

## Model Identification

In most sections of this manual, the individual models are identified by the chassis type instead of the model designation. The chassis type designations are the first six digits of the chassis number (see page 005/2).

For example, sales designation model 280 E is chassis type 123.033.

In some instances, only the first three digits (123) will be referred to. In this case, this section applies to all vehicles of this particular chassis type.

## Location of Specific Repair Instructions

Locate main component group in Group Index. The group number is listed in the upper outside corner of each page within the group.

Check group contents, first page of each group, for the exact job description required. The job numbers, succeeded by page numbers within each group are listed in the lower portion of the individual pages.

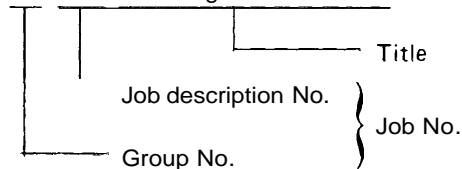
Unit Version 0 in the various Groups is general information applicable to the pertinent unit.

Unit Version with a *different numeral* is specific information for the title vehicle.

Depending on the unit installed in the vehicle, the numeral for the unit version may vary in the different groups.

Example:

32 - 120 Checking shock absorber



Data, adjusting values, processing dimensions, tightening torques and tools are listed at the beginning of each Section.

All the dimensions are in millimeters (mm), provided no other unit of measure is used.

The indicated part numbers are serving exclusively for identification and better differentiation of individual versions. When ordering spare parts, the part numbers must always be taken from the respective spare parts literature.

## Model and Unit Survey

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Model	Model Year From	To	Chassis Type	Engine Type
220 D	1968	1973	115.110	615.912
240 D	1974	1976	115.117	616.916
240 D	1977	—	123.123	616.912
300 D	1975	1976	115.114	617.910
300 D	1977	1981	123.130	617.912
300 CD	1978	1981	123.150	617.912
300 TD	1979	1980	123.190	617.912

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## Technical data

### Engine

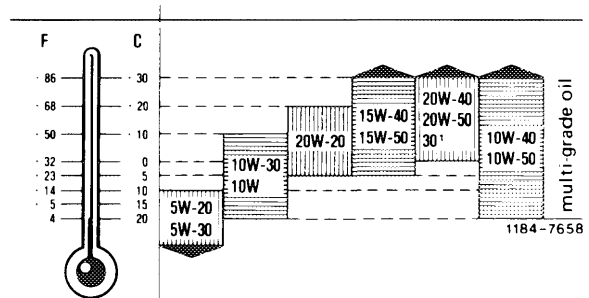
Model		220 D	240 D		300 D	
Chassis Type		115.110	115.117	123.123	115.114	123.130
Engine		615.912	616.916	616.912	617.910	617.912
Operation		Four-stroke diesel engine				
Number of cylinder		4			5	
Arrangement of cylinders		Upright in line				
Bore	mm/in.	87/3.43	91/3.58 <sup>1)</sup>		90.90/3.58 <sup>2)</sup>	
Stroke	mmlin.	92.413.64	92.413.64			
Total eff. piston displacement	cm <sup>3</sup> /cu.in.	2197/ 134.1	2404/146.7 <sup>1)</sup> 2399/146.4 <sup>2)</sup>		3005/183.4 <sup>1)</sup> 2998/183 <sup>2)</sup>	
Compression ratio		21:1				
Firing order		1-3-4-2			1-2-4-5-3	
Max. engine rpm (no load)		4350	5400	5200	5100	
Engine output	SAE net bhp/rpm	5714200	6214000	6514200	7714000	
Max. torque	SAE net lb.ft./rpm	88/2400	97/2400	97/2400	115/2400	
Crankshaft bearings		5			6	
Valve arrangement		Overhead				
Camshaft arrangement		OHC				
Oil cooling		Air-oil cooler				
Cooling		Water circulation pump, thermostat with by-pass line, fan with viscous coupling, finned tube radiator				
Lubrication		Forced oil circulation via gear-type oil pump				
Oil filter		Combination full-flow by-pass filter				
Air filter		Oil bath		Paper cartridge		

<sup>1)</sup> Up to model year 1978

<sup>2)</sup> Starting model year 1979

## 00-110 Removal and installation of engine (oil quantity)

Recommended viscosity grades  
according to SAE  
at constant ambient temperatures



1) SAE 40 oil can be used at constant ambient temperatures above +30 °C (+86° F).

Oil quantity in liters (for approved engine oils refer to "Service product specifications")



Engine	615.912/913 616.916 617.910	615.940/941 616.912 617.912
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Total quantity for refilling	6,5 <sup>1)</sup>	7,0 <sup>1)</sup>
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<sup>1)</sup> 0.5 liters more for models with air-cooled oil coolers

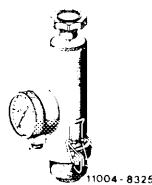
Tightening torques		Nm	(kpm)
Oil drain plug in oil pan	M 26	50	(5)
	M 12	40	(4)
Fastening bolt for lower part of oil filter (type 115.1)		40-45	(4.0-4.5)
Center bolt and nuts for oil filter cover (type 123.1)		20-25	(2.0-2.5)
Bolts for engine bearer at engine mount front (type 123.1)	M 12	70	(7)
	M 10	40	(4)
Nuts for engine stop on crossmember (type 115.1)		90	(9)
Adjusting screw for front engine stop (type 123.1)		130	(13)
Adjusting screw for rear engine mount	type 115.1	30	(3)
	type 123.1	40	(4)

### Special tools

Torque wrench handle 20-100 Nm (2-10 kpm)		001 589 35 21 00
Torque wrench handle 50-200 Nm (5-20 kpm)		001 589 44 21 00
Ratchet for torque wrench handle		001 589 42 09 00

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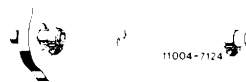
Pressure tester for cooling system and radiator cap



001 589 48 21 00

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Radiator cap with hose for leakage test



605 589 00 25 00

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Stud-end/box-end wrench 14 x 17 mm



000 589 24 07 00

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Oil removal syringe



112 589 00 72 00

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### Commercially available tool

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Engine hoist (1.5t lifting capacity)

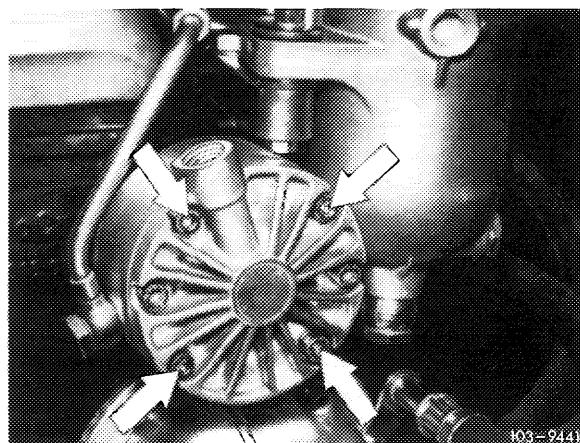
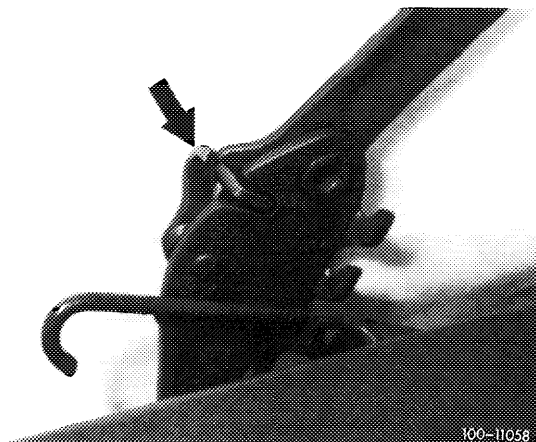
e. g. Backer, 5630 Remscheid,  
order No. 3178

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### Removal

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- 1 On type 123.1, move engine hood to 90° position and latch left-hand locking lever (arrow).
  - 2 Fully drain coolant.
  - 3 Remove radiator.
  - 4 On engine models 615 and 616, remove upper part of air filter. On engine model 617 in general and on engine models 615, 616 featuring injection pumps with mechanical governors, remove air filter.
  - 5 On models with air-conditioner, detach A/C compressor together with bracket and connected pipes, and then put down on one side.
- Remember to empty air-conditioner if A/C compressor is removed (83–516).
- 6 On models with level control, detach delivery oil pump together with connected lines. To do so, simply release bolts (arrows).



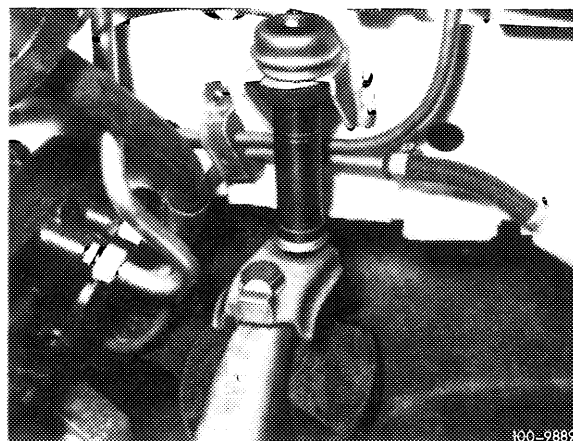
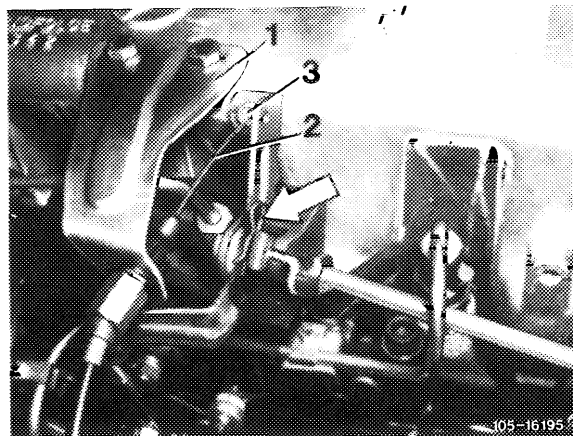
7 Draw oil out of power steering pump reservoir and disconnect hoses.

8 Unhook control linkage.

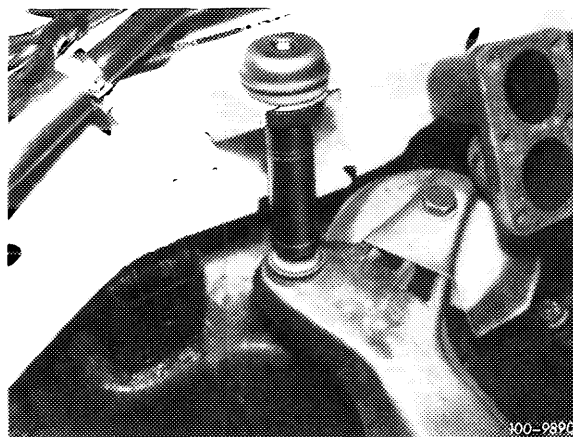
9 Disconnect all coolant, vacuum, oil, fuel and electric lines which lead to engine.

10 On uprated engines, remove longitudinal control shaft. To do so, unhook control rods, withdraw retaining ring (arrow) and force longitudinal control shaft backward.

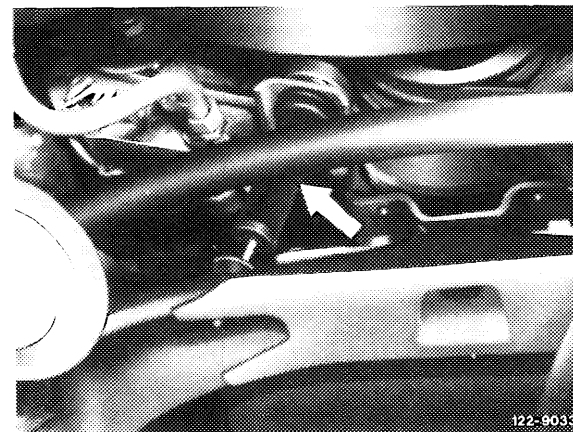
11 On types 115.117, 123.105/130/150 and 123.102/103/120/123/126/183 featuring automatic transmission, unscrew engine shock absorbers. On type 115.114, release engine shock absorbers from body-work and force out toward engine.



**Type 115.114**  
Engine shock absorber left (straight-ahead)

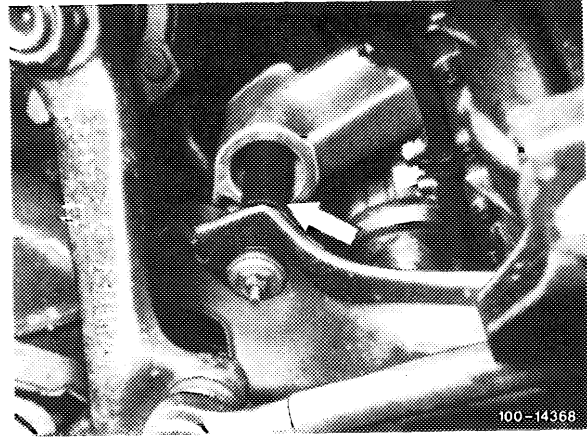


**Type 115.114**  
Engine shock absorber right (straight-ahead)



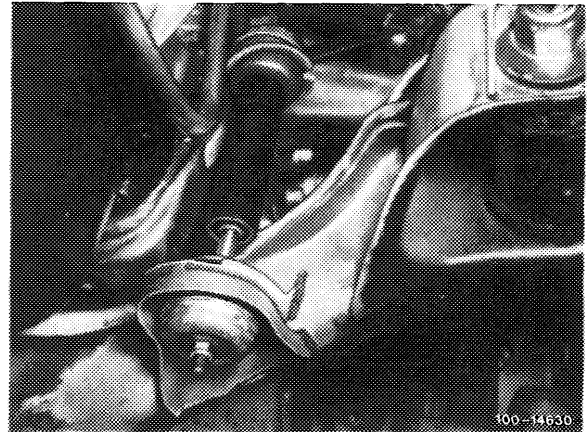
**Type 115.117**

Types 123.102/103/120/123/126/183  
featuring automatic transmissions



100-14366

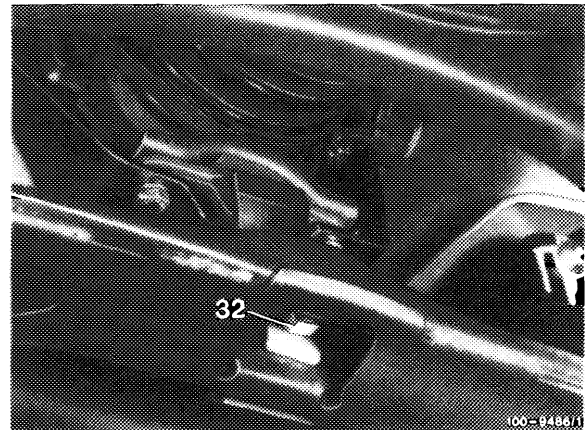
Types 123.105/130/150/190



100-14830

12 On types 115.110/115 and 123.1, unscrew engine stop.

On types 115.110/115, it is then necessary to unscrew self-locking nut (32) and withdraw adjusting screw.

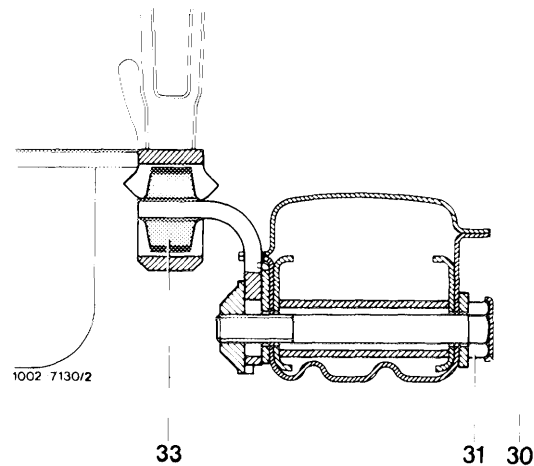


100-94861

Types 115.110/115

On type 123.1 (with the exception of types 123.105/130/150/190 featuring two engine shock absorbers), lift up retainer (30) and swivel away to one side. Unscrew adjusting screw (31).

13 Unscrew exhaust at exhaust manifold and at lateral support on transmission.



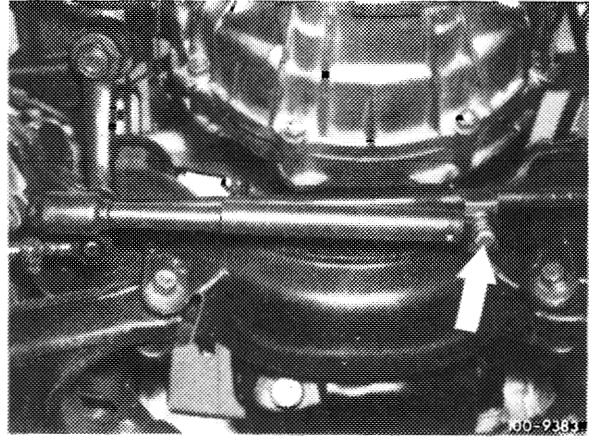
1002 7130/2

33

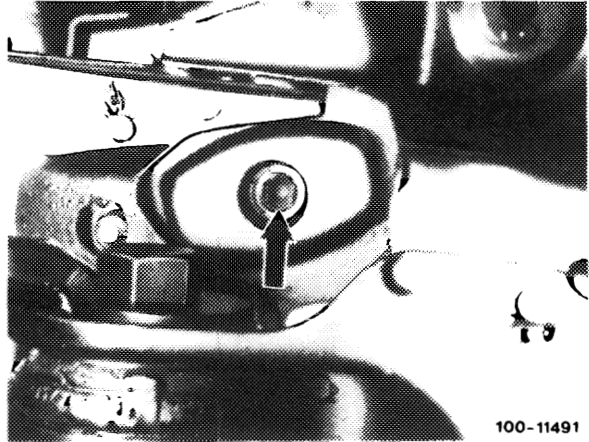
31 30

Type 123.1

14 On types 115.11011151117 featuring automatic transmissions, unscrew steering shock absorber one side (arrow) and turn away.



15 On type 123.1, unscrew engine bearer bolts at engine mount front, doing so from below. On type 115.1, work from above.



Type 123.1

100-11491

16 Unscrew propeller shaft at transmission.

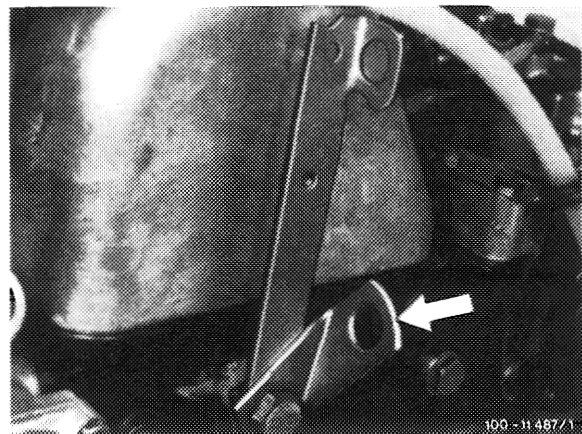
17 Release all connections and shift rods at transmission.

18 Remove rear engine bearer with engine mount.

19 Attach engine hoist ropes to suspension lugs.

For engines in type 115.1, bolt one suspension lug to cylinder head at front. Use may be made of the suspension lug fitted to engines in type 123.1.

The rear suspension lug on engines in type 115.1 is located on the intermediate flange. For engine 617 in type 115.1, wrap the rear rope around engine.

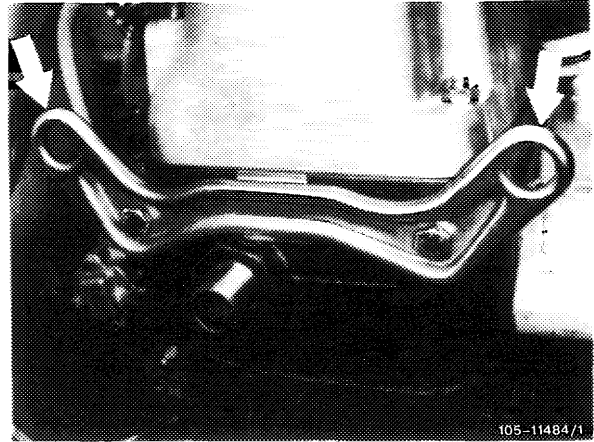


Front suspension lug, type 123.1

100-11487/1

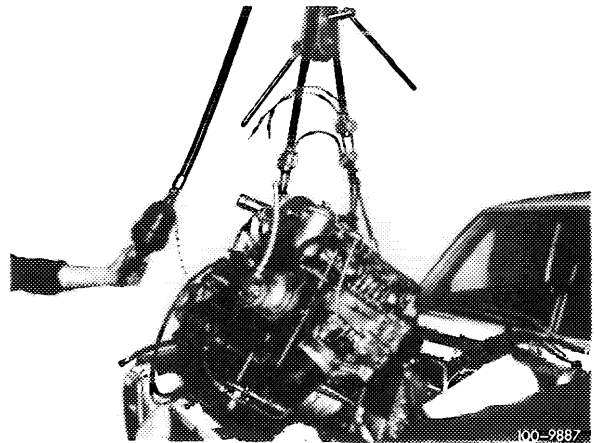


Rear suspension lug, type 123.1



20 Lift engine and transmission up and out at about 45°.

View showing engine 617 in type 115.1



## Installation

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### Caution:

When installing a new engine as a result of bearing failure, flush out the oil cooler, oil hoses, and clean oil filter housing.

21 Check engine mounts, engine shock absorbers, oil and fuel hoses, replacing if necessary.

22 Prior to attaching manual transmission to flange, check deep-groove ball bearing in crankshaft as well as clutch throwout unit, replacing if necessary.

23 Install and connect engine.

24 Attach and adjust propeller shaft (41-020).

- 25 Adjust engine stop (00–220).
- 26 Check all drain plugs for firm fit.
- 27 Fill with oils and coolant (20–010).
- 28 Pressure-test cooling system, using pressure tester.  
Check coolant for antifreeze (20–010).
- 29 Clean air filter element, replacing if necessary.
- 30 Adjust idle speed (07.1–050).

## 00—115 Checking compression pressure

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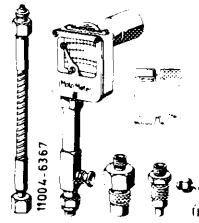
### Testing data in bar positive (atü) for hot engine

Compression pressure normal	22–24
Minimum compression pressure	ca. 15
Permissible difference between any two cylinders	max. 3

Tightening torques	Nm	(kpm)
Cap nuts of injection lines	25	(2.5)
Injection nozzles in precombustion chambers	70–80	(7–8)

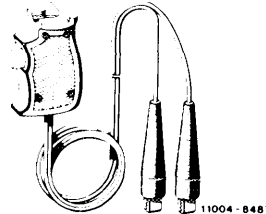
### Special tools

Compression pressure recorder with accessories



001 589 47 21 00

Remote starter switch (individual component of compression pressure recorder 001 589 46 21 00)



001 589 46 21 08

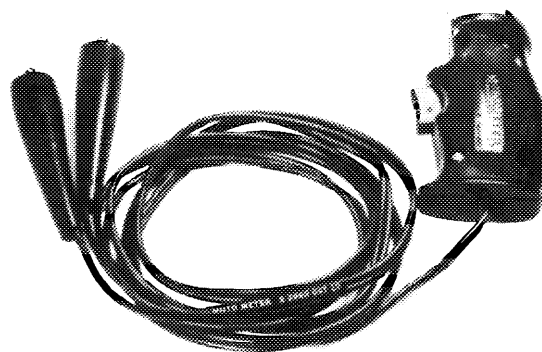
### Note

Check compression pressure at 80 °C coolant temperature. The compression pressure can be checked through the spark plug hole or the precombustion chambers. If engine fails to reach minimum combustion pressure, check cylinders for leakage (00–120).

## Checking

- 1 Unscrew all glow plugs or injection nozzles.
- 2 Connect remote starter to terminals 30 and 50 on starter.

Positive battery terminal can be used in place of terminal 30.

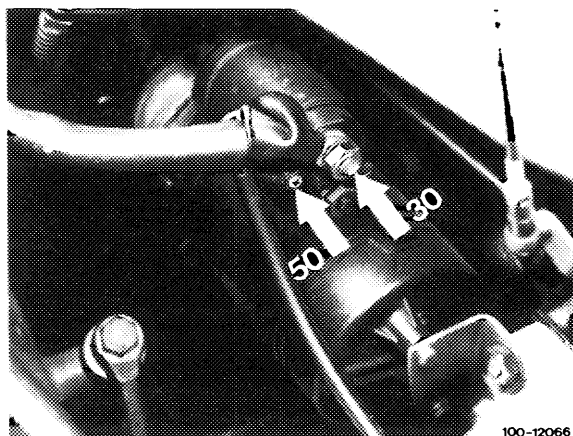


105-9061

- 3 With transmission in neutral, crank engine several times to eject carbon deposits.

### Caution:

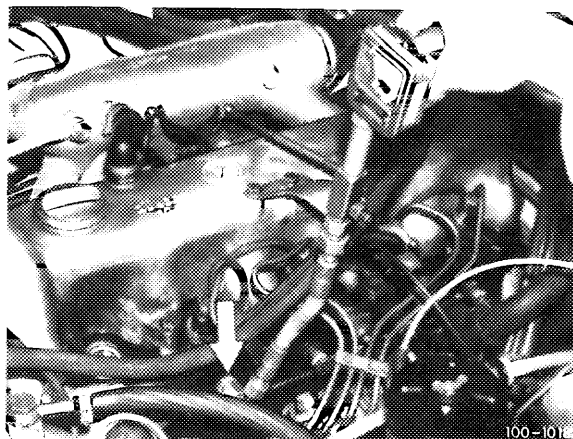
On engines featuring injection pumps with mechanical governors, first move stop lever (stop) in direction of engine so that injection pump will not inject fuel.



100-12066

- 4 Screw connector into glow plug hole or precombustion chamber of each cylinder in turn.
- 5 Connect compression pressure recorder.
- 6 To check pressure, crank engine by 8 revolutions while using full throttle.

Compression pressure recorder connected to glow plug hole.

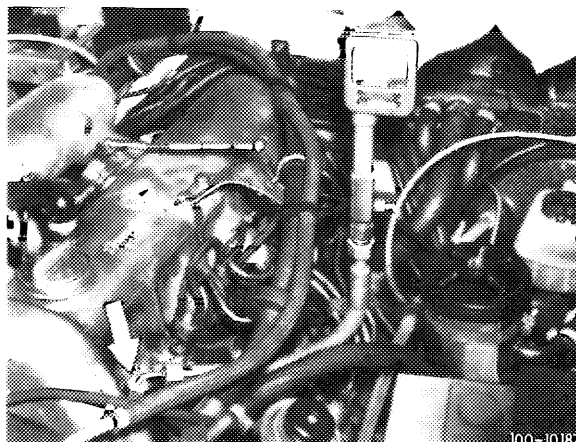


100-1011

On engine models 617 in general and on models 615, 616 featuring injection pumps with mechanical governors, do not use full throttle because these engines do not have throttle valves.

- 7 Prior to inserting the injection nozzles, fit new nozzle plates.

Compression pressure recorder connected to precombustion chamber



100-10187

## 00–120 Checking cylinders for leakage

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### Data

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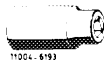
Total pressure loss	max. 25 %
at valves and cylinder head gasket	<b>max.</b> 10 %
at pistons and piston rings	max. 20 %

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### Special tool

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Socket 27 mm  
to crank engine



001 589 65 09 00

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### Commercially available tool

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Cylinder leakage tester

e.g. Bosch, EFAW 210 A  
SUN, CLT 228

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### Checking

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- 1 Warm up engine to operating temperature.
- 2 Unscrew glow plugs.
- 3 On engine models 615 and 616 featuring injection pumps with pneumatic governors, detach rubber gaiter at throttle body and set throttle valve to full delivery.  
  
On engines featuring injection pumps with mechanical governors, detach air filter.
- 4 Remove oil filler cap.
- 5 Remove radiator cap and top up coolant.
- 6 Screw connector into glow plug hole of No. 1 cylinder.

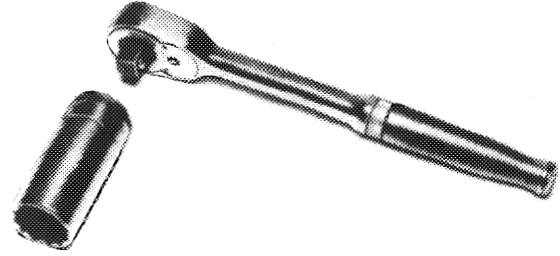
7 Set piston of No. 1 cylinder to ignition TDC.

To do so, turn engine at crankshaft, using tool combination.

8 Connect cylinder leakage tester to air system  
Calibrate tester.

9 Screw tester connecting hose to connector.

Make sure that crankshaft does not turn.

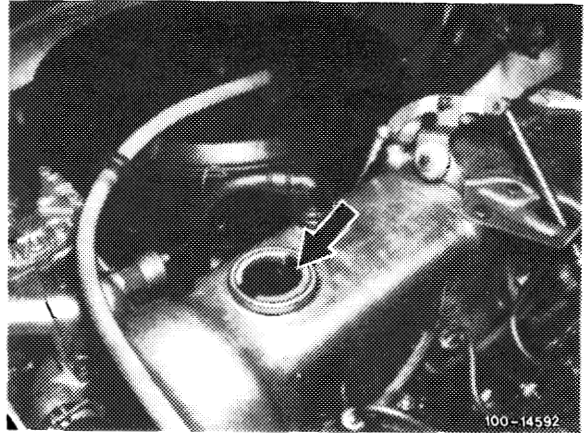


R 100/6498

10 Note pressure loss on tester.

11 Listen to check whether pressure escapes through intake pipe, exhaust, oil filler cap, glow plug hole of adjacent cylinder or radiator cap.

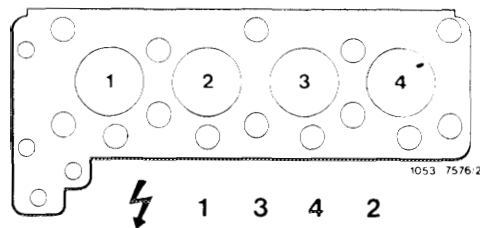
12 Check all cylinders in firing order.



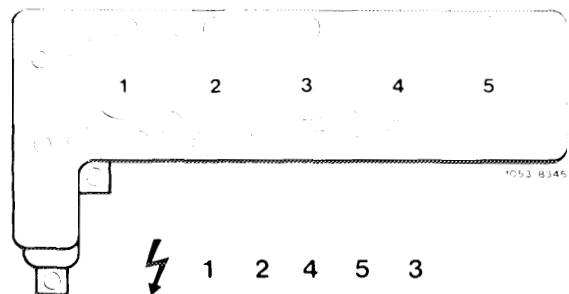
**Note:** The reading will be falsified if the piston ring gaps of a particular piston are directly above one another.

In case of doubt, continue to run engine and then check cylinders for leakage again after some time has elapsed.

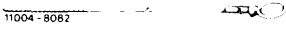
Engines 615, 616




Engine 617



**Special tools**

Oil dipstick with millimeter scale for type 115.1		110 589 11 21 00
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Oil dipstick with millimeter scale for type 123.1		115 589 15 21 00
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Valve to stop oil return from air-cooled oil cooler		110 589 00 91 00
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Temperature gauge		116 589 27 21 00
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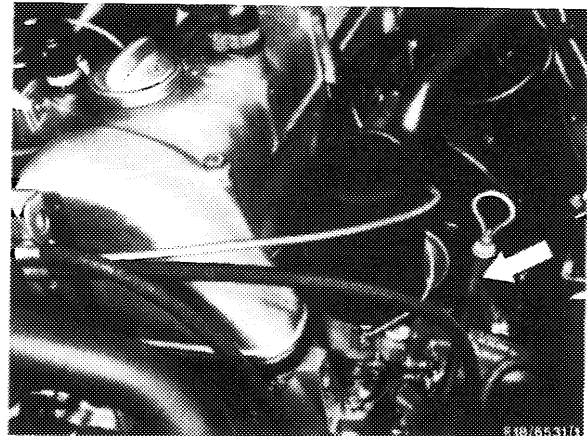
**Note**

The oil consumption can be measured using the oil dipstick with the millimeter scale as well as the accompanying diagram on the back of the recording chart.

Since there are two different oil dipsticks and different recording charts, please note the following points:

Oil dipstick as per part No. 110 589 11 21 00 (**blue handle**) is only to be used for engine having an oil dipstick tube without an **oil removal connection**, and oil dipstick as per part No. 115 589 15 21 00 (**red handle**) only for engines having an oil dipstick tube **designed for oil removal**.

Oil dipstick tube without oil removal connection

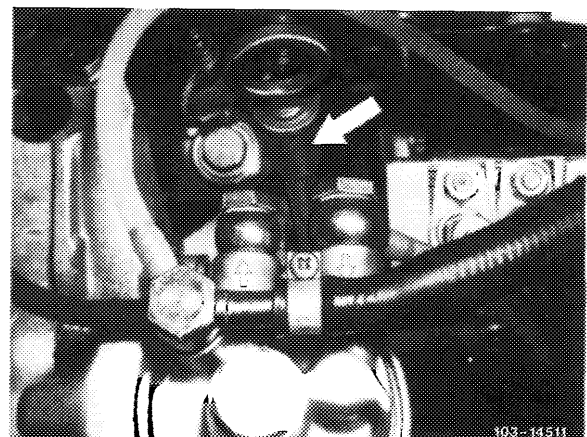


**Recording charts for engines without oil removal connection (oil dipstick with blue handle)**

German/English, publication No. 800 99 223 41 a  
or 800 99 223 00 b

French/Spanish, publication No. 800 99 223 42 a  
or 800 99 223 01 b

Oil dipstick tube with oil removal connection



Recording charts for engines with oil removal connection (oil dipstick with red handle)

German/English, publication No. 800 99 402 00

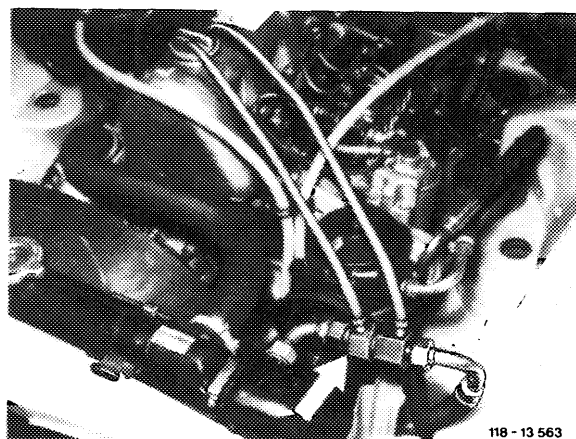
French/Spanish, publication No. 800 99 402 01

The recording charts that go with each particular type of oil dipstick can be identified by the engine designations at the top of the recording chart.

For engine models 616, 617 in type 115.1 and model 617 in type 123.1, it is necessary to fit the check valve between the air-cooled oil cooler and upper oil hose so that the oil will not run back out of the oil cooler during the measurement.

Should the check valve not fit for lack of space, it is to be inserted with the aid of a pipe bend and connecting pipe.

View showing engine 617



Prior to measuring consumption, remember to vent air-cooled oil cooler.

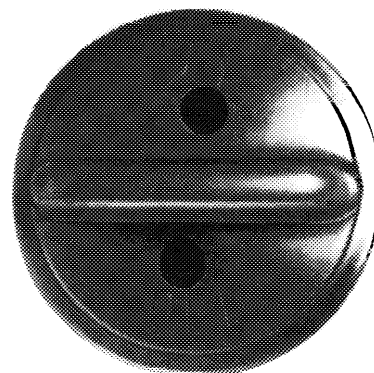
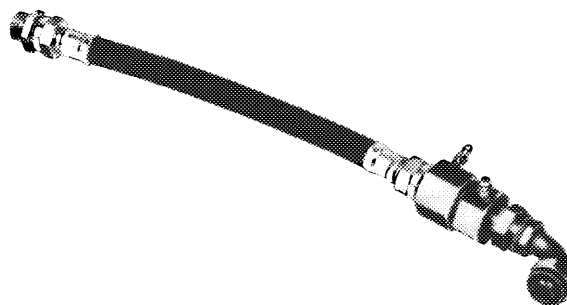
To do so, clip two transparent plastic hoses onto the vent plugs attached to the check valve. Remove filler cap from valve cover and push both hoses into the filler hole.

Caution:

To avoid oil ejection you are recommended to use a filler cap having two holes (outside diameter of hoses).

The procedure needed for the consumption measurement is described on the front of the recording chart.

In order to avoid incorrect readings, check engine oil for fuel dilution prior to commencing.





**07.1—100 Adjustment of idle speed and idle speed adjuster**

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A. Engine 615, 616 M-injection pump with pneumatic governor

**Standard version**

(AUS) (E) (J) (S) (ZA) (USA) up to 1975

**Testing and adjusting data**

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Idle speed 700–800/min

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**National version (USA) 1976**

Identification: Information plate in national language on cross member in front of radiator.

Adjust engines according to data of respective emission control information plate.

Color code: black

Model	Engine	Model year	Injection pump abbreviation	Idle speed 1/min
115.1	616.916	1976	M	700–800

**Special tools**

Oil telethermometer



116 589 27 21 00

Adaptor for revolution counter



616 589 00 63 00

**Conventional tool**

Revolution counter, mechanical with hexagonal adaptor

e.g. made by Gann, D-7000 Stuttgart 1

## Note

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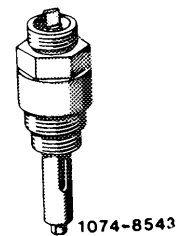
Do not adjust idle speed when engine is too hot, e.g. immediately following a fast ride or after measuring output on output dynamometer.

## Adjustment

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

2 Connect revolution counter. Use adaptor when connecting mechanical revolution counter.

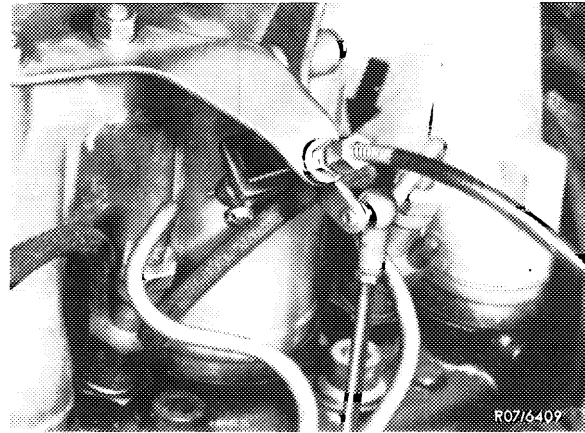


3 Run engine to 75–85 °C oil temperature.

4 Check regulating linkage for easy operation and wear.

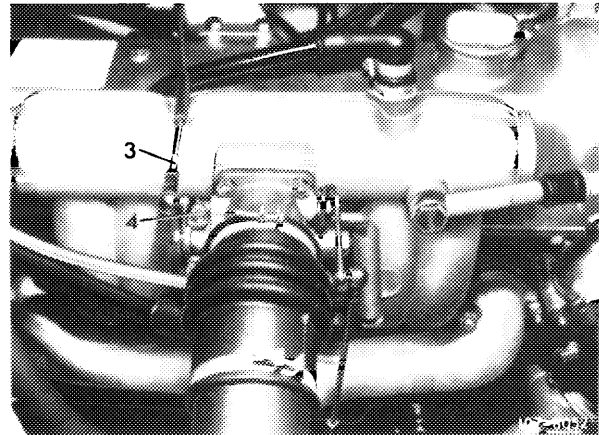
5 Turn idle speed adjuster completely to the right.

6 Check distance between adjusting ring and guide lever and adjust, if required. Nominal dimension approx. 0.1 mm.



7 Disconnect connecting rod (3). Check throttle valve and check valve flap for easy operation.

8 Check idle speed and adjust to specified speed by means of idle speed adjusting screw (4), if required. If the idle speed cannot be adjusted, check vacuum line, sealing rings for tickler shaft, governor housing, governor diaphragm for leaks (07.1–125).

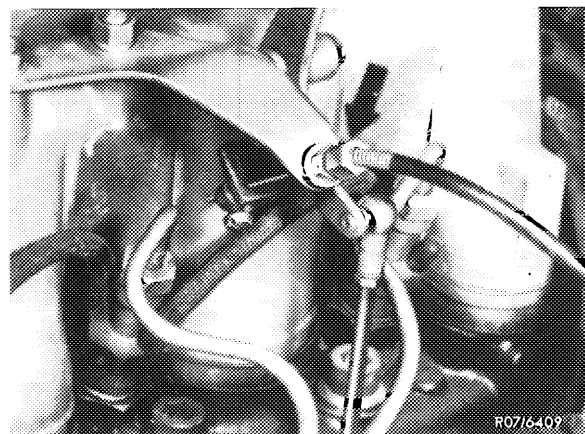


- 3 Connecting rod
- 4 Idle speed adjusting screw

9 Attach connecting rod (3) free of tension. Adjust regulating linkage, if required (30–300).

10 Set selector lever to driving position (automatic transmission), engage air conditioner, turn power steering to full lock, engine should run smoothly. Readjust speed, if required.

11 Set idle speed adjuster by turning knob counter-clockwise, approx. 1/2 turn idle travel should be available until idle speed increases. Adjust idle travel with adjusting screw (arrow) if required.



## B. Engine 615, 616, 617 MW and M/RSF-injection pump with mechanical governor

Standard version

(AUS) (E) (J) (S) up to 1978, (USA) up to 1975. (ZA)

Testing and adjusting data

Engine	Injection pump abbreviation	Idle speed 1/min
615, 616, 617 (59 kW)	MW, M/RSF	700–800
617 (65 kW)	M/RSF	650–750

(E) (S) starting 1979. (USA) (ZA) starting 1976

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

Model	Engine	Model year	Injection pump abbreviation	Idle speed 1/min
-------	--------	------------	-----------------------------	------------------

(S)

Identification: Injection pump governor housing lead-sealed.

123.1	616 (53 kW)	1979	M/RSF	750
	617 (59 kW)		MW	
	615 (44 kW)	1980/81	M/RSF	700–800
	616 (53 kW)		M/RSF	
	617 (65 kW)		M/RSF	

(USA) (ZA)

Color code: (USA) black

115.1	617.910	1976	MW	680–760
123.1	616.912 617.912	1977/78		700 ± 50
		1979		750
		1980/81		750 ± 50

## Special tools

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Oil telethermometer



116 589 27 21 00

---

Adaptor for revolution counter



616 589 00 63 00

---

## Conventional tool

---

Revolution counter, mechanical with hexagonal adaptor

e.g. made by Gann, D-7000 Stuttgart 1

---

## Note

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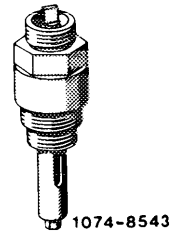
Do not adjust engine when it is too hot, e.g. immediately following a fast ride or after measuring output on output dynamometer.

## Adjustment

---

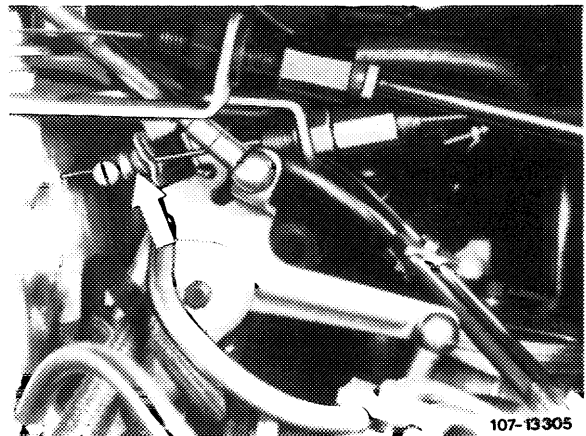
1 Switch off air conditioner or automatic climate control. Move selector lever into position "P".

- 2 Connect revolution counter.  
Use adaptor when connecting mechanical revolution counter.

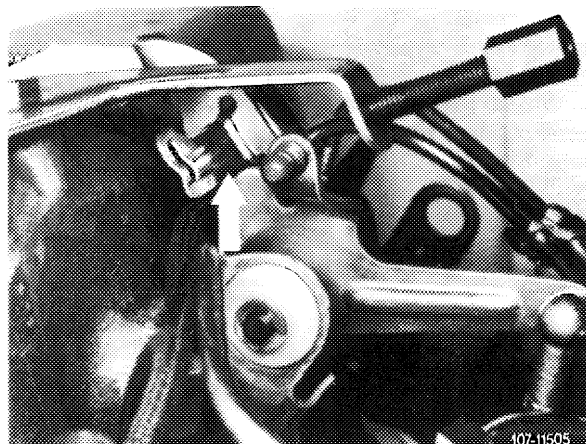


- 3 Run engine to 75–85 °C oil temperature.
- 4 Check regulating linkage for easy operation and wear.

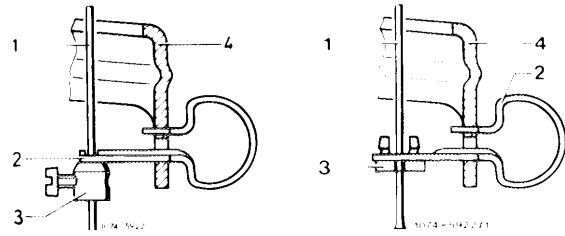
- 5 Turn idle speed adjuster completely to the right and check distance between adjusting ring and shaped spring or nipple and clip on shaped spring and adjust, if required. Nominal dimension = approx. 1.0 mm.



- Attention!**  
Check whether shaped spring (arrow) has been correctly installed.



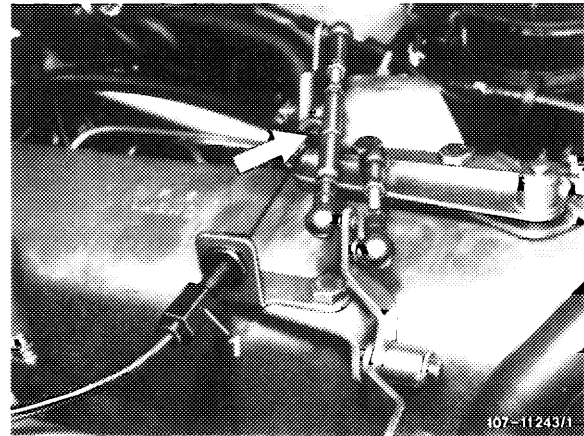
- 1 Cable control for increasing speed
- 2 Shaped spring
- 3 Adjusting ring/nipple
- 4 Guide lever



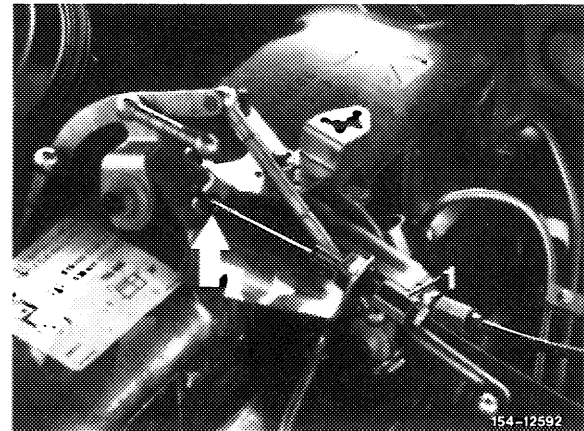
6 Check whether Bowden wire for Tempomat/cruise control rests free of tension against regulating lever (arrow). For this purpose, push shutoff lever up to stop. Adjust Bowden wire with adjusting nut (1), if required.

Release shutoff lever (idle speed position). In this position, Bowden wire is slack.

Engine 617 in model 115.1



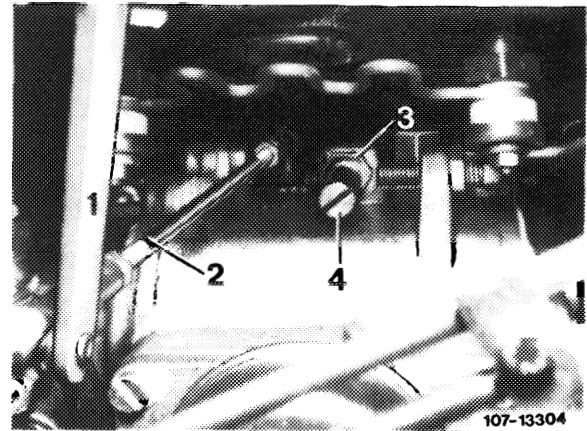
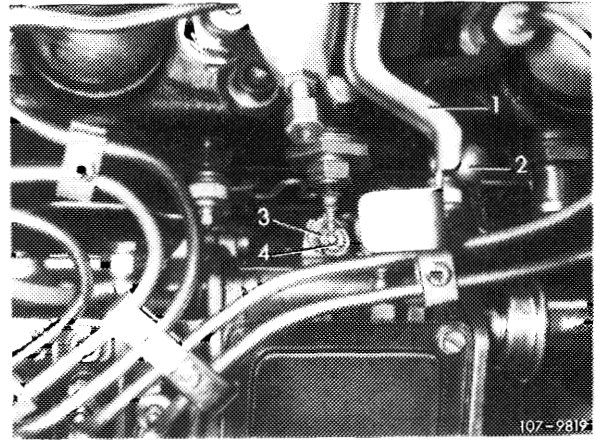
Engine 616, 617 in model 123.1



7 Disconnect connecting rod (2) on guide lever (1).

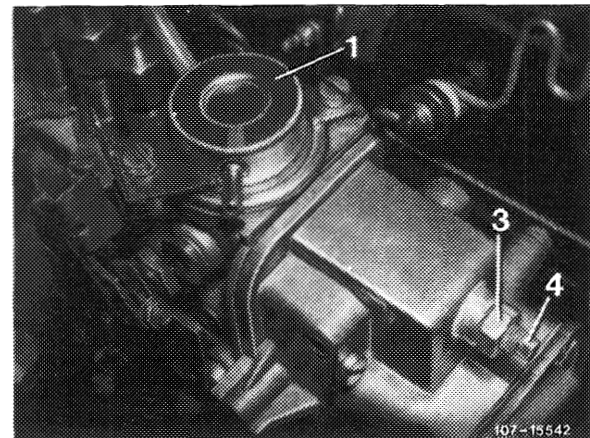
8 Check idle speed, loosen counternut (3) if required and set idle speed to specified speed by means of idle speed adjusting screw (4).

Engine 617.910 with MW-injection pump  
1 Guide lever  
2 Connecting rod  
3 Counternut  
4 Idle speed adjusting screw



Engine 616, 617 with MW-injection pump

Use box wrench to avoid damage to adjusting screw (4).



Engine 615, 616, 617 with M/RSF-injection pump

9 Attach connecting rod free of tension. Adjust regulating linkage, if required (30–300).

10 Place selector lever into driving position (automatic transmission), switch on air conditioner, turn power steering to full lock, engine should run smoothly. Readjust speed, if required.

11 Accelerate with accelerator pedal, while simultaneously turning idle speed adjuster counterclockwise. **Speed should now amount to 1000–1100/min.** Adjust with adjusting screw (arrow in fig. item 12), if required.

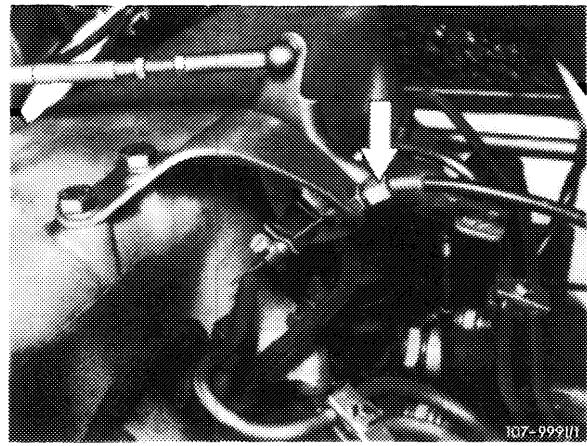


Run engine for some time at this speed. If speed increases automatically, slightly reduce speed at adjusting screw.

**Attention!**

When the speed is set higher, the idle speed control range is left. As a result, the engine speed can increase up to max speed (unloaded).

12 Adjust idle speed adjuster by turning knob counterclockwise, approx. 1/2 turn idle travel should be available until idle speed increases. Set idle speed by means of adjusting screw (arrow), if required.



## 07.1–105 Inspection and adjustment of no-load max speed

---

### Test values

Model	Engine	Injection pump abbreviation	Max speed no-load (end of governed speed) 1/min
115.1	615, 616	M	5200–5400
	617	MW	4700–5200
123.1	615, 616	M	4800–5200
	616, 617	MW	4700–5200
	615, 616, 617	M/RSF	4900–5200

### Special tools

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Oil telethermometer



116 589 27 21 00

Adaptor for revolution counter



6 16 589 00 63 00

### Conventional tool

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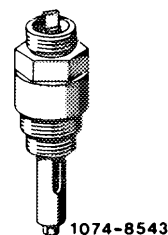
Revolution counter, mechanical with hexagonal adaptor

e.g. made by Gann, D-7000 Stuttgart 1

### Testing

---

- 1 Connect revolution counter.  
Use adaptor when connecting mechanical revolution counter.



- 2 Run engine to 75–85 °C oil temperature.
- 3 Slowly accelerate with accelerator pedal and read revolution counter. Specified engine speed should be attained.

Adjustment (M-injection pump with pneumatic governor)

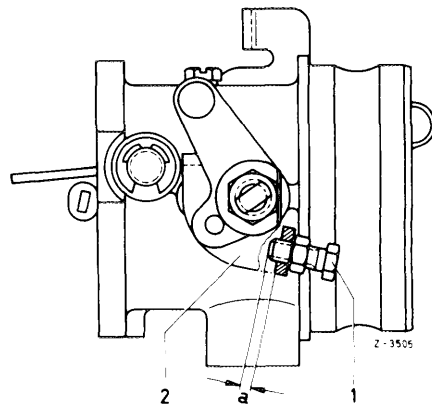
---

- 4 Adjust speed by means of full load stop screw (1) on throttle unit.

Screwing in = speed decrease

Screwing out = speed increase

- 1 Full load stop screw
- 2 Regulating lever
- a = Adjustment max 2 mm



Adjustment ("a") of throttle valve should not exceed max 2 mm.

If the full load stop screw is screwed in still further, the air feed will be throttled and driving performance will drop.

If the throttle unit can no longer be adjusted, tension or slacken governor spring by means of compensating washers (07.1–130).

- 5 If the respective speed is not attained on MW and **M/RSF-injection** pumps, check for presence of vacuum at vacuum box on injection pump. For this purpose, pull off hose on vacuum box. If the speed is still not attained, remove injection pump and adjust maximum speed free of load on a Bosch injection pump test bench.

## 07.1–125 Checking pneumatic governor of injection pump for leaks (engine 615, 616)

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Test values	mbar	(mm Hg)
Vacuum	70–90	(50–70)

### Conventional tools

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Vacuum meter, connecting nipple

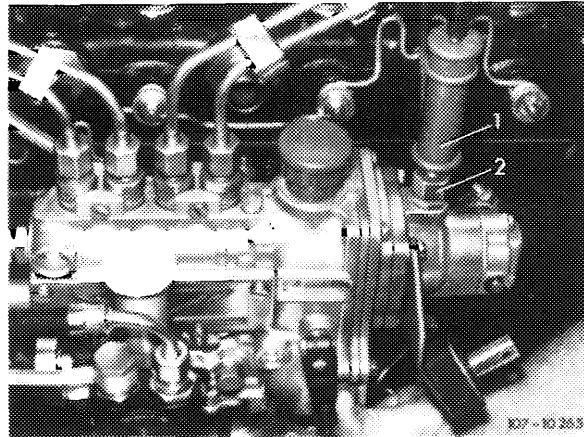
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### Checking

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- 1 Unscrew vacuum line on governor of injection pump.
- 2 Screw in connecting nipple (2).
- 3 Push adjusting lever on injection pump completely forward to stop and plug on test hose (1).

- 1 Test hose
- 2 Connecting nipple



- 4 Release adjusting lever and read test value.
- 5 Watch vacuum meter for constant pressure.
- 6 If pressure drops, the double thread connection for the vacuum line, the O-rings for the tickler shaft, the regulator housing or the regulator diaphragm may be leaking. Remove leaks, if any, or replace diaphragm of injection pump (07.1–215).

**Adjusting**

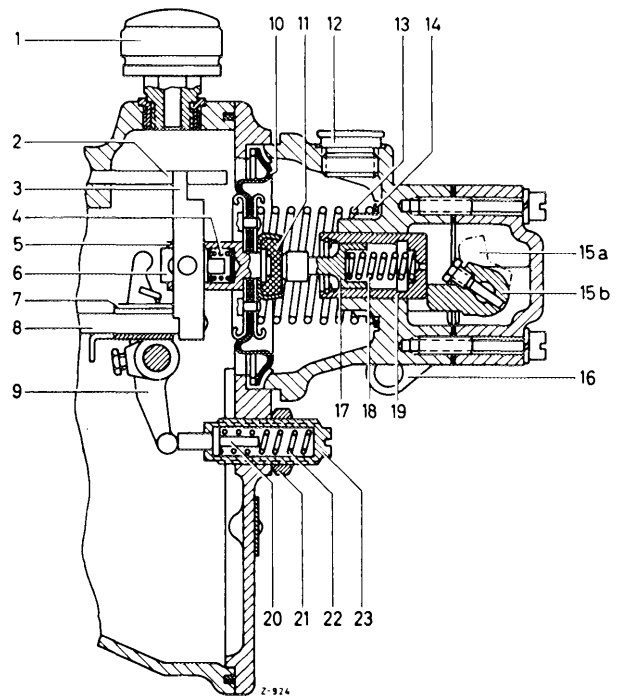
Unscrew governor cover and remove governor spring (13). Make sure that the governor spring (13) and the compensating washers (14) are not falling out when removing governor cover.

Putting in = speed increases  
 Taking out = speed decreases

A compensating washer 1 mm thick increases the engine speed by approx. 120–150/min. Compensating washers are available as follows:

- 0.5 mm thick
- 1.0 mm thick
- 2.0 mm thick

- 10 Diaphragm
- 13 Governor spring
- 14 Compensating washer



Test values

Engine	Injection nozzles Bosch designation	Opening pressure in bar gauge pressure <sup>1)</sup>	
		of new injection nozzles	of used injection nozzles at least

Standard version and (AUS) (J)

615.913/940	DN 0 SD 1510	115–123	100
615.941 616 (48 kW) 617 (59 kW)	DN 0 SD 220		
616 (53 kW) 617 (65 kW)	DN 0 SD 240 <sup>3)</sup>		

(E) (S) starting 1979

Identification (S) only: Injection pump with lead-sealed governor housing.

615.913/940	DN 0 SD 1510	115–123	100
615 616 (48 kW) 617 (59 kW)	DN OSD 220		
616 617	DN 0 SD 240 <sup>2)</sup>		

(USA) (ZA) starting 1979

Identification: Injection pump with green type-rating plate.

616 617	DN 0 SD 240 <sup>2)</sup>	115–123	100
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1) The difference in opening pressure of injection nozzles within one engine should not amount to more than 5 bar gauge pressure.

2) Starting 1979 nozzle holder with edge-type filter.

3) Engine 616, 617 starting from increased output.

Tightening torques

Nm

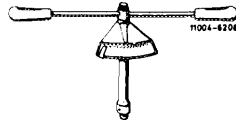
Injection nozzle upper and lower half

70–80

## Special tools

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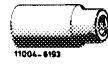
Torque wrench 1/2" square,  
40–130 Nm



000 589 22 21 00

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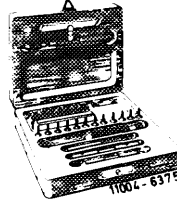
Socket 27 mm, 1/2" square  
for injection nozzle



001 589 65 09 00

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Cleaning kit



000 589 00 68 00

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## Conventional tools

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Tester EFEP 60 H

e.g. made by Bosch, D-7000 Stuttgart  
Order no. 0 681 200 502

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Cleaning needle 0.13 mm  $\phi$

e.g. made by Bosch, D-7000 Stuttgart  
Order no. KDEP 290013

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## Note

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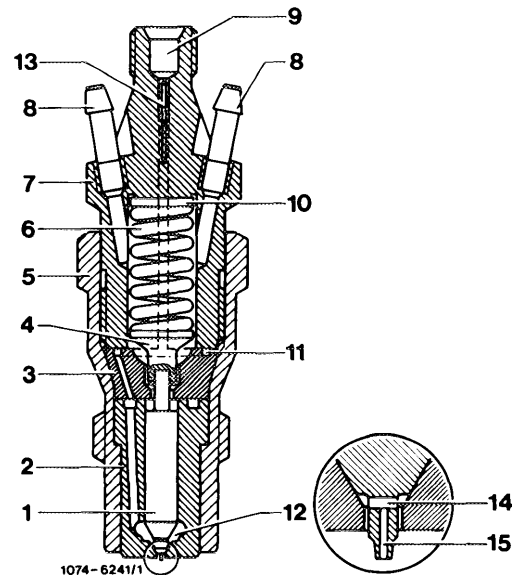
Use only clean testing oil or filtered diesel fuel for testing. When testing a nozzle, never move hand into jet of a nozzle. Jet will deeply enter flesh and will destroy the tissue. Fuel entering into blood may cause blood poisoning.

### Attention!

The shutoff valve of pressure gauge should remain closed during jet and buzzing test, since otherwise the pressure gauge may be damaged by excessive pressure increase.

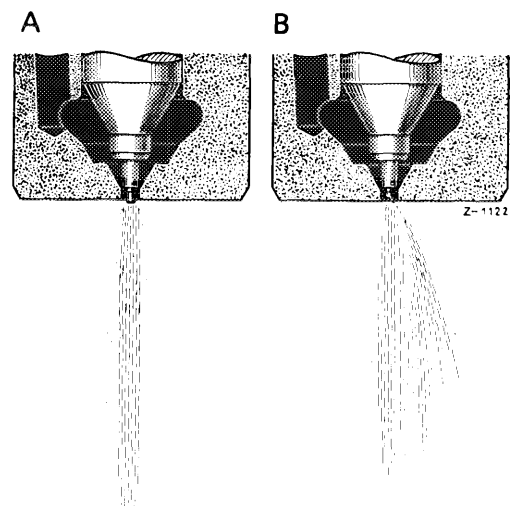
The injection nozzle with Bosch designation DN 0 SD 240 is a perforated pintle nozzle. This nozzle differs from the pintle nozzle by a crosswise and lengthwise bore (14 and 15) in throttle pintle. In addition, a maintenance-free rod-type filter (13) is pressed into top of injection nozzle holder (7).

- 1 Nozzle needle
- 2 Nozzle body
- 3 Nozzle holder element
- 4 Pressure pin
- 5 Injection nozzle holder bottom
- 6 Compression spring
- 7 Injection nozzle holder top
- 8 Leak oil connection
- 9 Fuel feed
- 10 Steel washer
- 11 Ring groove and feed bores
- 12 Pressure chamber in nozzle body
- 13 Rod-type filter
- 14 Crosswise bore
- 15 Lengthwise bore



## Testing

- 1 Remove injection nozzles (07.1–230).
- 2 Connect removed injection nozzle to tester. With pressure gauge switched **off**, plunge down energetically several times. With a perfectly moving nozzle needle nozzle should buzz together with a high whistling sound.
- 3 Jet test with shutoff valve closed. Insert injection nozzle into tester. At short, fast partial strokes (approx. 2 strokes per second) the jet should be rather concentrated and should break well. Individual drops, diagonal or diagonally broken jets, slightly wide jets are of no significance for combustion in engine.



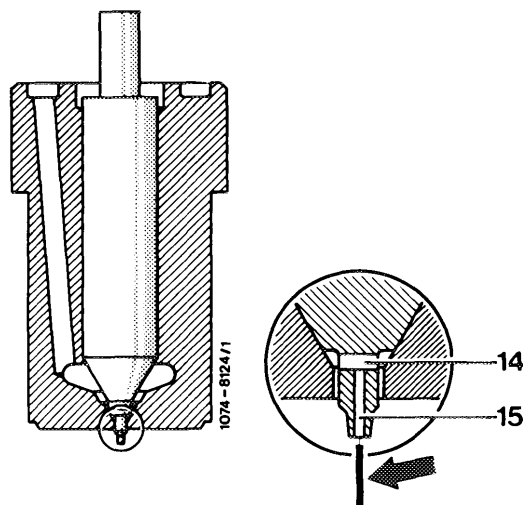
- A Good injection nozzle  
Jet concentrated and well atomized
- B Damaged injection nozzle  
Jet too wide, streaky and not concentrated



4 Test longitudinal bore (15) in throttle pintle. At slow, uniform downward movement of hand lever (approx. 4–6 seconds per stroke) a distinct, vertical cord-like jet (arrow) should come out of longitudinal bore (15). If no cord-like jet comes out, check longitudinal bore with cleaning needle 0.13 mm dia for unobstructed passage. If the longitudinal bore is clear, the injection nozzle can be used again.

Note: Test procedure also applies to new injection nozzles.

14 Crosswise bore  
15 Lengthwise bore

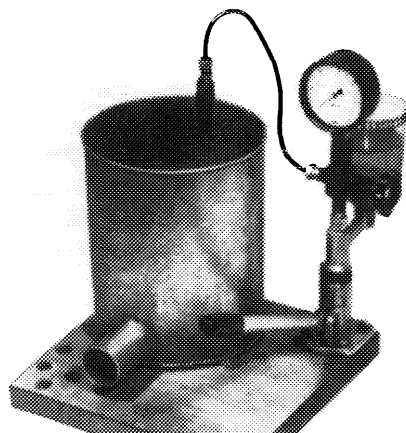


5 Buzzing test. Push hand lever slowly fully down (approx. 1 stroke per second); a damped buzzing of injection nozzle should be heard.

If the jet or the buzzing test are not in order, flush injection nozzle by means of several short, fast full strokes (2 strokes per second). The jet should be concentrated and emerge with a clearly heard, high whistling sound. Replace injection nozzle if required.

6 Test opening pressure of injection nozzle.

Slowly push hand lever down (1 stroke per second) with shutoff valve open. When ejection begins, read ejection pressure; injection nozzle should buzz distinctively. Set injection nozzle to specified ejection pressure (opening pressure), if required (07.1–137).



7 Check injection nozzle for leaks.

With shutoff valve open, slowly push pump lever down up to ejection pressure. Release pump lever, ejection pressure should remain constant. In the event of leaks, disassemble injection nozzle, clean, assemble and adjust (07.1–137).

Test values

Engine	Injection nozzles Bosch designation	Opening pressure in bar gauge pressure <sup>1)</sup>	
		with new injection nozzles	with used injection nozzles at least

Standard version and (AUS) (J)

615.913/940	DN 0 SD 1510	115–123	100
615.941 616 (48 kW) 617 (59 kW)	DN 0 SD 220		
616 (53 kW) 617 (65 kW)	DN 0 SD 240 <sup>3)</sup>		

(E) (S) starting 1979

Identification (S) only injection pump with lead-sealed governor housing.

615.913/940	DN 0 SD 1510	115–123	100
615 616 (48 kW) 617 (59 kW)	DN 0 SD 220		
616 617	DN 0 SD 240 <sup>2)</sup>		

(USA) (ZA) starting 1979

Identification Injection pump with green type-rating plate.

616 617	DN 0 SD 240 <sup>2)</sup>	115–123	100
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1) The difference in opening pressure of injection nozzles within one engine should not amount to more than 5 bar gauge pressure.

2) Starting 1979 nozzle holder with edge-type filter.

3) Engine 616, 617 starting from increased output.

Tightening torques

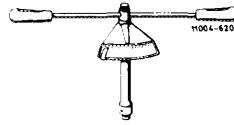
Nm

Injection nozzle upper and lower half

70–80

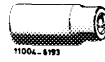
**Special tools**

Torque wrench 1/2" square,  
40–130 Nm



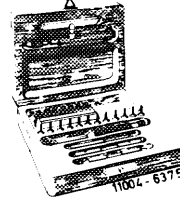
000 589 22 21 00

Socket 27 mm, 1/2" square  
for injection nozzle



001 589 65 09 00

Cleaning kit



000 589 00 68 00

**Conventional tools**

Tester EFEP 60 H

e.g. made by Bosch, D-7000 Stuttgart  
Order no. 0 681 200 502

Cleaning needle 0.13 mm dia

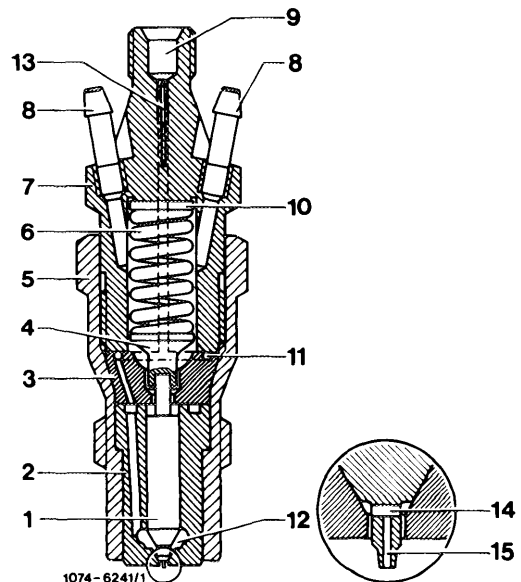
e.g. made by Bosch, D-7000 Stuttgart  
Order nor. KDEP 290013

**Note**

The injection nozzle with Bosch designation **DN 0 SD 240** is a perforated pintle nozzle. It differs from pintle nozzle by a crosswise bore and a longitudinal bore (14 and 15) in throttle pintle. In addition, a maintenance-free rod-type filter (13) is pressed into injection nozzle holder top (7).

The advantage of a perforated pintle nozzle is better injection at lower volume and less load, as well as a reduction of coking on ring gap.

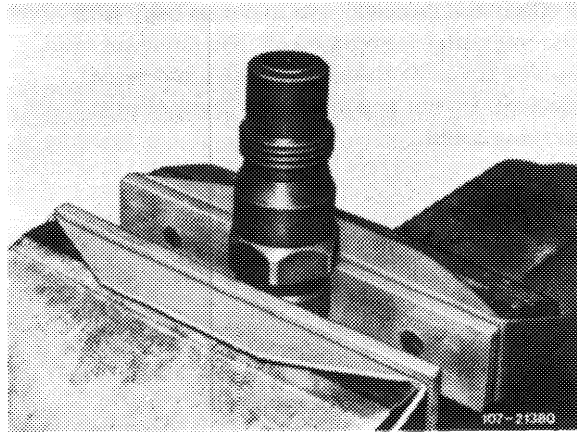
- 1 Nozzle needle
- 2 Nozzle body
- 3 Nozzle holder element
- 4 Pressure pin
- 5 Injection nozzle holder bottom
- 6 Compression spring
- 7 Injection nozzle holder top
- 8 Leak oil connection
- 9 Fuel feed
- 10 Steel washer
- 11 Ring groove and feed bores
- 12 Pressure chamber in nozzle body
- 13 Rod-type filter
- 14 Crosswise bore
- 15 Lengthwise bore



## Disassembly

- 1 Clamp injection nozzle holder top (7) with protective jaws into vise in such a manner that the leak oil line connections are not damaged.
- 2 Loosen injection nozzle holder bottom (5) with socket wrench insert and screw off.

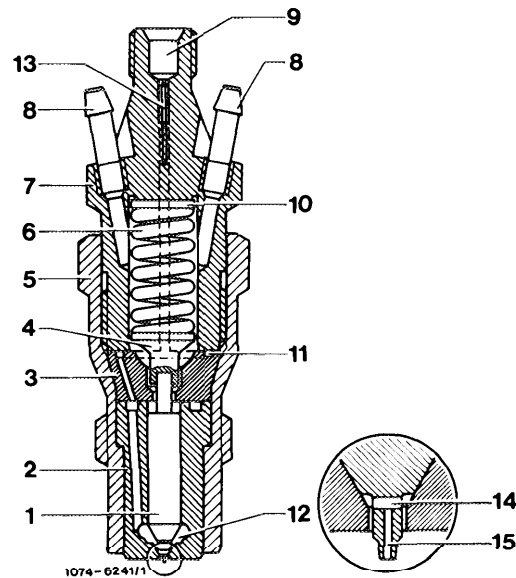
- 5 Injection nozzle holder bottom  
7 Injection nozzle holder top



- 3 Remove steel washer (10), compression spring (6), pressure pin (4), nozzle holder element (3) and nozzle body (2) with nozzle needle (1).

### Attention!

During disassembly make sure that the nozzle body, the nozzle needle and the individual components are not mixed up among each other.



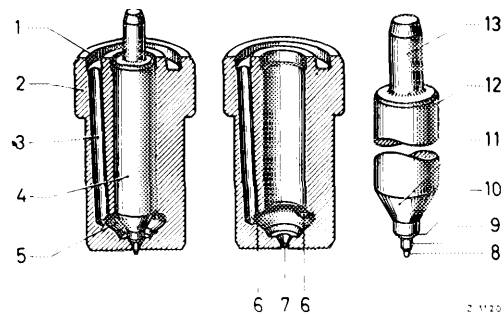
## Cleaning

- 4 Brush off combustion deposits outside on face of nozzle body (2), mainly around nozzle mouth, by means of a brass brush.

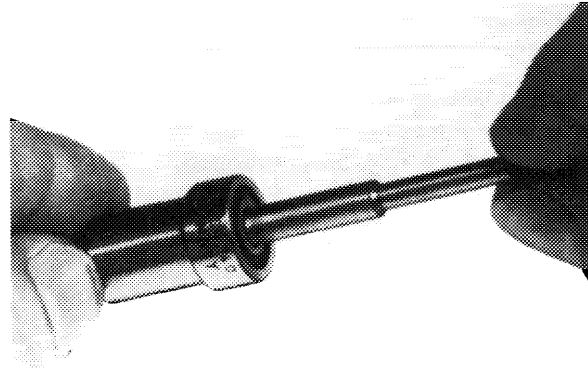
Touch up nozzle holder element (3) and nozzle body (2) on face of both sides on a surface plate.

- 5 Clean pressure chamber (5) of nozzle body by means of ring groove scraper.

- |   |                      |
|---|----------------------|
| 1 Ring groove                             | 7 Nozzle mouth       |
| 2 Nozzle body                             | 8 Spray pintle       |
| 3 Feed bore                               | 9 Throttle pin       |
| 4 Nozzle needle                           | 10 Needle seat       |
| 5 Pressure chamber                        | 11 Pressure shoulder |
| 6 Mouth of feed bores in pressure chamber | 12 Needle stem       |
|   | 13 Pressure pin      |

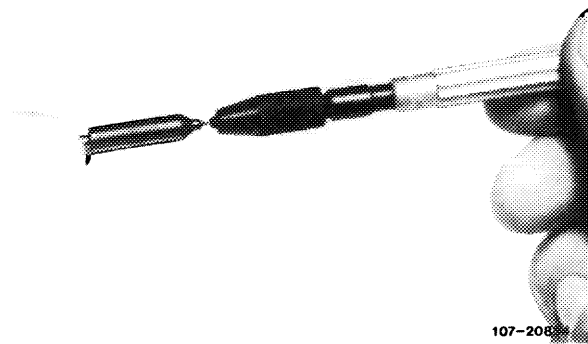


6 Clean nozzle needle seat in nozzle body with cleaning cutter from inside out. Do not clean from outside (to guide cleaning cutter or to prevent canting). Do not exert excessive pressure with cleaning cutter.

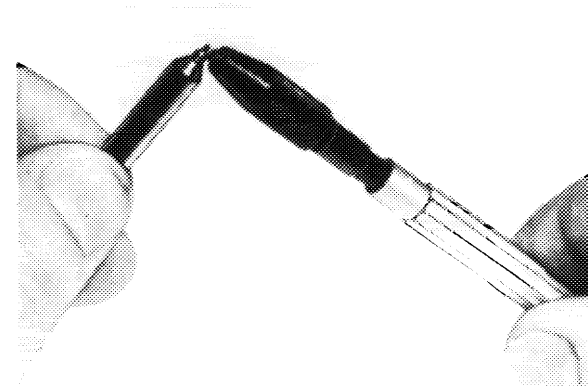


107-20853

7 Clean longitudinal and cross bore of nozzle needle with cleaning needle 0.13 mm dia.

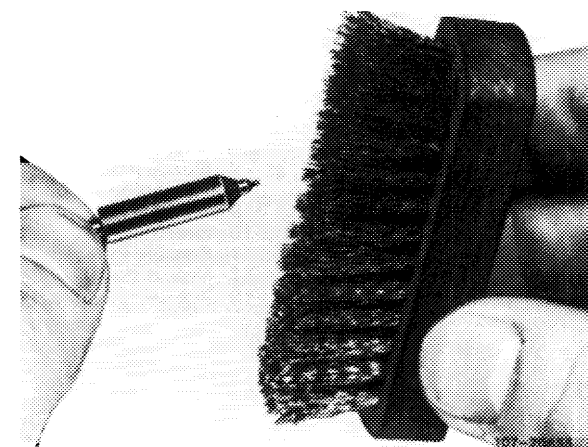


107-20854



107-20855

8 Clean nozzle needle with brass brush.

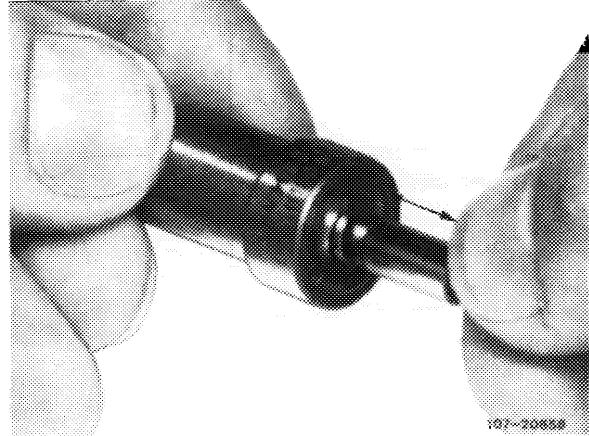


## Testing nozzle **needle**

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9 Visual test. Upon cleaning, test used nozzles visually. Test nozzle needle for dented or rough needle seat and for worn or damaged spray pintle. Replace damaged nozzles.

10 Slide test. For this purpose, immerse nozzle needle and nozzle body in filtered diesel fuel and insert nozzle needle into nozzle body. With nozzle needle held vertically the nozzle needle, which is pulled out by approx. one third, should slide back on its seat under its own weight. Replace injection nozzle, if required.

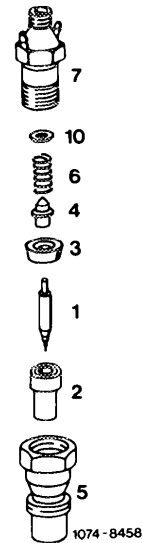


## Assembly

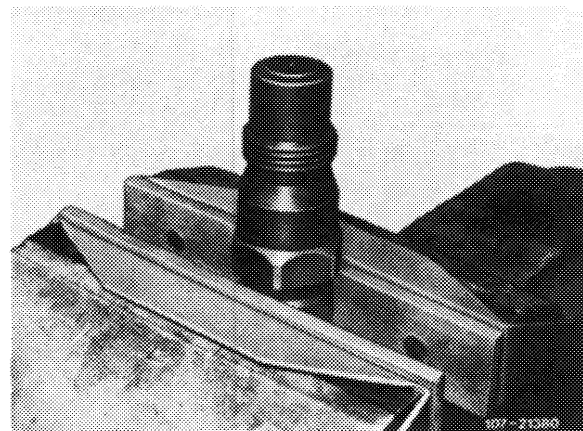
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11 Insert all parts in vice versa sequence into injection nozzle holder bottom (5) and screw on injection nozzle holder top (7), while inserting pressure pin (4) with bore into nozzle needle (1).

- |                         |                                  |
|-------------------------|----------------------------------|
| 1 Nozzle needle         | 5 Injection nozzle holder bottom |
| 2 Nozzle body           | 6 Compression spring             |
| 3 Nozzle holder element | 7 Injection nozzle holder top    |
| 4 Pressure pin          | 10 Steel washer                  |



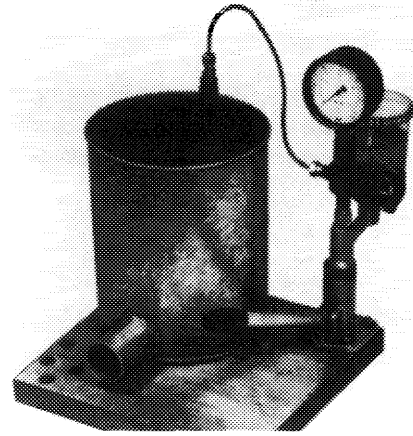
12 Clamp injection nozzle holder top (7) with protective jaws into vise and tighten injection nozzle holder bottom (5) to 70–80 Nm.



## Testing

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13 Test injection nozzles for jet, buzzing noise, opening (ejection) pressure and for leaks (07.1–135).



107-20857

## Adjusting

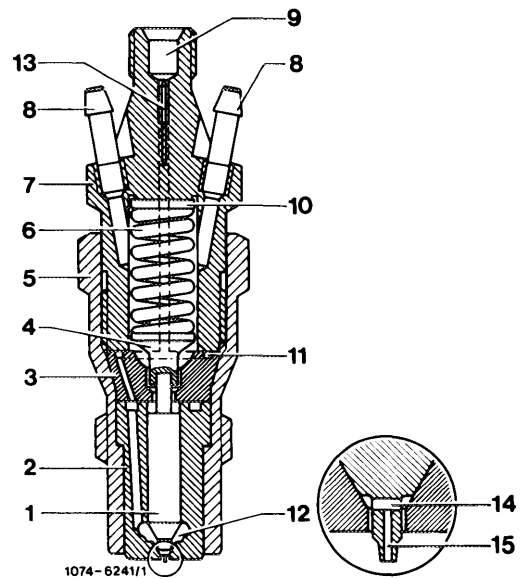
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14 Install or remove steel washers (10) between compression spring (6) and injection nozzle holder top (7) to maintain specified ejection (opening) pressure, if required for adjustment.

**Putting in = increased ejection pressure**

**Taking out = decreased ejection pressure**

Washers are available 1.0 to 1.8 mm thick in steps of 0.05 mm. An increase of preload by 0.05 mm increases ejection pressure by approx. 3.0 bar gauge pressure.

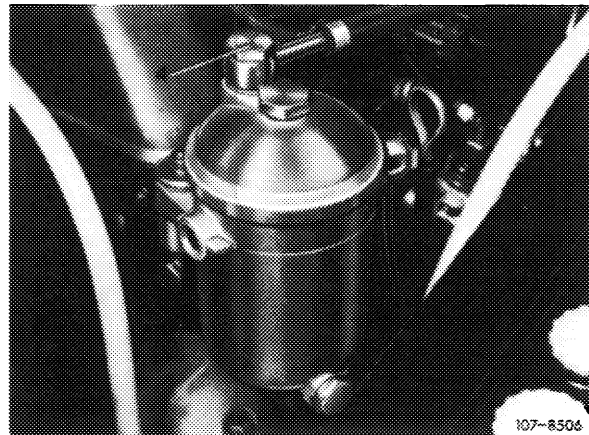
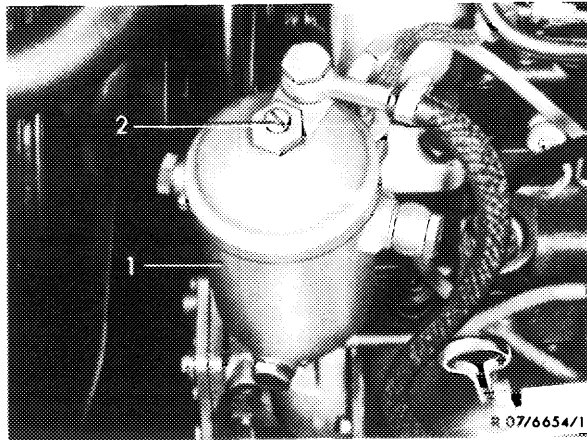


**Venting fuel filter**

---

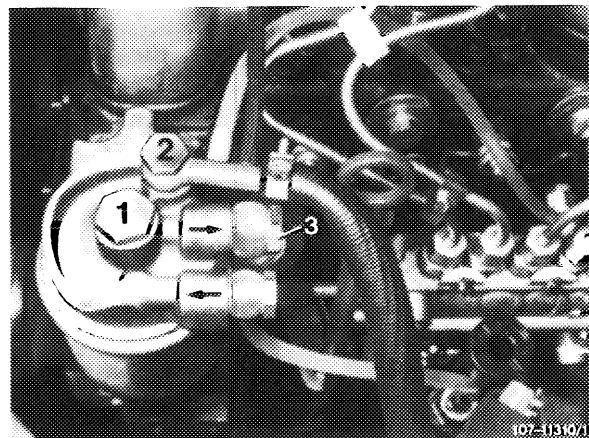
**Model 115.1**

1 Loosen venting screw (2) or with fuel filter without venting screw loosen hollow screw (2 and 4).



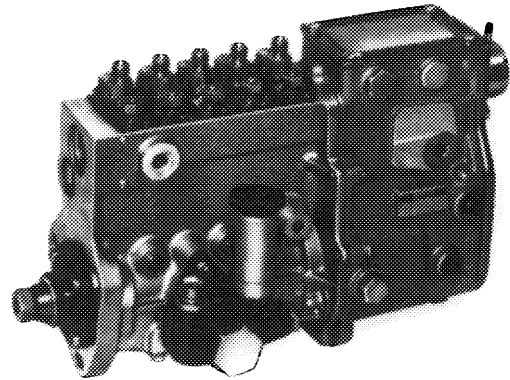
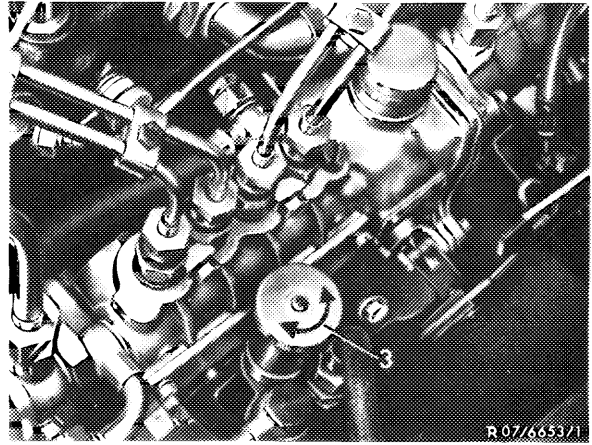
**Model 123.1**

Loosen hollow screw (3) and keep pumping with hand pump until fuel pumps out free of bubbles. Tighten hollow screw again.



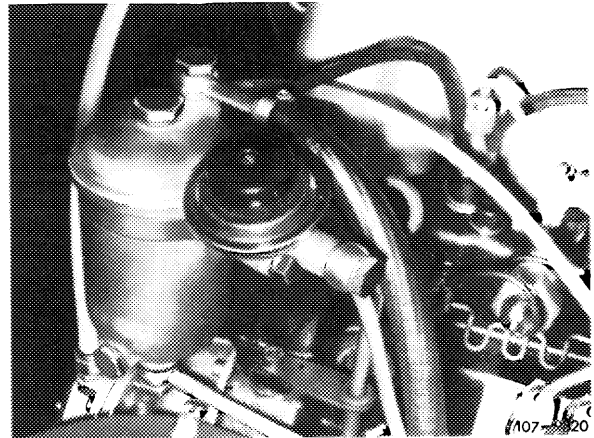


2 Loosen actuating button (3) of manual delivery pump (on engine 617 in model 115.1 not required) and keep actuating manual delivery pump until fuel emerges free of bubbles at vent screw (2) or hollow screw (2 and 4). Tighten vent screw or hollow screw again.



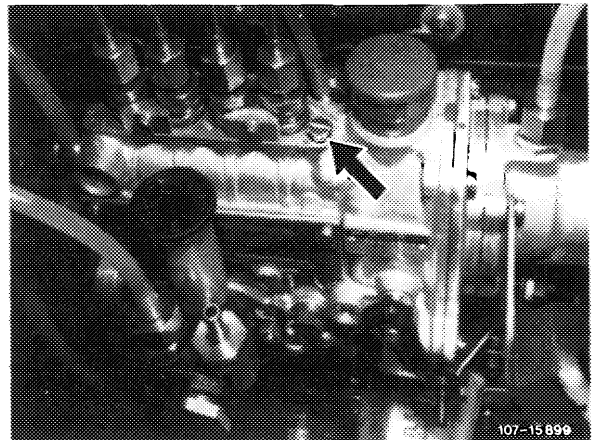
107-11312

Manual delivery pump  
Engine 617 in model 115.1

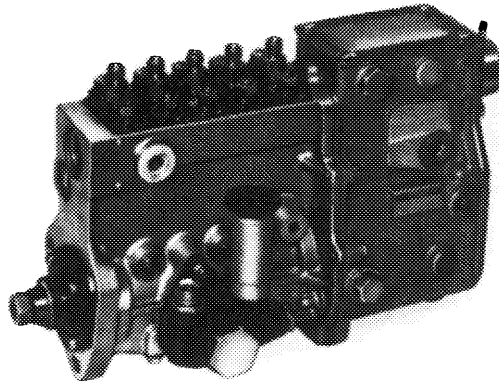


### Venting injection pump

3 M-injection pump with pneumatic governor. Loosen vent screw (arrow) on injection pump and also keep pumping with hand pump until fuel emerges free of bubbles. Tighten vent screw again.



4 MW and M/RSF-injection pump with mechanical governor. Keep pumping with hand pump until overflow valve on injection pump opens (audible buzzing noise).



107-11312

5 Tighten actuating button of manual delivery pump again.

Note: This will force pump piston on a sealing ring and the hand pump is sealed in outward direction. With actuating button released, the manual delivery pump will leak during operation and air may enter fuel system.

6 Run engine and check whether all connections are leaktight.

**Test values**

**Fuel pump**

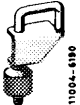
Injection pump – abbreviation	M		MW		MRSF
Engine	615, 616		617	616, 617	615, 616, 617
Model	115.1	123.1	115.1	123.1	123.1
Fuel pump Bosch designation	FP/K 22 M 13	FP/K 22 M 14	FP/K 22 MW 3	FP/K 22 MW 7	FP/K 22 M 101

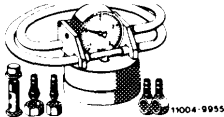
Vacuum	Measuring point	prior to pump input
	at idle speed bar gauge pressure	0.1
Delivery pressure	Measuring point	between fuel main filter and injection pump
	at idle speed bar gauge pressure	0.6–0.8
	at 3000/min bar gauge pressure	min 0.8
Delivery end pressure	at idle speed bar gauge pressure	min 1.1
	at 3000/min bar gauge pressure	min 1.3

**Fuel overflow valve**

Engine		Opening pressure in bar gauge pressure
615	at idle speed	0.6–0.8
616		
617	at 3000/min	min 1.3

**Special tools**

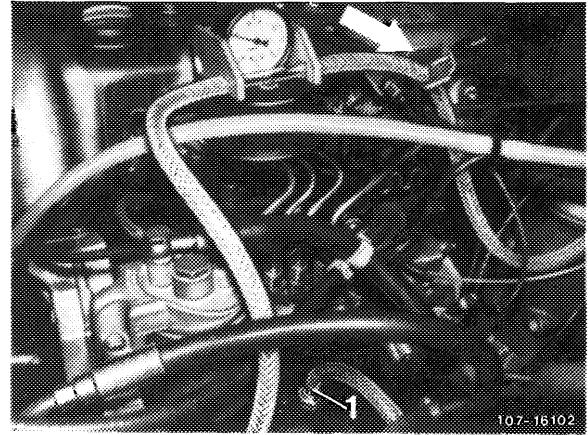
Clamp for fuel hose		000 589 40 37 00
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Tester for fuel pump		617 589 04 21 00
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## Measuring vacuum

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1 Connect tester at fuel input (1) on fuel pump. For this purpose, remove fuel feed line. Vent injection system (07.1–140).



Measure vacuum at idle speed. For this purpose, pinch hose (arrow) on tester behind pressure gauge with a clamp.

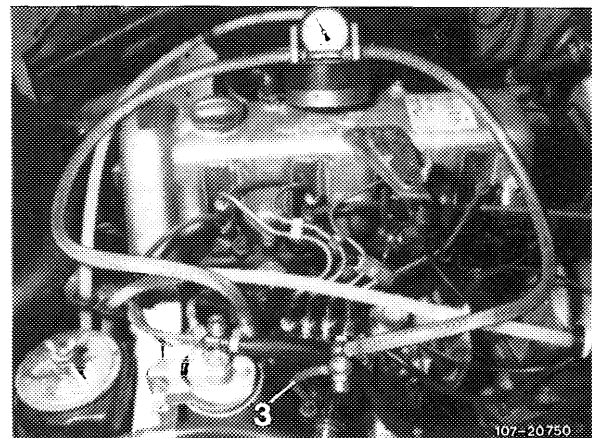
If the value is not attained, replace suction and pressure valves or replace fuel pump (07.1–235).

## Checking fuel delivery pressure

---

2 Unscrew fuel line (3) between fuel pump and fuel main filter.

3 Connect tester. For this purpose, connect fuel line together with hose line for tester to a double hollow screw and closing nut. Connect other hose line of tester to fuel filter.



4 Vent injection system (07.1–140).

5 Run engine to operating temperature.

6 Measure fuel delivery pressure at idle speed and at 3000/min.

At idle speed 0.6–0.8 bar gauge pressure.

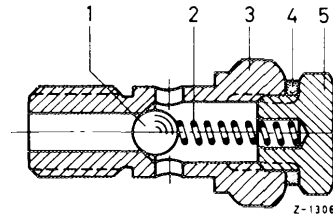
At 3000/min at least 0.8 bar gauge pressure.

7 If delivery pressure is too low:

a) Check overflow valve, while removing, disassembling and cleaning overflow valve on injection pump.

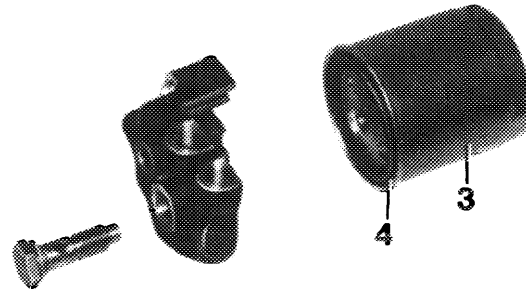
Increase preload of compression spring (2). For this purpose, lengthen compression spring to 26–27 mm.

- |                      |                |
|----------------------|----------------|
| 1 Ball               | 4 Sealing ring |
| 2 Compression spring | 5 Closing plug |
| 3 Housing            |                |



b) Check fuel filter for contamination. Mount new filter element with housing (3) and gasket (4), if required.

c) Replace suction and pressure valve or replace fuel pump (07.1–235).



107-1136i

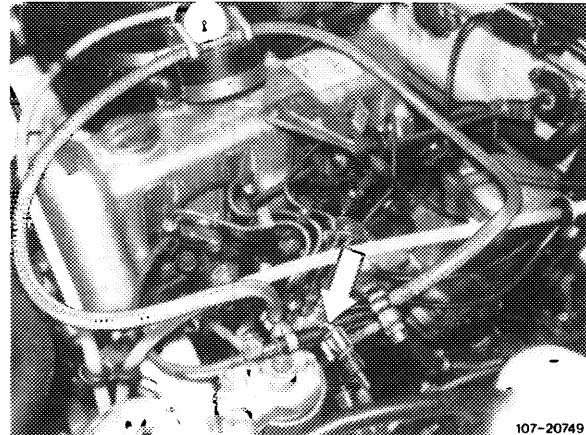
#### Checking fuel delivery end pressure

8 Pinch fuel return hose with a clamp (arrow)

9 Measure fuel delivery end pressure at idle speed and at 3000/min.

At idle speed min. 1.1 bar gauge pressure.

At 3000/min at least 1.3 bar gauge pressure.



10 If the delivery end pressure is too low, replace suction and pressure valves or replace fuel pump (07.1–235).

**A. Without tester**

**Note for vehicles with diaphragm vacuum pump**

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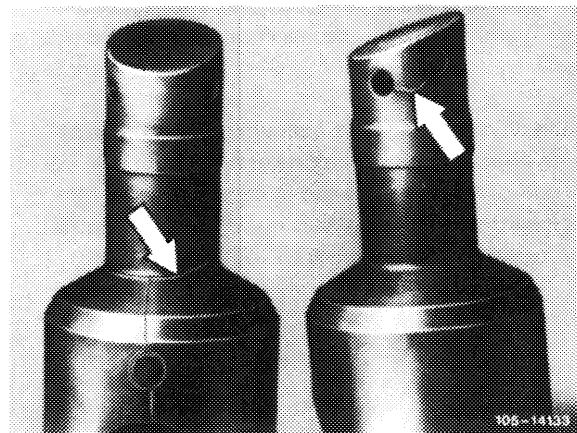
If engine oil shows up in vacuum lines or in brake unit, the diaphragm of the vacuum box or the diaphragm in vacuum pump may be defective.

If engine oil shows up, replace vacuum box as well as the vacuum lines containing oil, if required. Repair vacuum pump and replace brake unit, if these units are showing oil on connection for vacuum line.

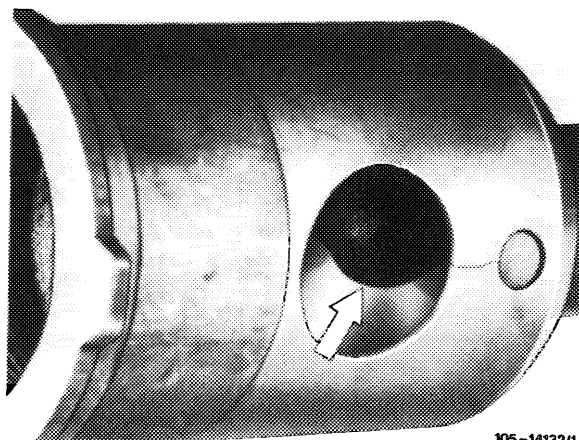
If a leaking diaphragm in vacuum pump or a leaking vacuum box on injection pump are responsible for oil entering combustion chambers via intake pipe, the resulting increased combustion temperature may lead to prechamber damage.

If the vacuum lines are showing an intensive black color along their entire length, the reason may be engine oil in combustion chamber. In such a case it will be of advantage to check all prechambers.

**Replace prechambers** with cracks in bottom (arrows) or burnt (scale-covered) ball pin surface (arrow), if not, damage to engine caused by chips or peelings from prechamber components may be expected.



Note: The piston-type vacuum pump is installed on standard version since June 1980 and on national version since model year 1981.



## Checkup

---

- 1 Run engine.
- 2 Pull vacuum line (brown) from T-fitting (7) and check for presence of vacuum.

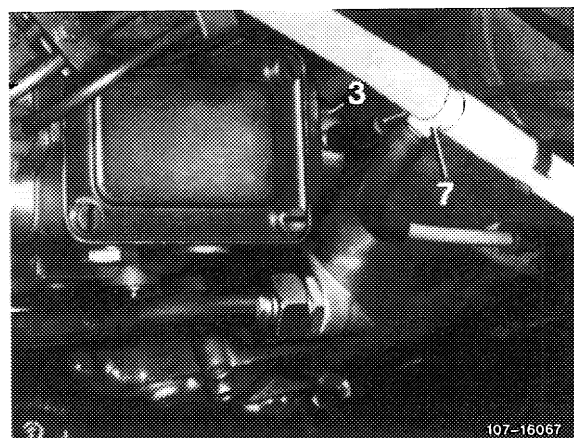
a) If there is no vacuum, unscrew vacuum line with T-fitting on vacuum pump and on brake unit.

Check throttle in T-fitting for unobstructed passage and blow out with compressed air, if required.

Note: On vehicles with diaphragm vacuum pump. If throttle is oiled up, the diaphragm in vacuum pump may be defective. This may be the case, if engine oil is seen on connection of vacuum line (pump end). Reconditioning of vacuum pump is described in repair instructions "Brakes model 115 and 123".

b) If vacuum is available at T-fitting, connect vacuum box (3) and T-fitting (7) to each other by means of a hose.

The vacuum coming from vacuum pump (8) is now acting directly against diaphragm in vacuum box (3) and will pull the control rod in injection pump into stop position. If the engine is not stopping immediately, replace vacuum box (07.1–220).

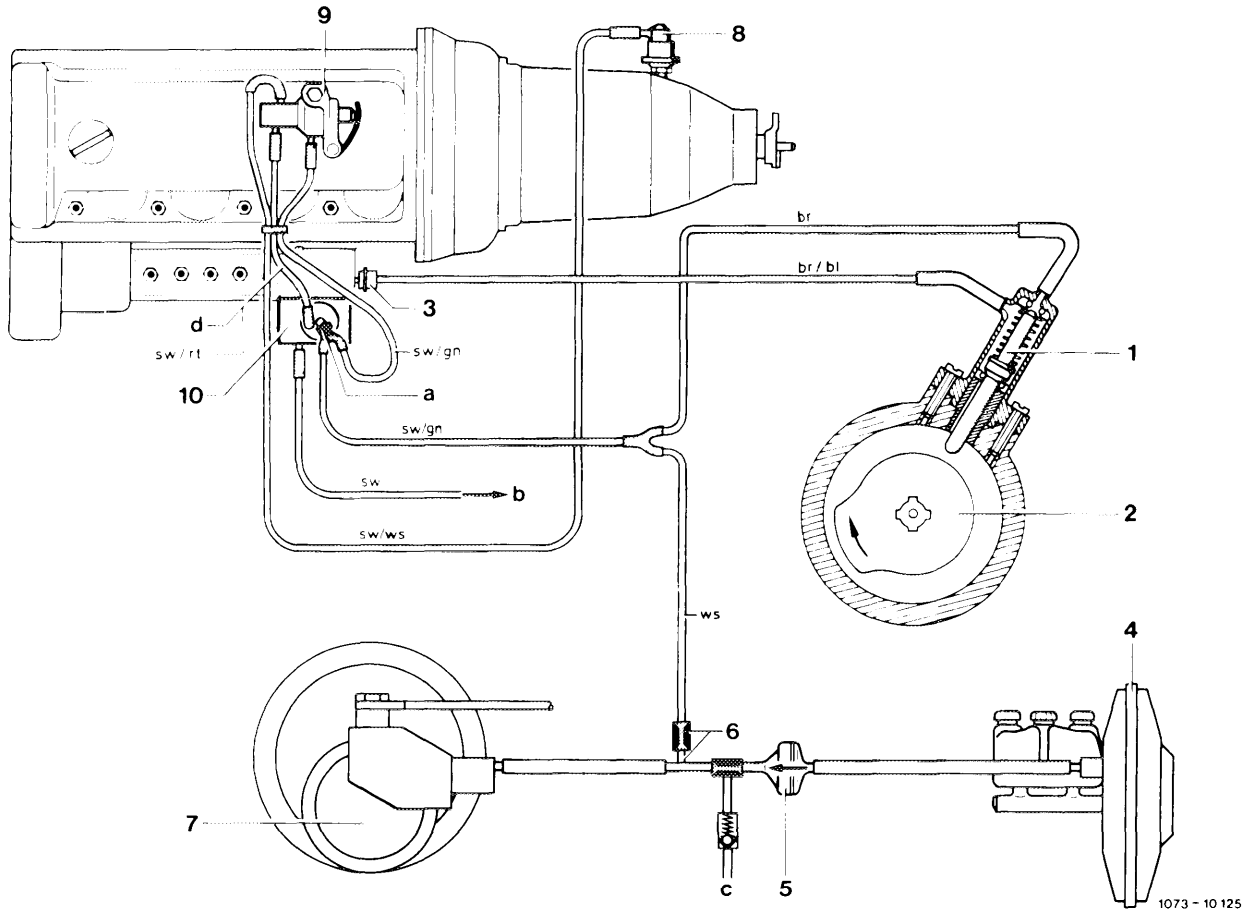


If the engine stops immediately, the vacuum box is in order. The complaint may then have been caused by a sticking valve (1) in steering lock. For replacing valve, refer to repair instructions "Steering model 115 and 123".

### Attention!

Do not mix up vacuum lines during assembly.

3 Run engine, check vacuum control unit and valve in steering lock for function and leaks.



- 1 Valve
- 2 Cam
- 3 Vacuum control unit injection pump
- 4 Brake unit
- 5 Check valve
- 6 T-piece with installed choke (orifice)
- 7 Vacuum pump
- 8 Vacuum control unit for transmission

- 9 Switchover valve
- 10 Vacuum control valve
- a Suction line
- b Vent line
- c Central lock
- d Control line

- br = brown
- br/bl = brown/blue
- sw/rt = black/red
- sw/gn = black/green
- sw = black
- sw/ws = black/white

1073 - 10 125



## B. With tester

### Data

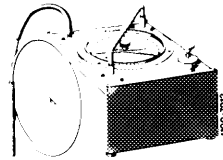
Permissible leakiness of system	6 mbar/min at 400 mbar vacuum
Permissible leakiness of individual components	5 mbar/min at 300 mbar vacuum
Plug-on length of connections	12 ± 2 mm

### Color code of vacuum lines for diesel key starting

Vacuum line	Color code
Suction line from distributor to valve for key starting (100)	brown
Control line from valve for key starting to shutoff box of injection pump (101)	brown/blue

### Special tool

Tester for vacuum

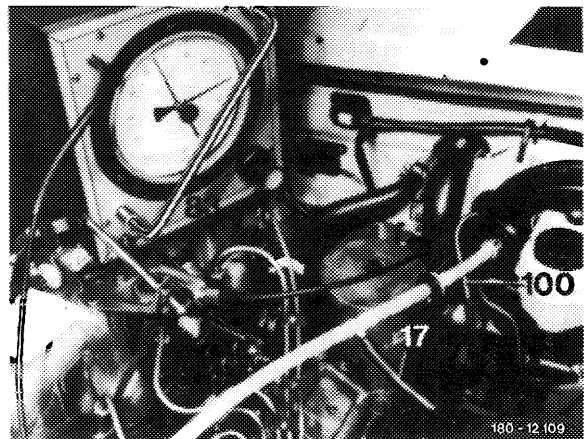


116 589 25 21 00

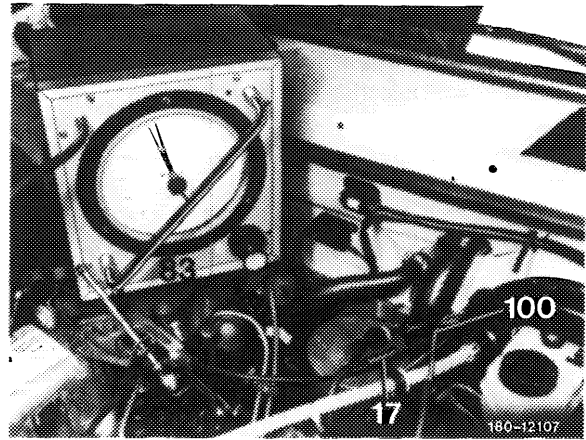
### Checkup

- 1 Set ignition key on steering lock to position "2".
- 2 Pull suction line (100) out of connection (17).

Layout without central interlock and air conditioner/automatic climate control



3 Connect tester (83) and evacuate.



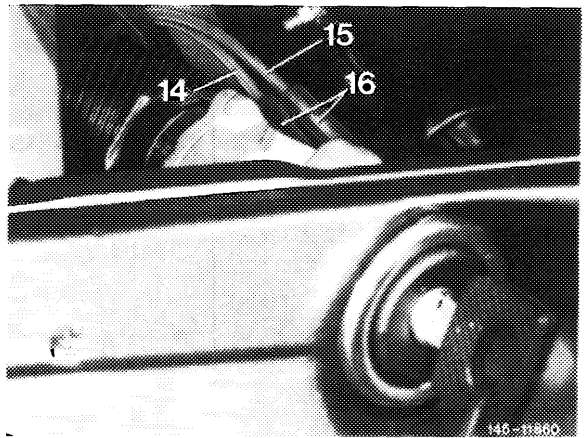
Layout with central interlock or air conditioner

4 If the pressure gauge shows a vacuum decrease the valve for key starting on steering lock is leaking.

5 Replace valve for key starting system on steering lock (46-640).

**Attention!**

Prior to replacing valve for key starting and vacuum box of injection pump, check hose lines and their connections.



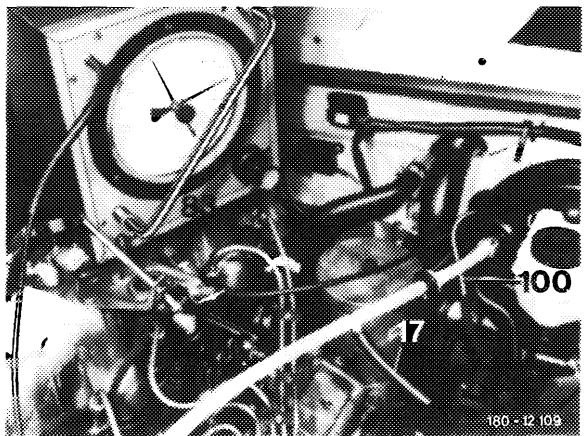
6 If readout on pressure gauge is not changing, the valve for key starting system is not leaking.

7 Turn ignition key on steering lock back to position "1" or "0".

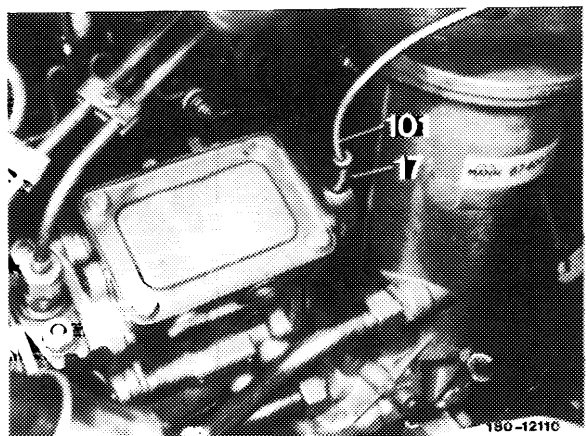
8 Evacuate system with tester (83).

9 If pressure gauge shows a vacuum decrease, the vacuum box or the valve may be leaking.

10 In such a case, disconnect tester (83) on suction line (100).



11 Pull control line (101) with connection (17) from vacuum box of injection pump.



12 Connect tester (83) to vacuum box (arrow) and evacuate.

13 If pressure gauge shows a vacuum decrease, the vacuum box of injection pump is leaking.

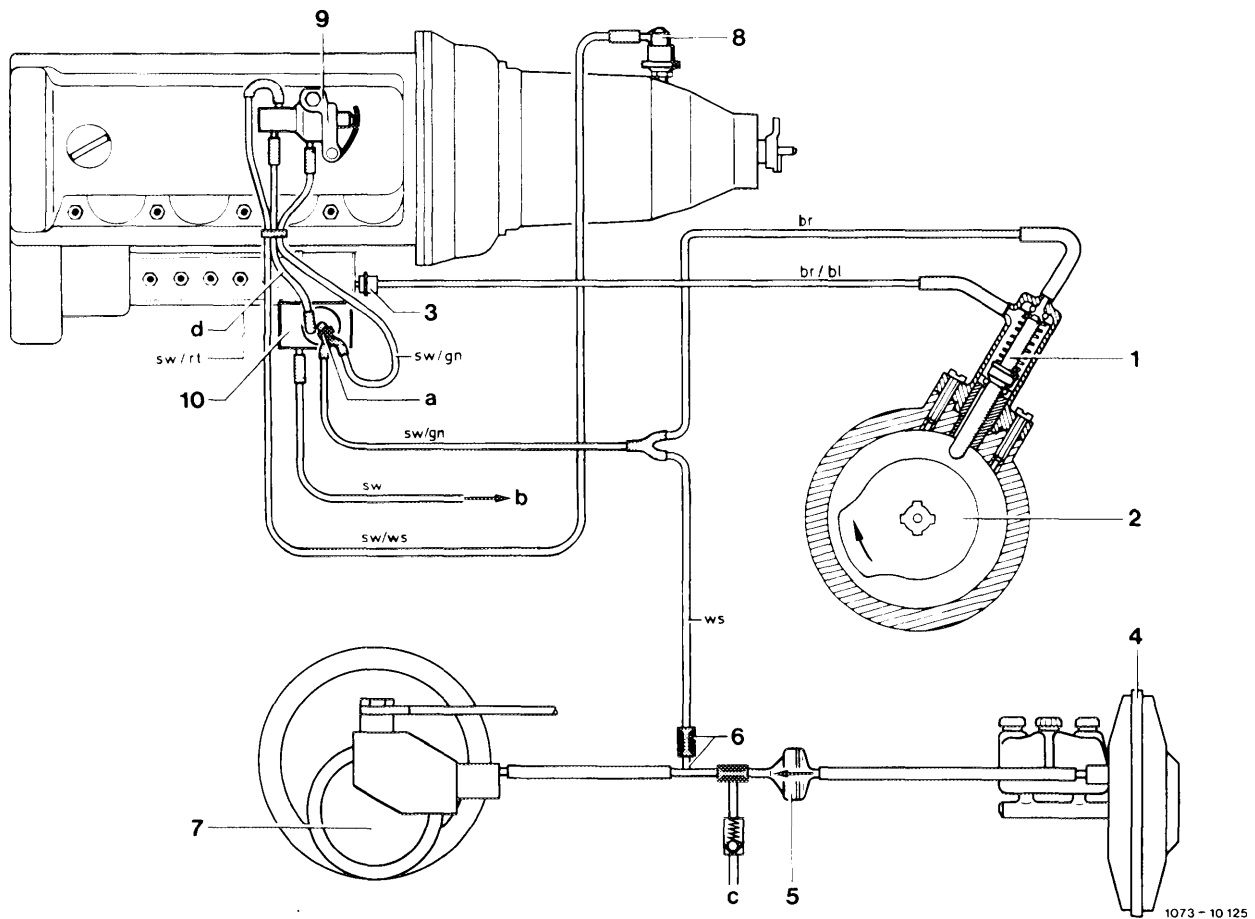
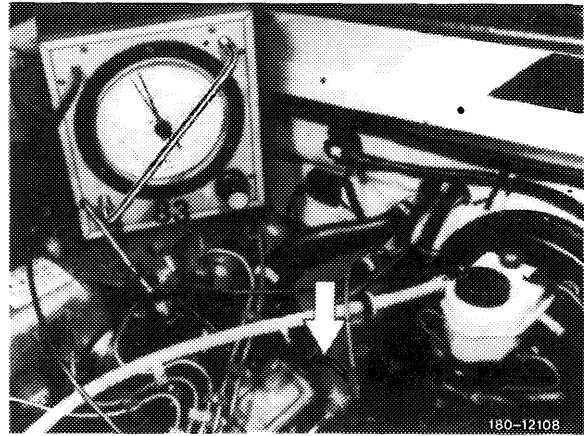
14 Replace vacuum box of injection pump (07.1-220).

15 If readout on pressure gauge is not changing, the vacuum box of the injection pump is leaktight and the leak is at valve for key starting system. Replace valve vor key starting system (46-640).

16 If the vacuum box and the valve on vehicles with central interlock or air conditioner are leaktight, the leak is in vacuum system, in central interlock, light range regulation or air conditioner.

18 In such a case, check central interlock (80-260).

19 Check vacuum elements, vacuum rotary switches and pull switches of air conditioner for leaks (83-545).



- 1 Valve
- 2 Cam
- 3 Vacuum control unit injection pump
- 4 Brake unit
- 5 Check valve
- 6 T-fitting with installed choke (orifice)
- 7 Vacuum pump
- 8 Vacuum control unit for transmission

- 9 Switchover valve
- 10 Vacuum control valve
- a Suction line
- b Vent line
- c Central lock

- br = brown
- br/bl = brown/blue
- sw/rt = black/red
- sw = black
- sw/ws = black/white

A. Engine 615,616 M-injection pump with pneumatic governor

Standard version

**Injection pump with governor and delivery pump for operating at altitudes up to 2000 m above sea level**

Model	Engine	Injection pump Bosch designation (abbreviation)	Governor Bosch designation	Delivery pump Bosch designation	Control rod path including compensating path <sup>1)</sup> mm	Test values <sup>2)</sup> MB-sheet Date or edition
115.1	615.912	PES 4 M 55 C 320 RS 47 (M)	EP/MN 60 M 23 DR	FP/K 22 M 13	14.8–15.0 <sup>4)</sup>	2,2 a 5. 1972
	615.913	PES 4 M 50 C 320 RS 14 (M)	EP/MN 60 M 25 DR		14.9–15.0	2,0 a 4th edition
123.1	615.940	PES 4 M 50 C 320 RS 59 (M)	EP/MN 60 M 45 DR	FP/K 22 M 14	14.4–14.5	2,0 d 4th edition
	615.941	PES 4 M 55 C 320 RS 60 (M)	EPIMN 60 M 44 DR		14.3–14.4	2,2 f 3rd edition
115.1	616.916 <sup>3)</sup>	PES 4 M 55 C 320 RS 47 (M)	EP/MN 60 M 38 DR EP/MN 60 M 39 DR <sup>4)</sup>	FP/K 22 M 13	15.2–15.3	2,4 a 3rd edition
123.1	616.912	PES 4 M 55 C 320 RS 60 (M)	EP/MN 60 M 46 DR	FP/K 22 M 14	14.8–14.9	2,4 d 4th edition

**Engine 615 for operating at altitudes above 2000 m above sea level**

115.1	615.912	PES 4 M 55 C 320 RS 47 z (M)	EPIMN 60 M 23 DR	FPIK 22 M 13	13.9–14.1 <sup>5)</sup>	2,2 a 5. 1972
	615.913	PES 4 M 50 C 320 RS 14 z (M)	EP/MN 60 M 25 DR		14.2–14.3	2,0 a 4th edition

- <sup>1)</sup> Data concerning control rod path represent the path of the control rod from full load stop to outermost stop position. By means of these data for the control rod and compensating path, the injection pump can be regulated occasionally and in an emergency without a test bench.
- <sup>2)</sup> **Accurate regulation and adjustment of injection pump is possible on an injection pump test bench only.** For workshops which own such a test bench, the required data sheets for the various pumps are available.
- <sup>3)</sup> In the event of replacements, (USA) version vehicles are supplied with injection pumps model year 1975/76 only.
- <sup>4)</sup> Replaced by M 38 DR when stocks were used up.
- <sup>5)</sup> On engines with injection nozzles DN 0 SD 1510, as a result of the shorter compensating path, the control rod path amounts to 14.5–14.7 mm and on injection pumps for altitudes above 2000 m it is 13.6–13.8 mm.



Identification: Full load stop screw and governor housing lead-sealed.

**Model year 1975/76**

115.1	615.912	PES 4 M 55 C 320 RS 47 (M)	EP/MN 60 M 27 DR	FP/K 22 M 13	14.2–14.4	2,2 c 1st edition
	615.913	PES 4 M 50 C 320 RS 14 (M)	EP/MN 60 M 28 DR		14.2–14.3	
	616.916	PES 4 M 55 C 320 RS 47 (M)	EP/MN 60 M 40 DR		14.5–14.6	2,4 a 3rd edition

Model year **1977178**

Model	engine	Injection pump Bosch designation (abbreviation)	Governor Bosch designation	Delivery pump Bosch designation	Control rod path including compensating path <sup>1)</sup> mm	Test values <sup>2)</sup> MB-sheet Date or edition
123.1	615.941	PES 4 M 55 C 320 RS 60 (M)	EP/MN 60 M 48 DR	FPIK 22 M 14	13.8–13.9	2,2 g 1st edition
	616.912	PES 4 M 55 C 320 RS 60 (M)	EP/MN 60 M 47 DR		14.5–14.7	2,4 g 2nd edition

Model year **1979**

123.1	615.941 <sup>3)</sup>	PES 4 M 55 C 320 RS 60 (M)	EP/MN 60 M 48 DR	FPIK 22 M 14	13,8–13,9	2,2 g 1st edition
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1) Data concerning control rod path represent the path of the control rod from full load stop to outermost stop position. By means of these data for the control rod and compensating path, the injection pump can be regulated occasionally and in an emergency without a test bench.

2) **Accurate regulation and adjustment of injection pump is possible on an injection pump test bench only.** For workshops which own such a test bench, the required data sheets for the various pumps are available.

3) Up to February 1979.

**USA**

Identification: green information plate.

Model year **1975176**

115.1	616.916	PES 4 M 55 C 320 RS 58 (M)	EP/MN 60 M 41 DR	FP/K 22 M 13	14.0–16.0	2,4 b 4th edition
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1) Data concerning control rod path represent the path of the control rod from full load stop to outermost stop position. By means of these data for the control rod and compensating path, the injection pump can be regulated occasionally and in an emergency without a test bench.

2) **Accurate regulation and adjustment of injection pump is possible on an injection pump test bench only.** For workshops which own such a test bench, the required data sheets for the various pumps are available.

**Test values**

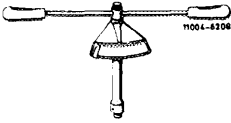



Engine	615.9121941	615.9131940	616
Begin of delivery before TDC in compression stroke <sup>1) 2)</sup>	24°	26°	24°

1) The injection pump is in begin of delivery position, when the marking line on camshaft of injection pump is in alignment with line on flange of injection pump.

2) The begin of delivery position is checked and set following installation of injection pump according to overflow method (07.1–1101115).

Tightening torques	Engine	Nm
Pipe connection for pressure valves	615,616	35
Injection lines	615,616	25

## Special tools

Torque wrench 1/2" square, 15–65 Nm		000 589 27 21 00
Socket wrench insert 13 mm, 3/8" square		000 589 21 07 22
Box wrench insert open, 17 mm, 1/2" square for injection lines		000 589 68 03 00
Overflow pipe		636 58902 2300

## Note

If lower fastening nut of injection pump (oil filter flange without recess) is poorly accessible, unscrew upper fastening screw from oil filter flange first. For this purpose, remove **lefthand** front wheel and unscrew fastening screw by means of an extended socket wrench. In addition, on engines 615.912 and 616, unscrew oil hoses from air-oil cooler on oil filter top.

Starting with the following chassis end numbers, an oil filter flange with recess is installed for better access to bottom fastening nut of injection pump on models 115.

## Series production

Model	Starting chassis end no.
115.115	098110
115.110	200205

## Removal

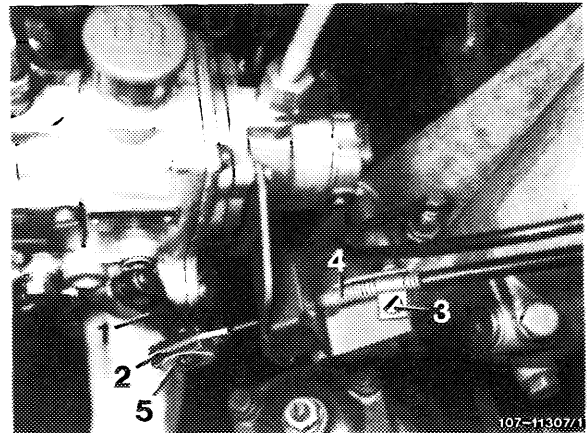
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1 Unscrew injection lines, vacuum line and fuel lines on injection pump. Plug closing caps on connections for injection lines and fuel hoses on injection pump.

2 Disconnect connecting rod on tickler.

3 Disconnect start-stop cable control on adjusting lever (1) of injection pump. For this purpose, remove cotter pin, washer (5), screw (3) on angle bracket and remove wire coil (4) with clamp.

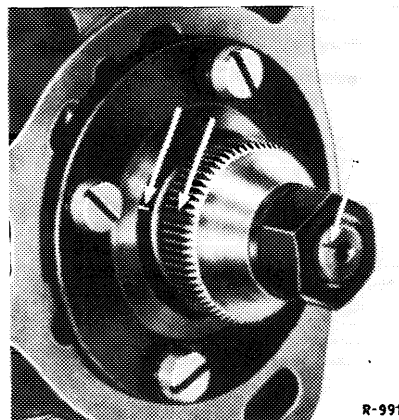
- 1 Adjusting lever
- 2 Oblong eye
- 3 Screw – angle bracket
- 4 Wire coil
- 5 Washer



4 Unscrew hex nut on supporting bell and fastening nuts of injection pump, then pull injection pump out of cylinder crankcase. Remove coupling sleeve from driver of injection pump or from drive shaft.

**Note:** When replacing a driver, apply counterhold for loosening hex nut by means of notched tooth wrench, then pull driver from injection pump shaft by means of puller. Clean shaft stub and driver; the two cones should be absolutely clean and free of grease.

When mounting a new driver, pay attention to Woodruff key and markings (arrows).

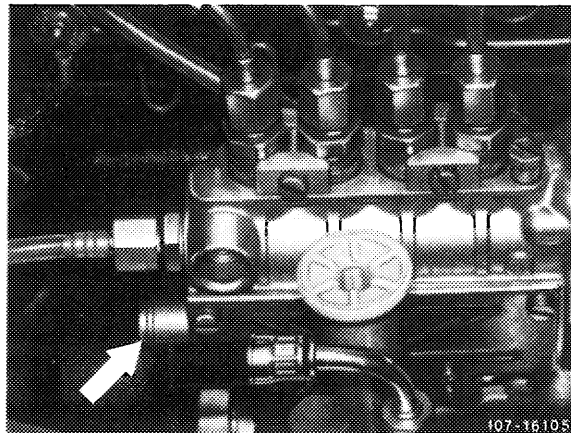


## Installation

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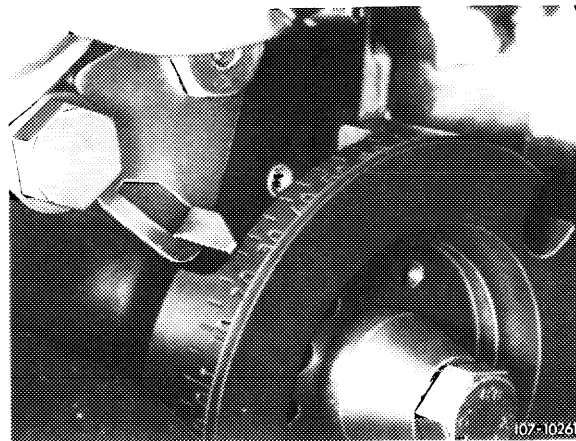
Prior to installing injection pump, check control rod for easy operation. If required, make operable as follows:

- a) Remove closing cap (arrow) of control rod.
- b) Push adjusting lever from stop to start position. Control rod should return automatically.
- c) If control rod is hard to move, which is caused by resinification, fill clean gasoline into fuel feed connection and permit to act for a short period on elements.
- d) Move control rod back and forth until it is freely operating.



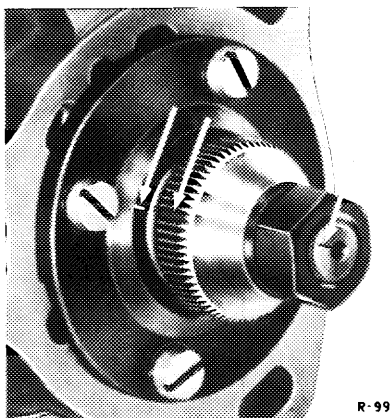
5 Set crankshaft to the following values in compression stroke of first cylinder.

615.9131940	26° before TDC
615.912/941	24° before TDC
616	24° before TDC



6 Slip coupling sleeve on intermediate gear shaft.

7 Set injection pump to begin of delivery. For this purpose, rotate pump shaft until tooth gap on driver and marking on injection pump are in alignment (arrows).





8 Mount new gasket.

9 Introduce injection pump in such a manner that the studs are in **center** of oblong holes (slots). This will permit swivelling in both directions for precision adjustment.

**Note:** Following precision adjustment, a distance of approx. 80 mm should be available from cylinder crankcase to center of pipe connection for injection lines to remove glow plugs.

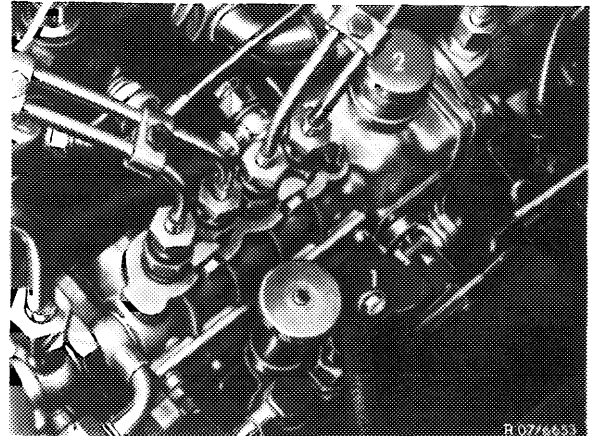
10 Mount washers and slightly tighten injection pump by means of hex nuts.

11 Check begin of delivery and adjust (07.1–110 and 115).

12 Tighten fastening nuts on front flange and on supporting bell.

13 Check oil level of injection pump and correct, if required. For this purpose, unscrew check plug (1). If oil level is too high, loosen governor cover and raise slightly so that the fuel-oil mixture can flow out. When the oil level is too low, unscrew filter (2) and add engine oil up to check bore.

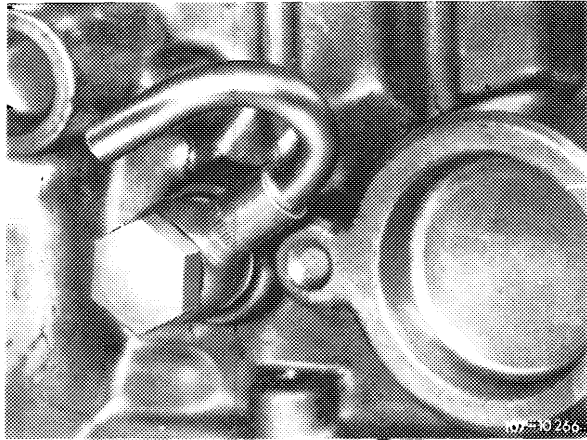
- 1 Check plug
- 2 Filter



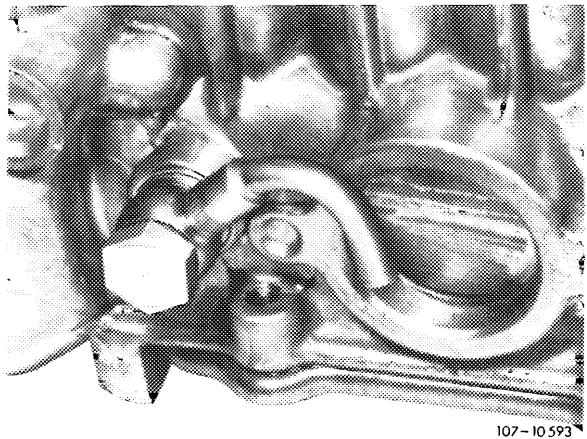
R 07/6633

14 Check position of overflow pipe and correct according to illustration, if required. For this purpose, loosen hollow screw and correct overflow pipe according to illustration.

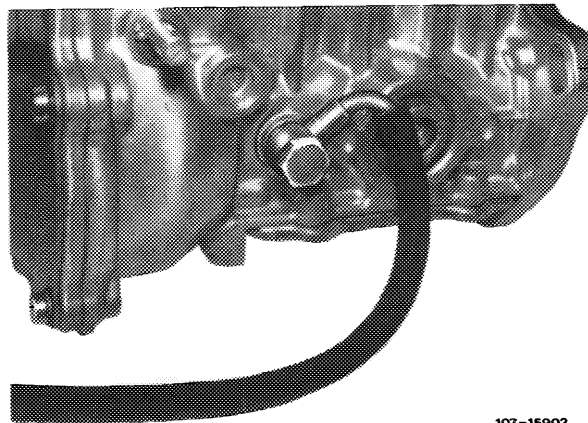
1st version



2nd version



3rd version



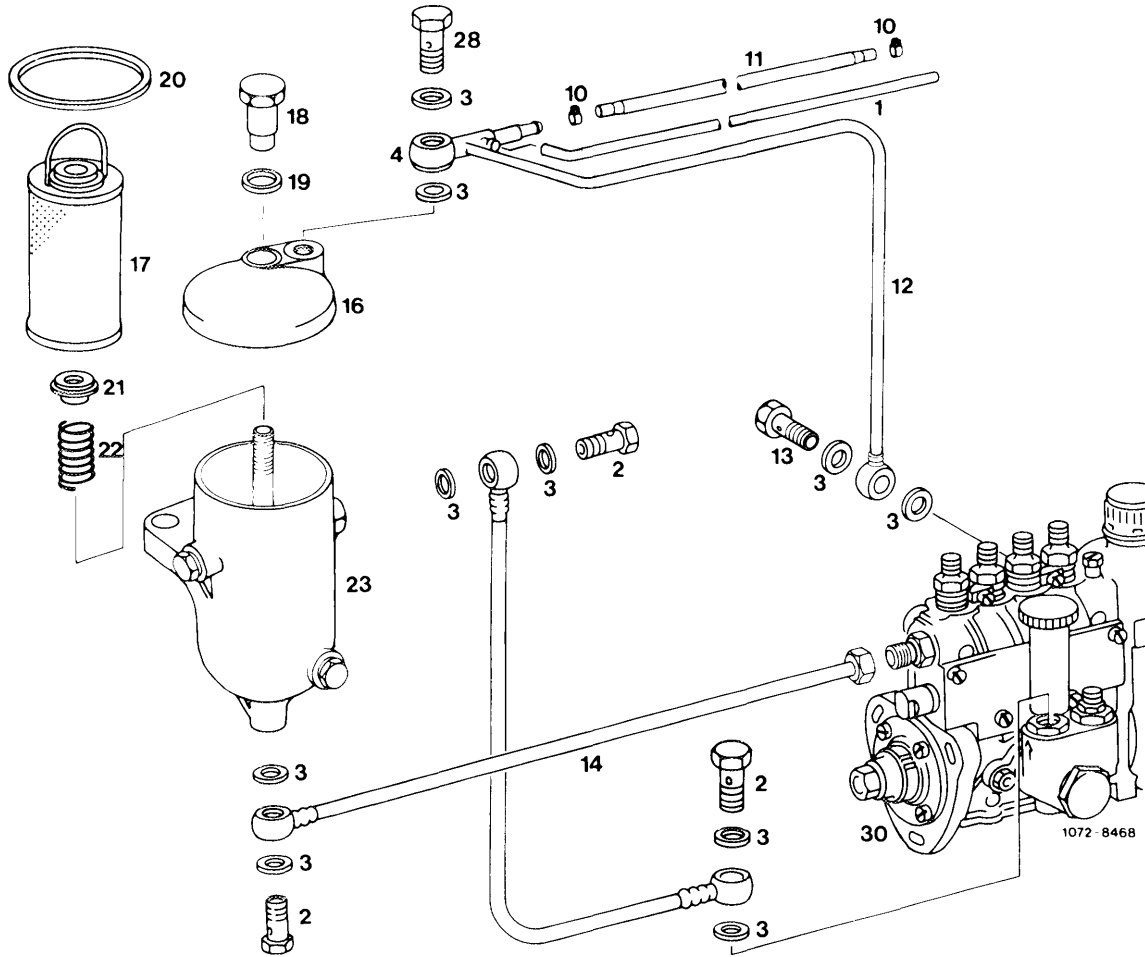
15 Mount start-stop cable control and adjust (07.1-340).

16 Run engine and check all connections for leaks.

17 Check idle speed and adjust, if required (07.1-100).

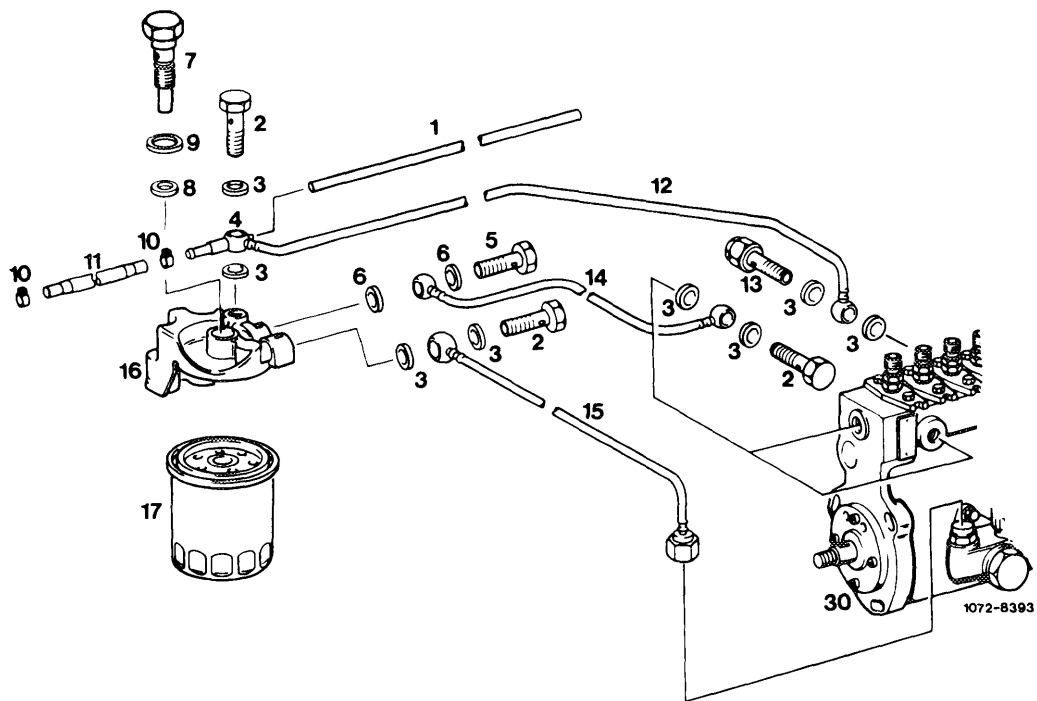


Fuel filter  
 Engine 615, 616 in model 115.1



- |                                 |                        |                                      |
|---------------------------------|------------------------|--------------------------------------|
| 1 Leak hose of injection nozzle | 13 Overflow valve      | 20 Rubber sealing ring               |
| 2 Hollow screw                  | 14 Fuel line           | 21 Spring plate                      |
| 3 Sealing ring                  | 15 Fuel line           | 22 Compression spring                |
| 4 Ring fitting                  | 16 Fuel filter top     | 23 Fuel filter bottom                |
| 10 Hose clamp                   | 17 Fuel filter element | 28 Hollow screw with calibrated bore |
| 11 Fuel expanding hose          | 18 Screw               | 30 Injection pump                    |
| 12 Return line                  | 19 Sealing ring        |                                      |

Engine 615, 616 in model 123.1



- 1 Leak hose of injection nozzle
- 2 Hollow screw with calibrated bore
- 3 Sealing ring
- 4 Ring fitting
- 5 Hollow screw
- 6 Sealing ring

- 7 Hollow screw
- 8 Sealing ring
- 9 O-ring
- 10 Hose clamp
- 11 Fuel expanding hose
- 12 Return line

- 13 Overflow valve
- 14 Fuel line
- 15 Fuel line
- 16 Fuel filter top
- 17 Fuel filter
- 30 Injection pump

## B. Engine 615, 616, 617 MW and M/RSF-injection pump with mechanical governor

Model	Engine	Injection pump Bosch designation (abbreviation)	Governor Bosch designation	Delivery pump Bosch designation	Test values <sup>1)</sup> MB-sheet Date or edition
-------	--------	---	-------------------------------	------------------------------------	--

### Standard version and (AUS) (J)

123.1	615.940	PES 4 M 50 C 320 RS 103 (M/RSF)	4)	FP/K 22 M 101	2,0 g 2,0 g 1 2,0 g 2 2,0 g 3 2nd edition
	616.912 <sup>2)</sup>	PES 4 MW 55/320 RS 17 (MW)	RW 375/2250 MW 23	FP/K 22 MW 7	2,4 g 2nd edition
	616.912 <sup>3)</sup>	PES 4 M 55 C 320 RS 104 (M/RSF)	4)	FP/K 22 M 101	2,4 h 2,4 h 1 3rd edition
	616.912	PES 4 M 55 C 320 RS 107 (M/RSF)	4)	FP/K 22 M 101	2,4 h 1 3rd edition
115.1	617.910	PES 5 MW 55/320 RS 3 (MW)	RW 350/2200 MW 2	FP/K 22 MW 3	3,0 a 4th edition
123.1	617.912	PES 5 MW 551320 RS 12 (MW)	RW 35012200 MW 15	FP/K 22 MW 7	3,0 d 5th edition
		PES 5 M 55 C 320 RS 105 (M/RSF)	4)	FP/K 22 M 101	3,0 l 3rd edition
		PES 5 M 55 C 320 RS 108 (M/RSF)	4)	FP/K 22 M 101	3,0 l 1st version

1) Accurate regulation and adjustment of injection pump is possible on an injection pump test bench only. For workshops which own such a test bench, the required data sheets for the various pumps are available.

2) Production starting chassis end no. 054194, October 1977.

3) Production starting chassis end no. 084808, August 1978.

4) Governor designation is included in injection pump combination number.

(E) (S)

Identification (S) injection pump only with lead-sealed governor housing and full load stop screw (on MW-injection pump only)

### Model year 1975/76

115.1	617.910	PES 5 MW 551320 RS 3 (MW)	RW 35012200 MW 10	FP/K 22 MW 3	3,0 a 4th edition
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### Model year 1977/78

123.1	616.912	PES 4 MW 55/320 RS 17 (MW)	RW 375/2250 MW 24	FP/K 22 MW 7	2,4 g 2nd edition
	617.912	PES 5 MW 55/320 RS 12 (MW)	RW 35012200 MW 20		3,0 e 4th edition

### Starting model year 1979

123.1	615.940	PES 4 M 50 C 320 RS 103 (MRSF)	2)	FP/K 22 M 101	2,0 g 2 2nd edition
	616.912	PES 4 M 55 C 320 RS 104 (MRSF)	2)		2,4 h 1 3rd edition
	617.912	PES 5 MW 55/320 RS 12 (MW)	RW 350/2200 MW 20	FP/K 22 MW 7	3,0 l 3rd edition

1) Accurate regulation and adjustment of injection pump is possible on an injection pump test bench only. For workshops which own such a test bench, the required data sheets for the various pumps are available.

2) Governor designation is included in injection pump combination number.

Model	Engine	Injection pump Bosch designation (abbreviation)	Governor Bosch designation	Delivery pump Bosch designation	Test values <sup>1)</sup> MB-sheet Date or edition
-------	--------	---	-------------------------------	------------------------------------	--

### Model year 1980181

Identification **(S)** only: Injection pump with lead-sealed governor housing.

123.1	615.940	PES4 M 50 C 320 RS 103 (M/RSF)	<sup>4)</sup>	FP/K 22 M 101	2,0 g 2 2nd edition
	616.912	PES 4 M 55 C 320 RS 104 <sup>2)</sup> (M/RSF)	<sup>4)</sup>	FP/K 22 M 101	24 h 1 3rd edition
		PES 4 M 55 C 320 RS 107 <sup>3)</sup> (M/RSF)	<sup>4)</sup>	FP/K 22 M 101	24 h 1 3rd edition
	617.912	PES 5 M 55 C 320 RS 105 (M/RSF)	<sup>4)</sup>	FP/K 22 M 101	3,0 l 3rd edition
		PES 5 M 55 C 320 RS 108 <sup>3)</sup> (M/RSF)	<sup>4)</sup>	FP/K 22 M 101	3,0 l 3rd edition

<sup>1)</sup> Accurate regulation and adjustment of injection pump is possible on an injection pump test bench only. For workshops which own such a test bench, the required data sheets for the various pumps are available.

<sup>2)</sup> Starting chassis end no. 084808, August 1978.

<sup>3)</sup> Starting November 1980.

<sup>4)</sup> Governor designation is included in injection pump combination number.

**(USA)** **(ZA)**

Identification: green information plate.

### Model year 1975176

115.1	617.910	PES 5 MW 551320 RS 4 (MW)	RW 35012200 MW 3	FP/K 22 MW 3	3,0 c 2nd edition
	617.910 <sup>2)</sup>	PES 5 MW 551320 RS 4 (MW)	RW 35012200 MW 11		3,0 b 2nd edition

### Model year 1977178

123.1	616.912 <sup>3)</sup>	PES 4 MW 55/320 RS 14 (MW)	RW 350/2200 MW 21	FP/K 22 MW 7	2,4 f 9th edition
	617.912 <sup>3)</sup>	PES 5 MW 55/320 RS 15 (MW)	RW 350/2200 MW 19		3,0 f 9th edition

### Model year 1979

123.1	616.912 <sup>3)</sup>	PES 4 MW 55/320 RS 14 (MW)	RW 375/2200 MW 21	FP/K 22 MW 7	2,4 f 9th edition
	617.912 <sup>3)</sup>	PES 5 MW 55/320 RS 15 (MW)	RW 375/2200 MW 19		3,0 f 9th edition

### Model year 1980181

123.1	616.912 <sup>3)</sup>	PES 4 MW 551320 RS 21 (MW)	RW 37512200 MW 27	FPIK 22 MW 21	2,4 i 1st edition
	617.912 <sup>3)</sup>	PES 5 MW 55/320 RS 20 (MW)	RW 375/2200 MW 27		3,0 k 2nd edition

<sup>1)</sup> Accurate regulation and adjustment of injection pump is possible on an injection **pump** test bench only. For workshops which own such a test bench, the required data sheets for the various pumps are available.

<sup>2)</sup> Injection pump with mechanical altitude correction, starting chassis end no. 007590.

<sup>3)</sup> Injection pump with automatic altitude correction.

## Test values

Engine	615	616,617
Begin of delivery before TDC in compression stroke <sup>1) 2)</sup>	26°	24°

### Attention!

On injection pumps with mechanical governor, push regulating lever of injection pump to full load while measuring and pull off vacuum hose from vacuum box.

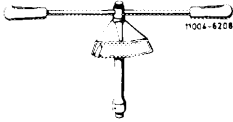




<sup>1)</sup> The injection pump is in begin of delivery position when the marking on camshaft of injection pump is in alignment with that on flange of injection pump.

<sup>2)</sup> Check begin of delivery position following installation of injection pump according to overflow method and adjust (07.1–110 and 115).

## Tightening torques

	Nm
Pipe connection for pressure valve	40–50
Injection line	25

## Special tools

Torque wrench 1/2" square, 15–65 Nm		000 589 27 21 00
Socket wrench insert 13 mm, 3/8" square		000 589 21 07 22
Box wrench insert open, 17 mm, 1/2" square for injection lines		000 589 68 03 00
Overflow pipe		636 58902 2300
Socket notched tooth 17 x 20, 1/2" square for pipe connection MRSF-injection pump		617 589 01 09 00 <sup>1)</sup>

<sup>1)</sup> Machine socket 617 589 00 09 00 (refer to 07.1–210).

## Self-made tool

Box wrench 13 mm	refer to Fig. item 4
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## Note

On engine 617 in model 123.1, remove oil filter (18–110).

On engine 617 in model 115.1, remove battery and battery frame.



## Removal

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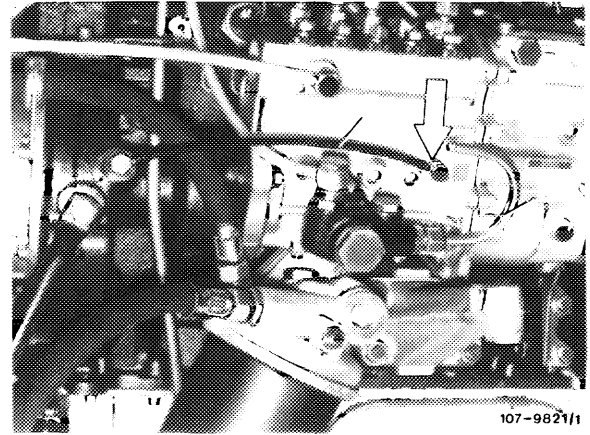
1 Pull vacuum hose on vacuum box and electric cable, disconnect regulating rod, unscrew injection lines and fuel lines on injection pump. Place closing caps on connections for injection lines and fuel hoses on injection pump.

2 On MW-injection pumps, unscrew lube oil line (5).

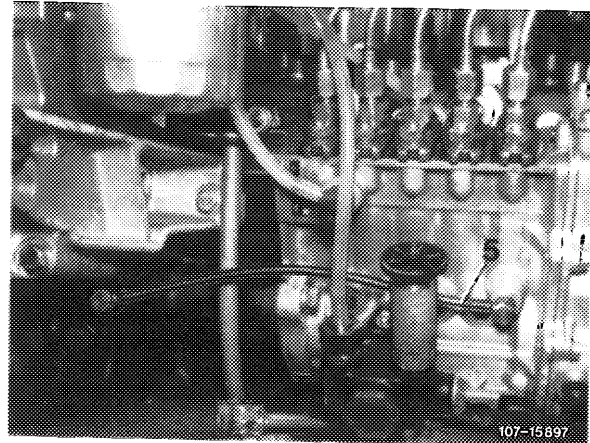
### Attention!

Prior to removing lube oil line (5), clean connecting points.

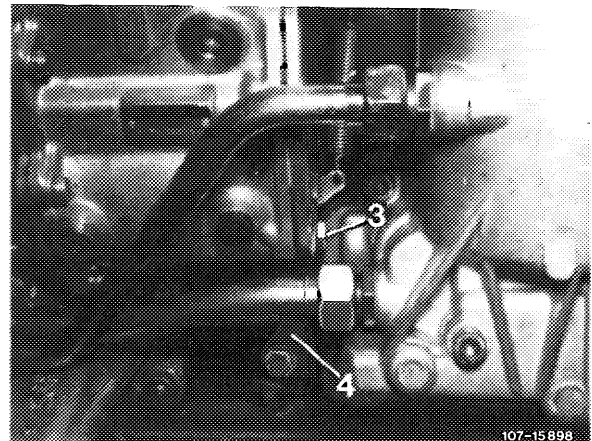
Model 115.1



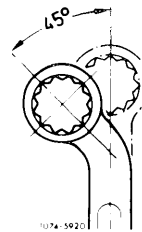
Model 123.1



3 Unscrew hex screws on supporting holder (4) and the three fastening nuts of injection pump. Loosen fastening screw (3) so that adjustments on slot can be made.



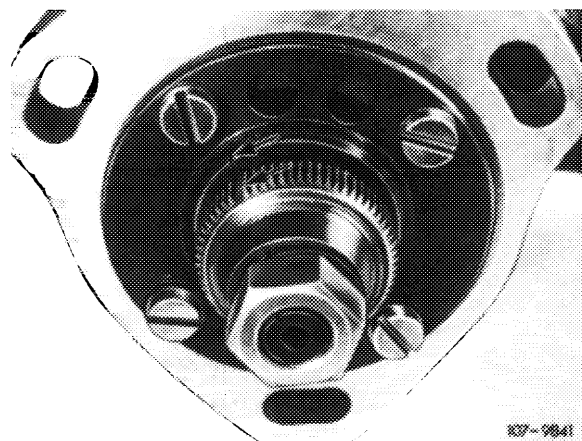
4 On engine 617 in model 115.1, use self-bent 13 mm box wrench according to drawing for loosening front fastening nuts.



5 Pull injection pump out of cylinder crankcase. Remove coupling sleeve from driver of injection pump or from drive shaft.

Note: When replacing a driver, apply counterhold with notched tooth wrench for loosening hex nut, then pull driver from injection pump shaft by means of puller. Clean shaft stub and driver; the two cones must be absolutely clean and free of grease.

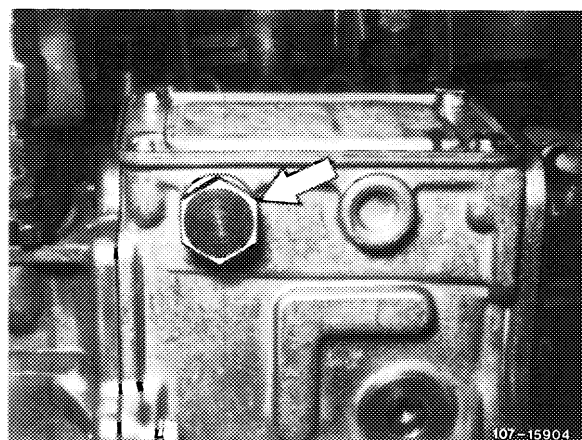
When mounting a new driver, pay attention to Woodruff key and to markings (arrows).



## Installation

Prior to installing a replacement injection pump proceed as follows:

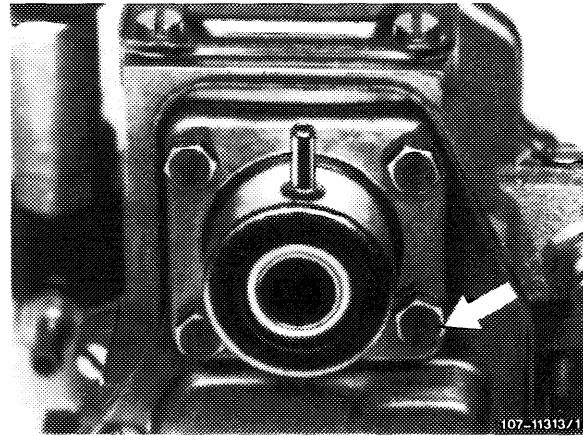
- For initial filling, add 0.4 liter engine oil after removing closing plug (arrow).



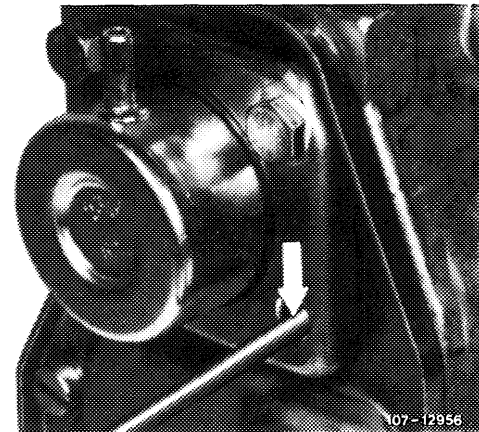
b) Check control rod for easy operation (except injection pumps with altitude adjusting box):

#### MW-injection pump

Unscrew lower righthand fastening screw (arrow) on shutoff box.



Insert a plug gauge through bore up to stop. Push plug gauge slightly against control rod. Move regulating lever on injection pump from idle speed to full load stop. Plug gauge should closely follow control rod.



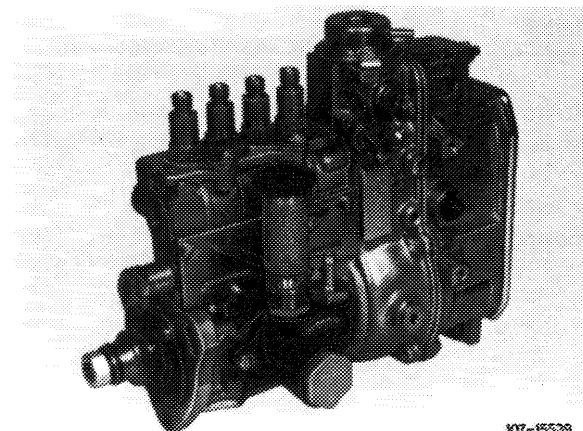
If control rod is hard to move under the influence of resinification, add clean gasoline into fuel feed connection to act on elements for a short period.

Push control rod back and forth until it is freely moving.

#### M/RSF-injection pump

Remove closing cap of control rod.

Move regulating lever on injection pump from idle speed to full load stop. Control rod should return automatically.



If control rod is hard to move under influence of resinification, fill clean gasoline into fuel feed connection to act on elements for a short period.

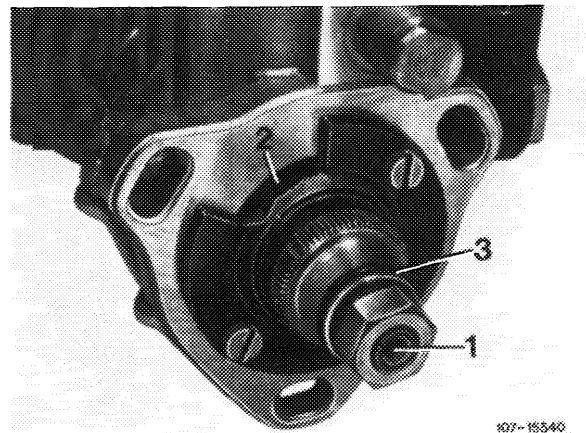
Push control rod back and forth until it is freely moving.

The injection pump receives the oil required for lubrication via intermediate gear shaft and hollow camshaft of injection pump.

The oil flows back into cylinder crankcase via ring gap (2) on sealing flange of camshaft.

For sealing coupling space between intermediate gear shaft and camshaft an O-ring (3) is inserted in drive pinion.

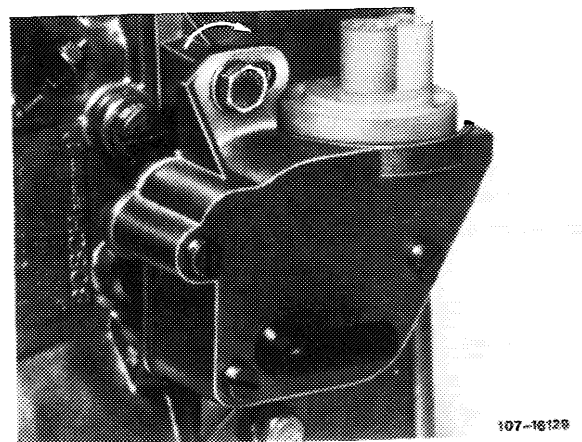
- 1 Oil inlet
- 2 Oil outlet
- 3 O-ring



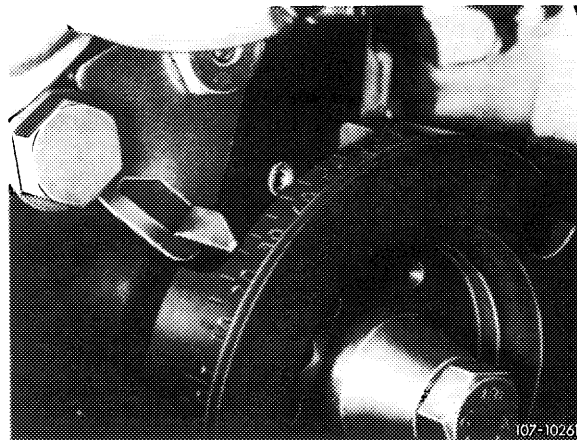
When removing and installing injection pump, make sure that the O-ring (3) is not damaged. Always replace damaged O-rings.

On vehicles with automatic transmission and vacuum control valve:

Unscrew vacuum control valve from removed injection pump, screw to injection pump about to be installed and adjust. For this purpose, push regulating lever of injection pump to full load and turn vacuum control valve to the right (arrow) up to noticeable stop. In this position, tighten fastening screws.

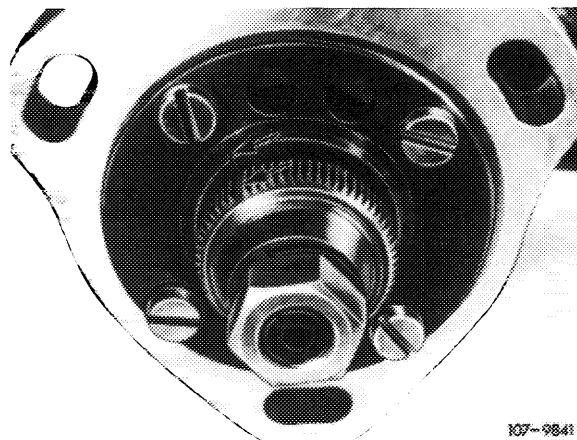


6 Set crankshaft to begin of delivery in compression stroke.



7 Mount new gasket.

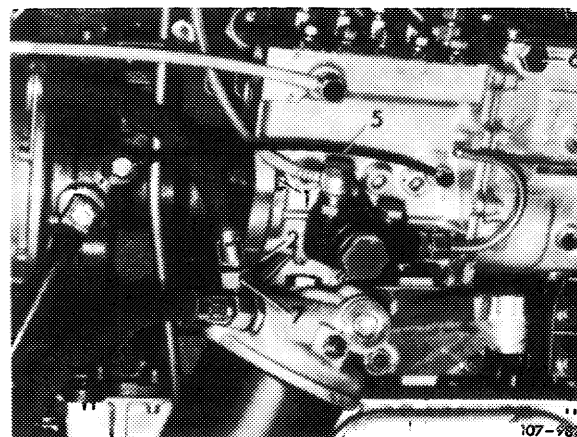
8 Set injection pump to mark. For this purpose, rotate camshaft of injection pump until marking line on camshaft is in alignment with line on flange (arrows).



9 Slip coupling sleeve on driver and introduce injection pump. Mount washers and slightly tighten injection pump by means of hex nuts.

Note: On engine 617 in model 115.1, unscrew oil hose (7) for easier access of washer and nut (2).

10 Check begin of delivery and adjust (07.1-110 and 115). Then tighten injection pump.

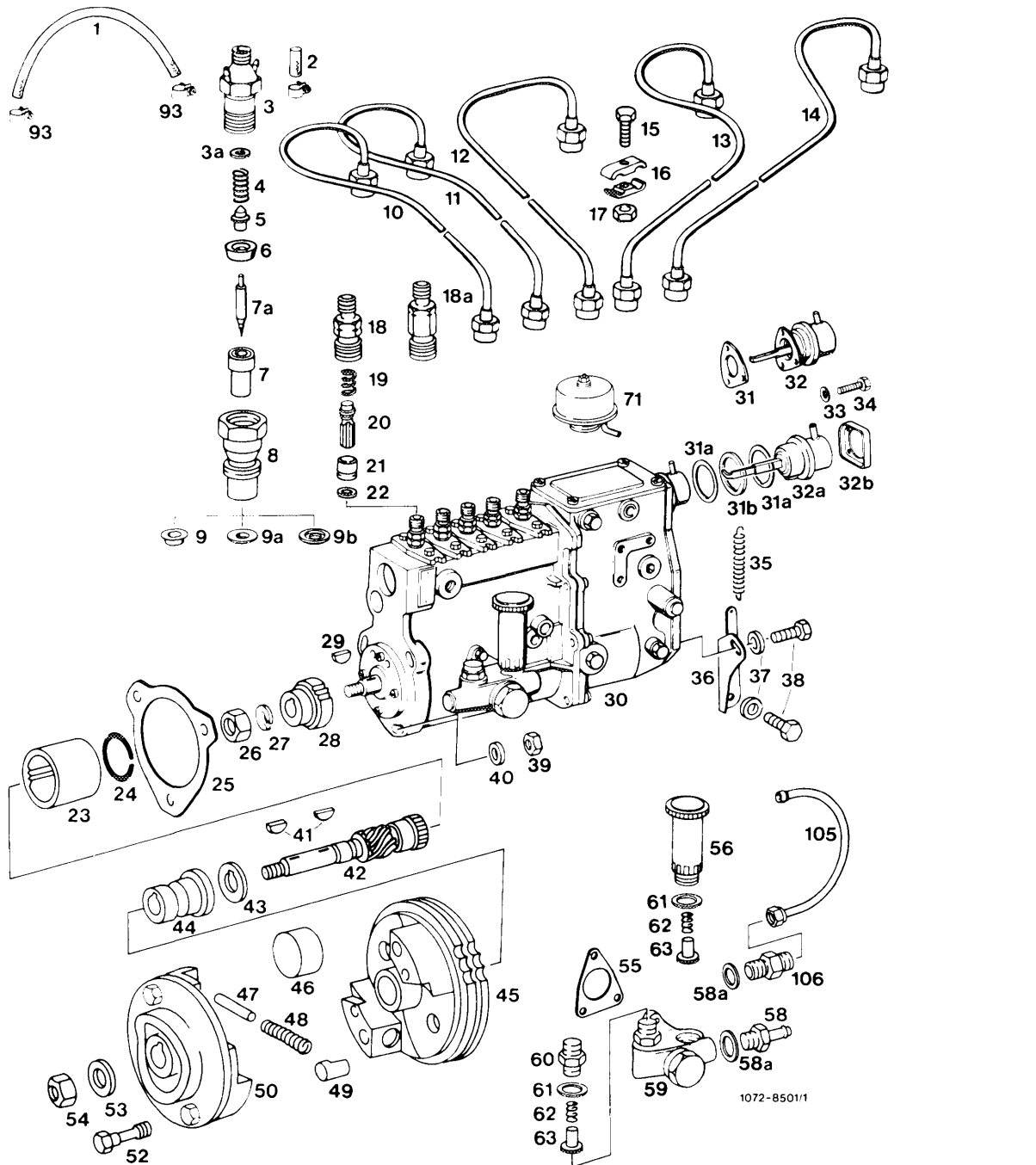


11 Take supporting holder (4) from removed injection pump.

For attaching supporting holder, use only spacing washers and hex screws intended for engine. Screw supporting holder to cylinder crankcase first, and then tighten fastening screw in oblong hole (slot) of supporting holder.

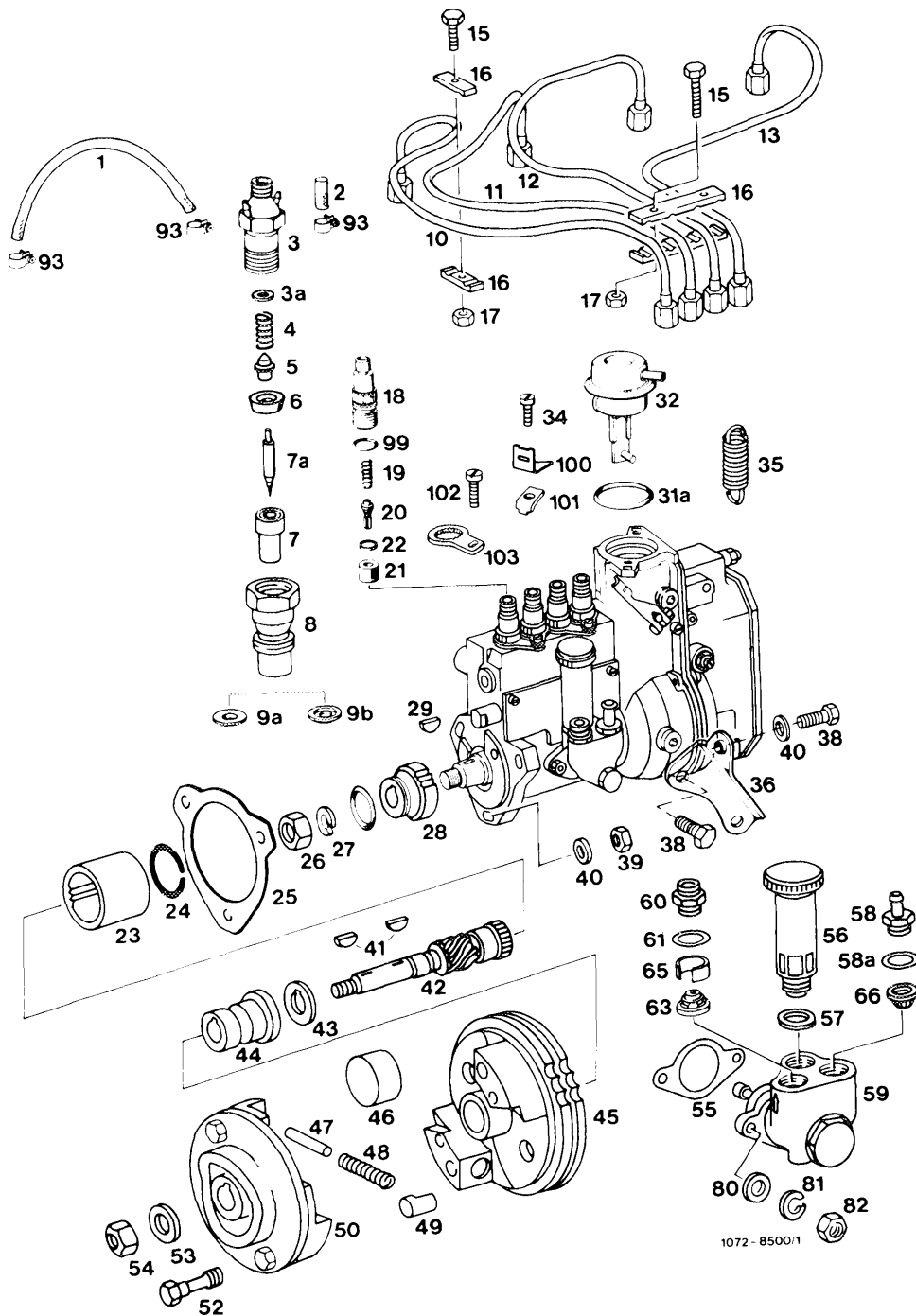
- 12 Vacuum hose on vacuum box, mount electric cable. Connect all fuel lines.
- 13 On **MW-injection** pumps, reattach lube oil line to injection pump.
- 14 Mount oil filter and oil filter cover with new gasket (18–110).
  
- 15 Mount battery frame and battery and connect.
- 16 Vent injection system with manual delivery pump (07.1–140).
- 17 Check regulating linkage and adjust, if required (30–300).
- 18 Run engine to operating temperature and check all connections for leaks.
- 19 Check idling speed and adjust, if required (07.1–100).

Mixture preparation  
 Engine 616, 617 MW-injection pump with mechanical governor



- |                                      |   |                                       |
|--------------------------------------|---|---------------------------------------|
| 1 Leak hose                          | 22 Copper sealing ring                              | 42 Intermediate gear shaft            |
| 2 Closing plug                       | 23 Sleeve   | 43 Thrust ring                        |
| 3 Injection nozzle holder top        | 24 Circlip  | 44 Bushing                            |
| 3a Steel washer                      | 25 Gasket   | 45 Segment for injection timer        |
| 4 Compression spring                 | 26 Nut  | 46 Governor weight                    |
| 5 Pressure pin                       | 27 Snap ring  | 47 Bolt                               |
| 6 Nozzle holder insert               | 28 Drive pinion                                     | 48 Compression spring                 |
| 7 Nozzle body                        | 29 Woodruff key                                     | 49 Bolt                               |
| 7a Nozzle needle                     | 30 Injection pump                                   | 50 Segment flange                     |
| 8 Injection nozzle holder lower half | 31 Gasket   | 52 Collar screw                       |
| 9 Small nozzle plate 1st version     | 31a Gasket  | 53 Washer                             |
| 9a Small nozzle plate 2nd version    | 31b Steel washer                                    | 54 Nut                                |
| 9b Small nozzle plate 3rd version    | 32 Vacuum control unit engine 617 in model 115      | 55 Gasket                             |
| 10 Injection line                    | 32a Vacuum control unit engine 616,617 in model 123 | 56 Fuel hand delivery pump            |
| 11 Injection line                    | 32b Flange  | 58 Connection                         |
| 12 Injection line                    | 33 Washer   | 58a Sealing ring                      |
| 13 Injection line                    | 34 Screw  | 59 Fuel delivery pump                 |
| 14 Injection line                    | 35 Return spring                                    | 60 Screw connection                   |
| 15 Screw                             | 36 Holder   | 61 Sealing ring                       |
| 16 Pipe holder                       | 37 Washer   | 62 Compression spring                 |
| 17 Nut                               | 38 Screw  | 63 Delivery and suction valve         |
| 18 Pipe connection                   | 39 Nut  | 71 Altitude adjusting box USA version |
| 18a Pipe connection USA version      | 40 Washer   | 93 Hose clamp Sweden version          |
| 19 Compression spring                | 41 Woodruff key                                     | 105 Fuel line                         |
| 20 Delivery valve                    |   | 106 Screw connection                  |
| 21 Delivery valve carrier            |   |                                       |

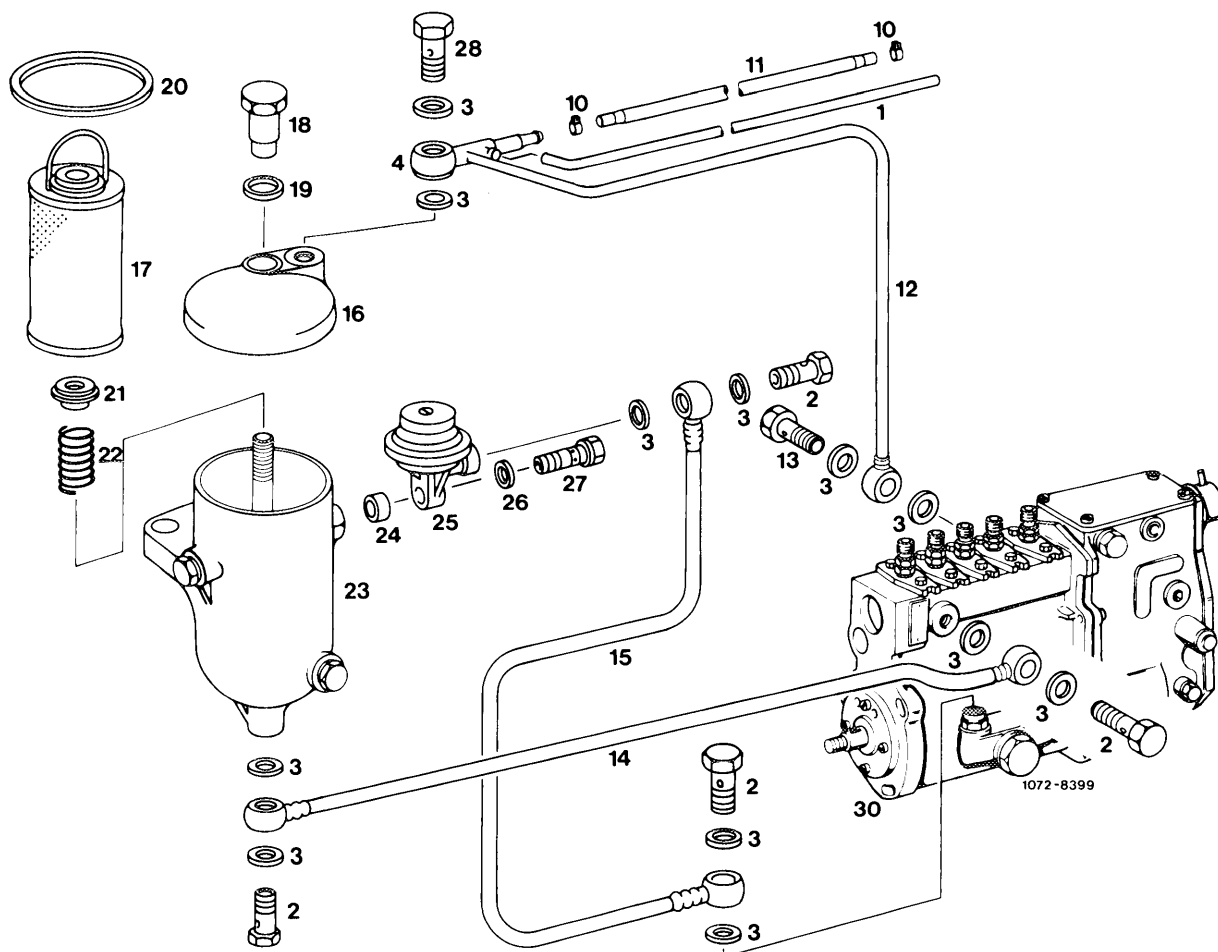
Engine 615, 616, 617 M/RSF-injection pump with mechanical governor



- |                                  |                                |                             |
|----------------------------------|--------------------------------|-----------------------------|
| 1 Leak hose                      | 25 Gasket                      | 52 Collar screw             |
| 2 Closing plug                   | 26 Nut                         | 53 Washer                   |
| 3 Injection nozzle holder top    | 27 Snap ring                   | 54 Nut                      |
| 4 Compression spring             | 28 Drive pinion                | 55 Gasket                   |
| 5 Pressure pin                   | 29 Woodruff key                | 56 Fuel hand delivery pump  |
| 6 Nozzle holder insert           | 30 Injection pump              | 57 Rubber sealing ring      |
| 7 Nozzle body                    | 31a O-ring                     | 58 Connection               |
| 7a Nozzle needle                 | 32 Vacuum control unit         | 58a Sealing ring            |
| 8 Injection nozzle holder bottom | 34 Screw                       | 59 Fuel delivery pump       |
| 9a Small nozzle plate            | 35 Return spring               | 60 Screw connection         |
| 10 Injection line                | 36 Holder                      | 61 Sealing ring             |
| 11 Injection line                | 38 Screw                       | 63 Delivery valve           |
| 12 Injection line                | 41 Woodruff key                | 65 Holder                   |
| 13 Injection line                | 42 Intermediate gear shaft     | 66 Suction valve            |
| 15 Screw                         | 43 Thrust ring                 | 80 Washer                   |
| 16 Pipe holder                   | 44 Bushing                     | 81 Snap ring                |
| 17 Nut                           | 45 Segment for injection timer | 82 Nut                      |
| 18 Pipe connection               | 46 Governor weight             | 93 Hose clip Sweden version |
| 19 Compression spring            | 47 Bolt                        | 99 O-ring                   |
| 20 Delivery valve                | 48 Compression spring          | 100 Holder                  |
| 21 Delivery valve carrier        | 49 Bolt                        | 101 Fastening plate         |
| 22 Copper sealing ring           | 50 Segment flange              | 102 Screw                   |
| 23 Sleeve                        |                                | 103 Locking plate           |
| 24 Circlip                       |                                |                             |

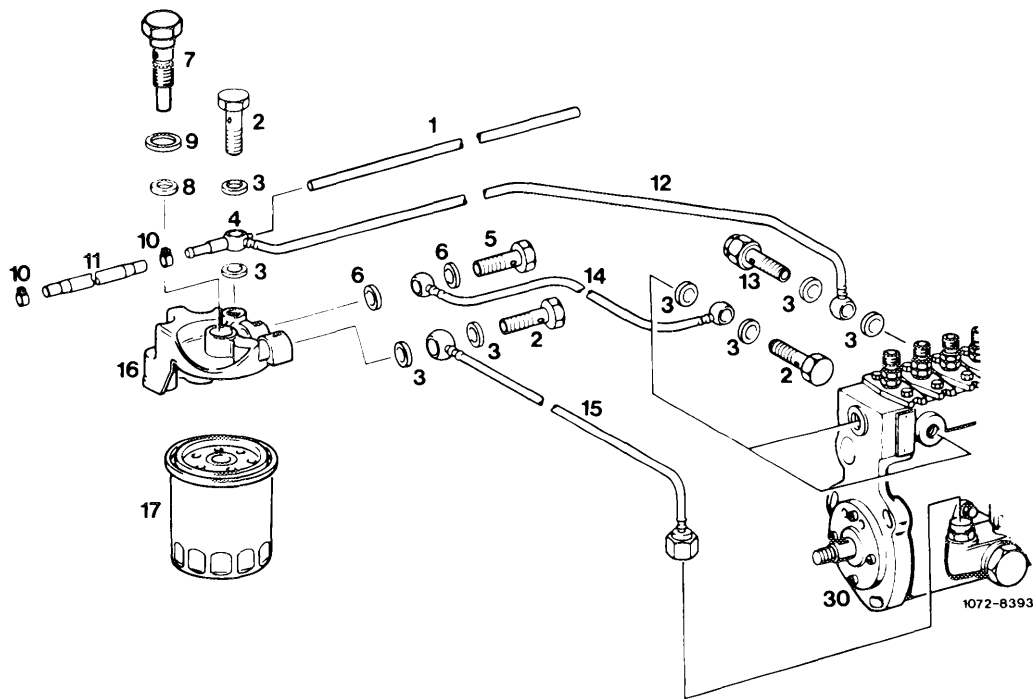


Fuel filter  
 Engine 617 in model 115.1



- |    |                               |    |                     |    |                                   |
|----|-------------------------------|----|---------------------|----|-----------------------------------|
| 1  | Leak hose of injection nozzle | 14 | Fuel line           | 22 | Compression spring                |
| 2  | Hollow screw                  | 15 | Fuel line           | 23 | Fuel filter bottom                |
| 3  | Sealing ring                  | 16 | Fuel filter top     | 24 | Spacing ring                      |
| 4  | Ring fitting                  | 17 | Fuel filter element | 25 | Fuel manual delivery pump         |
| 10 | Hose clamp                    | 18 | Screw               | 26 | Sealing ring                      |
| 11 | Fuel expanding hose           | 19 | Sealing ring        | 27 | Hollow screw                      |
| 12 | Return line                   | 20 | Rubber sealing ring | 28 | Hollow screw with calibrated bore |
| 13 | Overflow valve                | 21 | Spring retainer     | 30 | Injection pump                    |

Engine 615, 616, 617 in model 123.1



- |                                 |                        |                    |
|---------------------------------|------------------------|--------------------|
| 1 Leak hose of injection nozzle | 7 Hollow screw         | 13 Overflow valve  |
| 2 Hollowscrew                   | 8 Sealing ring         | 14 Fuel line       |
| 3 Sealing ring                  | 9 O-ring               | 15 Fuel line       |
| 4 Ring fitting                  | 10 Hose clamp          | 16 Fuel filter top |
| 5 Hollow screw                  | 11 Fuel expanding hose | 17 Fuel filter     |
| 6 Sealing ring                  | 12 Return line         | 30 Injection pump  |

## 07.1–205 Displacing injection pump (after adjusting begin of delivery)

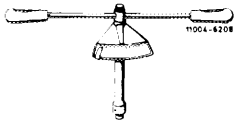
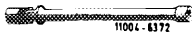


### Test values

Engine	615.9121941	615.9131940	616,617
Begin of delivery before TDC in compression stroke	24°	26°	24°

### Tightening torques

Designation	Injection pump abbreviation	Engine	Nm
Pipe connection for pressure valve	M, M/RSF	615, 616, 617	35
	MW	616, 617	40–50
Injection line	M, MW, M/RSF	615,616,617	25

### Special tools

Torque wrench 1/2" square, 15–65 Nm		000 589 27 21 00
Socket wrench insert 13 mm, 3/8" square		000 589 21 07 22
Overflow pipe		636 589 02 23 00
Box wrench insert open, 17 mm, 1/2" square for injection lines		000 589 68 03 00

### Displacing

- 1 Remove and install injection pump (07.1–200).
- 2 Pull out injection pump and introduce in such a manner that the studs are in center of oblong holes (slots).
- 3 Adjust begin of delivery (07.1–115).

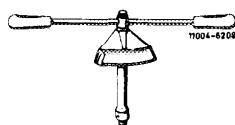
## 07.1—210 Replacing pipe connection, pressure valve or copper sealing ring of injection pump

### Tightening torques

Designation	Injection pump abbreviation	Engine	Nm
Pipe connection for pressure valve	M, MRSF	615, 616, 617	35
	MW	616, 617	40–50
Injection line	M, MW, M/RSF	615, 616, 617	25

### Special tools

Torque wrench 1/2" square,  
15–65 Nm



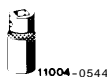
000 589 27 21 00

Box wrench insert open, 17 mm,  
1/2" square for injection lines



000 589 68 03 00

Socket wrench insert notched tooth  
17 x 20, 1/2" square for pipe connection  
M/RSF-injection pump



617 589 01 09 00<sup>1)</sup>

<sup>1)</sup> Machine socket wrench insert 617 589 00 09 00 (refer to 07.1—210).

### Note

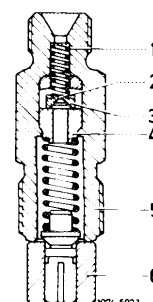
**(USA) starting model year 1975**

To reduce hydrocarbons in exhaust gases, the injection pump is provided with a relief throttle. The relief throttle is in pipe connection of injection pump, so that the pipe connection will be higher.

Engine 616 by 8.5 mm with M-injection pump.  
Engine 616, 617 by 7 mm with MW-injection pump.

The relief throttle (2) is a plate valve opening in direction of injection nozzle and provided with a throttle bore of 0.6 mm dia. The plate valve (3) is riveted in space above pressure valve spring.

- 1 Compression spring
- 2 Relief throttle
- 3 Plate valve
- 4 Valve seat
- 5 Pipe connection
- 6 Pressure valve carrier with pressure valve

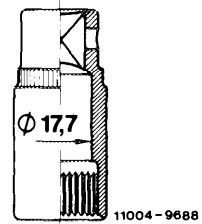
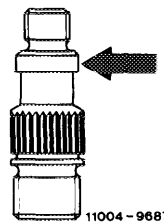


The relief throttle permits the fuel to pass in direction of injection nozzle. The pressure wave from injection nozzle in direction of injection pump, which is caused upon injection by the afterpumping effect of the nozzle needle while closing, is damped by the relief throttle. This will prevent the pressurewave from subsequently flowing back to injection nozzle and from setting up a re-injecting effect there. Re-injection would result in an increase of hydrocarbons in emissions.

### Modified pipe connection on M/RSF-injection pump (engine 615,616 and 617)

---

Since May 1980 a modified pipe connection with 17.4 mm OO (formerly 16 mm) is installed. For this connection and the former pipe connection, socket 617 589 01 09 00 is valid.



The socket 617 589 00 09 00 supplied up to now can be refinished as required by machining the ID to 17.7 mm. Then change part number of wrench to 617 589 01 09 00.

### A. Engine 615, 616, 617 M-injection pump with pneumatic governor and M/RSF-injection pump with mechanical governor

#### Removal

---

- 1 Clean injection pump on coupling nuts of injection lines and on pipe connections.
- 2 Unscrew injection lines, clamping jaws or locking plate and pipe connection.
- 3 Remove compression spring, copper sealing ring and pressure valve with pressure valve carrier.
- 4 Flush suction chamber of injection pump by actuating manual delivery pump. Remove foreign particles, if any.

## Installation

5 Clean pressure valve and pressure valve carrier, pay attention to easy operation and damage.

6 Insert pressure valve carrier (6) with ring groove in downward direction, pressure valve (4) and new copper sealing ring (5).

7 Mount compression spring (3) on pressure valve.

8 Slightly lubricate pipe connection and screw in with new rubber sealing ring (2).

9 For perfect seat of copper sealing ring (5), tighten pipe connection as follows:

Tighten pipe connection to 30 Nm and release again. Tighten once again to 30 Nm and also release again.

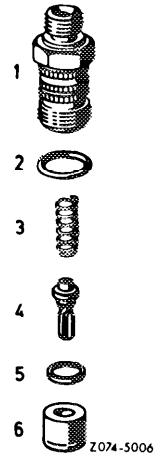
Then tighten to 35 Nm.

10 Mount injection lines and clamping jaws or locking plate and vent injection system (07.1–140).

11 Run engine, check for leaks and quiet idle speed.

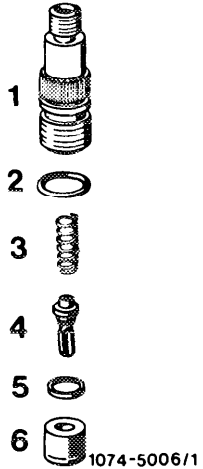
### M-injection pump

- 1 Pipe connection
- 2 Rubber sealing ring
- 3 Compression spring
- 4 Pressure valve
- 5 Copper sealing ring
- 6 Pressure valve carrier



### M/RSF-injection

- 1 Pipe connection
- 2 Rubber sealing ring
- 3 Compression spring
- 4 Pressure valve
- 5 Copper sealing ring
- 6 Pressure valve carrier



## B. Engine 616, 617 MW-injection pump with mechanical governor

### Note

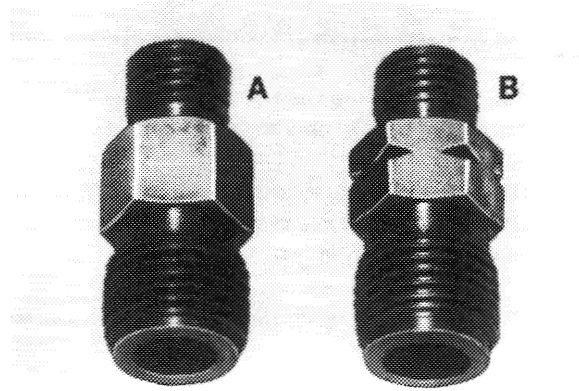
In the event of leaks between pipe connection and element connection proceed as follows:

a) Pipe connection with ring groove on hex head

Replace rejected pipe connection only.

b) Pipe connection without ring groove on hex head

Replace all 5 pipe connections, even if only a single pipe connection is leaking.



A Pipe connection without ring groove  
B Pipe connection with ring groove

107-13596

Start of production: Pipe connection (B) with ring groove engine 616 (USA) model year 1977 starting begin of production.

Engine 617 starting November 1975. Injection pump production date 531.

Removal

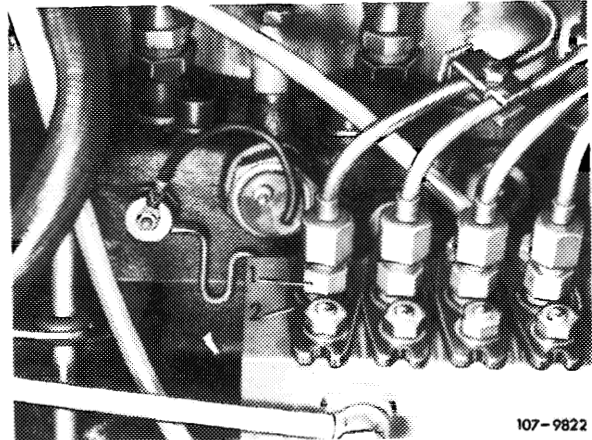
---

1 Clean injection pump on coupling nuts of injection lines and on pipe connections.

2 Unscrew injection lines and pipe connection.

Attention!

Do not loosen element connection (2), since otherwise a basic adjustment of injection pump on injection pump **test bench will be required.**



107-9822

3 Remove compression spring, copper sealing ring and pressure valve with pressure valve carrier.

4 Flush suction chamber of injection pump by actuating manual delivery pump. Remove foreign particles, if any.

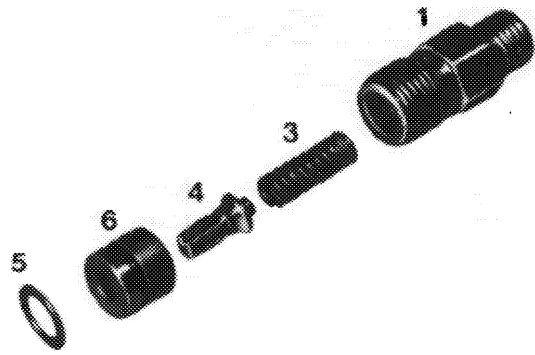
## Installation

---

5 Clean pressure valve and pressure valve carrier, check for easy operation and damage.

6 Insert new copper sealing ring (5) **under** pressure valve carrier (6). Install pressure valve carrier (6) with ring groove in downward direction. Mount pressure valve (4) and compression spring (3) again.

- 1 Pipe connection
- 3 Compression spring
- 4 Pressure valve
- 5 Copper sealing ring
- 6 Pressure valve carrier



107-10315/2

7 Slightly lubricate pipe connection (1) on threads, screw in and tighten in **one** step to 40–50 Nm.

8 Mount injection lines and vent injection system (07.1–140).

9 Run engine, check for leaks and quiet idle speed.



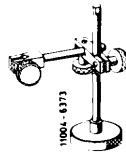
## 07.1—215 Replacing diaphragm of injection pump, adjusting compensating path (engine 615, 616 M-injection pump with pneumatic governor)

---

### Special tool

---

Holder for dial gauge



116 589 12 21 00

---

### Conventional tool

---

Dial gauge A 1 DIN 878

e.g. made by Mahr, D-7300 Esslingen  
Order no. 810

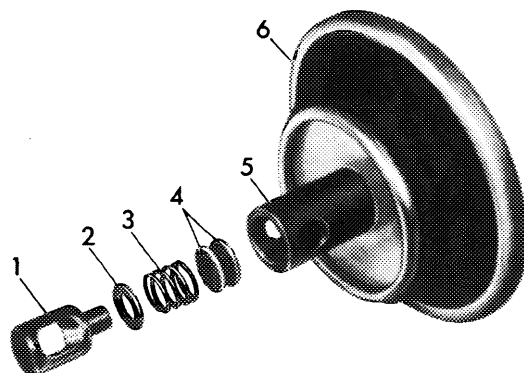
---

### Replacing diaphragm of injection pump

---

- 1 Disconnect connecting rod on tickler and start and stop cable control.
- 2 Unscrew governor cover and remove together with governor spring. Make sure that governor spring and the compensating washers are not falling out when removing governor cover.
- 3 Remove diaphragm by unscrewing large governor cover. Remove cotter pin with washer from control rod.
- 4 Remove diaphragm, while paying attention to installed parts 1–4.
- 5 Remove parts 1–4 from removed diaphragm and insert into new diaphragm.

- 1 Compensating bolt
- 2 Compensating washer for compensating spring preload
- 3 Compensating spring
- 4 Compensating washer for compensating path
- 5 Sleeve
- 6 Diaphragm

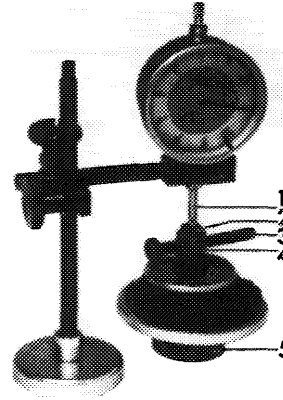


R-3107

## Adjusting compensating path

6 Measure compensating path. For this purpose, insert hex screw M 6 (3) through diaphragm sleeve (4) and compensating bolt (2). Place diaphragm on a tubular base (5) with max 35 mm OD, min 22 mm ID and min 10 mm in length. Then position holder of dial gauge in such a manner that the feeler pin (1) rests on center of compensating bolt (2).

- 1 Feeler pin of dial gauge
- 2 Compensating bolt
- 3 Screw M 6
- 4 Diaphragm sleeve
- 5 Tubular base



107-103%

7 Set dial gauge under preload to zero, then push compensating bolt (2) down.

Engine	Nominal value
615.912	= 1.1 mm
615.913	= 1.2 mm
616	= 1.1 mm

If required, adjust compensating path by adding or removing compensating washer (4) (Fig. item 5).

8 For installation proceed vice versa.

## 07.1–220 Replacing vacuum box on injection pump

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### Note

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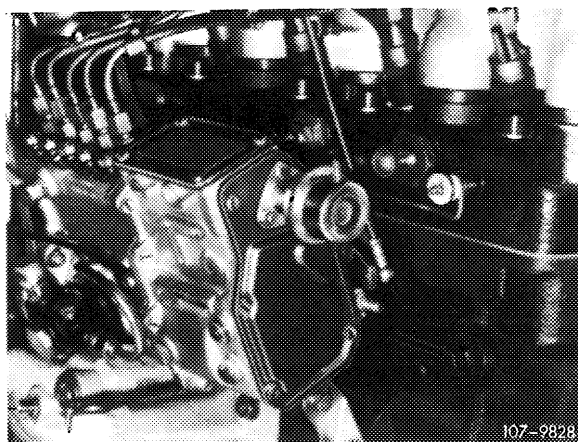
On injection pumps with mechanical or automatic altitude adjusting box do **not** unscrew upper governor cover, since otherwise an adjustment of the altitude box on injection pump test bench would be required.

### A. MW-injection pump in model 115.1

#### Removal

---

- 1 Unscrew rear governor cover and swivel sideways, so that the connecting rod disengages from control rod.
- 2 Unscrew vacuum box from governor cover. Two screws are inserted from inside and one from outside.



#### Installation

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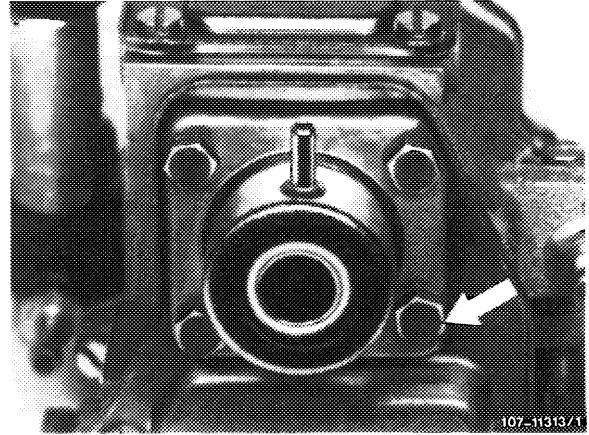
- 3 Remove upper governor cover.
- 4 Screw vacuum box with new gasket and new copper sealing ring to governor cover.
- 5 Mount rear governor cover with new gasket. Make sure that the connecting rod of the vacuum box engages in control rod (check through opening of upper governor cover).
- 6 Mount upper governor cover with new gasket.

## B. MW-injection pump in model 123.1

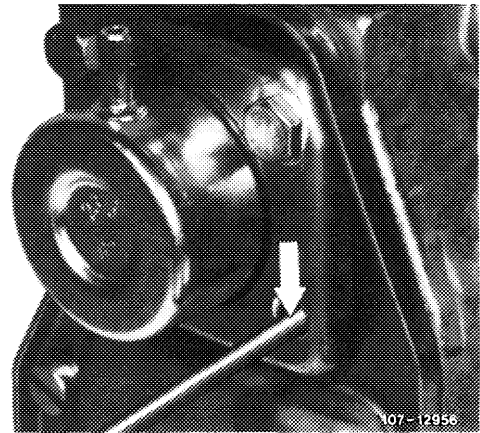
### Removal

---

- 1 Unscrew lower righthand fastening screw (arrow).



- 2 Check position of control rod. Push guide lever on cylinder head cover to stop while measuring position of control rod. For this purpose, insert plug gauge through bore against control rod and mark position of plug gauge.



### Attention!

On injection pumps with automatic altitude adjusting box the position of the control rod cannot be checked by means of a plug gauge. Since the plug gauge will not make contact with control rod but with rocker of altitude adjusting box.

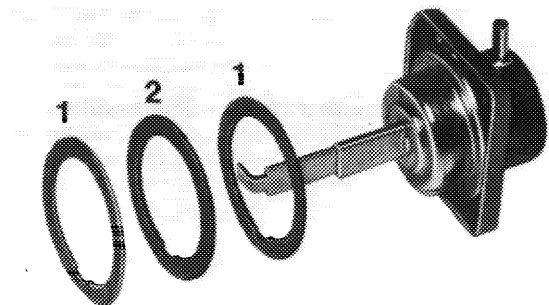
- 3 Remove vacuum box after loosening the three fastening screws.

### Installation

---

- 4 Screw vacuum box with two new gaskets (1) to governor cover.

Make sure that the connecting rod of the vacuum box engages in control rod.



- 1 Gasket
- 2 Steel ring

107-12972/1

- 5 To make sure, subsequently check control rod position once again as described in item 2. The mark on plug gauge should again be in alignment.

## C. M/RSF-injection pump in model 123.1

### Removal

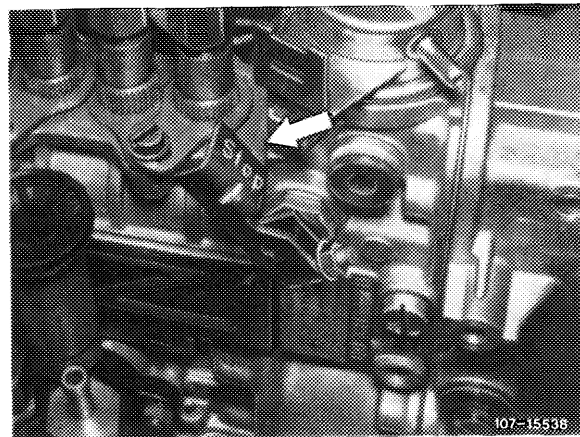
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- 1 Unscrew both fastening screws.
- 2 Slightly raise vacuum box, tilt toward the rear in direction of engine and remove.

### Installation

---

- 3 Check O-ring for damage and replace, if required.
- 4 Push emergency stop lever (arrow) to stop and engage connecting rod of vacuum box in rocker of emergency stop lever.
- 5 Mount fastening screws while paying attention to correct seat of fastening plates.



A. Mechanical altitude adjusting box engine 617  model year 1975176

**Note**

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Any damage on altitude correction instrument can be repaired only on an injection pump test bench with injection pump removed.

**Operation**

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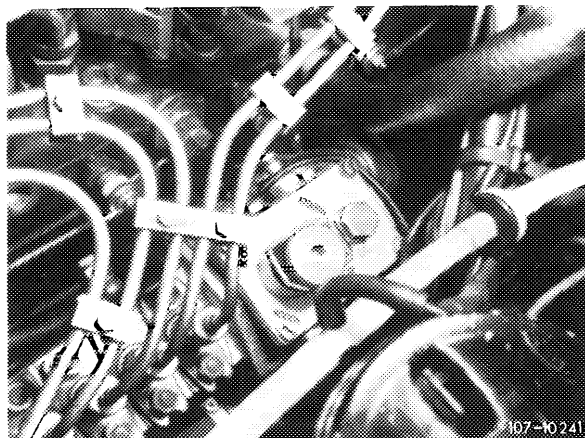
The mechanical altitude adjusting box is a manually adjustable altitude correction instrument which restricts the full load control path.

The altitude correction provides no parallel displacement of control path, which means that during an adjustment of the altitude correction the max possible control path is restricted by means of a fixed stop. This will make compensation inoperative and the control path remains constant throughout entire speed range.

The correction screw can be adjusted stepwise from 0—approx. 3,900 m (12,000 ft), each step amounting to approx. 650 m (2,000 ft).

Recommended adjustments:

- |   |                                |
|---|--------------------------------|
| Up to approx. 650 m (2,000 ft)                | = position 0                   |
| from 650 m (2,000 ft) – 2,000 m (6,000 ft)    | = position 1,300 m (4,000 ft)  |
| from 2,000 m (6,000 ft) – 3,200 m (10,000 ft) | = position 2,600 m (8,000 ft)  |
| from 3,200 m (10,000 ft)                      | = position 3,900 m (12,000 ft) |



B. Automatic altitude adjusting box engine 616, 617 @starting model year 1977 and (ZA)

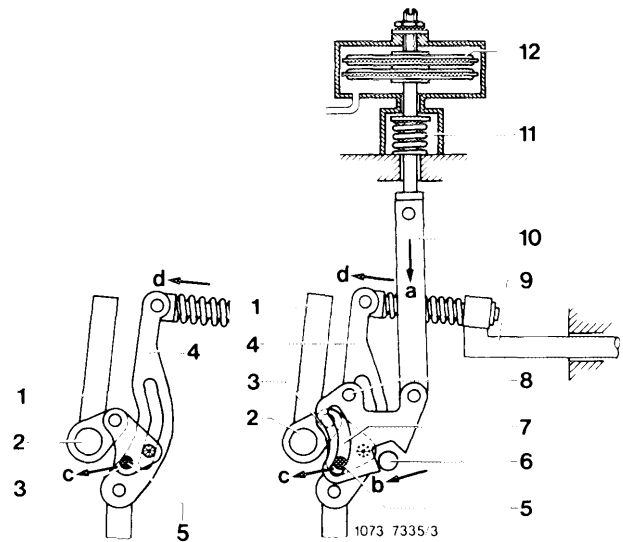
Starting model year 1977

Operation

With increasing altitude above normal (decreasing air pressure) the two diaphragm boxes (12) will expand. Starting from a given atmospheric pressure the internal force of diaphragm box will become higher than the preload of the altitude box pretensioning spring (11). Pushrod (10) will move in direction "a". As a result, slotted lever (7) will be lifted from stop (6) by means of a lever in direction "b" and lever (3) will move in direction "c" (refer to lefthand cutout of drawing).

Since the control lever (4) is coupled with lever (3) by means of a pin, the control lever (4) and thereby control rod (9) will move in direction "d" so that less fuel will be injected. The more the adjusting lever (1) is adjusted in direction of idle (stop), the more will pin (5) of lever (3) move toward pivot point (8).

- 1 Adjusting lever
- 2 Adjusting lever shaft
- 3 Lever
- 4 Regulating lever
- 5 Pin
- 6 Stop
- 7 Slotted lever
- 8 Pivot
- 9 Control rod
- 10 Pushrod
- 11 Altitude box pretensioning spring
- 12 Diaphragm box



As a result, adjustment during partial load will be in direction of less and will move to almost 0-adjustment in idling position. At low altitudes above normal altitude gate lever (7) will form a concentric circle around adjusting lever shaft (2), so that the governor procedure will not be corrected.

## Note

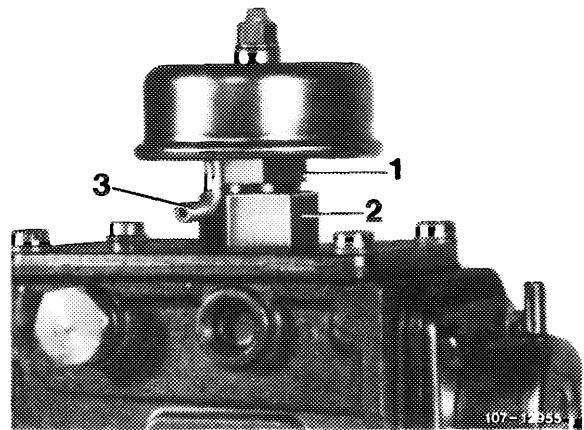
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The upper governor cover on injection pump can no longer be screwed off, since the connecting rod in governor is mounted together with altitude adjusting box.

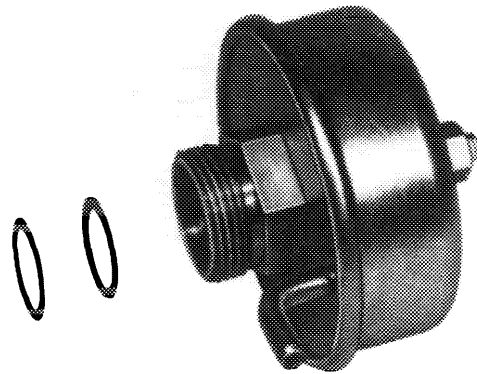
### Replacing automatic altitude adjusting box

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1 Apply counterhold to altitude adjusting box on hex head (1) and loosen coupling nut (2).



2 Unscrew altitude adjusting box. Use any washers remaining from removed altitude adjusting box, if required.

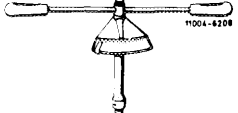

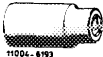


107 - 12 957

3 Mount new altitude adjusting box with washers. The venting pipe should be at the lowest point so that condensate, if any, can flow out.



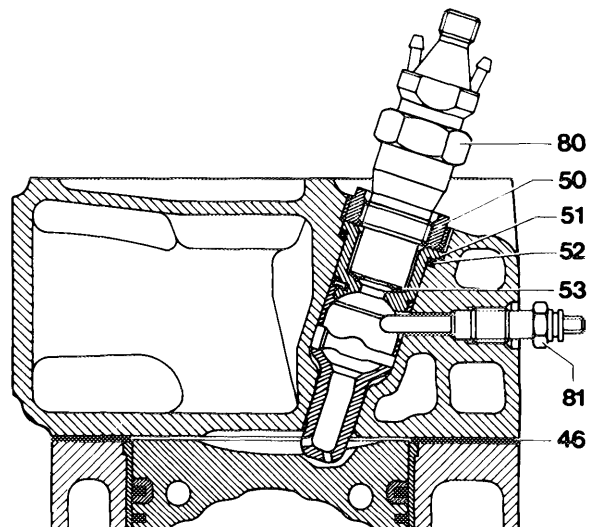
## 07.1–230 Removal and installation of injection nozzles (injectors)

Tightening torques		Nm
Injection nozzles		70–80
Injection lines		25
<b>Special tools</b>		
Torque wrench 1/2" square, 40–130 Nm		000 589 22 21 00
Torque wrench 1/2" square, 15–65 Nm		000 589 27 21 00
Box wrench insert open, 17 mm, 1/2" square for injection lines		000 589 68 03 00
Socket 27 mm, 1/2" square for injection nozzle		001 589 65 09 00

### Removal

- 1 Unscrew injection lines.
- 2 Pull off fuel hoses for leak oil and closing plugs of 4th or 5th injection nozzle.
- 3 Unscrew injection nozzles by means of socket. If a threaded ring of prechamber comes loose, retighten all threaded rings (05–117).
- 4 Remove nozzle plates.
- 5 Complete visual checkup of prechamber. For this purpose, illuminate with a flashlight and check whether ball pin is in order.

- 50 Threaded ring
- 51 Prechamber
- 52 Sealing ring
- 53 Nozzle plate
- 80 Nozzle holder combination
- 81 Pencil-element glow plug



1073-9935

## Installation

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6 For installation proceed vice versa. Use only **resilient** nozzle plates **from now on**. Pay attention to tightening torques.

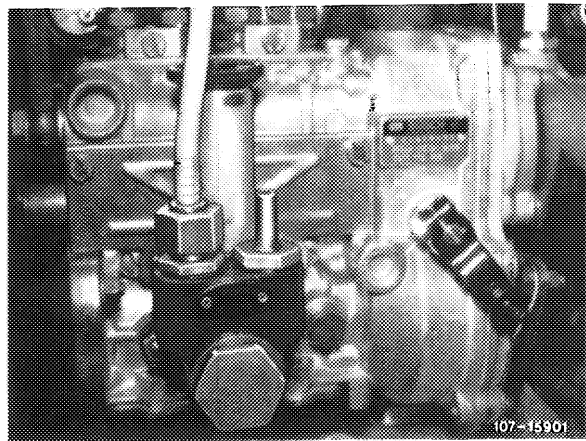
Attention!

Resilient nozzle plate may be used only once.

### Removal

---

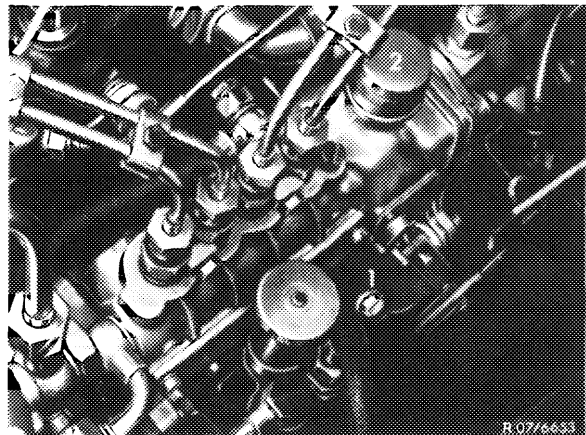
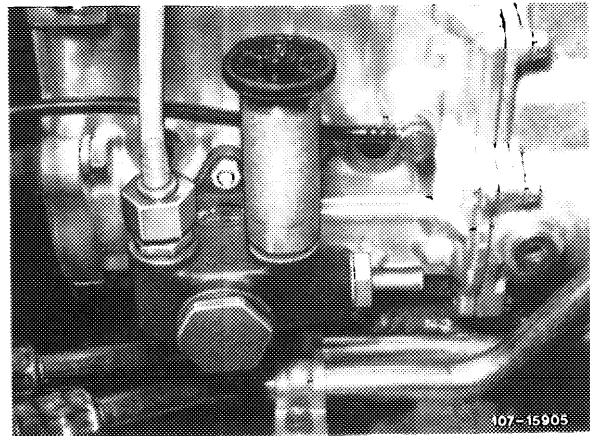
- 1 Unscrew all fuel connections.
- 2 Remove fuel pump after loosening both fastening nuts.
- 3 Clean fuel pump. Replace suction and pressure valves or replace fuel pump.



### Installation

---

- 4 Mount fuel pump with new gasket.
- 5 On M-injection pumps with pneumatic governor, correct oil level in injection pump. For this purpose, unscrew filter (2) on injection pump and add engine oil up to check bore (1).
- 6 Mount fuel connections and vent injection system (07.1—140).
- 7 Check fuel pump (07.1—145).



## 07.1—240 Removal and installation of injection timer

### Test values

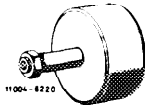
End play of intermediate gear shaft	0.05–0.12
-------------------------------------	-----------

### Tightening torques

	Nm
Hex nut for injection timer	70
Hex bolt for injection timer	40
Fastening screw for camshaft sprocket	80

### Special tools

Impact puller for slide rail bolt  
(basic unit)



116 589 20 33 00

Threaded bolt M 6, 50 mm long



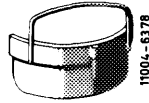
116589013400

Threaded bolt M 6, 150 mm long



11658902 3400

Holder



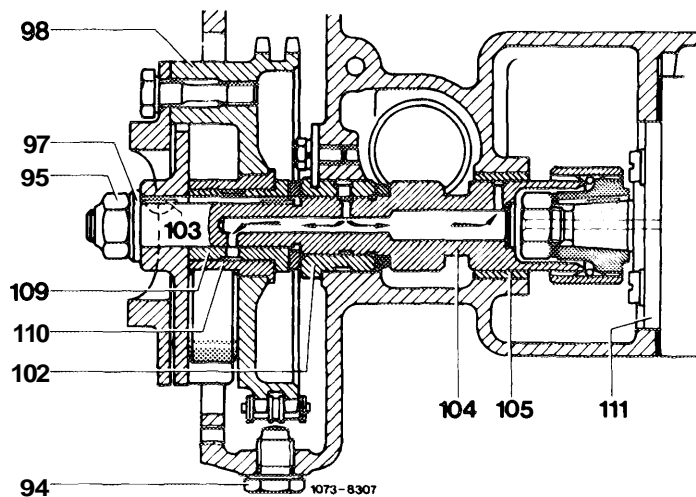
616 589 02 40 00

### Note

Fastening of injection timer changed.

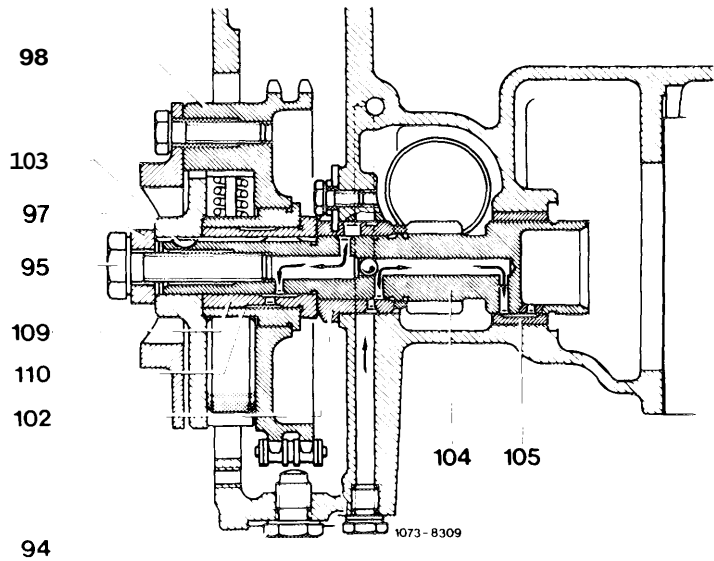
#### 1st version

Injection timer is attached to intermediate gear shaft by means of a nut (95) and a ground washer (97).



### 2nd version

Injection timer is attached to intermediate gear shaft by means of a hex screw (95) M 10 x 45.

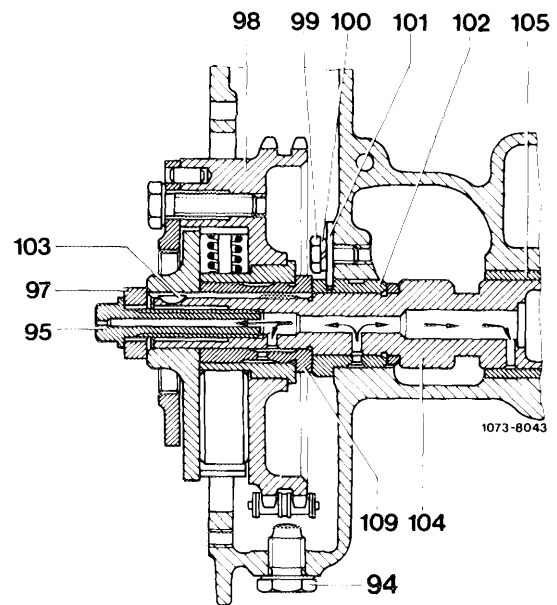


### 3rd version

Models 123.125 (sedan long) and 123.183 (T-sedan) with increased additional load are provided with a double diaphragm vacuum pump. The double diaphragm vacuum pump is driven via a toothed coupling sleeve, attachment and lubrication are by means of a hollow hex screw (95).

#### Attention!

Do not mix up the different hex screws and injection timers.

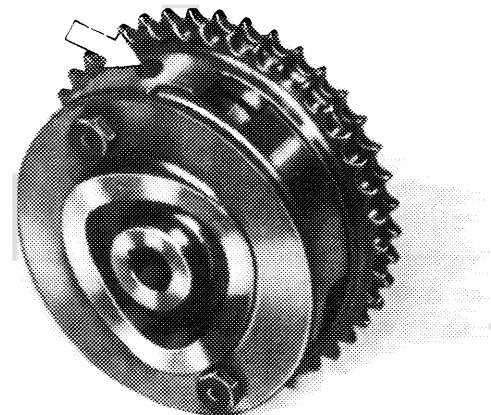


Adjusting range of injection timer changed from 6" to 7.5".

A yellow dot outside on housing serves for identification.

This injection timer is also installed on engines 617.95 (turbodiesel).

On former engines with filament glow plugs the injection timer (7.5° adjusting range) may not be installed to prevent damage to glow plugs.

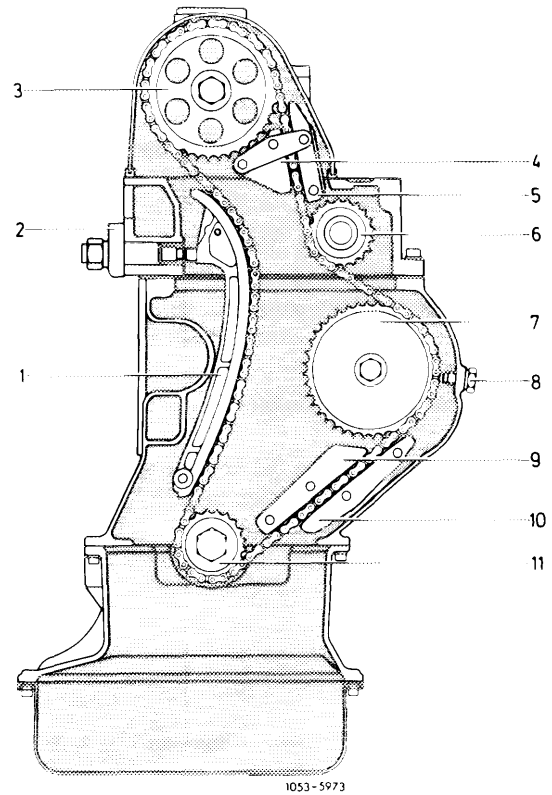


103-17177

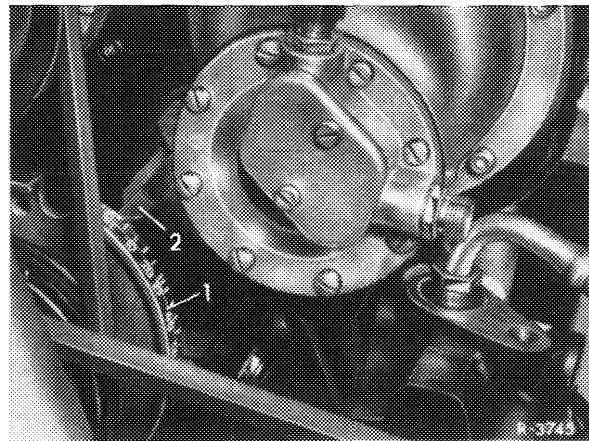
## Removal

- 1 Remove radiator (20–420).
- 2 Unscrew suction and pressure line from vacuum pump and remove vacuum pump from cylinder crankcase.
- 3 Unscrew fastening nut or hex screw of injection timer.
- 4 Remove cylinder head cover.
- 5 Unscrew fastening screw for camshaft sprocket (3).

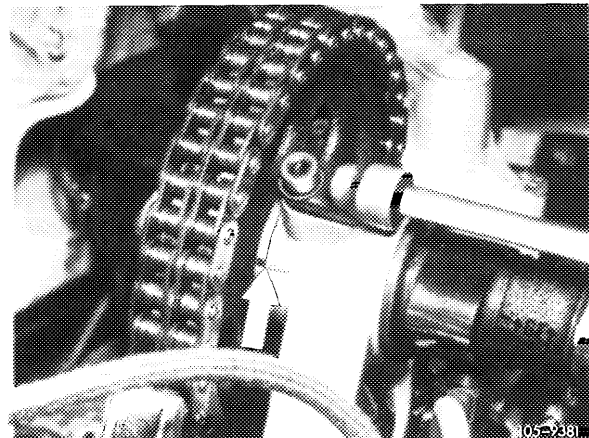
- |   |                   |    |            |
|---|-------------------|----|------------|
| 3 | Camshaft sprocket | 9  | Slide rail |
| 4 | Slide rail        | 10 | Slide rail |
| 8 | Lock screw        |    |            |



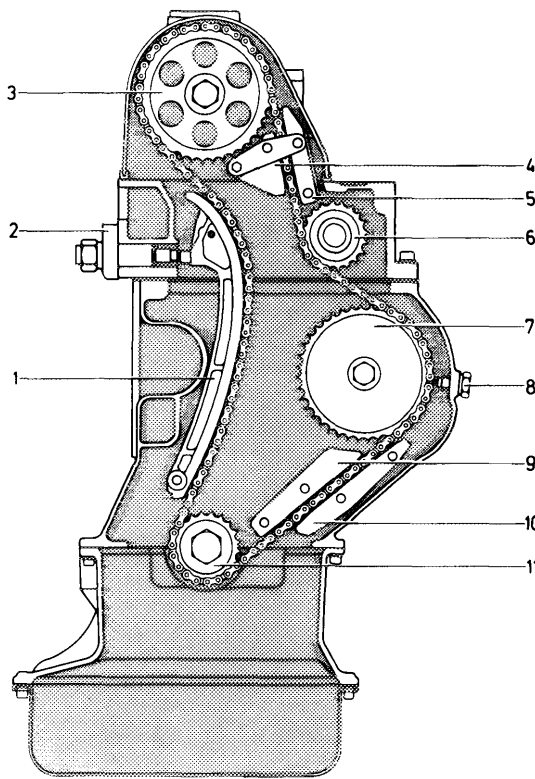
- 6 Rotate crankshaft in direction of rotation of engine to TDC mark.



Camshaft must be in alignment with marking of compensating washer and 1st camshaft bearing (arrow).



- 7 Mark meshing point of chain on injection timer and position of injection timer in relation to crankcase with paint.
- 8 Remove chain tensioner or push back pressure pin (05-310).
- 9 Remove slide rail (4) after removing hex screw.
- 10 Remove camshaft sprocket, while paying attention to compensating washer between camshaft and camshaft sprocket. Leave chain on camshaft and place together into chain box.
- 11 Unscrew lock screw (8) for chain drive and pull out upper bearing pin of slide rail (10) by means of puller.



- |                     |               |
|---------------------|---------------|
| 3 Camshaft sprocket | 9 Slide rail  |
| 4 Slide rail        | 10 Slide rail |
| 8 Lock screw        |               |

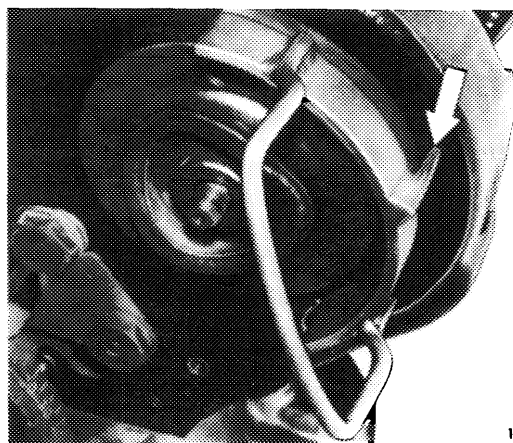
1053-5973

12 Lift chain from injection timer. For this purpose, slip holder in-between injection timer and chain. For better location, introduce guide pin (arrow) into threaded bore.

13 Remove or push off injection timer.

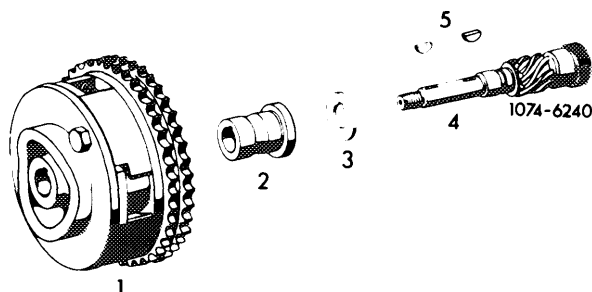
Attention!

Do not rotate **crankshaft** and camshaft following removal of injection timer.



107-10267

14 Remove bushing (2) for injection timer and thrust ring (3) from intermediate gear shaft.



- |                   |                           |
|-------------------|---------------------------|
| 1 Injection timer | 4 Intermediate gear shaft |
| 2 Bushing         | 5 Woodruff key            |
| 3 Thrust ring     |                           |

1074-6240

15 Check slide rails (9 and 10) (visual checkup) and replace, if required.

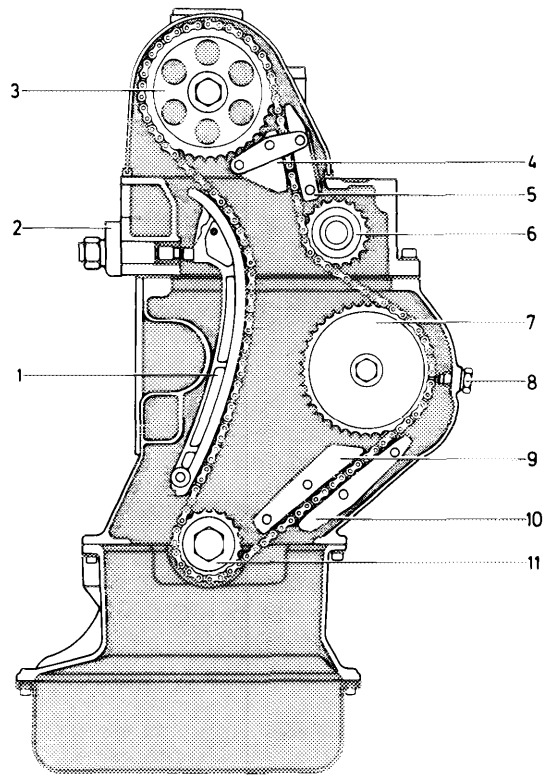
### Installation

16 Lubricate thrust ring (3) and bushing (2) and slip on intermediate gear shaft. Pay attention to correct seat of both Woodruff keys (5) (Fig. item 14).

Note: If an injection timer must be replaced, place used injection timer on new injection timer in such a manner that the splines of both injection timers are in alignment. Then transfer painted mark on old injection timer on new injection timer.

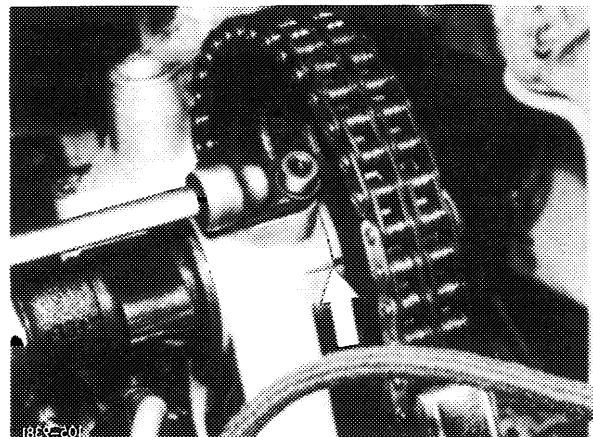
17 Slip injection timer on intermediate gear shaft.

9 Slide rail  
10 Slide rail



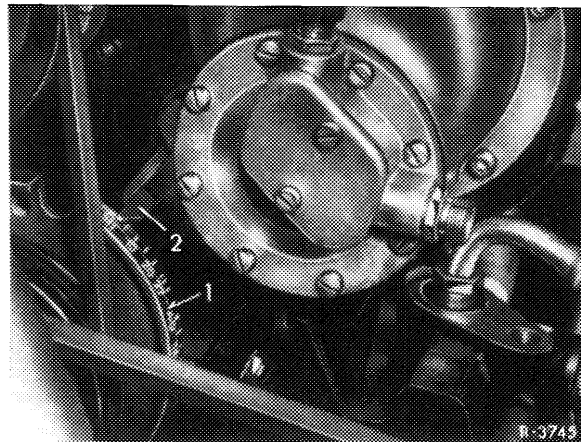
18 Pull chain in upward direction or lift camshaft sprocket with chain, making sure that the markings of injection timer and cylinder crankcase are in alignment. If required, rotate injection timer until the markings of injection timer and cylinder crankcase are in alignment. Then pull out holder.

19 Slip camshaft sprocket with chain mounted on camshaft, making sure that the marking of the compensating washer is in alignment with marking of first camshaft bearing.





Check again whether all markings are in alignment, similar to removal and TDC position on balancing disc.



20 Install chain tensioner (05–310).

21 Introduce bearing pins of slide rail (10) into cylinder crankcase (Fig. item 5). Coat bearing pin at end with sealing compound. When knocking-in, make sure that the locking wire of the slide rail engages in notch of bearing pin.

22 Screw in lock screw (8) with new sealing ring and tighten (Fig. item 30).

23 Check begin of delivery and adjust, if required (07.1–110 and 115).

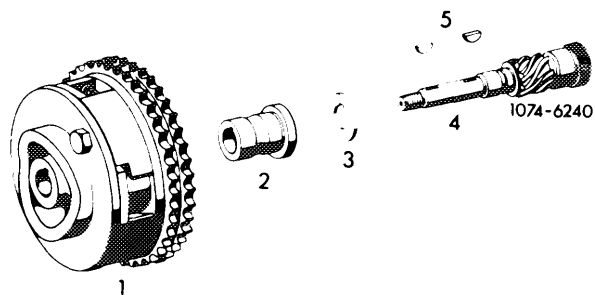
24 Vent injection system (07.1–140).

25 Mount hex nut and ground washer or hex screw.

**Attention!**

Use only specified ground washer, part no. 615 990 03 40.

26 Check end play of intermediate gear shaft. Should be 0.05–0.12 mm, touch up thrust ring (3), if required.



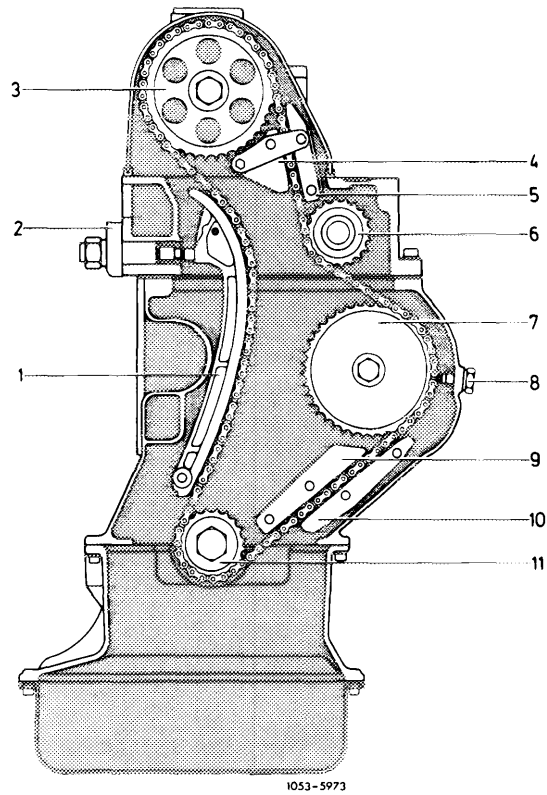
27 Mount fastening screw for camshaft sprocket and tighten to 80 Nm.

28 Check injection timer for function. For this purpose, turn hex nut or hex screw to the right up to stop by means of a wrench. Upon release, injection timer should return automatically to its old position.

29 Mount vacuum pump with new gasket and connect vacuum lines.

30 Introduce slide rail (4) with holder into bore of outer slide rail (5) and tighten.

- 3 Camshaft sprocket
- 4 Slide rail
- 8 Lock screw
- 9 Slide rail
- 10 Slide rail



31 Mount cylinder head cover, while paying attention to correct seat of rubber gasket.

32 Mount regulating linkage, check and adjust, if required (30–300).

33 Install radiator and connect all lines.

34 Run engine and check for leaks.

A. Model 115.1

Note

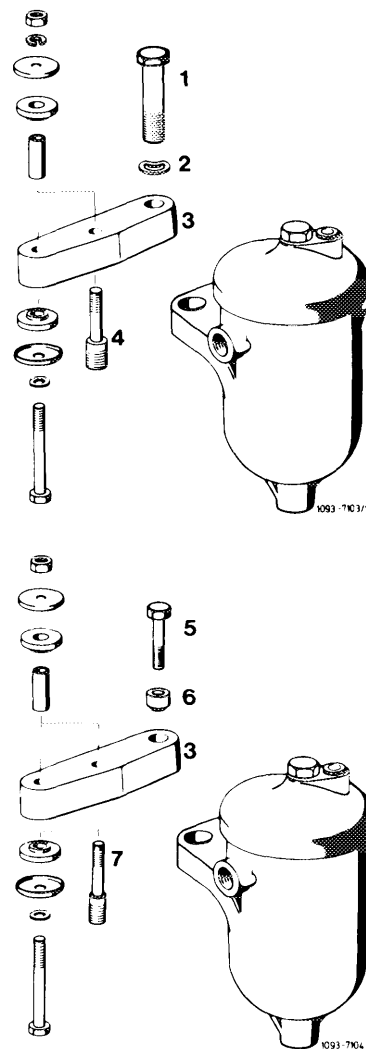
Vent injection system following assembly of fuel filter (07.1—140).

- 1st version  
 1 Screw M 12 x 35  
 2 Washer  
 3 Holder  
 4 Stud M 12

- 2nd version  
 3 Holder  
 5 Screw M 8 x 45  
 6 Washer  
 7 Stud M 8

Start of production for 2nd version

Model	Starting chassis end no.
115.110	463094
115.114	044385
115.115	334350
115.117	117734



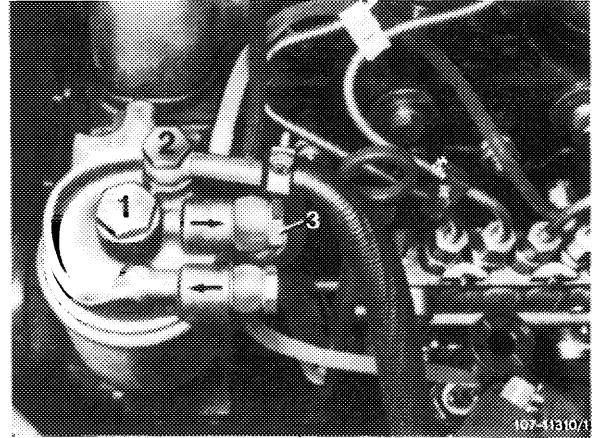
## B. Model 123.1

### Removal

---

1 Loosen fastening screw (1) and remove housing with filter element in downward direction.

- 1 Fastening screw
- 2 Hollowscrew

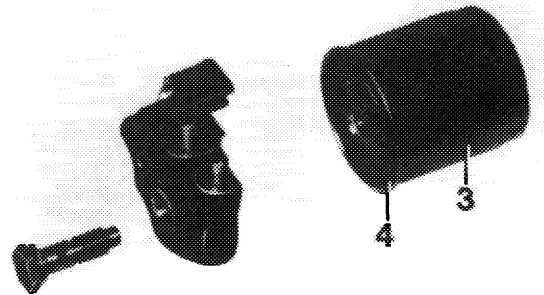


### Installation

---

2 Mount new filter element with housing (3) and gasket (4).

- 3 Filter element with housing
- 4 Gasket



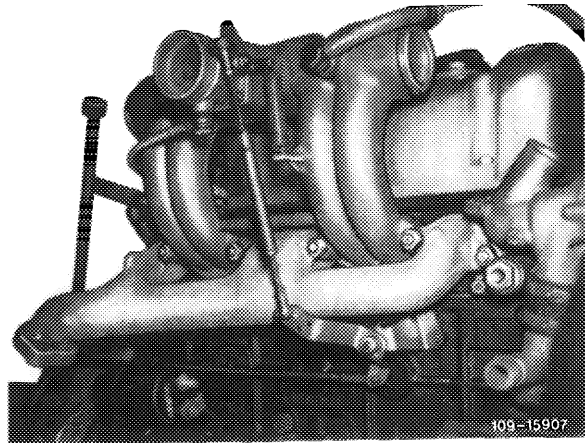
3 Upon assembly of fuel filter, vent injection system (07.1-140).

107-11363

**14-450 Removal and installation of intake pipe, replacement of gasket**

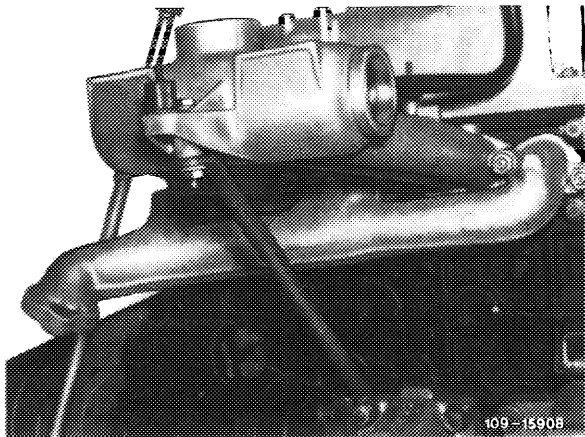
**Removal**

- 1 Remove air cleaner or scoop.
- 2 Disconnect regulating linkage.
- 3 On engine 615, 616 with choke control, unscrew vacuum lines.



Engine 615,616

- 4 On engines without choke control, unscrew support on intake pipe.



Engine 615,616

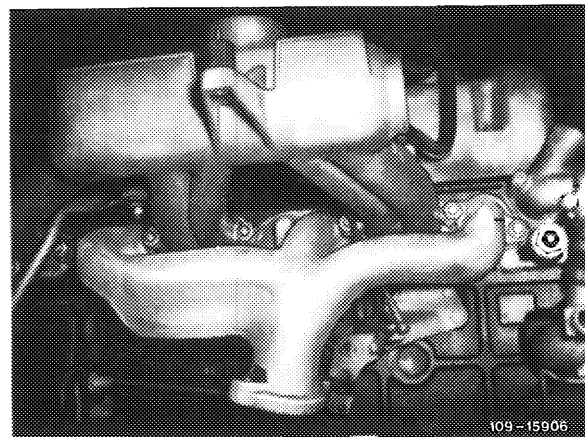
**Note:** Engine 617 is also provided with a support on intake pipe.

**Installation:** February 1979

Engine	starting engine end no.
617.912	manual transmission 074930 automatic transmission 068719

Model	starting chassis end no.
123.130	134304
123.150	003895

Engine 617



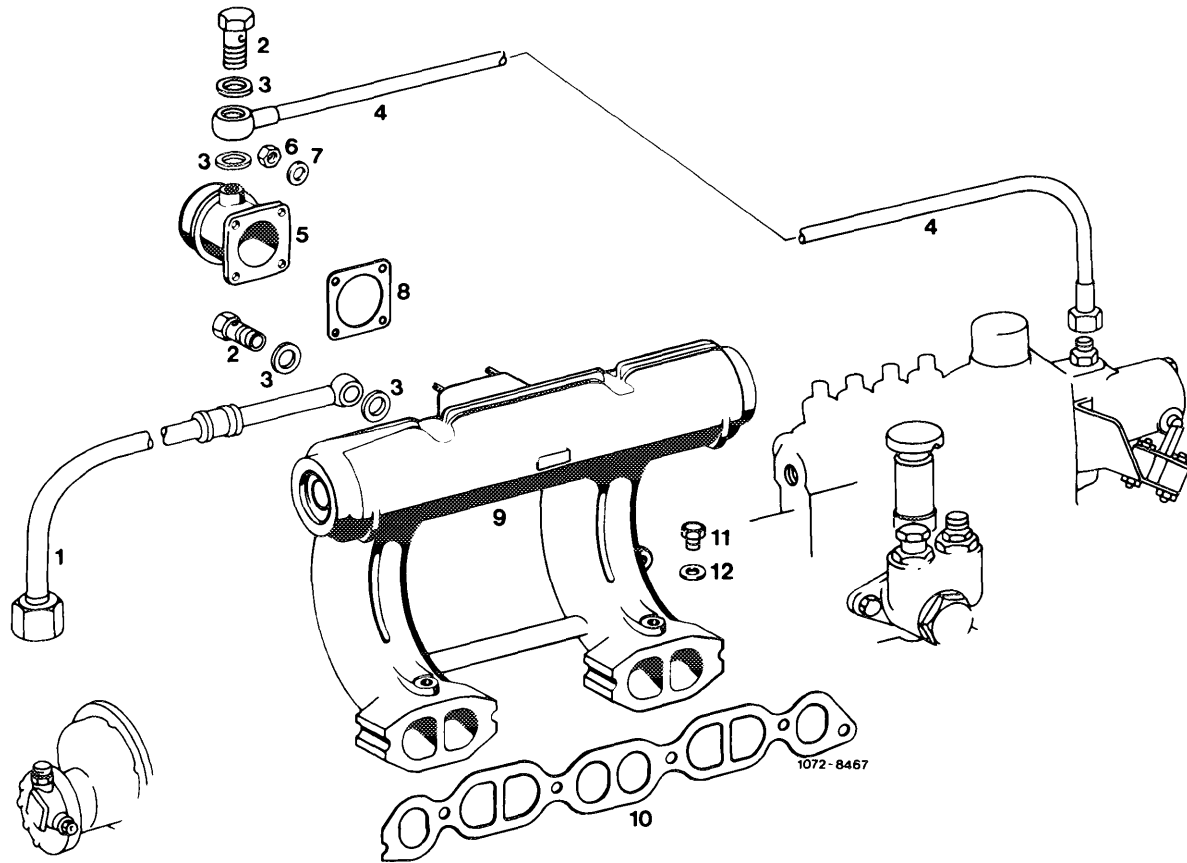
- 5 Remove cylinder crankcase breather.
- 6 Remove exhaust system (49–100).
- 7 Loosen fastening nuts and remove intake pipe together with exhaust manifold.
- 8 Clean intake pipe and check flange surfaces with straightedge, touch up on surface plate, if required.

## **Installation**

---

- 9 For installation use new gasket and proceed vice versa.
- 10 Adjust regulating linkage (30–300).
- 11 Run engine, check intake system for leaks by spraying with Iso-Oktan DIN 51756 or benzine.
- 12 Adjust idle speed (07.1–100).

**Intake system  
Engine 615,616**

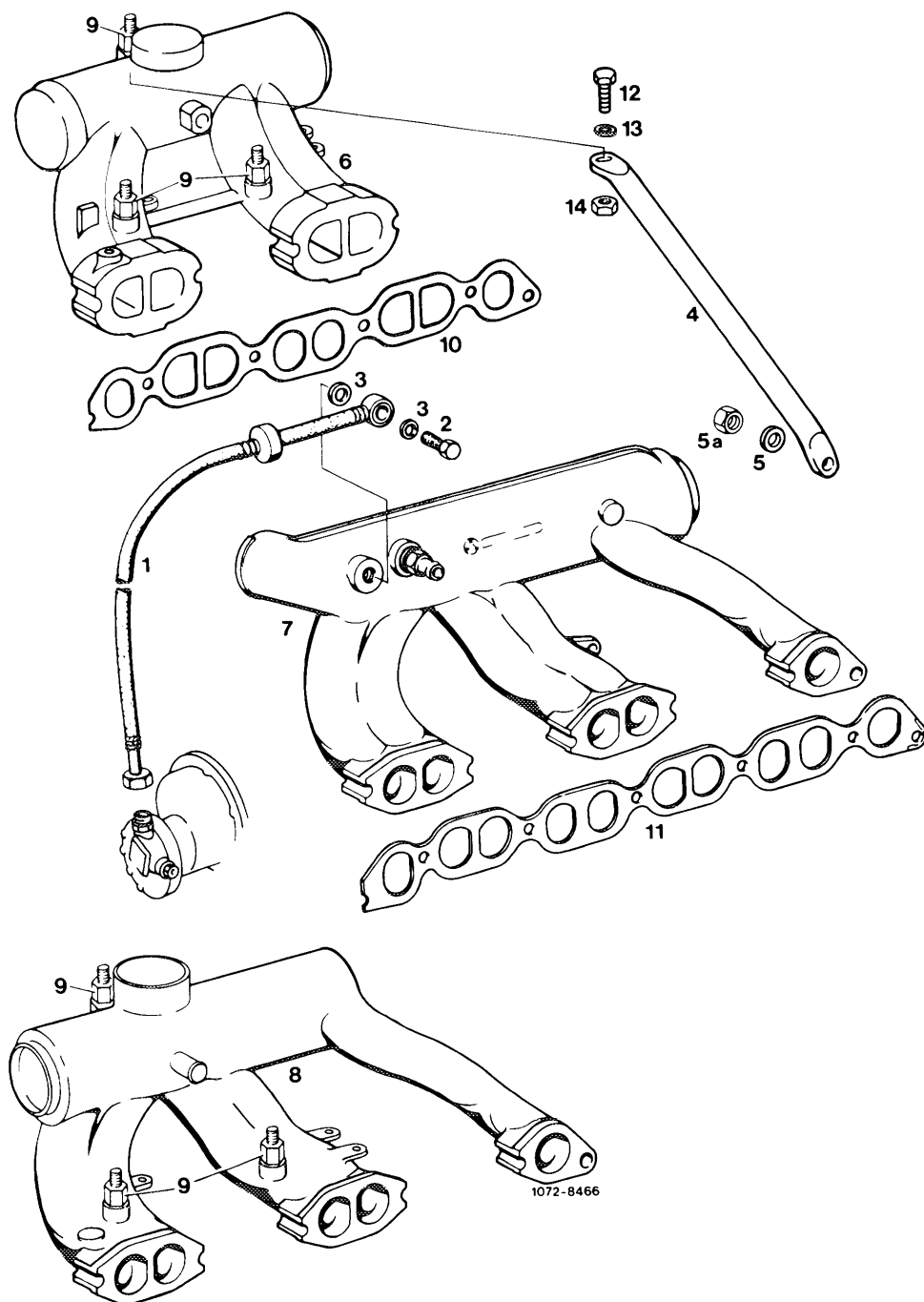


- 1 Vacuum line to vacuum pump
- 2 Hollow screw
- 3 Sealing ring
- 4 Vacuum line to injection pump

- 5 Choke control
- 6 Nut
- 7 Washer
- 8 Gasket

- 9 Intake pipe
- 10 Gasket
- 11 Closing plug
- 12 Sealing ring

Engine 615,616,617



- 1 Vacuum line to vacuum pump <sup>1)</sup>
- 2 Hollow screw
- 3 Sealing ring
- 4 Strut engine 615, 616, 617
- 5 Washer
- 5a Nut

- 6 Intake pipe engine 615, 616
- 7 Intake pipe engine 617 in model 115.1
- 8 Intake pipe engine 617 in model 123.1
- 9 Vibration mount
- 10 Gasket
- 11 Gasket

- 12 Screw
- 13 Washer
- 14 Nut
- 15 Nut

1) not with piston pump.

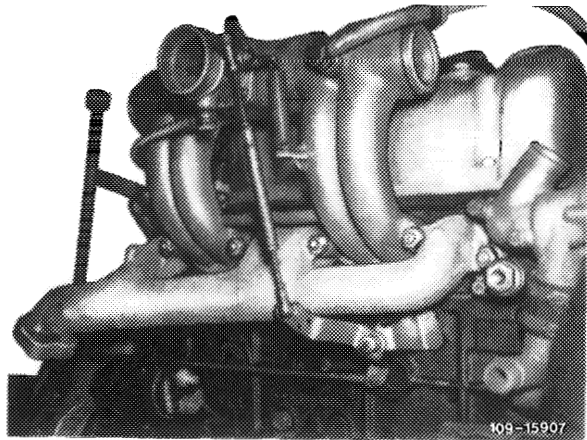


## 14-470 Removal and installation of exhaust manifold

### Removal

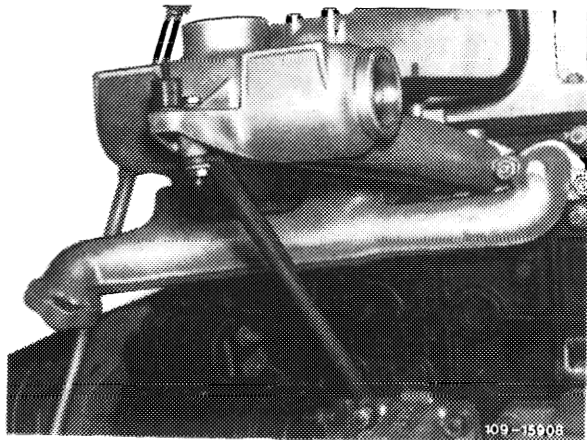
- 1 Remove air filter or hood.
- 2 Disconnect throttle linkage.
- 3 On engine 615,616 with choke control, unscrew vacuum lines.

Engine 615,616



- 4 On engines without choke control, unscrew support on intake manifold.

Engine 615,616



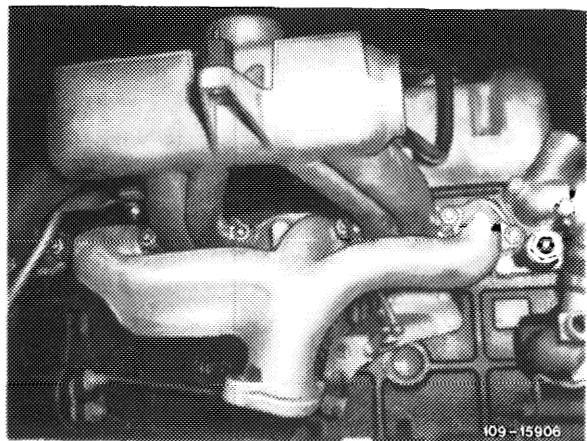
Note: Engine 617 is also provided with a support on intake manifold.

Start: February 1979

Engine		starting engine end No.
617.912	manual transmission	074930
	automatic transmission	068719

Model		starting chassis end No.
123.130		134304
123.150		003895

Engine 617



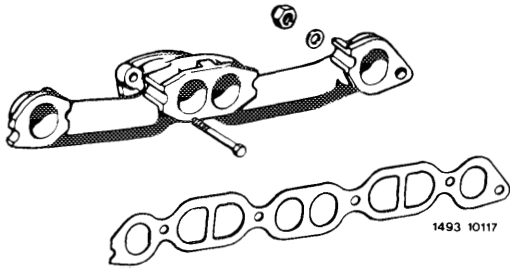
- 5 Remove cylinder crankcase breather.
- 6 Remove exhaust system (49—100).
- 7 Loosen fastening nuts and remove intake manifold together with exhaust manifold.

## **Installation**

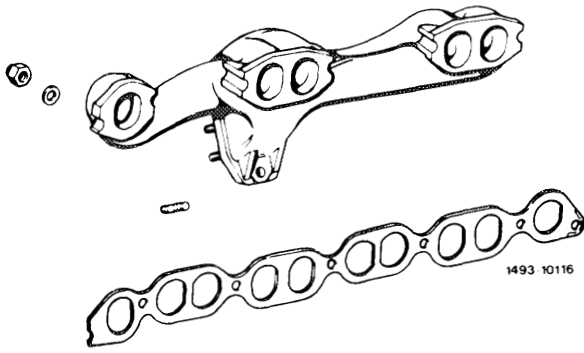
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- 8 For installation proceed vice versa, using a new gasket.
- 9 Adjust throttle linkage (30—300).
- 10 Run engine, check intake system by spraying with Iso-Oktan DIN 51756 or benzine for leaks.
- 11 Adjust idlespeed (07.1—100).

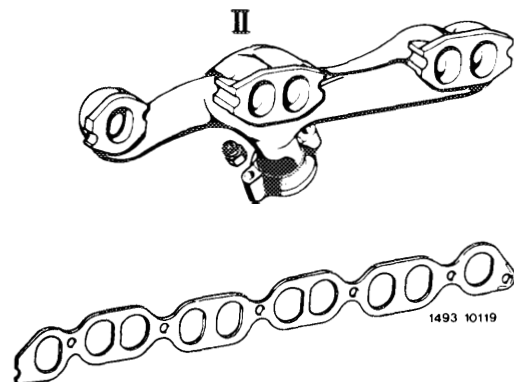
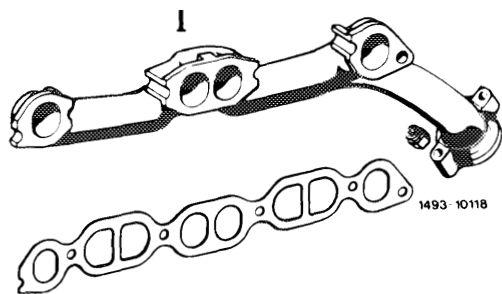
**Exhaust manifold  
Model 115.1 (except 115.114)**



**Model 115.114**



**Model 123.1 Lefthand and righthand steering**



- I For vehicles with engine 615 and 616
- II For vehicles with engine 617

A. General

On a diesel engine, combustion is effected by self-ignition of the fuel sprayed into the highly compressed and thereby highly heated combustion air.

In a cold engine, the self-ignition temperature is not attained by compression alone. A preglow system is therefore required, which serves the purpose of increasing the temperature of the compressed air to facilitate starting of the cold engine by the inflammation of fuel particles on filament of glow plug.

The duration of preglowing (preheating) depends on temperature of engine and on ambient temperature.

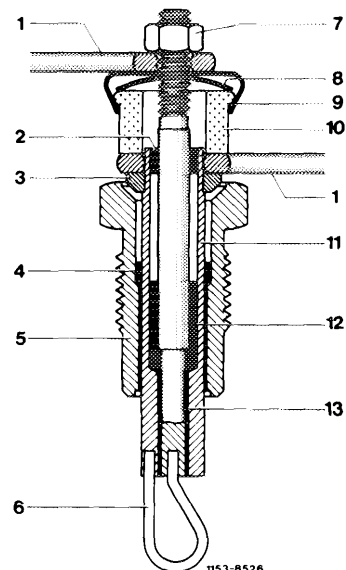
B. Glow plug design

a) Filament-type glow plugs

The filament-type glow plugs are essentially comprising the plug body (5) with threads M 18 x 1.5, one center electrode with filament wire and the outer electrode. The current is carried by conductor (1) or a connecting cable, depending on location of plug, to center electrode (13) or to ring element (3) of outer electrode (11). The center electrode (13) and the outer electrode (11) are connected to each other by means of the glow filament (6). The two electrodes are insulated in relation to each other by the insulating compound (12) and in relation to the plug body (5) by the insulation compound (4).

In addition, a plastic insulator (2) is installed at upper end of glow plug between outer and center electrode. The connection insulator (10) insulates the two current connections. The domed washer (8) installed in insulator serves as a lock for nut (7).

- |                                     |   |
|-------------------------------------|---|
| 1 Conductor                         | 8 Domed washer                            |
| 2 Plastic insulator                 | 9 Sheet-metal cap on connection insulator |
| 3 Ring element (on outer electrode) | 10 Connection insulator                   |
| 4 Insulation compound               | 11 Outer electrode                        |
| 5 Plug body                         | 12 Insulating compound                    |
| 6 Glow filament                     | 13 Center electrode                       |
| 7 Nut                               |   |



The life of a glow plug depends to a considerable extent on the condition of the injection nozzle and the combustion sequence. **Injection** pressures which are too low, binding nozzle needles, coked and dripping nozzles as well as a too early begin of injection may result in early breaking of filament. In addition, oil carbon bridges may lead to a ground connection and subsequent burning of filament.

If a glow plug is burnt out, it is absolutely necessary to check the glow plug which comes next in circuit, since a short-circuit between the threaded stem (1) and the outer pole (2) or the outer pole and cylinder head by metallic foreign particles or soot is possible. In addition, any residue in threaded bore of cylinder head must be removed.

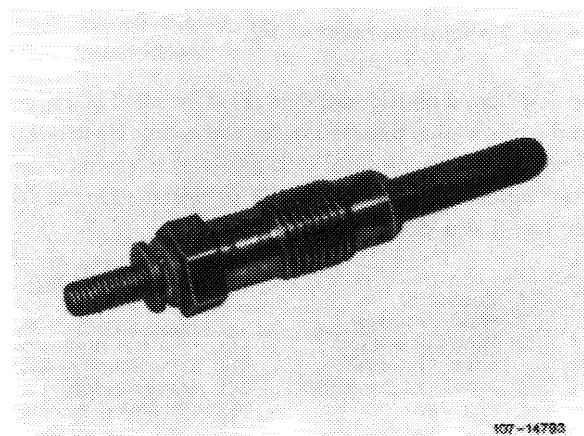
The temperature of the glow filament during pre-heating may amount to approx. 900–1000 °C. The combustion temperature of the engine at operating temperature amounts to approx. 800 °C. Temperatures above 900 °C during continuous operation will shorten the life of glow plugs. The glow plugs have an input of approx. 60 amps at a voltage drop of approx. 0.9 volt per glow plug. They are connected in series with resistance conductors.

#### **b) Quick-start pencil element glow plugs**

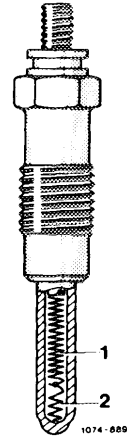
The quick-start pencil element glow plugs are essentially comprising a housing with M 12 x 1.25 threads and a heater rod pressed into housing.

The single-pole connecting pin is screwed to housing by means of a round brass nut which cannot be released.

The pencil element glow plugs are designed for a voltage of 11 volts and are operated in parallel.



The heater element comprises a heating and control coil connected in series.

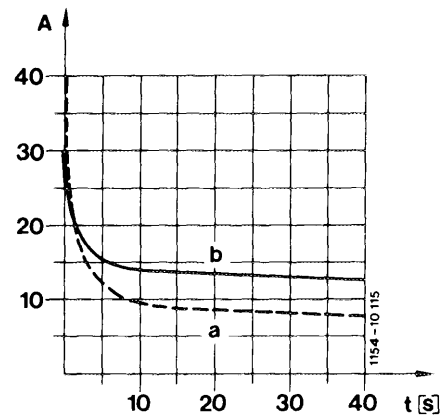


- 1 Control coil
- 2 Heater coil

When the glow system is switched on, a current of approx. 30 amps will flow per glow plug.

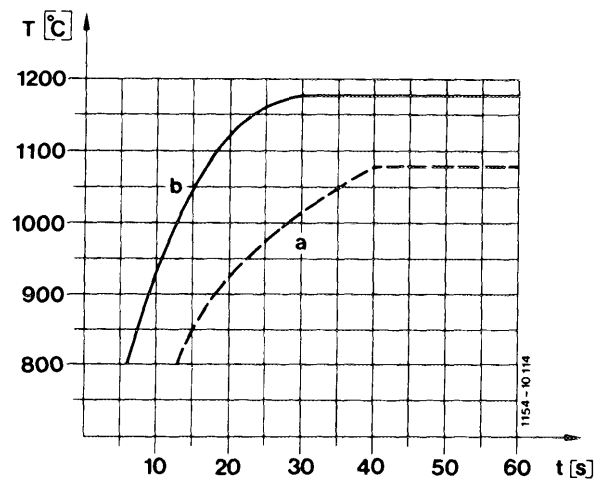
The heater coil heats the glow plug very quickly.

The control coil increases its resistance with increasing temperature and restricts the current to approx. 14 amps. This will protect the glow plug against overload.



b Current curve of quick-start pencil element glow plug

After a glow period of 9 seconds, a pencil element temperature of 900 °C/1652 °F is attained, after 30 seconds the max. temperature of 1180 °C/2147 °F.



b Temperature curve of quick-start pencil element glow plug

## C. Preglow system with glow plug resistance control engine 615,616 in model 115.1

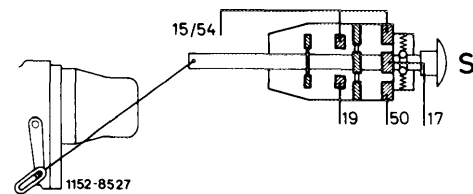
### Operation

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The mechanical-electrical preglow start and stop switch is a pull-push switch with four switch positions: stop position, drive position, preglow position and start position. In addition, the preglow start and stop switch is provided with a lock so that the key can be pulled off only in stop position.

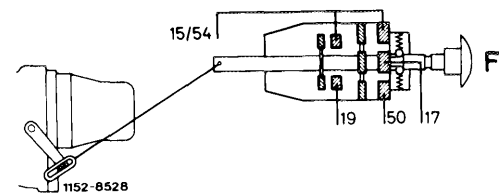
#### Stop position

In stop position the knob of the pull-push switch is completely pushed in and the adjusting lever on injection pump is moved into full forward position by means of the **Bowden** wire. In this position of the adjusting lever the control rod is in "stop" position, the pistons of the elements are at zero delivery, the engine receives no more fuel and will stop. In this position, the terminals 19, 50 and 17 are de-energized. The key on steering lock can be pulled off.



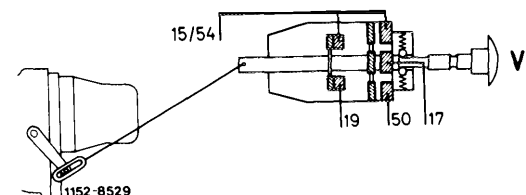
#### Drive position

In drive position, the **Bowden** wire with the oblong eye in relation to adjusting lever is located in such a manner that the eye is not resting against bolt of adjusting lever so that the adjusting lever is not actuated. When pulled out of stop position, the knob engages in the next following detent for the drive position. Terminals 19, 50 and 17 are de-energized. The key on steering lock cannot be pulled out.



#### Preglow position

After pulling knob out of drive position into preglow position, a small resistance will be felt. In this position, the switch must be held in place until the preglowing is completed.







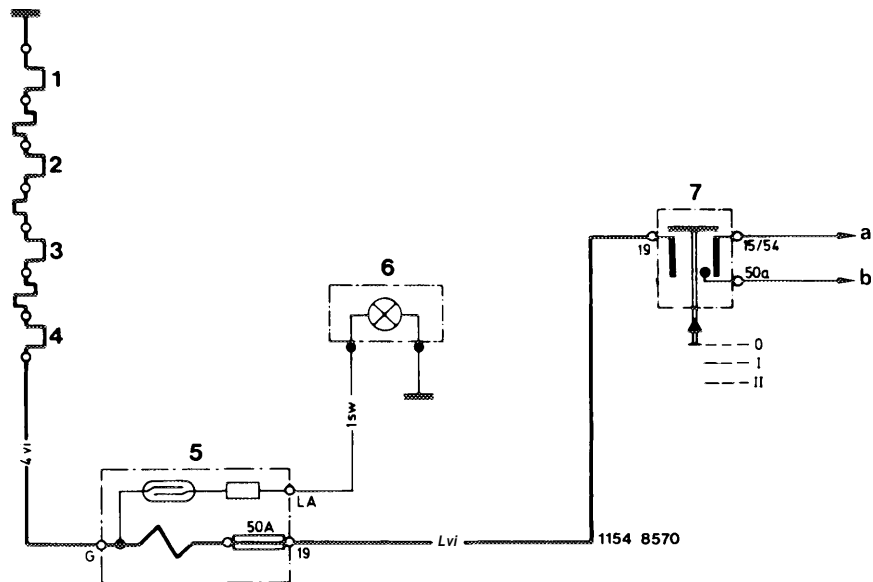
## D. Preglow system with preglow indicator lamp engine 615,616 in model 123.1

### Operation

The preglow system is switched on by pulling preglow starter switch into position I. The preglow indicator lamp lights up as long as preglowing continues.

The glow plugs are connected in series and protected by a 50 amps fuse.

- 1-4 Glow plugs and resistance bars
- 5 Fuse and reed contact
- 6 Preglow indicator lamp
- 7 Preglow starter switch
- a Tostesteeringlock
- b To starter



The preglowing current of approx. 50–60 amps is determined by the firm resistances of the glow plugs, as well as by the resistance conductors.

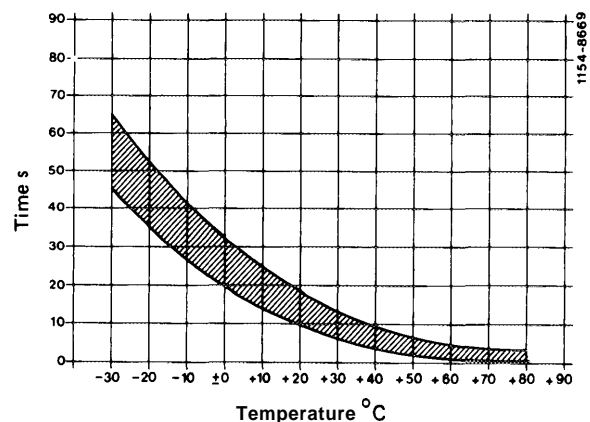
Too high a preglowing current is the result of a ground connection or short-circuit in preglow system, e. g. a defective glow plug.

Too low a preglowing current is the result of transition resistance caused e. g. by a loose glow plug connection or by an insufficiently charged battery.

The preglowing time depends on the ambient temperature and the coolant temperature and can be set at will. For the cold engine, the following preglowing periods are reference values:

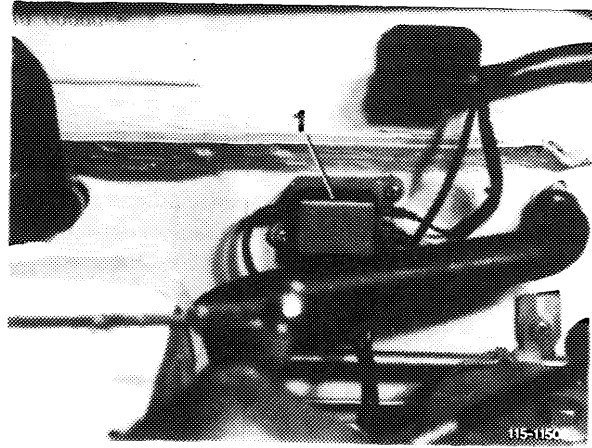
Ambient temperature +20 °C approx. 10 seconds  
 Ambient temperature 0 °C approx. 20 seconds  
 Ambient temperature -5 °C approx. 30 seconds

At lower temperatures pertinently longer up to max 1 minute.



Glow period at 52 amps

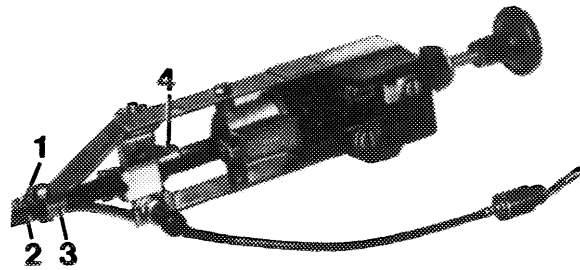
The preglow indicator lamp lights up as long as the preglow system is actuated. It is contacted with plus by means of the reed contact located in parallel with fuse. The reed contact is closed if the available glow current is adequate. Minus of indicator lamp is continuously connected to ground.



The engine is stopped by pushing preglow starter switch down.

Mechanical speed increase is effected by turning knob on preglow starter switch.

Turning counterclockwise = higher speed  
Turning clockwise = lower speed



1 Start and stop control  
2 Bowden wire for idle  
speed adjuster

3 Clamp  
4 Fuse

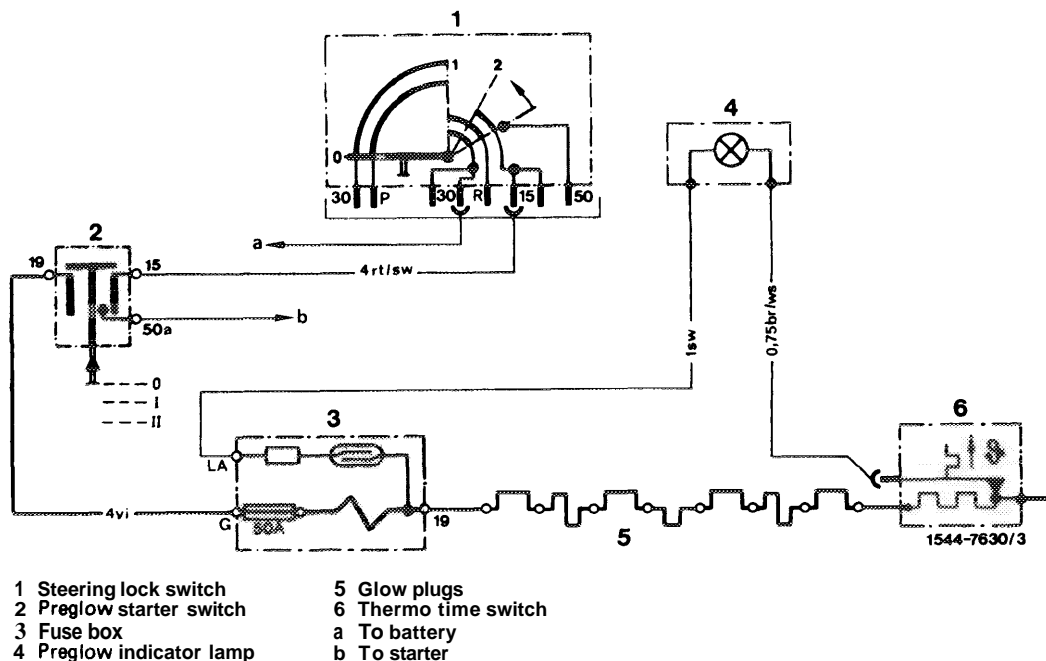
107-11304

## E. Preglow system with ready-for-starting lamp engine 615,616 in model 123.1

### Operation

The preglow system is switched on by pulling preglow starter switch into position I. The ready-for-starting condition of engine is indicated by an indicator lamp in instrument cluster. The glow plugs are connected in series and protected by a 50 amps fuse.

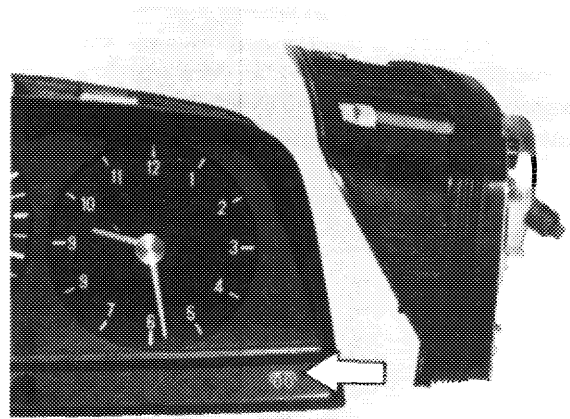
The preglow current of approx. 55 amps is determined by the firm resistors of the glow plugs, as well as the resistance conductors.



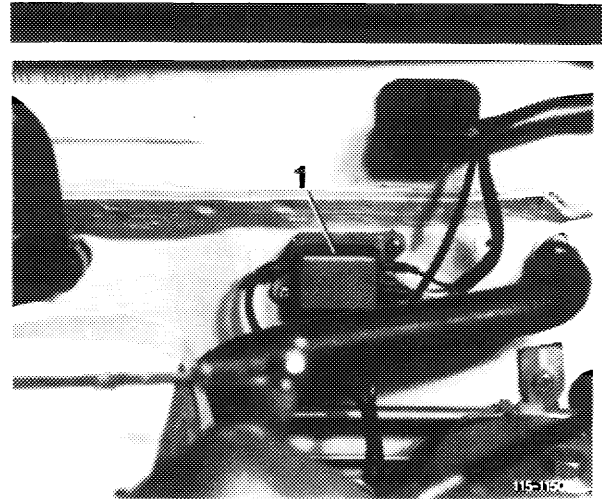
The reason for an excessively high glow current is a ground connection or short-circuit in the preglow system, e. g. a defective glow plug.

The reason for a too low glow current is a transfer resistance, e. g. a loose plug connection or an insufficiently charged battery.

The preglowing time is indicated in dependence of the ambient temperature and the engine temperature by a preglow indicator lamp in instrument cluster.



In preglow position and in starting position (I and II) of preglow starter switch the preglow indicator lamp is contacted with plus by means of a reed contact connected in parallel with fuse and closed if adequate glow current is available. The preglow indicator lamp is connected to minus by way of the rest contact in thermo time switch. At the end of the optimal preglow period the contact in thermo time switch opens. The preglow indicator lamp is extinguished and thereby shows that the engine is ready for starting.



## F. Preglow system with key start system engine 617 in model 115.1

### Operation

---

When the steering lock starter switch is actuated, in position "2" (preglowing start), the preglow system is switched on by the preglow time relay. The extinguished preglow indicator lamp in instrument cluster shows that the engine is ready for starting.

The glow plugs are started in series.

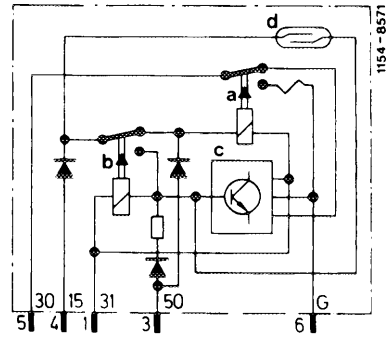
The preglow current of approx. 50–55 amps is determined by the firm resistors of the glow plugs and the resistance conductors.

Too high a preglowing current is the result of a ground connection or short-circuit in preglow system, e. g. a defective glow plug.

Too low a preglowing current is the result of transition resistance caused e. g. by a loose glow plug connection or by an insufficiently charged battery.

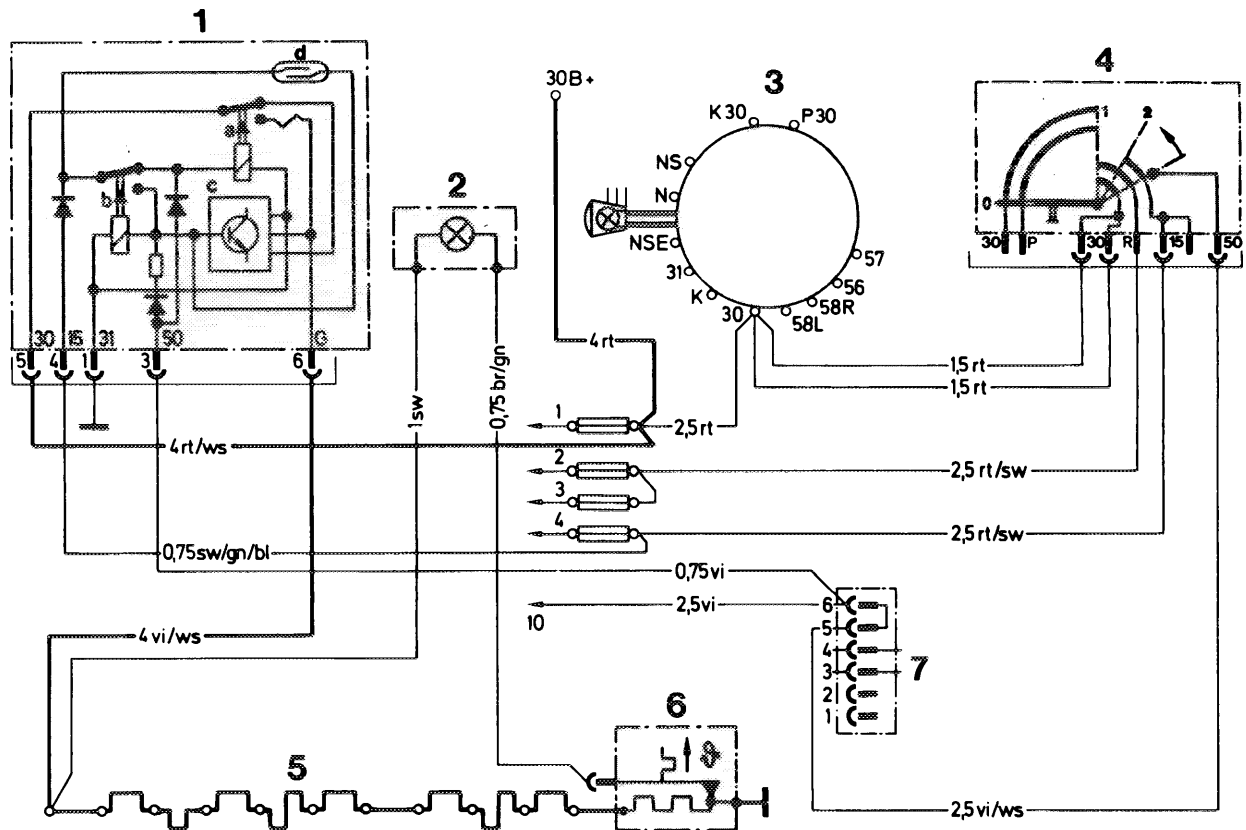
The preglow time relay is attached to pedal assembly behind instrument cluster.

The preglow time relay has an integrated power relay (a) for preglow current, a control relay (b) for switching off power relay, an electronic component (c) for the safety circuit and a reed contact (d) as overload protection.



In key position "2" terminal 4 of preglow time relay (1) is contacted via terminal 15 of steering lock starter switch (4) and the winding of power relay (a) via the rest contact of control relay (b)

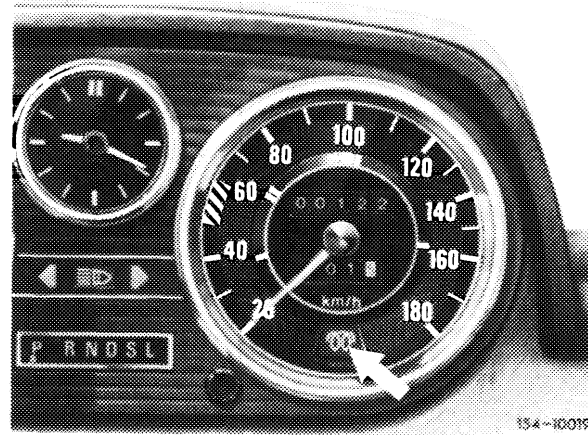
The contacts of the power relay are closing the preglow circuit. From B+ the preglow current flows via terminals 5 and 6 of preglow time relay (1) across the glow plugs and the thermo time switch (6) to ground. The preglow system is in operation.



1543-5924/4

- |                                 |   |
|---------------------------------|---|
| 1 Preglow relay                 | 5 Glow plugs with resistance conductors |
| 2 Preglow indicator lamp        | 6 Thermo-time switch                    |
| 3 Rotary light switch           | 7 Plug connection                       |
| 4 Steering lock starting switch |   |

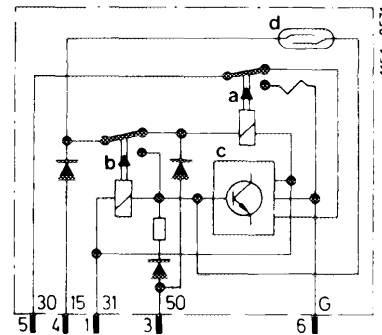
The preglow time is indicated by the preglow indicator lamp.



In dependence of the coolant temperature and the preglow current flowing across the thermo time switch, the preglow indicator lamp is contacted with minus by the closed contact in thermo time switch. In parallel with the glow plugs, the control lamp is connected to plus by a line connected to the glow plug of the 5th cylinder. When the optimal preglow time is obtained, the contact in thermo time switch will interrupt minus and the preglow indicator lamp is extinguished. The engine is now ready for starting.

In starting position the preglow time relay is contacted by terminal 50 of the steering lock starter switch via terminal 3. Control relay (b) is energized. The contacts are closing (interrupting the rest position) and remain closed via terminal 4 in a self-holding circuit.

The power relay (a) is not switching off, since during the starting operation the power relay is directly contacted via terminal 3. The preglow system remains switched on (refer to wiring diagram).



At end of starting operation the key moves back into position "2" (preglowing, drive).

The power relay switches off, since there is no voltage neither via terminal 3, nor via the interrupted rest contact of the control relay which remains switched on via terminal 4.

The preglow system is now in disconnected condition.

### Attention!

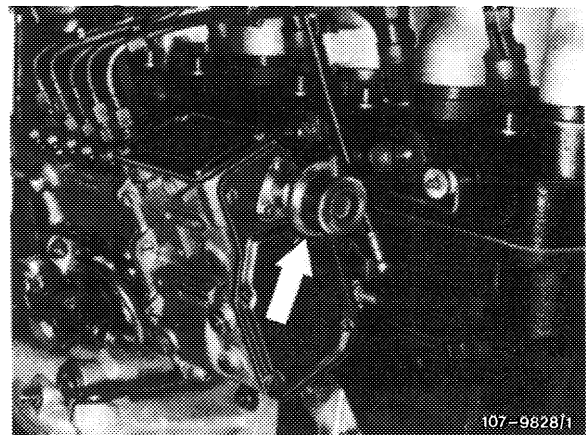
If the engine is not started when the preglow indicator lamp is extinguished, the preglow system remains switched on up to 90 + 20 seconds of preglow time.

When working in engine compartment, note that in such a case the resistance conductors are red hot.

After 90 + 20 seconds the safety relay is energized for a short moment by control relay (b). The control relay attracts and remains switched on under self-holding condition. The rest contact is interrupted and disconnects the voltage at power relay (a). As a result, the contacts of the power relay will interrupt the preglow current. The preglow system is now inoperative.

The engine is shut off by turning key to position "1" or "0".

The steering lock has an attached valve which is actuated by way of a cam when the key is turned. A vacuum box on injection pump is provided with a vacuum and the regulating rod of the injection pump is pulled to "stop".



## G. Preglow system with key start system engine 615,616,617 in model 123.1

### Operation

When the steering lock starter switch is actuated in position "2" (preglowing, start) the preglow system is switched on by the preglow time relay. The extinguished preglow indicator lamp in instrument cluster shows that the engine is ready for starting. The glow plugs are started in series and protected with a 50 amps fuse.

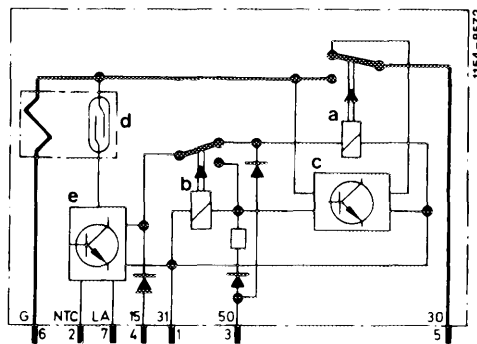
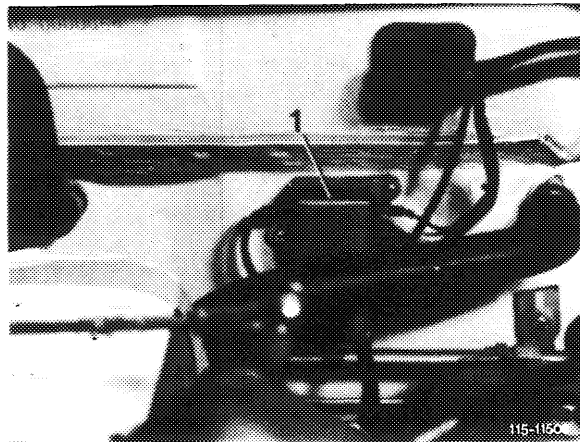
The preglow current of approx. 50–55 amps is determined by the firm resistors of the glow plugs and the resistance conductors.

Too high a preglowing current is the result of a ground connection or short-circuit in preglow system, e. g. a defective glow plug.

Too low a preglowing current is the result of transition resistance caused e. g. by a loose glow plug connection or by an insufficiently charged battery.

The preglow time relay is attached to instrument cluster on pedal assembly.

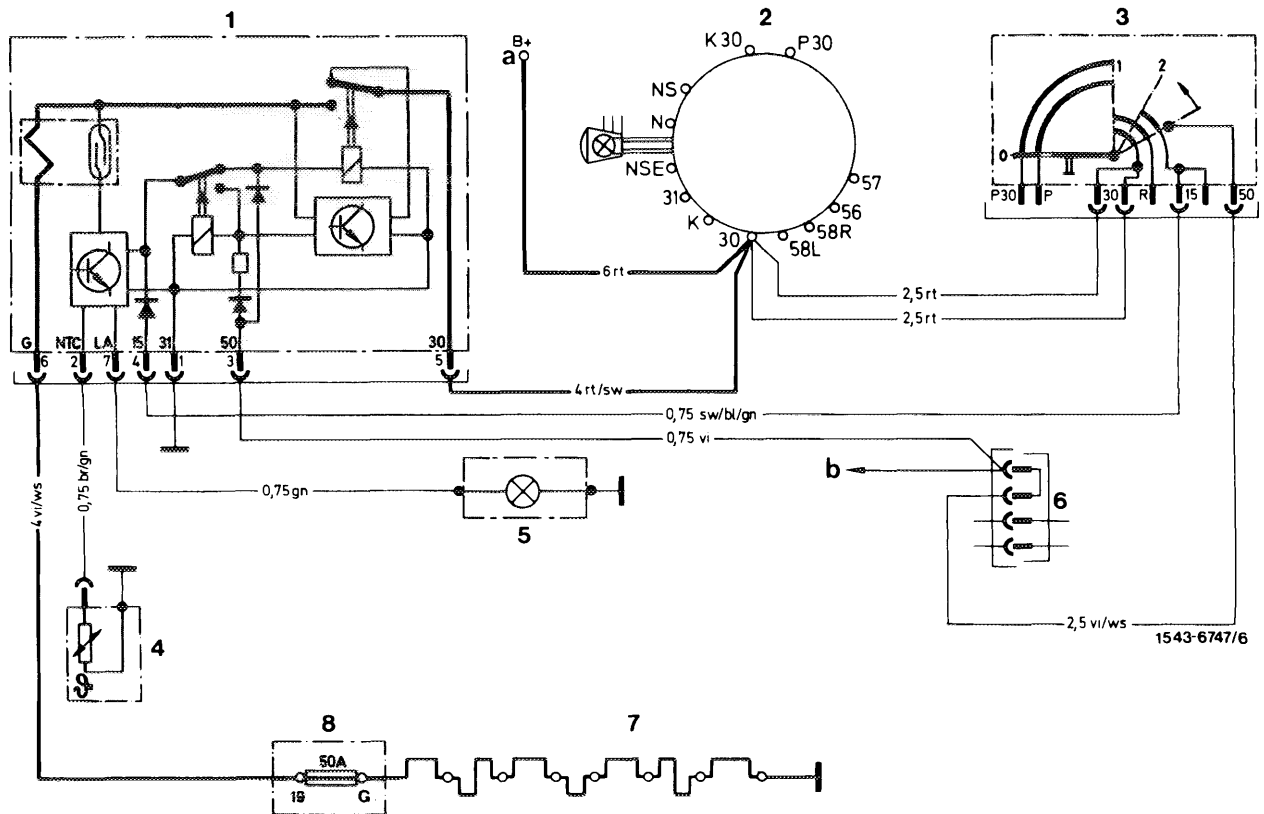
The preglow time relay has an integrated power relay (a) for preglow current, a control relay (b) for switching off power relay, an electronic component (c) for the safety circuit and an electronic component (d) with a primary reed contact for the preglow indicator lamp.





In key position "2" terminal 4 of preglow time relay (1) is contacted via terminal 15 of steering lock starter switch (3) and the winding of power relay via the rest contact of control relay (b).

The contacts of the power relay are closing the preglow circuit. From B+ the preglow current flows across terminal 5 and 6 of preglow time relay (1) via fuse (8) and the glow plugs to ground.

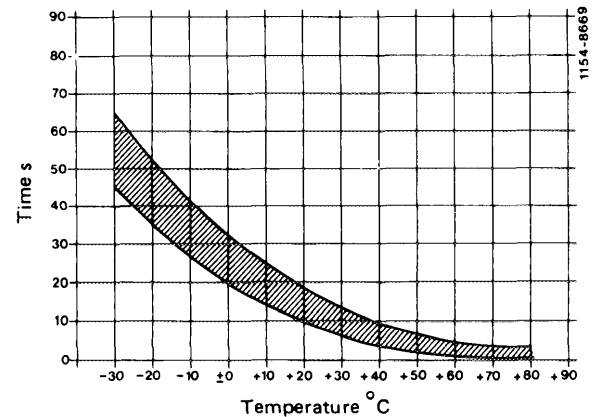


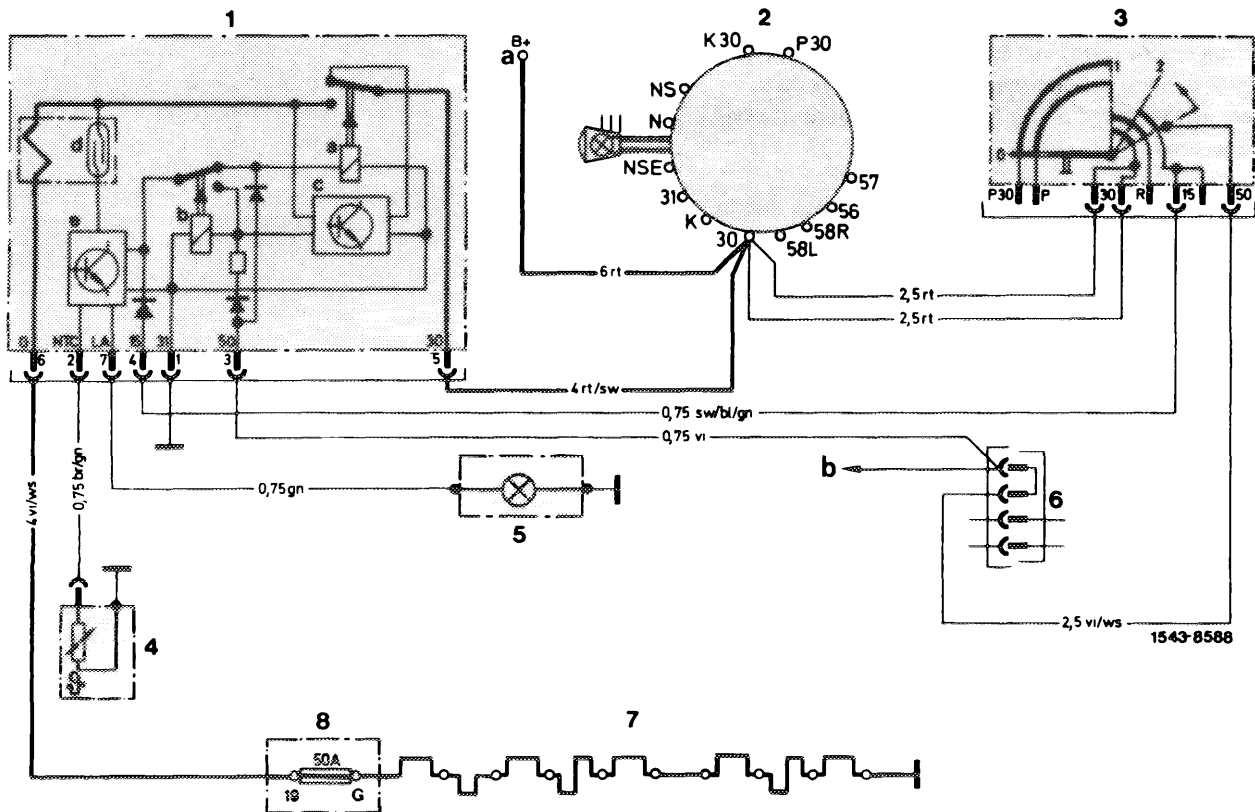
Wiring diagram engine 615,616

- |                                 |   |
|---------------------------------|---|
| 1 Preglow time relay            | 6 Plug connection                       |
| 2 Rotary light switch           | 7 Glow plugs with resistance conductors |
| 3 Steering lock starting switch | 8 Fuse box                              |
| 4 Temperature sensor            | b To starter terminal 50                |
| 5 Preglow indicator             |   |

For preglowing, the preglow indicator lamp is switched by means of an electronic component in preglow time relay. A temperature sensor (NTC) in coolant circuit changes its resistance (cold = high, warm = low resistance) in dependence of coolant temperature and activates the electronic component. After attaining the required time, the preglow indicator lamp is switched off.

The optimal preglow period is indicated when the preglow indicator lamp goes out.



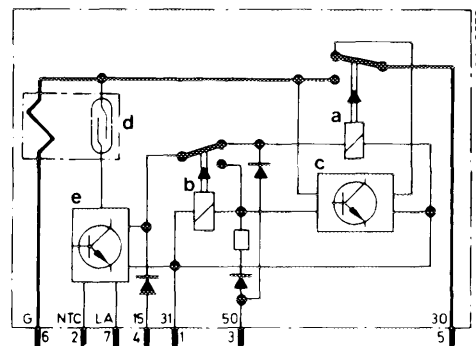


Wiring diagram engine 617

- |                                 |                          |   |
|---------------------------------|--------------------------|---|
| 1 Preglow time relay            | 4 Temperature sensor     | 7 Glow plugs with resistance conductors |
| 2 Rotary light switch           | 5 Preglow indicator lamp | 8 Fuse box                              |
| 3 Steering lock starting switch | 6 Plug connection        | b To starter terminal 50                |

In starting position the preglow time relay is contacted by terminal 50 of the steering lock starter switch via terminal 3. Control relay (b) is energized. The contacts are closing (interrupting the rest position) and remain closed via terminal 4 in a self-holding circuit.

The power relay (a) is not switching off, since during the starting operation the power relay is directly contacted via terminal 3. The preglow system remains switched on.



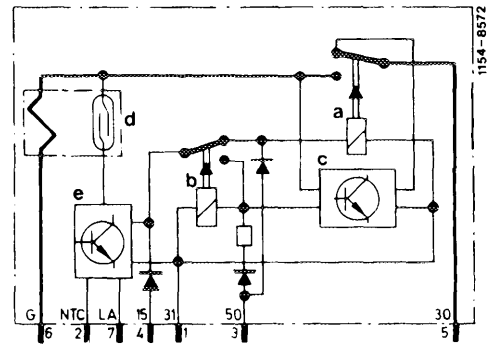
At end of starting operation the key moves back into position "2" (preglowing, drive). The power relay switches off, since there is no voltage neither via terminal 3, nor via the interrupted rest contact of the control relay (b) which remains switched on via terminal 4. The preglow system is now in disconnected condition.

**Attention!**

If the engine is not started when the preglow indicator lamp is extinguished, the preglow system remains switched on up to 90 + 20 seconds of preglow time.

When working in engine compartment, note that in such a case the resistance conductors are red hot.

After 90 + 20 seconds the safety relay is energized for a short moment by control relay (b). The control relay attracts and remains switched on under self-holding condition. The rest contact is interrupted and disconnects the voltage at power relay (a). As a result, the contacts of the power relay will interrupt the preglow current. The preglow system is now inoperative.

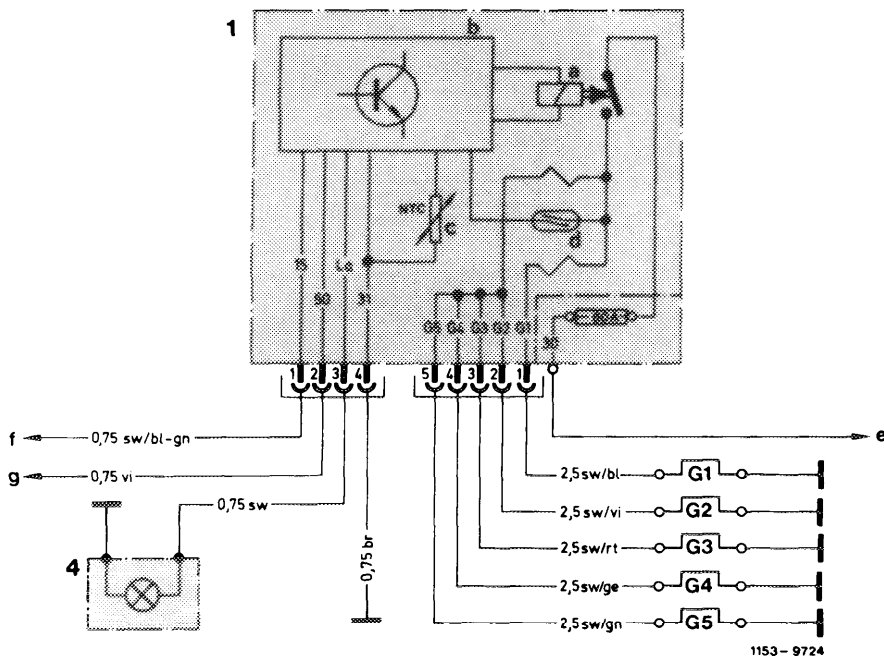


## H. Quick-start preglow system engine 615, 616, 617.91 in model 123.1

### General

The essential components of the preglow system are the quick-start pencil element glow plugs, the preglow time relay and the preglow indicator lamp.

### Wiring diagram



- 1 Preglow time relay
  - a Power relay
  - b Electronic unit
  - c Temperature sensor (NTC resistor)
  - d Reed relay
  - e To starter terminal 30
  - f To fuse box terminal 15
  - g To plug connection starter lockout backup lamp switch terminal 50
- 4 Preglow indicator lamp
- G 1 – G 5 Pencil element glow plugs

Note: On engine 615, 616, the pencil element glow plug G 5 is no longer installed.

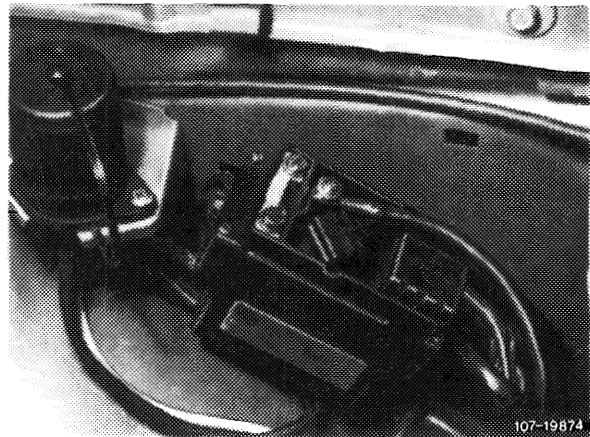
### Quick-start pencil element glow plugs

The quickstart pencil element glow plugs are designed for a voltage of 11 volts and are operated in parallel.

### Preglow time relay

The preglow time relay is located in engine compartment at the left on wheelhouse.

After removing protective cap, the electric connections, as well as the 80-amp fuse are accessible.



The former temperature sensor in coolant circuit is no longer installed. Instead, the relay temperature or relay-ambient temperature is obtained by means of an NTC resistor in preglow time relay.

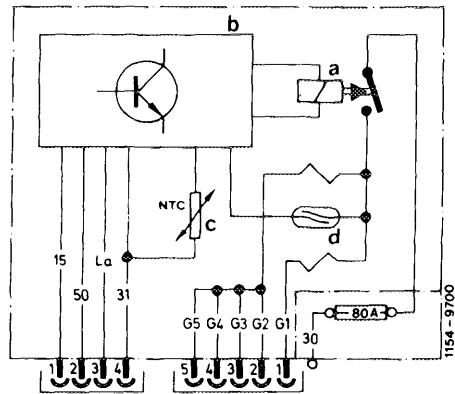
### Functions of preglow time relay

The preglow time relay comprises the following functions:

- Switching of glow current
- Ready-for-start indicator
- Safety shutoff
- Fault indicator

### Switching of glow current

By actuation of key in position "2" (preglow, driving), the preglow time relay (voltage at terminal 15) is engaged. The power relay (a) closes the circuit from terminal 30 (positive) via fuse to pencil element glow plugs G1 – G5.



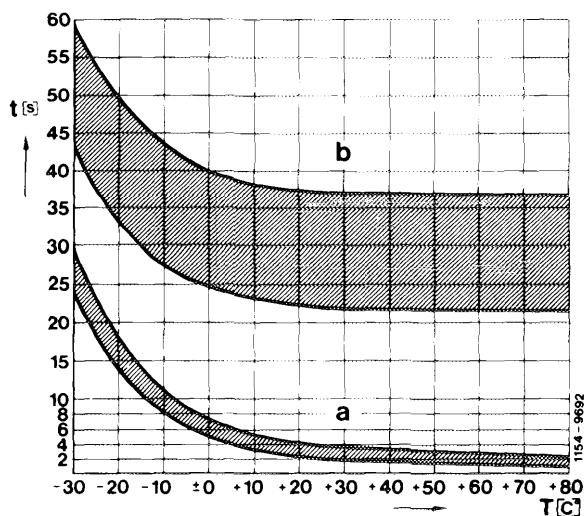
If the key is turned to position "3" (start), the power relay (a) remains attracted, activated by terminal 50. The glow period continues until the key is turned back to position "2".

### Ready-for-start indicator

A temperature sensor installed in preglow time relay obtains the glow period.

When the glow system is switched on, the preglow indicator lamp in instrument cluster will light up.

If the required glow period, in dependence of the ambient temperature of the preglow time relay, is attained, the preglow indicator lamp goes out and thereby indicates the ready-for-starting condition.



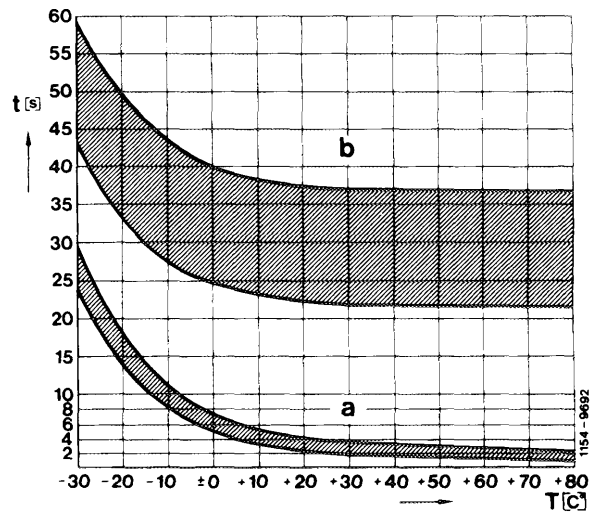
a Preglow period

### Safety shutoff

If there is no start within 20–35 seconds following indication of ready-for-starting condition, the glow current is interrupted by the safety shutoff. If another start follows, the glow system is **again** switched on for the duration of the starting period.

The safety shutoff is no longer a fixed condition. It is determined by the time up to ready-for-starting condition (preglow indicator lamp goes out) plus 20 to 35 seconds.

a Preglow period  
b Safety shutoff



### Fault indication

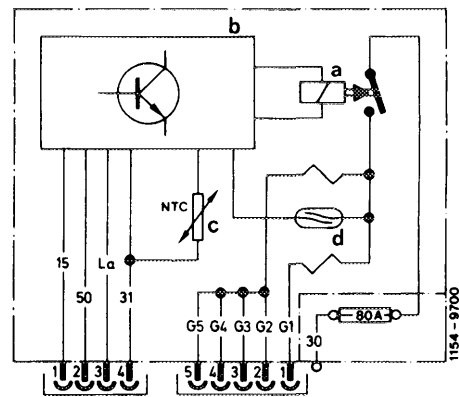
A fault in preglow system is indicated if the preglow indicator lamp is **not lighting** up when the key is actuated in position "2".

The following faults are indicated:

- Interruption of line to connection terminal 30.
- 80-amp fuse defective.
- Power relay in preglow time relay defective.
- Interruption of one or more lines to pencil element glow plugs.
- Interruption of one or more pencil element glow plug.

**Note:** If tolerances of pencil **element** glow plugs or of Reed relay (**d**) are unfavorable, response of fault indicator only if two pencil element glow plugs are defective is acceptable.

Faults are indicated (pencil element glow plug resistance control) by comparing the current of pencil element glow plug **G1** with current of remaining pencil element glow plugs **G2–G5** (or **G2–G4**) connected in parallel.

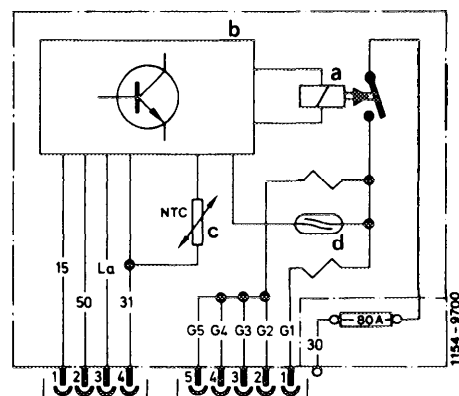


The currents of the two lines to the pencil element glow plugs **G1** and **G2** up to **G5** (or **G2–G4**) are routed through two Reed relay coils with different numbers of windings connected opposite to each other.

If the current flow in both coils is the same, the magnetic fields will cancel each other and the Reed contact will not respond.

If the balance of the magnetic field is interrupted by the **loss** of one or several pencil element glow plugs, the Reed contact will close and the electronic system (**b**) will be activated.

The preglow indicator lamp switches off immediately and will therefore not light up when the preglowing begins.





**Conventional tools**

Voltmeter (measuring range 0-3 volts/0-16 volts)

Ammeter (measuring range 0-60 amps)

**Note**

Battery charged min 60 % (acid density approx. 1.22 g/cc).

A. With glow plug resistance control engine 615,616 in model 115.1

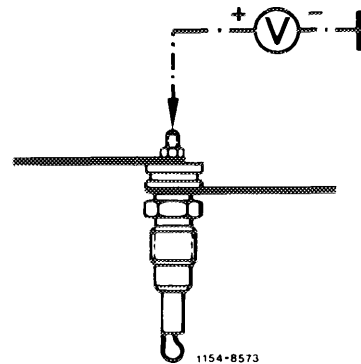
**a) Preglow system not preglowing**

This complaint indicates an interruption in circuit of preglow system.

Set voltmeter to measuring range 0-16 volts. Connect plus cable of voltmeter to input (threaded stud) of glow plug of 4th cylinder and minus cable to ground. Actuate preglow system and read voltage on voltmeter.

If voltmeter indicates 12 volts, the interruption is located at glow plugs or their connections.

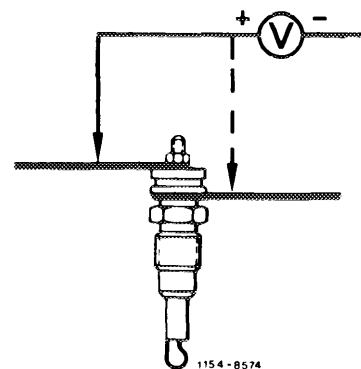
If the voltmeter indicates 0 volt, look for interruption at preglow starter switch or on glow plug resistance control.



**1. Checking glow plugs for interruption**

Connect minus cable of voltmeter to ground. Check voltage at current input and output of the 4 glow plugs by means of plus cable of voltmeter.

If a glow plug at current input shows 12 volts and at output 0 volt, the respective glow plug is interrupted and must be exchanged.

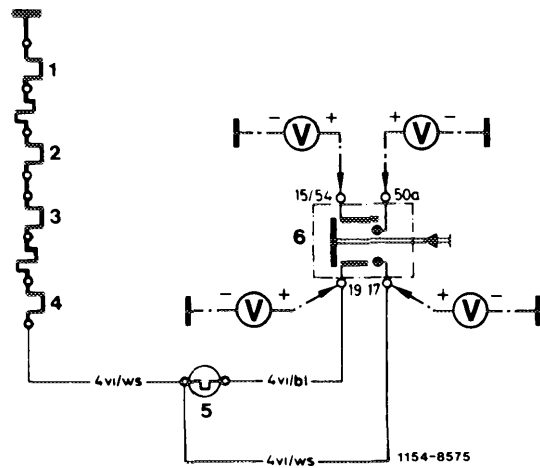


## 2. Checking preglow starter switch and gkw plug resistance control

Connect minus cable of voltmeter to ground. By means of the voltmeter plus cable the connections of the preglow starter switch should indicate the following values:

In switch position 0 (key in steering lock in position "2") on terminal 15/54 = 12 volts.

In switch position I (preglow position) on terminal 19 = approx. 11 volts.



### Preglow starter switch

In switch position II (starting position) on terminal 17 and on terminal 50a = approx. 11 volts.

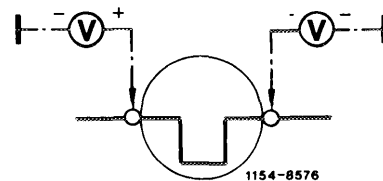
If the voltage on terminal 15/54 = 0, check line to steering lock switch or steering lock switch as well as connection.

If the voltage on terminal 19, 17 or 50a = 0, exchange preglow starter switch.

### Gbw plug resistance control

Voltage at glow plug resistance control input and output approx. 11 volts.

If voltage is 0, the line or the glow plug resistance control is interrupted and line or control must be replaced.



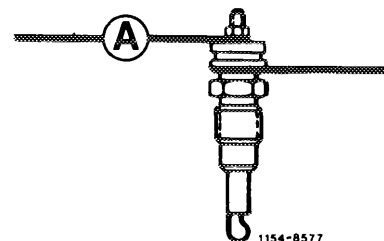
### b) Preglow system glows too slowly or too fast

In the event of such a complaint, the current flowing through the preglow system is too low as a result of transfer resistances or too high as a result of a short-circuit.

First measure glow current with ammeter.

For this purpose, connect ammeter at connection of glow plug cylinder 4.

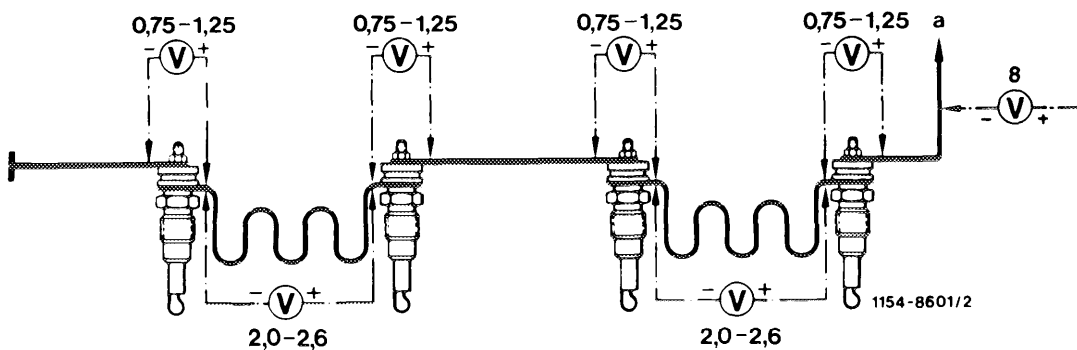
**Glow current in preglow position: approx. 50–55 amps.**



Measured after 15 seconds (battery charged min 60 %).

If this glow current is not attained, measure voltage drop in preglow system by means of voltmeter.

Check connections for tight seat.



a To glow plug position control

If this glow current is exceeded, a short-circuit in preglow system is indicated (glow plugs, preglow starter switch, preglow resistance control).

If a glow plug fails as a result of a short-circuit, measure glow current once again after replacing glow plug.

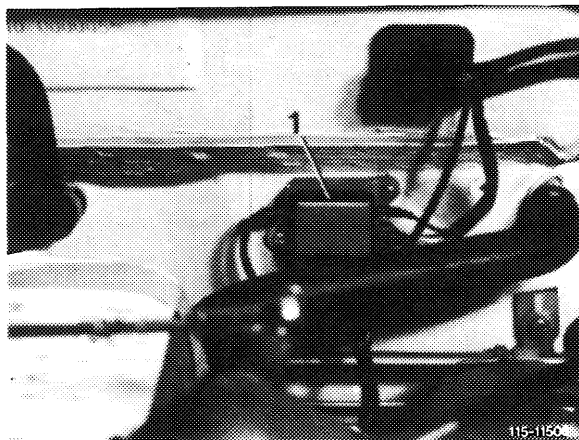
## B. With preglow indicator lamp engine 615,616 in model 123.1

### a) Preglow system not preglowing

This complaint is based on an interruption in current circuit of preglow system.

#### Attention!

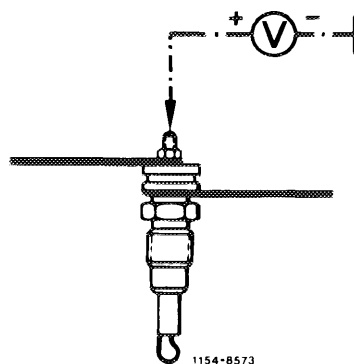
The preglow system is fused, check fuse. (The separate fuse box is mounted on front wall inside engine compartment).



Adjust voltmeter, measuring range 0–16 volts. Connect plus cable of voltmeter to input (threaded stud) of glow plug of 4th cylinder and minus cable of voltmeter to ground. Actuate preglow system and read voltage on voltmeter.

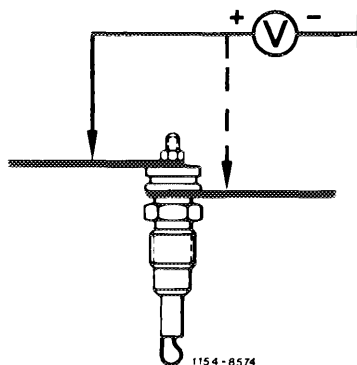
If voltmeter indicates 12 volts, the interruption is at glow plug or their connections.

If voltmeter indicates 0 volt, the interruption is at preglow starter switch or its connections.



### 1. Checking glow plugs for interruption

Connect minus cable of voltmeter to ground. Check voltage at current input and output of the four glow plugs by means of plus cable. If 12 volts are measured at input of a glow plug and 0 volt at output, the respective glow plug is interrupted and must be replaced.

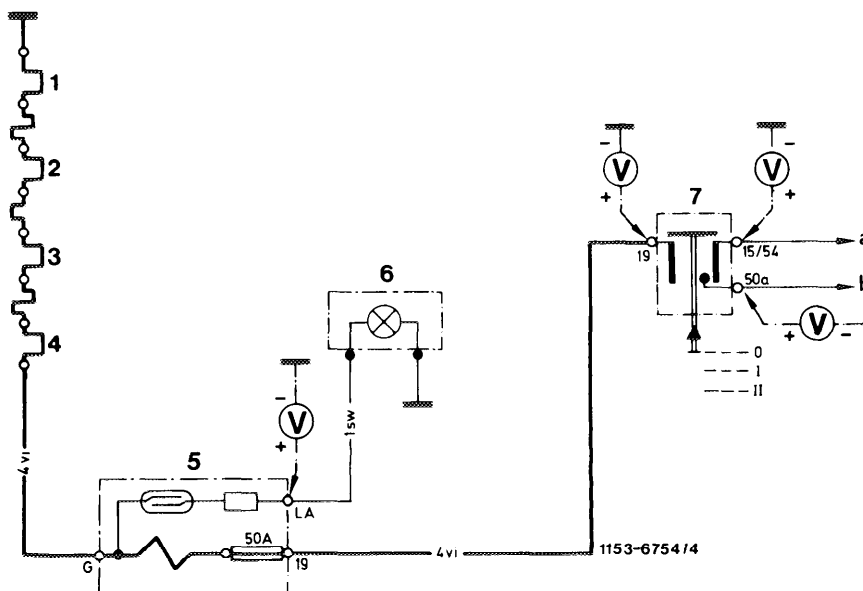


### 2. Checking preglow starter switch and connections

Connect minus cable of voltmeter to ground. The following values must be measured at connections of preglow starter switch with plus cable of voltmeter:

In switch position 0 (key in steering lock in position "2") on terminal 15/54 = 12 volts.

In switch position I and II (preglow or start position) on terminal 19 and 50a = approx. 11 volts.



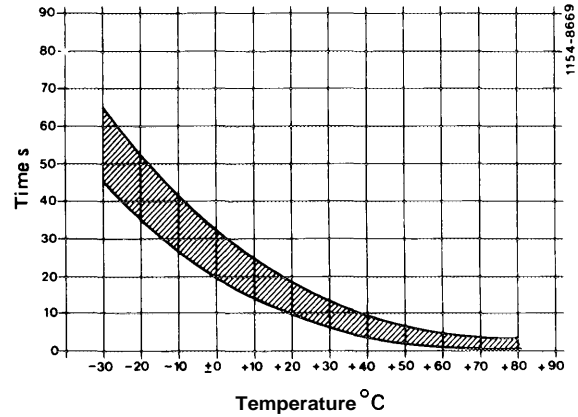
If the voltage at terminal 15/54 = 0 volt, check line to steering lock switch or steering lock switch itself, as well as the respective connection.

If the voltage at terminal 19 and 50a = 0 volt, replace preglow starter switch.

### b) Preglow system preglowing too slowly or too fast

---

Nominal time at: +20 °C approx. 12 seconds  
- 5 °C approx. 30 seconds



Glow period at 52 amps

In the event of this complaint, the current flowing through preglow system is too low as a result of transfer resistances, or too high as a result of a short-circuit.

First, measure glow current with ammeter.

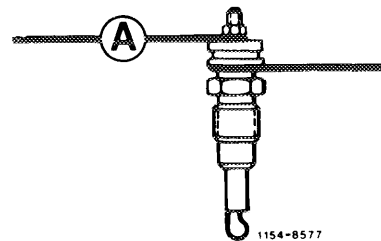
For this purpose, connect ammeter at glow plug connection of cylinder 4.

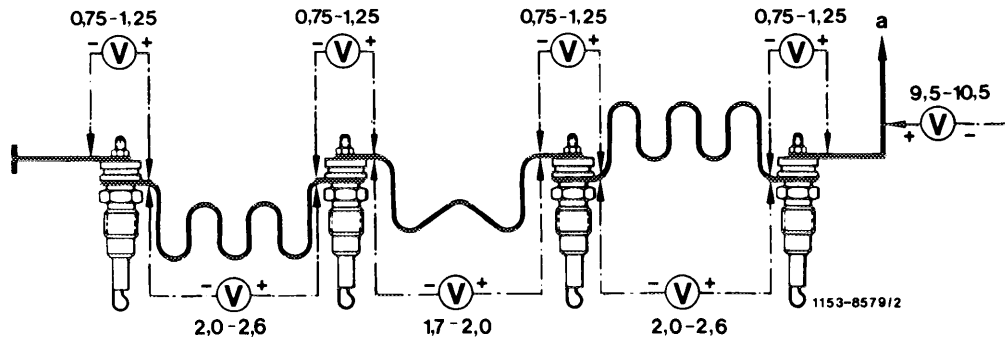
**Glow current in preglow position: approx. 50–55 amps.**

Measured after 15 seconds (battery charged min 60 %).

If this glow current is not attained, measure voltage drop in preglow system with voltmeter.

Check connections for tight seat.





a To fuse

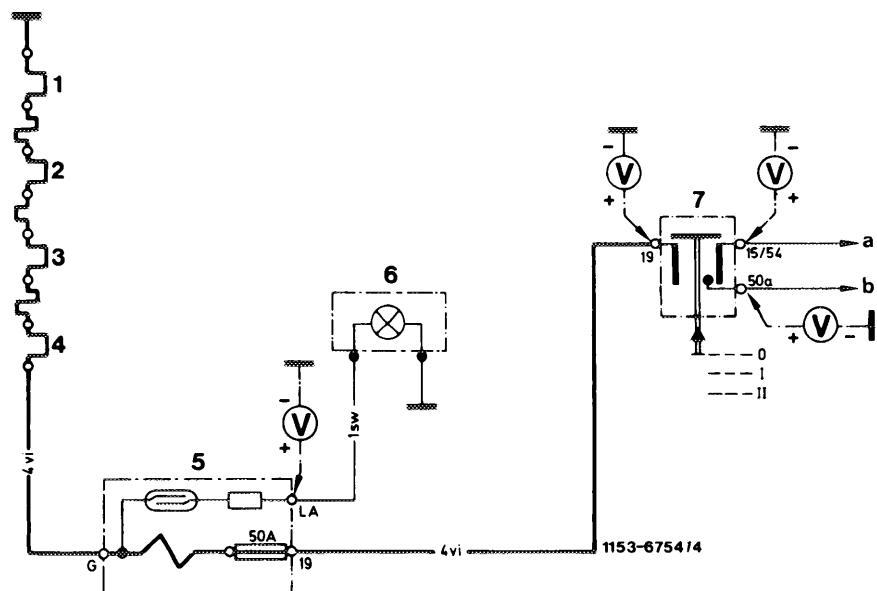
If this glow current is exceeded, a short-circuit in preglow system is indicated (glow plugs, preglow starter switch).

If a glow plug is lost as the result of a short-circuit, exchange plug and measure glow current once again.

**c) Preglow system glows, but preglow indicator lamp not indicating**

Connect voltmeter to connection LA of fuse box (5) and to ground. Actuate preglow system and read voltage on voltmeter.

If voltage indicates approx. 12 volts, check bulb and feed lines of preglow indicator lamp (pay attention to tight seat of bulb in socket).



If voltmeter indicates 0 volt, measure preglow current.

If approx. 50–55 amps are measured, the reed contact of the fuse box is defective and the fuse box must be replaced.

If a low glow current is measured, a transfer resistance in preglow system is indicated or the battery is insufficiently charged.

Check connections of glow plugs for tight seat and recharge battery, if required.

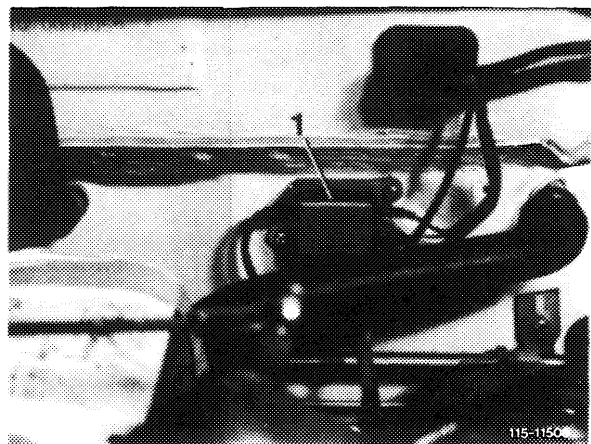
### C. With ready-for-starting lamp engine 615,616 in model 123.1

#### a) Preglow system not preglowing

This complaint is based on an interruption in current circuit of preglow system.

##### **Attention!**

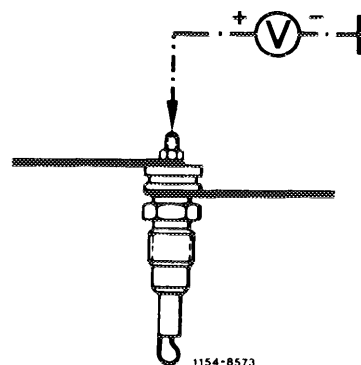
Preglow system is fused. Check fuse. (The separate fuse box is mounted on front wall of engine compartment).



Set voltmeter to measuring range 0–16 volts. Connect plus cable of voltmeter to input of glow plug of 4th cylinder and connect minus cable to ground. Operate preglow system and read voltage on voltmeter.

If voltmeter indicates 12 volts, look for fault on glow plugs or their connections.

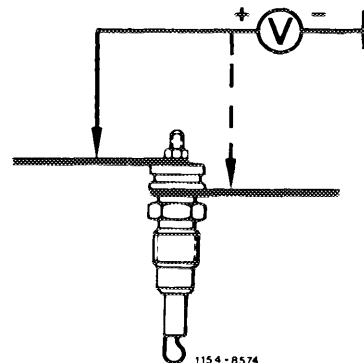
If voltmeter indicates 0 volt, look for fault on preglow starter switch or its connections.



#### 1. Check glow plugs for interruption

Connect minus cable of voltmeter to ground. Check voltage with plus cable of voltmeter at current input and current output of the four glow plugs.

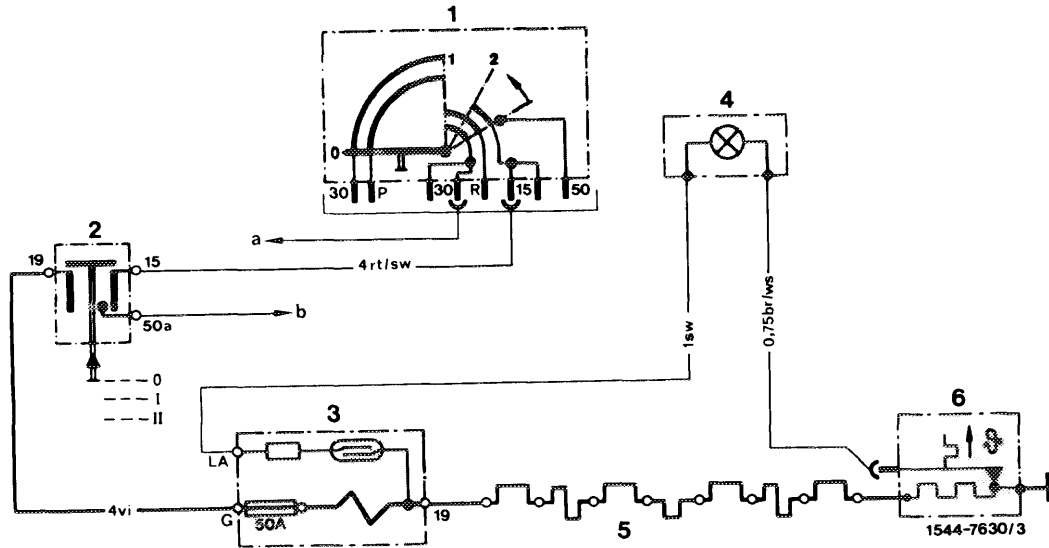
If 12 volts are measured at current input of a glow plug and 0 volt at output, this glow plug is interrupted and must be replaced.



## 2. Checking preglow starter switch and connections

Connect minus cable of voltmeter to ground.  
Measure the following values with plus cable of voltmeter at connections of preglow starter switch:

In starter position 0 (key in steering lock in position "2") on terminal 15 = 12 volts.



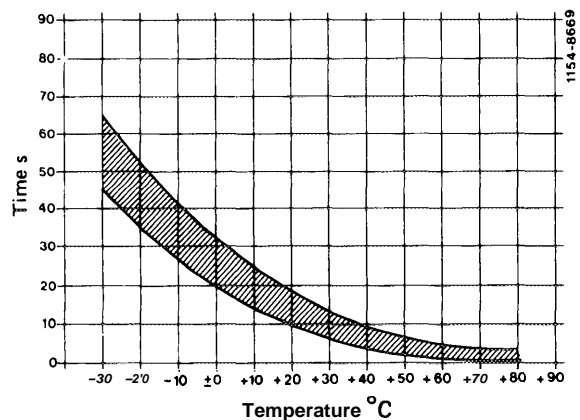
If voltage at terminal 15 = 0 volt, check line to steering lock switch or steering lock switch itself as well as the respective connection.

Voltage in switch position I and II on terminal 19 and 50a = approx. 11 volts.

If voltage on terminal 19 and 50a = 0 volt, replace preglow starter switch.

### b) Preglow system preglows too slow or too fast

Nominal time at: +20 °C approx. 12 seconds  
- 5 °C approx. 30 seconds



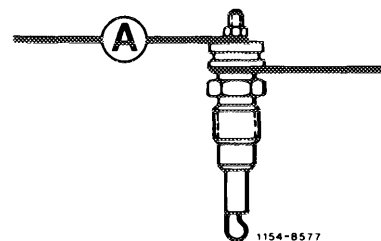
Glow period at 52 amps



This complaint is caused by insufficient current flowing through preglow system as the result of transfer resistances, or too much current as the result of a short-circuit.

Measure glow current first with ammeter.

For this purpose, connect ammeter to connection of glow plug for cylinder 4.

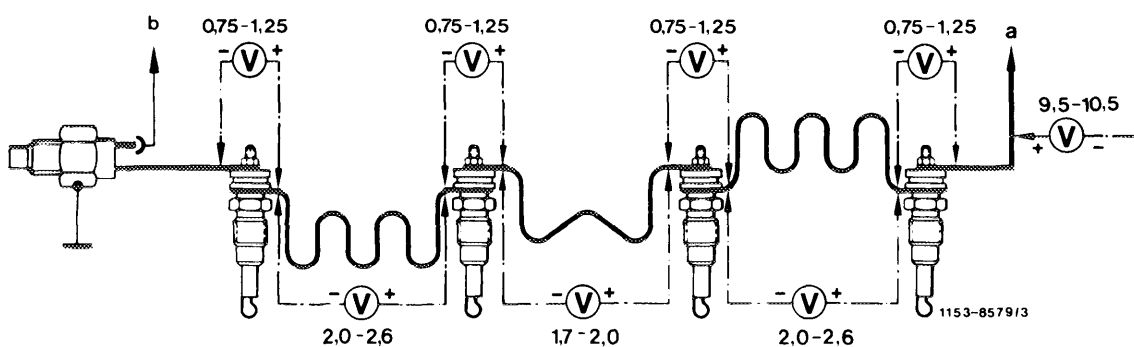


**Glow current in preglow position: approx. 50–55 amps.**

Measured after 15 seconds (battery charged at least 60 %).

If this glow current is not attained, measure voltage drop in preglow system with voltmeter.

Check connections for tight seat.



- a To fuse
- b To preglow indicator lamp

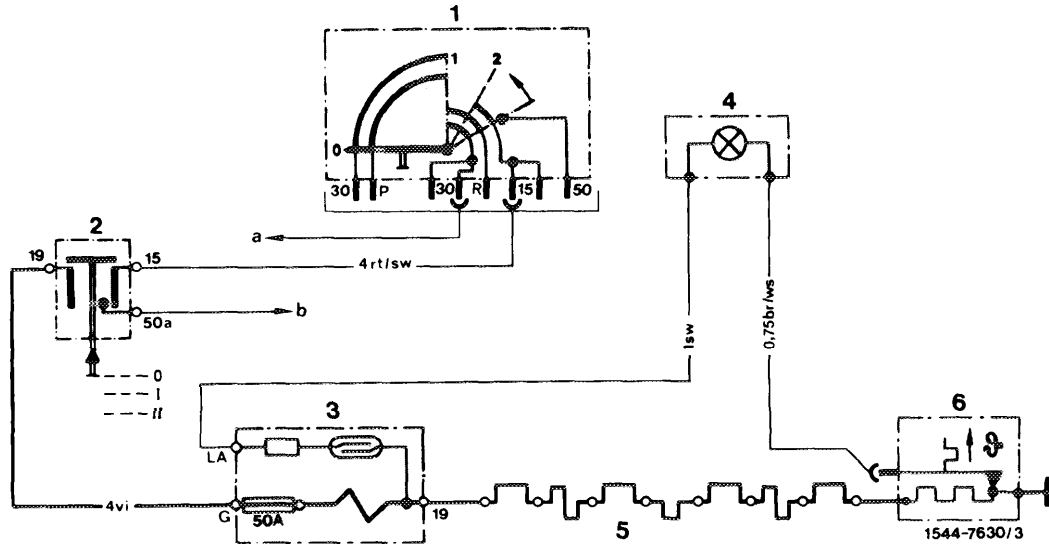
If this glow current is exceeded, a short-circuit in preglow system is indicated (glow plugs, preglow starter switch).

If a glow plug is lost by a short-circuit, measure glow current once again after replacing plug.

**c) Preglow system glows, but preglow indicator lamp not indicating**

Connect voltmeter to connection LA of fuse box (3) and to ground. Actuate preglow system and read voltage on voltmeter.

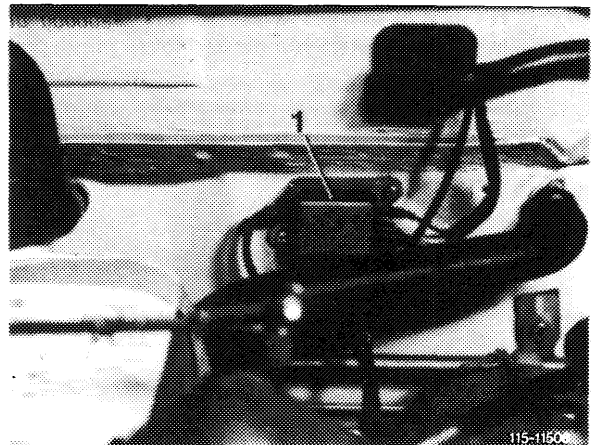
If voltmeter indicates approx. 12 volts, check bulb and feed line of preglow indicator lamp (pay attention to tight seat of bulb in socket).



Pull coupler from thermo time switch and connect directly to ground. Actuate preglow system. If preglow indicator lamp lights up, replace thermo time switch.

If voltmeter indicates 0 volt, measure preglow current.

If approx. 50–55 amps are measured, the reed contact of fuse box is defective and the fuse box must be replaced.



If the glow current measured is too low, a transfer resistance in preglow system is indicated or the battery is insufficiently charged.

Check connections of glow plugs and preglow starter switch for tight seat and recharge battery, if required.

#### D. With key start system engine 617 in model 115.1

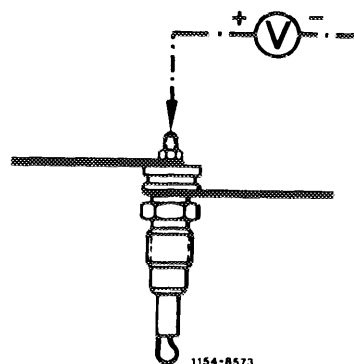
##### a) Preglow system not preglowing

---

This complaint is the result of an interruption in circuit of preglow system.

Adjust voltmeter to measuring range 0–16 volts. Connect plus cable of voltmeter to input of glow plug of 5th cylinder and connect minus cable to ground. Turn key on steering lock starter switch to position "2" and read voltage on voltmeter.

If voltmeter indicates 12 volts, look for interruption on glow plugs or their connections.

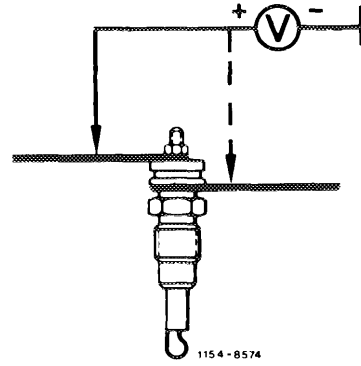


If voltmeter indicates 0 volt, look for interruption at preglow time relay or its connections.

### 1. Checking glow plugs for interruption

Connect minus cable of voltmeter to ground. Check voltage with plus cable of voltmeter at current input and output of the five glow plugs.

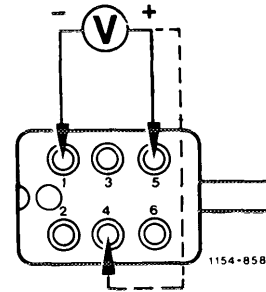
If 12 volts are measured at current input of a glow plug and 0 volt at output, this glow plug is interrupted and must be replaced.



### 2. Checking preglow time relay and its connection

Turn key of steering lock starter switch to position "2".

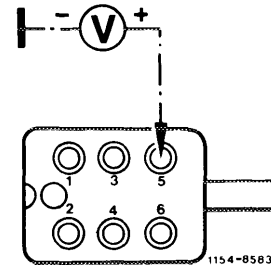
Pull coupler from preglow time relay. Connect minus cable of voltmeter to socket 1 of coupler. Check socket 5 and 4 one after the other with plus cable of voltmeter. If voltmeter indicates each time 12 volts, replace preglow time relay.



If voltmeter indicates 0 volt, connect minus cable of voltmeter to ground. Check at socket 5 of voltmeter with test cable.

If voltmeter indicates 12 volts, line 31 to socket 1 is interrupted.

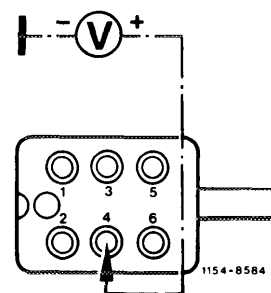
If voltmeter indicates 0 volt, line 30 to socket 5 is interrupted.



Then check socket 4 with plus cable of voltmeter.

If voltmeter indicates 0 volt, line 15 to socket 4 is interrupted.

In the event of complaints, check lines or connections for a loose contact.

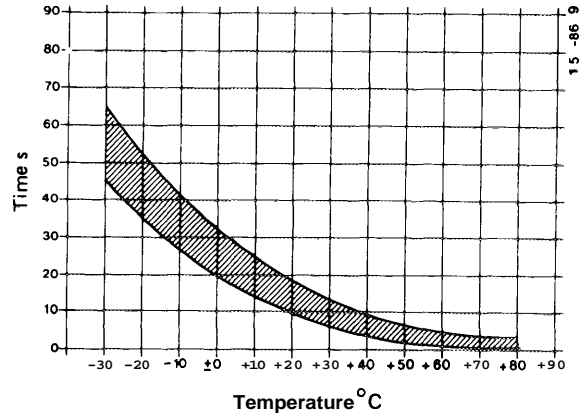


**b) Preglow system preglows too slowly or too fast**

Nominal time at: +20 °C approx. 12 seconds  
 - 5 °C approx. 30 seconds

This complaint is caused by insufficient current flowing through preglow system as a result of transfer resistances or too much current as the result of a short-circuit.

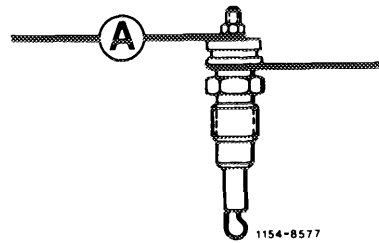
Glow period at 52 amps



Measure glow current with ammeter first. For this purpose, connect ammeter to connection of glow plug for cylinder 5.

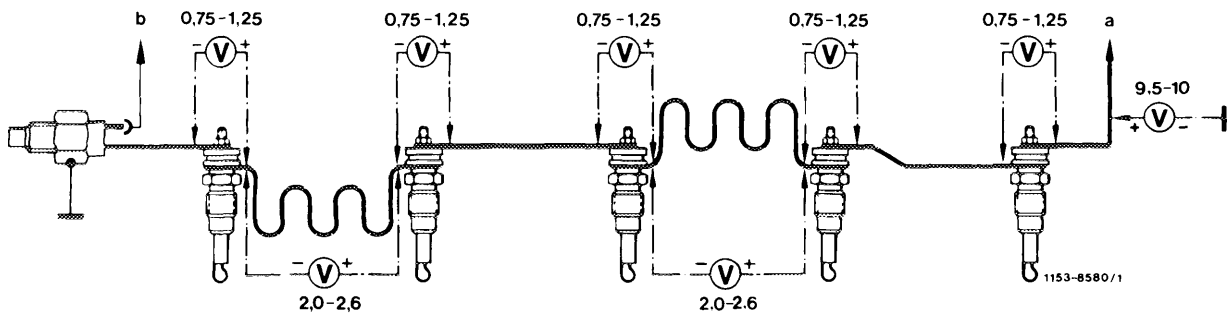
**Glow current in preglow position: 50--55 amps.**

Measured after approx. 15 seconds (battery charged at least 60 %).



If this glow current is not attained, measure voltage drop in preglow system with voltmeter.

Check connections for tight seat.



- a To fuse
- b To preglow indicator lamp

### Attention!

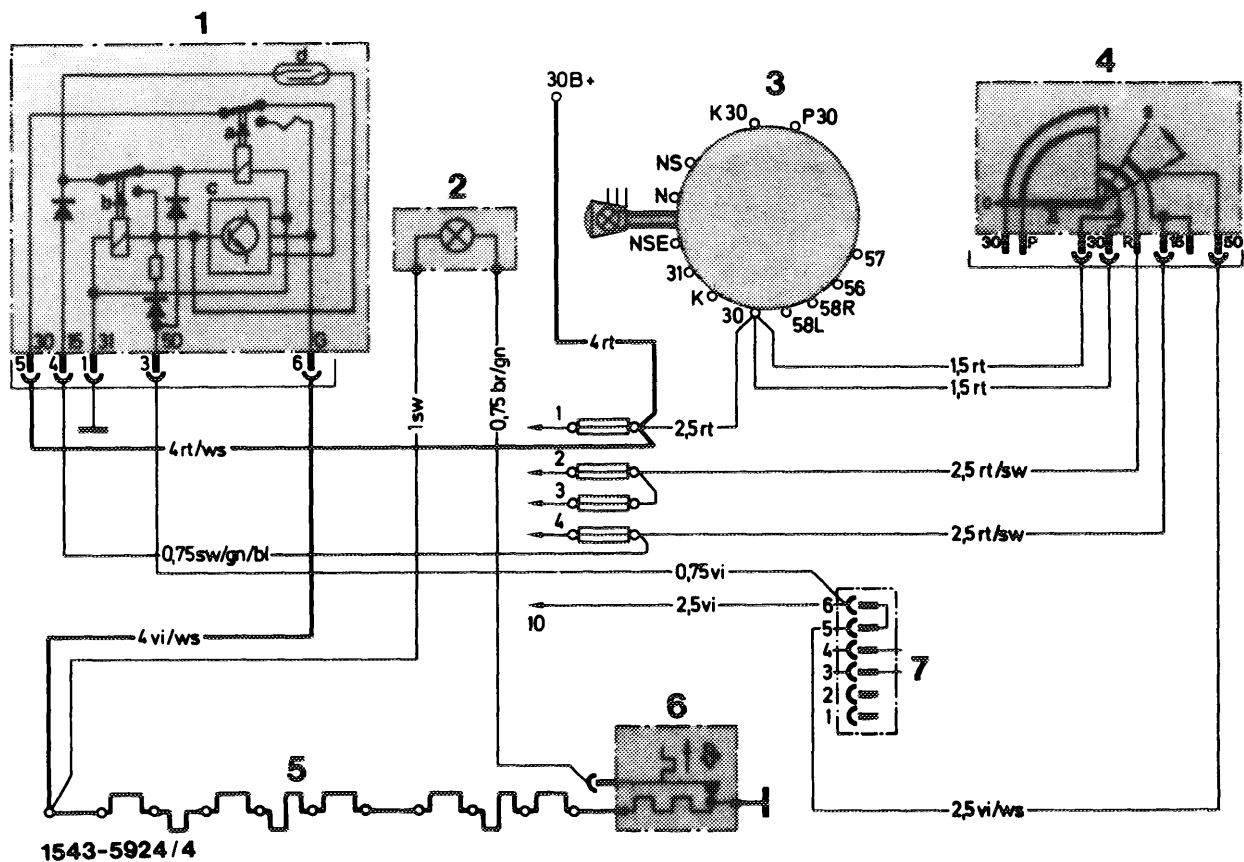
When checking the voltage, connections of glow plugs, as well as the resistance conductors may not be shorted against ground (screwdriver against engine block), since this may lead to failure of preglow time relay.

If this glow current is exceeded, a short-circuit on preglow system is indicated.

If one of the glow plugs is lost by a short-circuit, change glow plug and measure preglow current once again.

### c) Preglow system glows, preglow indicator lamp not indicating

1. Check line from glow plug cylinder 5 to preglow indicator for interruption.
2. Check bulb of preglow indicator lamp in instrument cluster (pay attention to tight seat of bulb in socket).



## E. With key starting system engine 615, 616,617 in model 123.1

### **Preglow system in general**

---

Glow plugs are connected in series. The current flows across glow plugs from cylinder (5-) 4-3-2-1 to ground. Each glow plug is designed for a voltage of 0.9 volt at a max. current of 63 amps.

For this reason, the glow plugs are connected to resistance conductors, on which the remaining voltage is consumed (drops). The resistance conductors will also become red hot during preglowing.

The extent of the preglow current is determined by the total resistance in the preglow system (glow plugs plus resistance conductors).

Consequently, the cores for a burnt-out glow plug or a defective fuse under influence of an excessively high current flow can never be the preglow time relay. In such cases there is a reduction of total resistance in preglow system (e. g. short circuit to ground of one or several glow plugs by coking or by contact with pre-chamber).

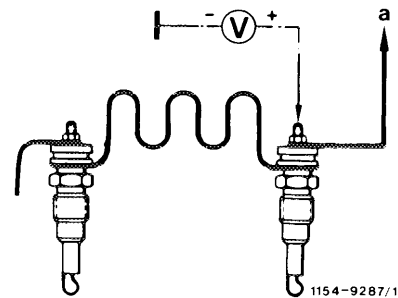
A ground short on glow plug results in varying effects in preglow system. A glow plug ground short of the 4th or 5th cylinders, for example, will immediately make the fuse defective, while in the event of a glow plug ground short of the 3rd cylinder, the glow plug of the 4th cylinder will burn out (perhaps after several preglowing operations, as the case may be). Therefore, in the event of a burnt-out glow plug, always test the prior glow plug for a ground short and replace, if required.

a) **Preglow** system not preglowing

---

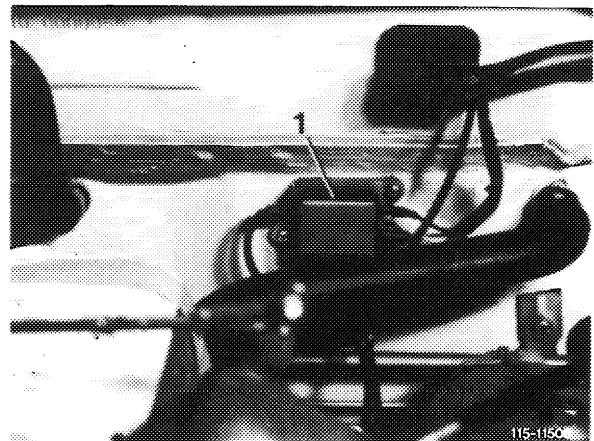
This complaint is caused by an interruption in current circuit of preglow system.

For accurate determination of fault source (whether glow bulbs or other components), connect voltmeter (measuring range 0–30 volts) to current input of glow plug of 4th or 5th cylinder and to vehicle ground and read voltage (preglow system engaged).



Readout approx. 12 volts = interruption at glow plugs including connections (but not at preglow time relay).

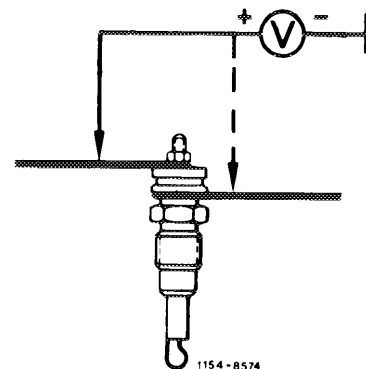
Readout 0 volt = fuse defective, preglow time relay or activation of relay defective.



1. Check glow plugs for interruption

Connect negative cable of voltmeter to ground. Check voltage by means of positive cable of voltmeter connected to current input and output of 4 or 5 glow plugs (while disconnecting ground of glow plugs on 1st cylinder).

If 12 volts are measured at current input of a glow plug and 0 volt at output, this glow plug is interrupted and must be replaced.



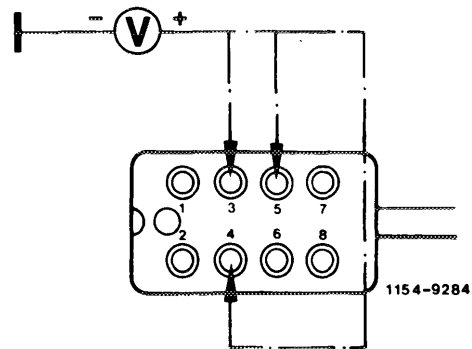


### Attention!

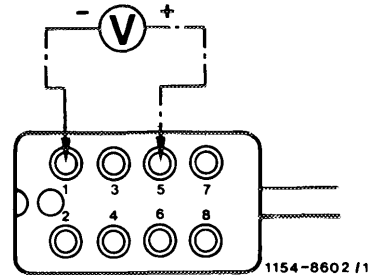
Never short connections of glow plugs or resistance conductors against ground (e. g. screw driver against engine block); this may result in failure of preglow time relay!

## 2. Testing preglow time relay and connections

Pull coupler from preglow time relay. Connect negative cable of voltmeter to vehicle ground. Check voltage at jack 5, 4 and 3 one after the other by means of positive cable, at jack 3, the starter should be actuated.



Then connect negative cable of voltmeter to jack 1 and positive cable to jack 5 and measure voltage.



### Nominal values

Jack 5 = approx. 12 volts (terminal 30, continuous voltage)

Jack 4 = approx. 12 volts (terminal 15, preglow system engaged)

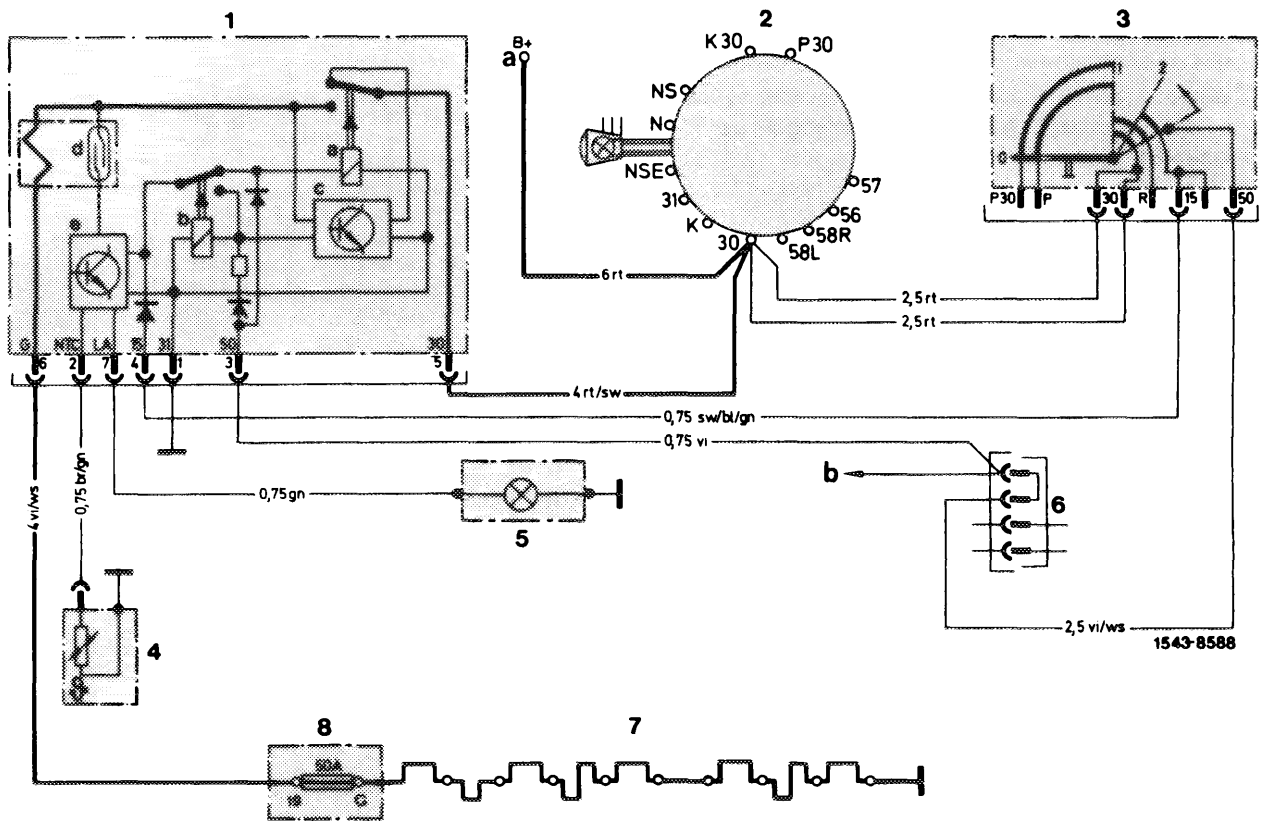
Jack 3 = approx. 12 volts (terminal 50, while starting)

Jack 1 = approx. 12 volts (terminal 31, negative line)

If 0 volt is measured at one of the jacks, test respective line for interruption or repair interruption.

If 12 volts are measured on all jacks, the preglow time relay is defective, replace preglow time relay.

Wiring diagram



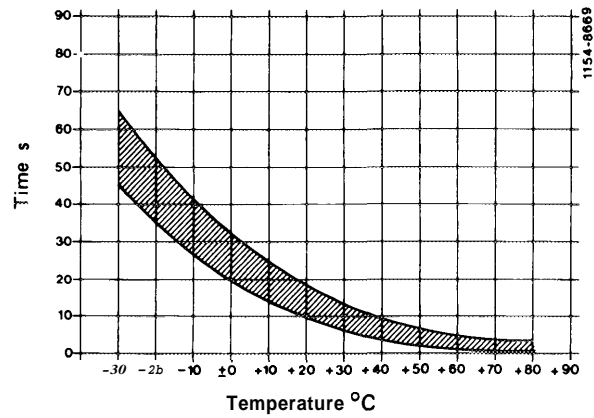
- |                                 |  |
|---------------------------------|--|
| 1 Preglow time relay            | 6 Line connector (engine harness)      |
| 2 Rotary light switch           | 7 Glow plugs and resistance conductors |
| 3 Steering lock starting switch | 8 Fuse                                 |
| 4 Temperature sensor            | a To battery                           |
| 5 Ready-for-starting indicator  | b To starter                           |

**b) Preglowing system glowing too slowly or too fast**

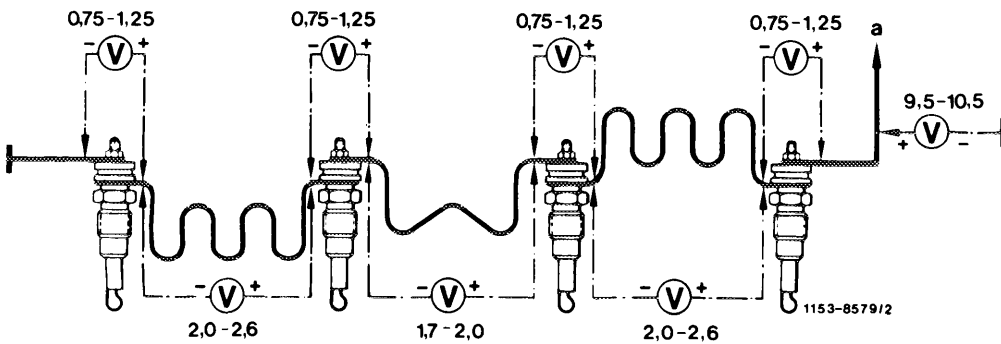
Nominal time at: + 20 °C/68 °F approx. 12 seconds  
 - 5 °C/23 °F approx. 30 seconds

Preglowing system preglows too slowly because not enough current can flow through transition resistances in glow plugs or on connections.

Preglowing system preglows too fast because too much current flows through one or several glow plugs due to ground short.

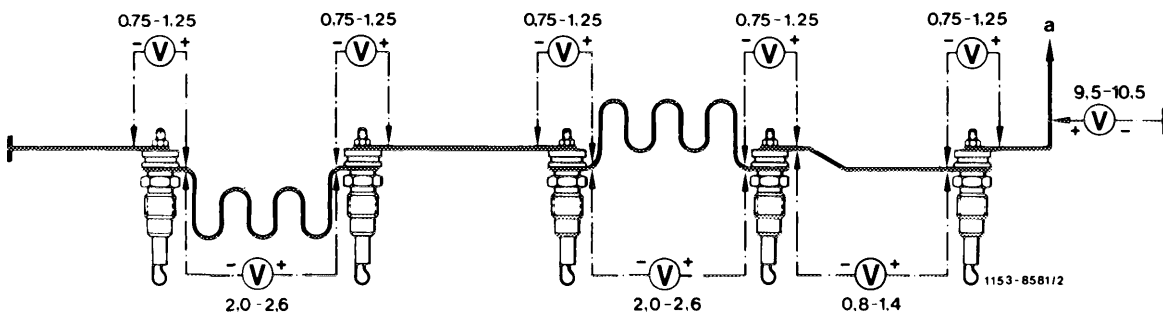


These faults can be found by measuring voltage drop of each glow plug. Measure voltage on glow plugs at current input and output with test points of voltmeter (measuring range 0-3 volts).



Engine 615, 616

a To fuse



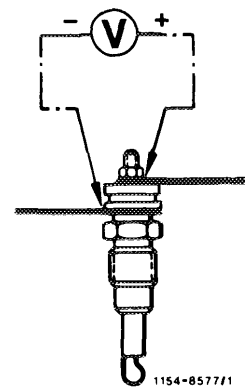
Engine 617

a To fuse

**Attention!**

Measure as close as possible to glow plug, since otherwise measuring faults (higher voltage drop) will show up by including the resistance conductors into measuring.

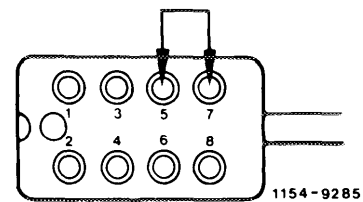
When measuring, pay attention to risk of short circuit!



**c) Preglowing system preglows, preglow indicator not lighting up or not going out**

If the preglow indicator lamp is not lighting up, pull coupler from temperature sensor — indicator lamp should now light up. In such a case, replace temperature sensor.

If the indicator lamp is not lighting up, pull coupler from preglow time relay and bridge jack 5 (terminal 30) with jack 7. If the indicator lamp is now lighting up, replace preglow time relay. If indicator lamp is not lighting up, check bulb or renew, or repair line interruption.



If the preglow indicator lamp is not going out after attaining ready-for-starting condition, connect coupler of temperature sensor to ground. If indicator lamp is now going out, the temperature sensor is interrupted and should be replaced. If the indicator lamp is not going out, the preglow time relay is defective or the line to relay is interrupted. Replace preglow time relay or repair line interruption.

**Note:** The temperature sensor can be tested with an ohmmeter.

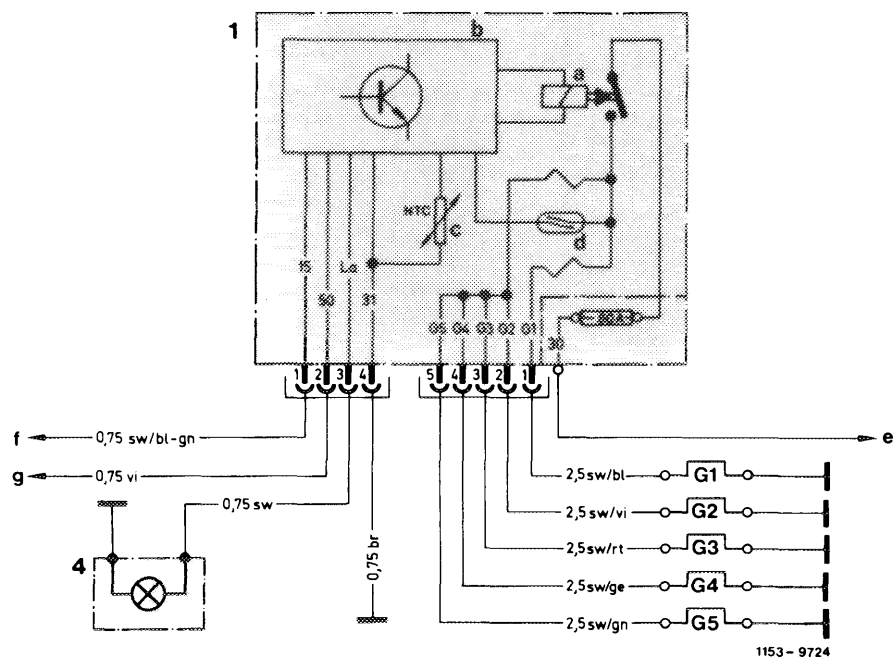
Resistance values according to coolant temperature:

0 °C/0 °F = approx. 8500 ohms  
+25 °C/77 °F = approx. 2500 ohms  
+80 °C/176 °F = approx. 300 ohms

At readout of 0 ohm, the temperature sensor has a short circuit, at readout ∞ ohm, the temperature sensor is interrupted and should be replaced.

## F. Quick-start preglow system engine 615, 616, 617.91 in model 123.1

### Wiring diagram



- 1 Preglow time relay  
 a Power relay  
 b Electronic unit  
 c Temperature sensor (NTC-resistor)  
 d Reed relay  
 e To starter terminal 30  
 f To fuse box terminal 15  
 g To plug connection starter lockout and backup lamp switch terminal 50  
 4 Preglow indicator lamp  
 G 1 – G5 Pencil element glow plugs

**Note:** On engine 615, 616, pencil element glow plug G5 is not required.

### 1. Test bulb and its line

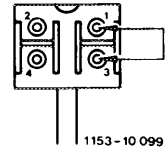
#### Complaint:

Preglow indicator lamp not lighting up when preglowing system is switched on, in spite of ready-for-starting condition.

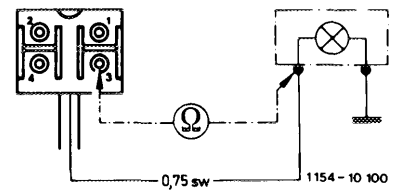
**Remedy:**

Pull 4-point coupler from preglow **time** relay, turn key into position "2", bridge jack 1 and 3 for coupler.

If preglow indicator lamp is not lighting up, check bulb or renew, if required.



If bulb is in order, check black line from coupler of jack 3 of preglow time relay up to preglow indicator lamp for interruption, repair interruption.



If preglow indicator lamp is lighting up, the preglow time relay is defective and should be replaced.

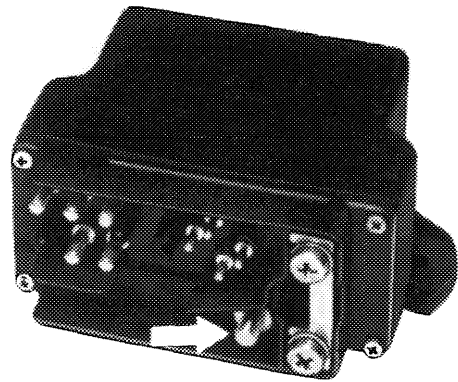
**2. Test main current circuit of preglow system for interruption**

Complaint:

**Preglow** indicator lamp not lighting up, engine cannot be started.

Remedy:

Measure voltage at terminal 30 of preglow time relay against ground by means of voltmeter.

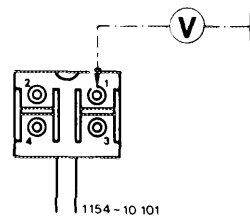


115-20011/1

If no voltage is indicated, check red line from starter terminal 30 up to preglow time relay terminal 30 for interruption, and, repair interruption, if required.

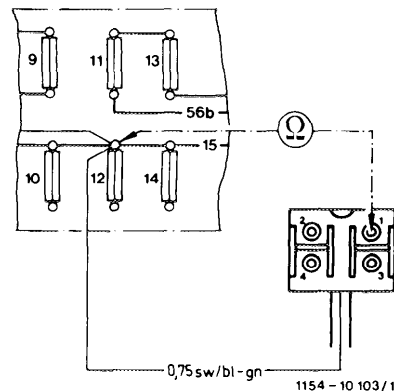
If voltage is indicated (approx. 12 volts), test 80-amp fuse for tight seat or interruption and renew, if required.

If so far no fault has been found, test voltage at jack 1 of 4-point coupler of preglow time relay against ground.



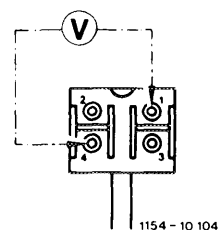


If no voltage is indicated with preglow system switched on, test black/blue-green line from fuse box terminal 15 up to coupler jack 1 of preglow time relay for interruption and repair interruption, if required.



If voltage is indicated (approx. 12 volts), connect voltmeter to jack 1 (terminal 15) and jack 4 (terminal 31) and test voltage (should be approx. 12 volts).

If no voltage is indicated, test brown line from jack 4 to ground for interruption and repair interruption, if required.



If so far no fault has been found, preglow time relay is defective, replace preglow time relay.

### 3. Test pencil element glow plugs and **their lines**

Complaint:

Preglow indicator lamp not lighting up, engine firing poorly, one or several pencil element glow plugs or their lines to pencil element glow plugs may be interrupted.

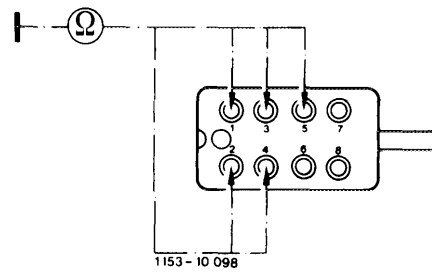
Complaint:

Preglow indicator lamp lighting up, engine firing poorly after attaining ready-for-starting condition, a pencil element glow plug or a line to pencil element glow plugs of cylinders 2–4 (2–5) may be interrupted.

Pull 6-point coupler from preglow time relay.

Measure resistance against ground (engine block) by means of ohmmeter one after the other as follows:

- Jack 1 of coupler = pencil element glow plug cylinder 1
- Jack 2 of coupler = pencil element glow plug cylinder 2
- Jack 3 of coupler = pencil element glow plug cylinder 3
- Jack 4 of coupler = pencil element glow plug cylinder 4
- Jack 5 of coupler = pencil element glow plug cylinder 5



If resistance  $\infty$  is measured, the respective pencil element glow plug or supply line or connection may be interrupted.

If measured resistance is smaller (e. g. at 20 °C/68 °F < 1 ohm), the supply line and the pencil element glow plug is in order.

Note: It is possible that (as the result of unfavorable tolerances) the indicator lamp will indicate a fault only after 2 pencil element glow plugs in cylinders 2–5.

To make sure that the fault indication in preglow time relay is not defective, disconnect 2 pencil element glow plugs of cylinders 2–4 (2–5) in such a case and repeat preglow procedure.

If warning lamp now indicates a fault (not lighting up), the preglow time relay is in order.

### 1. Filament wire torn (hair crack)

---

Cause:

Start of delivery too early or damaged nozzles (dropping, hanging).



107-16708

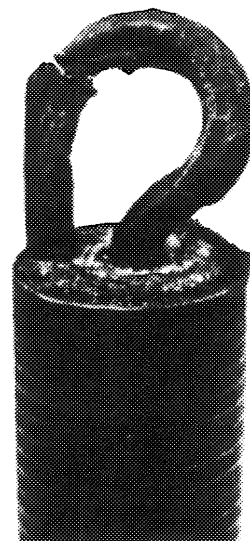
### 2. Filament wire burnt out or scorched (wire black or brown)

---

Cause:

Overheated while driving by damaged nozzles (dropping, hanging), begin of delivery too early or oil in combustion area (e. g. caused by leaking vacuum pump or damaged valve stem seal).

**Note:** If a filament wire is burnt out, always test prior glow plug. Also pay attention to deposits in glow plug bore. If coked, clean glow plug bore with reamer 617 589 00 53 00.



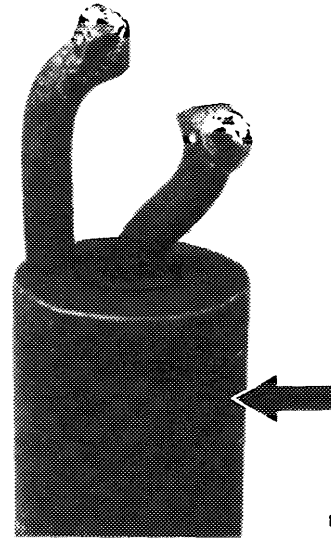
107-16706

### 3. Filament wire burnt down (wire grey)

---

Cause:

- a) Ground short on glow plug stem (outer pole, arrow) caused by coked glow plug bore (remedy by reaming glow plug bore in cylinder head). Ground short by distorted conductor resting against throttle linkage (for example at full load).
- b) Preglow time relay not switching off after starting (test preglow time relay).



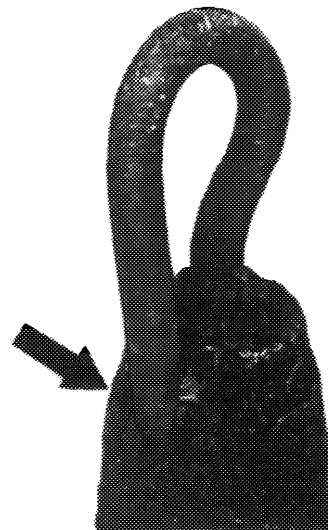
107-16707

### 4. Glow plug stem burnt out (arrow)

---

Cause:

- a) Coolant in combustion area through damaged cylinder head seal or crack in cylinder head.
- b) Water in fuel, if all glow plugs are showing the same damage pattern.
- c) Oil in combustion area caused by leaking vacuum pump, damaged valve stem seal or excessively high engine oil level (e. g. considerable internal leaking of injection pump with engine circulation lubrication).



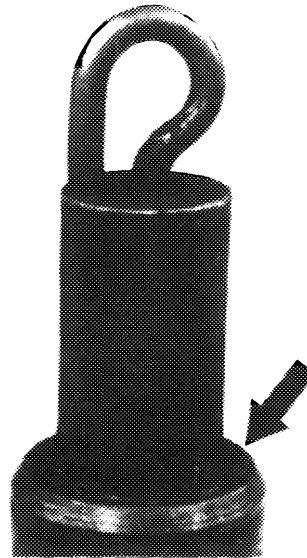
107-16709

## 5. Ground short between glow plug stem and housing

---

### Cause:

Oil carbon, as the result of predominating short-distance operation, excessively early begin of delivery or metallic particles (e. g. chips).



107-16710

**Tightening torque**

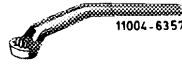
Nm

Glow plugs

50

**Special tools**

Box wrench



617 589 00 03 00

Reamer



617 589005300

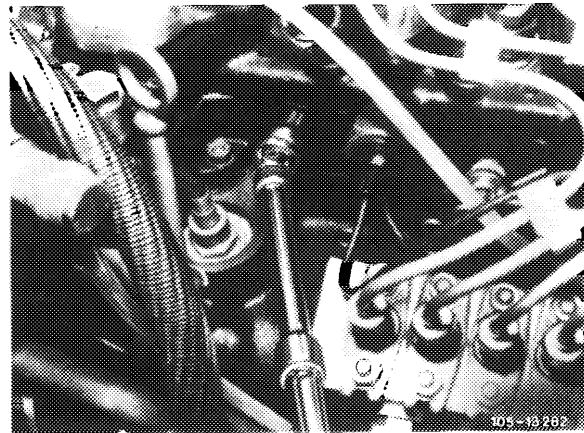
**Removal**

- 1 Unscrew all nuts, remove connecting line, connection insulators and conductors.
- 2 Unscrew glow plugs with box wrench.

**Installation**

3 Prior to installing glow plugs, clean glow plug channels and bores in prechambers with reamer. For this purpose, fill flutes of reamer with grease and ream glow plug channels.

**Note:** In the course of time, oil carbon will settle in glow plug channels. This may result in a ground connection of glow plugs.



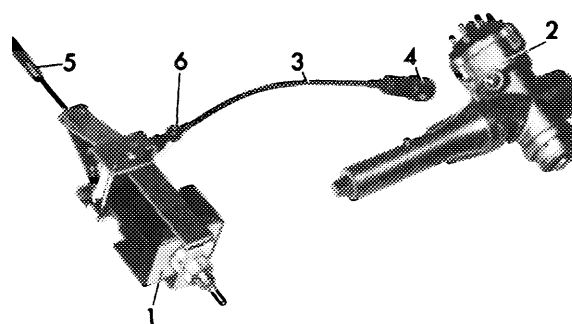
- 4 After reaming glow plug channels, crank engine several times with starter motor, so that the residue is blown out of combustion chamber.
- 5 Install glow plugs, connect to conductors, connect connection cable and attach with nuts.
- 7 Check glow plugs for function.

### Adjustment

---

- 1 Push start and stop control into stop position.
- 2 Unscrew adjusting screw (6) until steering lock switch is released. Then unscrew by an additional 1 to 1 1/2 turns and counterlock adjusting screw.

- |                          |                           |
|--------------------------|---------------------------|
| 1 Preglow starter switch | 4 Cap nut M 10            |
| 2 Steering lock switch   | Part no. 001 587 01 00 01 |
| 3 Cable control          | 5 Start and stop control  |
|                          | 6 Adjusting screw         |



154-9749

- 3 Check adjustment.

#### Attention!

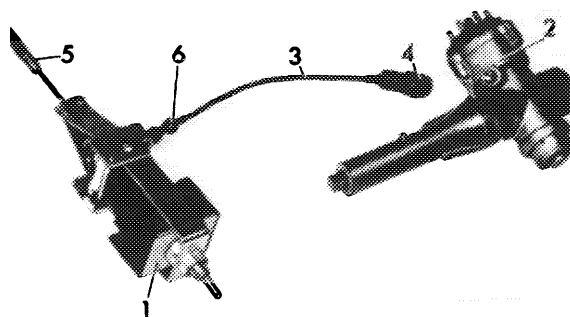
If the preglow starter switch is in driving position, actuation of key in steering lock switch should not be possible.

## A. Model 115.1

### Removal

---

- 1 Remove instrument cluster.
- 2 Unscrew pull knob and rosette and pull preglow starter switch (1) into range of combination cutout.
- 3 Unscrew cable control (3) from steering lock switch (2).
- 4 Loosen start and stop control (5) to injection pump on preglow starter switch and disconnect.
- 5 Pretension cable control with cap nut (4), disconnect on preglow starter switch and unscrew.
- 6 Disconnect electric lines.



- |                           |                          |
|---------------------------|--------------------------|
| 1 Preglow starter switch  | 5 Start and stop control |
| 2 Steering lock switch    | 6 Adjusting screw        |
| 3 Cable control           |                          |
| 4 Cap nut M 10            |                          |
| Part no. 001 587 01 00 01 |                          |

154-9749

### Installation

---

- 7 For installation proceed vice versa.

Connection of electric lines:

Color <b>red/black</b>	Terminal 54	2.5 mm <sup>2</sup>
Color <b>purple/white</b>	Terminal 50a	2.5 mm <sup>2</sup>
Color <b>purple/white</b>	Terminal 17	4 mm <sup>2</sup>
Color purple / <b>blue</b>	Terminal 19	4 mm <sup>2</sup>



## B. Model 123.1

### Removal

---

1 Remove start and stop control on injection pump and Bowden wire for idle speed adjuster on guide lever at cylinder head cover.

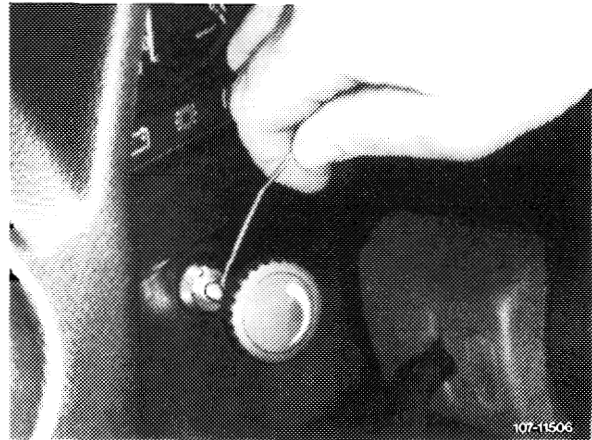
2 Remove pull-push knob on instrument panel. For this purpose, insert a wire through bore of pull-push knob and press off cover.

3 Unscrew hex nut and remove pull-push knob.

4 Unscrew fastening nut on instrument panel and pull out preglow starter switch with Bowden wires in downward direction.

#### Attention!

Avoid buckling of Bowden wires.



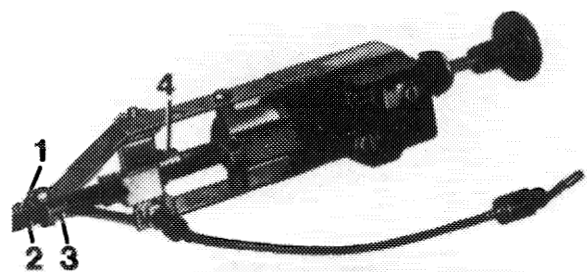
5 Remove Bowden wires.

a) Remove start and stop control (1). For this purpose, force off lock (4).

b) Remove Bowden wire for idle speed adjuster (2). For this purpose, remove clamp (3), unscrew wire coil, lift slightly and pull out.

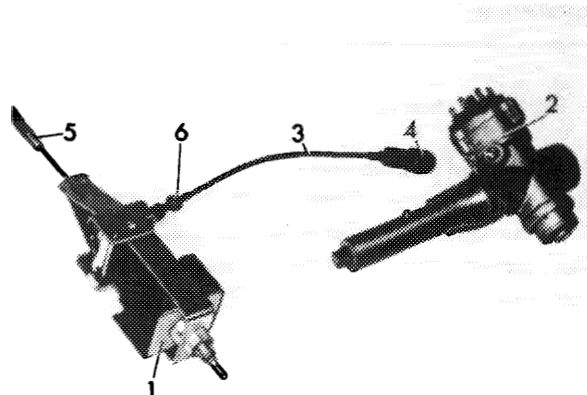
1 Start and stop control  
2 Bowden wire for idle  
speed adjuster

3 Clamp  
4 Lock



107-11304

6 Unscrew cable control (4) on steering lock switch (2).



154-9749

**7 Disconnect electric lines and remove preglow starter switch.**

### **Installation**

---

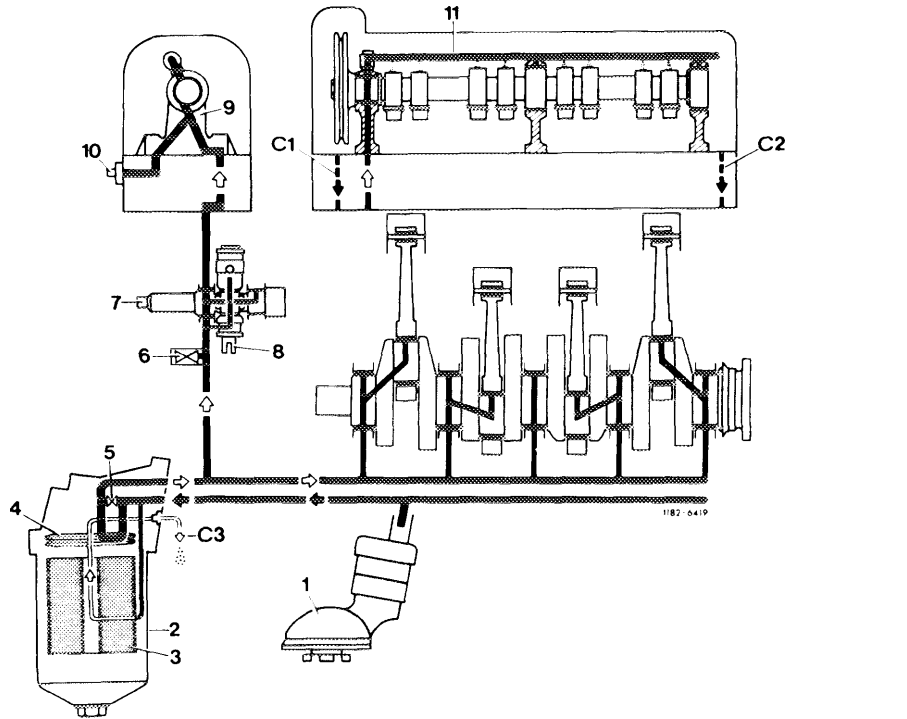
**8 For installation proceed vice versa.**

**Connection of electric lines:**

<b>Color red/black</b>	<b>Terminal 15/54</b>
<b>Color purple</b>	<b>Terminal 19</b>
<b>Color purple/white</b>	<b>Terminal 50</b>

A. Model 115.1

Oil circuit



- |                                 |                                 |   |
|---------------------------------|---------------------------------|---|
| 1 Oil pump                      | 6 Pressure relief valve         | 11 Oil pipe   |
| 2 Oil filter                    | 7 Intermediate gear shaft       | C1 Oil return flow front                                      |
| 3 Bypassfilter element          | 8 Worm gear for oil pump        | C2 Oil return flow bore rear                                  |
| 4 Main flow filter element      | 9 Camshaft bearing sprocket end | C3 Oil return flow via throttle of bypass filter into oil pan |
| 5 Overflow valve filter element | 10 Chain tensioner              |   |

**Air oil cooler and thermostat in oil filter**

Engine with air oil cooler

thermostat in oil filter

615.912 up to chassis end No. 400248

—

616 general

—

617 general

general

## Oil pressure

At operating temperature, the oil pressure at idle may drop to 0.5 bar gauge pressure (0.5 atü). During acceleration, the oil pressure should rise again immediately and should attain at least 3 bar gauge pressure (3 atü) at 3000/min.

Opening pressures of pressure relief valves	bar gauge pressure	(atü)
Bypass valve – filter element	3.5	(3.5)
Bypass valve – air oil cooler	1.5	(1.5)
Pressure relief valve in main oil duct front engine 615	5.0	(5.0)
Pressure relief valve on oil pump engine 616,617	8.0 or 7.0	(8.0 or 7.0 atü)
<b>Thermostat – oil filter engine 617</b>		°C
Begin of opening		95 ± 4
Fully opened		110 ± 4

## Pressure relief valve

On engine 615, the pressure relief valve is screwed in or on, respectively, main oil duct at engine face and on engines 616/617 at oil pump.

If there is no oil pressure or if the oil pressure is too low, check whether oil pressure relief valve on oil pump has dropped or become loose.

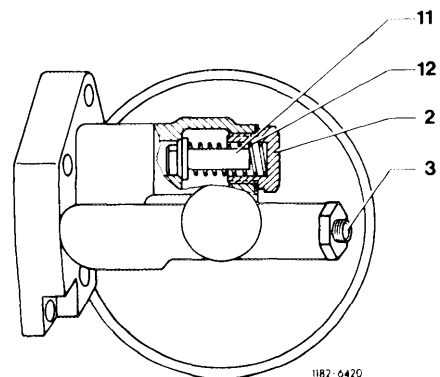
In both cases, coat threads of oil pressure relief valve with sealing compound, part No. 002 989 94 71 and screw-in.

## Bypass valve in oil filter

The bypass valve (11) opens when the difference in pressure between the dirty side and the clean side of filter exceeds 3.5 bar gauge pressure.

This will happen when the filter element is heavily contaminated. The oil will then flow to engine in uncleaned condition.

- 2 Closing plug with sealing ring
- 3 Connection for oil pressure gauge
- 11 Star valve (overflow valve – filter element)
- 12 Compression spring



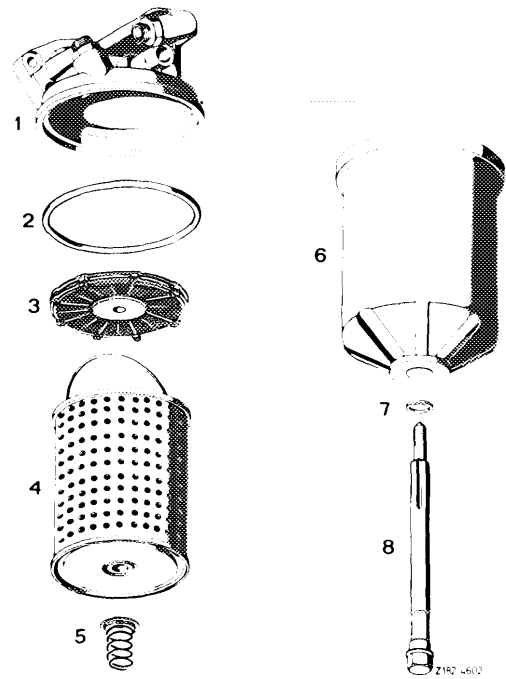
## Oil filter

The main and bypass filter elements are separately located.

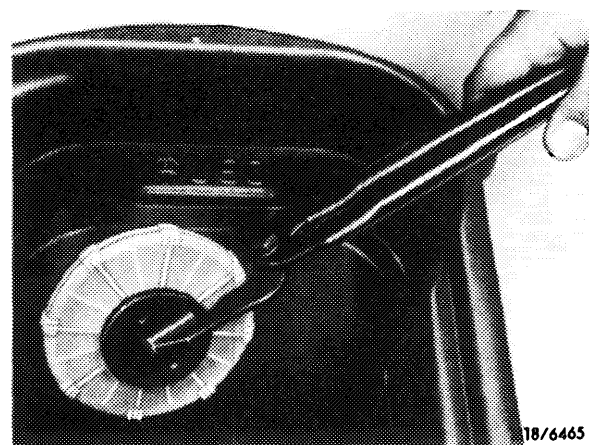
During first inspection (500–1000 km), replace initial operation filter element with filter cartridge (4) and main flow filter plate element (3).

Then replace filter cartridge during oil change every 5000 km.

- 1 Filter top
- 2 Sealing ring
- 3 Main flow filter element
- 4 Bypass filter element
- 5 Compression spring with spring retainer
- 6 Filter bottom
- 7 Sealing ring
- 8 Hex. bolt



Clean main flow filter plate element with holding pliers 110 589 00 68 00 in benzine.

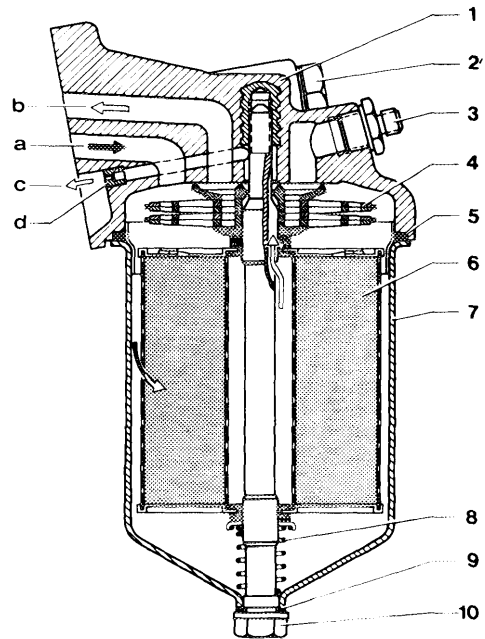


18/6465

## Operation

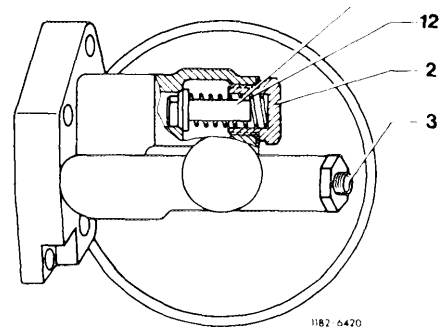
### Engines 615 and 616

Coming from feed duct (a), the oil flows into oil filter housing. The major portion of the oil flows through main flow filter element (4) and via duct (b) into main oil duct and to the bearing points. The remaining oil flows from outside through bypass filter element (6) where it is finely filtered and from there across a groove in hex. bolt (10) through throttle bore (d) back into oil pan.



### Engine 615

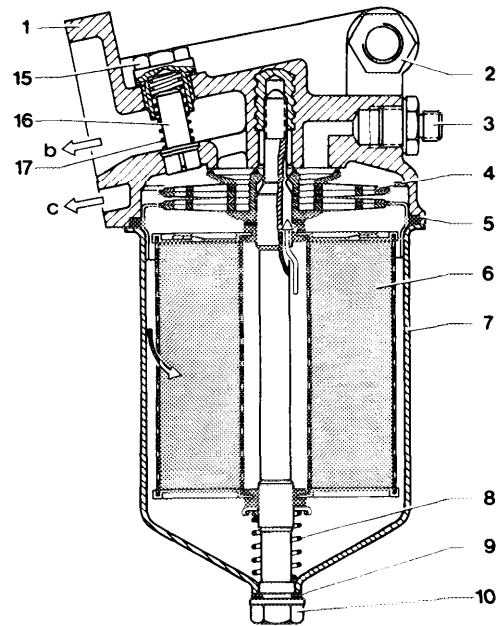
- 1 Filter top
- 2 Closing plug with sealing ring
- 3 Connection for oil pressure gauge
- 4 Main flow filter element
- 5 Sealing ring
- 6 Bypass filter element
- 7 Filter bottom
- 8 Compression spring with spring retainer
- 9 Sealing ring
- 10 Hex. bolt
- 11 Star valve (overflow valve - filter element)
- 12 Compression spring
- a Uncleaned oil to filter
- b Cleaned oil to lube points
- c Cleaned oil from bypass filter element into oil pan
- d Throttle (also installed on engines 616, 617.91)



## Engine 616

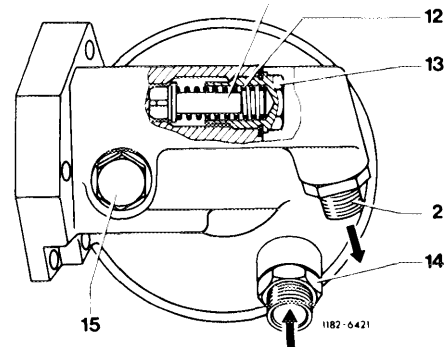
Starting at a differential pressure of approx. 1.5–1.7 bar, the oil will flow directly to main and bypass filter element.

Below approx. 1.5–1.7 bar differential pressure, the bypass valve (11) will close. The oil will now flow via air oil cooler to main and bypass filter element.



## Engine 616

- 1 Filter top
- 2 Screw connection with sealing ring (uncleaned oil to oil cooler)
- 3 Connection for oil pressure gauge
- 4 Main flow filter element
- 5 Sealing ring
- 6 Bypass filter element
- 7 Filter bottom
- 8 Compression spring with spring retainer
- 9 Sealing ring
- 10 Hex. bolt
- 11 Star valve (bypass valve – air oil cooler)
- 12 Compression spring
- 13 Closing plug with sealing ring
- 14 Screw connection with sealing ring (uncleaned oil from oil cooler)
- 15 Closing plug with sealing ring
- 16 Star valve (overflow valve – filter element)
- 17 Compression spring
- b Cleaned oil to lube points
- c Cleaned oil from bypass filter element into oil pan



## Engine 617

Starting at an oil temperature of approx. 95°C, thermostat (13) begins displacing control valve (12).

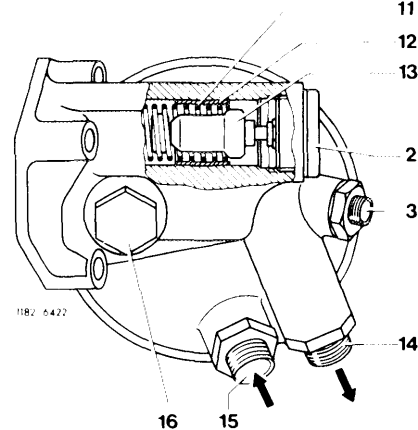
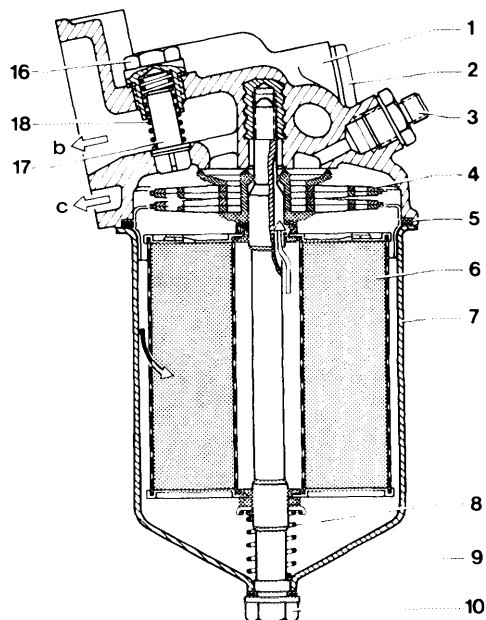
In end position, the direct flow to main or bypass filter element is closed except for a given quantity of oil.

This quantity of oil is enough to guarantee lubrication of engine at low outside temperatures when the through-flow in oil cooler is extensively prevented by the viscosity of the oil.

The major portion of the oil flows to air oil cooler and is cooled there, it will then flow back to oil filter housing and through main and bypass filter element to bearing points or oil pan.

### Engine 617

- 1 Filter top
- 2 Closing plug with sealing ring
- 3 Connection for oil pressure gauge
- 4 Main flow filter element
- 5 Sealing ring
- 6 Bypass filter element
- 7 Filter bottom
- 8 Compression spring with spring retainer
- 9 Sealing ring
- 10 Hex. screw
- 11 Compression spring
- 12 Control valve
- 13 Thermostat
- 14 Screw connection with sealing ring (uncleaned oil to oil cooler)
- 15 Screw connection with sealing ring (uncleaned oil from oil cooler)
- 16 Closing plug with sealing ring
- 17 Star valve (overflow valve – filter element)
- 18 Compression spring
- b Cleaned oil to lube points
- c Cleaned oil from bypass filter element into oil pan

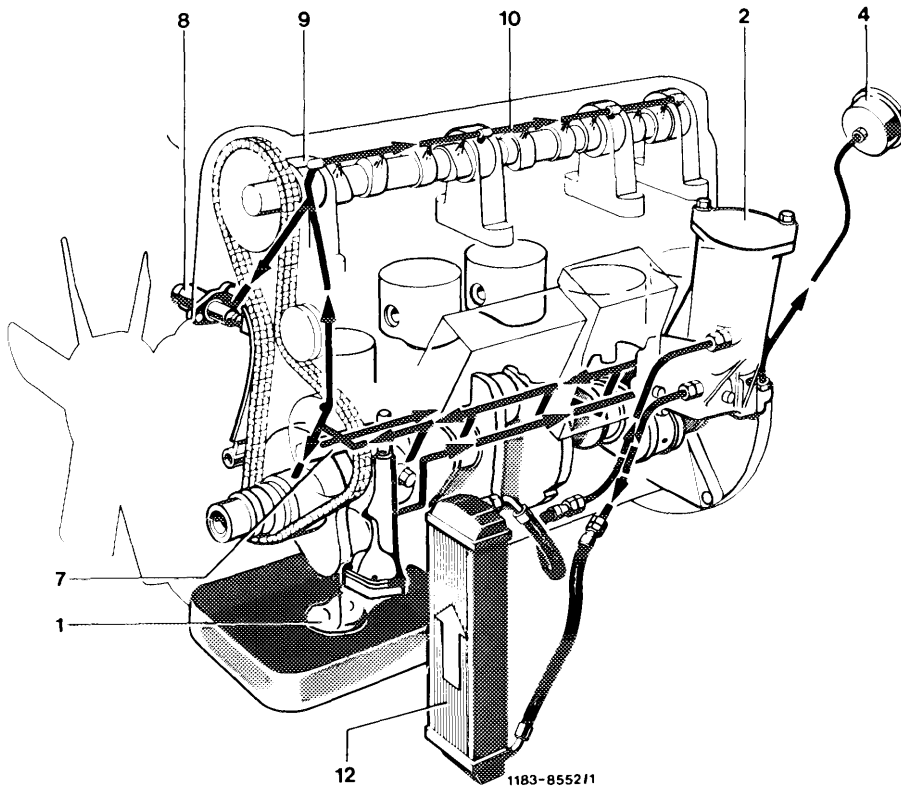


When the filter element is badly contaminated and the differential pressure between the dirty and the clean side of the filter exceeds 3.5 bar gauge pressure, the bypass valve (17) will open. The oil will then flow to engine in uncleaned condition.



B. Model 123.1

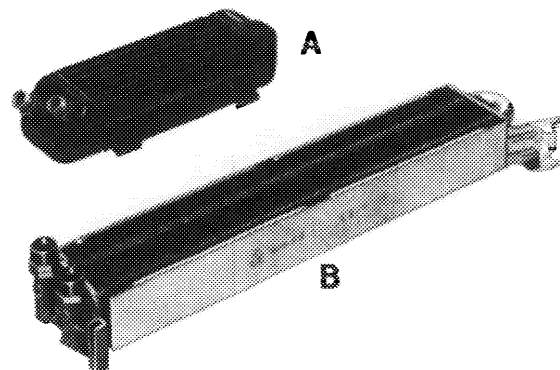
Oil circuit



- |  |                                 |
|--|---------------------------------|
| 1 Oil pump with screwed-on pressure relief valve | 8 Chain tensioner               |
| 2 Oilfilter                                      | 9 Camshaft bearing sprocket end |
| 4 Pressure gauge                                 | 10 Oil pipe                     |
| 7 Intermediate gear shaft                        | 12 Air oil cooler               |

On engines 616.912, starting February 1979, on vehicles with air conditioning system, the air oil cooler of version A has been replaced by version B.

Air oil coolers of version B cannot be installed in vehicles with version A.



### Air oil cooler and thermostat in oil filter

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Engine with air oil cooler and thermostat in oil filter

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615 only on vehicles with air conditioning system

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616 standard up to June 1978, starting July 1978 on vehicles with air conditioning system only

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617 general

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### Oil pressure

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At operating temperature, the oil pressure at idle may drop to 0.5 bar gauge pressure (atü).

During acceleration, the oil pressure should immediately rise again and attain at least 3 bar gauge pressure (atü) at 3000/min.

In the event of complaints about trembling of oil pressure gauge needle, the throttle pin, part No. 123 542 00 74 can be installed in pressure gauge line at instrument end with tip first.

### Pressure relief valves

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Opening pressure of pressure relief valves	bar gauge pressure (atü)
Bypass valve (8) in oil filter	3.5
Pressure relief valve on oil pump	7
<b>Thermostat – oil filter engine 617</b>	°C
Begin of opening	95 ± 4
Fully opened	110 ± 4

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### Pressure relief valve on oil pump

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The dampened oil pressure relief valve (7 bar gauge pressure) is screwed to oil pump.

At no or insufficient oil pressure, check whether oil pressure relief valve has dropped from oil pump or has become loose.

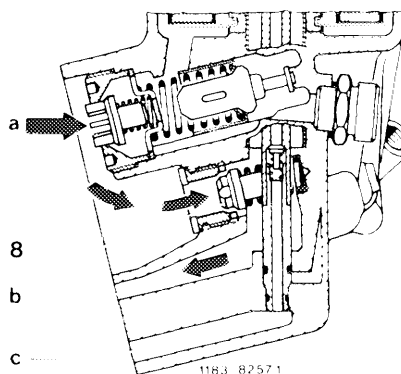
In both cases, coat threads on oil pressure relief valve with sealing compound, part No. 002 989 94 71 and screw-in.

### Bypass valve in oil filter

The bypass valve (8) opens when the differential pressure between the dirty and the clean side of the filter exceeds 3.5 bar.

This will happen when the filter element is badly contaminated. The oil will then flow to engine in uncleaned condition.

- 8 Bypass valve
- a from oil pump
- b to main oil duct

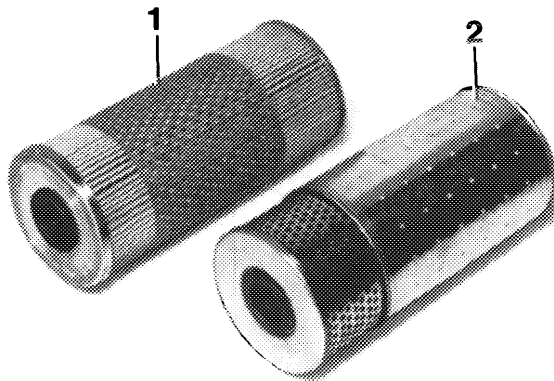


### Oil filter

The main and bypass filter element are combined in a cartridge.

During the first inspection (500–1000 km), replace initial operation filter element (1) with combination filter element (2).

- 1 Initial operation oil filter element
- 2 Combination filter element

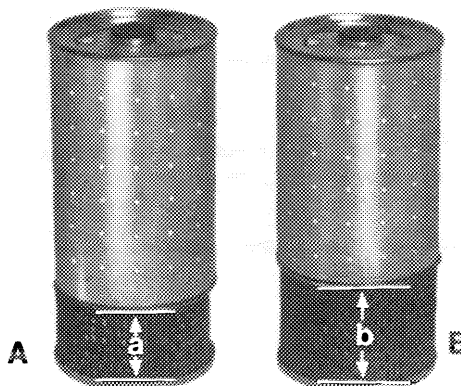


Then replace combination filter element during oil change every 5000 km.

Filter element (B), part No. 617 184 01 25 replaces filter element, part No. 617 184 00 25 and can be installed in all diesel engines with upright oil filter.

On the other hand, do not install filter element, part No. 617 184 00 25 in engine 617.950.

- A Combination filter element dimension a = 40 mm
- B Combination filter element dimension b = 55 mm

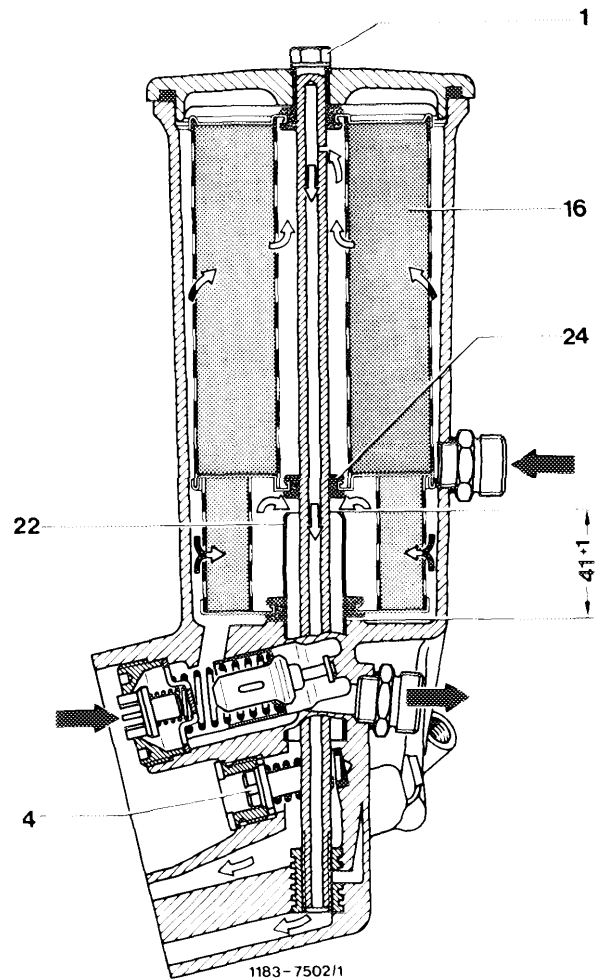


### 1st version

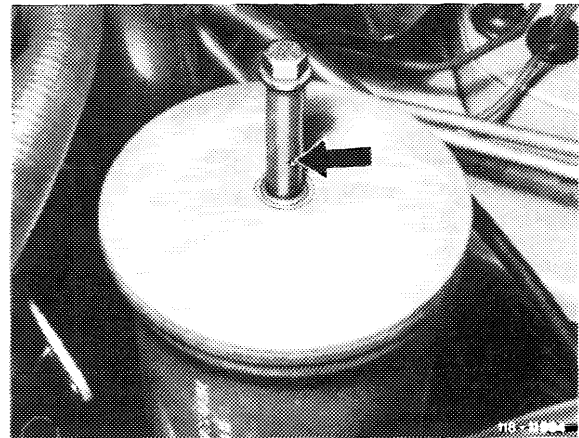
Up to October 1976, the oil filter cover has been attached with a central bolt (1). The central bolt (1) is simultaneously the return flow pipe for the fine-filtered engine oil.

The central bolt has no check valve.

- 1 Central bolt
- 8 Bypass valve
- 16 Filter element
- 22 Header pipe
- 24 Sealing ring



When changing the filter element, loosen central bolt and pull out until the throttle bore (arrow) projects about 5 mm above housing cover. As a result, the return flow duct in filter housing lower half will no longer be closed by the central bolt and the engine oil can flow back into oil pan.

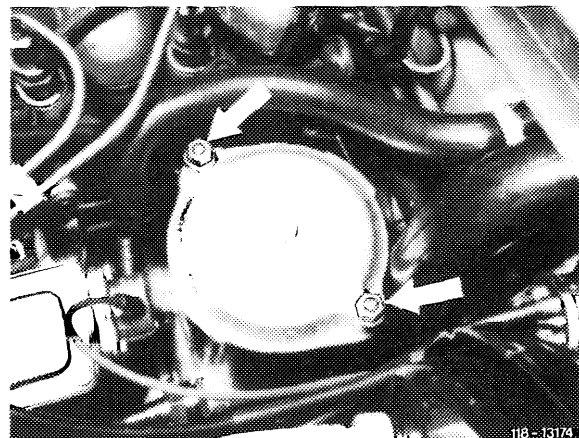


### 2nd version

Starting November 1976, the oil filter cover is attached by means of two nuts.

The return flow pipe (18) is pressed into cover and is provided with a check valve (19).

When changing the filter element, unscrew cover (3) and pull up for a given distance. As a result, the return flow pipe (18) on cover will free a bore which connects the ducts (b) and (c) with each other. The oil in oil filter will flow into oil pan through duct (c).

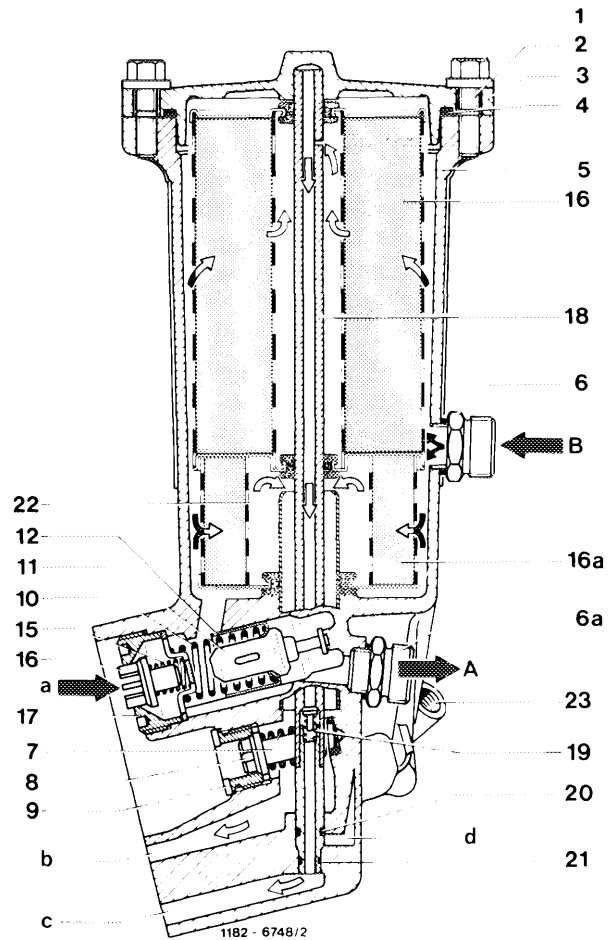


## Operation

The oil filter comprises the following main components:

- a) Oil filter housing with bypass valve, return flow locking valve and thermostat.
- b) Cover with return flow pipe, check valve and sealing ring.
- c) combination filter element.

- |                           |   |
|---------------------------|---|
| 1 Nut M 8                 | 17 Valve seat return flow locking valve |
| 2 Stud M 8                | 18 Return flow pipe                     |
| 3 Cover                   | 19 Check valve                          |
| 4 Sealing ring            | 20 O-ring                               |
| 5 Oil filter housing      | 21 O-ring                               |
| 6 Threaded connection     | 22 Header pipe                          |
| 6a Threaded connection    | 23 Connection for oil pressure gauge    |
| 7 Compression spring      | A Uncleaned oil to air oil cooler       |
| 8 Star valve              | B Uncleaned oil from air oil cooler     |
| 9 Valve seat bypass valve | a from oil pump                         |
| 10 Compression spring     | b to bearing points                     |
| 11 Thermostat             | c fine-filtered oil to oil pan          |
| 12 Control valve          | d oil return flow bore to oil pan       |
| 15 Compression spring     |   |
| 16 Star valve             |   |



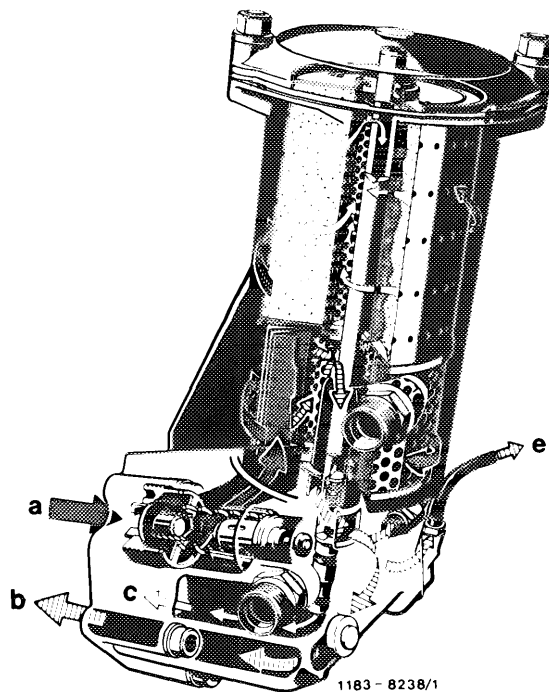
Coming from feed duct (a), the oil flows through return flow locking valve (16 and 17) into oil filter housing and flows directly to combination filter element.

After flowing through combination filter element, the oil, which has been cleaned in main flow filter element (16a), continues flowing through header pipe (22) and duct (b) to main oil duct and on to bearing points.

On the other hand, the oil, which has been fine-filtered in bypass filter section (16), flows through return flow pipe (18) and duct (c) to oil pan.

To keep the main flow and the bypass flow separate, a rubber seal is inserted in combination filter element.

- |                     |                                |
|---------------------|--------------------------------|
| a from oil pump     | c fine-filtered oil to oil pan |
| b to bearing points | e oil pressure gauge           |

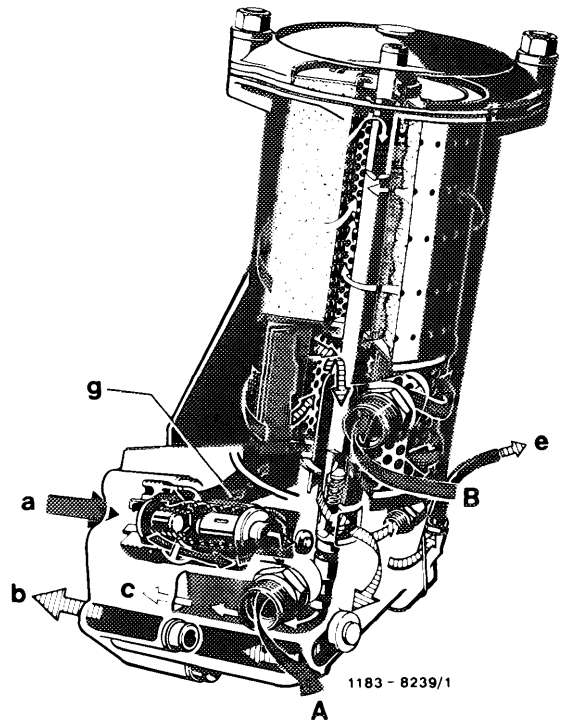


Starting at an oil temperature of approx. 95°C, the thermostat (11) begins displacing the control valve (12), which will attain its end position at approx. 110°C. In the end position, the direct flow to combination filter element is closed except for a given quantity of oil (g). This oil quantity is enough to guarantee lubrication of engine at low outside temperatures, when the through-flow in oil cooler is considerably detained by the now viscous oil.

The major oil quantity arrives at air oil cooler where it is cooled and then flows back to oil filter housing and through oil filter housing from outside in.

The cleaned oil flows through header pipe (22) or return flow pipe (18) to bearing points or into oil pan.

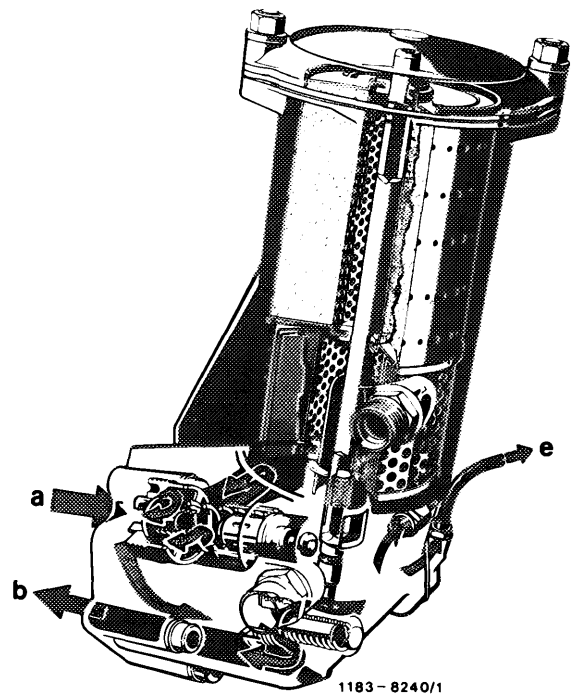
- |   |                     |   |   |
|---|---------------------|---|---|
| A | to air oil cooler   | c | fine-filtered oil to oil pan                        |
| B | from air oil cooler | e | oil pressure gauge                                  |
| a | from oil pump       | g | oil quantity directly to combination filter element |
| b | to bearing points   |   |   |



If the filter element is badly contaminated and the differential pressure between the dirty and the clean side of the filter exceeds 3.5 bar, the bypass valve (8 and 9) opens. The oil will then flow to engine in uncleaned condition.

The return flow locking valve (16 and 17) and the check valve (19) in return flow pipe (18) prevent the oil from oil filter flowing back into oil pan when the engine is shut off for longer periods.

- |   |                    |
|---|--------------------|
| a | from oil pump      |
| b | to bearing points  |
| e | oil pressure gauge |



## Complaints concerning oil filter

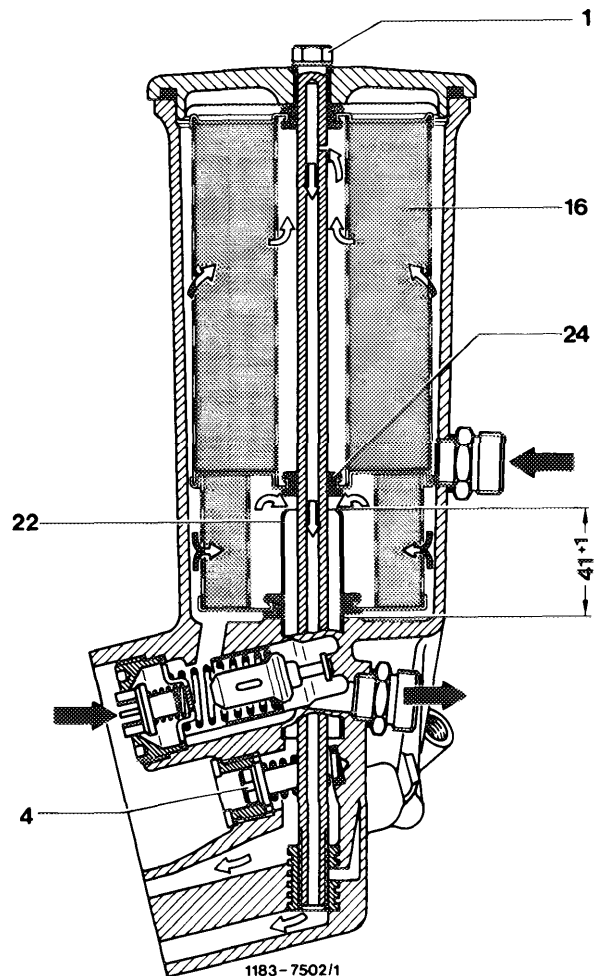
1 On oil filter 1st version, the oil may flow from oil filter housing back into oil pan after an extended period of inoperation of engine. As a result, the following faults will **occur**:

- a) Delayed indication of oil pressure by pressure gauge.
- b) Oil level in engine too high.

Note: Replacement of oil filter because of these complaints is not justified, since in this connection any fears concerning subsequent bearing damage are unfounded. The lubrication of the bearing points is guaranteed by the residual oil in bearing points in spite of a delayed response of the oil pressure gauge.

2 If following a change of filter element an oil pressure (0.5 atü) is indicated at idle speed, observe the following:

Excessive force when inserting central bolt (1) during a filter change may push the sealing ring (24) out of its hold into a position in front of header pipe (22). The oil will then be supplied via the overflow valve (8) which will result in a drop in oil pressure. To avoid pushing out sealing ring (24), insert central bolt (1) into oil filter without using force.



Check pressing-in depth of riser pipe in oil filter.  
Height of riser pipe from upper edge of pipe up to contact surface of filter element should not exceed  $41 + 1$  mm. If the height exceeds 42 mm, renew complete oil filter.

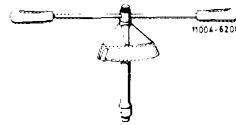


## 18-110 Removal and installation of oil filter

Tightening torques	Nm	(kpm)
Central bolt – oil filter cover (version 1)	20–25	(2.0–2.5)
Nuts for oil filter cover (version 2)		
Screws for oil filter on cylinder crankcase	30	(3)

### Special tools

Torque wrench 3/8" square,  
8–32 Nm (80–320 kpcm)



001 589 51 21 00

Box wrench open, 12 mm, 3/8" square

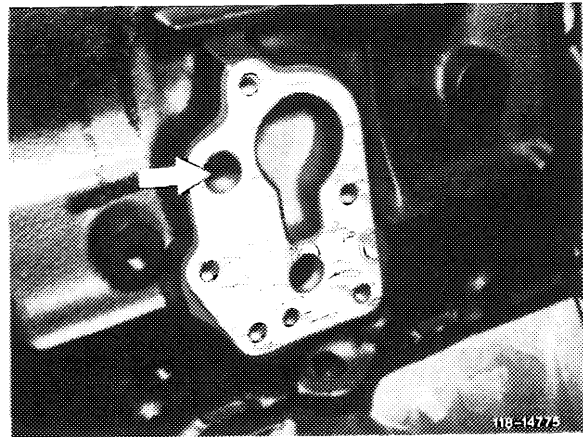


617 589 01 03 00

### Note

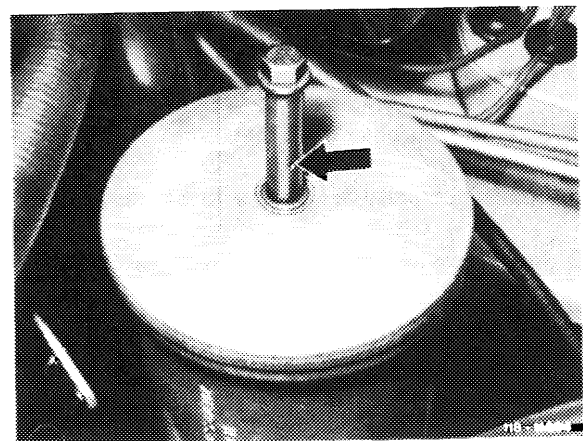
When the oil filter is removed, residue from gasket may remain stuck to flange surface of cylinder crankcase.

To prevent such residue from entering the clean oil duct (arrow) of cylinder crankcase during removal (e.g. by scraping), make sure to cover or close bores first.

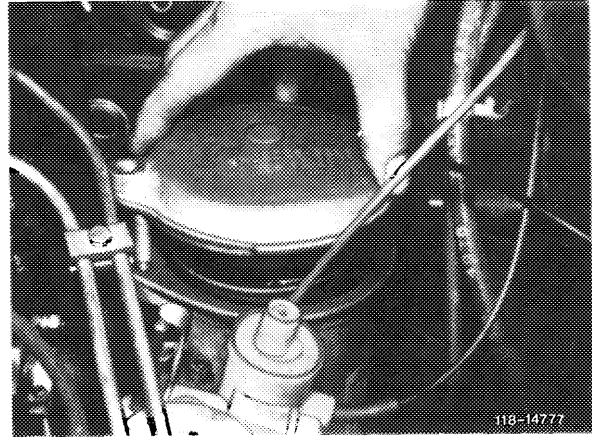


### Removal

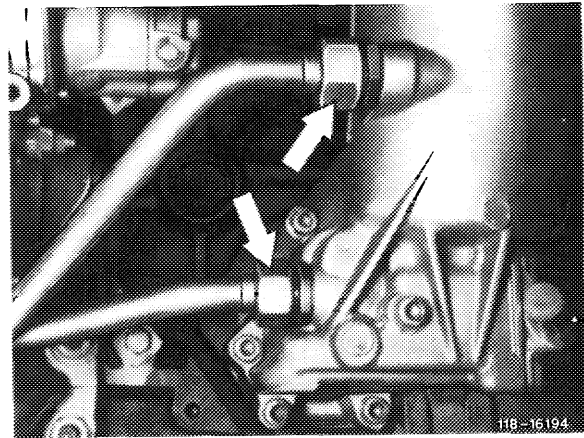
1 On 1st version, loosen central bolt and pull out for approx. 50 mm so that the oil can flow back into oil pan. Throttle bore (arrow) should be visible.



**On 2nd version**, unscrew oil filter cover and pull up for a short distance so that the oil can flow back to oil pan.



2 Unscrew oil cooler lines (arrows). Apply counter-hold to threaded connections for this purpose.

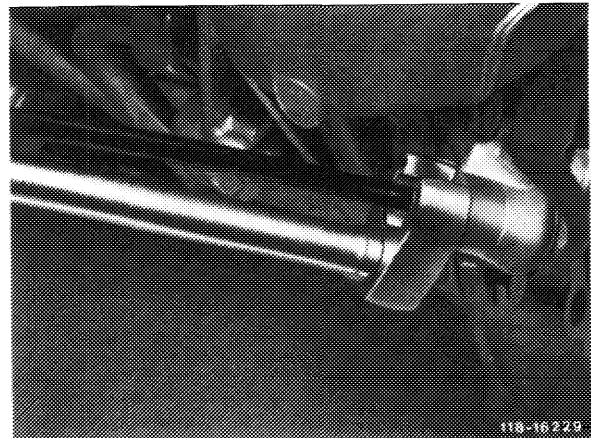


3 Unscrew oil pressure indicator with open box wrench on oil filter.

4 Unscrew oil filter and remove.

5 Clean sealing surfaces on oil filter and cylinder crankcase.

For this purpose, close bores on cylinder crankcase.



### Installation

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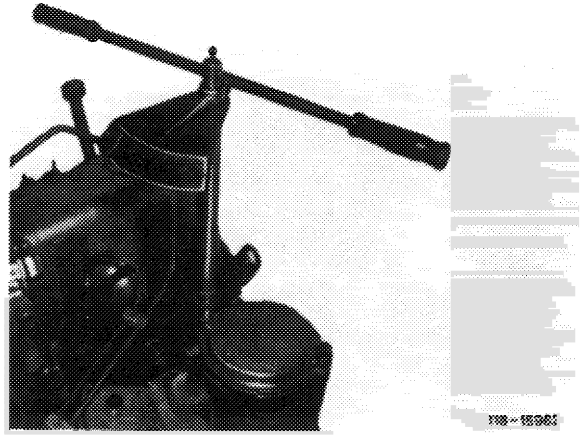
6 Position oil filter with new gasket and screw down.

7 Screw-on oil cooler lines.

8 Connect oil pressure indicator to oil filter.

9 Insert new oil filter element, if required.

- 10 Mount oil filter cover and screw down.
- 11 Run engine at idle speed and check for leaks.



## 18–120 Checking thermostat in oil filter

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Thermostat – oil filter	°C
Begin of opening	95 ± 4
Fully opened	110 ± 4

### Special tool

---

Telethermometer for measuring engine oil temperature



116 589 27 21 00

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### Nose

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The following engines are provided with a thermostat in oil filter:

Engine 615 in model 123.1 on vehicles with air conditioning system.

Engine 616 in model 123.1 generally up to August 1978 and starting August 1978 on vehicles with air conditioning system only.

Engine 617 in model 115.1 and 123.1 generally.

### Checking

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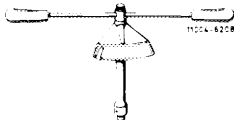
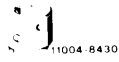
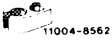
- 1 Exchange oil dipstick for flexible heat sensor
- 2 Run engine at increased speed and watch telethermometer.
- 3 At 95 ± 4°C, a clear rise of oil temperature on oil cooler should be noticed (manually).

If not, replace thermostat.

## 18–125 Removal and installation of thermostat in oil filter

Tightening torques	Nm	(kpm)
Central bolt for oil filter cover (1st version)	20–25	(2.0–2.5)
Nuts for oil filter cover (2nd version)		
Valve seat ring in oil filter housing (model 123.1)	40	(4)
Closing plug in oil filter housing (model 115.1)		

### Special tools

Torque wrench 3/8" square, 8–32 Nm (80–320 kpcm)		001 589 51 21 00
Socket 1/2" square for valve seat ring		617 589 01 03 00
Box wrench open, 12 mm, 3/8" square		617 589 01 03 00

### Note

The following engines are provided with a thermostat in oil filter:

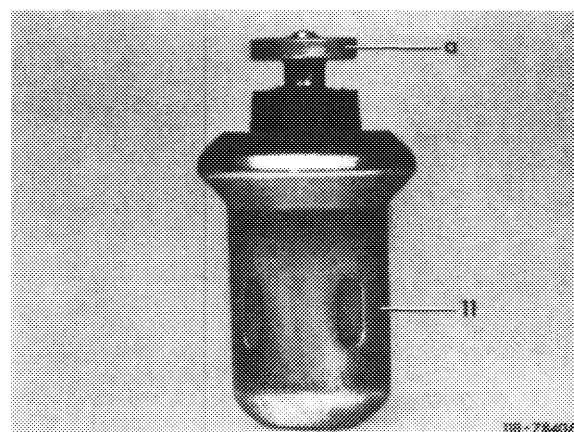
Engine 615 in model 123.1 on vehicles with air conditioning system.

Engine 616 in model 123.1 up to August 1978 generally and starting August 1978 on vehicles with air conditioning system only.

Engine 617 in models 115.1 and 123.1 generally.

Remove functioning thermostat only at temperatures below 60°C, since otherwise the thrust pin (a) will be pushed out.

Never pull thrust pin (a) out of wax thermostat, since otherwise proper function will not be guaranteed any longer.

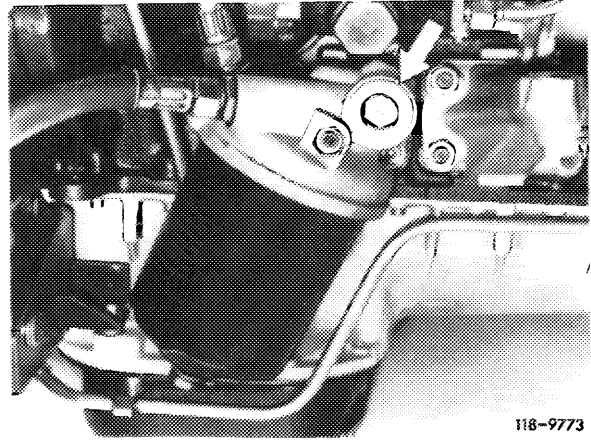


## A. Engine 617 in model 115.1

### Removal

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- 1 Unscrew closing plug (arrow).
- 2 Remove thermostat with control valve and compression spring.



118-9773

### Installation

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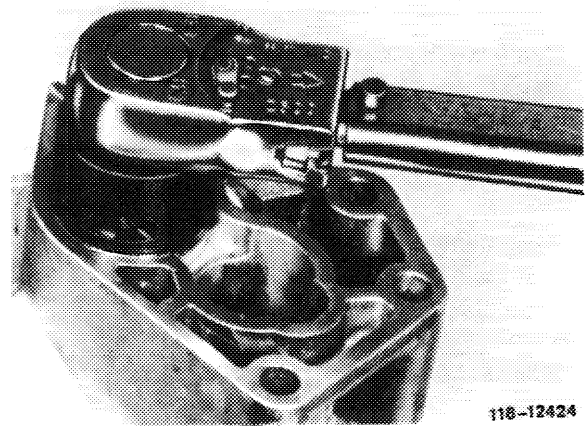
- 3 Insert thermostat with control valve and compression spring.
- 4 Screw-in closing plug with new sealing ring
- 5 Check oil level

## B. Engine 615, 616, 617 in model 123.1

### Removal

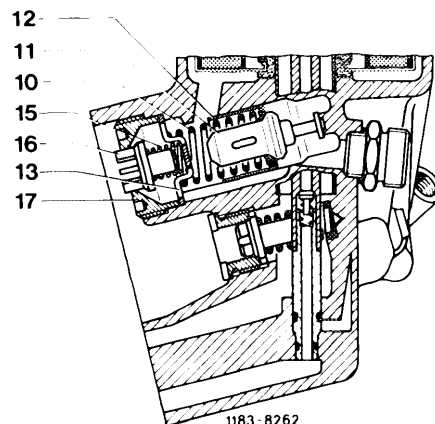
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- 1 Remove oil filter (18-110).
- 2 Unscrew valve seat ring (17) with wrench socket.



118-12424

- 3 Remove start valve (16), spring retainer (13) and compression spring (15).
- 4 Remove thermostat (11) with control valve (12) and compression spring (10).



- |                       |                       |
|-----------------------|-----------------------|
| 10 Compression spring | 15 Compression spring |
| 11 Thermostat         | 16 Star valve         |
| 12 Control valve      | 17 Valve seat ring    |
| 13 Spring retainer    |                       |

1183-8262

## Installation

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5 Insert thermostat (11) with control valve (12) and compression spring (10).

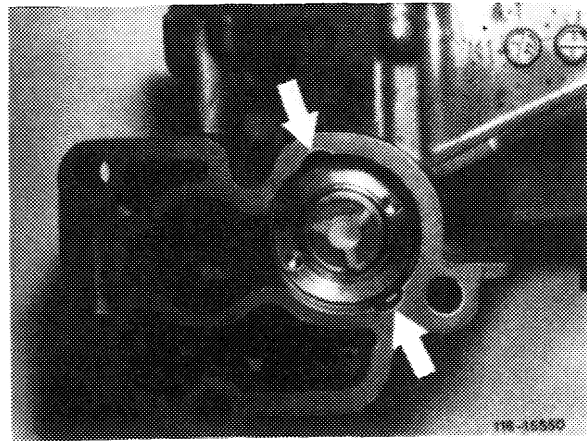
6 Insert spring retainer (13), compression spring (15) and star valve (16).

7 Position valve seat ring and tighten to 40 Nm **(4 kpm)** with wrench.



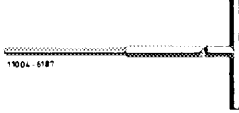
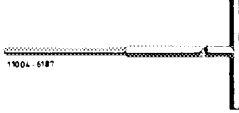
8 Peen valve seat ring in both recesses on oil filter housing (arrows) by means of a crosscut chisel.

9 Install oil filter with new gasket.

10 Correct oil level.



## 18–210 Removal and installation of oil pump

Tightening torques		Nm	(kpm)
Oil drain plug to oil pan	M 12	40	(4)
	M 26	50	(5)
Oil pan lower half to upper half		10	(1)
Special tools			
Torque wrench handle 20–100 Nm (2–10 kpm)		001589352100	
Torque wrench handle 50–200 Nm (5–20 kpm)		001 589442100	
Plug-type ratchet 1/2" square for torque wrench		001 589 42 09 00	
Allen wrench 5 mm, 300 mm long		116 589 02 07 00	

### Note

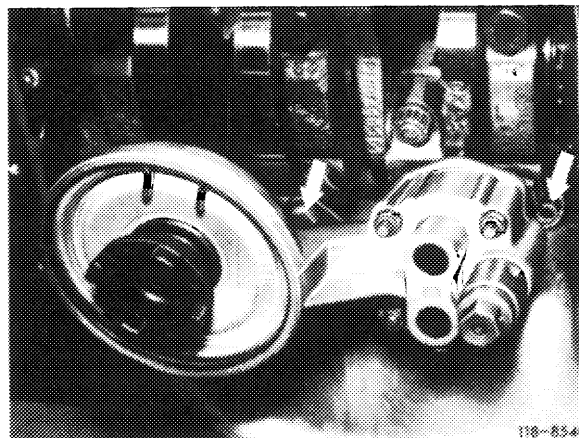
As a spare part, the oil pump, part No. 115 180 13 01, of engine 115 will be delivered for engines 615.912/ 913.

### Removal

- 1 Drain engine oil.
- 2 Remove oil pan lower half.
- 3 Unscrew fastening screw on cylinder crankcase and on bearing cap.
- 4 Pull out oil pump.

### Installation

- 5 For installation proceed vice versa.



118-8540



## 18—215 Removal and installation of oil pressure relief valve

Tightening torques		Nrn	(kpm)
Oil drain plug to oil pan	M 12	40	(4)
	M 26	50	(5)
Oil pan lower half to upper half		10	(1)
Oil pressure relief valve		40	(4)

Opening pressures of pressure relief valves	bar gauge pressure	(atü)
Pressure relief valve in main oil duct front (engine 615.912/913)	5.0	(5.0)
Pressure relief valve on oil pump (engines 615.940/941, 616, 617.91)	7.0	(7.0)

### Notes

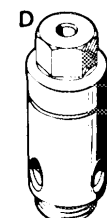
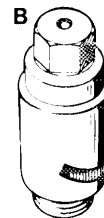
The engines are provided with different oil pressure relief valves:

On engines 615.912/913 the oil pressure relief valve is installed in main oil duct, and on engines 615.940/941, 616 and 617 it is screwed to oil pump.

On engines 616.916 and 617.910 different oil pressure relief valves were installed.

#### Version A (engine 616.916)

Oil pressure relief valve (8 bar gauge pressure), part No. 100 180 03 15, with 3 control bores.



**Version B (engines 616.916 and 617.910)**

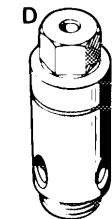
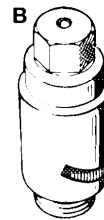
Oil pressure relief valve (8 bar gauge pressure), part No. 616 180 00 15, with diagonal slot (shark mouth).

**Version C (engines 615.9401941, 616 and 617)**

Oil pressure relief valve (5 bar gauge pressure), part No. 115 180 02 15, with axially offset control bores.

**Version D (engines 615.912/913)**

Oil pressure relief valve (5 bar gauge pressure), part No. 115 180 02 15, with 3 control bores.



1184-6505/1

**Complaints concerning engines 616.916, 617.910**

On these engines, when engines are **cold**, oil noises or a pressure drop may occur (at idle below 2 bar with cold oil or 1 bar with warm oil). As a remedy, the oil pressure relief valve of version C may be installed.

Loose or dropped oil pressure relief valves can be screwed in using sealing compound, part No. 002 989 94 71.

## A. Engine 615.912/913

### Removal

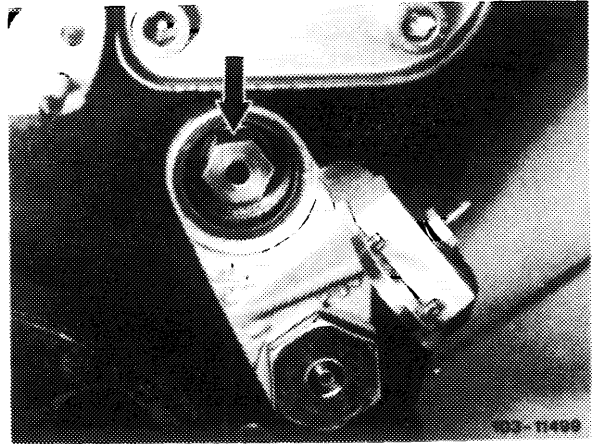
---

- 1 Unscrew closing plug on face.
- 2 Unscrew oil pressure relief valve (arrow).

### Installation

---

- 3 For installation proceed vice versa. Screw-in closing plug with new sealing ring.



## B. Engine 615.940/941, 616 and 617

### Removal

---

- 1 Drain engine oil.
- 2 Remove oil pan lower half.
- 3 Unscrew oil pressure relief valve on oil pump.

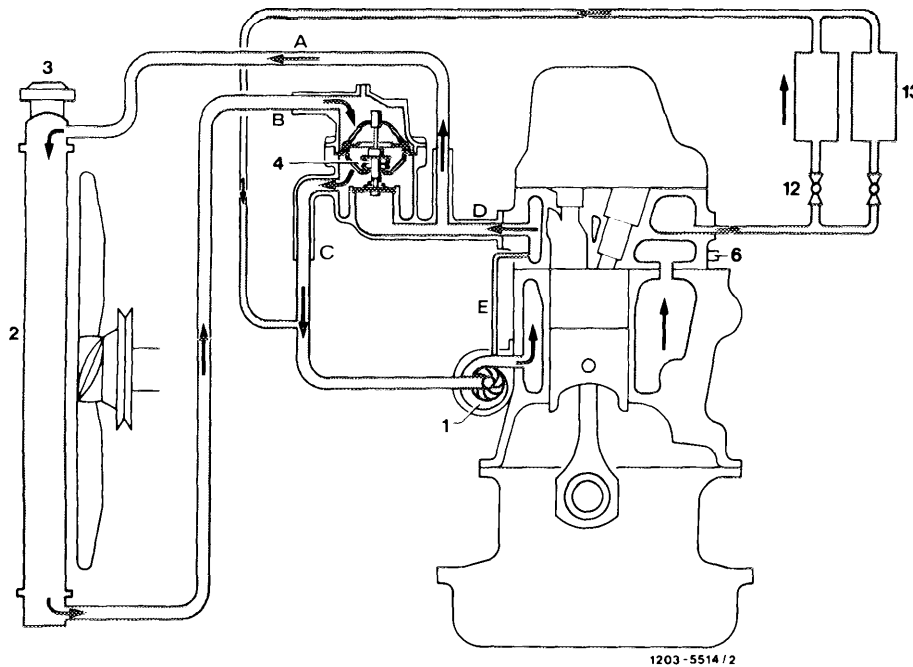
### Installation

---

- 4 For installation proceed vice versa. Correct oil level in engine.

A. Model 115.1 and 123.1 (version up to February 1979)

Coolant circuit



Circuit at coolant temperatures above approx. 94°C

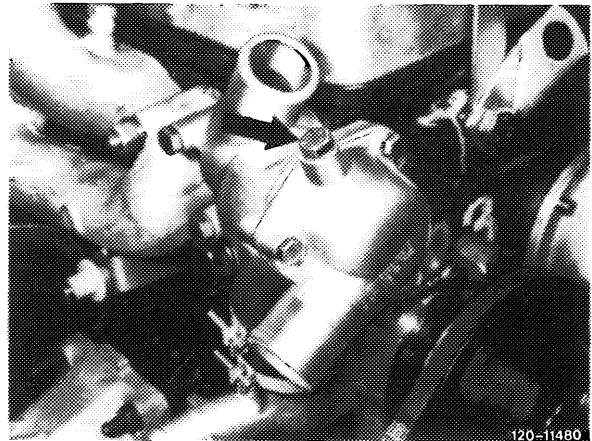
- |  |                                  |
|--|----------------------------------|
| 1 Water pump                                     | A to radiator                    |
| 2 Radiator                                       | B from radiator                  |
| 3 Radiator cap,<br>code No. 100                  | C to water pump<br>(bypass line) |
| 4 Thermostat                                     | D from engine                    |
| 6 Temperature transmitter<br>for telethermometer | E vent line                      |
| 12 Regulating valve for<br>valve heater          |                                  |
| 13 Heat exchanger                                |                                  |

## Thermostats

Engine	Thermostat begins to open at	Up to engine No.	Starting engine No.	Starting begin of series
615.912	79°	323 903	—	—
615.913		185 880	—	—
615.912	80°	—	323 904	—
615.913		—	185 881	—
615.94		—	—	x
616.617		—	—	x

The thermostat layout on model 123.1 (1st version) differs. On vehicles without air conditioning system, the thermostat housing with thermostat is located horizontally and on vehicles with air conditioning system vertically for reasons of space.

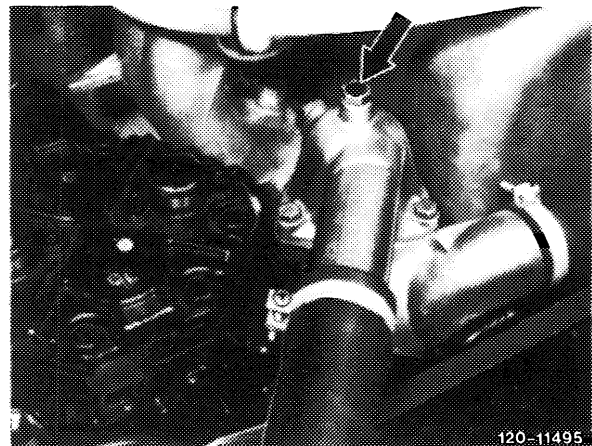
Layout on vehicles without air conditioning



The ID's of connections in direction of radiator were reduced from 35 mm to 29 mm.

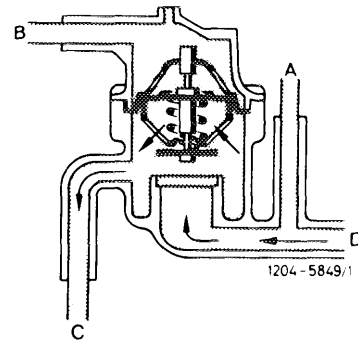
When filling, unscrew vent screw (arrows) on thermostat housing cover until coolant flows out.

Layout on vehicles with air conditioning



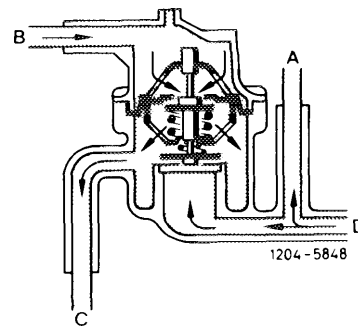
The main valve is closed up to a coolant temperature of approx. 80°C and the bypass disc is fully opened. The flow (B) from radiator is thereby interrupted and the coolant flows via bypass line (C) directly to water pump.

- A to radiator
- B from radiator
- C bypass line
- D from cylinder head



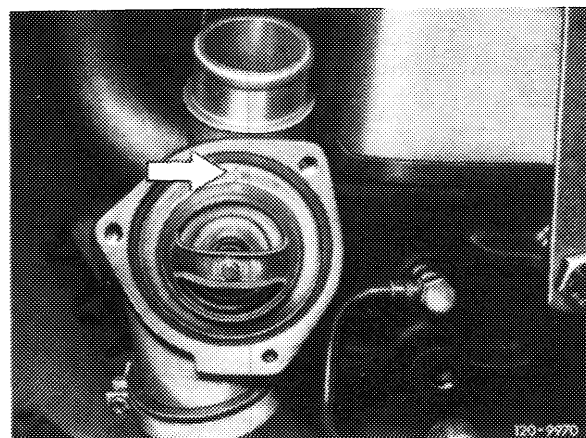
At coolant temperatures of approx. 80°C to 94°C, the main valve as well as the bypass valve are more or less opened, depending on engine load. The coolant flows via radiator (A) and bypass line (C) to water pump.

- A to radiator
- B from radiator
- C bypass line
- D from cylinder head



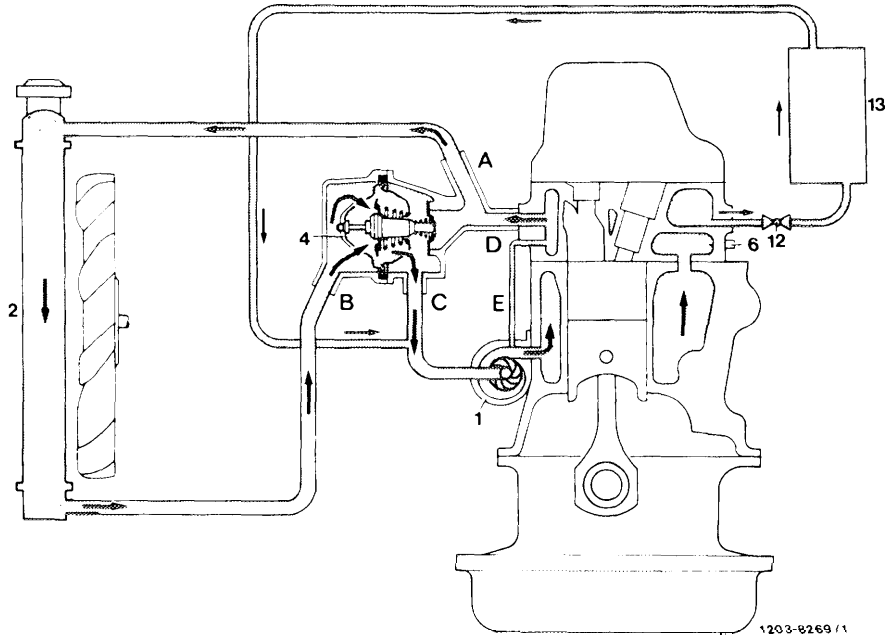
At coolant temperatures above approx. 94°C, the bypass line (C) is closed by the bypass disc. The entire coolant volume should flow through radiator (refer to overall diagram). It is therefore wrong to remove thermostat for better cooling of engine.

If the thermostat is replaced, make sure during installation that the punched-on arrow is pointing upwards or in driving direction toward the rear.



B. Model 123.1 (2nd version starting February 1979)

Coolant circuit



Circuit at coolant temperatures above approx. 94°C.

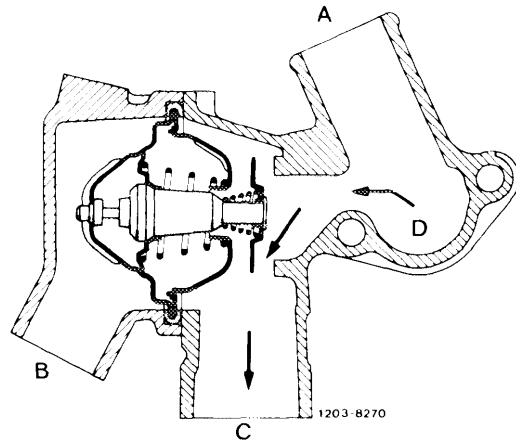
- |  |                               |
|--|-------------------------------|
| 1 Water pump                                     | A to radiator                 |
| 2 Radiator                                       | B from radiator               |
| 4 Thermostat                                     | C to water pump (bypass line) |
| 6 Temperature transmitter<br>for telethermometer | D from engine                 |
| 12 Regulating valve for<br>vehicle heater        | E vent line                   |
| 13 Heat exchanger                                |                               |

Thermostat

The thermostat installed on all engines begins to open at 80°C.

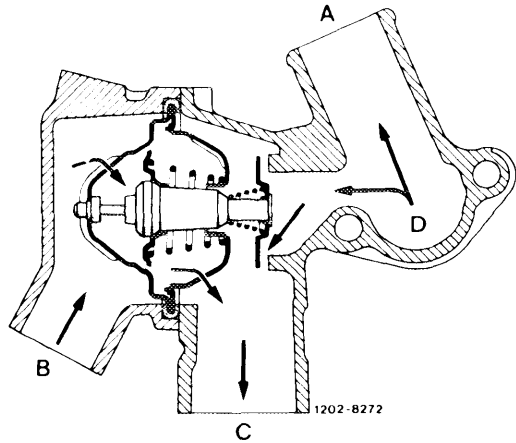
The main valve is closed up to a coolant temperature of approx. 80°C and the bypass disc is fully opened. The flow (B) from radiator is thereby interrupted and the coolant flows via bypass line (C) directly to water pump.

- A to radiator
- B from radiator
- C bypass line
- D from cylinder head

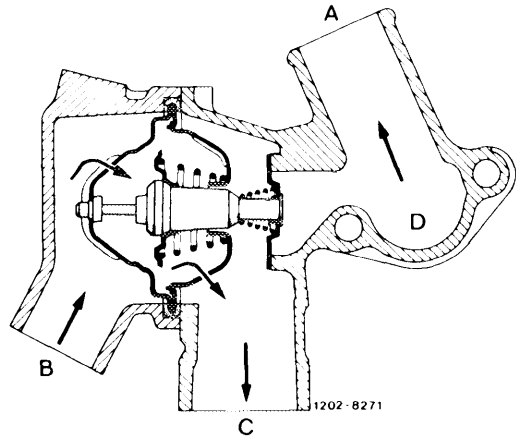


At coolant temperatures of approx. 80°C to 94°C, the main valve as well as the bypass valve are more or less open, depending on engine load. The coolant flows via radiator (A) and bypass line (C) to water pump.

- A to radiator
- B from radiator
- C bypass line
- D from cylinder head



At coolant temperatures above approx. 94°C, the bypass line (C) is closed by the bypass disc. The entire coolant volume should flow through radiator (refer to overall diagram). It is therefore wrong to remove thermostat for better cooling of engine.

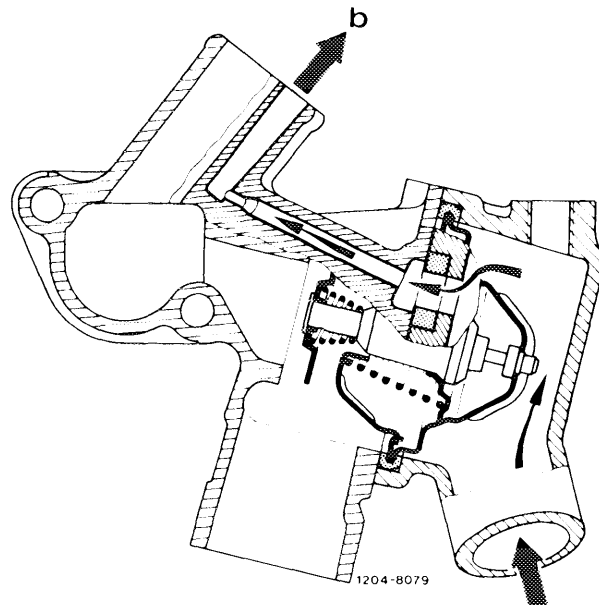


### Venting of thermostat housing

The thermostat housing is suspended and has an integrated, independent venting system.

The air in the cooling system can flow to the radiator and the expansion tank through a bore which bypasses the thermostat.

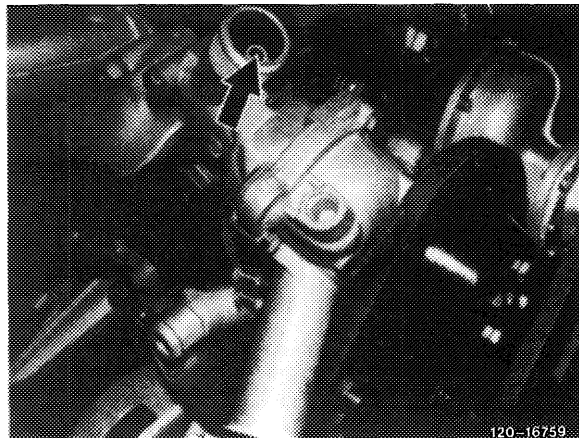
- a from radiator
- b to radiator





This venting method has the following advantages:

- a) When filling-in the coolant, the coolant circuit will be independently vented.
- b) Better continuous venting of coolant circuit when engine is operating.



### Engine cooling

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The spring-loaded cap (code No. 100) on radiator establishes a gauge pressure of approx. 1 bar (atü) in the cooling system.

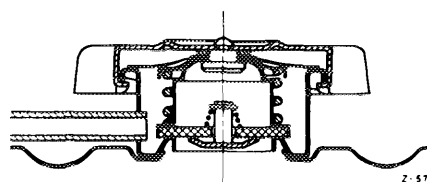
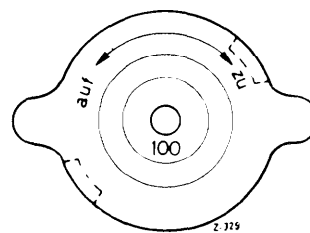
The cooling system is filled ex factory for use throughout the year with a coolant which comprises approx. 55 % by volume of water and 45 % by volume of anti-freeze.

The anti-freeze provides protection down to  $-30^{\circ}\text{C}$  and by means of additives in anti-freeze prevents corrosion in cooling system. Since the additives are subject to ageing, the coolant should be changed every two years.

If no anti-freeze is available and only water is filled in, be sure to add 1 % of treating compound (anti corrosion oil) (10 cc/l water).

On model 115.1 always add 1 % = 10 cc/l of treating compound for lubricating heater valves, also when using anti-freeze.

The anti-freeze increases the boiling point, which amounts to approx.  $118^{\circ}\text{C}$  for water at 1 bar (atü) gauge pressure, to approx.  $125^{\circ}\text{C}$  by the mixture filled-in at the factory.



The red mark on telethermometer begins at 122°C (since the middle of May 1975, formerly at 115°C)

This point must be specially observed when only water and treating agent are filled in. In such a case, water may be thrown out before the indicator of the coolant thermometer is at the red mark.

When driving under full load, on mountain roads and bumper to bumper, or following a fast ride on an express highway with subsequent traffic congestion, or when driving in areas with high outside temperatures, the coolant temperature indicator may rise up to the red mark if an anti-freeze of at least  $-30^{\circ}\text{C}$  is filled in, without any ejection of coolant or faulty running of engine.

When the engine is operated for an extended period with the vehicle stopped, e.g. vehicle congestion, it will be of advantage on vehicles with automatic transmission to move the selector lever into position „N“. This will reduce the heat development in transmission and thereby additional heating up of coolant by way of the transmission oil cooler.

When coolant is lost by leaks in cooling system or by ejection as a result of overheating, add a pertinently prepared coolant.

Losses caused by evaporation can be compensated by adding tap water.

## 20-010 Draining and filling-in of coolant – Anti-freeze table

Tightening torques	Nm	(kpm)
Drain plug radiator model 115.1	6-10	(0.6-1)
Drain plug radiator model 123.1	1.5-2 <sup>1)</sup>	(0.15-0.2)

<sup>1)</sup> This torque can be set by means of a washer or a coin.

### Mixing ratio of anti-freeze<sup>1)</sup> and water<sup>2)</sup>

Model	Anti-freeze/water in liters		
	115.1		123.1
Engine	615.912/913	615.940/941	617.912
	616.912/617.910	616.912	
Anti-freeze up to	- 20°C	3.75/7.25	3.50/6.50
	- 30°C	5.00/6.00	4.50/5.50
	- 40°C	5.75/5.25	5.25/4.75
Total filling capacity in liters	11	10	11

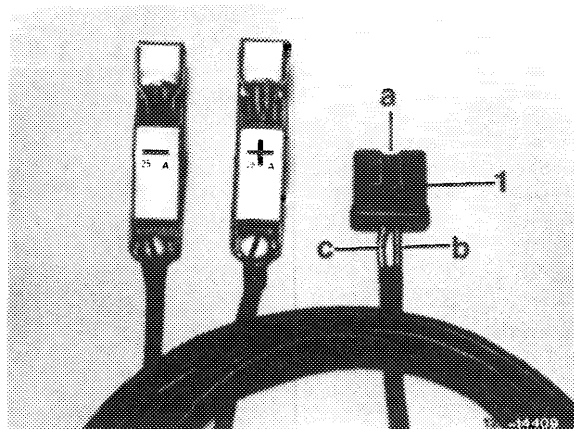
<sup>1)</sup> Refer to specifications for service products page 325.

<sup>2)</sup> Refer to specifications for service products page 310.

<sup>3)</sup> With water, add 1% = 10 cc/l anti-corrosion compound, on model 115.1 also when using anti-freeze (refer to specifications for service products page 311).

### Self-made tool for vehicles with automatic climate control

Coupling (1), part No. 002 545 49 28  
 approx. 1 m cable 1.5mm<sup>2</sup> black (b) +  
 approx. 1 m cable 1.5mm<sup>2</sup> brown (c) –  
 1 cable terminal +  
 1 cable terminal –



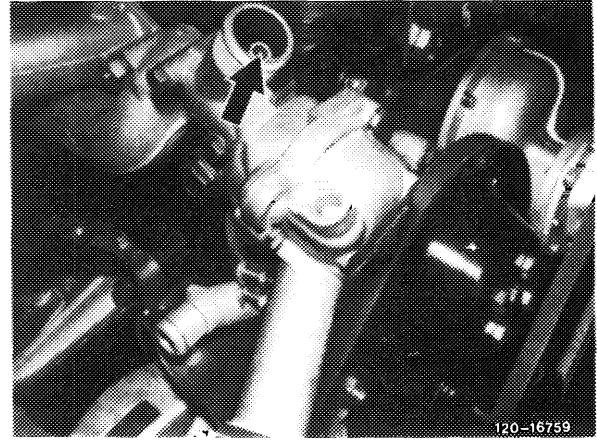
a = Fixing groove

## Note

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A thermostat housing with automatic vent is installed on model 123.1 starting February 1979 (2nd version).

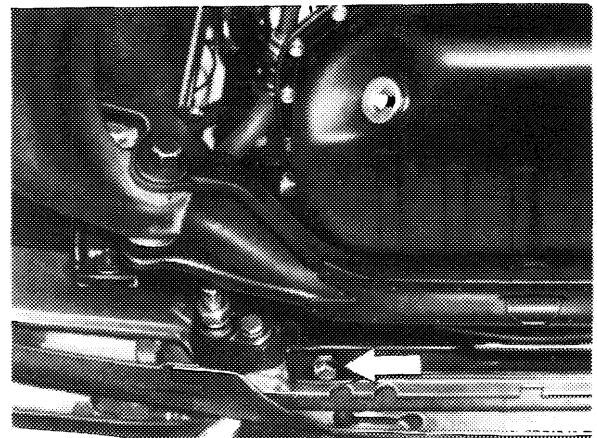
When filling up on vehicles with automatic climate control, proceed as described in section „B“.



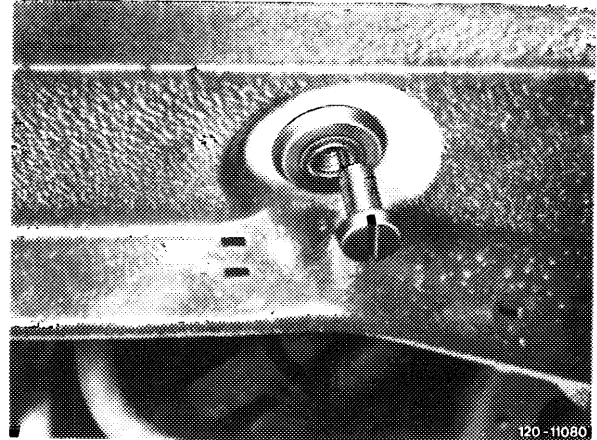
## Draining

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- 1 Open radiator cap in steps (only below 90°C).
- 2 Unscrew drain plug on radiator.

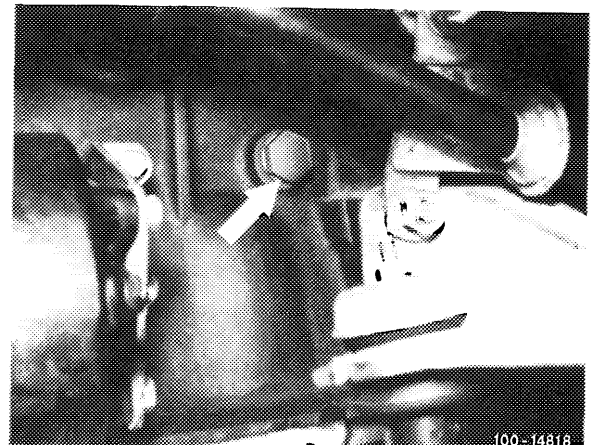


Model 115.1



Model 123.1

- 3 Unscrew drain plug on cylinder crankcase.

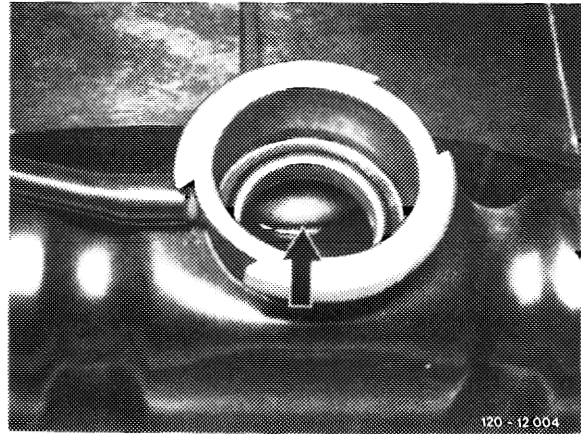


## Filling-in

### a) Vehicles without automatic climate control

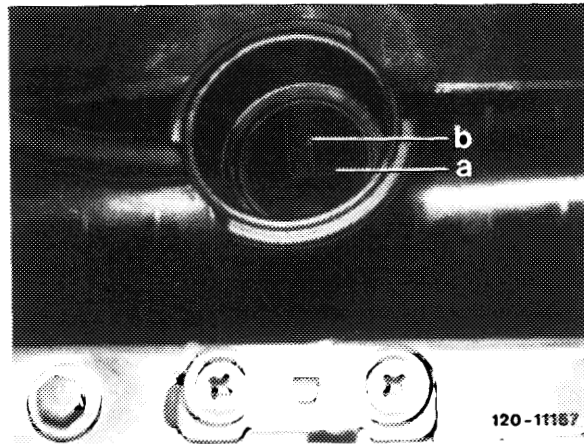
- 4 Fill-in coolant up to mark on radiator filler neck.
- 5 On models 115.1 and 123.1 (1st version), open vent screw on coolant thermostat housing until coolant flows out.

Model 115.1



- 6 Start engine and run warm. Mount radiator cap.

Model 123.1



### b) Vehicles with automatic climate control

- 4 Slowly fill-in coolant up to mark on radiator filler neck. Do not mount radiator cap.
- 5 Start engine and run warm up to approx. 40°C.
- 6 Pull-off plug of heating water pump (arrow) on feed line. Connect heating water pump to battery with self-made tool and push „DEF“-button.
- 7 Run engine warm under intermittent acceleration until thermostat opens.

**Note:** Mount radiator cap starting at 60°C.

- 8 Connect heating water pump again to feed line.
- 9 Check coolant level (below 90°C) and fill-up to specified level.



### A. De-oiling

- 1 Completely drain cooling system.
- 2 Remove thermostat element 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 P3/1 l water water).

#### **Attention !**

On vehicles with **aluminum radiator**, a neutral cleaner such as P 3 Croni (made by Henkel) or Grisiron 7220 (made by Farbwerke Hochst) must be used instead of the heavily alkaline 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, fill cooling system twice with fresh water, run warm (approx. 5 minutes) and drain.

### 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 three 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 seal.

7 Fill the cooling system with specified coolant specification for service products page 310 to 325).

Note: For decalcification and derusting, commercial products named 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 thermostat

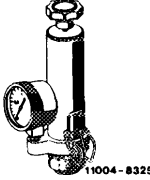
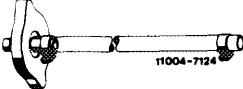
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Tightening torques		Nm	(kpm)
Screws for thermostat housing cover		10	(1)
Drain plug, radiator	Typ 115.1	6-10	(0.6-1)
	Typ 123.1	1.5-2 <sup>1)</sup>	(0.15-0.2)

<sup>1)</sup> This torque can be set by means of a washer or a coin.

### Special tools

---

Tester for cooling system	 11004-8325	001 589 48 21 00
Radiator cap with hose for leak test	 11004-7124	605 589 00 25 00

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### A. Model 115.1 and 123.1 (1st version up to February 1979)

#### Removal

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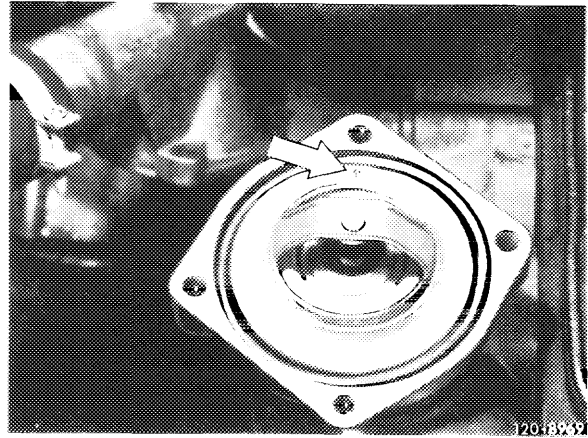
- 1 Drain coolant.
- 2 Disconnect hose on thermostat housing cover.
- 3 Unscrew thermostat housing cover.
  
- 4 Remove thermostat with seal out of cover.



## Installation

---

- 5 When a new thermostat is installed, place a new gasket on thermostat housing.
- 6 Position thermostat with gasket in cover in such a manner that the arrow on thermostat is pointing upwards or toward the rear in installed condition.
- 7 Screw-on cover and connect hose.



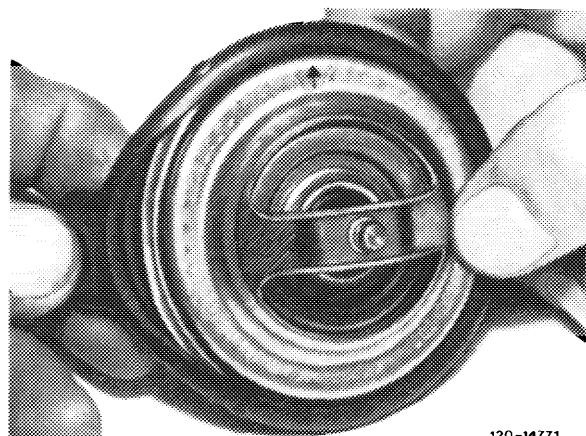
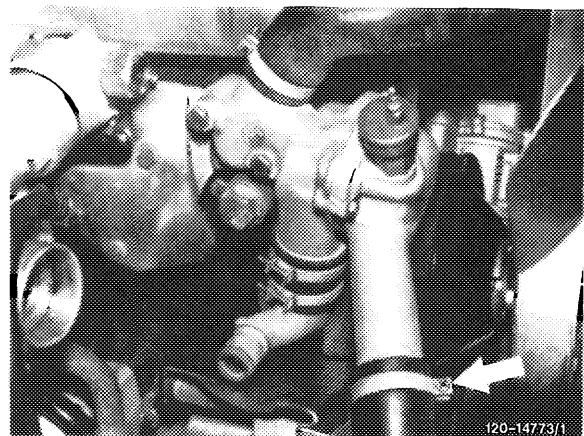
- 8 Add coolant (20-010).
- 9 Pressure-test cooling system with tester.

## B. Model 123.1 (2nd version starting February 1979)

### Removal

---

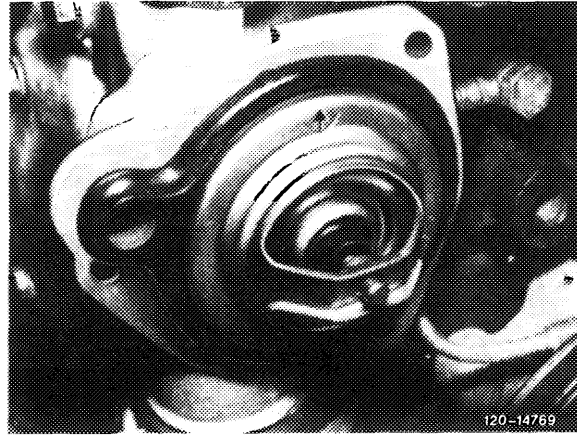
- 1 Drain coolant.
- 2 Disconnect hose on thermostat housing cover.
- 3 Unscrew thermostat housing cover.
- 4 Remove thermostat with gasket out of cover.



## Installation

---

- 5 When a new thermostat is installed, place a new gasket on thermostat housing.
- 6 Position thermostat with gasket in cover in such a manner that the arrow on thermostat is pointing upwards or toward the rear in installed condition.
- 7 Screw-on cover and connect hose.
- 8 Add coolant (20-010).
- 9 Pressure-test cooling system with tester.

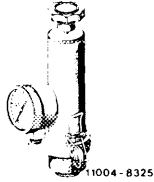
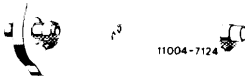


## 20–210 Removal and installation of water pump

Tightening torques		Nm	(kpm)
Drain plug, radiator	type 115.1	6–10	(0.6–1)
	type 123.1	15–2 <sup>1)</sup>	(a 15–0.2)
Water pump to water pump housing		9	(0.9)
Fan to water pump		25	(2.5)

<sup>1)</sup> This torque can be set by means of a washer or a coin.

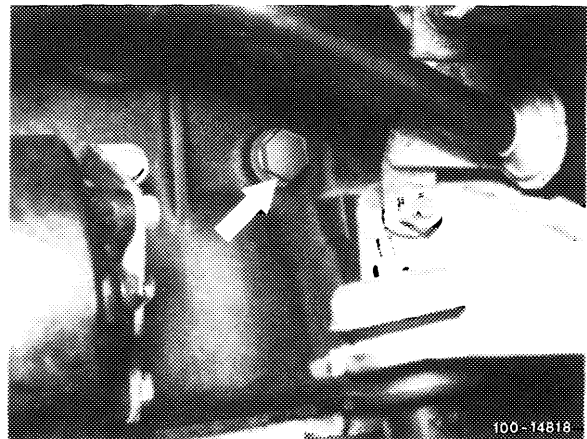
### Special tools

Tester for cooling system		001 589 48 21 00
Radiator cap with hose for leak test for leak test		605 589 00 25 00

### Removal

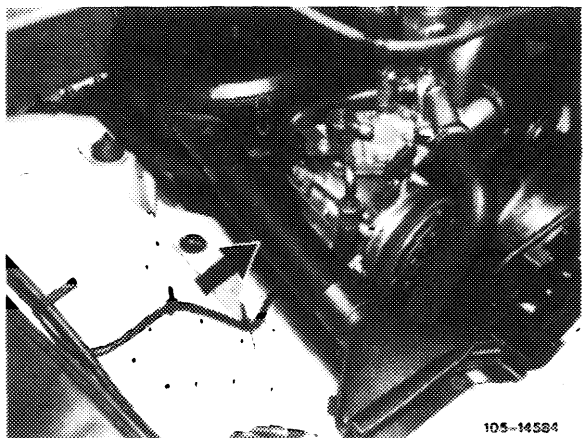
- 1 Completely drain coolant (20–010)
- 2 Unscrew fan.
- 3 Slacken V-belt of alternator and remove.

Drain plug on cylinder crankcase

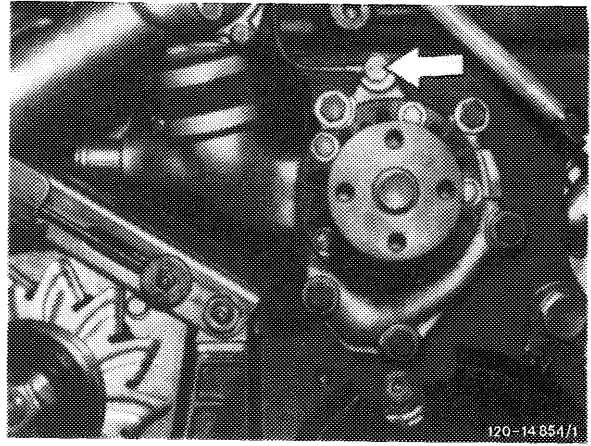


- 4 On vehicles with automatic climate control, remove York refrigerant compressor with carrier and connected lines and put aside.

For this purpose, on engine 617 in model 123.1, remove adaptor between air filter and scoop.



5 Unscrew water pump and remove.



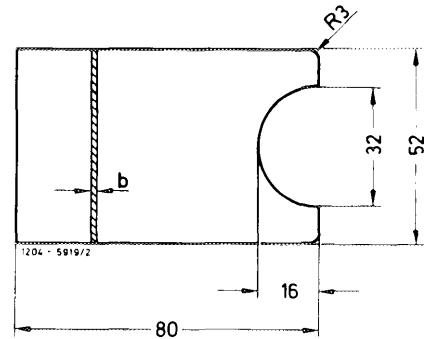
### Installation

---

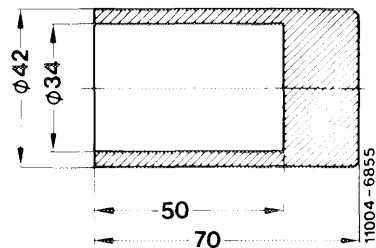
- 6 Insert water pump with new gasket and screw down.
- 7 For further installation proceed vice versa.
- 8 Tension V-belt of alternator (13-340).
- 9 Pressure-test cooling system with tester.

Self-made tools

Spacing plate  
 b = 2 mm



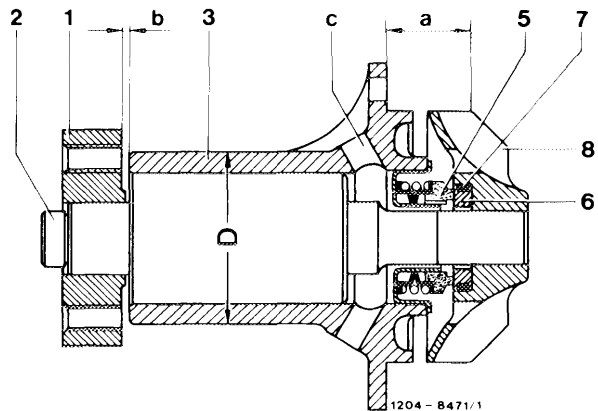
Installation sleeve



Note

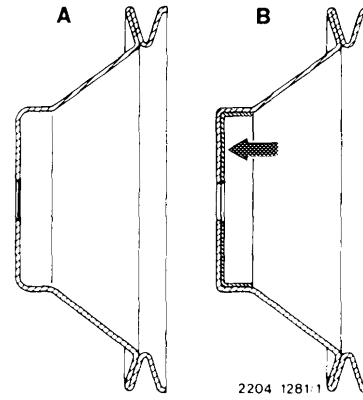
On engine 617.912, from engine end No. 046716 to 061708 with manual transmission and from 043754 to 058448 with automatic transmission, the water pump of engines 615, 616 with the smaller bearing dia. of 36 mm (D) has been installed.

- |   |                |
|---|----------------|
| 1 Fan hub                               | 7 O-ring       |
| 2 Water pump shaft with compact bearing | 8 Impeller     |
| 3 Bearing housing                       | a 22.8—23.2 mm |
| 5 Sliding ring seal                     | b 2 mm         |
| 6 Counter-ring                          | c Vent bores   |
|   | D Bearing dia. |



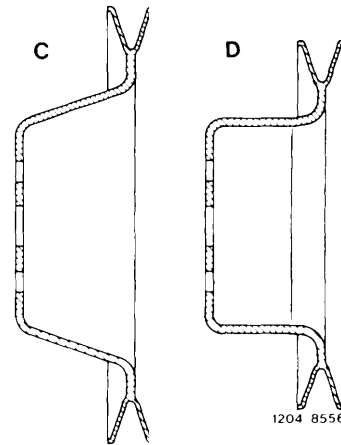
The water pump of engine 617.912 has a bearing diameter of 40 mm. In the event of repairs, install the water pump used up to now.

On engine 617.912 with 9.5 V-belt profile, the water pump pulley version A has been replaced by version B with soldered-in cup (arrow) starting October 1978. In the event of repairs, install new pulley with part No. 617 205 01 10.

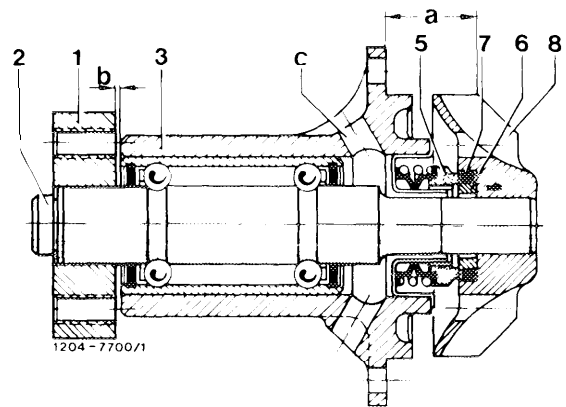


A 1st version  
B 2nd version

On engine 616.912, the water pump pulley with 12.5 V-belt profile is installed since February 1979 on vehicles with manual transmission with a diameter of 176 mm (C) and on vehicles with automatic transmission with a diameter of 148 mm (D).



C Manual transmission with V-belt 12.5 x 1035  
D Automatic transmission with V-belt 12.5 x 1000

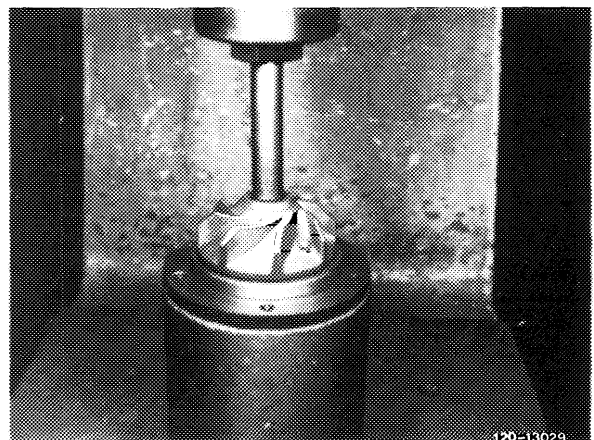


#### Water pump engine 617

- |   |                |
|---|----------------|
| 1 Fan hub                               | 7 O-ring       |
| 2 Water pump shaft with compact bearing | 8 Impeller     |
| 3 Bearing housing                       | a 22.8–23.2 mm |
| 5 Sliding ring seal                     | b 2 m m        |
| 6 Counter-ring                          | c Vent bores   |

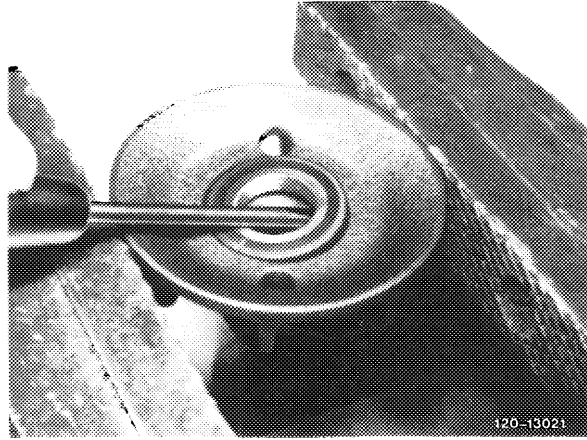
#### Disassembly

- 1 Support bearing housing with pertinent tubing and press-out water pump shaft by means of a mandrel.
- 2 Knock sliding ring seals from bearing housing.



3 Remove counter-ring from impeller.

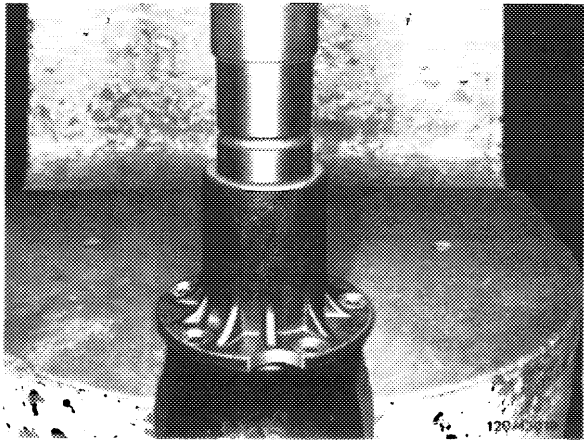
**Note:** Always replace compact bearing and fan hub following disassembly.



#### Assembly

4 Press-in new compact bearing flush with bearing housing by means of a tube positioned against outer race.

Do not press against water pump shaft.

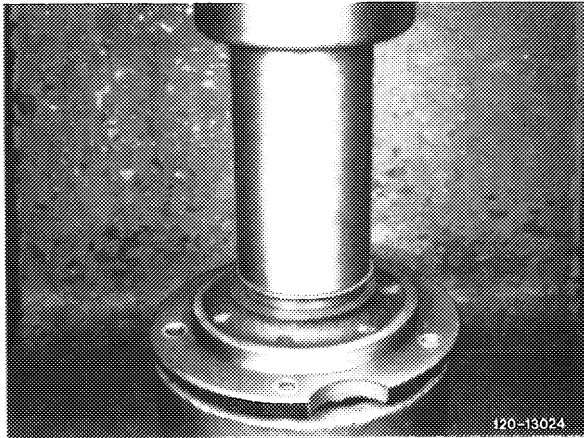


5 Coat mounting bore of sliding ring seal in bearing housing sliding ring with sealing compound.

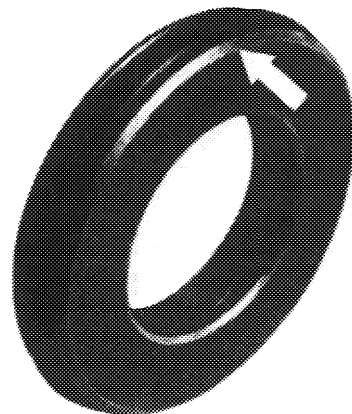
Press-in or knock-in sliding ring seal with pressing-in sleeve.

**Attention !**

Support only against bearing housing and not against water pump shaft.



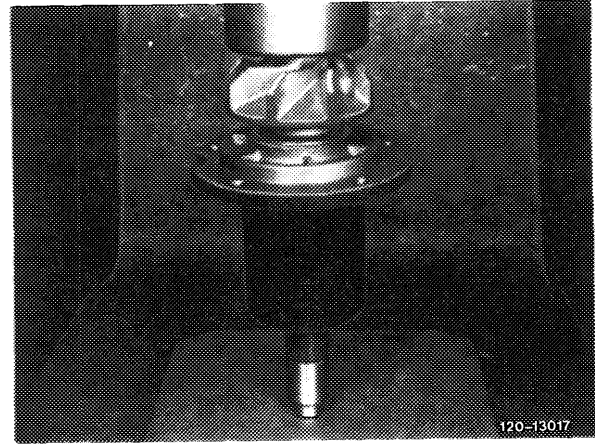
6 Coat O-ring on counter-ring with brake cylinder paste and push with chamfered side (arrow) into thoroughly cleaned impeller.



7 Clean sealing surfaces of counter-ring and sliding ring seal free of dust by means of a chamois cloth.

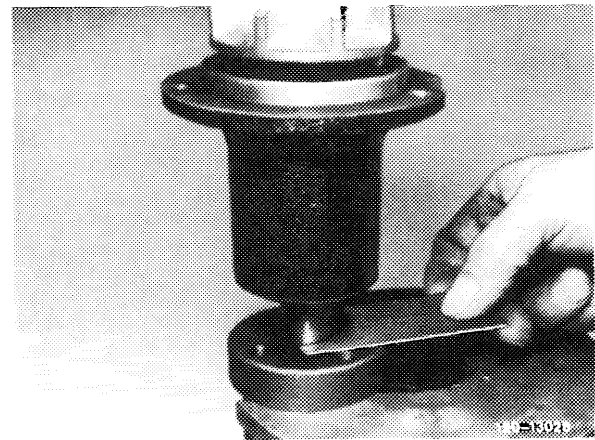
8 Degrease both shaft studs and impeller in bore.

9 Press-on impeller flush with shaft while supporting water pump shaft.



10 Heat fan hub on a hot plate to approx. 300°C (annealing color dark – up to light blue).

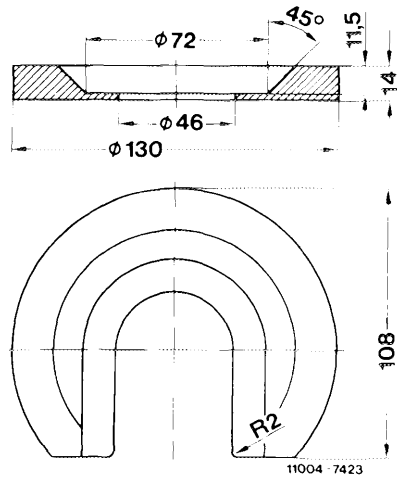
Place heated fan hub on a recessed base. Hold spacing plate on water pump shaft, slip water pump shaft on fan hub and apply a blast of compressed air against hub. Wait for a few seconds until fan hub is firm and then cool immediately in water bath.



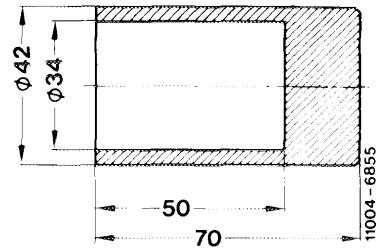


Self-made tools

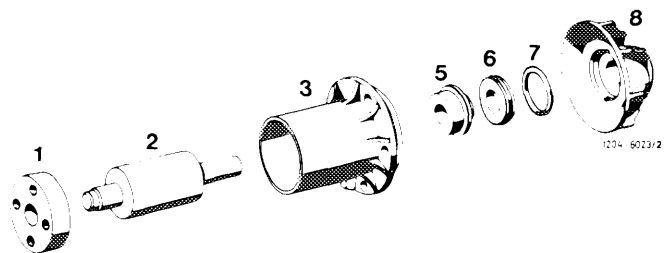
Pressing-off disc for impeller



Pressing-in sleeve



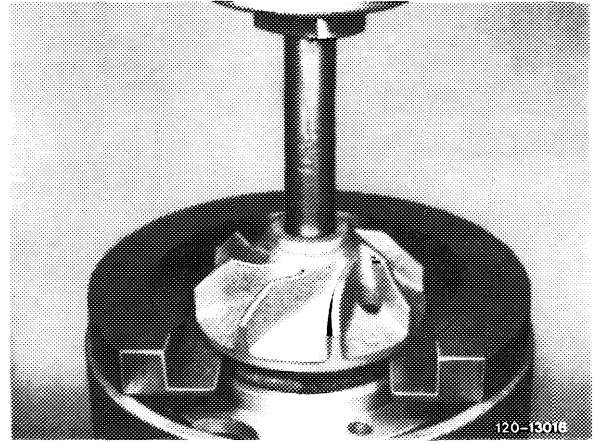
- |   |                     |
|---|---------------------|
| 1 Fan hub                               | 5 Sliding ring seal |
| 2 Water pump shaft with compact bearing | 6 Counter-ring      |
| 3 Bearing housing                       | 7 O-ring            |
|   | 8 Impeller          |



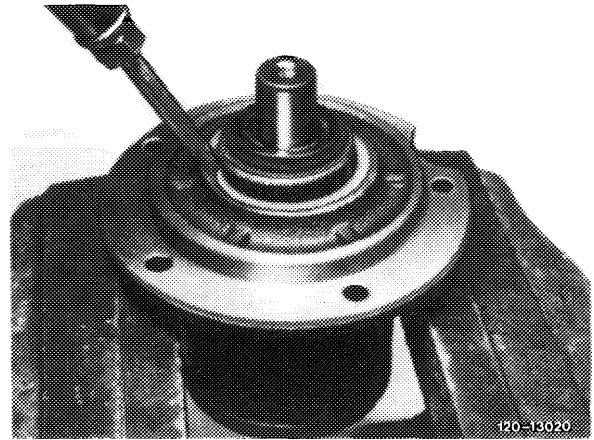
## Disassembly

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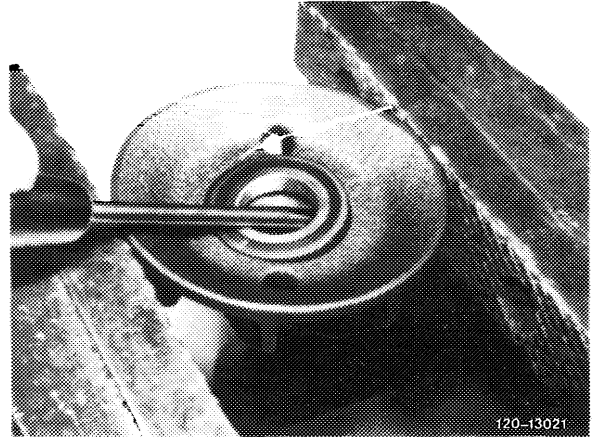
1 Press-off impeller. For this purpose, place pressing-off disc between impeller and bearing housing.



2 Apply light hammer blows at several points between bearing housing and sliding ring seal to cancel the pre-load and force sliding ring seal out.



3 Force counter-ring out of impeller.



## Assembly

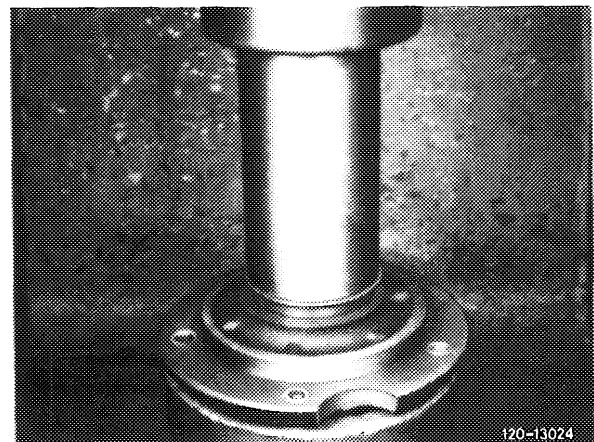
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4 Slightly coat mounting bore of sliding ring seal in water pump housing with sealing compound.

Press-in sliding ring seal by means of pressing-in sleeve or knock out.

### **Attention !**

Support at bearing housing only and not at water pump shaft.



5 Coat O-ring on counter-ring with brake cylinder paste and push with chamfered side (arrow) into thoroughly cleaned impeller.

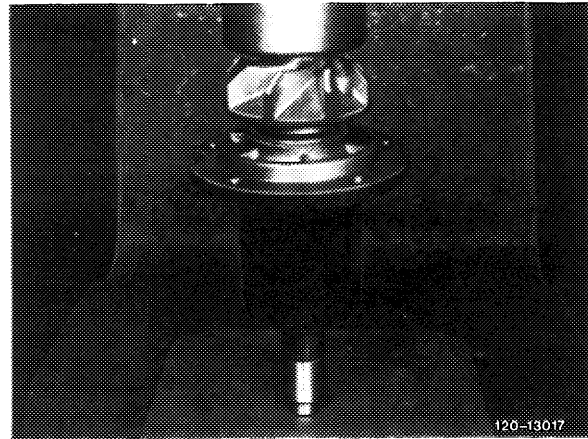


120 - 10863

6 Clean sealing surfaces of counter-ring and sliding ring seal free of dust with chamois cloth.

7 Degrease shaft stud and impeller in bore.

8 Press-on impeller flush with shaft while supporting water pump shaft.



120-13017

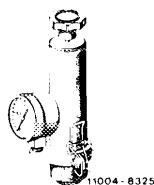
## 20–230 Removal and installation of water pump housing

Tightening torques		Nm	(kpm)
Radiator drain plug	type 115.1	6–10	(0.6–1)
	type 123.1	1.5–2 <sup>1)</sup>	(0.15–0.2)
Water pump to water pump housing		9	(0.9)
Fan to water pump		25	(2.5)

<sup>1)</sup> This torque can be set by means of a washer or a coin.

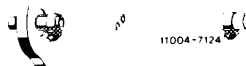
### Special tools

Tester for cooling system



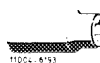
001 589 48 21 00

Radiator cap with hose for leak test



605 589 00 25 00

Socket 27 mm, 1/2'' square for rotating engine

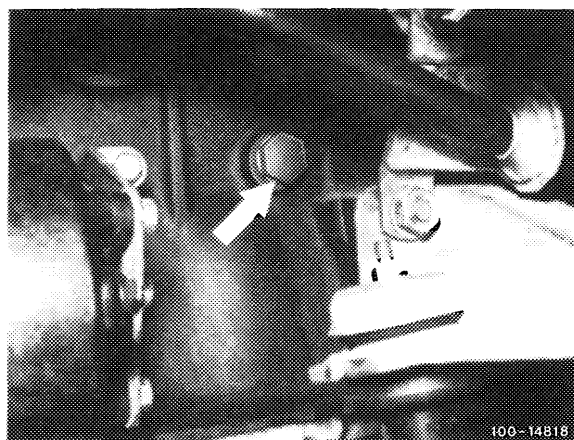


001 589 65 09 00

### Removal

- 1 Completely drain coolant (20–010).
- 2 Remove radiator (20–420).
- 3 Unscrew fan.
- 4 Slacken V-belt and remove.

Drain plug on cylinder crankcase



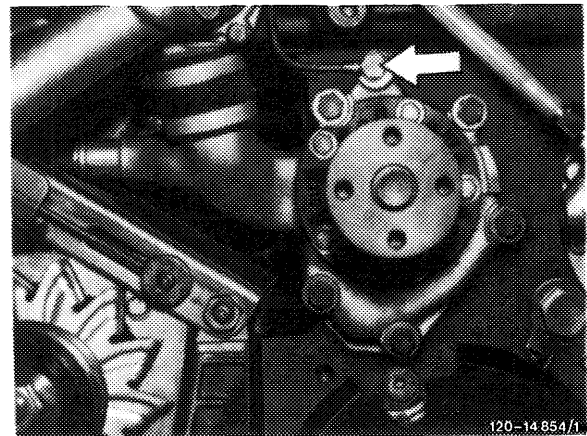
5 On engine 617, remove pulley and vibration damper.

6 Disconnect heating water return hose on water pump housing.

7 Disconnect hose between thermostat and water pump housing.

8 Unscrew vent line from water pump housing (arrow).

9 Unscrew water pump housing and remove together with water pump.



### Installation

---

10 Position water pump housing with new gasket and screw down.

11 For further installation proceed vice versa to removal.

12 Add coolant (20-010).

13 Pressure-test cooling system with tester.

**Operation**

The Viscofan coupling is a maintenance-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 (75) into the reservoir (74) (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 higher outside temperatures, the air which flows through the radiator and actuates bimetallic strip will become warmer. The bimetallic strip (69) changes its shape under the increasing heat and opens at approx. 73°C a valve by means of a control pin (68) and thereby the path of the oil from the reservoir (74) into the working chamber (75) so that the fan will be additionally engaged.

During this control operation, the coolant temperature is between 90 and 95°C.

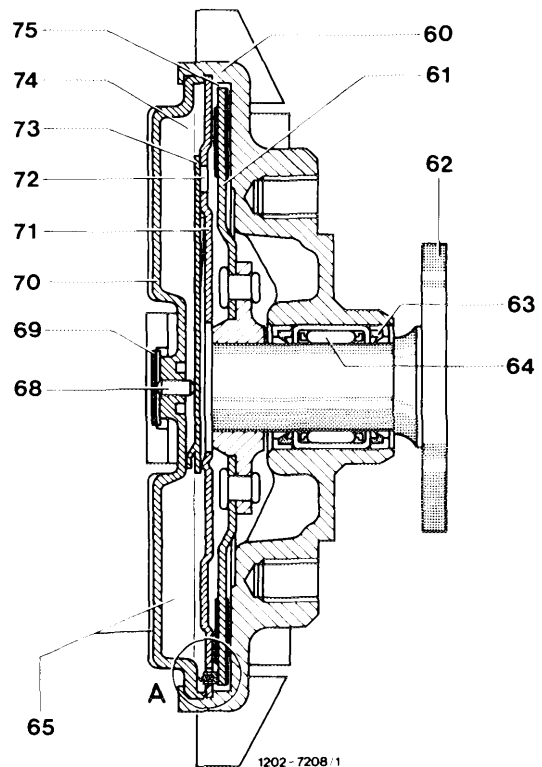
With the clutch engaged, the fan speed in lower speed range will increase approximately proportional with the increasing engine speed, but will not exceed 35001 min in upper speed range.

**Checking connected temperature**

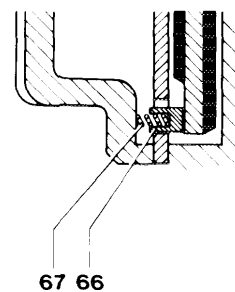
Run engine at 4000–4500/min. When a coolant temperature of 90 to 95°C is attained, the fan speed should increase by approx. 1000/min., which can be clearly noticed acoustically.

**Reconditioning**

A defective coupling cannot be repaired with workshop equipment, and a new coupling should be installed.



Detail on A



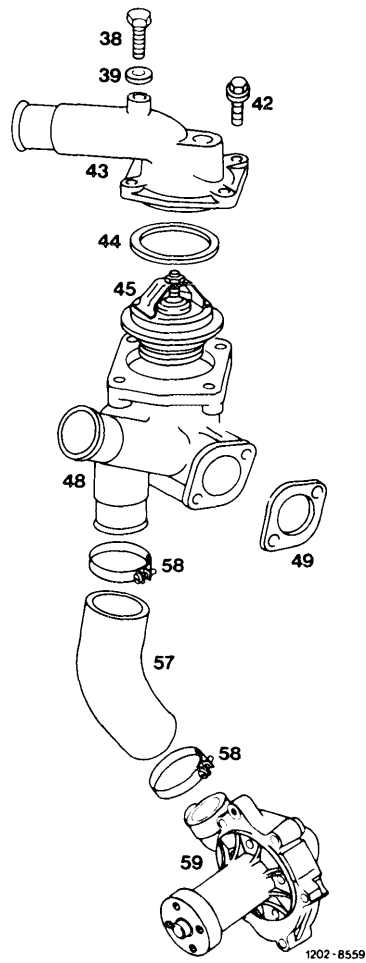
- 60 Coupling body (secondary member)
- 61 Pulley (primary member)
- 62 Flange shaft
- 63 Sealing ring
- 64 Needle bearing
- 65 Cooling fins
- 66 Oil scraper
- 67 Compression spring
- 68 Control pin
- 69 Bimetallic strip
- 70 Cover with holding clip
- 71 Intermediate washer
- 72 Feed hole
- 73 Valve lever
- 74 Reservoir
- 75 Work chamber

## **Transportation and storage**

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Temperature-controlled Viscofan couplings should be transported and stored vertically. For short periods— e.g. during assembly — the coupling may rest on a flange, but never on front end.

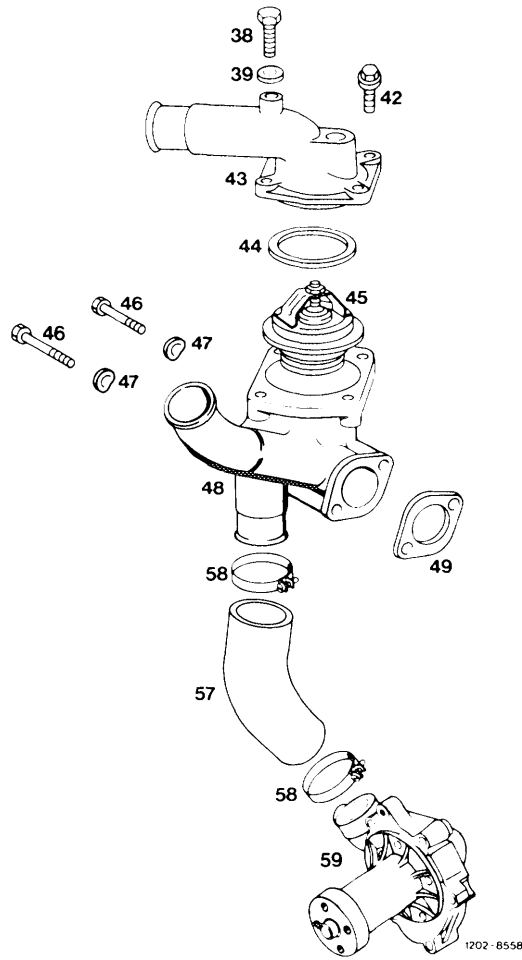
A. Engines 615, 616 in model 115.1



- |                             |                            |
|-----------------------------|----------------------------|
| 38 Screw                    | 48 Thermostat housing      |
| 39 Sealing ring             | 49 Gasket                  |
| 42 4 combination screws     | 57 Hose                    |
| 43 Thermostat housing cover | 58 Clamp                   |
| 44 Gasket                   | 59 Water pump with housing |
| 45 Thermostat               |                            |

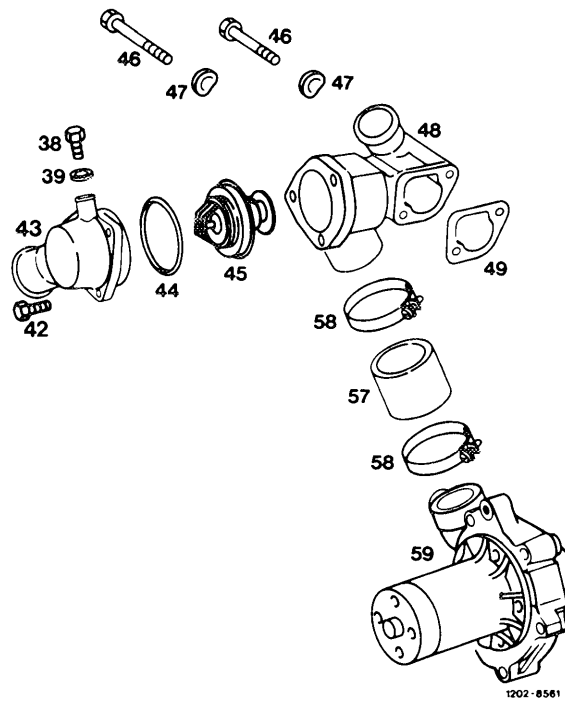


B. Engines 615, 616 in model 115.1 with air conditioning system



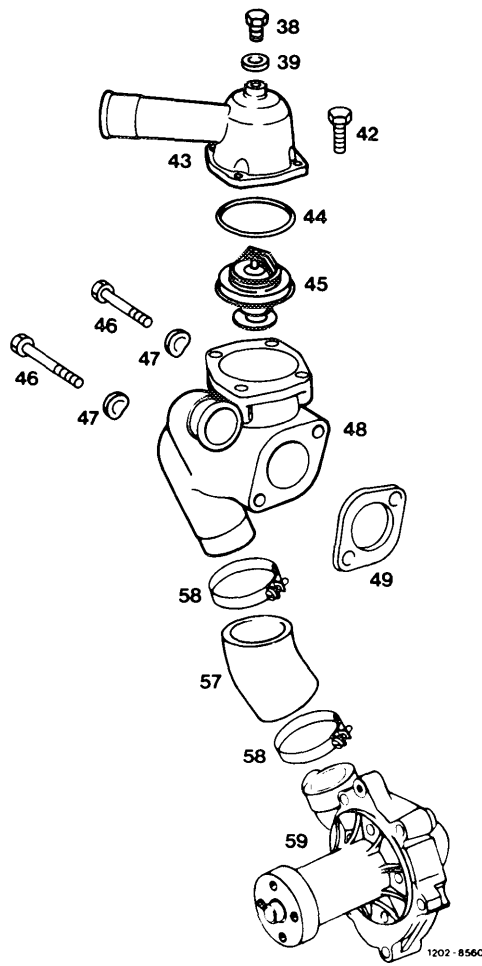
- |                             |                            |
|-----------------------------|----------------------------|
| 38 Screw                    | 46 Screw                   |
| 39 Sealing ring             | 47 Spring washer           |
| 42 3 combination screws     | 48 Thermostat housing      |
| 43 Thermostat housing cover | 49 Gasket                  |
| 44 Gasket                   | 57 Hose                    |
| 45 Thermostat               | 58 Clamp                   |
|                             | 59 Water pump with housing |

C. Engine 617 in model 115.1



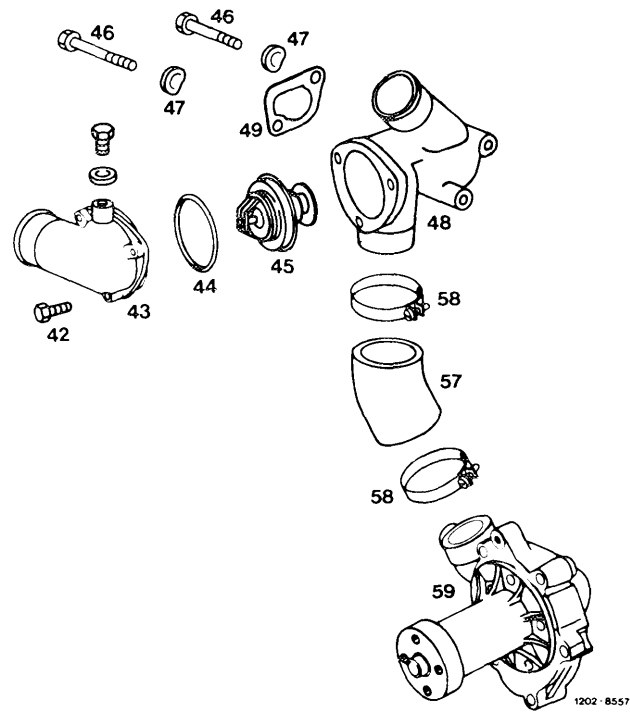
- |                             |                             |
|-----------------------------|-----------------------------|
| 38 Screw                    | 46 Screw                    |
| 39 Gasket                   | 47 Spring washer            |
| 42 3 combination screws     | 48 Thermostat housing cover |
| 43 Thermostat housing cover | 49 Gasket                   |
| 44 Gasket                   | 57 Hose                     |
| 45 Thermostat               | 58 Clamp                    |
|                             | 59 Water pump with housing  |

D. Engine 617 in model 115.1 with air conditioning system  
 Engines 615, 616 in model 123.1 (1st version) with air conditioning system



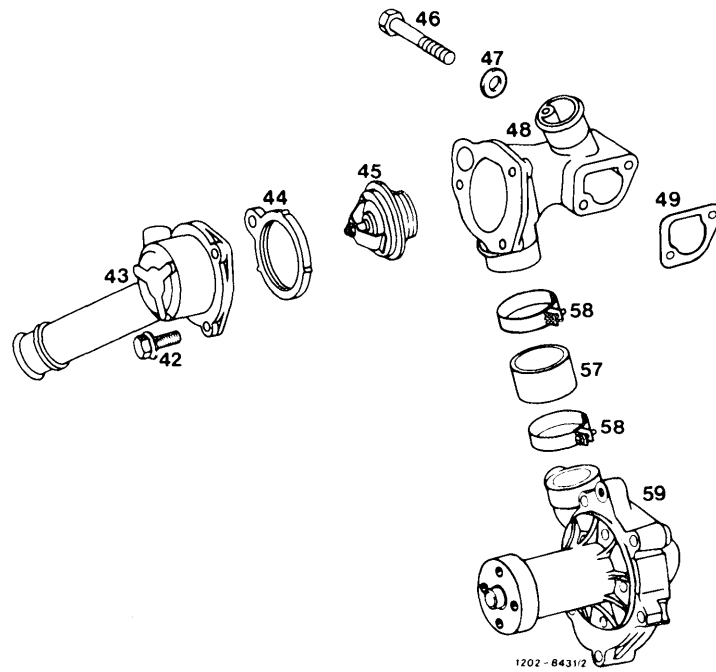
- |                             |                            |
|-----------------------------|----------------------------|
| 38 Screw                    | 46 Screw                   |
| 39 Sealing ring             | 47 Spring washer           |
| 42 4 combination screws     | 48 Thermostat housing      |
| 43 Thermostat housing cover | 49 Gasket                  |
| 44 Gasket                   | 57 Hose                    |
| 45 Thermostat               | 58 Clamp                   |
|                             | 59 Water pump with housing |

E. Engines 615, 616, 617 in model 123.1 (1st version)



- |    |                          |    |                         |
|----|--------------------------|----|-------------------------|
| 42 | 3 combination screws     | 46 | Screw                   |
| 43 | Thermostat housing cover | 47 | Spring washer           |
| 44 | Gasket                   | 48 | Thermostat housing      |
| 45 | Thermostat               | 49 | Gasket                  |
|    |                          | 57 | Hose                    |
|    |                          | 58 | Clamp                   |
|    |                          | 59 | Water pump with housing |

**F. Engines 615, 616, 617 in model 123.1 (2nd version)**



- |    |                          |    |                         |
|----|--------------------------|----|-------------------------|
| 42 | 3 combination screws     | 46 | 2 screws                |
| 43 | Thermostat housing cover | 47 | 2 spring washers        |
| 44 | Gasket                   | 48 | Thermostat housing      |
| 45 | Thermostat               | 49 | Gasket                  |
|    |                          | 57 | Hose                    |
|    |                          | 58 | Clamp                   |
|    |                          | 59 | Water pump with housing |