

### 13 Fuel Supply

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6.76 Fuel Supply and Control

SPECIFICATIONS

Model	320 i	320 i A
Manufacturer / system		Bosch / continuous fuel injection
Idle speed	rpm	900 ± 50
	CO % Vol.	max. 2.0 for 49 State Version max. 3.5 for California Version
<u>Fuel Delivery Pump</u>		
Make / No.		Bosch / 0 580 254 992
Delivery pressure	bar (psi)	4.5 ... 5.2 (64 ... 74)
<u>Test Values</u>		
Cold control pressure		+ 10° C (+ 50° F) 0.5 bar (7 psi) } see diagram on page 13-50/3 + 40° C (+104° F) 2.0 bar (28 psi) }
Warm control pressure	bar (psi)	3.4 ... 3.8 (48 ... 54) <sup>1)</sup>
System pressure	bar (psi)	4.5 ... 5.2 (64 ... 74)
Cut-off pressure	bar (psi)	not less than 1.7 (24) after about 5 minutes
Transfer valve opens	bar (psi)	3.5 ... 4.0 (50 ... 57)
<u>Air Flow Sensor</u>		
Make / No.		Bosch / 0 438 040 019 for 49 State Version Bosch / 0 438 040 027 for California Version
Basic sensor plate setting		flush with beginning of taper

1) 4.45 bar (63 psi) for warm-up regulator with altitude control, Bosch No. 0 438 140 037.

	320 i	320 i A
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Fuel Distributor

Make / No.

Bosch / 0 438 120 030 for 49 State Version  
 Bosch / 0 438 120 039 for California Version

Warm-up Regulator

Make / No.

Bosch / 0 438 140 004

For operating at altitudes chiefly 1500 meters above sea level

Injection Valves

Make / No.

Bosch / 0 437 502 007

Opening pressure

3.3 (47)

Injection rate deviation within 4 cylinders %

max. 15

Cold Start Valve

Make / No.

Bosch / 0 280 170 405

Operating pressure

approx. 4.5 (64)

Temperature Timing Switch

Make / No.

Bosch / 0 280 130 214

Switching point

+ 35 (+ 95)

Opening time at - 20° C (- 4° F)

max. 8

sec.

Fuel Supply and ControlSPECIFICATIONS

320 i A

320 i

Auxiliary Air Regulator

Make / No.	Bosch / 0 280 140 104
Air bore half open	at approx. + 20° C (68° F)
Air bore shut	after about 5 minutes
Fuel reservoir Make / No.	Bosch / 0 438 170 001
Operating pressure	approx. 5 (70)
Reservoir volume	20 (1.2)

bar (psi)  
3  
cm<sup>3</sup> (in)

Torque Specifications in Nm / kpm (ft. lbs.)

Injection valve coupling nuts	25 / 2.5 (18)
Temperature timing switch	max. 30 / 3.0 (22)
Fuel filter hollow bolt	2.0 + 0.3 (14.5 + 2)

mkp (ft. lbs.)

13 00 054 ADJUSTING ENGINE IDLE SPEED - CHECKING  
EXHAUST EMISSIONS

Requirements for all adjustments:

Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).

Ignition timing and valve clearance correct.

Air filter cartridge in good condition.

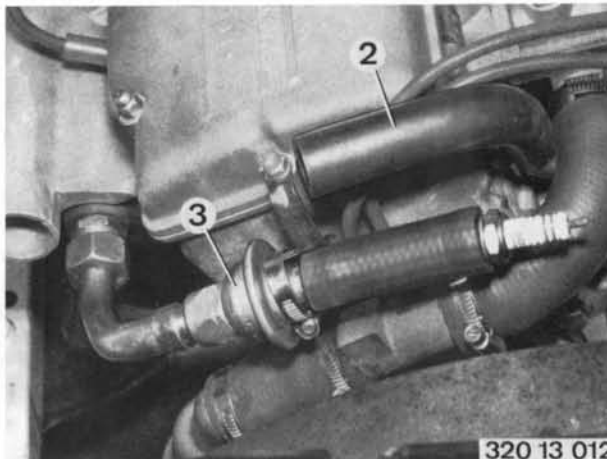
CO tester at operating temperature and calibrated.

Adjust engine idle speed to 900 ± 50 rpm with screw (1).



Detach hose (2) at check valve.

Plug check valve (3).



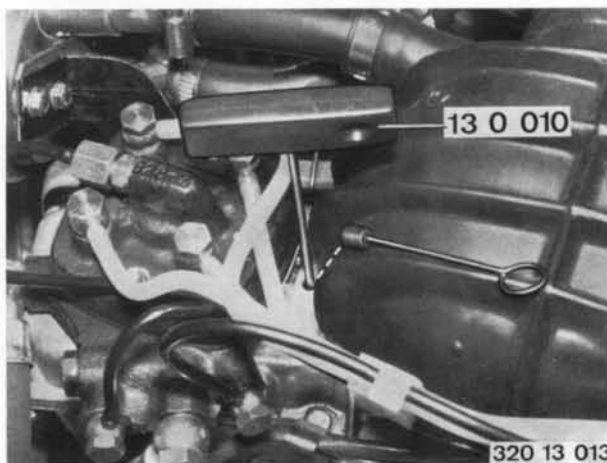
Pull plug out of fuel distributor.

Adjust CO level with adjusting wrench 13 0 010.

Max. 2.0 % by vol. for 49 State Version

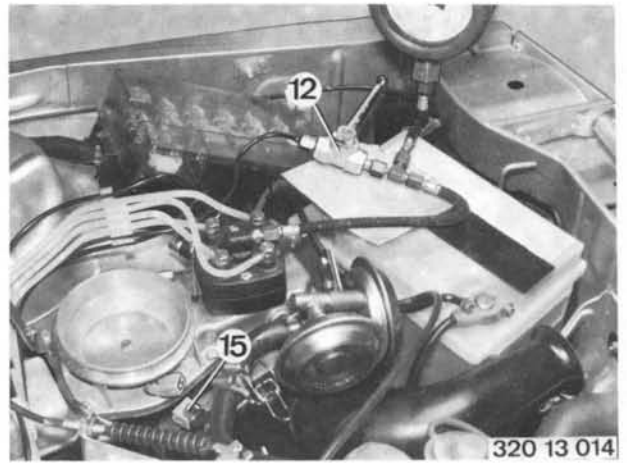
Max. 3.5 % by vol. for California Version

Caution! Don't accelerate while making adjustments. If CO level cannot be adjusted to specifications with engine running at idle speed free of misfiring, refer to "Troubleshooting" on page 13-50/9.



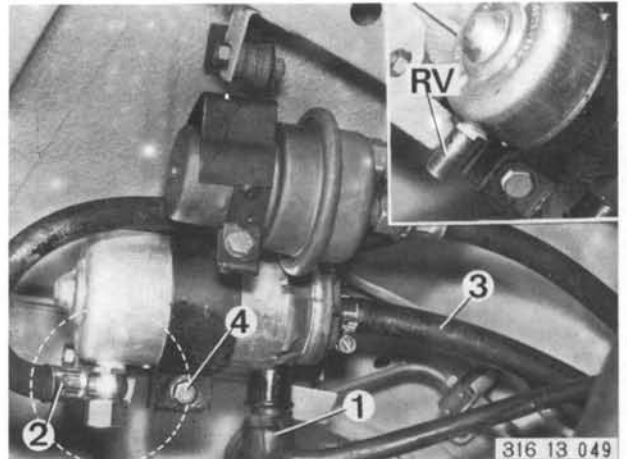
### 13 31 009 CHECKING FUEL PUMP DELIVERY PRESSURE

Connect Special Tool 13 3 060 between fuel distributor and warm-up regulator.  
Shut two-way valve (12).  
Disconnect wire plug (15) on mixture control unit.  
Turn on ignition.  
Delivery pressure specification: 4.5 ... 5.2 bar or  
64 ... 74 psi.  
Turn off ignition.



### 13 31 030 REPLACING FUEL PUMP

Disconnect wire plug (1).  
Detach suction line (2) and pressure line (3).  
Caution! Seals.  
Remove screw (4) from holder.  
As long as starter is operated or engine is running,  
fuel pump receives current (1).  
Overflow and check valves are installed in fuel  
pump. The check valve (RV) prevents fuel system from  
draining when fuel pump is not running.



Pull out fuel pump toward front.

Caution! Only use Bosch fuel pumps, No. 0 580 254 992.



1) See safety wiring diagram - 13 50 009.

13 32 051 REPLACING FUEL FILTER

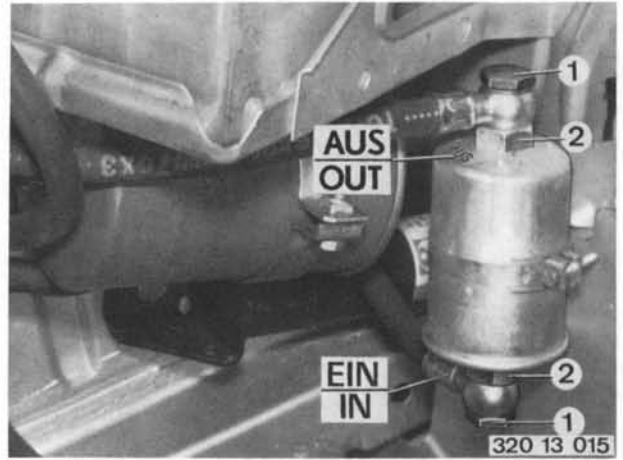
Replace fuel filter every 30,000 km (18,000 miles).  
Detach hose connections and clip.

Installation Note! Note direction of flow. (top  
connection = out)

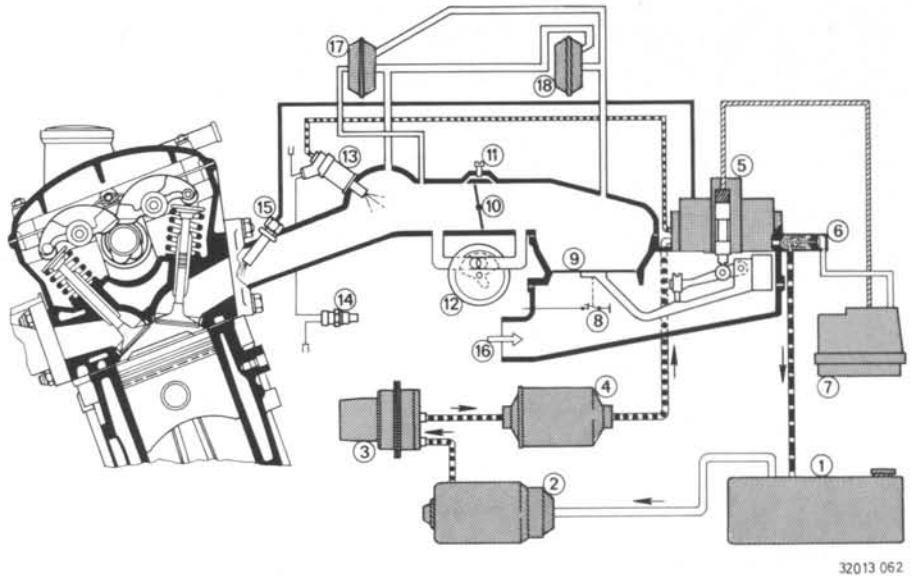
Only use original replacement parts. The housing has  
a cloth filter in addition to the paper filter.

Caution! Tighten hollow bolt (1) with 2.0 + 0.3 mkp  
(14.5 + 2 ft. lbs.).

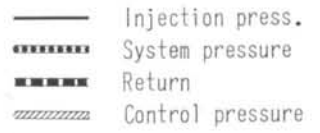
Counterhold on hexagon (2) to prevent leaks.



- 1 Fuel tank
- 2 Fuel delivery pump
- 3 Pressure reservoir
- 4 Fuel filter
- 5 Fuel distributor
- 6 System pressure regulator
- 7 Warm-up regulator
- 8 Safety switch
- 9 Sensor plate
- 10 Throttle valve
- 11 Idle adjusting screw
- 12 Auxiliary air regulator
- 13 Start valve
- 14 Thermo timing valve
- 15 Injection valves
- 16 Air inlet
- 17 Vacuum regulator
- 18 Auxiliary air valve



32013 062



13 50 009 CHECKING FUNCTION OF FUEL INJECTION SYSTEM

A) Visual Inspection with Engine Stopped

Eliminate visible leaks on fuel system by replacing or sealing pertinent part.  
 Check vacuum system for loose or damaged hoses, condition of start valve seals, injection valves and intake pipes, eliminating defects if necessary. Air drawn in erroneously will not be processed by air flow sensor. Follow-up problems: erratic engine idle due to lean mixture.

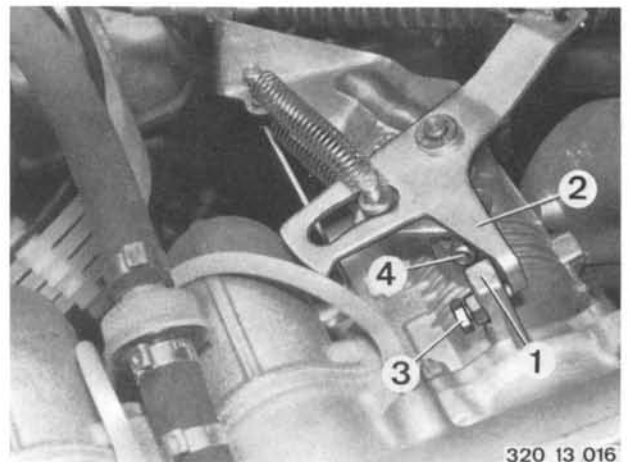
B) Basic Throttle Setting

Detach accelerator cable.  
 Loosen screw (3).  
 Adjust distance between stop (1) and lever (2) to 1 + 0.5 mm (0.039 + 0.019 in.) with screw (3).  
 Loosen clamping screw (4).  
 Position throttle valve in housing to be without play.  
 Tighten clamping screw (4).  
 Tighten screw (3) by one turn and counterlock.  
 Detach accelerator cable and adjust - 35 41 420.

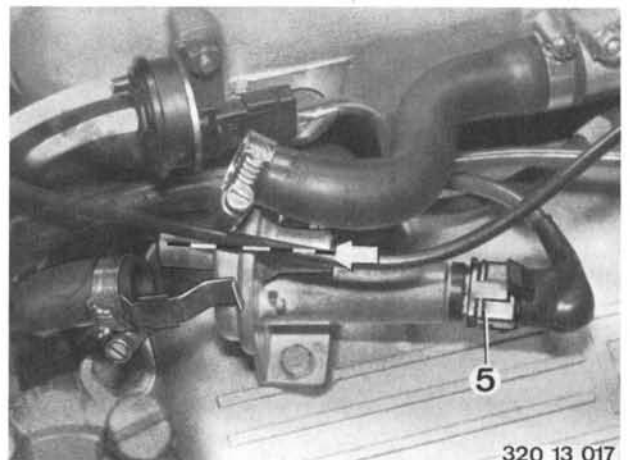
C) Auxiliary Air Regulator

Disconnect wire plug (5) at auxiliary air regulator. Detach both hoses at auxiliary air regulator. Air bore of cut-off valve is half open on cold engine (approx. + 20° C / + 68° F).  
 Turn on ignition.  
 Wire plug (5) must have voltage <sup>1)</sup>.  
 Connect wire plug (5).  
 Attach both hoses to auxiliary air regulator.  
 With engine running air bore must be closed completely by cut-off valve after about 5 minutes. Replace auxiliary air regulator, if air bore remains open even after knocking lightly.

- 1) No voltage: check fuse or relay.

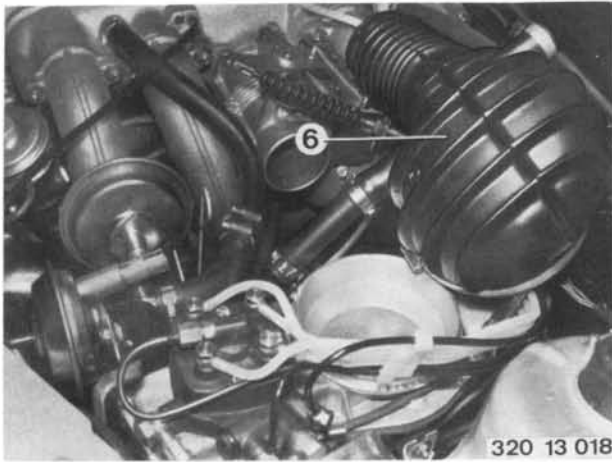


320 13 016



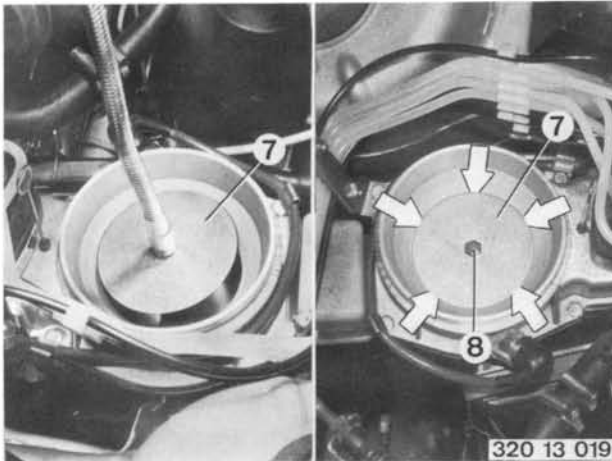
320 13 017





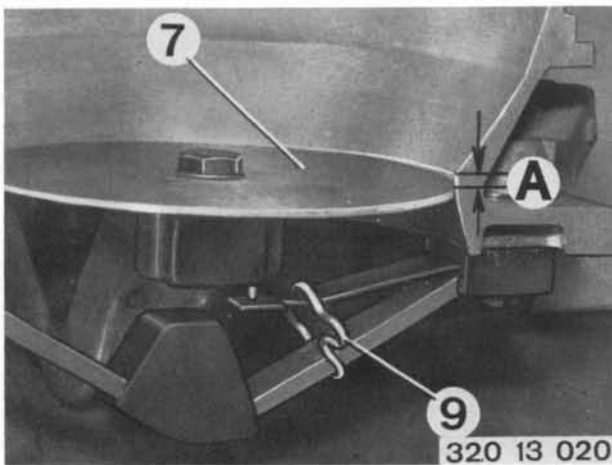
D) Mixture Control Unit / Sensor Plate

Detach intake cowl (6) at mixture control unit and throttle housing.



Turn ignition on for about 5 seconds and then off again. During this time pull up sensor plate (7) with an appropriate tool (magnet or similar) slowly. The amount of resistance must be constant over the entire length and there should be no resistance felt when moving down fast 1).

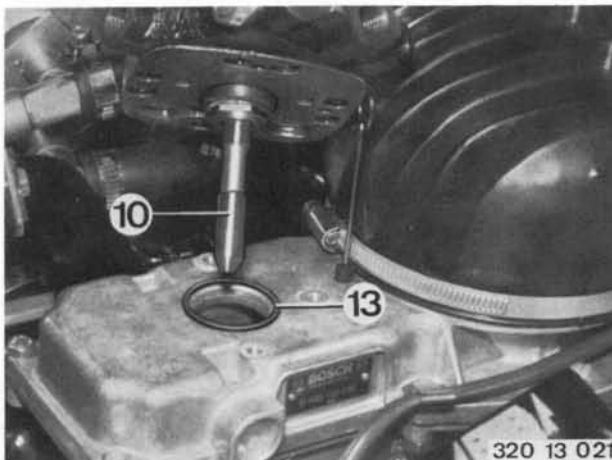
Don't let sensor plate (7) scrape along wall, if necessary loosen screw (8) and center sensor plate.



Sensor plate (7) should be flush with or max. 0.5 mm deeper than beginning of taper on venturi. (A)

Correction: Take mixture control unit off of intermediate housing and bend spring (9) accordingly.

Sensor plate (7) too high - engine runs on  
too low - poor cold or warm starts



If control piston (10) sticks, take fuel distributor off of mixture control unit - 13 51 013.

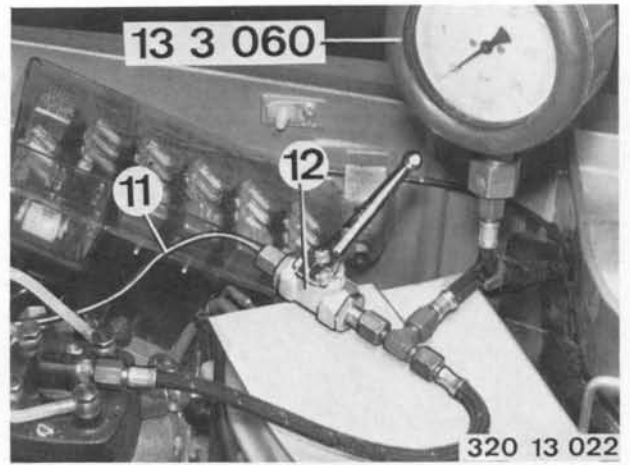
Caution! If fuel distributor assembly is replaced, be sure to replace gasket and adjust CO level.

Check control piston (10) for damage, if it has fallen out and clean thoroughly with gasoline before installing.

1) Control piston (10) sticks when resistance is uneven.

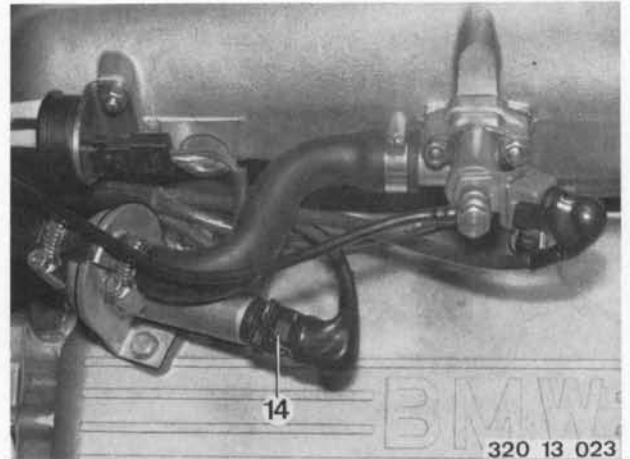
E) Connecting Pressure Tester - 13 3 060

Detach control pressure line (11) at fuel distributor and connect 2-way valve (12). Suspend pressure gauge from appropriate point. Connect pressure hose to fuel distributor.

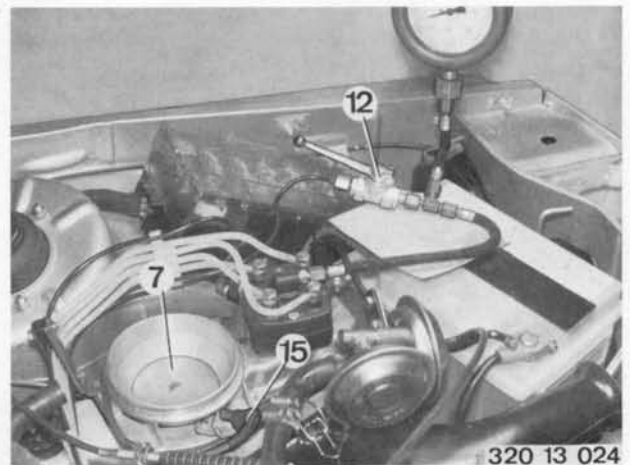


F) Cold Engine Control Pressure

This test need only be performed for cold start or warm-up difficulties. Disconnect power plug (14) at auxiliary air regulator to prevent auxiliary air regulator from being subjected to uncontrollable heat.



This requires that sensor plate (7) does not stick. Detach wire plug (15) at mixture control unit. Turn on ignition. Set 2-way valve (12) for flow-through.



Control pressure depends on coolant temperature and can be taken from the diagram.

Pressure too low

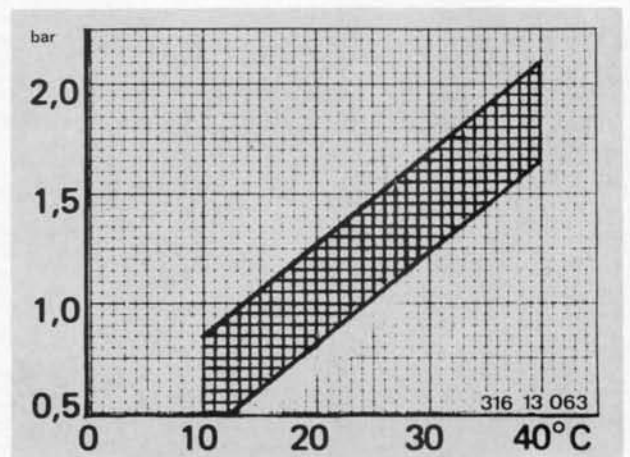
- warm-up regulator defective

Pressure too high

- fuel return flow insufficient

- warm-up regulator defective

Turn off ignition.





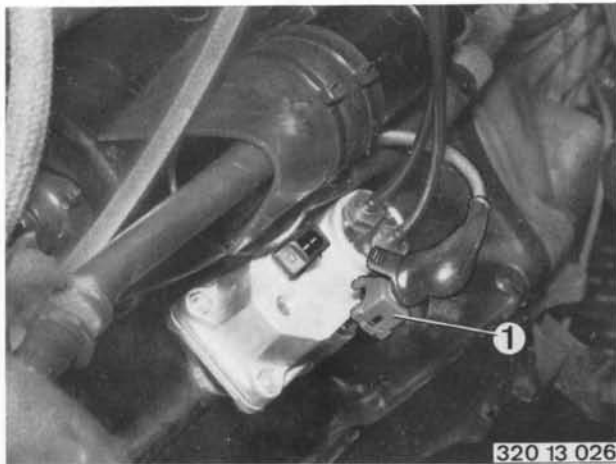
#### G) Warm Engine Control Pressure

Set 2-way valve (12) at flow-through.

Disconnect wire plug (15) at mixture control unit.

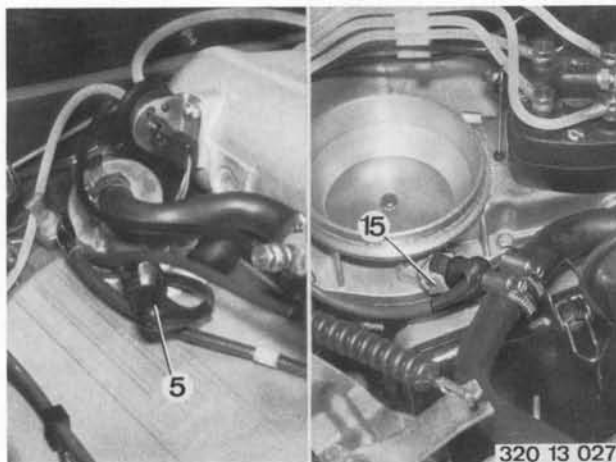
Turn on ignition.

Warm-up regulator is good, if after about 3 min. the control pressure of a stopped engine has reached 3.4 ... 3.8 bar (48 ... 54 psi).



Control pressure does not rise:

- wire plug (1) without power / eliminate defect
- heating coil defective / replace warm-up regulator - 13 63 050

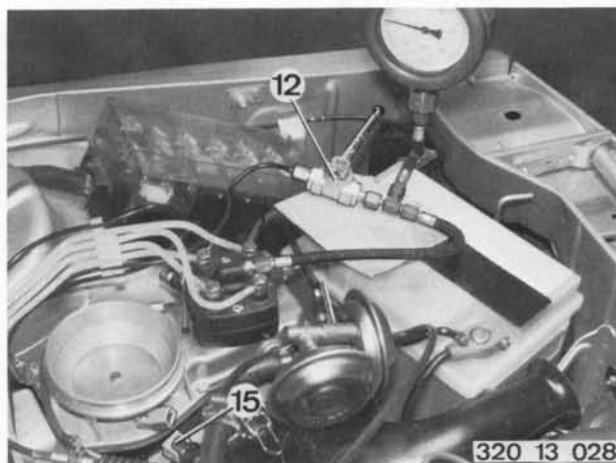


Test on running engine:

Install intake cowl.

Connect wire plug (5) to auxiliary air regulator and plug (15) to mixture control unit.

With engine running at idle speed control pressure must be 3.4 ... 3.8 bar (48 ... 54 psi).



#### H) Cold or Warm Engine System Pressure

Shut 2-way valve (12) when engine is stopped.

Disconnect wire plug (15) at mixture control unit.

Turn on ignition.

System pressure specification: 4.5 ... 5.2 bar or  
64 ... 74 psi.

Turn off ignition.

System pressure too low:

- fuel lines/connections leak
- fuel filter seriously clogged
- engine runs on <sup>1)</sup>
- fuel pump delivery rate inadequate
- system pressure adjustment incorrect

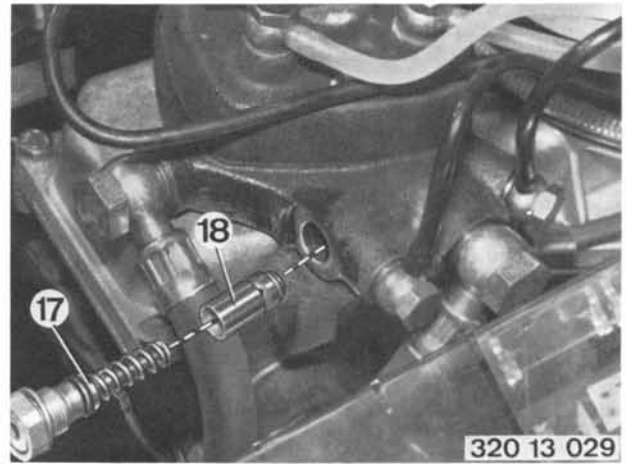
Pressure change caused by shim (17) thickness:

0.06 bar (.85 psi) - 0.1 mm (0.004 in.)

0.3 bar (4.3 psi) - 0.5 mm (0.020 in.)

System pressure too high:

- fuel return flow insufficient
- system pressure regulator setting incorrect
- control piston (18) stuck

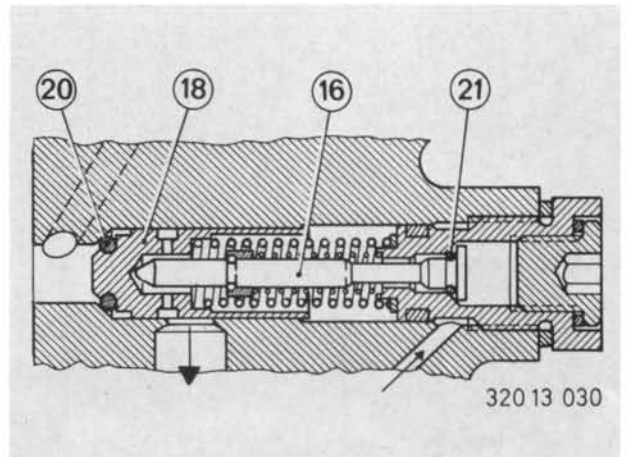


To prevent hot starting difficulties, transfer valve (16) must open at 3.5 ... 4.0 bar (50 ... 57 psi).

16 Transfer valve

18 Control piston

20 and 21 O-rings



#### 1) Cut-off Pressure / Checking for Leaks

Open two-way valve (12).

Turn on ignition.

Disconnect wire plug (15) at mixture control unit and connect it again.

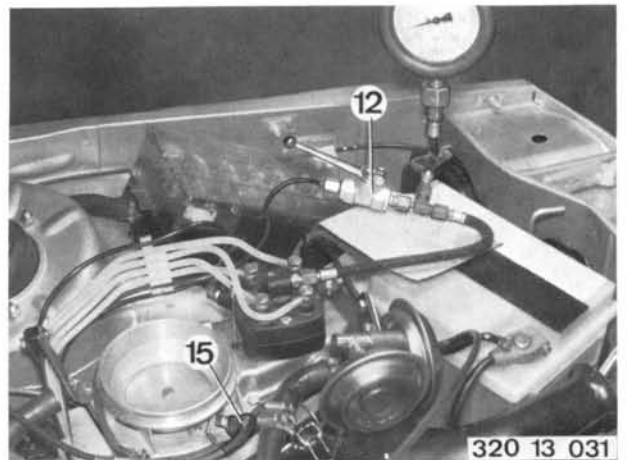
Turn off ignition.

Cut-off pressure must not drop below 1.7 bar or 24 psi after several minutes.

Pressure drop too early:

- o-ring (20) in system pressure regulator leaks
- warm-up regulator or supply line leaks
- check valve in fuel pump leaks
- pressure reservoir leaks
- o-ring (21) on transfer valve leaks

Remove pressure tester 13 3 060.



#### K) Vacuum Regulator

When coasting vacuum regulator (1) must be open and supply air behind throttle valve via bypass bore.

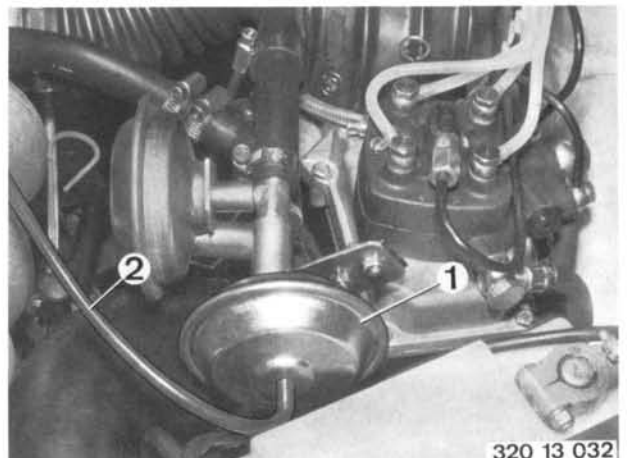
Test: Detach vacuum hose (2).

Plug connector on header.

Boost engine speed to 3000 rpm briefly.

Speed must drop suddenly.

Engine speed should drop slowly when vacuum hose (2) is connected.



1) See replacing fuel pump - 13 31 030.



#### L) Auxiliary Air Valve

The engine receives additional air during and immediately after starting procedures via auxiliary air valve (3).

Auxiliary air valve is good, if after starting engine the engine speed is higher than the specified engine speed for a brief period.



#### M) Temperature Timing Switch

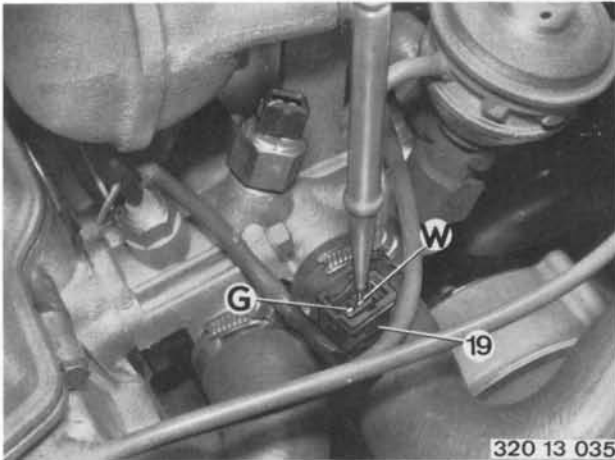
The temperature timing switch controls the cold start valve's opening time in agreement with the coolant temperature.

Opening time at  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) is max. 8 seconds and the off temperature is  $+35^{\circ}\text{C}$  ( $+95^{\circ}\text{F}$ ).

Function check: Disconnect wire plug (19).

Connect test lamp to battery + and connection W in temperature timing switch.

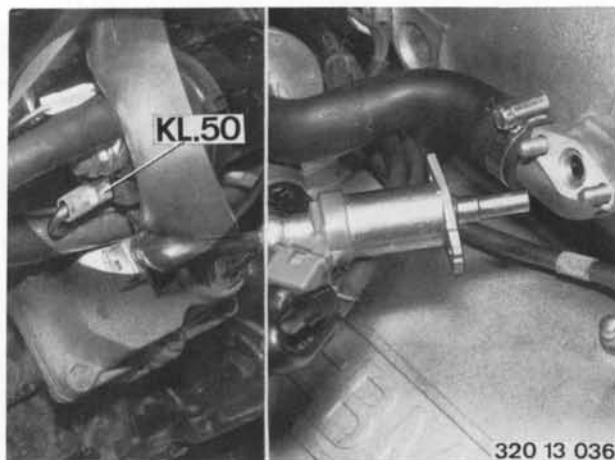
Test lamp must burn bright at coolant temperatures below  $+35^{\circ}\text{C}$  ( $+95^{\circ}\text{F}$ ) and go out above  $+35^{\circ}\text{C}$  ( $+95^{\circ}\text{F}$ ).



#### N) Cold Start Valve

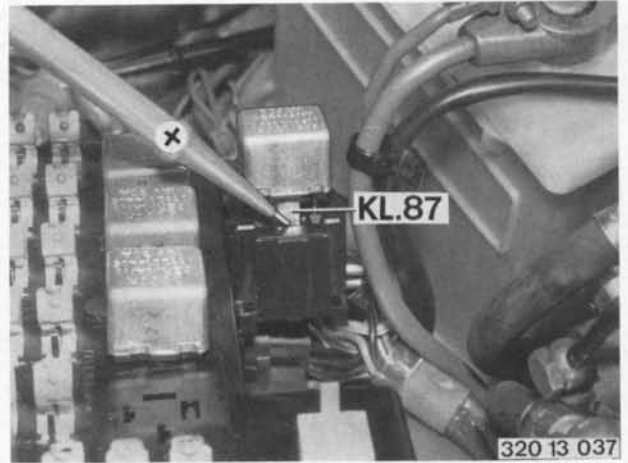
Disconnect wire plug (19) at temperature timing switch.

Connect brown/black wire (contact W) to ground.



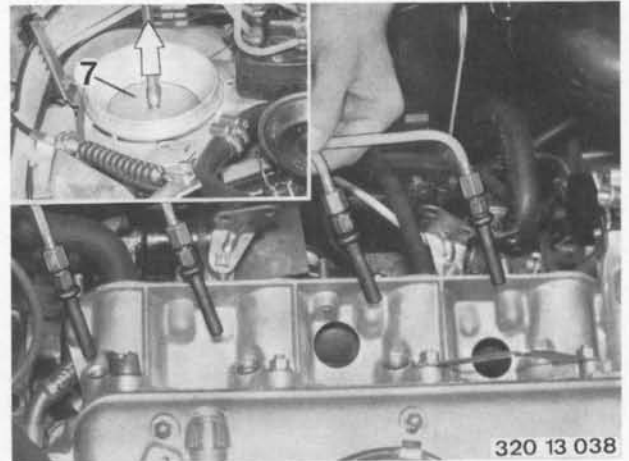
Disconnect terminal 50 wire at solenoid.  
Take cold start valve off of header.

Connect relay terminal 87 to battery +.  
Cold start valve should eject.  
Replace a cold start valve which will not open  
or does not eject.



#### 0) Injection Valves / Injection Rate

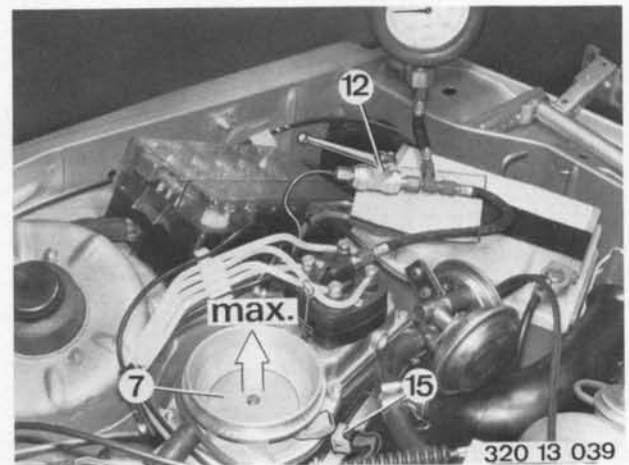
Injection valves must open on their own at a pressure of approx. 3.3 bar (47 psi).  
Install pressure tester 13 3 060.  
Remove injection valves 13 53 100.  
Lift sensor plate (7), if there is cut-off pressure (see point 1).  
Injection valves are good, if not more than one drop leaks every 15 seconds.



Set two-way valve (12) at flow-through.  
Turn on ignition.  
Disconnect wire plug (15) at mixture control unit.  
Lift sensor plate (7) for about 4 seconds maximum.  
System pressure must not drop more than 0.3 bar or 4 psi.

Pressure drop greater:

- fuel filter seriously clogged
- fuel pump delivery rate inadequate <sup>1)</sup>
- fuel in fuel tank insufficient

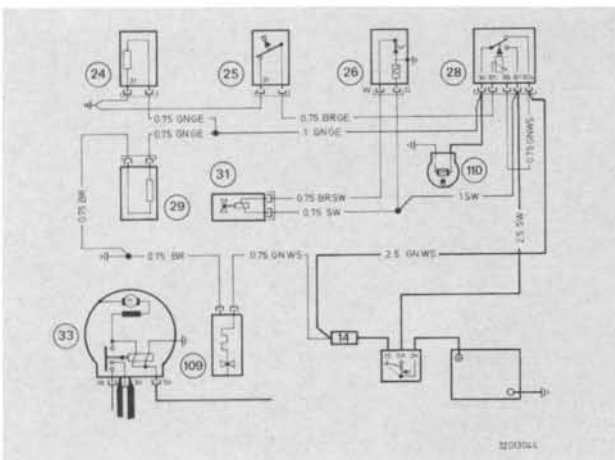
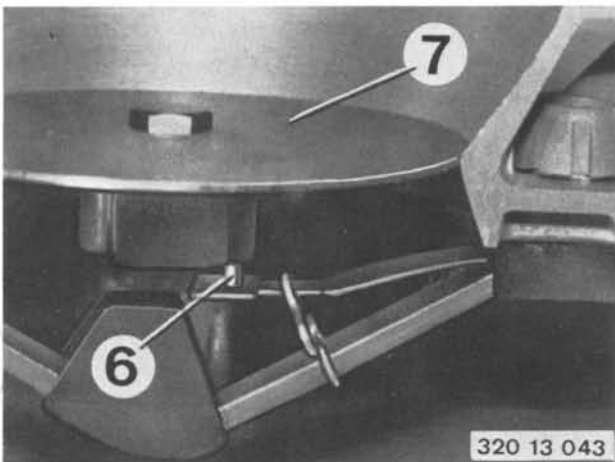
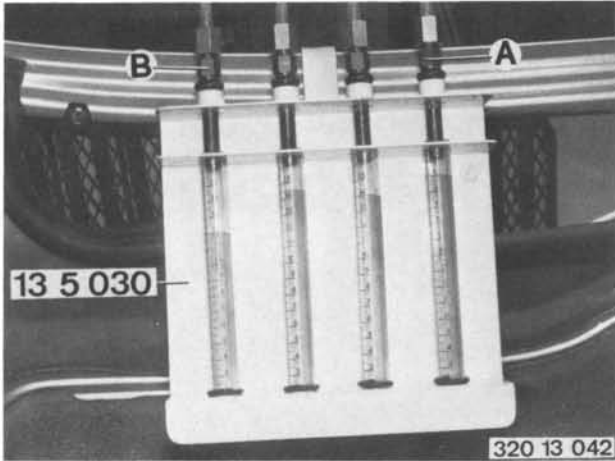
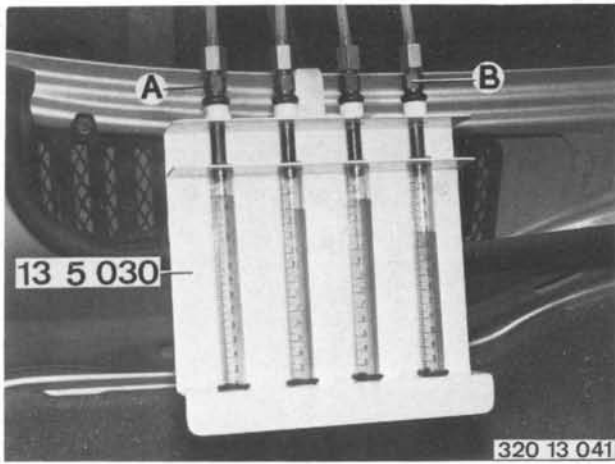


Only perform this test when compression of all cylinders is good, but engine runs very erratically.

Remove injection valves - 13 53 100.  
Connect injection lines and wires to tester 13 5 030 with threaded adapters 13 5 012.



1) See replacing fuel pump - 13 31 030.



Secure tester to engine hood.  
 Connect injection valves to lines and guide their ends into measuring tubes.  
 Lift sensor plate until measuring tubes are full.  
 Empty measuring tubes.  
 Now lift sensor plate long enough until fuel reaches 15 cm<sup>3</sup> (0.9 cu. in.) mark of 1 glass, e.g. (A).  
 Maximum deviation between cylinders is 15 %.

Deviations greater than 15 %:  
 Exchange deviating valve (B) against normal ejecting valve (A).  
 If the injection rate of valve (A) which previously had a normal injection rate differs greatly, injection valve (A) is defective.  
 But if the error is now transferred to injection valve (B), replace the fuel distributor.

P) Safety Wiring

The electric fuel pump of a stopped or suddenly stopped engine is without power by way of the closed ground contact (6) underneath sensor plate (7).  
 When operating the starter or as soon as the engine draws in air, the sensor plate is operated, the ground contact is broken and the pump begins to deliver fuel.

- 14 Fuse
- 24 Warm-up regulator
- 25 Air flow sensor
- 26 Temperature timing switch
- 28 Relay
- 29 Auxiliary air regulator
- 31 Starting valve
- 33 Starter
- 109 Timing valve
- 110 Replacing Fuel Pump

6.76 Troubleshooting Chart for Engines with Bosch Continuous Fuel Injection

Engine will not start when cold	
Engine will not start when warm	
Poor cold starting	
Poor warm starting	
Erratic idling - vibrations in warm-up phase	
Erratic idling - vibrations when engine is warm	
Engine backfires in intake manifold	
Engine backfires in exhaust	
Engine misfires while driving car	
Engine power output insufficient	
Engine runs on	
Fuel consumption too high	
CO % by volume at idle speed too high	
CO % by volume at idle speed too low	
Idle speed too high and cannot be adjusted	

x x	CAUSE:
x x	Electric fuel pump does not run
x x	Cold control pressure beyond tolerances
x x	Warm control pressure too high
x x	Warm control pressure too low
x x	Auxiliary air regulator will not close
x x	Auxiliary air regulator will not open
x x	Start valve will not open
x x	Start valve leaks
x x	System pressure beyond tolerances
x x	Sensor plate set incorrectly
x x	Sensor plate or control piston hard to move
x x	Vacuum system leaks
x x	General fuel system leaks
x x	Injection valves leak
x x	Idle speed adjustment too rich
x x	Idle speed adjustment too lean
x x	Throttle valve does not open fully
x x	Temperature timing switch will not close
x x	Pressure reservoir leaks
x x	Seal on system pressure piston leaks
x x	Auxiliary air valve will not open
x x	Vacuum regulator will not close
x x	Timing valve open
x x	Timing valve closed
x x	Transfer valve will not open

REFER TO FOR CORRECTION:

- Fuel pump - 13 31 030
- Warm-up regulator - 13 50 009, Points F), G)
- Auxiliary air regulator - 13 50 009, Point C)
- Cold start valve - 13 50 009, Point N)
- System pressure - 13 50 009, Point H)
- Mixture control unit - 13 50 009, Point D)
- Visual inspection - 13 50 009, Point A)
- Injection valves - 13 50 009, Point O)
- Engine idle speed/exhaust test - 13 00 054
- Throttle valve - 13 50 009, Point B)
- Temperature timing switch - 13 50 009, Point M)
- Pressure reservoir - 16 12 040
- System pressure - 13 50 009, Point H)
- Auxiliary air valve - 13 50 009, Point L)
- Vacuum regulator - 13 50 009, Point K)
- Replace timing valve - 11 74 071
- Replace timing valve - 11 74 071
- System pressure - 13 50 009, Point H)

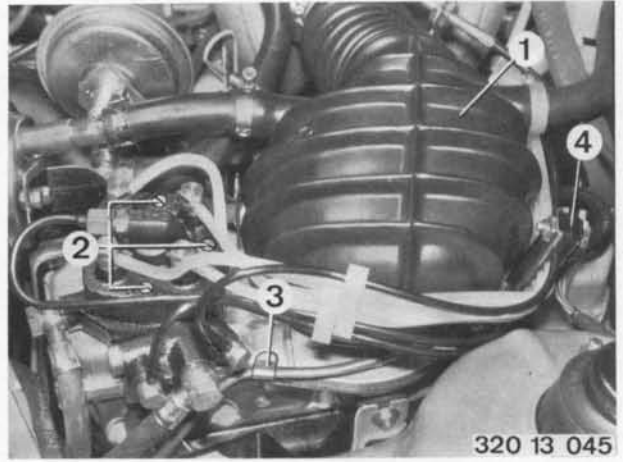
Use of this Troubleshooting Chart requires the following.

- 1) Normal compression in all cylinders.
- 2) Correct valve clearances.
- 3) Correct dwell angle and ignition timing.
- 4) Good working order for all ignition system parts.
- 5) Correct safety wiring - 13 50 009 (Point N).



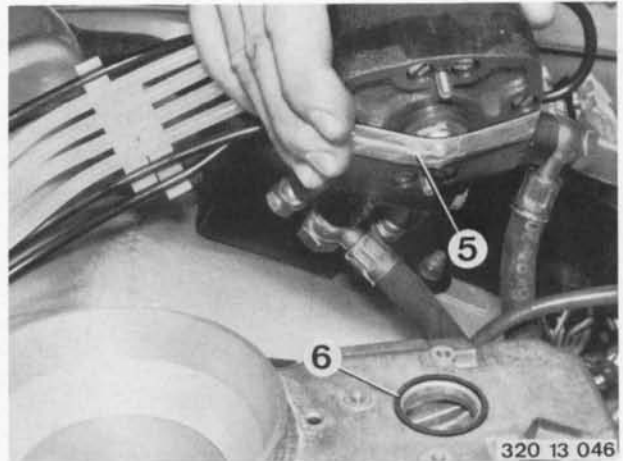
13 51 010 REMOVING AND INSTALLING MIXTURE CONTROL UNIT

Remove intake cowl (1).  
Loosen three slotted head screws (2).  
Bend open wire clips (3).  
Remove wire holder (4).

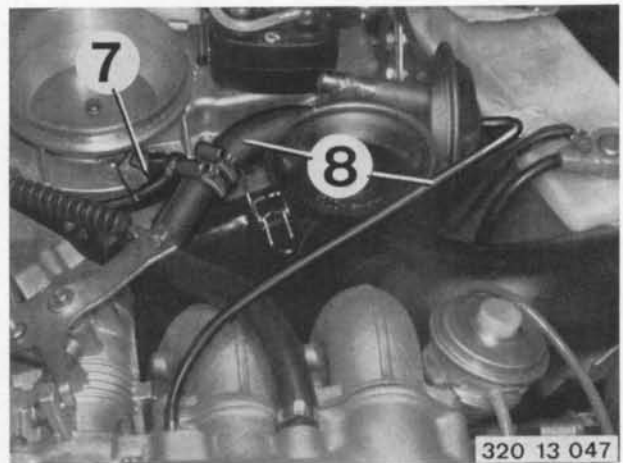


Use adhesive tape or similar to keep control piston (5) from falling out.

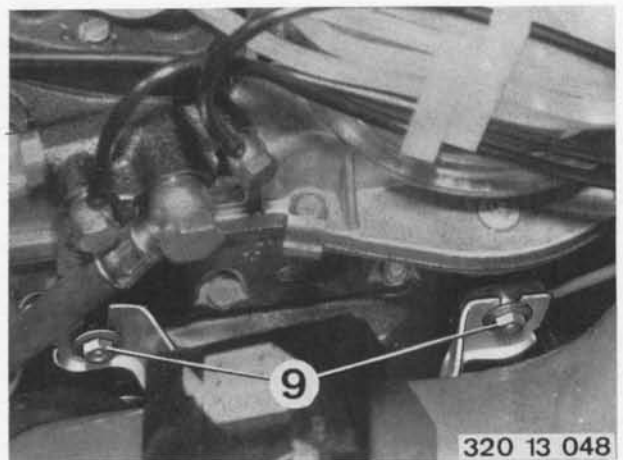
Installation Note! Replace seal (6).

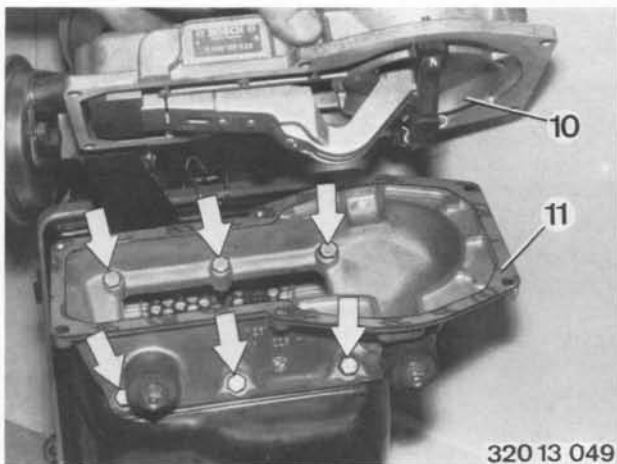


Disconnect plug (7).  
Detach vacuum hoses (8).



Loosen nuts (9).  
Lift out entire mixture control unit.





320 13 049

Always replace entire mixture control unit.  
Detach upper housing section (10).  
Take lower housing section off of air cleaner housing.

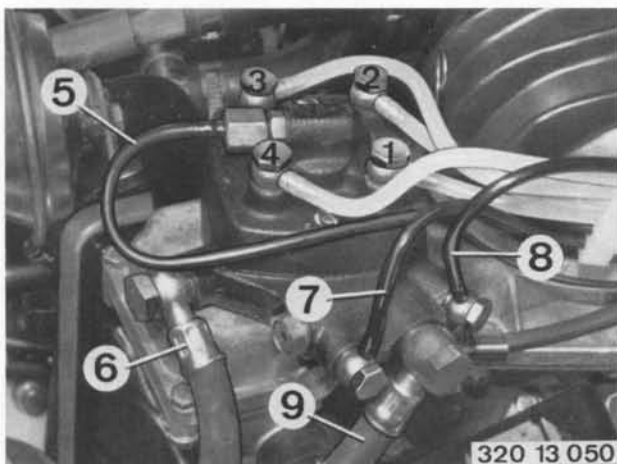
Installation Note! Replace gasket (11).

Caution! Venturi has different shapes.

Air flow sensor:

Bosch No. 0 438 120 030 for 49 State Version

Bosch No. 0 438 120 039 for California Version



320 13 050

13 51 013 REPLACING FUEL DISTRIBUTOR

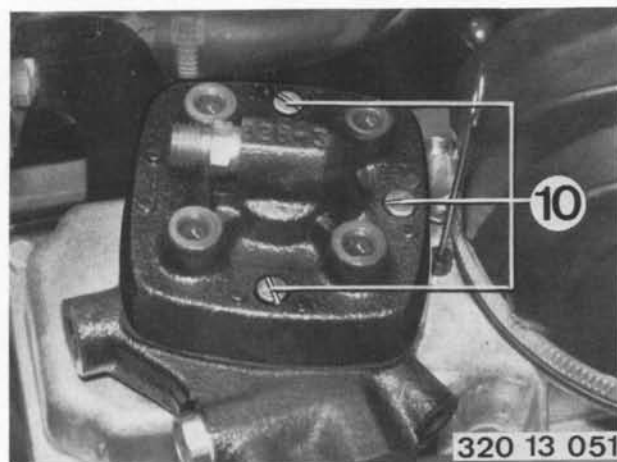
Caution! Different fuel distributors:

Bosch No. 0 438 040 019 for 49 State Version

Bosch No. 0 438 040 027 for California Version

Detach fuel lines 1 ... 9.

- 1 ... 4 To injection valves
- 5 To warm-up regulator
- 6 Fuel filter outlet
- 7 To warm-up regulator
- 8 To start valve
- 9 To fuel tank



320 13 051

Remove slotted head screws (10).



320 13 052

Lift fuel distributor off of mixture control unit.

Installation Note! Replace seal (11).

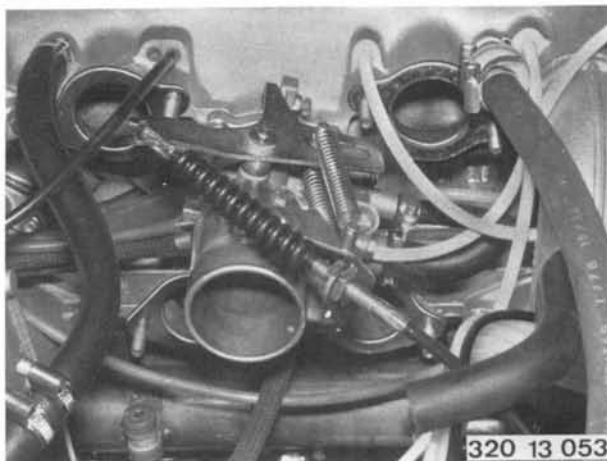
Caution! Check control piston (12) for damage and clean in gasoline very thoroughly.

Adjust engine idle speed and CO level - 13 00 054.

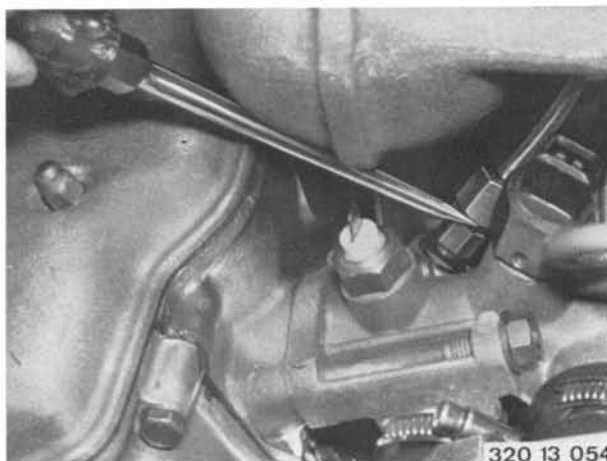
13 53 100 REMOVING AND INSTALLING INJECTION VALVES

Remove intake cowl and intake pipes at cyl. 2 and 3.

Installation Note! Replace gaskets.



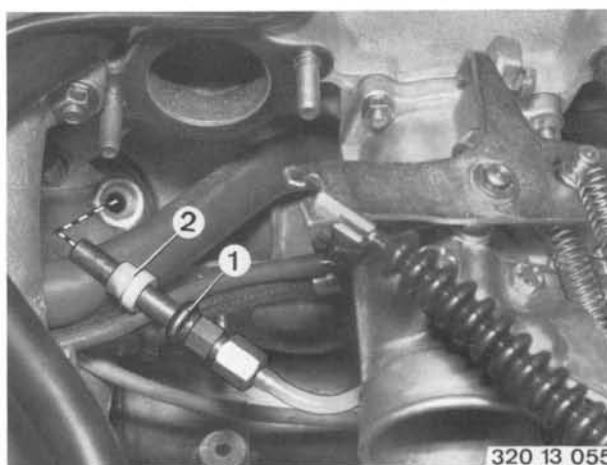
Use screwdriver between header and cylinder head cover to lift injection valves out of intake.



Detach injection valves at injection lines and mark.

Installation Note! Check injection valves - 13 50 009, Point 0).

Press rubber seal (1) into groove on intake.  
Guide insulator (2) back into intake, if it was pulled out by mistake.



### 13 63 050 REMOVING AND INSTALLING WARM-UP REGULATOR

The warm-up regulator controls the control pressure in relation to engine's temperature during warm-up phase.

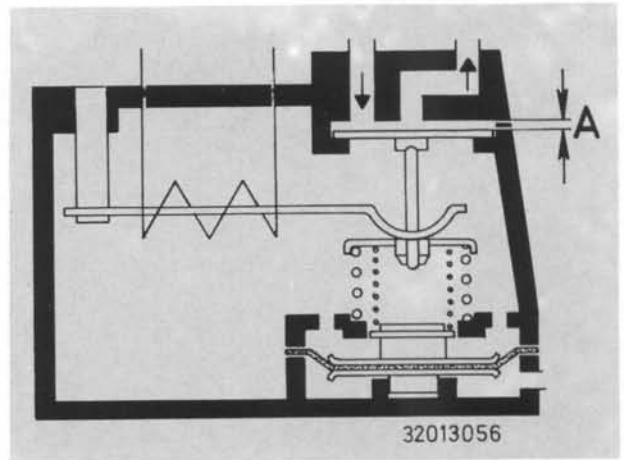
Cold engine: large opening (A)

low control pressure - rich mixture -

Warm engine: small opening (A)

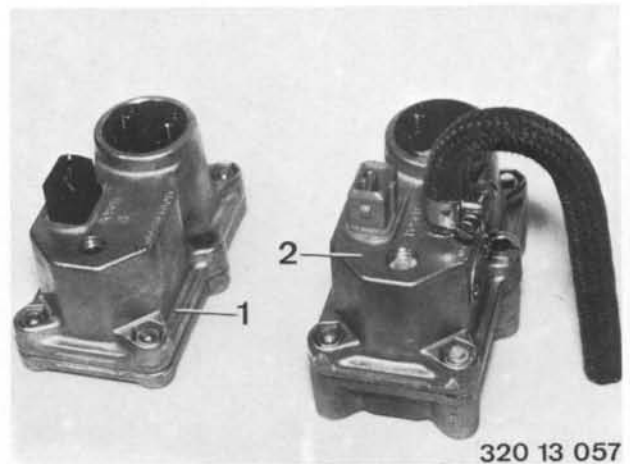
high control pressure - lean mixture

After reaching the operating temperature warm-up regulator holds control pressure at 3.4 ... 3.8 bar or 48 ... 54 psi.

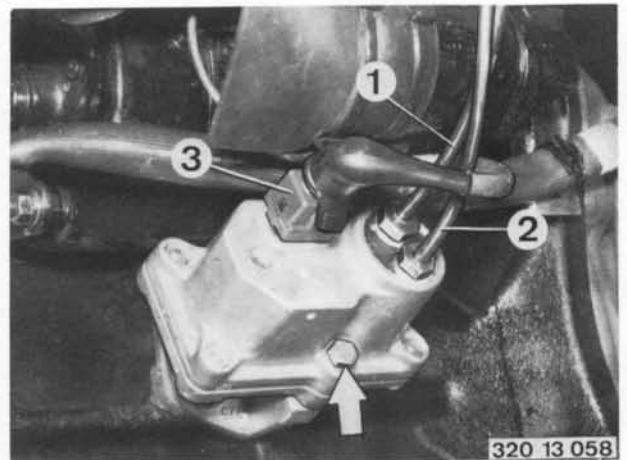


Cars driven chiefly at altitudes of 1500 meters (5000 feet) or more above sea level must be equipped with a warm-up regulator having an altitude control.

- 1 Normal warm-up regulator
- 2 Warm-up regulator with altitude control



Detach control line (1) and return line (2).  
Disconnect wire plug (3).  
Remove warm-up regulator.

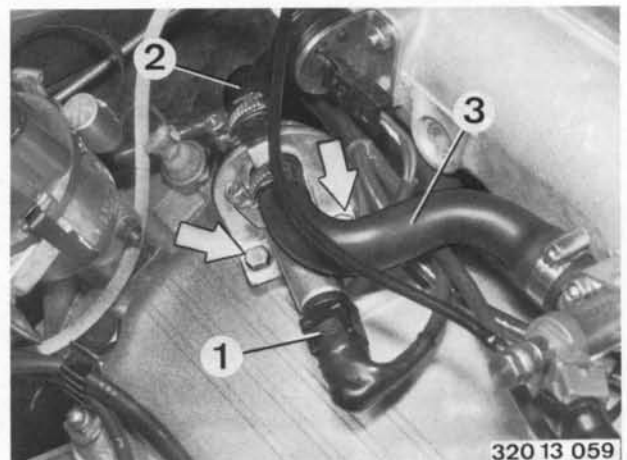


### 13 63 060 REPLACING AUXILIARY AIR REGULATOR

Disconnect wire plug (1).

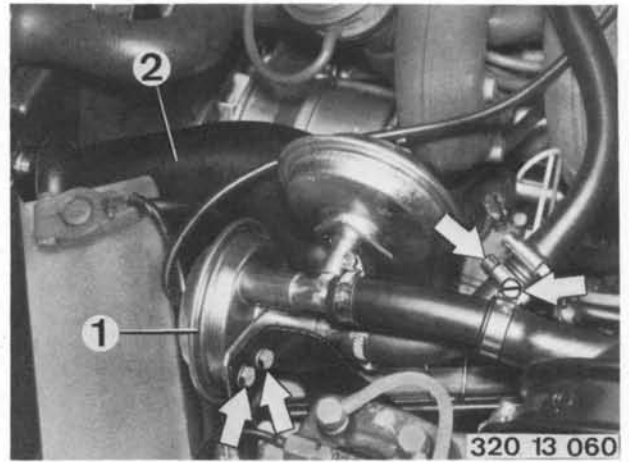
Detach hoses (2 and 3).

Take auxiliary air regulator off of cylinder head cover.



13 72 001 REPLACING AIR FILTER CARTRIDGE

Replace air filter cartridge every 12500 miles.  
Remove vacuum regulator (1) and intake cowl (2).



Open quarter-turn fasteners.  
Pull out air filter cartridge from above.

Installation Note! Perforated screen end faces  
mixture control unit.

