

07.1 Injection system

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07.1-001 Survey engine-injection pump-injection nozzle-nozzle holder

Standard version and (USA)

| | | |
|------------------|-----------------------------|-------------------|
| Engine | 601.911 standard version | 601.921 (USA) |
| Injection pump | PES 4 M 55 C 320 RS 152 | |
| Governor | RSF 375/2250 M 53 | RSF 375/2250 M 56 |
| Fuel pump | FP/KG 24 M 150 | |
| Injection nozzle | DN 0 SD 261/- | DN 0 SD 24-/- |
| Nozzle holder | KCA 30 S 44 | KCA 30 S 46 |

07.1-010 Operation of injection system

The injection system differs from that of engines 615, 616 and 617 as follows:

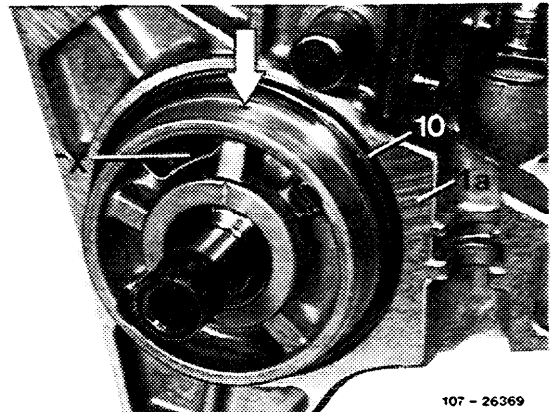
- Lubrication of injection pump.
- Relief throttle in delivery valve holder.
- Pneumatic idle speed increase.
- Reference impulse verification (RIV).
- Injection timing by means of adjusting device and injection pump flange.
- Injection system, self-venting.
- Fuel pump with higher delivery capacity, thereby eliminating hand pump.
- Overflow valve with throttle (orifice).
- Injection nozzle as **flat surface pintle** nozzle for standard version and as hole-type pintle nozzle for (USA).
- Injection timer mounted directly on injection pump shaft. Fastened by means of central bolt with **left-hand threads**.
- Fuel heater.

A. Lubrication of injection pump

The injection pump is connected to engine oil circuit by means of an oil bore (arrow).

Oil return flow is by way of ring gap (x) between bearing and housing in cylinder crankcase.

An O-ring (10) is installed on flange (1a) for sealing the clutch space between injection pump flange and crankcase.

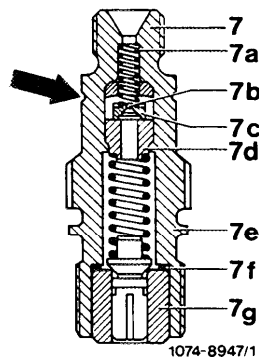


107 - 26369

B. Relief throttle in delivery valve holder

Relief throttles are installed in delivery valve holders of injection pump to reduce the hydro-carbon share in exhaust gas. An annular groove is located on delivery valve holder for identification (arrow). The relief throttle (7b) is a reed valve (7c) with an orifice of 0.6 mm dia., which opens in direction of injection nozzle. The valve seat (7d) is riveted into delivery valve holder.

- 7 Delivery valve holder connection
- 7a Spring
- 7b Relief throttle
- 7c Reed valve
- 7d Valve seat
- 7e Delivery valve holder
- 7f Seal
- 7g Delivery valve

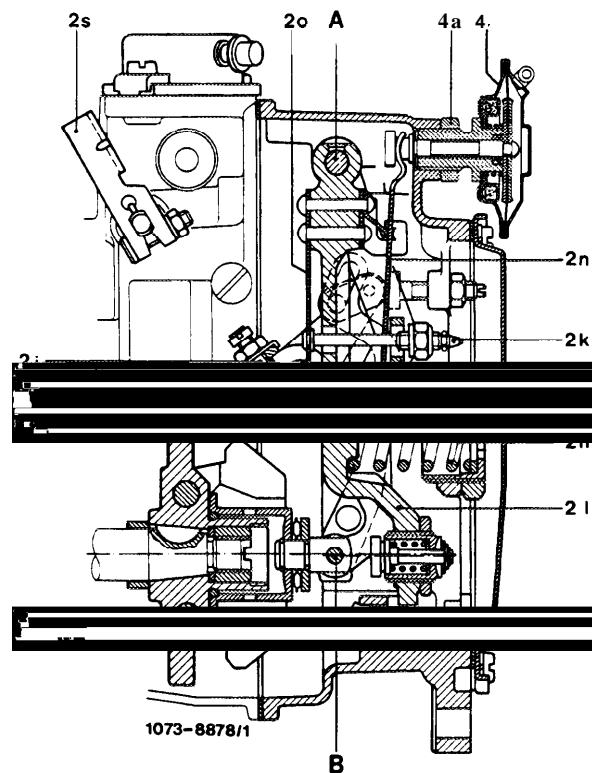


C. Layout and operation of RSF-governor

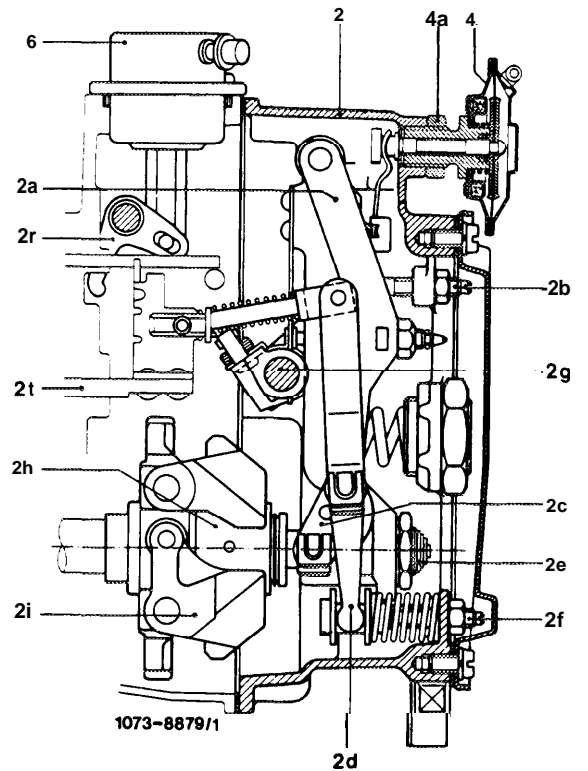
The governor is an idle speed-maximum speed **governo** with its regulating spring (2 m) measured and adjusted in such a manner that the governor will not govern in partial load range, apart from adaptation (refer to „Regulation during start and full load“).

In partial load and full load range the control rod (2t) of injection pump is operated by accelerator pedal only, which is connected to adjusting lever (2g) of governor via regulating linkage.

The vacuum control unit (4) preloads the idle speed spring and adjusts the idle speed.



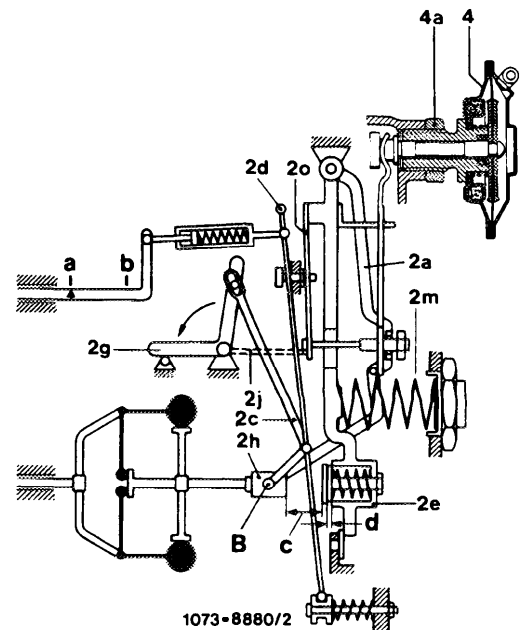
- 2 Governor
- 2a Guide lever
- 2b Stop screw for delivery at idle
- 2c Transfer lever
- 2d Regulating lever
- 2e Spring capsule (adaptation)
- 2f Full load adjusting screw
- 2g Adjusting lever
- 2h Sliding sleeve
- 2i Flyweights (pump-governor-group)
- 2j Idle speed auxiliary spring-shutoff
- 2k Adjusting screw for idle speed auxiliary spring (tickler)
- 2l Tensioning lever
- 2m Governor spring
- 2n Idle speed spring
- 2o idle speed auxiliary spring (tickler)
- 2p Linkage lever
- 2r Stop lever
- 2s Emergency stop lever
- 2t Control rod
- 4 Vacuum control unit idle speed increase
- 4a Adjusting nut for idle speed
- 6 Vacuum control unit (stop)



Regulation during start and full load

If, with the engine stopped, the adjusting lever (2g) is placed against full load stop (fixed stop on governor housing), the transfer lever (2c) will swing around pivot „B” and will take the regulating lever (2d) along in direction of start.

In full load position of adjusting lever (2g, „full throttle”) the idle speed auxiliary spring (2o, tickler) is forced away from guide lever under influence of idle speed auxiliary spring-shutoff (2j) A faster break away from starting position of governor will result.



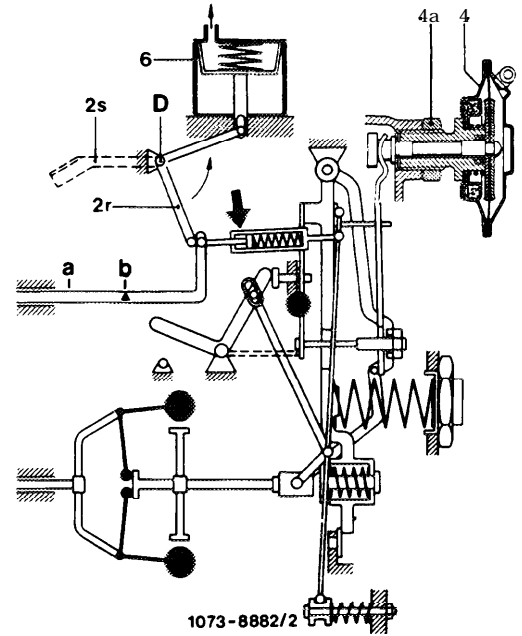
- a Start
- b Stop
- c Idle speed stage
- d Adaptation

Stop position of governor

The vacuum control unit (6) is provided with a vacuum by means of vacuum pump via steering lock of vehicle. As a result, the diaphragm of the vacuum control unit is attracted against the pressure of the diaphragm spring.

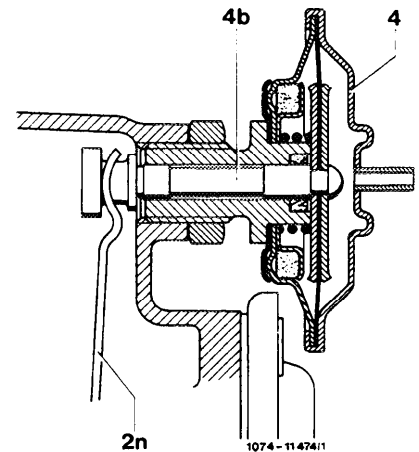
The vacuum control unit (6) is connected to a stop lever (2r). This lever will swivel around pivot „D” and will thereby pull the control rod of the injection pump into „stop position”.

This will bridge the shunt spring of the regulating lever. Likewise, the control rod can be pulled from outer side of governor into „stop position” via emergency stop lever (2s).

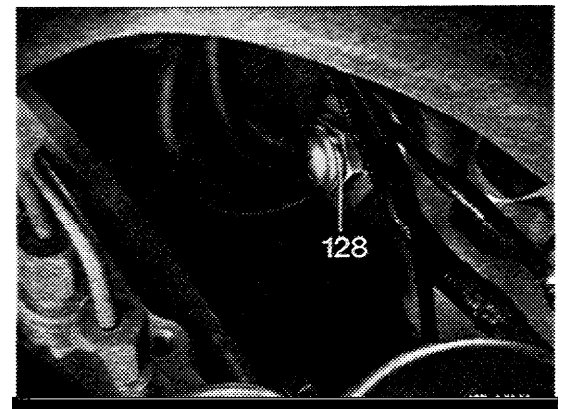


D. Pneumatic idle speed increase

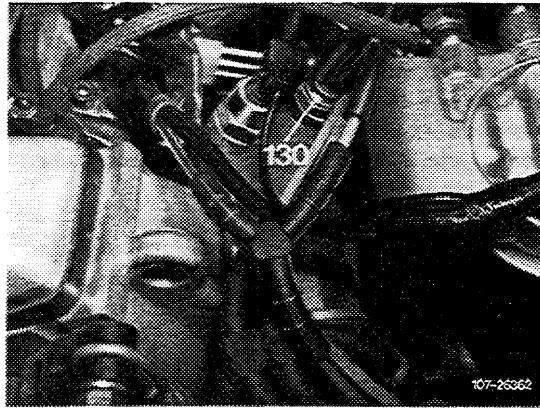
Idle speed increase for rpm stabilization is effected up to approx. 17 °C coolant temperature, as well as on vehicles with automatic transmission when the refrigerant compressor is additionally connected also above approx. 17 °C coolant temperature.

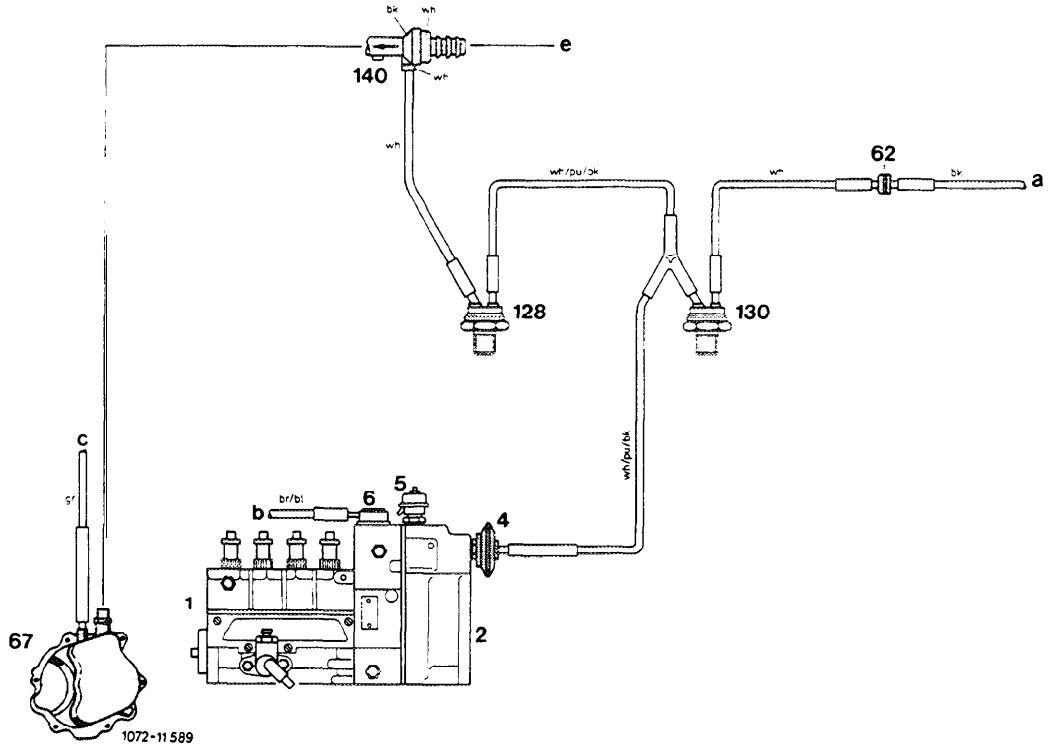


The vacuum control unit (4) attached to governor housing is activated via thermostats (128 and 130) and switchover valve (127). If the vacuum control unit (4) is energized by a vacuum (approx. 500 mbar), the idle speed spring is attracted via plunger



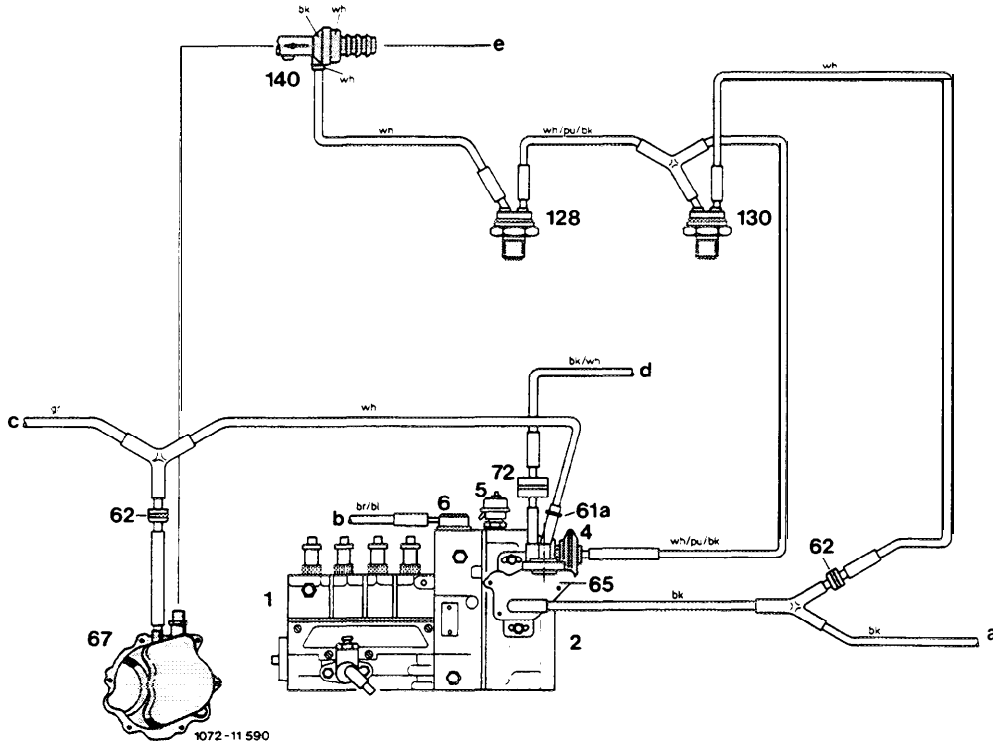
Coolant temperature < approx. 17 °C





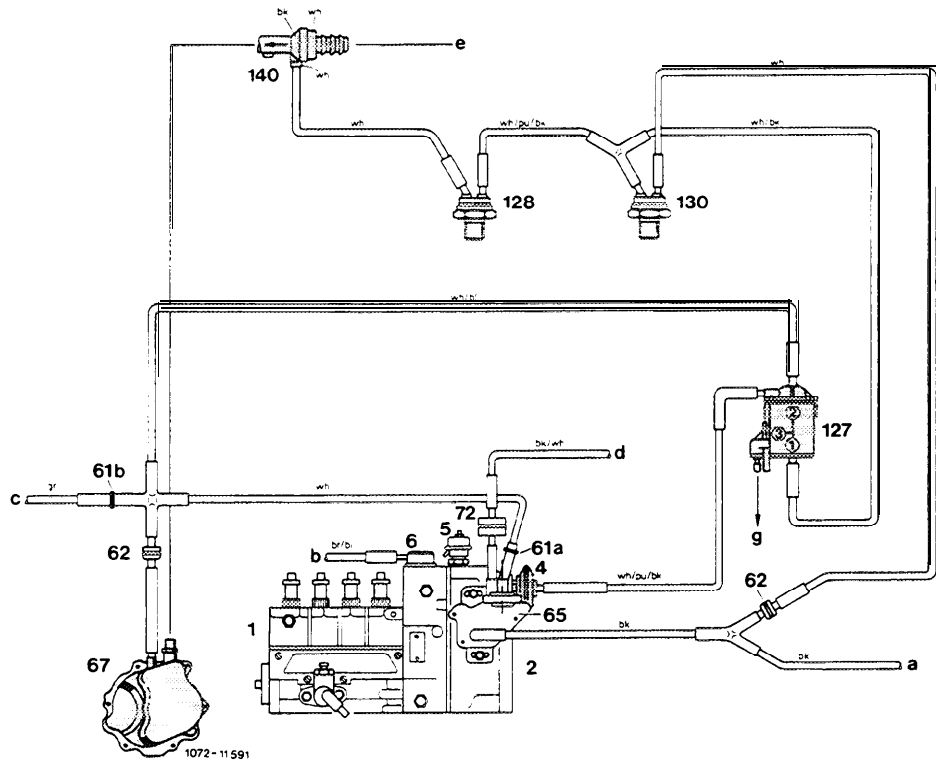
Function diagram idle speed increase with manual transmission, standard version and **USA** Federal

- | | | |
|---|---------------------------------|-------------|
| 1 Injection pump | a Vent line to vehicle interior | bk = black |
| 2 Governor | b Key shutoff | bl = blue |
| 4 Vacuum control unit idle speed increase | c Remaining consumers | br = brown |
| 5 ADA-capsule (altitude pressure compensator@ | e Brake unit | gr = green |
| 6 Vacuum control unit (stop) | | pu = purple |
| 62 Vent filter | | re = red |
| 67 Vacuum pump | | wh = white |
| 128 Thermovalve closes at approx. 17 °C | | |
| 130 Thermovalve opens at approx. 17 °C | | |
| 140 Check valve brake unit | | |



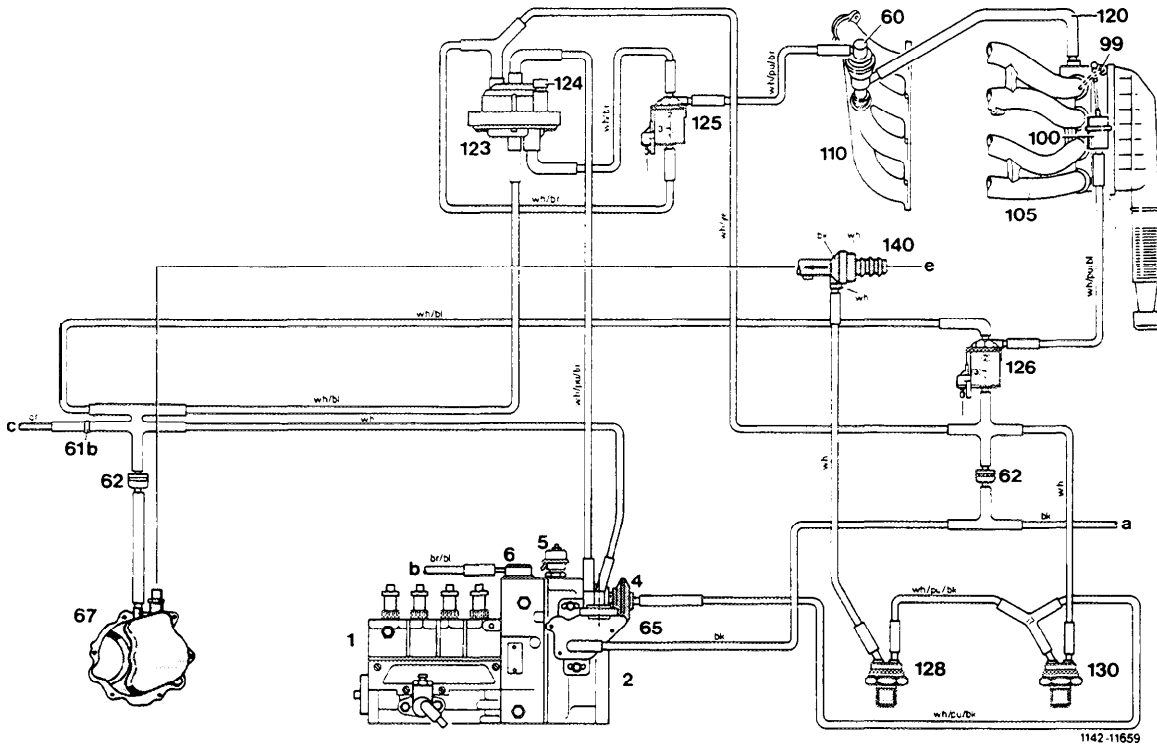
Function diagram idle speed increase with automatic transmission, standard version

- | | | |
|---|--|-------------|
| 1 Injection pump | a Vent line to vehicle interior | bk = black |
| 2 Governor | b Key shutoff | bl = blue |
| 4 Vacuum control unit idle speed increase | c Remaining consumers | br = brown |
| 5 ADA-capsule (altitude pressure compensator@ | d Vacuum control unit automatic transmission | gr = green |
| 6 Vacuum control unit (stop) | e Brake unit | pu = purple |
| 61a Orifice (blue) | | re = red |
| 62 Vent filter | | wh = white |
| 65 Vacuum control valve | | |
| 67 Vacuum pump | | |
| 72 Damper | | |
| 128 Thermovealve closes at approx. 17 °C | | |
| 130 Thermovealve opens at approx. 17 °C | | |
| 140 Check valve brake unit | | |



Function diagram idle speed increase with automatic transmission, @ Federal

- | | | |
|---|--|--|
| <ul style="list-style-type: none"> 1 Injection pump 2 Governor 4 Vacuum control unit idle speed increase 5 ADA-capsule (altitude pressure compensator) 6 Vacuum control unit (stop) 61a Orifice (blue) 61b Orifice 0.5 mm dia. orange 62 Vent filter 65 Vacuum control valve 67 Vacuum pump 72 Damper 127 Switchover valve, electric 128 Thermovalve closes at approx. 17 °C 130 Thermovalve opens at approx. 17 °C 140 Check valve brake unit | <ul style="list-style-type: none"> a Vent line to vehicle interior b Key shutoff c Remaining consumers d Vacuum control unit automatic transmission e Brake unit g To refrigerant compressor | <ul style="list-style-type: none"> bk = black bl = blue br = brown gr = green pu = purple re = red wh = white |
|---|--|--|

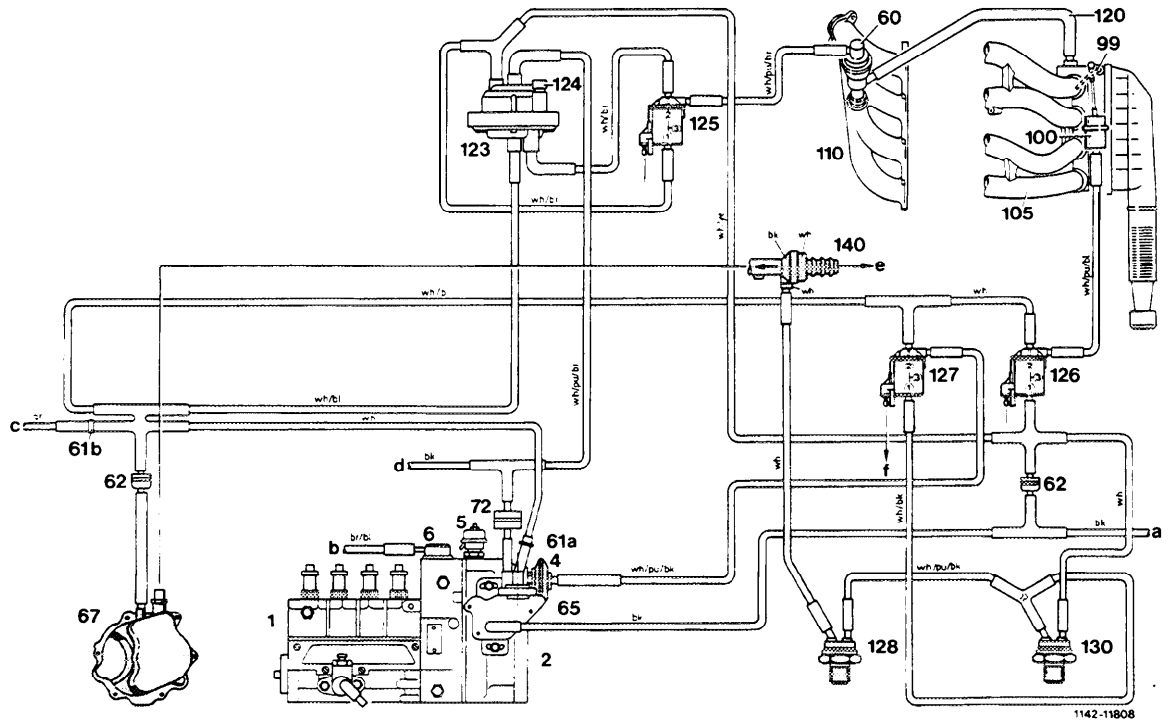


Function diagram idle speed increase with manual transmission, **USA** California

- 1 Injection pump
- 2 Governor
- 4 Vacuum control unit idle speed increase
- 5 ADA-capsule (altitude pressure compensator)
- 6 Vacuum control unit (stop)
- 60 EGR-valve
- 61 b Orifice 0.5 mm dia. (orange)
- 62 Vent filter
- 65 Vacuum control valve
- 67 Vacuum pump
- 99 Pressure control flap
- 100 Vacuum control unit for (99)
- 105 Intake manifold
- 110 Exhaust manifold
- 120 EGR-line
- 123 Pressure converter
- 124 Adjusting screw for (123)
- 125 Switchover valve electric for EGR-valve
- 126 Switchover valve electric for pressure control flap
- 128 Thermovalve closes at approx. 17 °C
- 130 Thermovalve opens at approx. 17 °C
- 140 Check valve brake unit

- a Vent line to vehicle interior
- b Key shutoff
- c Remaining consumers
- d Vacuum control unit automatic transmission
- e Brake unit
- f To refrigerant compressor-control unit

- bk = black
- bl = blue
- br = brown
- gr = green
- pu = purple
- re = red
- ye = yellow



Function diagram idle speed increase with automatic transmission, **USA** California

- 1 Injection pump
- 2 Governor
- 4 Vacuum control unit idle speed increase
- 5 ADA-capsule (altitude pressure compensator)
- 6 Vacuum control unit (stop)
- 60 EGR-valve
- 61 a Orifice
- 61 b Orifice 0.5 mm dia. (orange)
- 62 Vent filter
- 65 Vacuum control valve
- 67 Vacuum pump
- 72 Damper
- 99 Pressure control flap
- 100 Vacuum control unit for (99)
- 105 Intake manifold
- 110 Exhaust manifold
- 120 EGA-line
- 123 Pressure converter
- 124 Adjusting screw for (123)
- 125 Switchover valve electric for EGR-valve
- 126 Switchover valve electric for pressure control flap
- 127 Switchover valve electric for rpm increase
- 128 Thermovalve closes at approx. 17 °C
- 130 Thermovalve opens at approx. 17 °C
- 140 Check valve brake unit

- a Vent line to vehicle interior
- b Key shutoff
- c Remaining consumers
- d Vacuum control unit automatic transmission
- e Brake unit
- f To refrigerant compressor-control unit

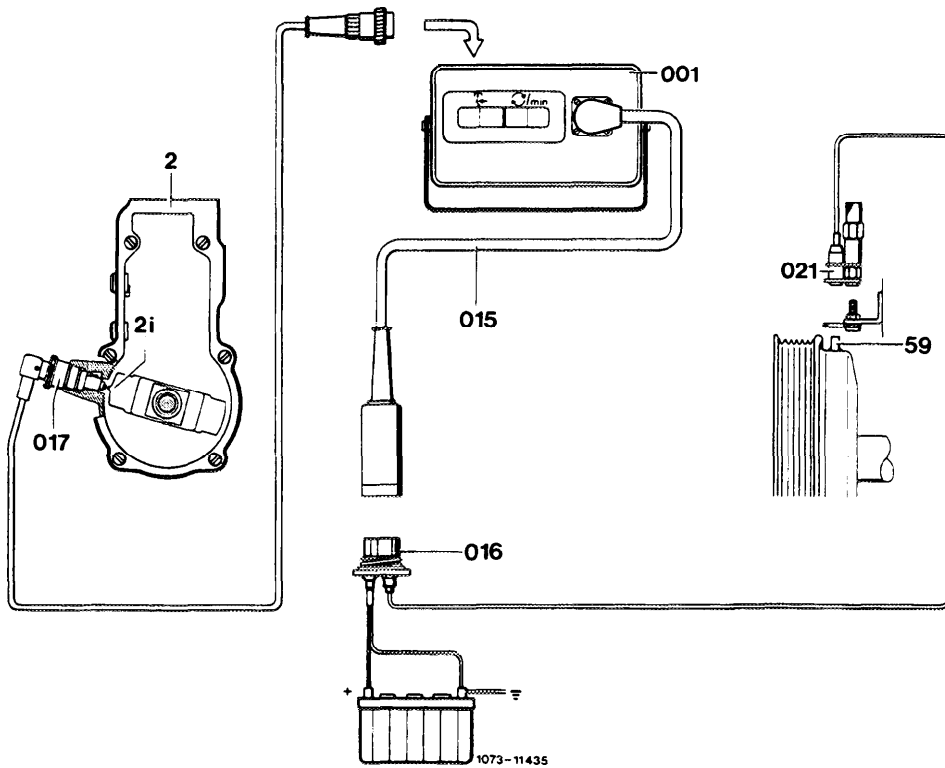
- bk = black
- bl = blue
- br = brown
- gr = green
- pu = purple
- re = red
- ye = yellow

E. Reference impulse verification (RI V)

Measuring the association of injection pump in relation to engine requires two signals:

- TDC-impulse from crankshaft.
- Regulating impulse from injection pump.

Both impulses are supplied by impulse transmitters. To obtain a measuring signal, the sensor pins must be moved past the impulse transmitters at a minimum speed (idle speed). A measuring instrument measures the chronological distance between the two impulses and converts the result into an angle value, which is then indicated.

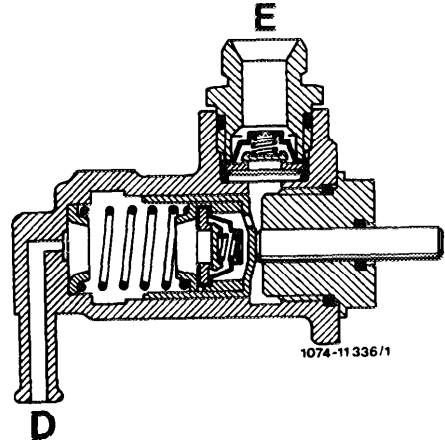


001 Digital tester
2 Governor
2i Flyweight with sensor pin
015 Test cable

016 Socket
017 Reference impulse transmitter
021 TDC-impulse transmitter
059 Sensor pin

F. Fuel pump

An increased delivery capacity of fuel pump makes the fuel system self-venting. The manual delivery pump is no longer installed.

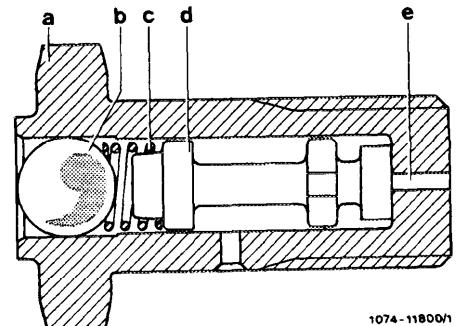


E Delivery end
D Suction end

Venting of injection pump requires an orifice in overflow valve.

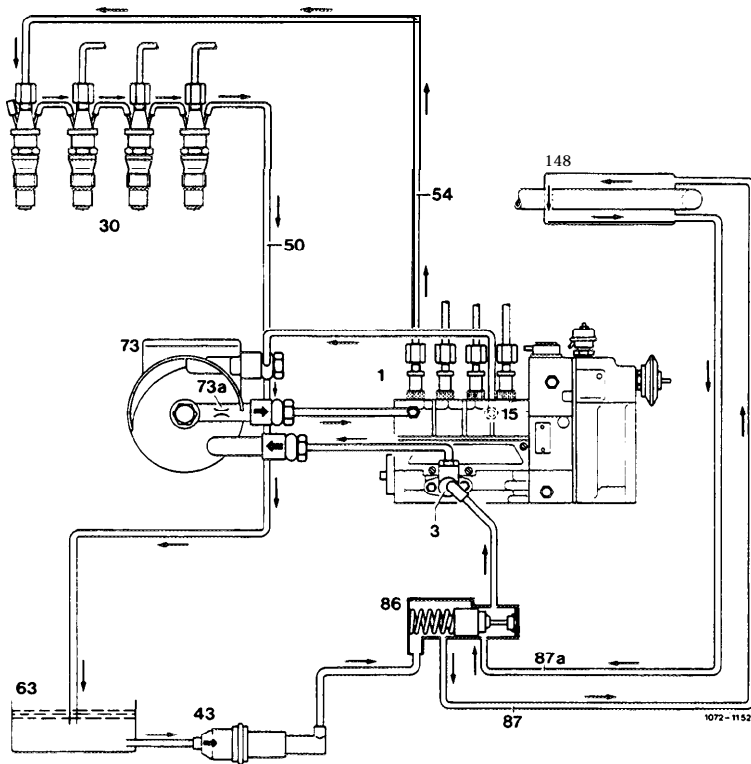
Overflow valve with 1.5 mm dia. orifice

The overflow valve prevents unfiltered fuel from entering injection pump.

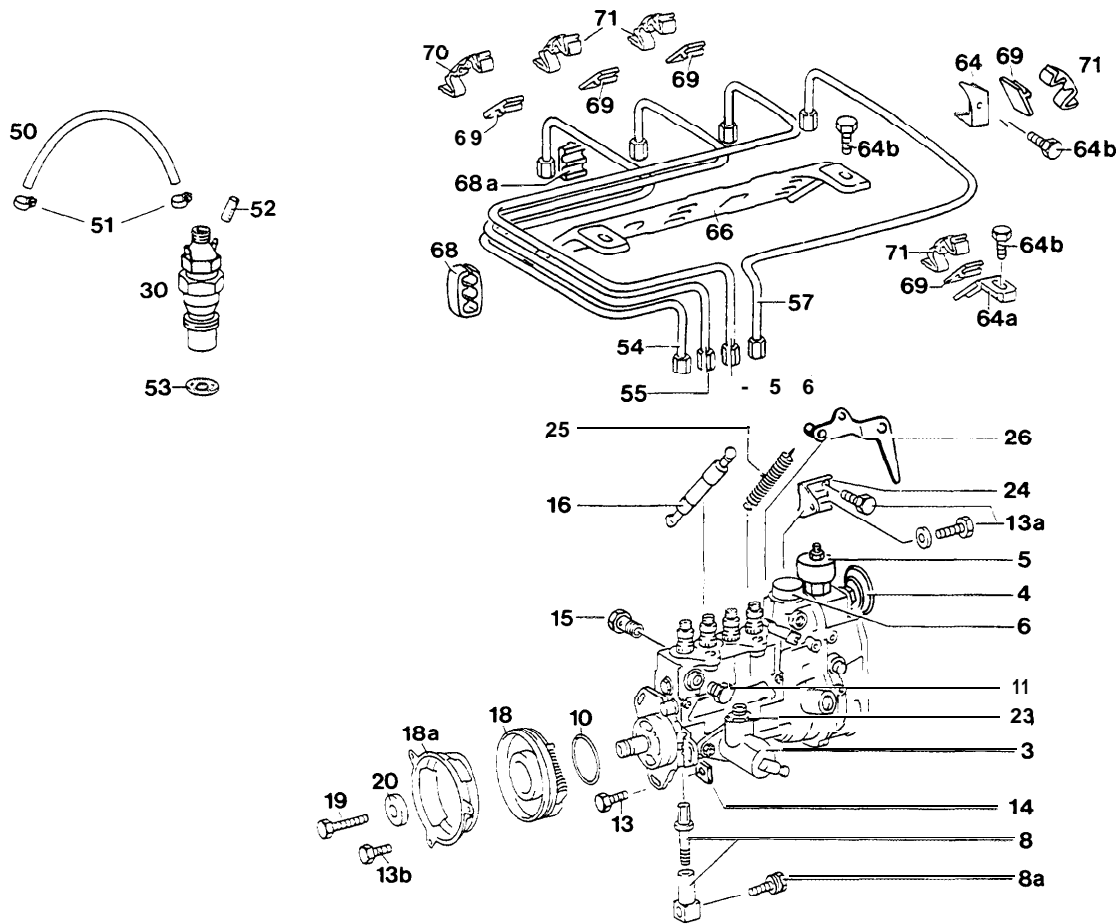


a Housing
b Ball
c Spring
d Slide
e Inlet

G. Function diagram low pressure circuit



- 1 Injection pump
- 3 Fuel pump
- 15 Overflow valve with orifice 1.5 mm dia.
- 30 Injection nozzles
- 43 Fuel prefilter
- 50 Leak oil hose
- 54 Injection line cylinder 1
- 63 Fuel tank
- 73 Fuel filter top
- 73a Orifice in fuel filter top 0.8 mm dia.
- 86 Fuel thermostat open, position up to +8°C, fuel is preheated
- 87 Supply line – cold fuel
- 87a Return line – preheated fuel
- 148 Heater feed line with fuel heat exchanger



1072 - 11886

- 3 Fuel pump
- 4 Vacuum control unit idle speed increase „PLA“
- 5 ADA-capsule (altitude pressure compensator)
- 6 Vacuum control unit (stop)
- 8 Injection timing-adjusting device
- 10 O-ring (seal)
- 11 Closing plug – RIV
- 13 Fastening screw front
- 13a Fastening screw rear
- 13b Screw for assembly basket
- 14 Cage nut
- 15 Overflow orifice 1.5 mm dia. injection pump
- 16 Damper
- 18 Injection timer
- 18a Injection timer-assembly basket
- 19 Center fastening screw „lefthand threads“
- 20 Washer
- 23 Pressure connection-delivery pump
- 24 Holder, injection pump rear
- 25 Spring

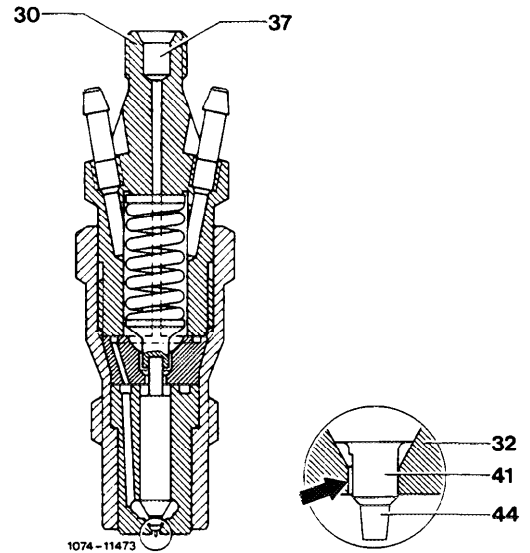
- 26 Adjusting lever
- 30 Injection nozzle, complete
- 50 Leak oil hose
- 51 Hose clamp
- 52 Closing plug
- 53 Nozzle reed
- 54 Injection line 1
- 55 Injection line 2
- 56 Injection line 3
- 57 Injection line 4
- 64 Holder, cylinder 4, nozzle end
- 64a Holder, cylinder 4, pump end
- 64b Screw
- 66 Holder, lines
- 68 Plastic clip
- 68a Plastic clip
- 69 Rubber base
- 70 Plastic holder for 3 lines
- 71 Plastic holder for 2 lines

A. Fiat surface pintle nozzle (standard version)

Bosch designation DN 0 SD 261/-

Differs from pintle nozzle by a flat surface (arrow) on throttle pintle (41). This will improve throttle effect.

- 30 Injection nozzle, complete
- 32 Nozzle body
- 37 Nozzle holder top
- 41 Throttle pintle
- 44 Injection pintle

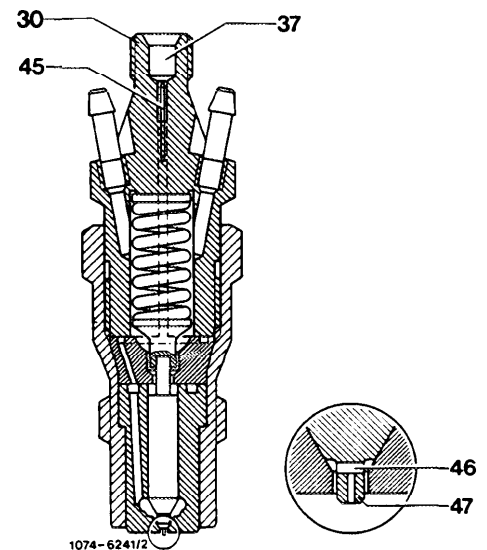


B. Hole-type pintle nozzle USA

Bosch designation DN 0 SD 240/

Differs from pintle nozzle by a transverse and lengthwise bore (46 and 47) in throttle pintle. A service-free bar filter (filter cartridge) (45) is inserted in nozzle holder top (37).

- 30 Injection nozzle, complete
- 37 Nozzle holder top
- 45 Bar filter (filter cartridge)
- 46 Transverse bore
- 47 Lengthwise bore



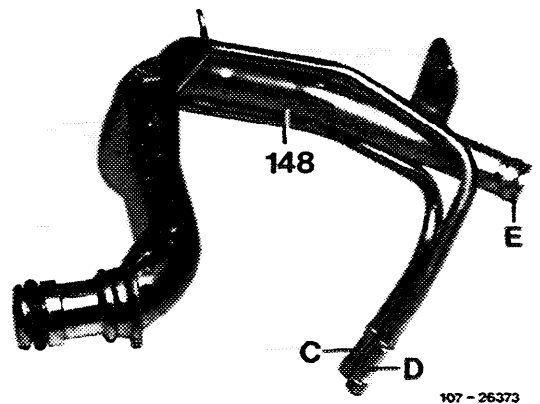
07.1-012 Operation of fuel preheater

A fuel heat exchanger (148) is installed in feed line of heater to preheat the fuel.

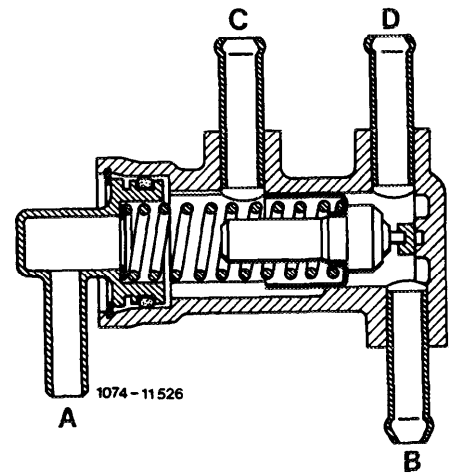
Full preheating up to $+8^{\circ}\text{C}$. The required fuel is guided through fuel heat exchanger.

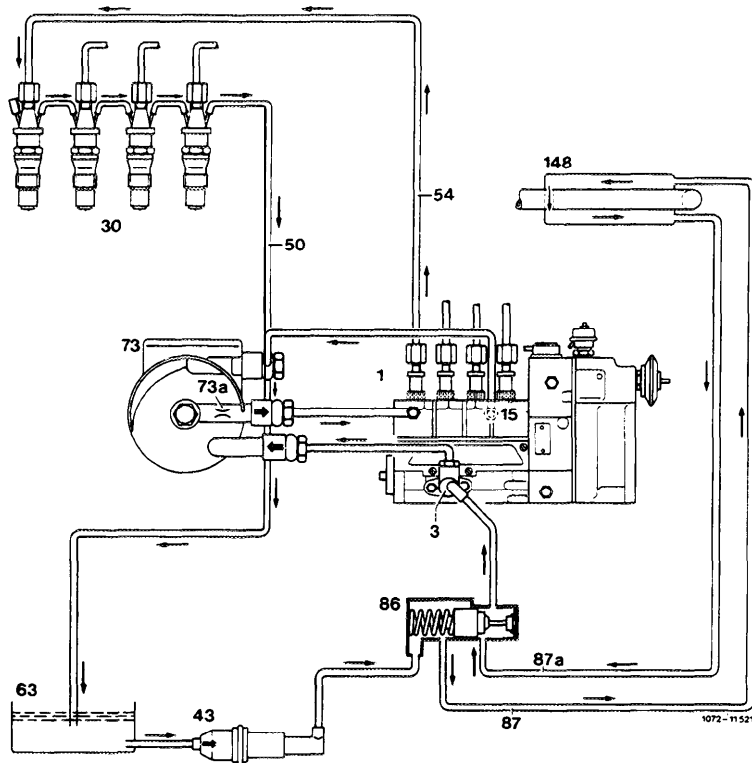
Fuel heat exchanger

C Supply
D Return flow
E Heater feed



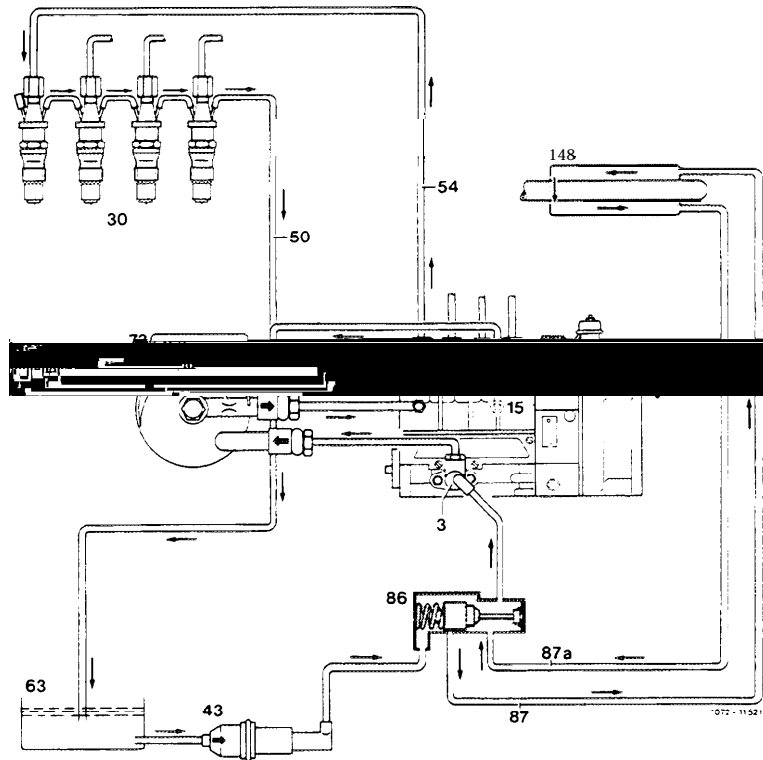
Mixed operation from +8





Function diagram fuel preheating up to $+8^{\circ}\text{C}$

- | | |
|--|----------------------------------|
| Injection pump | 50 Leak oil hose |
| 3 Fuel pump | 54 Injection line cylinder1 |
| 15 Overflow valve with orifice 1.5 mm dia. | 63 Fuel tank |
| 30 Injection nozzle | 86 Fuel thermostat |
| 42 Fuel filter | 87 Supply line (cold fuel) |
| 42a Orifice in fuel filter top 0.8 mm dia. | 87a Return line (preheated fuel) |
| 43 Fuel prefilter | 148 Fuel heat exchanger |



Function diagram fuel preheating above +25°C

- | | |
|--|----------------------------------|
| 1 Injection pump | 50 Leak oil hose |
| 3 Fuel pump | 54 Injection line cylinder 1 |
| 15 Overflow valve with orifice 1.5 mm dia. | 63 Fuel tank |
| 30 Injection nozzles | 86 Fuel thermostat closed |
| 42 Fuel filter | 87 Supply line (cold fuel) |
| 42a Orifice in fuel filter top 0.8 mm dia. | 87a Return line (preheated fuel) |
| 43 Fuel prefilter | 148 Fuel heat exchanger |

07.1-100 Adjustment of idle speed

Job no. of work units or standard texts and flat rates data 07-2053

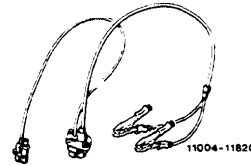
Test value

Idle speed

750 ± 50/min

Special tool

TDC-impulse transmitter



601 589 04 21 00

Conventional tool

Digital tester

e.g. Bosch, MOT 001.03

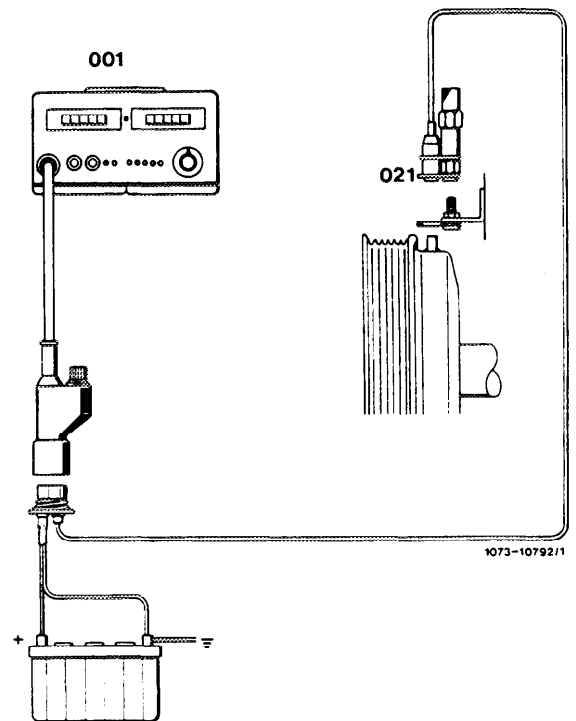
e.g. Sun, DIT 9000

Adjustment

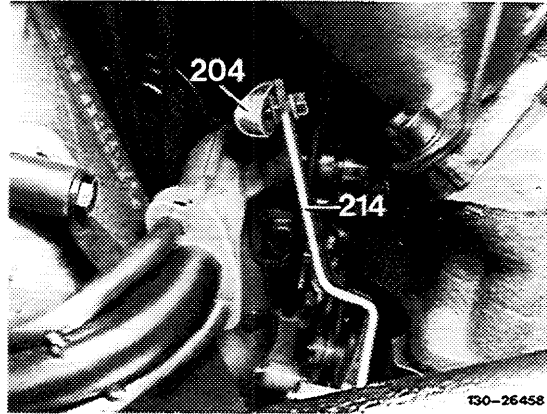
1 Connect digital tester (001) and impulse transmitter (021).

2 Check regulation for easy operation and condition.

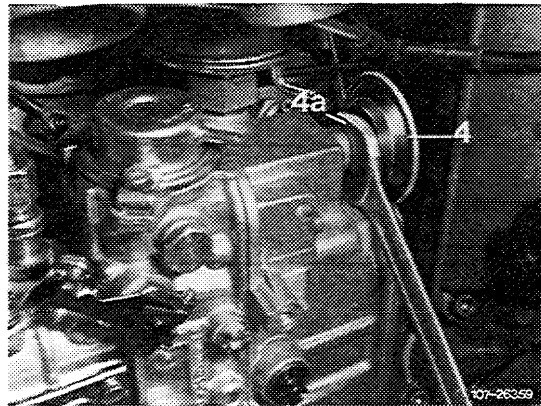
3 Run engine to 60-80 °C coolant temperature.



4 Disengage connecting rod (204) on transfer lever (214)



5 Check idle speed 750 450/min, adjust by turning vacuum control unit (4), if required, loosen counter-nut (4a) for this purpose.



6 Engage connecting rod (204) free of tension.

7 Switch on all auxiliary units and check engine for smooth running.

07.1-102 Checking pneumatic idle speed increase

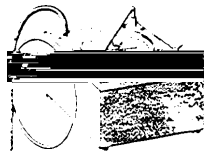
Job no. of work units or standard texts and flat rates data 07–2009.

Test values

| | |
|-------------------------------------|---------------------------------------|
| Idle speed increase | min 100/min at approx. 500 mbar |
| Permissible pressure drop of system | from 500 to 400 mbar approx. 1 min |

Special tool

Test unit O-1000 mbar for vacuum



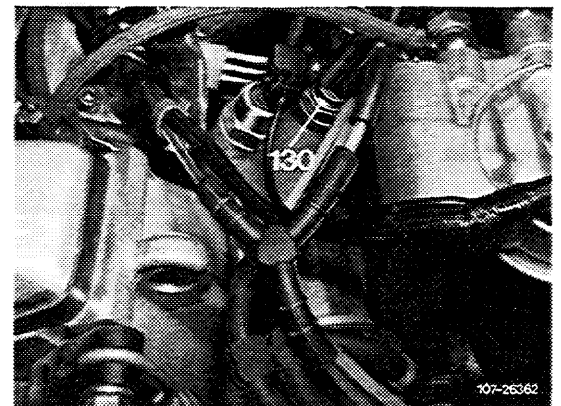
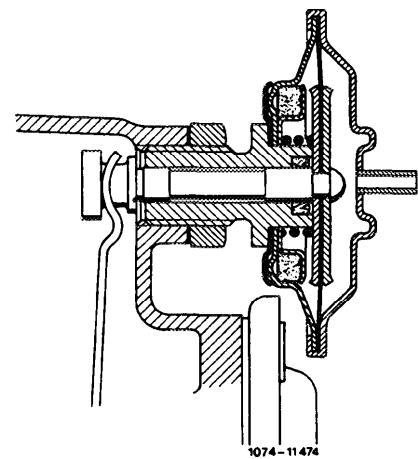
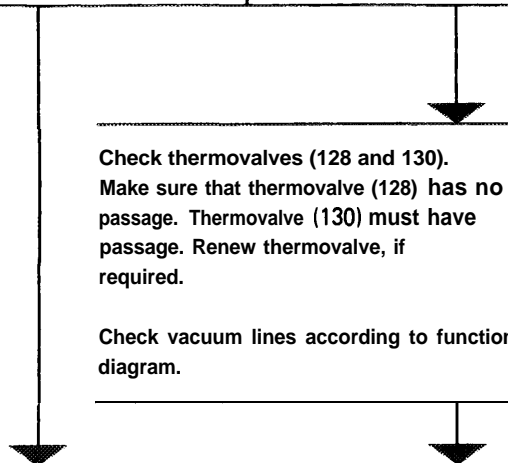
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Note

Prior to performing this job, check idle speed adjustment.

Renewing of vacuum control unit on injection pump can be made at a Bosch service station only, since renewal of vacuum control unit requires disassembly of governor and subsequent adjustment on a Bosch injection pump test bench.

| | |
|---|--------------|
| Engine at idle. Connect vacuum tester to straight connection of thermovalve (130) and energize with 500 mbar. Engine speed increases by approx. 100/min. | |
| In order | Not in order |



Engine stopped.

Check vacuum control unit (4) for leaks.

Energize vacuum tester, connection as above, with approx. 500 mbar. Vacuum value may drop approx. 100 mbar in 1 minute.

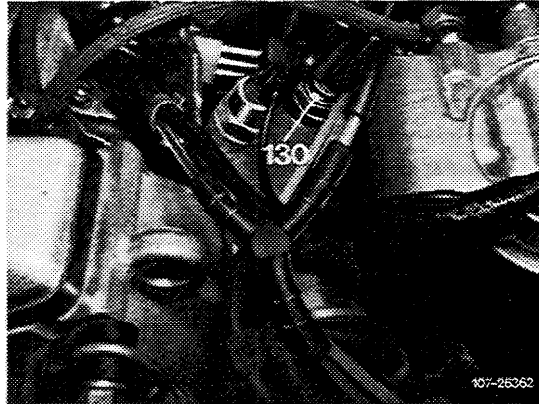
| | |
|-----------------------|---------------------------|
| Vacuum value in order | Vacuum value not in order |
|-----------------------|---------------------------|

Check vacuum lines and connections for damage, renew vacuum control unit, if required.

Check vent line for passage. Engine stops. Pull vacuum line from straight connection of thermo-valve (130) and connect with vacuum tester. Operate hand pump, but do not build up a vacuum.

| | |
|--------------------|------------------------|
| Vent line in order | Vent line not in order |
|--------------------|------------------------|

Renew vent filter (62), blow out vacuum line.



End of test

07.1-104 Checking engine output and exhaust gas on chassis dynamometer

Job no. of work units or standard texts and flat rates data 07-1200.

Scope

Fill in data sheet.
Check fluid levels in engine, radiator and automatic transmission.
Remove and install air cleaner cover.
Connect digital tester according to connection diagram.
Check regulating system for easy operation and for condition and lubricate.
Check full throttle stop of accelerator pedal and adjust.
Run engine oil temperature under partial load to 75-85 °C.
Check idle speed, adjust.
Check pneumatic idle speed increase.
Check max. speed under no load condition.
Check tire pressure of rear wheels.
Cool engine with blower.
Check performance – perform tachometer checkup.
Exhaust gas (emission) test under load.

Test values

Performance reference values and exhaust gas (emission) value

| Engine | Rpm 1/min | Full load performance ¹⁾ in kW (HP) | | Exhaust gas (emission) value % CO |
|---------|------------------|--|---|--------------------------------------|
| | | Manual transmission, 3rd speed | Automatic transmission driving position „S“ | |
| 601.911 | 4500 | 40 (54) | 37 (50) | max. 0.25 |

Note: During performance measurements be sure to include the different influencing factors.

¹⁾ The test values are minimum performances; the permissible losses for power steering of approx. 1.5 kW(2 HP) are already deducted.

Injection timing at 750 ±50/min 15° ± 1° after TDC²⁾

Idle speed 750 ±50/min

Idle speed increase min. 100/min at approx. 500 mbar

²⁾ RI-value – indirect injection timing.

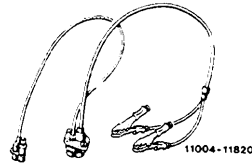
Special tools

Oil telethermometer



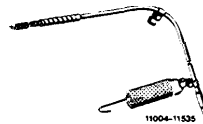
1 165 892 72 100

TDC-impulse transmitter



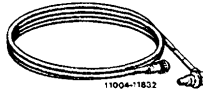
601 589 04 21 00

Exhaust gas probe, flexible



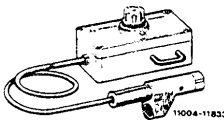
126 589 11 63 00

R I-transmitter



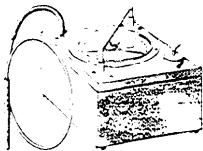
617 589 1021 00

Adapter (for available digital testers)



617 5890921 00

Tester 0–1000 mbar for vacuum



116 589 25 21 00

Conventional testers

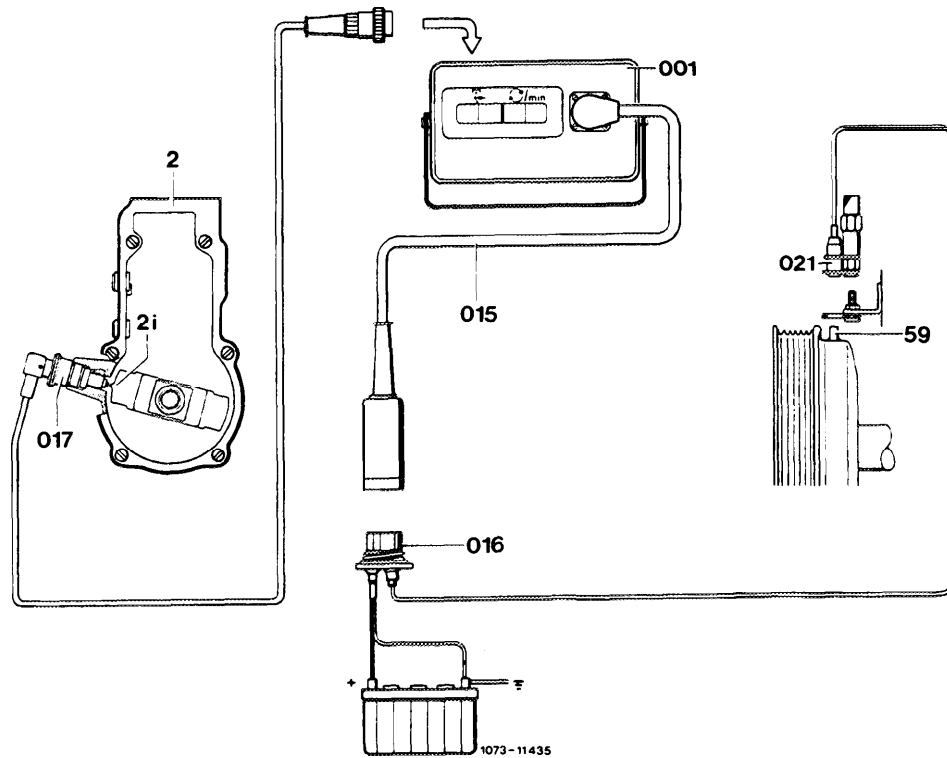
CO-measuring instrument

e.g. Bosch, ETD 019.00

Digital testers

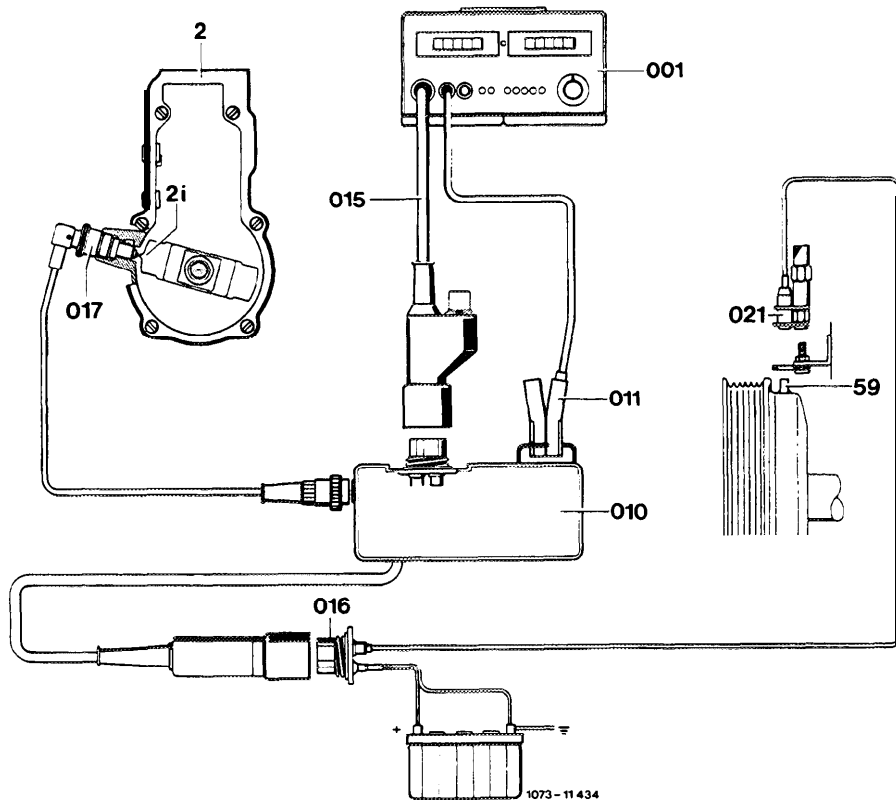
e.g. Sun, DIT 900

e.g. AVL, Diesel-Tester 875



Connection diagram for test instruments without adapter,
e.g. Bosch ETD 019.00, Sun DIT 9000, AVL Diesel-Tester 875

- | | |
|--------------------------|-----------------------------|
| 001 Digital tester | 016 Diagnosis socket |
| 2 Governor | 017 R I-transmitter |
| 2i RI-transmitter pin | 021 TDC-impulse transmitter |
| 015 Test cable with plug | 59 TDC-transmitter pin |

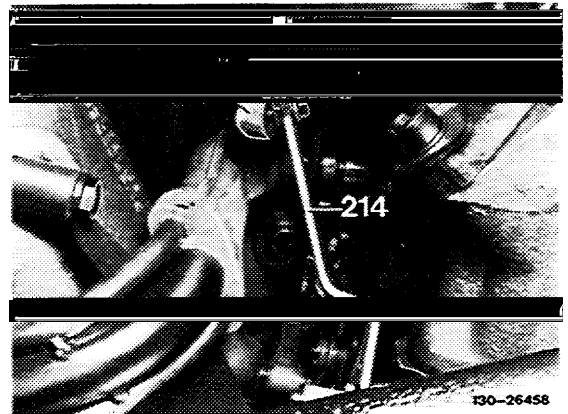
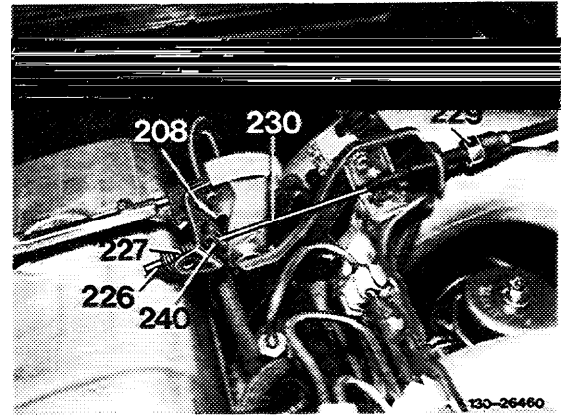


Connection diagram for available testers with adapter,
e.g. Bosch 001.03, Hartmann & Braun EOMT 3

- | | |
|-----------------------|-----------------------------|
| 001 Digital tester | 015 Test cable with plug |
| 2 Governor | 016 Diagnosis socket |
| 2i RI-transmitter pin | 017 RI-transmitter |
| 010 Adapter | 021 TDC-impulse transmitter |
| 011 Trigger clamp | 59 TDC-transmitter pin |

Checking

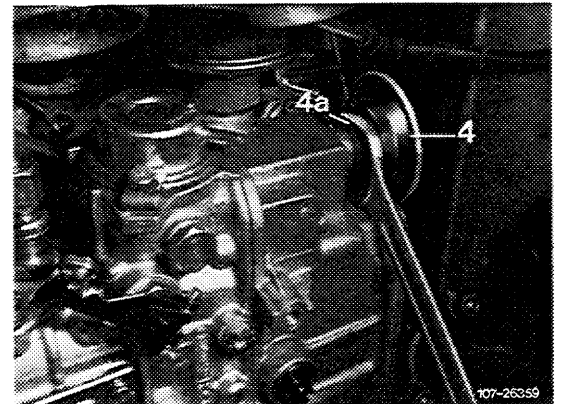
- 1 Fill in data sheet.
- 2 Check fluid levels: in engine, radiator and automatic transmission and correct, if required.
- 3 Remove and install air cleaner cover.
- 4 Connect digital tester according to connection diagram.
- 5 Check regulating system for easy operation and condition and lubricate.
- 6 Check full throttle stop from direction of accelerator pedal, adjust by means of adjusting screw (229), if required.
- 7 Run engine oil temperature under partial load to 75-85 °C.
- 8 Disengage connecting rod (204) on transfer lever (214).



- 9 Check idle speed 750 ± 50 /min, adjust by turning vacuum control unit (4), if required, loosen counter-nut (4a) for this purpose.

Engage connecting rod (204) free of tension.

Switch on all auxiliary units and check engine speed.

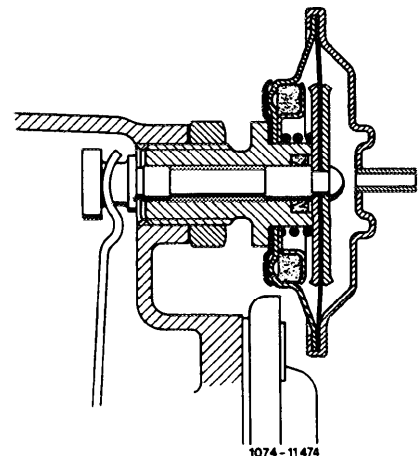


- 10 Check pneumatic idle speed increase:

Attention!

Prior to performing this job, check idle speed adjustment.

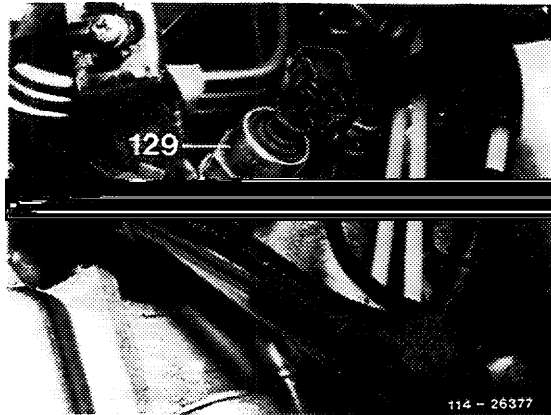
The vacuum control unit for idle speed increase on injection pump can be renewed only with injection pump removed.



Engine at idle.

Connect vacuum tester to straight connection of thermovalve (130) and energize with 500 mbar. Engine speed increases by approx. 100/min, check pneumatic idle speed increase, if required (07.1-102).

Note: The vacuum control unit idle speed increase on injection pump can be renewed only with injection pump removed.

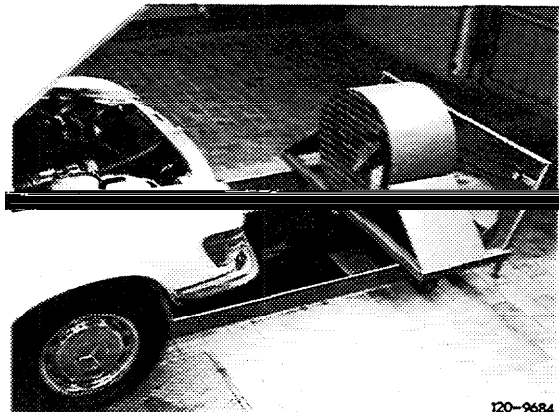


11 Secure front wheels. For this purpose, place chocks at a distance of approx. 100 mm in front of front wheels.

12 Check tire pressure of rear wheels and correct, if required.

13 Check trunk contents, remove heat-sensitive items.

14 Cool engine with blower.



15 Check full load performance.

Attention!

Run at full load only as long as required for reading the instruments.

16 Check exhaust gas (emission) value under load.

If the specified exhaust gas values under load cannot be attained in spite of fully including idle speed emission value tolerance, set injection pump on pump test bench to upper tolerance limit.

07.1-109 Checking injection timing (high-pressure method)

Job no. of work units or standard texts and flat rates data 07-8234.

Test value

| | |
|------------------|---|
| Injection timing | In compression stroke 24° before TDC |
|------------------|---|

Attention!

While measuring, move regulating lever of injection pump to full load and pull off vacuum hose at vacuum control unit „Stop”.

Tightening torque (reference value)

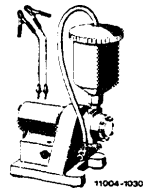
Nm

Injection line

1 O-20

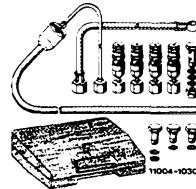
Special tools

Pump unit, complete



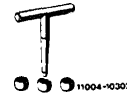
617589007100

Connecting parts with storage case



617589009100

Quick lock



617589029100

Torque wrench with plug-in ratchet,
1/2" square, 25-1 30 Nm



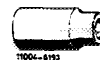
001589662100

Box wrench element, open, 14 mm,
1/4" square for injection lines



000589770300

Socket wrench element 27 mm,
1/2" square

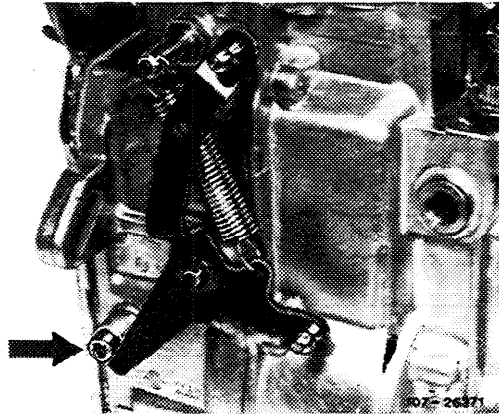


001589650900

Testing

- 1 Clean injection lines in range of coupling nuts on injection pump as well as on fuel filter.
- 2 Set control rod of injection pump to full load.

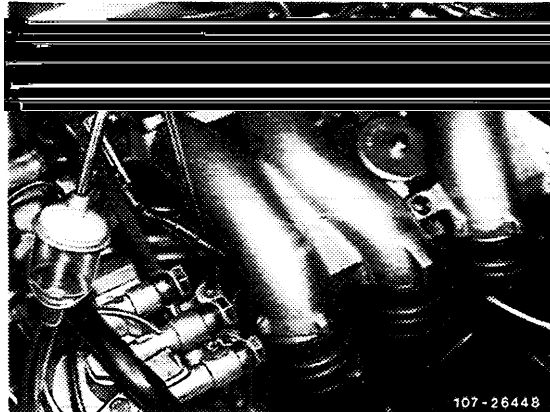
Adjusting lever on full load stop



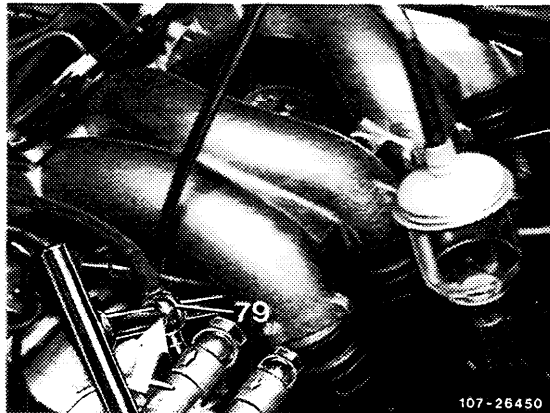
- 3 Completely remove air cleaner.
- 4 Pull off vacuum line on stop capsule.

- 5 Unscrew injection line from cylinder 1.

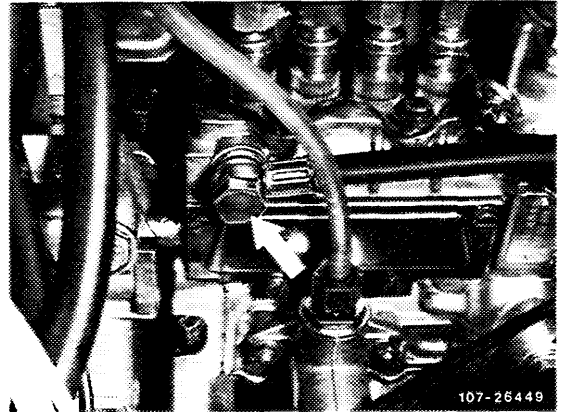
Screw test line with sight glass to injection pump and install return flow line to fuel tank of pump unit.



- 6 Close fuel return line from injection pump to fuel filter. Insert O-ring into ring fitting (79) of return flow line and firmly press in quick lock (arrow).



7 Connect supply line from pump unit to injection pump supply (arrow).



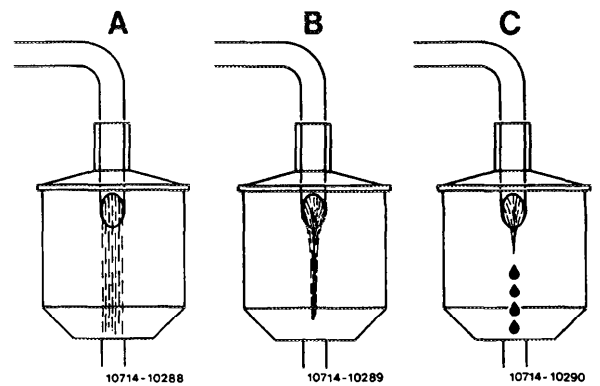
8 Connect connecting cable of pump unit to vehicle battery (red terminal positive, black terminal negative).

9 Rotate crankshaft in direction of rotation of engine up to approx. 35° before TDC in compression stroke of first cylinder. Engage pump unit.

Attention!

Engage pump unit for measuring only. If an injection nozzle is leaking, fuel may enter combustion chamber.

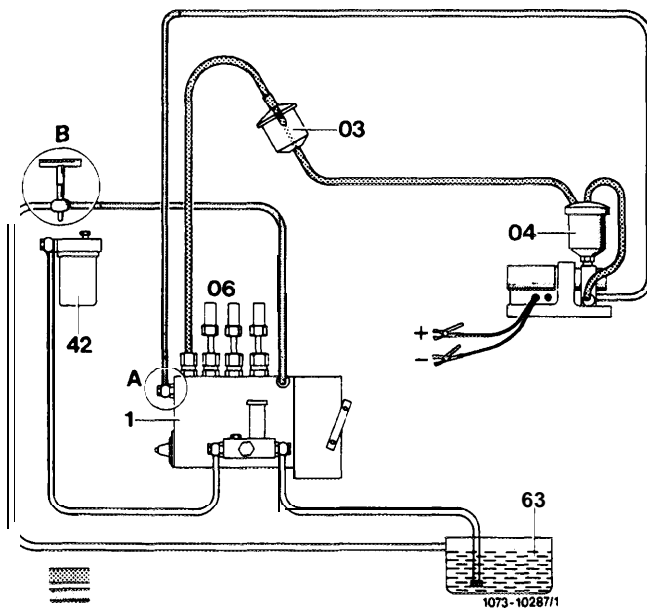
10





11 Disconnect pump unit. Assemble injection system.
Mount air cleaner.

Note: When engine is started, the injection system will vent itself automatically.

12 Run engine and check all connections for leaks.



Connection diagram high-pressure overflow method

 Return flow line
 High-pressure approx. 34 bar

1 Injection pump
 03 Sight glass
 04 Pump unit
 06 Pressure limiting valves (not required)
 42 Fuel filter
 63 Fuel tank

A Hollow screw, fuel supply from pump unit
 B Fuel return flow line closed with quick lock or clamp

07.1-111 Checking injection timing (position pickup-RIV-method)

Job no. of work units or standard texts and flat rates data 07-8240.

Test values

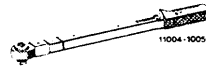
| | Test value | Adjusting value |
|--------------------------------------|------------------------------|------------------------|
| RI-value (indirect injection timing) | $15 \pm 1^{\circ}$ after TDC | 15° after TDC |

Tightening torques (reference values)

| | Nm |
|--|--------|
| Closing plug on governor (measuring point) | 30-35 |
| Injection lines | 1 0-20 |
| Injection pump flange | 20-25 |

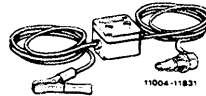
Special tools

Torque wrench with plug-in ratchet,
1/2" square, 25-130 Nm



001 5896621 00

Position indicator



617 589 08 21 00

Socket wrench element 27 mm,
1/2" square



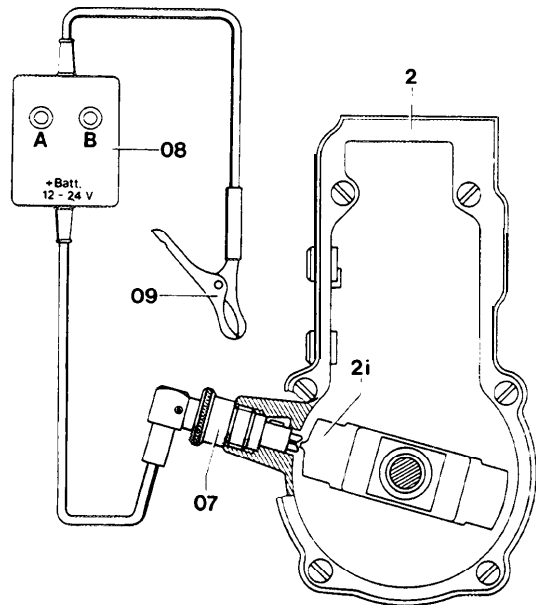
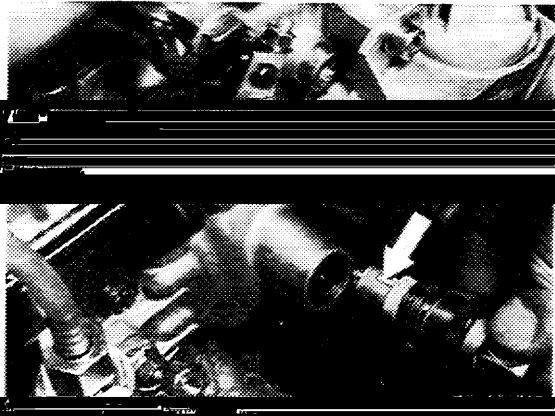
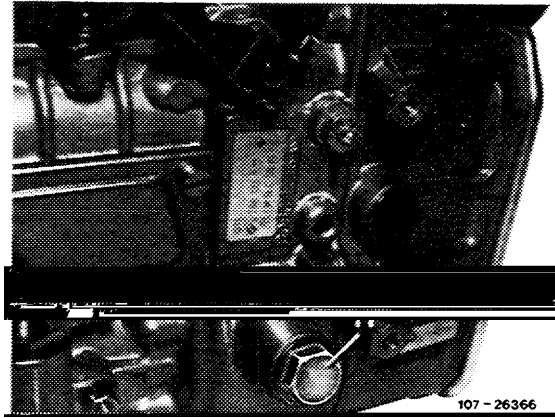
001 589 65 09 00

Checking

- 1 Remove air cleaner top (arrows).



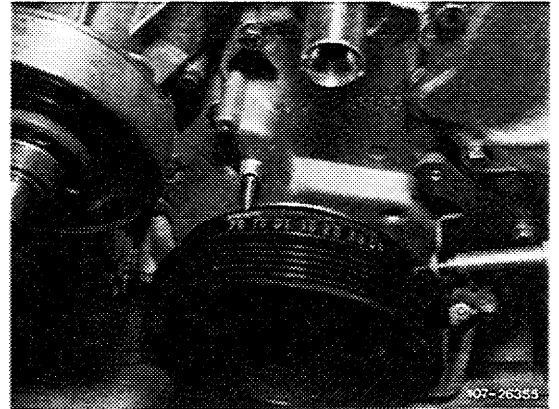
2 Remove closing plug



5 Rotate crankshaft with tool manually (in direction of rotation only), until lamp „A” lights up. Carefully continue rotating crankshaft until **both lamps** are lighting up „A + B”. In this position, read RI-value (indirect injection timing) on graduated disk.

Nominal value: 15° after TDC

If only lamp „B” ist lighting up, repeat test.



6 Remove position indicator.

7 Screw in closing plug.

8 Mount air cleaner top.

9 Perform leak test with engine running.

10 Check engine oil level and correct, if required.

07.1-I 12 Checking injection timing with digital tester (RIV-method)

Job no. of work units or standard texts and flat rates data 07-8244.

Test values

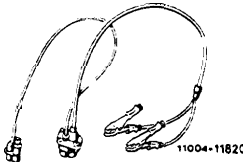
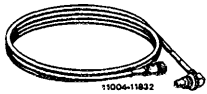
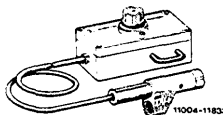

| | |
|-----------------------|--------------------|
| Rpm | 750 ± 50/min |
| RI-adjusting value') | 15° after TDC |
| R I-test value | 15° ± 1° after TDC |

¹⁾ Indirect injection timing.

Tightening torques (reference values)

| | |
|--|-----------|
| | N m |
| Closing plug on governor (measuring point) | 3 0 - 3 5 |
| Injection pump flange | 2 0 - 2 5 |

Special tools

| | | |
|---|--|-------------------------|
| TDC-impulse transmitter |  | 6 0 1 5 8 9 0 4 2 1 0 0 |
| R I-transmitter |  | 6 1 7 5 8 9 1 0 2 1 0 0 |
| Adapter (for available digital testers) |  | 6 1 7 6 8 9 0 9 2 1 0 0 |
| Torque wrench with plug-in ratchet, 1/2" square, 25-l 30 Nm |  | 0 0 1 5 8 9 6 6 2 1 0 0 |

Conventional tools

Application with adapter

| | |
|-----------------|-------------------------------|
| Digital testers | e.g. Bosch, MOT 001.03 |
| | e.g. Hartmann & Braun, EOMT 3 |

Application without adapter

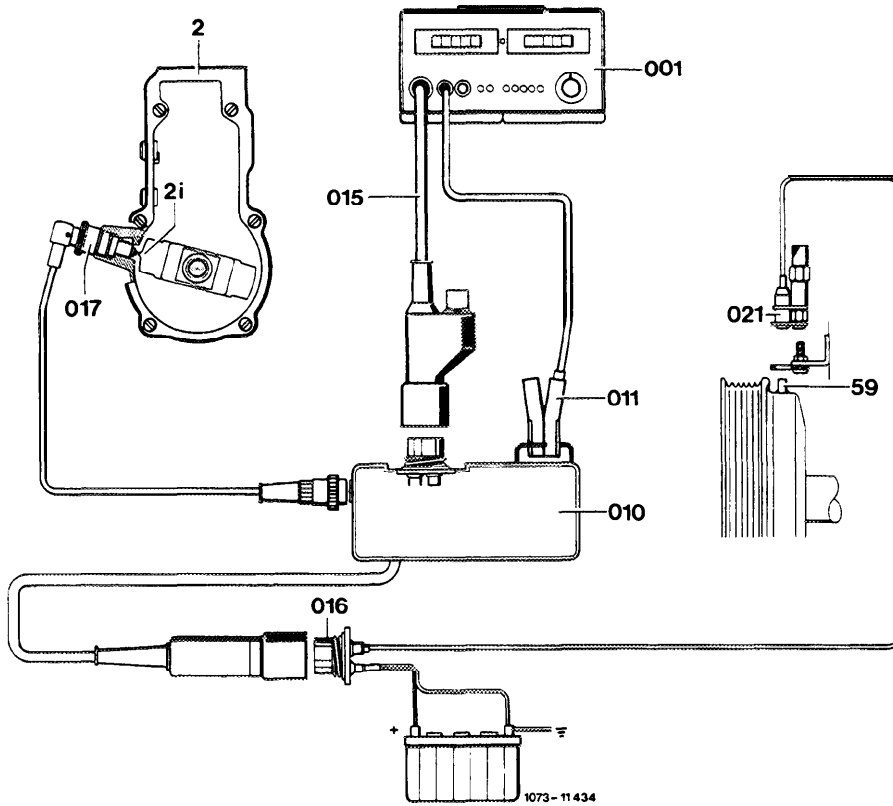
e.g. Bosch, ETD 019.00

Digital testers

e.g. Sun, DIT 900

e.g. AVL, Diesel-Tester 875

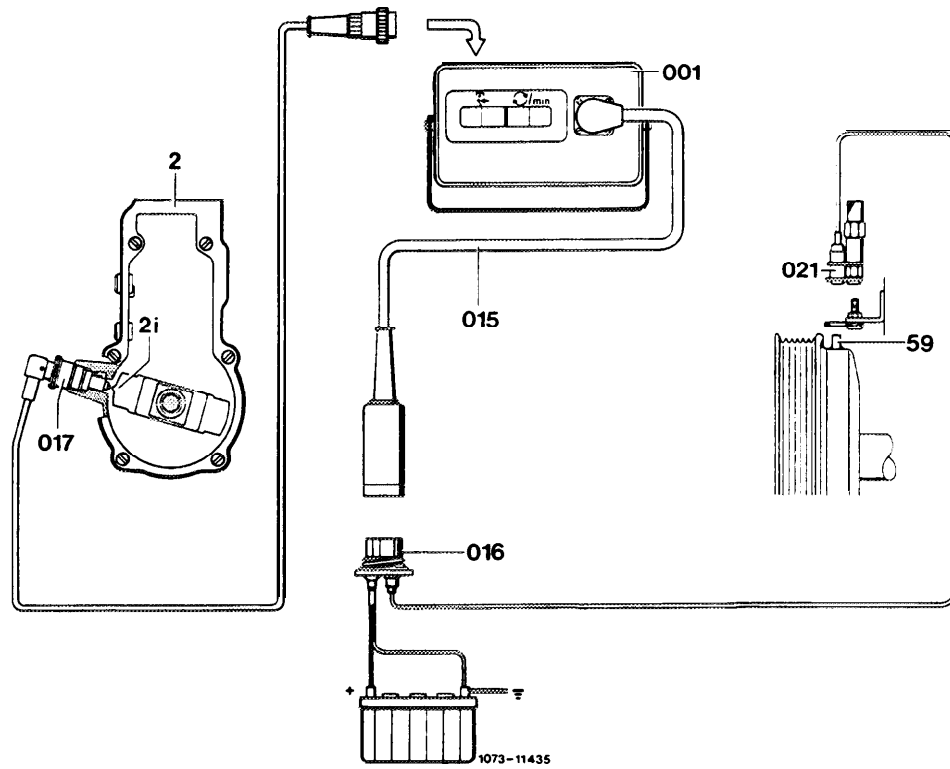
Connection diagram for available testers with adapter,
e.g. Bosch MOT 001.03, Hartmann & Braun EOMT 3



001 Digital tester
010 Adapter
011 Trigger clamp
015 Test cable with plug
016 Diagnosis socket

017 RI-transmitter
021 TDC-impulse transmitter
2 Regulator
2i RI-transmitter pin
59 TDC-transmitter pin

Connection diagram for testers without adapter,
 e.g. Bosch ETC 019.00, Sun DIT 9000, AVL Diesel-Tester 875

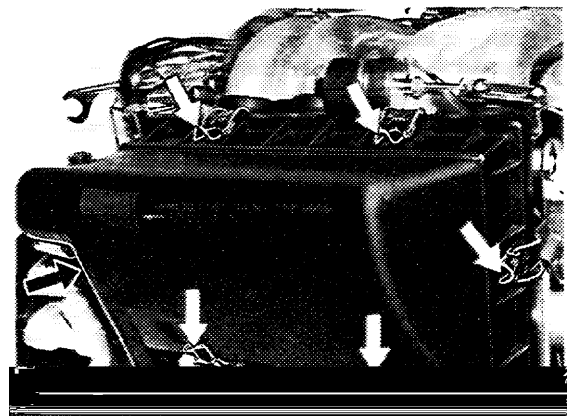


2 Regulator
 2i RI-transmitter pin
 001 Digital tester
 015 Test cable with plug

016 Diagnosis socket
 017 R I-transmitter
 021 TDC-impulse transmitter
 59 TDC-transmitter pin

Checking

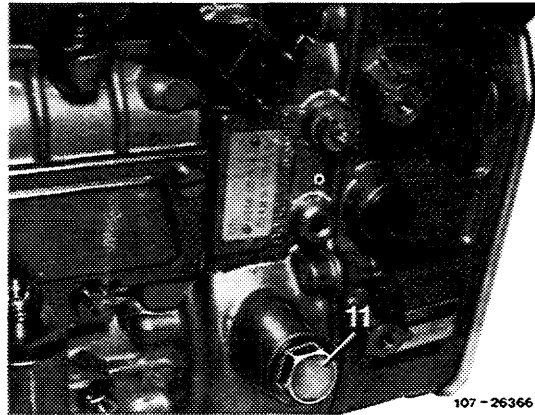
Remove air cleaner cover (arrows),



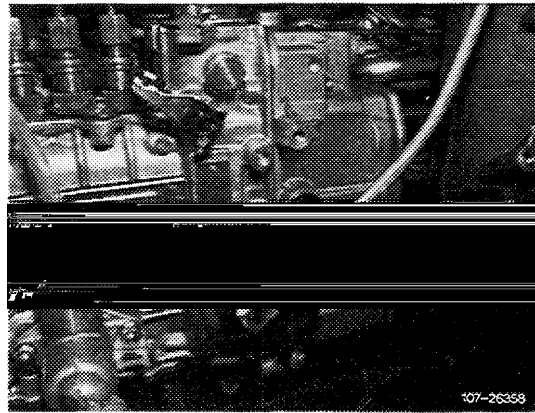
2 Remove closing plug from regulator.

Attention!

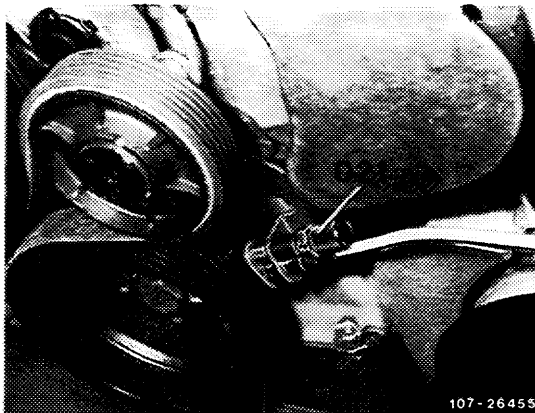
Catch emerging oil.



3 Connect digital tester according to connection diagram.



017 RI-transmitter on regulator (injection pump)



021 TDC-impulse transmitter on holder (engine)

4 Engine at idle. Read TI-value (indirect injection timing) at idle speed 750 ± 50 /min on digital tester.

RI-nominal value: 15° after TDC at 750 ± 50 /min.

-
- 5 Stop engine.
 - 6 Disconnect digital tester.
 - 7 Screw in closing plug on regulator.
 - 8 Mount air cleaner top.
 - 9 Perform leak test with engine running.
 - 10 Check engine oil level, and correct, if required.

07.1-I 15 Adjusting injection timing (high-pressure method) — following checkup

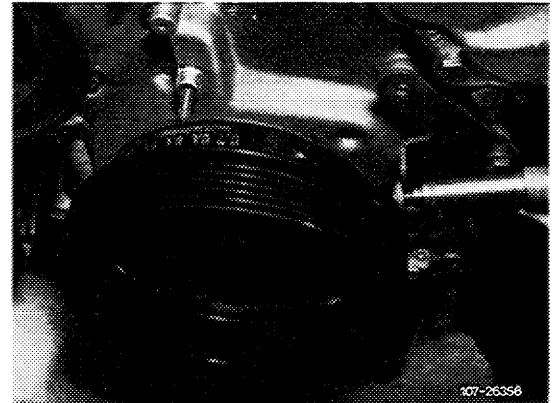
Job no. of work units or standard texts and f tat rates data 07-8300.

Note

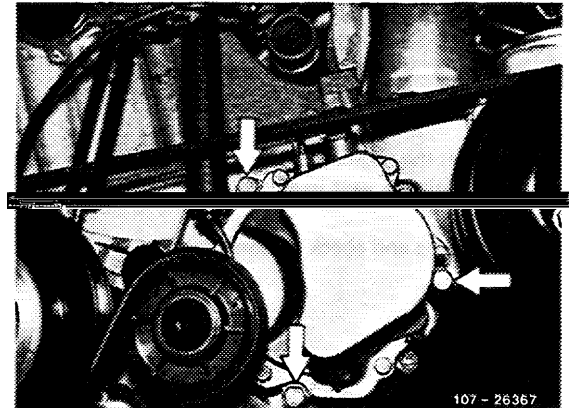
Prior to adjustment, check injection timing on cylinder 1 (07.1-109).

Adjusting

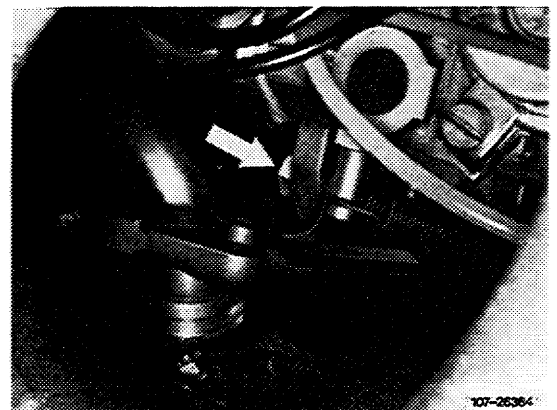
1 Set crankshaft in direction of roation to 24° before TDC in compression stroke of 1st cylinder.



2 Loosen fastening screws (arrows) on injection pump flange and on supporting holder (arrow).



Fastening of supporting holde



3 Engage pump unit.

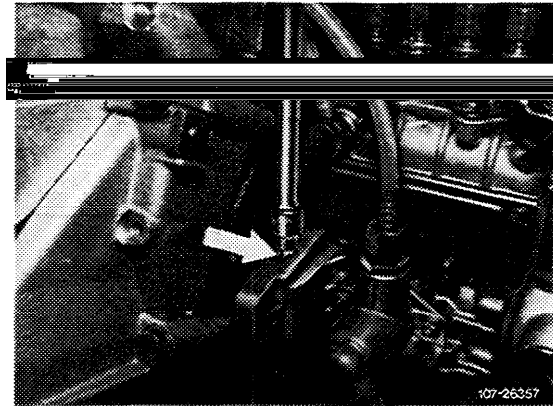
4 Swivel injection pump by turning adjusting screw on adjusting device, while watching fuel jet. If the fuel jet changes to chain-like drops, begin of delivery (injection timing) has been attained.

Nominal value: 24° before TDC.

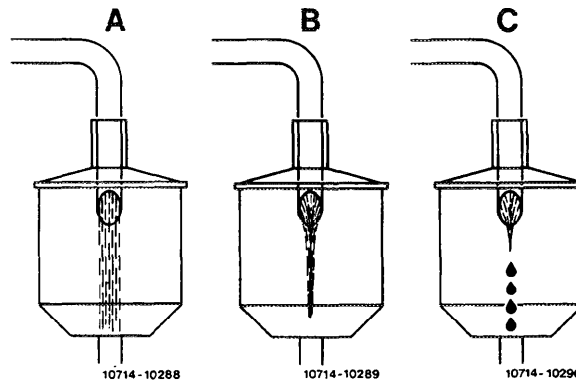
Direction of rotation of adjusting screw

Clockwise = injection timing retarded

Counterclockwise = injection timing advanced



Note: If adjustment cannot be made any further, displace injection pump. Removal and installation of injection pump (07.1-200).



- A Fuel jet full
- B Fuel jet restricted
shortly before begin of delivery (injection timing)
- C Chain-like drops begin of delivery (injection timing)

5 Disconnect pump unit.

6 Assemble injection system and check regulating linkage, adjust, if required (30-300).

Note: When the engine is started, the injection system will automatically vent itself.

7 Run engine and check all connections for leaks.

07.1-I 16 Adjusting injection timing (position pickup-RIV-method) — following checkup

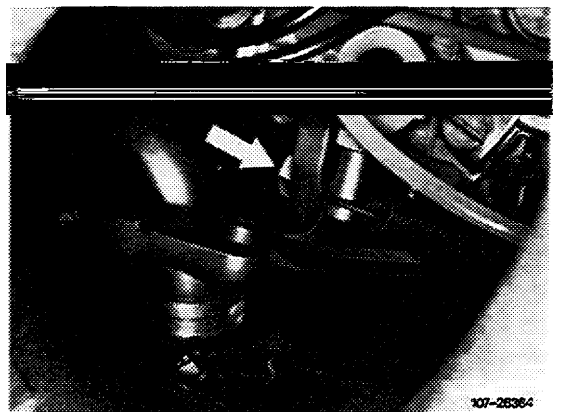
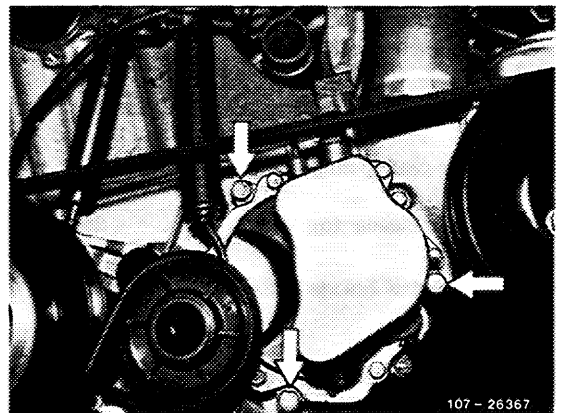
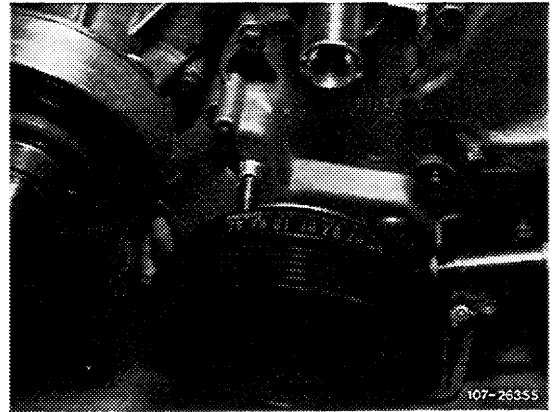
Job no. of work units or standard texts and flat rates data 07—8300.

Note

Prior to making adjustments, check begin of delivery (injection timing) (07.1-I 11).

Adjustment

1 Set crankshaft in



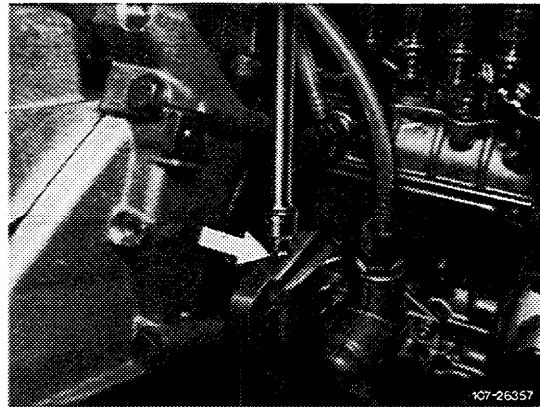
3 Swivel injection pump by turning adjusting screw on injection timing-adjusting device until both lamps are lighting up.

Direction of rotation of adjusting screw

Clockwise = injection timing retarded

Counterclockwise = injection timing advanced

RI-nominal value 15° after TDC.



Note: If adjustment cannot be made any further, displace injection pump. Removal and installation of injection pump (07.1-200).

4 Tighten fastening screws on injection pump flange and on supporting holder.

5 Remove position indicator (position pickup).

6 Screw in closing plug.

7 Mount air cleaner top.

8 Check control linkage and adjust, if required (30–300).

9 Perform leak test with engine running.

10 Check engine oil level and correct, if required.

07.1-I 17 Adjusting injection timing with digital tester(R IV-method) -- following checkup

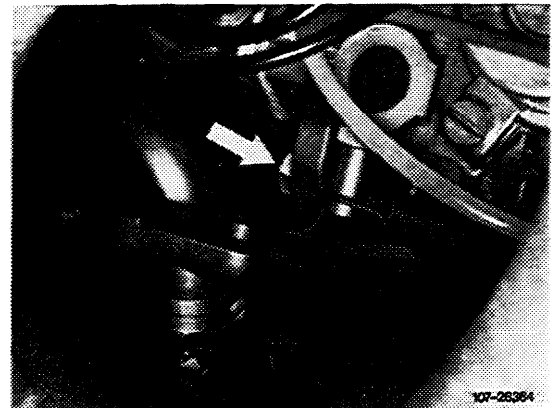
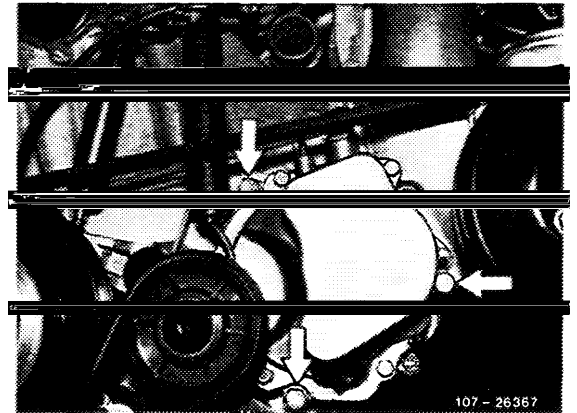
Job no. of work units or standard texts and flat rates data 07-8300.

Note

Prior to making adjustments, check begin of delivery (injection timing) (07.1-I 12).

Adjusting

1 Loosen fastening screws (arrows) on injection pump flange as well as on supporting holder (arrow).



Screw on supporting holder

2 Run engine at 750 ± 50 /min at idle.

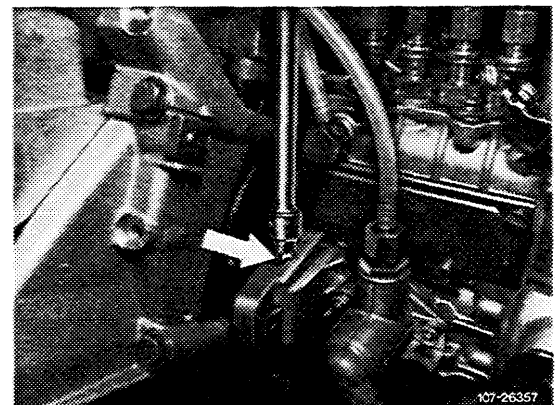
3 Adjust RI-value (indirect injection timing) by turning adjusting screw on injection timing-adjusting device.

RI-nominal value: 15° after TDC at 750 ± 50 /min.

Direction of rotation of adjusting screw

Clockwise = injection timing retarded

Counterclockwise = injection timing advanced



Note: If adjustments cannot be made any further, displace injection pump. Removal and installation of injection pump (07.1-200).

4 Stop engine.

5 Disconnect tester.

6 Screw in closing plug on regulator.

7 Mount air cleaner.

8 Check control linkage and adjust, if required (30–300).

9 Perform leak test with engine running.

10 Check engine oil level and correct, if required.

07.1-135 Checking injection nozzles

Job no. of work units or standard texts and flat rates data 07-6712.

Injection nozzles removed (07.1-230).

Test values

| Injection nozzle | new | used |
|-------------------------|---------|----------|
| Opening pressure in bar | 115-125 | min. 100 |

Special tool

Cleaning unit



000 589 00 68 00

Conventional tools

Tester EFEP 80 H

e.g. Bosch, D-7000 Stuttgart
order no. 0 881 200 502

Cleaning needle 0.18 mm dia.

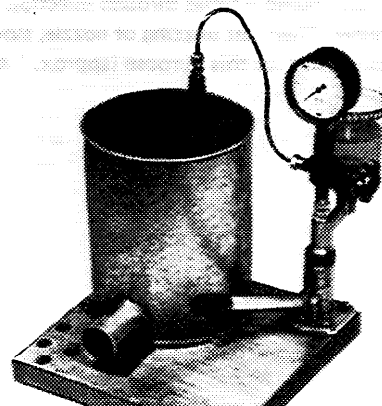
e.g. Bosch, D-7000 Stuttgart
order no. KDEP 2900/4

Note

For testing, use clean test oil or filtered diesel oil only. When checking a nozzle, never place hand in jet of a nozzle. The jet will enter deeply and destroy the tissue. Fuel entering the blood may cause blood poisoning.

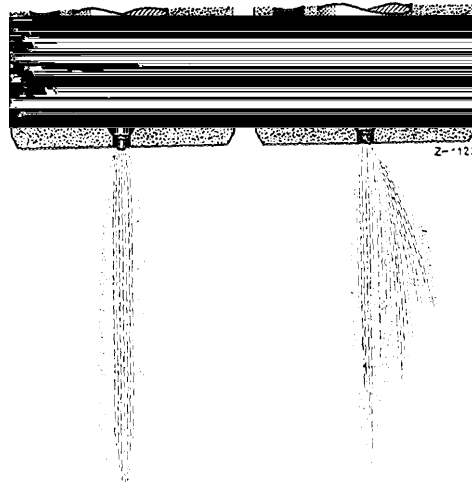
A. Throttle pintle and flat surface pintle nozzle

1 Energetically pump 5 times through injection nozzle on tester. Then test buzzing of nozzle, slowly actuating hand lever for this purpose (approx. 1 stroke per second).



107-20857

2 Test jet: During short, fast partial strokes (at least 2 strokes per second) the jet should be rather closed and tear off well.



- A Jet pattern closed and well atomized
- B Jet pattern torn up, too wide and spreading

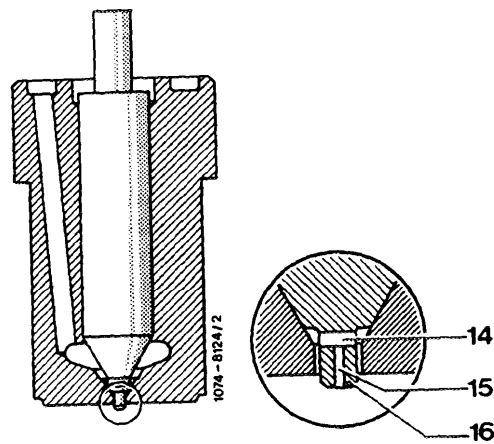
3 Check opening pressure: Nominal value 115-125 bar with new nozzle, min. 100 bar with used nozzles.

Move hand lever slowly downward (at least 1 stroke per second) and read opening pressure on pressure gauge.

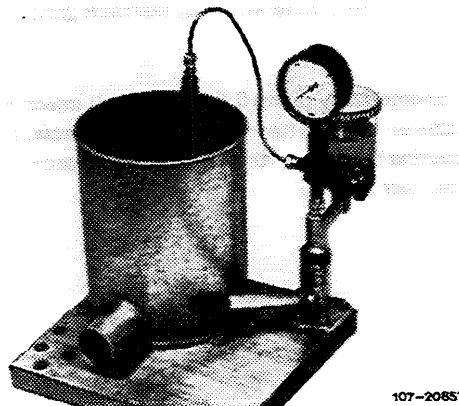
For this test, shutoff valve must be open.

B. Hole-type pintle nozzle

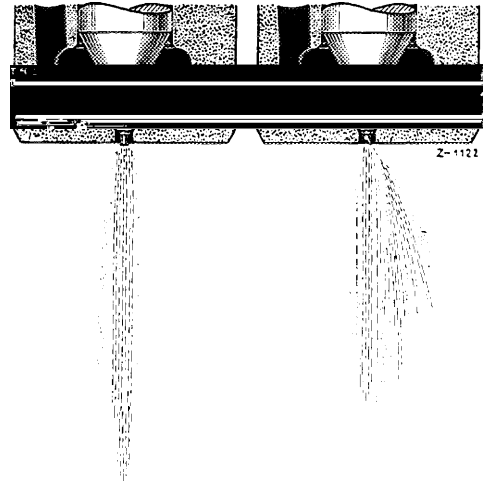
1 Prior to testing: Check longitudinal bore (15) with cleaning needle of 0.18 mm dia. for passage.



2 Energetically pump 5 times through injection nozzle on tester. Then test buzzing of nozzle, slowly actuating hand lever for this purpose (approx. 1 stroke per second).



3 Test jet: During short, fast partial strokes (at least 2 strokes per second) the jet should be rather closed and tear off well.

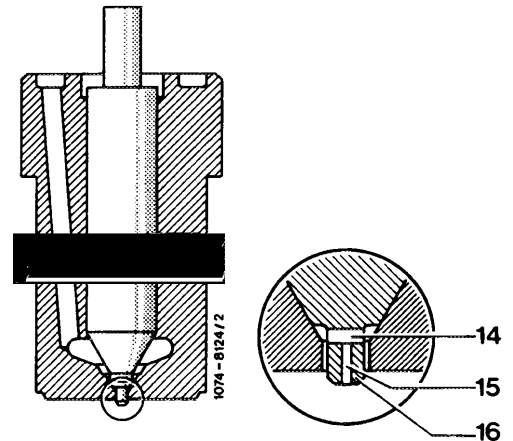


- A Jet pattern closed and well atomized
- B Jet pattern torn up, too wide and spreading

4 Generate initial jet by moving hand lever slowly in downward direction (4-6 s/stroke).

A vertical cord-like jet should come out of center bore (15).

Note: On new nozzles it is rather difficult to generate the initial jet, for this reason check longitudinal bore with cleaning needle of 0.18 mm dia. for passage.



5 Check opening pressure.

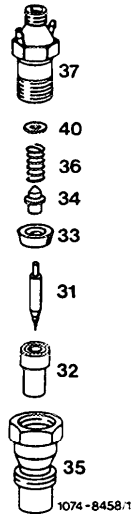
Nominal value: 115-1 25 bar with new nozzle, at least 100 bar with used nozzle.

Move hand lever slowly in downward direction (approx. 1 stroke per second) and read opening pressure on pressure gauge.

Shutoff valve must be open during test.

07.1–137 Disassembling, cleaning, assembling and adjusting injection nozzles (following checkup)

Job no. of work units or standard texts and flat rates data 07-6750.



- | | | |
|----|------------------------------------|---|
| 31 | Nozzl e needl e | Visual and slide test; on hole-type pintle nozzle clean center and longitudinal bore |
| 32 | Nozzle body | Remove combustion residue |
| 33 | Nozzle holder element | Touch up on surface plate |
| 34 | Thrustpin | Tip should point toward upper part |
| 35 | Nozzle holder lower part | 70-80 Nm |
| 36 | Compression spring | |
| 37 | Nozzle holder upper part. | Clamp in protective jaws |
| 40 | Steel disk | Adjust for opening pressure. Nominal value 115-125 bar with new nozzle or nozzle to be newly adjusted, min. 100 bar with used nozzle. Opening pressure will be higher or lower depending on thickness of disk, 0.05 mm provide approx. 3 bar difference in pressure |

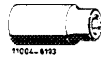
Special tools

Torque wrench with plug-in ratchet,
1/2" square, 25-130 Nm



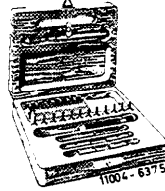
001 589 66 21 00

Socket wrench element 27 mm, 1/2" square



001 589 65 09 00

Cleaning unit



000 589 00 68 00

Conventional tool

Cleaning needles 0.18 mm dia.

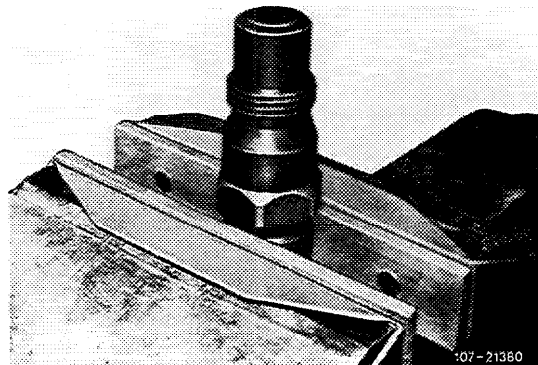
e.g. Bosch, D-7000 Stuttgart
order no. KDEP 2900/4

Note

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

Disassembly

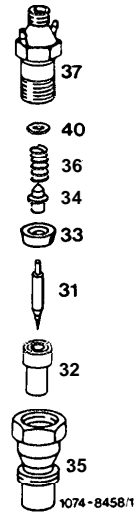
1 Clamp injection nozzle holder upper part (37) with
protective jaws into vice in such a manner that the
leak oil line connections are not damaged.



107 - 21350

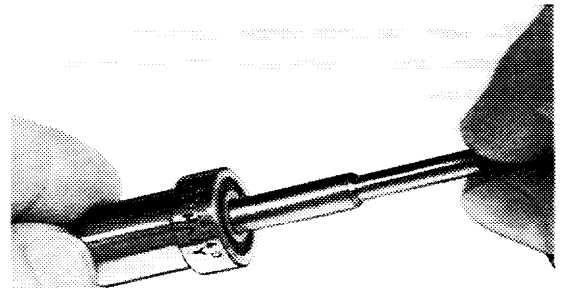
2 Disassemble injection nozzle.

- 31 Nozzle needle
- 32 Nozzle body
- 33 Nozzle holder element
- 34 Pressure pin
- 35 Injection nozzle holder lower part
- 36 Compression spring
- 37 injection nozzle holder upper part
- 40 Steel disk for making adjustments



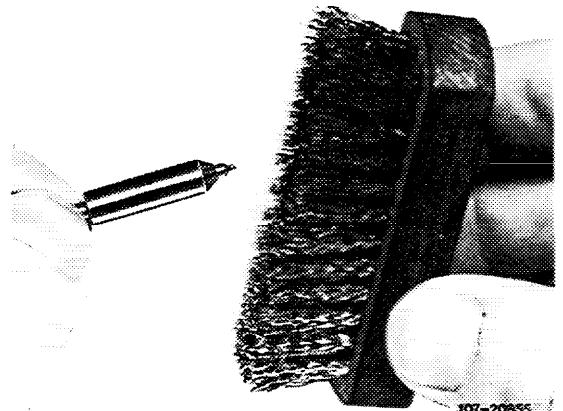
Cleaning and testing

3 Remove combustion residue on nozzle needle seat with cleaning cutter.



107-20853

4 Clean nozzle needle and nozzle body with brass brush.



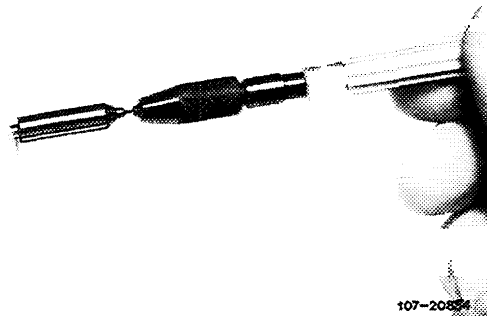
107-20855

5 Visual and slide check.

Immerse nozzle into filtered diesel fuel. With nozzle body held vertically, the nozzle needle should slide under its own weight in direction of nozzle seat.

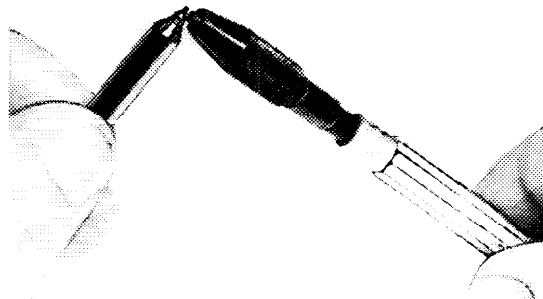
6 Touch up nozzle holder element (33) on surface plate.

7 With hole-type pintle nozzle, additionally clean longitudinal and transverse bore with cleaning needle 0.18 mm dia.



Longitudinal bore

107-20824



Transverse bore

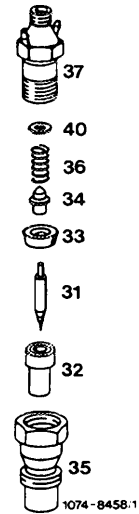
107-20856

Assembly

8 Assemble injection nozzle. Tightening torque for **injection** nozzle holder 70-80 Nm.

9 Check injection nozzle for function (07.1-135) and adjust, if required (07.1-137).

- 31 Nozzle needle
- 32 Nozzle body
- 33 Nozzle holder element
- 34 Pressure pin
- 35 Injection nozzle holder lower part
- 36 Compression spring
- 37 Injection nozzle holder upper part
- 40 Steel disk for making adjustment



Adjusting

10 Add **thicker** or thinner disks depending on opening pressure.

Thicker disk = increases opening pressure

Thinner disk = reduces opening pressure

Disks are available from 1 .0 to 1.8 mm thick, in steps of 0.05 to 0.05 mm. An increase of preload by 0.05 mm increases opening pressure by approx. 3.0 bar.

07.1-145 Checking fuel pump

Job no. of work units or standard texts and flat rates data 07-5700.

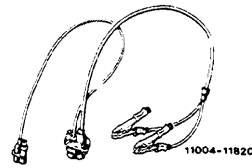
Test value

Delivery at min. 200 rpm (stop lever pushed)

min. 200 ml/30s

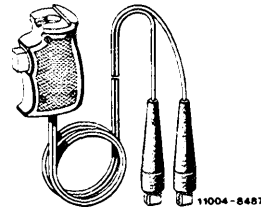
Special tools

TDC-impulse transmitter



601 589 04 21 00

Contact handle (for starting)



001 58946 21 08

Conventional tools

Digital tester

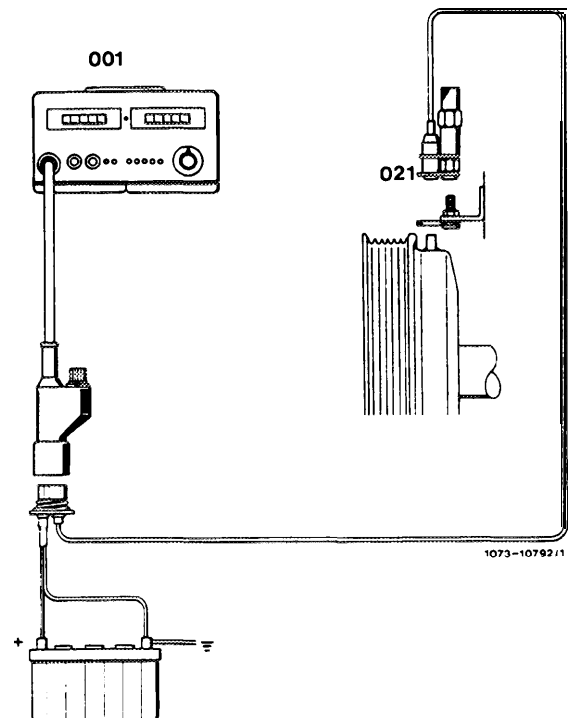
e.g. Bosch, MOT 001.03

Measuring glass or measuring cup (min. 1 liter)

Stop watch

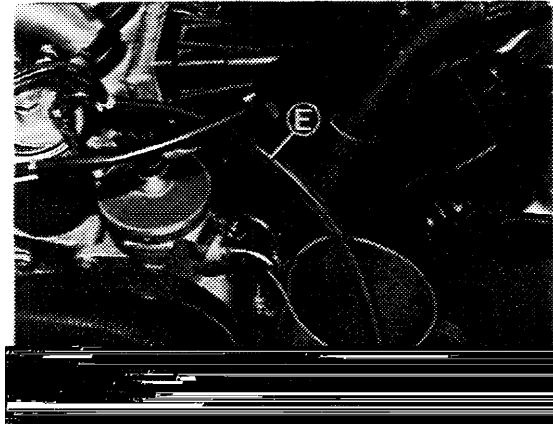
Testing

1 Connect digital tester (001) according to connection diagram.



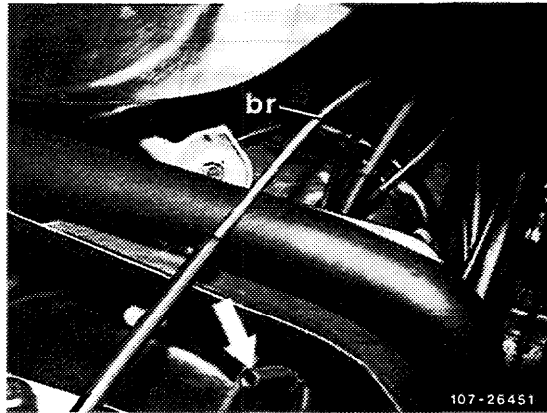
001 Digital tester
021 TDC-impulse transmitter

2 Disconnect return flow line (E)
measuring cup.



Testing

- 1 Set ignition key on steering lock to position „2”.
- 2 Pull suction line (brown) out of connection (arrow).



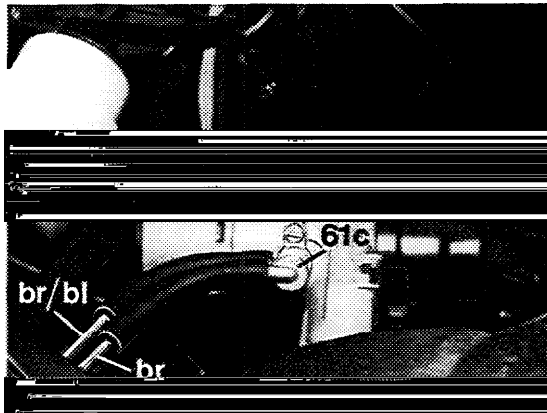
- 3 Connect tester and activate with vacuum.

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

If pressure gauge shows a vacuum drop, valve (61c) on steering lock is leaking.

Attention!

Prior to exchanging valve for key-starting system and the vacuum control unit of injection pump, check hose lines and their connections.

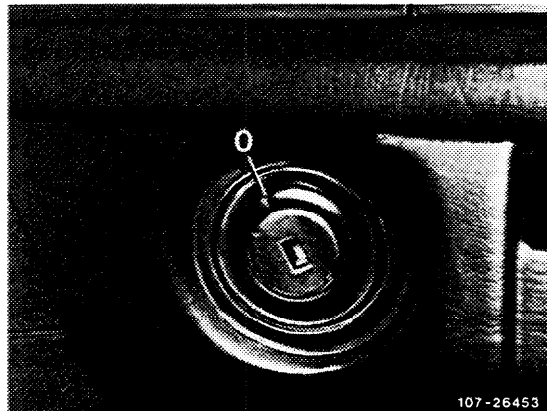


- 4 Renew valve for key-starting system on steering lock.


- 5 Turn ignition key on steering lock back to position „0”.

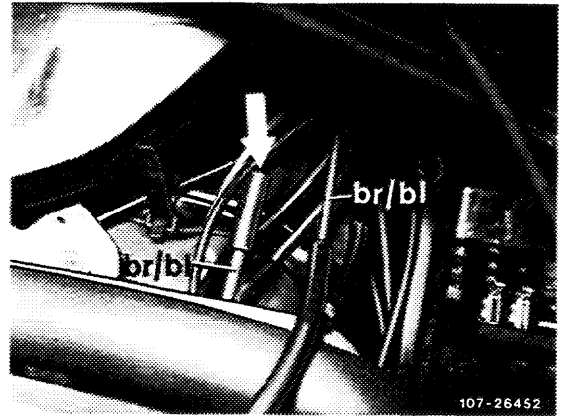
If pressure gauge shows a vacuum drop, the vacuum control unit or the valve may be leaking.

- 6 In such a case, disconnect tester on suction line.

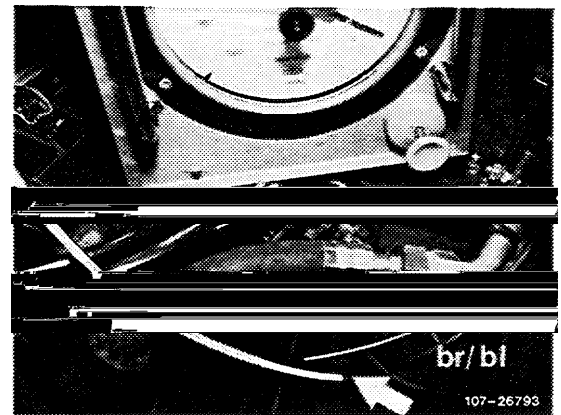


7 Pull control line (brown/blue) from connection (arrow).

Layout standard version and 



@California version



8 Connect tester to connection and activate with vacuum.

If pressure gauge shows a vacuum drop, the vacuum control unit of injection pump is leaking.

Attention!

Prior to exchanging vacuum control unit, check hose lines and their connections.

9 Renew vacuum control unit (07.1-220).

07.1-200 Removal and installation of injection pump

Job no. of work units or standard texts and flat rates data 07-8410.

Test value

| | |
|---|--------------------------|
| injection timing (indirect), position of engine | 15° after TDC cylinder 1 |
|---|--------------------------|

Tightening torques (reference values)

Nm


| | |
|---|-------|
| Closing plug on regulator (measuring point) | 30-35 |
|---|-------|

| | |
|----------------|--------|
| Injection line | 1 0-20 |
|----------------|--------|

| | |
|-----------------------|-------|
| Injection pump flange | 20-25 |
|-----------------------|-------|

| | |
|---|-------|
| Central fastening bolt on injection timer (lefthand threads) | 40-50 |
|---|-------|

Special tools

| | | |
|--|---|------------------|
| Torque wrench with plug-in ratchet, 1/2" square, 25-1 30 Nm |  11004-10094 | 001 589 66 21 00 |
|--|---|------------------|



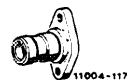
| | | |
|---------------|---|------------------|
| Locking screw |  11004-11773 | 601 589 05 21 00 |
|---------------|---|------------------|



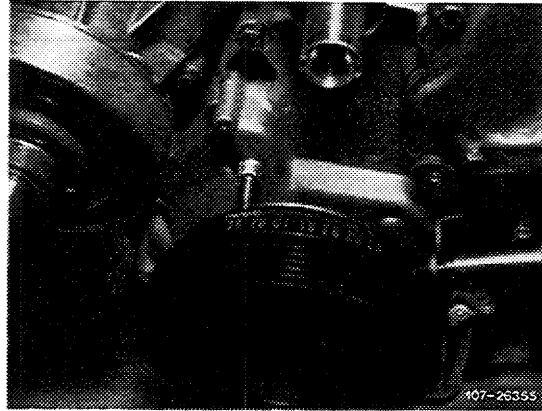
| | | |
|--|--|------------------|
| Socket wrench element 27 mm, 1/2" square |  11004-0913 | 001 589 65 09 00 |
|--|--|------------------|



| | | |
|-----|--|--|
| Box |  11004-105201 | |
|-----|--|--|



3 Rotate crankshaft in direction of rotation to 15° after TDC of 1st cylinder.



4 Disengage belt tensioner (13-340).

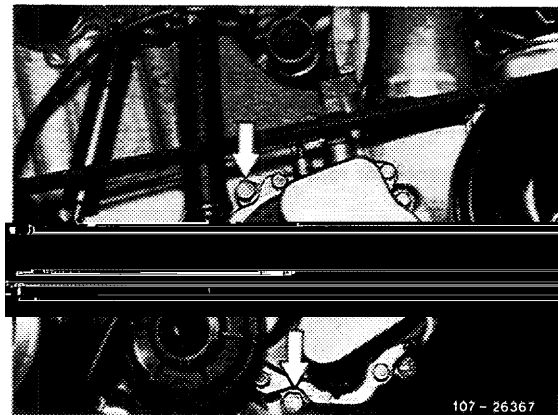
5 Remove chain tensioner (05-310).

6 Connect injection and fuel lines to injection pump.

7 Pull vacuum lines from vacuum control unit for idle speed increase, stop unit and vacuum control valve, if required.

8 Disengage regulating linkage on adjusting lever.

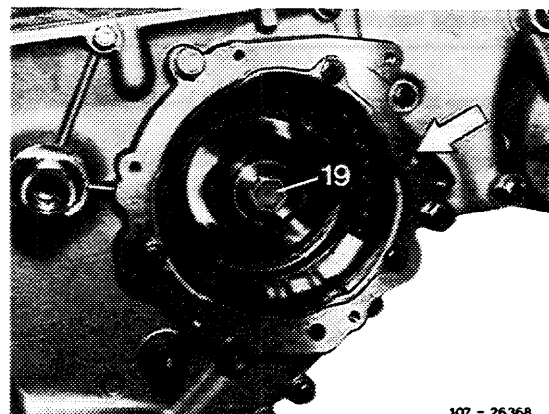
9 Remove vacuum pump (43-610).



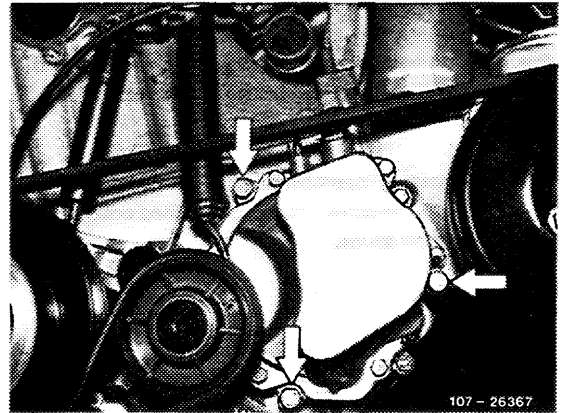
10 Loosen central fastening screw (19) (lefthand thread), apply counterhold to crankshaft for this purpose.

Attention!

LEFTHAND THREADS



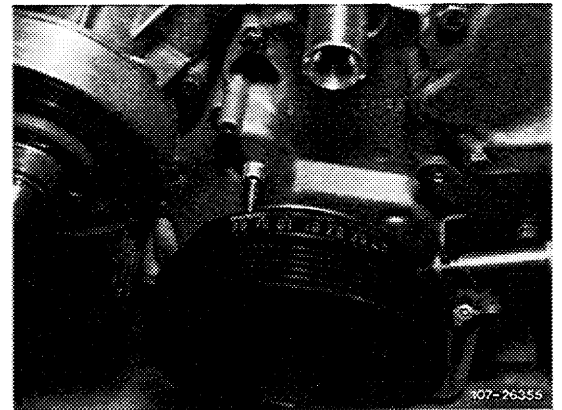
11 Unscrew fastening screws (arrows) and screw on supporting holder.



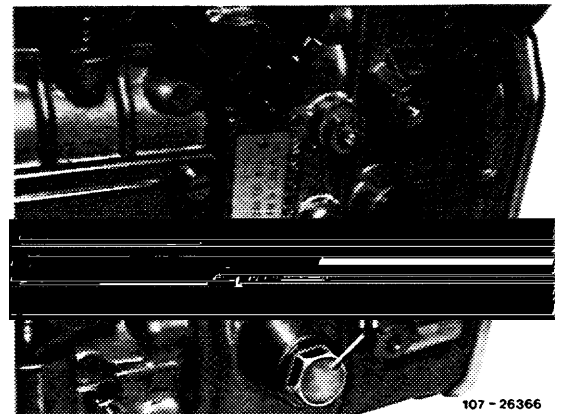
12 Pull out injection pump toward the rear.

Installation notes

13 Check whether engine is at 15° after TDC of first cylinder.



14 Remove closing plug (11).

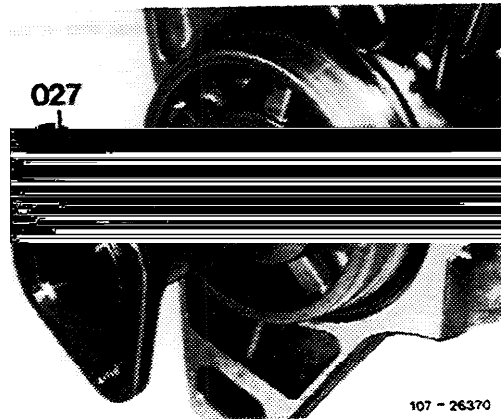


15 Rotate injection pump with serration wrench (027) on injection pump camshaft until lug of regulator shows up on bore, slip in locking gauge (023) in this position until gauge is noticeably engaging.

Attention!

Risk of damaging injection pump!

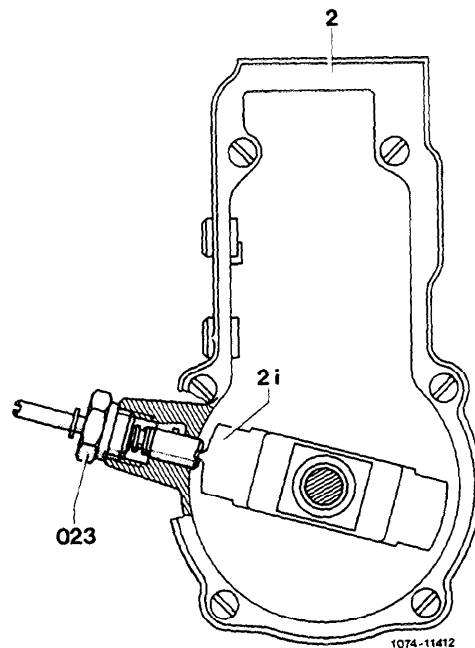
As soon as the injection pump is installed and tightened, remove locking gauge.



107 - 26370

16 Assemble engine.

Note: When the engine is started, the injection system will automatically vent itself.

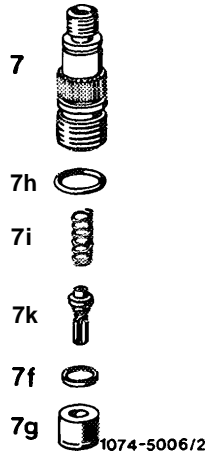


1074-11412

07.1-210 Renewing delivery valve seal

Job no. of work units or standard texts and flat rates data 07-8627

Removal and installation of air cleaner (09-400).



- 7 Delivery valve holder 35 Nm
- 7f Copper seal Renew
- 7g Delivery valve carrier Note installation position
- 7h O-ring. Lubricate prior to installation.
- 7i Compression spring
- 7k Delivery valve

Special tool

Socket wrench element notched tooth 17 x 20,
1/2" square

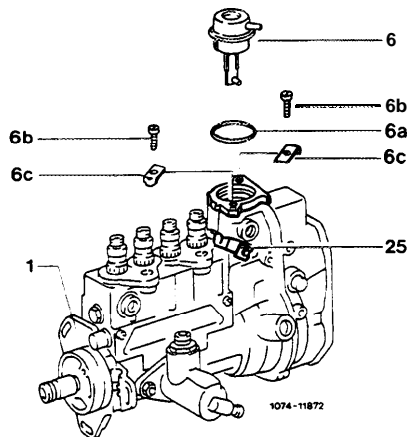


617 589 01 09 00

07.1-220 Renewing vacuum control unit

Job no. of work units or standard texts and flat rates data 07-8618

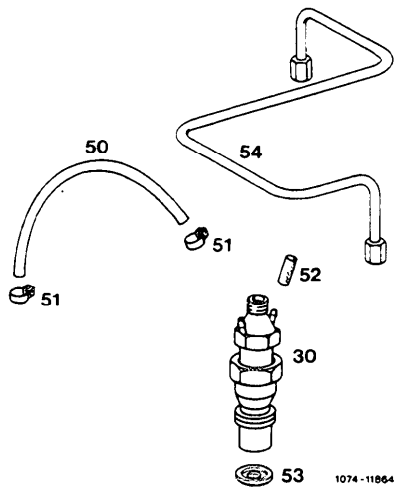
Removal and installation of air cleaner (09-400).



- | | |
|-------------------------------|--|
| 1 Injection pump | |
| 6 Vacuum control unit (stop). | Slightly lift during removal, tilt rearward toward engine end and pull out |
| 6a O-ring | |
| 6b Screw | |
| 6c Holder | |
| 25 Emergency stop lever. | During installation, push and let connecting rod of vacuum control unit engage in rocker of emergency stop lever |

07.1-230 Removal and installation of injection nozzle

Job no. of work units or standard texts and flat rates data 07-6810.

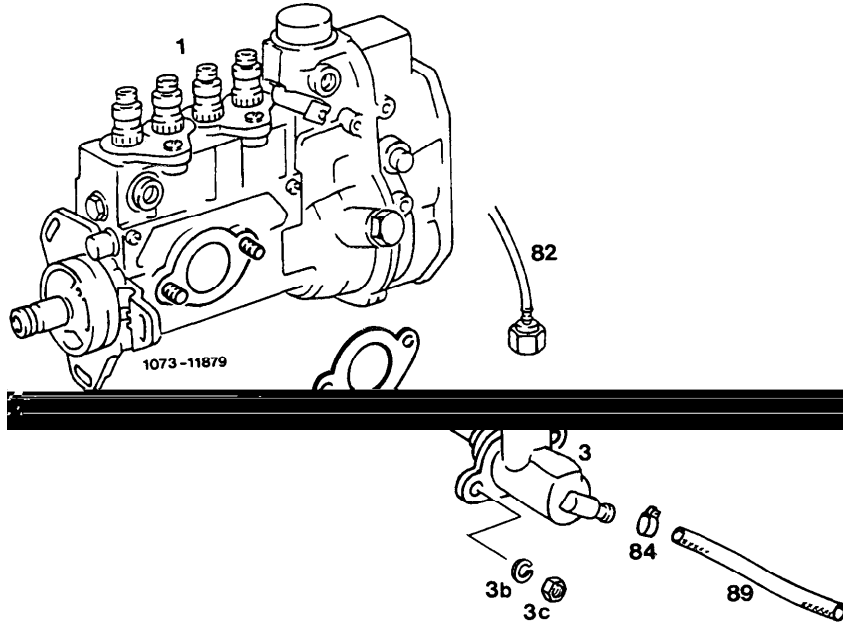


- 30 Injection nozzle 70-80 Nm, use special tool 001 589 65 09 00
- 50 Leak oil hose
- 51 Hose clamp (S only)
- 52 Closing plug
- 53 Nozzle reed. Renew
- 54 Injection lines cylinder 110–20 Nm (reference value)

07.1-235 Removal and installation of fuel pump

Job no. of work units or standard texts and flat rates data 07-5710.


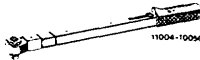
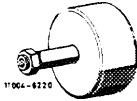

Remove air cleaner cover (09-400).



- 1 Injection pump
- 3 Fuel pump.

07.1-240 Removal and installation of injection timer

Job no. of work units or standard texts and flat rates data 07-8014.

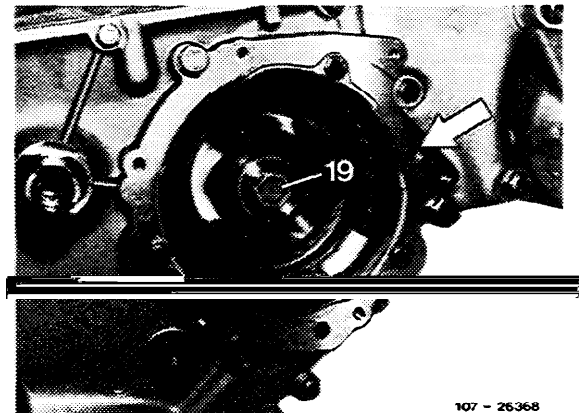
| Tightening torque | | Nm |
|--|--|------------------|
| Central fastening screw on injection timer (lefthand threads) | | 40-50 |
| Special tools | | |
| Socket wrench element 27 mm, 1/2" square |  | 001 589 65 09 00 |
| Torque wrench with plug-in ratchet, 1/2" square, 25-30 Nm |  | 001 589 66 21 00 |
| Impact puller |  | 116589203300 |
| Threaded bolt M 6 |  | 11658901 3400 |

Note

Injection pump removed, remove and install injection pump (07.1-200).

Removal and installation

- 1 Remove assembly basket.
- 2 Remove camshaft timing gear for slackening chain.
- 3 Pull out locking pin (arrow).



4 Push timing chain in outward direction, slip in sheet metal strip of approx. 0.2 mm for this purpose, and pull out injection timer.

5 Install injection pump.

6 Check injection timing with digital tester (07.1-I 12). adjust, if required (07.1-I 17).

07.1-245 Renewing fuel filter

Job no. of work units or standard texts and flat rates data 07-5513.

Note

Fuel system will vent itself automatically when starting, owing to higher delivery capacity of fuel pump and throttles (orifices) in filter top, as well as on injection pump.

Function diagram, refer to 07.1-010 section „G“.

Removal and installation

- 1 Disengage vacuum line on holder.
- 2 Loosen fastening screw (74) and remove filter (42) in downward direction.

42 Filter
73 Fuel filter top
74 Screw
76 O-ring
77 Sealing ring (aluminum)

