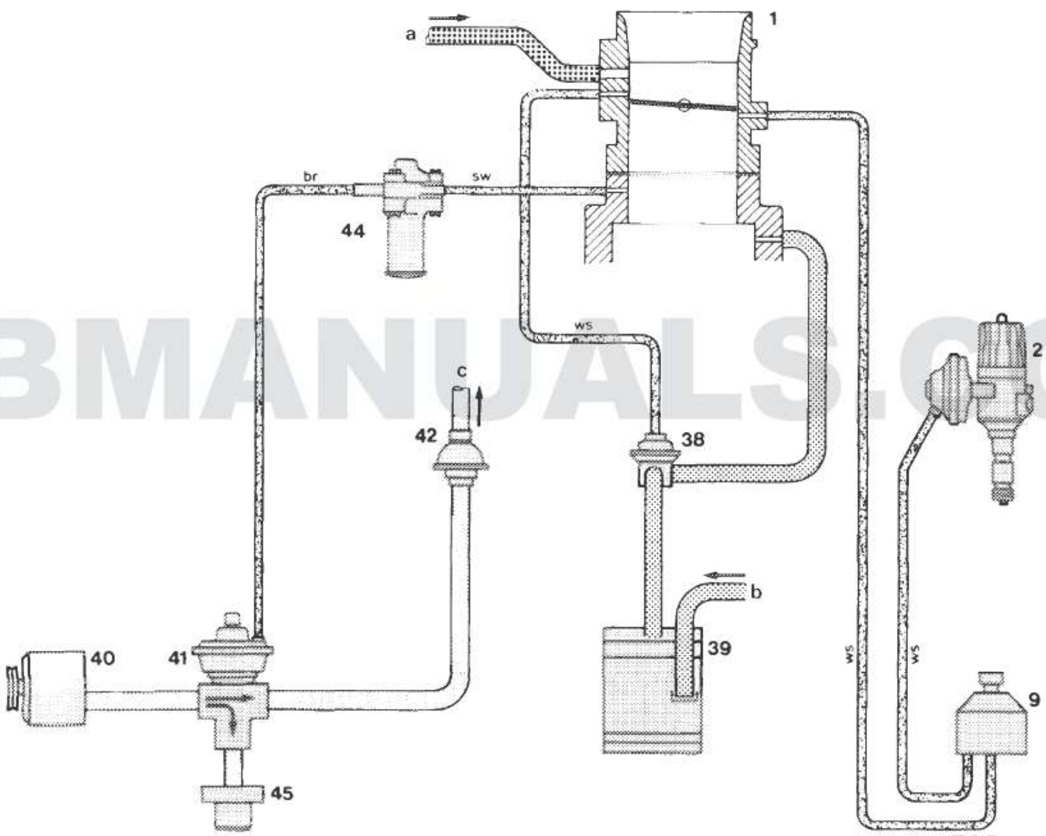


14–100 Test program

California version 1974

For complaints such as:	Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.
Test conditions:	Engine at operating temperature, run engine at idle speed.
Test the following:	Ignition switchover, EGR, air injection and fuel evaporation system.

Function diagram



1 Throttle valve housing
2 Ignition distributor
9 Switchover valve ignition
38 Purge valve
39 Charcoal canister
40 Air pump
41 Diverter valve
42 Check valve
44 Vacuum control valve
45 Air filter

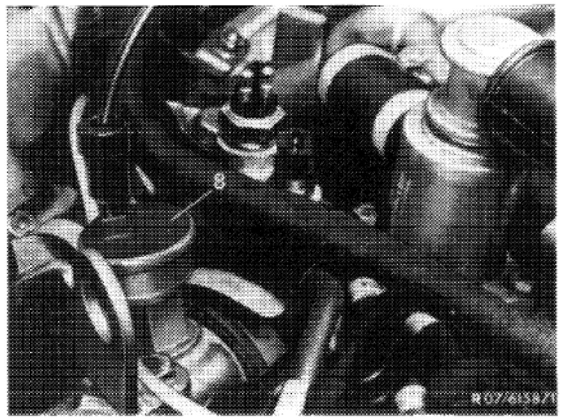
a EGR line
b Connection fuel tank
c Air injection line to cylinder head

br = brown
sw = black
ws = white

Testing ignition switchover

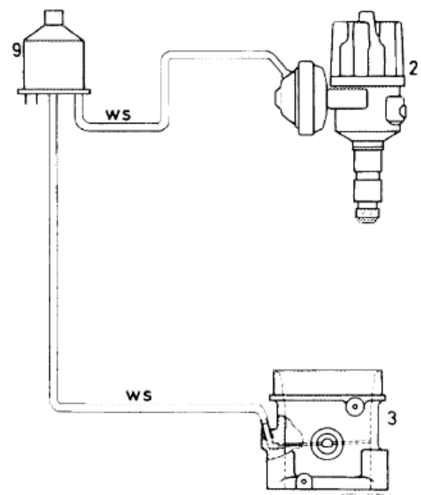
Pull plug from temperature switch 100 °C (8) and connect to ground.

Engine speed increasing.	Engine speed not increasing.



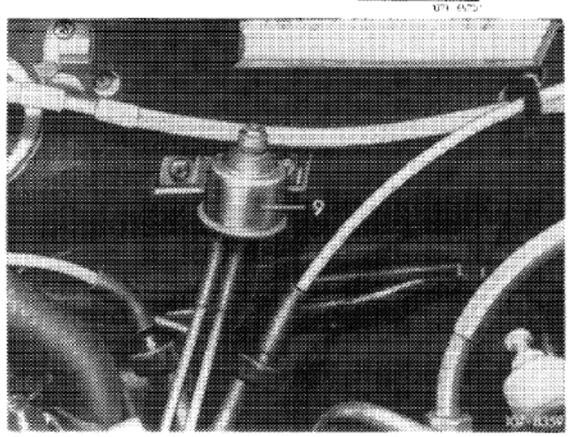
Testing vacuum lines

The vacuum line from throttle valve housing (3) leads to center connection of switchover valve (9), that of vacuum control unit of ignition distributor (2) to outer connection of switchover valve (9).



Testing vacuum

Pull vacuum line from center connection of switchover valve (9) and keep closed with finger. If vacuum is evident, plug vacuum line in again. If no vacuum is evident, blow out vacuum draw-off connection on throttle valve housing with compressed air.

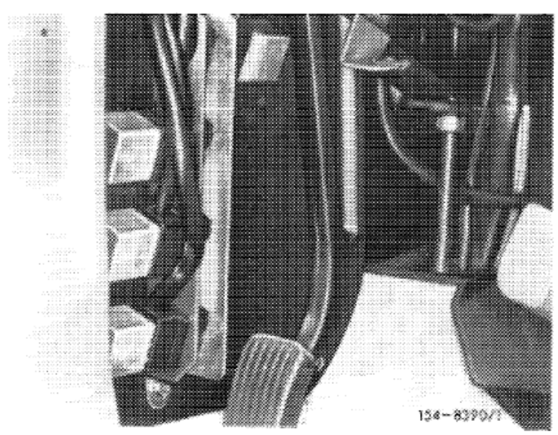


Testing relay (code number 5) for switchover valve

Connect test lamp to connecting plug of switchover valve (9) and plug of temperature switch (8) to ground. Relay is in order if test lamp lights up.

Replace switchover valve (9).

If test lamp is not lighting up, replace relay.

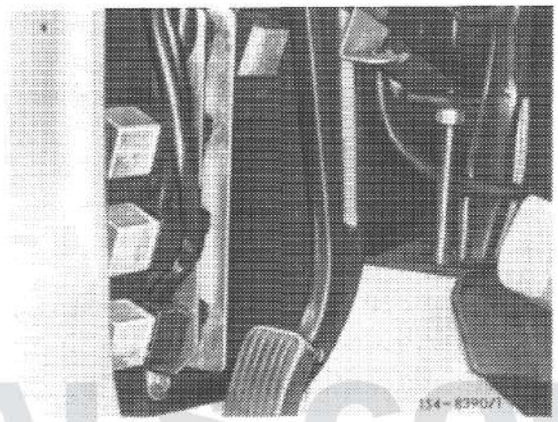


Testing ignition switchover

Switch on air conditioning system.

Engine speed increasing.	Engine speed not increasing.

Replace relay (code number 5) if clutch of refrigerant compressor is attracted.



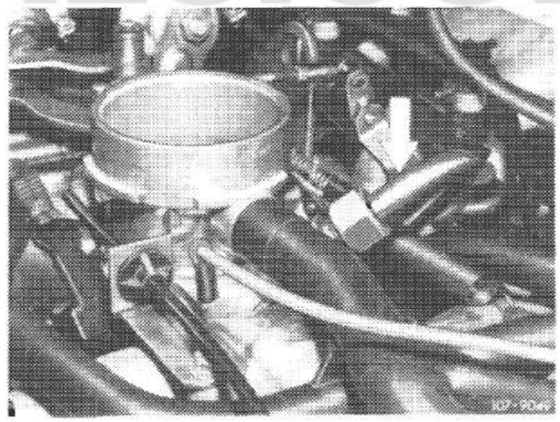
Testing EGR

Remove air filter and put aside.

Note: Do not pull off plug for temperature sensor air (testing of CO values).

Do not mount air filter.

Exhaust gas flows from EGR line into throttle valve housing.	No exhaust gas flow.



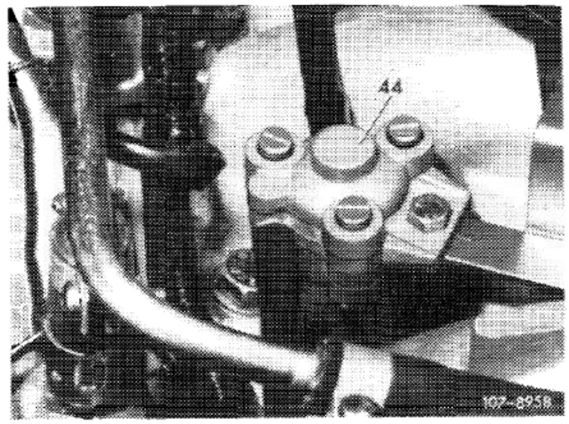
Check tapping connection of exhaust pipe, EGR line and connection on throttle valve housing.

Testing air injection

Pull brown vacuum line from vacuum control valve (44). Increase engine speed to above approx. 2000/min and release regulating linkage.

Do not mount air filter.

At connection of vacuum control valve (44) a vacuum should be available for a short period.	No vacuum available.



Replace vacuum control valve (44).

Testing air injection

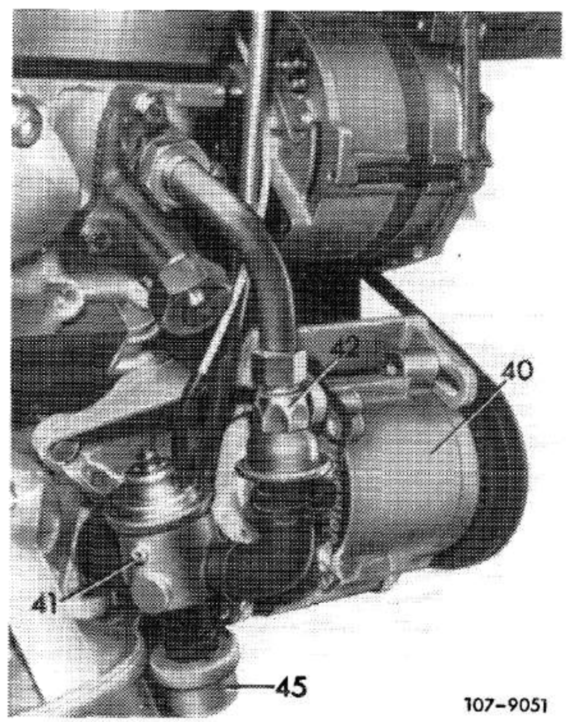
Connect CO measuring instrument and read exhaust gas value. Pull brown vacuum line from vacuum control valve (44) and connect to vacuum line of control unit (actuator) of cruise control.

CO value increasing.	CO value not increasing.

Testing diverter valve (41)

Remove air filter (45) from purge valve and check whether air flows out of hose.

If no air flows out, replace diverter valve (41).

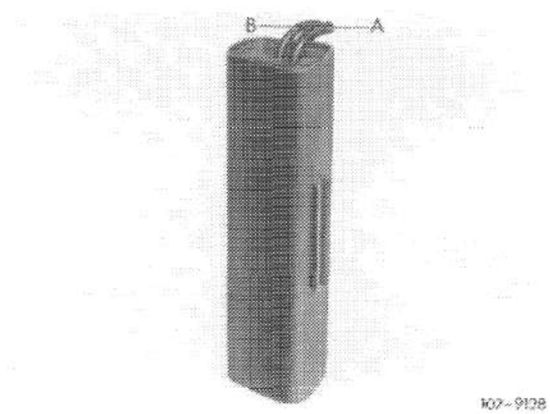


107–9051

Testing fuel evaporation control system

Pull draw-off hose from connection "B" of charcoal canister and close opening of hose with finger. Slowly increase engine speed to above approx. 2000/min.

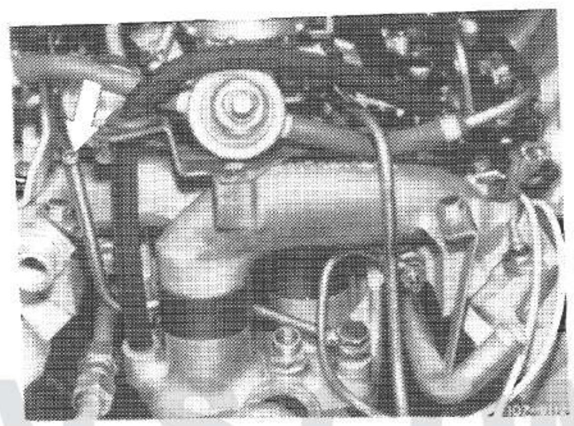
Vacuum available, vacuum increases at increasing speed.	No vacuum.



Testing draw-off line for intake pipe

Loosen hose for charcoal canister on purge valve (38) and blow through valve in direction of intake pipe with compressed air. Replace purge valve (38).

If vacuum is not increasing at higher speed:

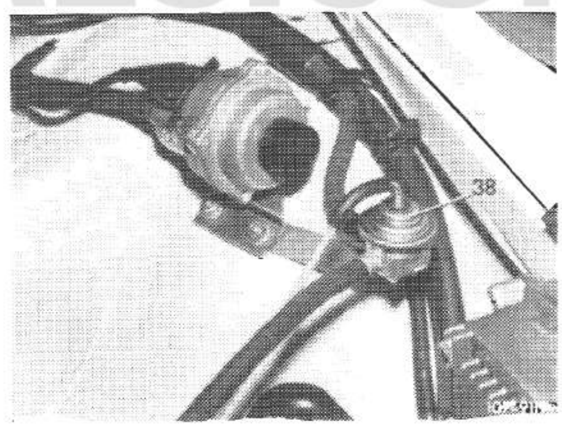


Test vacuum at purge valve (38)

Pull black vacuum line from purge valve (38). Connect vacuum gauge or keep opening of hose closed with finger. Slowly increase engine speed. A light vacuum should be available at idle. Vacuum should increase with increasing speed.

If a vacuum shows up, replace purge valve (38).

If there is no vacuum, blow through vacuum line to throttle valve housing with compressed air.



End of test.

Federal version model year 1974

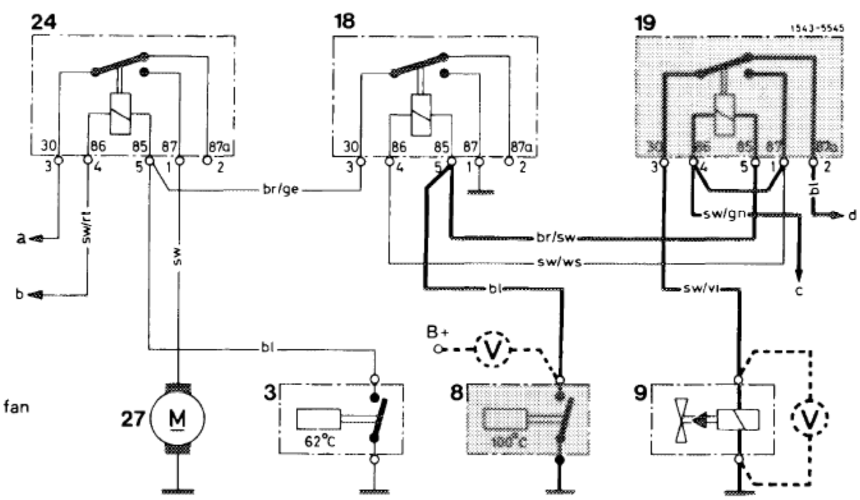
Drawn with ignition switched off.

Connection of test instruments is drawn in dashed lines.

Color code

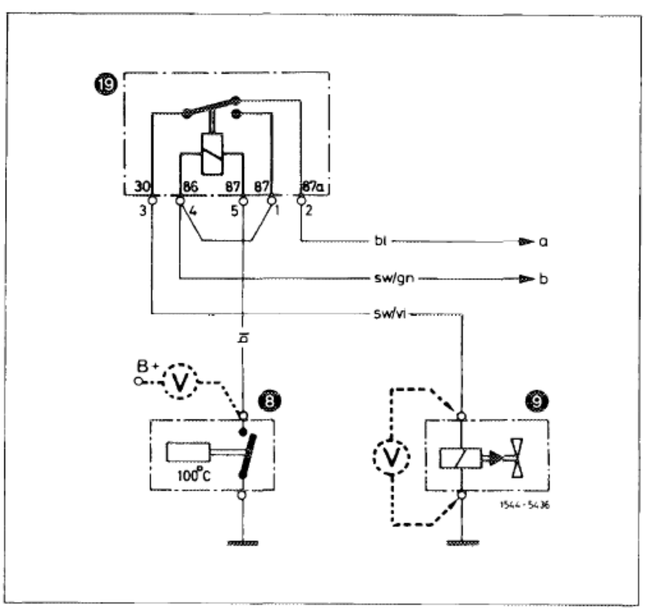
bl = blue	gn = green	sw = black	a Fuse no. 2 (15/54)
br = brown	rs = pink	vi = purple	b Fuse no. 4 (15/54)
ge = yellow	rt = red	ws = white	c Fuse no. 4 (15/54)
			d Switch air conditioning system

Ignition switchover model 116.032/033



3 Temperature switch 62 °C
8 Temperature switch 100 °C
9 Switchover valve ignition
18 Cut-off relay supplementary fan of ignition switchover
19 Relay switchover vlave
24 Relay supplementary fan
27 Supplementary fan

Ignition switchover model 107.024/044



8 Temperature switch 100 °C
9 Switchover valve ignition
19 Relay switchover valve
a Switch air conditioning system
b Fuse no. 12 (15/54)

California version model year 1974

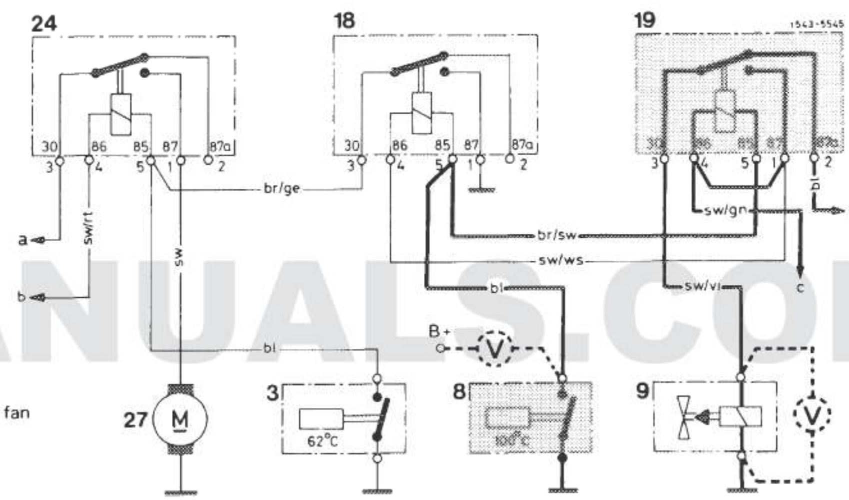
Drawn with ignition switched off.

Connection of test instruments is drawn in dashed lines.

Color code

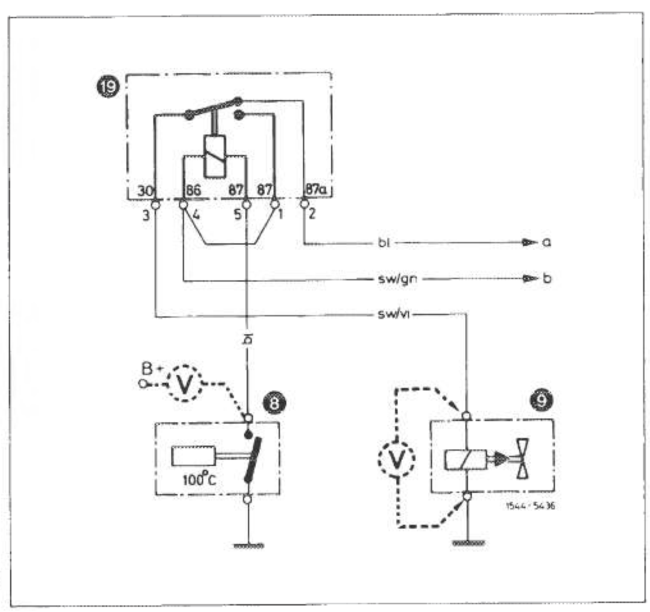
bl = blue	gn = green	sw = black	a Fuse no. 2 (15/54)
br = brown	rs = pink	vi = purple	b Fuse no. 4 (15/54)
ge = yellow	rt = red	ws = white	c Fuse no. 4 (15/54)
			d Switch air conditioning system

Ignition switchover model 116.032/033



3 Temperature switch 62 °C
8 Temperature switch 100 °C
9 Switchover valve ignition
18 Cut-off relay supplementary fan of ignition switchover
19 Relay switchover valve
24 Relay supplementary fan
27 Supplementary fan

Ignition switchover model 107.024/044



8 Temperature switch 100 °C
9 Switchover valve ignition
19 Relay switchover valve
a Switch air conditioning system
b Fuse no. 12 (15/54)

14–250 Removal and installation of air pump

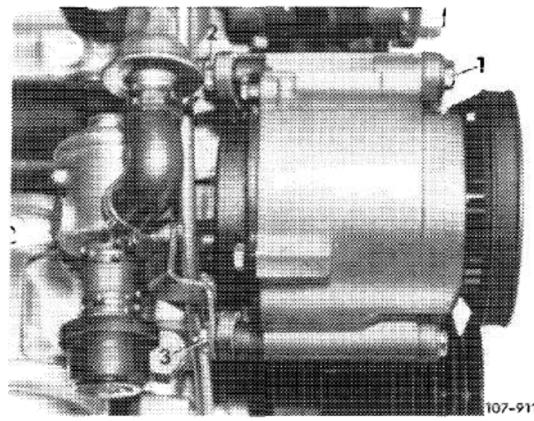
California version model year 1974

Removal

1 Compress hose clip on contoured hose of air pump with combination pliers and push toward the rear for approx. 2 cm.

2 Loosen clamping screws (1 and 2) as well as fastening screw (3) and unscrew.

3 Remove V-belt and contoured hose, remove air pump.



107-9113

Installation

4 For installation proceed vice versa.

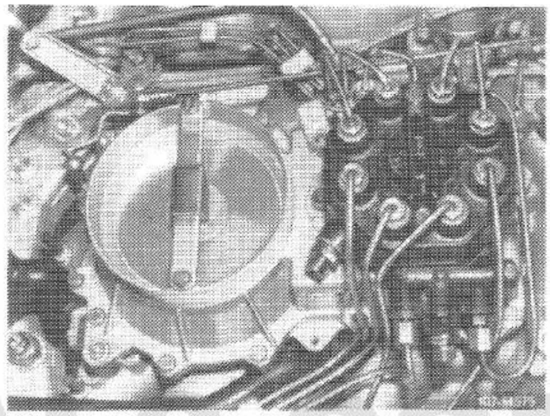
Note: The V-belt is correctly tensioned if it can be resiliently pushed down under energetic thumb pressure.

09–450 Removal and installation of intake manifold upper and lower half, renewing gaskets

Note

During removal and installation of intake manifold the mixture regulator with air guide housing need not be removed.

Removal



1 Disconnect battery.

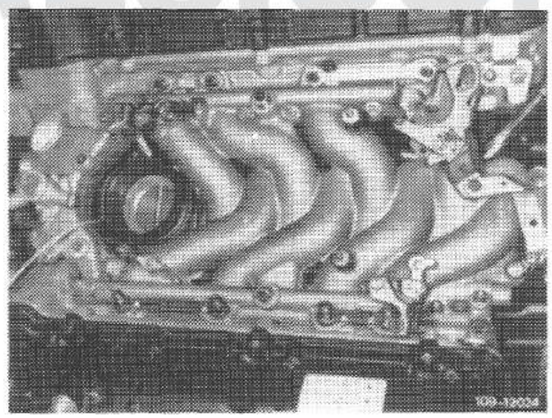
2 Partially drain coolant.

3 Unscrew injection lines and fuel lines. Catch fuel with a cloth.

Deactivate fuel lines.

4 Pull off supplementary air lines.

5 Remove control pressure rod for automatic transmission.



6 Unscrew bearing bracket for gate regulation.

7 Unscrew bearing bracket for longitudinal regulating shaft.

8 Pull off all connecting cables and plug connections.

9 Unscrew vacuum line for automatic transmission and for brake unit.

10 Unscrew idle speed air distributor.

11 Loosen coolant hoses and pull off.

12 Unscrew all fastening screws and remove intake pipe toward the rear.

13 Clean intake manifold and check flange surfaces with straightedge or touch up on surface plate.

Installation

14 Mount intake manifold with new gaskets in vice versa sequence.

Use only graphited intake manifold gaskets.
Do not install non-graphited intake manifold gaskets similar to engine 117.96 (5.0).

15 Adjust regulating linkage (30–300).

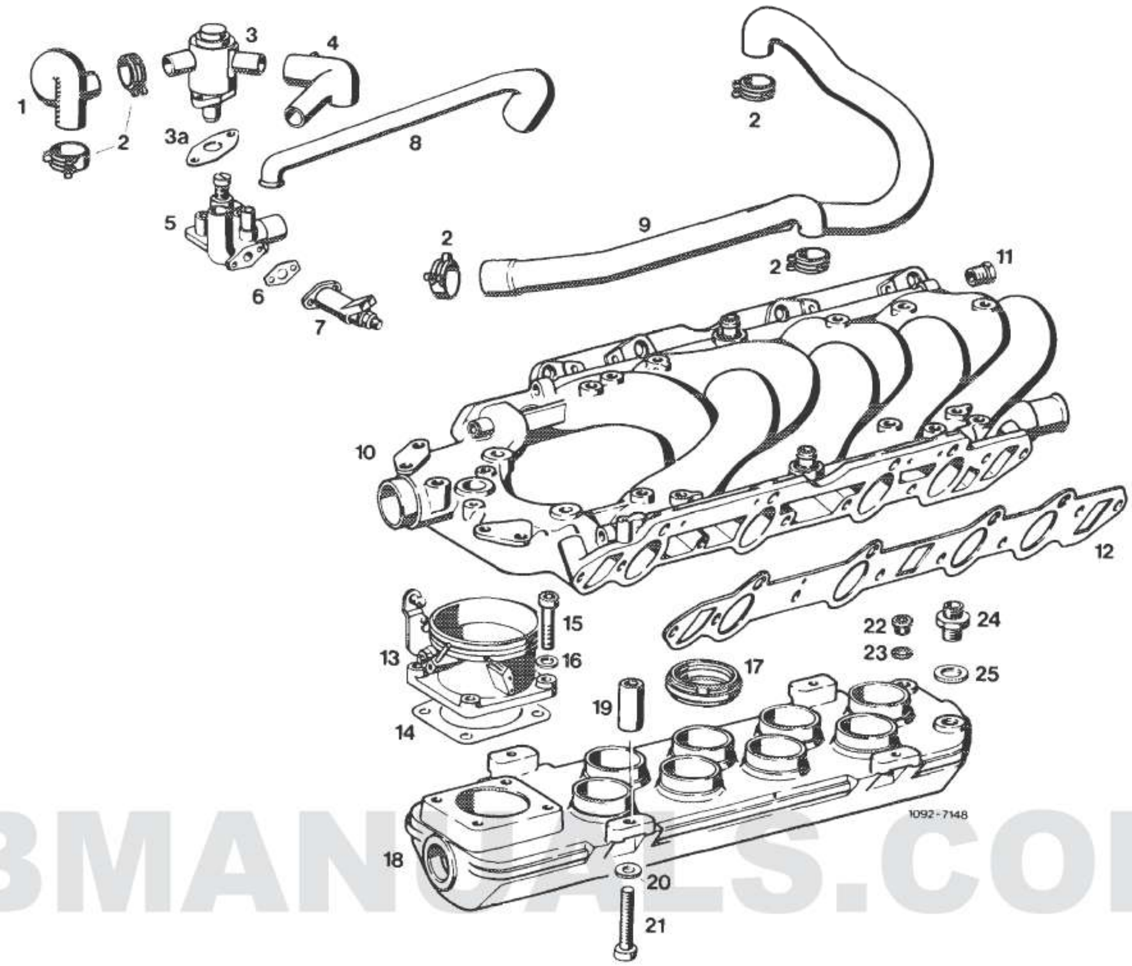
16 Connect battery.

17 Add coolant.

18 Keep engine running, check fuel lines for leaks. Check intake system, fuel distributor and injection valves by spraying with Iso-Oktan or benzine for leaks.

19 Adjust idle speed (07.3–100).

Intake manifold



1 Contoured hose
2 Coiled hose clips
3 Supplementary air valve
3a Gasket
4 Contoured hose
5 Idle speed air distributor
6 Gasket
7 Cold-starting valve
8 Contoured hose
9 Supplementary air line
10 Intake manifold upper half
11 Closing plug
12 Gasket
13 Throttle valve housing
14 Gasket
15 Hex. socket screw
16 Washer
17 Rubber connection
18 Intake manifold lower half
19 Spacing sleeve
20 Washer
21 Hex. socket screw
22 Closing plug
23 Sealing ring
24 Double thread connection
25 Sealing ring

14–455 Renewing intake manifold (intake manifold removed)

1 Remove and install intake manifold (14–450).

2 Remove and install injection valves and insulating sleeves (07.3–215).

3 Remove and install mixture regulator with air guide housing (07.3–225).

4 Unscrew all unscrewable parts on removed intake manifold and mount on new intake manifold with new gaskets.

5 Unscrew intake manifold upper half from intake manifold lower half. For this purpose, loosen vacuum line for brake unit on intake manifold lower half, then unscrew fastening screws and pull from rubber adaptors.

6 Mount intake manifold lower half with new rubber adaptors to intake manifold upper half.

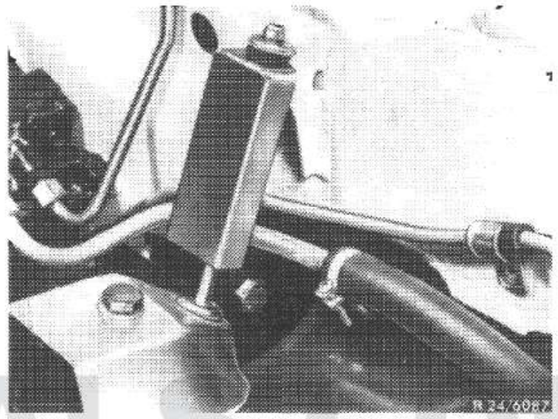
Attention!
The intake manifold lower half has a different shape as that of engine 117.960 (5.0) and can therefore not be installed in this engine.

49–470 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm
Bolt for engine mount	75

Removal



1 Remove exhaust system (49–100).

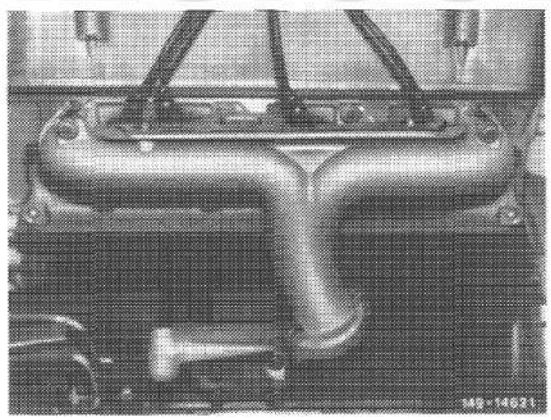
Note: Survey exhaust manifold (14–472).

2 Pull off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with fastener and shielding plates. For this purpose, unscrew bolt for engine mount.

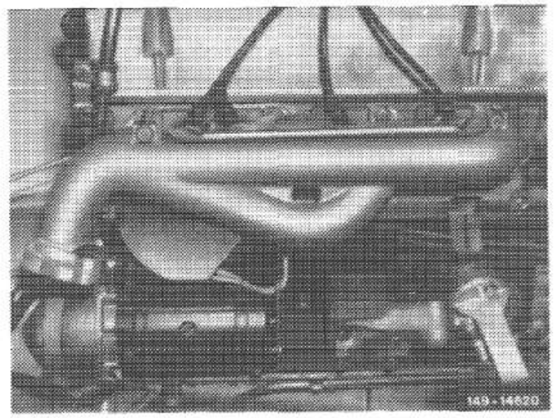
Exhaust manifold left



5 Remove air cleaner.

6 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right

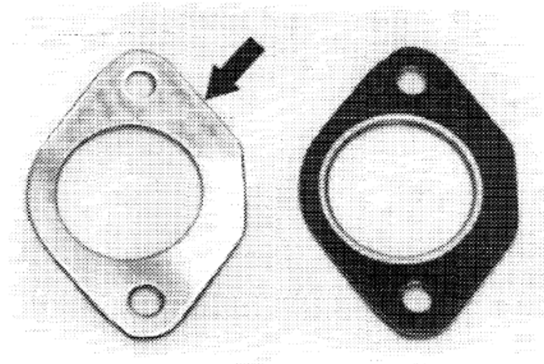


7 Remove windshield washer tank.

8 Unscrew coolant supply tank. Unscrew fastening clamp for coolant hose, loosen cable band for electric line and put supply tank aside.

9 Remove battery, battery holder and shielding plate.

10 Unscrew exhaust nuts and bolts and remove exhaust manifold.



107–12067

Installation

11 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

12 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

13 Tighten bolts for engine mount to 75 Nm.

14 Mount exhaust system.

15 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

16 Keep engine running and check exhaust system lor leaks.

B. Model 116

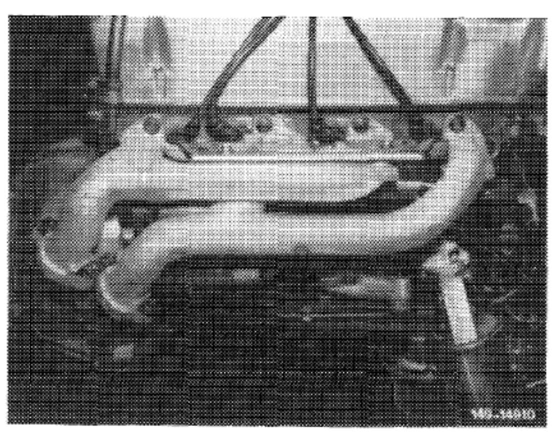
Note

Starting with the following chassis end no. a two-fluted **righthand** exhaust manifold is installed.

Start of production: December 1977

Model	starting chassis end no.
116.028/029	044654
116.032/033	076606

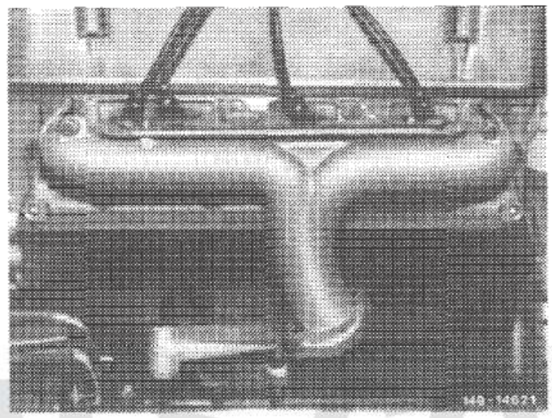
On previously manufactured vehicles the former exhaust manifold remains installed.



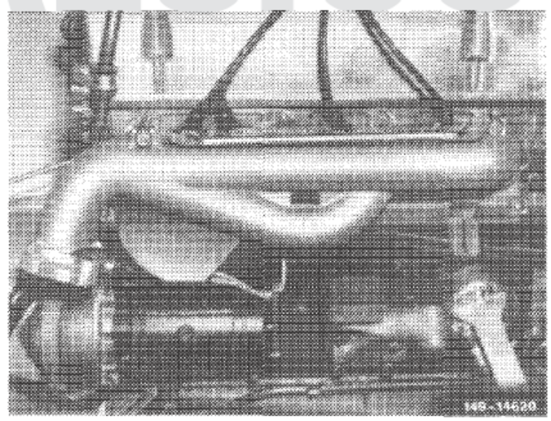
14–472 Survey exhaust manifold

A. Standard version

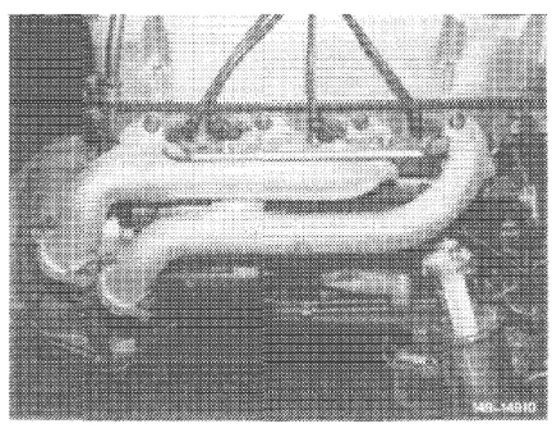
Lefthand steering



Exhaust manifold left

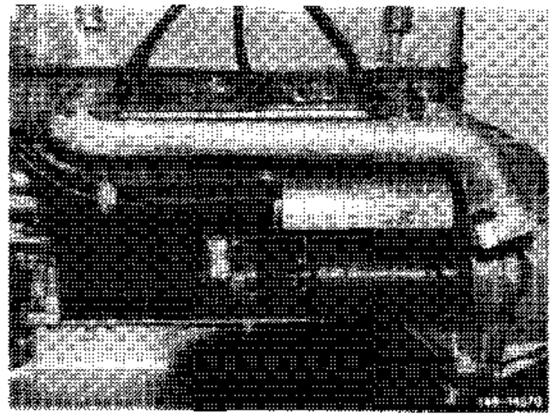


Exhaust manifold right

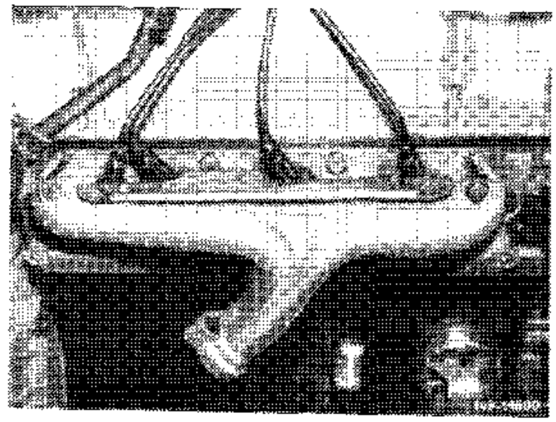


Exhaust manifold right
two-fluted model 116

Righthand steering



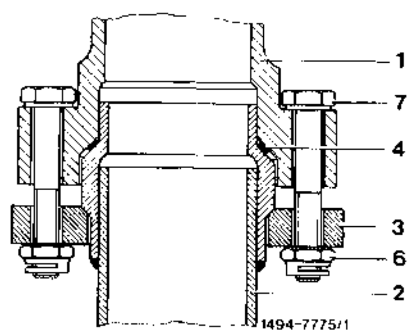
Exhaust manifold left



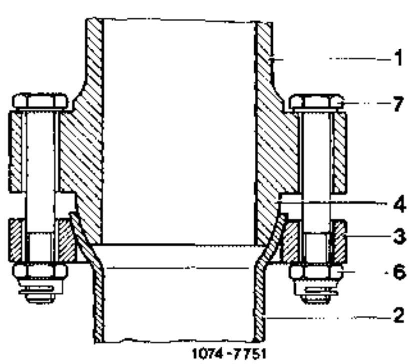
Exhaust manifold right

Repair versions

Starting approx. November 1977, the exhaust manifolds are provided with an external ball connection (up to now trapezoid connection). As a result, when installing exhaust manifolds with external ball connection, replace front exhaust pipe with trapezoid connection against an exhaust pipe with external ball connection.



Trapezoid connection
(past version)



External ball connection

Removal

1 Remove exhaust system (49–100).

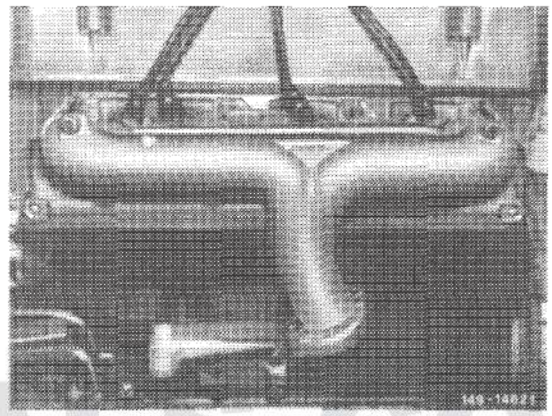
2 Pull off ignition cable.

3 Unscrew shielding plate on exhaust manifold.

Exhaust manifold left

4 Remove air cleaner.

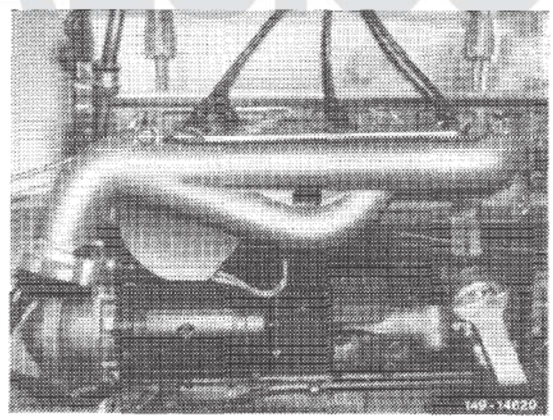
5 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Exhaust manifold right

6 Remove battery and battery holder.

7 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Installation

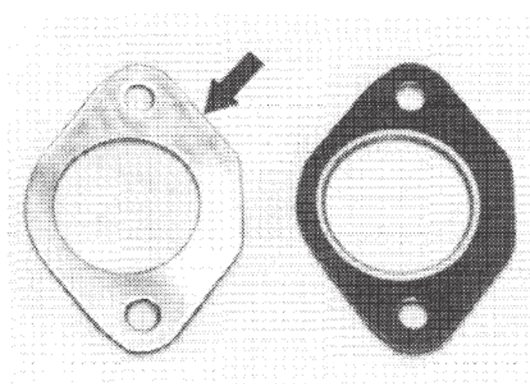
8 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

9 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

10 Mount exhaust system.

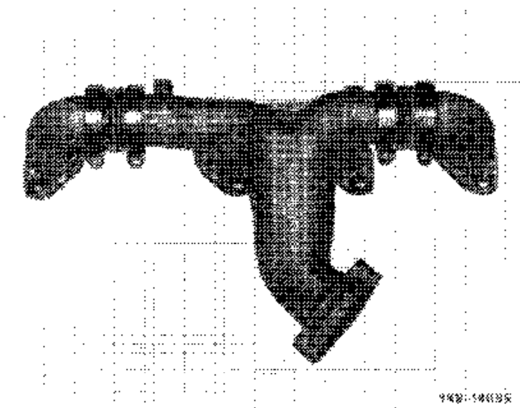
11 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

12 Keep engine running and check exhaust system for leaks.

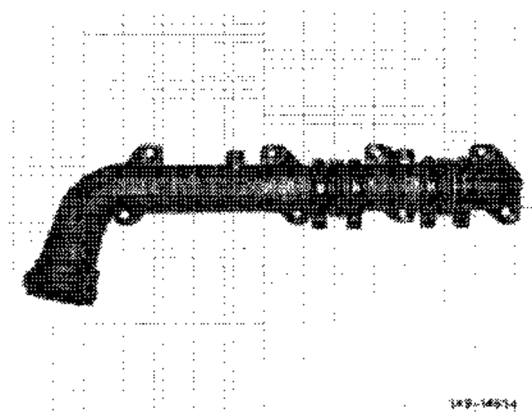


107-12067

Lefthand steering



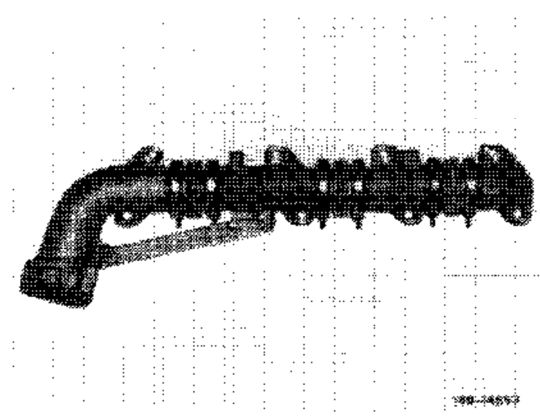
Exhaust manifold left



Exhaust manifold right

In the event of damage on exhaust manifolds with 2 bellows as a result of extremely sharp driving, the exhaust manifold can be subsequently provided with 3 bellows at righthand engine side on model 116.

This exhaust manifold has a trapezoid connection. Consequently, on vehicles manufactered after approx. November 1977, the front exhaust pipe with external ball connection must be replaced by an exhaust pipe with trapezoid connection.



Exhaust manifold right
model 116

Righthand steering

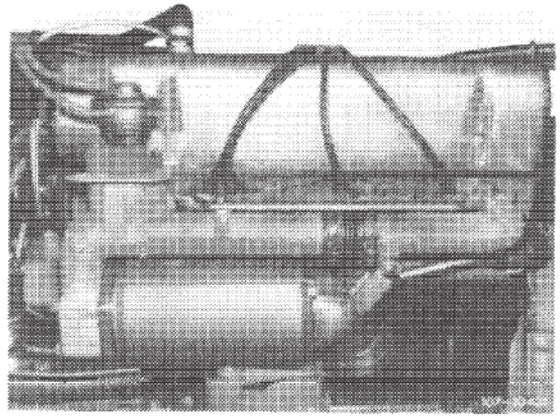
On righthand steering vehicles the exhaust manifolds must be replaced like for like.

B. National version (AUS) (J) (S) (USA)

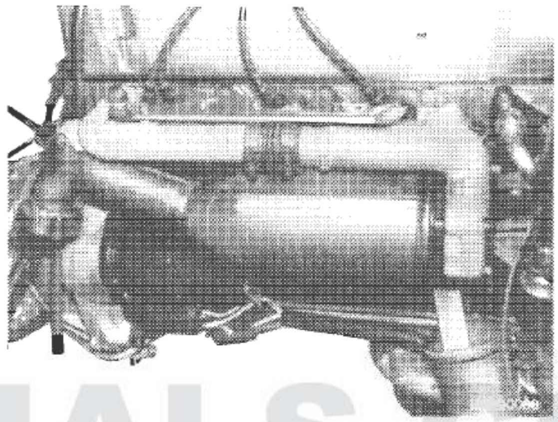
(J) (S) (USA) Model year 1976

Exhaust manifold with internal ball

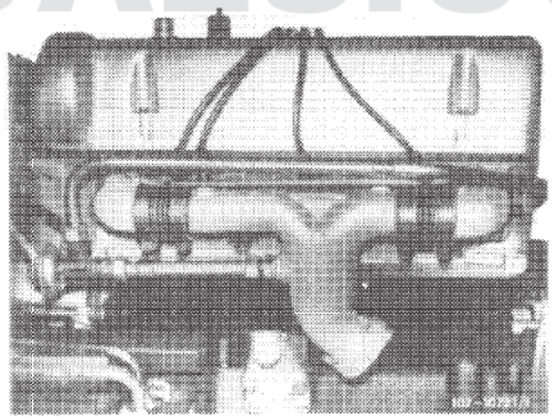
(J) (USA)
Exhaust manifold left



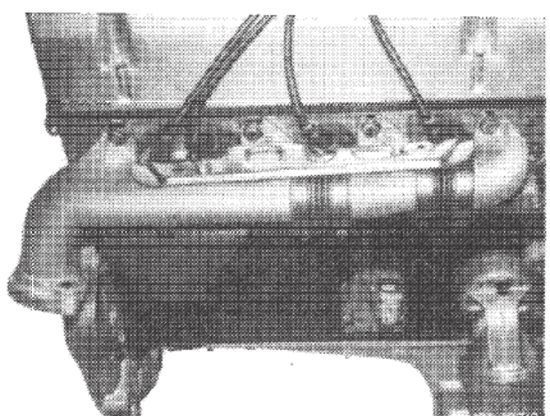
Exhaust manifold right



(S)
Exhaust manifold left



Exhaust manifold right

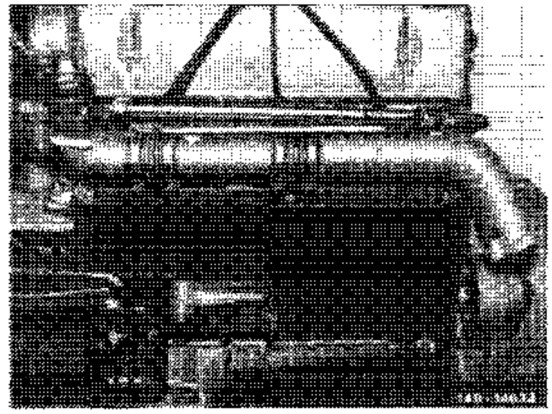


(AUS) (J) (S) model year 1977–1980
(USA) model year 1977–1979

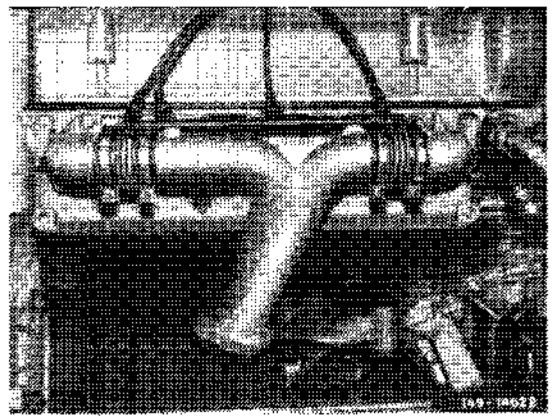
1977 exhaust manifold with internal ball,
starting 1978 exhaust manifold with external ball

Note: If on vehicles model year 1977 an exhaust manifold with external ball connection is installed, the front exhaust pipe must be replaced.

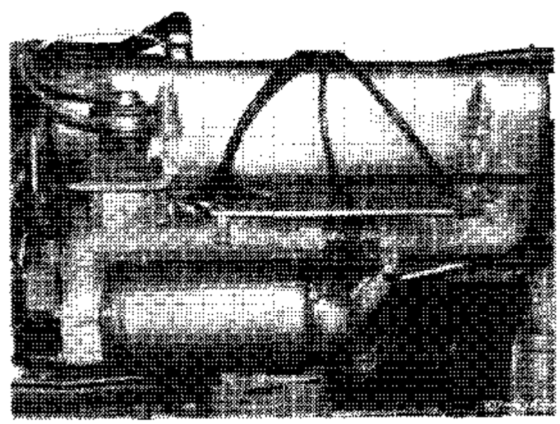
(AUS)
Exhaust manifold left



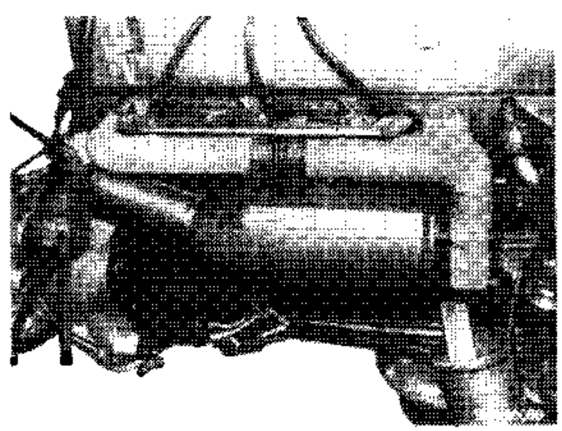
Exhaust manifold right



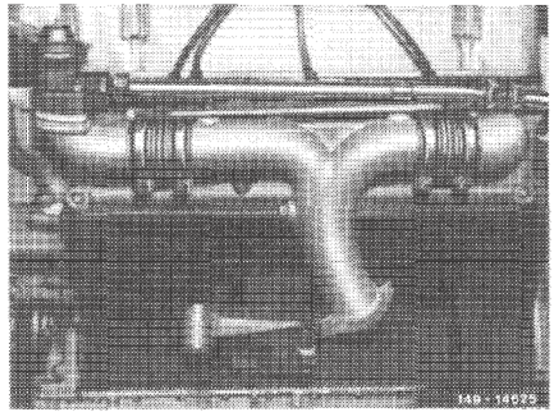
(J)
Exhaust manifold left



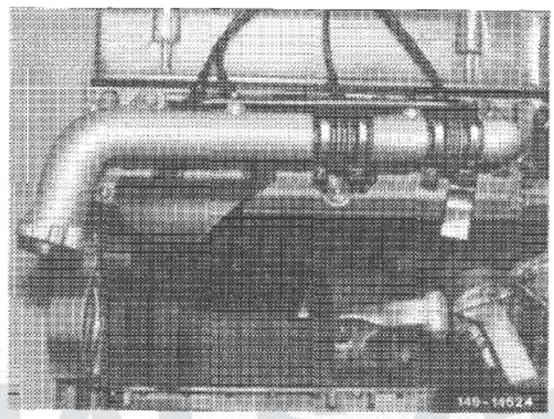
Exhaust manifold right



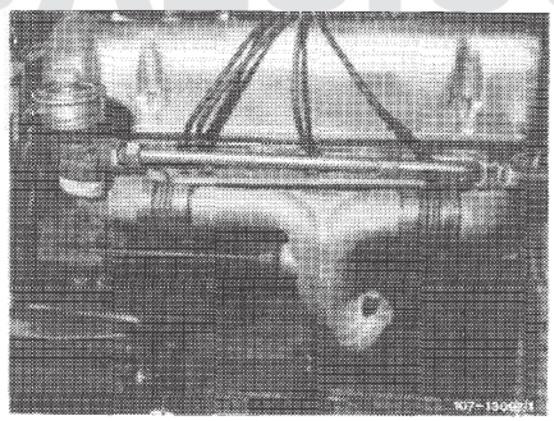
S
Exhaust manifold left



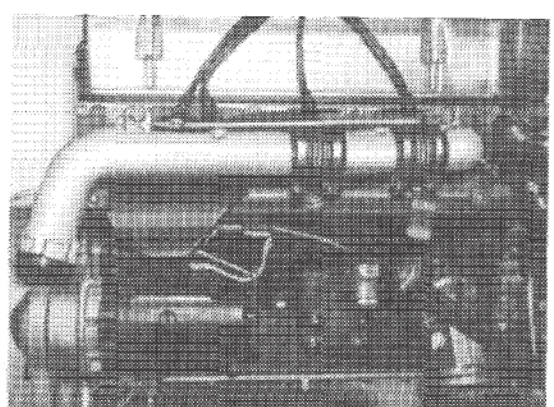
Exhaust manifold right



USA
Exhaust manifold left

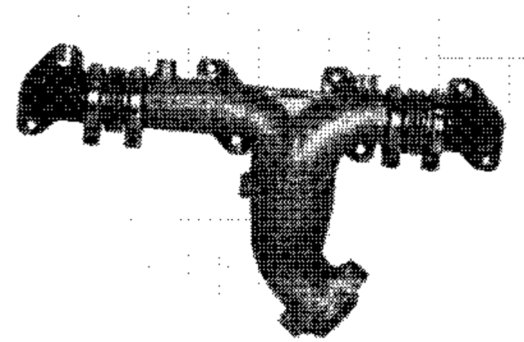


Exhaust manifold right



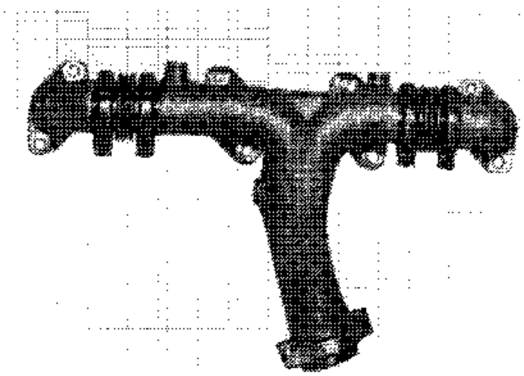
(USA) model year 1980

Without EGR



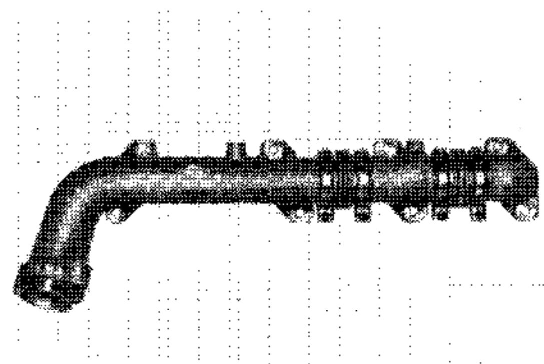
Exhaust manifold left
Model 107

114 – 18851



Exhaust manifold left
Model 116

114 – 18852



Exhaust manifold right
Model 107 and 116

114 – 18854

Testing and adjusting data

A. Standard version

Engine	Ignition distributor Bosch no.	Adjusting value[1]) of firing point without vacuum 3000/min	Test value ignition timing with/without vacuum: idle with	1500/min without	3000/min without	Vacuum adjustment after "retard" at idle	"advance" at 3000/min	Installation value of ignition distributor at starting speed without vacuum
116	0 237 404 003		TDC ± 3°	15–19°	30°	8–12°	8–12°	10° BTDC
117	0 237 404 002	30°[2])						8° BTDC
	0 237 404 006		TDC ± 3°	14–22°	30°	8–12°	8–12°	10° BTDC

[1]) If normally compressed engines are operating with fuel under 98 RON (min. 88 MON) adjust firing point in direction of "retard" and match to octane rating of fuel used. A reference value for this adjustment is: Set firing point back by 1–2° crank angle per 1 RON. Max. setback should not exceed 6° crank angle.
Attention!
Taking firing point back is considered an **"emergency measure".** Reduced input and increased fuel consumption will result. In addition, the engine cannot be fully loaded. **As soon as fuel with specified octane number is available, set engine to full advance.**

[2]) For ignition timing, pull off both vacuum lines for ignition adjustment. Switch off air conditioning system, automatic transmission in position "N" or "P".

B. National version (AUS) (J) (S) (USA)

Engine	Ignition distributor Bosch no.	Adjusting value of firing point with vacuum at idle	Test value ignition timing without vacuum 1500/min	3500/min	Vacuum adjustment after "retard" at idle	"advance" at 3000/min	Installation value of ignition distributor at starting speed without vacuum

(AUS) 1977

Identification: Silver information plate on cross member in front of radiator

117	0 237 405 001	TDC	9–16°	27–33°	6–10°	8–12°	7° BTDC

(AUS) starting 1978

117	0 237 405 002	TDC	9–17°	26–34°	6–10°	8–12°	8° BTDC

(AUS) 1980

117	0 237 405 008	TDC	9–17°	26–34°	6–10°	8–12°	8° BTDC

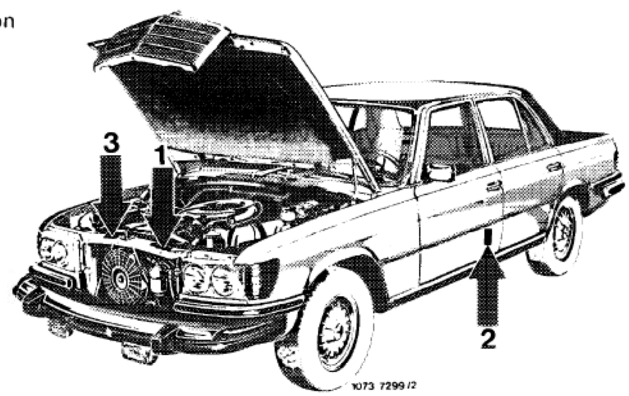
(J) starting 1976

Identification: Information plate on cross member in front of radiator in Japanese language

117	0 237 405 001	TDC	9–16°	27–33°	6–10°	8–12°	7° BTDC

14–001 Functional characteristics

The various emission control systems of USA version vehicles are identified by respective information plates (arrows 1, 2 and 3).



1. Information plate on cross member in front of radiator

This plate shows the identification data as well as all the important engine adjustment data.

Recognizing emission control system from color of information plate – basic color/lettering

Model year	Federal version	California version	Federal version high altitudes	Federal version tourist vehicles	California version tourist vehicles
1971	black/silver	black/silver	–	–	–
1972			–	–	–
1973			–	–	–
1974		green/silver	–	–	–
1975			–	yellow/silver	yellow/silver
1976			–		
1977	black/white	yellow/black	red/black	black/white	yellow/black
1978			–		
1979			–		
1980		black/white	–		black/white

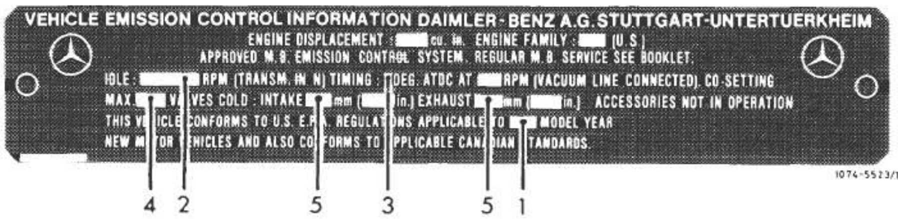
The information plate shows:

1. MODEL YEAR
2. IDLE . . . RPM
3. TIMING . . . DEG. AT . . . RPM
4. Emission value at idle without air injection max . . .

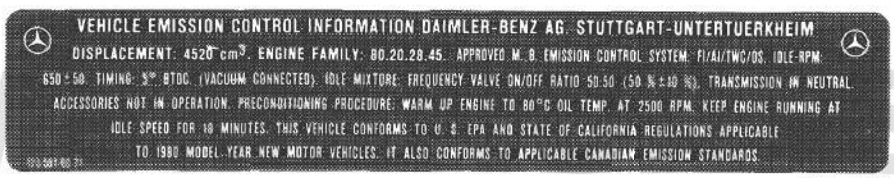
   CO–SETTING MAX. . . . AIR INJECTION DISCONNECTED

5. Valve clearance: INTAKE (. . . in)
   EXHAUST (. . . in)

Information plate up to model year 1979



Information plate model year 1980



1144-9543

Identification data are encoded in an 8-digit code no.

Example: Engine family 80. 20. 28. 45

80 20 2 8 45

Model year — 80

National code no. — 20

20 = Federal and California
21 = Federal
22 = California

Combustion system — 2

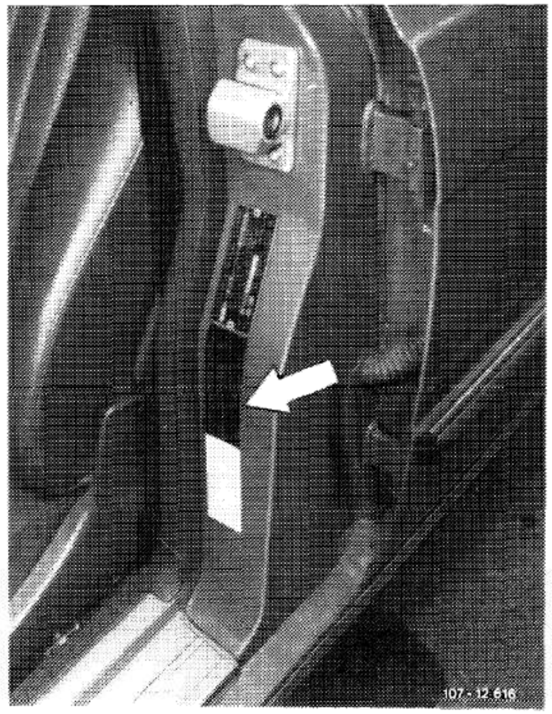
1 = Carburetor
2 = Injection, gasoline
3 = Diesel
4 = Diesel, turbo

Number of cylinders — 8

Displacement approx. 4500 cc — 45

2. Information plate on door pillar of driver's door

This plate shows whether vehicle is provided with catalysts or not.



Recognizing catalysts from color of information plate – basic color/lettering

Model year	Federal version	California version	Federal version high altitudes	Federal version tourist vehicles	California version tourist vehicles
1976	black/silver	black/silver	–	red/silver	red/silver
1977		green/silver	black/silver		blue/silver
1978		black/silver	–		red/silver
1979			–		

Information plates

This vehicle is provided with catalysts.

1074 – 8259

Tourist vehicles

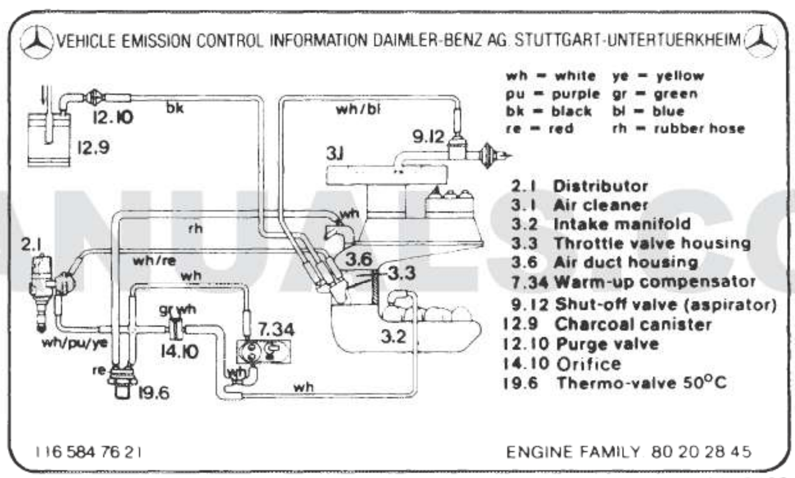
This vehicle is not provided with catalysts by manufacturer.

Catalysts must be installed prior to import into USA.

1074 – 8260

3. Information plate for vacuum line installation located on cross member in front of radiator (California only)

This plate shows the vacuum line layout for all emission system components in engine compartment.



1144–9406

14–050 Discription of operation

Model year 1980

A. General Information

In model year 1980 a uniform emission control system is installed for Federal and California versions.

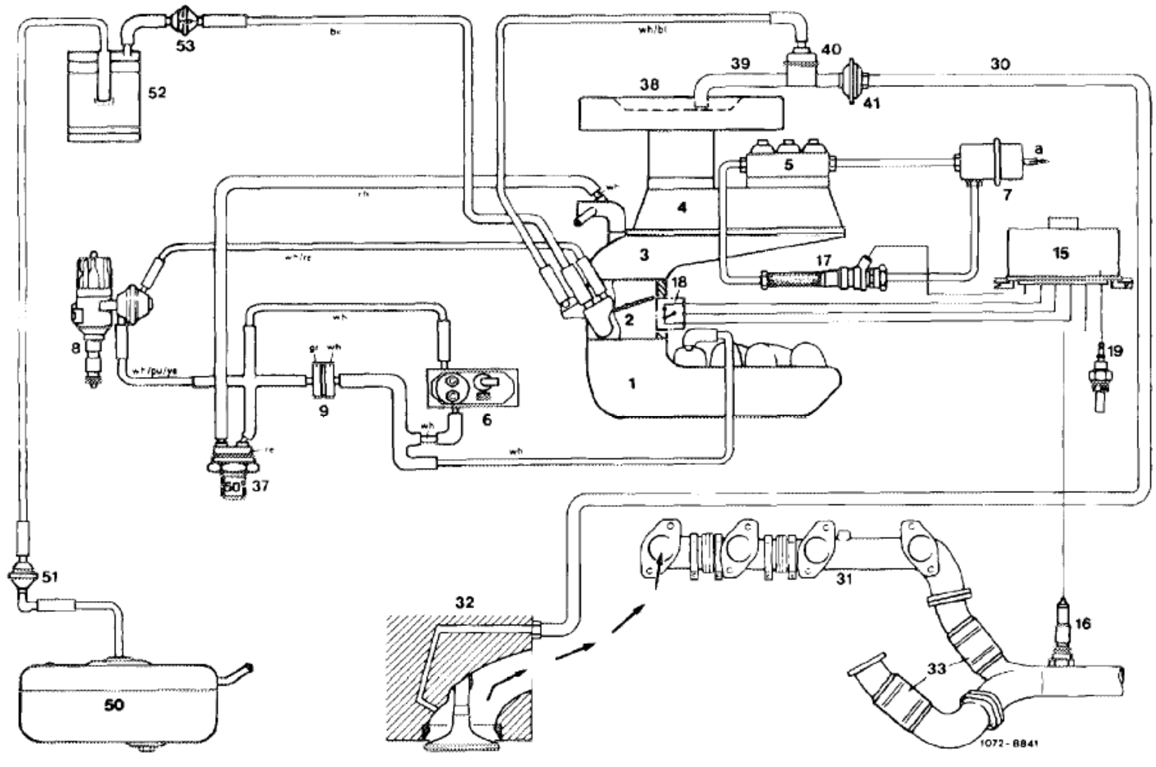
Color Coding of Vacuum Lines

The base of the emission control vacuum lines is transparent (white).

Colored stripes on vacuum lines identify individual functions.

Emission Control System Arrangement	
Ignition	
Advanced timing	red
Retarded timing	yellow/purple
Air injection	blue

Functional Schematic, Vacuum Line Diagram



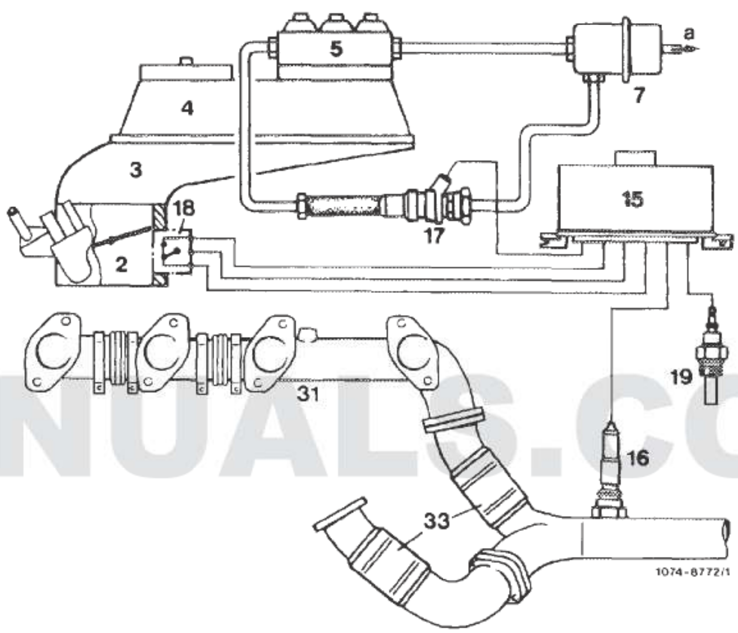
1 Intake manifold
2 Throttle valve housing
3 Air duct housing
4 Air flow sensor
5 Fuel distributor
6 Warm-up enrichment compensator
7 Pressure damper
8 Ignition distributor
9 Restricting orifice
15 Electronic control unit
16 Oxygen sensor
17 Frequency valve
18 Throttle valve switch
19 Temperature switch, oil 16 °C/60 °F
30 Air injection line
31 Exhaust manifold
32 Cylinder head
33 Primary catalyst
37 Thermo-vacuum valve 50 °C/122 °F
38 Air filter
39 Special shaped hose
40 Air shut-off valve
41 Aspirator valve
50 Fuel tank
51 Vent valve
52 Charcoal canister
53 Purge valve
a Leak-off connection

Color code
bk = black
bl = blue
gr = green
re = red
rh = rubber
ye = yellow
wh = white
pu = purple

B. Lambda Control (λ = Lambda)

In order to comply with stricter emission regulations for internal combustion engines, it is necessary to meter the air-fuel mixture more accurately.

The oxygen sensor control system ensures that a constant air-fuel weight ratio is maintained at approx. 14.5 : 1 ($\lambda = 1$). That means, that an exact proportioning between the injected fuel and the air drawn in can be obtained. This is the ideal mixture ratio, which reduces, in conjunction with the 3-way catalysts, the emissions of HC, CO and NO_x in the exhaust gas to a minimum.

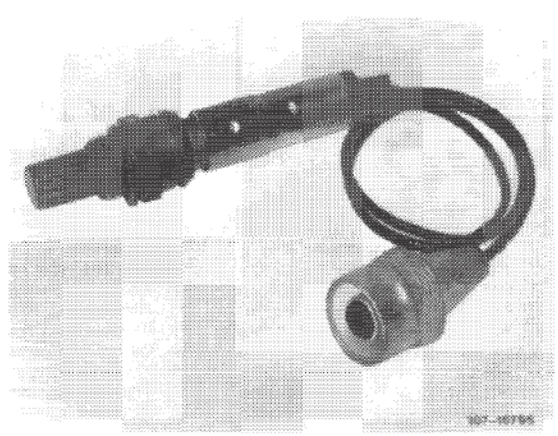


2 Throttle valve housing
3 Air duct housing
4 Air flow sensor
5 Fuel distributor
7 Pressure damper
15 Electronic control unit
16 Oxygen sensor
17 Frequency valve
18 Throttle valve switch
19 Temperature switch, oil 16 °C/60 °F
31 Exhaust manifold
33 Primary catalyst
a Leak-off connection

Components of Lambda Control

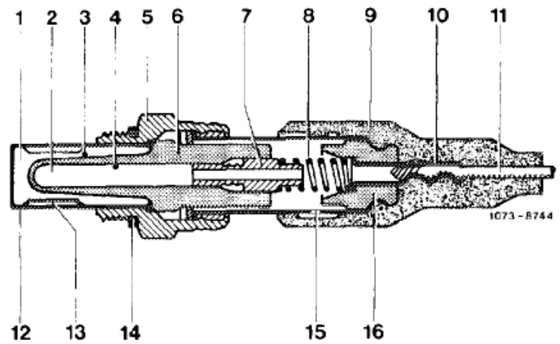
Oxygen Sensor

The oxygen sensor is screwed into the front part of the exhaust pipe to measure the oxygen content in the exhaust gases.



Construction

The protective casing (12) protects the probe's ceramic insert (6) against mechanical damage. The outer part of the ceramic insert is in contact with the exhaust gases, the inner side with surrounding air. The ceramic surfaces are coated with a thin layer of permeable platinum. In addition, a porous layer of ceramic was added on the exhaust side, which protects the platinum surface underneath against fouling from combustion materials, ensuring a long life of the oxygen sensor.



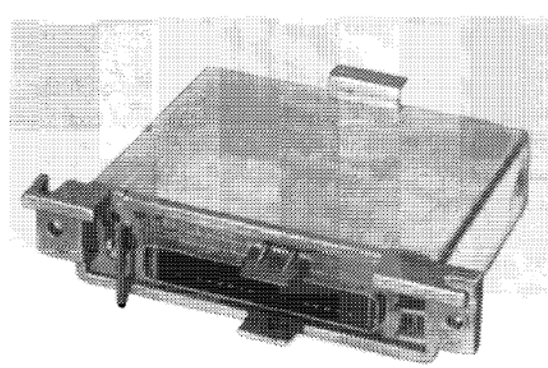
1 Exhaust gas side
2 Outside air side
3 Outer electro-conductive layer
4 Inner electro-conductive layer
5 Probe body with hexagon
6 Probe-ceramic
7 Contact bushing
8 Contact spring
9 Protective boot
10 Crimp connector
11 Connecting leak
12 Case
13 Exhaust gas intake slots
14 Seal ring
15 Fresh air intake slot
16 Insulator

Function

At a temperature of approx. 300 °C/580 °F the ceramic material becomes conductive to the oxygen ions. A different amount of oxygen between either side (exhaust gas side and fresh air side) presents a chemical reaction between the adjoining surfaces and induces an electrical potential. The value of this potential represents the measurement for oxygen differential on both sides of the oxygen sensor. The oxygen sensor is highly sensitive at a range of $\lambda = 1$ (ideal air-fuel ratio) and signals the electronic control unit of this being the desired value.

Electronic Control Unit

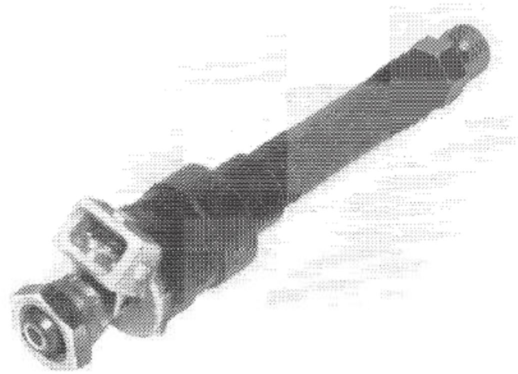
The electronic control unit is located behind the right kick panel. A combination of printed circuits regulates the air-fuel mixture to an ideal value of $\lambda = 1$.



107-16791

Frequency Valve

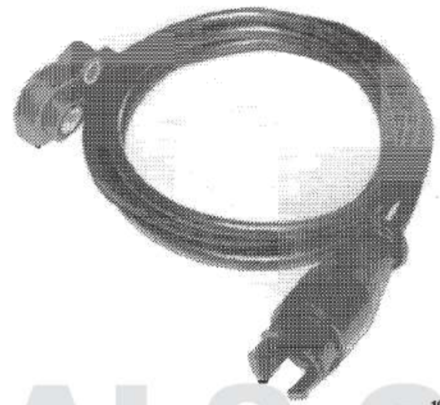
The frequency valve is attached to the air flow sensor housing. It is connected to a fuel line from the lower chamber of the fuel distributor via the pressure damper to the return line of the warm-up enrichment compensator.



107–16794

Throttle Valve Switch

The throttle valve switch is installed on the throttle valve housing and has two functions: Idle and full throttle contact.



107–17070

Idle Contact

At idle, the throttle valve switch limits the operating range of the oxygen sensor through the electronic control unit. This will eliminate rpm fluctuation at idle.

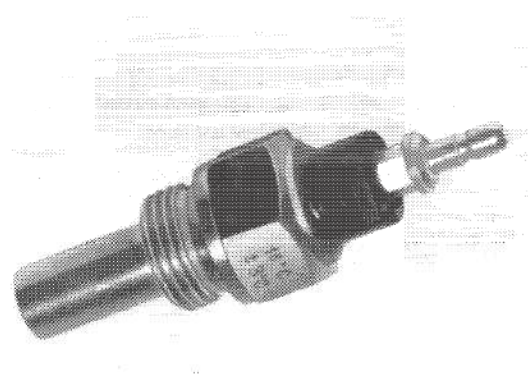
Full Throttle Contact

If the vehicle is driven at full throttle (throttle valve at full throttle stop), the full throttle contact produces in the electronic control unit a fixed 60 to 40 on-off ratio (rich mixture).

Oil Temperature Switch – 16 °C/60 °F

The temperature switch is screwed into the oil filter housing. Below an engine oil temperature of approx. 16 °C/60 °F the temperature switch connects the electronic control unit to ground (–) which produces a fixed 60 to 40 on-off ratio.

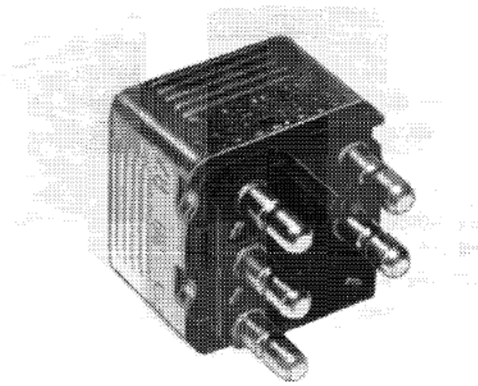
At approx. 16 °C/60 °F the oil temperature switch opens and the electronic control unit resumes its normal cycling.



107–16798

Voltage Supply Relay

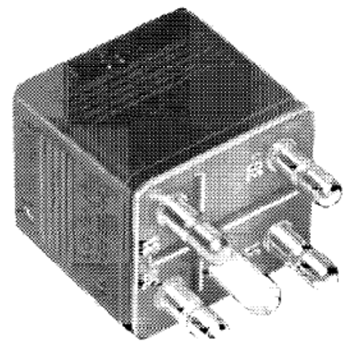
The Lambda system receives voltage from the voltage supply relay located behind the glove box.



107–17461

Excess Voltage Protection Unit

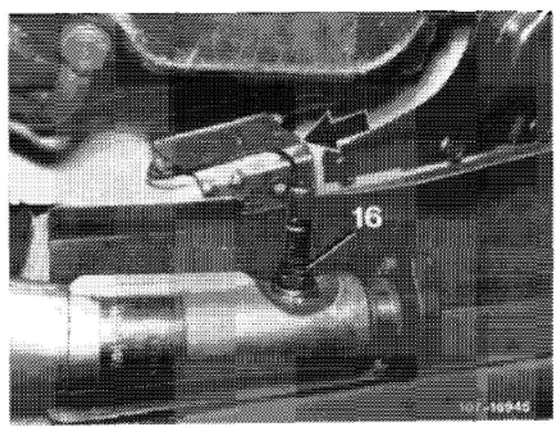
To prevent damage to components of the Lambda system in the event of overloading the vehicle's electrical system (fast charging of battery, loose battery connection), an excess voltage protection unit is connected ahead of the voltage supply relay.



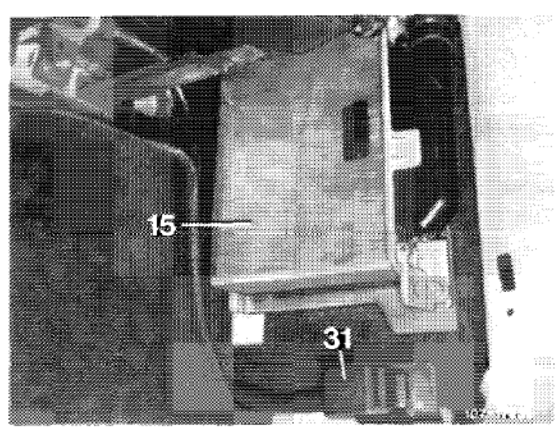
154-17174

Description of Operation

At an operating temperature of 300 °C/580 °F the oxygen sensor (16), which is screwed into the front exhaust pipe, builds up an electrical potential according to the amount of oxygen received through the exhaust gases, and signals the electronic control unit if the mixture is richer or leaner than the ideal mixture of Lambda = 1.

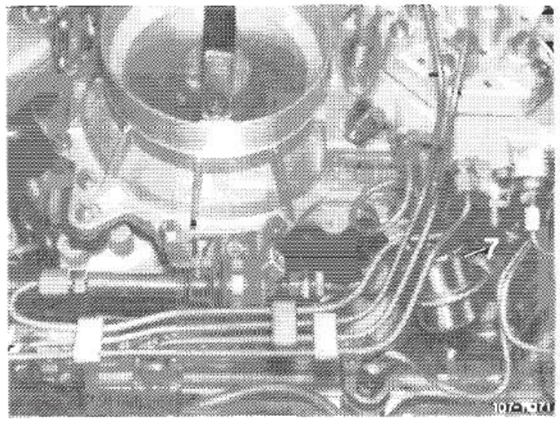


The electronic control unit (15) conveys signals received from the oxygen sensor, as electrical impulses to the frequency valve (17).



The frequency valve is a solenoid valve which, depending on the received electrical impulses varies the differential pressure at the metering slots and thereby the amount of injected fuel (On-Off ratio) (see 07.3, Fuel Distributor).

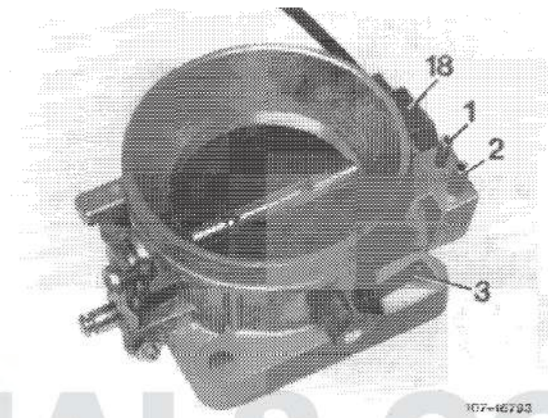
While driving with full throttle or below an engine oil temperature of 16 °C/60 °F, the Lambda control is cancelled, and the electronic control unit cycles the frequency valve at a constant 60 % open and 40 % closed ratio.

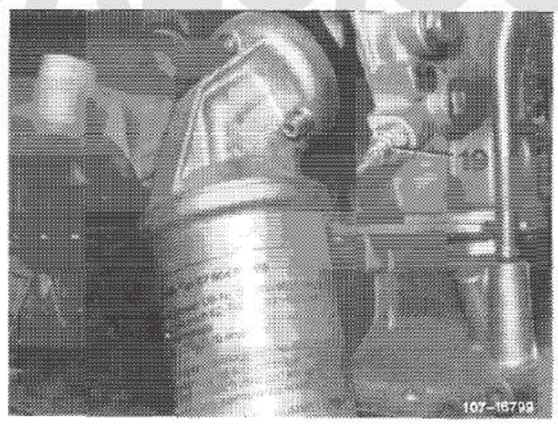


These two operating conditions are controlled by the throttle valve switch (18) or by the oil temperature switch (19).

At 30.000 miles an indicator light on the instrument panel lights up to indicate that the oxygen sensor must be replaced.

Beyond that, it is suggested to replace the oxygen sensor every 30.000 miles.





C. Air injection

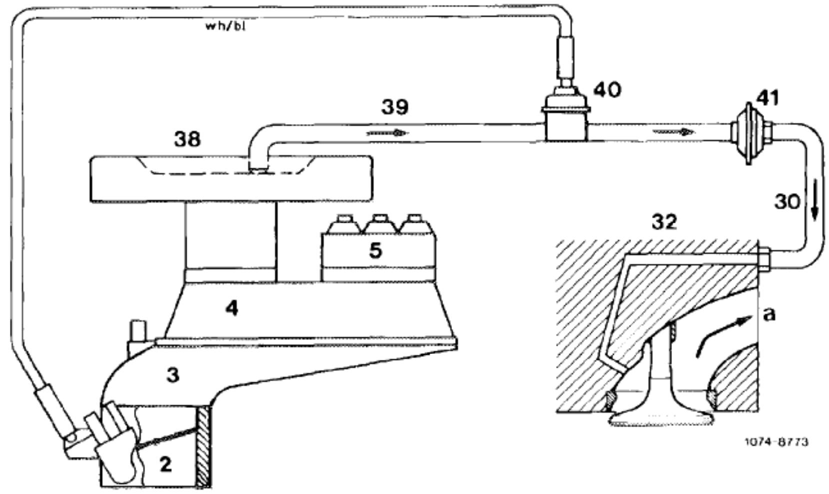
To achieve a smooth idle air is injected into the hot zone behind the exhaust valves at all temperatures.

Subsequently the oxygen sensor detects a lean mixture, and the air-fuel ratio is slightly enriched by the electronic control unit.

Operational Schematic

2 Throttle valve housing
3 Air duct housing
4 Air flow sensor
5 Fuel distributor
30 Air injection line
32 Cylinder head
38 Air cleaner
39 Special shaped hose
40 Air shut-off valve
41 Aspirator valve
a to exhaust manifold

Color code
bl = blue
wh = white

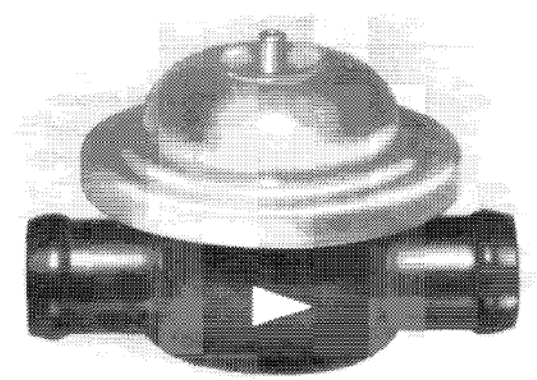


1074-8773

Components of Air Injection System

Air Shut-Off Valve

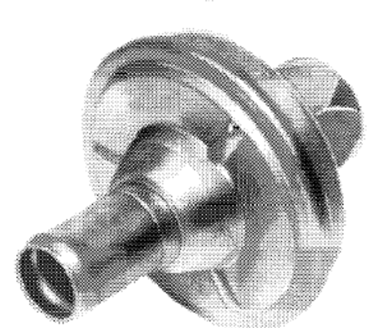
The vacuum governed air shut-off valve is located in the special shaped hose between the air filter and the aspirator valve, and controls the air injection in dependance of vacuum.



107-17170

Aspirator Valve

The aspirator valve is installed into the air injection line leading to the cylinder head. Its function is air injection and preventing the hot exhaust gases from flowing back to the air filter.

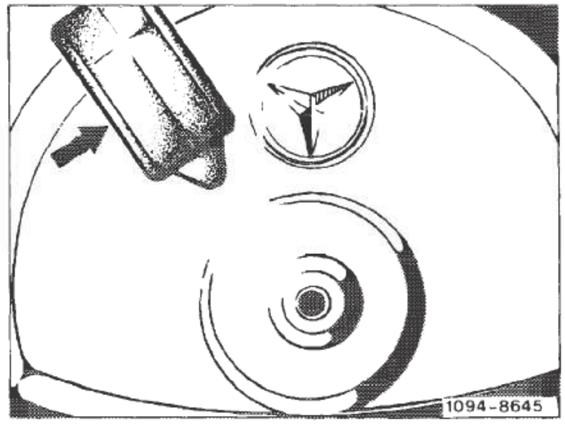


107-12615

Air Filter

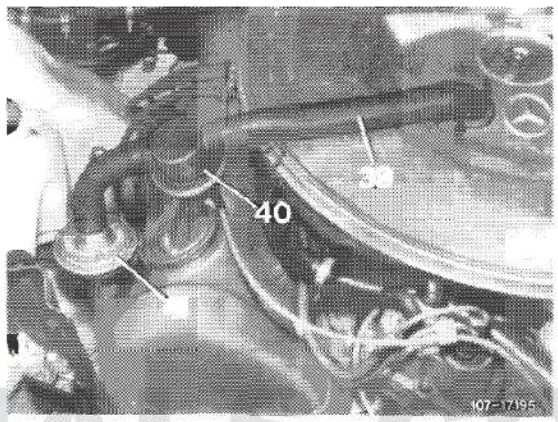
The cover of the air filter is provided with a connection for air injection.

The special shaped hose (arrow) is connected on the air filter cover and draws air from the clean air side of the air filter.



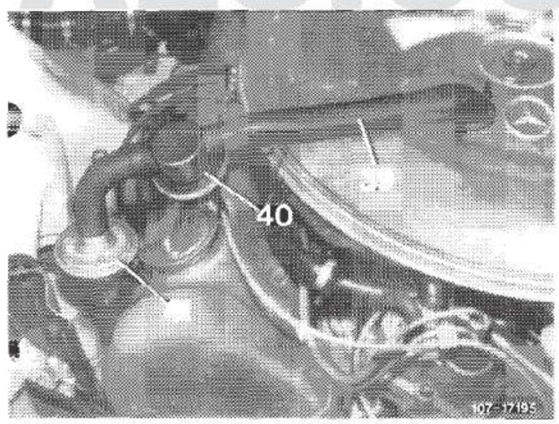
Special Shaped Hoses, Air Injection Lines and Air Passages

The air is drawn from the air filter via the special shaped hoses, and transferred via injection lines and air passages through the injection ports behind the exhaust valves.



Description of Operation

With the engine running and throttle valve closed (idle position), the intake manifold vacuum causes the air shut-off valve (40) to open. The aspirator valve (41) draws air from the filtered air side of the air filter past its heat resistant diaphragm. The vacuum pulsations that are created behind the exhaust valves and in the exhaust manifold, open the aspirator's diaphragm. If the pressure is positive, it closes the diaphragm and prevents gases from flowing into the air cleaner.

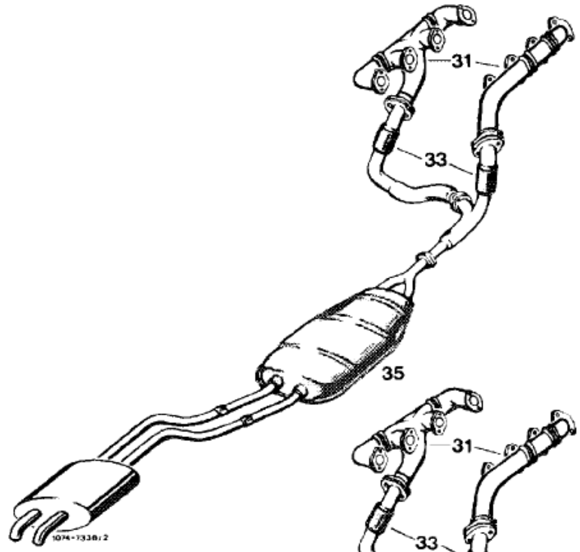


The oxygen contained in the air is combined with hot exhaust gas and is conducted through the primary catalyst to the oxygen sensor. The sensor senses a lean mixture and transmits appropriate signals to the control unit so that the idle mixture will be slightly enriched. This serves to achieve stable running at idle.

D. Catalytic Converter

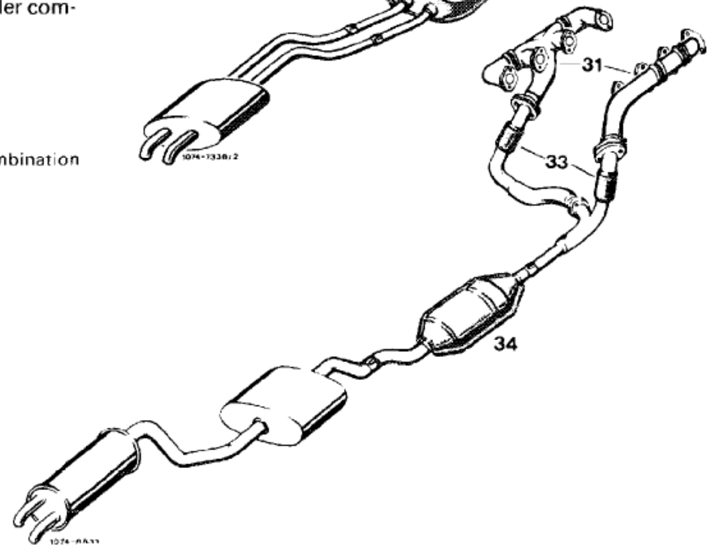
The catalysts are designed as three-way catalytic converters and are located in the exhaust system in front of the mufflers. By using this configuration, the toxic components CO (carbon monoxide), HC (hydrocarbons) and NO_x (nitric oxides) can be proportionately reduced to a minimal amount in connection with the use of the oxygen sensor (at $\lambda = 1$).

We differentiate between primary and underfloor catalyst. Chassis type 107 has a catalyst-muffler combination.



Chassis Type 107

31 Exhaust manifold
33 Primary catalyst
35 Catalyst-muffler combination

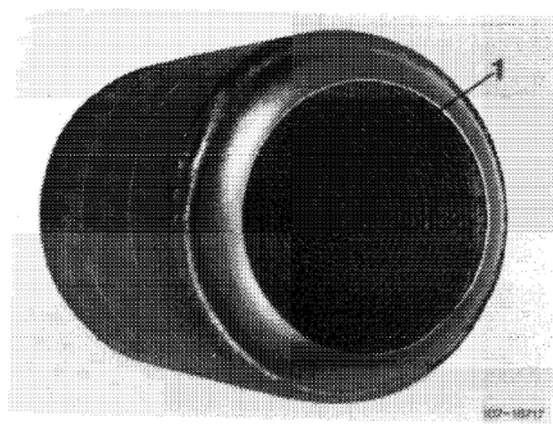


Chassis Type 116

31 Exhaust manifold
33 Primary catalyst
34 Underfloor catalyst

Primary Catalyst

This catalyst consists of a monolith, a honeycomb-shaped structure of steel and is pressed into the exhaust pipe and welded to it.



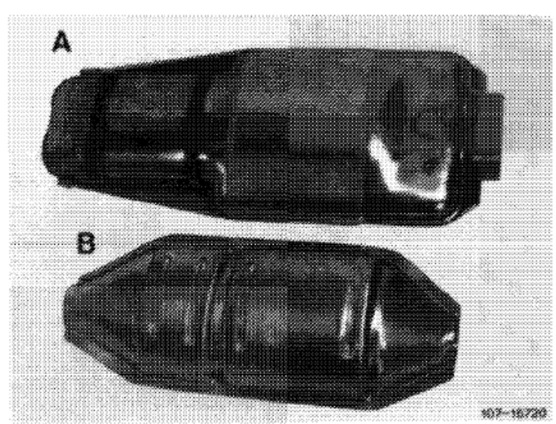
Primary Catalyst

1 Monolith (steel structure)

Underfloor Catalyst and Catalyst-Muffler Combination

The catalysts consist of a monolith (3), a honeycomb-structure of ceramic material which is elastically mounted in a wire mesh structure (2).

The precious metal coating on the monolith accelerates the reduction and/or oxidation of toxic materials.

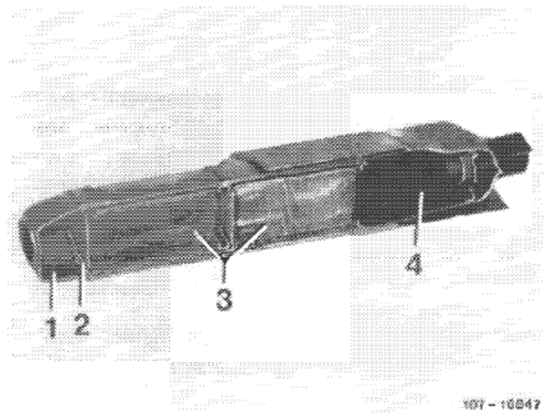


A Catalyst-muffler combination, Chassis type 107
B Underfloor catalyst, Chassis type 116

Run engine **only** on unleaded gasoline to keep catalysts operational.

Avoid overheating of catalysts.

Extended overheating of catalysts will result in damage, which means that the monoliths may melt.



Model 107

1 Housing
2 Wire mesh
3 Monolith
4 Muffler

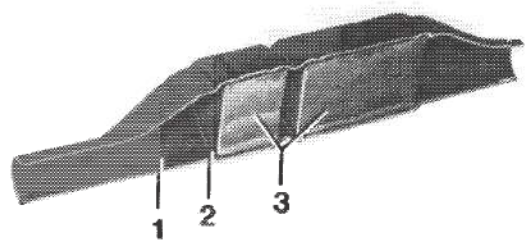
Catalysts may overheat for the following reasons:

a) Lack of engine maintenance.

Spark plugs in proper condition are important for life of catalysts.

b) Due to irregular firing, the fuel-air mixture becomes too rich.

c) Emission control system has been tampered with.



Model 116

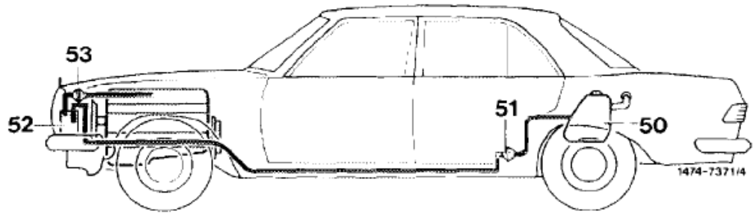
1 Housing
2 Wire mesh
3 Monolith

E. Fuel evaporation control system

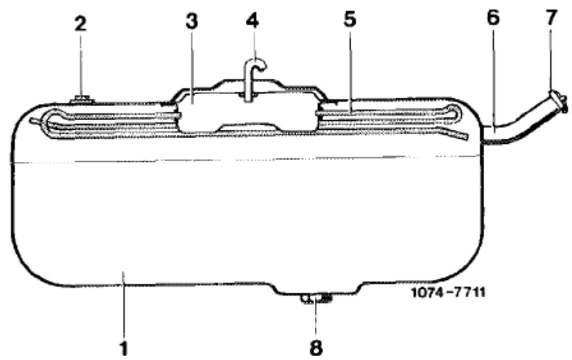
A fuel evaporation control system has been installed to improve emissions which are not directly connected to engine combustion.

Function diagram

50 Fuel tank
51 Vent valve unit
52 Charcoal canister
53 Purge valve



Components of fuel evaporation control system

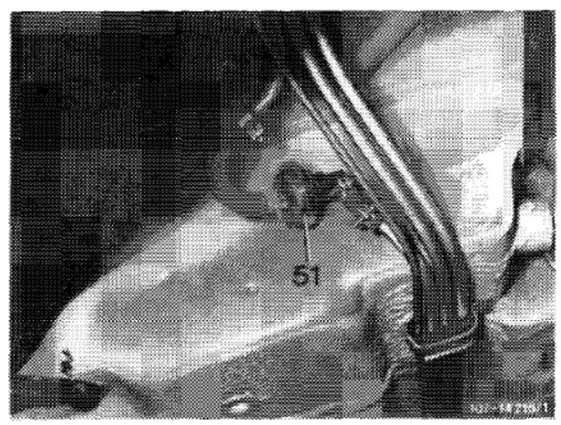


Fuel tank

A collecting tray inside fuel tank is connected to the pipe system. The connection to vent valve unit enters the collecting tray.

1 Fuel tank
2 Immersion tube transmitter
3 Expansion tank
4 Connection vent valve unit
5 Pipe system
6 Filler neck
7 Tank cap
8 Connection fuel feed line

Vent valve unit

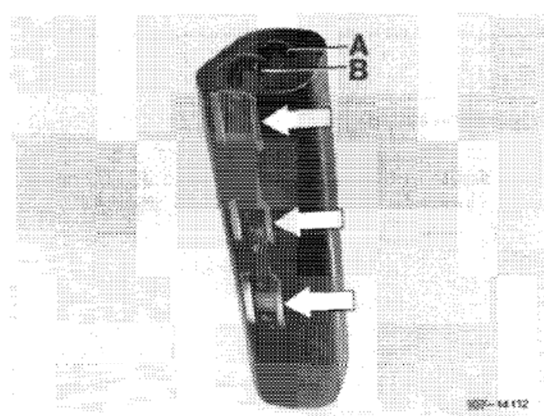


The vent valve unit (51) is mounted underneath vehicle at level of rear legroom.

The unit comprises a negative vent valve (pressure relief valve) and a positive vent valve (vacuum relief valve).

Note: The vent valve unit is optionally available in two versions which are, however, identical with regard to operation and effect.

Charcoal canister



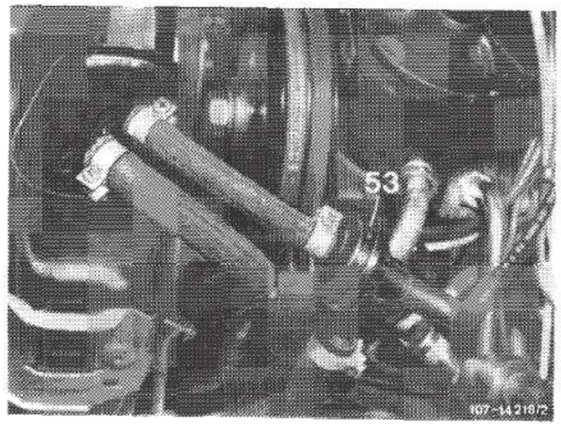
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn off again while driving.

A Draw-off connection
B Tank vent connection

Purge valve

The purge valve (53) is located in purge line from charcoal canister to throttle valve housing.

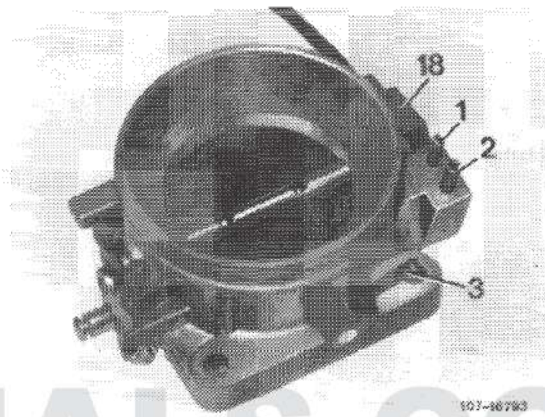
Note: The purge valve is optionally available in two versions which, however, are identical with regard to operation and effect.



Throttle valve housing

Connection (2) on throttle valve housing serves for drawing evaporation vapors from charcoal canister.

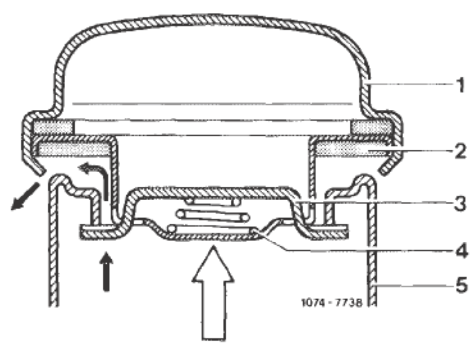
The throttle valve switch (18) is installed to regulate lamdba control (idle and full throttle stop).



1 Connection vacuum advance
2 Draw-off connection charcoal canister
3 Connection air shutoff valve
18 Throttle valve switch

Fuel tank closing cap

To prevent increased overpressure in fuel tank, the fuel tank cap has been modified starting model year 1978.

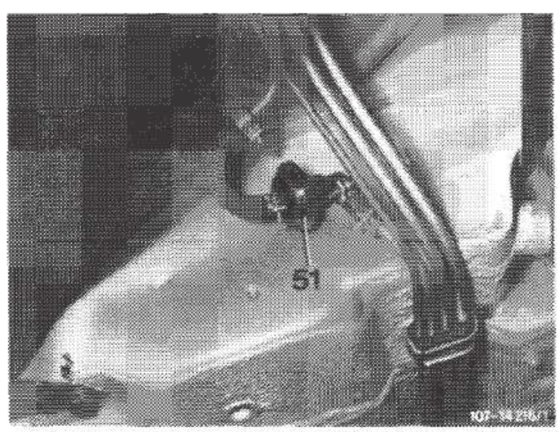


1 Closing cap
2 Gasket
3 Clamp
4 Compression spring
5 Filler neck

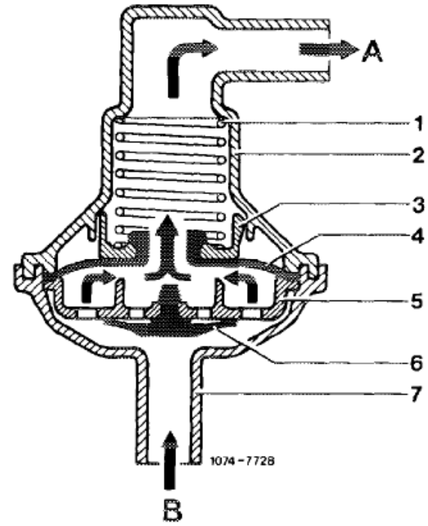
Operation

Evaporation system

The pressure in fuel tank is increased to 30–50 mbar by the vent valve unit (51). As a result, less fuel vapors can escape from fuel tank.



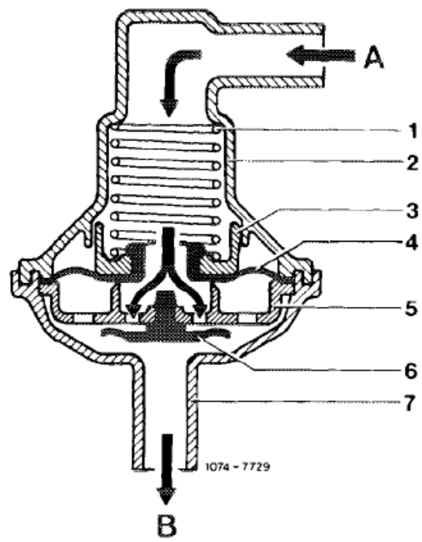
As soon as the pressure in fuel tank reaches 30–50 mbar, the negative vent valve (4) opens allowing the fuel vapors to flow to the charcoal canister where they are stored if the engines is not running.



Vent valve unit open to charcoal canister

1 Compression spring
2 Valve housing
3 Spring retainer
4 Negative vent valve (pressure relief valve)
5 Valve disc
6 Positive vent valve (vacuum relief valve)
7 Connection
A Connection charcoal canister
B Connection fuel tank

When the fuel cools down, the smaller volume is compensated by the intake of air or fuel evaporation vapors from charcoal canister via positive vent valve (6) starting at a vacuum of 1–16 mbar. If the vacuum in fuel tank drops below 1 mbar, the positive vent valve (6) will close.



Vent valve unit open to fuel tank

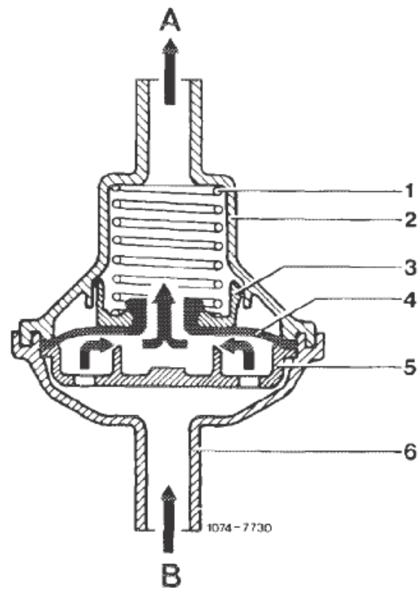
If the pressure in the fuel tank increases to above 0.1–0.3 bar due to a malfunction in the fuel evaporation system, the fuel vapors escape via fuel tank cap.

Purge system

The charcoal canister is connected to the throttle valve housing by means of a line in which the purge valve is installed.

When the engine is running and the vacuum in the purge line exceeds 30–50 mbar, the purge valve will open. The fuel vapors stored in charcoal canister can be drawn off depending on throttle valve position.

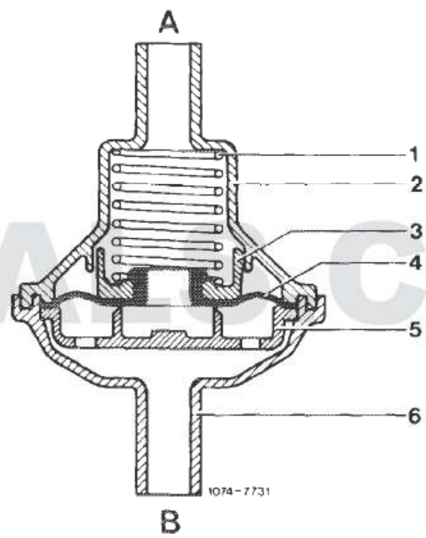
When the throttle valve opens, the two purge bores in throttle valve housing, which are entering a common duct, are both passed over one after the other. As a result, purging in lower partial range begins in dosages which are not influencing the driving characteristics.



Purge valve (open)

1 Compression spring
2 Valve housing
3 Spring retainer
4 Negative vent valve (pressure relief valve)
5 Valve disc
6 Connection
A Connection throttle valve housing
B Connection charcoal canister

At idle and during deceleration (throttle valve closed) the two purge bores are at atmospheric side of throttle valve. There is no purging of charcoal canister.

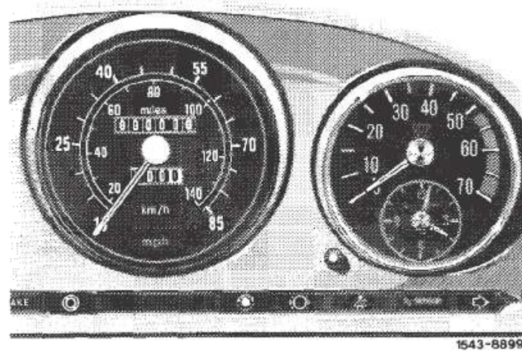


Purge valve (closed)

F. Oxygen sensor renewal indicator

Pertinent legislation specifies that the oxygen sensor must be renewed once after 30 000 miles. This is indicated by an "oxygen sensor" indicator lamp (arrow) in instrument cluster lighting up.

The oxygen sensor is renewed in the USA only.

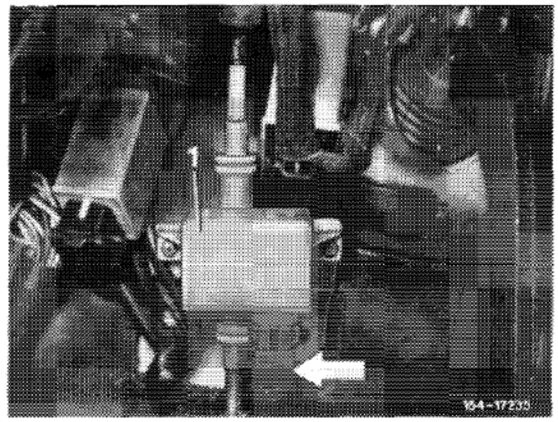


The mileage indicator is attached under instrument panel and is driven by tachometer shaft. When the respective number of miles is attained, a contact will close and the "oxygen sensor" indicator lamp will light up.

After replacing the oxygen sensor, the indicator lamp is made inoperative by pulling-off plug (arrow) on mileage counter.

Note: Prior to installing oxygen sensor, coat its threads with hot lubricating paste 000 989 88 51.

The tightening torque of oxygen sensor is 50–60 Nm.



G. Hints for troubleshooting lambda control

For complaints such as:

Poor warm-up characteristics of engine, hunting at idle, not accepting gas or splashing during acceleration, proceed as follows:

1 *Check* frequency valve while running engine at operating temperature and at idle, place hand on output end (fuel hose) of frequency valve to check for noticeable operation. If frequency valve is not operating, perform test program (14–100).

2 Check on/off ratio and regulate, if required (07.3–105).

3 Check adjustment of throttle valve switch and correct, if required (07.3–170).

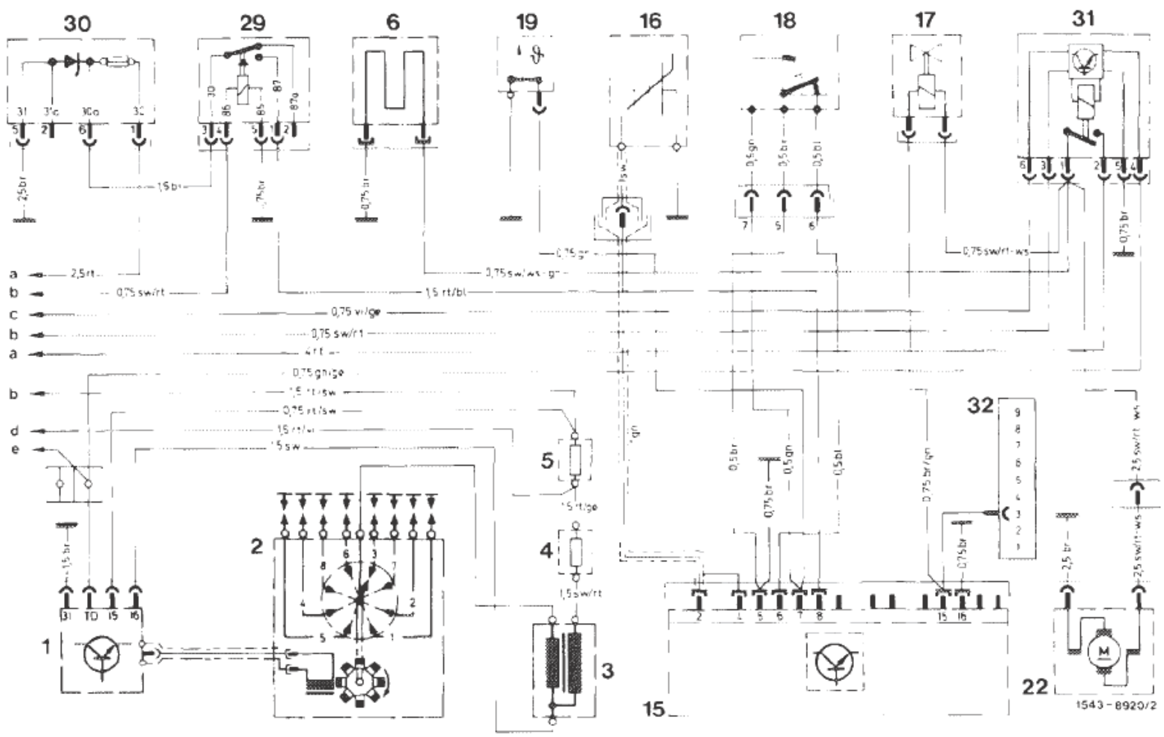
4 Check acceleration enrichment of warm-up compensator (07.3–175).

5 Check fuel pressures and firing point and correct, if required (07.3–120 or 15–500).

6 Check engine for mechanical condition and eliminate faults, if required.

There should be no more faults after these complaints have been remedied.

H. Electric wiring diagram lambda control

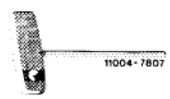


1 Transistorized ignition switching unit
2 Ignition distributor
3 Ignition coil
4 Pre-resistance 0.6 Ω
5 Pre-resistance 0.4 Ω
6 Warm-up compensator
15 Lambda control unit
16 Oxygen sensor
17 Frequency valve
18 Throttle valve switch
19 Temperature switch 16 °C/61 °F
22 Fuel delivery pump
29 Relay voltage supply
30 Overvoltage protection
31 Fuel pump relay (electronic)
32 Diagnosis socket
a Cable connector, terminal 30
b Fusebox, terminal 15
c Relay air-conditioning/starter terminal 87
d Starter terminal 16
e Diagnosis socket, jack 1

14–100 Test Program

For complaints such as:	On-Off ratio cannot be maintained, poor engine warm-up performance, uneven idle, engine not accelerating or splashing when accelerating, the following test have to be made. Testing of Lambda control Testing of air injection Testing of fuel evaporation control system
Condition:	Assuming that the fuel injection and ignition system is o.k.

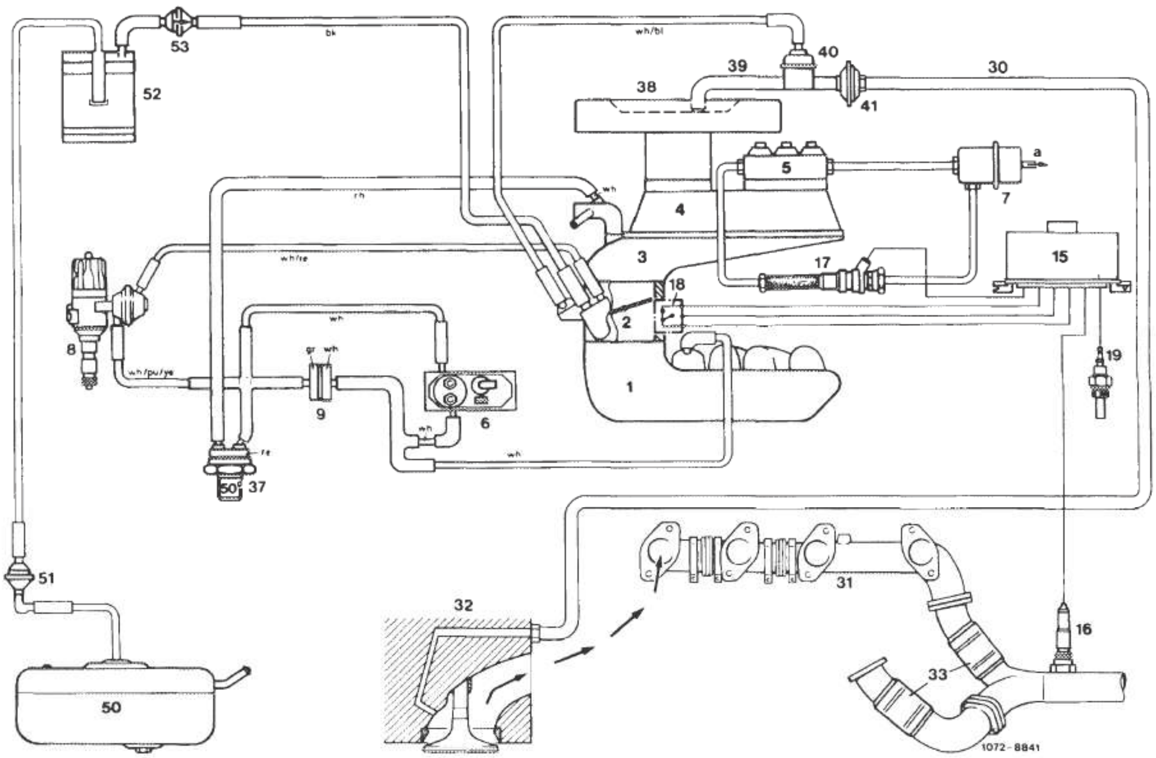
Special Tools

Remote oil temperature gauge		116 589 27 21 00
Allen wrench 3 mm		000 589 14 11 00
Adapter for testing electrical circuits and individual parts		110 589 14 21 00

Shop Tools

Tachometer, Multimeter (Volts – Ohms)	
Lambda control tester	KDJE–P 600

Functional Schematic



1 Intake manifold
2 Throttle valve housing
3 Air duct housing
4 Air flow sensor
5 Fuel distributor
6 Warm-up enrichment compensator
7 Pressure damper
8 Ignition distributor
9 Restricting orifice
15 Electronic control unit

16 Oxygen sensor
17 Frequency valve
18 Throttle valve switch
19 Temperature switch, oil 16 °C/60 °F
30 Air injection line
31 Exhaust manifold
32 Cylinder head
33 Primary catalyst
37 Thermo-vacuum valve 50 °C/122 °F
38 Air filter

39 Special shaped hose
40 Air shut-off valve
41 Aspirator valve
50 Fuel tank
51 Vent valve
52 Charcoal canister
53 Purge valve
a Leak-off connection

Color Code
bk = black
bl = blue
gr = green
re = red
rh = rubber
ye = yellow
wh = white
pu = purple

A. Quick test with lambda control tester KDJE–P600

The lambda control tester can be used for adjusting on/off ratio at idle, but also for a quick diagnosis of lambda control.

Connect lambda control tester to diagnosis socket and revolution counter. Connect oil telethermometer.

Note: If the specified nominal value is not attained, refer to quick test with adapter.

Scope of test	Actuation	Readout/nominal value
Cold running control		
a) Engine oil temperature < 13 °C	Engine at idle	Constant between 56–64 %
b) Simulation	Pull plug from temperature switch 16 °C/61 °F and connect to ground	Readout as above
Warm-up control		
a) Engine oil temperature < 20 °C/ 68 °F, oxygen sensor not yet ready for operation (< approx. 300 °C/572 °F)	Engine at idle	Constant between 46–54 %
b) Simulation	Separate plug of oxygen sensor	Readout as above
Control at operating temperature		
Engine oil temperature approx. 80 °C, oxygen sensor ready for operation (< approx. 300 °C)	Engine at idle	Slowly swinging needle
Idle contact closed	Throttle valve at idle stop	Deflection of needle approx. 8–12 %
Idle contact open	Slightly open throttle valve	Deflection of needle approx. 13–23 %
Full throttle contact closed	Apply full throttle for a short moment	Constant between 56–64 %
Lean stop control unit	Separate plug of oxygen sensor	Constant
	Connect plug for control unit to 2 Volt output of tester **for a short moment**	< approx. 20 %
Rich stop control unit	Separate plug of oxygen sensor	Constant
	Connect plug for control unit to ground **for a short moment**	> 87 %

B. Quick test with adapter

Connect adapter to plug control unit and multimeter to adapter.

Test Set-Up	Circuit or Component Tested	Stetting of Controls	Specified value . . . . *If deviating see individual component test program section*
Adapter Position 1 with voltmeter	Supply voltage	Ignition turned on	12 ± 2 Volts, adapter indicator light on *If deviating see section I*
Adapter Position 2 with ohmmeter	Throttle valve switch	Ignition off Idle position . . . . Full throttle position	∞ Ohms (infinity) 0 Ohms *If deviating see sections IV + V*
	16 °C/60 °F Temperature switch	Ignition off	Below $<16 \pm 3\,^{\circ}C$ = 0 Ohms Above $>16 \pm 3\,^{\circ}C$ = ∞ Ohms *If deviating see sections II + III*
Adapter Position 3 with ohmmeter	Throttle valve switch	Ignition off Idle position . . . . Advance throttle linkage slightly . . .	0 Ohms ∞ Ohms *If deviating see sections IV + V*
Adapter Position 4 with voltmeter	Frequency valve	Ignition on crank engine	12 ± 2 volts *If deviating see sections VI + IX*
Adapter Position 5 with ohmmeter	O_2 Sensor probe cable and connection to electronic control unit	Ignition off Pull off O_2 sensor connection and bridge plug going to electronic control unit	∞ Ohms 0 Ohms *If deviating see sections VII + VIII*
Disconnect special testing adapter and reinsert plug into the electronic unit. Connect Lambda control tester		Run engine until operating temperature is obtained	On-Off ration 50 % ± 10 % *If deviating see section X*
Remove special shaped hose from the air shut-off valve		Start engine	Suction sound must be audible from the aspirator valve *If deviating see section XI*
Disconnect purge line at the charcoal canister leading to the throttle valve housing		Run engine at idle . . . . at approx. 2000 rpm	No vacuum present Vacuum present *If deviating see section XII*

C. Test Program for Individual Components

Test Section A

Test Requirements: Special testing adapter connected to plug of electronic control unit and multimeter connected to the special testing adapter.

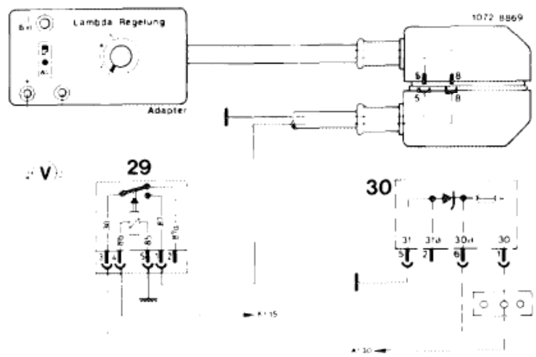
Connect remote oil temperature gauge.

I Voltage supply test for the electronic control unit

Turn selector knob of testing adapter to position 1, set multimeter to 0–30 V range, turn ignition on and read voltage.

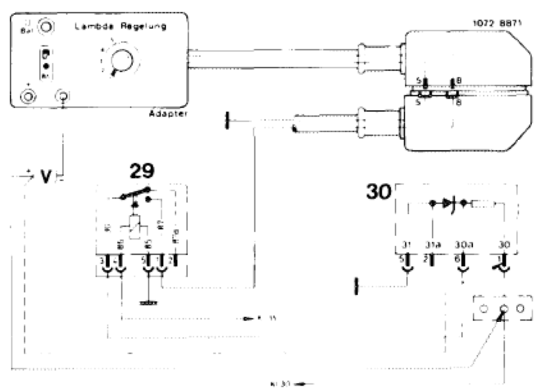
Indicator light of testing adapter:
Light on | Light off

Reading
approx. 12 Volt | 0 Volt



Disconnect positive lead of Voltmeter from the testing adapter and take reading at:
Terminal block (terminal 30). Excess-voltage protection unit, terminal 1

Reading
approx. 12 Volt | 0 Volt

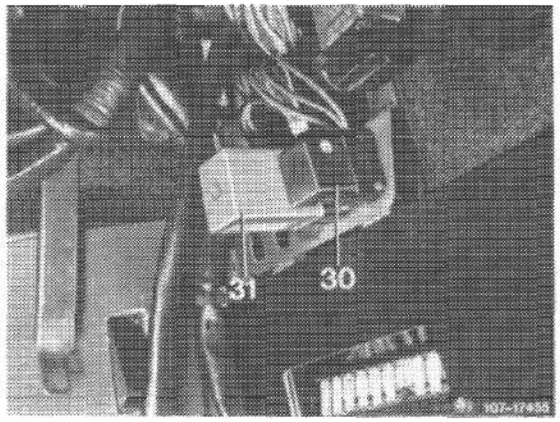


Check for break in electrical wiring and repair.
Reading approx. 12 Volt.

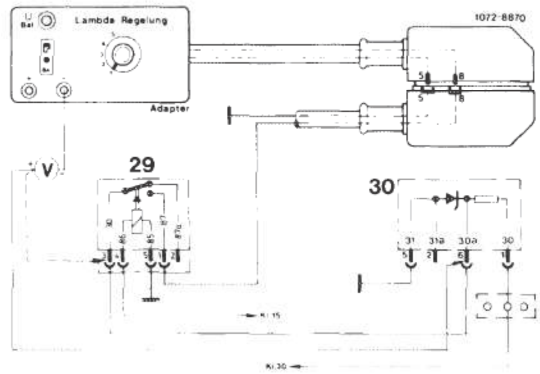
Insert the excess-voltage protection unit (30) into the plug in such a way, that the voltage on terminal 6 can be measured with the positive voltmeter lead.

Reading

approx. 12 Volt	0 Volt



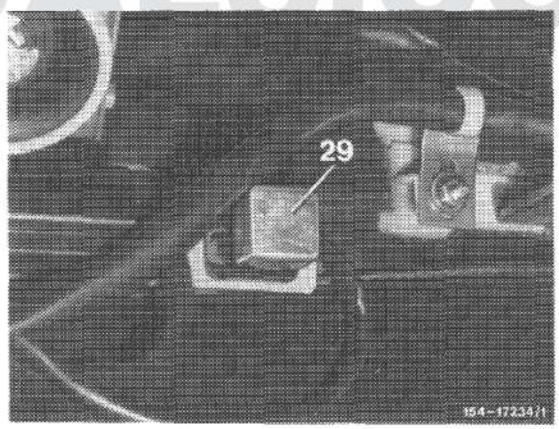
Replace excess-voltage protection unit (30).
Reading approx. 12 Volt.



Insert the voltage supply relay (29) into the plug in such a way, that the voltage on terminal 3 can be measured with the positive voltmeter lead.

Reading

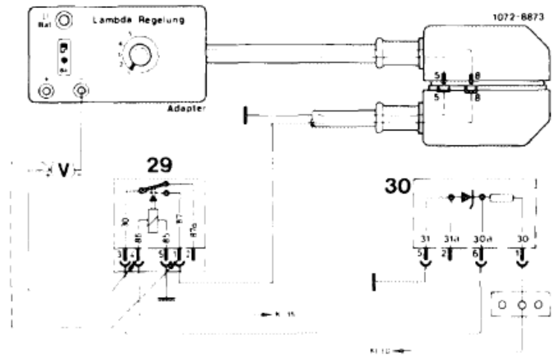
approx. 12 Volt	0 Volt



Check for break in wire between the excess voltage protection unit and the voltage supply relay and repair.
Reading approx. 12 Volt.

Measure voltage at terminal 4 ignition turned on.

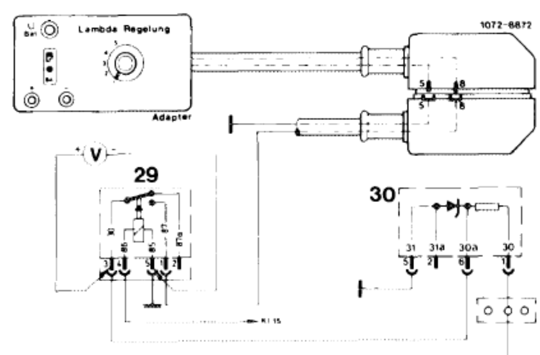
Reading	
approx. 12 Volt	0 Volt



Check for break in wire leading to terminal 15 and repair.
Reading approx. 12 Volt.

Connect voltmeter across terminal 3 and 5.

Reading	
approx. 12 Volt	0 Volt

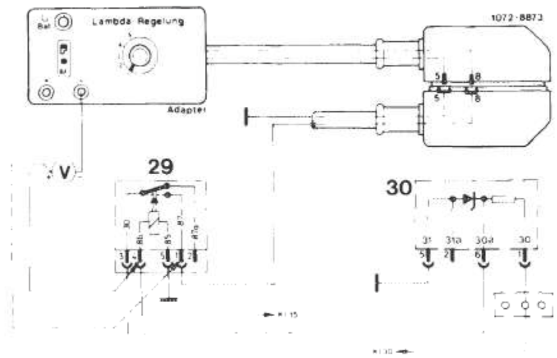


Check ground wire (terminal 5) for break and repair.
Reading approx. 12 Volt.

Insert the voltage supply relay in the plug in such a way, that the voltage on terminal 1 can be measured.

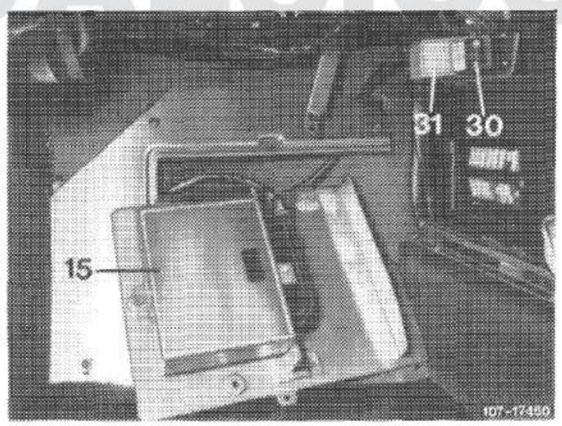
Reading

approx. 12 Volt | 0 Volt.



Replace voltage supply relay.
Reading approx. 12 Volt.

Connect voltmeter to the testing adapter and check voltage.



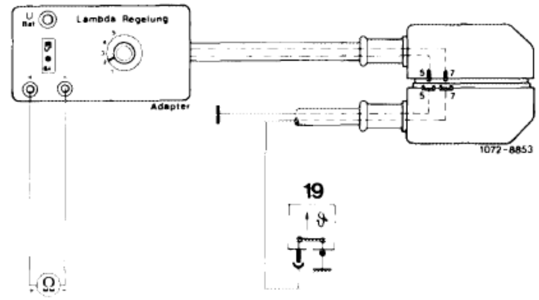
Reading

approx. 12 Volt | 0 Volt

Check for break in wire between voltage supply relay (29) and plug of electronic control unit and repair.
Reading approx. 12 Volt.

End of test

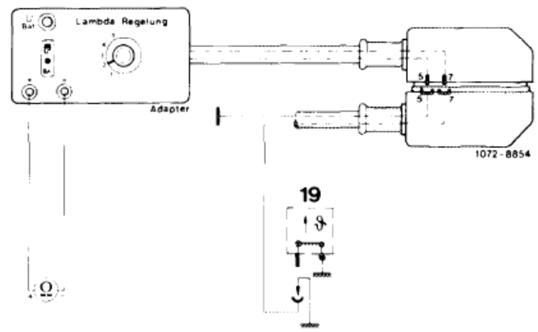
II Testing of Temperature Switch – Oil 16 °C/ 60 °F (Oil temperature below 13 °C/55 °F)



Turn selector knob of testing adapter to position 2, set multimeter to 0–∞ Ohm range, turn ignition off and read Ohms. Disconnect plug on throttle valve switch.

Reading

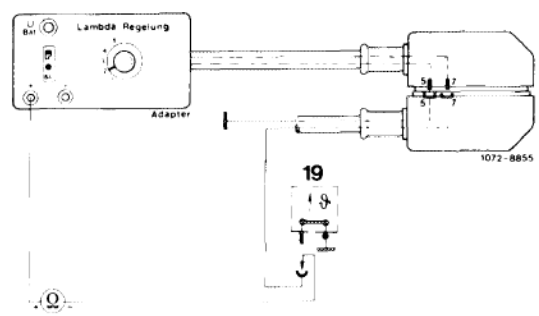
0 Ohm	∞ Ohm



Disconnect plug of temperature switch – oil, and ground plug.

If reading is 0 Ohm, replace temperature switch.

If reading is ∞ Ohm, check for break in wire leading from plug of electronic control unit (terminal 7) to the temperature switch plug.



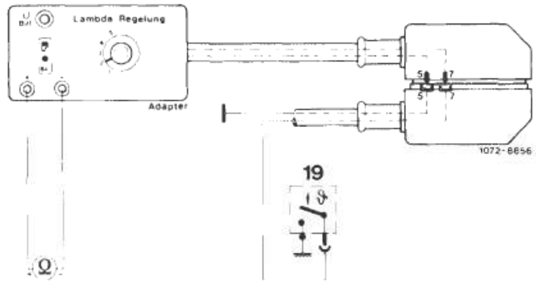
End of test

III Testing of Temperature Switch – Oil 16 °C/60 °F (Oil temperature above 20 °C/68 °F)

Turn selector knob of testing adapter to position 2, set multimeter to 0–∞ Ohm range and ignition off.

Disconnect plug of throttle valve switch. Read Ohms.

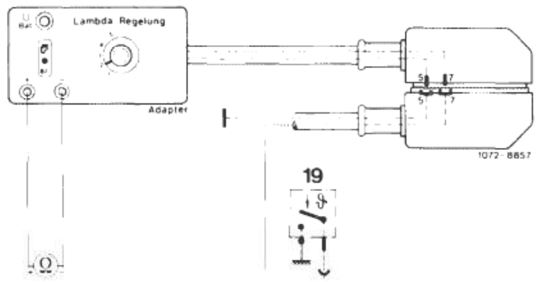
Reading	
∞ Ohm	0 Ohm



Disconnect plug from temperature switch – oil, and ground plug.

If reading is ∞ Ohm, replace temperature switch.

If reading is 0 Ohm, check for grounding out of wire leading from plug of electronic control unit (terminal 7) to the plug of the temperature switch.



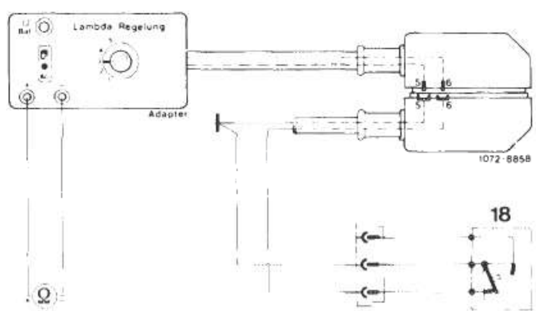
End of test

IV Testing of Throttle Valve Switch (Idle position, engine oil temperature above 20 °C/68 °F)

Turn selector knob of testing adapter to position 3, set multimeter to 0–∞ Ohm range, and ignition off.

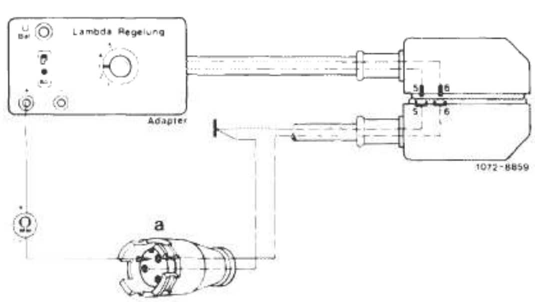
Throttle valve in idle position. Read Ohms.

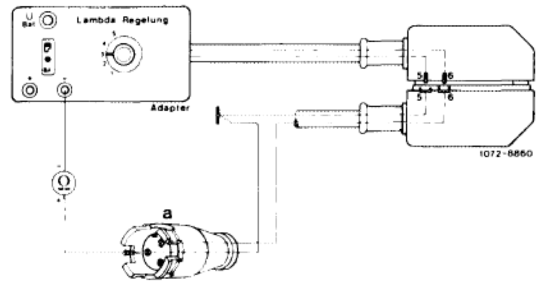
Reading	
Idle position 0 Ohm	∞ Ohm
Advance throttle linkage slightly ∞ Ohm	0 Ohm



Disconnect plug from throttle valve switch. Check for broken wires from plug (a) to plug of electronic control unit (terminal 6 and 15) according to the wiring diagram.

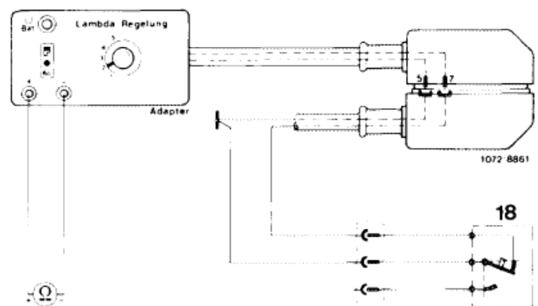
If wires are in order, replace throttle valve switch.





End of test

V Testing of the Throttle Valve Switch (Full throttle position, engine oil temperature above 20 °C/68 °F)

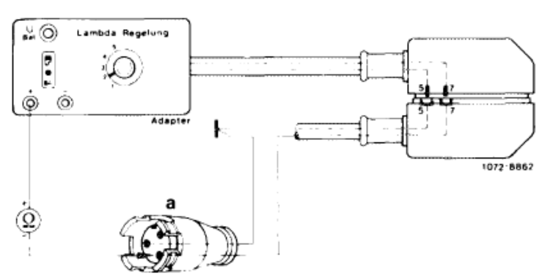


Turn selector knob of testing adapter to position 2, multimeter to —∞ Ohm range and ignition off.

Advance throttle linkage to full throttle position. Read Ohms

Reading	
Full throttle position – 0 Ohm	∞ Ohm
Return throttle linkage slightly ∞ Ohm	0 Ohm

Disconnect plug from throttle valve switch. Check for broken wires from plug (a) to plug of electronic control unit (terminal 7). If wires are in order, replace throttle valve switch.

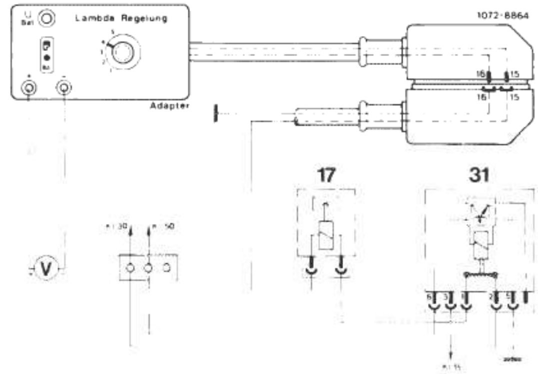


End of test

VI Testing of the Frequency Valve

Turn selector knob to position 4, set multimeter to 0–30 Volt range, turn on ignition and crank engine. Read voltage indicated.

Reading	
approx. 12 Volt	0 Volt



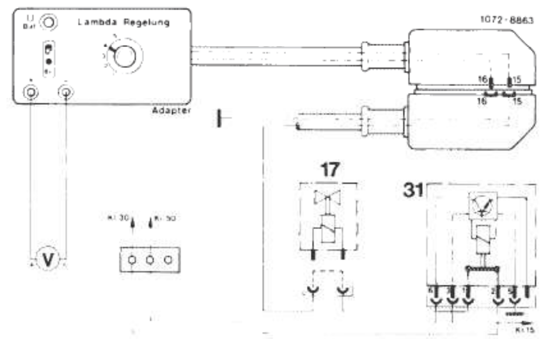
0 Volt:

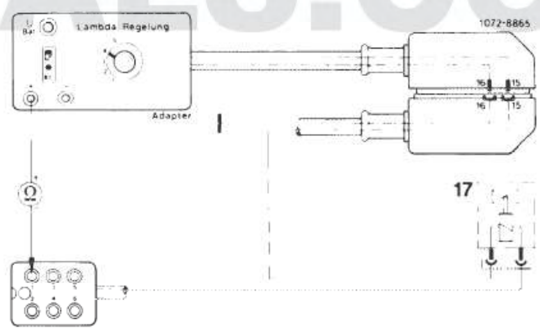
Disconnect plug from frequency valve and bridge the plug.

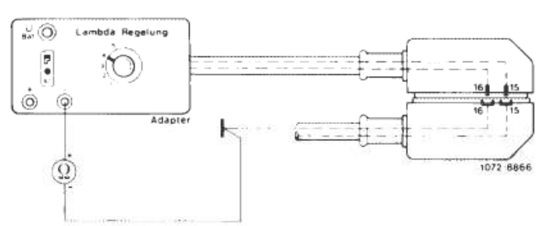
Crank the engine. If reading is 12 Volt, replace frequency valve.

If reading is 0 Volt, turn off ignition, set multimeter to 0–∞ Ohm range.

Check for break in wire leading from the plug of the electronic control unit (terminal 15) to the plug of the electronic fuel pump relay (terminal 1), also check for break in wire leading from plug of electronic control unit (terminal 16) to the ground connection in right footwell under instrument panel.

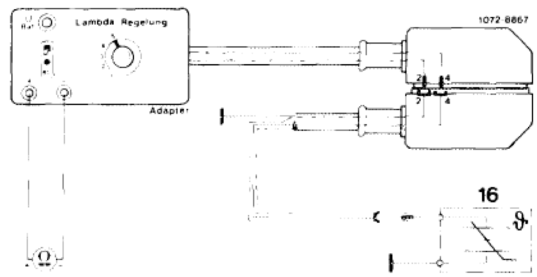






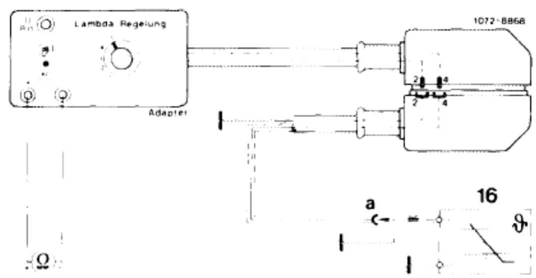
End of test

VII Testing of Wire to O_2 Sensor (16)



Turn selector knob to position 5, set multimeter to 0—∞ Ohm range, ignition off and O_2 sensor disconnected. Read Ohms indicated.	
Reading	
∞ Ohm	0 Ohm

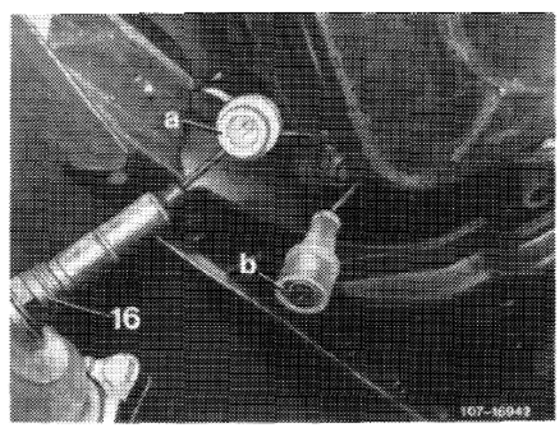
The wire leading from the connector of the O_2 sensor to the plug of the electronic control unit is short circuited.



Connect connector (a) to ground.

If reading is 0 Ohm, the wire is in order.

If reading is ∞ Ohm, the wire is broken.



End of test

Test Section B

Test Requirements: Remove testing adapter and connect electronic control unit.

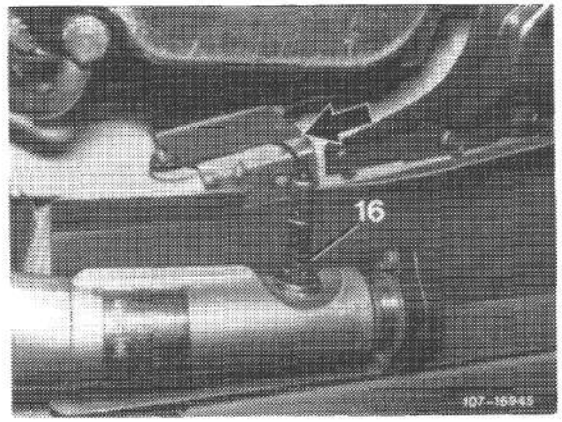
Connect the on-off ratio tester to the diagnostic plug. Start engine (coupling of O_2 sensor connected).

VIII Testing of the O_2 Sensor (16)

Temperature of the O_2 sensor below + 300 °C. Read on-off ratio.	
Reading	
Constant 50 %	Constant 92 %

O_2 sensor is short circuited. Replace O_2 sensor.

End of test

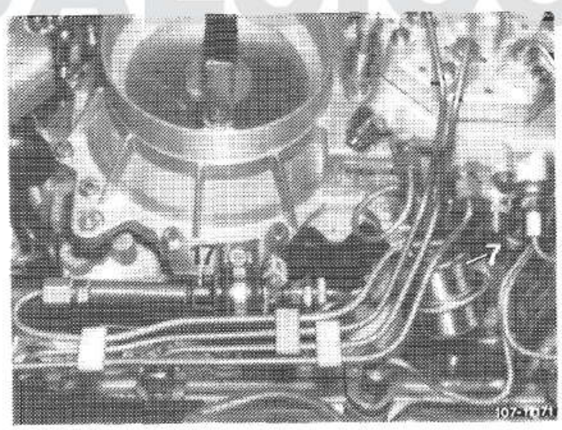


IX Testing of the Frequency Valve (17)

Engine oil temperature above 20 °C/68 °F. Engine at idle. Place hand on frequency valve.	
Operation of frequency valve can be felt	Frequency valve does not operate

Replace frequency valve

End of test



X Testing of Lambda Control

Engine oil temperature approx. 75–85 °C. Engine idling (650 ± 50 rpm). Read on-off ratio.

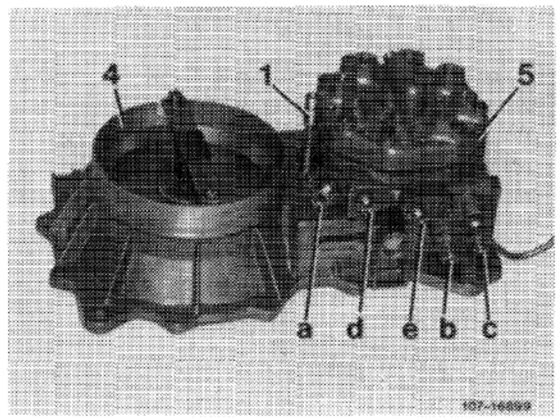
Reading	
Between 40 % – 60 %	Below 40 % or above 60 % Constant 50 %

Adjust mixture adjusting screw to obtain a reading of 50 ± 5 % on-off ratio.

If the specified value cannot be adjusted, replace the electronic control unit.

If reading indicates a constant 50 % the O_2 sensor is defective. Replace.

End of test



XI Air Injection Test

Run engine at idle (650 ± 50 rpm). Remove special shaped hose at air shut-off valve.

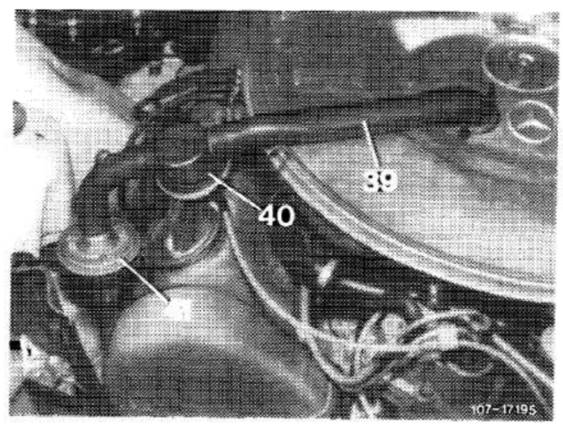
Suction sound must be audible.	No suction sound present.

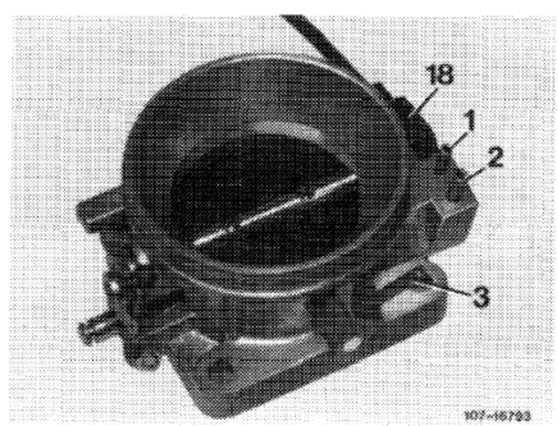
Check vacuum lines and vacuum supply. The blue vacuum line is connected from the throttle valve housing (connection 3) to the air shut-off valve.

Remove vacuum line from the air shut-off valve and check if vacuum is present.

If vacuum is not present, blow out vacuum connection at throttle valve housing.

If vacuum is present, remove air shut-off valve (40).

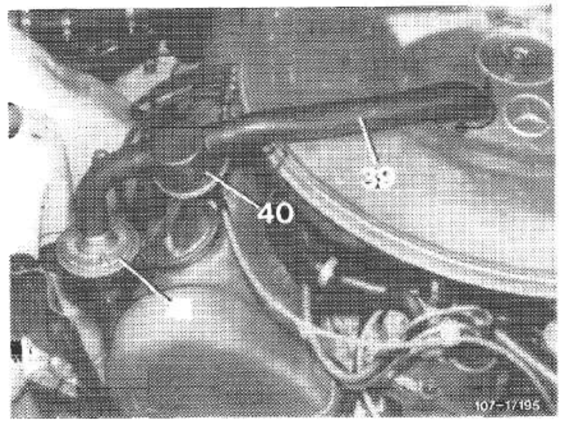




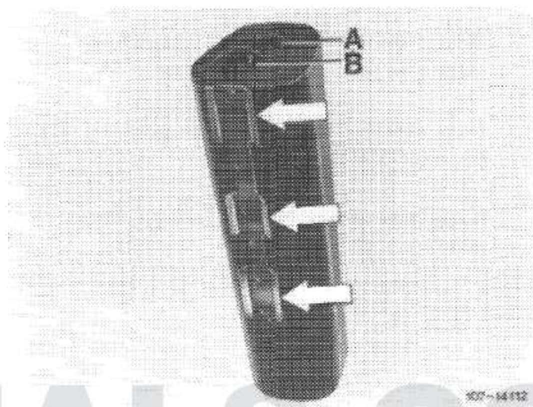
If the suction sound is now audible, renew air shut-off valve.

If no suction sound is audible, replace the aspirator valve (41).

End of test



XII Testing of Fuel Evaporation Control System



Remove purge line (A) from charcoal canister (leading to the throttle valve housing) and close off with finger. Slowly increase engine speed to above 2000 rpm.	
No vacuum at engine idle. With increasing rpm, increase in vacuum.	No vacuum with increasing rpm.

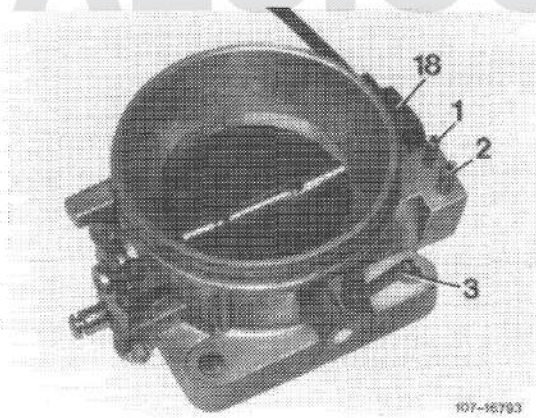
Testing of purge line connection and purge valve.

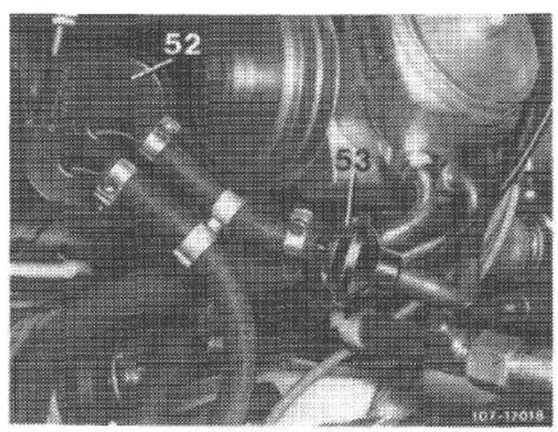
The purge line must be connected to the throttle valve housing (2). Make certain that the purge line does not leak. Blow out connection at throttle valve housing with compressed air.

If vacuum is still not present, remove the purge line in front of purge valve (53) and repeat the test.

If vacuum is present, replace purge valve.

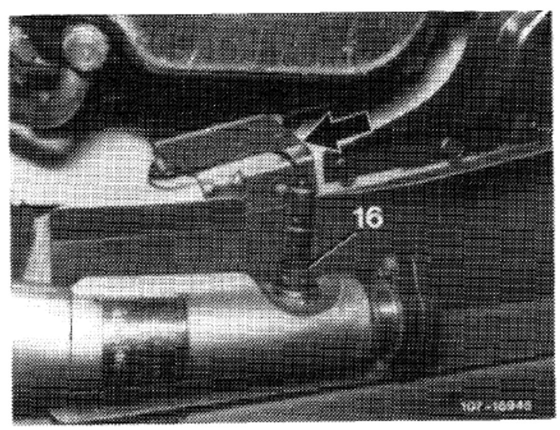
End of test





14–200 Removal and installation of catalysts

Tightening torques	Nm
Self-locking nuts on exhaust manifold to exhaust flange	20–25
Self-locking hex. nuts to lateral support of clamp	7
Hex. bolts of flange connection	20
Oxygen sensor	50–60



Removal

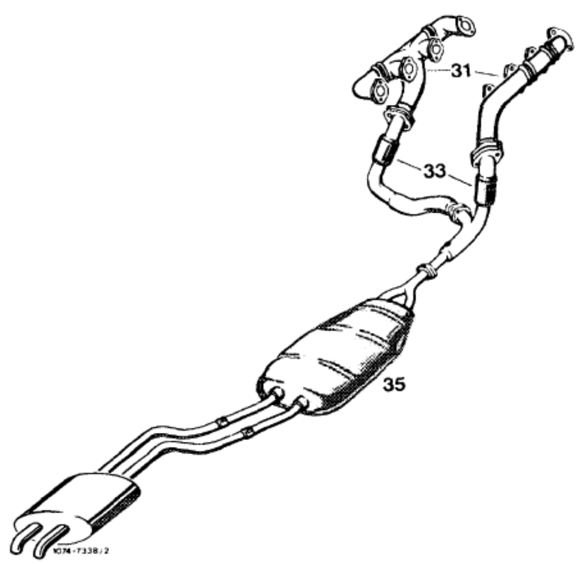
1 Remove oxygen sensor (16).

2 Remove exhaust system (49–100).

3 Unscrew primary catalysts.

4 On model 107 loosen plug flange connections between catalyst-muffler combination (35) and remove catalyst-muffler combination by turning slightly.

Note: If the plug flange connection cannot be separated, heat exhaust pipes. For safety reasons, place a protective panel against frame floor prior to heating pipes.

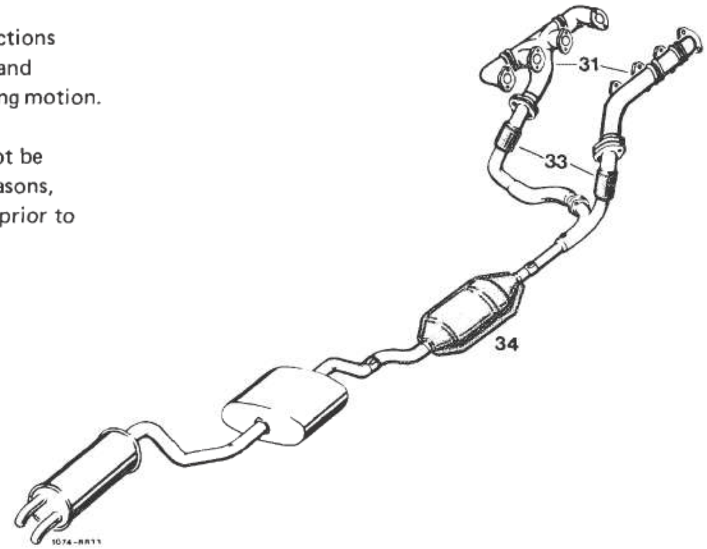


Model 107

31 Exhaust manifold
33 Primary catalyst
35 Catalyst-muffler combination

5 On model 116, loosen plug flange connections before and behind underfloor catalyst (34) and remove underfloor catalyst by a slight turning motion.

Note: If the plug flange combinations cannot be separated, heat exhaust pipes. For safety reasons, place a protective panel against frame floor prior to heating pipe.



Model 116

31 Exhaust manifold
33 Primary catalyst
34 Underfloor catalyst

Installation

6 Plug catalyst-muffler combination or underfloor catalyst to plug flange connections of exhaust system.

7 Flange-on primary catalysts (slightly tighten screws of flange connections).

8 Install exhaust system (49–100).

9 Coat threads of oxygen sensor with hot lubricating paste, part no. 000 989 88 51.

10 Install oxygen sensor.

11 Start engine and check exhaust system for leaks.

09–450 Removal and installation of intake manifold upper and lower half, renewing gaskets

Note

During removal and installation of intake manifold the mixture regulator with air guide housing need not be removed.

Removal

1 Disconnect battery.

2 Partially drain coolant.

3 Unscrew injection lines and fuel lines. Catch fuel with a cloth.

Deactivate fuel lines.

4 Pull off supplementary air lines.

5 Remove control pressure rod for automatic transmission.

6 Unscrew bearing bracket for gate regulation.

7 Unscrew bearing bracket for longitudinal regulating shaft.

8 Pull off all connecting cables and plug connections.

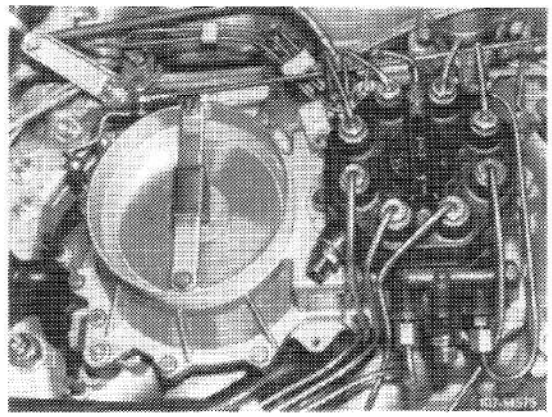
9 Unscrew vacuum line for automatic transmission and for brake unit.

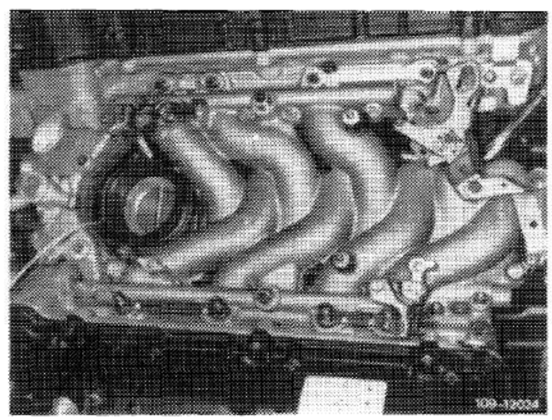
10 Unscrew idle speed air distributor.

11 Loosen coolant hoses and pull off.

12 Unscrew all fastening screws and remove intake pipe toward the rear.

13 Clean intake manifold and check flange surfaces with straightedge or touch up on surface plate.





Installation

14 Mount intake manifold with new gaskets in vice versa sequence.

Use only graphited intake manifold gaskets.
Do not install non-graphited intake manifold gaskets similar to engine 117.96 (5.0).

15 Adjust regulating linkage (30–300).

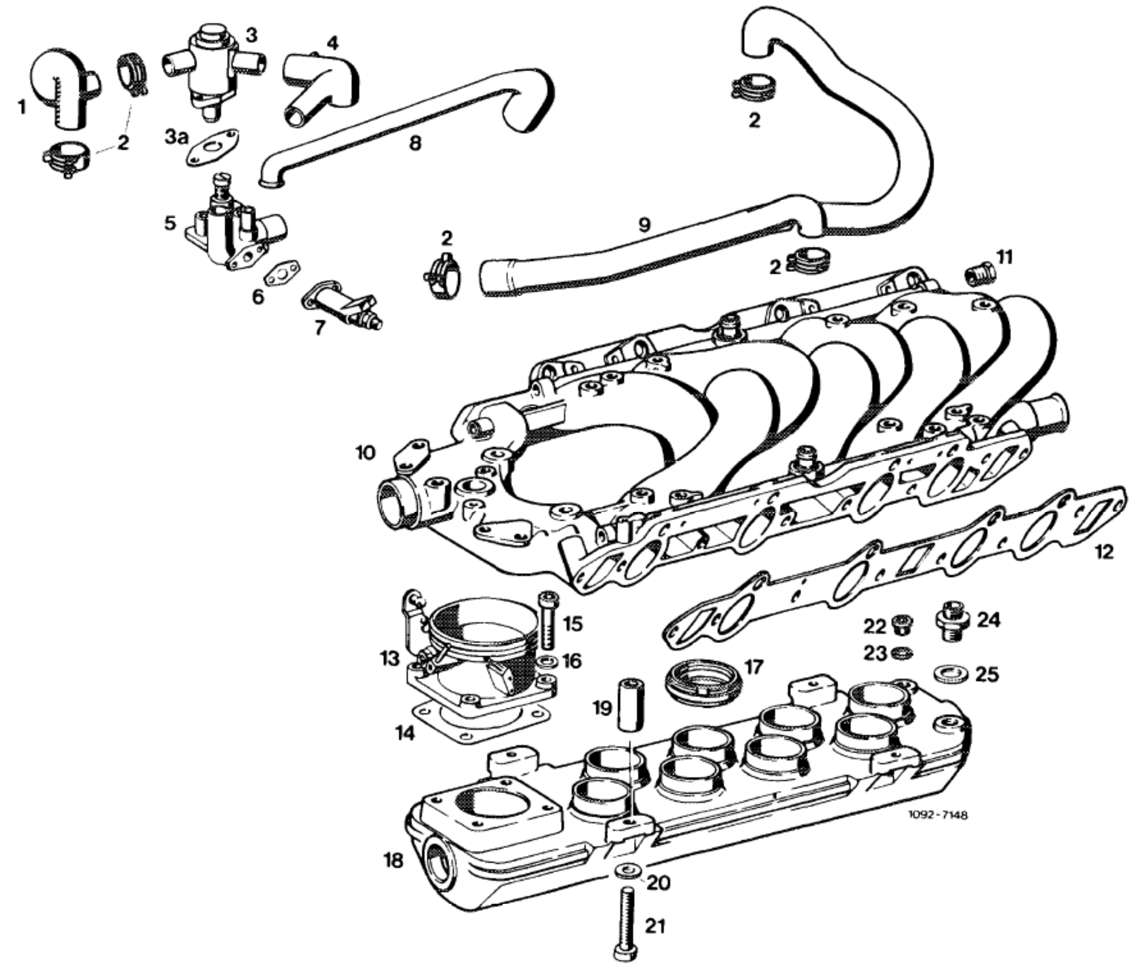
16 Connect battery.

17 Add coolant.

18 Keep engine running, check fuel lines for leaks. Check intake system, fuel distributor and injection valves by spraying with Iso-Oktan or benzine for leaks.

19 Adjust idle speed (07.3–100).

Intake manifold



1 Contoured hose
2 Coiled hose clips
3 Supplementary air valve
3a Gasket
4 Contoured hose
5 Idle speed air distributor
6 Gasket
7 Cold-starting valve
8 Contoured hose
9 Supplementary air line
10 Intake manifold upper half
11 Closing plug
12 Gasket
13 Throttle valve housing
14 Gasket
15 Hex. socket screw
16 Washer
17 Rubber connection
18 Intake manifold lower half
19 Spacing sleeve
20 Washer
21 Hex. socket screw
22 Closing plug
23 Sealing ring
24 Double thread connection
25 Sealing ring

14–455 Renewing intake manifold (intake manifold removed)

1 Remove and install intake manifold (14–450).

2 Remove and install injection valves and insulating sleeves (07.3–215).

3 Remove and install mixture regulator with air guide housing (07.3–225).

4 Unscrew all unscrewable parts on removed intake manifold and mount on new intake manifold with new gaskets.

5 Unscrew intake manifold upper half from intake manifold lower half. For this purpose, loosen vacuum line for brake unit on intake manifold lower half, then unscrew fastening screws and pull from rubber adaptors.

6 Mount intake manifold lower half with new rubber adaptors to intake manifold upper half.

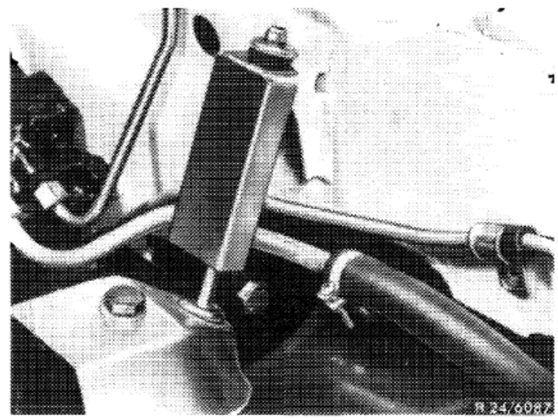
Attention!
The intake manifold lower half has a different shape as that of engine 117.960 (5.0) and can therefore not be installed in this engine.

49–470 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm
Bolt for engine mount	75

Removal



1 Remove exhaust system (49–100).

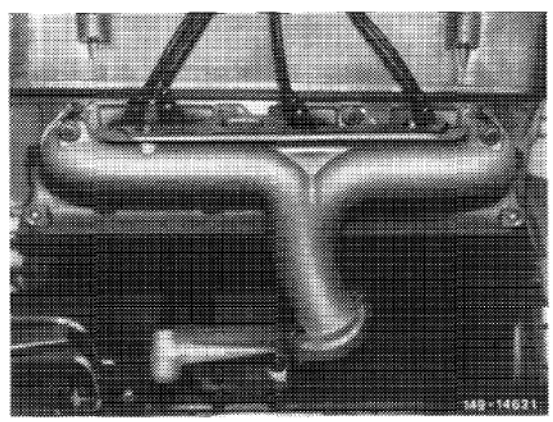
Note: Survey exhaust manifold (14–472).

2 Pull off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with fastener and shielding plates. For this purpose, unscrew bolt for engine mount.

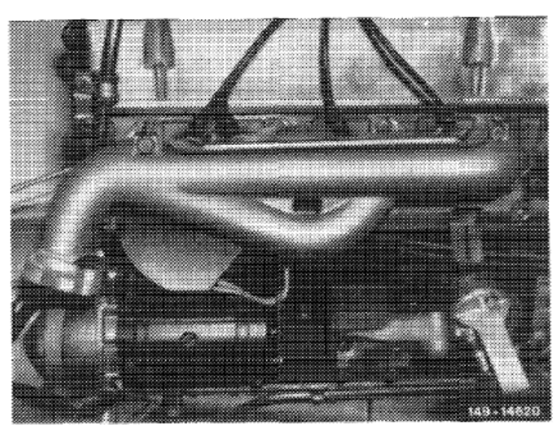
Exhaust manifold left



5 Remove air cleaner.

6 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right

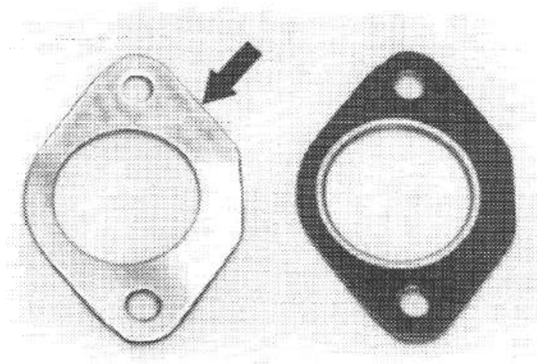


7 Remove windshield washer tank.

8 Unscrew coolant supply tank. Unscrew fastening clamp for coolant hose, loosen cable band for electric line and put supply tank aside.

9 Remove battery, battery holder and shielding plate.

10 Unscrew exhaust nuts and bolts and remove exhaust manifold.



107–12067

Installation

11 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

12 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

13 Tighten bolts for engine mount to 75 Nm.

14 Mount exhaust system.

15 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

16 Keep engine running and check exhaust system lor leaks.

B. Model 116

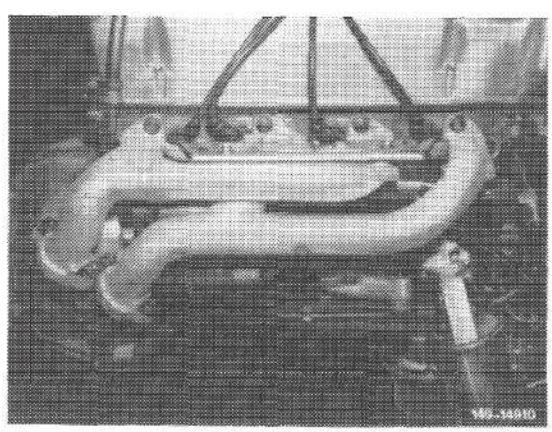
Note

Starting with the following chassis end no. a two-fluted **righthand** exhaust manifold is installed.

Start of production: December 1977

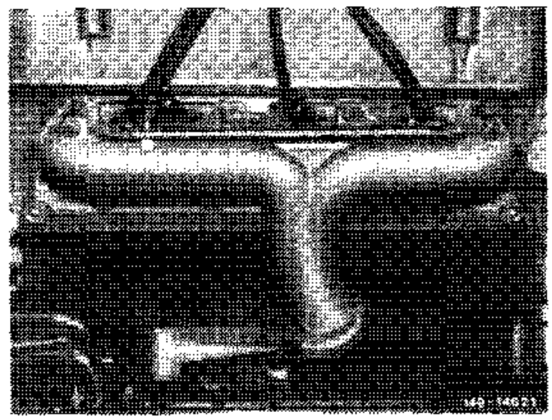
Model	starting chassis end no.
116.028/029	044654
116.032/033	076606

On previously manufactured vehicles the former exhaust manifold remains installed.

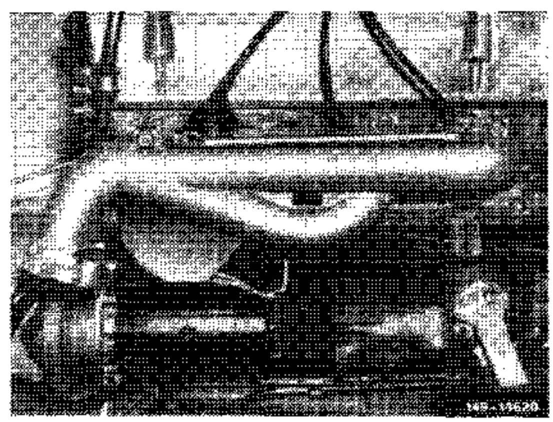


A. Standard version

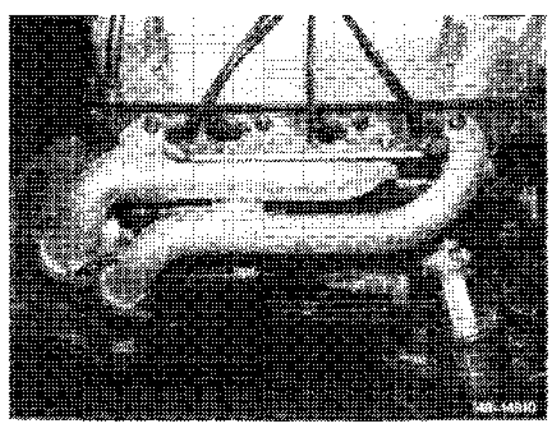
Lefthand steering



Exhaust manifold left

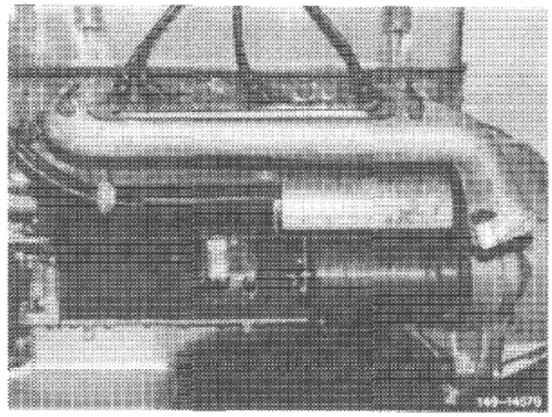


Exhaust manifold right

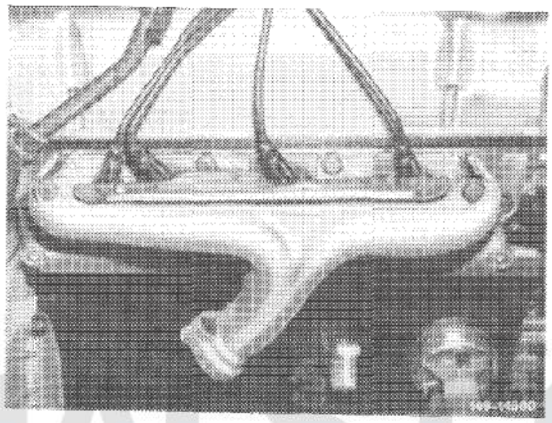


Exhaust manifold right
two-fluted model 116

Righthand steering



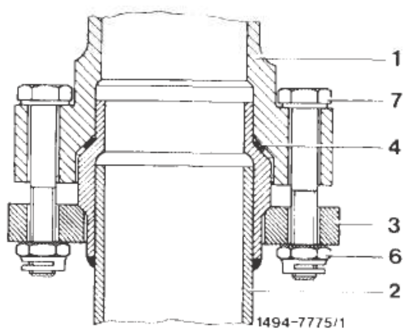
Exhaust manifold left



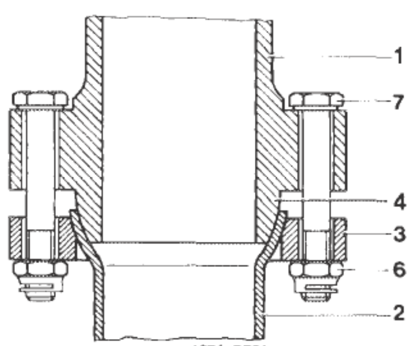
Exhaust manifold right

Repair versions

Starting approx. November 1977, the exhaust manifolds are provided with an external ball connection (up to now trapezoid connection). As a result, when installing exhaust manifolds with external ball connection, replace front exhaust pipe with trapezoid connection against an exhaust pipe with external ball connection.



Trapezoid connection
(past version)



External ball connection

Removal

1 Remove exhaust system (49–100).

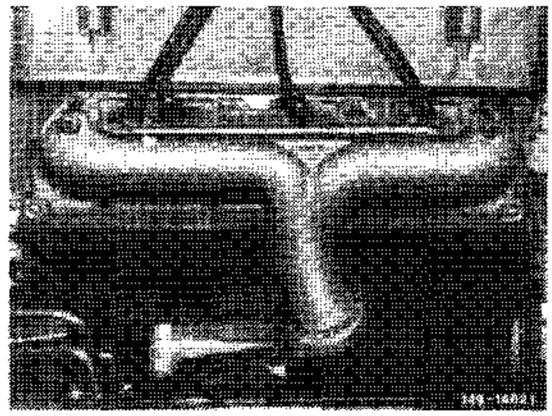
2 Pull off ignition cable.

3 Unscrew shielding plate on exhaust manifold.

Exhaust manifold left

4 Remove air cleaner.

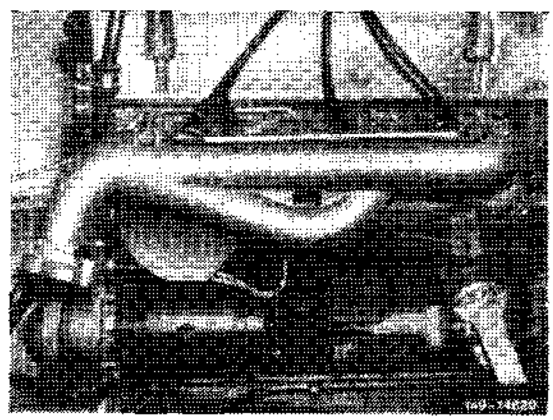
5 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Exhaust manifold right

6 Remove battery and battery holder.

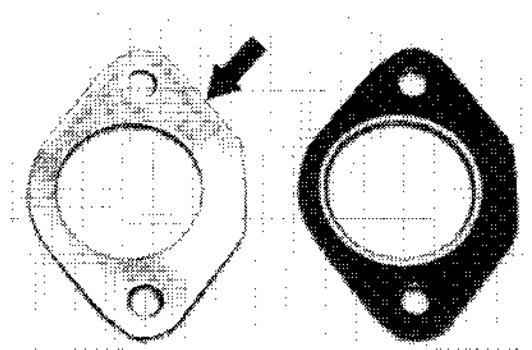
7 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Installation

8 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

9 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

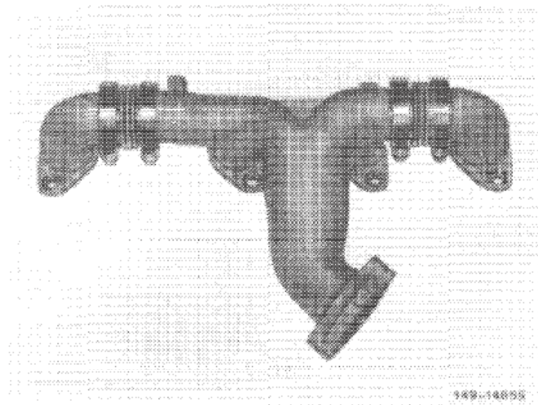


10 Mount exhaust system.

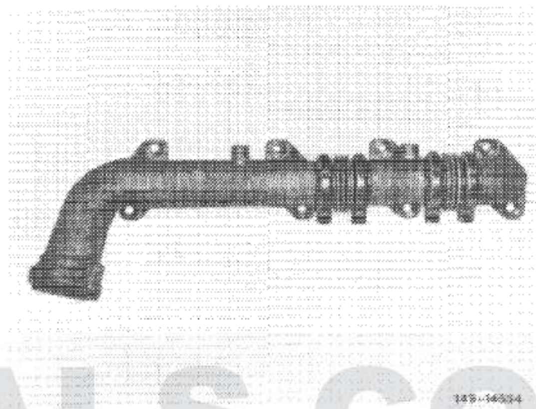
11 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

12 Keep engine running and check exhaust system for leaks.

Lefthand steering



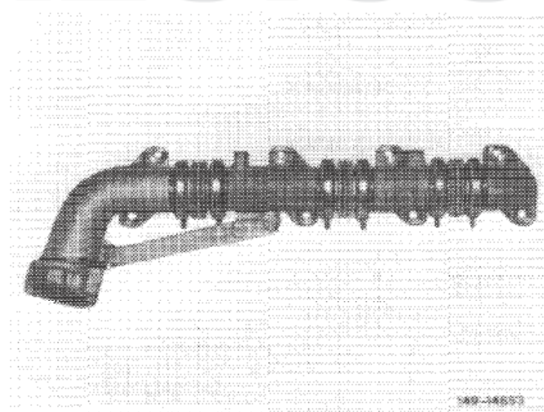
Exhaust manifold left



Exhaust manifold right

In the event of damage on exhaust manifolds with 2 bellows as a result of extremely sharp driving, the exhaust manifold can be subsequently provided with 3 bellows at righthand engine side on model 116.

This exhaust manifold has a trapezoid connection. Consequently, on vehicles manufactered after approx. November 1977, the front exhaust pipe with external ball connection must be replaced by an exhaust pipe with trapezoid connection.



Exhaust manifold right
model 116

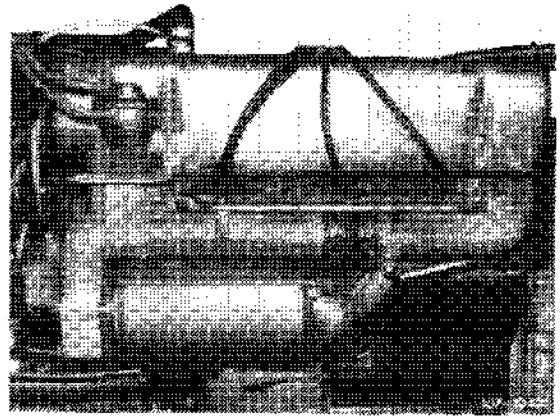
Righthand steering

On righthand steering vehicles the exhaust manifolds must be replaced like for like.

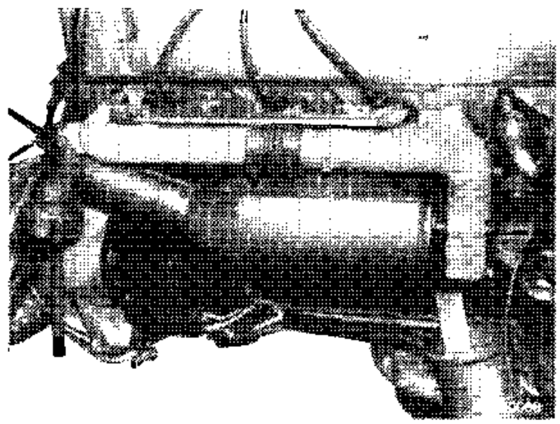
B. National version (AUS) (J) (S) (USA)

(J) (S) (USA) Model year 1976

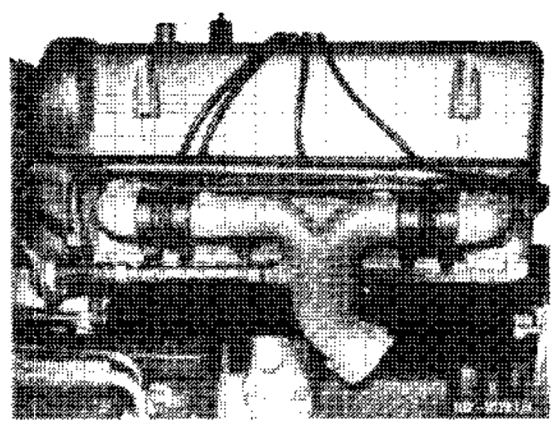
Exhaust manifold with internal ball



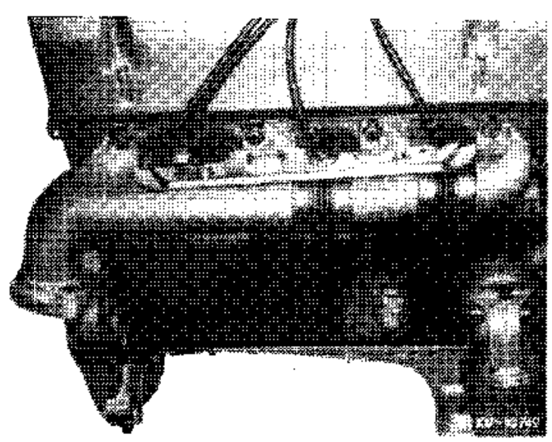
(J) (USA)
Exhaust manifold left



Exhaust manifold right



(S)
Exhaust manifold left

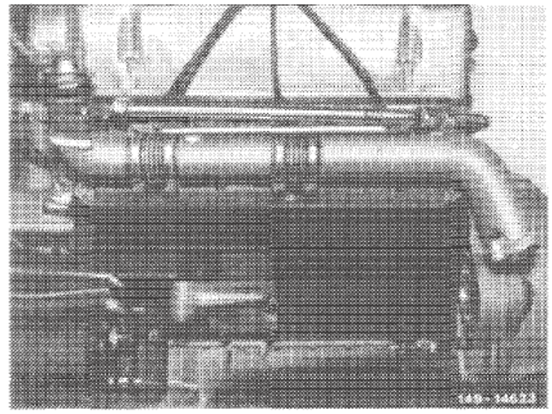


Exhaust manifold right

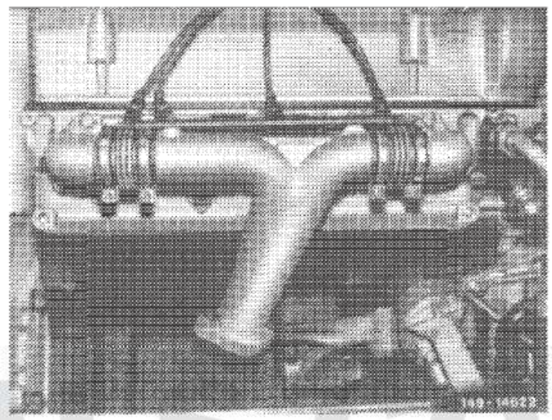
AUS J S model year 1977–1980
USA model year 1977–1979

1977 exhaust manifold with internal ball,
starting 1978 exhaust manifold with external ball

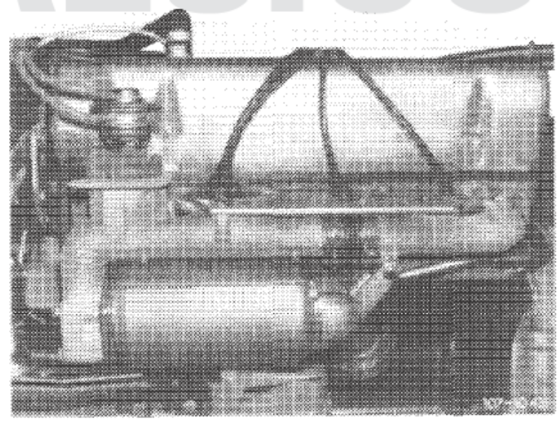
Note: If on vehicles model year 1977 an exhaust manifold with external ball connection is installed, the front exhaust pipe must be replaced.



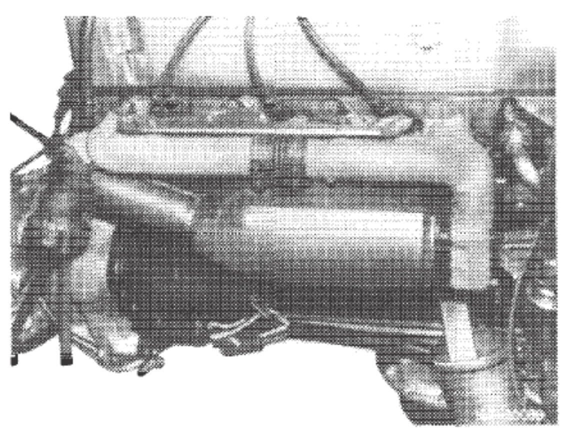
AUS
Exhaust manifold left



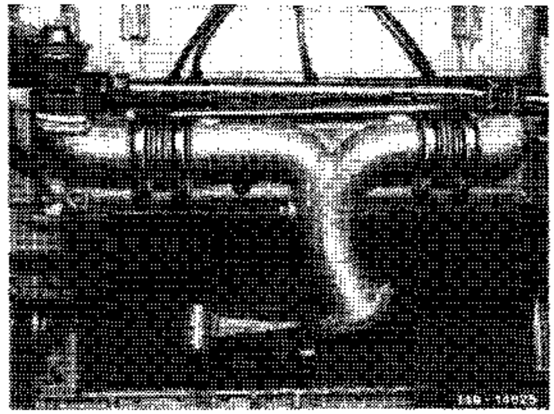
Exhaust manifold right



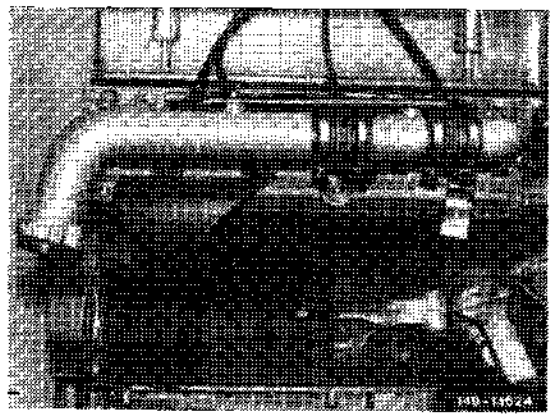
J
Exhaust manifold left



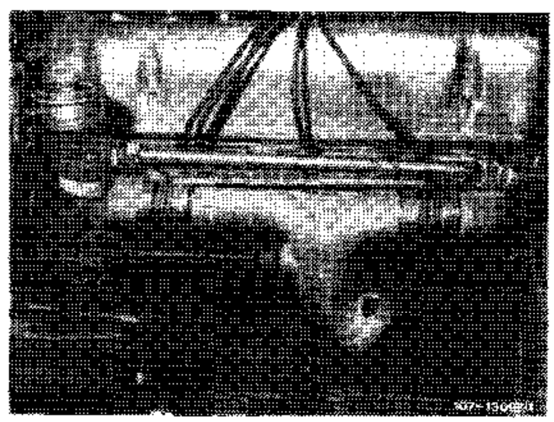
Exhaust manifold right



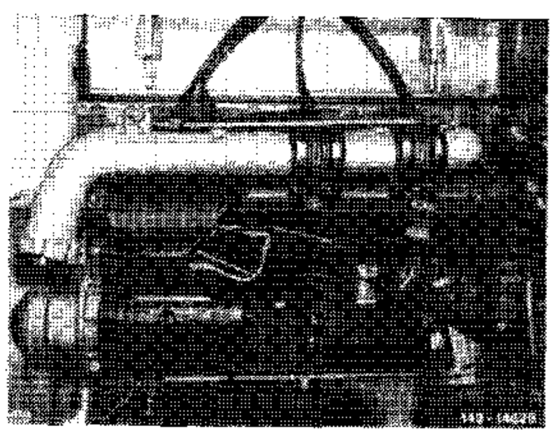
S
Exhaust manifold left



Exhaust manifold right



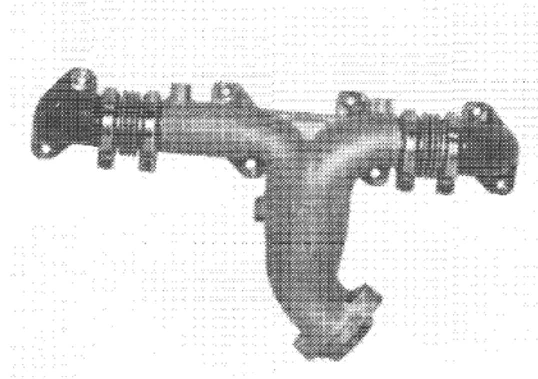
USA
Exhaust manifold left



Exhaust manifold right

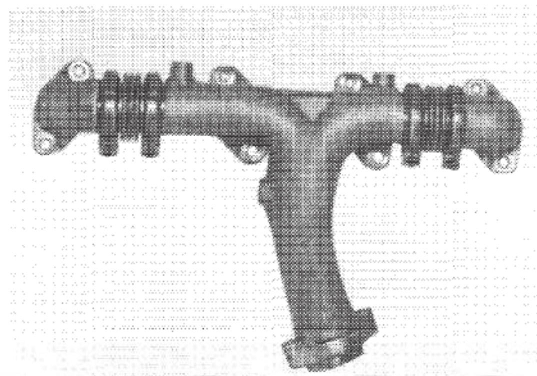
(USA) **model year 1980**

Without EGR



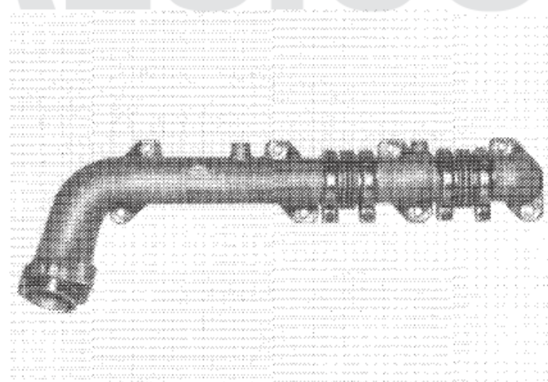
Exhaust manifold left
Model 107

114 – 16851



Exhaust manifold left
Model 116

114 – 16853

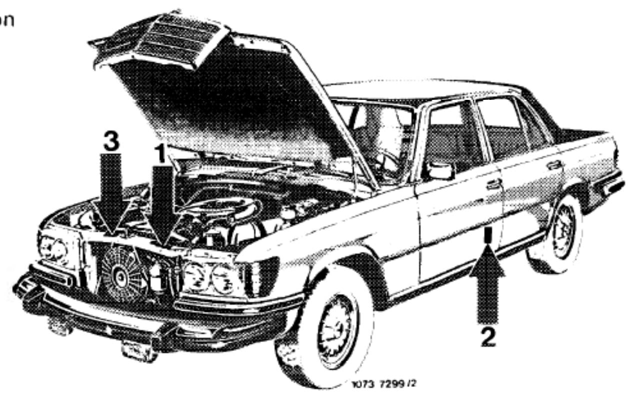


Exhaust manifold right
Model 107 and 116

114 – 16854

14–001 Functional characteristics

The various emission control systems of USA version vehicles are identified by respective information plates (arrows 1, 2 and 3).



1. Information plate on cross member in front of radiator

This plate shows the identification data as well as all the important engine adjustment data.

Recognizing emission control system from color of information plate – basic color/lettering

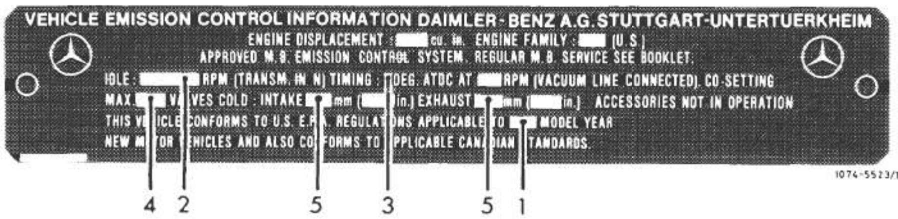
<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1971</td><td rowspan="6">black/silver</td><td rowspan="3">black/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1972</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1973</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1974</td><td rowspan="3">green/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1975</td><td>–</td><td rowspan="2">yellow/silver</td><td rowspan="2">yellow/silver</td></tr>
<tr><td>1976</td><td>–</td></tr>
<tr><td>1977</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td><td>red/black</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td></tr>
<tr><td>1978</td><td>–</td></tr>
<tr><td>1979</td><td>–</td></tr>
<tr><td>1980</td><td>black/white</td><td>–</td><td>black/white</td></tr>
</table>

The information plate shows:

1. MODEL YEAR
2. IDLE . . . RPM
3. TIMING . . . DEG. AT . . . RPM
4. Emission value at idle without air injection max . . .

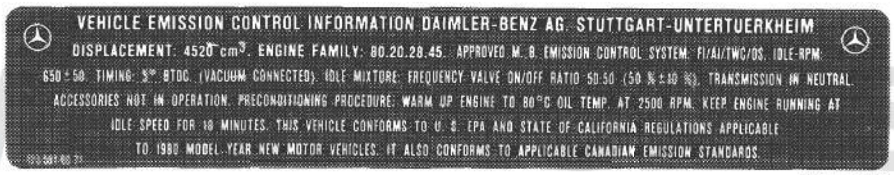
   CO–SETTING MAX. . . . AIR INJECTION DISCONNECTED
5. Valve clearance: INTAKE (. . . in)
   EXHAUST (. . . in)

Information plate up to model year 1979



1074-5523/1

Information plate model year 1980



1144-9543

Identification data are encoded in an 8-digit code no.

Example: Engine family 80. 20. 28. 45

80 20 2 8 45

Model year — 80

National code no. — 20

20 = Federal and California
21 = Federal
22 = California

Combustion system — 2

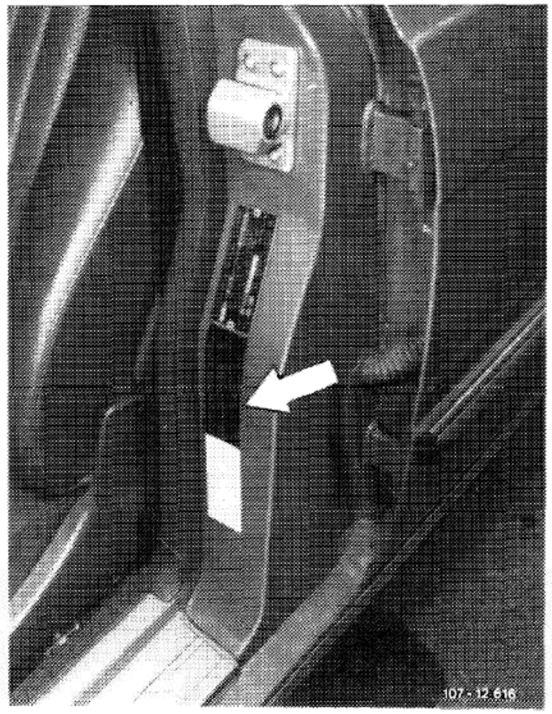
1 = Carburetor
2 = Injection, gasoline
3 = Diesel
4 = Diesel, turbo

Number of cylinders — 8

Displacement
approx. 4500 cc — 45

2. Information plate on door pillar of driver's door

This plate shows whether vehicle is provided with catalysts or not.



107-12 616

Recognizing catalysts from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1976</td><td rowspan="4">black/silver</td><td>black/silver</td><td>–</td><td rowspan="4">red/silver</td><td>red/silver</td></tr>
<tr><td>1977</td><td>green/silver</td><td>black/silver</td><td>blue/silver</td></tr>
<tr><td>1978</td><td rowspan="2">black/silver</td><td>–</td><td rowspan="2">red/silver</td></tr>
<tr><td>1979</td><td>–</td></tr>
</table>

Information plates

This vehicle is provided with catalysts.

1074 – 8259

Tourist vehicles

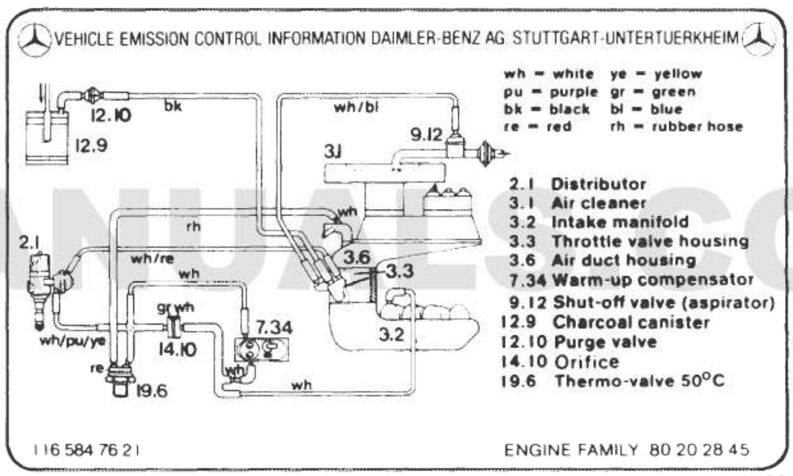
This vehicle is not provided with catalysts by manufacturer.

Catalysts must be installed prior to import into USA.

1074 – 8260

3. Information plate for vacuum line installation located on cross member in front of radiator (California only)

This plate shows the vacuum line layout for all emission system components in engine compartment.



1144–9406

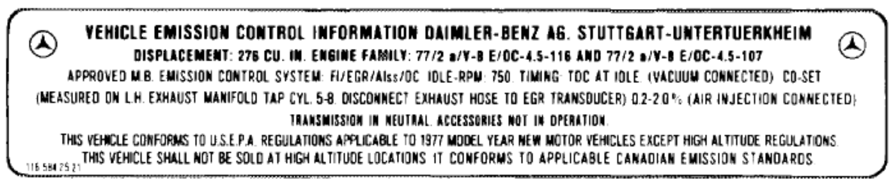
14–050 Operation

Federal and California version model year 1977/78/79

A. General

Information plate

Federal version basic color black.
California version basic color yellow.
Federal version high altitudes basic color red (model year 1977 only).



1074–7503

Identification of vacuum lines

The basic color of vacuum lines for emission control system is transparent (white).

Additional color stripes are used to facilitate identification of the individual functions.

Lines originating at a vacuum source (originating lines) **have only one color stripe.**

Lines terminating at a vacuum-operated device (terminating lines) **have two color stripes.** Purple is always the second color.

Emission control system	Color coding of originating vacuum line	Color coding of terminating vacuum line
Ignition switchover		
Advance	red	–
Retard	yellow	yellow/purple
EGR	brown	brown/purple
Air injection	blue	blue/purple

Engine 117 is supplied with two different emission control systems:

1. Federal emission control system (black information plate).

2. California emission control system (yellow information plate).

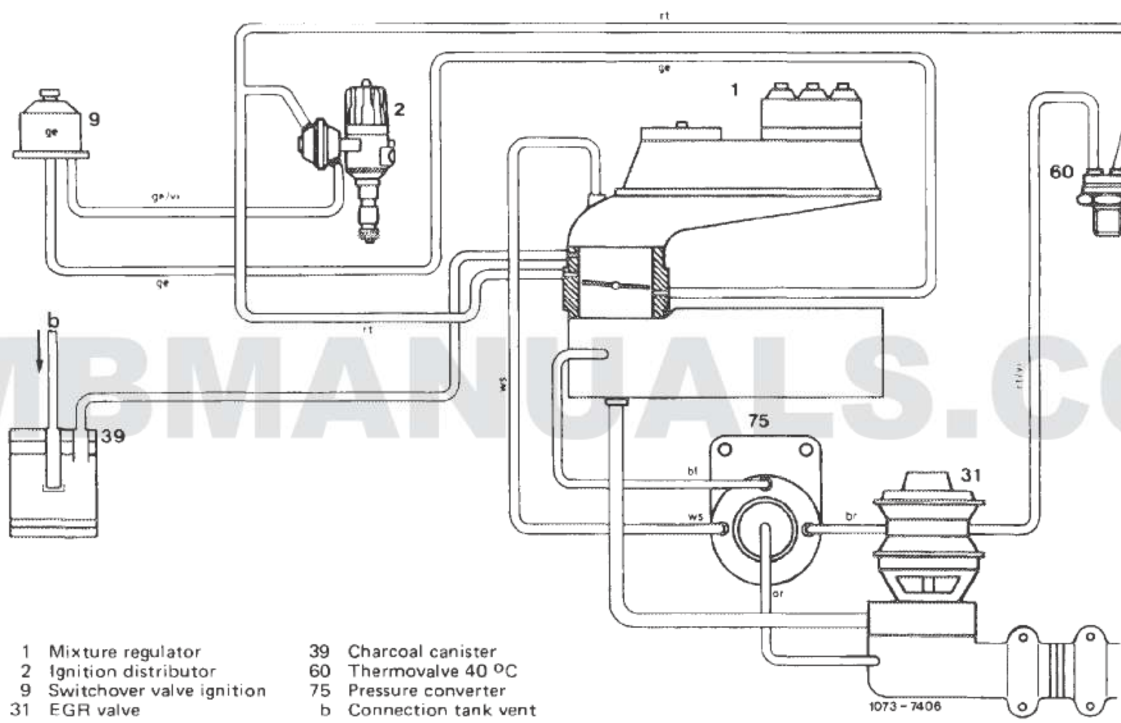
The two emission control systems differ with regard to air intake and air injection.

B. EGR (exhaust gas recirculation)

To reduce nitrogen oxides in exhaust gases, a portion of the gases from the exhaust manifold is returned to the intake pipe.

The quantity of the returned exhaust gas is controlled by the throttle valve position and the intake pipe vacuum.

Function diagram

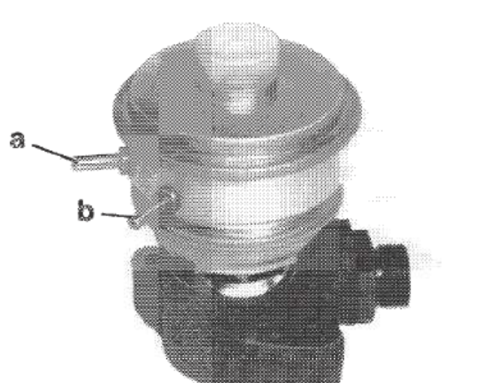


1 Mixture regulator
2 Ignition distributor
9 Switchover valve ignition
31 EGR valve
39 Charcoal canister
60 Thermovalve 40 °C
75 Pressure converter
b Connection tank vent

EGR components:

EGR valve

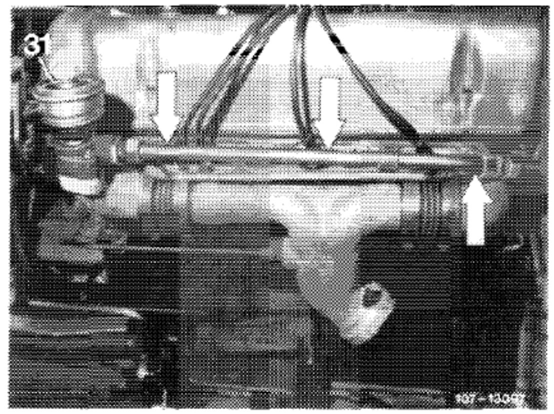
For better adaptation of EGR the EGR valve is designed as a three-diaphragm valve.



107 - 12 620

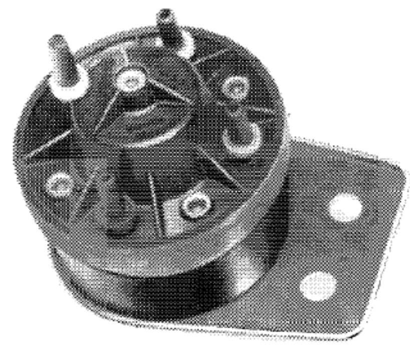
EGR line (arrows)

The exhaust gases are routed from EGR valve through EGR line into intake pipe.



Pressure transducer

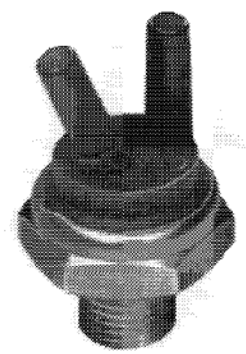
The pressure transducer controls the EGR volume in dependence of exhaust backpressure.



107-12314

Thermovalve 40 °C (color code black)

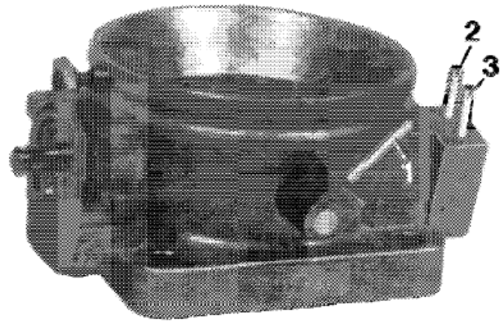
The thermovalve is screwed into coolant-controlled portion of intake pipe and opens at approx. 40 °C coolant temperature.



107-10895

Throttle valve housing

A tapping pipe (2) has been attached to throttle valve housing for drawing off vacuum required for controlling EGR and vacuum advance of firing point.



1 Vacuum connection ignition retard
2 Vacuum connection ignition advance
3 Vacuum connection charcoal canister

107-13054

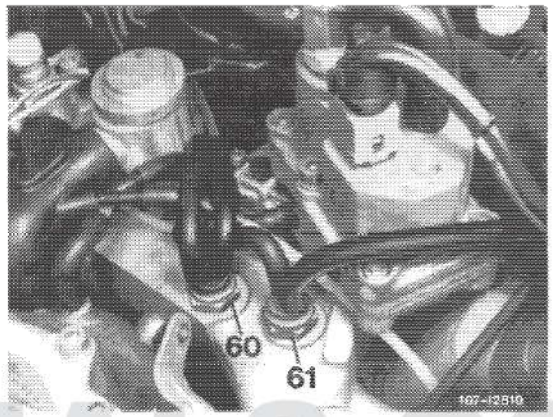
EGR is activated:

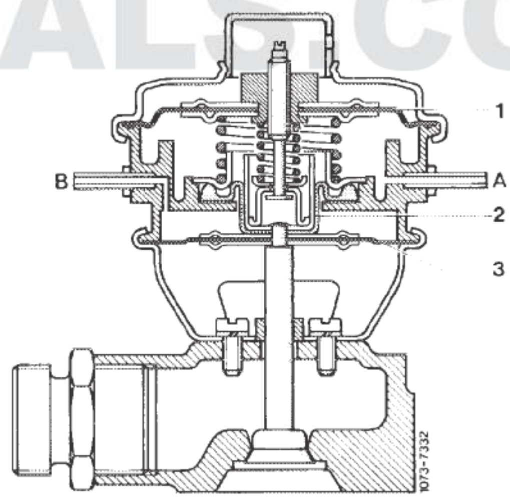
- At 40 °C coolant temperature.
- During acceleration.
- During partial load operation.
- During transition to deceleration (coasting).

Operation

Above 40 °C, in the driving ranges named above, a part of the exhaust gases is returned from the exhaust manifold to the intake pipe.

The amount of recirculated exhaust gases depends on the throttle valve position (vacuum tapped at throttle valve housing) and the exhaust backpressure in exhaust manifold. Depending on throttle valve position the center diaphragm chamber of the EGR valve is more or less supplied with vacuum via thermovalve 40 °C (60) in cylinder head.



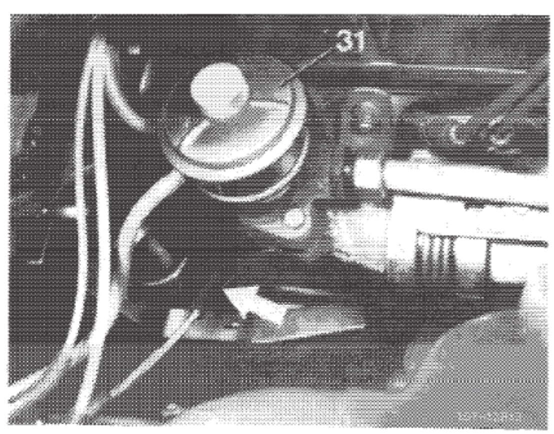


1 Shutoff diaphragm
2 Cup-type diaphragm
3 Working diaphragm
A Connection vacuum line to thermovalve
B Connection vacuum line from pressure transducer

The upper diaphragm chamber is continuously connected to atmosphere by means of a vent bore.

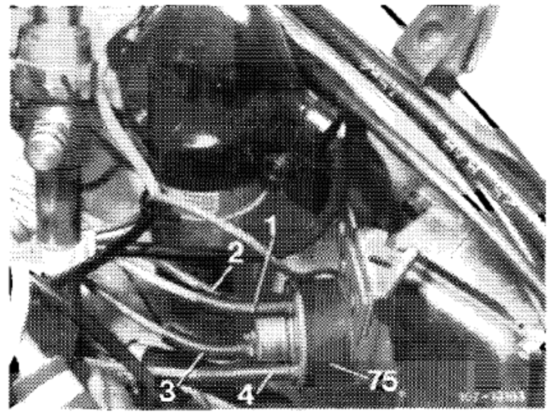
Depending on vacuum, the shutoff diaphragm (1) is pushed with coupling pin downwards against spring force and the valve can open.

Opening and closing of valve is controlled by pressure transducer which provides the positive or negative ventilation for diaphragm chamber above working diaphragm (3) depending on pressure of exhaust gases in exhaust manifold.



Pressure transducer

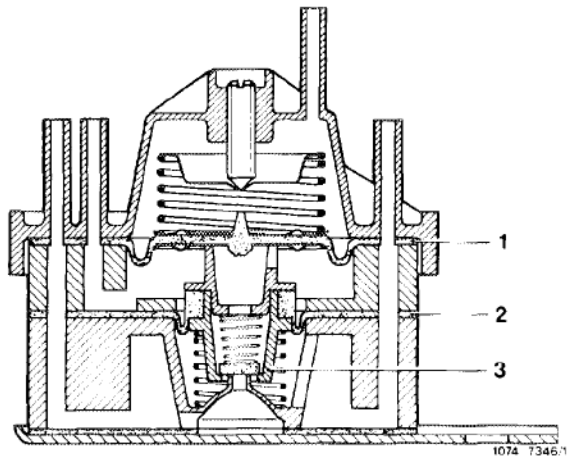
The pressure transducer is subdivided into three chambers by means of two spring-loaded diaphragms, the upper diaphragm (1) and the lower diaphragm (2). Both diaphragms are connected to each other by means of a diaphragm cup.



1 Connection intake pipe vacuum (blue)
2 Connection vent line (white)
3 Connection exhaust gas backpressure line (orange)
4 Connection vacuum control line to EGR valve (brown)

The exhaust gas backpressure is effective in upper diaphragm chamber. The center diaphragm chamber is continuously and positively vented through air guide housing. This will not influence the position of the diaphragms. The lower diaphragm chamber is positively or negatively vented depending on exhaust gas backpressure.

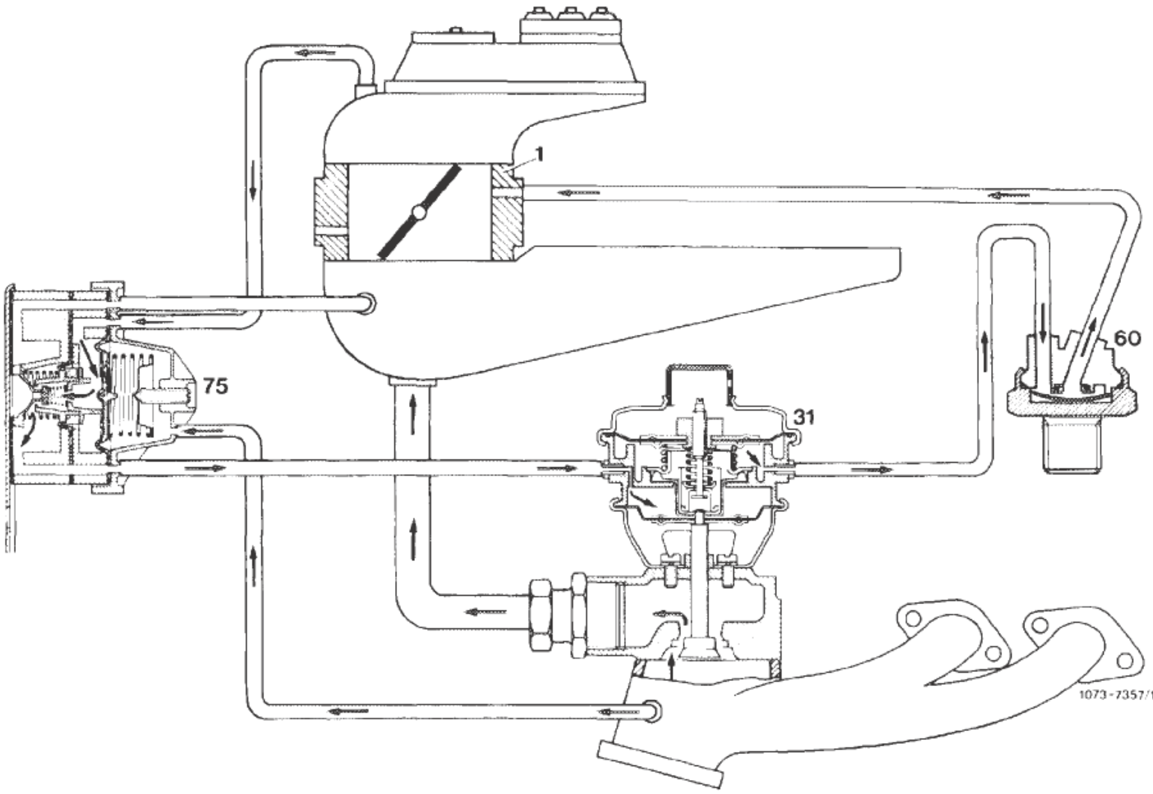
The different driving conditions provide three positions for pressure transducer:



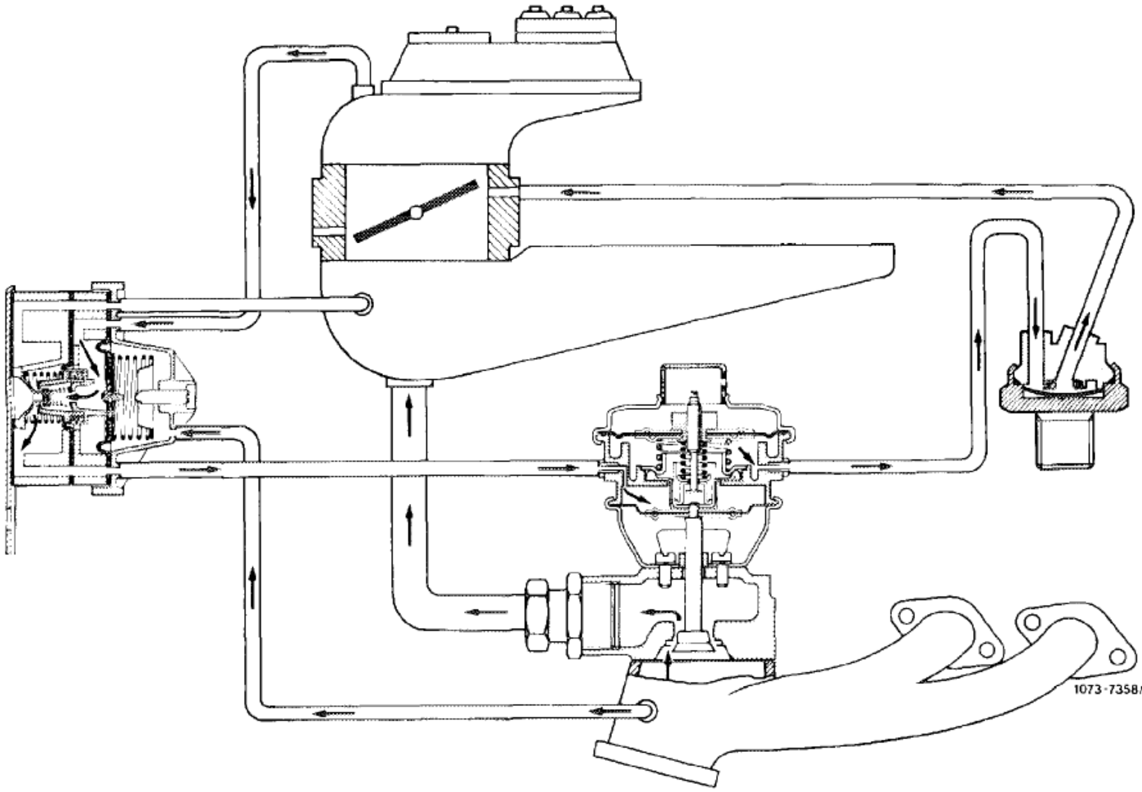
1 Upper diaphragm
2 Lower diaphragm
3 Diaphragm cup

1. During acceleration the exhaust gas backpressure increases and forces the upper diaphragm with diaphragm cup and the lower diaphragm in downward direction.

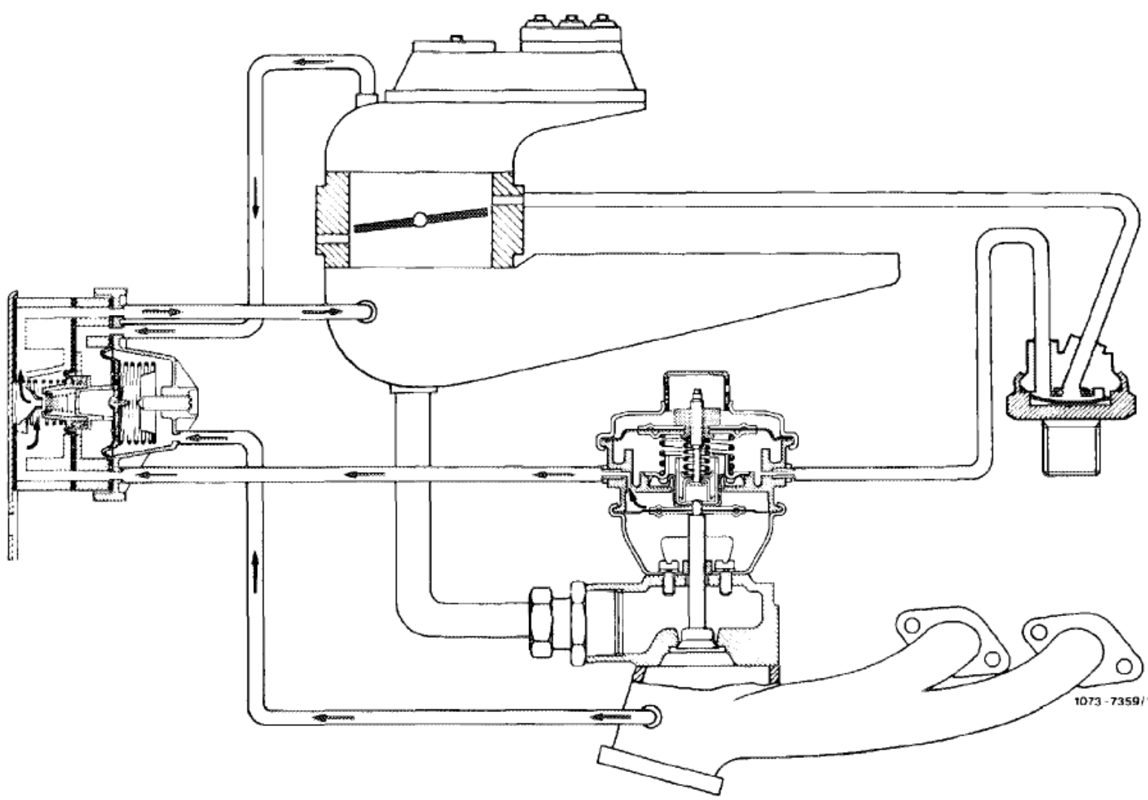
The valve reed in diaphragm cup closes the intake pipe vacuum line in lower diaphragm chamber. Simultaneously, the valve reed opens the positive venting bore from center to lower diaphragm chamber. The lower diaphragm chamber in EGR valve is positively vented by means of the vacuum control line coming from lower diaphragm chamber. The spring in EGR valve pushes the working diaphragm with valve down. The valve opens completely and the largest possible quantity of exhaust gases flows to intake pipe.



2. During transition to deceleration (coasting) the exhaust gas backpressure decreases. The upper diaphragm (1) including the diaphragm cup and the lower diaphragm are returning to their starting position. The valve reed opens the intake pipe vacuum line and seats on lower part of diaphragm cup. This will interrupt the positive venting of the lower diaphragm chamber. The intake pipe vacuum now prevailing in this diaphragm chamber provides the negative ventilation for the lower diaphragm chamber in EGR valve via the vacuum control line. Depending on size of vacuum the valve is pulled in closing direction against the spring force. The quantity of fed exhaust gas decreases.



3. During constant driving the pressure conditions in upper and lower diaphragm chamber are in balance. The EGR valve remains in its momentary position. The recirculated quantity of exhaust gases remains constant.



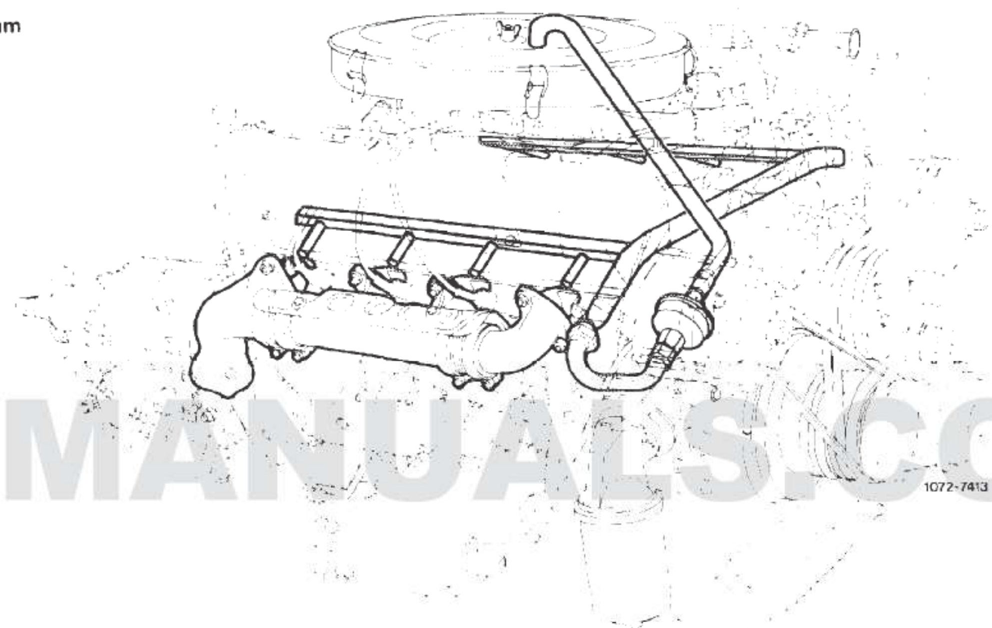
C. Air injection Federal version

To reduce the incompletely burnt components in the exhaust gases, air is injected into hot zone behind exhaust valves.

Afterburning is controlled by way of the engine temperature and pressure conditions in intake pipe.

To avoid backfiring in exhaust, as well as overheating of catalyst, the air injection is shut off in given driving ranges.

Function diagram

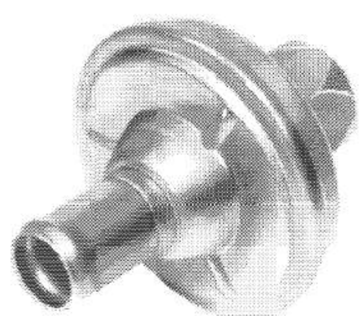


1072-7413

Components of air injection:

Check valve

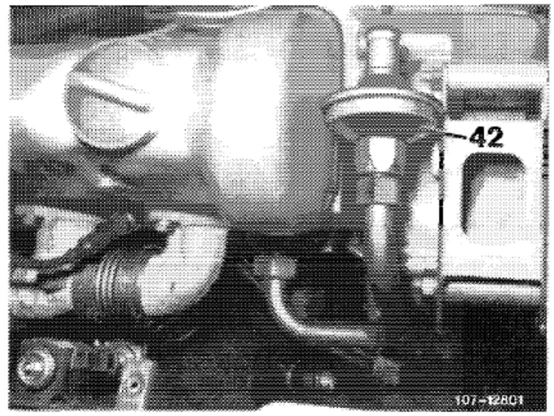
The check valve prevents hot exhaust gases from flowing into air filter.



107-12615

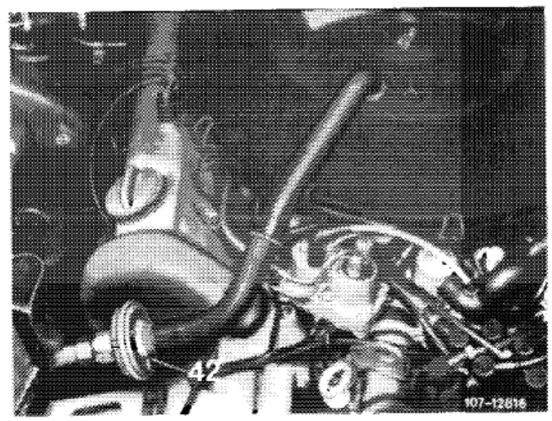
Intake lines or intake ducts

The drawn-in air flows through intake line or intake ducts behind the exhaust valves.



Air filter

A connection for the air intake is attached to cover of air filter.

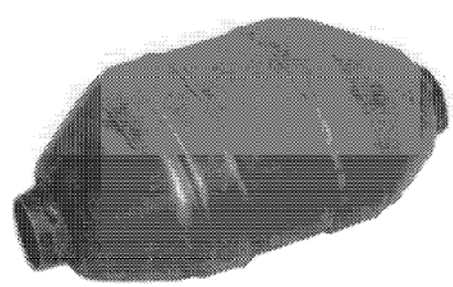


Catalysts

The catalysts are designed as underfloor catalysts.

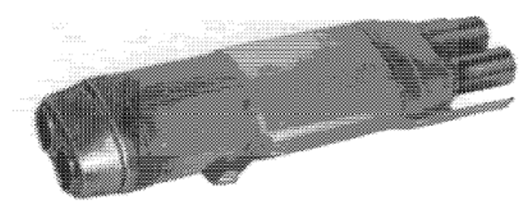
On model 116 one catalyst is installed for each cylinder bank.

On model 107, the center muffler is combined with catalyst.



Model 116

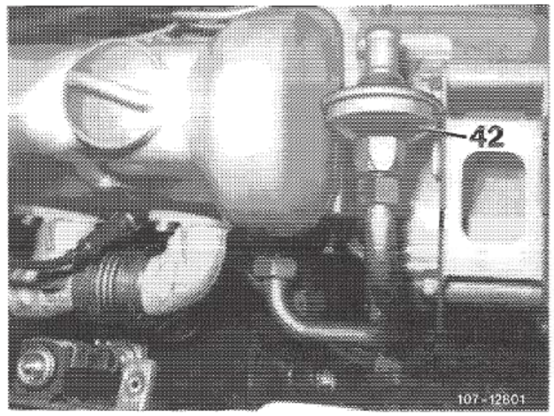
107-12970



Model 107

107-12960

Operation



With the engine running, fresh air is constantly drawn in via the air intake ports by the alternating pressures (pressure oscillations) on exhaust valves.

The exhaust gases and the drawn-in air are routed through the exhaust pipes into the catalysts. The oxygen in the air encounters the hot exhaust gases for reaction in catalyst.

The "intake valve" (42) sucks the air from the fresh air side of air filter around a diaphragm which consists of a temperature-resistent material. The diaphragm opens and permits the fresh air to mix with the exhaust gases during the low pressure (vacuum) impulses which are generated behind the exhaust valves and in exhaust manifold. When the pressure is positive, the diaphragm closes and prevents that the exhaust gases are flowing into air filter. The intake valve has its highest efficiency at idle and slightly increased idling speed, when the vacuum is the highest.

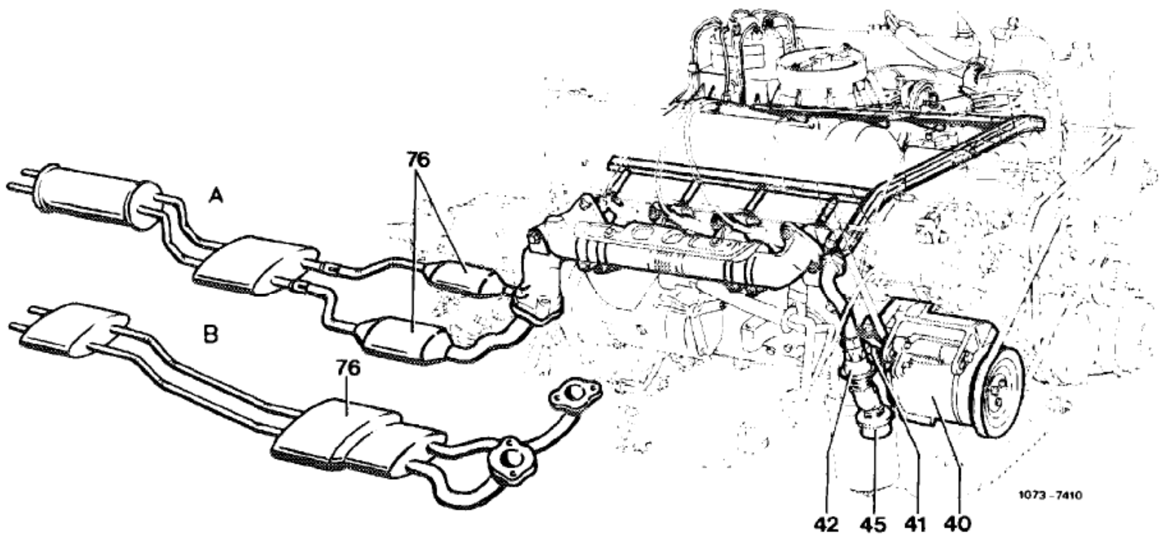
D. Air injection California version

To reduce the incompletely burnt components in exhaust gas, air is injected into hot zone behind exhaust valves.

Afterburning is controlled by means of the engine temperature and vacuum conditions in intake pipe.

To prevent backfiring in exhaust, as well as overheating of catalyst, the air injection is switched off in given driving ranges.

Function diagram

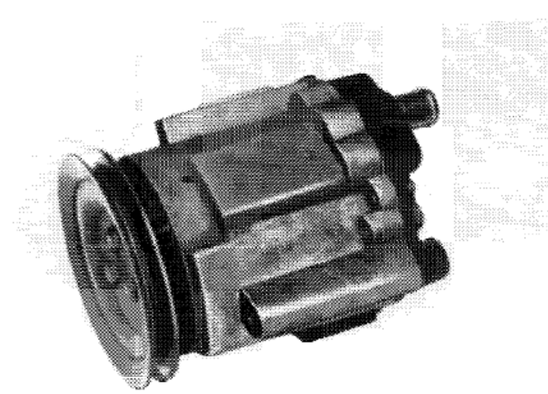


40 Air pump
41 Diverter valve
42 Check valve
45 Air filter
76 Underfloor catalysts
A Model 116
B Model 107

Components of air injection:

Air pump (Saginaw pump)

The air pump is an impeller pump with maintenance-free centrifugal filter which cleans the drawn-in air.

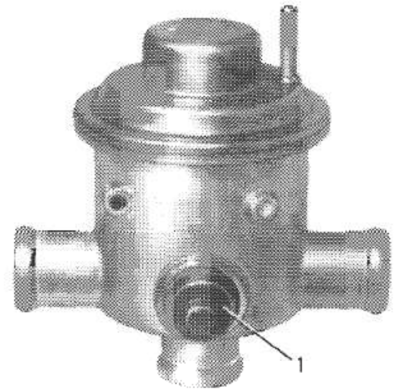


107-8959/1

Diverter valve

The diverter valve serves the purpose of discharging the delivered air below 17 °C coolant temperature by way of a separate air filter for silencing.

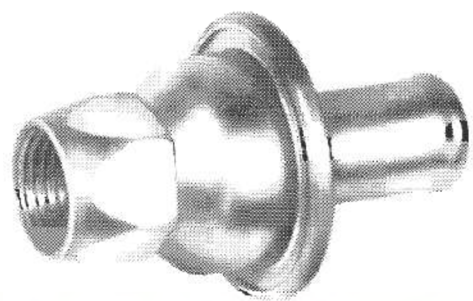
The diverter valve is provided with a safety valve (1) which discharges the delivered air at a given overpressure to protect the pump vanes against overload.



107-10092

Check valve

The check valve prevents the inflow of hot exhaust gases into air line.

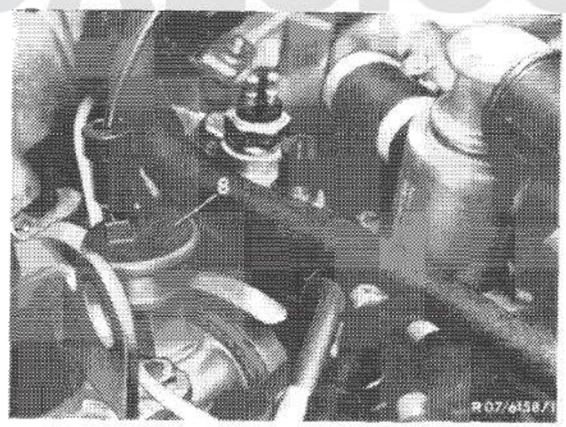


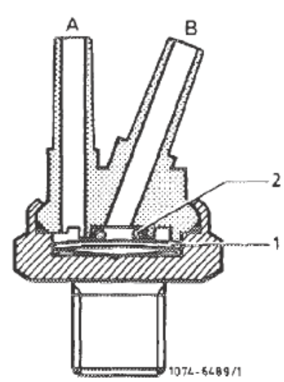
107-9193

Thermovalve 17 °C (color code blue)

The thermovalve is screwed into coolant-controlled portion of intake pipe and opens at approx. 17 °C coolant temperature. Below 17 °C coolant temperature the bimetallic plate rests against O-ring and closes connection "B".

Above 17 °C coolant temperature the bimetallic plate snaps downward when heated. Both connections are connected to each other.





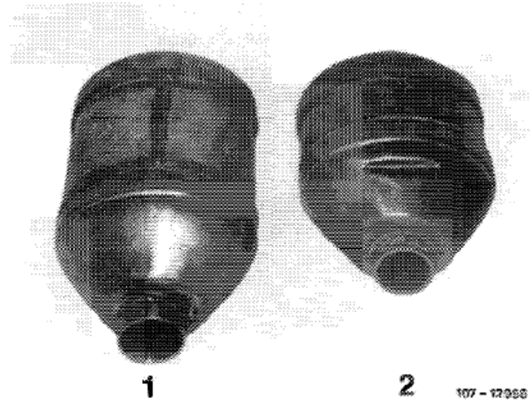
1 Bimetallic plate
2 O-ring
A To EGR valve
B To throttle valve housing

Catalysts

The catalysts are designed as underfloor catalysts.

On model 116, one catalyst per cylinder bank is installed.

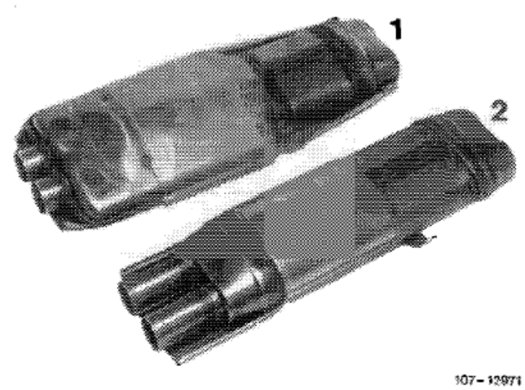
On model 107, the catalyst is combined with center muffler to save space.



Model 116

1 California version
2 Federal version

Due to the stricter emission values in California, this version is provided with larger catalysts.

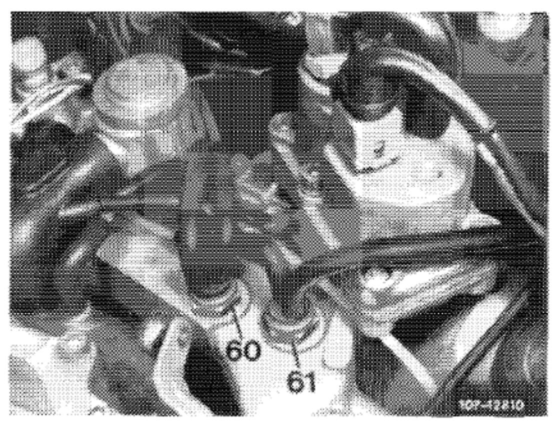


Model 107

1 California version
2 Federal version

Operation

Starting at a coolant temperature of approx. 17 °C in intake pipe, air is diverted into exhaust ducts of cylinder heads during idle, deceleration and under partial load.



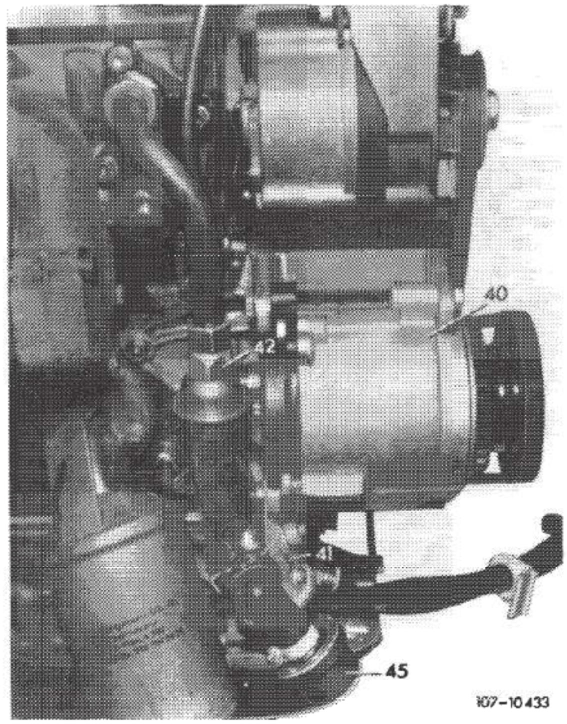
60 Thermovalve 40 °C
61 Thermovalve 17 °C

The air pump is driven by the crankshaft via a V-belt and delivers constantly air when the engine is running.

The air flows to diverter valve (41). Starting at approx. 17 °C coolant temperature, when the diaphragm of the diverter valve is supplied with a vacuum, the air is ejected into the cylinder heads by way of check valve (42). Below 17 °C coolant temperature, when no vacuum is supplied for diaphragm of diverter valve, the delivered air is blown into the open air through the air filter for silencing (45).

The exhaust gases and the injected air are routed through the exhaust pipes into the catalysts.

The oxygen in the injected air encounters the hot exhaust gases for reaction in catalyst.



40 Air pump
41 Diverter valve
42 Check valve
45 Air filter for silencing (muffler)

107–10433

E. Air intake tourist vehicles Federal version

Tourist vehicles are supplied ex factory without a catalyst.

For this reason, only the air intake is different compared with Federal version.

To reduce the incompletely burnt components in exhaust gas, air is drawn into hot zone behind exhaust valves.

Afterburning is controlled via the engine temperature and vacuum conditions in intake pipe.

To prevent backfiring in exhaust, the air intake is shut off in given driving ranges.

Components of air intake:

Except for catalysts, components are similar to Federal version.

F. Air injection tourist vehicles California version

Tourist vehicles are supplied ex factory without catalysts.

For this reason, only the air injection is different from California version.

To reduce the incompletely burnt components in exhaust gas, air is injected into hot zone behind exhaust valves.

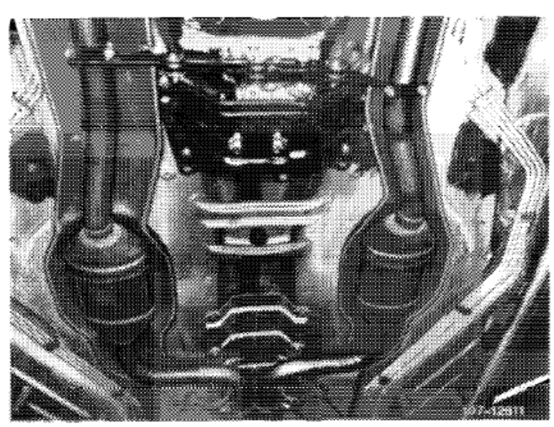
Afterburning is controlled via the engine temperature and vacuum conditions in intake pipe.

To prevent backfiring in exhaust, the air injection is shut off in given driving ranges.

Components of air injection:

Except for catalysts the components are similar to the California version.

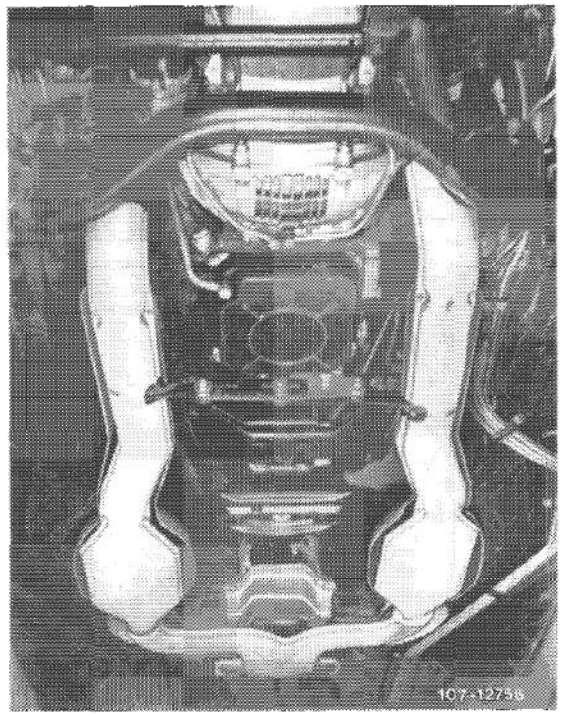
G. Catalysts



The catalysts are installed in exhaust system in front of mufflers (silencers). Because of the higher temperatures, the front exhaust pipes and the catalysts are covered with heat shields.

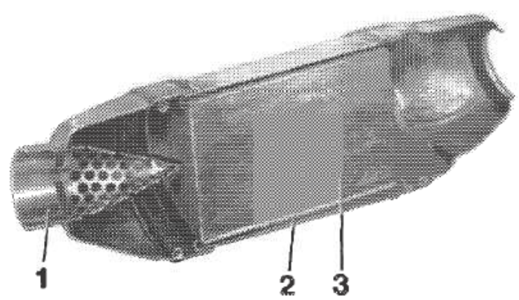
Model 116 is provided with two catalysts.

On model 107 the catalyst is combined with center muffler (silencer).



Model 116 with heat shields

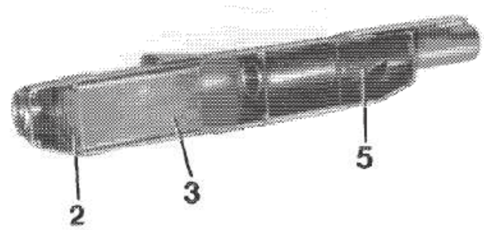
The catalyst comprises an oval monolith (3), a honeycomb-shaped body of ceramic material elastically supported in a wire netting (2). The noble metal evaporated on the monolith, the actual catalyst, accelerates the oxydation of CO and hydrocarbons while adding fresh air at the proper temperature.



Model 116

1 Distribution plate
2 Wire netting
3 Monolith

To keep catalyst in functioning condition, operate engine with unleaded fuel **only.**



Model 107

2 Wire netting
3 Monolith
5 Exhaust pipe

Overheating of catalysts should be prevented

Extended overheating of catalyst will result in catalyst damage, i.e. the monoliths in catalyst may melt.

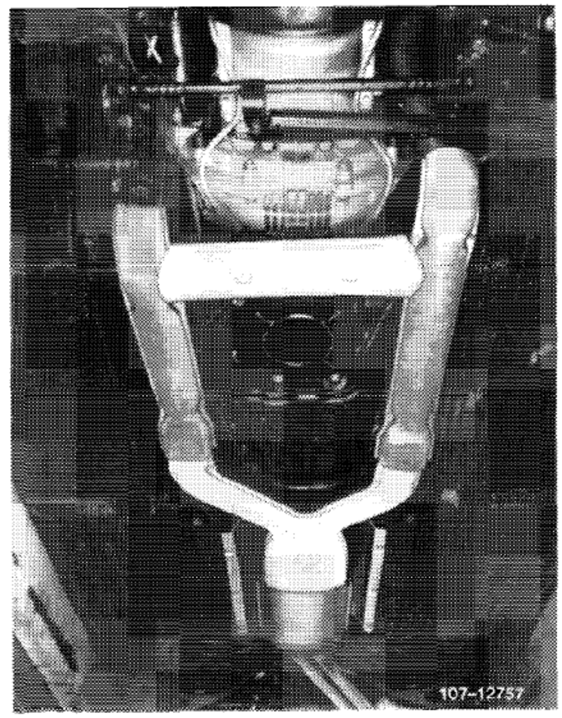
Overheating of catalyst may occur if:

a) The specified engine service is not maintained.

Perfect spark plugs are important for life of catalyst.

b) Irregular operation of engine results in excessively enirchment of fuel-air mixture.

c) Exhaust gas emission control system is arbitrarily changed.

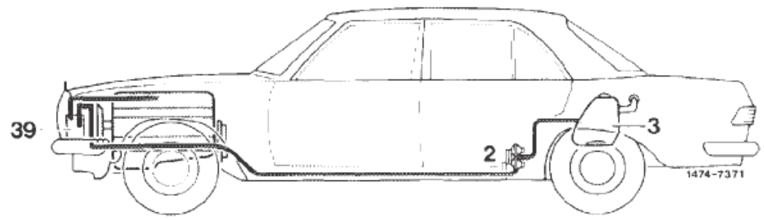


Model 107 with heat shields

H. Fuel evaporation control model year 1977

A fuel evaporation control system has been installed to improve emissions which are not directly connected with engine combustion.

Function diagram

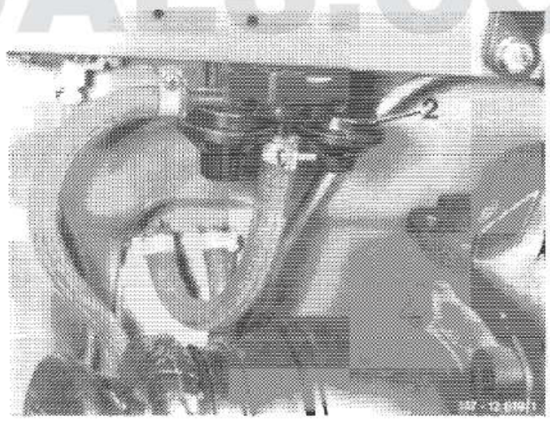


2 Valve system
3 Fuel tank
39 Charcoal canister

Components of fuel evaporation control system:

Valve system

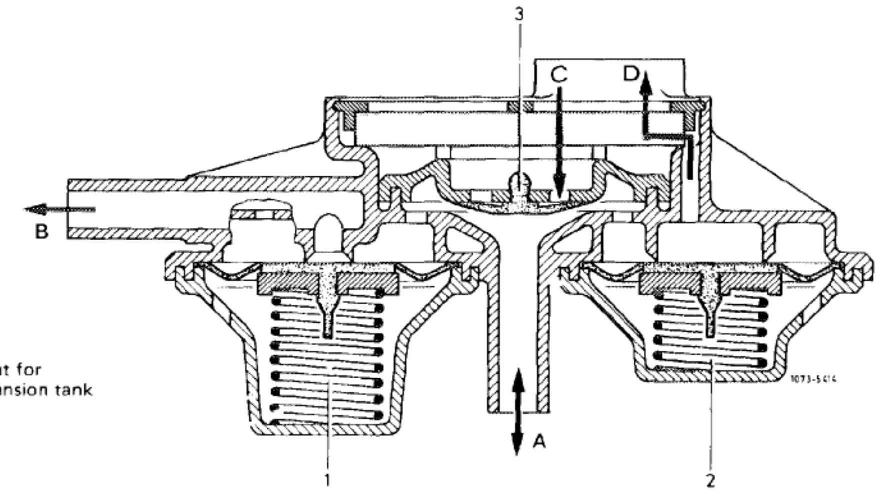
The valve system is mounted underneath vehicle at level of rear legroom.



The valve system comprises three valves:

1. Negative vent valve
2. Pressure relief valve
3. Positive vent valve

The **negative vent valve** opens at a slight overpressure. The evaporation vapors are flowing via negative vent valve into a line toward charcoal canister.



Sectional view valve system

1 Negative vent valve
2 Pressure relief valve
3 Positive vent valve
A Input to valve system/output for positive venting of fuel expansion tank
B To charcoal canister
C Fresh air input
D Output pressure relief valve

The **pressure relief valve** opens as a safety valve in the event of an overpressure in fuel evaporation control system. The fuel vapors are bled directly into the open air.

The **positive vent valve** opens whenever cooling down of fuel tank or reduced contents result in a vacuum.

Charcoal canister

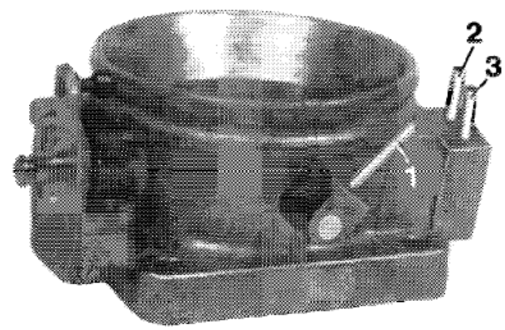
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn again out of canister when driving.

A Connection tank vent
B Draw-off connectior

107–9128

Throttle valve housing

The throttle valve housing is provided with a connection to draw evaporation vapors from charcoal canister.

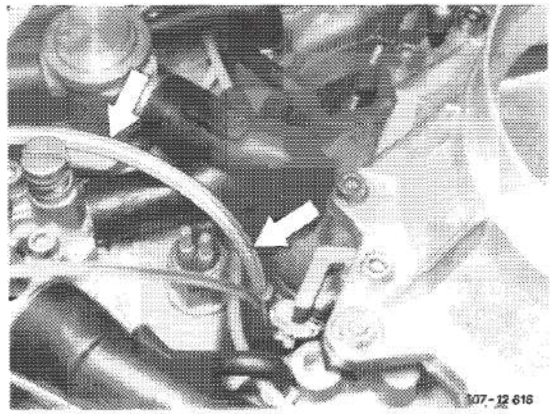


1 Vacuum connection ignition adjustment retard
2 Vacuum connection ignition adjustment advance
3 Vacuum connection charcoal canister

107–13054

Operation

The fuel evaporation vapors from fuel tank are routed to charcoal canister via valve system (2). In the charcoal canister the fuel evaporation vapors are stored when the engine is stopped and are drawn off into throttle valve housing starting at a given throttle valve position when the engine is running.

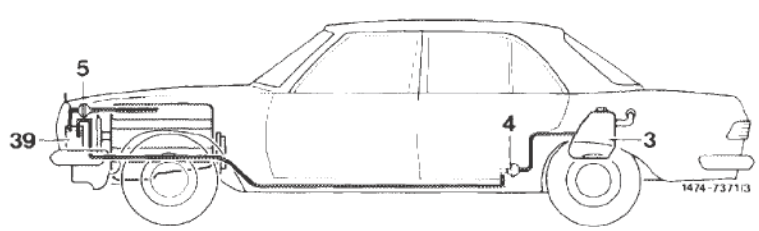


Arrow = draw-off line to throttle valve housing

I. Fuel evaporation control system model year 1978/79

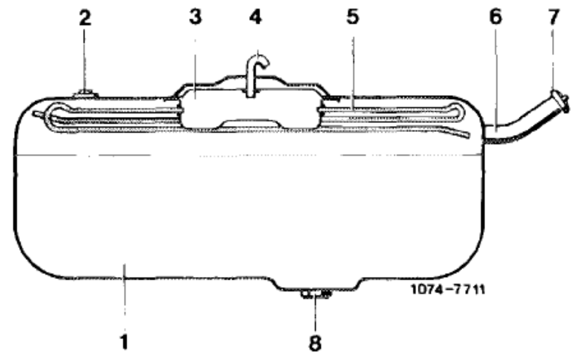
A fuel evaporation control system has been installed to improve emissions which are not directly connected with engine combustion.

Function diagram



2 Fuel tank
4 Vent valve unit
5 Regenerating valve
39 Charcoal canister

Components of fuel evaporation control system:



Fuel tank

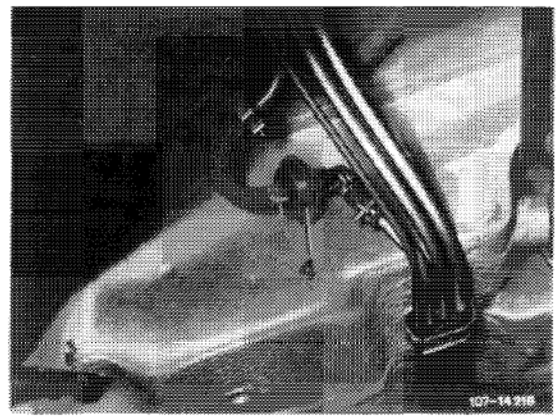
A collecting tray connected to pipe system is installed in fuel tank. The connection to vent valve unit enters into the tray.

1	Fuel tank	5	Pipe system
2	Immersion tube transmitter	6	Filler neck
3	Expansion tank	7	Closing cover
4	Connection vent valve unit	8	Connection fuel feed line

Vent valve unit

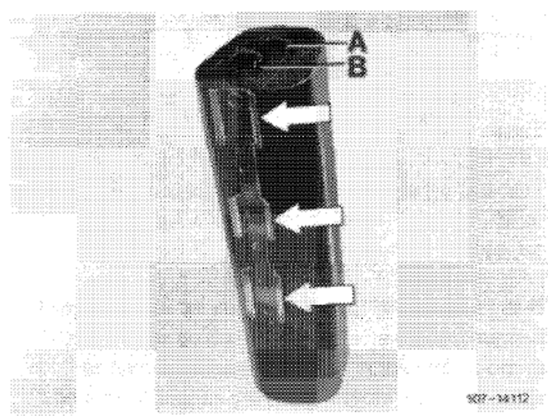
The vent valve unit (4) is mounted underneath vehicle at level of rear legroom and takes the place of the valve system known from model year 1977.

The valve unit comprises a negative vent valve (pressure relief valve) and a positive vent valve (vacuum relief valve).



Charcoal canister

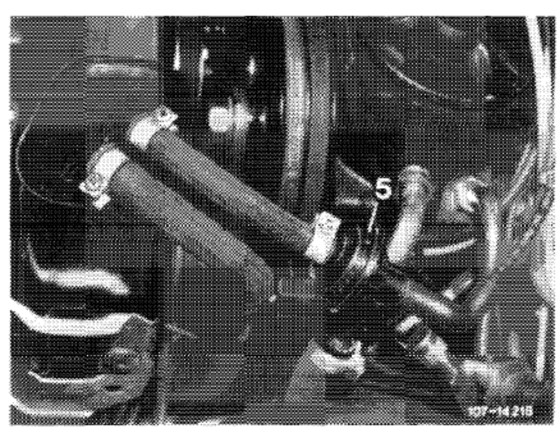
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn off again while driving.



A Draw-off connection
B Tank vent connection

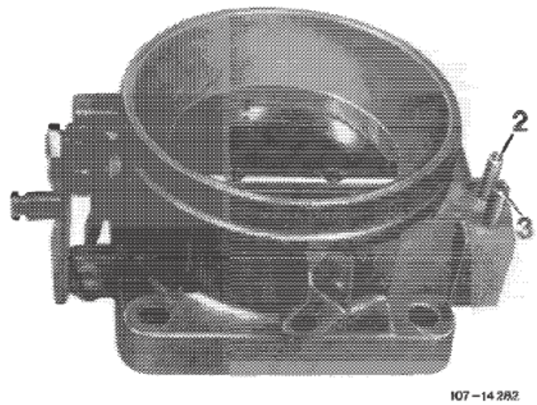
Regenerating valve

The regenerating valve (5) is located in regenerating line from charcoal canister to throttle valve housing.



Throttle valve housing

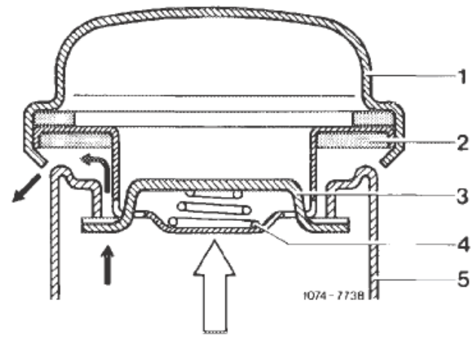
The throttle valve housing has been slightly changed compared with model year 1977. To avoid mixing up the vacuum connections, the OD of the vacuum connection to charcoal canister has been increased from 4 to 5 mm. Two regenerating bores were added above throttle valve for drawing off evaporation vapors from charcoal canister.



2 Vacuum connection ignition advance
3 Vacuum connection charcoal canister

Fuel tank cap

To avoid increased overpressure in fuel tank, the fuel tank cap has been modified.



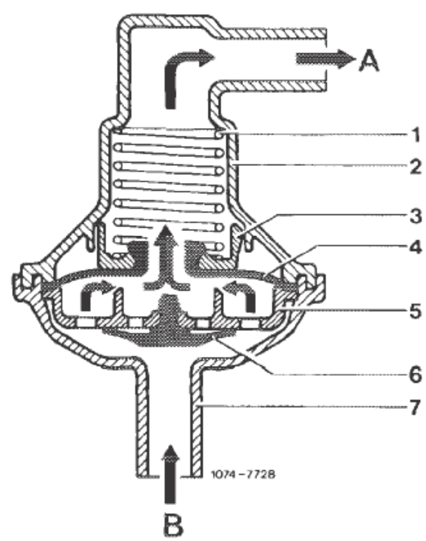
1 Cap
2 Sealing ring
3 Clamp
4 Compression spring
5 Filler neck

Operation

Evaporation system

The vent valve unit increases the pressure in fuel tank to 30–50 mbar, so that these fuel evaporation vapors can escape from fuel tank.

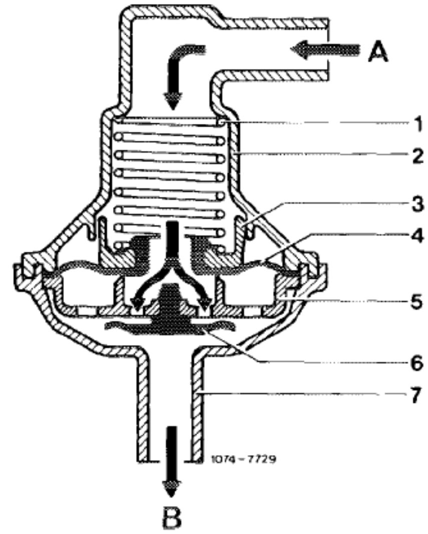
If the pressure in fuel tank arrives at 30–50 mbar the pressure relief valve (4) opens and permits the fuel evaporation vapors to flow toward charcoal canister where they are stored when the engine is stopped.



Vent valve unit open to charcoal canister

1 Compression spring
2 Valve housing
3 Spring seat
4 Pressure relief valve (negative vent valve)
5 Valve disc
6 Vacuum relief valve (positive vent valve)
7 Connection
A Connection charcoal canister
B Connection fuel tank

When the fuel cools down, the decreasing volume is compensated by the intake of air or fuel evaporation vapors from charcoal canister via vacuum relief valve (6) starting at a vacuum of 1–16 mbar. If the vacuum in fuel tank drops below 1 mbar, the vacuum relief valve (6) will close.



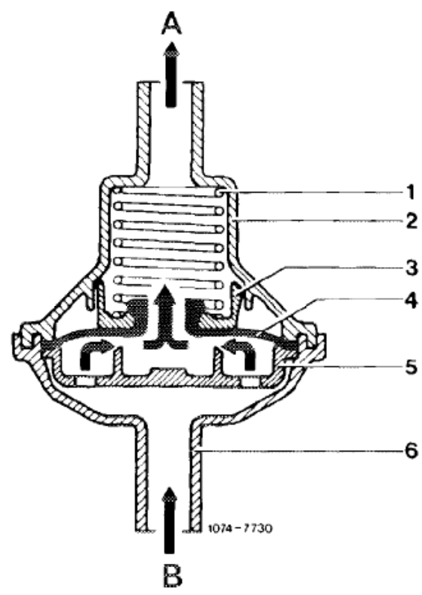
Vent valve unit open to fuel tank

If the pressure in the fuel tank increases above 0.1–0.3 bar due to a malfunction in the fuel evaporation system, the fuel vapors escape via the fuel tank cap.

Regenerating system

The charcoal canister is connected to the throttle valve housing by means of a line in which the regenerating valve is enclosed.

When the engine is running and the vacuum in the regenerating line exceeds 30–50 mbar, the regenerating valve opens. The fuel vapors stored in charcoal canister can be drawn off depending on the throttle valve position.

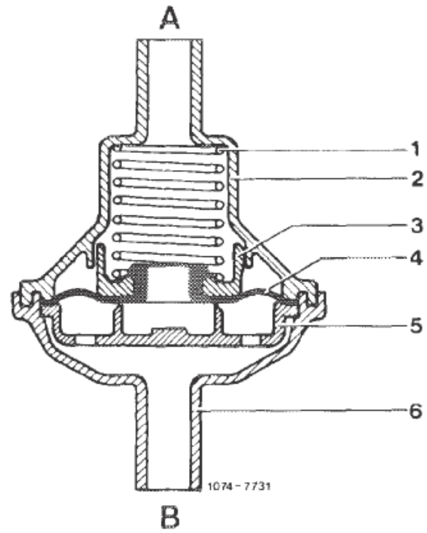


Regenerating valve (open)

1 Compression spring
2 Valve housing
3 Spring seat
4 Pressure relief valve
5 Valve disc
6 Connection
A Connection throttle valve housing
B Connection charcoal canister

When the throttle valve opens, the two regenerating bores in throttle valve housing, which are entering a common duct, are both passed over one after the other. As a result, regeneration in lower partial load range begins in dosages which are not influencing the driving characteristics.

At idle and during deceleration (throttle valve closed) the two regenerating bores are at atmospheric side of throttle valve. There is no regeneration of charcoal in canister.



Regenerating valve (closed)

Model year 1977/78/79

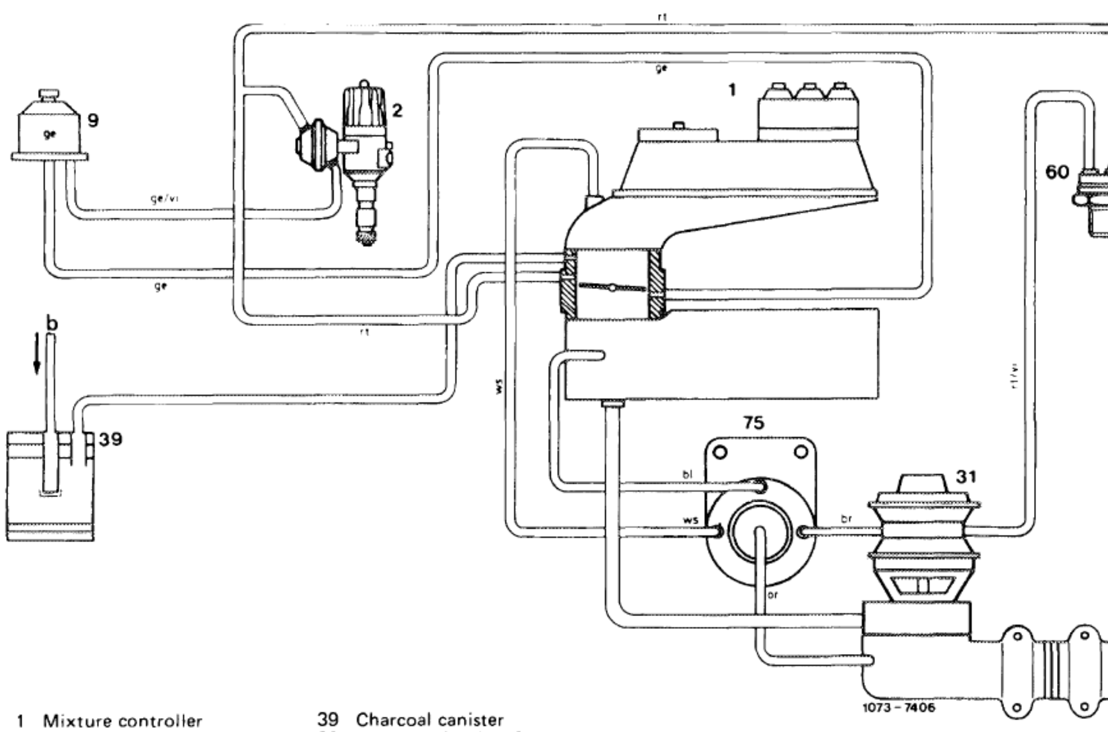
A. Federal version, tourist vehicles Federal version

For complaints such as: Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.

Test conditions: Engine at operating temperature, run engine at idle speed.

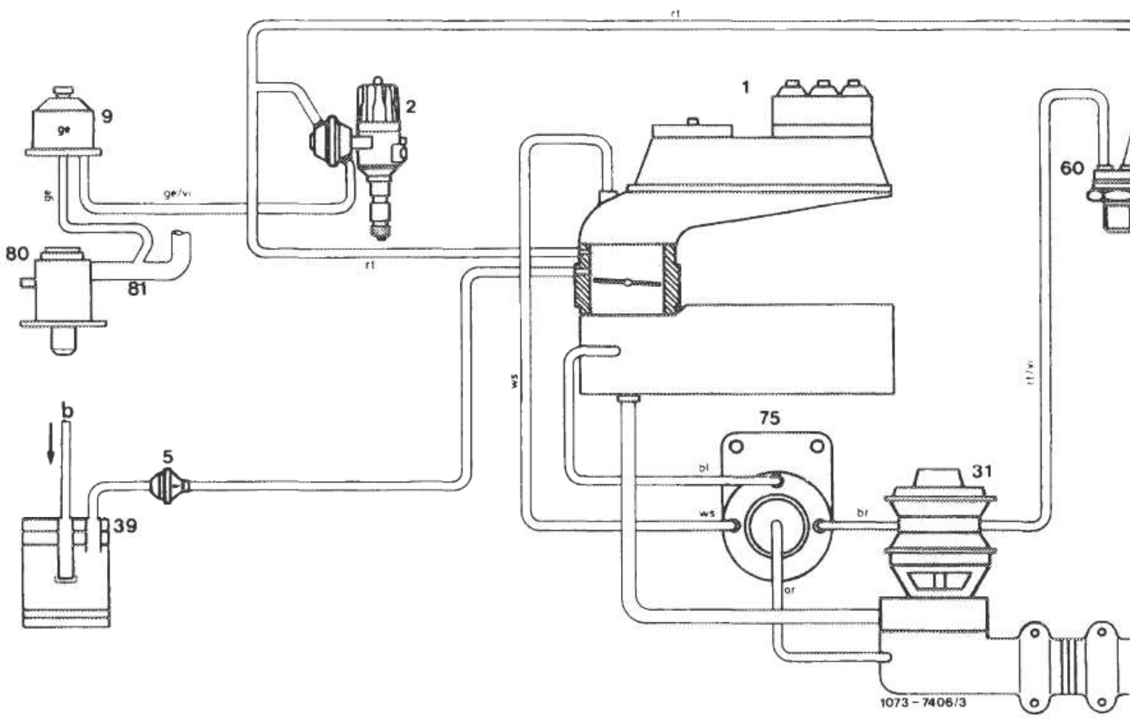
Test the following: EGR, air intake and fuel evaporation control system.

Function diagram model year 1977



1 Mixture controller
2 Ignition distributor
9 Switchover valve ignition
31 EGR valve
39 Charcoal canister
60 Thermovalve 40 °C
75 Pressure transducer
b Connection tank vent

Function diagram model year 1978/79

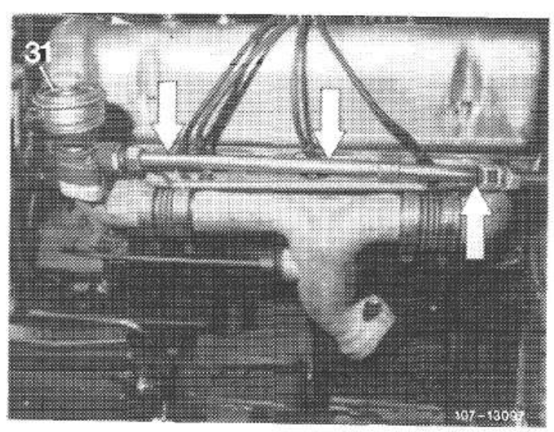


1 Mixture controller
2 Ignition distributor
5 Regenerating valve
9 Switchover valve ignition
31 EGR valve
39 Charcoal canister
60 Thermovalve 40 °C
75 Pressure transducer
80 Auxiliary air valve
81 Contoured hose
b Connection tank vent

Testing EGR

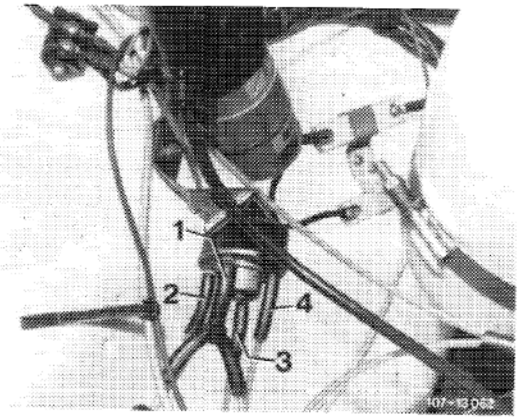
Pull brown vacuum line from EGR valve (31) and slowly increase idle speed.

Engine runs irregularly starting at approx. 1200/min or stops.	Engine runs without change.



Testing vacuum lines

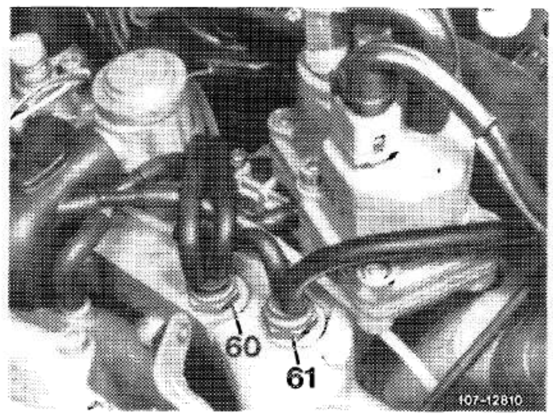
Test layout of vacuum lines on pressure transducer and intake pipe. Note that connections on pressure transducer are identified with color rings. The attached vacuum lines should have the same color.



1 Connection intake pipe vacuum (blue)
2 Connection vent line (white)
3 Connection exhaust gas backpressure line (orange)
4 Connection vacuum line to EGR valve (brown)

On black thermovalve 40 °C (60) the red vacuum line should be plugged to diagonal connection, and the purple/red vacuum line to straight connection.

Check all pertinent vacuum lines for leaks and blow out vacuum connections.

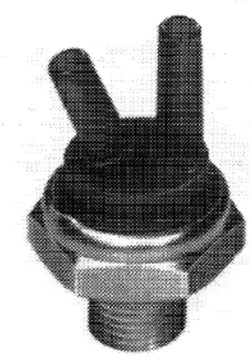


Testing thermovalve 40 °C (60)

The thermovalve is identified by a black plastic section and the designation "50 AA 4" punched into metal section.

Pull off red/purple vacuum line, let engine run and accelerate.

Vacuum should be felt at free connection.

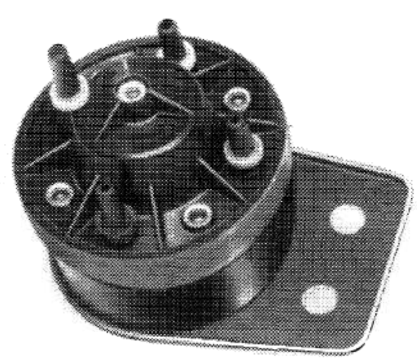


107-10895

Testing pressure transducer (75)

Run engine at idle speed. Pull off brown vacuum line on EGR valve. Connect vacuum pressure gauge or keep vacuum line closed with finger. Vacuum should be available at idle speed.

If there is no vacuum, renew pressure transducer.



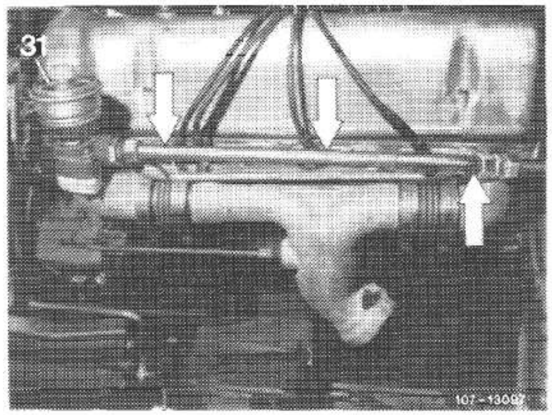
107-12314

Testing EGR valve (31)

Run engine at idle speed. Pull off both hoses on EGR valve.

Plug brown vacuum line to connection for red/purple vacuum line. Engine should run irregularly or come to a stop.

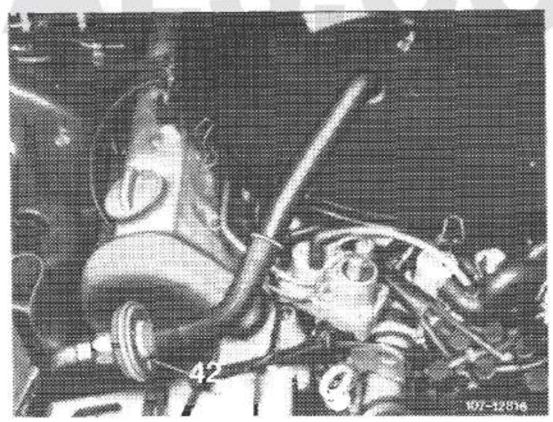
If operation of engine is not changing, renew EGR valve.



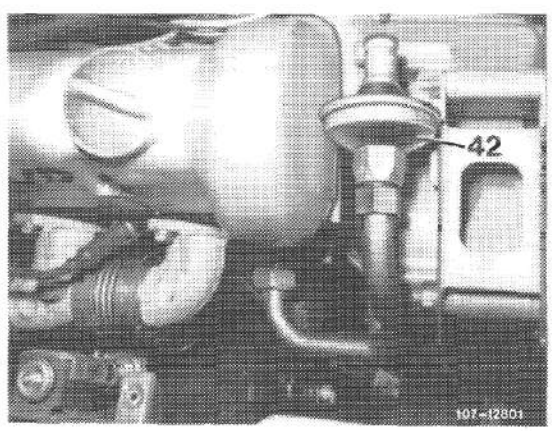
Testing air intake

Remove draw-off hose from air filter and keep closed with one finger.

Vacuum available (suction noise can be heard).	No vacuum.



Renew check valve (42).

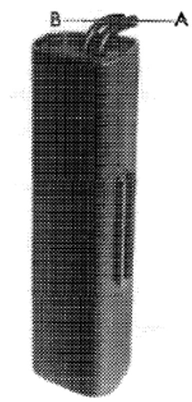


Testing fuel evaporation control system

Pull draw-off hose (B) to throttle valve housing from charcoal canister and keep closed with a finger or connect vacuum gauge.

Slowly increase engine speed to above approx. 2000/min.

No vacuum at idle. Vacuum increases with increasing speed.	No vacuum increase at increasing speed.

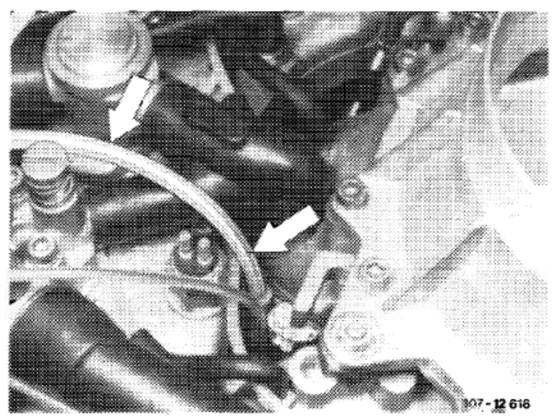


107-9128

Model year 1977

Testing draw-off hose

The draw-off hose (arrows) should be plugged to throttle valve housing. Check hose for leaks and blow out connection on throttle valve housing.



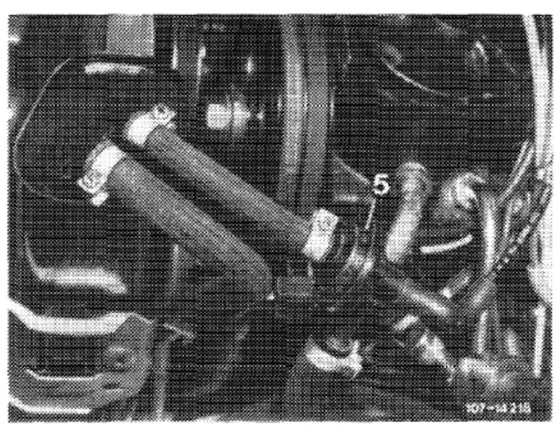
Model year 1978/79

Testing draw-off hose and regenerating valve

The draw-off hose (arrows) should be plugged to throttle valve housing. Check hose for leaks and blow out connection on throttle valve housing.

If there is still no vacuum, pull draw-off hose from regenerating valve and repeat test.

If there is a vacuum, replace regenerating valve.



End of test.

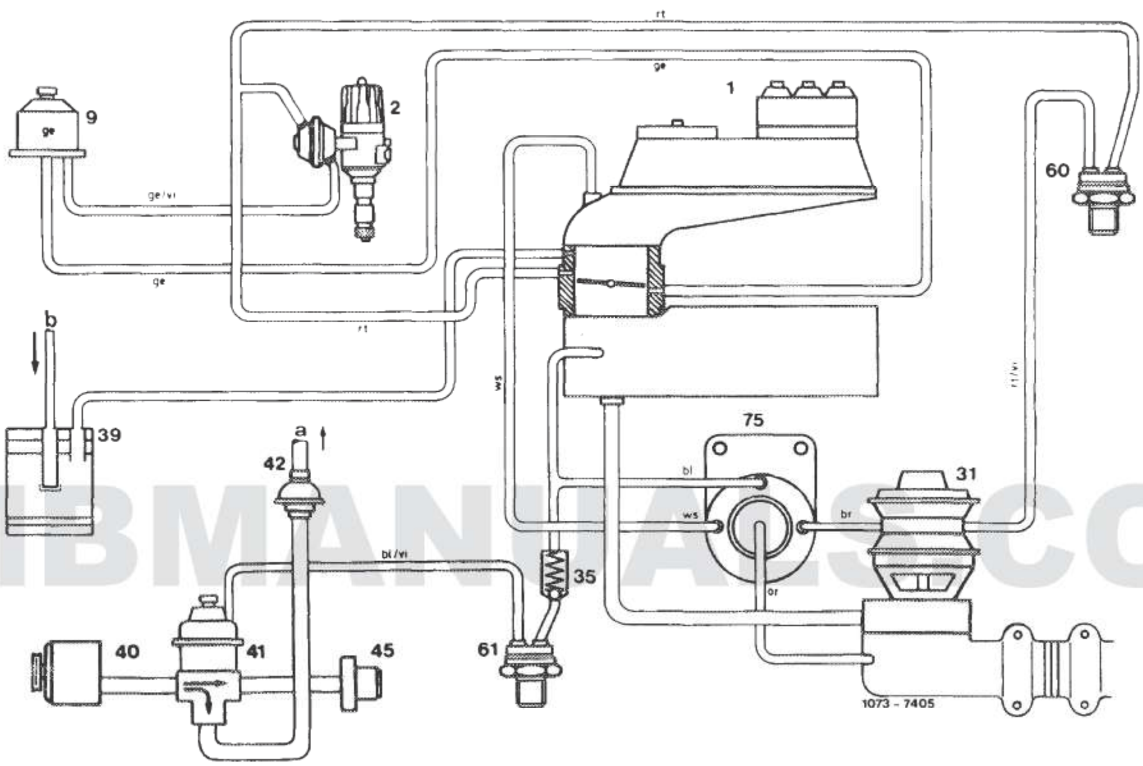
B. California version, tourist vehicles California version

For complaints such as: Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.

Test conditions: Engine at operating temperature, run engine at idle speed.

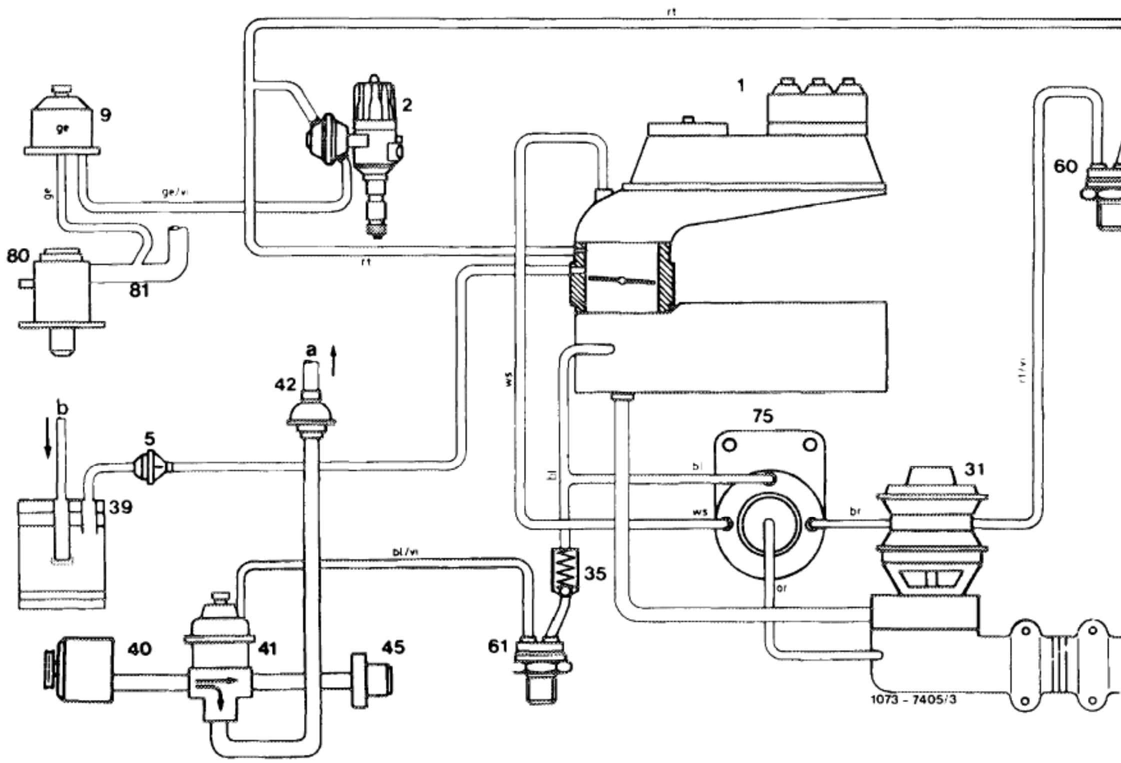
Test the following: EGR, air injection and fuel evaporation control system.

Function diagram model year 1977



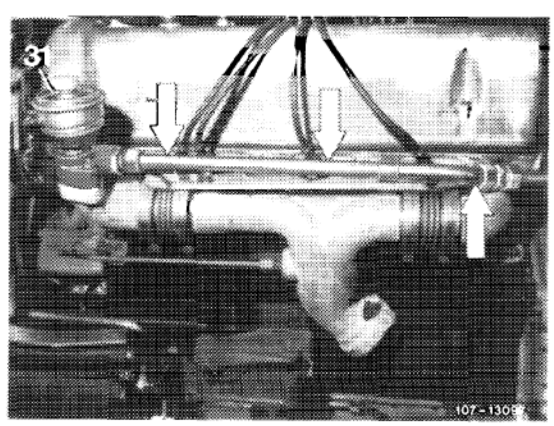
1 Mixture controller	39 Charcoal canister	60 Thermovalve 40 °C	a Air injection line cylinder head
2 Ignition distributor	40 Air pump	61 Thermovalve 17 °C	b Connection tank vent
9 Switchover valve ignition	41 Diverter valve	75 Pressure transducer	
31 EGR valve	42 Check valve	78 Air filter for silencing	
35 Check valve	45 Air filter		

Function diagram model year 1978/79



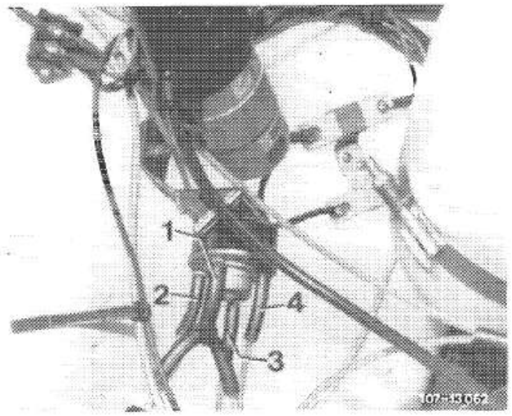
1	Mixture controller	39	Charcoal canister	75	Pressure transducer	a	Air injection line cylinder head
2	Ignition distributor	40	Air pump	78	Air filter for silencing	b	Connection tank vent
5	Regenerating valve	41	Air switchover valve	80	Auxiliary air valve		
9	Switchover valve ignition	42	Check valve	81	Contoured hose		
31	EGR valve	60	Thermovalve 40 °C				
35	Check valve	61	Thermovalve 17 °C				

Testing EGR Pull off brown vacuum line on EGR valve (31) and slowly increase idle speed.	
Engine runs irregularly starting at approx. 1200/min or comes to a stop.	Engine operation continuous without change.



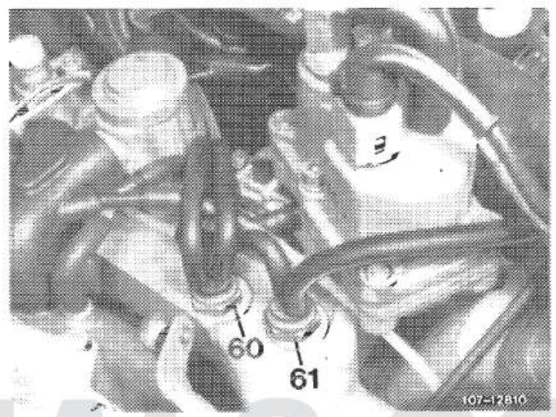
Testing vacuum lines

Test layout of vacuum lines on transducer and intake pipe. Note that connections on pressure transducer are identified with color rings. The plug-on vacuum lines should have the same color.



1 Connection intake pipe vacuum (blue)
2 Connection positive vent line (white)
3 Connection exhaust gas backpressure line (orange)
4 Connection vacuum control line to EGR valve (brown)

On black thermovalve 40 °C (60) the red vacuum line should be connected to diagonal connection, and the rubber hose to straight connection. Check all pertinent vacuum lines for leaks and blow out vacuum draw-off connections.

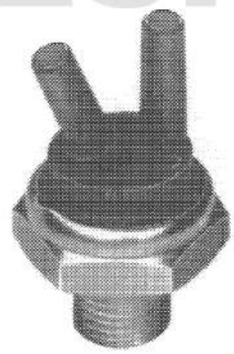


Testing thermovalve 40 °C (60)

The thermovalve is identified by black plastic section and by the designation "50 AA 4" punched into metal section.

Pull off red/purple vacuum line, run engine and accelerate.

Vacuum should be noticeable at free connection.

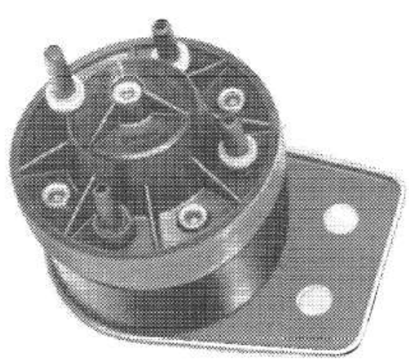


107-10893

Testing pressure transducer (75)

Run engine at idle. Pull off brown vacuum line from EGR valve. Connect pressure gauge or keep vacuum line closed with finger. Vacuum should be available at idle speed.

If there is no vacuum, renew pressure transducer.



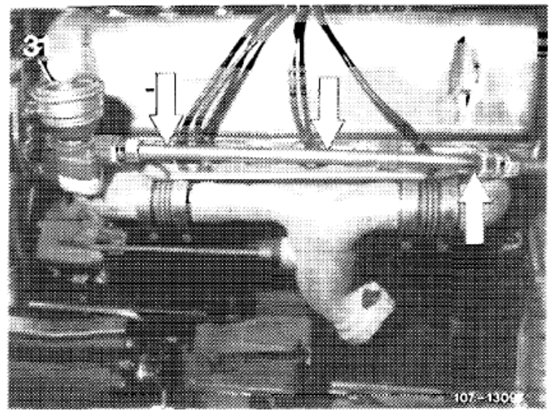
107-12314

Testing EGR valve (31)

Run engine at idle speed. Pull off both hoses on EGR valve.

Plug brown vacuum line to connection for red/purple vacuum line. Engine should run irregularly or come to a stop.

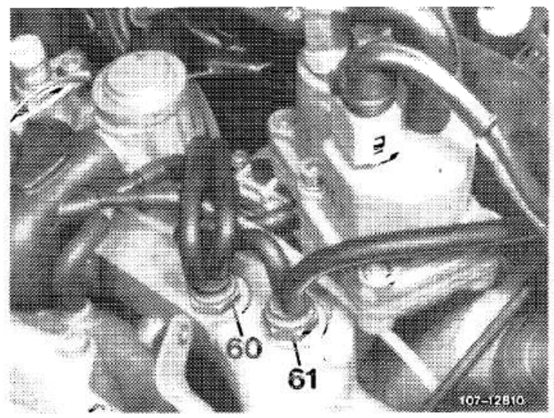
If operation of engine is not changing, renew EGR valve.



Testing air injection

Connect CO measuring instrument to exhaust gas backpressure line and read exhaust gas value. Pull blue/purple vacuum line from straight connection of thermovalve (61) and close connection.

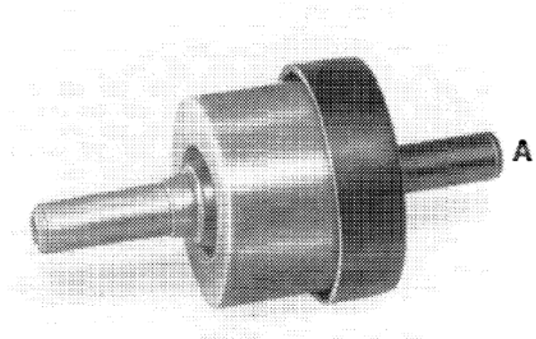
Exhaust gas value increasing.	Exhaust gas value not increasing.



Testing vacuum lines

The blue vacuum line with the check valve (35) plugged in-between leads from intake pipe to diagonal connection of thermovalve (61). The purple/blue vacuum line leads from straight connection of thermovalve (61) to diverter valve (41).

Connection (A) of check valve (35) should face intake pipe.



107-12701/1

Testing vacuum

Pull vacuum line from diagonal connection of thermovalve (61). Connect vacuum gauge or keep closed with finger. Vacuum should be available at idle speed. If there is no vacuum, test vacuum lines for leaks and blow through vacuum tapping hole (draw-off) on intake pipe.

If there is a vacuum, test thermovalve (61) or renew.

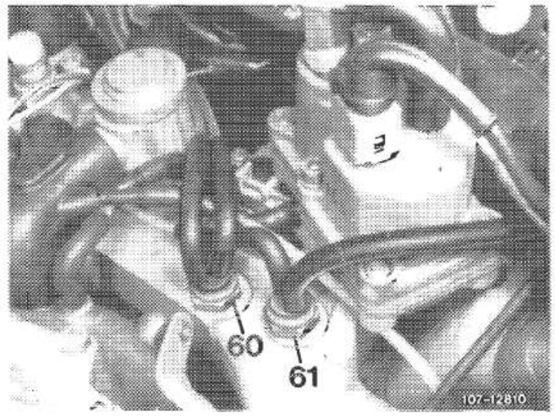
Testing thermovalve 17 °C (61)

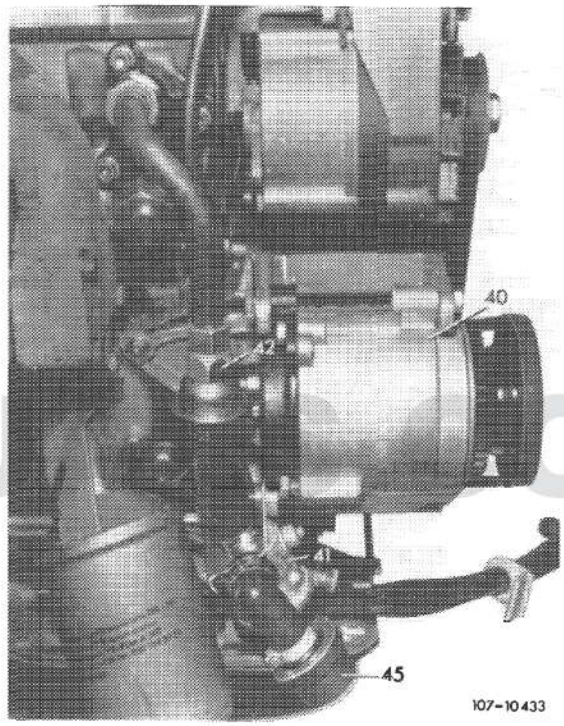
The thermovalve is identified by its blue plastic section and the designation "50 AB 5" punched into metal section.

Note: Starting model year 1978 with color code **green**, designation "50 AC 13".

Pull off blue/purple vacuum line. Run engine and accelerate. Vacuum should be felt at free connection.

If thermovalve is in order, renew diverter valve (41).





107-10433

Testing fuel evaporation system

Pull draw-off line (B) to throttle valve housing from charcoal canister and keep closed with finger or connect vacuum gauge.

Slowly increase engine speed to above approx. 2000/min.

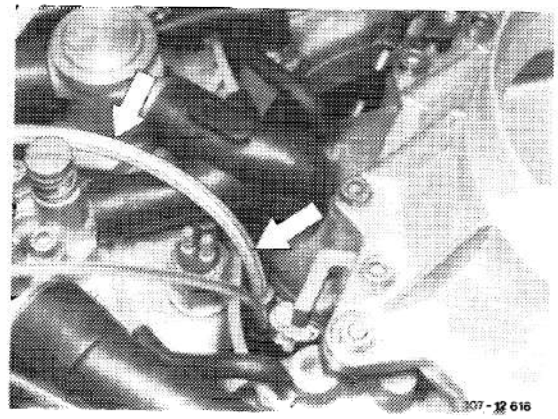
No vacuum at idle. Vacuum increasing with increasing speed.	No vacuum increase with increasing speed.

107-9128

Model year 1977

Testing draw-off hose

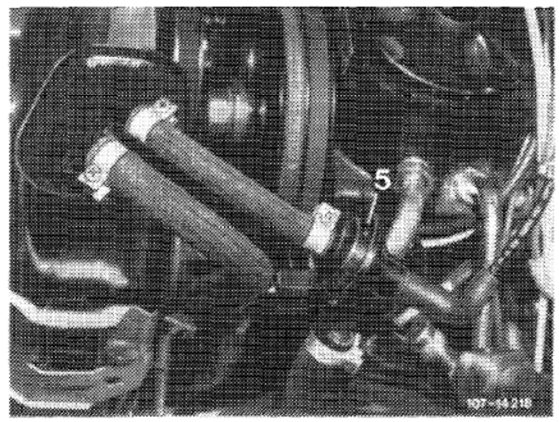
Draw-off hose (arrows) must be plugged to throttle valve housing. Check hose for leaks and blow out connection on throttle valve housing.



Model year 1978/79

Testing draw-off hose and regenerating valve

Draw-off hose (arrows) must be plugged to throttle valve housing. Check hose for leaks and blow out connection on throttle valve housing.



If there is still no vacuum, pull draw-off hose in front of regenerating valve and repeat test.

If vacuum is available, renew regenerating valve.

End of test.

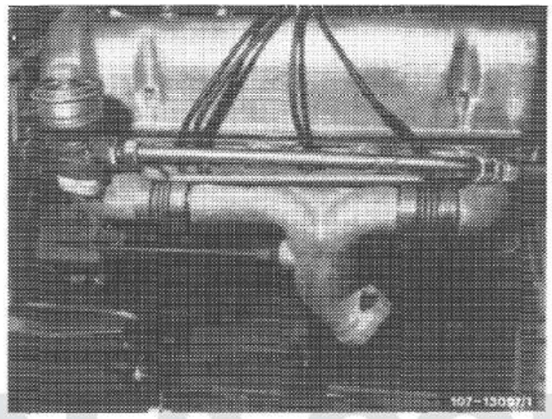
14–200 Removal and installation of catalyst

Model year 1977/78/79

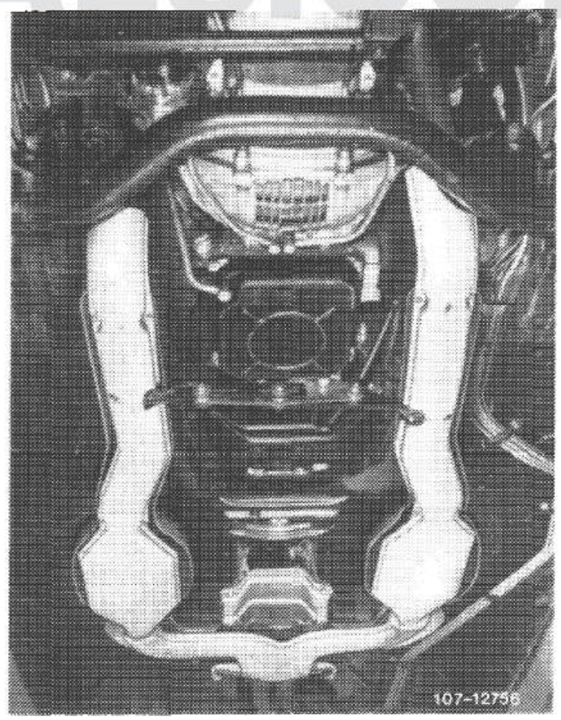
A. Model 116.033

Removal

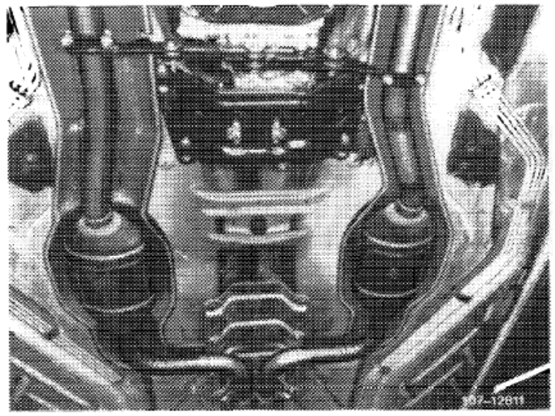
1 Loosen nuts of flange connections on exhaust manifold and unscrew.



2 Remove heat shields.

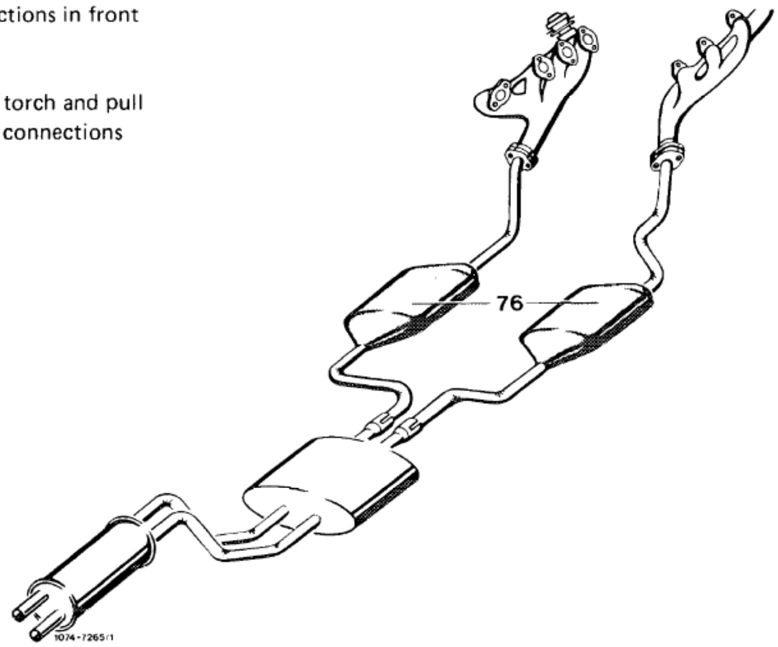


3 Remove lateral support on transmission, disconnect rubber rings of exhaust suspension and completely remove exhaust system.



4 Loosen exhaust pipe at plug connections in front of mufflers.

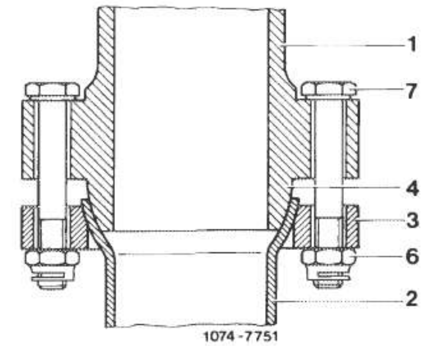
5 Heat plug connections with a blow torch and pull catalyst with exhaust pipe out of plug connections while slightly rotating assembly.



Installation

6 Insert catalyst with exhaust pipe into plug connections, slightly tighten plug connections.

7 Install exhaust system and straighten. Attach screws and nuts of flange connections to exhaust manifold. Pay attention to good seat of ball connection. Tighten plug connections. Tightening torque of self-locking hex nuts (6) is 20 Nm (2 kpm).

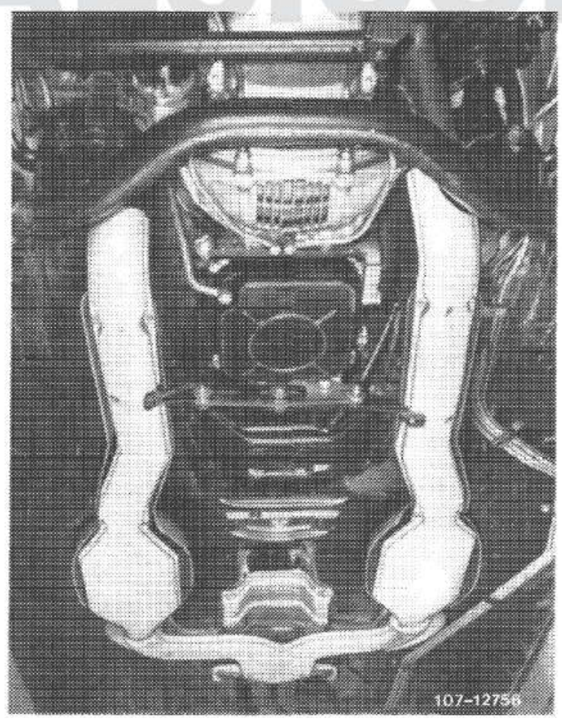


1 Exhaust manifold
2 Exhaust pipe
3 Flange
4 Outer ball connection
6 Self-locking hex nut
7 Hex screw

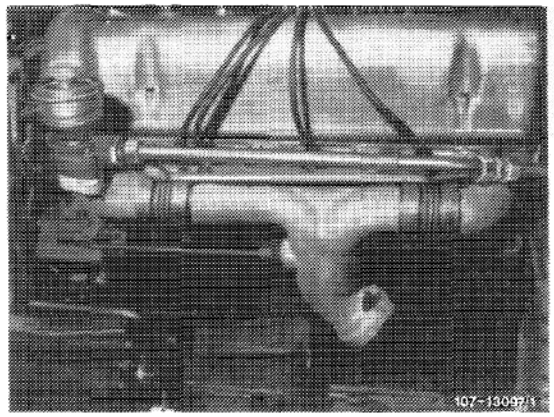
8 Attach lateral supports to transmission.

9 Check exhaust system for leaks.

10 Install heat shields.



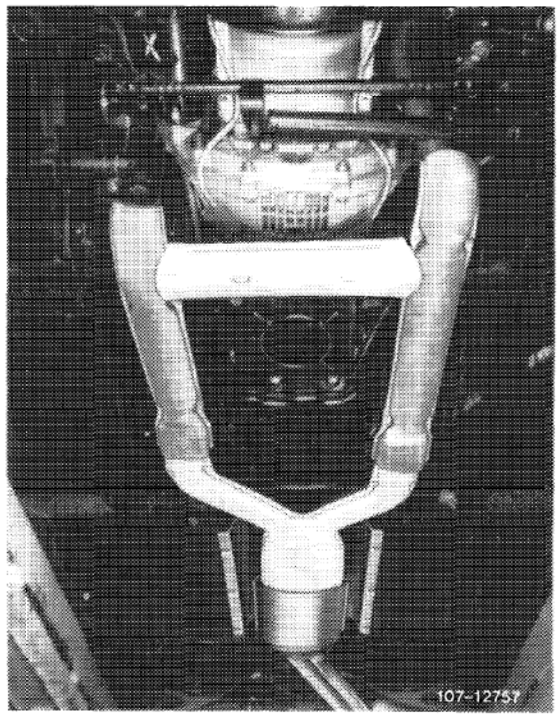
B. Model 107.024/044



Removal

1 Loosen nuts of flange connections on exhaust manifold and unscrew.

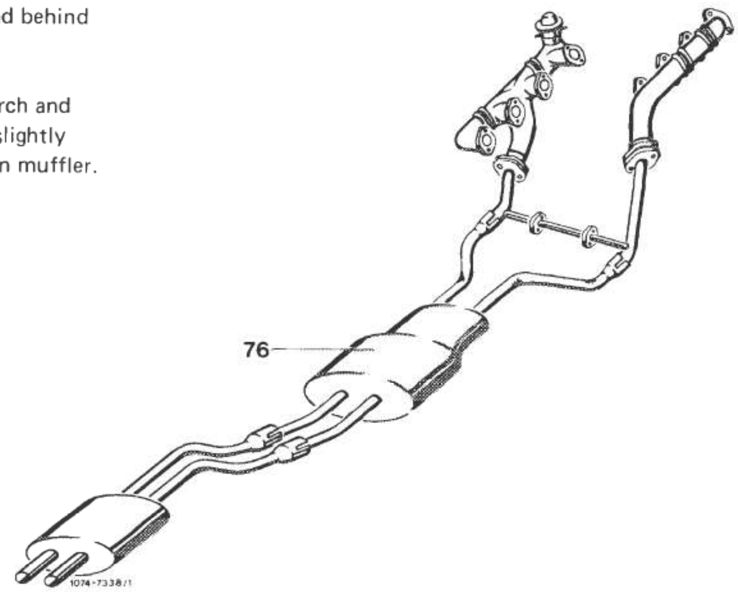
2 Remove heat shields.



3 Disconnect all rubber rings of exhaust suspension and completely remove exhaust system.

4 Loosen plug connections in front of and behind catalyst-muffler combination.

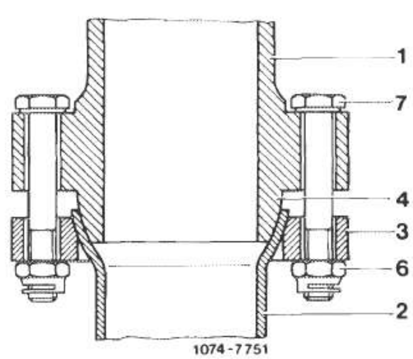
5 Heat plug connections with welding torch and pull out catalyst-muffler combination by slightly rotating front exhaust pipes as well as main muffler.



Installation

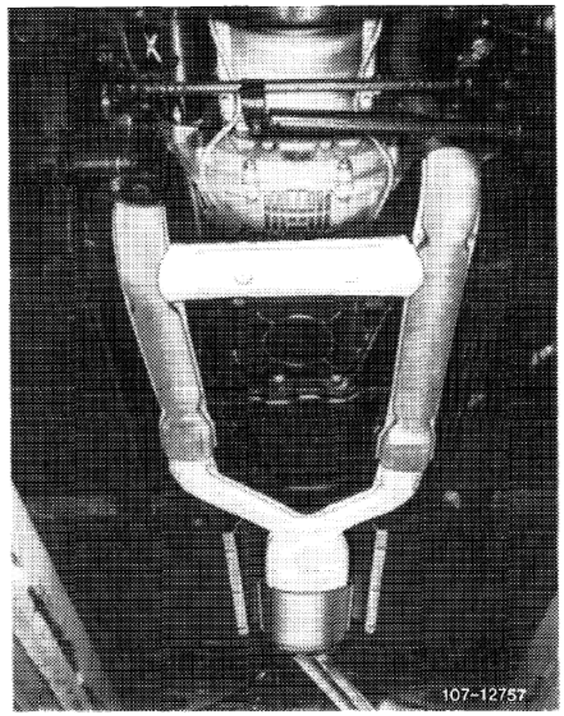
6 Assemble catalyst-muffler combination with front exhaust pipes and main muffler. Slightly tighten plug connections.

7 Install exhaust system and straighten. Attach screws and nuts of flange connections to exhaust manifold. Pay attention to good seat of ball connection. Tighten all plug connections. Tightening torque of self-locking hex nuts (6) is 20 Nm (2 kpm).



1 Exhaust manifold
2 Exhaust pipe
3 Flange
4 Outer ball connection
6 Self-locking hex nut
7 Hex screw

8 Test exhaust system for leaks.



9 Install heat shields.

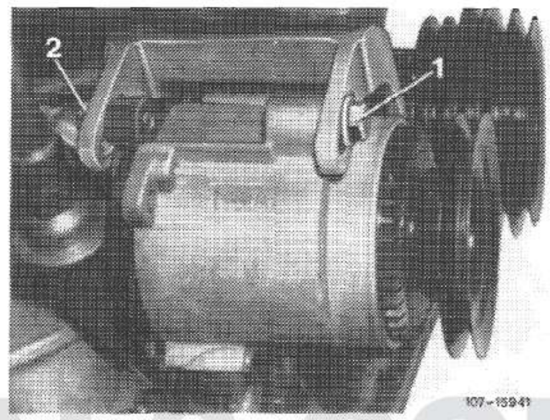
14–250 Removal and installation of air pump

Federal and California version model year 1977/78/79

Removal

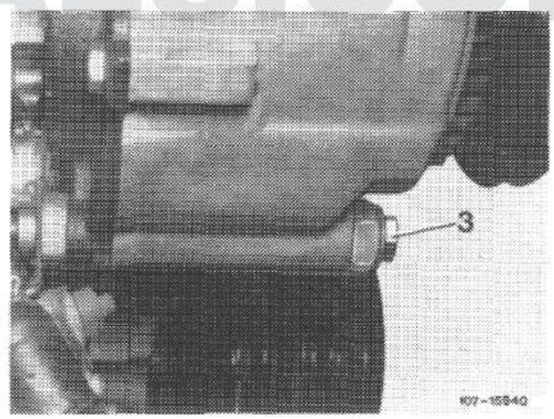
1 Compress hose clip on contoured hose (arrow) with combination pliers and push approx. 2 cm to the rear.

2 Loosen clamping screws (1, 2 and 3) and unscrew.



107–15941

3 Remove V-belt and contoured hose, remove air pump.



107–15940

Installation

4 For installation proceed vice versa.

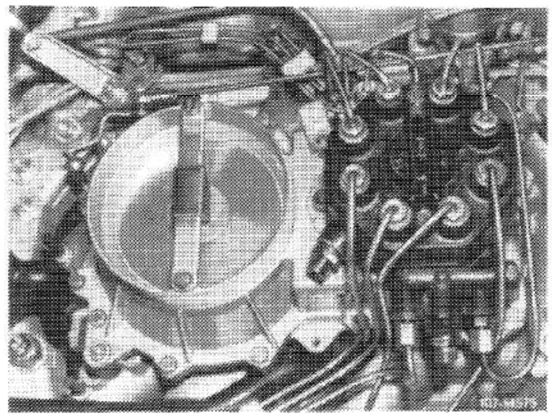
Note: The V-belt is correctly tensioned if it can be resiliently pushed down under energetic thumb pressure.

09–450 Removal and installation of intake manifold upper and lower half, renewing gaskets

Note

During removal and installation of intake manifold the mixture regulator with air guide housing need not be removed.

Removal



1 Disconnect battery.

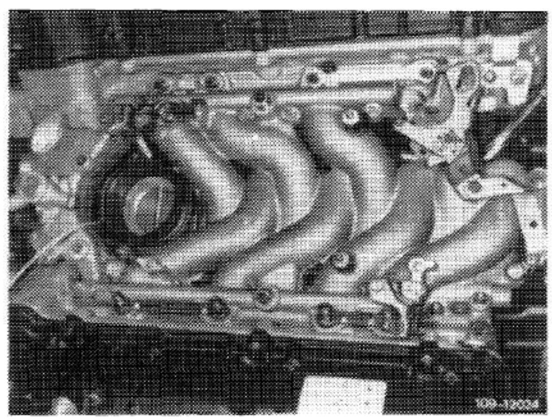
2 Partially drain coolant.

3 Unscrew injection lines and fuel lines. Catch fuel with a cloth.

Deactivate fuel lines.

4 Pull off supplementary air lines.

5 Remove control pressure rod for automatic transmission.



6 Unscrew bearing bracket for gate regulation.

7 Unscrew bearing bracket for longitudinal regulating shaft.

8 Pull off all connecting cables and plug connections.

9 Unscrew vacuum line for automatic transmission and for brake unit.

10 Unscrew idle speed air distributor.

11 Loosen coolant hoses and pull off.

12 Unscrew all fastening screws and remove intake pipe toward the rear.

13 Clean intake manifold and check flange surfaces with straightedge or touch up on surface plate.

Installation

14 Mount intake manifold with new gaskets in vice versa sequence.

Use only graphited intake manifold gaskets.
Do not install non-graphited intake manifold gaskets similar to engine 117.96 (5.0).

15 Adjust regulating linkage (30–300).

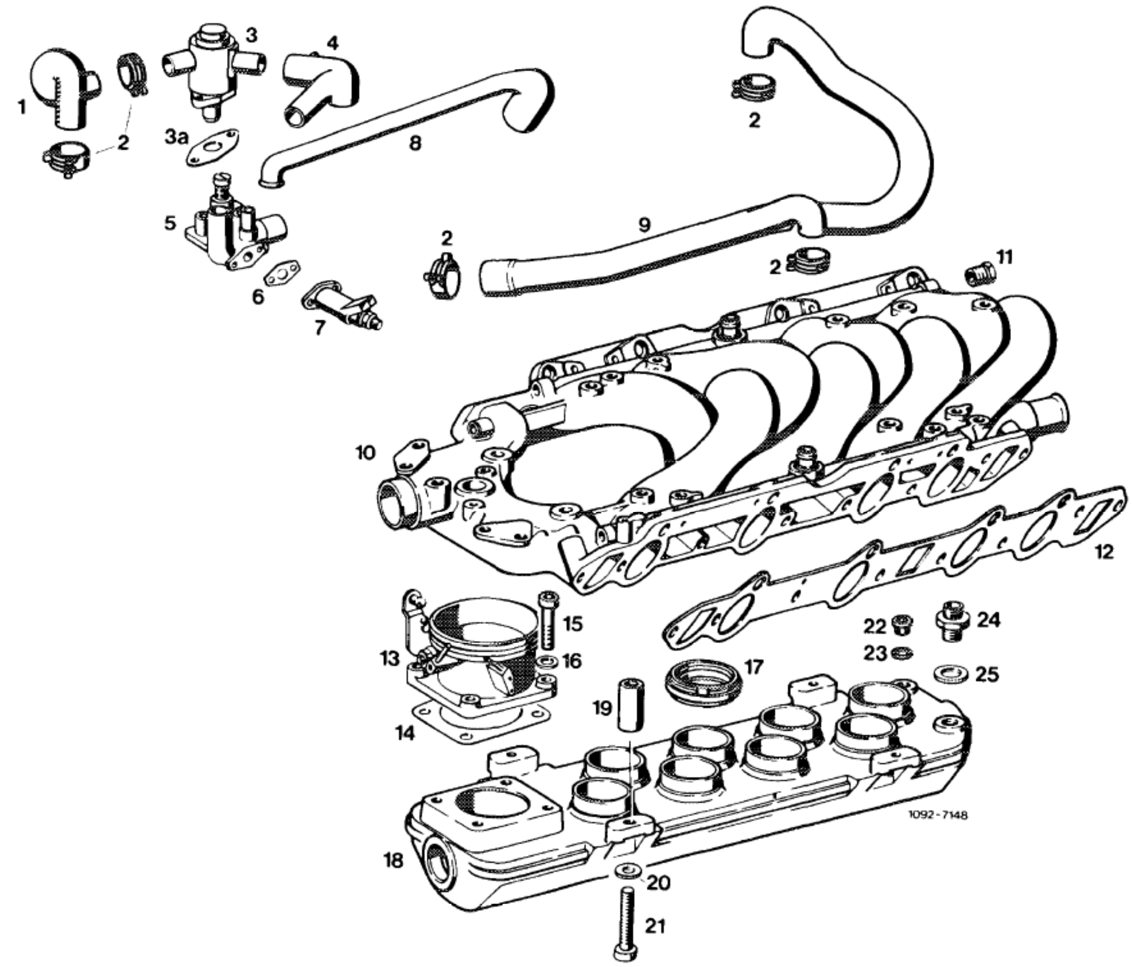
16 Connect battery.

17 Add coolant.

18 Keep engine running, check fuel lines for leaks. Check intake system, fuel distributor and injection valves by spraying with Iso-Oktan or benzine for leaks.

19 Adjust idle speed (07.3–100).

Intake manifold



1 Contoured hose
2 Coiled hose clips
3 Supplementary air valve
3a Gasket
4 Contoured hose
5 Idle speed air distributor
6 Gasket
7 Cold-starting valve
8 Contoured hose
9 Supplementary air line
10 Intake manifold upper half
11 Closing plug
12 Gasket
13 Throttle valve housing
14 Gasket
15 Hex. socket screw
16 Washer
17 Rubber connection
18 Intake manifold lower half
19 Spacing sleeve
20 Washer
21 Hex. socket screw
22 Closing plug
23 Sealing ring
24 Double thread connection
25 Sealing ring

14–455 Renewing intake manifold (intake manifold removed)

1 Remove and install intake manifold (14–450).

2 Remove and install injection valves and insulating sleeves (07.3–215).

3 Remove and install mixture regulator with air guide housing (07.3–225).

4 Unscrew all unscrewable parts on removed intake manifold and mount on new intake manifold with new gaskets.

5 Unscrew intake manifold upper half from intake manifold lower half. For this purpose, loosen vacuum line for brake unit on intake manifold lower half, then unscrew fastening screws and pull from rubber adaptors.

6 Mount intake manifold lower half with new rubber adaptors to intake manifold upper half.

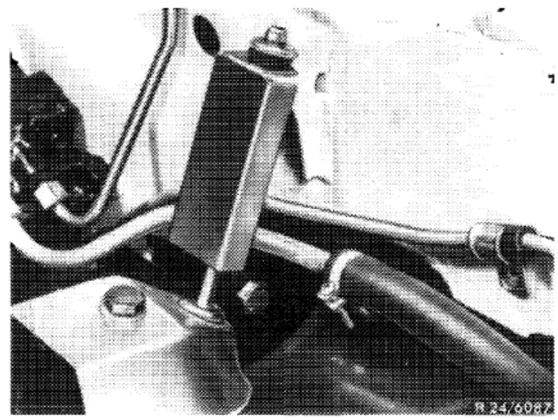
Attention!
The intake manifold lower half has a different shape as that of engine 117.960 (5.0) and can therefore not be installed in this engine.

49–470 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm
Bolt for engine mount	75

Removal



1 Remove exhaust system (49–100).

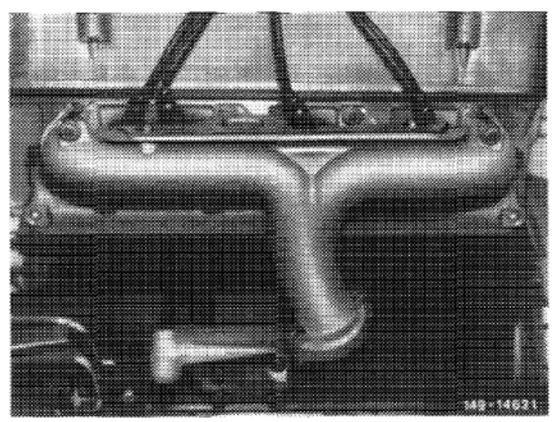
Note: Survey exhaust manifold (14–472).

2 Pull off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with fastener and shielding plates. For this purpose, unscrew bolt for engine mount.

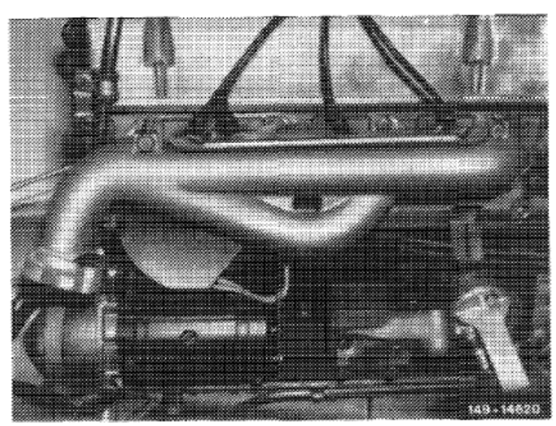
Exhaust manifold left



5 Remove air cleaner.

6 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right

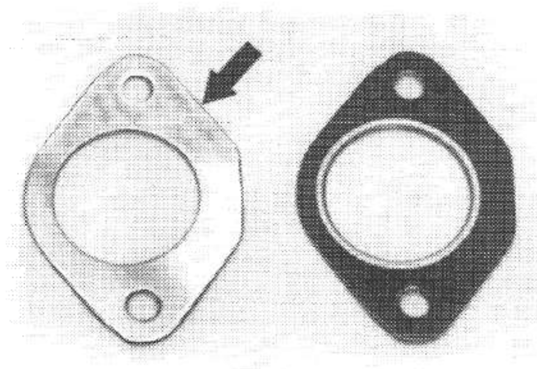


7 Remove windshield washer tank.

8 Unscrew coolant supply tank. Unscrew fastening clamp for coolant hose, loosen cable band for electric line and put supply tank aside.

9 Remove battery, battery holder and shielding plate.

10 Unscrew exhaust nuts and bolts and remove exhaust manifold.



107–12067

Installation

11 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

12 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

13 Tighten bolts for engine mount to 75 Nm.

14 Mount exhaust system.

15 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

16 Keep engine running and check exhaust system lor leaks.

B. Model 116

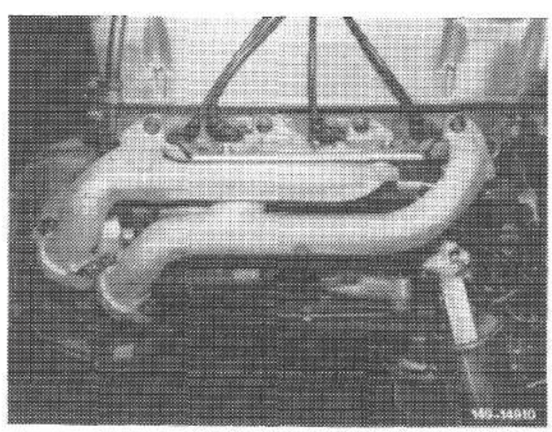
Note

Starting with the following chassis end no. a two-fluted **righthand** exhaust manifold is installed.

Start of production: December 1977

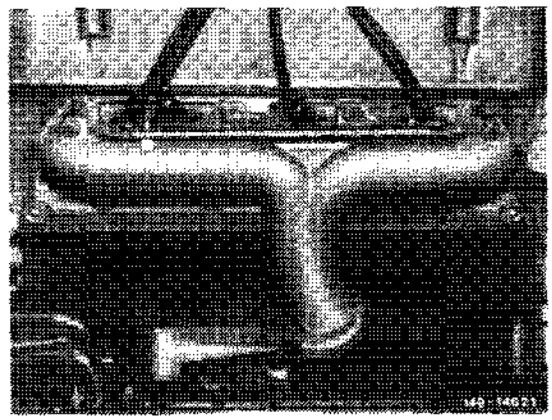
Model	starting chassis end no.
116.028/029	044654
116.032/033	076606

On previously manufactured vehicles the former exhaust manifold remains installed.

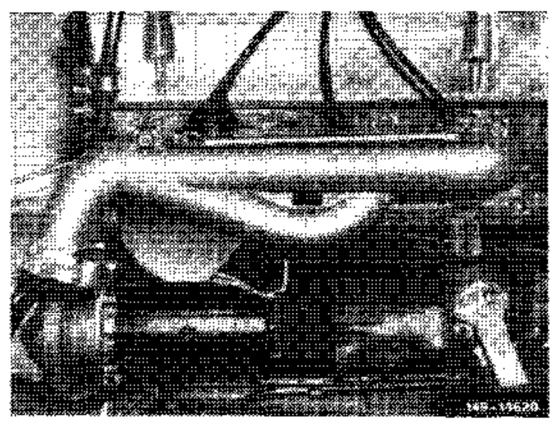


A. Standard version

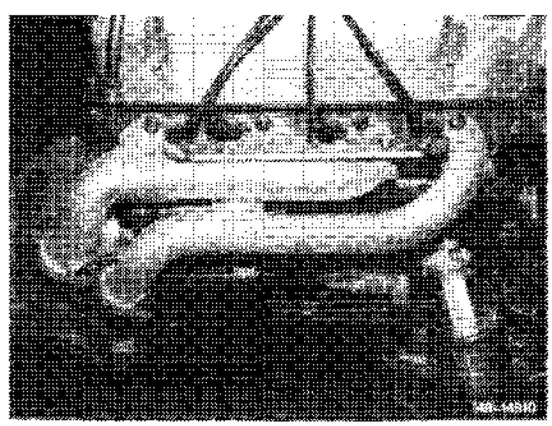
Lefthand steering



Exhaust manifold left

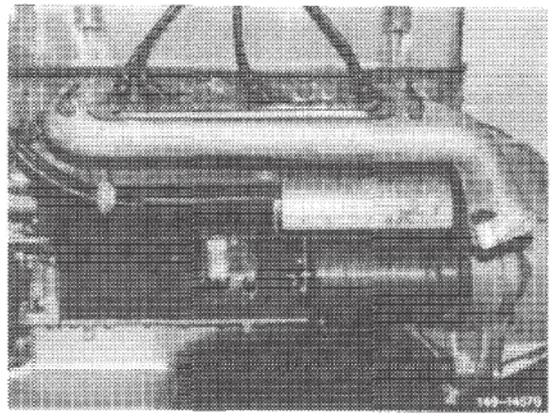


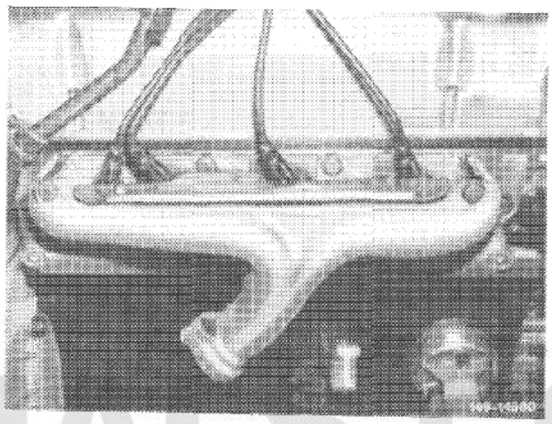
Exhaust manifold right



Exhaust manifold right
two-fluted model 116

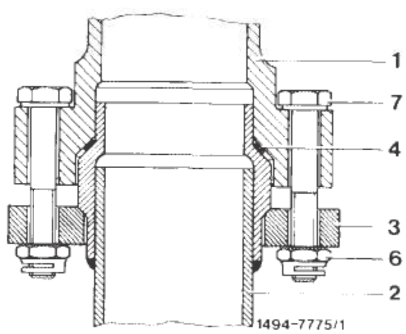
Righthand steering


Exhaust manifold left

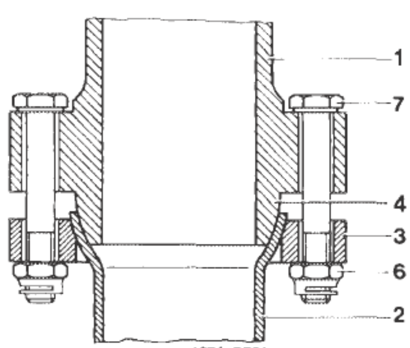

Exhaust manifold right

Repair versions

Starting approx. November 1977, the exhaust manifolds are provided with an external ball connection (up to now trapezoid connection). As a result, when installing exhaust manifolds with external ball connection, replace front exhaust pipe with trapezoid connection against an exhaust pipe with external ball connection.



Trapezoid connection
(past version)



External ball connection

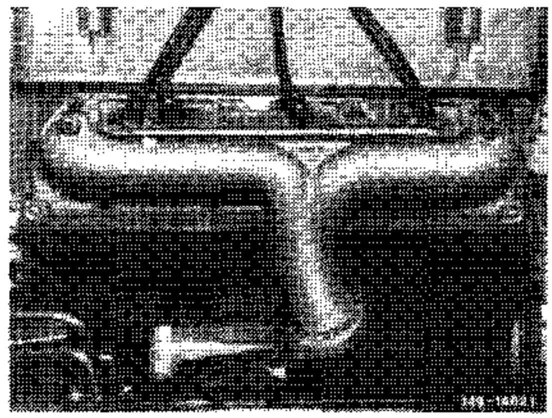
Removal

1 Remove exhaust system (49–100).

2 Pull off ignition cable.

3 Unscrew shielding plate on exhaust manifold.

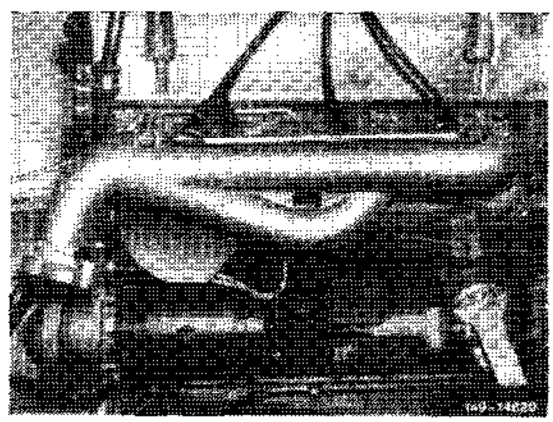
Exhaust manifold left



4 Remove air cleaner.

5 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right

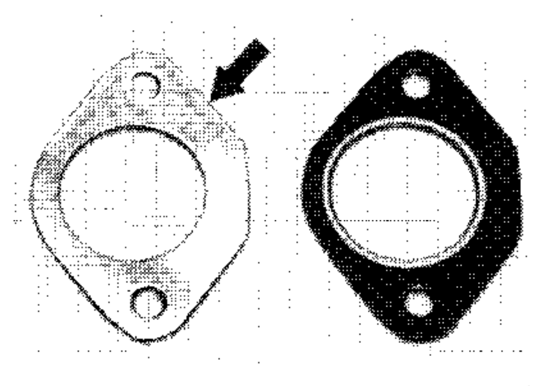


6 Remove battery and battery holder.

7 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Installation

8 For installation proceed vice versa. Replace all gaskets and exhaust nuts.



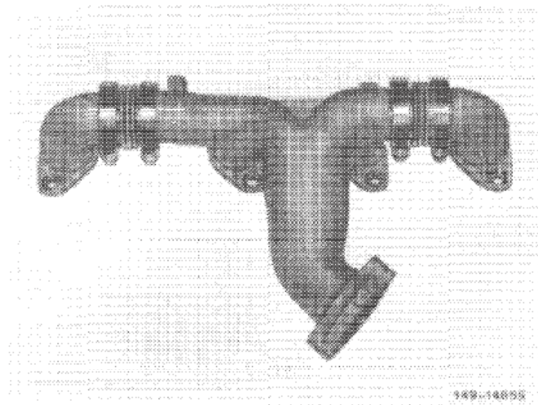
9 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

10 Mount exhaust system.

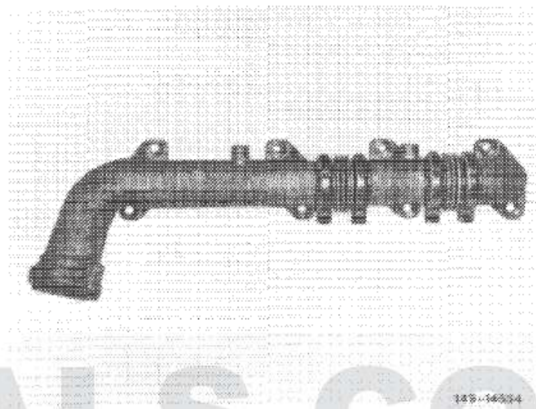
11 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

12 Keep engine running and check exhaust system for leaks.

Lefthand steering



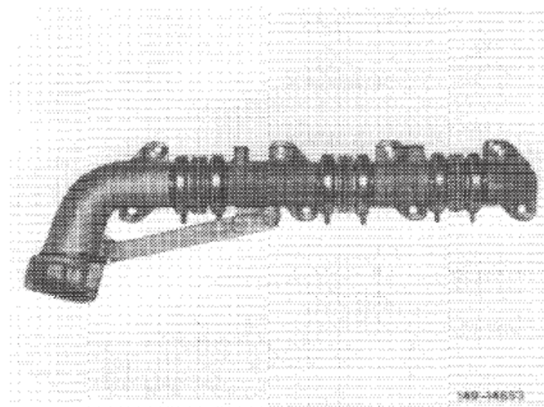
Exhaust manifold left



Exhaust manifold right

In the event of damage on exhaust manifolds with 2 bellows as a result of extremely sharp driving, the exhaust manifold can be subsequently provided with 3 bellows at righthand engine side on model 116.

This exhaust manifold has a trapezoid connection. Consequently, on vehicles manufactered after approx. November 1977, the front exhaust pipe with external ball connection must be replaced by an exhaust pipe with trapezoid connection.



Exhaust manifold right
model 116

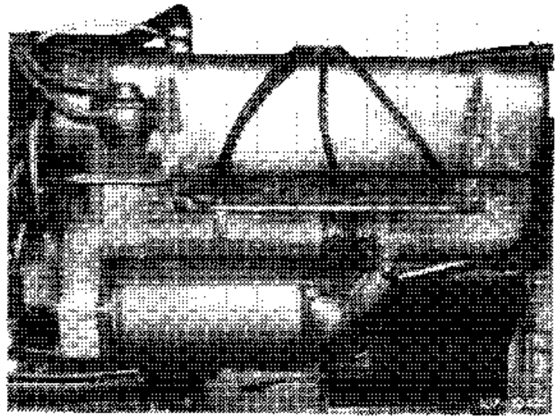
Righthand steering

On righthand steering vehicles the exhaust manifolds must be replaced like for like.

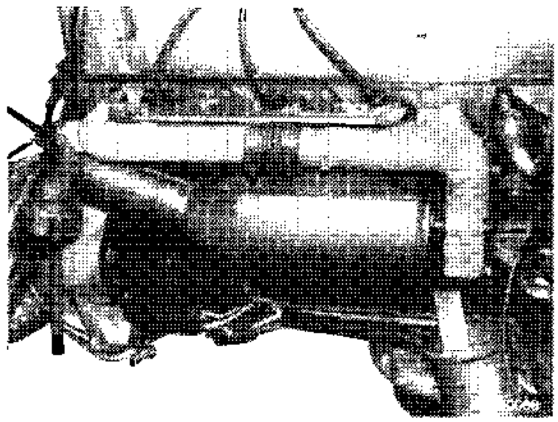
B. National version AUS J S USA

J S USA Model year 1976

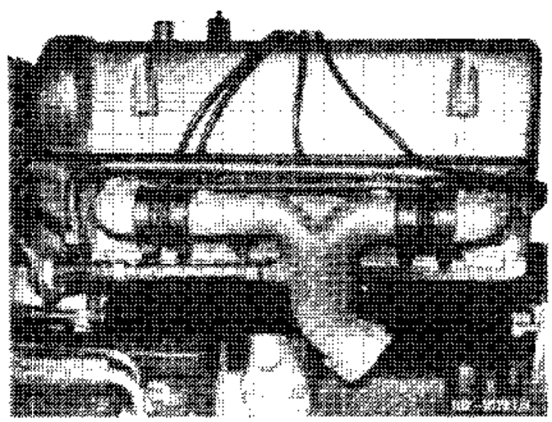
Exhaust manifold with internal ball



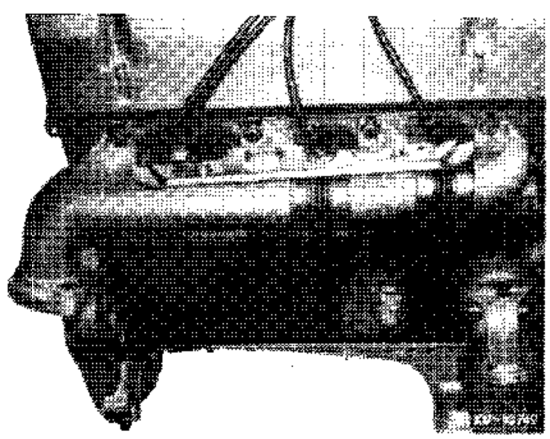
J USA
Exhaust manifold left



Exhaust manifold right



S
Exhaust manifold left

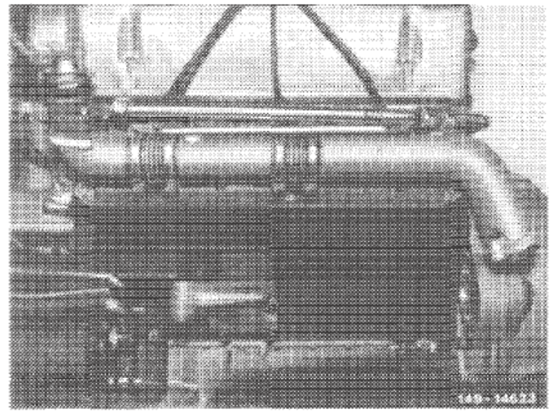


Exhaust manifold right

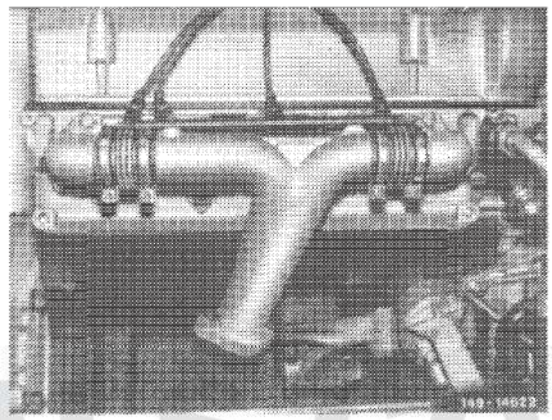
(AUS) (J) (S) model year 1977–1980
(USA) model year 1977–1979

1977 exhaust manifold with internal ball,
starting 1978 exhaust manifold with external ball

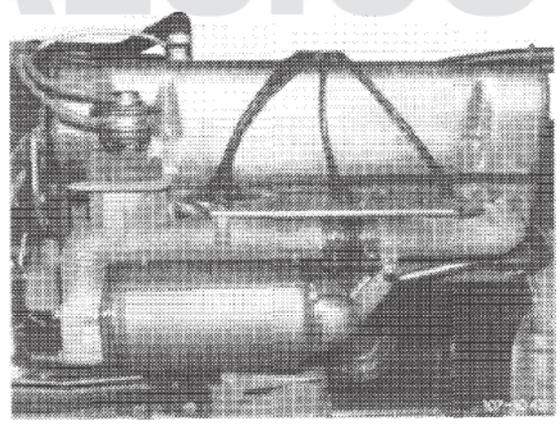
Note: If on vehicles model year 1977 an exhaust manifold with external ball connection is installed, the front exhaust pipe must be replaced.



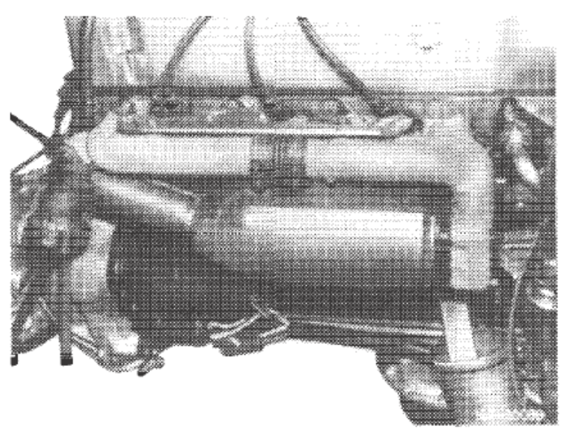
(AUS)
Exhaust manifold left



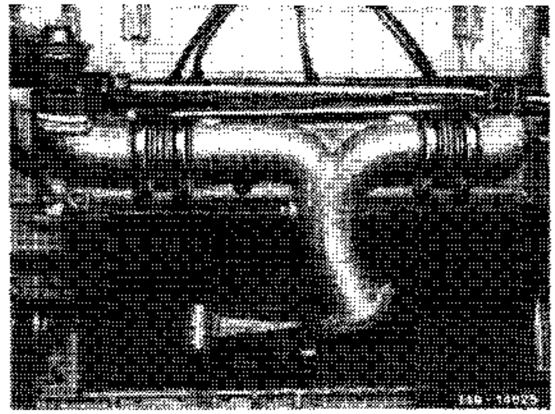
Exhaust manifold right



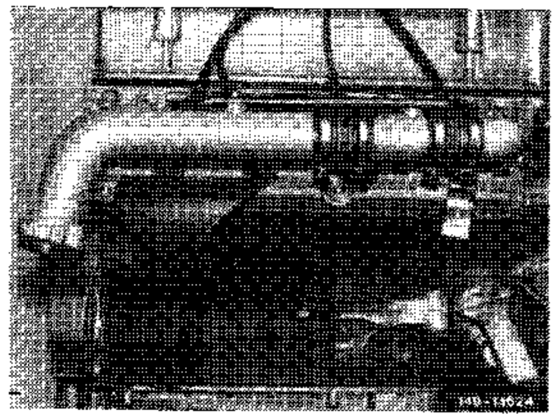
(J)
Exhaust manifold left



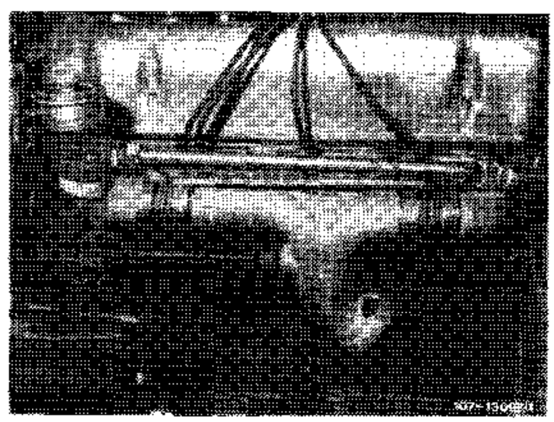
Exhaust manifold right



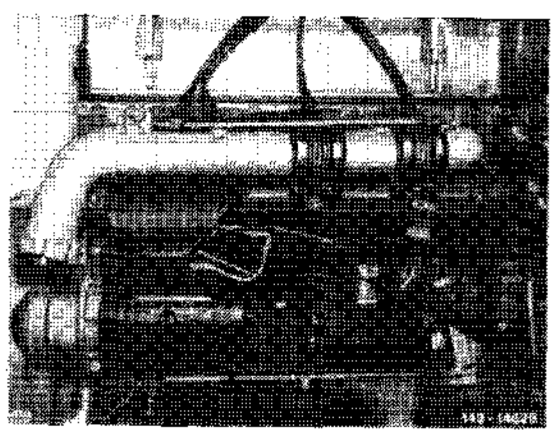
S
Exhaust manifold left



Exhaust manifold right



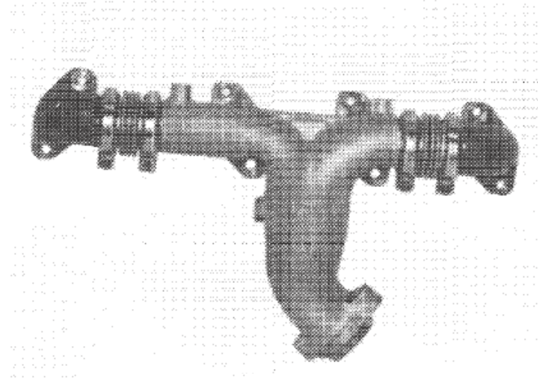
USA
Exhaust manifold left



Exhaust manifold right

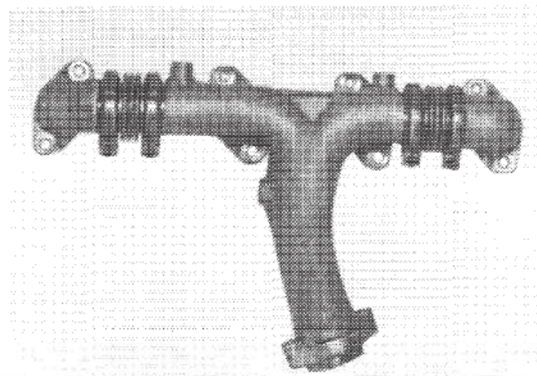
(USA) model year 1980

Without EGR



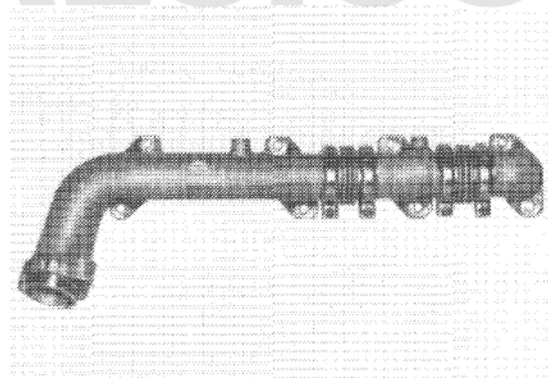
Exhaust manifold left
Model 107

114 – 16851



Exhaust manifold left
Model 116

114 – 16852

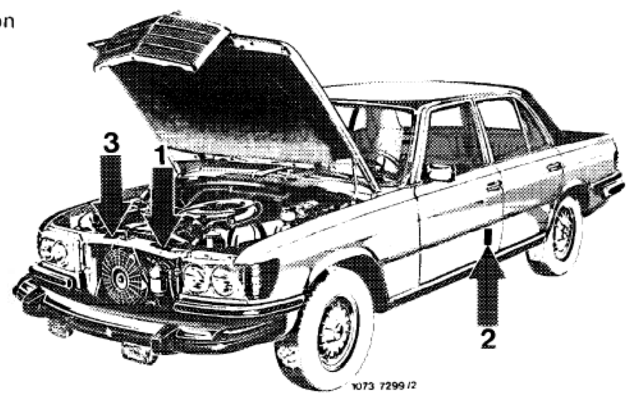


Exhaust manifold right
Model 107 and 116

114 – 16854

14–001 Functional characteristics

The various emission control systems of USA version vehicles are identified by respective information plates (arrows 1, 2 and 3).



1. Information plate on cross member in front of radiator

This plate shows the identification data as well as all the important engine adjustment data.

Recognizing emission control system from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1971</td><td rowspan="6">black/silver</td><td rowspan="3">black/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1972</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1973</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1974</td><td rowspan="3">green/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1975</td><td>–</td><td rowspan="2">yellow/silver</td><td rowspan="2">yellow/silver</td></tr>
<tr><td>1976</td><td>–</td></tr>
<tr><td>1977</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td><td>red/black</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td></tr>
<tr><td>1978</td><td>–</td></tr>
<tr><td>1979</td><td>–</td></tr>
<tr><td>1980</td><td>black/white</td><td>–</td><td>black/white</td></tr>
</table>

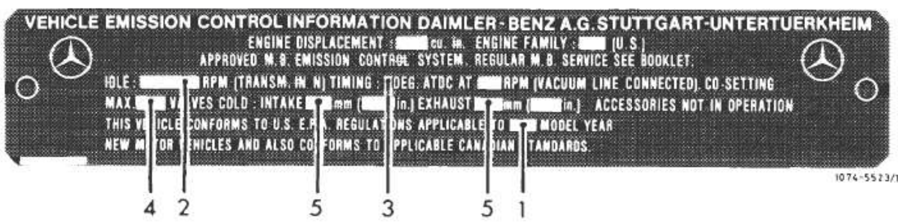
The information plate shows:

1. MODEL YEAR
2. IDLE . . . RPM
3. TIMING . . . DEG. AT . . . RPM
4. Emission value at idle without air injection max . . .

   CO–SETTING MAX. . . . AIR INJECTION DISCONNECTED

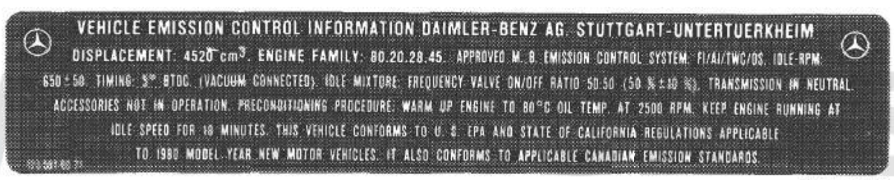
5. Valve clearance: INTAKE (. . . in)
   EXHAUST (. . . in)

Information plate up to model year 1979



1074-5523/1

Information plate model year 1980



1144-9543

Identification data are encoded in an 8-digit code no.

Example: Engine family 80. 20. 28. 45

80 20 2 8 45

Model year — 80

National code no. — 20

20 = Federal and California
21 = Federal
22 = California

Combustion system — 2

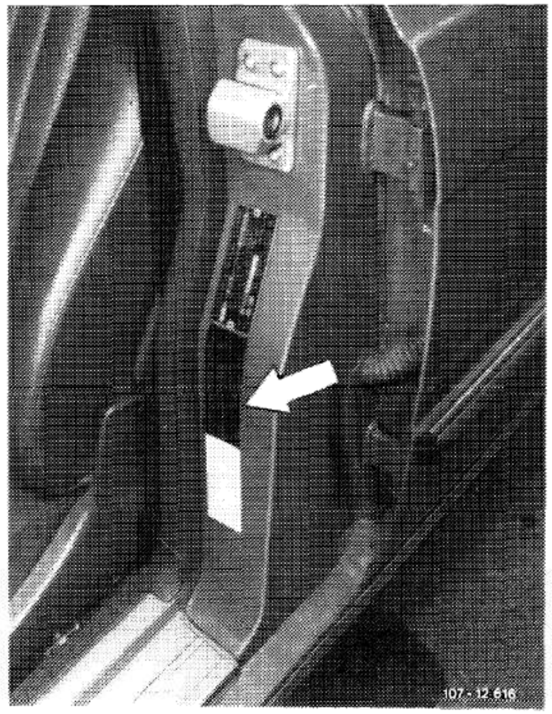
1 = Carburetor
2 = Injection, gasoline
3 = Diesel
4 = Diesel, turbo

Number of cylinders — 8

Displacement
approx. 4500 cc — 45

2. Information plate on door pillar of driver's door

This plate shows whether vehicle is provided with catalysts or not.



Recognizing catalysts from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1976</td><td rowspan="4">black/silver</td><td>black/silver</td><td>–</td><td rowspan="4">red/silver</td><td>red/silver</td></tr>
<tr><td>1977</td><td>green/silver</td><td>black/silver</td><td>blue/silver</td></tr>
<tr><td>1978</td><td rowspan="2">black/silver</td><td>–</td><td rowspan="2">red/silver</td></tr>
<tr><td>1979</td><td>–</td></tr>
</table>

Information plates

This vehicle is provided with catalysts.

1074 – 8259

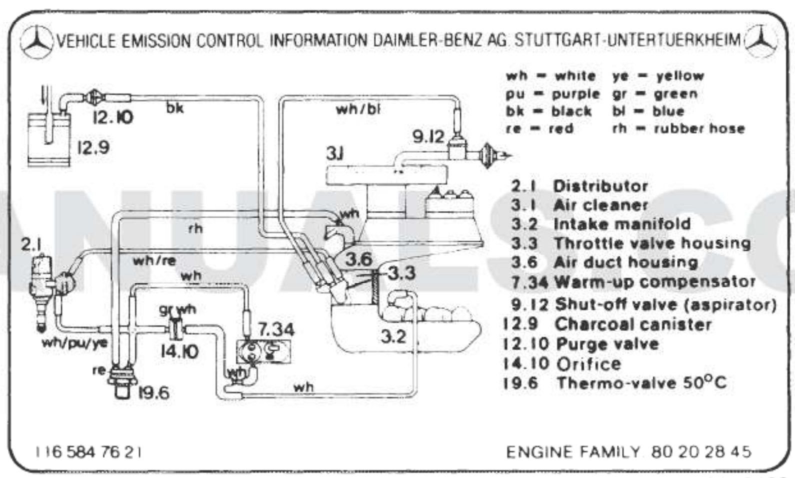
Tourist vehicles
This vehicle is not provided with catalysts by manufacturer.

Catalysts must be installed prior to import into USA.

1074 – 8260

3. Information plate for vacuum line installation located on cross member in front of radiator (California only)

This plate shows the vacuum line layout for all emission system components in engine compartment.



1144 – 9406

14–050 Operation

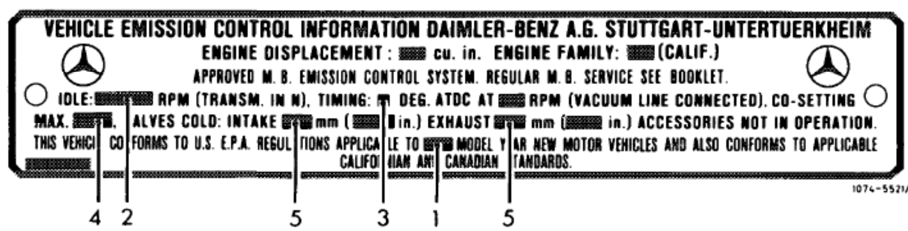
Federal and California version model year 1976

A. General

Information plate

Federal version basic color black.

California version basic color green.



1 Model year
2 Idle . . . rpm
3 Timing at . . . rpm
4 Emission value at idle
5 Valve clearance

Identification of vacuum lines

The basic color of vacuum lines for emission control system is transparent (white).

Additional color stripes are used to facilitate identification of the individual functions.

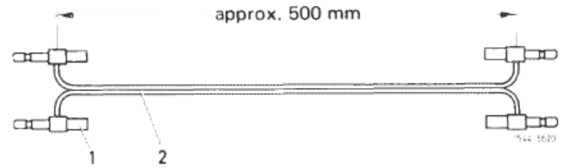
Lines originating at a vacuum source (originating lines) **have only one color stripe.**

Lines terminating at a vacuum-operated device (terminating lines) **have two color stripes.** Purple is always the second color.

Emission control system	Color coding of originating vacuum line	Color coding of terminating vacuum line
Ignition switchover		
Advance	red	red/purple
Retard	yellow	yellow/purple
EGR	brown	brown/purple
Air injection	blue	blue/purple
Fuel evaporation control system		
Purge valve	black	

Test cable

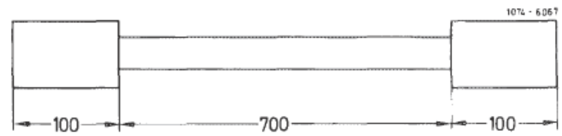
To test the individual components of emission control system we recommend a self-made test cable according to illustration.



1 Coupling part no. 003 545 28 28 (housing omitted)
2 Cable 1.5 mm^2

Test line

Make a vacuum line according to illustration to test vacuum switch (56) and EGR valve.



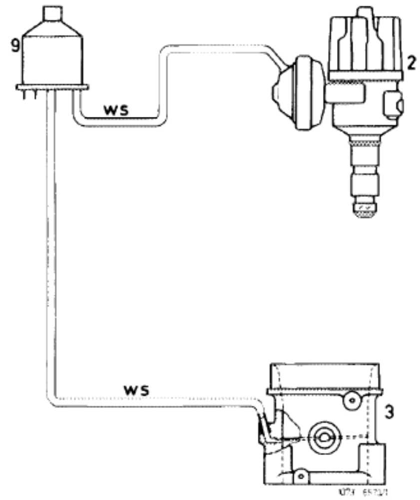
700 = 700 mm vacuum line 4 x 1 mm
100 = 100 mm hose 8 x 2 mm

B. Ignition timing

The ignition timing influences the running characteristics of the engine.

Ignition timing in direction of "retard" results in a higher engine temperature, longer periods of dwell and thereby in a reduction of CH and CO values.

Function diagram



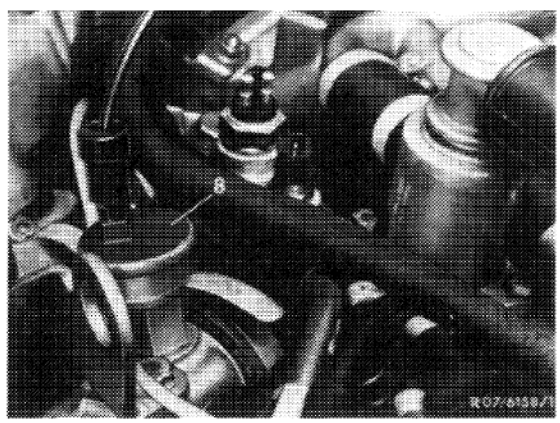
2 Ignition distributor
3 Throttle valve housing
9 Switchover valve

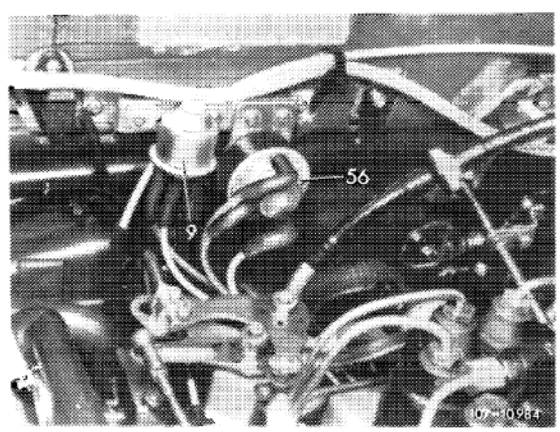
Vacuum adjustment in direction of "retard" becomes effective at the following operating conditions:

- Below 100 °C coolant temperature.
- Engine at idle.
- Engine decelerating (coasting) (throttle valve at idle speed stop).
- Air conditioning system switched off.

Vacuum adjustment in direction of "retard" is switched off and on by means of switchover valve (9), which is contacted by temperature switch 100 °C (8) via relay (19).

Below 100 °C coolant temperature the temperature switch 100 °C (8) is open, the switchover valve (9) is de-energized. The vacuum flows from throttle valve housing (3) via switchover valve (9) to diaphragm of vacuum unit of ignition distributor.



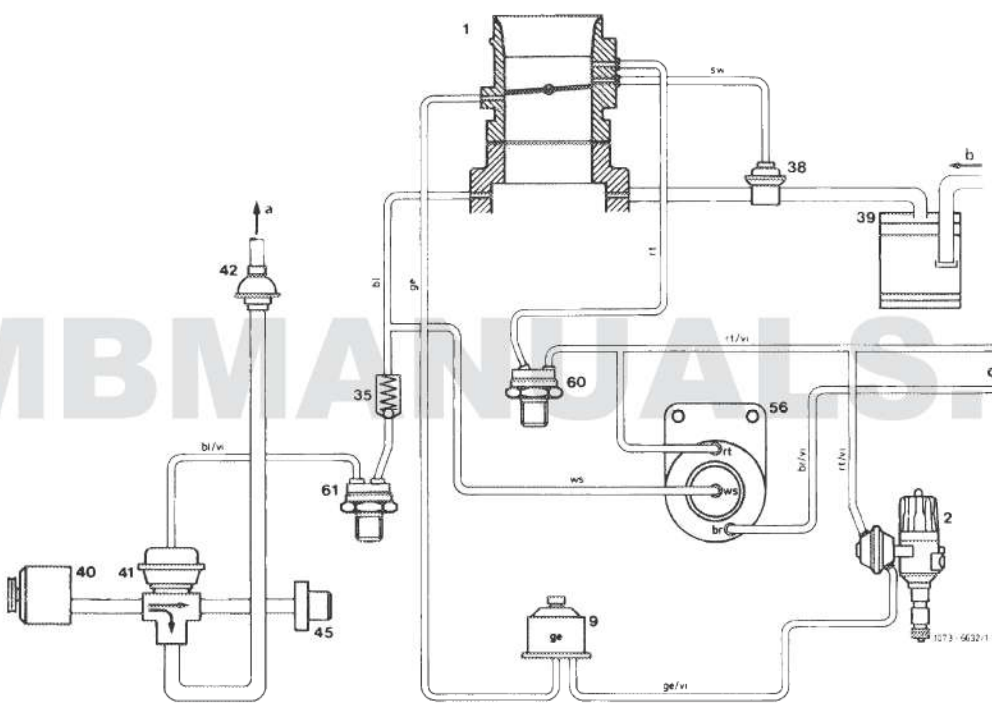


C. EGR (exhaust gas recirculation)

To reduce nitrogen oxides in exhaust gases, a portion of the gases from the exhaust manifold is returned to the intake pipe.

The quantity of the returned exhaust gas is controlled by the throttle valve position and the intake pipe vacuum.

Function diagram



1 Throttle valve housing
2 Ignition distributor
9 Switchover valve ignition retard
31 EGR valve
35 Check valve
38 Purge valve
39 Charcoal canister
40 Air pump

41 Diverter valve
42 Check valve air injection
45 Air filter for silencing
56 Vacuum switch
60 Thermovalve 40 °C (black)
61 Thermovalve 17 °C (blue)
a Air injection line to cylinder head
b Connection tank vent

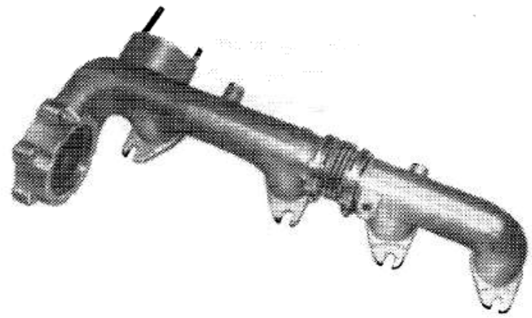
bl = blue
br = brown
ge = yellow
rt = red
sw = black
vi = purple
ws = white

EGR components:

Exhaust manifolds

Exhaust manifolds now have one bellows only. A flange is cast-on at the front for assembly of catalyst.

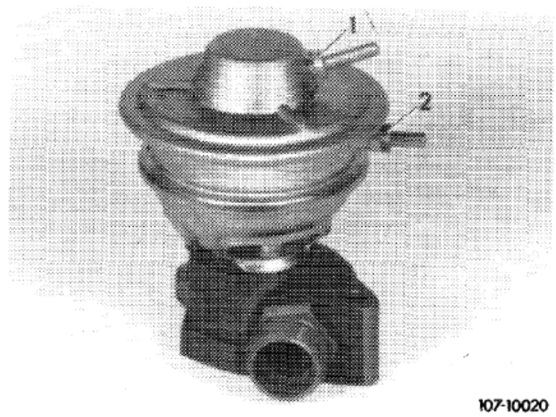
For EGR, a bore as well as a flange for the EGR valve are located at lefthand exhaust manifold.



107–10009

EGR valve

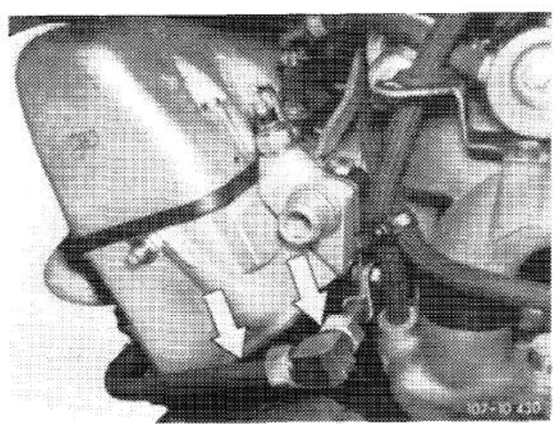
For better adaptation of EGR on engine, the EGR valve is provided with a double diaphragm.



107-10020

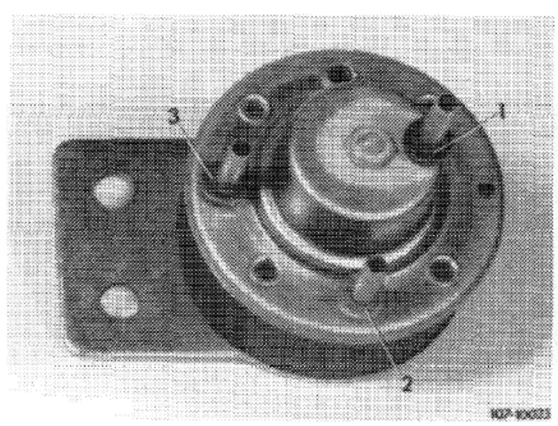
EGR line

The EGR line runs from EGR valve under exhaust manifold from the rear to intake pipe.



Vacuum switch

A vacuum switch is installed to control EGR.

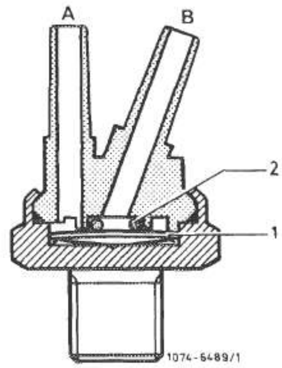


1 Connection in center with white ring: throttle valve housing/purge valve
2 Connection with red ring: ignition advance/EGR valve 1st stage
3 Connection with brown ring: EGR valve 2nd stage

Thermovalve 40 °C (color code black)

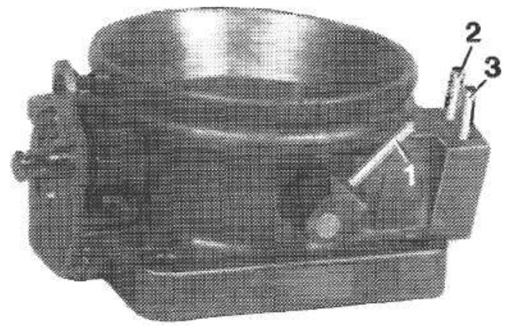
The thermovalve (60) is screwed into portion of intake pipe included in coolant flow and **opens** at approx. 40 °C coolant temperature. Below 40 °C coolant temperature the bimetallic plate rests against O-ring and closes connection "B".

Above 40 °C coolant temperature the bimetallic plate snaps downward when heated. Both connections are connected to each other.



Throttle valve housing

The throttle valve housing is provided with three vacuum connections to control the individual units.



107-13054

1 Vacuum connection ignition "retard"
2 Vacuum connection with red ring: EGR 1st stage/ ignition "advance"
3 Vacuum connection with black ring: vacuum switch/ purge valve

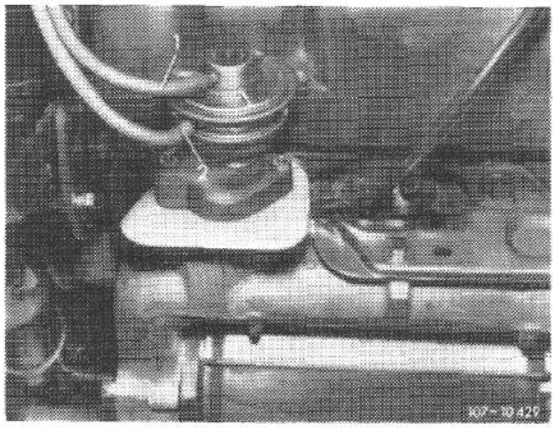
EGR is activated:

- Above 40 °C coolant temperature.
- During acceleration.
- During partial load operation.
- During transition to deceleration (coasting).

Operation

Above 40 °C in the driving ranges named above, a part of the exhaust gases is returned from exhaust manifold to intake pipe.

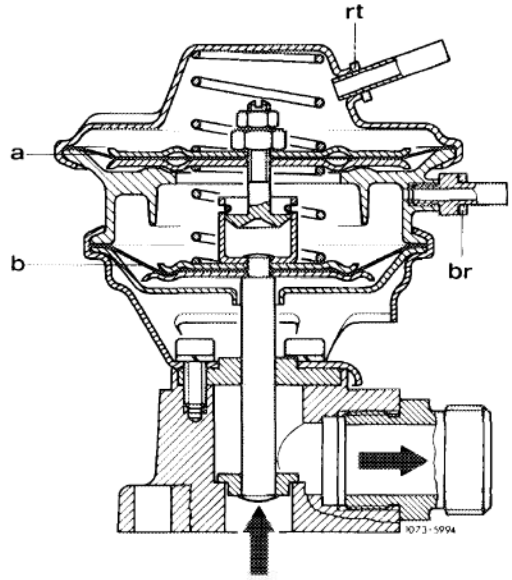
EGR is effected in two stages, the volume (quantity) of the returned exhaust gases depends on position of throttle valve (vacuum tapped at throttle valve housing).



EGR 1st stage (small quantity)

While driving at coolant temperatures above approx. 40 °C.

The thermovalve (60) is open and the connection from throttle valve housing to EGR valve is established. Valve will lift off with adequate vacuum and exhaust gases are drawn into intake pipe.



EGR 2nd stage (large quantity)

When the vehicle is accelerated, the vacuum on throttle valve housing drops and the 2nd stage of the EGR valve is activated with vacuum via vacuum switch (56). The EGR valve can fully open in dependence of the intake pipe vacuum.

Vacuum switch

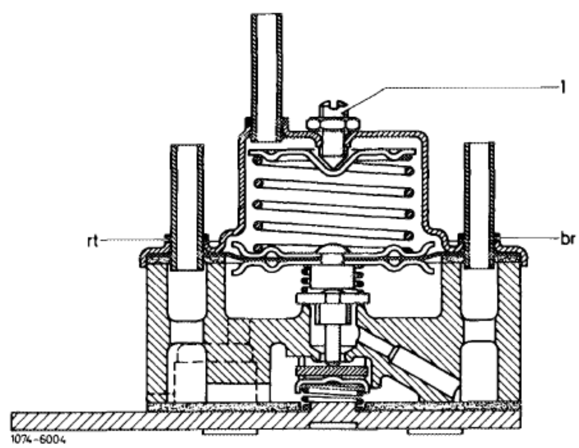
If the vacuum on center connection drops below the preset value, the spring will push the diaphragm downwards.

The upper plate valve (1) is closed, the lower valve is opened and connections red and brown are connected to each other.

If the vacuum on center connection exceeds the preset value, the diaphragm is pushed upwards by the atmospheric pressure against bottom face.

The lower plate valve is closed and the upper valve is opened. The red connection is sealed, the brown connection is positively vented.

Note: Positive venting is effected via bottom face of large diaphragm, from there via a filter from outside.

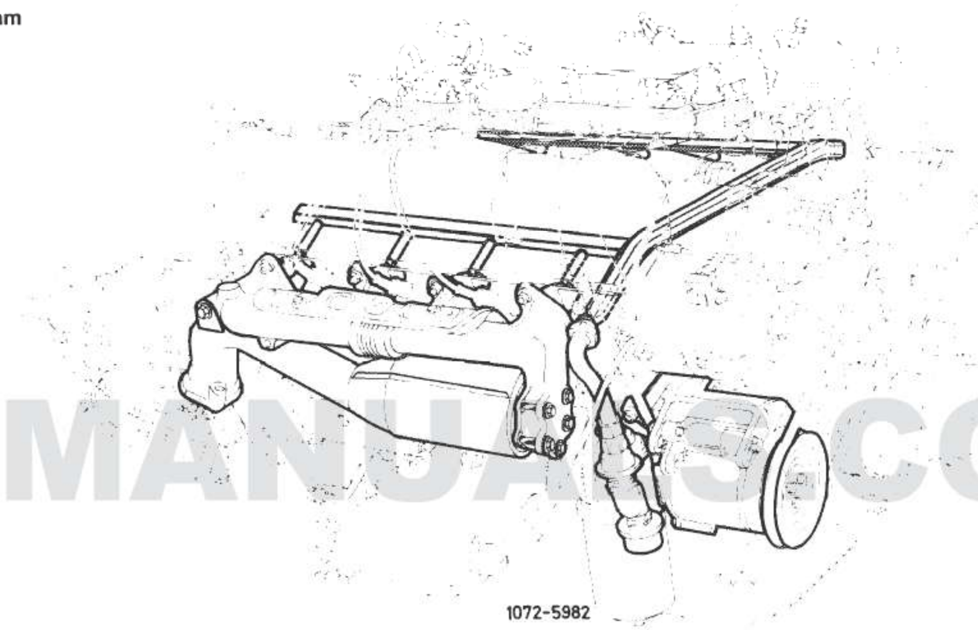


D. Air injection

To reduce the incompletely burnt components in exhaust gas, air is injected into hot zone behind exhaust valves.

To prevent backfiring in exhaust, the air injection is controlled via switchover valve (33) and diverter valve (41).

Function diagram

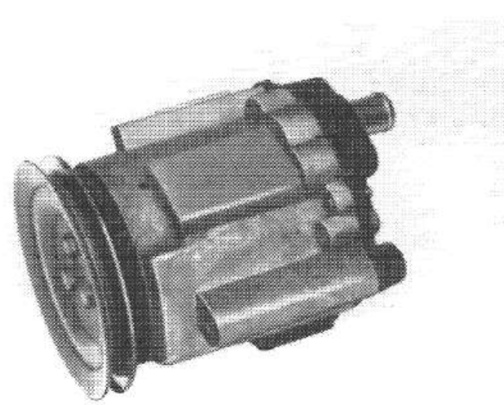


1072-5982

Components of air injection:

Air pump (Saginaw pump)

The air pump is an impeller pump with a maintenance-free centrifugal filter which cleans the drawn-in air.

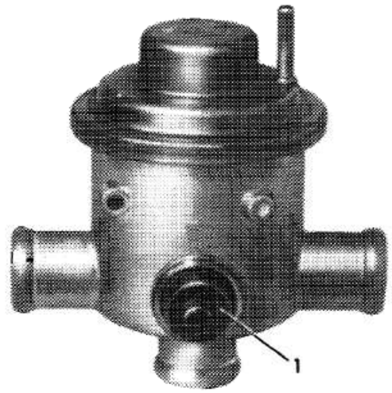


107-8959/1

Diverter valve

The diverter valve serves the purpose of discharging the delivered air below 17 °C coolant temperature by way of a separate air filter for silencing.

The diverter valve is provided with a safety valve (1) which discharges the delivered air at a given overpressure to protect the pump vanes against overload.

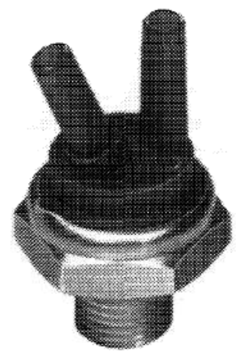


107-10092

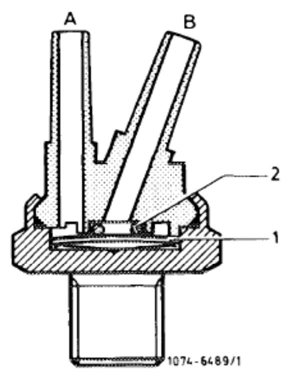
Thermovalve 17 °C (color code blue)

The thermovalve (61) is screwed into coolant-controlled portion of intake pipe and **opens** at approx. 17 °C coolant temperature. Below 17 °C coolant temperature the bimetallic plate rests against O-ring and closes connection "B".

Above 17 °C coolant temperature the bimetallic plate snaps downward when heated. Both connections are connected to each other.



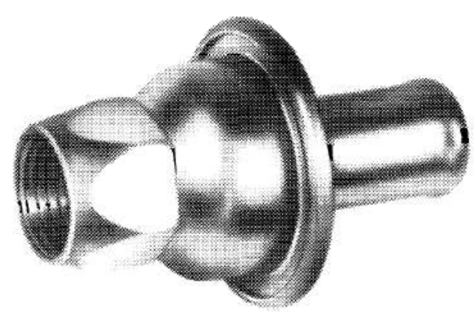
107-10895



1074-6489/1

Check valve (42)

The check valve prevents the inflow of hot exhaust gases into air line.



107-9193

Operation

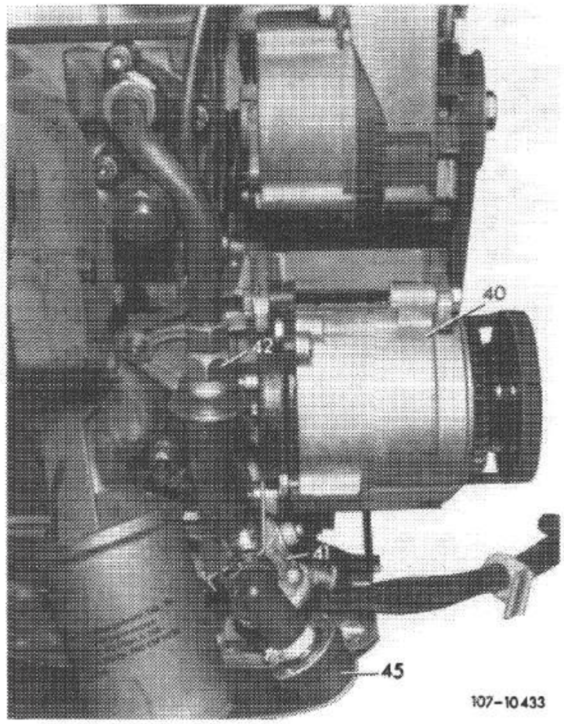
Starting at a coolant temperature of approx. 17 °C in cylinder head, air is injected into exhaust ports of cylinder head at idle, during deceleration (coasting) and when operating under partial load.

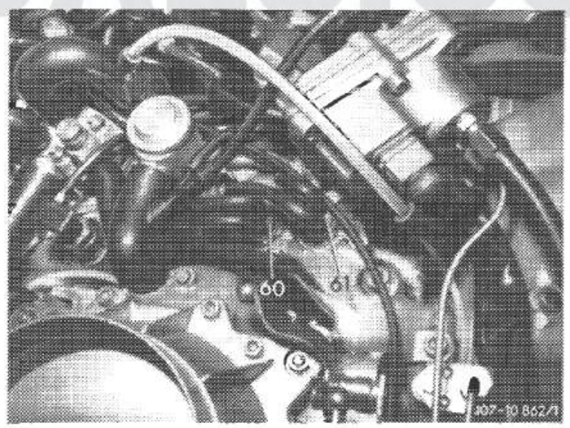
The oxygen in the air encounters the hot exhaust gases and reacts in catalyst. At coolant temperatures below approx. 17 °C the delivered air is discharged into the atmosphere via an air filter for silencing.

Air injection and air discharge is controlled via diverter valve (41).

The thermovalve (61) is open. The intake pipe vacuum can act on diaphragm of diverter valve (41) via thermovalve (61).

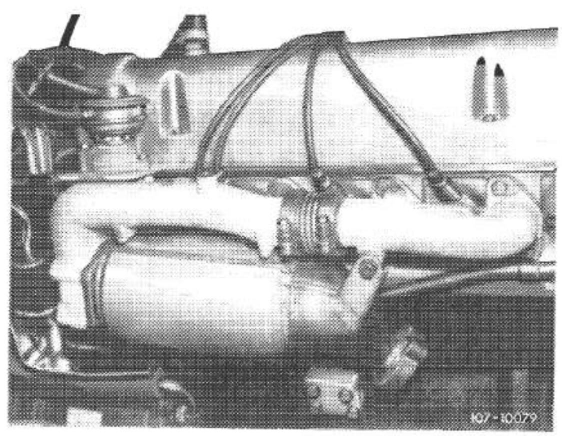
The connection for air discharge is closed and the air delivered by the air pump (40) is discharged into exhaust ports of cylinder heads via check valve (42).





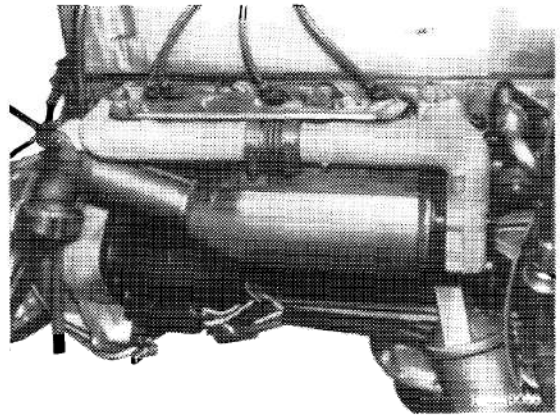
E. Catalyst

The exhaust gases at each engine side are routed through a catalyst.



Lefthand engine side

The catalyst comprises two elastically suspended monoliths inside a wire netting, a honeycomb-shaped cylindrical body made of a ceramic material. The noble metal evaporated on the monoliths, the actual catalyst, accelerates the oxidation of CO and hydrocarbons with the addition of fresh air at pertinent temperature.



Righthand engine side

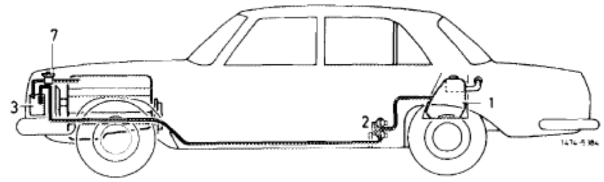
To maintain function of catalyst, the engine should be operated with lead-free fuel only. Since lead-free fuel is available outside the USA only in limited quantities, these vehicles (outside the USA) are operated with fuel containing lead. When these vehicles are imported into the USA, new catalysts are installed and the fuel system is flushed. To show that these jobs have been completed, the yellow exhaust gas information plate is exchanged for the black information plate valid in the USA.

F. Fuel evaporation control system

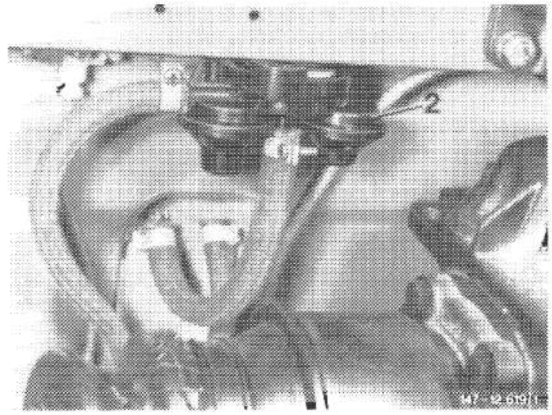
A fuel evaporation system has been installed to improve emission characteristics which have nothing to do with engine combustion.

Function diagram

1 Fuel tank with expansion tank
2 Valve system
3 Charcoal canister
7 Purge valve



Components of fuel evaporation control system:



Valve system

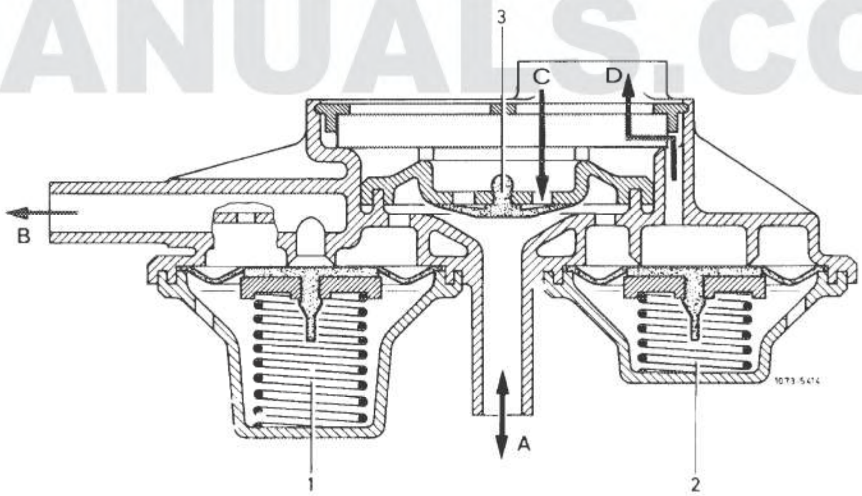
The valve system is mounted under vehicle at level of rear legroom. The system comprises three valves:

1. Negative vent valve
2. Pressure relief valve
3. Positive vent valve

The **negative vent valve** opens at a slight overpressure. The evaporation vapors will flow through negative vent valve (1) (direction B) into a line to charcoal canister.

The **pressure relief valve** is a safety valve and opens in the event of an overpressure in fuel evaporation system. The fuel vapors are vented directly into the open air.

The **positive vent valve** opens in the event of a vacuum caused when the fuel tank is cooling down.



1 Negative vent valve
2 Pressure relief valve
3 Positive vent valve
A To valve/to expansion tank
B To charcoal canister
C Fresh air input
D Output pressure relief valve

Charcoal canister

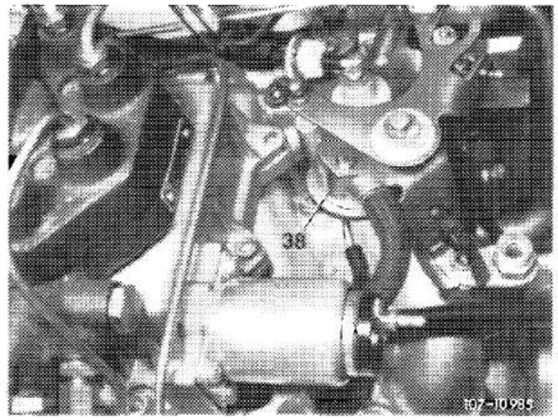
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn off again when driving.

A Connection tank vent
B Connection purge valve

107-9128

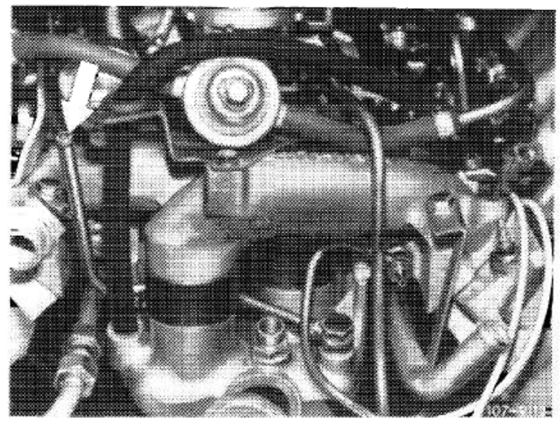
Purge valve

The purge valve is controlled by the vacuum of the throttle valve. When the diaphragm is activated with a vacuum, the valve opens and the fuel evaporation vapors can be drawn from charcoal canister.



Intake pipe connection

The intake pipe is provided with a connection (arrow) to draw the fuel evaporation vapors from charcoal canister.



Operation

The fuel evaporation vapors from fuel tank are stored in charcoal canister when the engine is stopped, and they are drawn from charcoal canister when the engine is running in dependence of the intake pipe vacuum.

When the throttle valve is opened, the diaphragm of the purge valve is activated with a vacuum and the valve is opened.

The intake pipe vacuum draws the stored vapors from charcoal canister.

14–100 Test program

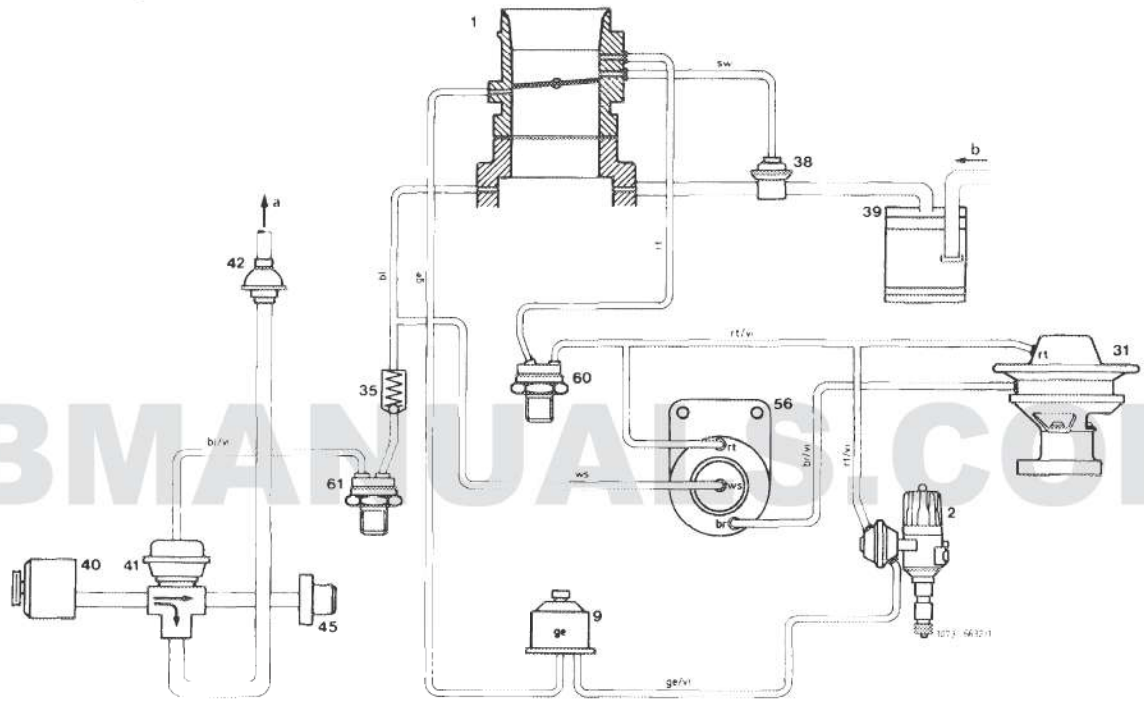
Federal and California version model year 1976

For complaints such as: Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.

Test conditions: Engine at operating temperature, run engine at idle speed.

Test the following: Ignition switchover, EGR, air injection and fuel evaporation control system.

Function diagram



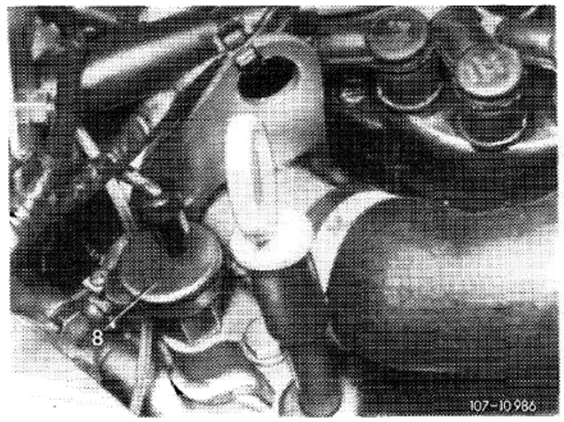
1 Throttle valve housing
2 Ignition distributor
9 Switchover valve ignition retard
31 EGR valve
35 Check valve
38 Purge valve
39 Charcoal canister
40 Air pump
41 Diverter valve
42 Check valve air injection
45 Air filter for silencing
56 Vacuum switch
60 Thermovalve 40 °C (black)
61 Thermovalve 17 °C (blue)
a Air injection line to cylinder head
b Connection tank vent

bl = blue
br = brown
ge = yellow
rt = red
sw = black
vi = purple
ws = white

Testing ignition switchover

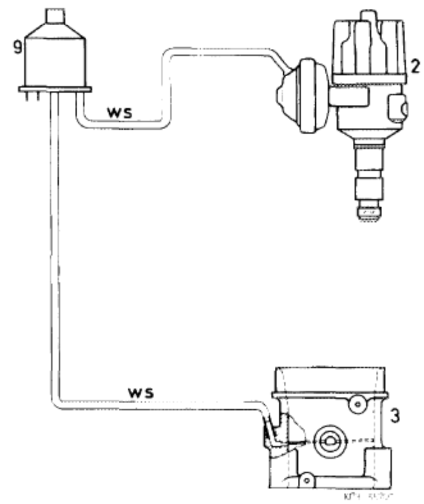
Pull plug from temperature switch 100 °C (8) and connect to ground.

Engine speed increasing.	Engine speed not increasing.



Testing vacuum lines

The vacuum line from throttle valve housing (3) leads to center connection of switchover valve (9), that of vacuum control unit of ignition distributor (2) to outer connection of switchover valve (9).



Testing vacuum

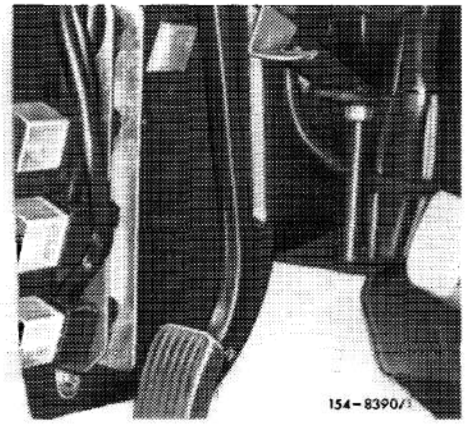
Pull vacuum line from center connection of switchover valve (9) and keep closed with finger. If vacuum is evident, plug vacuum line in again. If no vacuum is evident, blow out vacuum draw-off connection on throttle valve housing with compressed air.

Testing relay (code number 5) for switchover valve

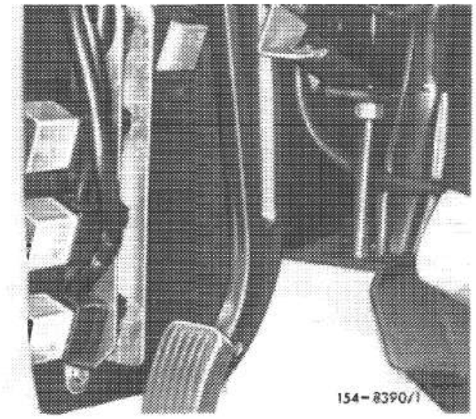
Connect test lamp to connecting plug of switchover valve (9) and plug of temperature switch (8) to ground. Relay is in order if test lamp lights up.

Replace switchover valve (9).

If test lamp is not lighting up, replace relay.

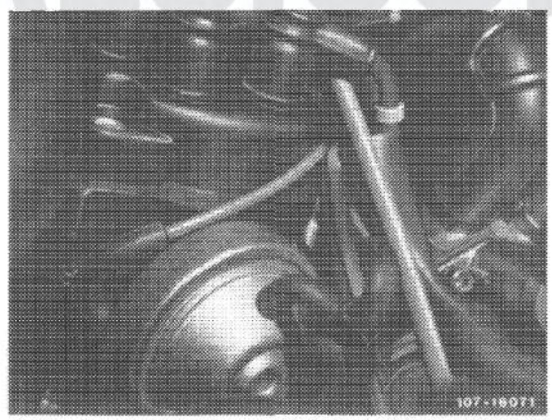


Testing ignition switchover Switch on air conditioning system.	
Engine speed increasing.	Engine speed not increasing.


154–8390/1

Replace relay (code number 5) if clutch of refrigerant compressor is attracted.

Testing ignition switchover Pull both vacuum lines from ignition distributor (cancellation of ignition retard).	
Engine speed slightly increasing.	Engine speed not increasing.

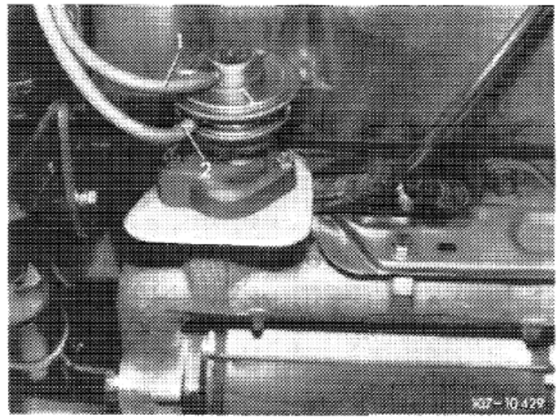

107–18071

Replace double vacuum unit on ignition distributor.

Testing EGR

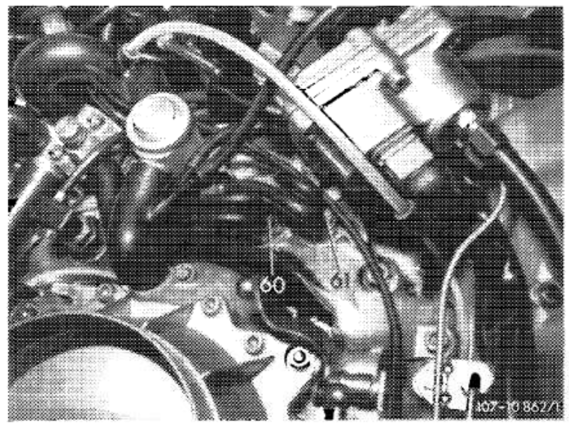
Pull red/purple vacuum line from EGR valve. Connect vacuum gauge to red/purple line and to red connection of EGR valve. Increase engine speed to approx. 2500/min.

No vacuum at idle, increasing vacuum with increasing speed.	Vacuum not increasing with increasing speed.



Testing vacuum lines

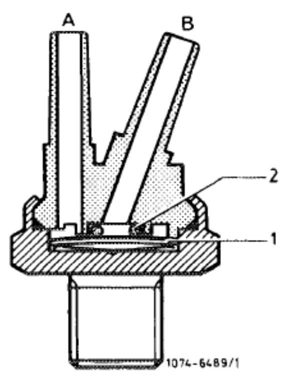
The red vacuum line of red connection on throttle valve housing should be connected to diagonal connection of thermovalve (60), the red/purple line to straight connection of thermovalve (60), to red connection of vacuum switch and to red connection of EGR valve.



Testing thermovalve 40 °C (60)

The thermovalve should open when heated to above 40 °C ambient temperature and should close again when cooling down to approx. 30 °C.

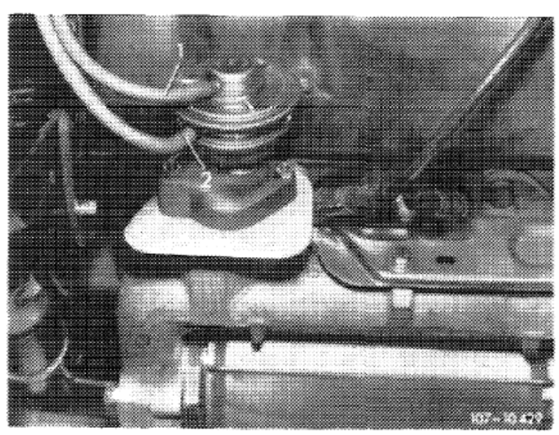
If no fault shows up, check vacuum tapping bore on throttle valve housing.



Testing EGR

Pull brown/purple vacuum line from EGR valve. Plug vacuum gauge to brown/purple line and to EGR valve bottom connection. Increase engine speed to approx. 2500/min.

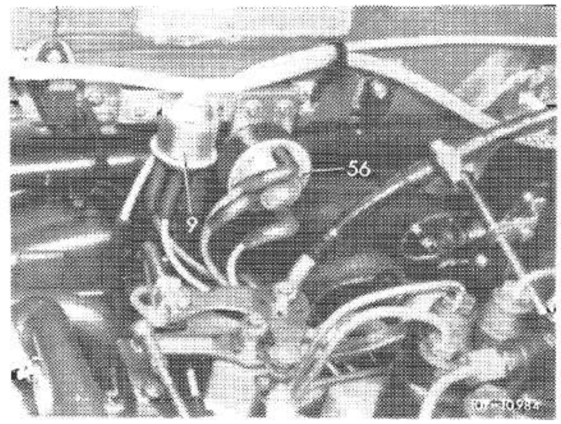
No vacuum at idle, increasing vacuum with increasing speed.	Vacuum not increasing with increasing apeed.



Testing vacuum lines

The red/purple vacuum line should be plugged to red connection of vacuum switch, the white vacuum line to center connection and the brown/purple vacuum line to brown connection of vacuum switch.

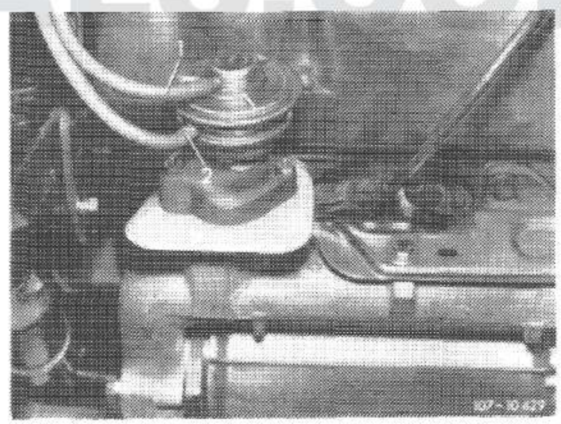
If no vacuum is measured in spite of correct connection of vacuum line, replace vacuum switch (56).



Testing EGR

Pull yellow/purple vacuum line from ignition distributor. Pull both vacuum lines from EGR valve. Connect yellow/purple vacuum line with upper or lower connection of EGR valve by means of test line.

Engine runs irregularly in both stages or comes to a stop.	Operation of engine not changing.

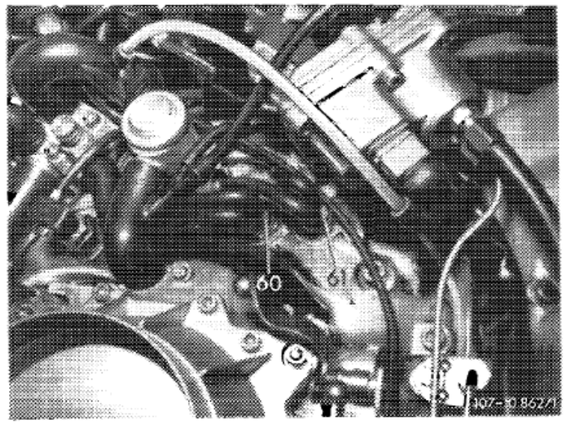


Replace EGR valve.

Testing EGR

Connect CO measuring instrument and read exhaust gas value. Pull blue/purple vacuum line from blue thermovalve (61). Measure exhaust gas value (air injection is switched off).

CO value noticeably changing.	CO value not changing.



Testing vacuum lines

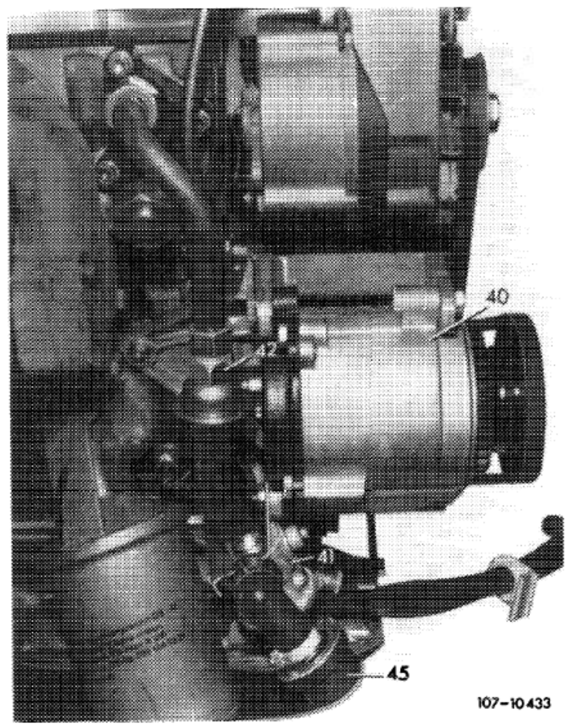
The blue vacuum line should be connected to diagonal connection of blue thermovalve (61), the blue/purple line to straight connection.

Testing diverter valve (41)

Unscrew damper filter (45) on diverter valve (41). Pull blue/purple vacuum line from blue thermovalve (61).

Air should flow out of diverter valve.

If no air flows out, replace diverter valve and repeat test. Test air pump or V-belt tension, if required.



107-10433

Testing fuel evaporation control system

Pull draw-off hose on connection "B" of charcoal canister and keep hose opening closed with finger. Slowly increase engine speed to above approx. 2000/min.

Low vacuum at idle, increasing vacuum with increasing speed.	No vacuum at idle, no vacuum increase at increasing speed.

107-9128

Testing draw-off line to intake pipe

For this purpose, loosen hose to charcoal canister on purge valve (38) and blow out valve in direction of intake pipe with compressed air. Replace purge valve (38), if required.

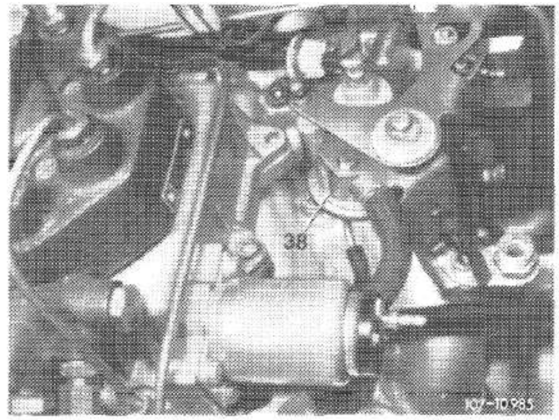
If vacuum is not increasing at higher speed:

Test vacuum at purge valve

Pull white vacuum line from purge valve (38). Connect vacuum gauge or keep hose opening closed with finger. Slowly increase engine speed. No vacuum should be available at idle. Increasing speed should result in increasing vacuum.

If vacuum is available, replace purge valve (38).

If no vacuum is available, clean vacuum tapping bore in throttle valve housing.



End of test.

14–200 Removal and installation of catalyst

Federal and California version model year 1976

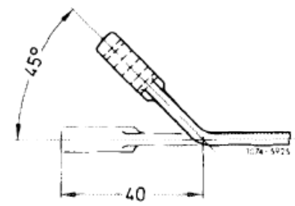
Special tool

Saltus ratchet 13 mm		000 589 31 16 00

Conventional tool

Starter wrench 10 x 12 mm	e.g. made by Stahlwille

Self-made tool

Box wrench 12 x 13 mm, offset	

Removal

1 Unscrew exhaust system from below on catalyst flange. Use offset box wrench.

2 Completely take down exhaust system.

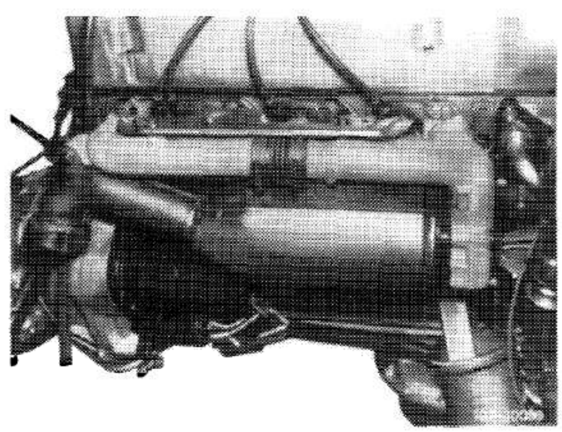
Remove catalyst at the right

3 On model 116, remove battery and battery box.

On model 107, remove water tank of windshield washer, unscrew coolant expansion tank and take from holder. Put down tank as far as possible to the front.

4 Pull off spark plug connector and unscrew shielding plate.

5 Unscrew catalyst holder.



6 Unscrew fastening screws on flange of catalyst by means of Saltus ratchet.

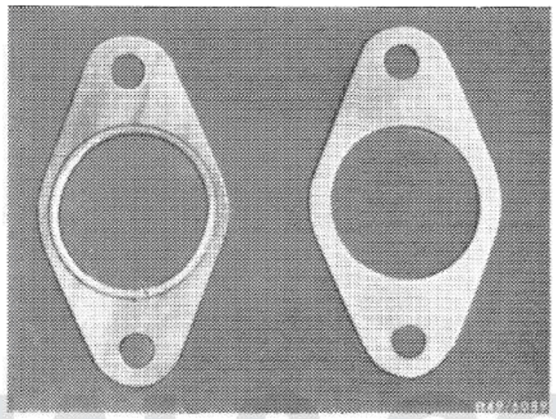
7 Unscrew upper screws on exhaust manifold.

8 Loosen nuts below on exhaust manifold with starter wrench; completely unscrew the three front nuts.

Note: The fastening bores of exhaust manifold are slotted at bottom, for this reason the lower nuts (except the three at the front) need not be completely unscrewed from removal of exhaust manifold.

9 Pull out exhaust manifold in upward direction, disassemble exhaust manifold at bellows, if required.

10 Remove catalyst.



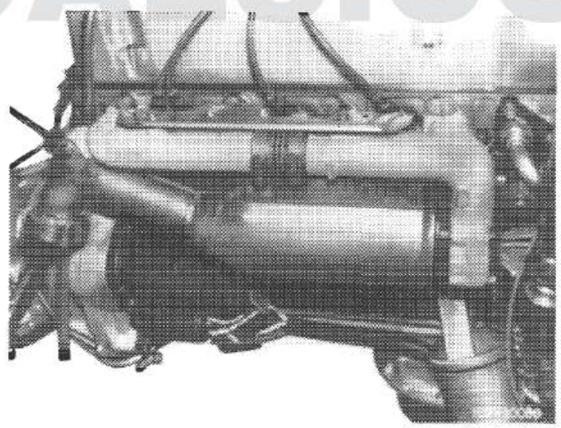
Install catalyst at the right

11 Insert new catalyst.

12 Renew exhaust manifold gaskets. Install flange gaskets with smooth surface facing exhaust manifold.

13 Insert exhaust manifold.

Attention!
Insert **center inside screw** for attaching catalyst to exhaust manifold together with a washer **prior to inserting manifold.** Installation later on is not possible.

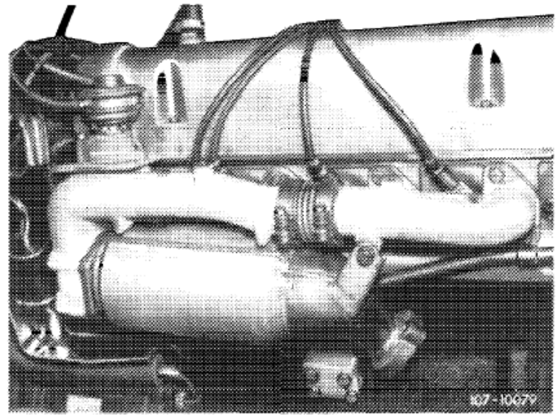


14 Position screws with washers at the top, new nuts with washers at the bottom. Tighten exhaust manifold.

15 Position catalyst with new gasket and new screws. Position catalyst holder. Tighten all screws.

16 Mount spark plug connector; install shielding plates. On model 116, install battery box and battery. On model 107, install coolant expansion tank and water tank on windshield washer.

Removing catalyst at the left



17 Pull off spark plug connector and unscrew shielding plate.

18 Remove EGR valve.

19 Unscrew catalyst holder.

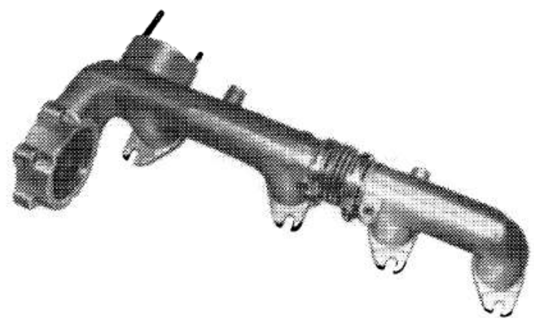
20 Unscrew fastening screws on flange of catalyst by means of Saltus ratchet. Put catalyst aside in downward direction. On model 107, remove engine shock absorber, if required.

21 Unscrew upper screws on exhaust manifold.

22 Loosen nuts at bottom of exhaust manifold with starter wrench, completely unscrew the three front nuts.

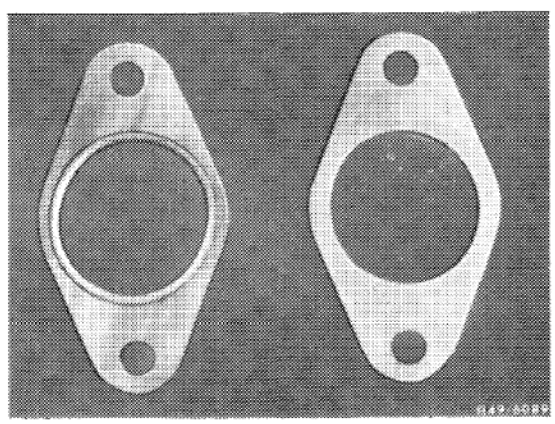
23 Loosen bellows and remove front exhaust manifold.

24 Remove catalyst.



107–10009

Installing catalyst at the left



25 Insert new catalyst.

26 Renew exhaust manifold gaskets. Install flange gaskets with smooth surface facing exhaust manifold.

27 Install exhaust manifold. Position screws with washers at the top, new nuts with washers at the bottom and tighten. Mount bellows.

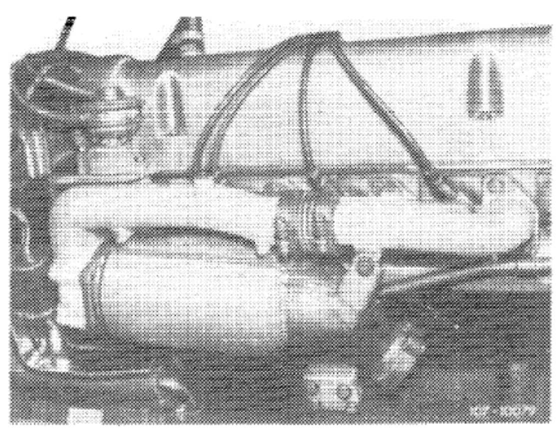
28 Position catalyst with new gasket and new screws. Position catalyst holder. Tighten all screws.

29 Install EGR valve with new gasket. Connect line with colors red/purple at top and brown/purple at bottom on valve.

30 Mount shielding plates and spark plug connectors.

31 Install exhaust system.

32 Check for leaks.



14–250 Removal and installation of air pump

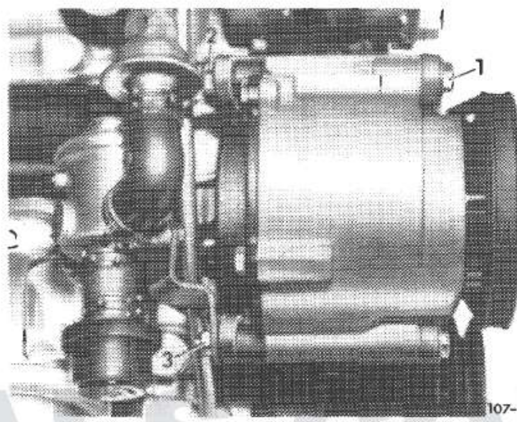
Federal and California version model year 1976

Removal

1 Compress hose clip on contoured hose of air pump with combination pliers and push approx. 2 cm to the rear.

2 Loosen clamping screws (1 and 2) as well as fastening screw (3) and unscrew.

3 Remove V-belt and contoured hose, remove air pump.



Installation

4 For installation proceed vice versa.

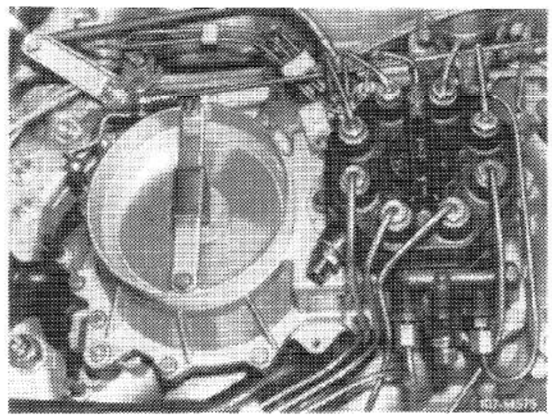
Note: The V-belt is correctly tensioned if it can be resiliently pushed down by energetic thumb pressure.

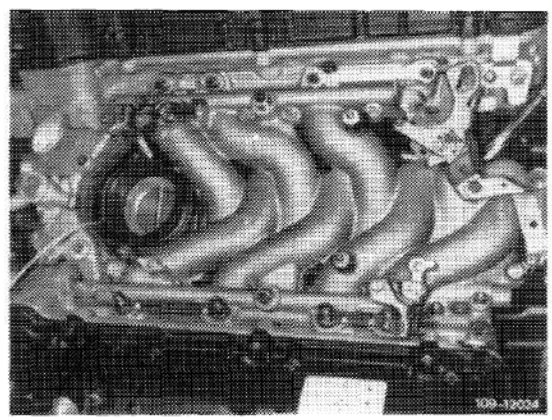
09–450 Removal and installation of intake manifold upper and lower half, renewing gaskets

Note

During removal and installation of intake manifold the mixture regulator with air guide housing need not be removed.

Removal





1 Disconnect battery.

2 Partially drain coolant.

3 Unscrew injection lines and fuel lines. Catch fuel with a cloth.

Deactivate fuel lines.

4 Pull off supplementary air lines.

5 Remove control pressure rod for automatic transmission.

6 Unscrew bearing bracket for gate regulation.

7 Unscrew bearing bracket for longitudinal regulating shaft.

8 Pull off all connecting cables and plug connections.

9 Unscrew vacuum line for automatic transmission and for brake unit.

10 Unscrew idle speed air distributor.

11 Loosen coolant hoses and pull off.

12 Unscrew all fastening screws and remove intake pipe toward the rear.

13 Clean intake manifold and check flange surfaces with straightedge or touch up on surface plate.

Installation

14 Mount intake manifold with new gaskets in vice versa sequence.

Use only graphited intake manifold gaskets.
Do not install non-graphited intake manifold gaskets similar to engine 117.96 (5.0).

15 Adjust regulating linkage (30–300).

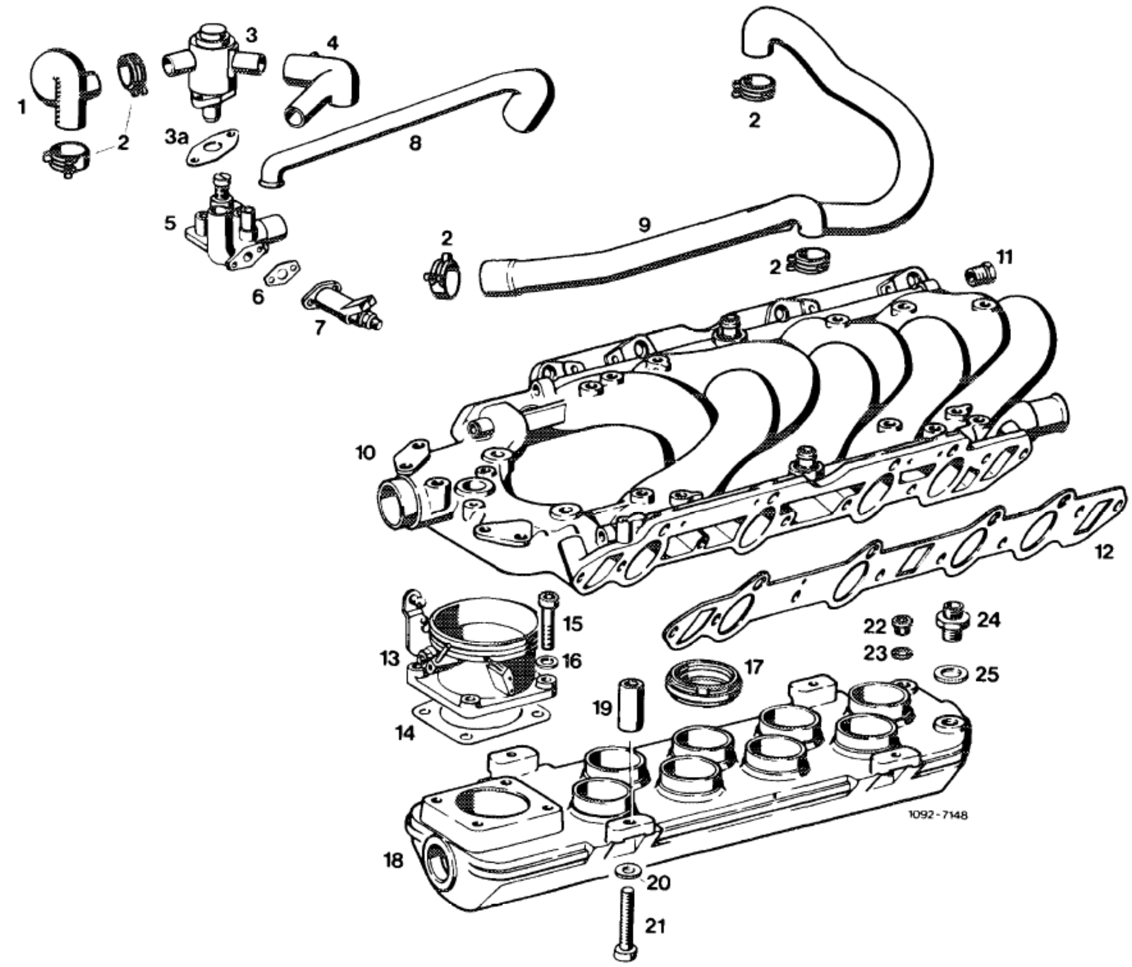
16 Connect battery.

17 Add coolant.

18 Keep engine running, check fuel lines for leaks. Check intake system, fuel distributor and injection valves by spraying with Iso-Oktan or benzine for leaks.

19 Adjust idle speed (07.3–100).

Intake manifold



1 Contoured hose
2 Coiled hose clips
3 Supplementary air valve
3a Gasket
4 Contoured hose
5 Idle speed air distributor
6 Gasket
7 Cold-starting valve
8 Contoured hose
9 Supplementary air line
10 Intake manifold upper half
11 Closing plug
12 Gasket
13 Throttle valve housing
14 Gasket
15 Hex. socket screw
16 Washer
17 Rubber connection
18 Intake manifold lower half
19 Spacing sleeve
20 Washer
21 Hex. socket screw
22 Closing plug
23 Sealing ring
24 Double thread connection
25 Sealing ring

14–455 Renewing intake manifold (intake manifold removed)

1 Remove and install intake manifold (14–450).

2 Remove and install injection valves and insulating sleeves (07.3–215).

3 Remove and install mixture regulator with air guide housing (07.3–225).

4 Unscrew all unscrewable parts on removed intake manifold and mount on new intake manifold with new gaskets.

5 Unscrew intake manifold upper half from intake manifold lower half. For this purpose, loosen vacuum line for brake unit on intake manifold lower half, then unscrew fastening screws and pull from rubber adaptors.

6 Mount intake manifold lower half with new rubber adaptors to intake manifold upper half.

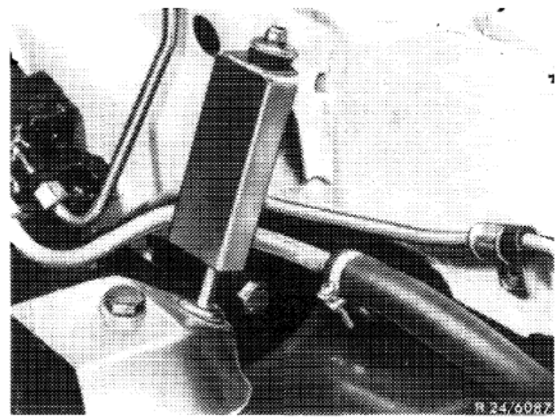
Attention!
The intake manifold lower half has a different shape as that of engine 117.960 (5.0) and can therefore not be installed in this engine.

49–470 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm
Bolt for engine mount	75

Removal



1 Remove exhaust system (49–100).

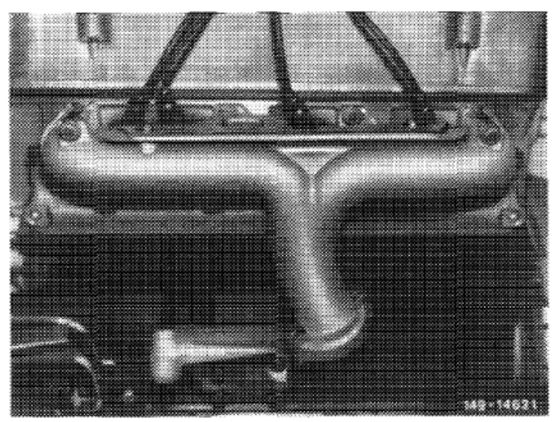
Note: Survey exhaust manifold (14–472).

2 Pull off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with fastener and shielding plates. For this purpose, unscrew bolt for engine mount.

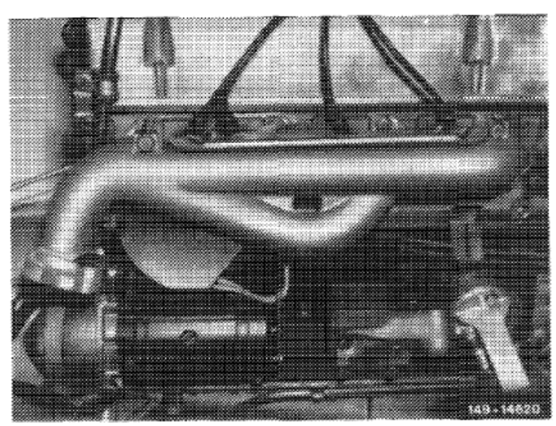
Exhaust manifold left



5 Remove air cleaner.

6 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right

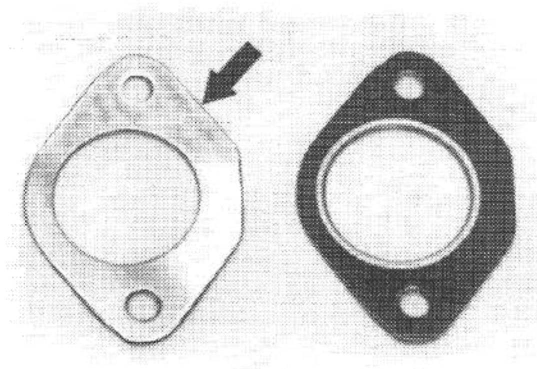


7 Remove windshield washer tank.

8 Unscrew coolant supply tank. Unscrew fastening clamp for coolant hose, loosen cable band for electric line and put supply tank aside.

9 Remove battery, battery holder and shielding plate.

10 Unscrew exhaust nuts and bolts and remove exhaust manifold.



107–12067

Installation

11 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

12 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

13 Tighten bolts for engine mount to 75 Nm.

14 Mount exhaust system.

15 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

16 Keep engine running and check exhaust system lor leaks.

B. Model 116

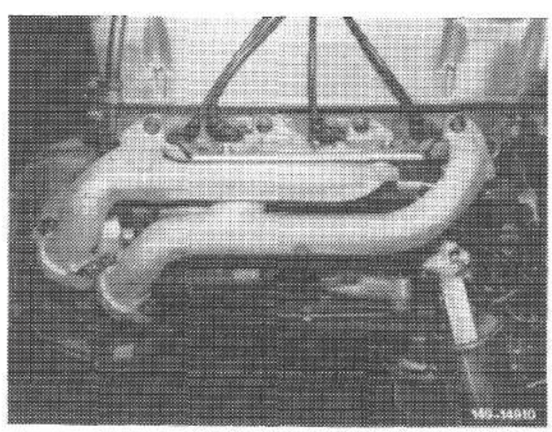
Note

Starting with the following chassis end no. a two-fluted **righthand** exhaust manifold is installed.

Start of production: December 1977

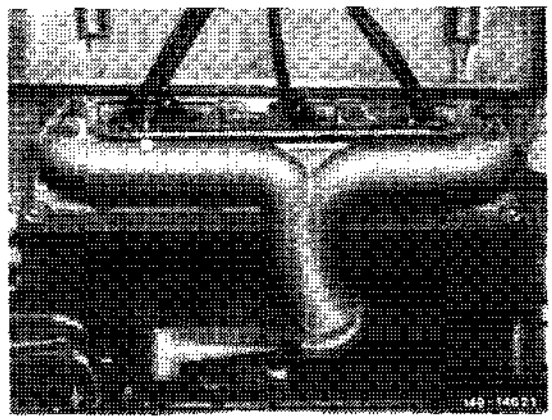
Model	starting chassis end no.
116.028/029	044654
116.032/033	076606

On previously manufactured vehicles the former exhaust manifold remains installed.

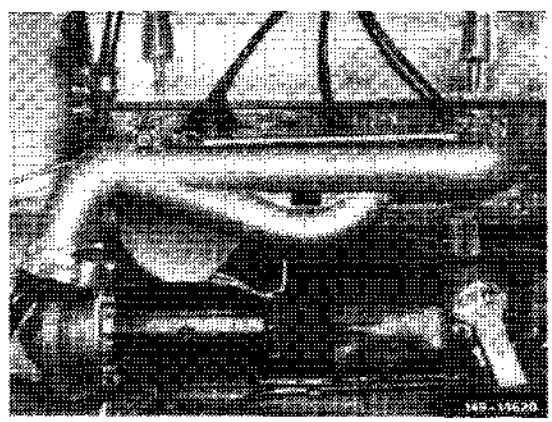


A. Standard version

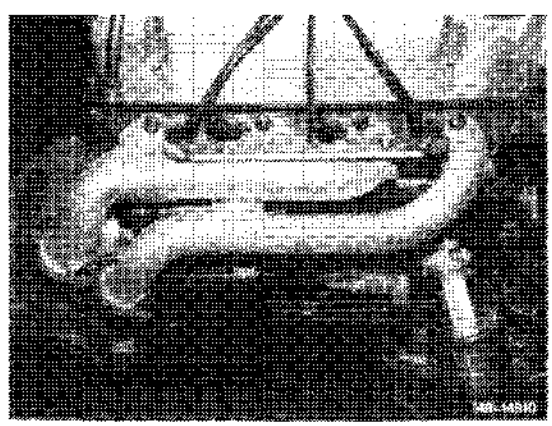
Lefthand steering



Exhaust manifold left

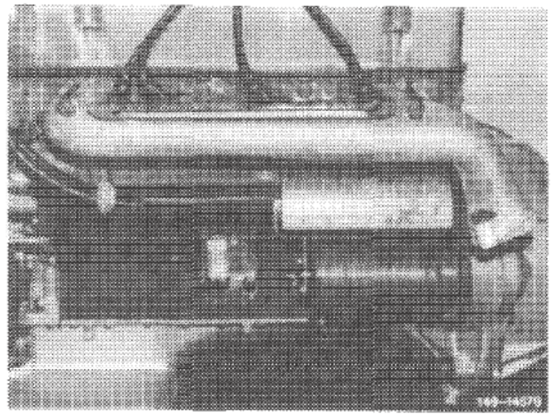


Exhaust manifold right

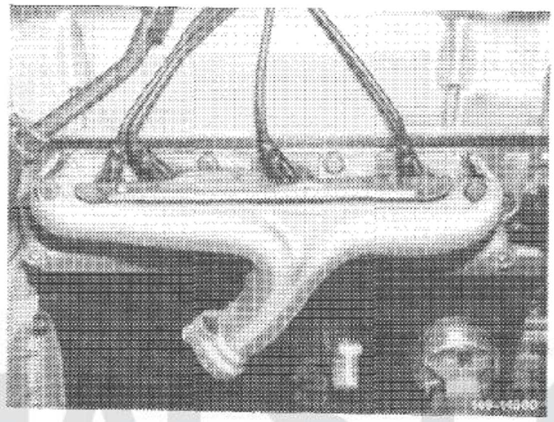


Exhaust manifold right
two-fluted model 116

Righthand steering



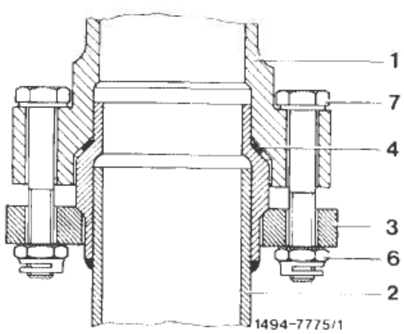
Exhaust manifold left



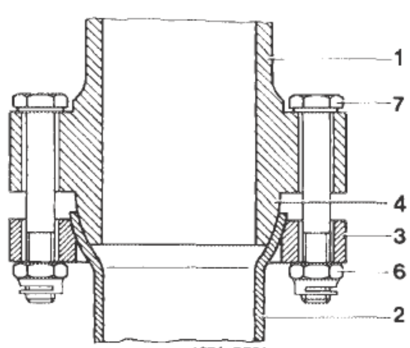
Exhaust manifold right

Repair versions

Starting approx. November 1977, the exhaust manifolds are provided with an external ball connection (up to now trapezoid connection). As a result, when installing exhaust manifolds with external ball connection, replace front exhaust pipe with trapezoid connection against an exhaust pipe with external ball connection.



Trapezoid connection
(past version)



External ball connection

Removal

1 Remove exhaust system (49–100).

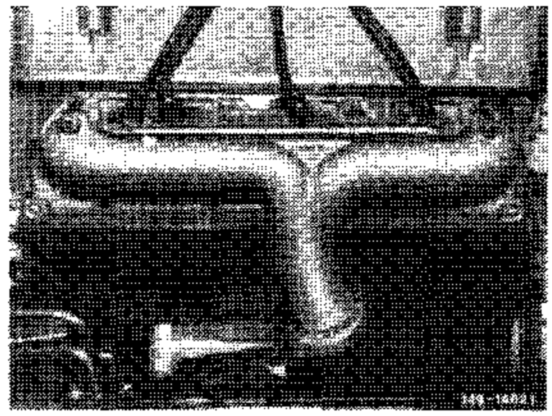
2 Pull off ignition cable.

3 Unscrew shielding plate on exhaust manifold.

Exhaust manifold left

4 Remove air cleaner.

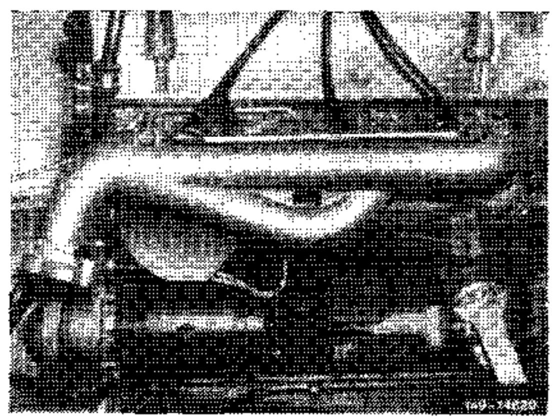
5 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Exhaust manifold right

6 Remove battery and battery holder.

7 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Installation

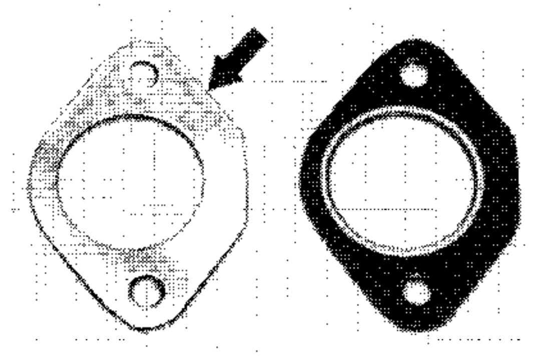
8 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

9 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

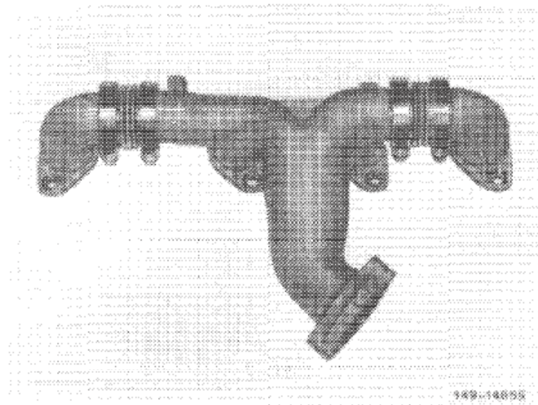
10 Mount exhaust system.

11 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

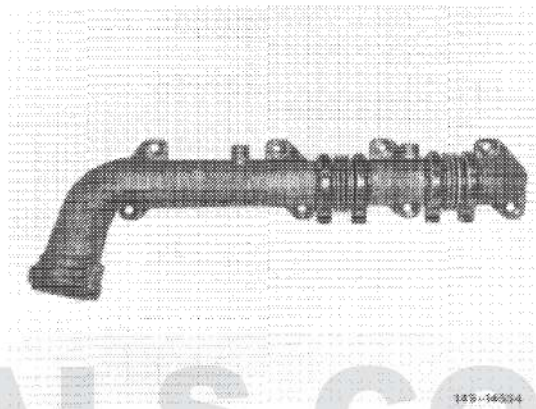
12 Keep engine running and check exhaust system for leaks.



Lefthand steering



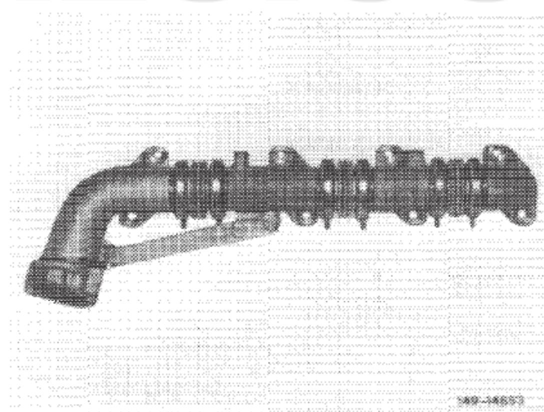
Exhaust manifold left



Exhaust manifold right

In the event of damage on exhaust manifolds with 2 bellows as a result of extremely sharp driving, the exhaust manifold can be subsequently provided with 3 bellows at righthand engine side on model 116.

This exhaust manifold has a trapezoid connection. Consequently, on vehicles manufactered after approx. November 1977, the front exhaust pipe with external ball connection must be replaced by an exhaust pipe with trapezoid connection.



Exhaust manifold right
model 116

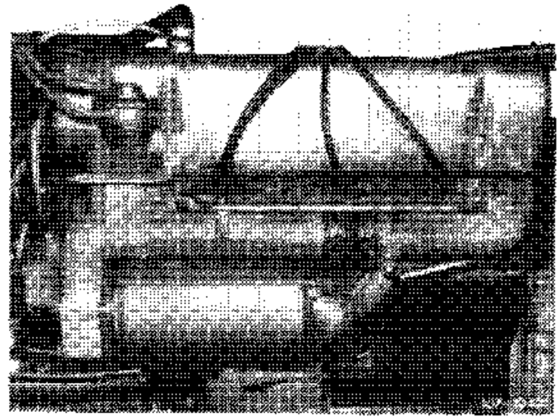
Righthand steering

On righthand steering vehicles the exhaust manifolds must be replaced like for like.

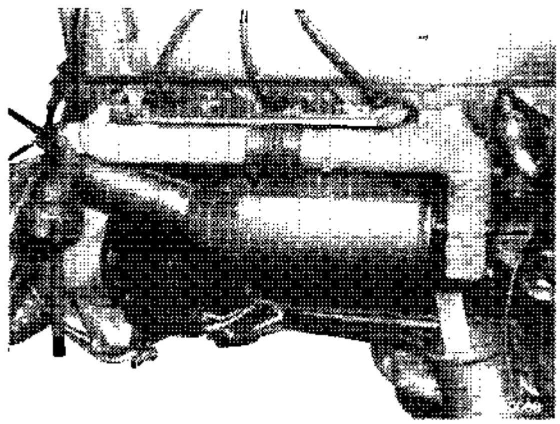
B. National version AUS J S USA

J S USA Model year 1976

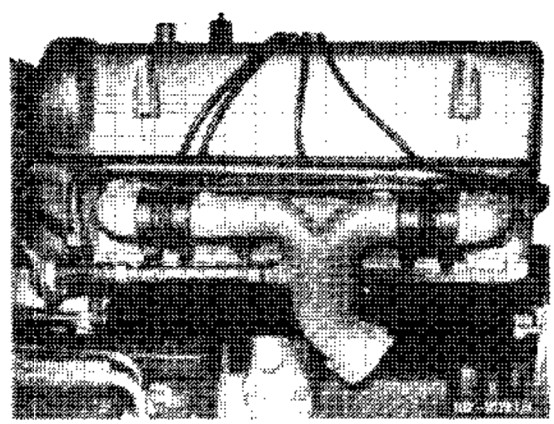
Exhaust manifold with internal ball



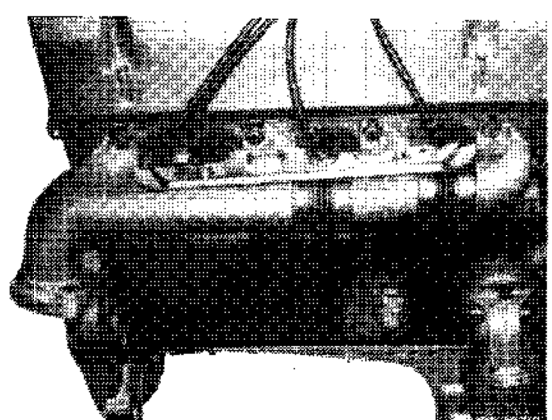
J USA
Exhaust manifold left



Exhaust manifold right



S
Exhaust manifold left

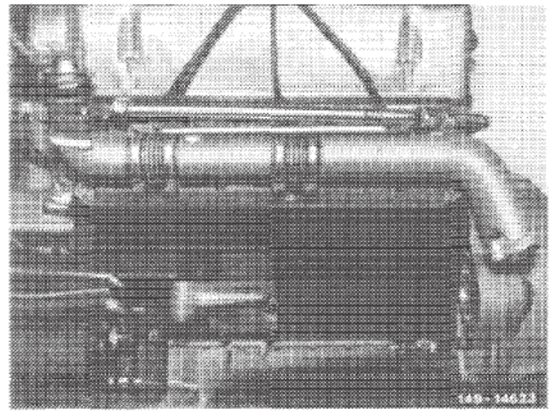


Exhaust manifold right

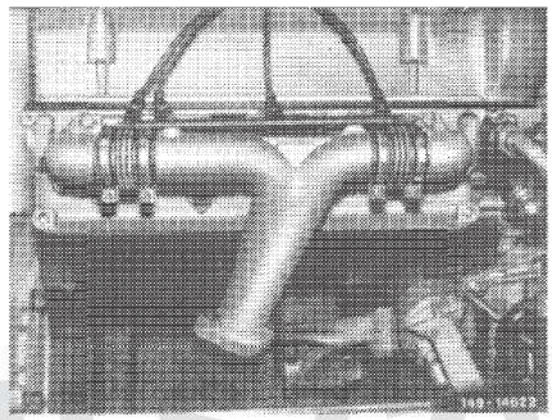
AUS J S model year 1977–1980
USA model year 1977–1979

1977 exhaust manifold with internal ball,
starting 1978 exhaust manifold with external ball

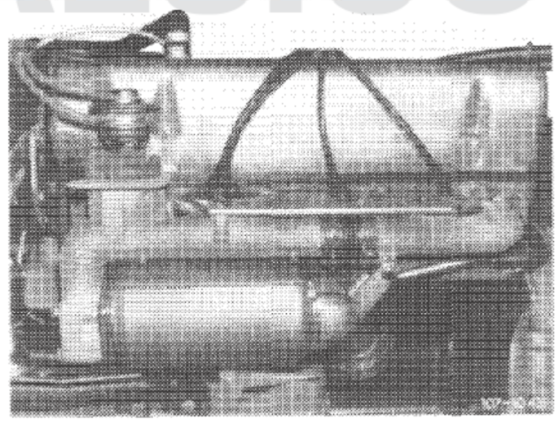
Note: If on vehicles model year 1977 an exhaust manifold with external ball connection is installed, the front exhaust pipe must be replaced.



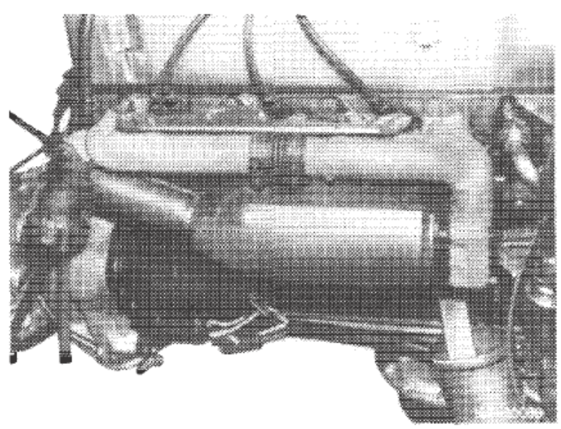
AUS
Exhaust manifold left



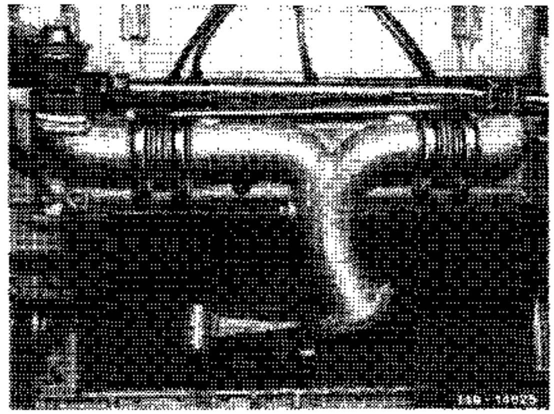
Exhaust manifold right



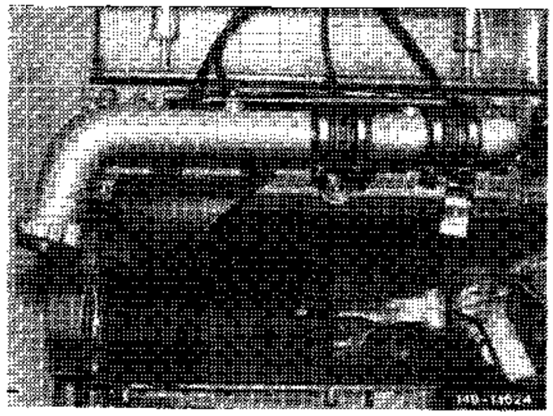
J
Exhaust manifold left



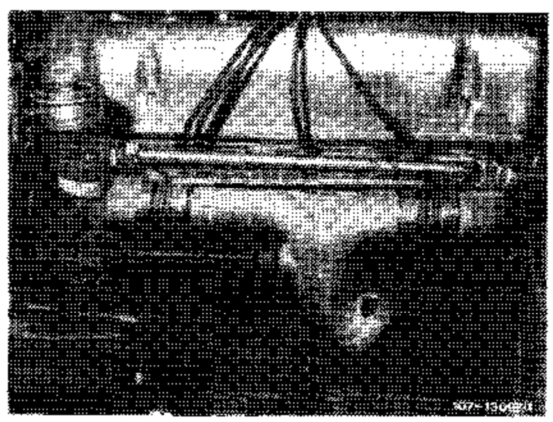
Exhaust manifold right



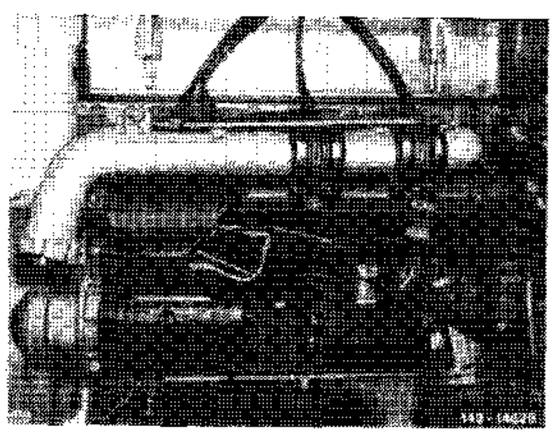
S
Exhaust manifold left



Exhaust manifold right



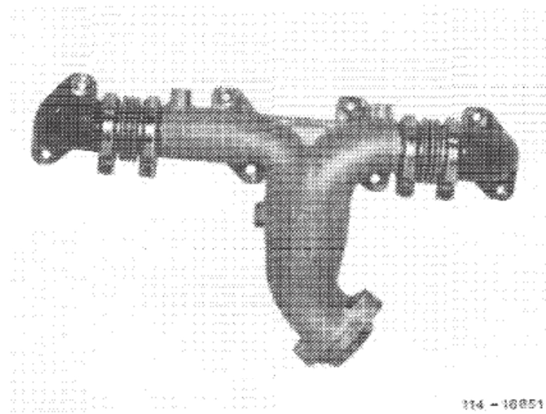
USA
Exhaust manifold left



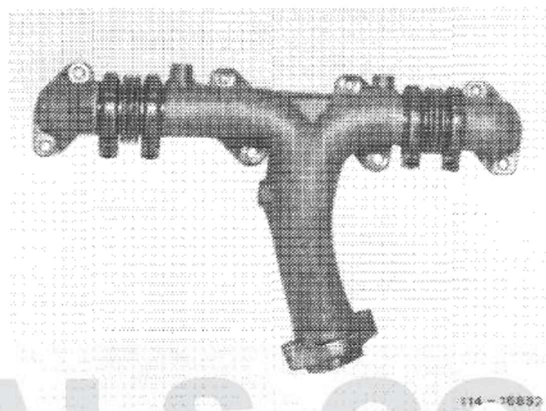
Exhaust manifold right

USA model year 1980

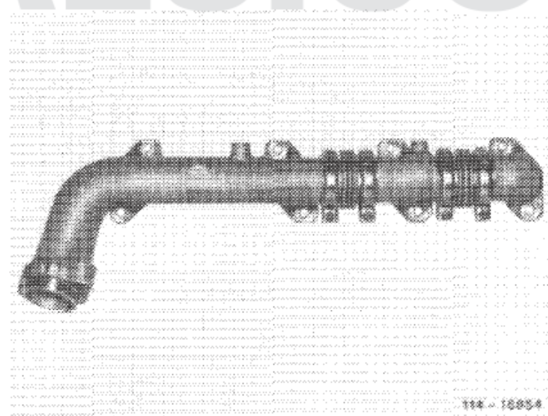
Without EGR



Exhaust manifold left
Model 107



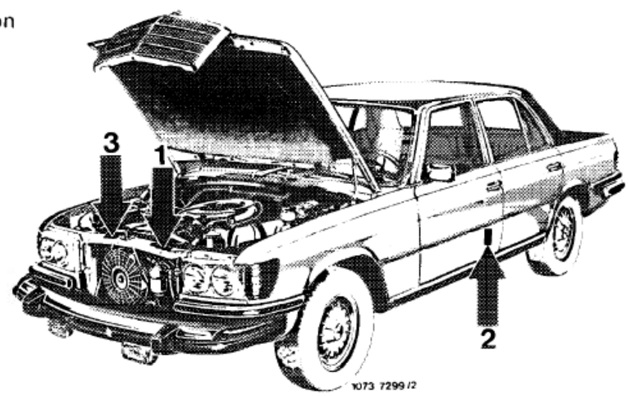
Exhaust manifold left
Model 116



Exhaust manifold right
Model 107 and 116

14–001 Functional characteristics

The various emission control systems of USA version vehicles are identified by respective information plates (arrows 1, 2 and 3).



1. Information plate on cross member in front of radiator

This plate shows the identification data as well as all the important engine adjustment data.

Recognizing emission control system from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1971</td><td rowspan="6">black/silver</td><td rowspan="3">black/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1972</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1973</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1974</td><td rowspan="3">green/silver</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1975</td><td>–</td><td rowspan="2">yellow/silver</td><td rowspan="2">yellow/silver</td></tr>
<tr><td>1976</td><td>–</td></tr>
<tr><td>1977</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td><td>red/black</td><td rowspan="4">black/white</td><td rowspan="3">yellow/black</td></tr>
<tr><td>1978</td><td>–</td></tr>
<tr><td>1979</td><td>–</td></tr>
<tr><td>1980</td><td>black/white</td><td>–</td><td>black/white</td></tr>
</table>

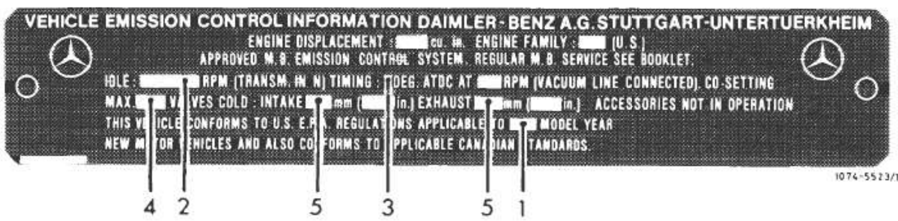
The information plate shows:

1. MODEL YEAR
2. IDLE . . . RPM
3. TIMING . . . DEG. AT . . . RPM
4. Emission value at idle without air injection max . . .

   CO–SETTING MAX. . . . AIR INJECTION DISCONNECTED

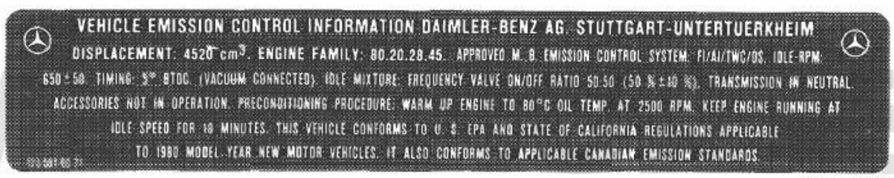
5. Valve clearance: INTAKE (. . . in)
   EXHAUST (. . . in)

Information plate up to model year 1979



1074-5523/1

Information plate model year 1980



1144-9543

Identification data are encoded in an 8-digit code no.

Example: Engine family 80. 20. 28. 45

80 20 2 8 45

Model year — 80

National code no. — 20

20 = Federal and California
21 = Federal
22 = California

Combustion system — 2

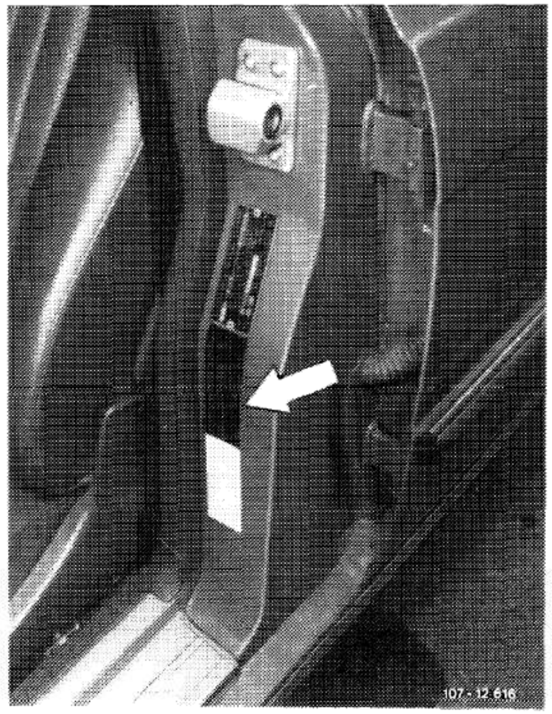
1 = Carburetor
2 = Injection, gasoline
3 = Diesel
4 = Diesel, turbo

Number of cylinders — 8

Displacement approx. 4500 cc — 45

2. Information plate on door pillar of driver's door

This plate shows whether vehicle is provided with catalysts or not.



107 - 12 616

Recognizing catalysts from color of information plate – basic color/lettering

<table>
<tr><th>Model year</th><th>Federal version</th><th>California version</th><th>Federal version high altitudes</th><th>Federal version tourist vehicles</th><th>California version tourist vehicles</th></tr>
<tr><td>1976</td><td rowspan="4">black/silver</td><td>black/silver</td><td>–</td><td rowspan="4">red/silver</td><td>red/silver</td></tr>
<tr><td>1977</td><td>green/silver</td><td>black/silver</td><td>blue/silver</td></tr>
<tr><td>1978</td><td rowspan="2">black/silver</td><td>–</td><td rowspan="2">red/silver</td></tr>
<tr><td>1979</td><td>–</td></tr>
</table>

Information plates

This vehicle is provided with catalysts.

1074 – 8259

Tourist vehicles

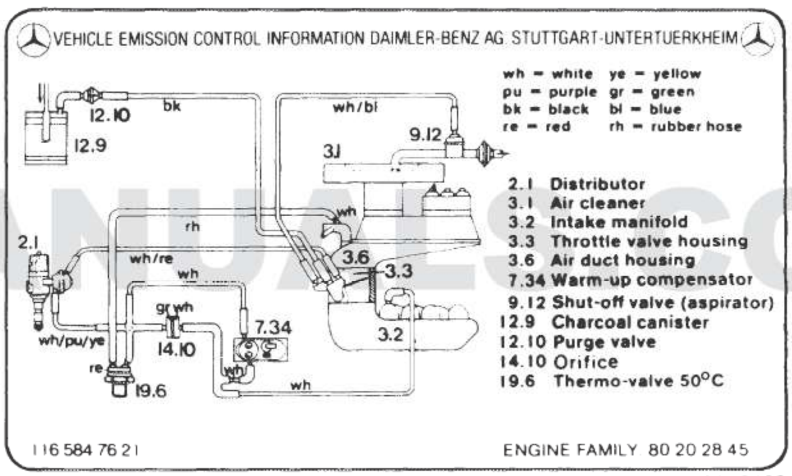
This vehicle is not provided with catalysts by manufacturer.

Catalysts must be installed prior to import into USA.

1074 – 8260

3. Information plate for vacuum line installation located on cross member in front of radiator (California only)

This plate shows the vacuum line layout for all emission system components in engine compartment.



1144 – 9406

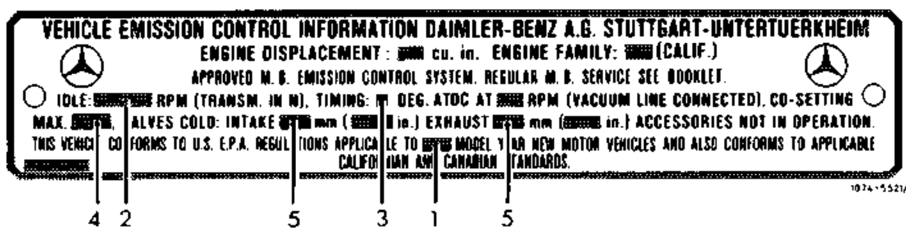
14–050 Operation

Federal and California version model year 1975

A. General

Information plate

Federal version basic color black
California version basic color green



1 Model year
2 Idle . . . rpm
3 Timing at speed of . . . rpm
4 Emission value at idle
5 Valve clearance

Identification of vacuum lines

Starting model year 1975 a new identification system for all vacuum lines in vehicle has been introduced.

The basic color of the vacuum lines for emission control system is transparent (white).

To facilitate recognition of the individual functions, additional color stripes will be used similar to the model years before.

Lines originating at a vacuum source (originating lines) have one color stripe only. These lines, to the extent they are part of a switchover valve, are plugged to the center connection of the switchover valve having the same color.

Lines terminating at a vacuum-operated device (terminating lines) have two color stripes. Purple is always the second color. These lines are plugged outside to switchover valves having the same color.

Emission control system	Color of vacuum originating line	Color of vacuum terminating line
Ignition switchover		
Advance	red	red/purple
Retard	yellow	yellow/purple
EGR	brown	brown/purple
Air injection	blue	blue/purple
Fuel evaporation control system		
Purge valve	black	black/purple

Color coding of cable connections

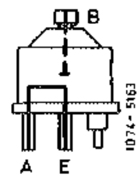
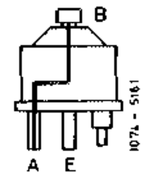
Starting model year 1975 the cable connections of switchover valves are color-coded with tape according to their function (e.g. blue for air injection).

Vacuum switchover valve

For easy identification, the filter caps are color-coded according to valve function.

Yellow cap – valve for ignition retard
Blue cap – valve for air injection
Red cap – valve for ignition advance/EGR

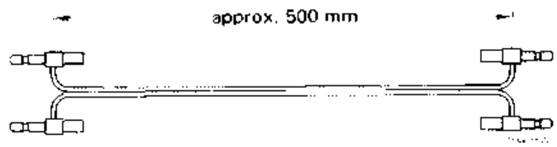
Do not confuse vacuum connections when mounting valves. Always slip vacuum-carrying line (originating line) on center connection. It is unimportant whether this connection is at top or bottom of valve.

Operation	Part. no.	Color	De-energized	Energized
In a de-energized condition, connection B is closed. Vacuum connections A and E are connected to each other. When energized, port E is closed and only connection A is open to atmosphere. Never confuse connections E and A.	001 540 08 97 001 540 18 97 001 540 09 97	yellow blue red		

A = Connection to vacuum unit B = Connection to atmosphere E = Connection to vacuum source

Test cable

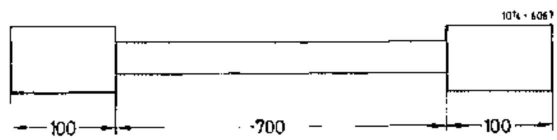
To test the individual components of emission control system use a self-made cable according to drawing.



1 Coupling part no. 003 545 28 28 (housing omitted)
2 Cable 1.5 mm²

Test line

Make a vacuum line according to illustration to test vacuum switch (56) and EGR valve.



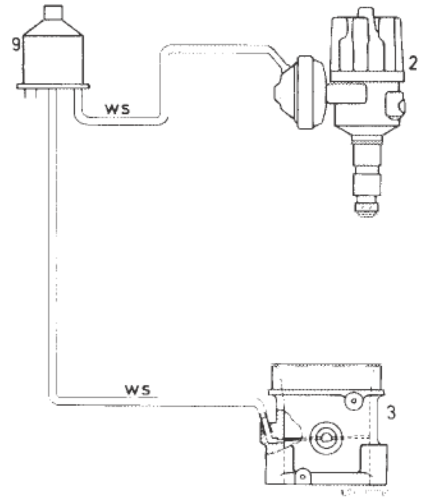
700 = 700 mm vacuum line 4 x 1 mm
100 = 100 mm hose 8 x 2 mm

B. Ignition timing

The ignition timing influences the running characteristics of the engine.

Ignition timing in direction of "retard" results in a higher engine temperature, longer periods of dwell and thereby in a reduction of CH and CO values.

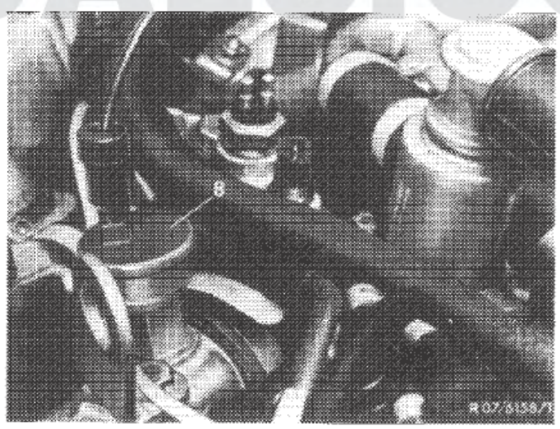
Function diagram



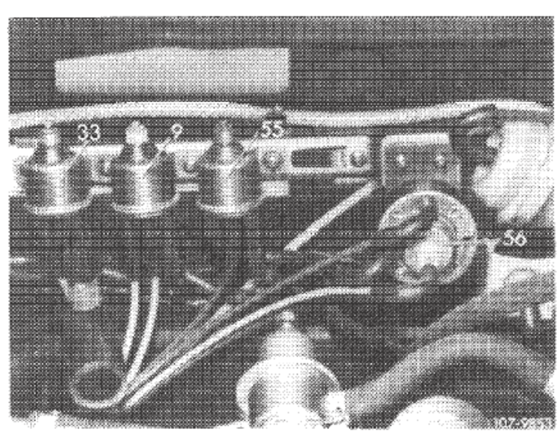
2 Ignition distributor
3 Throttle valve housing
9 Switchover valve

Vacuum adjustment in direction of "retard" becomes effective at the following operating conditions:

- Below 100 °C coolant temperature.
- Engine at idle.
- Engine decelerating (coasting) (throttle valve at idle speed stop).
- Air conditioning system switched off.



Vacuum adjustment in direction of "retard" is switched off and on by means of switchover valve (9), which is contacted by temperature switch 100 °C (8) via relay (19).



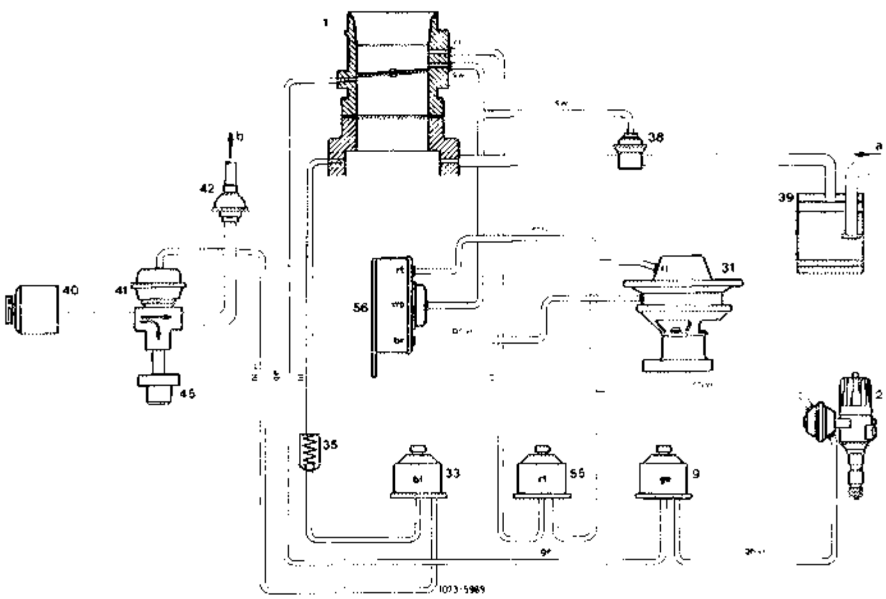
Below 100 °C coolant temperature the temperature switch 100 °C (8) is open, the switchover valve (9) is de-energized. The vacuum flows from throttle valve housing (3) via switchover valve (9) to diaphragm of vacuum unit of ignition distributor.

C. EGR (exhaust gas recirculation)

To reduce nitrogen oxides in exhaust gases, a portion of the gases from the exhaust manifold is returned to the intake pipe.

The quantity of the returned exhaust gas is controlled by the throttle valve position and the intake pipe vacuum.

Function diagram



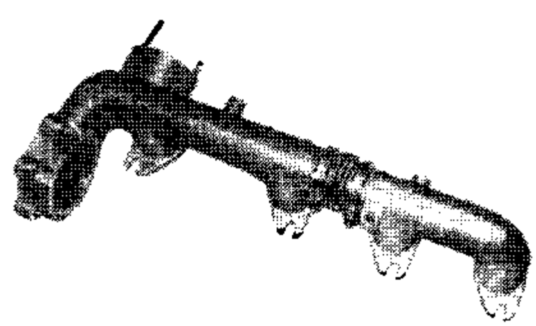
1	Throttle valve housing	41	Diverter valve	bl	=	blue
2	Ignition distributor	42	Check valve air injection	br	=	brown
9	Switchover valve ignition retard	45	Air filter for silencing	ge	=	yellow
31	EGR valve	55	Switchover valve EGR/ignition advance	rt	=	red
33	Switchover valve air injection	56	Vacuum switch	sw	=	black
35	Check valve			vi	=	purple
38	Purge valve			ws	=	white
39	Charcoal canister	a	Connection tank vent			
40	Air pump	b	Air injection line to cylinder head			

EGR components:

Exhaust manifolds

Exhaust manifolds now have one bellows only. A flange is cast-on at the front for assembly of catalyst.

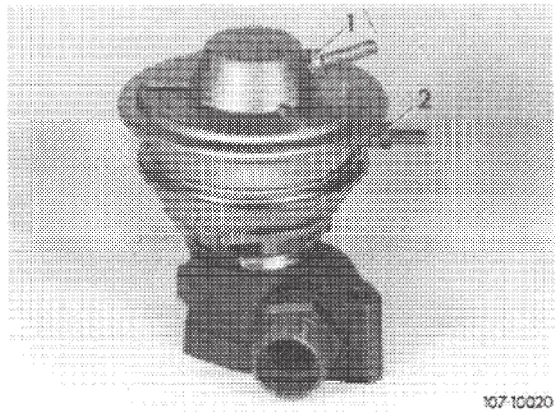
For EGR, a bore as well as a flange for the EGR valve are located at lefthand exhaust manifold.



107–10009

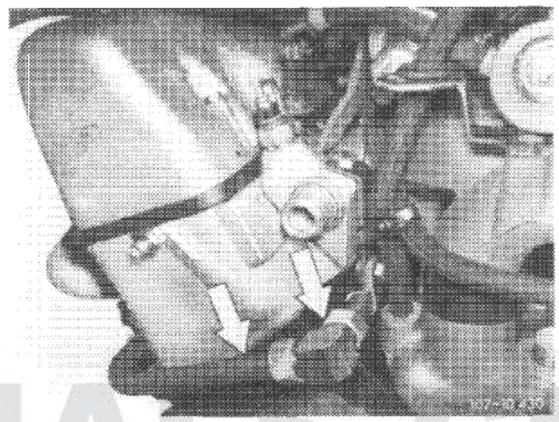
EGR valve

For better adaptation of EGR on engine, the EGR valve is provided with a double diaphragm.



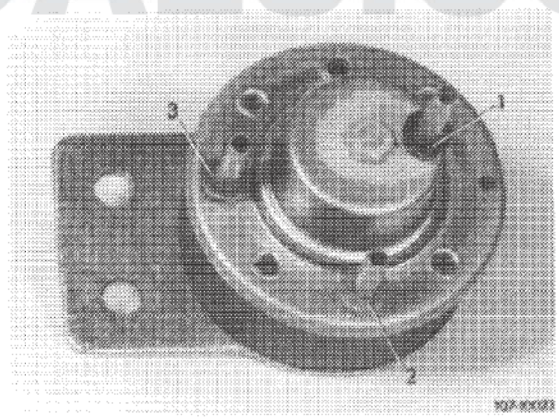
EGR line

The EGR line runs from EGR valve under exhaust manifold from the rear to intake pipe (arrows).



Vacuum switch

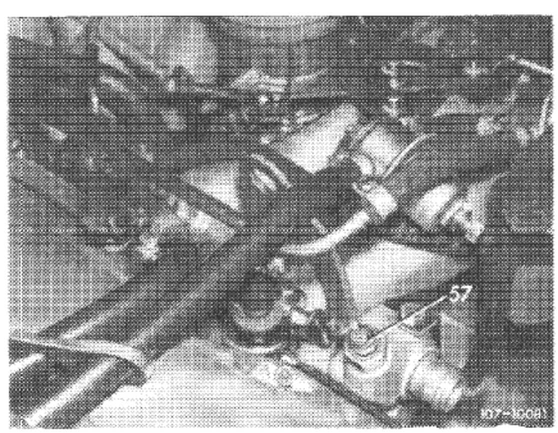
A vacuum switch is installed to control EGR.



1 Connection in center with white ring: throttle valve housing/purge valve
2 Connection with red ring: ignition advance/EGR valve 1st stage
3 Connection with brown ring: EGR valve 2nd stage

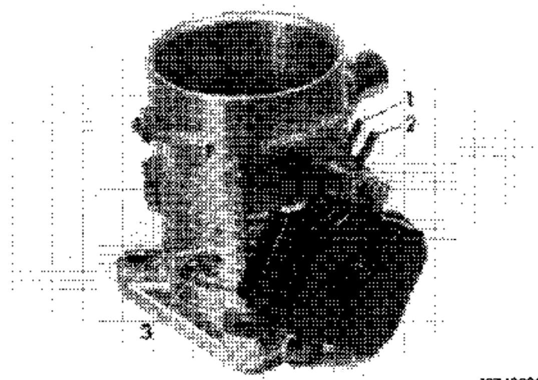
Temperature switch 40 °C (57)

A temperature switch 40 °C is installed for temperature-dependent control of large EGR volumes and ignition advance.



Throttle valve housing

The throttle valve housing is provided with three vacuum connections to control the individual units.



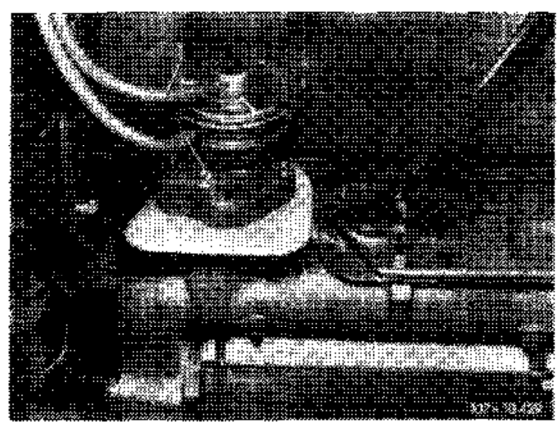
107-10027

1 Vacuum connection with red ring: EGR 1st stage/ ignition "advance"
2 Vacuum connection with black ring: vacuum switch/ purge valve
3 Vacuum connection ignition "retard"

EGR is activated:

- Above 40 °C coolant temperature.
- During acceleration.
- During partial load operation.
- During transition to deceleration (coasting).

Operation



Above 40 °C in the driving ranges named above, a part of the exhaust gases is returned from exhaust manifold to intake pipe.

EGR is effected in two stages, the volume (quantity) of the returned exhaust gases depends on position of throttle valve (vacuum tapped at throttle valve housing).

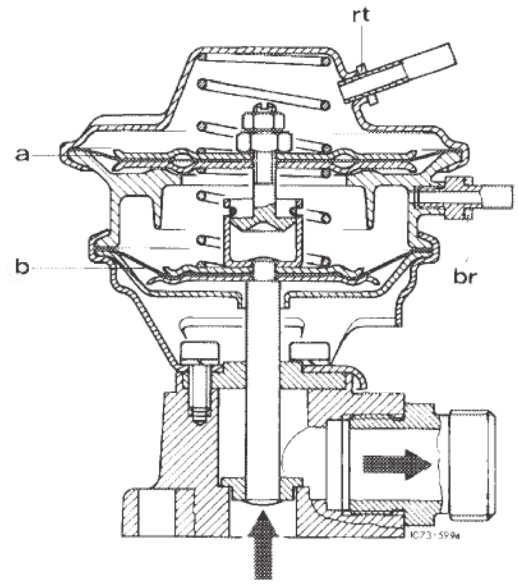
EGR 1st stage (small quantity)

The switchover valve (55) controlled via temperature switch 40 °C and relay (58) is de-energized. The connection from throttle valve housing to EGR valve is established.

At adequate vacuum, the EGR valve is slightly lifted and a small quantity of the exhaust gases is returned (recirculated) to intake pipe.

EGR 2nd stage (large quantity)

When the vehicle is accelerated, the vacuum on throttle valve housing drops and the 2nd stage of the EGR valve is activated with vacuum via vacuum switch (56). The EGR valve can fully open in dependence of the intake pipe vacuum.



Vacuum switch

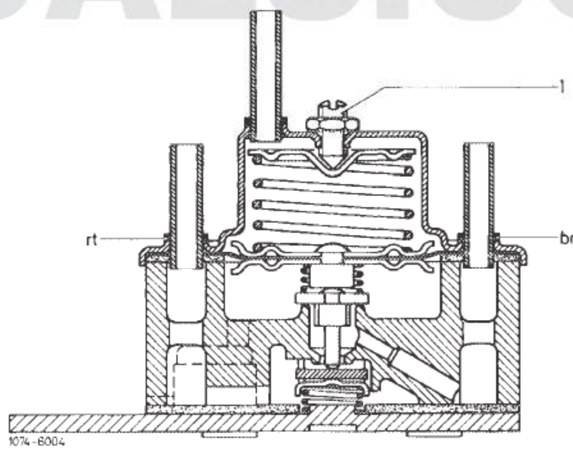
If the vacuum on center connection drops below the preset value, the spring will push the diaphragm downwards.

The upper plate valve (1) is closed, the lower valve is opened and connections red and brown are connected to each other.

If the vacuum on center connection exceeds the preset value, the diaphragm is pushed upwards by the atmospheric pressure against bottom face.

The lower plate valve is closed and the upper valve is opened. The red connection is sealed, the brown connection is positively vented.

Note: Positive venting is effected via bottom face of large diaphragm, from there via a filter from outside.

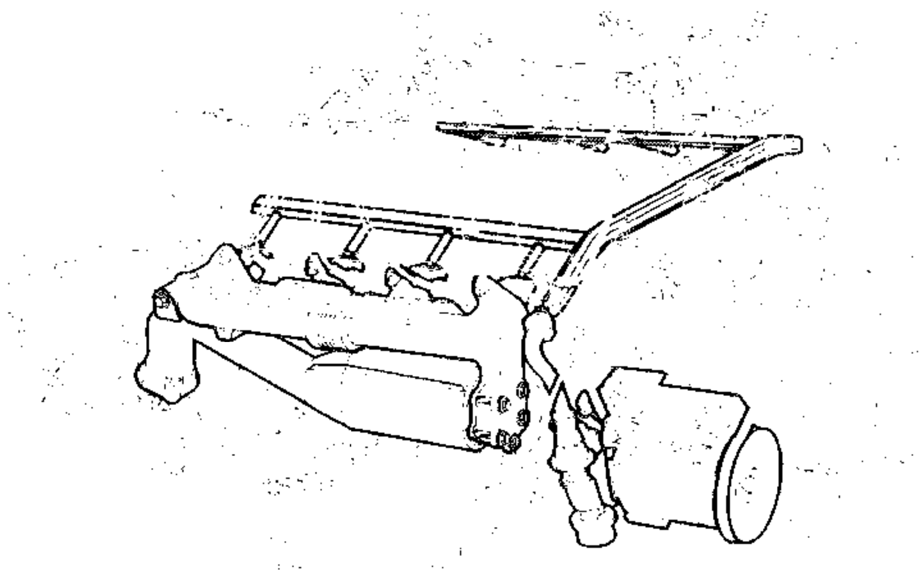


D. Air injection

To reduce the incompletely burnt components in exhaust gas, air is injected into hot zone behind exhaust valves.

To prevent backfiring in exhaust, the air injection is controlled via switchover valve (33) and diverter valve (41).

Function diagram



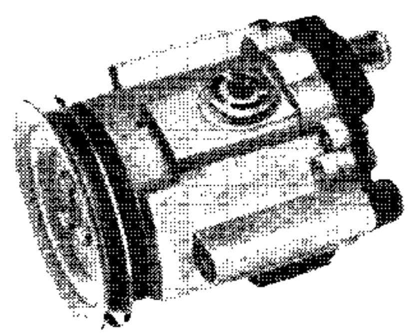
1072-5982

Components of air injection:

Air pump (Saginaw pump)

The air pump is an impeller pump with a maintenance-free centrifugal filter which cleans the drawn-in air.

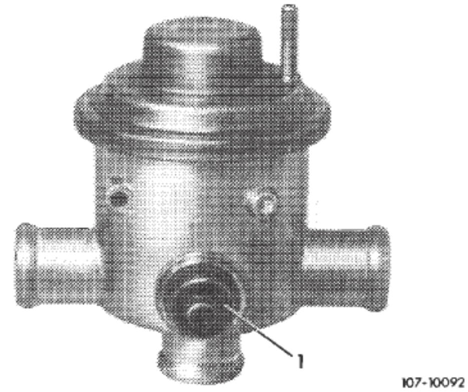
The pump housing is provided with a safety valve which discharges the delivered air at a given overpressure to protect the pump vanes against overloads.



107-8959

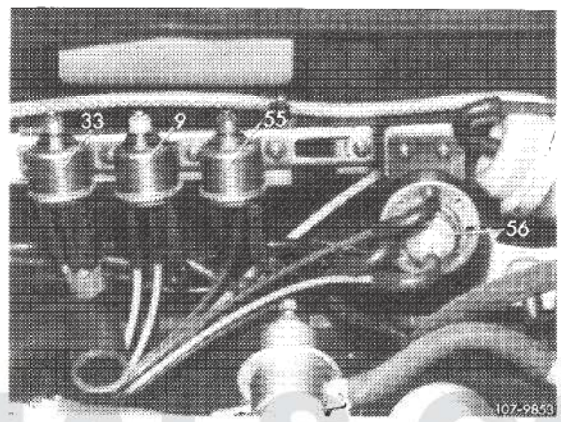
Diverter valve

The diverter valve serves the purpose of discharging the delivered air below 17 °C oil temperature by way of an air filter (silencer).



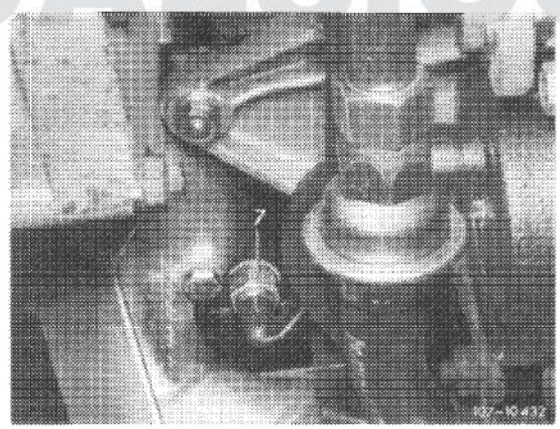
Switchover valve (33)

The switchover valve is located in engine compartment at front wall and controls the air injection and the air discharge.



Temperature switch 17 °C

A temperature switch 17 °C (7) is installed in oil circuit to control air injection and air discharge.



Check valve (42)

The check valve prevents the inflow of hot exhaust gases into air line.

Air is injected above 17 °C oil temperature.

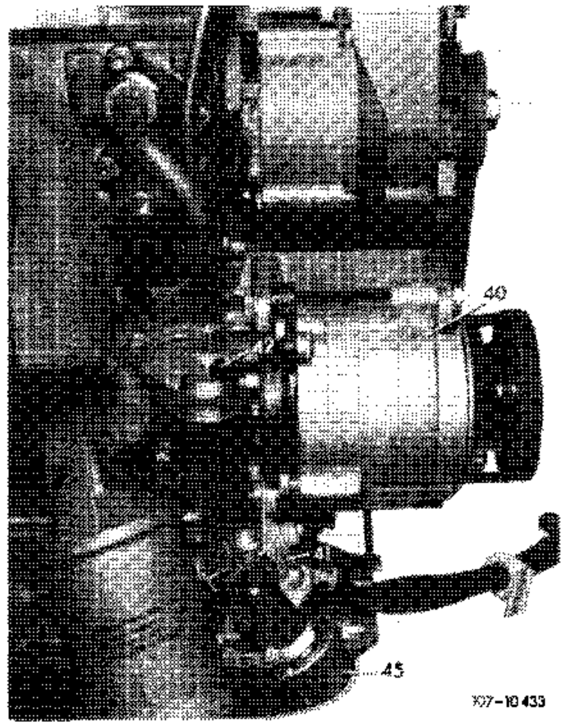
Operation

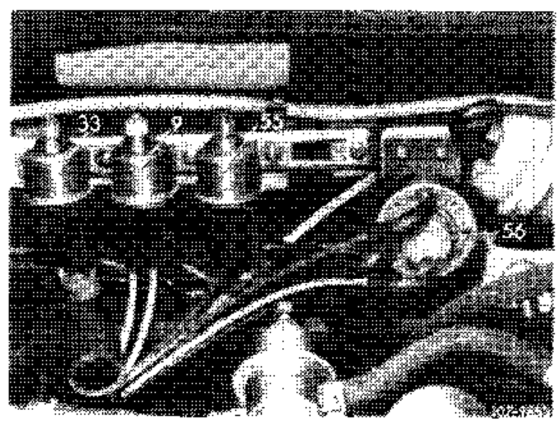
The oil temperature switch 17 °C (7) in engine block is open. The blue switchover valve (33) is de-energized. The intake pipe vacuum can act on diaphragm of diverter valve (41) via blue switchover valve (33).

The connection for air discharge is closed and the air delivered by the air pump (40) is discharged into exhaust ports of cylinder heads via check valve (42).

The oxygen in the air encounters the hot exhaust gases and reacts in catalyst. At coolant temperatures below approx. 17 °C the delivered air is discharged into the atmosphere via an air filter for silencing.

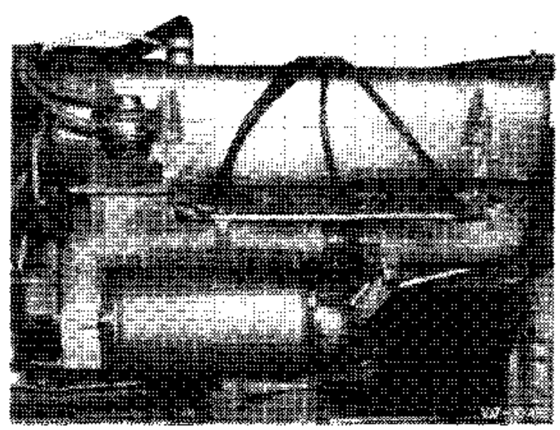
Air injection and air discharge is controlled via diverter valve (41).





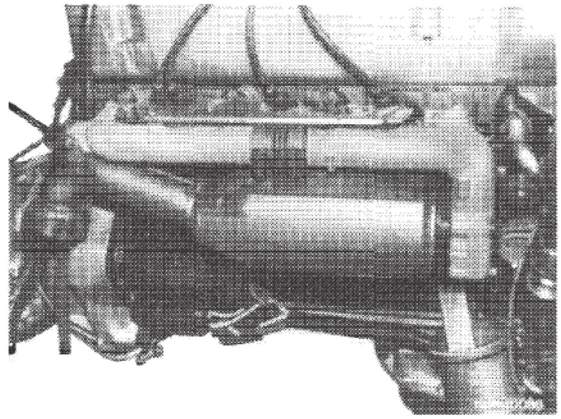
E. Catalyst

The exhaust gases at each engine side are routed through a catalyst.



Lefthand engine side

The catalyst comprises two elastically suspended monoliths inside a wire netting, a honeycomb-shaped cylindrical body made of a ceramic material. The noble metal evaporated on the monoliths, the actual catalyst, accelerates the oxidation of CO and hydrocarbons with the addition of fresh air at pertinent temperature.



Righthand engine side

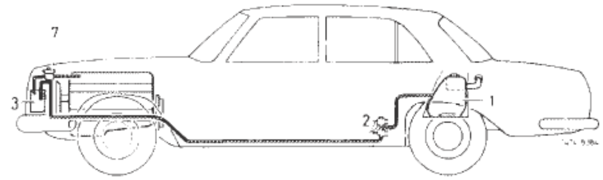
To maintain function of catalyst, the engine should be operated with lead-free fuel only. Since lead-free fuel is available outside the USA only in limited quantities, these vehicles (outside the USA) are operated with fuel containing lead. When these vehicles are imported into the USA, new catalysts are installed and the fuel system is flushed. To show that these jobs have been completed, the yellow exhaust gas information plate is exchanged for the black information plate valid in the USA.

F. Fuel evaporation control system

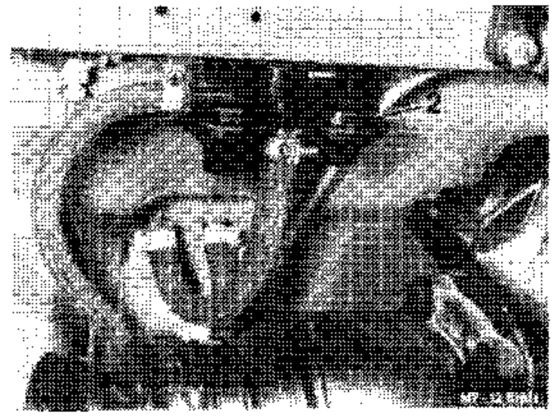
A fuel evaporation system has been installed to improve emission characteristics which have nothing to do with engine combustion.

Function diagram

1 Fuel tank with expansion tank
2 Valve system
3 Charcoal canister
7 Purge valve



Components of fuel evaporation control system:



Valve system

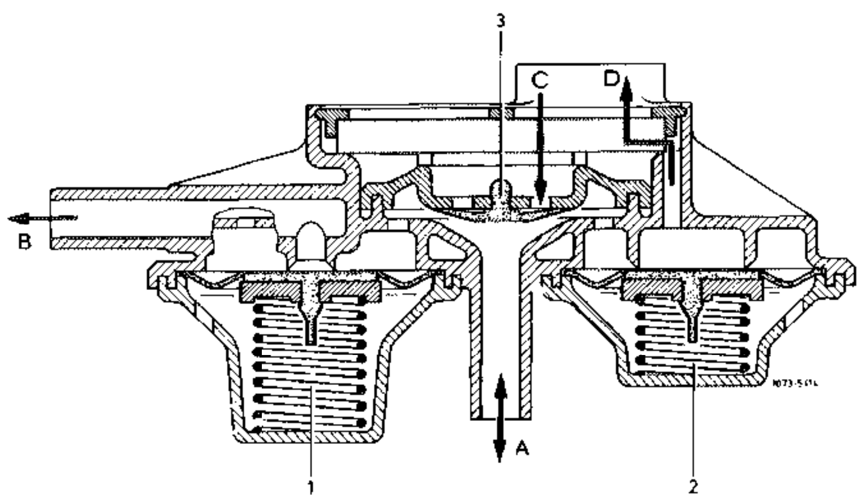
The valve system is mounted under vehicle at level of rear legroom. The system comprises three valves:

1. Negative vent valve
2. Pressure relief valve
3. Positive vent valve

The **negative vent valve** opens at a slight overpressure. The evaporation vapors will flow through negative vent valve (1) (direction B) into a line to charcoal canister.

The **pressure relief valve** is a safety valve and opens in the event of an overpressure in fuel evaporation system. The fuel vapors are vented directly into the open air.

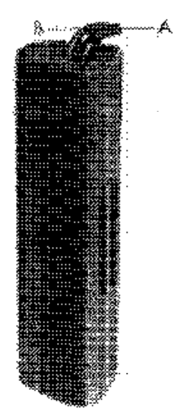
The **positive vent valve** opens in the event of a vacuum caused when the fuel tank is cooling down.



1 Negative vent valve
2 Pressure relief valve
3 Positive vent valve
A To valve/to expansion tank
B To charcoal canister
C Fresh air input
D Output pressure relief valve

Charcoal canister

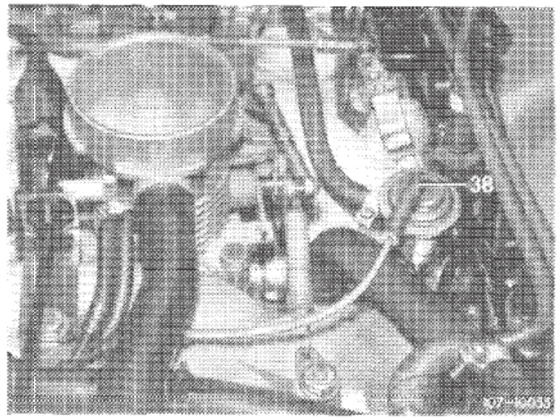
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn off again when driving.



A Connection tank vent
B Connection purge valve

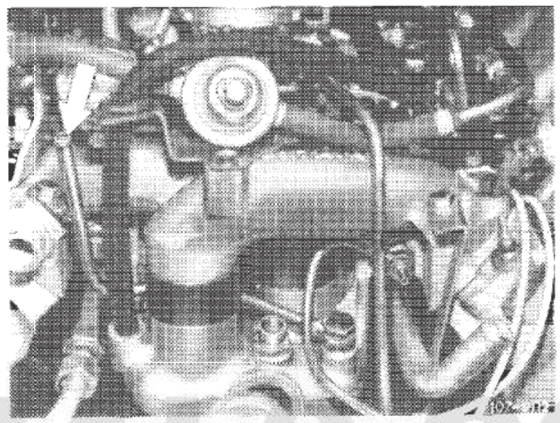
Purge valve

The purge valve (38) is controlled by the vacuum of the throttle valve. When the diaphragm is activated with a vacuum, the valve opens and the fuel evaporation vapors can be drawn from charcoal canister.



Intake pipe connection

The intake pipe is provided with a connection (arrow) to draw the fuel evaporation vapors from charcoal canister.



Operation

The fuel evaporation vapors from fuel tank are stored in charcoal canister when the engine is stopped, and they are drawn from charcoal canister when the engine is running in dependence of the intake pipe vacuum.

When the throttle valve is opened, the diaphragm of the purge valve is activated with a vacuum and the valve is opened.

The intake pipe vacuum draws the stored vapors from charcoal canister.

14–100 Test program

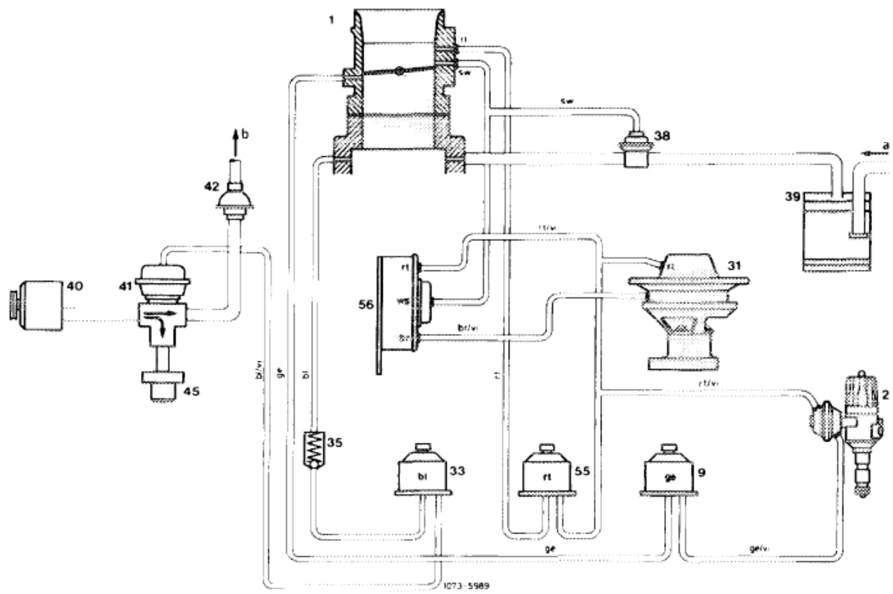
Federal and California version model year 1975

For complaints such as: Poor warming-up characteristics of engine, poor idle speed, engine not accelerating or splashing during acceleration, check emission control system for function.

Test conditions: All fuses in order, engine at operating temperature, run engine at idle speed.

Test the following: Ignition switchover, EGR, air injection and fuel evaporation control system.

Function diagram

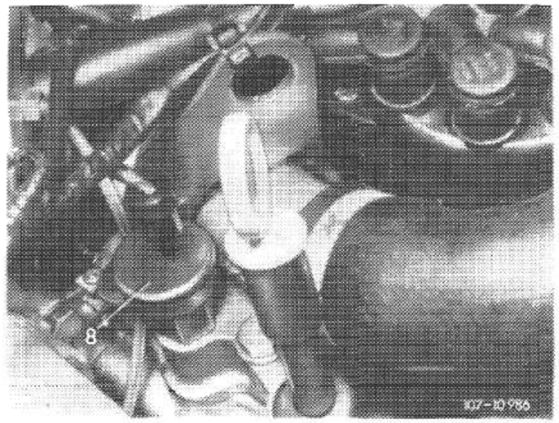


1	Throttle valve housing	41	Diverter valve	bl	= blue
2	Ignition distributor	42	Check valve air injection	br	= brown
9	Switchover valve ignition retard	45	Air filter for silencing	ge	= yellow
31	EGR valve	55	Switchover valve EGR/ignition advance	rt	= red
33	Switchover valve air injection	56	Vacuum switch	sw	= black
35	Check valve			vi	= purple
38	Purge valve			ws	= white
39	Charcoal canister	a	Connection tank vent		
40	Air pump	b	Air injection line to cylinder head		

Testing ignition switchover

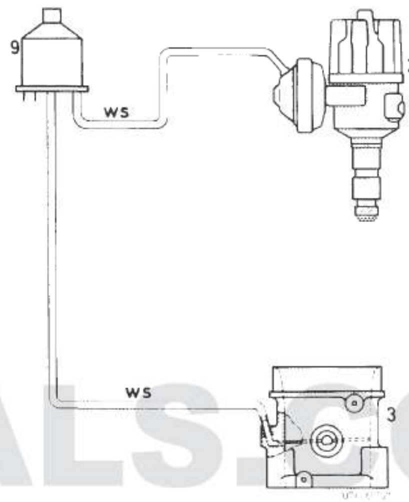
Pull plug from temperature switch 100 °C (8) and connect to ground.

Engine speed increasing.	Engine speed not increasing.



Testing vacuum lines

The vacuum line from throttle valve housing (3) leads to center connection of switchover valve (9), that of vacuum control unit of ignition distributor (2) to outer connection of switchover valve (9).



Testing vacuum

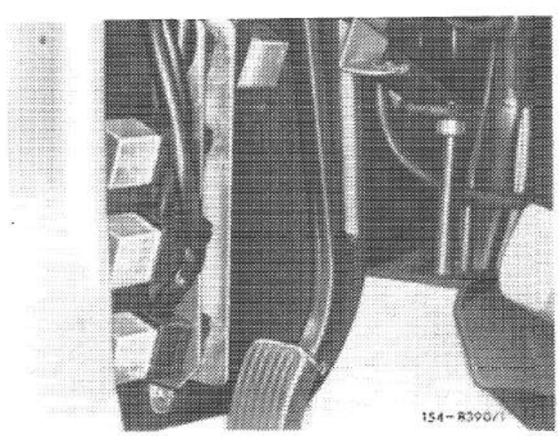
Pull vacuum line from center connection of switchover valve (9) and keep closed with finger. If vacuum is evident, plug vacuum line in again. If no vacuum is evident, blow out vacuum draw-off connection on throttle valve housing with compressed air.

Testing relay (code number 5) for switchover valve

Connect test lamp to connecting plug of switchover valve (9) and plug of temperature switch (8) to ground. Relay is in order if test lamp lights up.

Replace switchover valve (9).

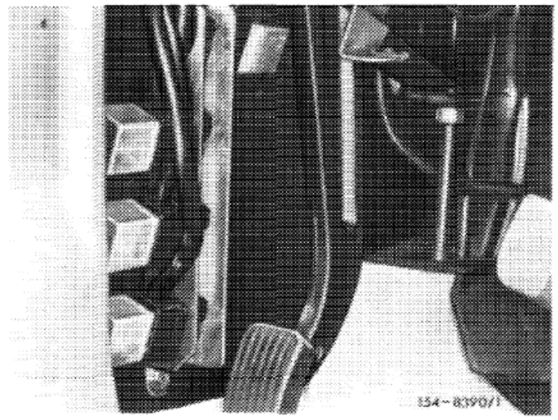
If test lamp is not lighting up, replace relay.



Testing ignition switchover

Switch on air conditioning system.

Engine speed increasing.	Engine speed not increasing.

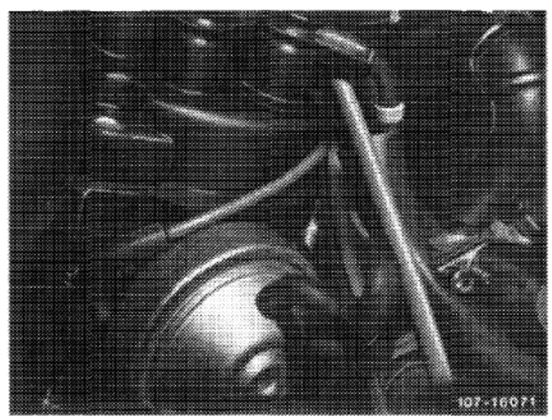


Replace relay (code number 5) if clutch of refrigerant compressor is attracted.

Testing ignition switchover

Pull both vacuum lines from ignition distributor (cancellation of ignition retard).

Engine speed slightly increasing.	Engine speed not increasing.

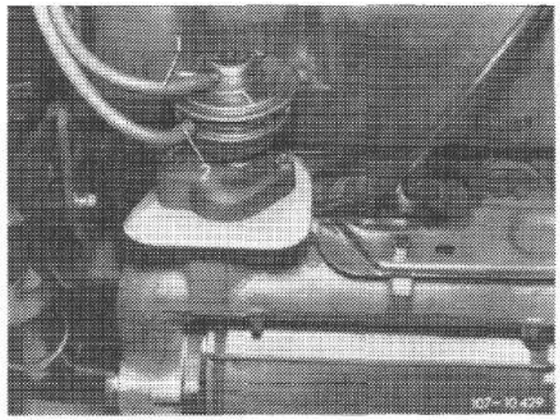


Replace double vacuum unit on ignition distributor.

Testing EGR

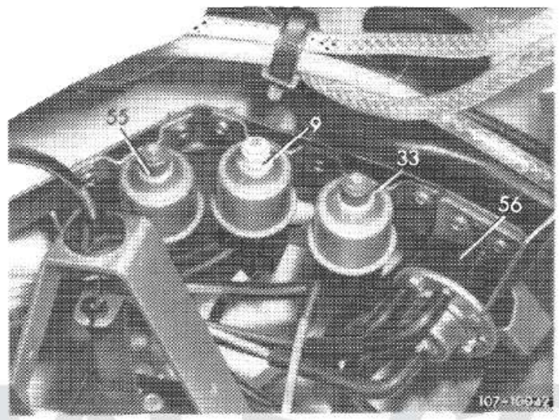
Pull red/purple vacuum line from EGR valve. Connect vacuum gauge to red/purple line and to red connection of EGR valve. Increase engine speed to approx. 2500/min.

No vacuum at idle, increasing vacuum with increasing speed.	Vacuum not increasing with increasing speed.



Testing vacuum lines

The red vacuum line of red connection on throttle valve housing should be connected to center connection of switchover valve (55), the red/purple line to outer connection of switchover valve (55), to red connection of vacuum switch and to red connection of EGR valve.

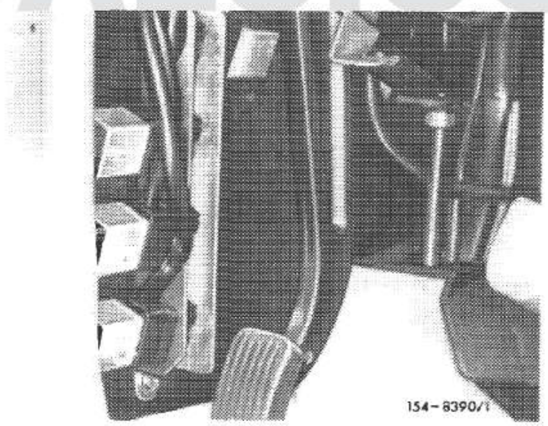


Testing red switchover valve (55)

Stop engine. Switch on ignition. Pull plug from temperature switch 40 °C. Switchover valve should switch audibly or noticeably on valve.

If valve is not switching, repeat test with a new valve.

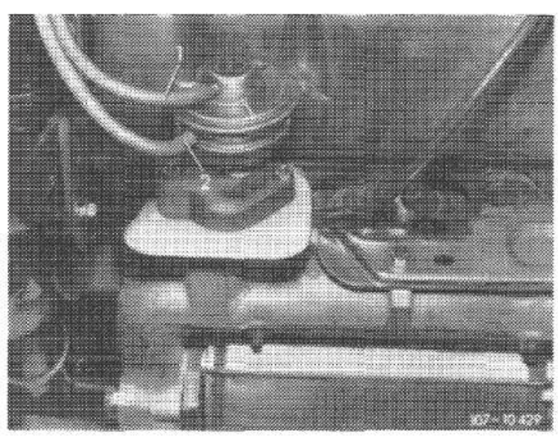
If valve is not switching, replace relay (58) code number 19.



Testing EGR

Pull brown/purple vacuum line from EGR valve. Plug vacuum gauge to brown/purple line and to EGR valve bottom connection. Increase engine speed to approx. 2500/min.

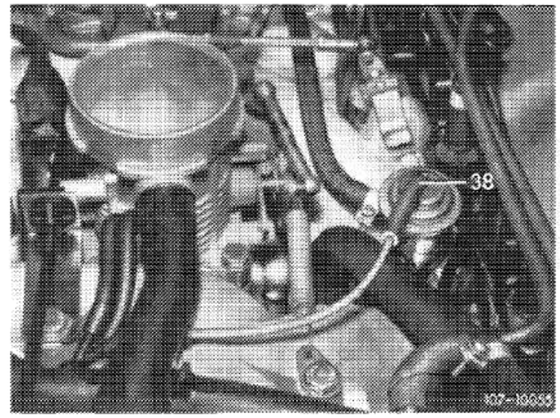
No vacuum at idle, increasing vacuum with increasing speed.	Vacuum not increasing with increasing speed.

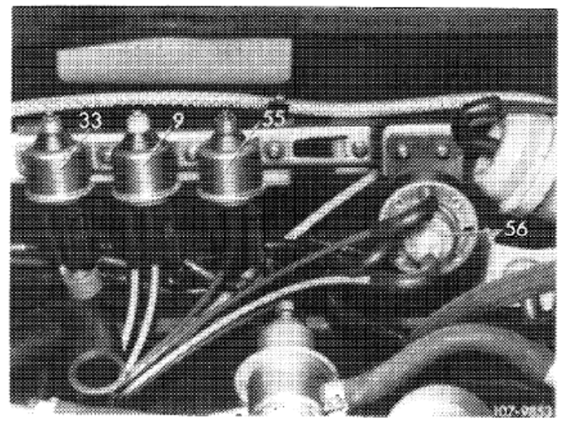


Testing vacuum lines

The black vacuum line from black connection of throttle valve housing should be connected to purge via distributor, and that of distributor with a white vacuum line to white connection of vacuum switch. The brown/purple vacuum line should be connected to brown connection of vacuum switch and to bottom connection of EGR valve.

If no vacuum is measured in spite of correct connection of vacuum line, replace vacuum switch (56).



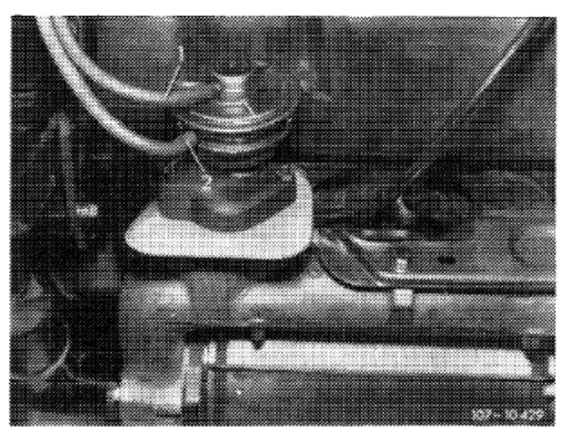


Testing EGR

Pull yellow/purple vacuum line from ignition distributor. Pull both vacuum lines from EGR valve. Connect yellow/purple vacuum line with upper or lower connection of EGR valve by means of test line.

Engine runs irregularly in both stages or comes to a stop.	Operation of engine not changing.

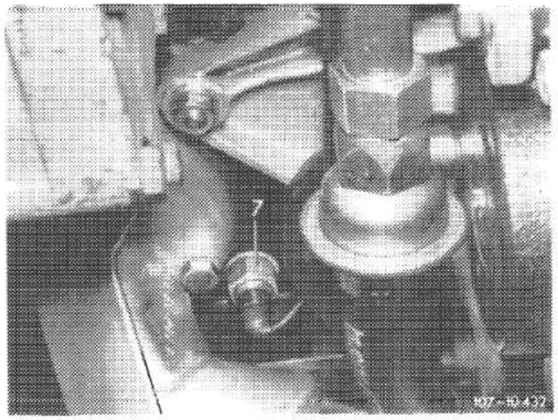
Replace EGR valve.



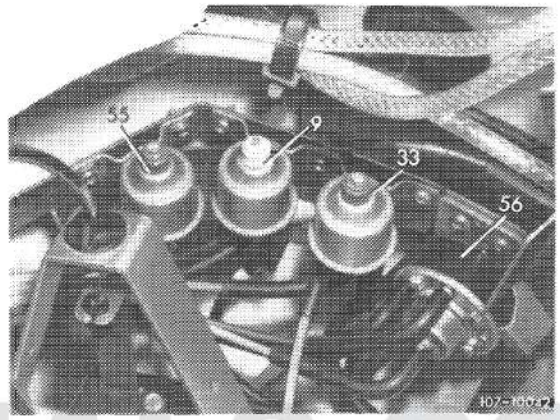
Testing EGR

Connect CO measuring instrument and read emission value. Loosen plug connection of temperature switch 17 °C (7) and connect to ground by means of test cable. Measure emission value (air injection switched off).

CO value noticeably changing.	CO value not changing.

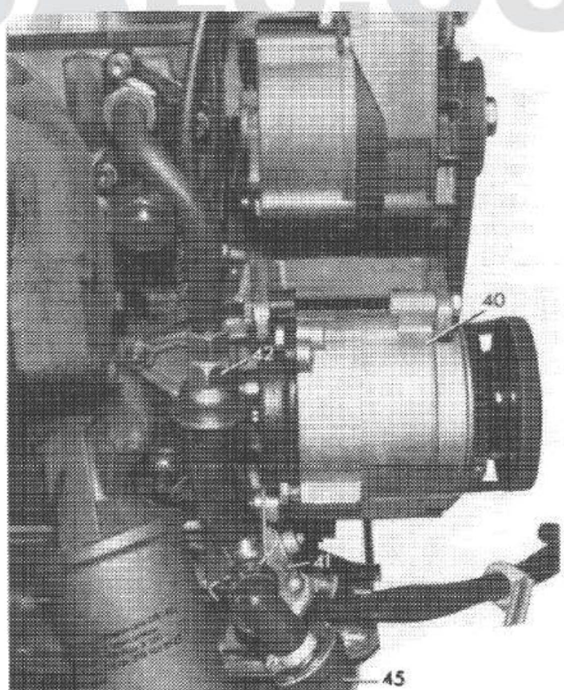


Place hand on blue switchover valve (33). Loosen plug connection of temperature switch 17 °C and connect to ground. Switchover valve should now switch. If valve is not switching, replace switchover valve (33).



Unscrew damper filter (45) on diverter valve (41). Loosen plug connection of temperature switch 17 °C and connect to ground by means of test cable. Air should come out at diverter valve.

If no air comes out, replace diverter valve and repeat test. If required, test air pump or V-velt tension.



107-10433

Testing fuel evaporation control system

Pull draw-off hose on connection "B" of charcoal canister and keep hose opening closed with finger. Slowly increase engine speed to above approx. 2000/min.

Low vacuum at idle, increasing vacuum with increasing speed.	No vacuum at idle, no vacuum increase at increasing speed.

Testing draw-off line to intake pipe

For this purpose, loosen hose to charcoal canister on purge valve (38) and blow out valve in direction of intake pipe with compressed air. Replace purge valve (38), if required.

If vacuum is not increasing at higher speed:

Test vacuum at purge valve

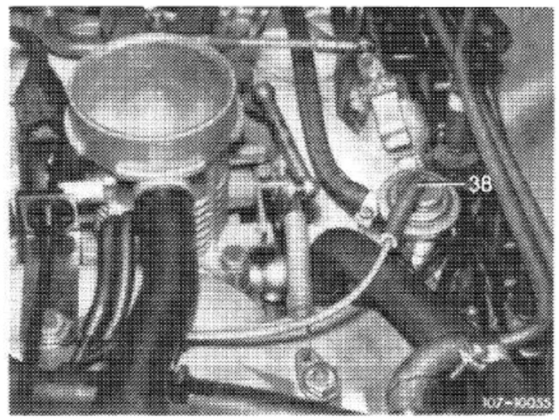
Pull white vacuum line from purge valve (38). Connect vacuum gauge or keep hose opening closed with finger. Slowly increase engine speed. No vacuum should be available at idle. Increasing speed should result in increasing vacuum.

If vacuum is avalilable, replace purge valve (38).

If no vacuum is available, blow out vacuum tapping bore in throttle valve housing with compressed air. Clean throttle valve housing, if required.

End of test.

107–9128



Model year 1975

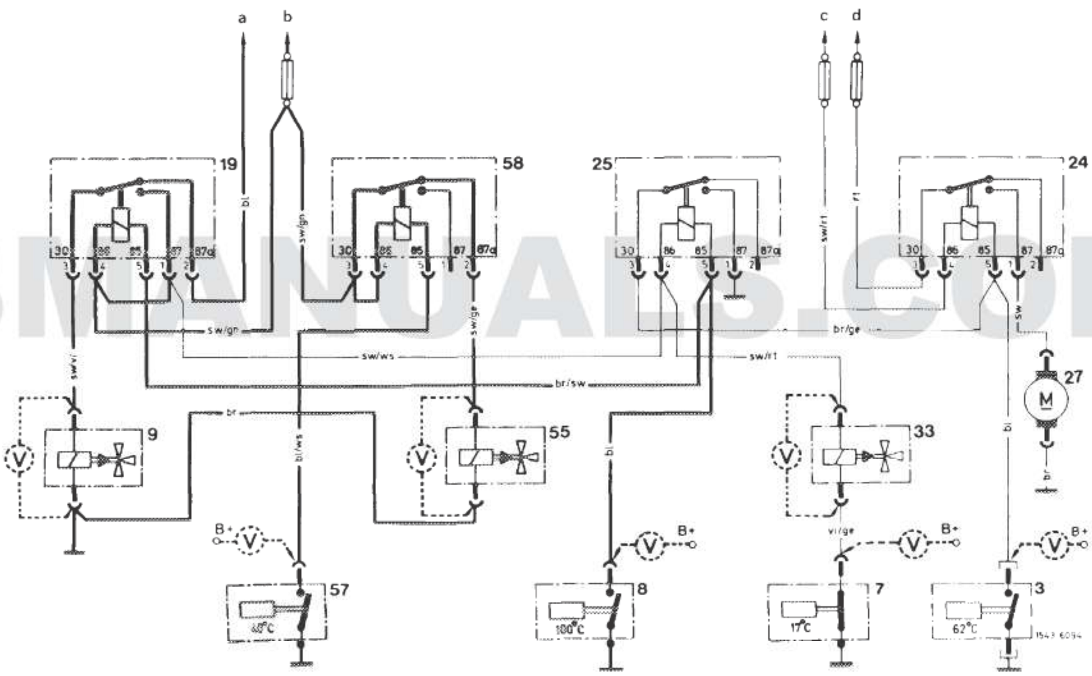
Drawn with ignition switched off and below 17 °C oil temperature.

Connection of test instruments is drawn in dashed lines.

Color code

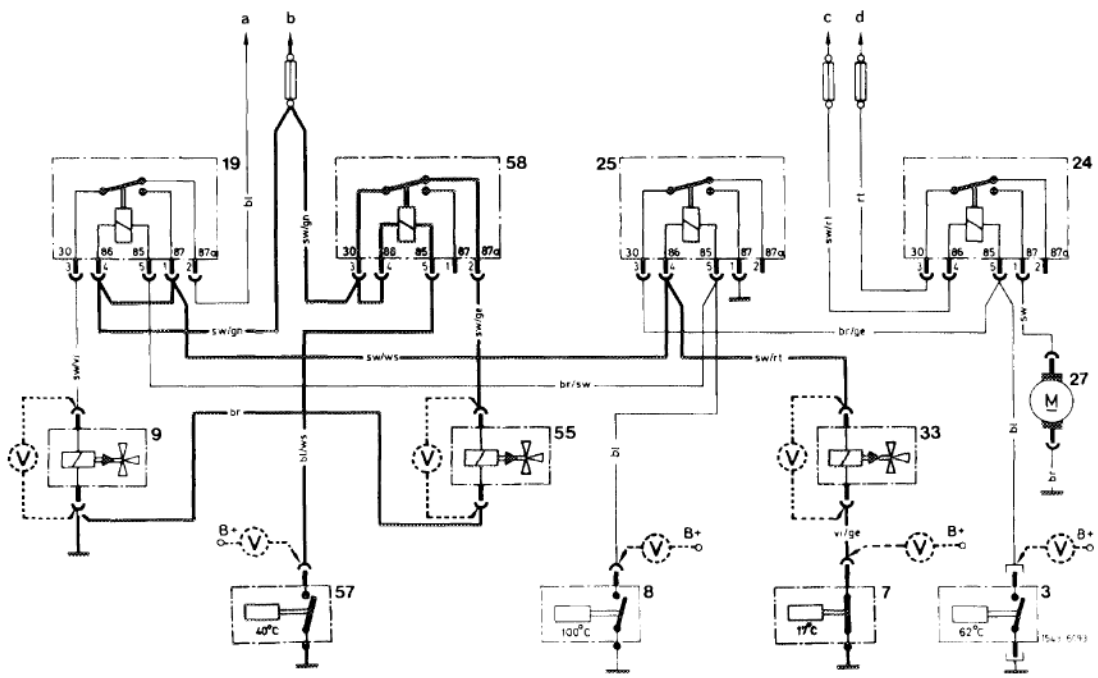
bl = blue	gn = green	vi = purple	a Switch air conditioning system/starter
br = brown	rt = red	ws = white	b Fuse no. 4 (15/54)
ge = yellow	sw = black		c Fuse no. 10 (15/54)
			d Fuse no. 2 (30)

Ignition switchover model 116.032/033



3 Temperature switch 62 °C
7 Temperature switch 17 °C
8 Temperature switch 100 °C
9 Switchover valve ignition (yellow)
19 Relay switchover valve ignition
24 Relay supplementary fan
25 Relay for disconnecting temperature switch 62 °C from temperature switch 100 °C
27 Supplementary fan
33 Switchover valve air injection (blue)
55 Switchover valve ignition advance/EGR (red)
57 Temperature switch 40 °C
58 Relay EGR

EGR, air injection model 116.032/033



3 Temperature switch 62 °C
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24 Relay supplementary fan
25 Relay for disconnecting temperature switch 62 °C from temperature switch 100 °C
27 Supplementary fan
33 Switchover valve air injection (blue)
55 Switchover valve ignition advance/EGR (red)
57 Temperature switch 40 °C
58 Relay EGR

Drawn with ignition switched off and below 17 °C oil temperature.

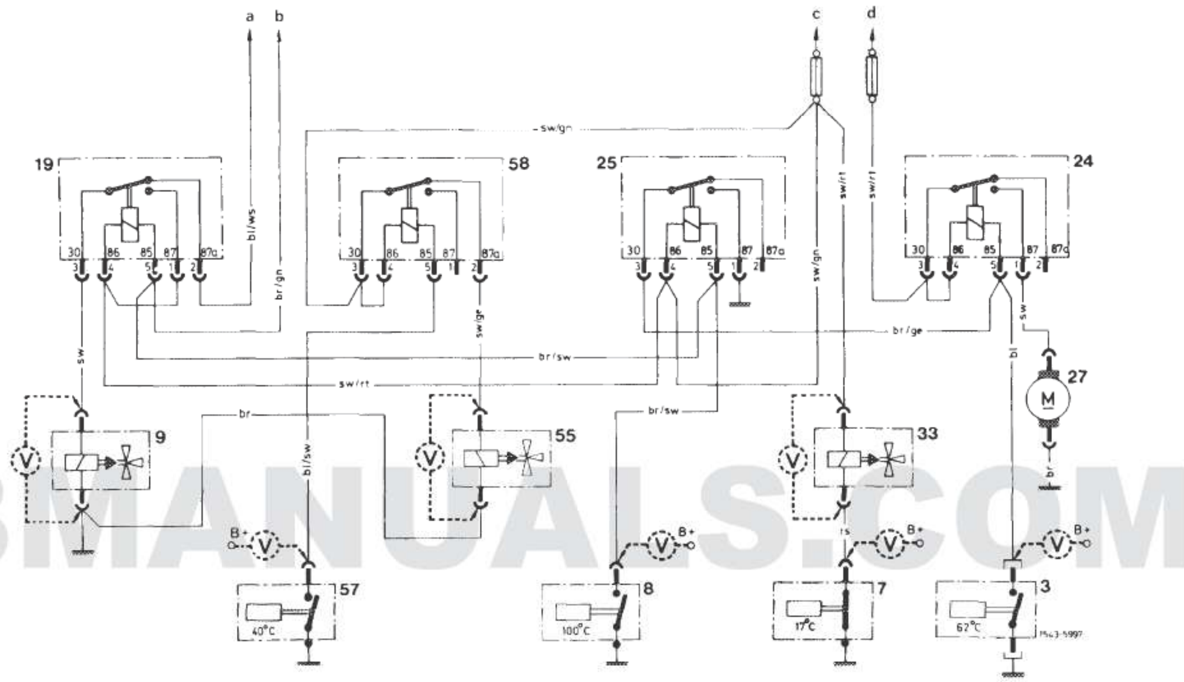
Connection of test instruments is drawn in dashed lines.

Color code

bl = blue
br = brown
ge = yellow
gn = green
rs = pink
rt = red
sw = black
ws = white

a Temperature regulator air conditioning system
b Coupling electronic harness
c Fuse no. 12 (15/54)
d Fuse no. 8 (15/54)

Type 107.024/044



3 Temperature switch 62 °C
7 Temperature switch 17 °C
8 Temperature switch 100 °C
9 Switchover valve ignition (yellow)
19 Relay switchover valve ignition
24 Relay supplementary fan
25 Relay for disconnecting temperature switch 62 °C from temperature switch 100 °C
27 Supplementary fan
33 Switchover valve air injection (blue)
55 Switchover valve ignition advance/EGR (red)
57 Temperature switch 40 °C
58 Relay EGR

14–200 Removal and installation of catalyst

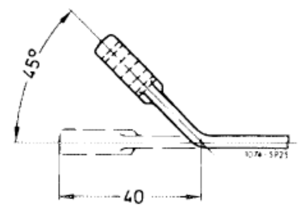
Special tools

Saltus ratchet 13 mm		000 589 31 16 00

Conventional tool

Starter wrench 10 x 12 mm	e.g. made by Stahlwille

Self-made tool

Box wrench 12 x 13 mm, offset	

Removal

1 Unscrew exhaust system from below on catalyst flange. Use offset box wrench.

2 Completely take down exhaust system.

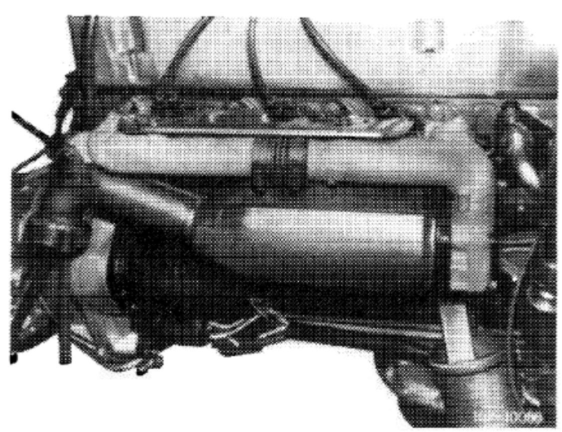
Remove catalyst at the right

3 On model 116, remove battery and battery box.

On model 107, remove water tank of windshield washer, unscrew coolant expansion tank and take from holder. Put down tank as far as possible to the front.

4 Pull off spark plug connector and unscrew shielding plate.

5 Unscrew catalyst holder.



6 Unscrew fastening screws on flange of catalyst by means of Saltus ratchet.

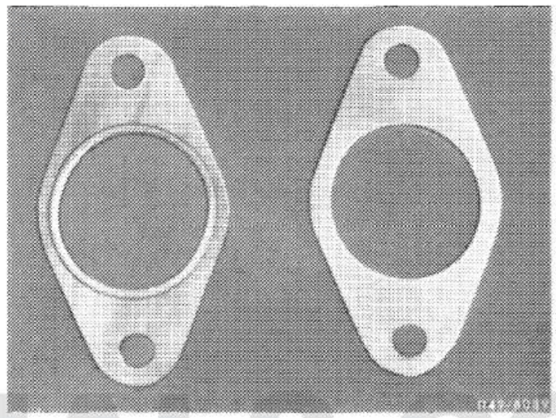
7 Unscrew upper screws on exhaust manifold.

8 Loosen nuts below on exhaust manifold with starter wrench; completely unscrew the three front nuts.

Note: The fastening bores of exhaust manifold are slotted at bottom, for this reason the lower nuts (except the three at the front) need not be completely unscrewed for removal of exhaust manifold.

9 Pull out exhaust manifold in upward direction, disassemble exhaust manifold at bellows, if required.

10 Remove catalyst.



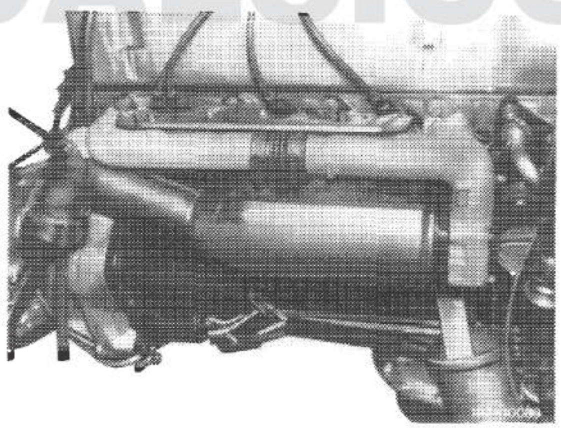
Install catalyst at the right

11 Insert new catalyst.

12 Renew exhaust manifold gaskets.
Install flange gaskets with smooth surface facing exhaust manifold.

13 Insert exhaust manifold.

Attention!
Insert **center inside screw** for attaching catalyst to exhaust manifold together with a washer **prior to inserting manifold.** Installation lateron is not possible.



14 Position screws with washers at the top, new nuts with washers at the bottom. Tighten exhaust manifold.

15 Position catalyst with new gasket and new screws. Position catalyst holder. Tighten all screws.

16 Mount spark plug connector; install shielding plates. On model 116, install battery box and battery. On model 107, install coolant expansion tank and water tank of windshield washer.

Removing catalyst at the left

17 Pull off spark plug connector and unscrew shielding plate.

18 Remove EGR valve.

19 Unscrew catalyst holder.

20 Unscrew fastening screws on flange of catalyst by means of Saltus ratchet. Put catalyst aside in downward direction. On model 107, remove engine shock absorber, if required.

21 Unscrew upper screws on exhaust manifold.

22 Loosen nuts at bottom of exhaust manifold with starter wrench, completely unscrew the three front nuts.

23 Loosen bellows and remove front exhaust manifold.

24 Remove catalyst.

Installing catalyst at the left

25 Insert new catalyst.

26 Renew exhaust manifold gaskets.
Install flange gaskets with smooth surface facing exhaust manifold.

27 Install exhaust manifold. Position screws with washers at the top, new nuts with washers at the bottom and tighten. Mount bellows.

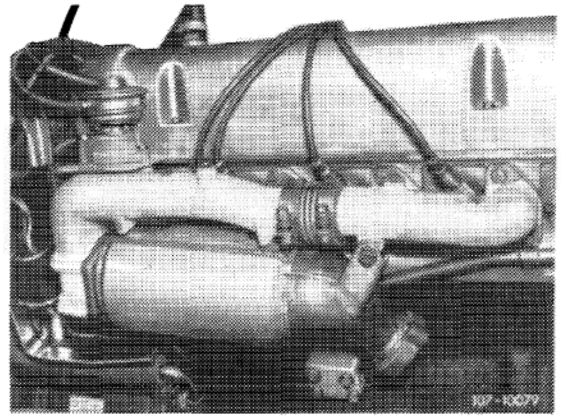
28 Position catalyst with new gasket and new screws. Position catalyst holder. Tighten all screws.

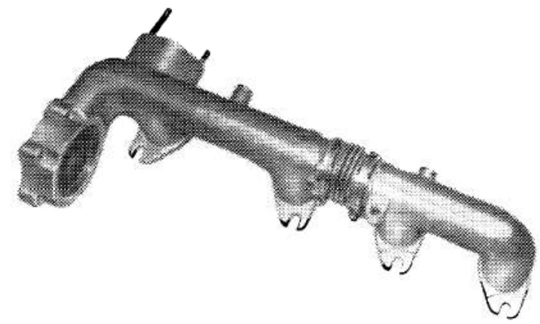
29 Install EGR valve with new gasket. Connect line with colors red/purple at top and brown/purple at bottom on valve.

30 Mount shielding plates and spark plug connectors.

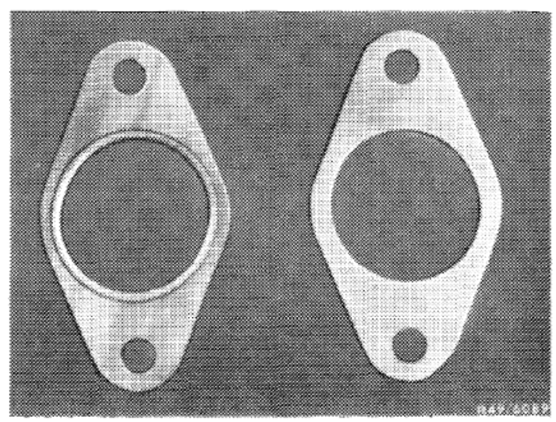
31 Install exhaust system.

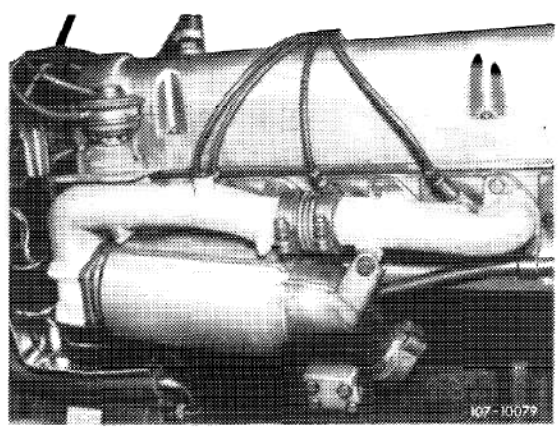
32 Check for leaks.





107-10009





14–250 Removal and installation of air pump

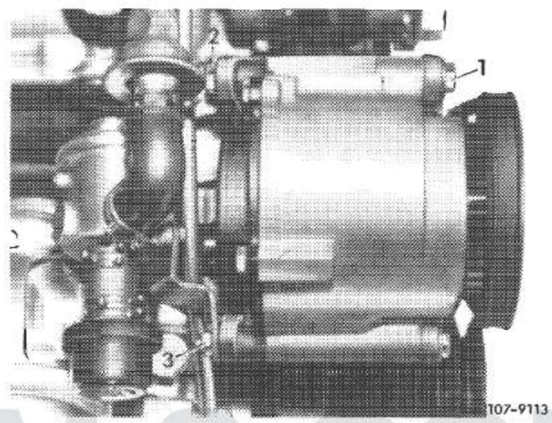
Federal and California version model year 1975

Removal

1 Compress hose clip on contoured hose of air pump with combination pliers and push approx. 2 cm to the rear.

2 Loosen clamping screws (1 and 2) as well as fastening screw (3) and unscrew.

3 Remove V-belt and contoured hose, remove air pump.



Installation

4 For installation proceed vice versa.

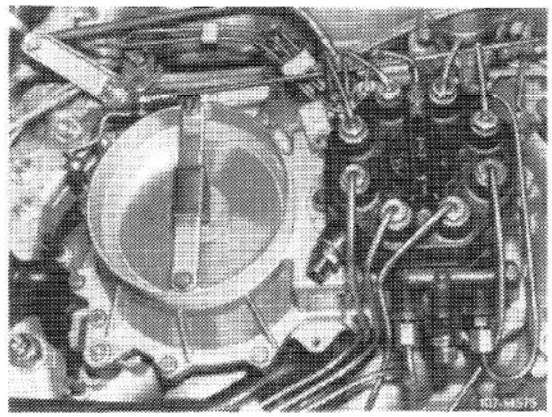
Note: The V-belt is correctly tensioned if it can be resiliently pushed down by energetic thumb pressure.

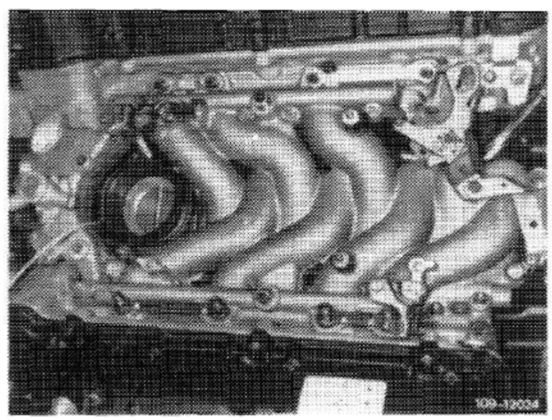
09–450 Removal and installation of intake manifold upper and lower half, renewing gaskets

Note

During removal and installation of intake manifold the mixture regulator with air guide housing need not be removed.

Removal





1 Disconnect battery.

2 Partially drain coolant.

3 Unscrew injection lines and fuel lines. Catch fuel with a cloth.

Deactivate fuel lines.

4 Pull off supplementary air lines.

5 Remove control pressure rod for automatic transmission.

6 Unscrew bearing bracket for gate regulation.

7 Unscrew bearing bracket for longitudinal regulating shaft.

8 Pull off all connecting cables and plug connections.

9 Unscrew vacuum line for automatic transmission and for brake unit.

10 Unscrew idle speed air distributor.

11 Loosen coolant hoses and pull off.

12 Unscrew all fastening screws and remove intake pipe toward the rear.

13 Clean intake manifold and check flange surfaces with straightedge or touch up on surface plate.

Installation

14 Mount intake manifold with new gaskets in vice versa sequence.

Use only graphited intake manifold gaskets.
Do not install non-graphited intake manifold gaskets similar to engine 117.96 (5.0).

15 Adjust regulating linkage (30–300).

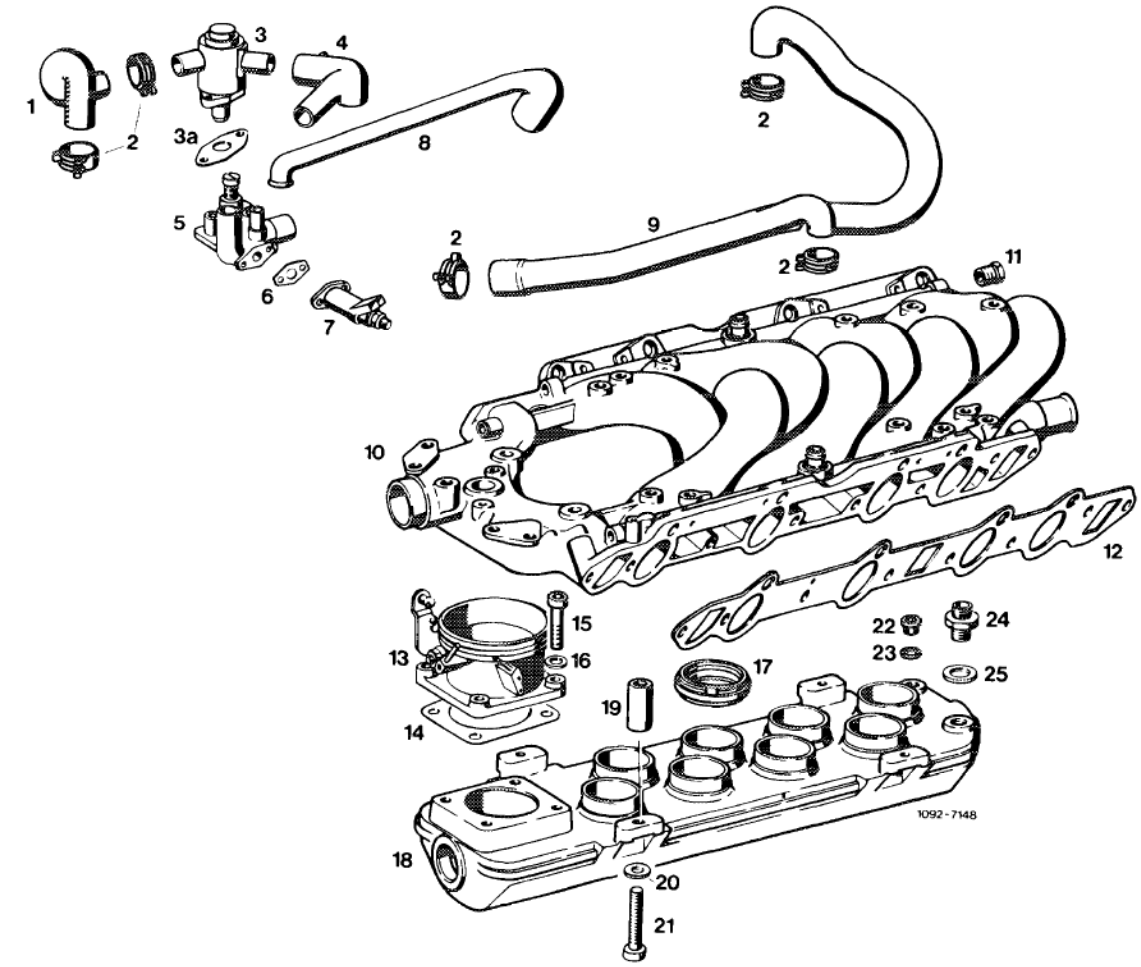
16 Connect battery.

17 Add coolant.

18 Keep engine running, check fuel lines for leaks. Check intake system, fuel distributor and injection valves by spraying with Iso-Oktan or benzine for leaks.

19 Adjust idle speed (07.3–100).

Intake manifold



1 Contoured hose
2 Coiled hose clips
3 Supplementary air valve
3a Gasket
4 Contoured hose
5 Idle speed air distributor
6 Gasket
7 Cold-starting valve
8 Contoured hose
9 Supplementary air line
10 Intake manifold upper half
11 Closing plug
12 Gasket
13 Throttle valve housing
14 Gasket
15 Hex. socket screw
16 Washer
17 Rubber connection
18 Intake manifold lower half
19 Spacing sleeve
20 Washer
21 Hex. socket screw
22 Closing plug
23 Sealing ring
24 Double thread connection
25 Sealing ring

14–455 Renewing intake manifold (intake manifold removed)

1 Remove and install intake manifold (14–450).

2 Remove and install injection valves and insulating sleeves (07.3–215).

3 Remove and install mixture regulator with air guide housing (07.3–225).

4 Unscrew all unscrewable parts on removed intake manifold and mount on new intake manifold with new gaskets.

5 Unscrew intake manifold upper half from intake manifold lower half. For this purpose, loosen vacuum line for brake unit on intake manifold lower half, then unscrew fastening screws and pull from rubber adaptors.

6 Mount intake manifold lower half with new rubber adaptors to intake manifold upper half.

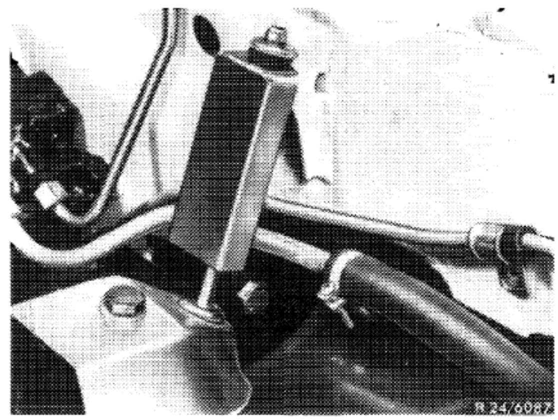
Attention!
The intake manifold lower half has a different shape as that of engine 117.960 (5.0) and can therefore not be installed in this engine.

49–470 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm
Bolt for engine mount	75

Removal



1 Remove exhaust system (49–100).

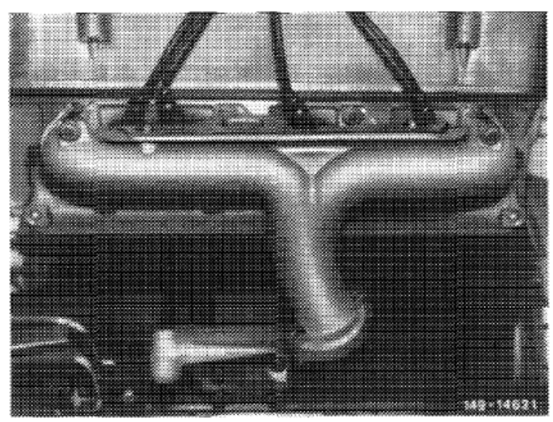
Note: Survey exhaust manifold (14–472).

2 Pull off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with fastener and shielding plates. For this purpose, unscrew bolt for engine mount.

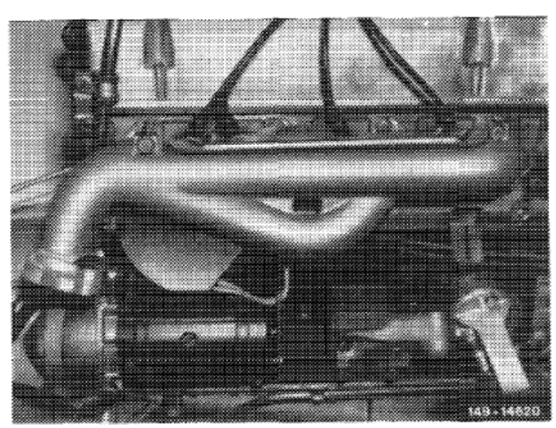
Exhaust manifold left



5 Remove air cleaner.

6 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Exhaust manifold right



7 Remove windshield washer tank.

8 Unscrew coolant supply tank. Unscrew fastening clamp for coolant hose, loosen cable band for electric line and put supply tank aside.

9 Remove battery, battery holder and shielding plate.

10 Unscrew exhaust nuts and bolts and remove exhaust manifold.

Installation

11 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

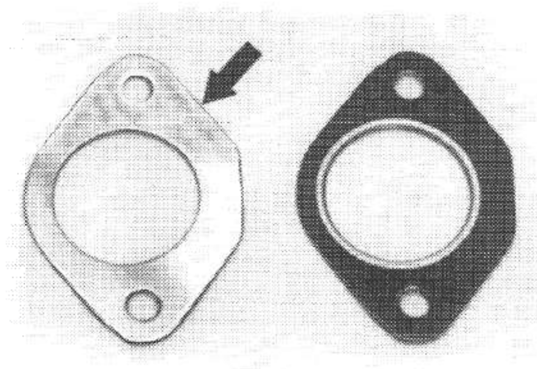
12 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

13 Tighten bolts for engine mount to 75 Nm.

14 Mount exhaust system.

15 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

16 Keep engine running and check exhaust system lor leaks.



107–12067

B. Model 116

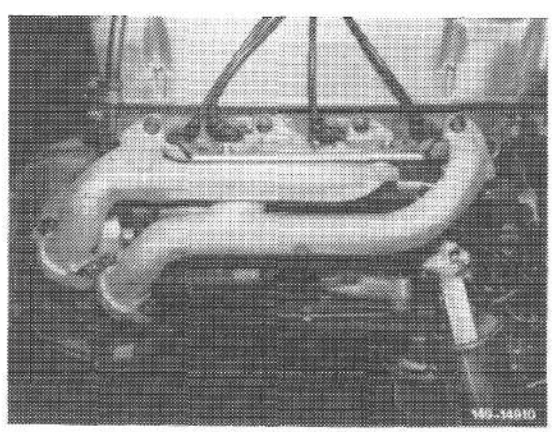
Note

Starting with the following chassis end no. a two-fluted **righthand** exhaust manifold is installed.

Start of production: December 1977

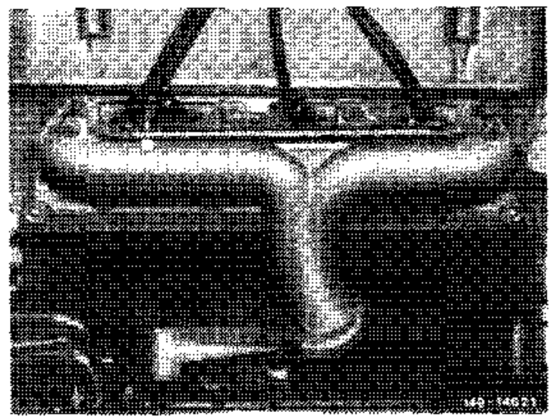
Model	starting chassis end no.
116.028/029	044654
116.032/033	076606

On previously manufactured vehicles the former exhaust manifold remains installed.

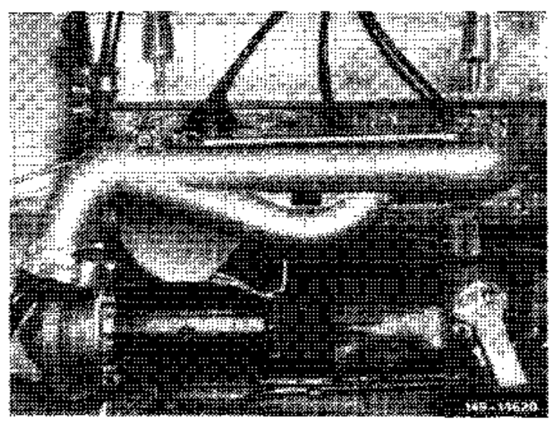


A. Standard version

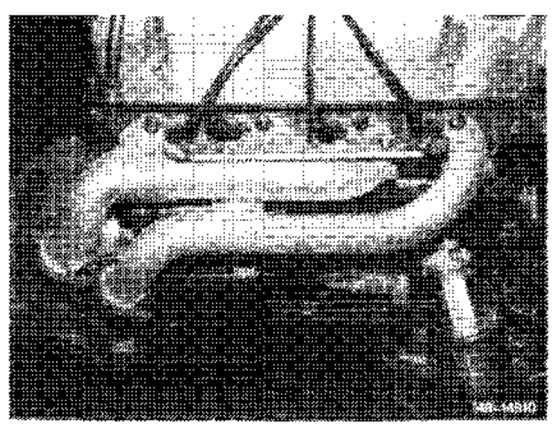
Lefthand steering



Exhaust manifold left

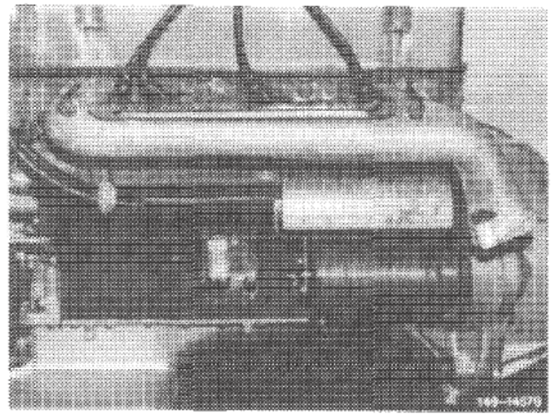


Exhaust manifold right

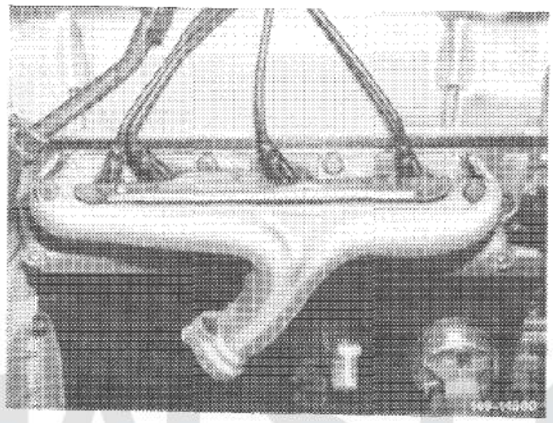


Exhaust manifold right
two-fluted model 116

Righthand steering



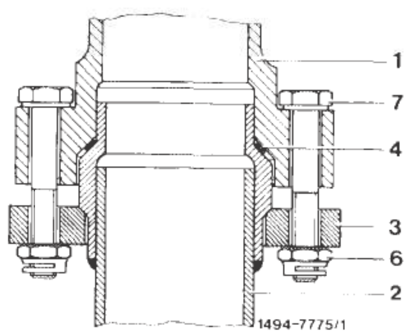
Exhaust manifold left



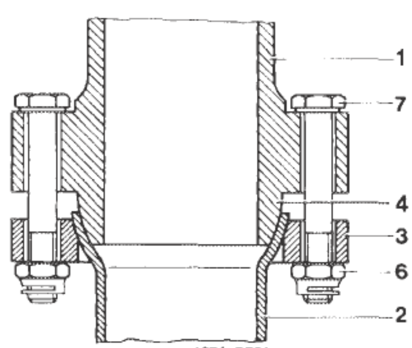
Exhaust manifold right

Repair versions

Starting approx. November 1977, the exhaust manifolds are provided with an external ball connection (up to now trapezoid connection). As a result, when installing exhaust manifolds with external ball connection, replace front exhaust pipe with trapezoid connection against an exhaust pipe with external ball connection.



Trapezoid connection
(past version)



External ball connection

Removal

1 Remove exhaust system (49–100).

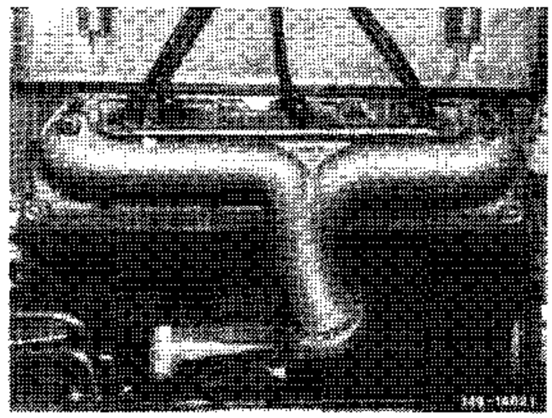
2 Pull off ignition cable.

3 Unscrew shielding plate on exhaust manifold.

Exhaust manifold left

4 Remove air cleaner.

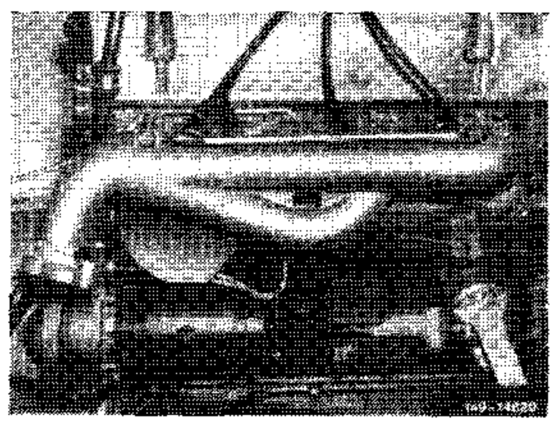
5 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Exhaust manifold right

6 Remove battery and battery holder.

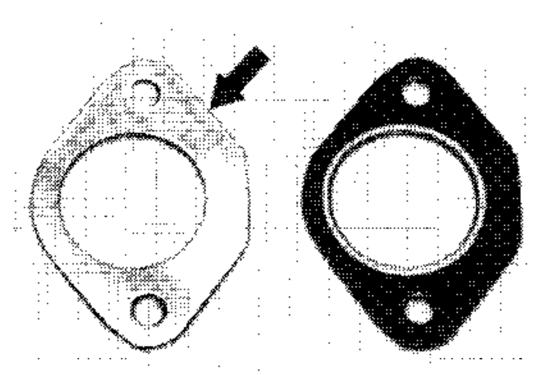
7 Unscrew exhaust nuts and bolts and remove exhaust manifold.



Installation

8 For installation proceed vice versa. Replace all gaskets and exhaust nuts.

9 Mount flange gaskets with sheet-metal (arrow) facing exhaust manifold.

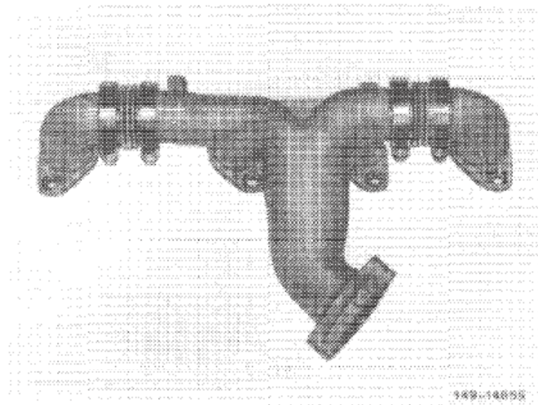


10 Mount exhaust system.

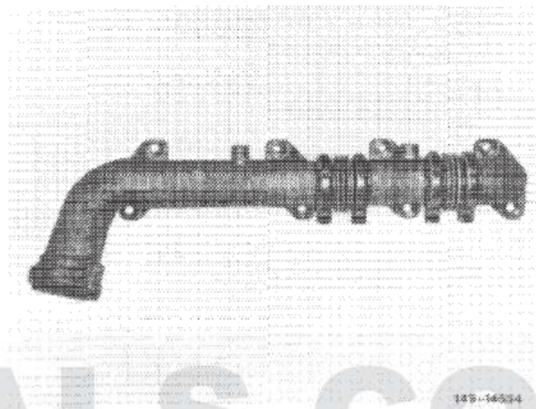
11 Mount air cleaner. Make sure of correct seat of sealing ring between air flow sensor and air cleaner.

12 Keep engine running and check exhaust system for leaks.

Lefthand steering



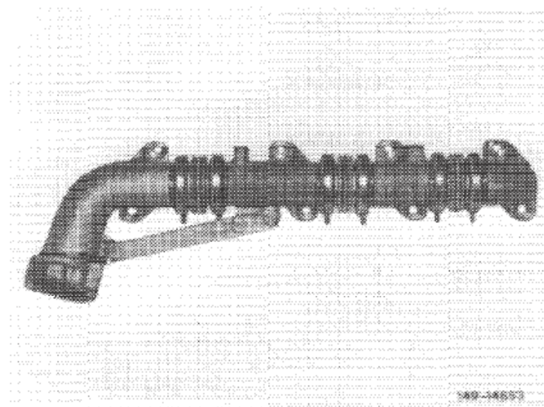
Exhaust manifold left



Exhaust manifold right

In the event of damage on exhaust manifolds with 2 bellows as a result of extremely sharp driving, the exhaust manifold can be subsequently provided with 3 bellows at righthand engine side on model 116.

This exhaust manifold has a trapezoid connection. Consequently, on vehicles manufactered after approx. November 1977, the front exhaust pipe with external ball connection must be replaced by an exhaust pipe with trapezoid connection.



Exhaust manifold right
model 116

Righthand steering

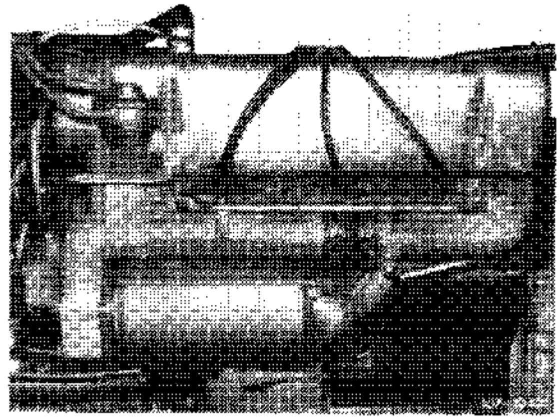
On righthand steering vehicles the exhaust manifolds must be replaced like for like.

B. National version (AUS) (J) (S) (USA)

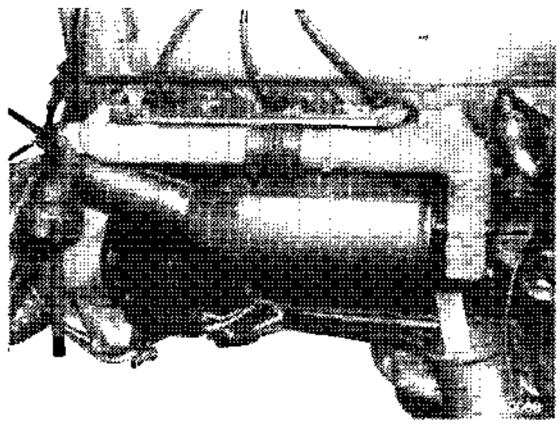
(J) (S) (USA) Model year 1976

Exhaust manifold with internal ball

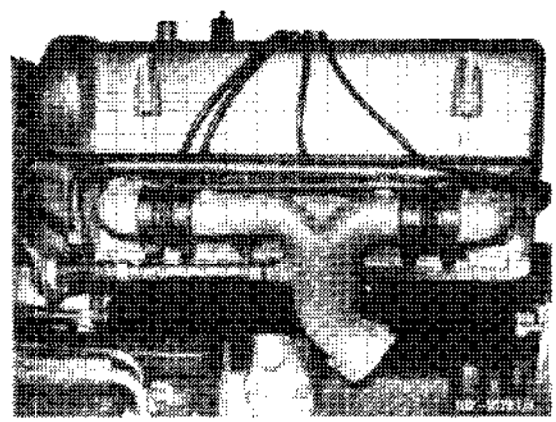
(J) (USA)
Exhaust manifold left



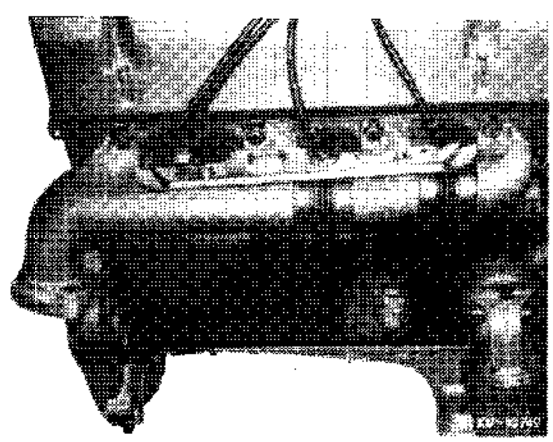
Exhaust manifold right



(S)
Exhaust manifold left



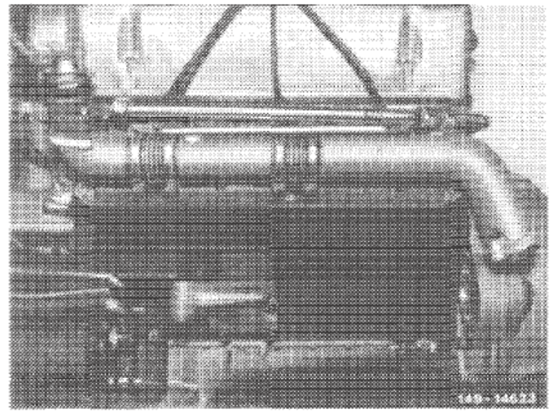
Exhaust manifold right



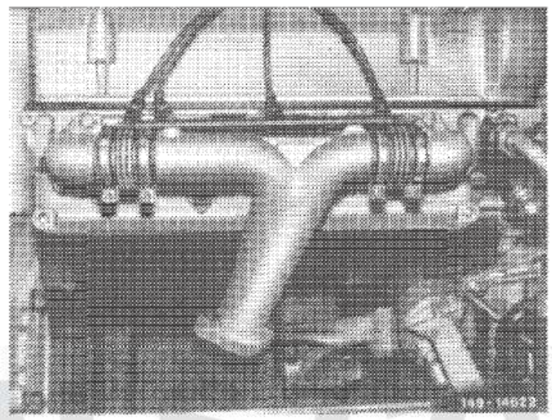
AUS J S model year 1977–1980
USA model year 1977–1979

1977 exhaust manifold with internal ball,
starting 1978 exhaust manifold with external ball

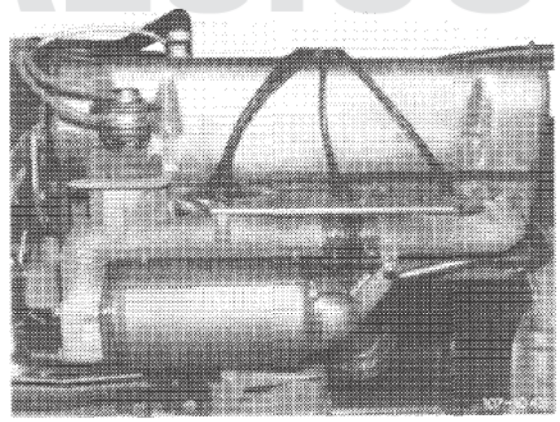
Note: If on vehicles model year 1977 an exhaust manifold with external ball connection is installed, the front exhaust pipe must be replaced.



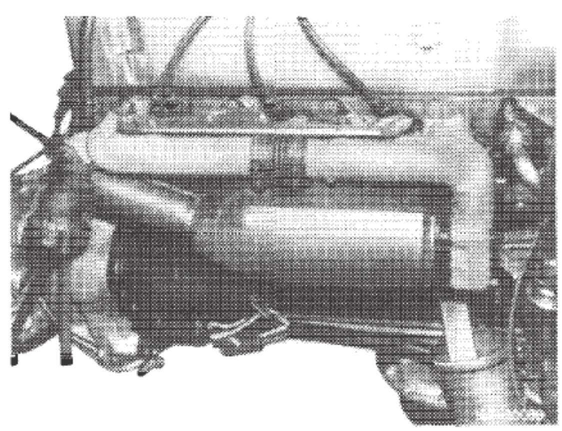
AUS
Exhaust manifold left



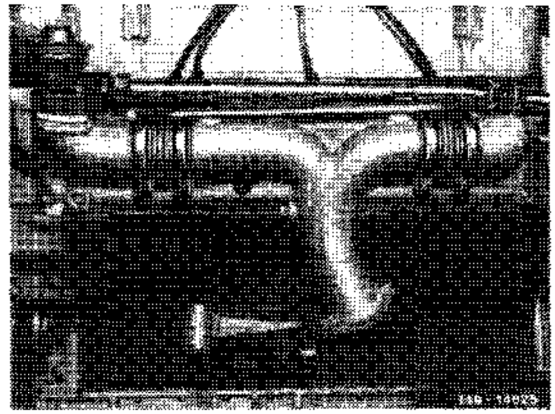
Exhaust manifold right



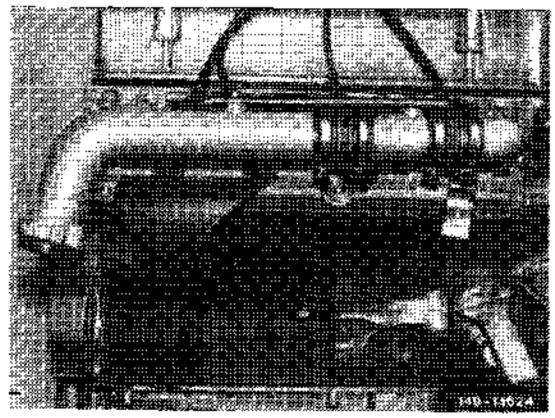
J
Exhaust manifold left



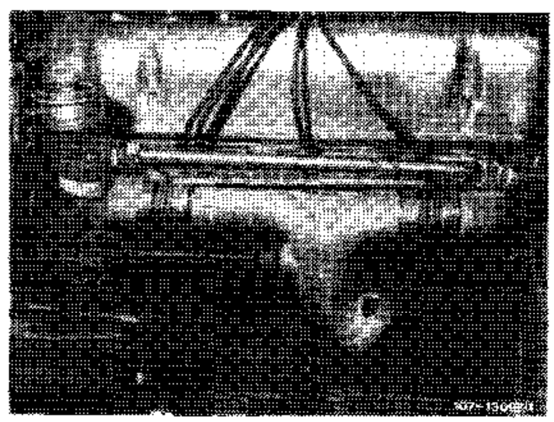
Exhaust manifold right



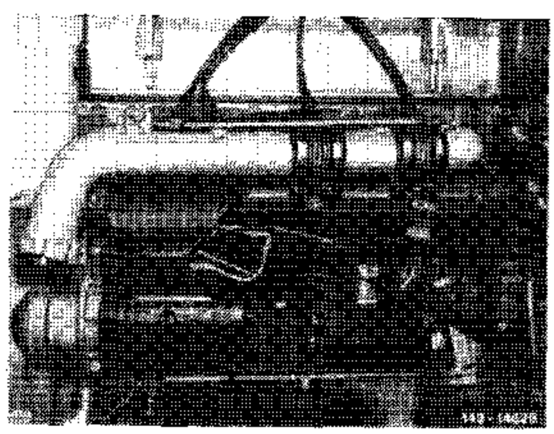
S
Exhaust manifold left



Exhaust manifold right



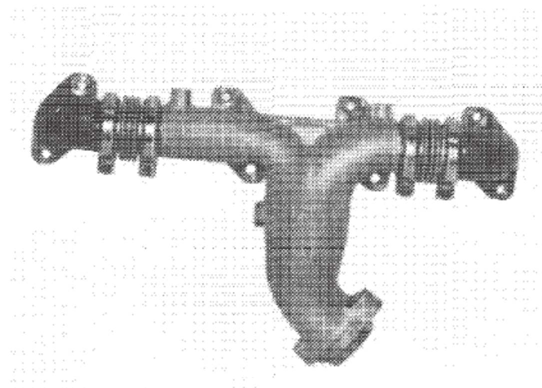
USA
Exhaust manifold left



Exhaust manifold right

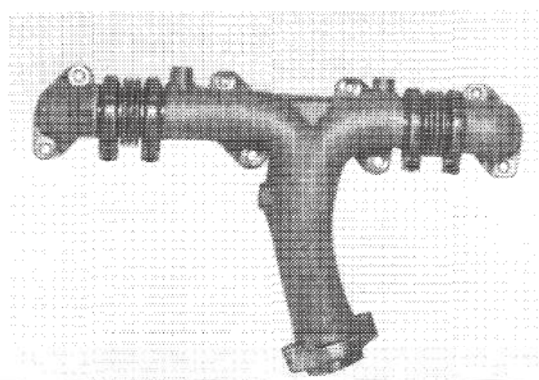
USA model year 1980

Without EGR



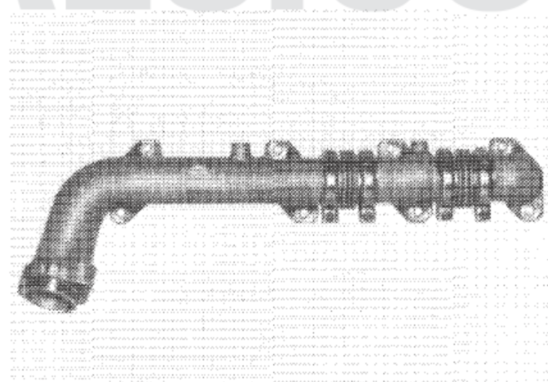
Exhaust manifold left
Model 107

114 – 16851



Exhaust manifold left
Model 116

114 – 16852



Exhaust manifold right
Model 107 and 116

114 – 16854

(J) 1980
Identification: Information plate on cross member in front of radiator in Japanese language

117	0 237 405 006	TDC	9–16°	27–33 °	6–10°	8–12°	7° BTDC

(S) 1976/77
Identification: Blue information plate in Swedish language on cross member in front of radiator

117	0 237 405 001	TDC	9–16°	27–33°	6–10°	8–12°	7° BTDC

(S) 1978/79

117	0 237 405 002	TDC	9–16°	27–33°	6–10°	8–12°	8° BTDC

(S) 1980

117	0 237 405 008	TDC	9–16°	27–33°	6–10°	8–12°	8° BTDC

(USA) 1976/77
Information plate in English language on cross member in front of radiator
Identification: 1976 black or green
1977 Federal black, California yellow, Federal high altitudes red

117	0 237 405 002	TDC	9–16°	27–33°	6–10°	8–12°	7° BTDC

(USA) 1978/79
Identification: Federal black, California yellow

117	0 237 405 002	TDC	9–16°	27–33 °	6–10°	8–12°	7° BTDC

(USA) 1980
Identification: Black information plate in English language on cross member in front of radiator

117	0 237 405 011 [2] 0 237 405 012 [2])	5° BTDC [1])	7–13°	22–28°	9–11°	8–12°	5° BTDC

1) Adjustment at operating temperature of engine. Vacuum retard adjustment is switched off above 50 °C engine temperature.
2) Starting February 1980.

Conventional tools

Revolution counter (speedometer), stroboscope	
Digital tester	Bosch, MOT 001.03

Checking and adjusting

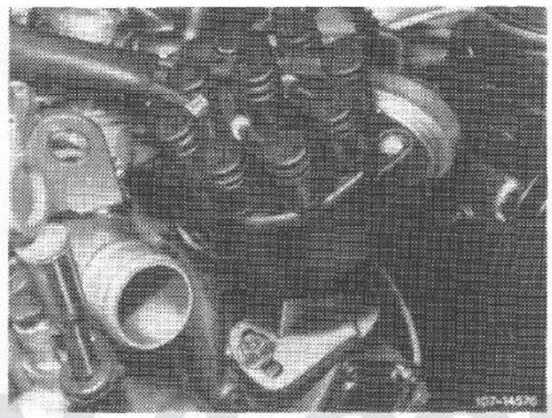
Note: On standard version, pull off both vacuum lines for ignition adjustment when adjusting firing point. After adjusting firing point, check specified firing point at idle with vacuum.

1 Check firing point with stroboscope or digital tester at specified speed with or without vacuum.

2 Loosen ignition distributor attachment, if applicable, and set adjusting value of firing point by turning ignition distributor.

Screw down ignition distributor and check firing point once again.

3 Check centrifugal and vacuum adjustment of ignition distributor. For this purpose, run through specified test values with or without vacuum adjustment.

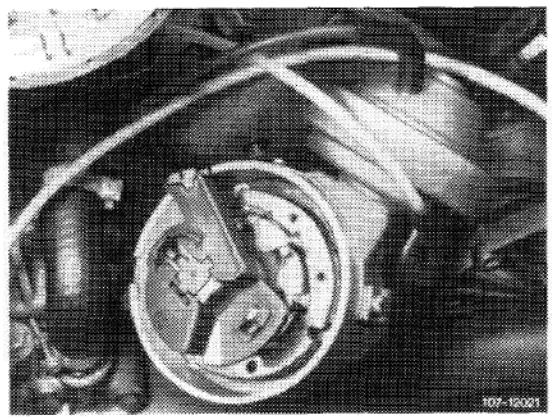


15–510 Removal and installation of ignition distributor

Note

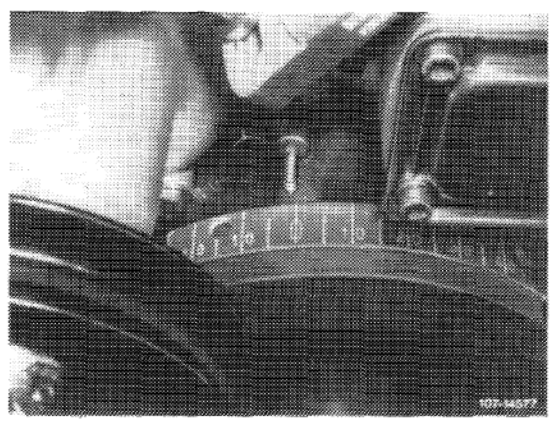
Turn crankshaft in direction of rotation of engine at fastening screw of V-belt pulley only.

Removal

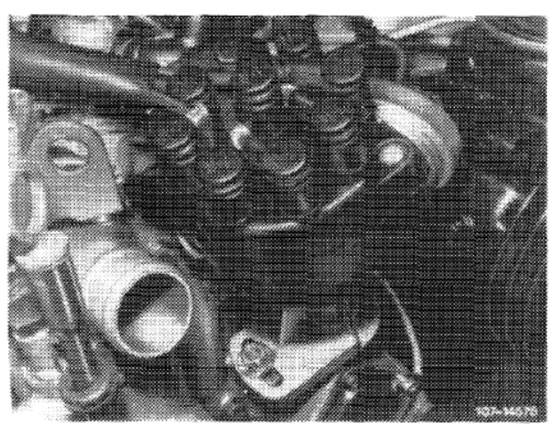


1 Remove distributor cap, cable plug connections and vacuum lines.

2 Set engine to ignition TDC of 1st cylinder. For this purpose, markings on distributor rotor and on distributor housing must be in alignment.



3 In addition, the pointer on crank case should be above TDC mark of vibration damper.



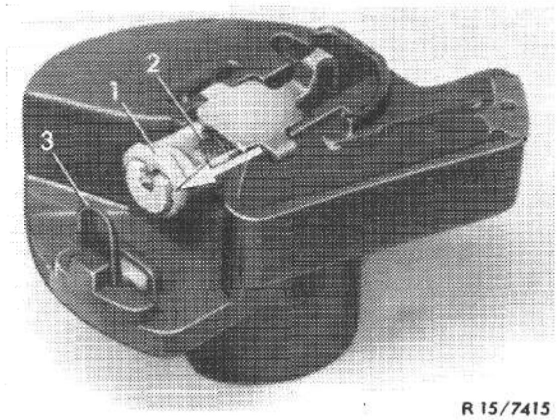
4 Loosen ignition distributor attachment and pull out ignition distributor.

Installation

5 For installation proceed vice versa. Pay special attention to ignition TDC of 1st cylinder and to markings on distributor housing and vibration damper.

Note: The ignition distributor rotor is provided with an rpm limitation (except USA and J). The distributor rotor is identified with breakaway speed M 116–6500/min, M 117–5800/min and with code number M 116–3.5, M 117–4.5.

6 Adjust firing point (ignition timing) (15–501).



1 Flyweight
2 Spring
3 Grounding spring

R 15/7415

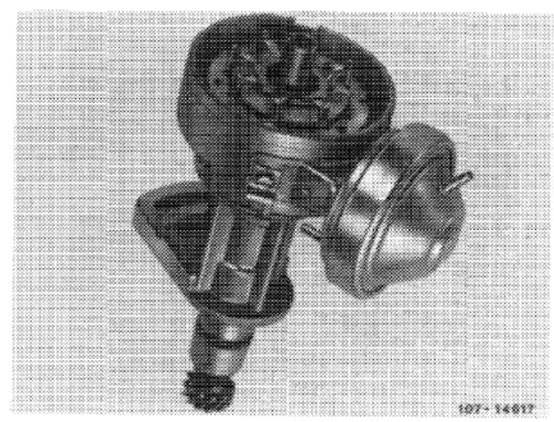
15–525 Removal and installation of vacuum control unit on ignition distributor

Removal

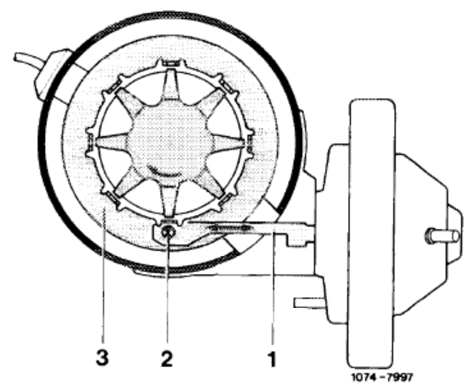
1 Remove ignition distributor (15–510).

2 Remove ignition distributor cap, ignition distributor rotor and dust cap.

3 Unscrew vacuum box on ignition distributor.

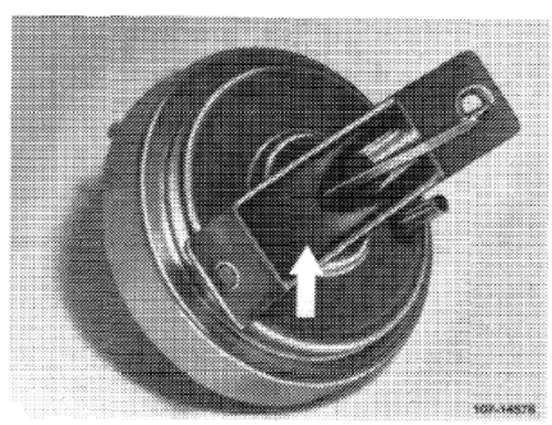


4 Remove vacuum box while lifting box slightly so that the pull rod (1) comes out of bolt (2) of pole disc (3).

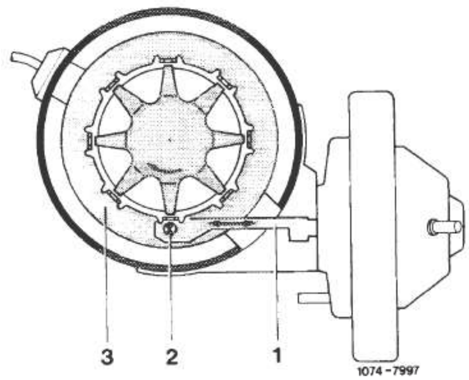


1 Pull rod
2 Bolt
3 Pole disc

5 Install vacuum box. Make sure that the holding body (arrow) is not distorted, since guiding of pull rod would no longer be assured.



6 Introduce vacuum box in such a manner that the pull rod (1) engages on bolt (2) of pole disc (3).



1 Pull rod
2 Bolt
3 Pole disc

7 Screw down vacuum box.

8 Check whether pull rod is correctly attached by turning pole disc in both directions.

9 Install ignition distributor (15–510).

10 Adjust firing point and check function of vacuum adjustment (15–501).

15–528 Notes concerning jobs on breakerless transistorized ignition system

Attention!
When working on breakerless transistorized ignition system be sure to observe the following points:

- Persons with heart stimulators should not work on such ignition systems.

- With the engine running or at starting speed, do not touch or pull off components of ignition system, ignition cable, ignition coil, spark plug connector.

- Perform assembly jobs on ignition system only with engine stopped and ignition switched off.

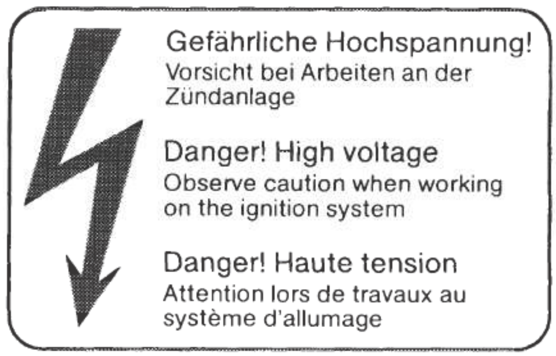
  Also connect and disconnect test instruments only with engine stopped and ignition switched off.

- Do not install adaptors or transmitters which are metallically bright on outer side, as for stroboscoping, into ignition cables, e.g. cylinder 1.

This ignition system is widely free of maintenance requirements and guarantees adequate ignition voltage even at max. speeds and a more accurate adherence to firing point.

Ignition coil and series resistors are similar to breaker-controlled transistorized ignition, while the electrical layout of the switching unit has been modified.

Identification: Yellow paint dot on housing top up to production date 930 and a different Bosch no. 0 227 100 001.



1154-9352

Components of ignition system:

Ignition coil

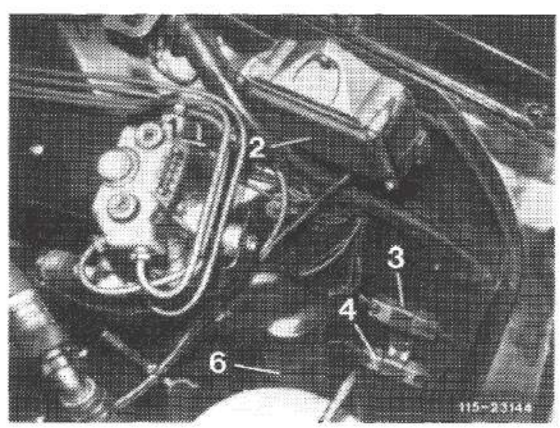
Design and external dimensions of ignition coil are similar to those of a normal high performance ignition coil. However, the coil layout is different. The transformation ratio amounts to approx. 1 : 185, as compared with 1 : 100 for conventional ignition coils.

Identification: Blue paintwork and sticker Transistor, Bosch no. 0 221 122 001.

Series resistors

Series resistors 0.4 Ω and 0.6 Ω are similar to those of former ignition coil series resistors: The resistance coil is surrounded by a ceramic body with projecting connections.

A sheet metal clamp is placed around ceramic body for fastening. The color of this clamp provides information with regard to resistance value, which is also punched in as a number.



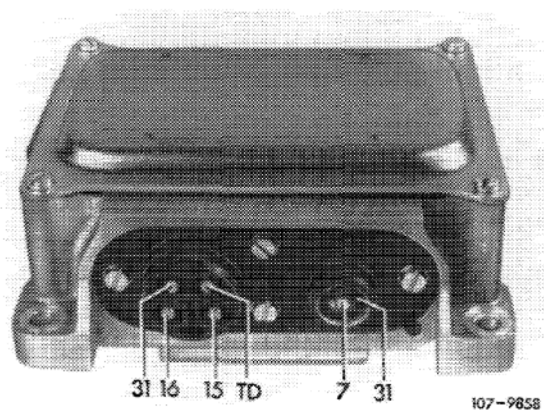
1 Cable connector
2 Switching unit
3 Series resistor 0.4 Ω
4 Series resistor 0.6 Ω

Color	Code number	Series resistor
anodized, blue	0.4	0.4 Ω
anodized, metallic	0.6	0.6 Ω

Switching unit

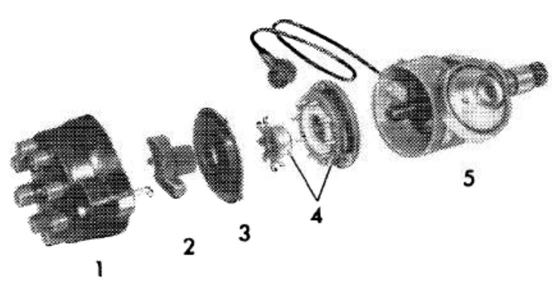
The switching unit contains several transistors, resistors and other electronic components in a metal housing. This metal housing protects the components against mechanical damage and splash water and serves also for eliminating dissipated electric heat. Contact on switching unit is made by a 4-point round plug connection and coaxial plugs for activation.

In the event of repairs, only the complete switching unit can be replaced.



Ignition distributor

Instead of the contact breaker, the ignition distributor is provided with a transmitter section, which operates according to the induction principle. Ignition timing by centrifugal force and vacuum is similar to former ignition distributor.

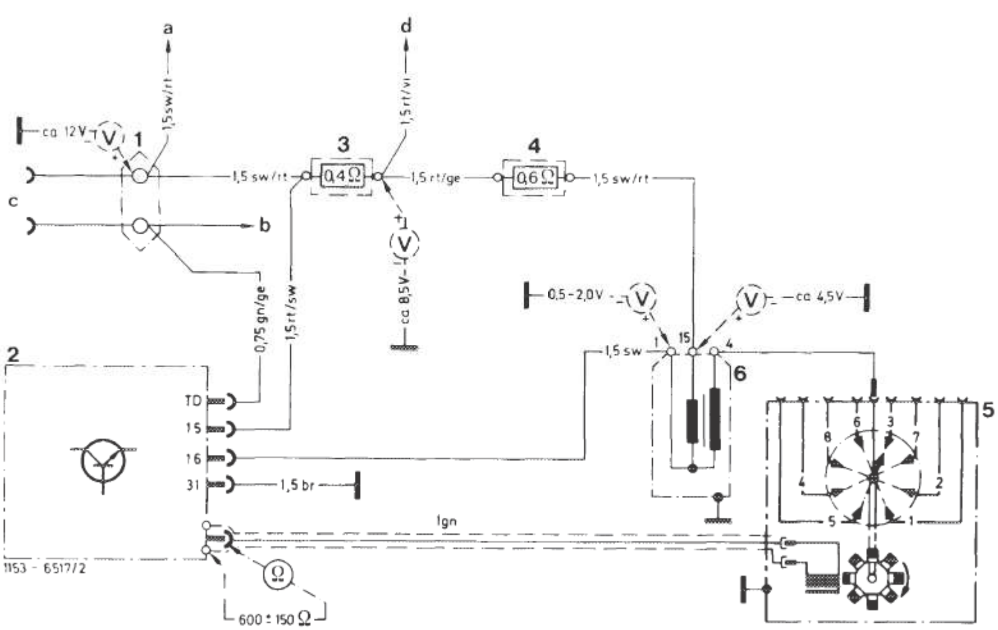


1 Ignition distributor cap
2 Ignition distributor rotor
3 Shielding cap
4 Transmitter section
5 Ignition distributor housing

Operation of transmitter section

A rotor with its number of teeth corresponding to number of engine cylinders, produces during its rotation per tooth a change of magnetic flux in a magnetic field, established by a permanent magnet. As a result, an induction coil located in magnetic field establishes a control voltage (0.3 V—100 V) which depends in its size on engine speed, with a steep change from positive to negative half wave. This steep change of polarity of control voltage is used in switching unit following zero passage from impulse shaping, impulse amplification and interruption of primary current.

If the primary current is interrupted, the ignition voltage is induced in secondary winding of ignition coil. The dwell angle control in switching unit adapts the current flow time of primary current to engine speed, which means that with increasing speed the dwell angle is also increasing, so that adequate ignition voltage is assured also in upper speed range.



Wiring diagram breakerless transistorized ignition system TSZ 4

1 2-point cable connector
2 Switching unit
3 Series resistor 0.4 Ω
4 Series resistor 0.6 Ω
5 Ignition distributor with transmitter section
6 Ignition coil

a Ignition starting switch terminal 15
b Instrument cluster, revolution counter
c Diagnosis socket
d Terminal 16 starter

Color code
br = brown
ge = yellow
gn = green
rt = red
sw = black

15–562 Testing breakerless transistorized ignition system TSZ 4

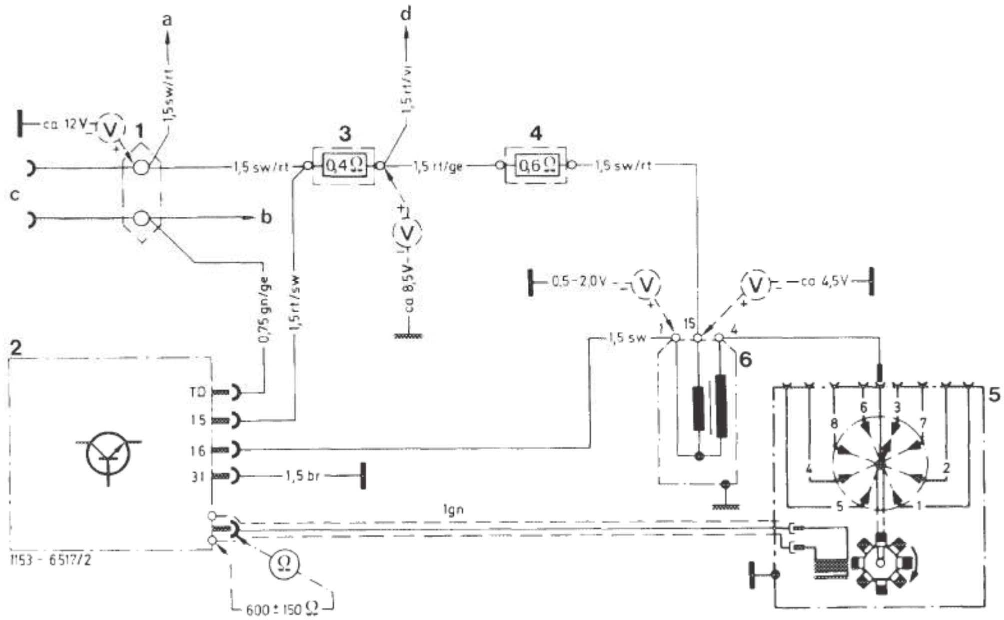
Test values

Battery rest potential		approx. 12 V
Ignition coil voltage	terminal 1 and ground	approx. 0.5–2 V
	terminal 15 and ground	approx. 4.5 V
Input voltage series resistor		approx. 12 V
Ignition coil resistor	primary terminal 1 and 15	0.33–0.46 Ω
	secondary terminal 1 and 4	7–12 kΩ
Transmitter resistance between terminal 7 and 31d		600 ± 100 Ω
Transmitter coil with control line terminal 7 and ground		∞
Dwell angle at	approx. 1500 rpm	25–39°
	approx. 5000 rpm[1])	33–40°

[1]) Perform dwell angle test at 5000 rpm only if complaints refer to misfiring at high speeds.

Conventional testers

Voltmeter, ohmmeter, dwell angle measuring instrument, revolution counter



Wiring diagram breakerless transistorized ignition with test values

1 Two-point cable connector
2 Switching unit
3 Series resistor 0.4 Ω
4 Series resistor 0.6 Ω
5 Ignition distributor with transmitter section
6 Ignition coil

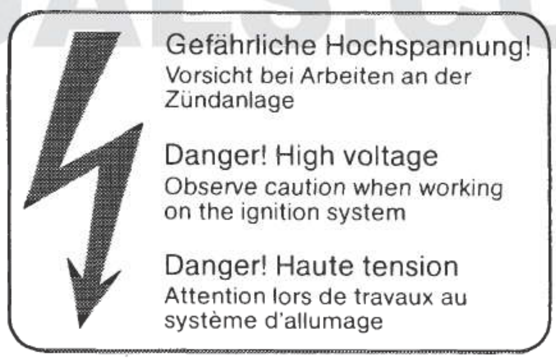
a Ignition starting switch terminal 15
b Instrument cluster, revolution counter
c Diagnosis socket
d Terminal 16 starter

Color code
br = brown
ge = yellow
gn = green
rt = red
sw = black

Note

In the event of complaints about misfiring, check high voltage side of ignition system first (spark plugs, ignition cable, spark plug connectors).

If complaints are about starting-up of engine, perform the following tests on ignition system in addition to test at fuel side:



1154-9352

Visual checkup

Check electric screw connections and plug connections of ignition system for tight seat.

Voltage test

Note: With ignition switched on and engine stopped, a constant primary current of approx. 8 Amps. will flow in this ignition system.

1 Input voltage on series resistance 0.4 Ω cable color black/red (15/54):

Nominal value approx. 12 Volts

2 Voltage on ignition coil at approx. 20 °C:

Terminal 15 and ground = approx. 4.5 Volts

Terminal 1 and ground = 0.5–2.0 Volts

a) If value is exceeded on terminal 1, switchgear is defective and should be replaced.

b) If value on terminal 1 is attained, but no ignition voltage (firing spark) is induced, check transmitter section in ignition distributor (5) and secondary winding of ignition coil.

Resistance values ignition coil:

Primary winding terminal 15 and terminal 1 = 0.33–0.46 Ω

Secondary winding terminal 1 and terminal 4 = 7–12 kΩ

Checking dwell angle

Note: The dwell angle (timing angle) cannot be adjusted. The inspection serves to check function of switchgear (dwell angle control).

Connect dwell angle measuring instrument (Connection similar to SI-standard switchgear).

Nominal value at

Engine speed	Dwell angle
1500±50/min	25–39°
5000±50/min[1])	33–40°

[1]) Check at 5000/min only if complaints are about misfiring at high speeds.

If this value is not attained when measuring dwell angle, check ignition distributor transmitter section first. If transmitter section is in order, exchange switchgear.

Testing ignition distributor transmitter section

Pull off control line of ignition distributor on switchgear and connect ohmmeter.

1 Test transmitter resistance between terminal 7 and 31d.

Nominal value: 600 ± 100 Ω

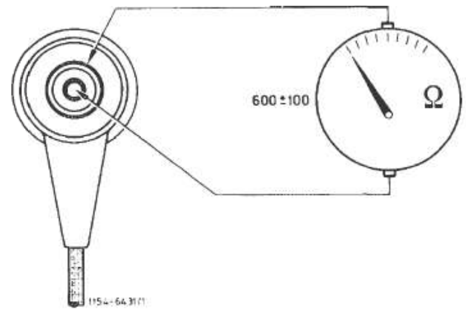
Note: On cold engine the ohmic value should be in lower half of specified value, on warm engine in upper half.

2 Test transmitter coil including control line for ground connection.

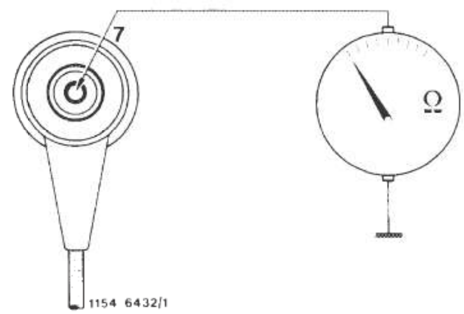
Nominal value: terminal 7 and ground = ∞

3 Check transmitter section for mechanical damage. There should be an air gap between rotor and stator.

Note: If transmitter section is defective, exchange complete ignition distributor.



Ohmmeter connection for testing transmitter resistance

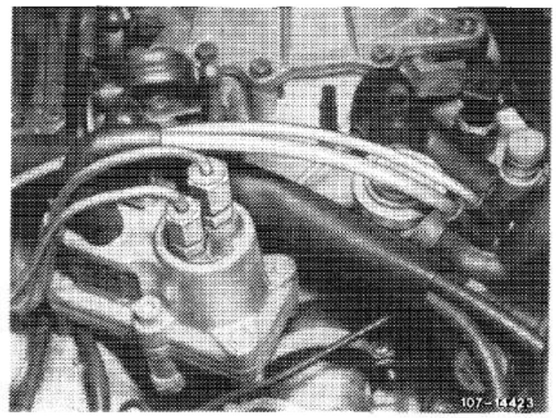


Ohmmeter connection for testing ground connection

15–571 Operation of vacuum retard adjustment

Note

To obtain a higher idle speed at low ambient temperatures following a cold start, the vacuum box on ignition distributor (harder spring) and the connection for the ignition retard adjustment (white-yellow line) has been modified. The connection for the ignition retard adjustment is now on contoured hose between supplementary air valve and idle speed air distributor. The connection on throttle valve housing for ignition retard adjustment used up to now has been discarded.



Operation

As a result of this change, the ignition is **not** adjusted toward retard at low ambient temperatures following a cold start as a result of the low intake pipe vacuum (supplementary air valve open). The idle speed will be raised by approx. 150–200/min immediately following a start.

After using up stocks in spare parts storage only the modified components (ignition distributor, contoured hose, throttle valve housing) will be available. Note the following:

a) Ignition distributor

When renewing ignition distributor or vacuum box the connection for retard adjustment need not be changed.

b) Contoured hose

When renewing contoured hose, close connection for retard adjustment blind, so that no false air will be drawn in.

c) Throttle valve housing

When renewing throttle valve housing, install contoured hose with connection for retard adjustment, and on engine 117 the modified vacuum box.

d) Engine 116

The vacuum box on ignition distributor has not been changed. The speed increase following a cold start is attained through installation of contoured hose and modified throttle valve housing.

Scope

1 Install modified contour hose.

2 Pull vacuum line white/yellow from throttle valve housing and connect to contour hose.

3 Close freed connection on throttle valve housing with rubber cap, part no. 000 987 11 45.

4 Mount new vacuum control unit for ignition distributor.

Spare parts

Designation	Part no.
Contour house	100 094 11 91
Throttle valve housing	001 140 19 53
Ignition distributor	002 158 57 01
Vacuum control unit	000 158 57 18
Rubber cap	000 987 11 45

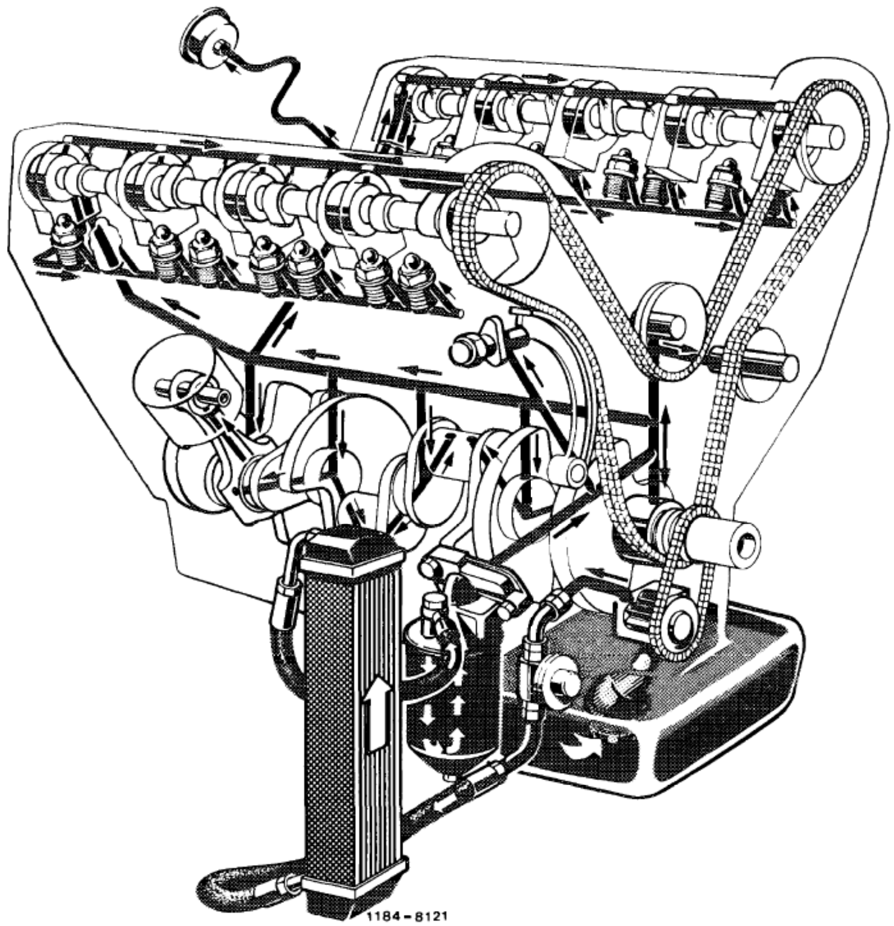
Note: If there is no change to modified vacuum retard adjustment, make sure that:

– the modified ignition distributor can be installed complete, or the vacuum control unit separately without additional changes and

– the vacuum connection on contour hose is closed when installing modified contour hose.

18–005 Oil circuit, oil pressure, pressure relief and bypass valve, oil filter

Oil circuit with air-oil cooler



Oil pressure

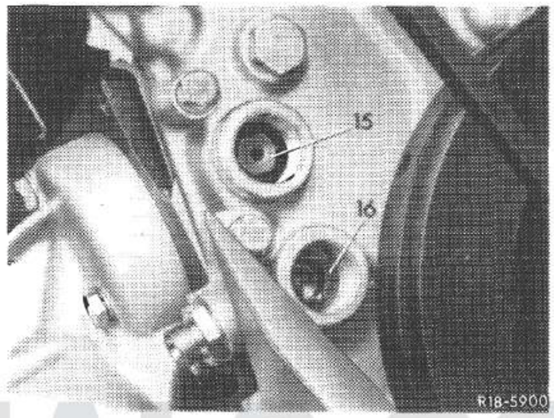
At operating temperature, the oil pressure at idle speed may drop to 0.3 bar gauge pressure.

During acceleration, the oil pressure should immediately rise again and attain at least 3 bar gauge pressure at 3000/min.

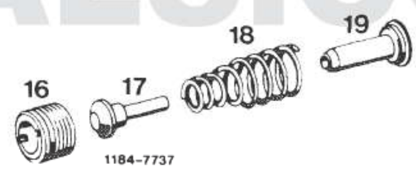
Opening pressure of pressure relief valves	bar gauge pressure
Pressure relief valve (15) in main oil duct	5
Bypass valve (16) air-oil cooler	1.5
Bypass valve (20) filter element	4.5

The **oil pressure relief valve** (15) at crankcase face end in main oil duct behind oil filter **limits the oil pressure to 5 bar gauge pressure** (5 atü). The overflowing oil returns to the oil pan. This valve is accessible upon opening of a closing plug in timing housing cover.

The pressure relief valve itself cannot be disassembled.



15 Oil pressure relief valve 5 bar gauge pressure
16 Bypass valve oil cooler 1.5 bar gauge pressure

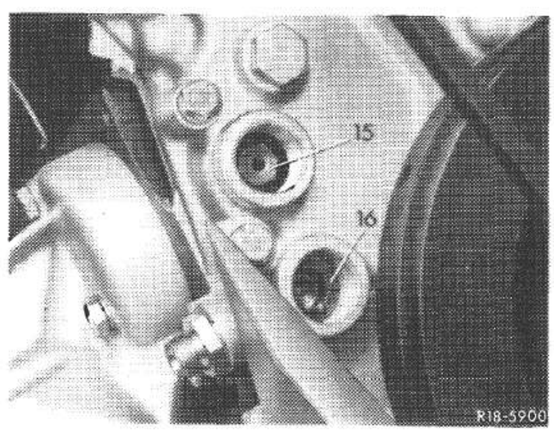


Bypass valve air-oil cooler

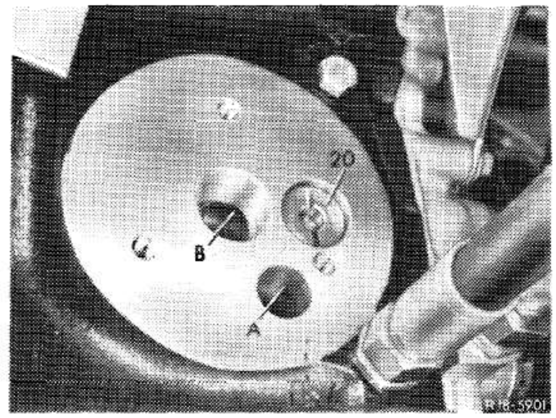
16 Valve seat ring
17 Valve cone
18 Compression spring
19 Valve guide

The **bypass valve** (16) for the air-oil cooler with an opening pressure of 1.5 bar gauge pressure on crankcase face end is concealed by a closing plug in timing housing cover. This valve opens when the flow resistance of the cold oil in oil cooler is high.

Note: To remove bypass valve (16), the vibration damper on vehicles with closing plug in forward position must be taken off (03–340).

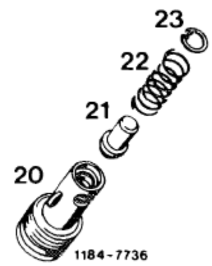


The **bypass valve** (20) for filter element is located in crankcase and enters the oil main duct. When the difference pressure between oil filter at dirt end and oil main duct exceeds 4.5 bar gauge pressure, that is, when e.g. the filter element is badly contaminated, this valve will open and the oil will flow to bearing points in uncleaned condition.

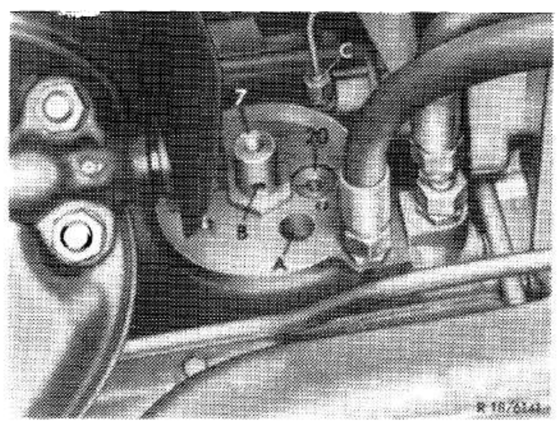


Engine 116.982/992/983/993/984/985
117.982/992/983/993/985/986

20 Bypass valve filter element
A Oil inlet unfiltered
B Oil outlet filtered

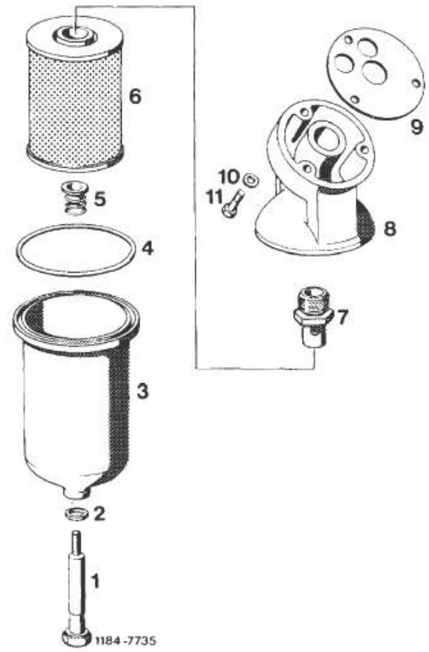


20 Bypass valve filter element
21 Valve
22 Compression spring
23 Locking ring



Engine 116.980/990/981/991
117.981/984

7 Connection
20 Bypass valve filter element
A Oil inlet unfiltered
B Oil outlet filtered
C Connection lube oil line – air compressor (type 109 only)



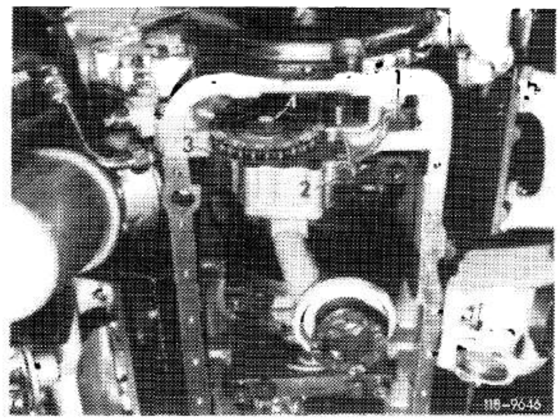
Oil filter

1 Center bolt
2 Sealing ring
3 Oil filter housing
4 O-ring
5 Compression spring with spring retainer
6 Paper filter element
7 Connection
8 Intermediate flange (types 107, 116)
9 Gasket
10 3 spring washers
11 3 screws M 8 x 45

18–210 Removal and installation of oil pump

Tightening torques	Nm
Sprocket to oil pump	30
Oil pump to timing housing cover	25

Removal



1 Remove oil pan lower half.

Note: On engines with a one-piece oil pan, remove oil pan as a complete unit (03–210).

2 Compensating weight of 1st crankpin horizontal.

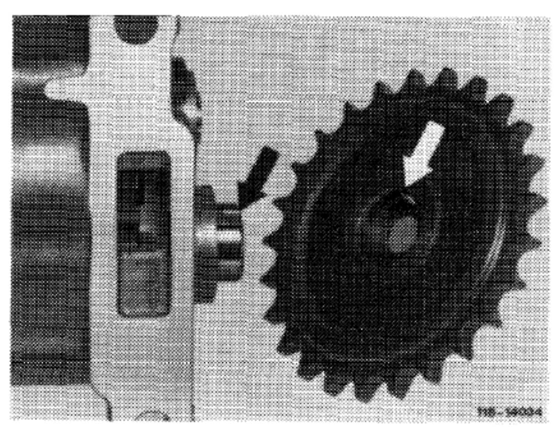
3 Unscrew screws (1, 2 and 3).

4 Loosen screw (4) on sprocket, tilt oil pump to the rear and remove screw.

5 Force sprocket from oil pump by means of a screw driver.

6 Lift sprocket from chain.

Installation



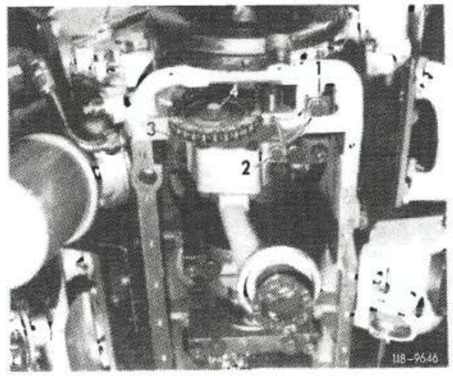
7 Attach sprocket to chain.

8 Push oil pump on sprocket. The clamping sleeve in sprocket should enter cutout of drive shaft (arrows).

9 Tilt oil pump to the rear, position screw (4) and tighten.

10 Screw-on oil pump.

Attention!
Lock tensioning spring of chain tensioner with a screw driver against rotation when tightening screw (1).



11 Mount oil pan.

12 Fill-in engine oil.

13 Start engine. Check oil pressure and for leaks.

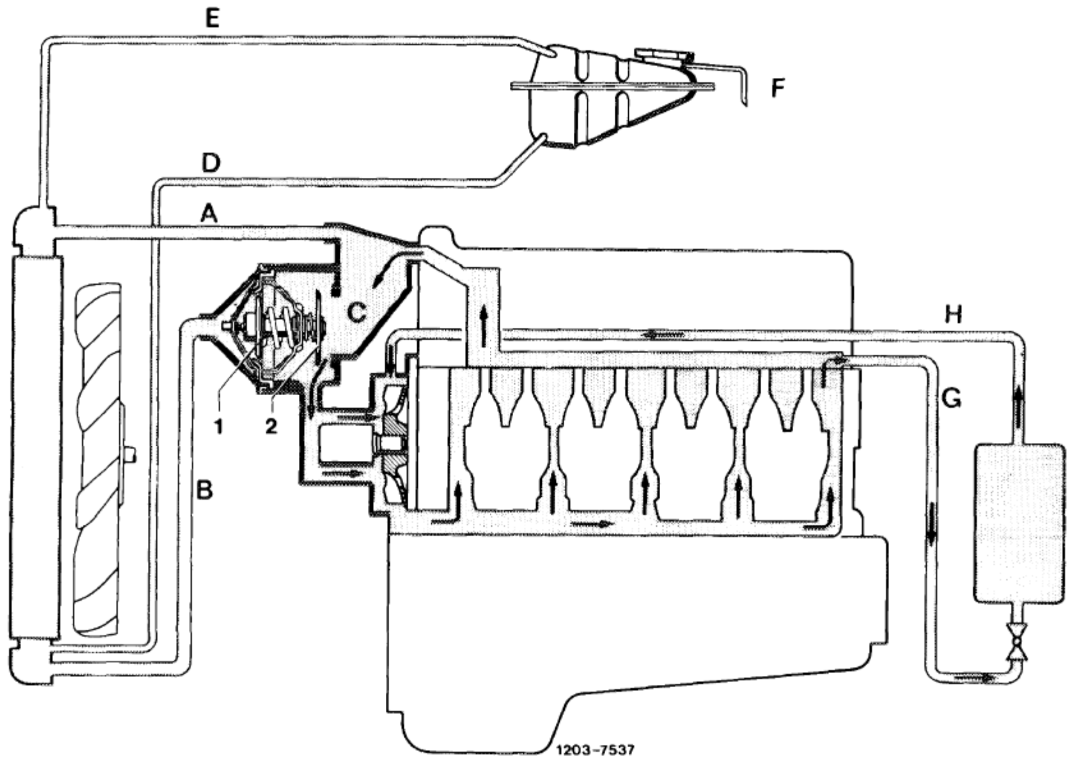
Note: When changing oil pump, make sure of uniform number of teeth of drive sprocket. If the tensioning clamp must be renewed, remove timing housing cover (01–210).

20–005 Coolant circuit and engine cooling

Coolant circuit

Warming-up period

Main valve (1) closed, bypass disc (2) fully opened.
Coolant temperature < 75 °C.

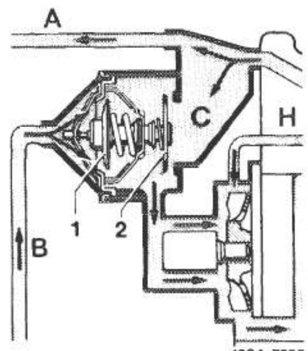


A From engine to radiator
B From radiator via thermostat to engine
C Bypass
D Feed, expansion tank – radiator

E Bleed line
F Overflow hose
G From engine to heater
H Heater water return line

Operation at partial load

With the engine at operating temperature, the main valve (1) as well as the bypass disc (2) are more or less open depending on engine load and ambient temperature. The coolant is guided both through radiator (A) as well as bypass (C) depending on thermostat position.

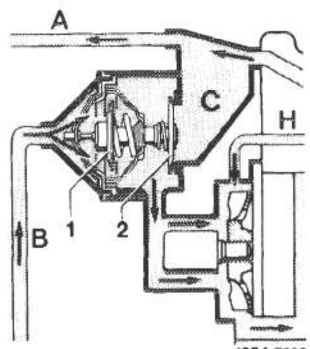


1204-7538

Full-load operation – high ambient temperatures

Main valve (1) fully opened. Bypass disc (2) closed.

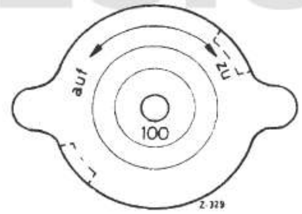
At high engine load and high ambient temperatures the bypass (C) is closed. At the latest at 95 °C coolant temperature. All the coolant should flow through radiator. It is therefore wrong to remove the thermostat for "better" cooling of engine.



1204-7539

Engine cooling

The spring-loaded radiator cap (code No. 100) establishes a gauge pressure of approx. 1 bar in cooling system.

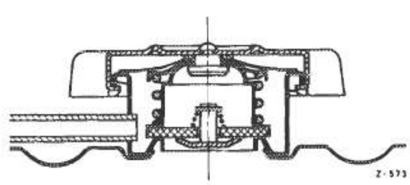


Z-329

The cooling system is filled ex factory throughout the year with a coolant which comprises approx. 55 % by volume of water and 45 % by volume of antifreeze.

This will guarantee protection against freezing up to –30 °C, while additives in anti-freeze will prevent corrosion in cooling system. Since the additives are subject to ageing, the coolant should be renewed every 2 years.

As a protection against corrosion, the concentration of the anti-freeze should not drop below 30 % by volume (–20 °C anti-freeze).



Z-573

Attention!
Use only anti-freeze compounds approved by us to prevent damage to light alloy components.

If no anti-freeze is available and only water is filled in, make sure that 1 % of a treating agent (anti-corrosion oil) (10 cc/l water) is added.

The anti-freeze will increase the boiling point for water amounting to approx. 118 °C at 1 bar gauge pressure to approx. 125 °C for the mixture filled in at the factory.

The red mark on telethermometer begins at 122 °C, prior to middle of 1975 at 115 °C.

This point must be given special attention, when only water with a treating agent is filled in. In such a case, water may be ejected before the indicator of the coolant thermometer arrives at the red mark.

At full load, while driving uphill and bumper-to-bumper, after fast driving on expressways with a subsequent vehicle congestion, or while driving in areas with high ambient temperatures, the coolant temperature indicator may rise up to red mark, protected by the anti-freeze up to min. –30 °C, **without any ejection of coolant or irregular engine performance.**

During extended stationary operation, e.g. in a traffic congestion, moving the selector lever into position "N" will be of advantage for vehicles with automatic transmission. The heat generated in the transmission and consequently the additional heating of the coolant will be reduced via the transmission fluid cooler.

If coolant is lost through leaks of cooling system or through ejection as a result of overheating, a pertinently treated coolant must be added. Losses caused by evaporation can be topped up with tap water.

20–010 Draining and filling-in of coolant – anti-freeze table

Tightening torques	Nm
Drain plug radiator	6–10

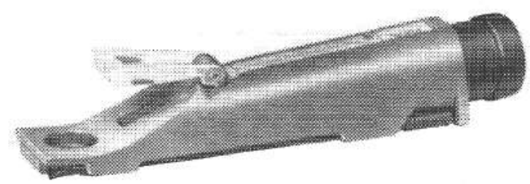
Mixing ratio of anti-freeze[1]) and water[2])

Anti-freeze up to	**Anti-freeze**/water in liters on types	
	107.023 107.043 116.028 116.029	107.024 107.044 116.032 116.033
–30 °C	**6.25**/7.75	**6.75**/8.25
–40 °C	**7.25**/6.75	**7.75**/7.25
Total capacity in liters	14	15

[1]) Refer to specifications for service products sheet 310.
[2]) Refer to specifications for service products sheet 325.

Conventional tool

Anti-freeze tester
Prestone VU-Check (Union Carbide)
e.g. Philipp Gather, D–4020 Mettmann 2



R–4789

Note

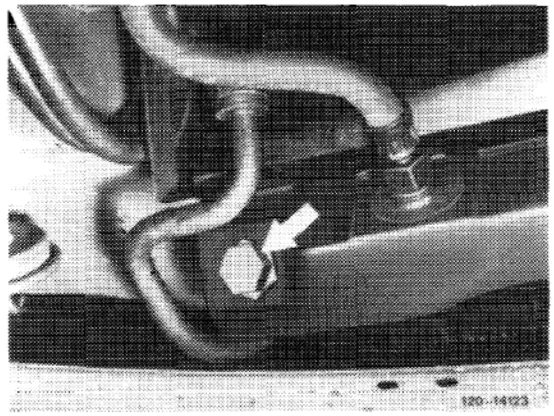
To prevent corrosion, concentration of anti-freeze should not drop below –20 °C (30 % by volume).

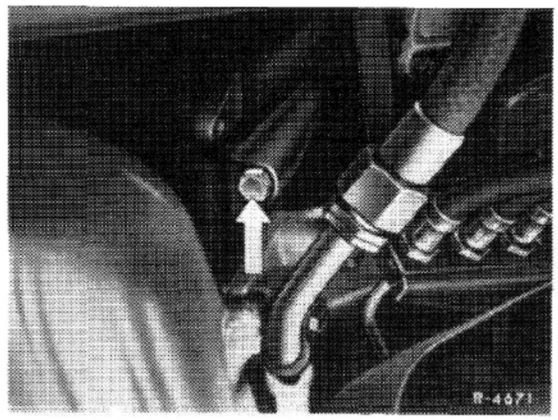
If no anti-freeze is available and only water is filled-in be sure to add 1 % treating compound (anti-corrosion oil, 10 cc/1 l water).

Draining

1 Open cap on expansion tank or radiator in steps **(only below 90 °C).**

2 Unscrew drain plugs on radiator as well as on both sides of cylinder crankcase.





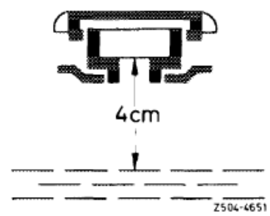
Filling-in

3 Set both heater levers to position "warm".

4 Fill-in coolant **slowly.**

On vehicles with expansion tank made of brass up to approx. 4 cm below sealing surface on radiator cap.

On vehicles with expansion tank made of transparent plastics up to mark shown on tank.

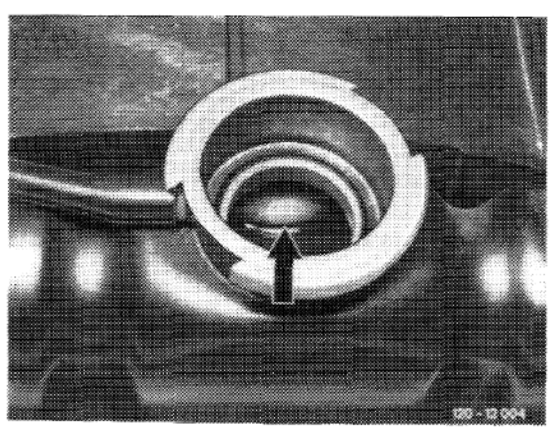


On vehicles without expansion tank to recess in upper radiator tank.

5 Run engine warm under **pulsating acceleration** and with radiator cap **closed** starting at **60 °C** until thermostat opens.

6 Check coolant level and top up until specified level is attained.

Attention!
Open radiator cap only below 90 °C coolant temperature



20–015 Cleaning the cooling system

A. De-oiling

1 Completely drain cooling system.

2 Remove thermostat element (20–110) and set heater lever to warm.

3 Fill cooling system with a 5 % solution of water and P 3-Standard (made by Henkel) (50 g P 3/1 liter water).

Attention!
On vehicles with **aluminium radiator,** a neutral cleaner or a mildly alcaline cleaner such as P 3-Croni (made by Henkel) or Grisiron 7220 (made by Farbwerke Höchst) must be used instead of the heavily alcaline cleaner P 3-Standard.

4 Run engine warm at medium speed up to approx. 80 °C (176 °F) and hold at this temperature for about 5 minutes.

5 Stop engine and permit cooling system to cool down to approx. 50 °C (122 °F).

6 Completely drain solution.

7 Immediately thereafter, flush cooling system with fresh water at engine idle, until all cleaning solution residue is removed from cooling system.

B. Decalcification, derusting

Attention!
Prior to decalcification, **be sure** to de-oil cooling system, even if there is no visible oiling up.

1 After second flushing job during de-oiling, fill cooling system with a 10 % (100 g/l) solution of water and citric acid, tartaric acid or oxalic acid (sold by the chemical trade) while giving preference to citric acid.

2 Run engine warm at medium speed up to approx. 80 °C (176 °F) and hold for approx. 10 minutes at this temperature.

3 Stop engine and permit to cool down to approx. 50 °C (122 °F).

4 Completely drain decalcification solution.

5 Flush cooling system at least 3 times with fresh water while running engine for at least 5 minutes with each flushing charge.

Badly calcified cooling systems may require a repetition of the treatment. Always prepare a fresh decalcification solution and repeat flushing steps.

6 Install thermostat element with new sealing ring.

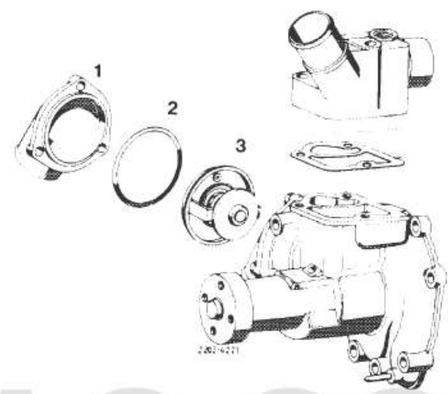
7 Fill cooling system with coolant (20–010).

Note: For decalcification and derusting, commercial products made with the acids named above may also be used.

Chromic acid or products containing chromates are prohibited by sewage regulations.

20–110 Removal and installation of coolant thermostat

Removal

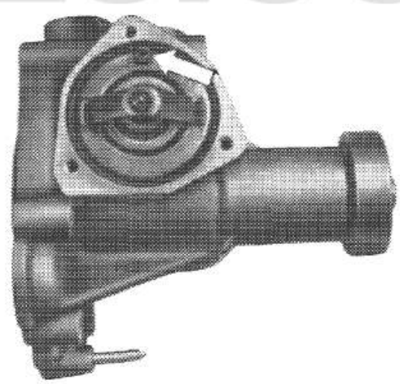


1 Drain coolant from radiator and cylinder crankcase (20–010).

2 Unscrew housing cover (1) and remove thermostat (3).

Note: On engine 116.981/991 and 117.981 disconnect battery as an additional job, and also remove air cleaner and alternator.

Installation



R 20–5053

3 Install thermostat with a new sealing ring (2) in such a manner that the ball valve is on top (arrow). During installation, make sure of unobstructed mobility of ball in valve.

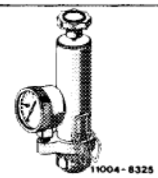
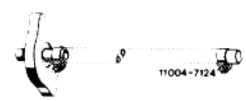
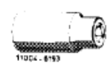
4 Add coolant (20–010).

5 Run engine and check for leaks.

20–210 Removal and installation of coolant pump

Tightening torques	Nm
Drain plug radiator	8

Special tools

Tester for cooling system		001 589 48 21 00
Radiator cap with hose for tester		605 589 00 25 00
Socket 27 mm, 1/2" square		001 589 65 09 00

Conventional tool

Socket 7 mm on flexible shaft for hose clamps with worm drive	e.g. Hazet, D–5630 Remscheid order no. 426–7

Note

On engines with CIS injection, removal of air filter and ignition distributor is eliminated (items 2, 8, 12 and 13).

Removal

1 Drain coolant from radiator and cylinder crankcase (20–010).

2 Remove air cleaner.

3 Slacken V-belt for coolant and power steering pump and remove (13–340).

4 Disconnect upper coolant hose on radiator and on thermostat housing.

5 Unscrew viscofan.

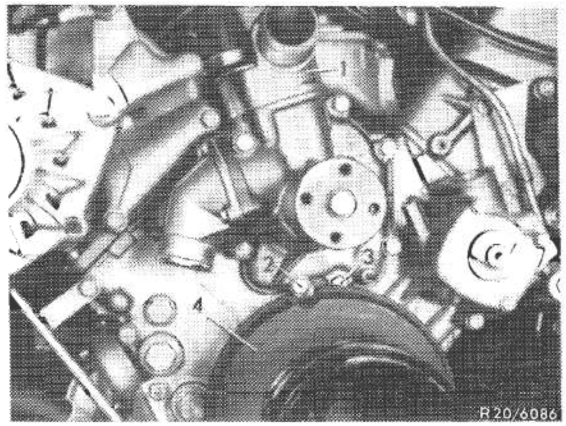
6 Remove lower coolant hose between thermostat housing and radiator.

7 Unscrew inlet connection (1) from coolant pump.

8 Remove ignition distributor (15–510).

9 When removing and installing coolant pump, turn vibration damper (4) in such a manner that the recess exposes each time one of the lower fastening screws (2 and 3).

10 Unscrew remaining fastening screws and remove coolant pump.



Installation

11 Clean sealing surfaces and install coolant pump in vice versa sequence.

12 Set cylinder 1 to ignition TDC, then introduce ignition distributor with distributor finger pointing to notch mark on distributor housing.

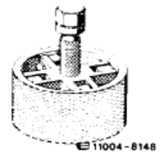
13 Check ignition and adjust, if required (15–501).

14 Add coolant (20–010).

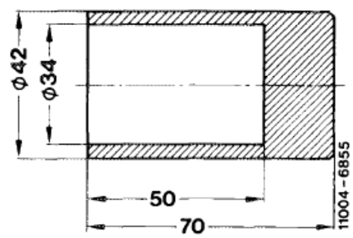
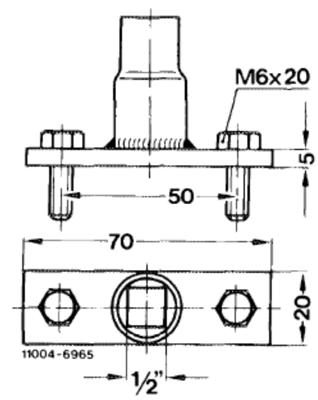
15 Check cooling system for leaks.

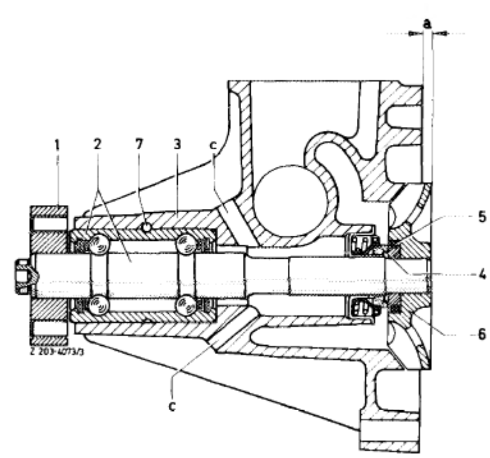
20–225 Sealing of coolant pump

Special tool

Puller for impeller		100 589 15 33 00

Self-made tools

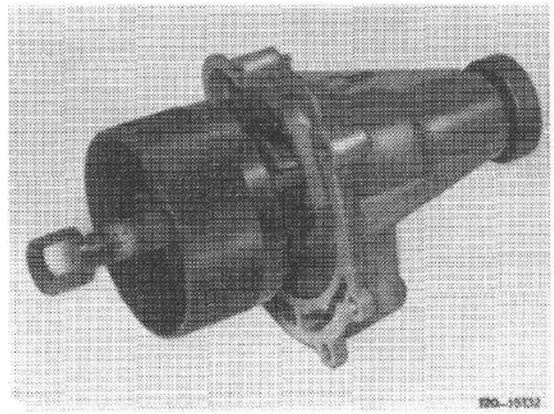
Pressing-in sleeve for slide ring seal	
Tester for tight-seat of impeller	



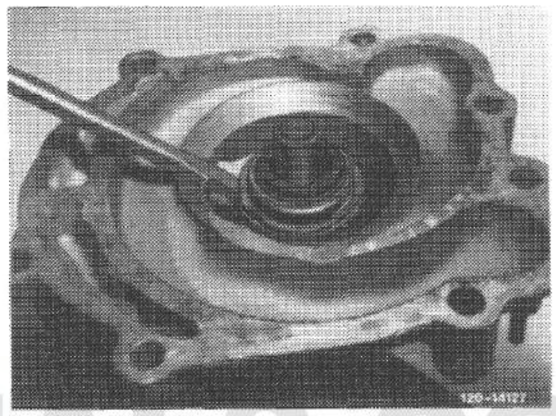
1 Flange
2 Coolant pump shaft with compact bearing
3 Coolant housing
4 Slide ring seal
5 Counter ring with sealing ring
6 Impeller
7 Set sleeve
a 5.3–5.7 mm
c Vent bores

Disassembly

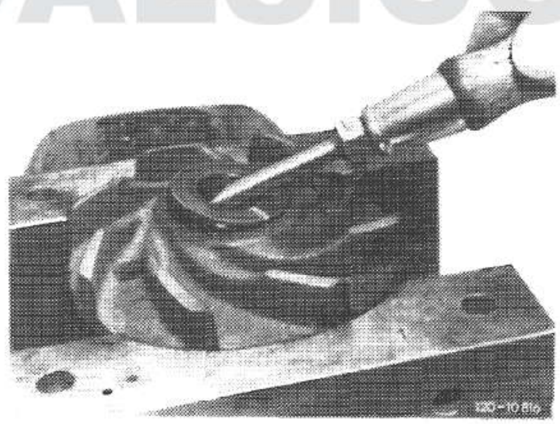
1 Pull off impeller.



2 At several points, apply light hammer blows between coolant pump housing and slide ring seal to eliminate tensions and force-out slide ring seal.



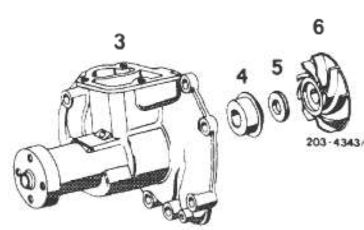
3 Force counter ring out of impeller.



Assembly

4 Slightly coat brass jacket of slide ring seal (4) with sealing compound, then press slide ring seal (4) into bearing housing, by means of pressing-in sleeve.

Attention!
Support at bearing housing only and not against water pump shaft.

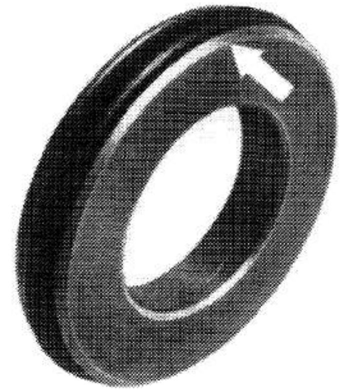


3 Bearing housing
4 Slide ring seal
5 Counter ring with O-ring
6 Impeller

5 Coat sealing ring on counterring with brake cylinder paste and push counterring with chamfered (arrow) into carefully cleaned mounting bore of impeller.

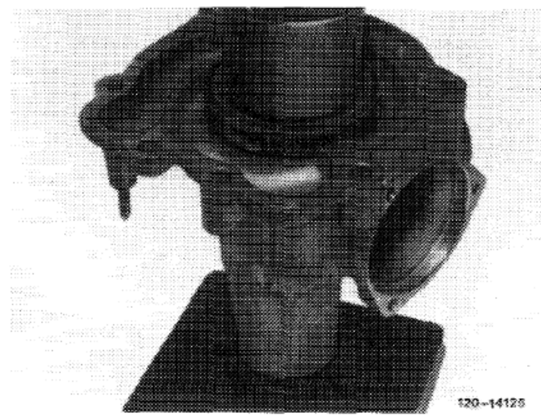
6 Clean sealing surfaces of counterring and slide ring seal free of dust by means of a leather rag.

7 Decrease shaft stub of coolant pump shaft and bore in impeller.



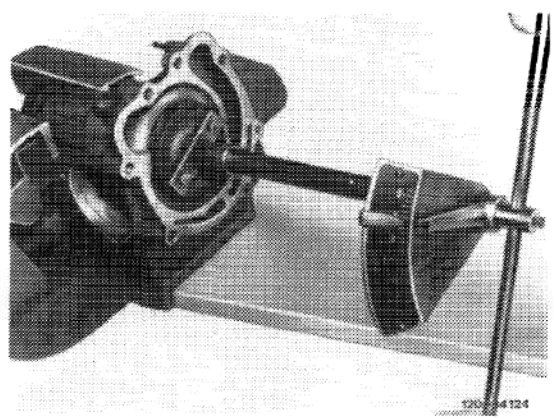
120 - 10863

8 Press-on impeller while supporting coolant pump shaft.



120-14125

9 Check force fit of impeller. Nominal torque min. 35 Nm.



120-14124

20–310 Viscofan coupling, temperature-controlled

Engine 116.980/990, 116.981/991

Function

The viscofan coupling is a service-free, hydraulic coupling which operates independent of temperature as well as infinitely variable.

When the engine is started (cold start), the fan will initially run at higher speed until the oil has flown back from the working chamber (16) into reservoir (15) (approx. 1–3 minutes). The fan coupling will then switch off. The fan speed in disconnected condition depends on engine speed, but a fan speed of approx. 2100/min should not be exceeded.

This condition remains in force, as long as the engine maintains its normal operating temperature.

If the coolant temperature increases as the result of a higher load or high ambient temperatures, the air which flows through the cooler and activates the bimetallic strip will become warmer. The bimetallic strip (10) changes its shape under the increasing heat and opens at approx. 73 °C a valve by means of a control pin (9) and thereby the path of the oil from the reservoir (15) to the work chamber (16) so that the fan will be additionally engaged.

During this control operation, the coolant temperature is between 90 and 95 °C.

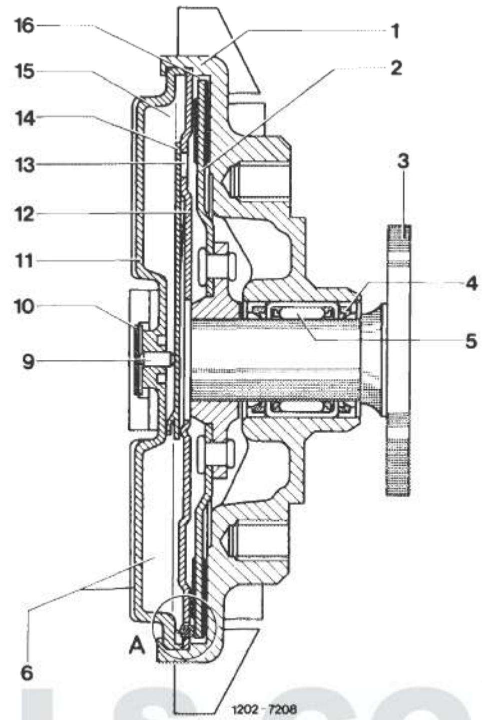
With the coupling engaged, the fan speed in lower speed range will increase approximately proportional with the increasing engine speed, but will not exceed 3500/min in upper speed range.

Checking connected temperature

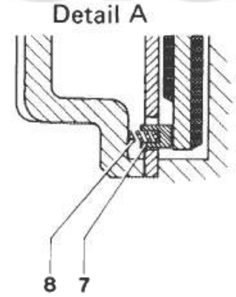
Run engine at 4000–4500/min. When a coolant temperature of 90 to 95 °C is attained, the fan speed should increase by approx. 1000/min, which can be clearly noticed acoustically.

Reconditioning

A defective coupling cannot be repaired with workshop equipment and a new coupling should be installed.



Detail A



1 Coupling body (secondary member)
2 Pulley (primary member)
3 Flange shaft
4 Sealing ring
5 Needle bearing
6 Cooling fins
7 Oil scraper
8 Compression spring
9 Control pin
10 Bimetallic member
11 Cover with holding clip
12 Intermediate washer
13 Feed hole
14 Valve lever
15 Reservoir
16 Work chamber

Transportation and storage

Temperature-controlled viscofan couplings should be transported and stored vertically. For short periods – e.g. during assembly – the coupling may rest on its flange end, but never on front end.

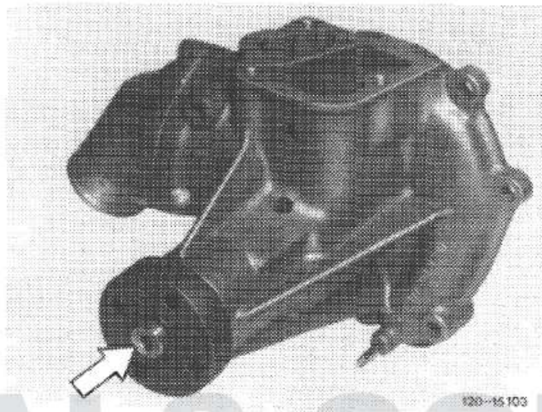
20–320 Viscofan coupling, speed-controlled

Note

The viscofan coupling, part No. 000 200 07 22, has been replaced by the viscofan coupling, part No. 116 200 01 22.

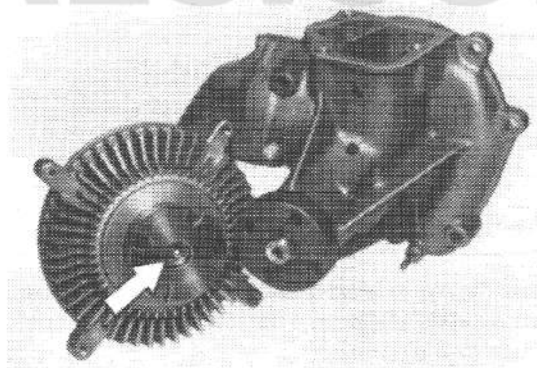
In the event of repairs, the new viscofan coupling may be installed together with coolant pump, part No. 117 200 03 01.

The coolant pump is identified by the 5 reinforcing fins on bearing housing and on bore (arrow) in coolant pump shaft.



120–15 103

The pin (arrow) in flange shaft prevents mounting the new viscofan coupling on a coolant pump of an older version.



120–15 102

Operation

Note: Data without brackets refer to engines 116, those within brackets to engines 117.

On this type of viscofan coupling, the fan speed depends on the engine speed.

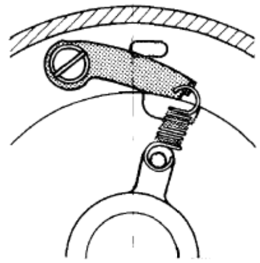
Up to an engine speed of approx. 4650 (3850)/min. the fan runs along proportionally to engine speed, while a fan speed of approx. 3000/min due to the ratio of the belt drive and slip in viscofan coupling may not be exceeded.

At increasing engine speed, the fan speed will drop to approx. 500/min and will attain approx. 600/min at max. speed of engine.

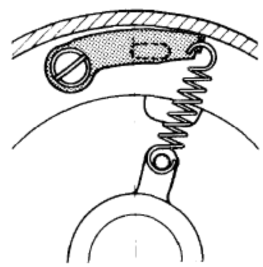
This control step is effected by the spring-loaded closing lever (10), which closes the bore (11) under the influence of centrifugal forces and interrupts the circulation of the power-transmitting fluid.

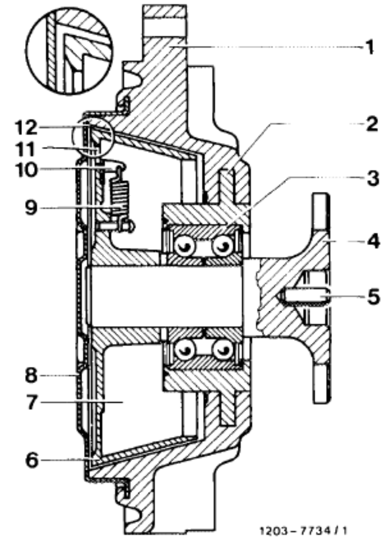
1 Secondary member
2 Steel bushing
3 Two-row angular contact ball bearing
4 Flange shaft
5 Pin
6 Primary or drive pulley
7 Reservoir
8 Closing cover
9 Closing spring
10 Closing lever
11 Feed bore
12 Work gap
A Connecting position
B Disconnecting position

A



B





Checking disconnection

Slowly increase engine speed. At max. 4650 (3850)/min, the drop in fan speed can be clearly heard.

Checking connection

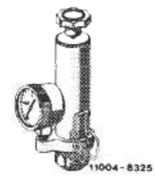
When the engine speed drops, the fan coupling should connect again at approx. 4100 (3400)/min, which can also be clearly heard.

Reconditioning

A defective viscofan coupling cannot be repaired with workshop means and must be replaced.

20–420 Removal and installation of radiator

Tightening torques	Nm
Drain plug radiator	6–10
Drain plug air-oil cooler	25–30

Special tools		
Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for tester	 11004-7124	605 589 00 25 00

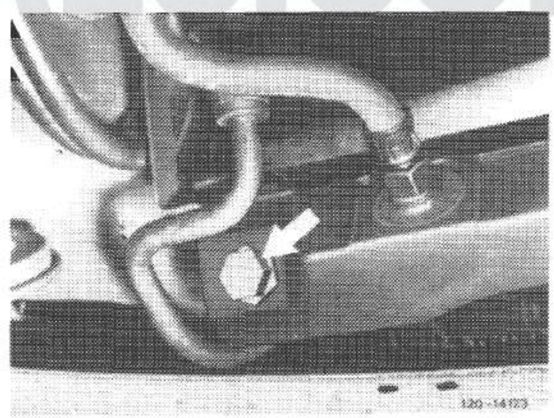
Removal

1 Drain coolant (20–010).

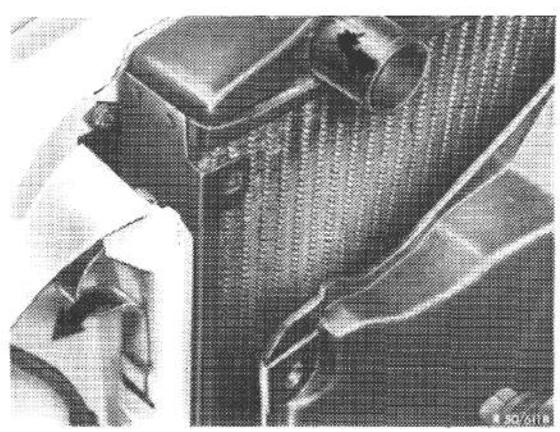
2 Drain oil from air-oil cooler by loosening hose connections.

3 Remove coolant hoses and hose connections. Close oil hoses with plastic caps.

4 Unscrew fan shell.



5 Push holding springs in direction of arrow or push rubber loops out of holder.



6 Lift-out radiator with air-oil cooler in upward direction.

Installation

7 For installation proceed vice versa.

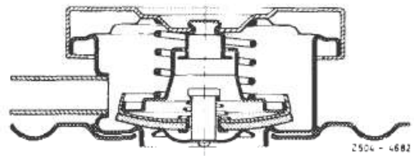
8 Add coolant (20–010).

9 Check cooling system for leaks.

Attention!
The air-oil cooler is made of aluminum. Position coupling nuts of oil hoses carefully and straight.

20–430 Checking radiator or expansion tank cap

Cap

Pressure relief valve opens at	new cap $1.0\ ^{+0.15}_{-0.1}$ bar gauge pressure	 2504-4682
	used cap $1.0\ _{-0.2}$ bar gauge pressure	
Vacuum valve opens at	0.1 bar vacuum	

Special tools

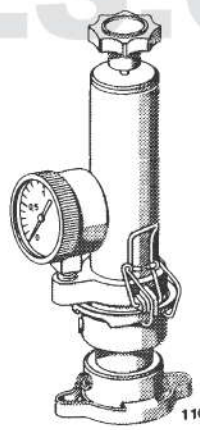
Tester for cooling system and radiator cap	 11004-8325	001 589 48 21 00
Double connection for expansion tank cap for tester	 11004-8326	000 589 73 63 00

Checking pressure relief valve

1 Attach double connection to tester by means of holding clips.

2 Place expansion tank cap on double connection.

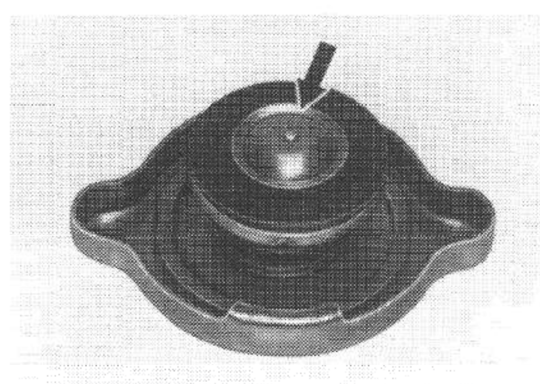
3 Check opening pressure by pumping.



11004-8666

Checking vacuum valve

The vacuum valve (arrow) should rest against rubber gasket, lifting-off should be easy. Valve should snap back when released.



120-14407

22--210 Removal and installation of engine mounts

Engine 116.982/992, 116.984, 117.982/992, 117.985

Engine mount front

1 Unscrew screw (6).

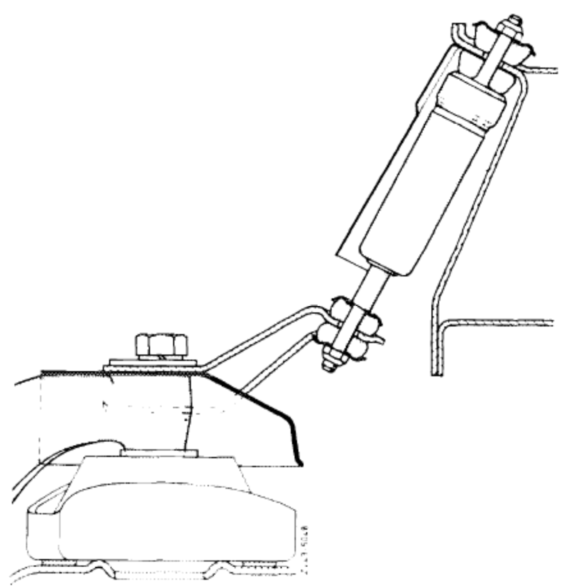
2 Turn holder (8) in lateral direction and remove shielding plate (9).

3 Lift engine at oil pan by means of pit lift.

Note: Use wooden shim to avoid damaging oil pan.

4 Unscrew engine carrier on engine and remove.

5 Unscrew engine mount on front axle carrier and remove.



6 For installation proceed vice versa.

7 Tighten screw (6) to 75 Nm.

Attention!
Check regulating linkage for function.

1 Nut
2 Disc washer
3 Rubber buffer
4 Shielding plate
5 Engine shock absorber
6 Fastening screw
7 Spring washer
8 Holder
9 Shielding plate
10 Engine carrier right
11 Engine carrier left
12 Washer
13 Screw
14 Combination screw
15 Engine mount

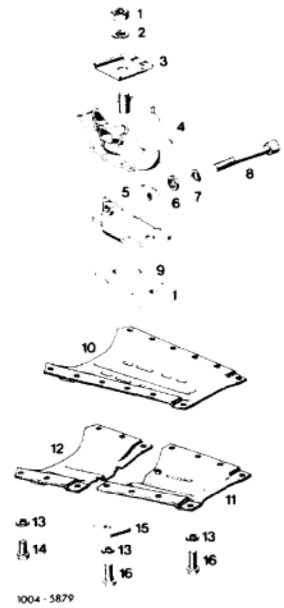
Engine mount rear

Attention!
Do not unscrew closing plate for removing engine mount (4).

During installation, attach engine mount to closing plate free of tension.

Upon installation of engine mount, loosen adjusting screw (8), run engine for a short moment at idle. With the engine stopped, tighten adjusting screw (8) to 25 Nm.

Attention!
Check regulating linkage for function.



1 Nut M 12 x 1.5
2 Spring washer B 12
3 Holding plate
4 Holder
6 Washer 8.4
7 Snap ring A 8
8 Adjusting screw M 8 x 75
9 Shim
10 Closing plate manual transmission
11 Closing plate automatic transmission
12 Closing plate automatic transmission
13 Snap ring A 8
14 Screw M 8 x 20
15 Shim
16 Screw M 8 x 32

Engine 116.980/990, 116.981/991, 117.981, 117.984

Engine mount front

1 Unscrew lefthand engine shock absorber on upper suspension.

2 Unscrew righthand engine shock absorber on lower suspension.

3 Unscrew screw for engine carrier on engine mount.

4 Lift engine at oil pan with pit lift.

Note: Use wooden shim to avoid damaging oil pan.

When lifting engine, make sure that the breather is not caught at radiator shell.

On vehicles with air suspension, observe notes concerning assembly jobs (workshop manual "Passenger car models starting 1968", job No. 32–11).

5 Unscrew engine mount on front axle carrier and remove.

6 For installation proceed vice versa.

Attention!
Check regulating linkage for function.

Engine mount rear

1 Unscrew hex. nut for engine mount on transmission.

2 Disconnect brake cable at front and take out of cable guide.

3 Unscrew engine mount from engine carrier.

4 Lift engine at transmission with pit lift.

5 Unscrew engine carrier and remove engine mount.

6 For installation proceed vice versa.

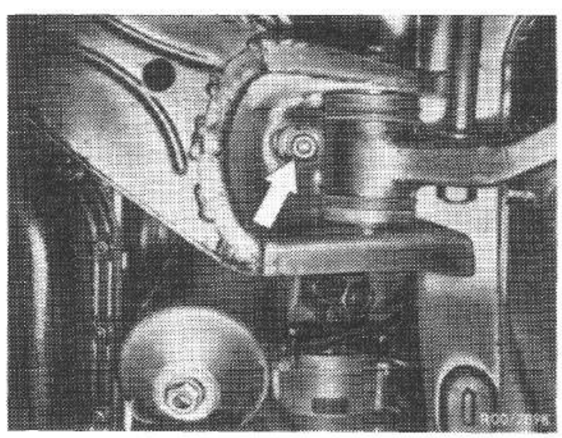
Attention!
Check regulating linkage for function.

Engine 116.983/993, 116.985, 117.983/993, 117.986

Engine mount front

1 Unscrew screw for engine carrier on engine mount (arrow).

2 Loosen engine shock absorber on front axle carrier.



3 Lift engine at oil pan with pit lift.

Note: Use wooden shim to avoid damaging oil pan.

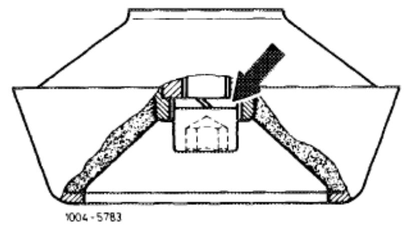
4 Unscrew engine carrier on engine and remove together with engine shock absorber and shielding plate.

5 Unscrew engine mount on engine carrier and remove.

6 For installation proceed vice versa.

Attention!
Snap ring (arrow) should not be too large.

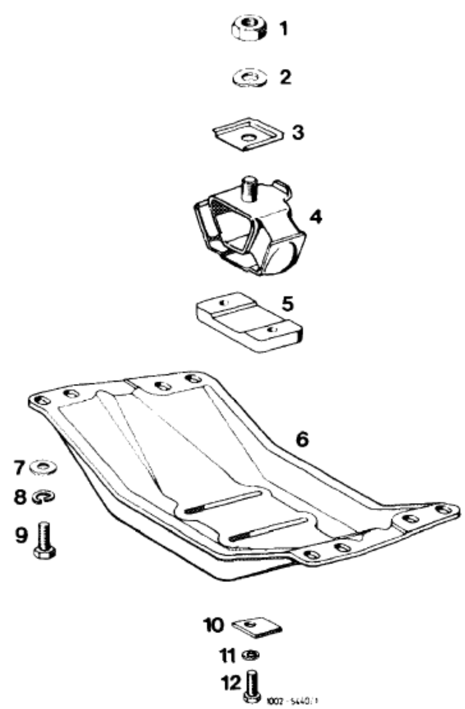
Check regulating linkage for function.



Engine mount rear

Attention!
Do not unscrew engine carrier (6) for removing engine mount (4).

Check shim (5) for correct installation position.



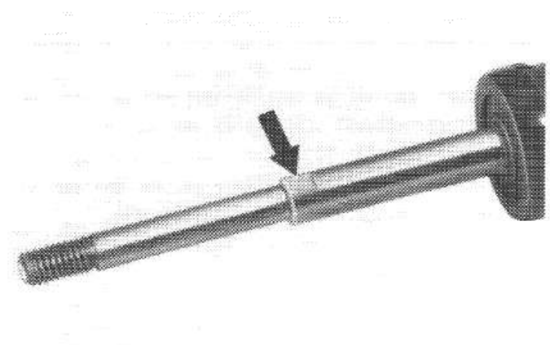
1	Nut M 12 x 1.5	7	Washer
2	Spring washer	8	Snap ring
3	Holding plate	9	Screw
4	Engine mount	10	Shim
5	Shim	11	Snap ring
6	Engine carrier	12	Screw

22–240 Removal and installation of engine shock absorber

Tightening torque	Nm
Engine shock absorber fastening hex. nut M 6	8–12

Note

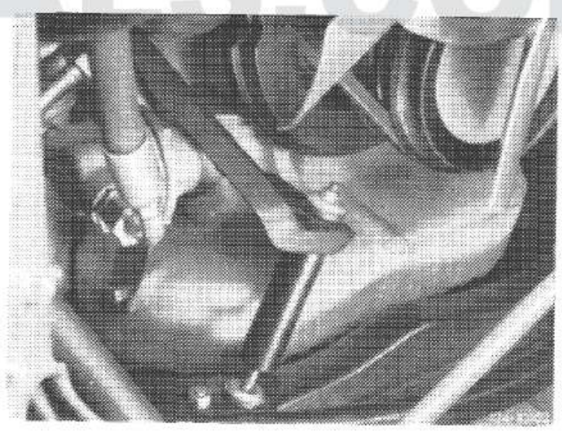
For loosening and tightening lower hex. nut apply counterhold against piston rod at wrench flat (arrow) provided for this purpose. Be sure to apply tightening torque 8–12 Nm. Do not tighten to limit.



100 – 13099

Engine 116.982/992, 116.984, 117.982/992, 117.985

Engine shock absorber right, 1st version



1 Unscrew engine shock absorber on holder and on front axle carrier.

2 Lift engine at oil pan with pit lift.

Use wooden shim to avoid damaging oil pan.

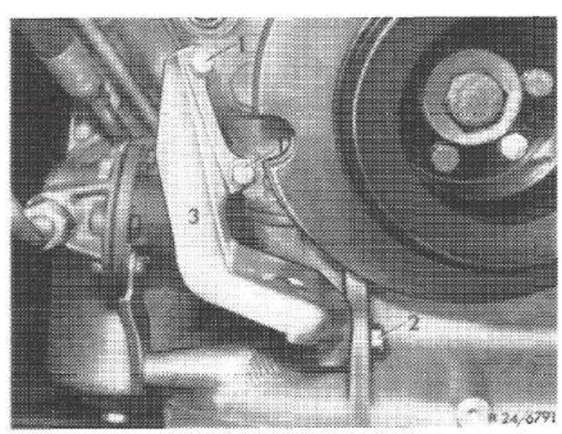
When lifting engine, make sure that the breather is not caught at radiator shell and that the engine mounts are not damaged.

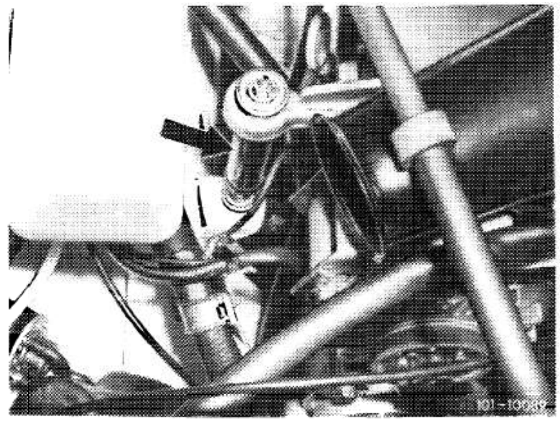
3 Remove engine shock absorber.

Attention!
On the following models a washer, part No. 115 990 75 40, must be placed into the two spot facings in timing housing cover for screws (1) between holder (3) and timing housing cover:

Model 107.043 up to chassis end No. 002375.
Model 107.044 up to chassis end No. 000355.

On chassis with the above end numbers, the contact surfaces on timing housing cover were milled flat.



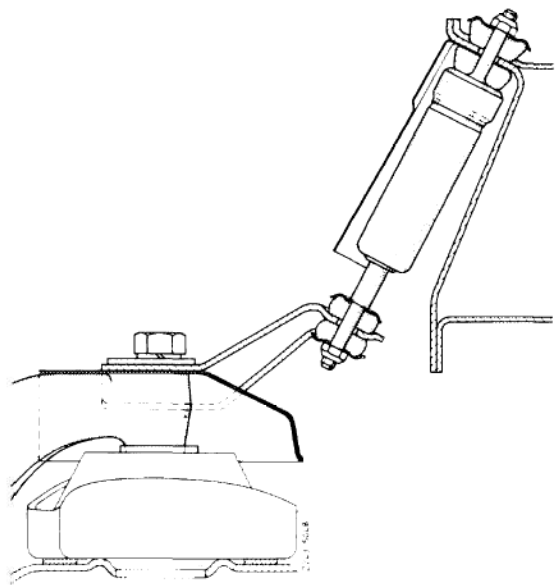


(USA) starting 1975

Engine shock absorber right, 2nd version

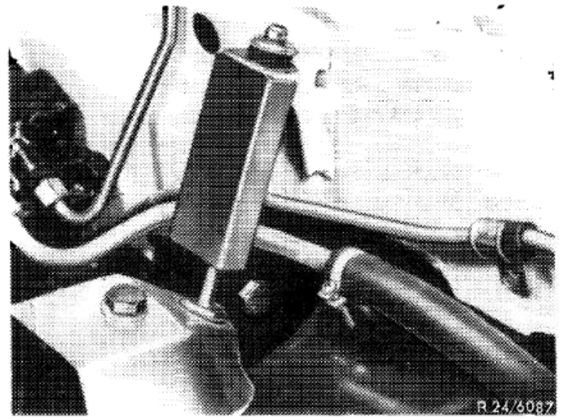
1 Loosen upper hex. nut and force engine shock absorber from holder.

2 Unscrew hex. screw on engine mount and remove engine shock absorber together with holder.



3 Unscrew engine shock absorber from holder.

4 For installation proceed vice versa.



Engine 116.980/990, 116.981/991, 117.981, 117.984

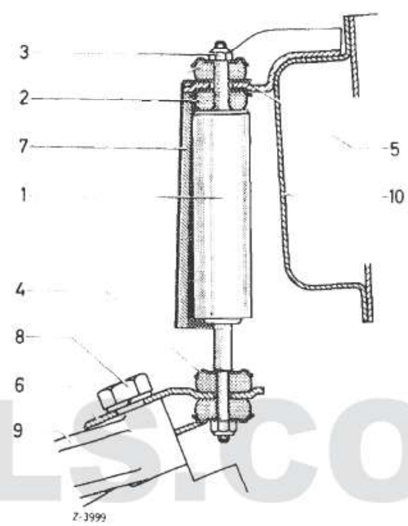
Engine shock absorber left

1 Loosen upper hex. nut and force engine shock absorber from holder.

2 Unscrew hex. bolts on engine mount and remove engine shock absorber together with holder.

3 Unscrew engine shock absorber from holder.

4 For installation proceed vice versa.



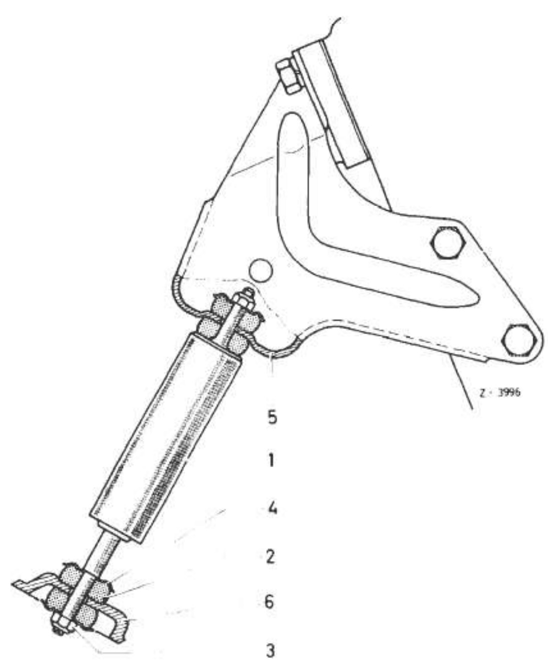
Lefthand shock absorber seen from the front

1 Engine shock absorber
2 Rubber buffer
3 Hex. nut
4 Disc washer
5 Holder
6 Holder
7 Shielding plate
8 Hex. screw
9 Engine carrier
10 Frame side member

Engine shock absorber right

1 Loosen screw for engine carrier on engine mount (do not unscrew completely).

2 Unscrew engine shock absorber at top and bottom suspension.



Righthand engine shock absorber seen from the front

1 Engine shock absorber
2 Rubber buffer
3 Hex. nut
4 Disc washer
5 Holder
6 Carrier

3 Lift engine at oil pan with pit lift.

Use wooden shim to avoid damaging oil pan.

When lifting engine, make sure that breather is not caught at radiator shell,

4 Remove engine shock absorber.

5 For installation proceed vice versa.

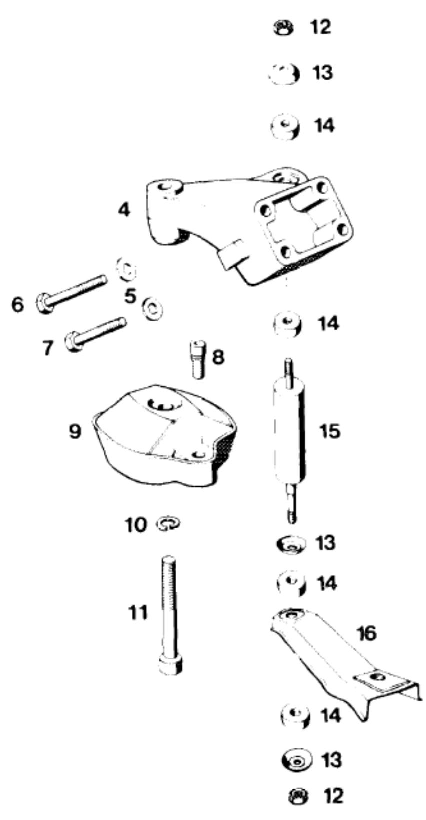
Engine 116.983, 993, 116.985, 117.983/993, 117.986

Engine shock absorber left and right

1 Loosen hex. nut (12) top and bottom.

2 Compress engine shock absorber and remove.

3 For installation proceed vice versa.



1	Screw	9	Engine mount
2	Spring washer	10	Snap ring
3	Shielding plate	11	Screw M 12 x 50
4	Engine carrier	12	Nut
5	Washer	13	Disc washer
6	Screw M 8 x 75	14	Rubber buffer
7	Screw M 8 x 60	15	Engine shock absorber
8	Combination screw	16	Holder on side member

30–300 Adjusting regulating linkage

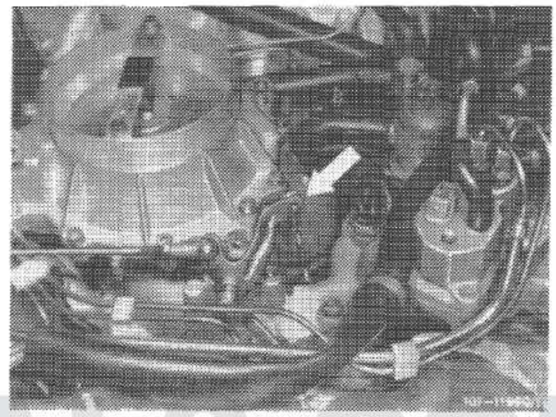
Adjusting data in mm

Model	107	116
Length of connecting rod from throttle valve housing to guide lever	104	
Length of connecting rod (21) from accelerator pedal to guide lever	122	
Length of pushrod (5) from longitudinal regulating shaft to accelerator pedal	105	60

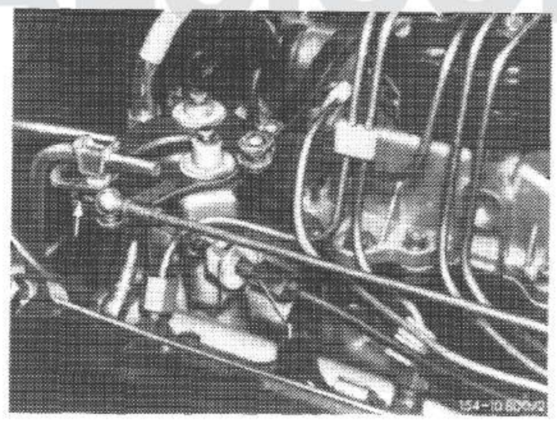
Adjusting

1 Check regulating linkage for easy operation and distortion. Replace linkage, if required.

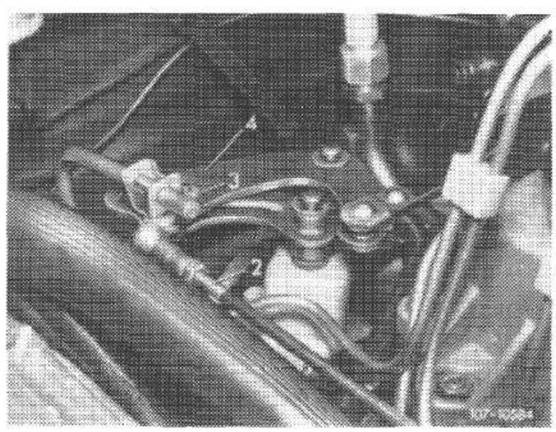
2 Disconnect connecting rod (arrow) on guide lever. Check whether throttle valve rests against idle speed stop. Reattach connecting rod free of tension and set to specified length, if required.



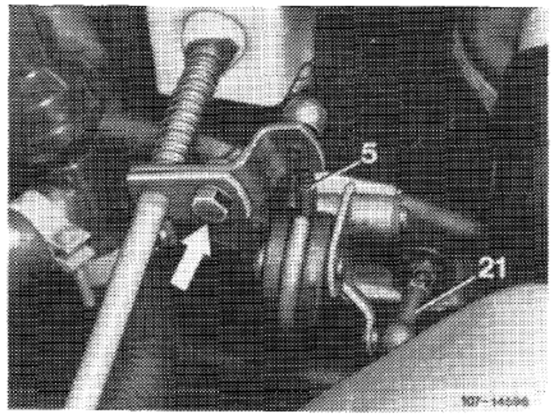
3 Vehicles with cruise control/tempomat.
Check whether bowden wire for cruise control/tempomat rests free of tension against regulating lever. Adjust with adjusting screw (1), if required.



4 Adjust connecting rod (2) in such a manner that roller (3) in gate lever (4) rests free of tension against end stop.



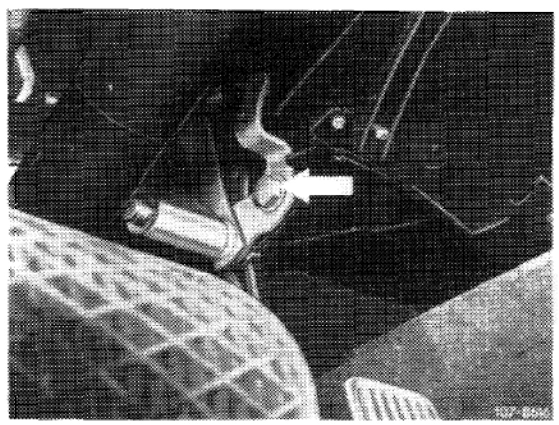
Checking full throttle stop



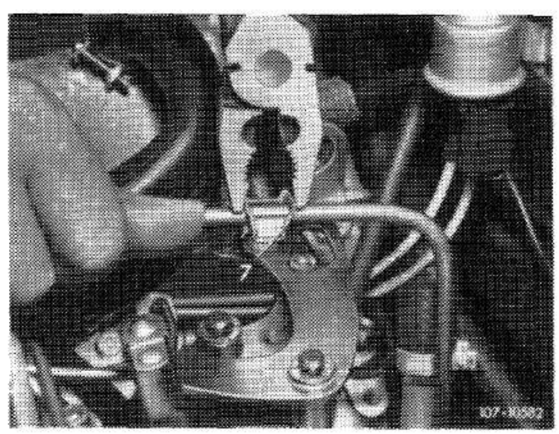
5 With engine stopped, step on accelerator pedal from inside vehicle down to full throttle stop or on automatic transmission up to stop on kickdown switch. The throttle valve lever should rest against full throttle stop. Loosen adjusting screw (arrow) if required, adjust regulating linkage in such a manner that the throttle valve lever rests against full throttle stop.

If full throttle or idle speed stop is not attained with this adjustment, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to specified length, measured from center of ball socket to center of damping ring.

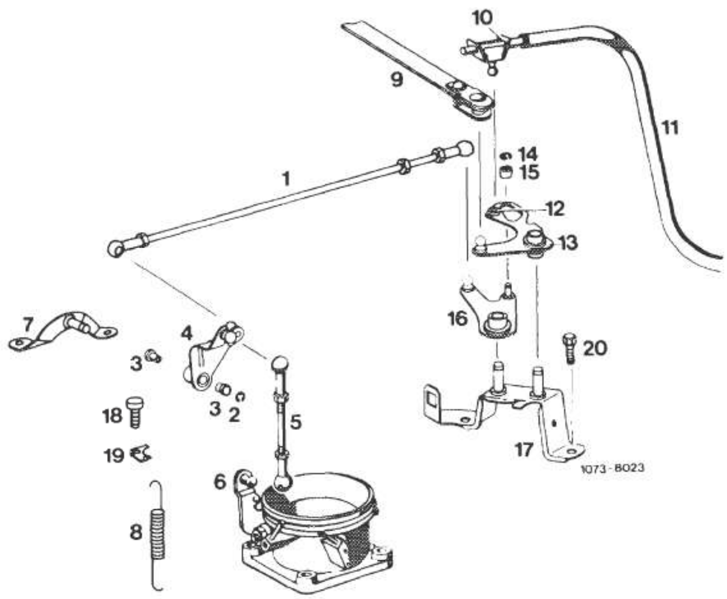
If on model 116 the full throttle or idle speed stop is not attained by means of the adjustment named above, set connecting rod (21) from guide lever engine compartment to accelerator pedal to 122 mm, measured from center of ball socket to center of ball socket. Adjust regulating lever inside vehicle, if required. For this purpose, loosen fastening screw (arrow), pull accelerator pedal slightly in upward direction and tighten fastening screw again.



6 Adjust control pressure rod (at idle speed position). For this purpose, compress adjusting clip (7) with pliers and push control pressure rod completely to the rear against stop.



Engine regulation



1 Regulating rod
2 Locking ring
3 Plastic bushing
4 Guide lever
5 Connecting rod
6 Throttle valve housing
7 Bearing bracket
8 Return spring
9 Connecting rod to longitudinal regulating shaft
10 Adjusting clip
11 Control pressure rod
12 Plastic bushing
13 Gate lever
14 Locking ring
15 Roller
16 Angle lever
17 Bearing bracket
18 Screw
19 Holder
20 Screw

30–320 Removal, installation and adjustment of front wall regulating shaft

A. Model 107

Adjusting data in mm

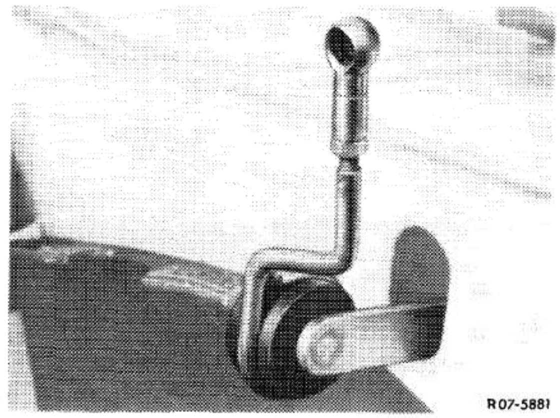
Length of pushrod (5) from longitudinal regulating shaft to accelerator pedal	105

Removal

1 Push regulating rod with damping ring from lever of regulating shaft.

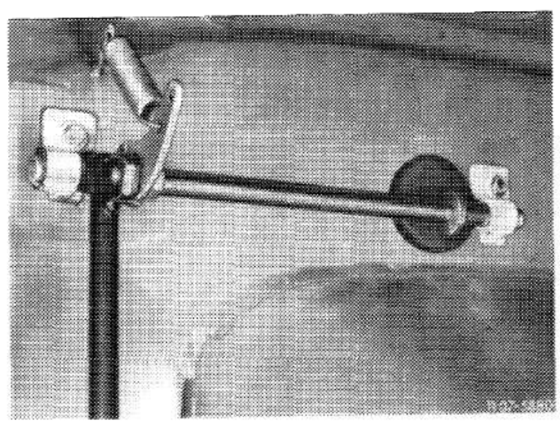
2 Remove accelerator pedal (30–330).

3 Remove heater box (83–100).



4 Disconnect return spring and screw hex. head sheet-metal screws from plastic bearings.

5 Push out plastic bearing in upward direction and remove regulating shaft with bearing.

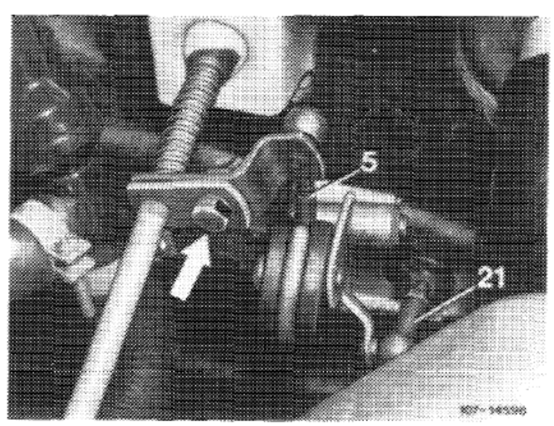


Installation

6 For installation proceed vice versa, while attaching return spring to inner hole. Grease bearing points as well as ball sockets of regulation with Molykote-Longterm 2.

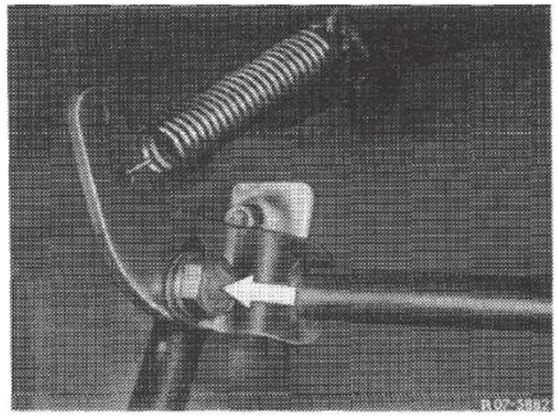
Adjustment

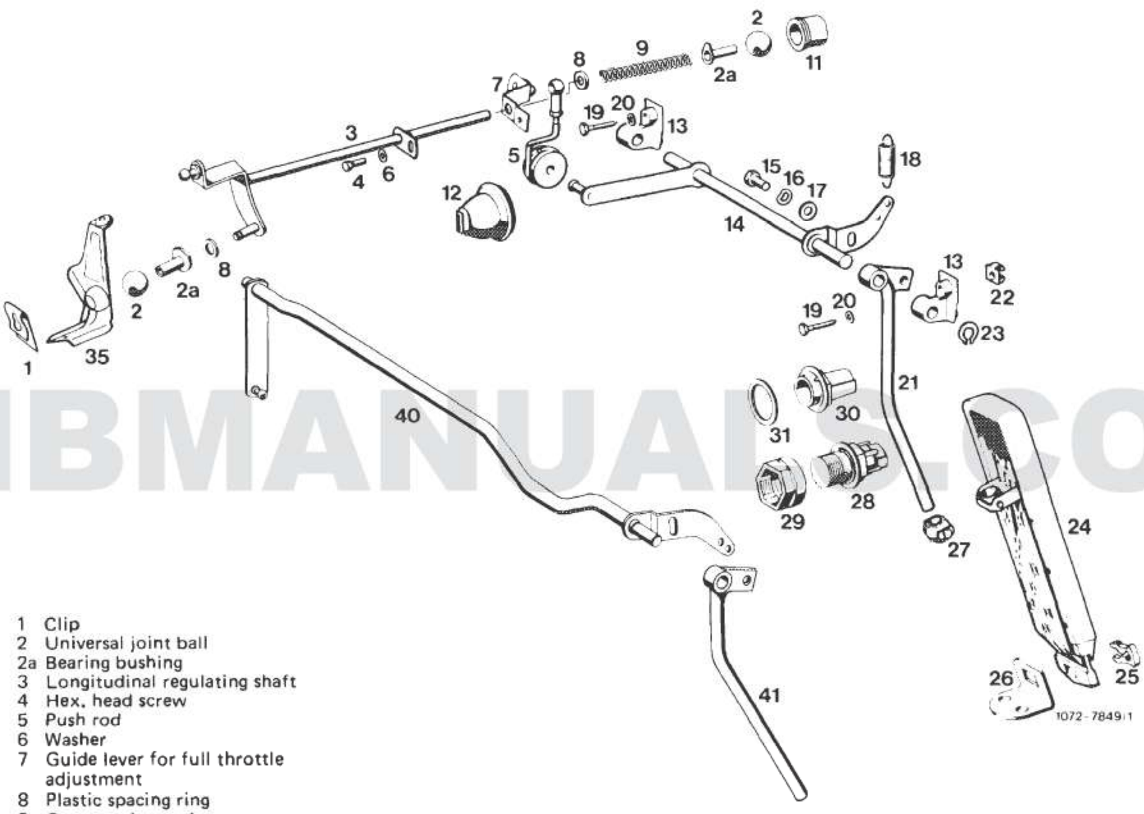
6 With engine stopped, step on accelerator pedal from inside vehicle up to full throttle stop or with automatic transmission up to stop on kickdown switch. Throttle valve lever should rest against full throttle stop. Loosen adjusting screw (arrow) if required, adjust regulating linkage in such a manner that the throttle valve lever rests against full throttle stop.



If the full throttle or idle speed stop is not attained with this adjustment, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to specified length, measured from center of ball socket to center of damping ring.

If the full throttle or idle speed stop is not attained with the previous adjustment, loosen hex. screw (arrow) inside vehicle, push regulating linkage up to full throttle stop on throttle valve housing and tighten hex. screw again.





1 Clip
2 Universal joint ball
2a Bearing bushing
3 Longitudinal regulating shaft
4 Hex. head screw
5 Push rod
6 Washer
7 Guide lever for full throttle adjustment
8 Plastic spacing ring
9 Compression spring
11 Bearing for longitudinal regulating shaft
12 Rubber grommet
13 Bearing
14 Front wall regulating shaft
15 Hex. head screw
16 Corrugated washer
17 Washer
18 Return spring
19 Screw
20 Washer
21 Accelerator pedal
22 Cage nut
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
30 Full throttle stop
31 Washer
35 Bearing for longitudinal regulating shaft
40 Front wall regulating shaft for righthand steering
41 Accelerator pedal lever for righthand steering

B. Model 116

Adjusting data in mm

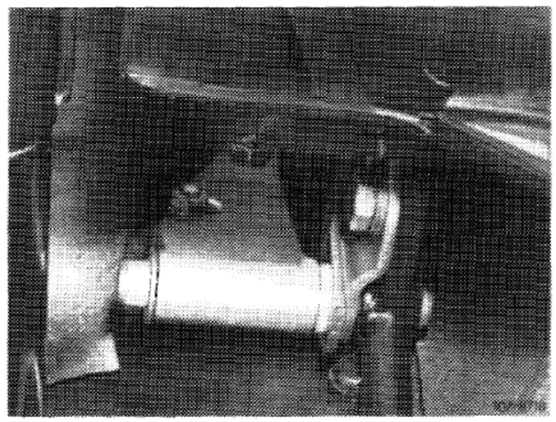
Length of connecting rod (21) from accelerator pedal to guide lever	122
Length of pushrod (5) from longitudinal regulating shaft to accelerator pedal	60

Removal

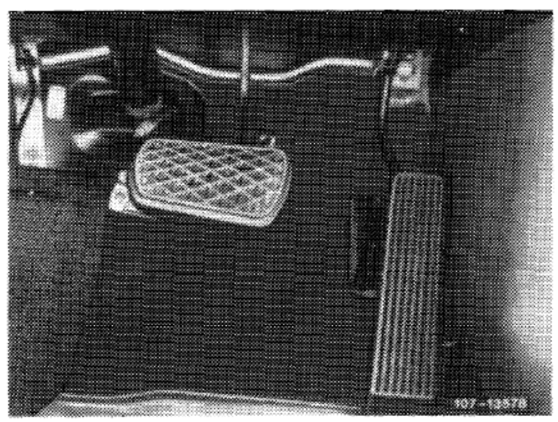
1 Remove accelerator pedal (30–330).

2 Disconnect connecting rod.

3 Disconnect return spring, unscrew fastening nuts from bearing bracket and remove regulating shaft with bearing bracket.



Lefthand steering



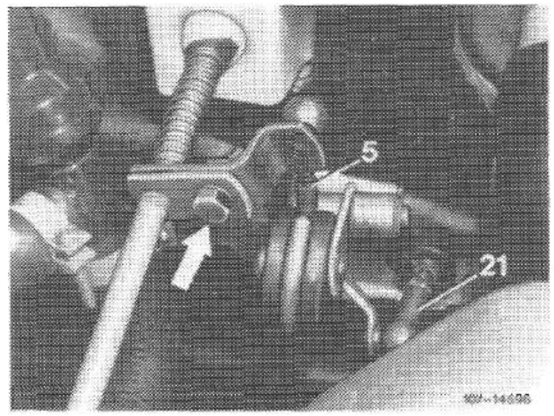
Righthand steering

Installation

4 For installation proceed vice versa, while attaching return spring to inner hole. Grease bearing points as well as ball sockets of regulation with Molykote-Longterm 2.

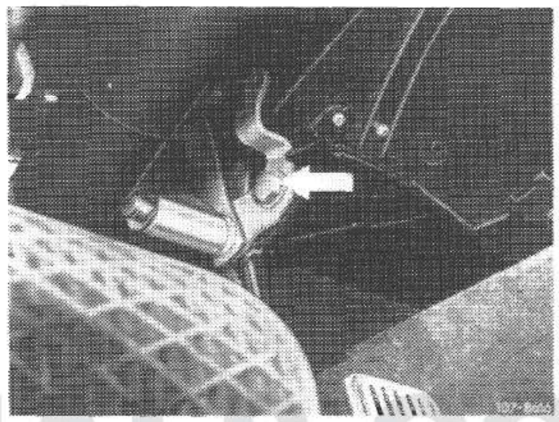
Adjustment

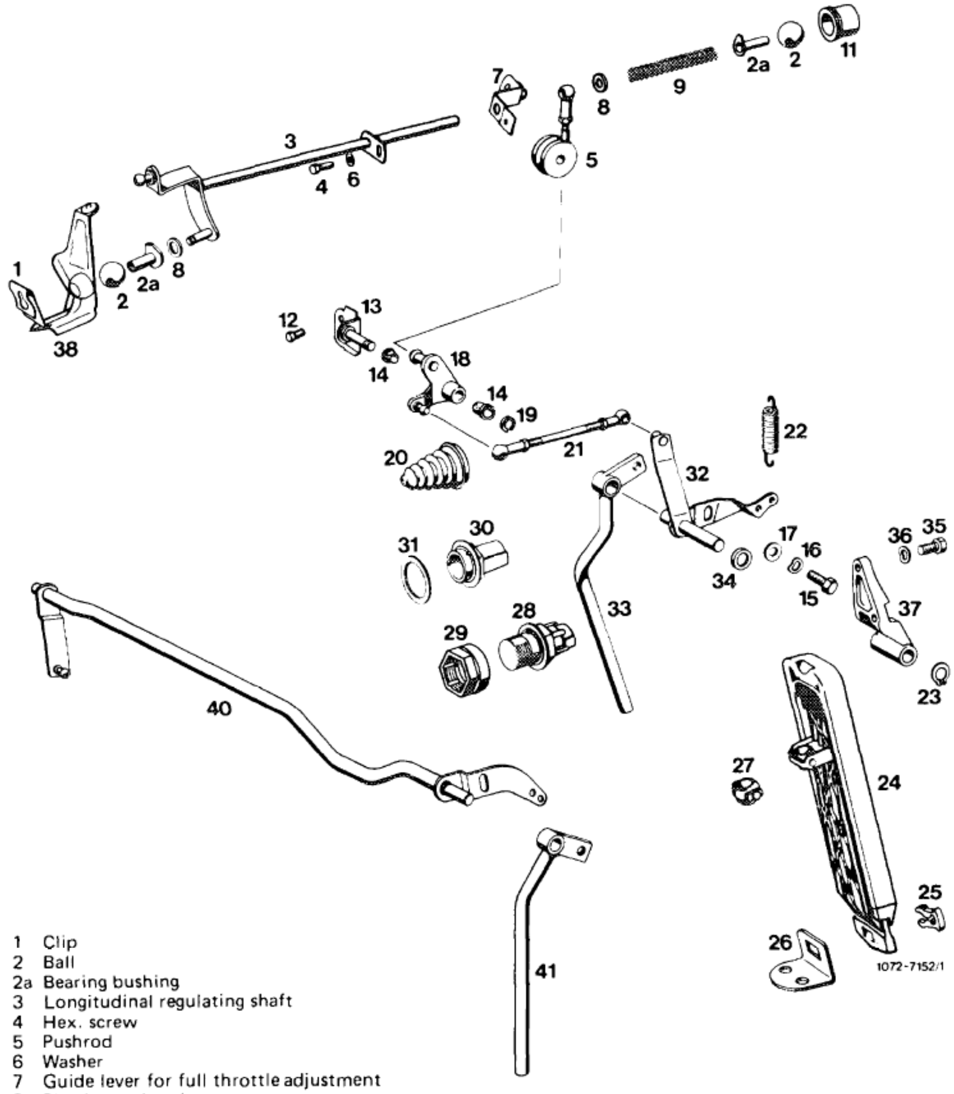
5 With the engine stopped, step on accelerator pedal from inside vehicle up to full throttle stop or with automatic transmission up to stop on kickdown switch. Throttle valve lever should rest against full throttle stop. Loosen adjusting screw (arrow) if required, and adjust regulating linkage in such a manner that the throttle valve lever rests against full throttle stop.



If the full throttle or idle speed stop is not attained with this adjustment, set pushrod (5) from longitudinal regulating shaft to accelerator pedal to specified length, measured from center of ball socket to center of damping ring.

If the full throttle or idle speed stop is not attained with the previous adjustment, set connecting rod (21) from guide lever engine compartment to accelerator pedal to 122 mm, measured from center of ball socket to center of ball socket. Adjust regulating lever inside vehicle, if required. For this purpose, loosen fastening screw (arrow), pull accelerator pedal slightly up and tighten fastening screw again.

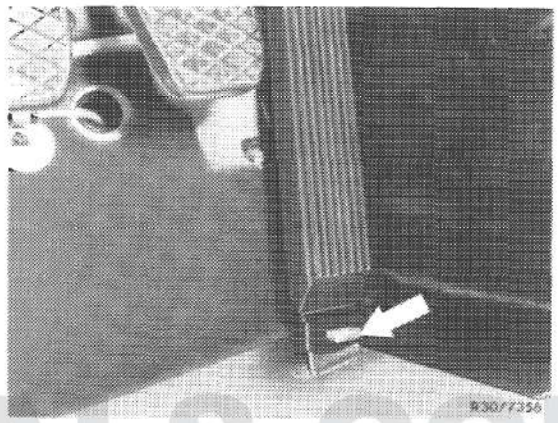




1 Clip
2 Ball
2a Bearing bushing
3 Longitudinal regulating shaft
4 Hex. screw
5 Pushrod
6 Washer
7 Guide lever for full throttle adjustment
8 Plastic spacing ring
9 Compression spring
11 Bearing for longitudinal regulating shaft
12 Hex. screw
13 Bearing
14 Plastic bushing
15 Hex. screw
16 Undulated washer
17 Washer
18 Guide lever
19 Lock
20 Rubber grommet
21 Connecting rod
22 Return spring
23 Lock
24 Accelerator pedal
25 Clip
26 Fastening plate
27 Joint
28 Kickdown switch
29 Adjusting nut
30 Full throttle stop
31 Washer
32 Guide lever
33 Accelerator pedal lever
34 Plastic spacing ring
35 Screw
36 Undulated washer
37 Bearing
38 Bearing for longitudinal regulating shaft
40 Front wall regulating shaft for righthand steering
41 Accelerator pedal lever for righthand steering

30–330 Removal and installation of accelerator pedal

Removal



1 Compress spreader clip (arrow) behind accelerator pedal and pull out.

Installation

2 During installation, make sure that the spreader clip is reliably engaging.

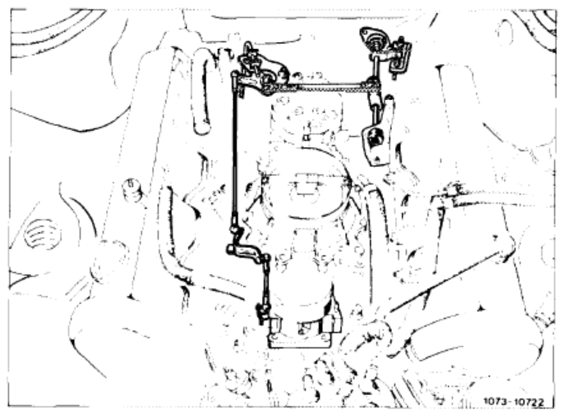
30–335 Lubricating regulating linkage and regulating shafts

Lubricating

Following each engine wash and preservation of engine compartment, lubricate all bearing points of all regulating shafts, regulating levers, joints of regulating linkage and cable controls with an oil can.

On vehicles in **USA version** use only the following hydraulic fluids for this purpose:

BP-Aero-Hydraulic
Catrol DB Hydraulik Fluid
Esso Univers J-13
Mobil Aero HFA
Shell Aero Fluid 4



47–700 Removal and installation of fuel tank

Filling capacities in litres

Model	107	116
Full readout	approx. 90	approx. 96
Warning light – reserve	11–13	

Tightening torques		Nm	(kpm)
Fastening screws or fastening nuts for fuel tank		20–25	(2–2.5)
Immersion tube transmitter	with O-ring	20–30	(2–3)
	with cork seal	3–4	(0.3–0.4)

Special tool

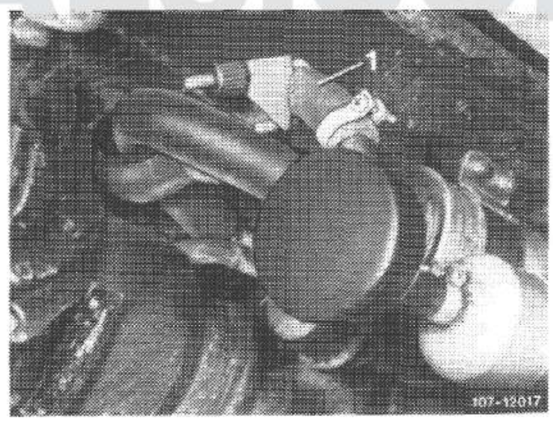
Clamp for fuel hose		000 589 40 37 00

Attention!
When removing fuel tank, pay attention to safety rules.

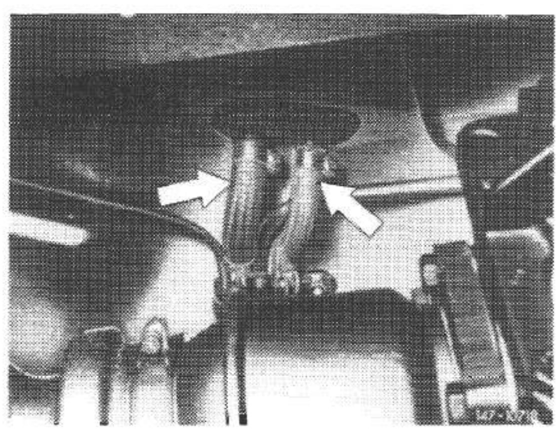
Removal

1 Disconnect (pinch) fuel suction hose (1) with a clamp.

2 Loosen fuel suction hose on damper reservoir and pull-off. Loosen clamp and drain fuel.

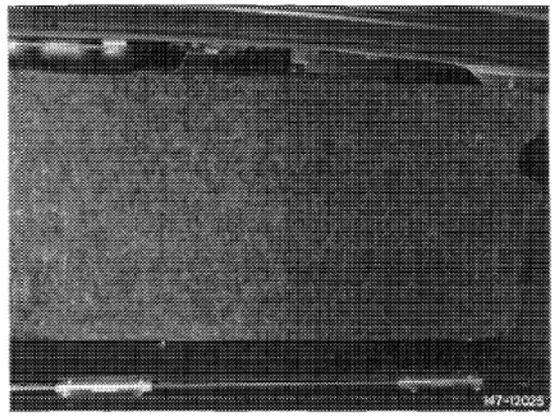


3 Loosen fuel return hose and breather hose on fuel tank and pull-off (arrows).

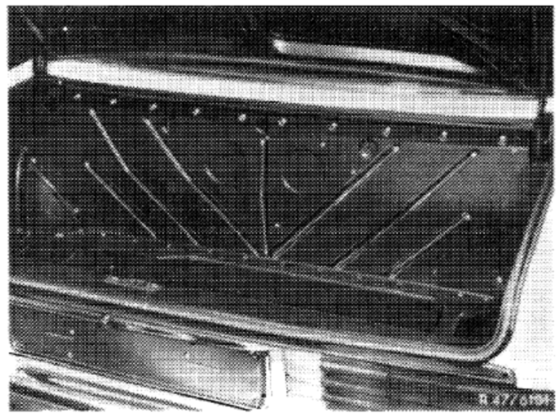


4 Remove rubber mat and vehicle jack from trunk.

5 Unscrew rear wall and remove.

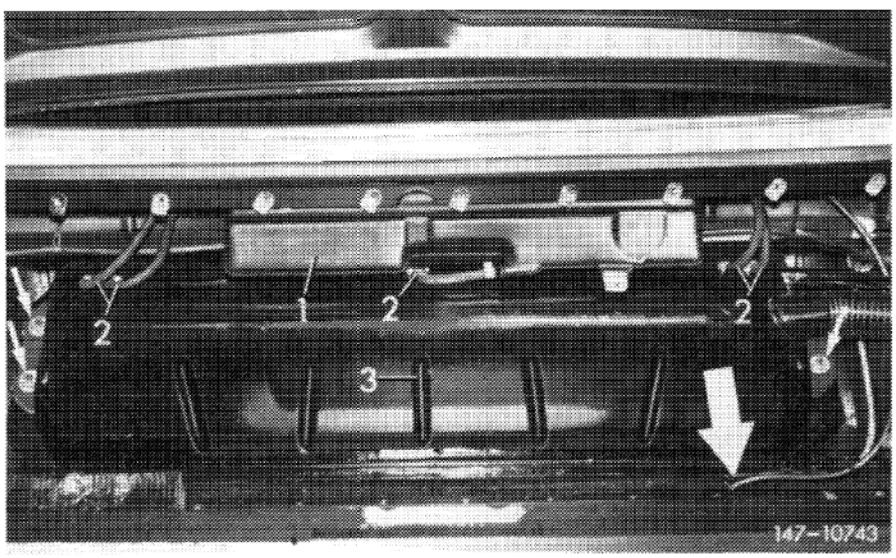


Model 107.02, 116



Model 107.04

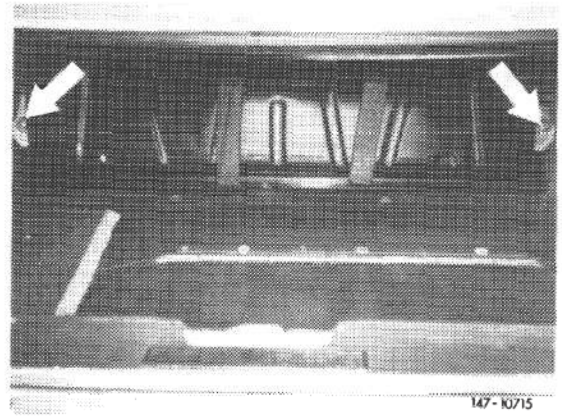
6 On model 107.04 remove fuel hoses (2) to expansion tank on fuel tank.



Model 107.04

7 Loosen fuel tank fastening screws or fastening nuts (arrows).

8 Remove fuel tank, while pulling cable plug connection from immersion tube transmitter and protect against slipping by means of a wire.



147-10715

Installation

9 Install fuel tank in vice versa sequence, proceed as follows:

a) Check whether foam rubber strips on fuel tank are tight, glue down if required.

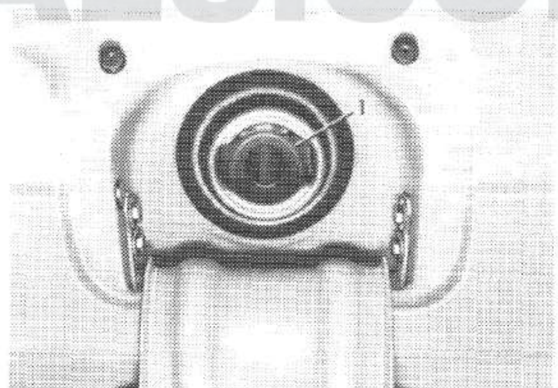
b) Mount fuel tank with specified reinforcing shims and washers.

c) Pay attention to correct seat of rubber sleeve on fuel filler neck.

d) Prior to slipping fuel tank completely into tank mount, plug-on cable plug connection of immersion tube transmitter.

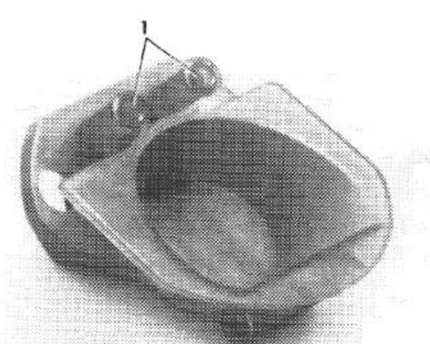
(USA) model year 1975

On these vehicles, the small size of the dispensing guns for lead-free fuel requires a guide funnel (1) installed in filler neck.



147-10052

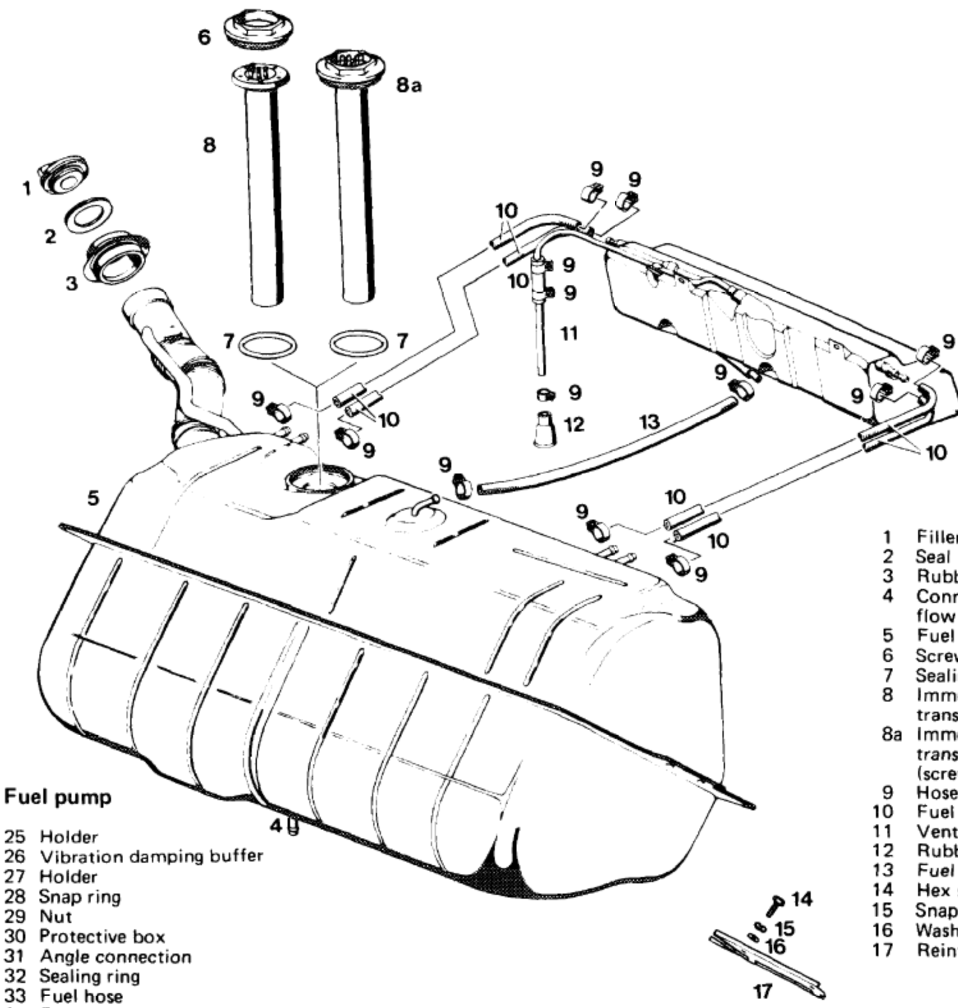
If the fuel tank of such a vehicle is replaced, also install a guide funnel on **USA vehicles only.** For this purpose, place guide funnel into filler neck prior to assembly of fuel tank and knock-in fastening rivets (1) with a mandrel up to stop.



147-10021

Fuel system, fuel tank breathing system (positive and negative venting)

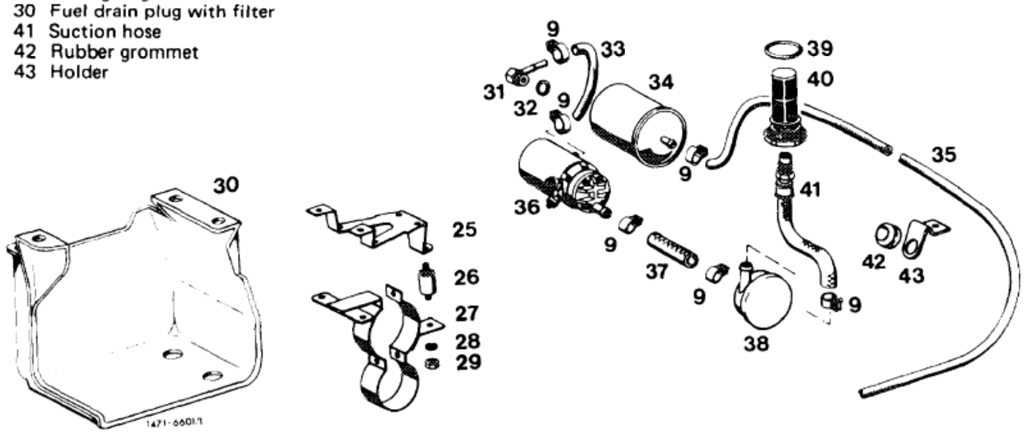
Model 107.04



1 Filler cap
2 Seal
3 Rubber sleeve
4 Connection for fuel return flow
5 Fuel tank
6 Screw flange
7 Sealing ring
8 Immersion tube transmitter 1st version
8a Immersion tube transmitter 2nd version (screw type)
9 Hose clip
10 Fuel hose
11 Vent tube
12 Rubber grommet
13 Fuel hose
14 Hex screw
15 Snap ring
16 Washer
17 Reinforcing shim

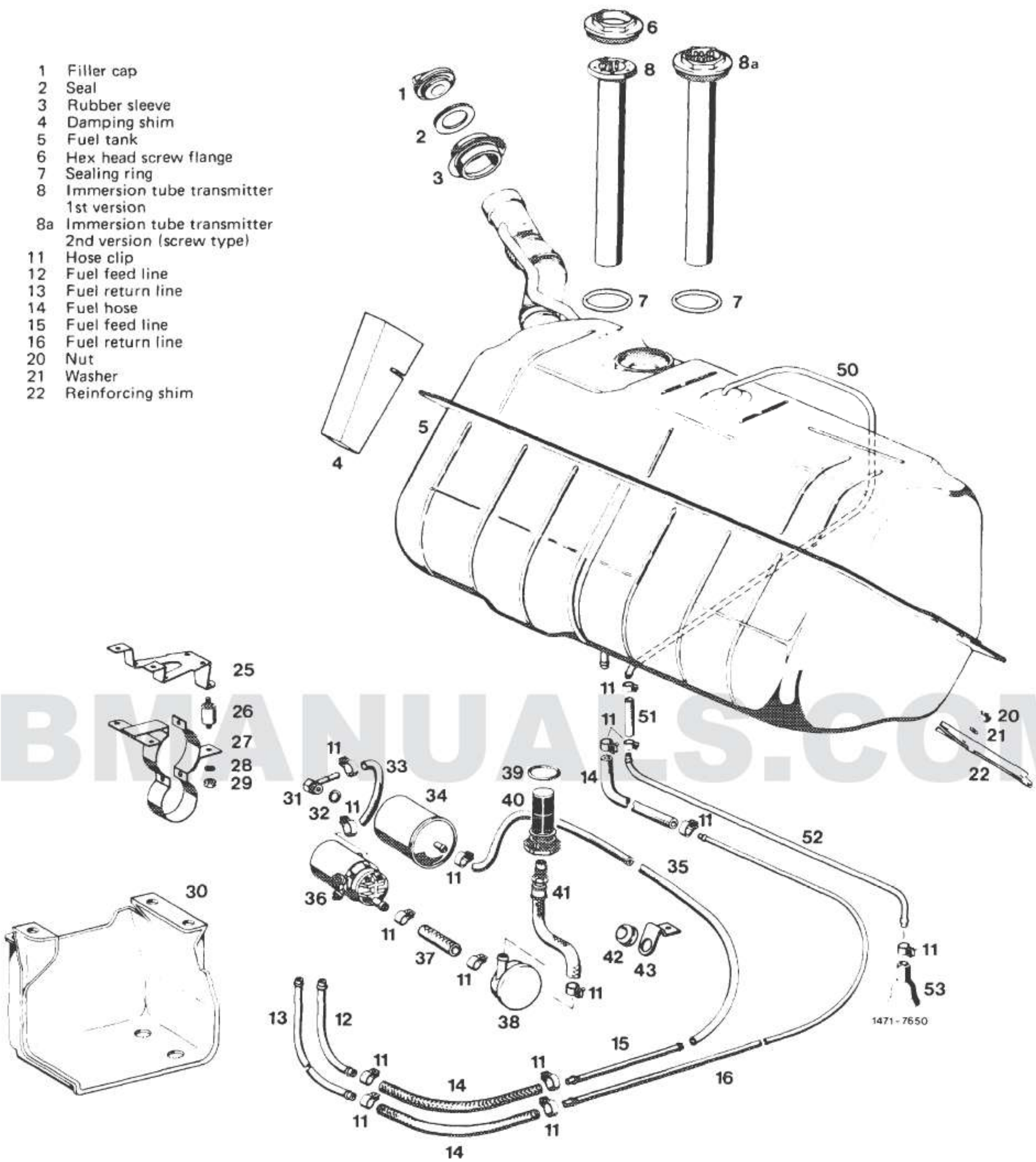
Fuel pump

25 Holder
26 Vibration damping buffer
27 Holder
28 Snap ring
29 Nut
30 Protective box
31 Angle connection
32 Sealing ring
33 Fuel hose
34 Fuel filter
35 Fuel hose
36 Fuel pump
37 Fuel hose
38 Damper container
39 Sealing ring
30 Fuel drain plug with filter
41 Suction hose
42 Rubber grommet
43 Holder



Model 107.02, 116

1 Filler cap
2 Seal
3 Rubber sleeve
4 Damping shim
5 Fuel tank
6 Hex head screw flange
7 Sealing ring
8 Immersion tube transmitter 1st version
8a Immersion tube transmitter 2nd version (screw type)
11 Hose clip
12 Fuel feed line
13 Fuel return line
14 Fuel hose
15 Fuel feed line
16 Fuel return line
20 Nut
21 Washer
22 Reinforcing shim



Fuel pump

25 Holder
26 Vibration damping buffer
27 Holder
28 Snap ring
29 Nut
30 Protective box
31 Angle connection
32 Sealing ring
33 Fuel hose
34 Fuel filter
35 Fuel hose
36 Fuel pump
37 Fuel hose
38 Damper container
39 Sealing ring
40 Fuel drain plug with filter
41 Fuel suction hose
42 Rubber r rommet
43 Holder

Fuel tank

50 Vent line
51 Fuel hose
52 Vent line
53 Rubber grommet

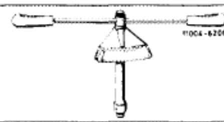
47–700 Removal and installation of fuel tank

Filling capacities in liters

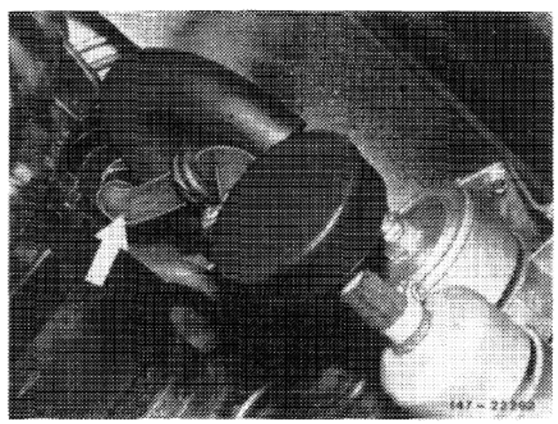
Model	107	116
Full readout	approx. 90	approx. 96
Warning lamp – reserve	11–13	

Tightening torques	Nm
Fastening screws or fastening nuts for fuel tank	17–25
Immersion tube transmitter	35–43
Fuel strainer	35–43

Special tool

Torque wrench double-arm, 15–65 Nm		000 589 27 21 00

Attention!
Pay attention to safety rules when removing fuel tank.

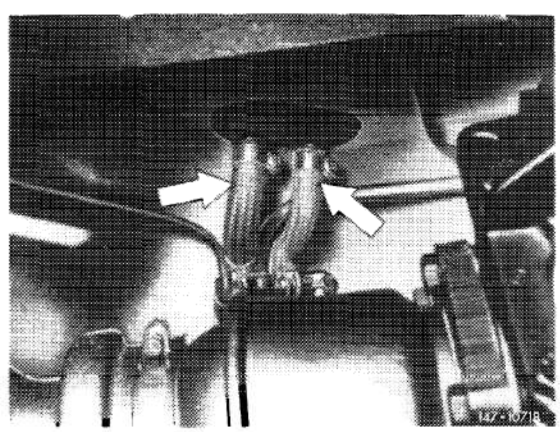


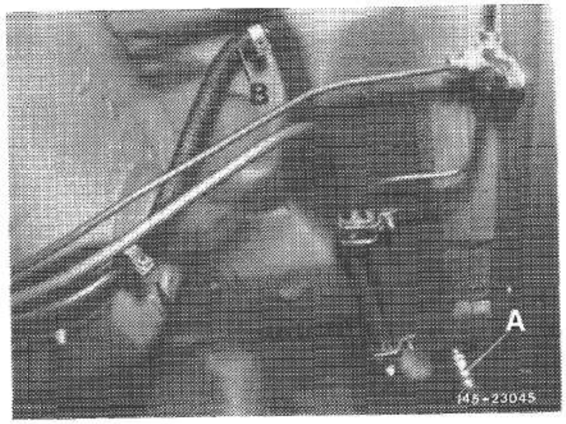
Removal

1 Disconnect grounding line on battery.

2 Drain fuel tank. For this purpose, carefully pump off fuel, so that no residual fuel remains in fuel tank.

3 Loosen suction hose, return hose and vent hose (arrows). Catch residual fuel in hoses. Close hoses and connections.



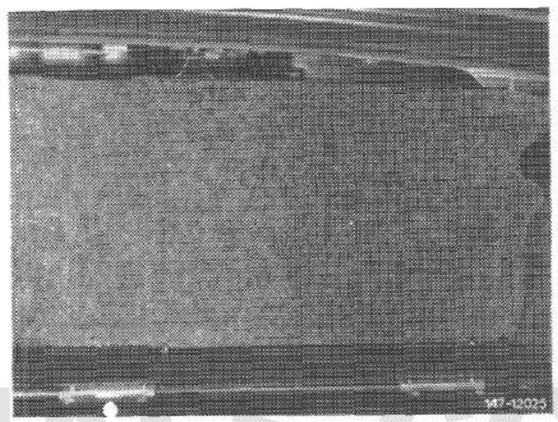


Model 107.04
A Forward flow
B Return flow

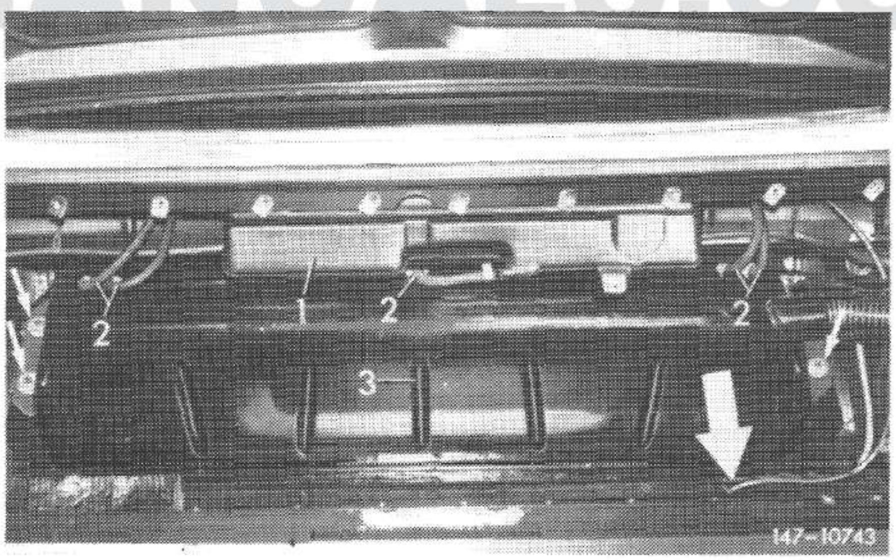
4 Remove trunk mat.

5 Unscrew back wall and remove.

Note: On model 107.04, remove fuel expansion tank (refer to job no. 47–705).



Model 107.02, 116

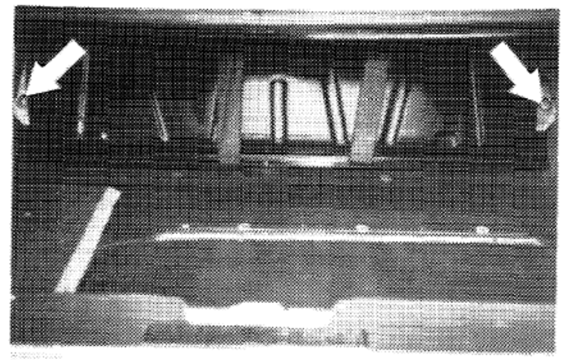


Model 107.04
1 Expansion tank
2 Fuel hoses
3 Fuel tank
Arrow = vent line

6 Unscrew fastening nuts (arrows).

7 Slightly pull out fuel tank and pull off coupling for fuel gauge.

8 Remove fuel tank.

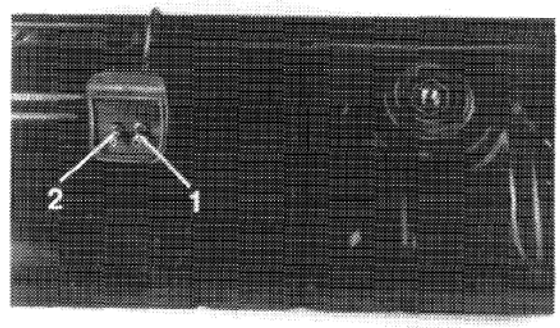


147-10715

Installation

9 Install fuel tank in vice versa sequence, paying attention to the following items:

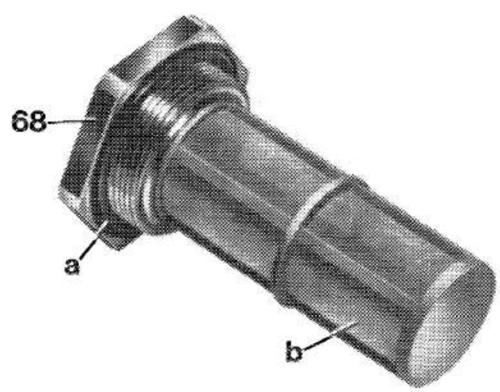
a) Glue-down both gaskets on underside of fuel tank with MB-universal glue, part no. 000 989 92 71. For installation, coat both gaskets after sealing surface or bead with sliding compound (talcum, wax or the like).



Model 107.02, 116
1 Vent line
2 Fuel return line

147 – 16744

b) Check whether damping strips on fuel tank are tight, glue down with MB-universal glue, part no. 009 989 92 71, if required.



147-17012/1

c) Blow out filter and check for damage. Renew sealing ring (a). Tighten fuel filter (68) to 35–43 Nm.

d) Mount fuel tank with reinforcing sheet metal and washers provided. Tighten fastening nuts to 17–25 Nm.

e) Pay attention to correct seat of rubber sleeve on fuel filler neck.

f) Plug-on coupler for fuel gauge and check for function (grounding line on battery connected).

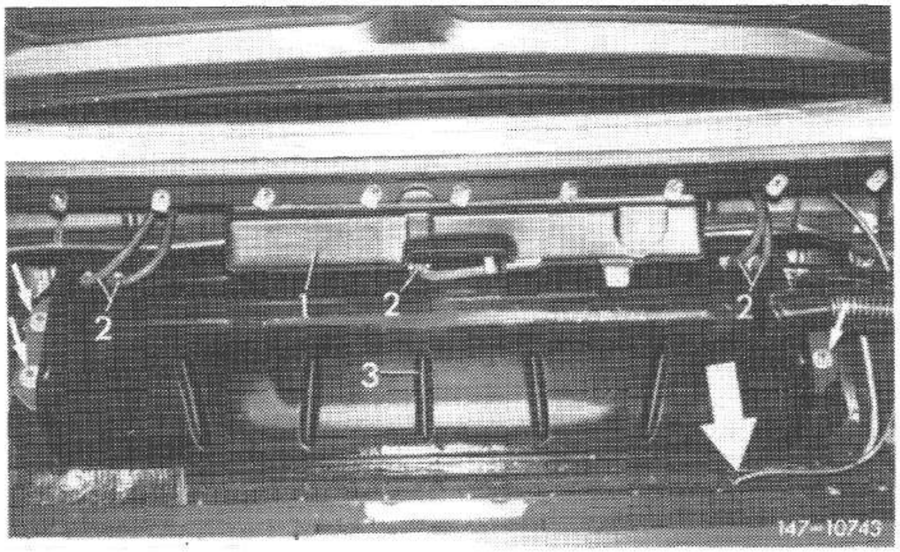
g) Check fuel hoses and renew, if required.

h) For installing expansion tank (model 107.04), displace vent line behind filler neck first.

i) When tightening hose clamps, apply counterhold to connections of expansion tank (model 107.04).

j) Plug-on protective sleeve at end of vent line (model 107.04).

k) Check fuel system for leaks.

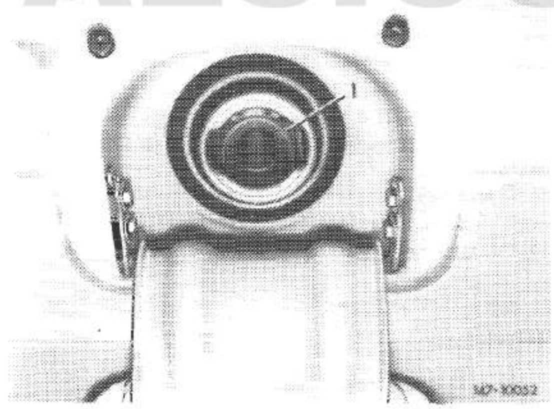


Model 107.04

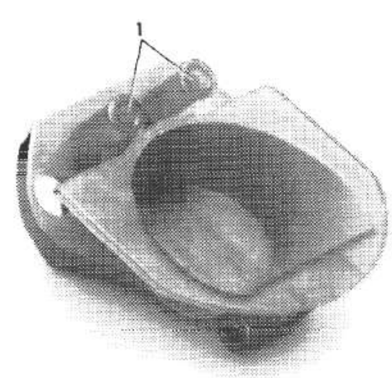
1 Expansion tank
2 Fuel hoses
3 Fuel tank
Arrow = vent line

(USA) starting 1976

Due to the small fueling guns for unleaded gasoline, these vehicles are provided with a guide funnel (1) in filler neck.

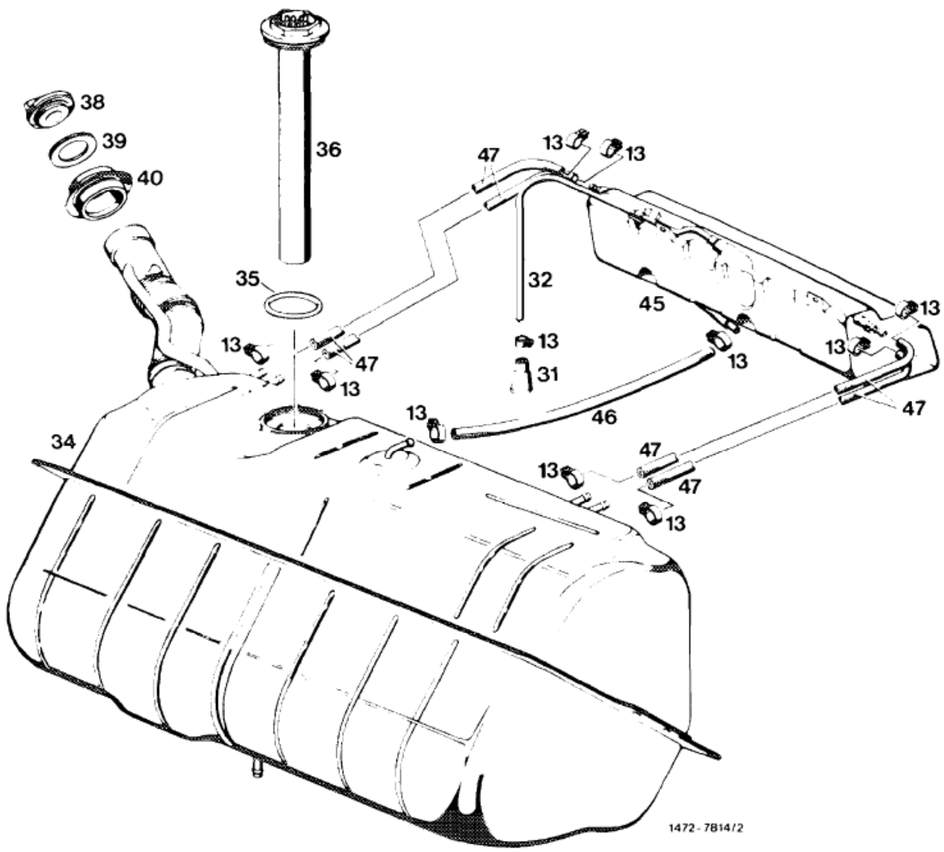


If a fuel tank is renewed on these vehicles, simultaneously install a guide funnel **on USA vehicles only.** For this purpose, prior to assembly of fuel tank, place guide funnel into filler neck and knock fastening rivets (1) in up to stop by means of a punch.



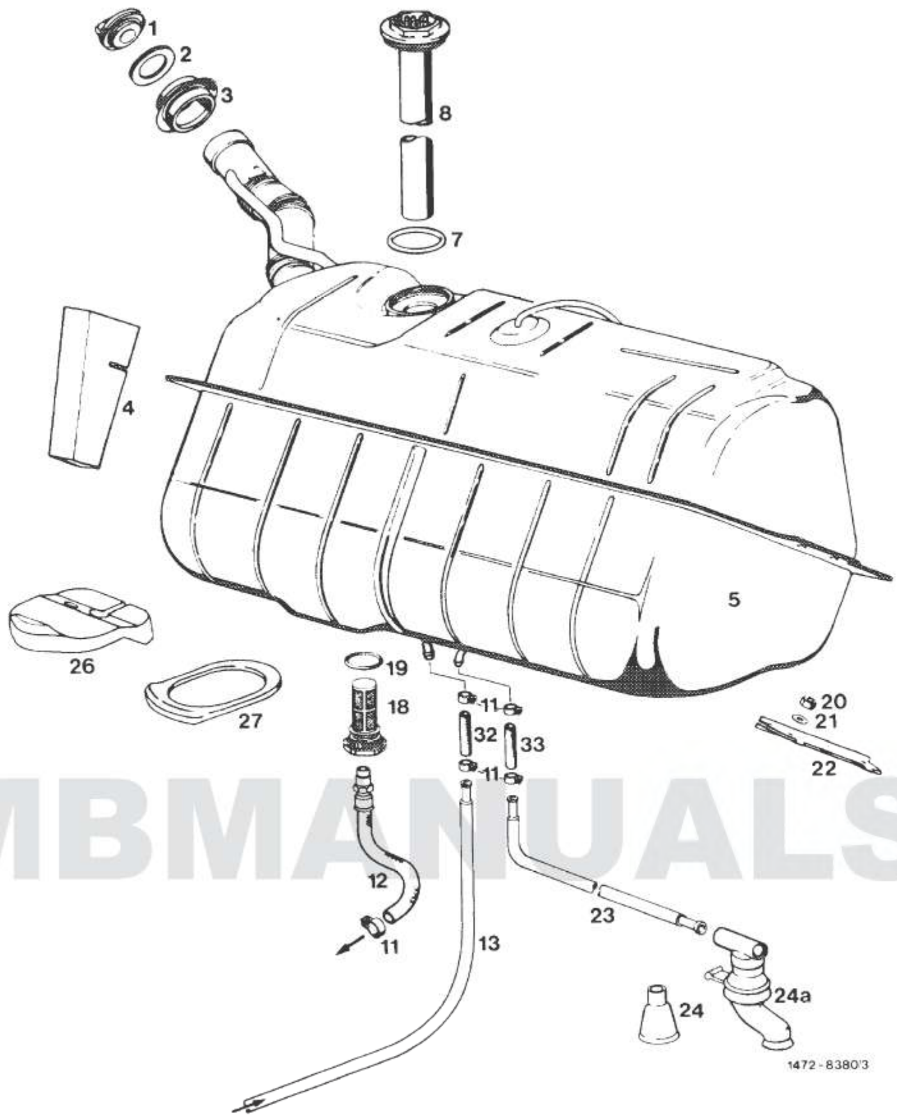
147-10021

Fuel tank positive and negative venting system model 107.04



13 Hose clamps
31 Protective sleeve
32 Vent line
34 Fuel tank
35 Sealing ring
36 Immersion tube transmitter
38 Closing cover
39 Gasket
40 Rubber grommet
45 Expansion tank
46 Fuel hose
47 Fuel hose

Fuel tank model 107.02, 116



1 Filler cap
2 Seal
3 Rubber sleeve
4 Damping shim
5 Fuel tank
7 Sealing ring
8 Immersion tube transmitter
11 Hose clamp
12 Fuel forward flow
13 Fuel return flow
18 Fuel filter
19 Sealing ring
20 Nut
21 Washer
22 Reinforcing member
23 Vent line
24 Venting sleeve 1st version
24a Venting sleeve 2nd version
26 Gasket
27 Gasket
32 Fuel hose
33 Fuel hose

47–705 Removal and installation of fuel expansion tank (model 107.04)

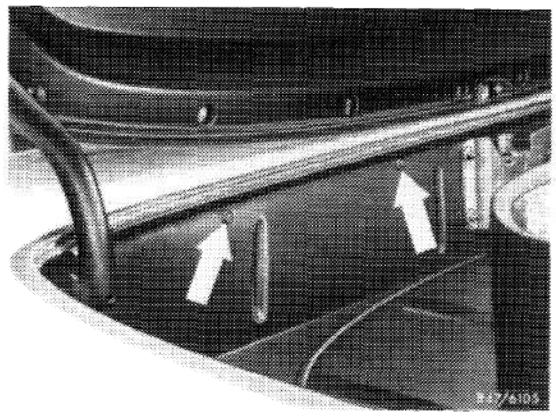
Note

On models 107.02 and 116 the fuel expansion tank is integrated in fuel tank and cannot be disassembled.

Removal

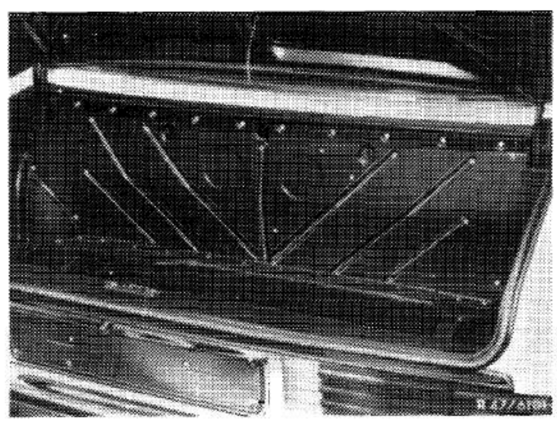
1 Remove hard top. Open top lock and remove top.

2 Unscrew both fastening screws for fuel expansion tank (arrows).



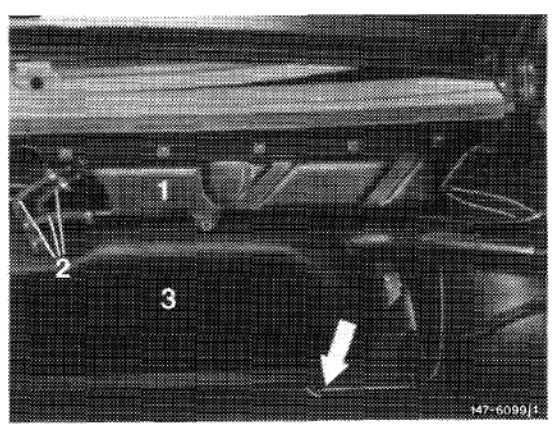
3 Remove rubber mat and vehicle jack from trunk.

4 Unscrew rear wall and remove.



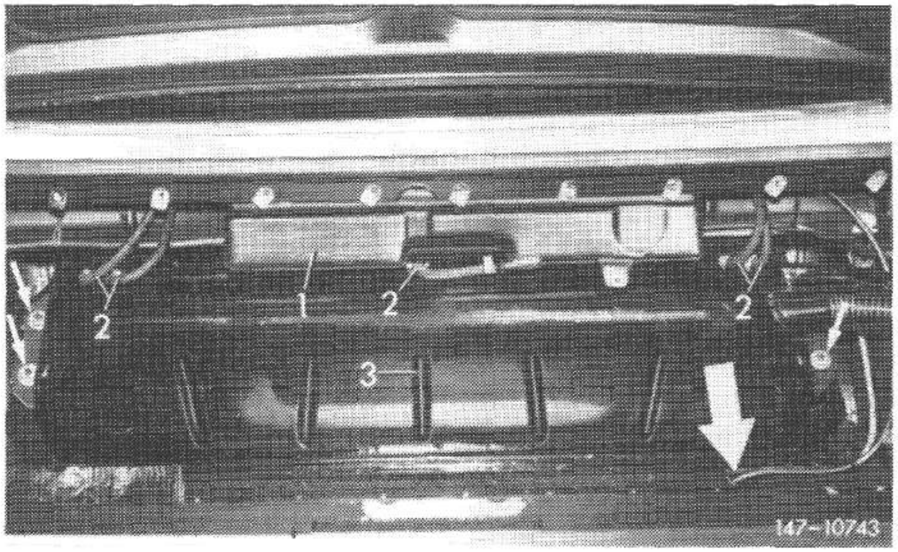
5 Loosen fuel hoses (2) on expansion tank (1).

6 Remove rubber sleeve from vent line (arrow).



Fuel expansion tank with 3 connections

1 Fuel expansion tank
2 Fuel hoses
3 Fuel tank

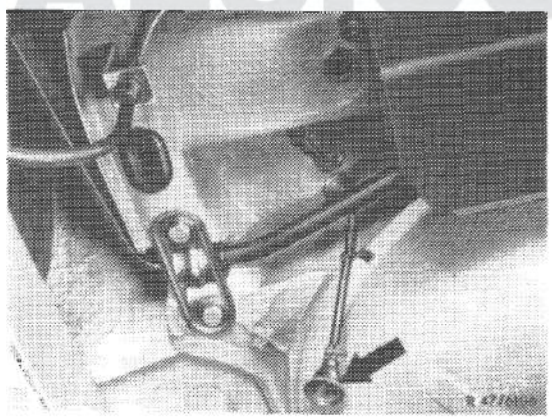


Fuel expansion tank with 5 connections

1 Fuel expansion tank
2 Fuel hoses
3 Fuel tank

7 Remove expansion tank while pulling out vent line (large arrow).

Installation



8 For installation proceed vice versa. Make sure that the positive and the negative venting line are installed first behind fuel tank vent connection.

When tightening hose clips, apply counterhold to connections of expansion tank.

47–705 Removal and installation of fuel expansion tank

Model 107.04

Note

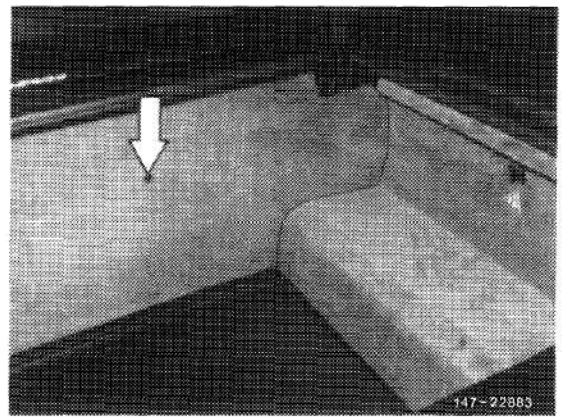
On models 107.02 and 116 the fuel expansion tank is integrated in fuel tank and cannot be disassembled.

Removal

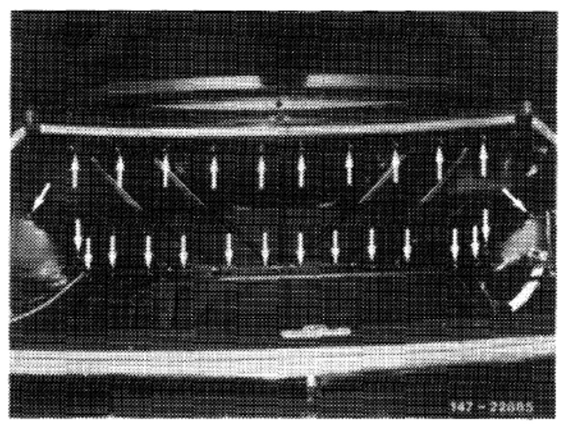
1 Remove hard top. Unfold top lock and remove top.

2 Remove trunk mat.

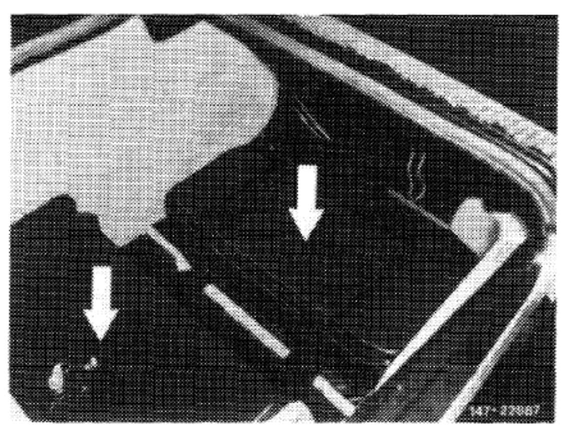
3 Unscrew fastening screw (arrow) for expansion tank.



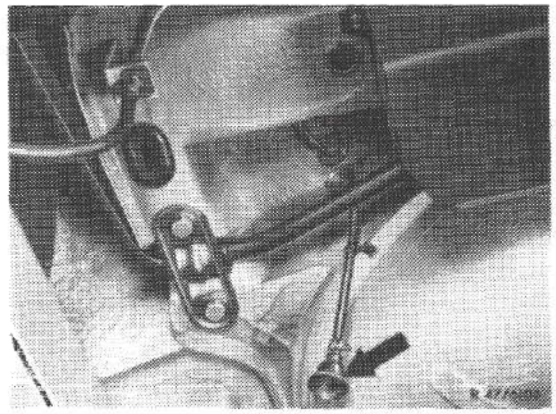
4 Unscrew back wall and remove. For this purpose, loosen lining in boundary range at top and laterally and unscrew fastening screws (arrows).



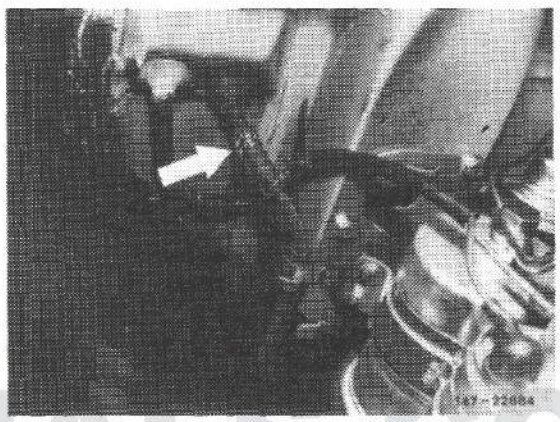
5 On vehicles with battery in trunk, remove battery and battery casing (arrows).



6 Remove protective sleeve (arrow) and pull vent line out of holding clamp.

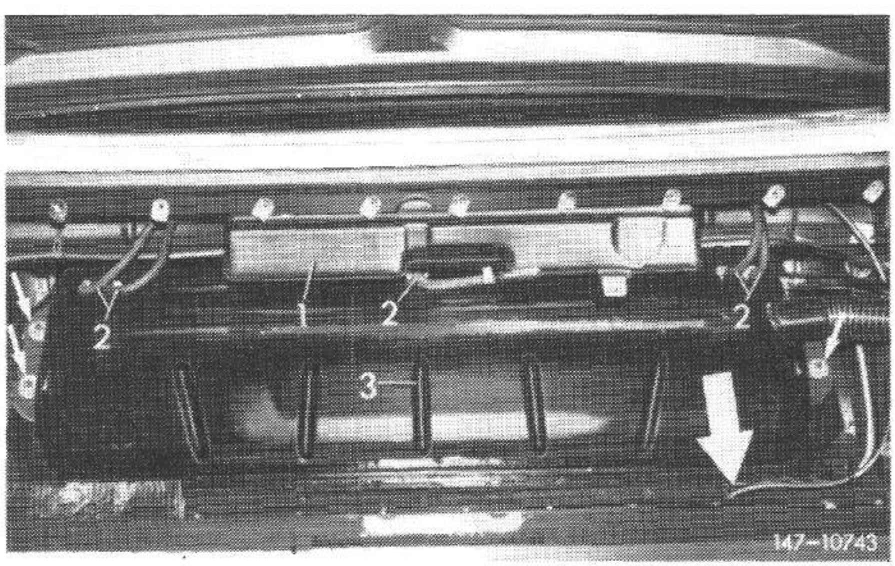


7 On vehicles in (AUS)-, (J)-, and (USA) version, pull fuel hose (arrow) from vent line.



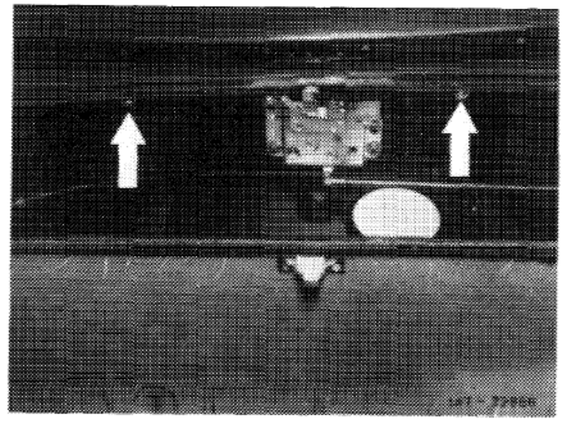
8 Remove fuel hoses (2) on fuel tank or on expansion tank.

Note: If the fuel hoses are mounted or removed on expansion tank, apply counterhold to connections when loosening or tightening hose clamps.



1 Expansion tank
2 Fuel hoses
3 Fuel tank
Arrow = vent line

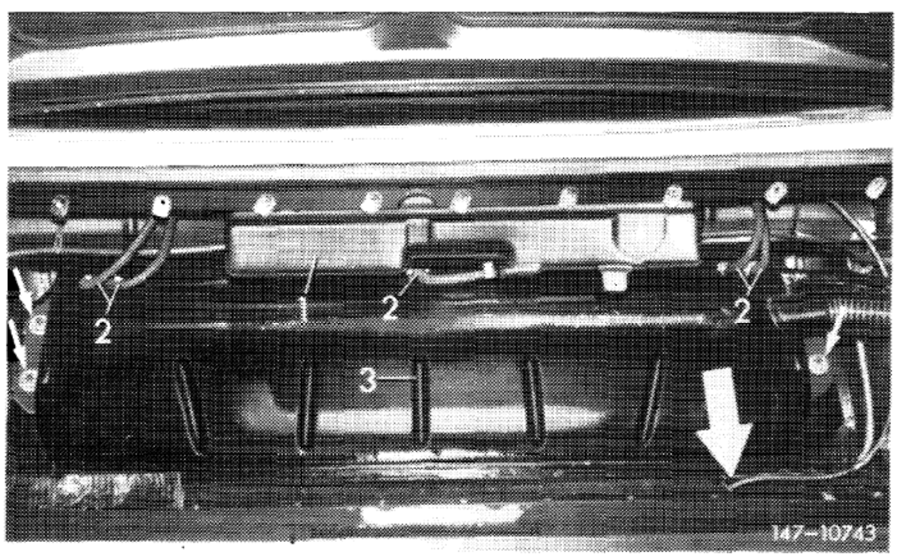
9 Unscrew fastening screws (arrows) and remove expansion tank. Pull out black vent line through trunk floor in upward direction.



Installation

10 For installation proceed vice versa. Make sure that the vent line is installed first behind filler neck of fuel tank.

11 Check fuel system for leaks.



Arrow = vent line

47–706 Installation of modified fuel tank and fuel expansion tank (model 107.043)

Note

Starting September 1971 modified fuel tanks and fuel expansion tanks are installed. They are provided with 5 connections each; the former versions had 3 connections each.

Standard production

Model	Starting chassis end no.
107.043	003443

Fuel tanks and fuel expansion tanks with 3 connections each may be installed in vehicles with lower chassis end number only.

With regard to spare parts, only the modified versions with 5 connections will be available.

Section A describes the installation of the modified fuel expansion tank for a fuel tank of the former version in vehicles with lower chassis end number.

Section B covers the installation of the modified fuel tank **and** the modified fuel expansion tank in vehicles with lower chassis end number.

Section B also applies to the installation of the modified fuel tank in vehicles with lower chassis end number, since such a case requires also the installation of the modified fuel expansion tank.

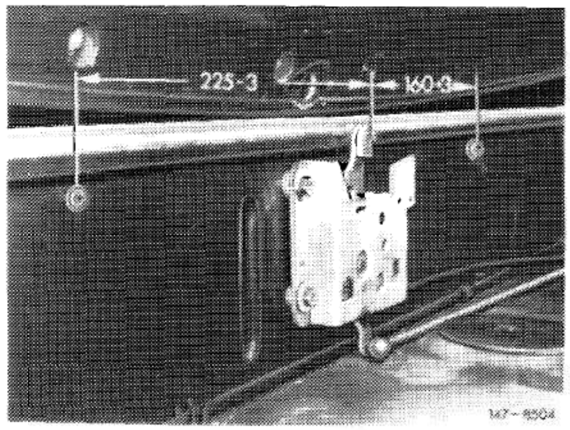
A. Installation of fuel expansion tank with 5 connections for a fuel tank with 3 connections

1 Remove former fuel expansion tank (47–705).

2 Trace fastening bores for expansion tank in top well and drill to 6.5 mm.

Dimensions in driving direction from center of top lock:

to the right	225 – 3 mm
to the left	160 + 3 mm
height	similar to old bore



3 Cut a fuel hose, part no. 110 476 11 26, to length of 900 mm.

4 Cut a protective jacket, part no. 107 997 14 82, to 850 mm length and slip on fuel hose.

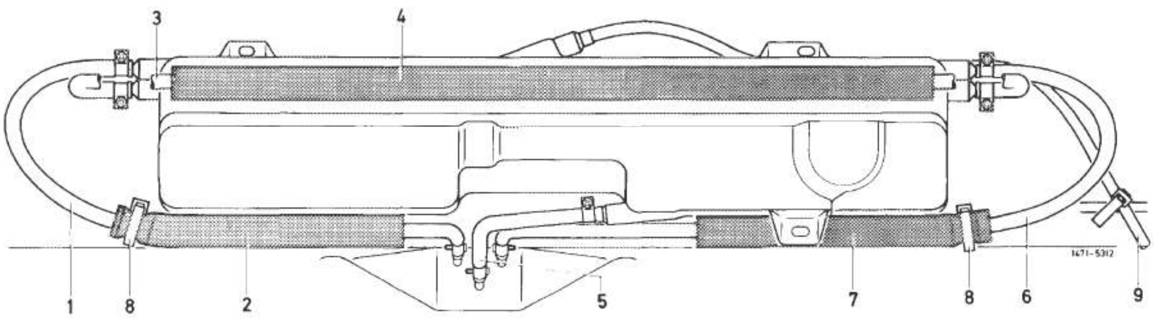
5 Connect both lower connections of expansion tank to fuel hose (3) and slipped-on protective jacket (4) and secure with hose clips.

6 Cut two fuel hoses (1 and 6), part no. 110 476 11 26, to 500 mm length each, slip on upper connections at right and left and protect with hose clips.

7 Cut one fuel hose (5), part no. 110 476 11 26, to length of 120 mm, slip on center connection and secure with a hose clip.

8 Cut two protective jackets (2 and 7), part no. 107 997 14 82, to 200 mm length each, slip on fuel hoses (1 and 6) at the right and left and protect against displacement by means of cable straps (8), part no. 001 997 41 90.

9 Install expansion tank with clip nuts, part no. 000 994 25 45. Make sure that the positive and negative venting line (9) is installed first behind fuel tank filler neck.



Fuel expansion tank with 5 connections

1 Fuel hose 500 mm long
2 Protective jacket 200 mm long
3 Fuel hose 900 mm long
4 Protective jacket 850 mm long
5 Fuel hose 120 mm long
6 Fuel hose 500 mm long
7 Protective jacket 200 mm long
8 Cable strap
9 Positive and negative venting line

10 Attach expansion tank on top well by means of two fastening screws.

11 Install all fuel hoses on fuel tank and on fuel expansion tank in such a manner that no buckling and chafing will occur and secure with hose clips.

12 Extend positive and negative venting line (9) into the open air and secure by means of a cable strap on electric cable for fuel pump.

13 Attach rubber sleeve to positive and negative venting line.

14 Screw-on rear wall, screw expansion tank clip nut to rear wall, insert rubber mat and vehicle jack.

15 Fold top, close top well and mount coupe top.

B. Installation of fuel tank and fuel expansion tank with 5 connections each

1 Drill new fastening holes for fuel expansion tank as described in section A, item 2.

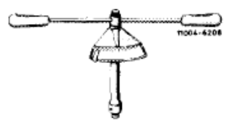
2 Upon installation of fuel tank and fuel expansion tank mount all fuel hoses in such a manner that no tensioning and chafing will occur.

47–710 Removal and installation of immersion tube transmitter

A. Immersion tube transmitter with rubber or cork seal (model 107.04)

Tightening torques	Nm	(kpcm)
Fastening nuts for immersion tube transmitter	3–4	(30–40)

Special tool

Torque wrench		000 589 67 21 00

Note

Immersion tube transmitter seals which were formerly glued-in, can no longer be replaced. In such a case, install a screw-type immersion tube transmitter for fuel tank (section B).

Modified seal

Since October 1971 the cork seal 110 471 01 80 between immersion tube transmitter and fuel tank is glued-in by means of a 2-component glue.

Production data of seals used up to now

Model	Designation	Chassis end no.
107.043	cork seal without glue	start of production – 001599
107.043 107.044 (USA)	rubber seal rubber seal	001600–003656 start of production – 001340
107.043 107.044 (USA)	cork seal with glue cork seal with glue	003657–009410 001341–009072

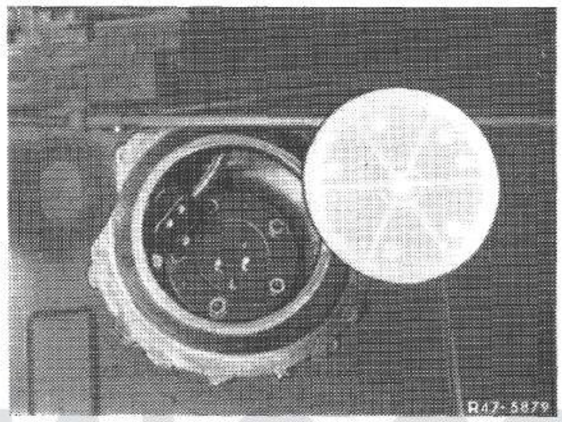
The rubber seal 107 471 01 80 installed on model 107.043 from chassis end no. 001600 to 003656, as well as on model 107.044 from start of production to chassis end no. 001340 is now invalid and may no longer be used.

Replacement of seal

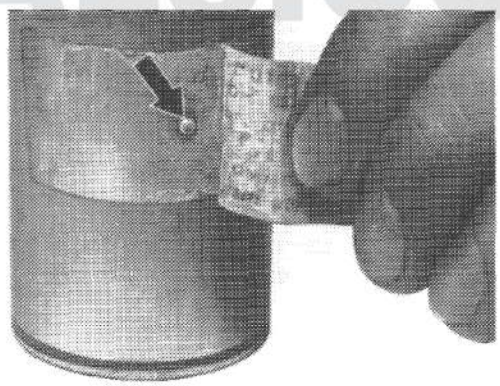
In the event of repairs, use **cork seal 110 471 01 80 only** and install by means of a 2-component glue. For this repair job the vehicle should not be fully fueled, since this alone will guarantee that the cork seal with the 2-component glue will not come into contact with the fuel.

1 Remove coupe top and unfold roadster top.

2 Remove plastic cover, pull cable plug connection from immersion tube transmitter and secure against slipping behind fuel tank. Remove immersion tube transmitter, also remove loose cork or rubber seal.



3 Thoroughly clean fuel tank in range of immersion tube transmitter.



107-10702

4 Check flange of immersion tube transmitter for distortion and dents at fastening bores. Make sure that dented or distorted immersion tube transmitters are replaced.

When installing a new immersion tube transmitter, remove locking pin installed for shipment.

5 Completely fill hardener from plastic bottle into can with ,,Epple 50'' glue and mix well. **Do not mix smaller quantities, since the mixing ratio must be accurately met.**

6 Coat cork seal 110 471 01 80 at bottom approx. 1 mm thick with mixed glue.

7 Set cork seal on tank in such a manner that the notch in seal points toward the rear.

8 Also coat top of seal and stud with glue 1 mm thick.

9 Insert immersion tube transmitter in such a manner that the brass pin for the cable plug – seen in driving direction – faces forward.

10 To prevent any distortion of immersion tube transmitter flange while tightening, mount 5 washers A 5, DIN 9021 NTS and tighten the fastening nuts of the immersion tube transmitter **uniformly and crosswise.**

11 Mount cable plug, insert plastic cover, set up roadster top or coupe top.

12 Leave vehicle in place for 3 hours, then fill up with fuel. During the curing period of 3 hours the glue should not come into contact with fuel.

The mixed glue **can be processed** for approx. **30 minutes.** Any glue not used after that time is useless.

The 2-component glue „Epple 50" including the hardener can be ordered directly from

Messrs.
E. Epple & co.
Seidenstraße 55
7000 Stuttgart 1

General representatives in export countries can order this glue including the hardener under the designation „Epple 50" from ET Esslingen-Mettingen. The glue has no spare part number.

B. Immersion tube transmitter with O-ring (model 107, 116)

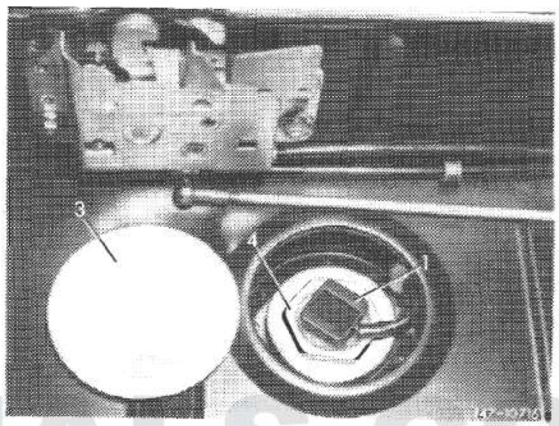
Tightening torques	Nm	(kpm)
Hex closing plug for immersion tube transmitter or screw-type immersion tube transmitter	20–30	(2–3)

Special tool		
Torque wrench		000 589 67 21 00

Removal

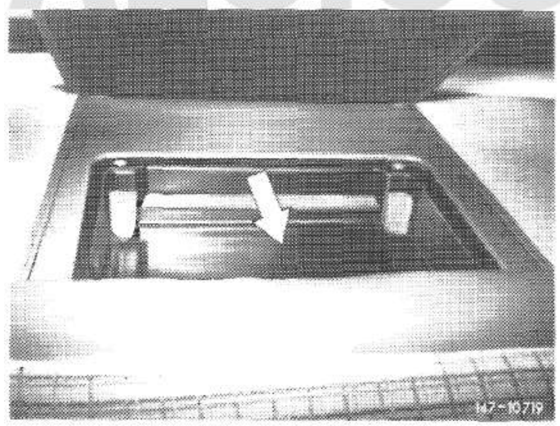
1 Remove hard top on model 107.04, open top lock and unfold top.

2 Remove top cover (3).



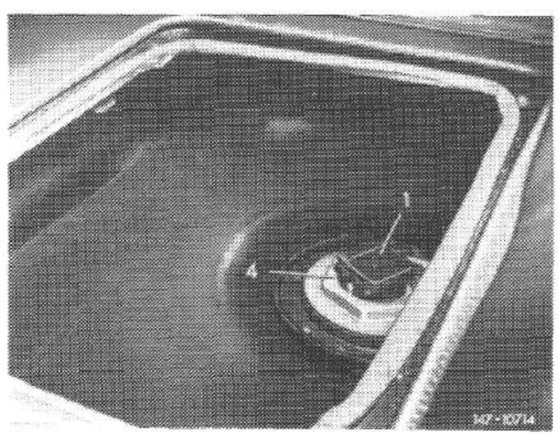
Model 107.04

3 On models 107.02 and 116, remove first aid kit and plastic shell (arrow).



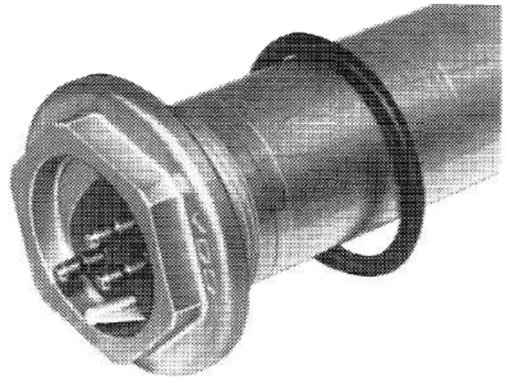
4 Pull plug (1) from immersion tube transmitter and protect against sliding off by means of a wire.

5 Unscrew hex closing plug (4) and remove immersion tube transmitter.



Immersion tube transmitters of the latest version are screwed directly into fuel tank.

Since approx. August 1976 these vehicles are provided with fuel tanks having directly screwed-in immersion tube transmitters.



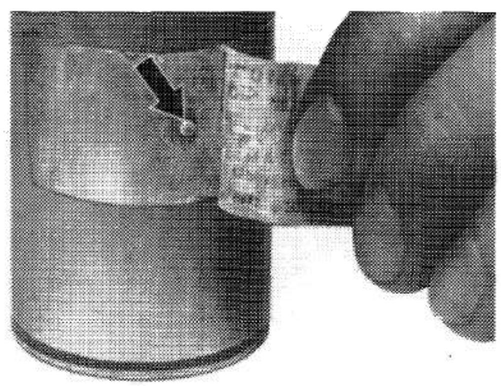
147-10810

Start of production

Model	Starting chassis end no.
107.023	011154
107.024	014504
107.043	012556
107.044	034421
116.028/029	035707
116.032/033	054893 (054742 USA)

Installation

For installation proceed vice versa and observe the following:



107-10702

a) The spare parts stockroom has two different versions of immersion tube transmitters. When replacing transmitters, make sure to exchange like for like.

b) Use new O-ring.

c) Remove locking pin (arrow) prior to inserting immersion tube transmitter.

d) Insert immersion tube transmitter in such a manner that the locking cam engages in recess of fuel tank or that brass locating pin for electric plug points toward the rear in relation to driving direction.

The above is no longer required for latest version of immersion tube transmitter.

Note: If an immersion tube transmitter with locking cam is installed in a fuel tank without recess, remove locking cam.

e) Check function of fuel gauge.

47–710 Removal and installation of immersion tube transmitter

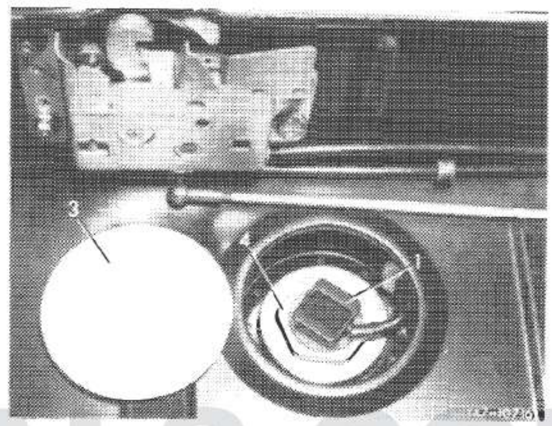
All models

Tightening torque	Nm
Immersion tube transmitter	35–43

Removal

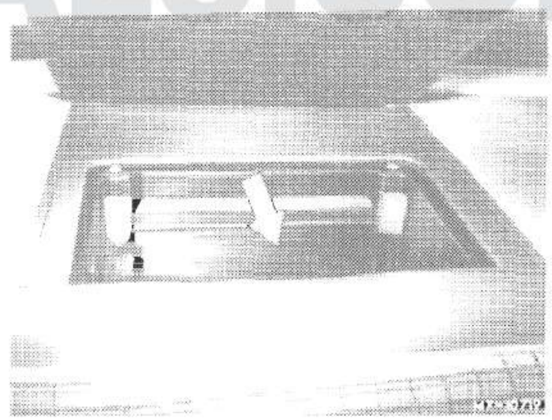
1 On model 107.04, remove hard top, open top lock and unfold top.

2 Remove closing cap (3).



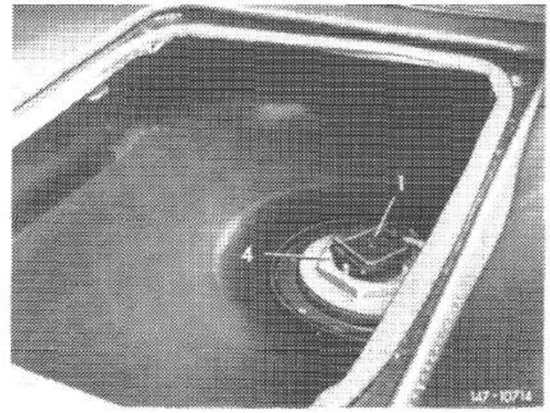
Model 107.04

3 On models 107.02 and 116, remove first aid kit and tray (arrow).



4 Pull coupler (1) from immersion tube transmitter (4) and protect against slipping by means of a wire.

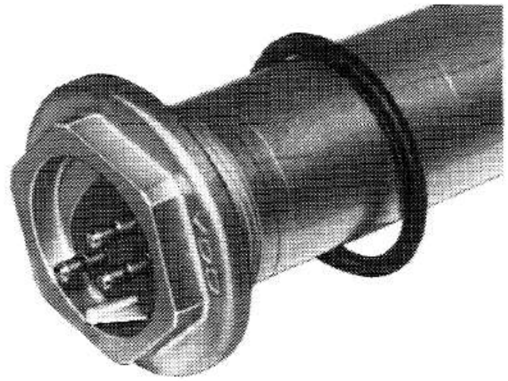
5 Unscrew immersion tube transmitter.



Installation

6 For installation proceed vice versa, paying attention to the following items:

a) Use new rubber sealing ring.



147-10810

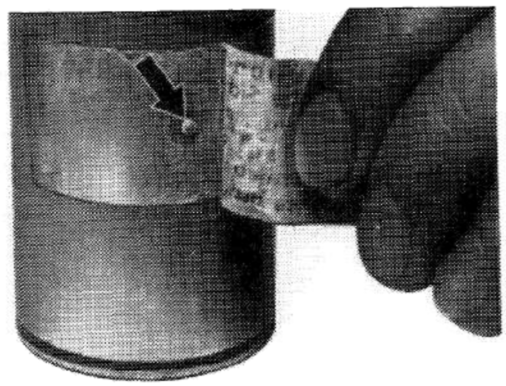
b) Remove locking pin (arrow) prior to installation of immersion tube transmitter.

c) Check function on fuel gauge.

d) Tighten immersion tube transmitter to 35–43 Nm.

e) Plug-on coupler for fuel gauge.

f) Check for leaks.

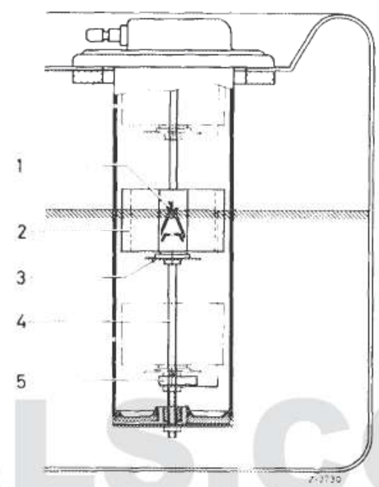


107-10702

47–715 Functional description of immersion tube transmitter for fuel gauge

When the fuel level drops, the sliding contact (1) on float (2) of immersion tube transmitter increases the resistance, the voltage drops and the needle in instrument will swing back.

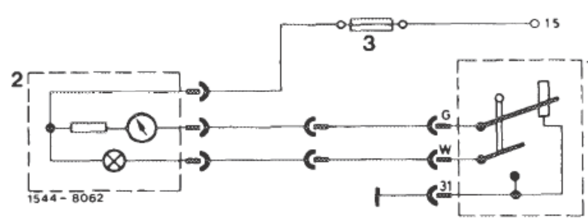
When the fuel level drops still further, the reserve warning contact (5) in immersion tube transmitter is closed and will connect the reserve warning light to ground.



Immerstion tube transmitter

1 Sliding contact
2 Float
3 Contact plate
4 Guide and contact rod
5 Reserve warning contact

The fuel gauge (indicating instrument) and the reserve warning lamp are energized via fuse when the ignition is switched on.



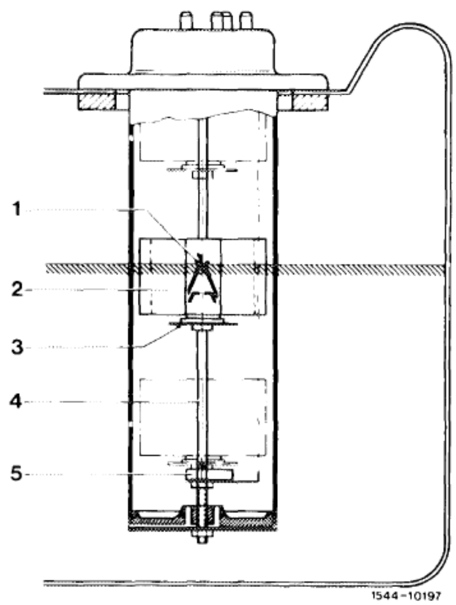
1 Immersion tube transmitter
2 Fuel gauge
3 Fuse

47–715 Operation of immersion tube transmitter for fuel gauge

All models

When the fuel level drops, the sliding contact (1) on float (2) of immersion tube transmitter increases the resistance value, the voltage will drop and the indicator needle in instrument will move back.

When the fuel level drops still further, the reserve warning contact (5) in immersion tube transmitter is closed and the reserve warning lamp will light up.

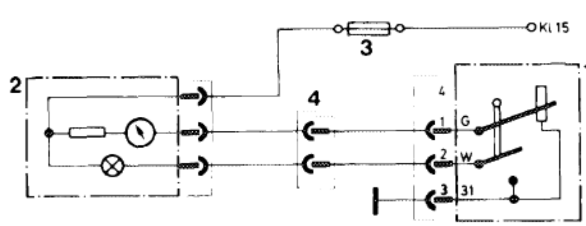


Immersion tube transmitter

1 Sliding contact
2 Float
3 Contact plate
4 Guide and contact bar
5 Reserve warning contact

The indicating instrument (gauge) and the reserve warning light are energized via fuse when the ignition is switched on.

Check fuel gauge (54–269).

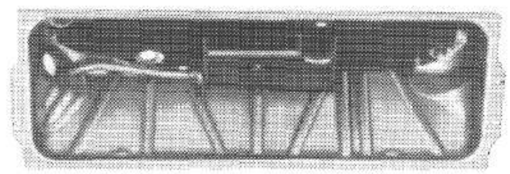


Sedan

1 Immersion tube transmitter
2 Fuel indicator (gauge)
3 Fuse
4 Cable connector tail lamp harness

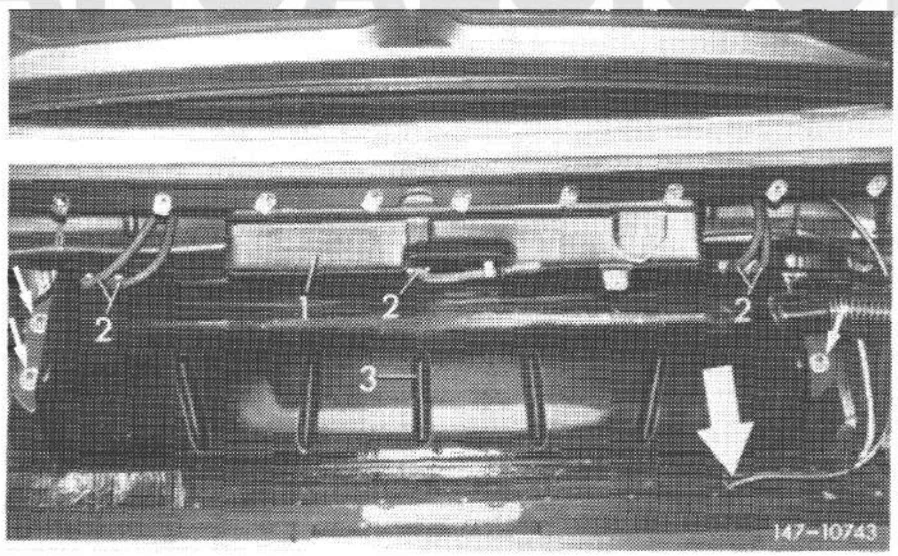
47–720 Functional description of fuel tank breathing system (positive and negative venting)

On model 107.02 and 116 a separate expansion tank is located **in fuel tank.**



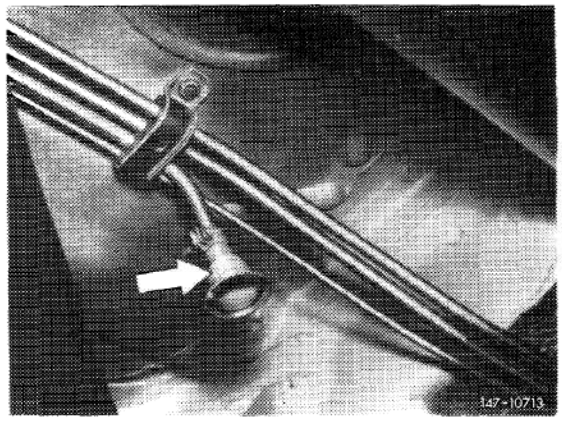
147–13629

On model 107.04 a separate expansion tank is located **outside fuel tank.**

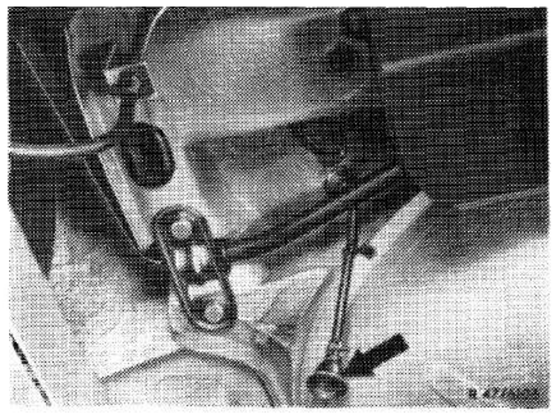


The fuel expansion tank is connected to five lines entering the fuel tank. These lines will become effective as overflow, drain or venting lines in dependence of fuel level and fuel temperature in fuel tank.

The fuel vapours escape through vent line (arrow) into the open air.



Model 107.02, 116

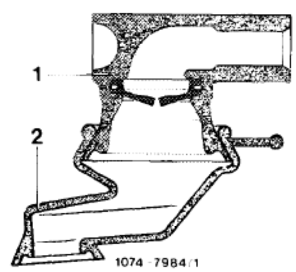


Model 107.04

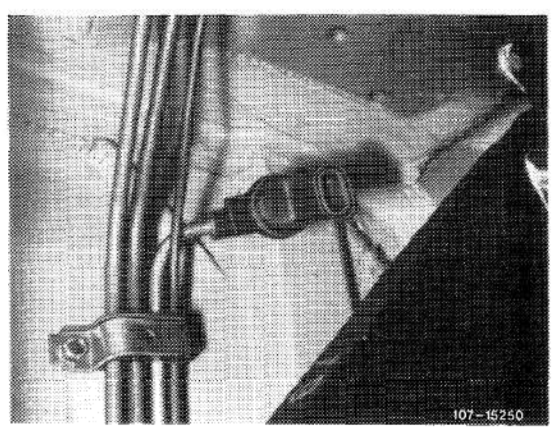
Repair instructions

In the event of repairs only the venting sleeve with diaphragm must be installed. In such a case, bend the breathing line (positive and negative venting) with a suitable mandrel in such a manner that the venting sleeve is pointing downwards.

Attention!
When rebending line, make sure that line is not buckling.



The diaphragm in the venting sleeve increases the pressure in fuel tank by approx. 10 mbar. The automatic dispensing gun (fuelling gun) will be switched off sooner when the fuel tank is vented.

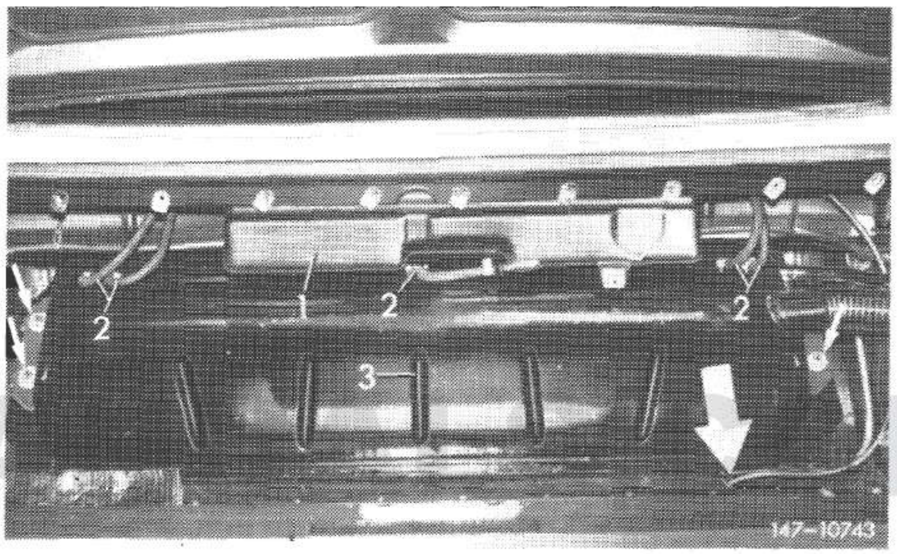


47–720 Operation of fuel tank positive and negative venting system

Model 107.04

On model 107.04 a separate expansion tank is located **outside fuel tank.**

Fuel vapors are escaping from fuel tank through fuel hoses to expansion tank and from there through vent line into the atmosphere.



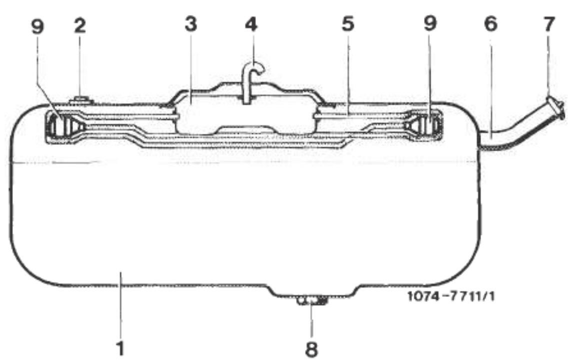
1 Expansion tank
2 Fuel hoses
3 Fuel tank
Large arrow = vent line

Model 107.02

Model 107.02 is provided with an expansion tank which is installed in fuel tank and can therefore not be disassembled.

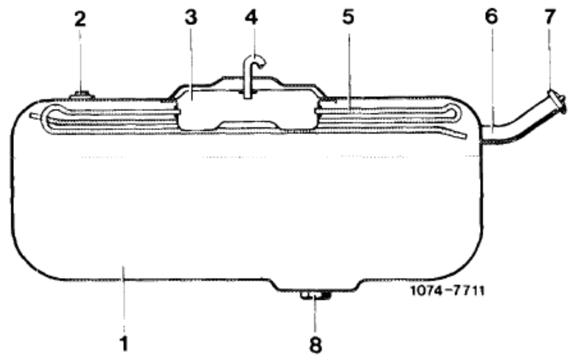
Model 116

Model 116 has a vent system comprising a collecting tray with pipe system and vent line.



3 Collecting tray
4 Vent line
5 Pipe system

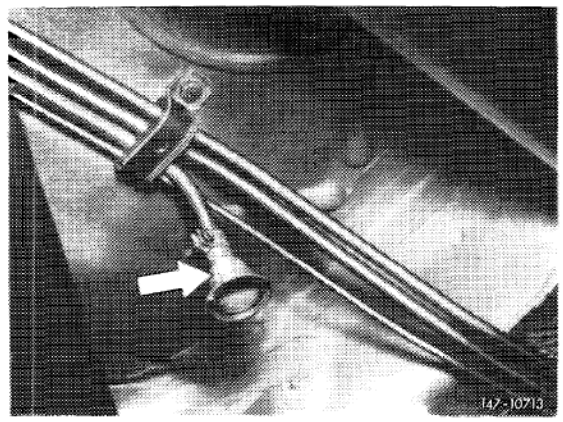
On vehicles of national version (J) 1980, breaker vessels are additionally installed at ends of pipe system.



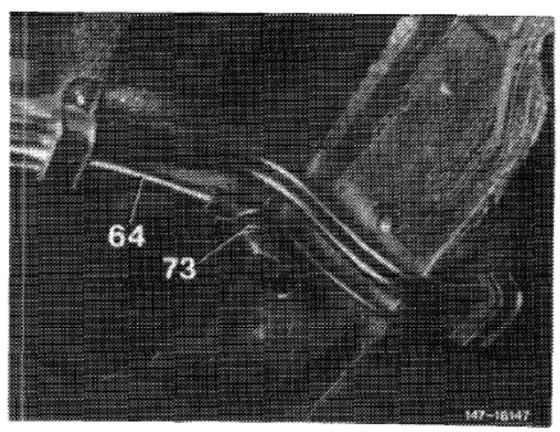
9 Breaker vessels

Fuel vapors escape via expansion tank (model 107.02) installed in fuel tank or through vent system (model 116) toward vent line and then into the atmosphere.

A protective sleeve (arrow) is plugged-on at end of vent line at model 107.04 and on all other vehicles manufactured up to February 1979.



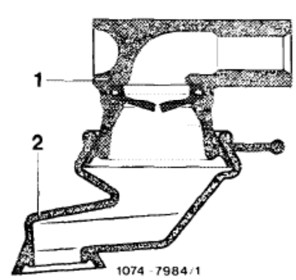
Starting March 1979, all vehicles (except model 107.04) are provided with a vent sleeve at end of vent line.



64 Vent line
73 Vent sleeve

In the event of repairs, install only vent sleeve with diaphragm also in older vehicles. In such a case, re-bend vent line with a suitable mandrel so that the vent sleeve is pointing downwards.

Attention!
Avoid kinks when re-bending vent line.



Vent sleeve with diaphragm

47–800 Fuel evaporation control system

A. (AUS) starting October 1974, (J) starting January 1973, (USA) 1973 and 1974 Federal emission control system

The fuel tank will be heated by high outside temperatures and the self-heating effects of the returning fuel. In some countries it is legally not permitted to let the resulting fuel vapours escape into the atmosphere.

For this reason, the vapours are drawn from fuel tank through the crankcase venting system into the combustion chambers while the engine is running, and they are stored in crankcase when the engine is stopped.

On model 107.04 five lines are leading from fuel tank to expansion tank.

These lines serve as venting, overflow or drain lines in dependence of fuel level in fuel tank, of fuel quantity and of the temperature.

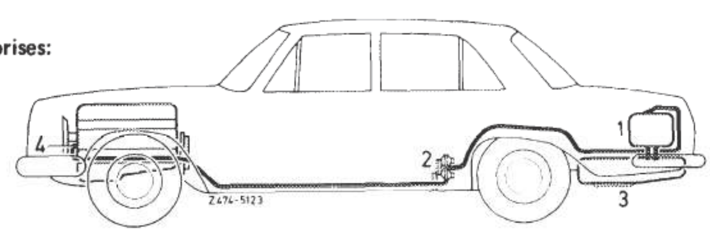
On model 107.04 the expansion tank is located above fuel tank.

At the highest point of the expansion tank is the connection for the positive and negative venting line (breathing line) to valve system (2).

On models 107.02 and 116 the expansion tank is located in fuel tank. Only one line leads to valve system.

The fuel evaporation control system comprises:

Fuel expansion tank (1)
Valve system (2)
Fuel tank (3)
Draw-off connection on crankcase (4)



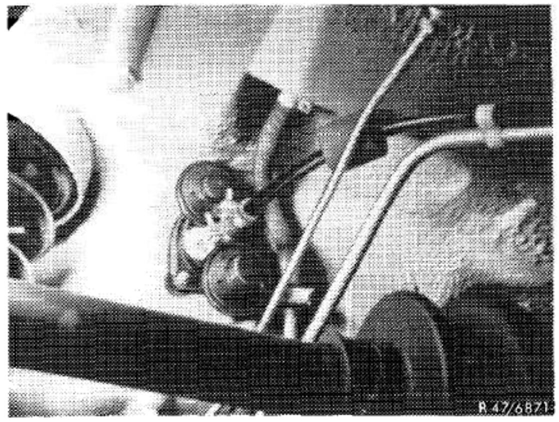
Valve system

The valve system is located underneath vehicle at level of rear legroom.

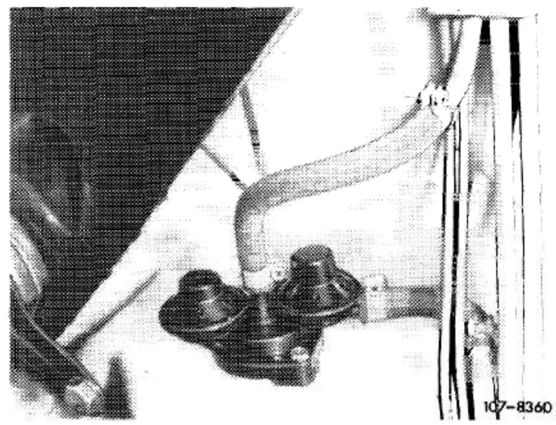
The valve system comprises three valves:

1. Negative venting valve
2. Pressure relief valve
3. Positive venting valve

Model 107



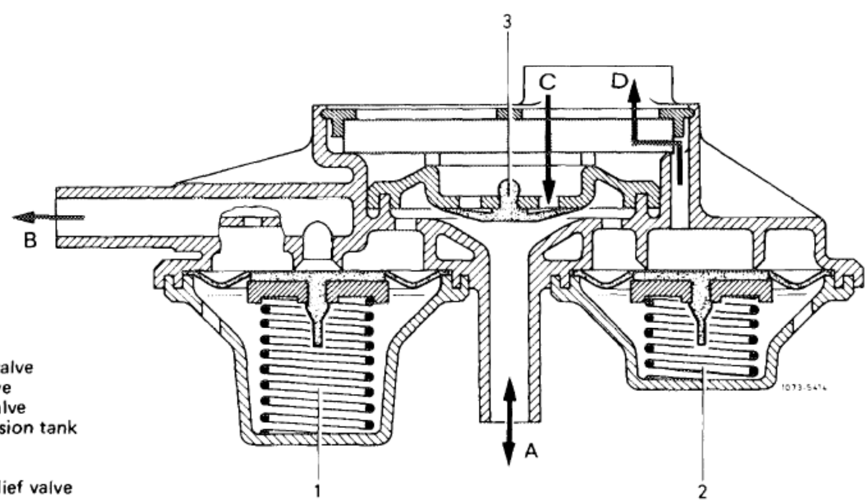
Model 116



The **negative venting valve** (1) opens at a slight overpressure. The evaporation vapours will flow via negative venting valve (1) (direction B) in a line toward engine. The line enters the crankcase at the respective connection.

The **pressure relief valve** (2) is a safety valve and opens when the fuel evaporation control system is subject to overpressure. The fuel vapours are vented (discharged) directly into the atmosphere.

The **positive venting valve** (3) opens when cooling down of fuel tank results in underpressure.

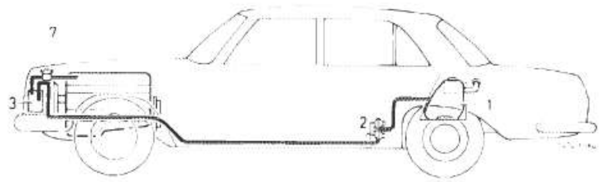


1 Negative venting valve
2 Pressure relief valve
3 Positive venting valve
A To valve/to expansion tank
B To crankcase
C Fresh air inlet
D Outlet pressure relief valve

B. (USA) 1974 California emission control system, (USA) 1975

Layout

1 Fuel tank with expansion tank
2 Valve system
3 Charcoal canister
7 Purge valve



The fuel evaporation control system comprises the fuel tank with expansion tank, the valve system, the charcoal canister, the purge valve and the purge (draw-off) connection on intake pipe.

The fuel tank with fuel expansion tank and the valve system are similar to the version already known.

Charcoal canister

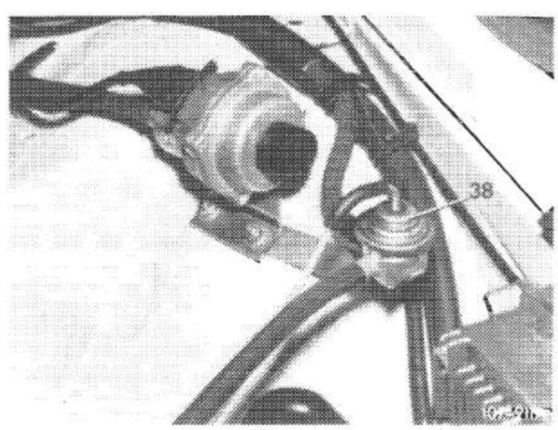
The fuel evaporation vapours from fuel tank are stored in charcoal canister and drawn-off again when vehicle is operated.

A Connection tank venting system
B Connection purge valve

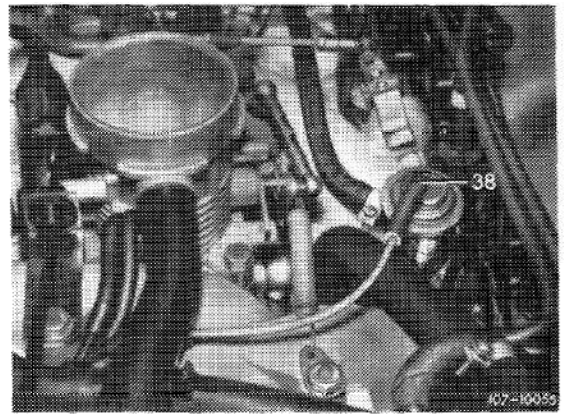
107–9128

Purge valve (draw-off valve)

The purge valve is controlled by the vacuum of the throttle valve. If the diaphragm is under vacuum control, the valve opens and the vapours can be drawn from charcoal canister.



Layout model year 1974
38 Purge valve (draw-off valve)

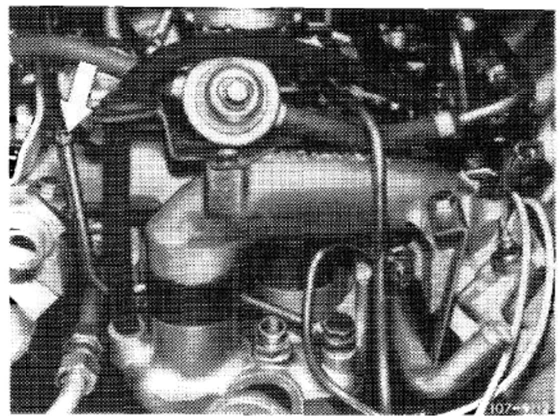


Layout model year 1975

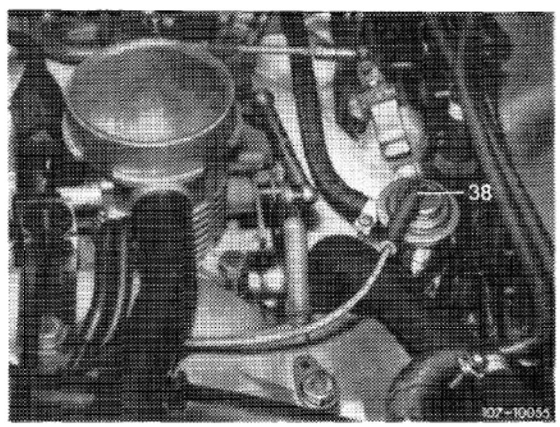
38 Purge valve (draw-off valve)

Intake pipe

The intake pipe is provided with a connection for drawing fuel evaporation vapours from charcoal canister.



Draw-off connection intake pipe model year 1974



Layout model year 1975

38 Purge valve (draw-off valve)

Operation

With the engine stopped, the fuel evaporation vapours from the fuel tank are stored in charcoal canister, with the engine running they are drawn from charcoal canister depending on intake pipe vacuum.

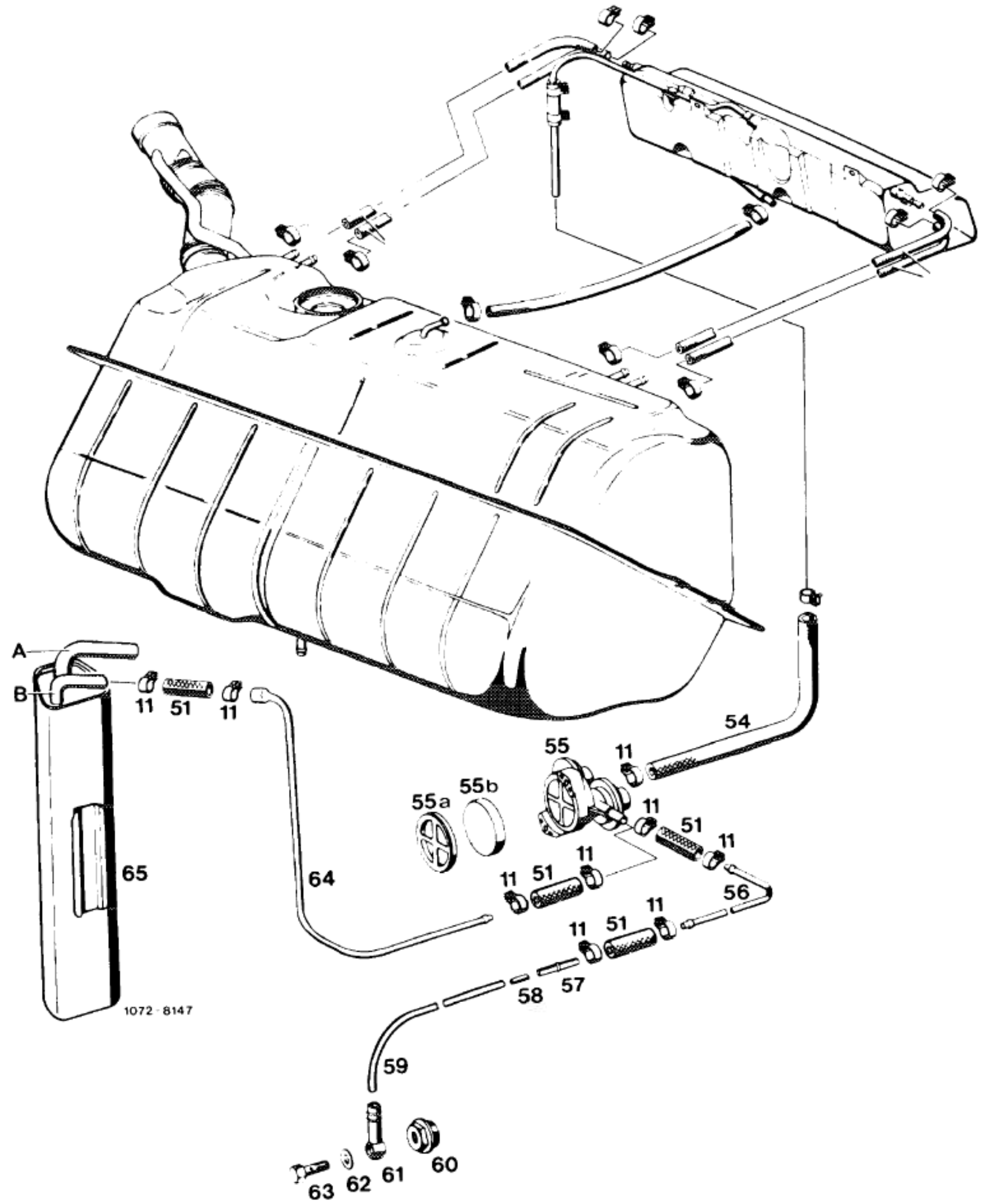
When the throttle valve opens, the diaphragm of the purge valve (draw-off valve) is activated by the vacuum and the valve is opened.

The intake pipe vacuum will draw the stored vapours from charcoal canister.

For checking system refer to:

Model year 1974   07.6–100
Model year 1975   07.6–100

Fuel evaporation system model 107.04 (AUS) (J) (USA)



11 Hose clip
51 Fuel hose
54 Fuel hose
55 Valve system
55a Cover
55b Filter
56 Negative venting line

(AUS) starting October 1974

(J) starting January 1973

(USA) 1973 and 1974 Federal

57 Connecting pipe
58 Throttle
59 Negative venting line
60 Closing plug
61 Ring fitting
62 Sealing ring
63 Hollow screw

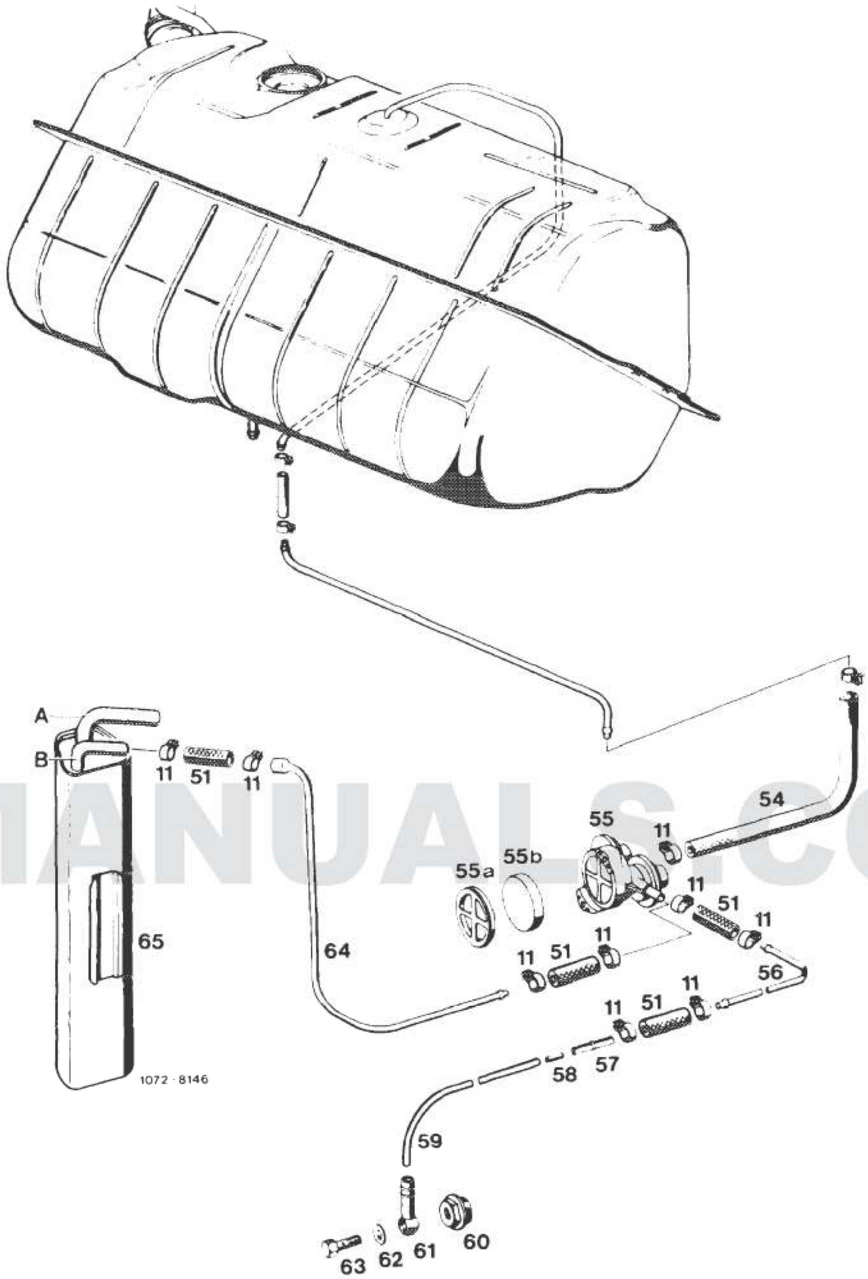
(USA) 1974 California

(USA) 1975 Federal and California

64 Negative venting line
65 Charcoal canister

Connections on charcoal canister
A Draw-off line to purge valve (draw-off valve)
B Fuel tank venting system

Fuel evaporation control system model 107.02, 116 (AUS) (J) (USA)



11 Hose clip
51 Fuel hose
54 Fuel hose
55 Valve system
55a Cover
55b Filter
56 Negative venting line

(AUS) starting October 1974
(J) starting January 1973
(USA) 1973 and 1974 Federal

57 Connecting pipe
58 Throttle
59 Negative venting line
60 Closing plug
61 Ring fitting
62 Sealing ring
63 Hollow screw

(USA) 1974 California
(USA) 1975 Federal and California

64 Negative venting line
65 Charcoal canister

Connections on charcoal canister
A Draw-off line to purge valve (draw-off valve)
B Fuel tank venting system

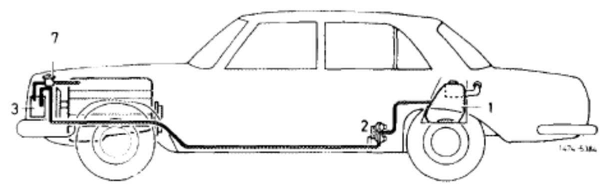
A. General

The fuel evapotation control system prevents the escape of fuel evaporation vapors from fuel system into atmosphere.

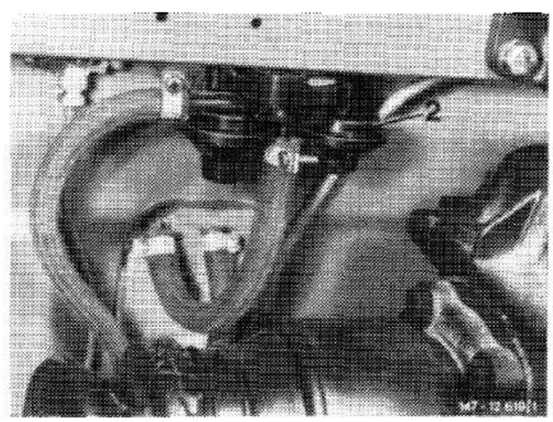
B. (J) 1976–1980, (USA) 1976

Function diagram

1 Fuel tank
2 Valve system
3 Charcoal canister
4 Draw-off valve



Components of fuel evaporation control system:



Valve system

The valve system is located underneath vehicle at level of rear leg room.

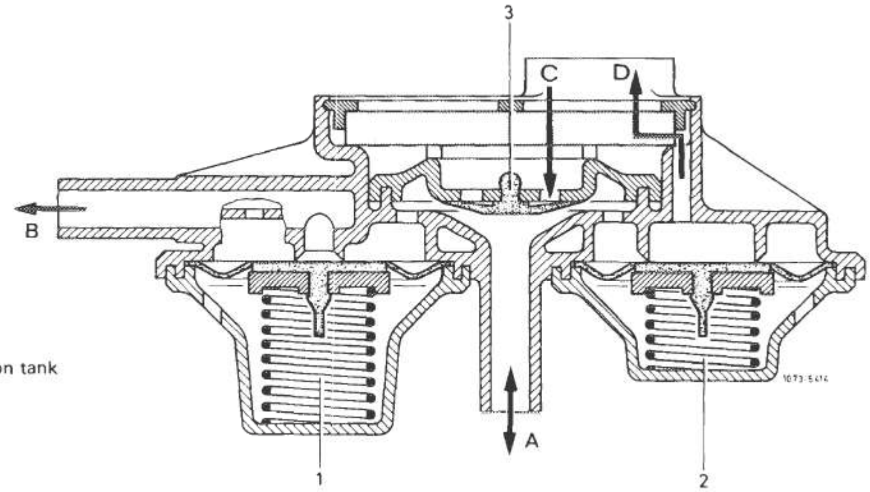
The valve system comprises three valves:

1. Negative venting valve
2. Pressure relief valve
3. Positive venting valve

The **negative venting valve** opens at a slight over-pressure. The evaporation vapors will flow via negative venting valve (1) (direction B) in a line toward charcoal canister.

The **pressure relief valve** is a safety valve and opens when the fuel evaporation control system is subject to overpressure. The fuel vapors are vented directly into the atmosphere.

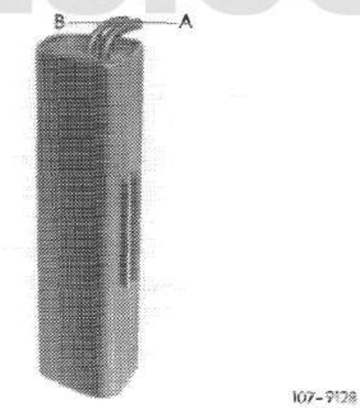
The **positive venting valve** opens when cooling down of fuel tank results in underpressure.



1 Negative venting valve
2 Pressure relief valve
3 Positive venting valve
A Inlet to valve system/
outlet to vent of fuel expansion tank
B To charcoal canister
C Fresh air inlet
D Outlet pressure relief valve

Charcoal canister

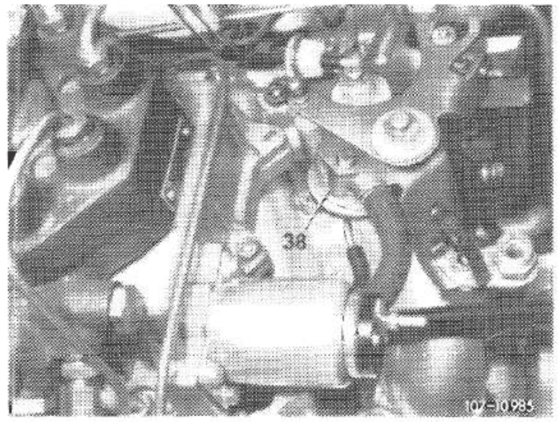
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn-off again while driving.



A Connection tank vent
B Connection purge valve

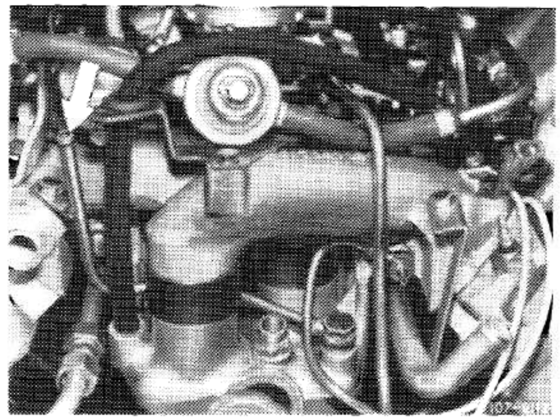
Purge valve

The purge valve is controlled by vacuum from throttle valve. If the diaphragm is energized by vacuum, the valve opens and the vapors can be drawn-off from charcoal canister.



Intake manifold connection

To draw fuel evaporation vapors from charcoal canister, the intake manifold is provided with a connection (arrow).



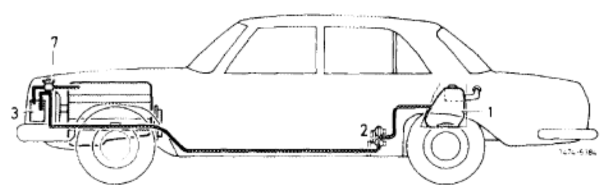
Functional description

The fuel evaporation vapors from fuel tank are stored in charcoal canister with engine stopped and are drawn from charcoal canister with engine running, depending on intake manifold vacuum.

When the throttle valve is open, diaphragm of the purge valve is energized by a vacuum and the valve is opened.

The stored vapors will be drawn from charcoal canister under influence of intake manifold vacuum.

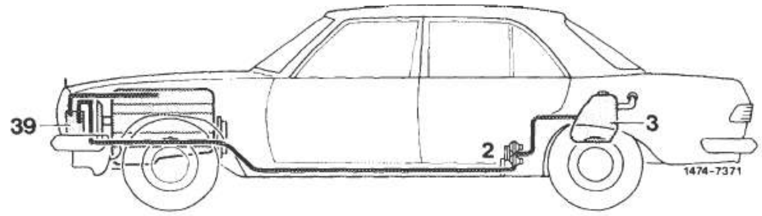
1 Fuel tank
2 Valve system
3 Charcoal canister
7 Purge valve



C. (AUS) (USA) 1977

The vacuum-controlled purge valve is no longer installed. The throttle valve has a draw-off connection which is connected to charcoal canister by way of a black plastic line.

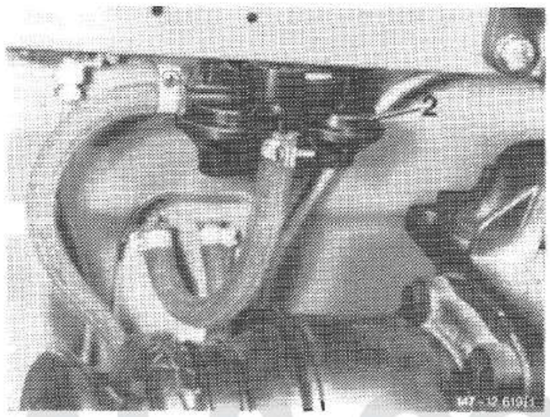
Function diagram



2 Valve system
3 Fuel tank
39 Charcoal canister

Components of fuel evaporation control system:

Valve system



The valve system is mounted under vehicle at level of rear leg room.

For functional description of valve system refer to section "B. (J) 1976–1980, (USA) 1976".

Charcoal canister

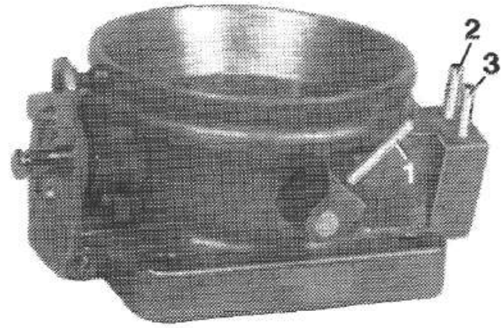
The fuel evaporation vapors from fuel tank are stored in charcoal canister and are drawn off again from canister while driving.

A Connection to valve system
B Purge system to throttle valve housing

107-9128

Throttle valve housing

The throttle valve housing is provided with a connection for drawing evaporation vapors from charcoal canister.



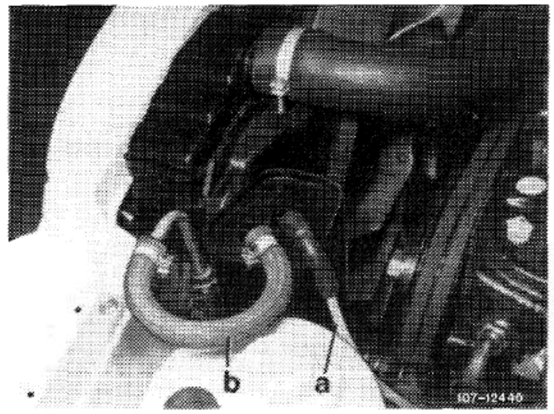
1 Vacuum connection ignition timing retard
2 Vacuum connection ignition timing advance
3 Vacuum connection charcoal canister

107-13054

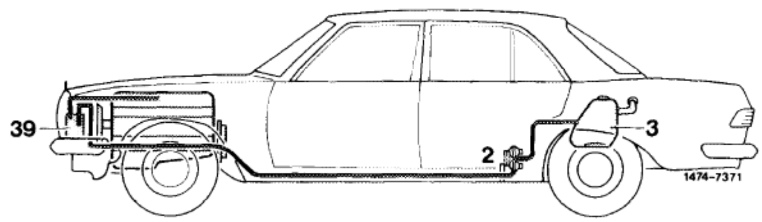
Functional description

The fuel evaporation vapors from fuel tank are routed via valve system (2) into charcoal canister.

The fuel evaporation vapors are stored in charcoal canister with the engine stopped, and are drawn-off into throttle valve housing with the engine running, starting at a given throttle valve position.



a To throttle valve housing
b From valve system

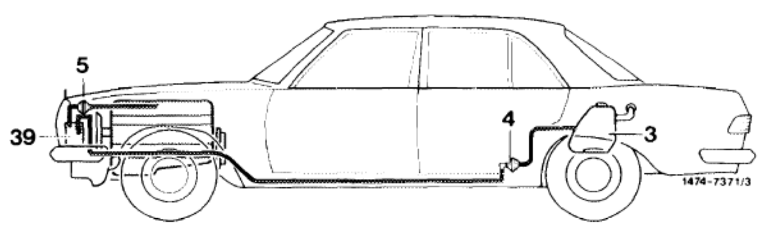


2 Valve system
3 Fuel tank
39 Charcoal canister

D. AUS USA 1978–1980

The vent valve unit replaces the valve system. A purge valve (regenerating valve) is installed into draw-off line between charcoal canister and throttle valve housing.

Function diagram

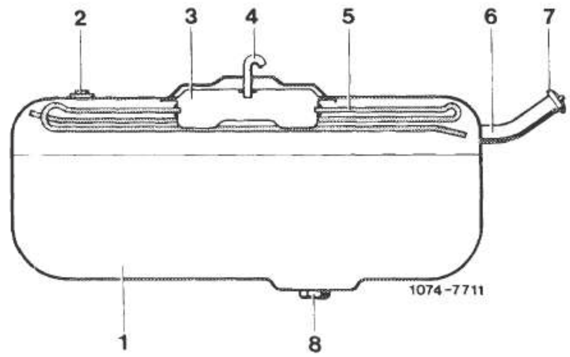


3 Fuel tank
4 Vent valve
5 Purge valve
(regenerating valve)
39 Charcoal canister

The system comprises the following components:

Fuel tank

The fuel tank with its pipe system and the collecting pan correspond to the already known version.

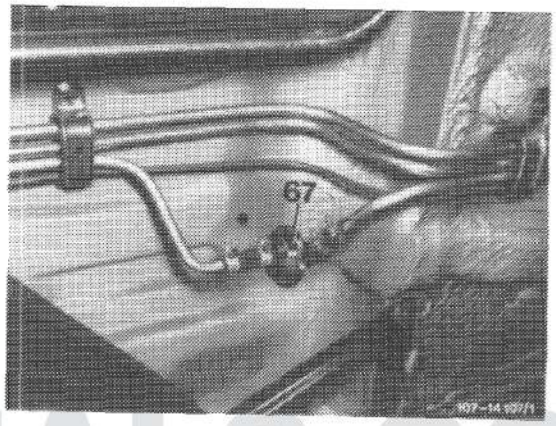


1 Fuel tank
2 Immersion tube transmitter
3 Expansion tank
4 Connection diverter valve
5 Pipe system
6 Filler neck
7 Closing cap
8 Connection fuel feed line

Vent valve unit

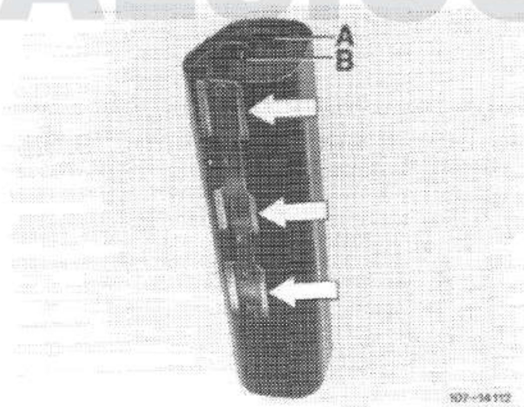
The vent valve unit (67) is mounted under vehicle at level or rear leg room and comprises a negative venting valve and a positive venting valve.

Note: Starting model year 1980, a vent valve unit of reduced diameter is optionally valid. Function and effect are the same.



Charcoal canister

The charcoal canister corresponds to the already known version, except that the fastener (arrow) has been modified.

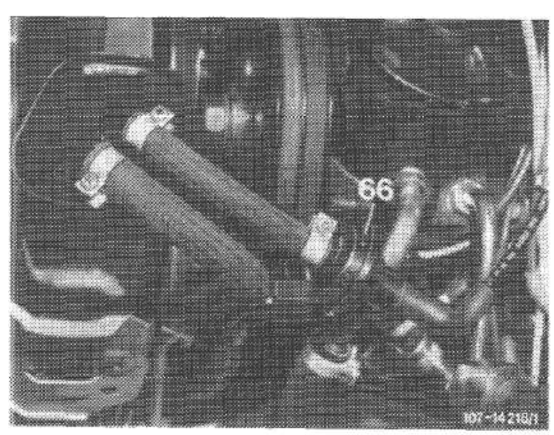


A Suction line to throttle valve housing
B Fuel tank negative vent

Regenerating valve

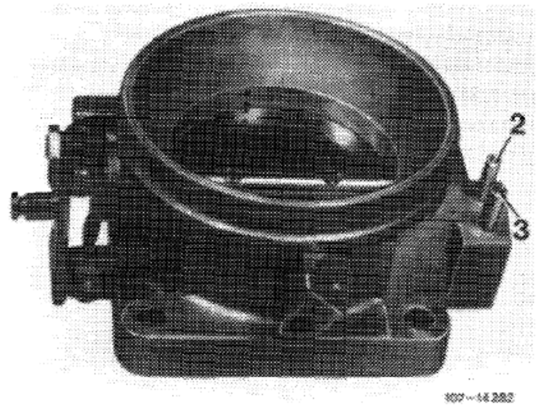
The regenerating valve (66) is located in regenerating line from charcoal canister to throttle valve housing.

Note: Starting model year 1980, a regenerating valve of smaller diameter is optionally valid. Function and operation are the same.



Throttle valve housing

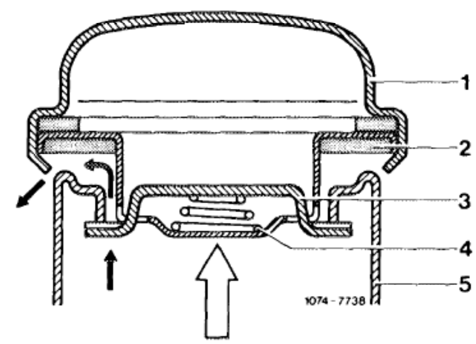
The throttle valve housing has been slightly modified as compared with model year 1977. To prevent mixing up vacuum connections, the OD of the vacuum connection to charcoal canister has been enlarged from 4 to 5 mm. For drawing evaporation vapors from charcoal canister two regenerating bores were provided above throttle valve.



2 Vacuum connection ignition advance
3 Vacuum connection charcoal canister

Fuel tank closing cap

To prevent increased overpressure in fuel tank, the fuel tank closing cap has been modified.



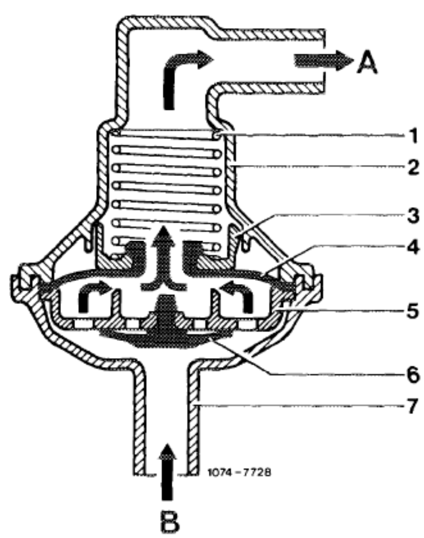
1 Closing cap
2 Sealing ring
3 Closing clip
4 Compression spring
5 Filler neck

Functional description

Evaporation system

The vent valve unit increases the pressure in fuel tank to 30–50 mbar. As a result, fewer fuel evaporation vapors will escape from fuel tank.

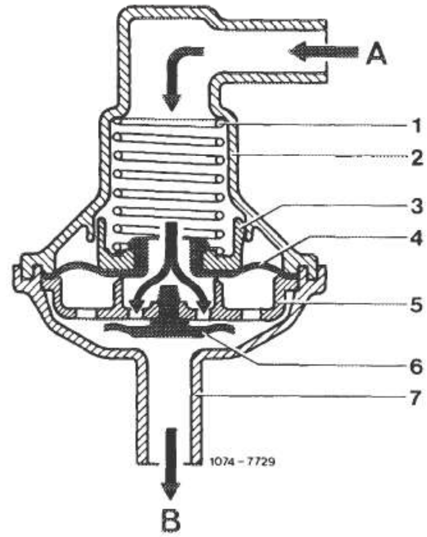
If the pressure in fuel tank amounts to 30–50 mbar, the negative venting valve (4) will open and permit the fuel evaporation vapors to flow to charcoal canister where they are stored when the engine is stopped.



Vent valve unit to charcoal canister opened

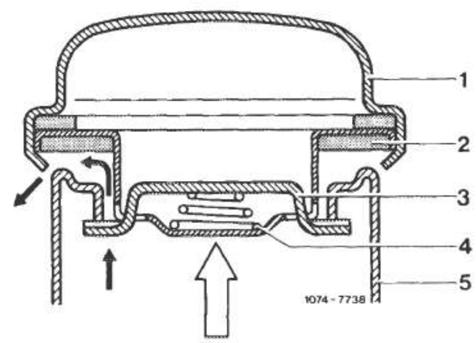
1 Compression spring
2 Valve housing
3 Spring retainer
4 Vent valve unit
5 Valve plate
6 Positive venting valve
7 Connection
A Connection charcoal canister
B Connection fuel tank

When the fuel is cooling down, the decreasing volume is compensated by the intake of air or fuel evaporation vapors from charcoal canister via vent valve unit (6) starting at a vacuum of 1–16 mbar. The vent valve unit (6) will close when the vacuum in fuel tank drops below 1 mbar.



Vent valve unit to fuel tank opens

If the pressure in fuel tank increases by 100–130 mbar as a result of a failure in evaporation system, the fuel evaporation vapors will escape from fuel tank through closing cover.

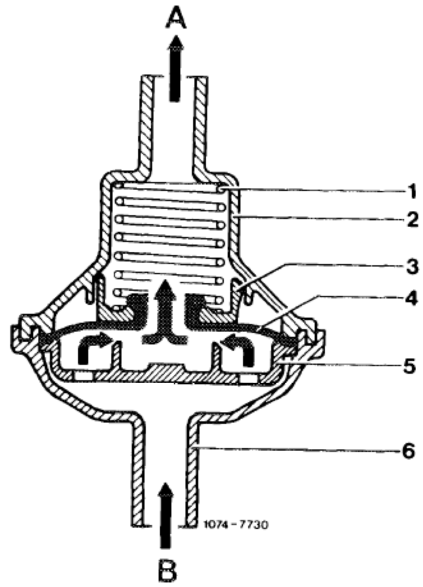


1 Closing cover
2 Sealing ring
3 Closing clip
4 Compression spring
5 Filler neck

Regenerating system

The charcoal canister is connected to throttle valve housing by means of a line, in which the regenerating valve is installed.

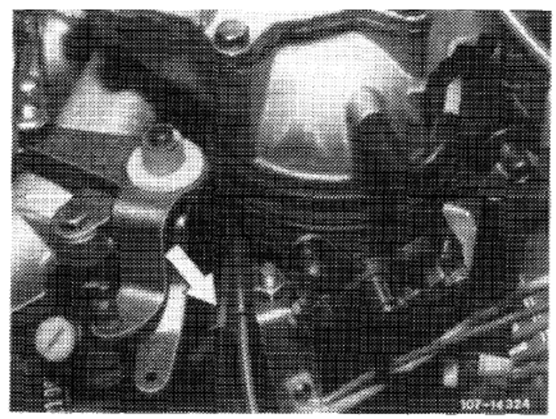
If with the engine running the vacuum value of 30–50 mbar in regenerating line is exceeded, the regenerating valve will open. The fuel evaporation vapors stored in charcoal canister can then be drawn off depending on position of throttle valve.



Regenerating valve (open)

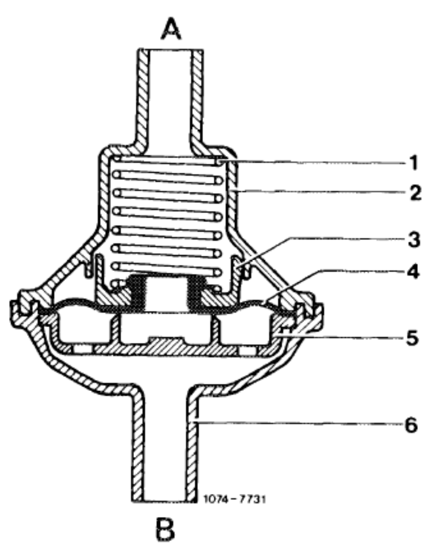
1 Compression spring
2 Valve housing
3 Spring retainer
4 Vent valve unit
5 Valve plate
6 Connection
A Connection throttle valve housing
B Connection charcoal canister

When the throttle valve opens, the two regenerating bores in throttle valve housing which are entering a common channel are passed over one after the other. As a result, regeneration in lower partial load range of engine will start at a dosage rate that the driving characteristics are not influenced.



Arrow = suction connection throttle valve

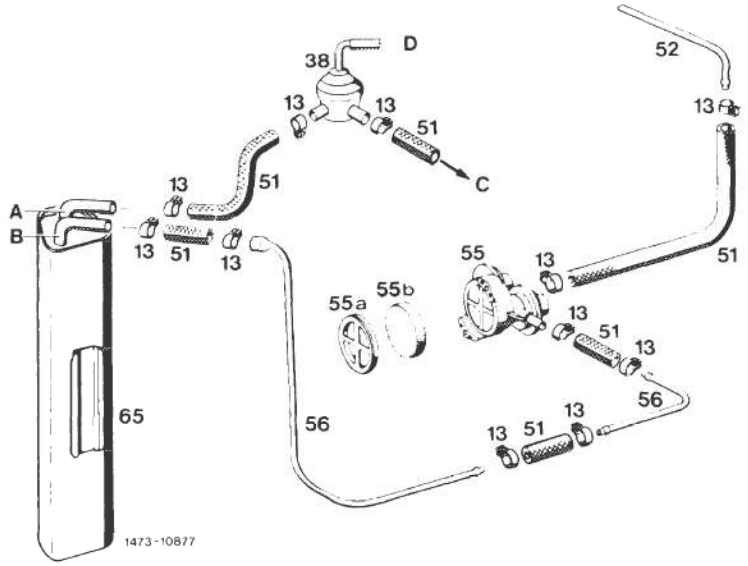
At idle and while coasting (deceleration) (throttle valve closed) the two regenerating bores are on atmospheric side of throttle valve. The regenerating valve is closed, there is no regeneration in charcoal canister.



Regenerating valve (closed)

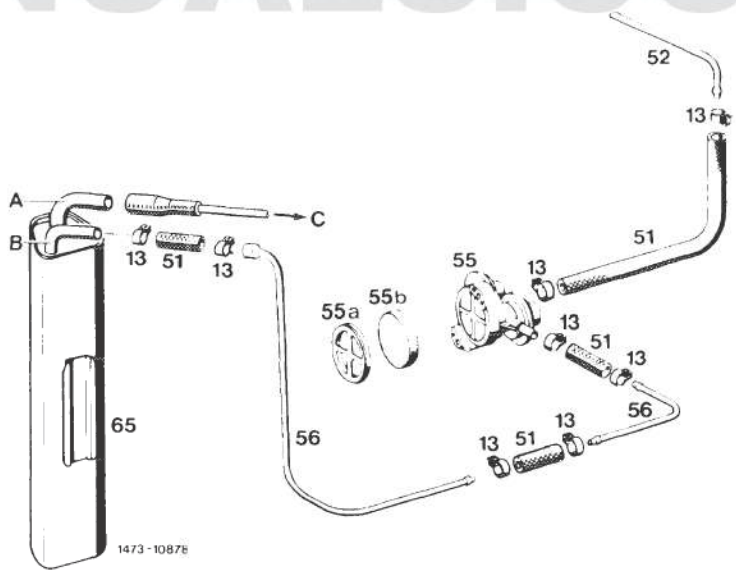
Survey fuel evaporation control system

(J) 1976–1980, (USA) 1976



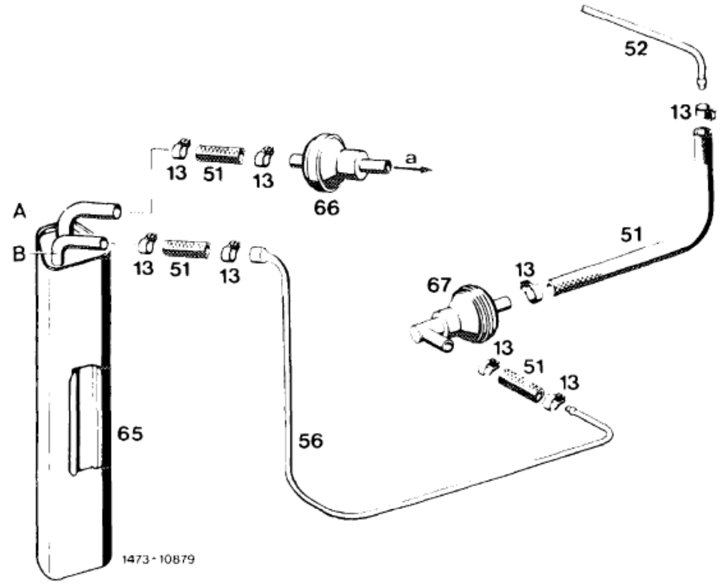
13 Hose clamp
51 Fuel hose
52 Vent line from fuel tank
55 Valve system
55a Cap
55b Filter
56 Vent line
65 Charcoal canister
A Draw-off connection
B Vent line connection
C Intake manifold draw-off connection
D Vacuum throttle valve housing

(AUS) (USA) 1977



13 Hose clamp
51 Fuel hose
52 Vent line from fuel tank
55 Valve system
55a Cap
55b Filter
56 Vent line
65 Charcoal canister
A Draw-off connection
B Vent line connection
C Draw-off connection throttle valve housing

(AUS) (USA) 1978–1980



13 Hose clamp
51 Fuel hose line
52 Vent line from fuel tank
56 Vent line
65 Charcoal canister
66 Regenerating valve
67 Vent valve unit
a To throttle valve housing
A Draw-off connection
B Vent line connection

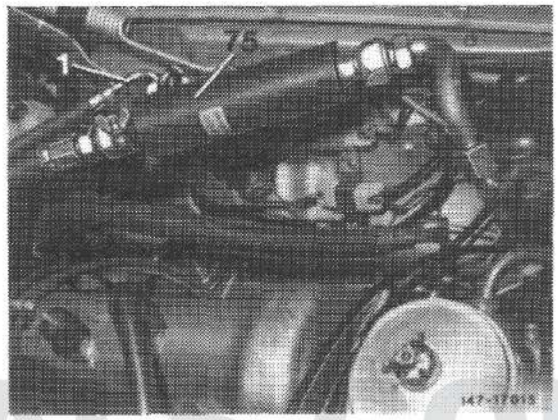
47–850 Fuel cooler (J) (USA)

(J) starting 1979, (USA) starting 1980

Model 107, 116

General

To keep the fuel temperature as low as possible also at high outside temperatures, a fuel cooler is installed in refrigerant line from evaporator to refrigerant compressor. This is essentially a double tube version, with the refrigerant (R 12) flowing through the inner tube and the fuel to be cooled through the annular space between outer and inner tube.

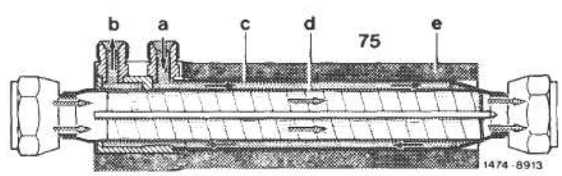


75 Fuel cooler

Operation

With the engine running, the excess fuel in fuel distributor flows through return flow line to fuel cooler (75) and then back into fuel tank.

As long as the refrigerant compressor is switched on, the gaseous refrigerant, which flows through the inner tube of the fuel cooler, will extract heat from the fuel.



a Fuel inlet
b Fuel outlet
c Outer tube
d Inner tube
e Armaflex hose

49–100 Removal and installation of exhaust system

Tightening torques	Nm	(kpm)
Self-locking nut on expansion pipe (model 107 only)	20–25	(2–2.5)
Self-locking nut on exhaust manifold to exhaust flange	20–25	(2–2.5)

Removal and installation of exhaust system is not fully explained, only a few particularly important items are described which must be observed during removal and installation or during partial renewal e.g. of resonance damper with plug connection.

Removal

1 If the plug connection cannot be separated, heat exhaust pipe. For safety reasons and prior to heating the pipes, place a protective panel on vehicle between frame floor and exhaust pipes.

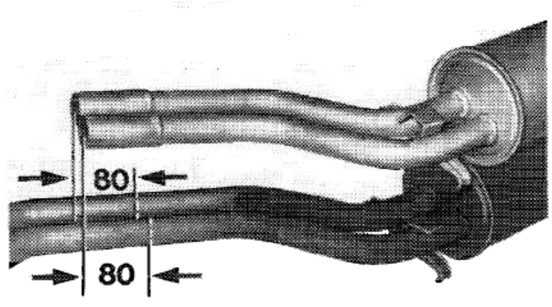
2 Check fastening members for re-use and replace, if required.

Installation

Replacement of resonance damper.

3 Place new resonance damper with plug connection accurately on removed installation (standard system) and mark pipe length of new resonance damper on removed unit.

Cut pipe 80 mm minus 10 mm from mark in direction of resonance damper to guarantee a plug-in depth of 70–80 mm.

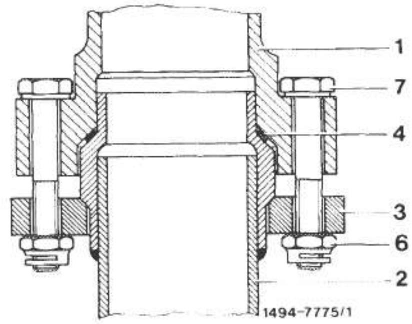


149-13369

4 Always replace self-locking hex nuts and sealing rings.

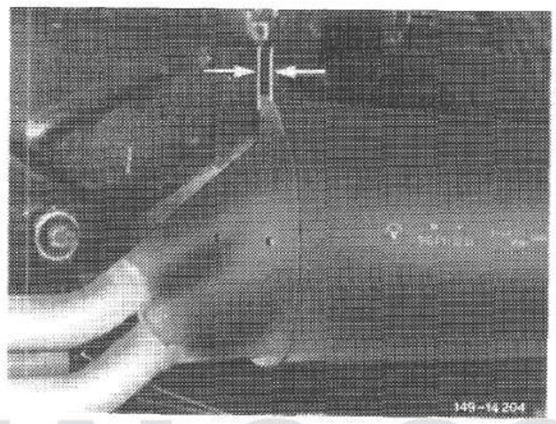
5 Exhaust pipe manifold connection.

Tighten flange connection to exhaust manifold not before the complete system is mounted in rubber rings. Tightening torque of hex bolts 20–25 Nm (2–2.5 kpm).



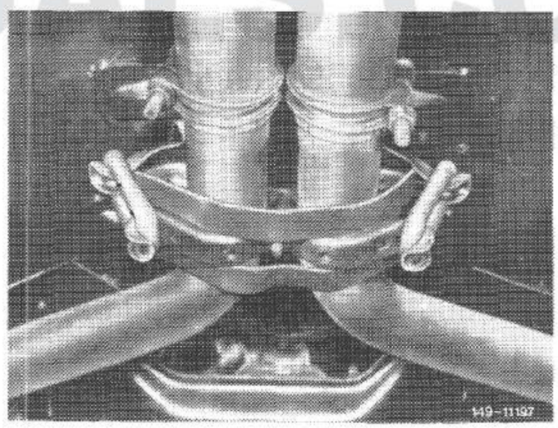
1 Exhaust manifold
2 Exhaust pipe with trapezoidal connection
3 Flange
4 Sealing ring
6 Self-locking hex nut
7 Hex bolt

6 **Pay attention to distance between center resonance damper and frame floor (distance approx. 20 mm, model 116 only, arrows).**

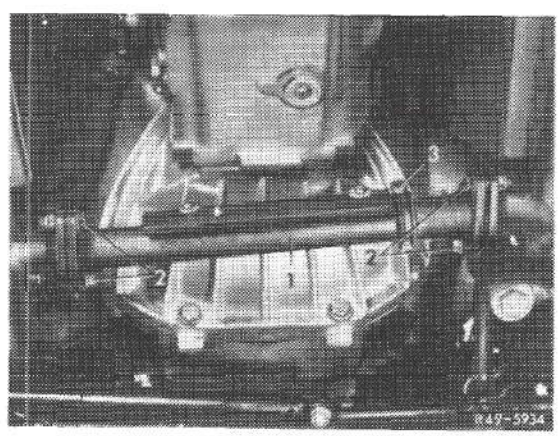


Note: The rubber rings are available in two different degrees of shore hardness. Hardness is identified by compression test.

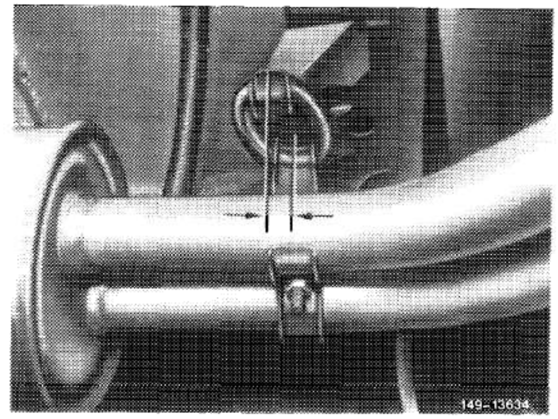
7 On model 116 use only the softer rubber rings at front exhaust suspension.



8 Tighten flange connection (2) on expansion pipe only after the complete exhaust system has been mounted. Then tighten pipe clip (3). Tightening torque of self-locking nuts 20–25 Nm (2–2.5 kpm) (model 107 only).

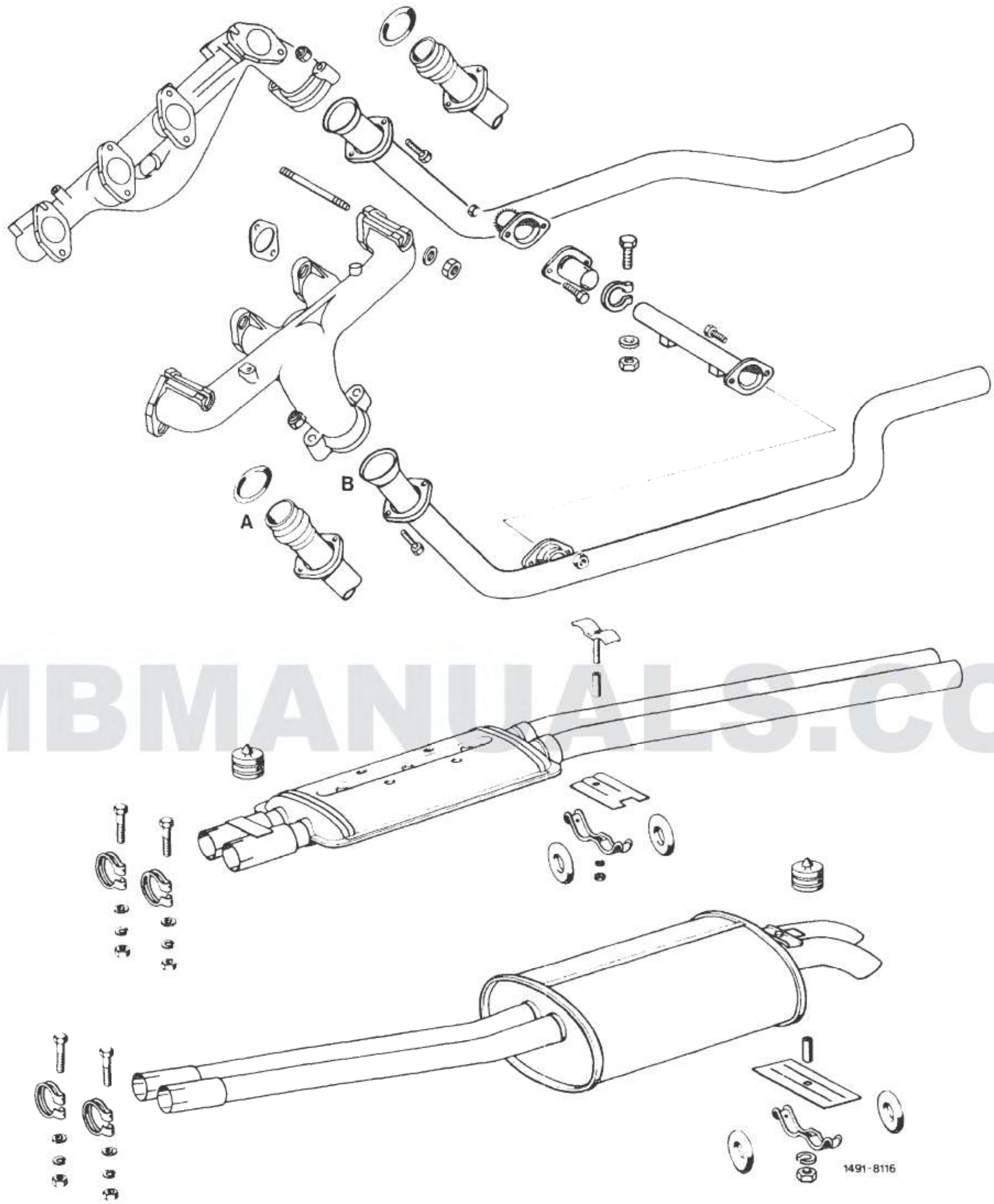


9 Mount resonance damper in such a manner that the holders of the resonance damper are **approx. 10 mm** in front of holders on frame floor (arrows), so that the correct installation position is assured when exhaust system is subject to elongation.



10 Run engine and check exhaust system for leaks.

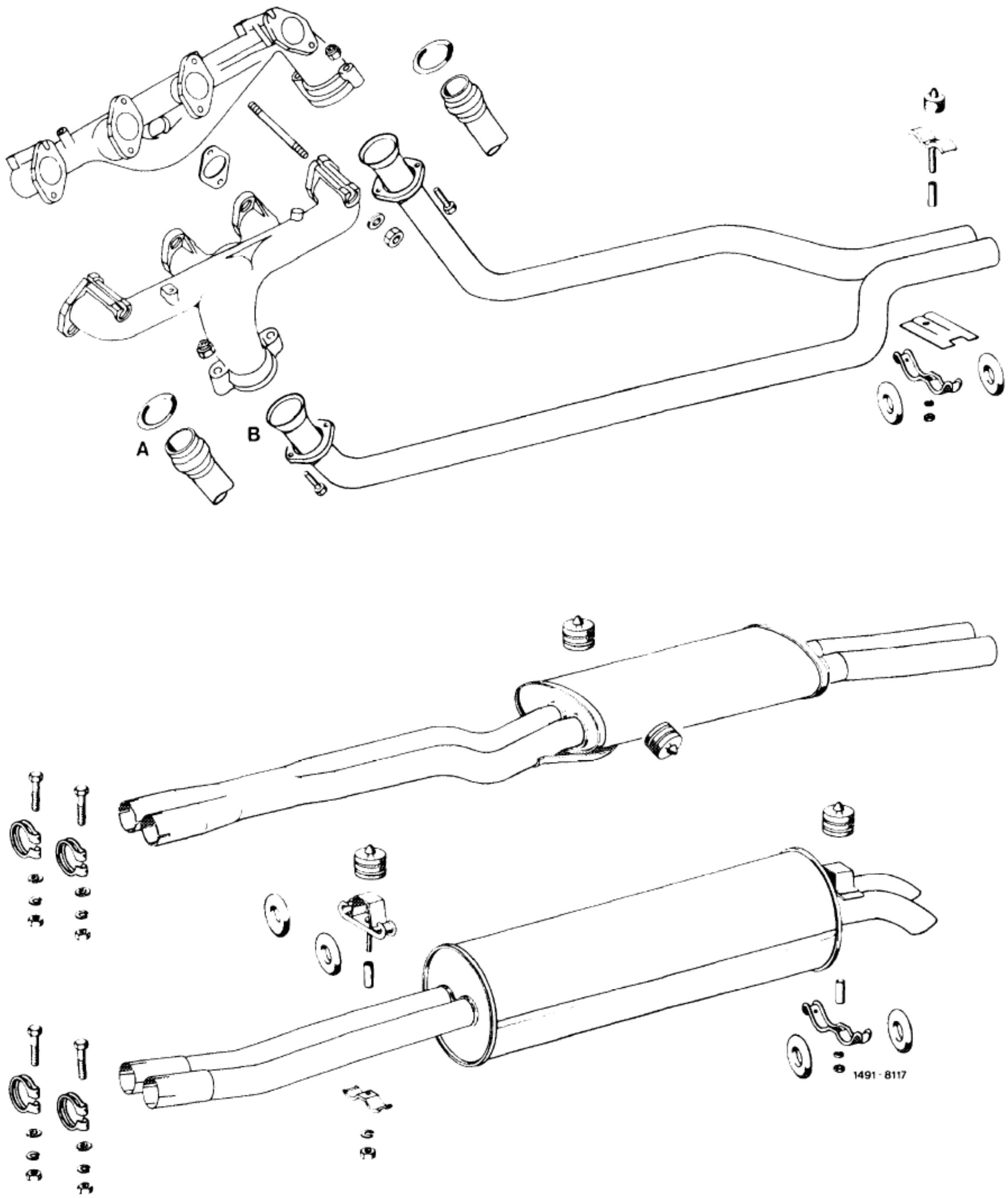
Exhaust manifold with complete exhaust system
Models 107.023/024/043/044



A Front exhaust pipe with trapezoidal connection (on vehicles with electronic gasoline injection and CIS 1st version)

B Front exhaust pipe with flare for ball connection (on vehicles with CIS 2nd version).

Exhaust manifold with complete exhaust system
Models 116.028/029/032 /033



A Front exhaust pipe with trapezoidal connection (on vehicles with electronic gasoline injection and CIS 1st version).
B Front exhaust pipe with flare for ball connection (on vehicles with CIS 2nd version).

49–100 Removal and installation of exhaust system

Tightening torques	Nm
Self-locking hex. nuts on compensating pipe (model 107 only)	20–25
Self-locking hex. nuts on exhaust manifold to exhaust flange	20–25

Note

Removal and installation of exhaust system is not fully explained, only a few particularly important items are described which must be observed during removal and installation or during partial renewal – e.g. of resonance damper with plug connection.

Removal

1 If plug connection is hard to separate, heat exhaust pipes. For safety reasons, mount a protective panel prior to heating pipes.

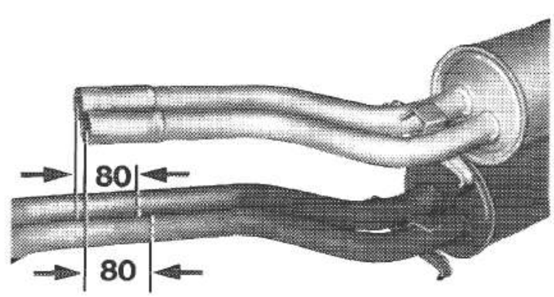
2 Check fastening members for re-use and replace, if required.

Installation

Replacement of resonance damper:

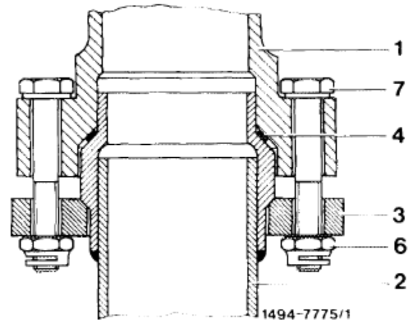
3 Place new resonance damper with plug connection accurately on removed installation (standard system) and mark pipe length of new resonance damper on removed unit.

Cut pipe 80 mm from mark minus 10 mm in direction of resonance damper to guarantee a plug-in depth of 70–80 mm.



149 – 13369

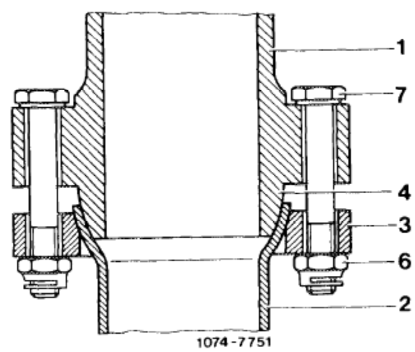
4 Always replace self-locking hex. nuts and sealing rings.



Exhaust pipe-manifold connection 1st version

1 Exhaust manifold
2 Exhaust pipe with cone
3 Flange
4 Sealing ring
6 Self-locking hex. nut
7 Hex. bolt

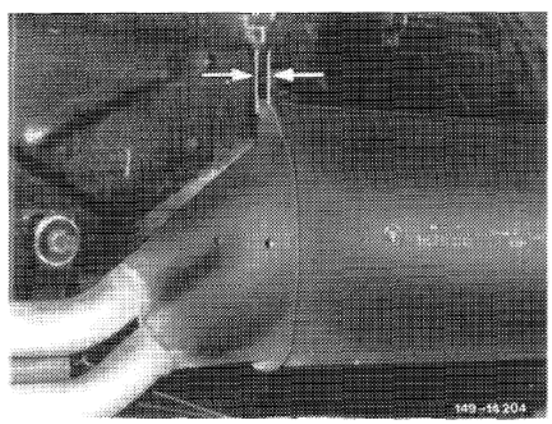
5 *Tighten flange connection to exhaust manifold not* before the complete system is mounted in rubber rings. Pay attention to correct seat of front exhaust pipe (2). Tightening torque of hex. bolts 20–25 Nm.



Exhaust pipe-manifold connection of 2nd version

1 Exhaust manifold
2 Flared exhaust pipe
3 Flange
4 Ball connection
6 Self-locking hex. nut
7 Hex. bolt

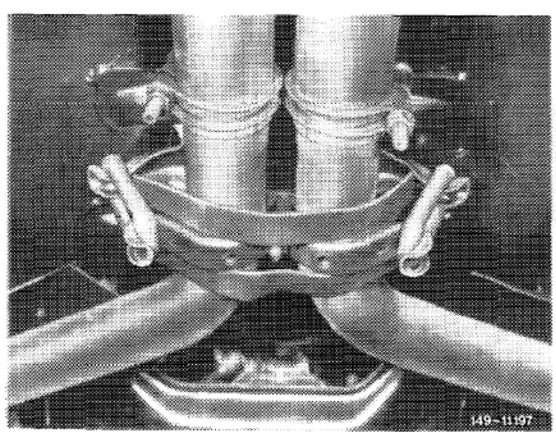
6 Pay attention to distance between center resonance damper and frame floor (on model 116 distance approx. 20 mm, arrows).



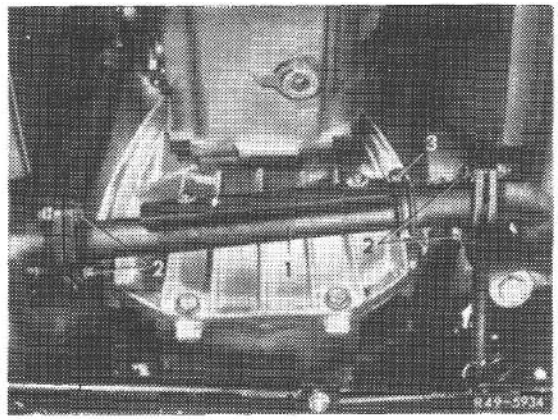
Note: Rubber rings are available in two degrees of shore hardness. Hardness is recognized by compressing rings.

On model 116 use only the softer rubber rings at front exhaust mounting.

Model 116

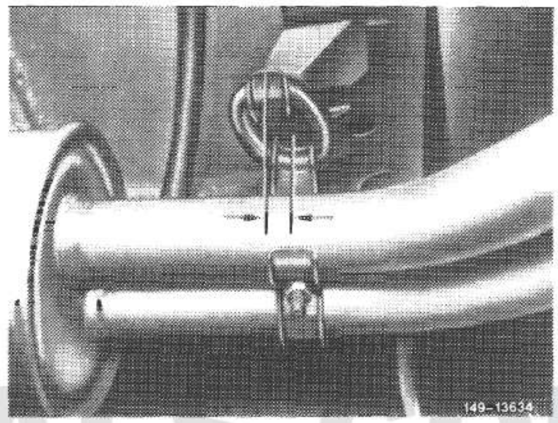


7 Tighten flange connection (2) on compensating pipe only when the complete exhaust system is mounted. Then tighten pipe clamp (3). Tightening torque of self-locking nuts 20–25 Nm (model 107 only).



Model 107

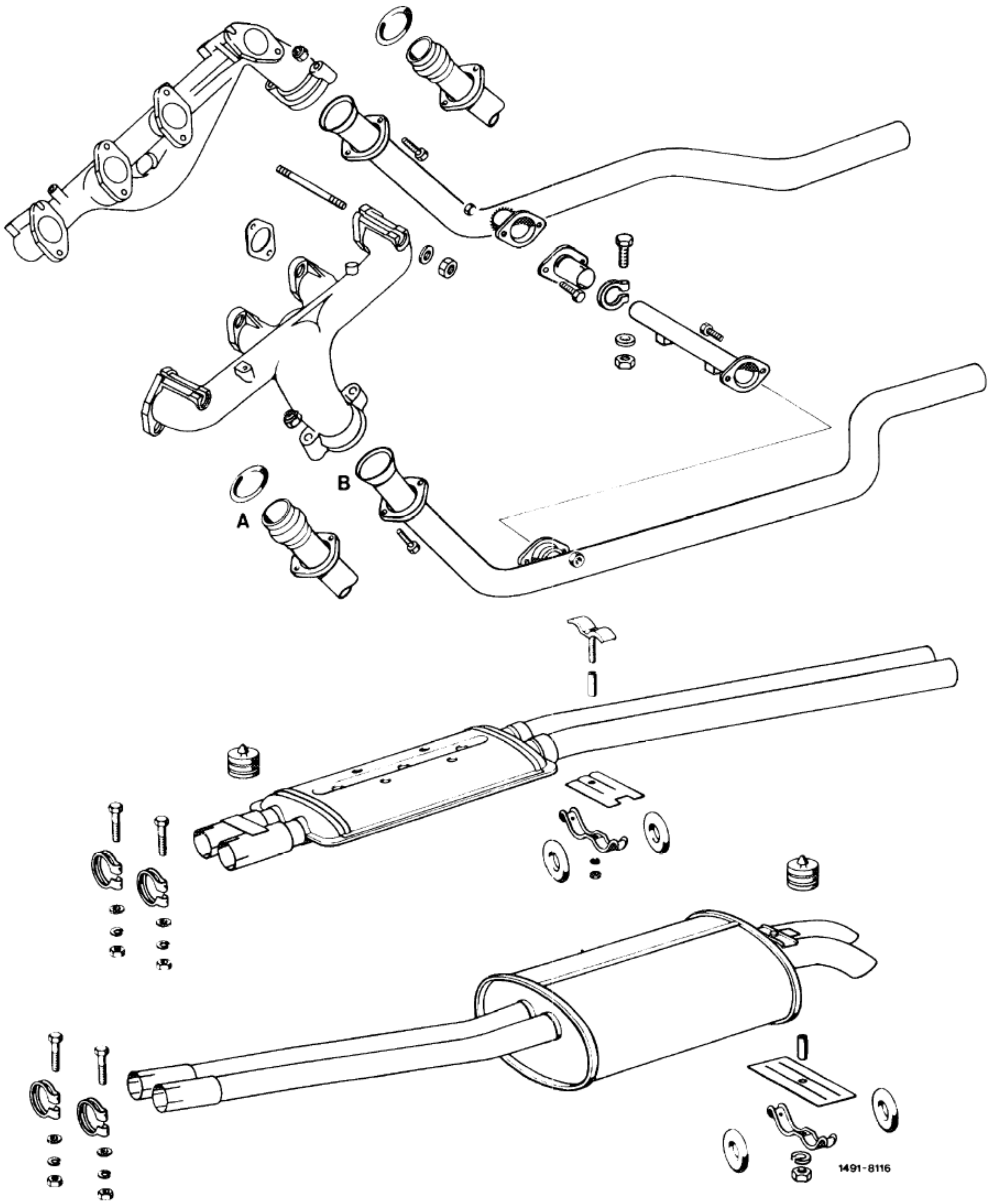
8 Mount resonance damper in such a manner that the holding clips of resonance damper are approx. 10 mm in front of holders on frame floor (arrow), so that in the event of elongation the exhaust system retains its correct installation position.



Model 116

9 Keep engine running and check exhaust system for leaks.

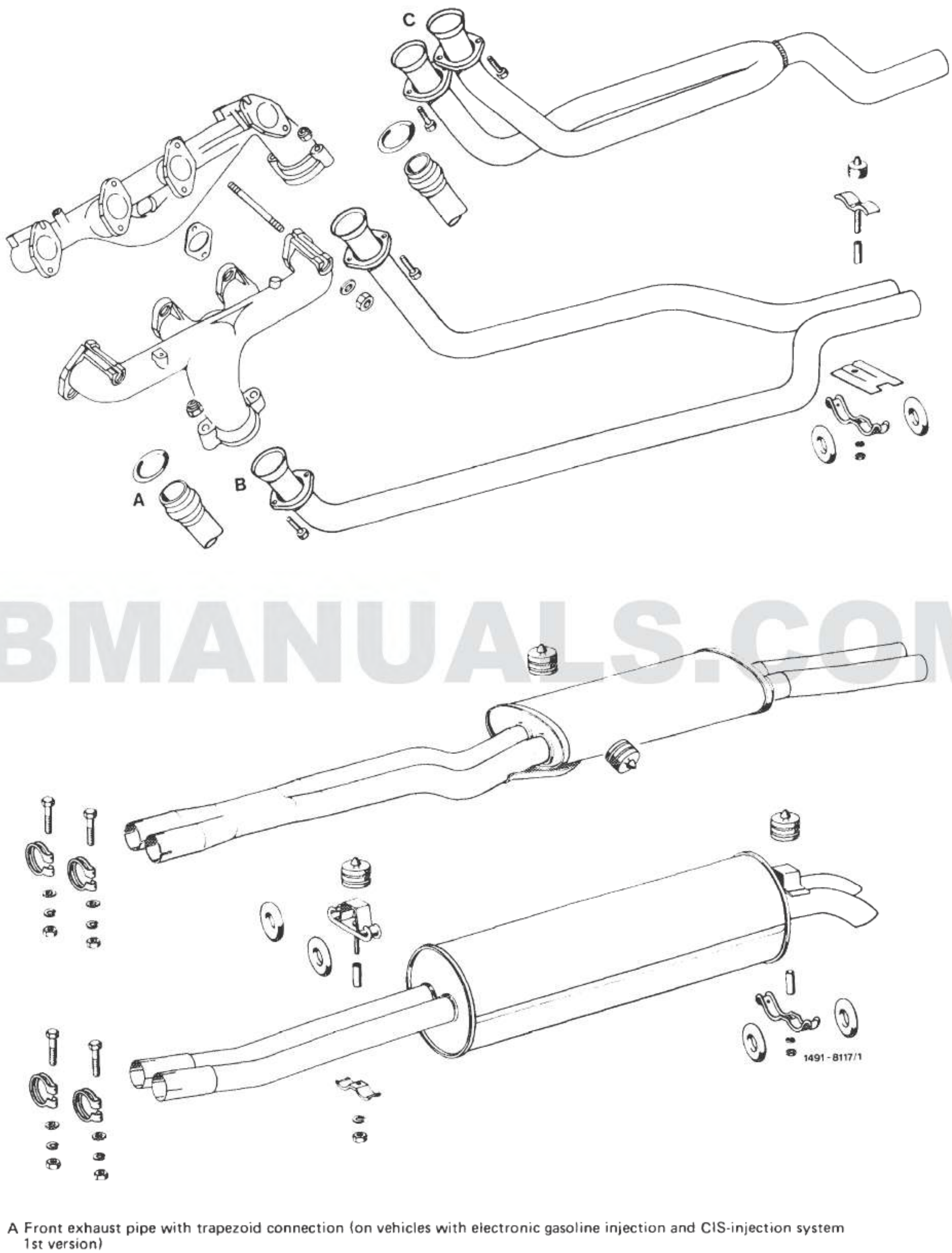
Exhaust manifold with complete exhaust system
Model 107.023/024/043/044



A Front exhaust pipe with trapezoid connection (on vehicles with electronic gasoline injection and CIS-injection system 1st version)

B Front exhaust pipe with flare for ball connection (on vehicles with CIS-injection system 2nd version)

Exhaust manifold with complete exhaust system
Model 116.028/029/032/033



A Front exhaust pipe with trapezoid connection (on vehicles with electronic gasoline injection and CIS-injection system 1st version)

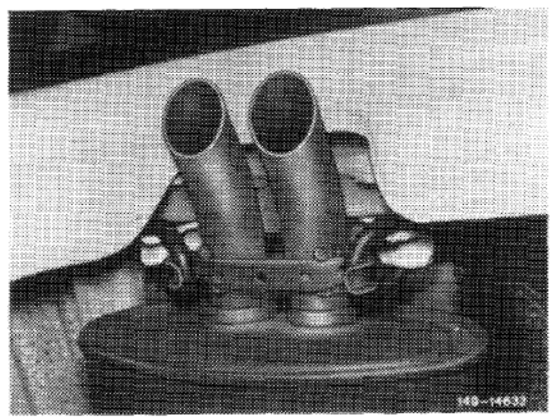
B Front exhaust pipe with flare for ball connection (on vehicles with CIS-injection system 2nd version)

C Front exhaust pipe – double flow starting January 1978

49–101 Exhaust system – technical modification

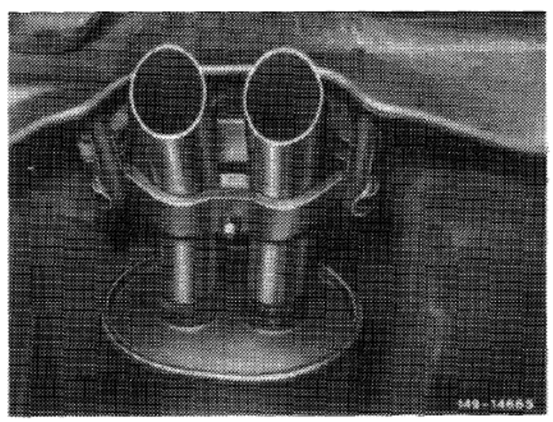
Starting 1978 only rear exhaust systems with diagonally downward end pipes on resonance damper are available as a spare part.

On model 107 the rear holder is again welded to end pipes.



Model 107

Model 116 has a modified rear holder for conversion to diagonally downward end pipes.



Model 116

49–450 Removal and installation of exhaust manifold

A. Model 107

Tightening torque	Nm	(kpm)
Screw for engine mount	75	(7.5)

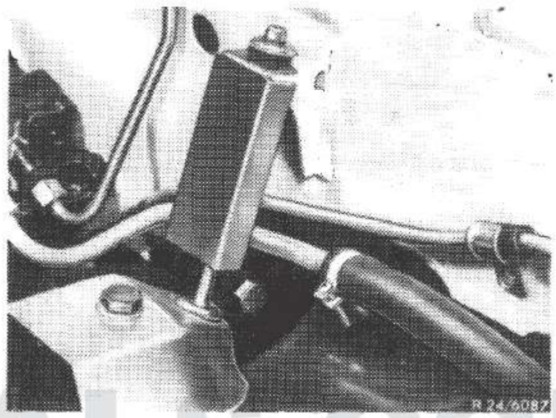
Removal

1 Remove exhaust system (49–100).

2 Pull-off ignition cable.

3 Unscrew shielding plates on exhaust manifold.

4 Unscrew engine shock absorber with holder and shielding plates. For this purpose, remove screw for engine mount.



Exhaust manifold left

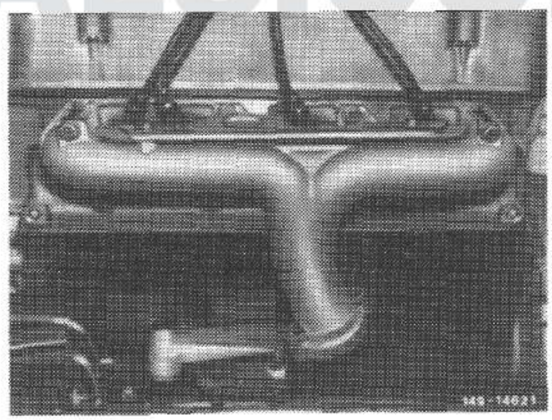
5 Remove air filter.

6 Remove cylinder head cover.

7 Remove vacuum hoses.

8 Unscrew exhaust nuts and screws and remove exhaust manifold. Slightly lift engine by means of pit lift, if required.

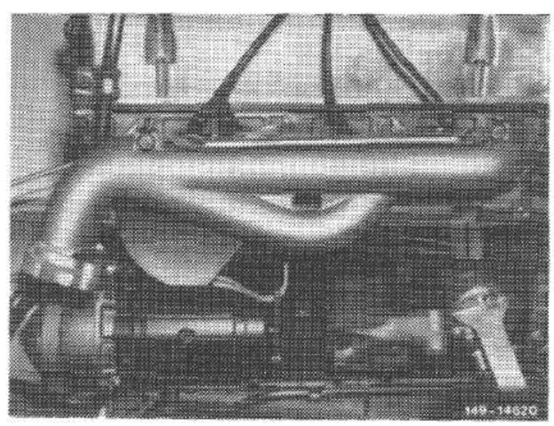
Note: For exhaust manifolds without slots, unscrew one stud each at front and rear on cylinder head.



Exhaust manifold right

9 Remove windshield washer reservoir. Unscrew coolant reservoir. Unscrew fastening clip for cooling water hose. Loosen cable strap for electric line and put reservoir aside.

10 Remove battery, battery holder and shielding plate.



11 Unscrew exhaust nuts and screws and remove exhaust manifold. Slightly lift engine with pit lift, if required.

Note: On exhaust manifolds without slots, unscrew one stud each at front and rear on cylinder head.

Installation

12 For installation proceed vice versa and renew all gaskets and exhaust nuts.

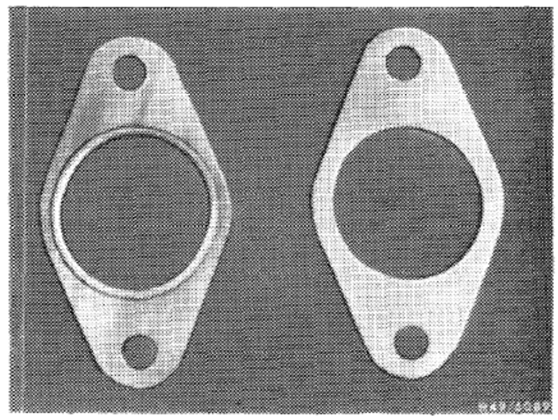
13 Mount flange gaskets with sheet metal facing cylinder head side.

14 Tighten screws for engine mount to 75 Nm (7.5 kpm).

15 Mount exhaust system.

16 Mount air filter.

17 Run engine and check exhaust system for leaks.



Cylinder head side Exhaust manifold side

B. Model 116

Removal

1 Remove exhaust system (49–100).

2 Pull-off ignition cable.

3 Unscrew shielding plates from exhaust manifold.

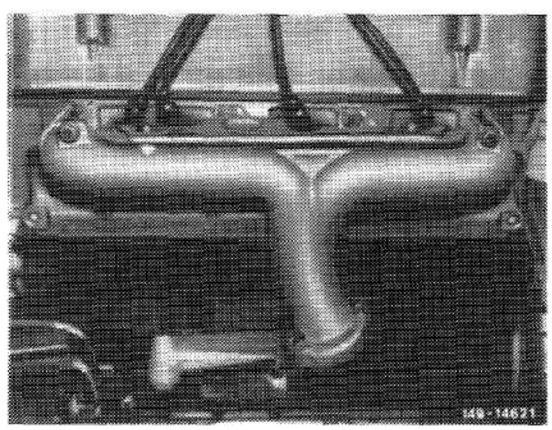
Exhaust manifold left

4 Remove air filter.

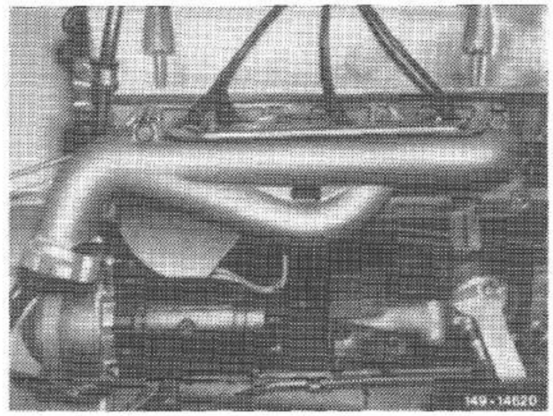
5 Remove cylinder head cover.

6 Remove vacuum hoses.

7 Unscrew exhaust nuts and screws and remove exhaust manifold. Slightly lift engine with pit lift, if required.



Note: On exhaust manifolds without slots unscrew one stud each at front and rear on cylinder head.



Exhaust manifold right

8 Remove battery and battery holder.

9 Unscrew exhaust nuts and screw and remove exhaust manifold. Slightly lift engine with pit lift, if required.

Note: On exhaust manifolds without slots, unscrew one stud each at front and rear on cylinder head.

Installation

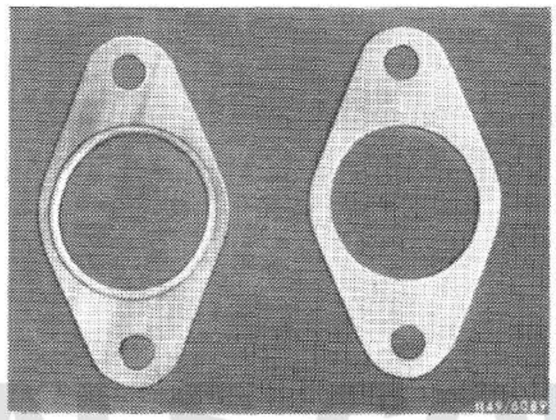
10 For installation proceed vice versa and renew all gaskets and exhaust nuts.

11 Mount flange seals with sheet metal facing cylinder head side.

12 Mount exhaust system.

13 Mount air filter.

14 Run engine and check exhaust system for leaks.

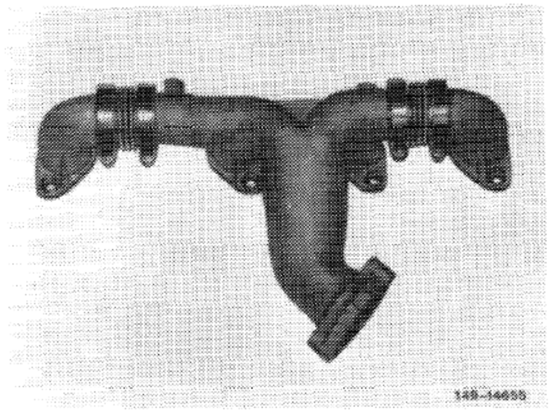


Cylinder head side Exhaust manifold side

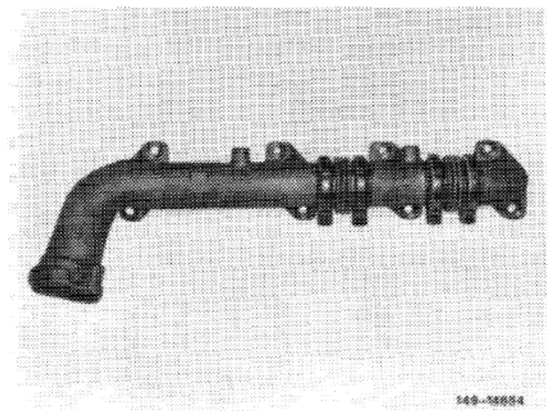
Repair versions

Left-hand steering

In the event of repairs, exhaust manifolds with outer ball connection (formerly trapezoidal connection) will be supplied. For this reason, when installing an exhaust manifold with outer ball connection, the front exhaust pipe with trapezoidal connection must be replaced by an exhaust pipe with outer ball connection.

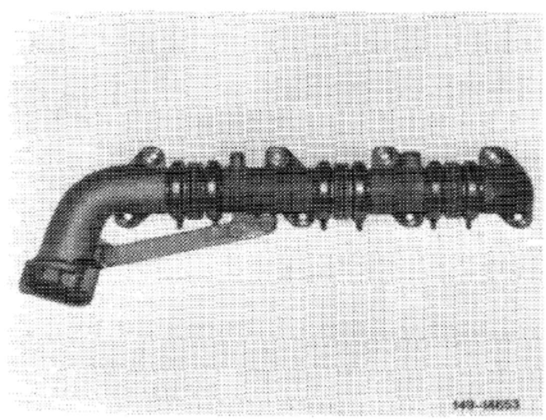


Exhaust manifold left



Exhaust manifold right

If during extremely sharp driving damage will show up even on exhaust manifolds with 2 bellows, the exhaust manifold can be subsequently provided with 3 bellows on right-hand engine side of model 116.



Exhaust manifold right model 116

Right-hand steering

On right-hand steering vehicles the exhaust manifolds are replaced like for like.