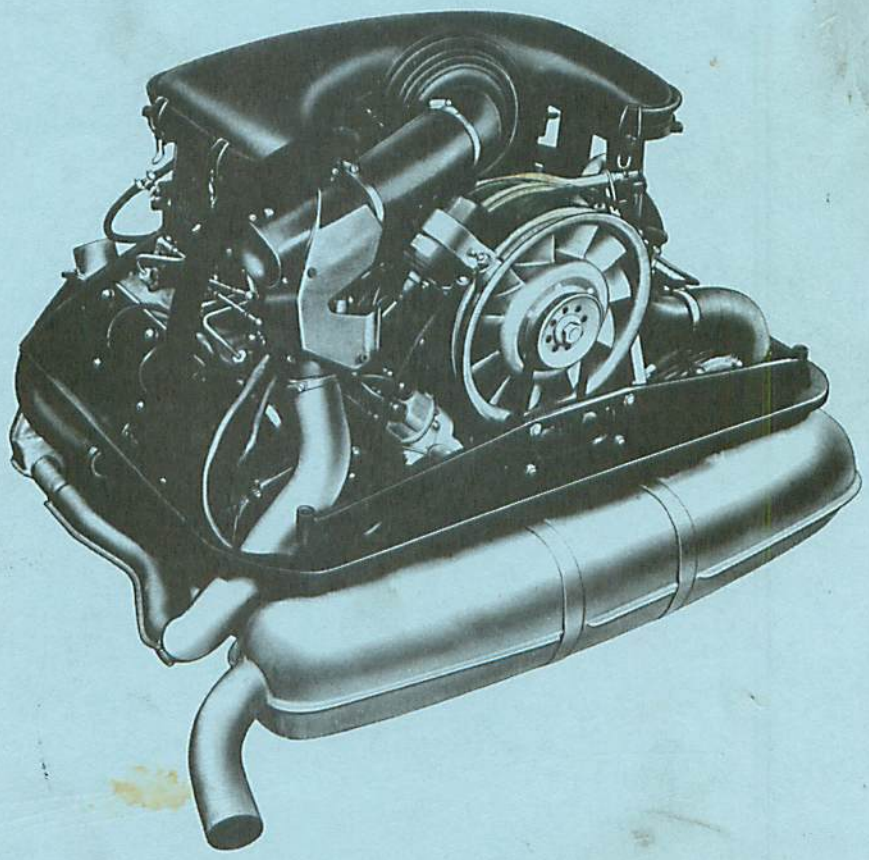
PORSCHE

Mechanical Fuel Injection

check
measure
adjust



Contents Page

PORSCHE

Mechanical Fuel Injection

This brochure describes the timing and adjustment of the mechanical fuel injection system.

It should assist the mechanic in performing all related operationes and serves as a reference book for the service adviser.

Any changes or modifications since the last production model can be found in this brochure.

PORSCHE Aktiengesellschaft
Kundendienstschule

Model 1969 – 2.0 liter engine

Engine Type – **911 E/158 SAE HP**
140 DIN HP

901/09 with manual transmission
901/11 with Sportomatic

– **911 S/190 SAE HP**
170 DIN HP

901/10 only with manual transmission

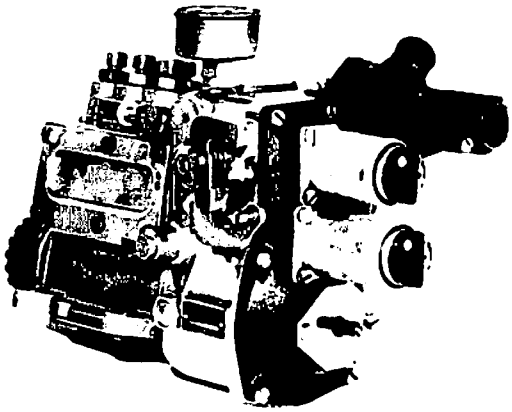
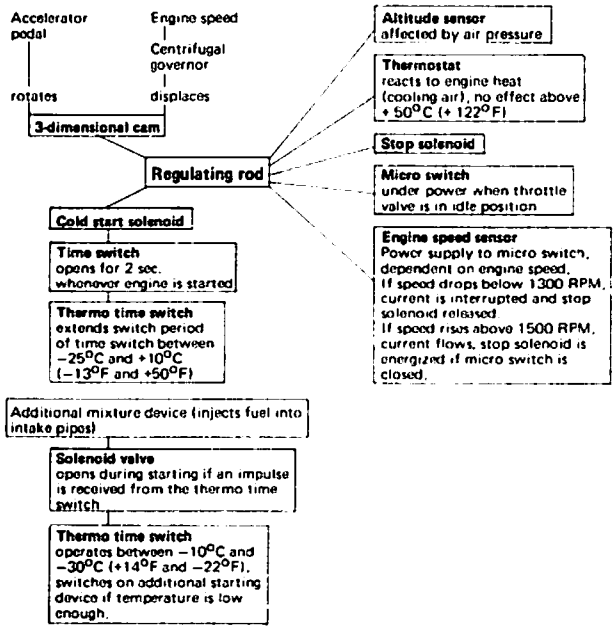


Diagram of regulating and correction system 2.0 litre engine



Characteristic Features:

Enrichment Solenoid controlled via a time limit relay.

Pump Designation: (Bosch-identification number)

(0408 126 001)
911 S – 0408 126 **005**

(0408 126 002)
911 E – 0408 126 **006**

Model 1970 – 2.2 liter engine

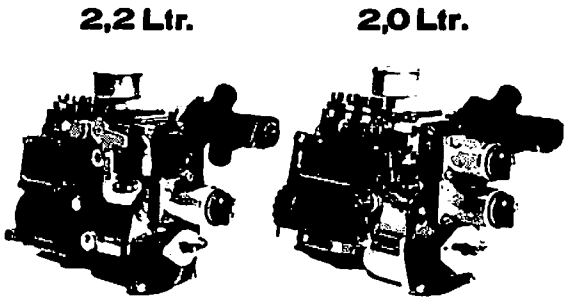
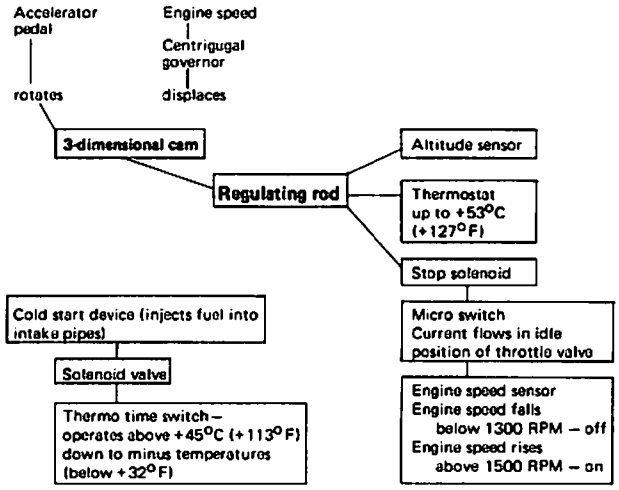


Diagram of regulating and correction system 2.2 litre engine



Engine Type – **911 E/175 SAE HP 155 DIN HP**

911/01 with manual transmission
911/04 with Sportomatic

– **911 S/200 SAE HP 180 DIN HP**

911/02 only with manual transmission

Characteristic Features:

No enrichment solenoid.

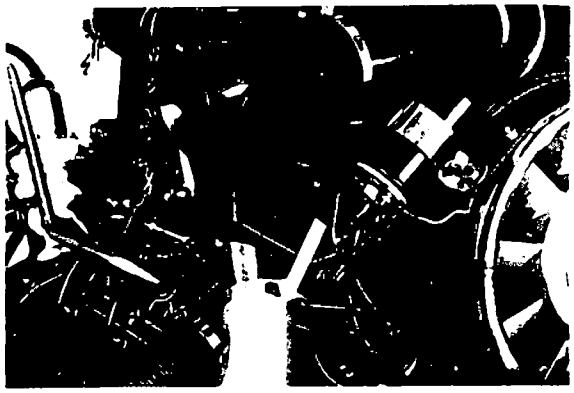
Pump designation: (Bosch-identification number)

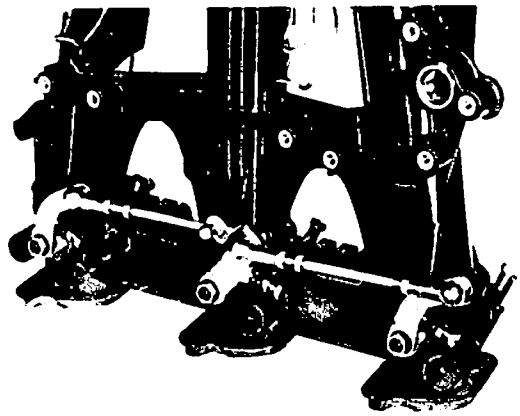
911 S – 0408 126 **009**
911 E – 0408 126 **010**

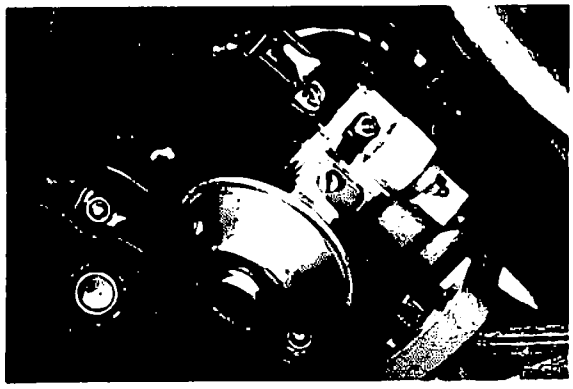
Model 1971 – 2.2 liter engine

Same as 1970 2.2 liter.

Model 1972 – 2.4 liter engine







Engine Type – **911 T/157 SAE HP 140 DIN HP**

911/51 with manual transmission
911/61 with Sportomatic

– **911 E/185 SAE HP 165 DIN HP**

911/52 with manual transmission
911/62 with Sportomatic

– **911 S/210 SAE HP 190 DIN HP**

911/53 with manual transmission
911/63 with Sportomatic

Characteristic Features:

Thermostatically controlled pre-heat device.

Intake manifolds make of synthetic material.

Vacuum controlled ignition distributor.

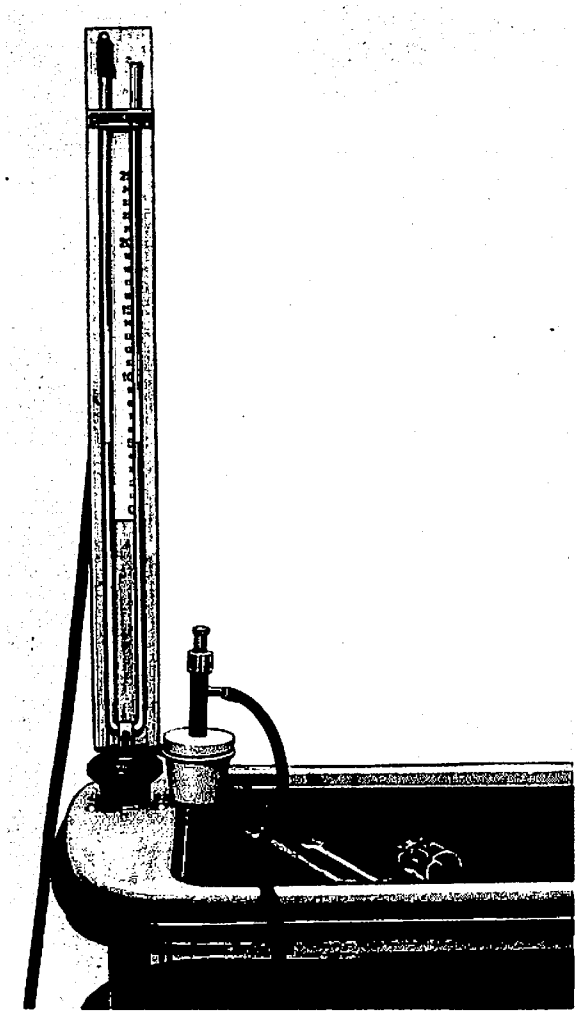
Pump Designation: (Bosch-identification number)

911 S – 0408 126 **013**
0408 126 **021**
911 E – 0408 126 **014**
911 T – 0408 126 **015**

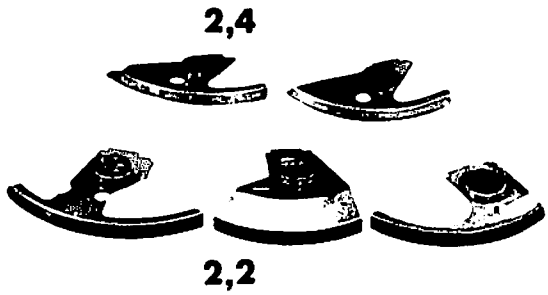
Model 1973 – 2.4 liter engine

Same as 1972 2.4 liter.

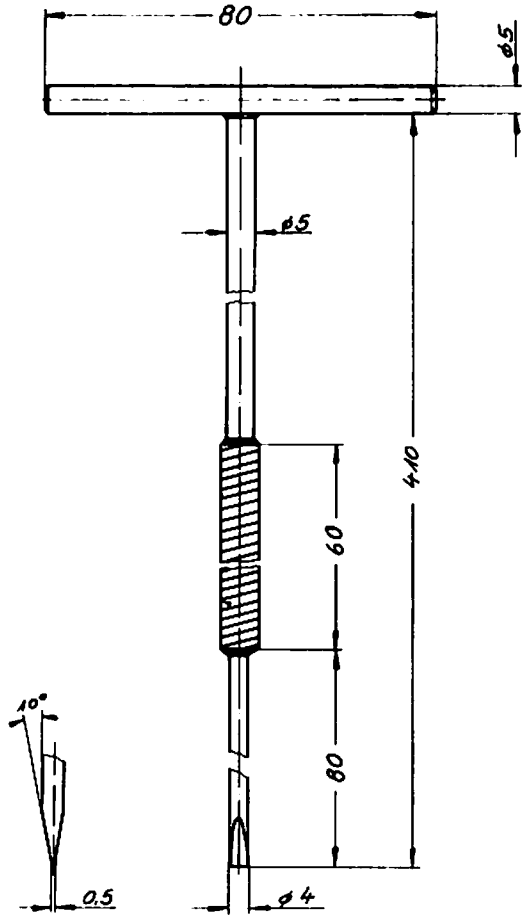
SPECIAL TOOLS



P 235	synchrometer
P 235 a	cone for synchrometer for 911 T



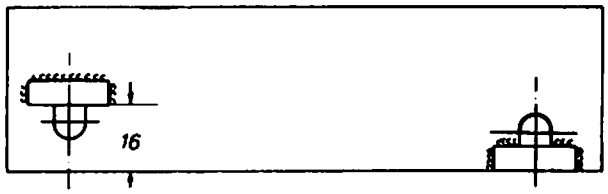
P 229 c



SPECIAL TOOLS

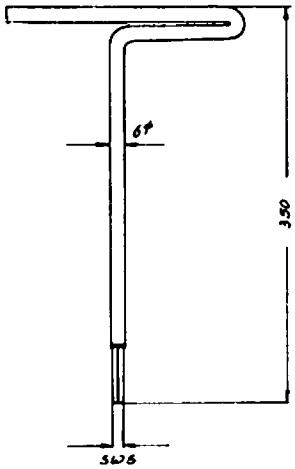
P 228 b	protractor and indicator up to and inclusive of Model 71
P 228 c	protractor and indicator from Model 72 on
P 229 b	screwdriver modify to . . .
P 229 c	with flexible center piece
P 230 b	wrench (idling speed 2.0 liters)
P 230 c	wrench (idling speed from 2.2 liters on)
P 233 b	pressure gauge (fuel feed pressure)
P 234 b	tensioning lever (toothed belt)
P 235	synchrometer
P 235 a	cone for synchrometer for 911 T
P 237	remote thermometer (intake-air temperature)

TOOLS YOU CAN MAKE YOURSELF



templet

for basic adjustment of throttle connecting rod



5 mm tee-handled allen wrench

for when making the part-load adjustment

AUXILIARY AIDS

CHEMTOOL B 12 cleaning fluid for cleaning air-bypass bores in throttle valve housing.

SOME BASIC POINTS

CHECK . . .

THINK . . .

REPAIR . . .

Remember, the injection system is not a separate component, as, for example, the generator.
It should be thought of as part of the engine.
No matter how well the injection system is adjusted, it cannot make up for problems in the operating condition of the engine.
Always begin injection system work by checking the engine's basic tune.

CHECK – IN SEQUENCE

1. Air Cleaner Cartridge
2. Compression Loss
3. Spark Plugs
   (Spark Plug Connectors)
4. Dwell Angle
5. Ignition Timing
6. Fuel Pressure and Flow
7. Injection Nozzles
8. Injection Timing
9. Correlation
10. Exhaust Emission Test
    a. at part-load
    b. at idling speed

NEVER DEVIATE FROM THIS SEQUENCE.

CHECK LOSS OF COMPRESSION

Leaky Valves =

loss of compression thru intake or exhaust

Leaky Piston Rings =

loss of compression thru crankcase – air vent

A leaky cylinder-head gasket is generally already noticeable at idling speed (engine warm) through a hissing noise.

The Cylinder Leak Test provides information on how tight the engine is.

Leakage at the valves
Leakage at the piston rings
Leakage at the cylinder head gasket

As a max. cylinder leakage of 10 % per cylinder should not be exceeded.

A cylinder leak test is more conclusive than a compression test.

If a **compression test** is used, observe the following:

Engine Oil Temp.	70 – 80°C
Throttle	wide open

Measure each cylinder with the same number of compression strokes.

Evaluation:

All cylinders should be within 10 %.

SPARK PLUGS

Burned spark plugs, adversely affect combustion. Therefore, the spark plugs must be thoroughly checked.
The exhaust-gas composition can be improved by up to 1 % just by replacing bad spark plugs.

Spark Plugs –

2.0-liter engine	Bosch W 265 P 21 NEW # W 3 DPO
2.2-liter engine	Bosch W 265 P 21 NEW # W 3 DPO Beru 265/14/3 P
2.4-liter engine	911 T: Bosch W 235 P 21 Beru 235/14/3 P NEW # W 5 DPO 911 E/S: Bosch W 265 P 21 Beru 265/14/3 P NEW # W 3 DPO

Checking DWELL ANGLE and IGNITION TIMING

Dwell angle and ignition timing influence combustion and exhaust-gas composition.

2.0 and 2.2 liter engines

Bosch-distributor
dwell angle **38° ± 3°**

2.4 liter engines

Bosch-distributor
dwell angle **38° ± 3°**

or **Marelli**-distributor
dwell angle **37° ± 3°**

DWELL ANGLE

Mechanical fuel injection engines are equipped with:
Up to 1972 Bosch distributor from 1972 Bosch or Marelli distributors

Note:

Marelli distributor rotors are fastened with a set-screw.

Ignition timing must always be checked whenever dwell angle is adjusted.

Adjusting IGNITION TIMING

Ignition timing is always adjusted at normal operating temperature, oil temperature 70 to 80°C.

2.4 liter ignition timing differs from that of 2.0 and 2.2 liter engines.

Note:

2.0 and 2.2 liter engines

Ignition timing 30 BDTC at 6,000 rpm
On 2.0 and 2.2 liter engines,
always check the ignition timing at idling speed.

(0 – 2 ATDC at idle speed)

If the setting is too late, surging may result.

Note:
If ignition timing is too late at idle, do not readjust until it is checked at 6,000 rpm. Timing that is earlier than 30 BTBC at 6,000 rpm will burn pistons.

If timing cannot be adjusted properly at both ends, remove the distributor and check the advancement curve.

2.0 and 2.2 liter engines

2.4 liter engine

The vacuum controlled distributor of the 2.4 liter engines retards the ignition timing at idle (up to 5 ATDC).

2.4 liter engine

1. Adjust the ignition timing to 5 ATDC at idling speed (900 ± 50 rpm) with the vacuum line connected.

When the throttle is opened and the engine accelerated, the ignition timing must shift from retard to advance.

Check by disconnecting the vacuum line while the engine is idling. The ignition timing must be between 4° and 6° BTDC. This approx. 10° timing variation (from 5 ATDC to 4 – 6 BTDC) is a result of the precise throttle-valve synchronization.

If the air-correction screws are opened too wide, the vacuum needed for ignition retard cannot build up. The timing may retard, for example, to only 3 ATDC. If the timing is now corrected to 5 ATDC, it will only change by 2 to 3 BTDC on acceleration.

The engine might have hesitation and bad transition performance.

2. Let the engine continue to run at idling speed, disconnect the vacuum line and watch the ignition timing mark change from late to early.
   When the vacuum line is disconnected, the ignition timing should be at 4 to 6 BTDC.

3. With the vacuum line disconnected, check the ignition timing at 6,000 rpm. It must be between 32 and 38 BTDC.

Note:

To fasten the toothed-belt gear on the engine camshaft, use only M 6 x 12 bolts, spare-part No. 900 167 088 02.

40° after overlap TDC on Cyl 1

Checking Injection Timing End of Delivery Stroke

The end of delivery stroke is adjusted to 40° after overlap TDC/Cyl 1 (check as follows).

Set engine in direction of rotation at **(TDC/Cyl 1)**.

From this position, turn 360° further (one revolution) until the Z 1 (Cyl 1) marking again lines up with the notch in the blower housing. Turn further to the FE marking, the engine is now in the correct position. On the cover of the injection pump and on the hub of the drive wheel there is a notch mark. When the pump is correctly adjusted the marks line up.
If the marks do not line up, adjust by moving the toothed belt, or, for fine adjustment, after loosening the three screws on the drive gear.

Checking and Adjusting CORRELATION

Correlation is the relation of the movement of the throttle valves to the movement of the pump regulator lever. The throttle valves have to move in precise relation to the pump regulator lever in order to maintain the most favorable fuel-air ratio.

SPECIAL TOOLS:

2.0 and 2.2 liter engines

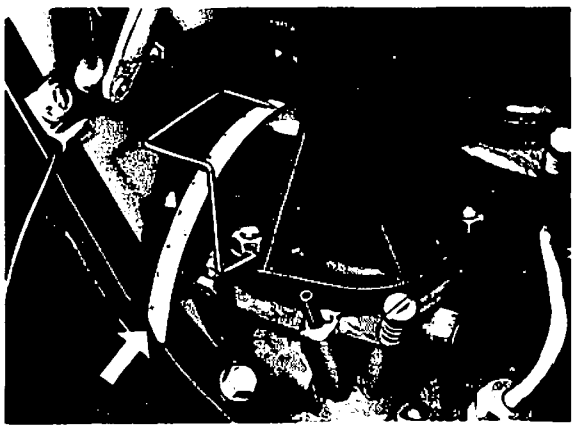
protractor and indicator
P 228 b

2.4 liter engines

protractor and indicator
P 228 c

Note:

The tool set P 228 c contains only the indicator and protractor for the newly designed throttle-valve housing from the 2.4 liter engine on. The protractor for the pump regulator lever has to be taken from the set P 228 b.



The arrow indicates the place where the right protractor can touch on the 2.4 liter engines. Reshape the protractor.

Checking of CORRELATION

1. Mount protractor

2. Make sure before you begin with the measurement that:

   The hand throttle is in zero position;

   all throttle valves and the pump regulator lever lie on the idling-speed stop;

   the protractors should not run unevenly on the indicator; the engine is at operating temperature (at least 60° C).

   Also check if the right protractor in the idling speed position doesn't touch the warm-air connecting pipes (see picture).

   Now set all indicators exactly on the zero point of the protractor.

   Avoid letting the throttle connecting rod "snap backward" because the protractor on the pump regulator may be moved out of place, which can lead unintentionally to wrong measurements.

Protractor Pump	Protractor Throttle Valve	Max. Deviation
0°	0°	
5°	3°	
10°	6°	± 0.5°
15°	9.5°	
20°	13°	
30°	21°	
40°	30°	
50°	40.5°	
60°	52°	± 1°
70°	65°	
79° – 82° (wide-open position)	80° – 85°	

3. The protractor on the pump regulator lever can be adjusted from degree to degree by slowly moving the throttle connecting rod (press on the middle lever of the cross-shaft). In doing so, the angles shown on the throttle-valve protractor are to be read and compared with the table.

Example:
When the angle of the pump regulator lever is 30°, the throttle valves must be 21° ± 0.5°. From 30° on of the pump angle, a tolerance of ± 1° is permissable.

If the values measured correspond to the table the throttle connecting rod must not be altered. This is also true if the throttle valve push rods are of different lengths. (Difference of up to 5 mm allowed.)

If the correlation values measured lie outside of the tolerances given in the table, the throttle valve push rods must be "basically adjusted".

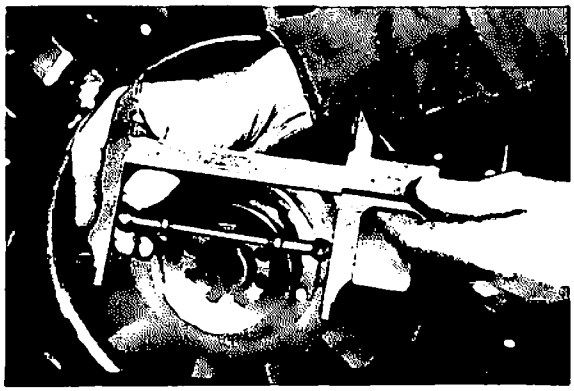
"Basic adjustment" of throttle valve push rods.

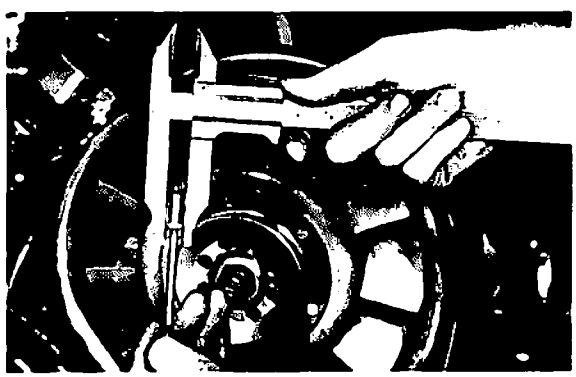
Preparation:

1. Disengage all connecting rods.
2. Turn back the microswitch.
3. Check whether the pump regulator lever and throttle valve lie on the idling-speed stop.

The length of the connecting rod between the pump regulator lever and the cross shaft is very important for an exact basic adjustment.

114 ± 0.2 mm (from ball center to ball center)





Execution:

1. Adjust the rod between the pump regulator lever and the cross shaft precisely to the measurement of 114 ± 0.2 mm.

   The self-made tool pictured opposite can be used for this.

   If this tool is not available, one must proceed as follows:

   a) Measure the total length of the rod.

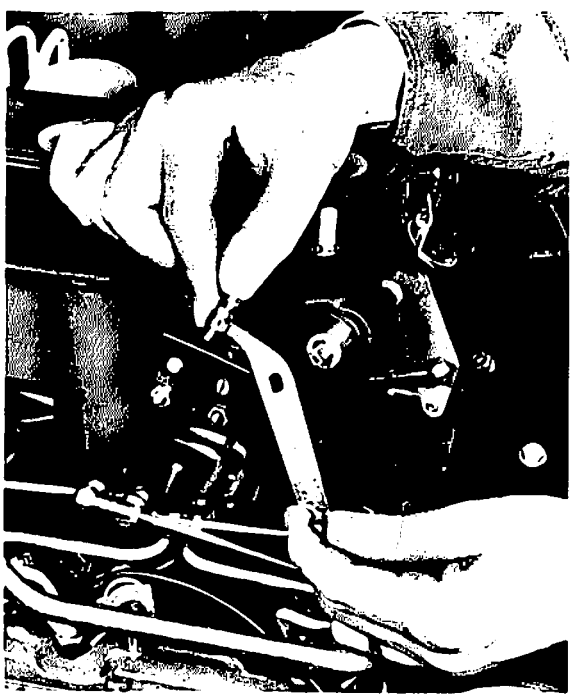
   b) Measure the diameter of one ball cup and deduct this measurement from the length of the rod.

   If the rod does not have the proper length, it must be corrected to 114 ± 0.2 mm.

Note:
When correcting the correlation, keep to the lower (–) tolerance for the throttle valves.

This will favorably affect the transition performance.

Push rods – left/right
max. difference 5.0 mm.



2. Re-engage the correctly adjusted connecting rod. The measurement for the push rods from the cross shaft to the throttle-valve housing is thus established.

   Check once again whether the pump regulator lever and the throttle valves lie on the idling-speed stop.

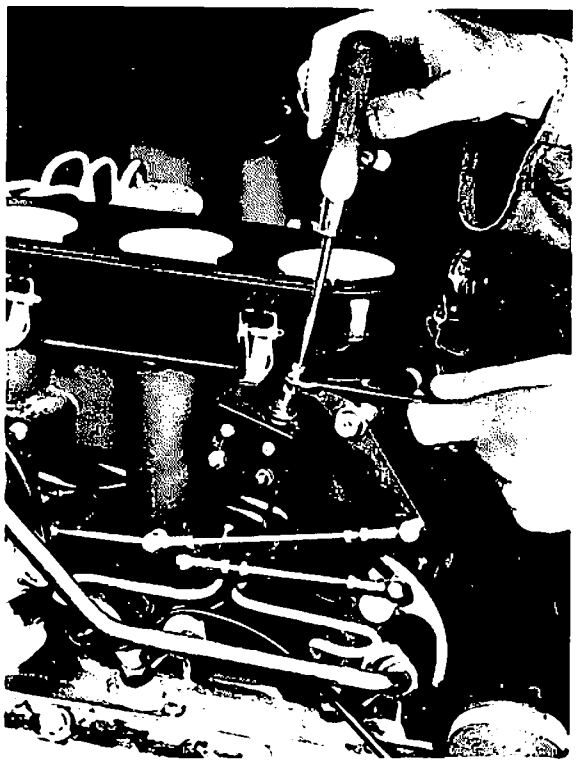
3. Now the two push rods – to the throttle valves – are to be adjusted so that they can be engaged free of tension and pressure.

   Note:
   The difference in length of the push rods may not be greater than 5.0 mm.

4. Disengage once again both push rods and measure the difference in length.

   Note:
   Don't mix up the rods!

   If the difference in length is greater than 5 mm, the left activating lever on the cross shaft can be adjusted in its receptacle enough to equalize the lengths of the rods.



5. Check the correlation.

6. After completing work on the throttle connecting rod, the microswitch for the stop solenoid has to be adjusted.

   Procedure:
   Turn in the screw until a click can be heard. From this position, turn in approx. 1/2 to 3/4 of a turn, then lock the screw counter nut.

SYNCHRONIZING THROTTLE VALVES

Synchronizing throttle valves is done at 3,000 rpm (engine at operating temperature).

Tools:

P 235 – synchrometer, for engine 911 T slender rubber cone P 235 a

P 229 b – screwdriver

Basic adjustment of the air-correction screws:

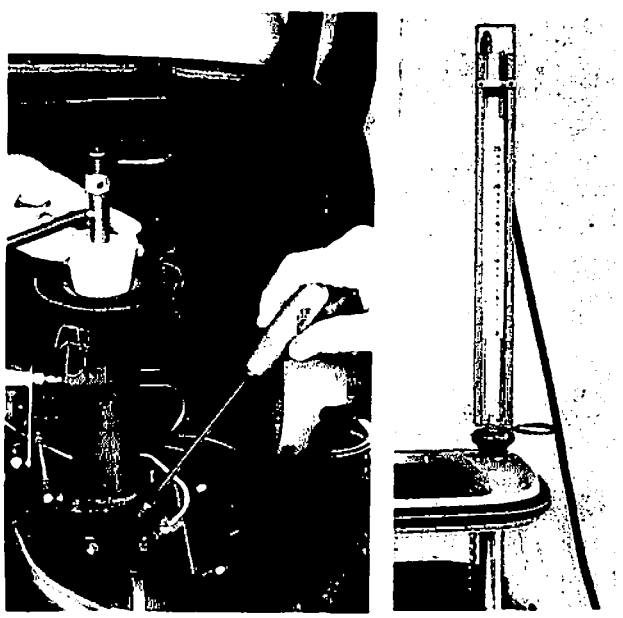
2.0 and 2.2 liter engines, open 5/2 revolutions.

2.4 liter engines, open 3/2 revolutions.

Example – measuring air flow

Cylinder 1 – 12.5
Cylinder 2 – 11.0
Cylinder 3 – 10.5
Cylinder 4 – 13.5
Cylinder 5 – 11.5
Cylinder 6 – 10.0

Total 69.0 : 6 = 11.5



Execution:

1. Fully close the air-correction screws (without applying excessive force).

   Then open, 5 half turns for 2.0 or 2.2 liter engines, 3 half turns for 2.4 liter engines.

2. Start engine and run at 3,000 rpm. Use the hand throttle.

3. Using the synchrometer, measure the air flow of each intake pipe and note the values (see example).

   Add the values for each cylinder and divide by 6. Adjust to the average value with the air control screws.

   Example, average value 11.5. This means that cylinder 1 is too high, the air-correction screw has to be closed. Cylinder 2 is too low, the air-correction screw must be opened, etc.

Note:

When adjusting be sure that the air-correction screws are not opened more than 8 half turns.

If the air control screws are opened more than 8 half turns with little change on the synchrometer, the air channels are carboned up.

The channels must be cleaned.

Cleaning of air channels

The air channels can be cleaned with the spray solvent

CHEMTOOL B 12

when the throttle-valve housings remain mounted.

Proceed as follows:

1. Remove the air-correction screws.

   Note:

   Clean the channels in succession. Don't mix up the correction screws.

2. Connect the plastic hose to the valve of the spray can and insert it into the bore of the adjusting screw.

3. Squirt in the spray. After a few minutes, the deposits in the air channel have dissolved. The correction screw can again be installed.

4. If completely plugged, remove throttle housings and clean bore with a drill bit.

5. Carry out the basic adjustment.

Prerequisites:

Make sure the test instrument is operating correctly.

Always follow the manufacturers operating instructions.
The emission test is in two phases:

the part load measurement
and the idling-speed measurement.

Always observe the following sequence:

first part load
then idling speed

Reversing the sequence results in incorrect values.

PART LOAD MEASUREMENT

SPECIFICATIONS

ENGINE TYPE	2.0 LITERS	2.2 LITERS	2.4 LITERS
Intake Temp.	Measure with P 237	Measure with P 237	No influence
Throttle-valve angle	7°	7°	9°
Engine rpm	2,500	2,500	2,400
Gear	2nd	2nd	2nd
CO Value	according to Table 1, dependent on intake temperature.	according to Table 2, dependent on intake temperature.	according to Table 3, independent of intake temperature.

Note: Important:

For safety, two persons are required for a road test measurement.

Hints regarding the Bosch emission tester:

Clean the water cut-off and feeding hose, replace the paper filter, calibrate the tester, place the exhaust pump on the rear seats, be sure that the exhaust emission is conducted from the pump into the open air. Set up the CO test instrument within the CO-driver's range of vision.

Execution:

The part load measurement can be carried out on a road test or on the chassis dynamometer.

The following sequence is for 2.2 liter engines, differences for 2.0 or 2.4 liters will be noted.

Let's begin –

A. **Preparation**

1. Attach a protractor with indicator to the left throttle-valve housing. Set the indicator at zero (hand throttle in zero position).

2. Bring the engine up to operating temperature (approx. 80°C).

3. Get the emission test instrument ready and connect according to the manufacturer's data.

Note: 2.4 liter engine

It is not necessary to measure the intake-air temperature.

Note: 2.4 liter engine

On the 2.4 liter engines, the throttle valve must be set at 9°.

4. Install the remote thermometer P 237.

   a) Fasten the temp. sensor to the intake snorkel of the air filter.
   (The sensor spiral must not touch any metal parts.)

   b) Place the indicator instrument inside the vehicle.

5. Using the hand throttle, set the throttle valves at an opening angle of 7°.

B. **Measuring Procedure**

1. Shift into 2nd gear, depress clutch pedal, start engine.

   Important:
   If the throttle angle was set with the hand throttle, do not touch the accelerator when starting.

Note: 2.4 liter engine

(Test speed 2,400 rpm)

2. Engage clutch, using the car's brakes slow down the engine to the test speed of 2,500 rpm.

Hints: Chassis Dynamometer

1 – Just as with the road test, make sure that there is no load whatsoever on the Dynamometer when driving off.

2 – Adjust the proper test rpm by putting a load on the Dynamometer.

3. In order to attain the most accurate measuring result possible, keep the engine running at the test rpm. One should drive for about 30 to 60 sec. before the first measuring values can be read.

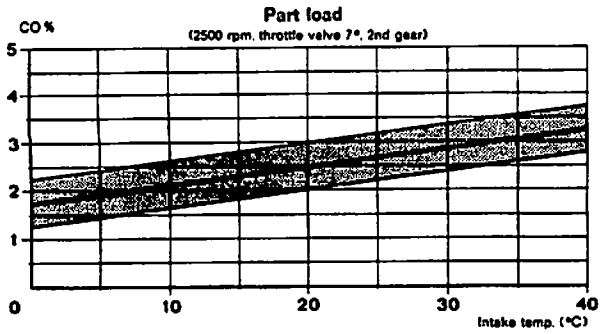
   The needle of the measuring instrument must stand still. Then read the CO value and the intake-air temperature.

Note: 2.4 liter engine

The intake-air temp. does not have to be considered.

4. Stop vehicle and switch off the engine.

2,2 Ltr. 911 E



Part Load CO values for 2.4 liters

911 T	1.5 – 2.0 % CO
911 E	2.0 – 2.5 % CO
911 S	2.0 – 2.5 % CO

C. **Evaluation of the Measuring Results**

For example:

The car which you tested was a 2.2 liter 911 E and you have noted the following values:

Intake air = 27°C
CO = 4.2 %

Read from the nominal-value diagram for the 2.2 liter 911 E the correct CO value for 27° C and compare it with your measuring value.

The nominal value for our example is:

At 27°C = 2.7 ± 0.5 % CO ie. at the measured intake-air temperature of 27°C, the CO content in the exhaust gas ought to be between 2.2 and 3.2 %. Our test vehicle is too rich and has to be adjusted.

D. **Adjustment of Part Load CO**

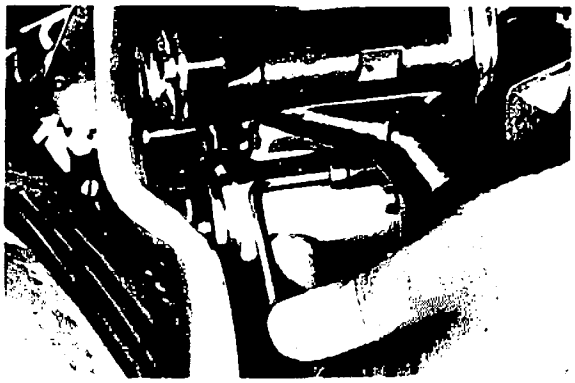
Note:

ADJUST ONLY WHEN ENGINE IS NOT RUNNING.

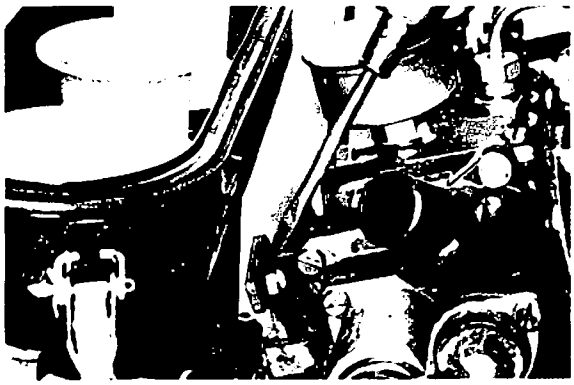
The adjustment operations are to be performed as quickly as possible to avoid heating up the intake manifold.

Hint:

It is advisable to make a T-grip wrench with soldered-on hexagon as described in the chapter tools —. It is considerably easier to work with it than with the offset wrench shown in the picture.

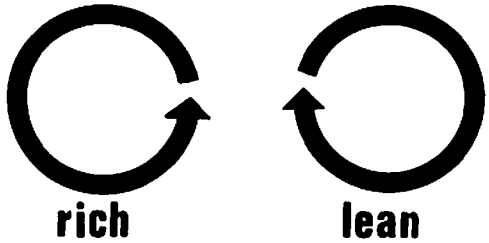


Note: 2.0 liters



To reach the adjusting screw for part load the 2.0 liter engines, loosen the SW 14 screw for the starter solenoid lever far enough so that it does not interfere with the pump regulator lever.

The adjusting screw has only 6 clicks per turn on the 2.0 liter engines.



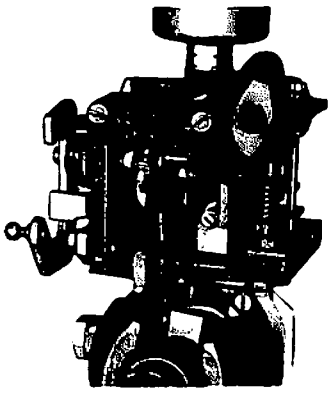
The adjusting screw for part load is located at the end of the control behind an allen head bolt.

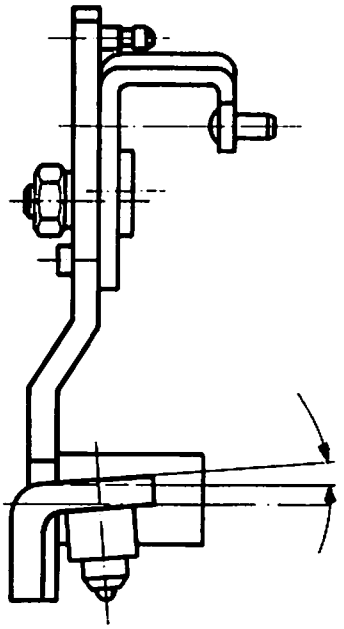
1. Remove the hex. socket-head bolt.

2. Using the special tool P 229 c, the adjusting screw on the control-rack head can now be turned.

   The adjustment screw "clicks" at each 1/12 of a turn.

3. For a leaner mixture, turn the adjusting clockwise.
   For a richer mixture, turn the screw counterclockwise.
   Check the CO after every two clicks.





Note: 2.0 liters

Don't forget to tighten the screw SW 14
(for the bearing bolt of the starting solenoid).

Note:

Never press in on the adjusting screw when turning. Any pressure may bend the sensor lever. The sensor lever is then at the wrong point on the contoured cam and the whole spectrum of the injection pump is altered. The performance of the engine will be severely impaired.

Recommendation:

Modify the screwdriver P 229 b, to P 229 c according to the sketch. This will simplify adjusting.

4. Re-install the plug on the access to the control rack.

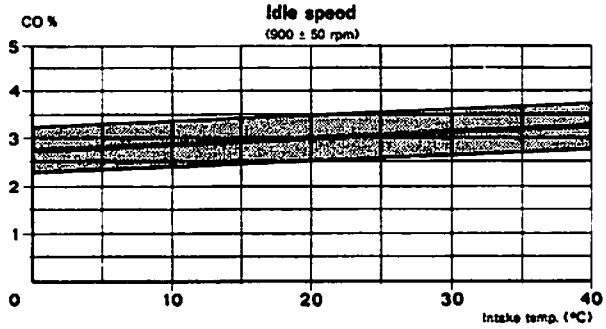
5. Repeat the part load measurement.

IDLING-SPEED MEASUREMENT

Check the idling-speed CO **only** after the part load measurement. The idling-speed CO should never be measured along without previously measuring the part load CO and, if necessary, correcting it.

Reason: An incorrect part load CO value influences the exhaust-gas composition so strongly that it can no longer be corrected with the idling-speed adjusting screw.
Therefore, never regulate the idling-speed CO without first checking the medium-speed CO and, if necessary, correcting it.

2,2 Ltr. 911 E



Execution:

There are no significant differences among the individual engine types for conducting the idling-speed CO measurement. Different adjustment values of the intake-air temp. 2.0 and 2.2 liter engines must be observed, however.

The procedure is as follows:

1. Set the hand throttle at zero.
2. Let the engine run at idling speed (900 ± 50 rpm).
3. After the end of a short waiting period, read and note the CO content and the intake air temp.
4. Switch off the engine.

Here again an example:

You will recall that we used a 2.2 liter 911 E in our example.

We measure now a CO value of 2.4 %
An intake-air temp. of 30°C.

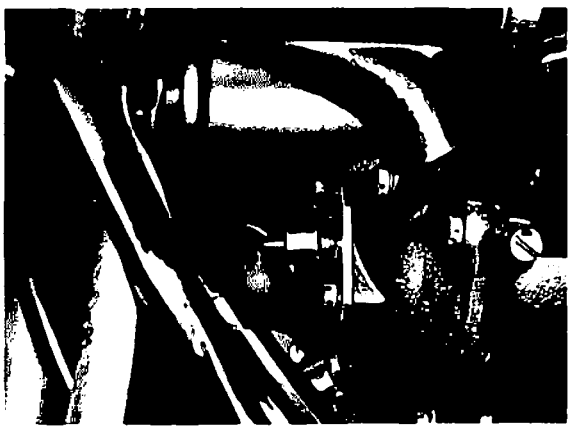
From the nominal-value diagram we read that for an intake-air temp. of 30°, the CO content ought to be 3.1 ± 0.5 %. Our test vehicle is thus too lean.

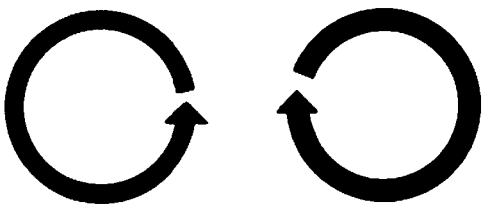
Remember also that for the idling-speed adjustment:

REGULATE ONLY WHEN THE ENGINE IS NOT RUNNING!

Note:

From Model 70 on (2.2 liters) an opening which is closed off with a plastic cover can be found in the air-duct housing. The adjustment screw can be reached by going between the blades of the blower wheel and through the hole in the air duct with the special tool.





This is not possible on the 2.0 liter engines. Here the tool P 230 b with flexible shaft must be used.

5. Using the special tool P 230 c, press in the spring-tensioned adjustment screw on the govenor housing of the injection pump and by turning lightly, let it catch in the slot of the adjusting screw.

6. The idling-speed adjusting screw has 6 clicks for one turn. When adjusting turn only 1 to 2 clicks at a time, then measure CO. Turn counterclockwiese for lean, turn clockwise for rich.

7. Adjusting CO content will change the idle speed. You must correct the idle speed to 900 ± 50 rpm by evenly turning the 6 air-correction screws.

GENERAL HINTS FOR MEASURING ON A CHASSIS DYNAMOMETER

Tests have shown that at low outside temperatures there are only slight differences between CO measurements made on the chassis dynamometer and on the road. At higher outside temperature, however, there can be deviations of approx. 0.5 % CO (in the direction of lean).

This is true only for dynamometers that are set up under ideal conditions, ie., with adequate ventilation.

It is necessary to compare dynamometer measurements to road measurements and apply the difference in reading as a correction factor.

Example:

Medium-speed measurement of 4 vehicles of type 911 E (2.2 liters) on the chassis dynamometer and on the road.

	Dynamometer	Road	Deviation
1.	3.2 % CO	2.3 % CO	0.9 % CO
2.	3.2 % CO	2.2 % CO	1.0 % CO
3.	3.9 % CO	2.7 % CO	1.2 % CO
4.	3.4 % CO	2.5 % CO	0.9 % CO
			4.0 % CO : 4 = 1 % CO

The corrective factor for this dynamometer is 1 % CO.

In order to correctly adjust a 2.2 liter 911 E to 2.5 ± 0.5 % CO for the road at an intake-air temperature of 20°C (911 E 2.2 liters), the injection system must be adjusted at 3.5 % CO on the dynamometer. Otherwise the transition speed performance will be impaired by an adjustment that is too lean.

To insure correct results intake-air temperature, oil temperature (no more than 80°C) and intake stack temperature (only hand warm) is of crucial importance. Moreover, it is important that both measurements (dynamometer or road) be performed with the same emission test instrument.

The performance of the engine should finally be judged by a road test. During the road test the following points should be especially observed:

a) Transition Speed Performance
b) Performance While Driving At Constant rpm
c) Performance During Start-Stop Operation

If at all possible, the performance during warm-up should also be judged.

If the system was tuned according to the description above and if all the proper sequences were observed, engines will, as a rule, have a performance that is acceptable in all points. In the following section, deficiencies are described which appear in spite of all the above mentioned adjustments.

Before you go any further, however, ask yourself whether all the points mentioned up to now have been conscienteously carried out.

Recheck any points of which you are not sure.

The CO value is too high and can be regulated only with great difficulty or not at all at medium speed and idling speed.

Checking of Warm-Up Thermostat

The thermostat enriches the fuel-air mixture when a cold engine is started. Enrichment stops at a temp. of approx. 53°C.

The thermostat can be checked by measuring the CO emission. Cold engine content is high. As the engine temperature increases, the CO content decreases since enrichment is reduced.

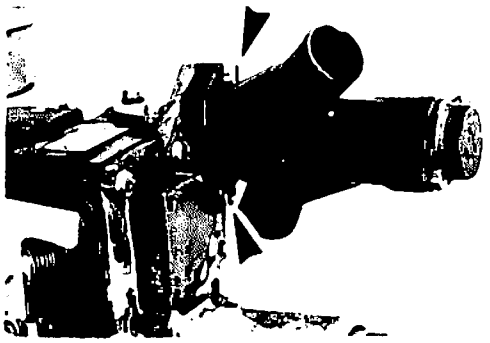
Enrichment is over when the needle of the CO measuring instrument no longer moves in the direction of lean. The CO now should be the normal value for idling speed or medium speed.

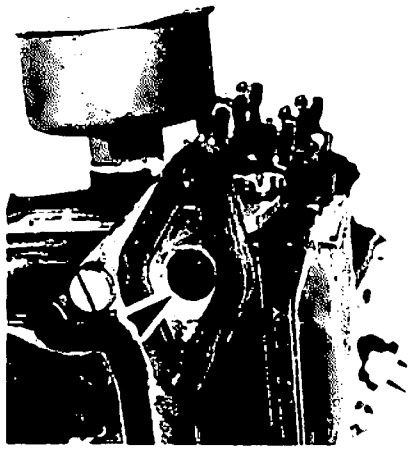
Problems:

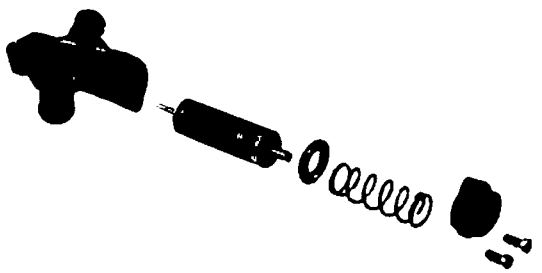
When there are problems first check if the thermostat is dirty and if the feed hose is pinched or leaking.
In such cases, the thermostat will not reach the cut-off temperature, or reach it slowly the CO content of the exhaust cannot be regulated.

Check:

1. Warm-Up Thermostat
2. Feeding Hose







Note: 2.4 liter engines

From Model '72 on, all engines use 87 octane fuel.

Engines operated on higher octane fuel will not run properly since the greater the anti-knock capacity (octane number) of the fuel, the more difficult the fuel becomes to ignite.

Thus if a 2.4 liter engine is operated on 98 octane fuel, the CO content in the exhaust gas will be high and very difficult to adjust properly.

When difficulties arise adjusting the CO content, ask the customer what kind of gasoline he is using.

Cleaning of Warm-Up Thermostat

Procedure:

1. Disconnect thermostat from pump.

   Note:
   Don't lose the rubber sealing gasket between the thermostat and the pump housing.

2. Remove the cover from the thermostat.

   Note:
   The cover is held under spring tension.

3. Draw out the expansion elements as a complete package.

   Note:
   Don't slip the expansion elements and compensation discs off the shaft.
   If the expansion elements or discs are mixed up, the warm up characteristics of the thermostat will be changed.

4. Wash out the expansion-element package and thermostat housing.

	Engine Dies (No Misfiring) Check: 1. Injection Valves 2. Valve Clearance
Note: If the engine dies but the injection valves are okay and valve adjustment is correct, the cause may be incorrect timing. First check whether both or only one side is involved by removing the intake-valve covers and checking the timing without removing the chain-housing cover.	
	Backfiring In Exhaust Check: 1. Microswitch, rpm transducer and stop solenoid.
Backfiring in the exhaust will occasionally occur and cannot always be completely avoided, even by the most careful tuning. Backfiring is strongly influenced by the accelerator pedal position. If the accelerator pedal does not return all the way during start-stop operation (foot stays on the pedal), the micro-switch/rpm transducer will not function correctly and backfiring is increased. Thus when complaints are made, always test drive or inquire into the customer's driving habits.	
Note: Checking the microswitch, the stop solenoid and the rpm transducer. 1. Start the engine. 2. Accelerate to approx. 2,000 rpm. 3. Press the microswitch. By pressing the microswitch, the stop solenoid is switched on. Engine speed will drop to 1,300 rpm. At this point the rpm transducer shuts off current to the stop solenoid. The engine again receives fuel and the speed increased to 1,500 rpm where the stop solenoid again cuts off the fuel. The engine speed drops to 1,300 rpm.	

Thus when the throttles are opened and the microswitch pressed, the engine speed must hunt continually between 1,300 and 1,500 rpm.
If this is not the case, then check each of the three components individually to find the defect.

Note:

Backfiring can be caused by an incorrectly adjusted microswitch. Set the microswitch to 3/4 of a turn (from the switching point). If necessary, it can be increased up to 1 full turn (from the switching point).

Note: 2.4 liter 911 S

For complaints such as "the engine stalls at intersections" or while "depressing the clutch during stop and go driving install an rpm transducer from the 911 T carburetor engine.
The rpm transducer switch to be used has the spare-part No. 901 615 113 00. Since April 17, 1972, these switches have been installed as standard equipment on all 911 S 2.4 liter engines and are distinguished by a green paint spot.

Used as of chassis number

Coupe	**911 230 1279**
Targa	**911 231 0689**

INDIVIDUAL CHECKS

Microswitch

a) Connect a hot wire to one terminal of the microswitch.

b) Ground the other terminal with a test lamp.

c) Turn on the ignition and actuate the microswitch. When pressed down, the test lamp must light. When released the test lamp must go out.

RPM Transducer

a) Connect the test lamp with terminal 30 b on the microswitch.

b) Start engine and slowly accelerate, at approx. 1,500 rpm the test lamp must light up.

c) Release the pedal, at approx, 1,300 rpm, the test lamp must go out.

Stop Solenoid

When the microswitch and the rpm transducer check out, the problem lies with the stop solenoid. To check, supply current to the stop solenoid (from terminal 30 in the rearend fuse box) while the engine is not running. An audible click must be heard. The stop solenoid can only be replaced by an authorized Bosch Service Center.

Note:

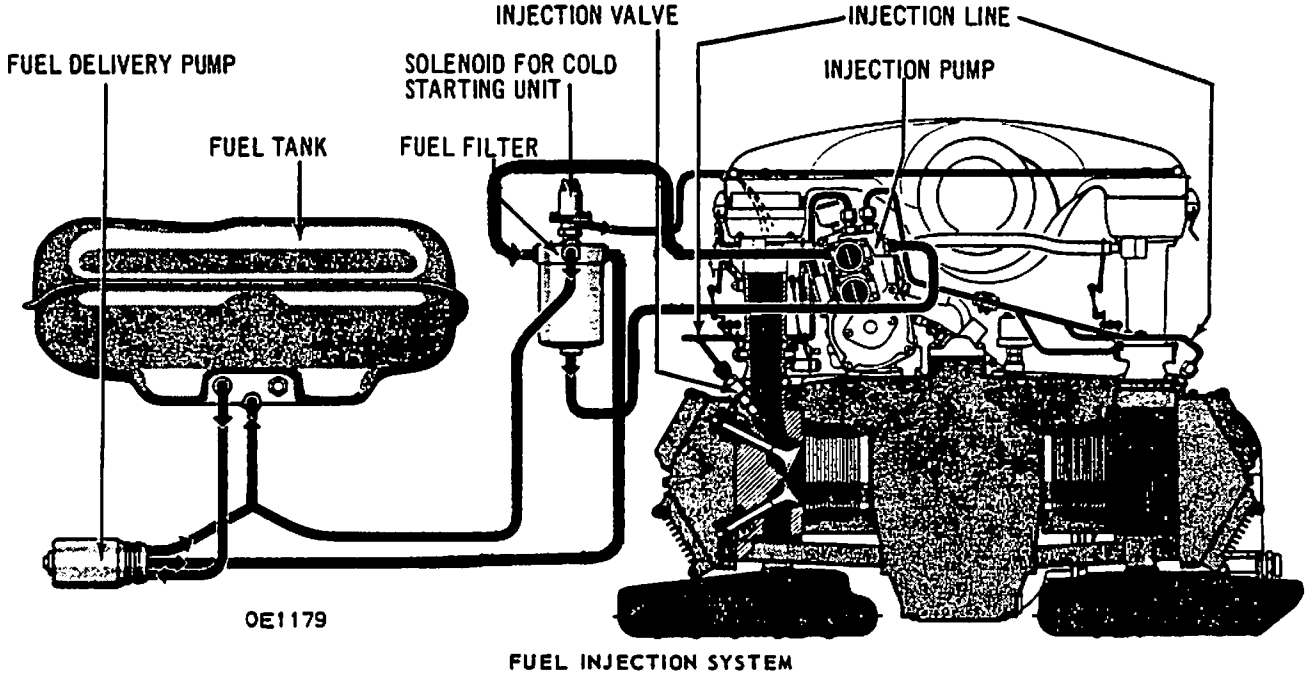
If the control rack does not move freely, fuel will not be completely shut off. The small amount of fuel still being delivered will cause backfiring.

2. **Control Rack Action**

a) Remove the protective rubber cap on the actuating rack end.

b) Using a clean object, push back lightly in the opposite direction of travel. When released, the control rack must spring back on its own to its original position. The control rack must move freely and not jam or catch.

When the stop solenoid is switched on (cable from terminal 30 of the rearend fuse box), the control rack must pull all the way back. If a clean object is now pressed against the control rack, there should be no movement.

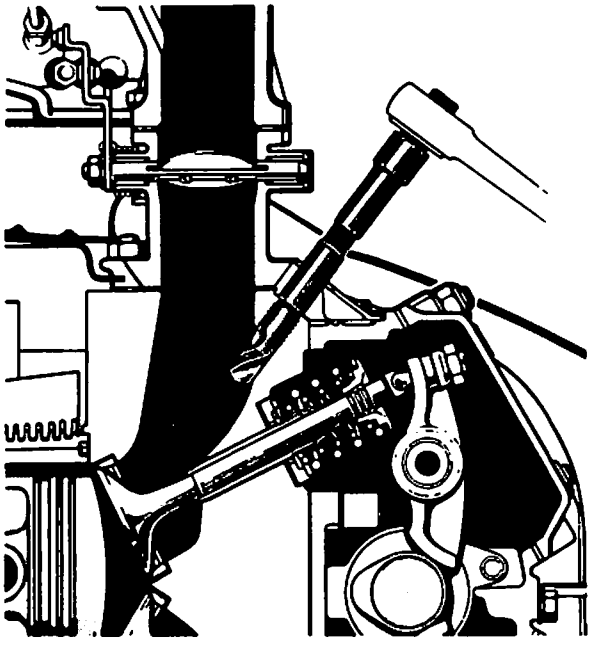


FUEL INJECTION SYSTEM

Remedy:

1. Remove and check injectors.

2. Take a drill of 10.5 mm ϕ (fill the grooves with grease) and insert into all the injector receiving bores to a depth of approx. 45 mm. After cleaning each hole check that enough grease is on the drill to pick up fillings.



Engine is difficult to start when warm, dies at intersections, balks in stop and go operation.

Cause:

On some engines (especially 911 E/Model 73), A burr may remain on the end of the thread after the injector holes in the cylinder heads were drilled. This burr will interfere with the injector causing poor injector closing.

This leads to the difficulties mentioned above.

PUTTING INJECTION PUMPS INTO OPERATION THAT HAVE BEEN IN STORAGE

See Product Information Circular P 250 of February 27, 1973.

Install new injection pumps according to the instructions in the repair guide "Porsche 911 page NK 33".

The date of manufacture can be found with the help of the table through the code number on the identification plate of the injection pump (see picture).

Example: 807 — month of manufacture (here the month of July = 07)
year of manufacture (here 1968)

i. e. — code number of manufacture 807 = date of manufacture July 1968

Note: The monthly code numbers change after every ten years.

1960 . . . . . 1969 . . . . . = 01 12
1970 . . . . . 1979 . . . . . = 21 32

Summary:

	1968	1969	1970	1971	1972	1973
January	801	901	021	121	221	321
February	802	902	022	122	222	322
March	803	903	023	123	223	323
April	804	904	024	124	224	324
May	805	905	025	125	225	325
June	806	906	026	126	226	326
July	807	907	027	127	227	327
August	808	908	028	128	228	328
September	809	909	029	129	229	329
October	810	910	030	130	230	330
November	811	911	031	131	231	331
December	812	912	032	132	232	332

TREATING INJECTION PUMPS WHICH HAVE BEEN TEMPORARILY INSTALLED FOR TEST PURPOSES:

Used motor oil, may cause corrosion and gummy deposits in injector pumps after being stored. To avoid such damage, used pumps must be cleaned before they are put into storage. Product Information Circular p. 250 from Feb. 27, 1973 gives details.

Note:

When working with cleaning fluid observe fire safety precautions.

BOSCH - INJECTION PUMPS TYPE 911

Summary of injection pumps installed from Model 1969 up to the present.

Engine		Model	Bosch No.	Porsche No.
911 E	2.0 liters	69	0408 126 002	901 110 226 00
911 E	2.0 liters	69	0408 126 006	901 110 226 01
911 S	2.0 liters	69	0408 126 001	901 110 227 00
911 S	2.0 liters	69	0408 126 005	901 110 227 01
911 E	2.2 liters	70/71	0408 126 010	911 110 221 00
911 S	2.2 liters	70/71	0408 126 009	911 110 222 00
911 TE	2.4 liters	72/73	0408 126 015	911 110 251 00
911 E	2.4 liters	72/73	0408 126 014	911 110 252 00
911 S	2.4 liters	72/73	0408 126 013	911 110 253 00
911 S	2.4 liters	72/73	0408 126 021	911 110 253 00

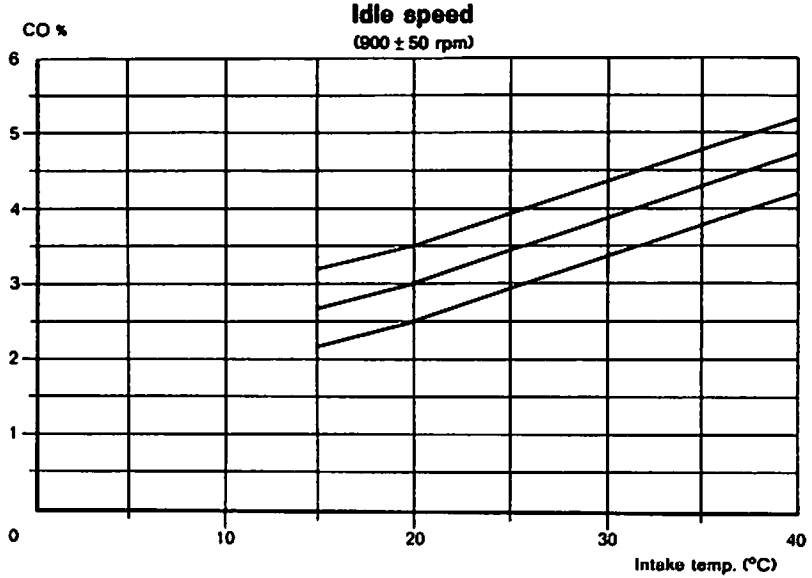
Influence of intake air temperature on CO values

2.0l engines

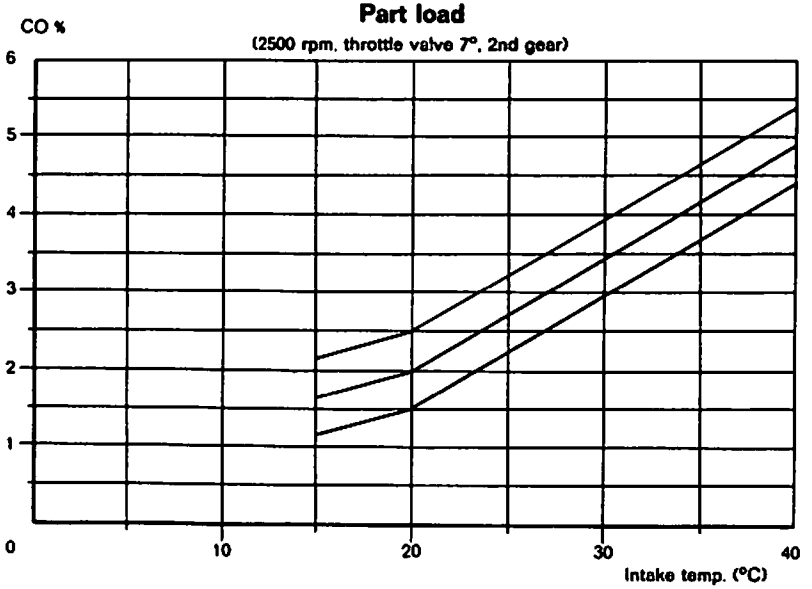
Oil temperature 80° C (176°F)

911 E

Idle speed
(900 ± 50 rpm)

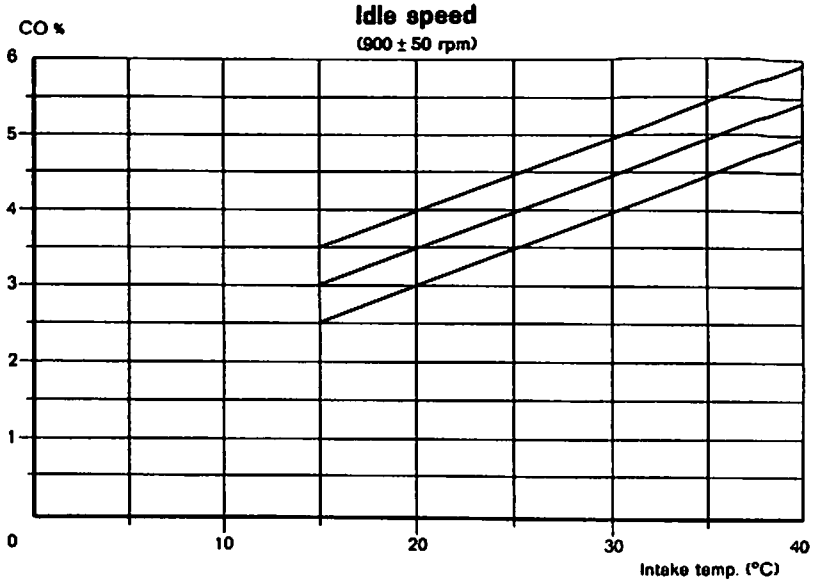


Part load
(2500 rpm, throttle valve 7°, 2nd gear)

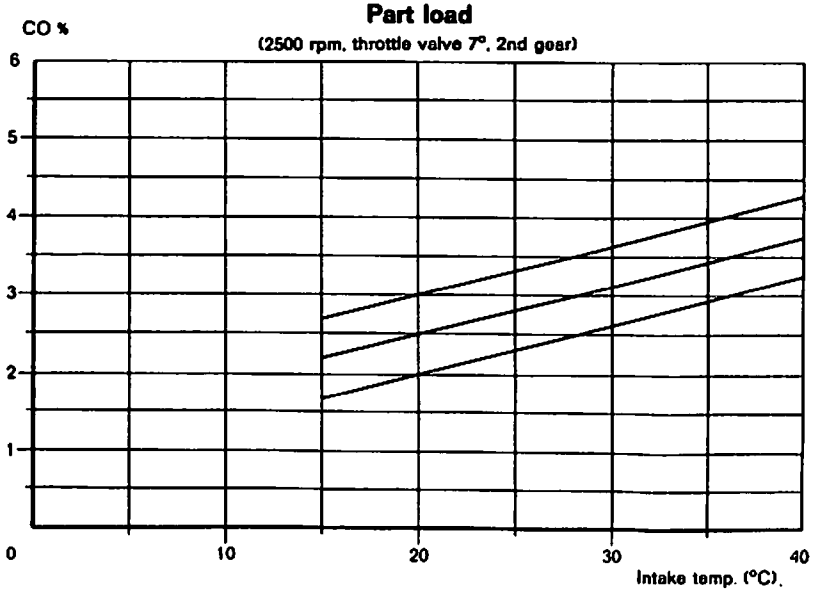


911 S

Idle speed
(900 ± 50 rpm)



Part load
(2500 rpm, throttle valve 7°, 2nd gear)

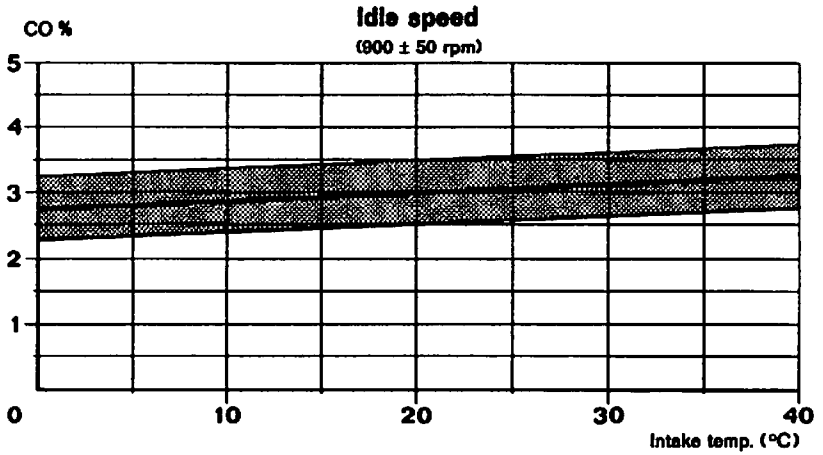


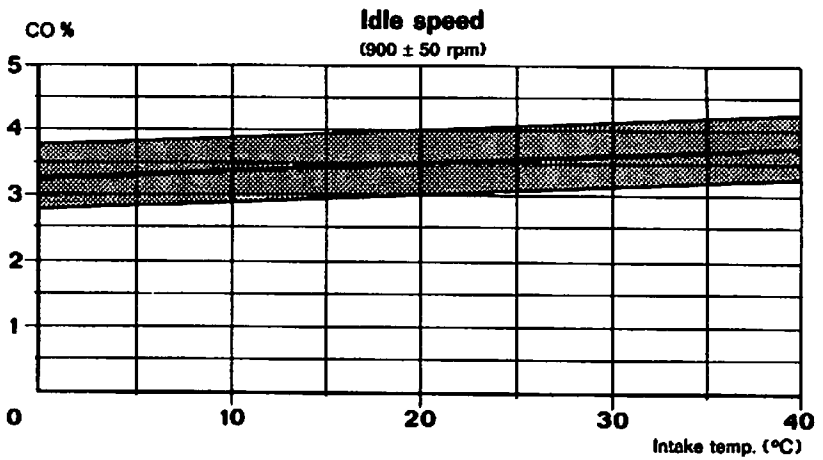
Influence of intake air temperature on CO values of the 2,2 l engines

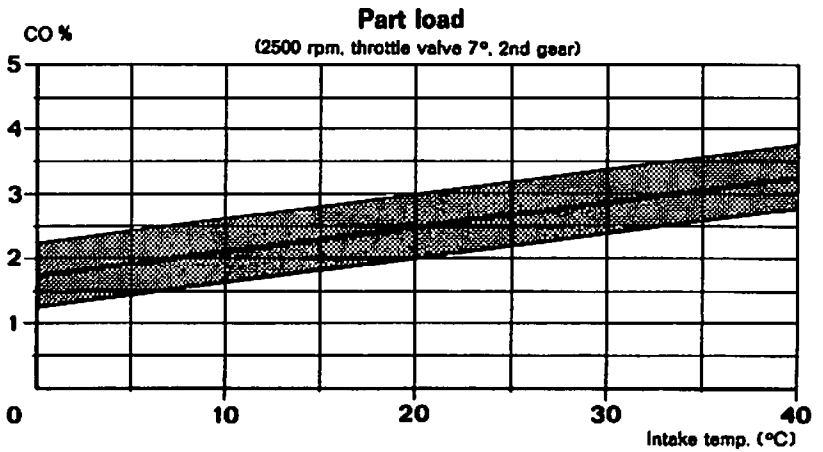
911 E-C

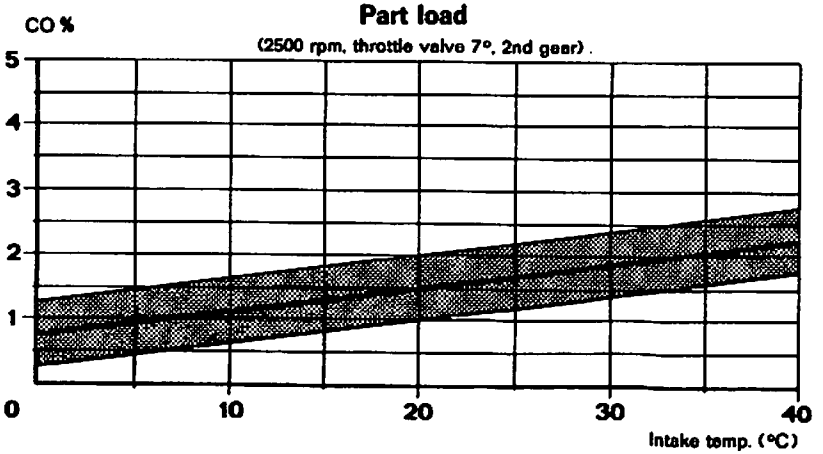
Oil temperature 65 - 80° C (150 - 175° F)

911 S-C









CO-Value of the 2.4 liter engines

Part Load

Throttle valve must be set at 9°. Test speed 2400 rpm

911 T	1.5 – 2.0 %
911 E	2.0 – 2.5 %
911 S	2.0 – 2.5 %

Idle speed (900 ± 50 rpm)

For al engines	2.5 ± 0.5 %

Checking of Injection Pumps – Porsche 911 T, E, S
Parts Identifier 250 10

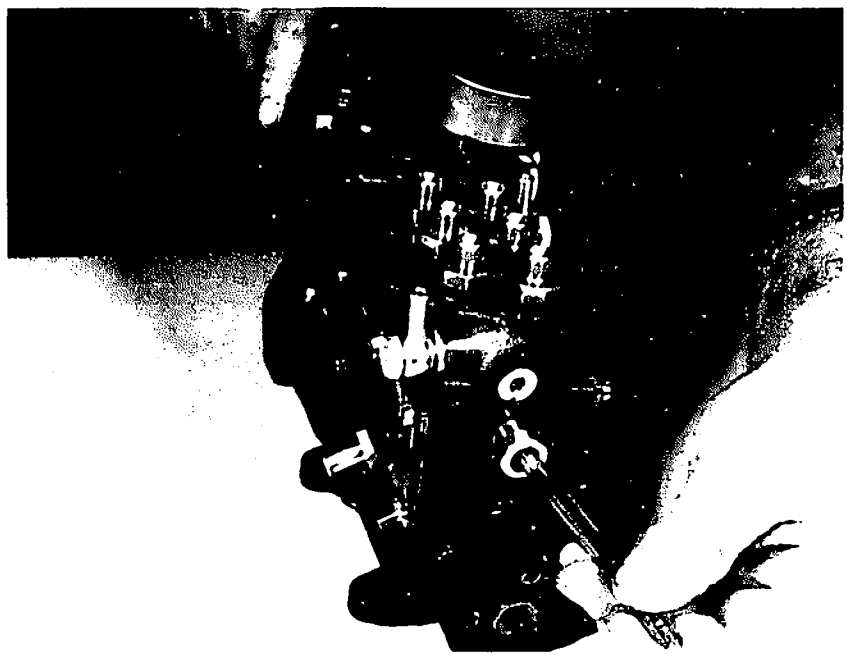
Fuel injection pumps, new or rebuilt, are internally preserved with Bosch test oil No 5 701 301 725. This oil prevents gumming or seizing of pump components generally up to one year, depending on storage conditions.

Regardless of storage time, we suggest that all fuel injection pumps be inspected prior to installation for free moving of camshaft and control rack.

Check or free fuel injection pumps, if necessary, as follows:

Check Pump

a) Remove plastic cover of control rod bushing on drive end of pump (as shown in picture No 1)



b) Insert ball point pen (reversed) or similar object and push control rack (as shown in picture No 1) toward the governor of the pump. Do not apply force.

c) If pump is well preserved and no gumming has taken place, the rack will move relatively free and will return to its original position after the inserted object is withdrawn.

PORSCHE

P 235 Vacuum (depression) gauge

General

When the throttle valves are opened the same depression should be present in each intake pipe so that each cylinder draws in an identical volume of air. If any cylinder draws in more air than the remainder, the mixture in that cylinder will be correspondingly weaker. Since the same quantity of fuel is injected into all cylinders, any cylinder containing too much air will show a tendency towards knocking or detonation. On fuel injection engines the air-flow volume must therefore be measured with the throttle valves in the part load position. The vacuum gauge will be needed for this procedure.

Before use the U-tube on the gauge must be filled up to figure 5 with brake fluid

Take the reading as follows.

Run the engine until normal operating temperature of 60-80°C (140-175°F) is reached. Set engine speed to 3000 rpm with the hand throttle. Put the rubber cap of the gauge into each of the intake venturi in turn. Read off and carefully note the height of the column of fluid in each case. Add the readings together and divide by the number of cylinders. Each individual cylinder must then be reset to give this average reading by turning the air correction screw.

Adjustment at idle speed with the Synchrotester by turning the idle air screws is not needed after the above test has been carried out.

The vacuum gauge can also be used for adjusing idle settings on carburetor engines. In this case, screw in the air control screw on the gauge until the fluid level is seen to rise when the reading is taken.

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Dr. Ing. h. c F. Porsche KG

Stuttgart-Zuffenhausen
9. July 1969