Job No.

Function of preglow system . . . . . 15 – 705
Function of preglow system - Turbodiesel . . . . . 15 – 705
Checking preglow system without afterglow function . . . . . 15 – 710
Testing preglow system without afterglow function - Turbodiesel . . . . . 15 – 710
Checking preglow system with afterglow function . . . . . 15 – 711
Testing preglow system with afterglow function - Turbodiesel . . . . . 15 – 711
Removal and installation of glow plugs . . . . . 15 – 715
Removal and installation of glow plugs - Turbodiesel . . . . . 15 – 715

15-705 Function of preglow system

A. General

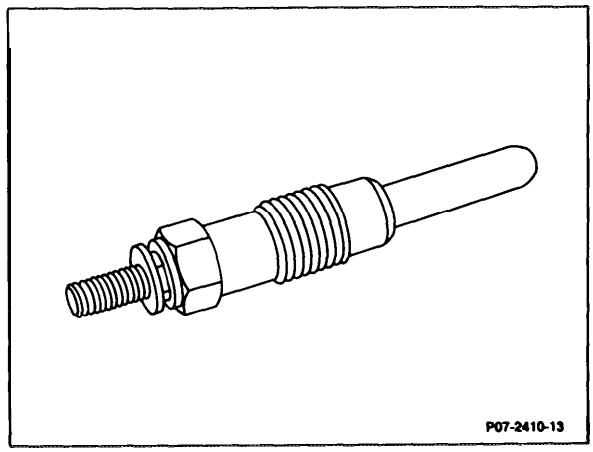
Combustion in the diesel engine occurs through the injection of self-igniting diesel fuel into highly compressed and therefore, hot combustion air.

If the engine is cold, the self-ignition temperature is not reached by compression alone. A preglow system is therefore required to increase the temperature of the compressed air and to allow the engine to start by directly igniting fuel particles on the glow plugs.

The duration of preglow depends on the ambient temperature.

Construction of the quick-start pencil-type glow plugs

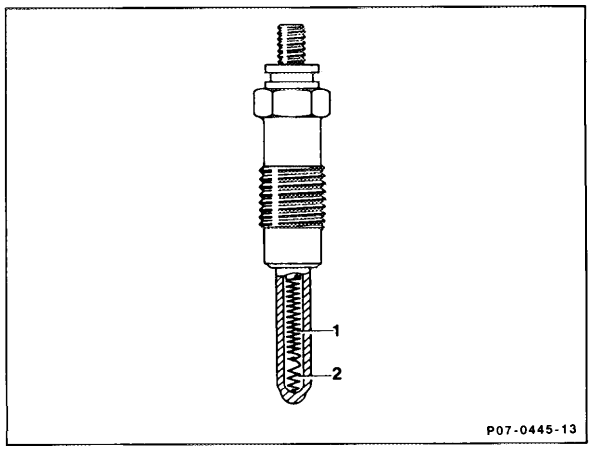
The main components of the pencil-type glow plugs are a housing with screw-in thread M 12 x 1.25 and a heater pin pressed into the housing.



The single-pole connection pin is secured to the housing by means of a permenant connection consisting of a brass round nut.

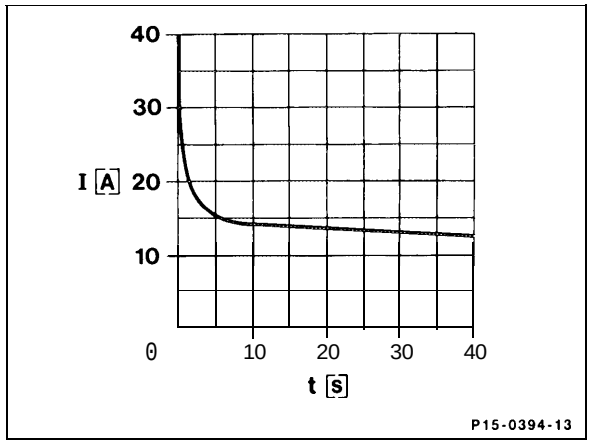
The pencil-type glow plugs are designed for a voltage of 11.5 V and are connected in parallel.

The heating element consists of a series-connected heater and control coil.



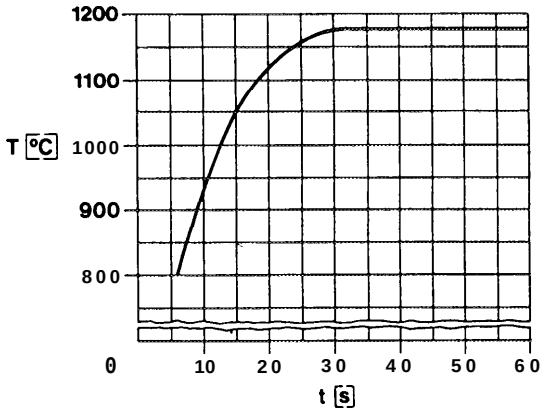
1 Control coil
2 Heater coil

When the glow system is turned on, a current of approx. 30 A is supplied to each glow plug. The heater coil heats up the glow plug very rapidly. The control coil resistance increases with rising temperature, limiting the current to approx. 8-16 A. The glow plug is thus protected against overload.



Current curve of the quick-start pencil type glow plug

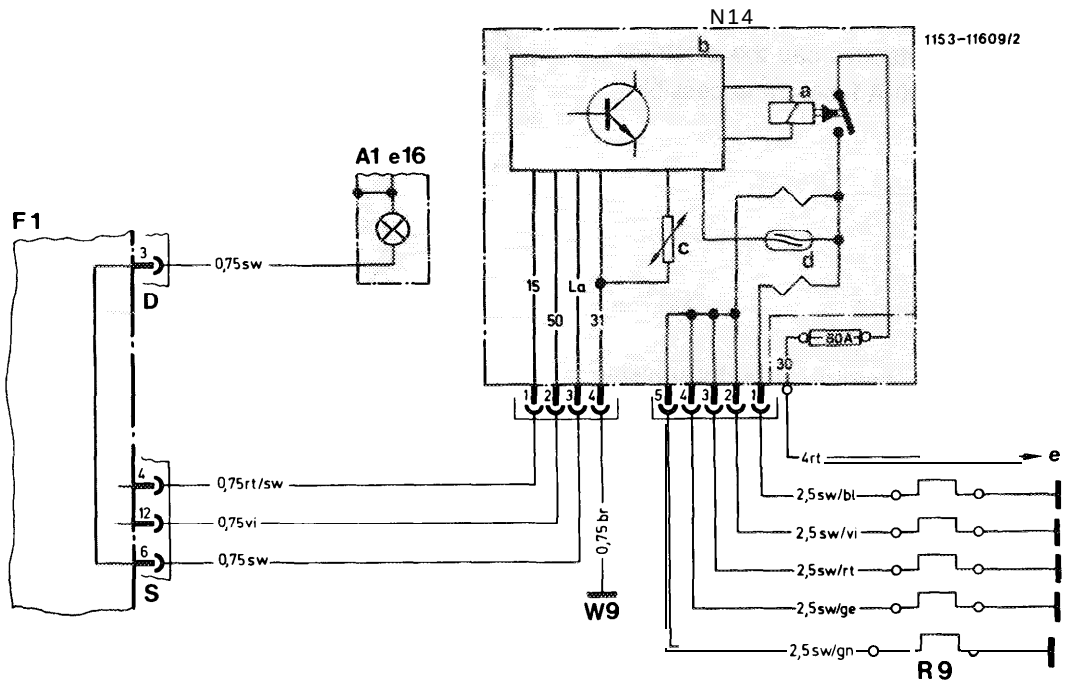
After a glow period of 9 seconds, a heating element temperature of 900°C is reached, the maximum temperature of 1180 °C being reached after 30 seconds.



Temperature curve of quick-start pencil-type glow plug

P15-0395-15

B. Quick-start preglow system

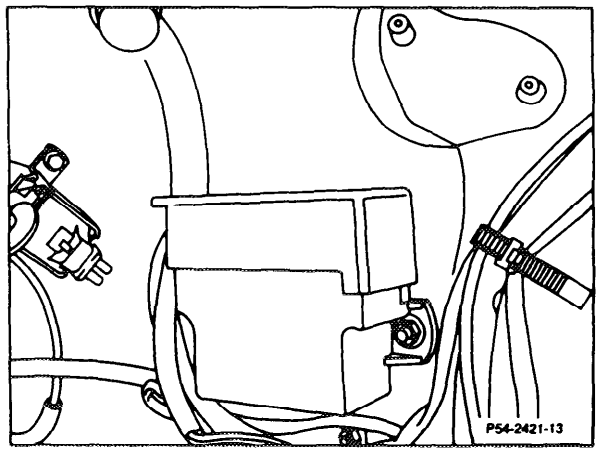


Wiring diagram model 201 .126

Ale16	Preglow indicator in Instrument cluster
N14	Preglow time-delay relay
	a Power relay
	b Electronic unit
	c Temperature sensor (NTC resistor)
	d Reed relay
F1	Central electrics
R9	Glow plugs
W9	Ground, front left (near headlamp unit)
e	X35 Terminal block terminal 30/terminal 61 (battery)

Preglow time relay
The preglow time-delay relay is installed in the engine compartment on the left wheel arch.

After removing the protective cap the electrical connections and the 80-A fuse are accessible.



Model 201

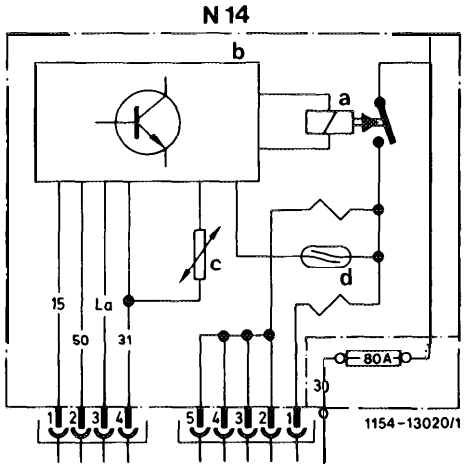
An NTC resistor in the preglow time-delay relay registers the relay ambient temperature.

Functions of the preglow time-delay relay
The preglow time-delay relay has the following functions:

- Activating the glow current
- Indicating readiness to start
- Safety cutout
- Identifying faults

Note
With unfavorable tolerances of the pencil-type glow plugs or the Reed relay (d) it is permissible that the fault indication responds only if two pencil-type glow plugs R9 are defective.

The fault indication (monitoring of pencil-type glow plugs) is effected by comparing the current of the 1st pencil-type glow plug with the current of the 2nd to 5th pencil-type glow plugs connected in parallel.



The currents of the two lines to the pencil-type glow plugs 1 and 2-5 are directed via two counterwound Reed relay windings with different numbers of windings.

With identical current flow in both windings the magnetic fields cancel each other and the Reed contact does not respond.

If the equilibrium of the magnetic fields is disturbed by the failure of one or several pencil-type glow plugs, the Reed contact closes and the electronics unit (b) is activated.

The preglow indicator lamp switches off immediately and, consequently, no longer lights up at the start of the preglow process.

Glow current control

When actuating the key in position “2” (preglow, driving) the preglow time-delay relay (voltage) on terminal **15** is switched on. The power relay (a) closes the power circuit from terminal 30 (plus) via the fuse to the pencil-type glow plugs.

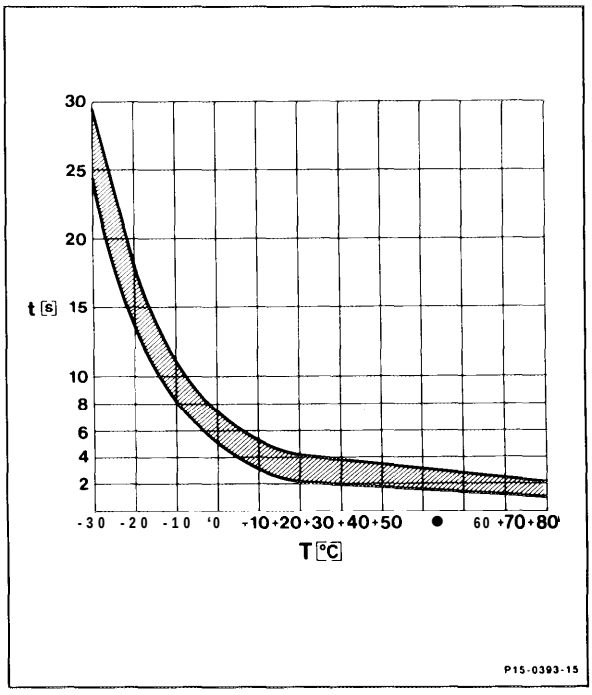
If the key is turned to position “3” (start), the power relay (a) remains retracted, activated by terminal 50. The glowing process is continued until the key is returned to position "2".

Ready-for-starting indication

A temperature sensor installed in the preglow time-delay relay determines the glow period.

The preglow indicator lamp in the instrument cluster lights up when the glow system is turned on.

If the required glow time, dependent on the ambient temperature of the preglow time-delay relay, has been reached, the preglow indicator lamp goes out, indicating readiness to start.

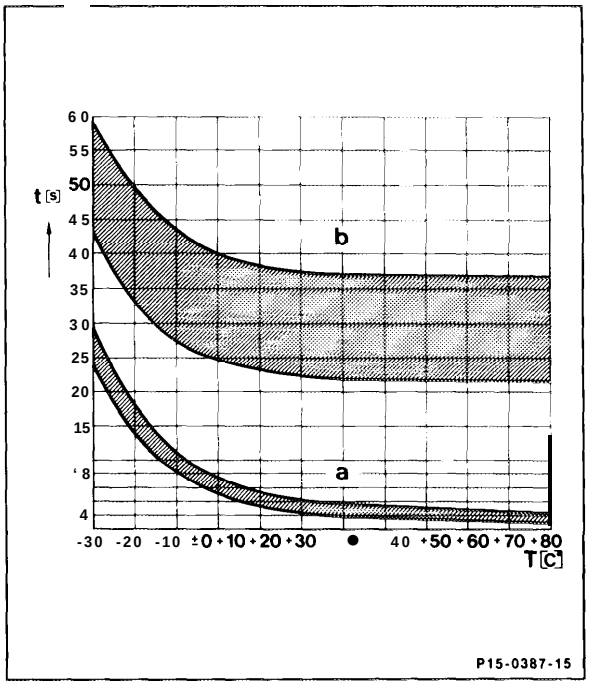


Preglow time

Safety cut-out

If the engine does not start within 20-25 seconds after the readiness for starting has been indicated, the glow current is interrupted by the safety cut-out. If the engine is started thereafter, the glow system is again switched on for the duration of the starting process.

The safety cut-out is no longer fixed. It is determined from the time up to readiness for starting (the preglow indicator lamp goes out) plus 20-35 seconds.



a Preglow time
b Safety cut-out

Fault display

A fault in the preglow system is indicated by failure of the preglow indicator lamp to light up when actuating the key in position “2”.

The following faults are registered:

Interruption of the line to the connection terminal 30.
80-A fuse defective.
Power relay in the preglow time-delay relay defective.
Interruption of one or several lines to the pencil-type glow plugs.
Interruption of one or several pencil-type glow plugs.

C. Preglow system with afterglow

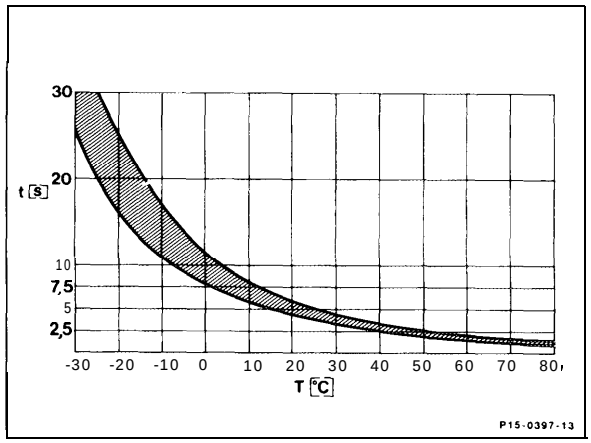
The preglow system has been changed from the previous system in the following areas:

- Preglow time-delay relay
- Coolant temperature sensor
- Pencil-type glow plugs

Preglow time-delay relay

Preglow time

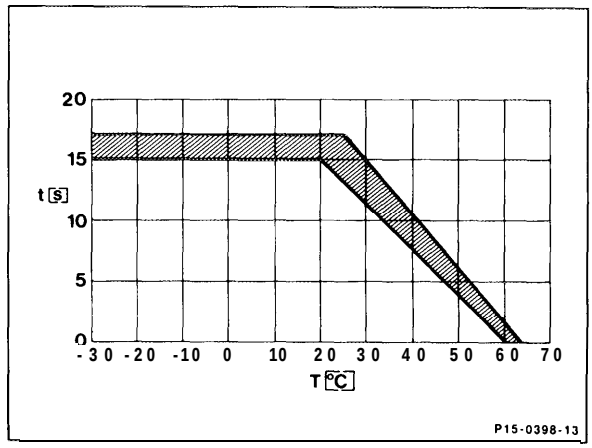
The duration of preglow until the preglow indicator lamp goes out is dependent on coolant temperature (see diagram).



Preglow time t in seconds
Coolant temperature T in °C

Afterglowing time

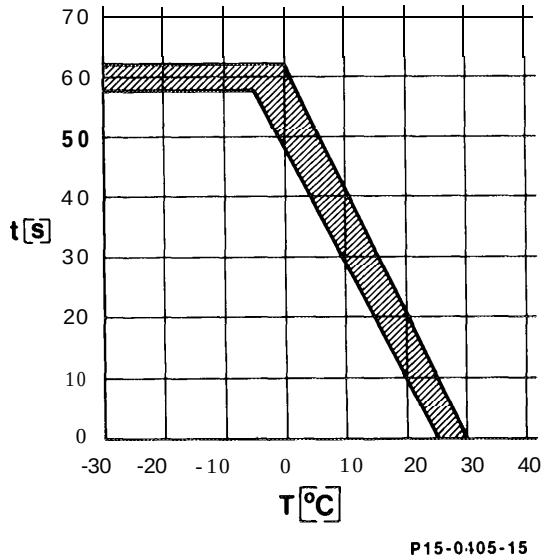
In order to improve the warm-up characteristics of the engine, the glow process is continued with the engine running as a function of the coolant temperature.



Afterglowing time t in seconds
Coolant temperature T in °C

b) Version MJ 89, code 830

Afterglowing time up to a maximum of 60 s (see diagram)



Afterglowing time t in seconds
Coolant temperature T in °C

Production breakpoint: January 1989 (preglow system with afterglowing)

Model	Engine	Engine end no. Manual transmission	Engine end no. Automatic transmission
124.133 124.193	603.960	–	017932
201.126	602.911	073017	014820

Monitoring of glow plugs

The glow plugs are monitored individually by a microprocessor in the preglow time relay.

In addition, the glow plugs are constantly monitored during vehicle operation by a low test current. Failure of one or several glow plugs is indicated if the preglow indicator lamp lights up for approx. 1 minute with the engine running.

Fault indication by preglow indicator lamp

- Lamp fails to light up even during preglow, lights up for approx. 1 minute while driving.
  Fault: One or more glow plugs defective.

- Lamp fails to light up during preglowing and also while driving.
  Fault: Indicator lamp defective, line interruption to the indicator lamp, preglow time relay defective.

- Lamp lights up permanently.
  Fault: Preglow time relay defective (relay sticking).

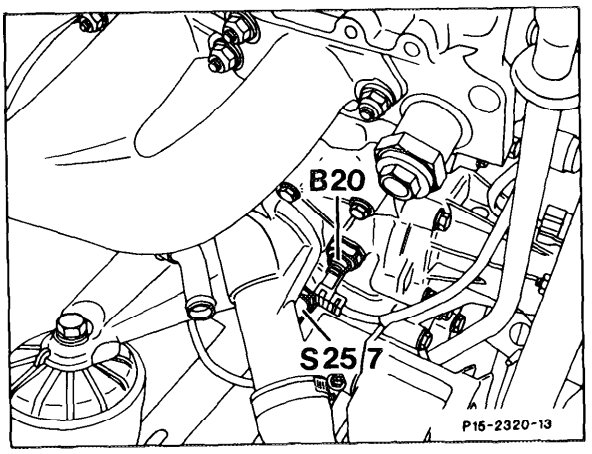
- Lamp fails to light up, engine is hard to start or fails to start altogether.
  Fault: Short circuit on one or more glow plugs, line interruption, preglow time relay defective.

Protection of preglow current circuit

Instead of the 80-A fuse an electronic cut-out has been installed. If a short circuit occurs, the power circuit is interrupted. After the short circuit has been eliminated, the fuse of the relay is restored to the operational state by turning the key in the steering lock back to "0".

Coolant temperature sensor

A coolant temperature sensor (B20) or (B11/8) is installed to control the preglow and afterglow times.

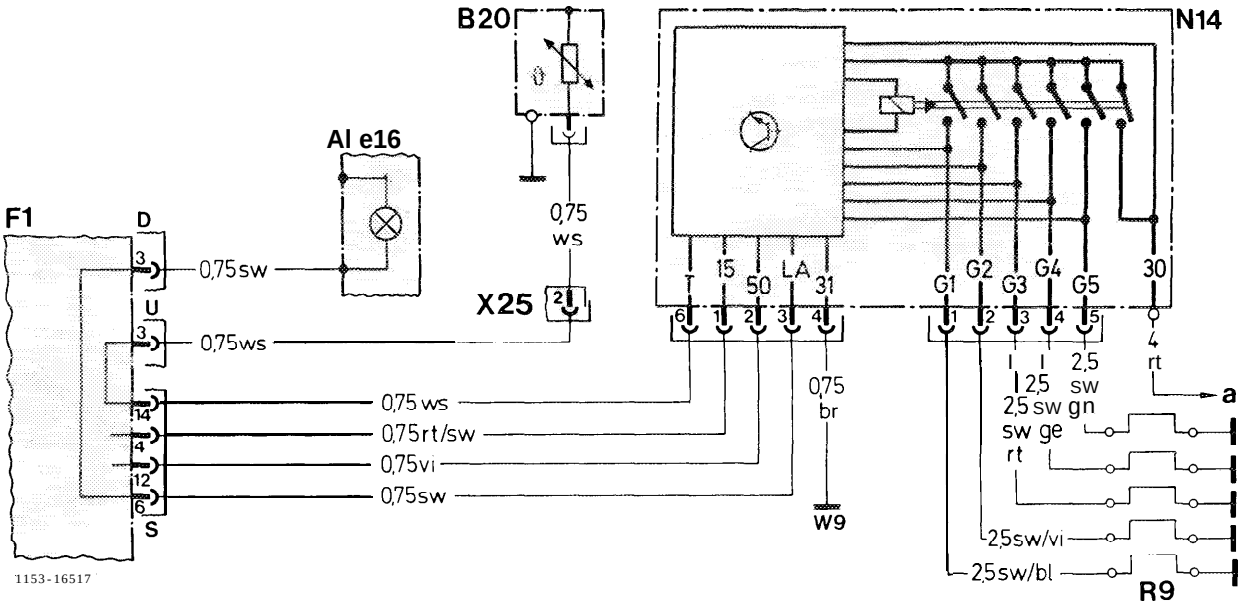


Arrangement engine 602

Pencil-type glow plugs

For afterglowing, pencil-type glow plugs with three different heater tube lengths are installed (see Checking preglow 15-711).

Wiring diagram engine 602.911 model year 1989 code **830**



Ale16	Instrument cluster preglow indicator	R9	Glow plugs
B20	Temperature sensor (preglow)	W9	Ground, front left (near headlamp unit)
F1	Central electrics	x25	Connector preglow cable harness
N14	Preglow time-delay relay	a	X35 Terminal block terminal 30, terminal 61 (battery)

15–705 Function of preglow system - Turbodiesel

General

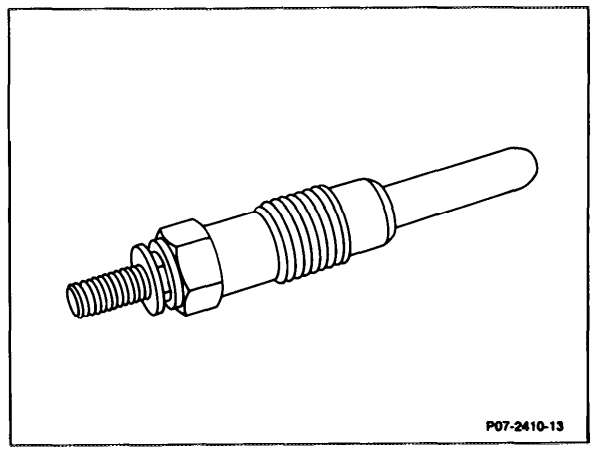
Combustion in the diesel engine occurs through the injection of self-igniting diesel fuel into highly compressed and therefore, hot combustion air.

When the engine is cold, the self-ignition temperature is not reached by compression alone. A preglow system is therefore required to increase the temperature of the compressed air and to allow the engine to start by directly igniting fuel particles on the glow plugs.

The duration of preglow depends on the ambient temperature.

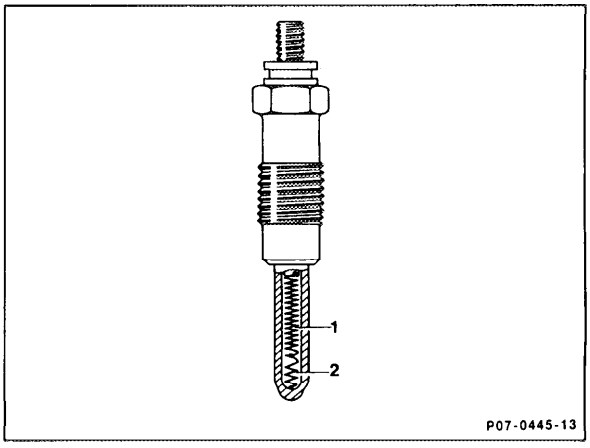
Design of the quick-start pencil-type glow plugs

The pencil-type glow plugs consist essentially of a housing with an MI 2 x 1.25 internal thread and a heating element press-fitted into the housing.



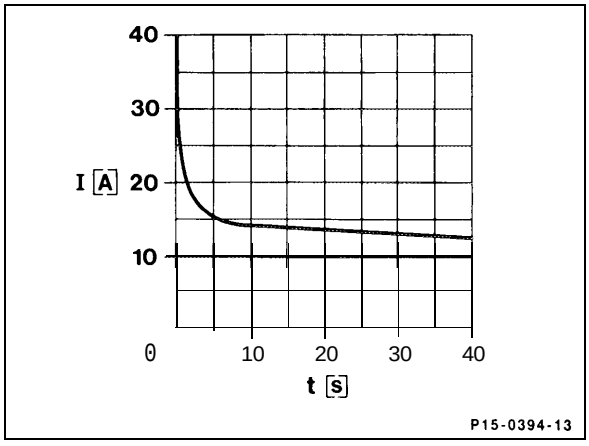
The single-pole connecting pin is screwed into the housing by a non-detachable brass round nut.
The pencil-type glow plugs are designed for a voltage of 11.5 Volts and are connected in parallel.

The heating element consists of a series-connected heating and control coil.



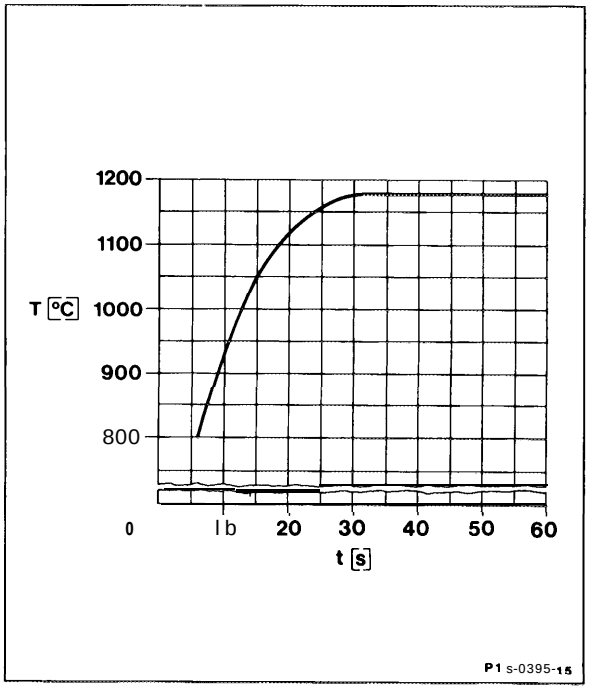
1 Control winding
2 Heating winding

When the glow system is turned on, a current of approx. 30 A is supplied to each glow plug. The heater coil heats the glow plug very rapidly. The control coil resistance increases with rising temperature, limiting the current to approximately 8-15 A. The glow plug is thus protected against overload.

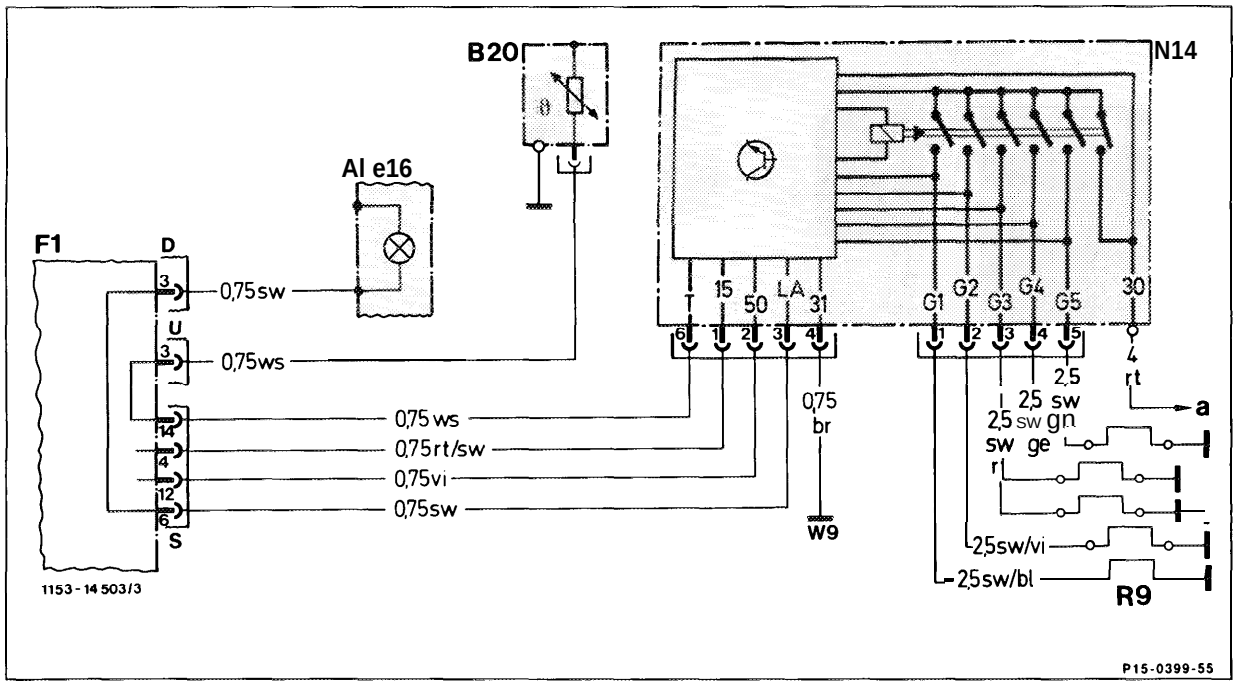


Current curve of quick-start pencil-type glow plug

After a glow period of 9 seconds, a heating element temperature of 900°C is reached, the maximum temperature of 1180°C being reached after 30 seconds.

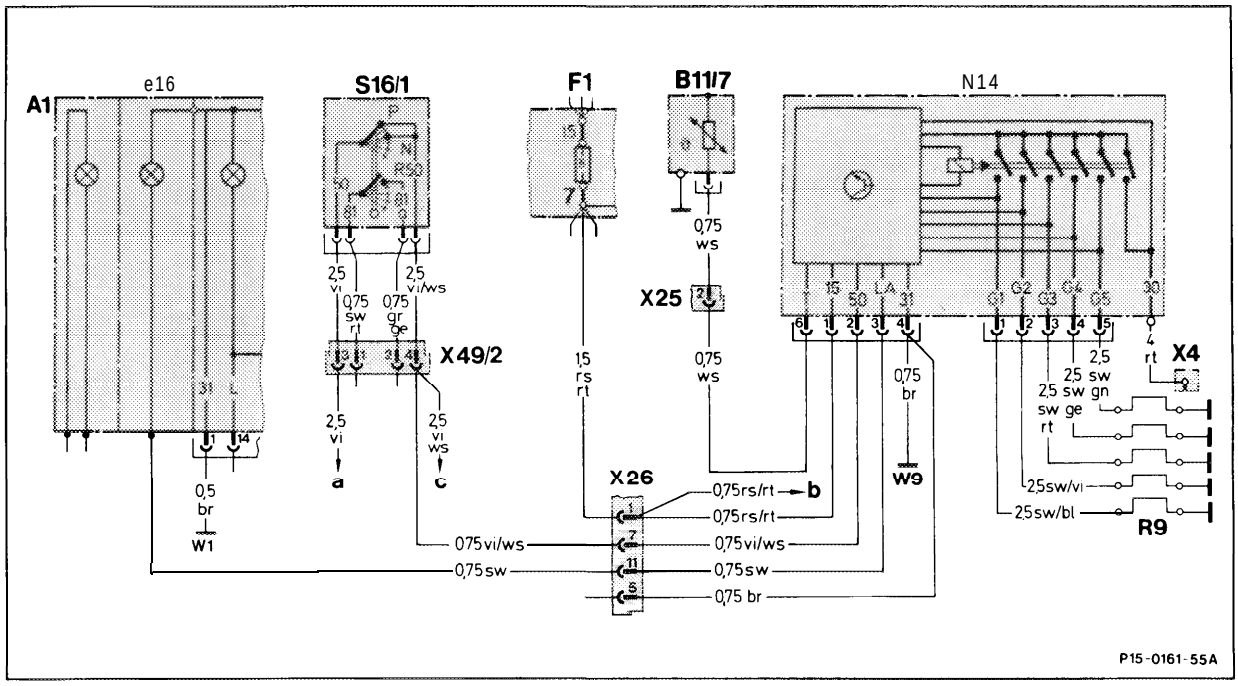


Temperature curve of quick-start pencil-type glow plug



Wiring Diagram Engine 602.961, Model 201.128

Ale16	Instrument cluster, preglow indicator	R9	Glow plugs
B20	Temperature sensor (preglow)	W9	Ground, front left (next to lamp unit)
F1	Electrical centre	a	X35 terminal block, terminal 30
N14	Preglow time relay		



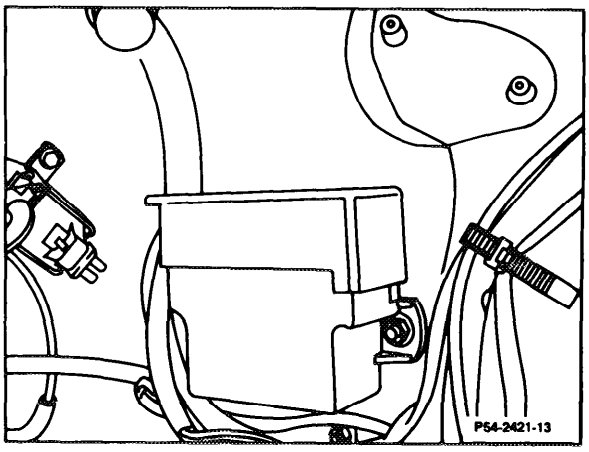
Wiring Diagram Engine 602.962, Model 124.128

Ale16	Instrument cluster, preglow Indicator
B11/7	Temperature sensor (preglow)
F1	Fuse and relay box
N14	Preglow time relay
R9	Glow plugs
S16/1	Starter lockout and backup light switch (with automatic transmission only)
W1	Main ground (behind Instrument cluster)
W9	Ground, front left (next to lamp unit)
x 4	Terminal block, terminal 30 (fuse and relay box)
x25	Plug connector, preglow wiring harness
X26	Plug connector, interior/engine 12-pin
x49/2	Plug connector, starter lockout and backup light switch
a	S2/2 glow start switch terminal 50
b	K1 Relay, over-voltage protection contact 3 (with air-conditioning system only)
c	X27 plug connector, starter wiring harness contact 2

Preglow time relay

The preglow time relay is housed in the engine compartment on the left wheel arch.

The electrical connections are accessible after removing the protective cap.



Installation of preglow time relay shown on Model 201

Functions of preglow time relay

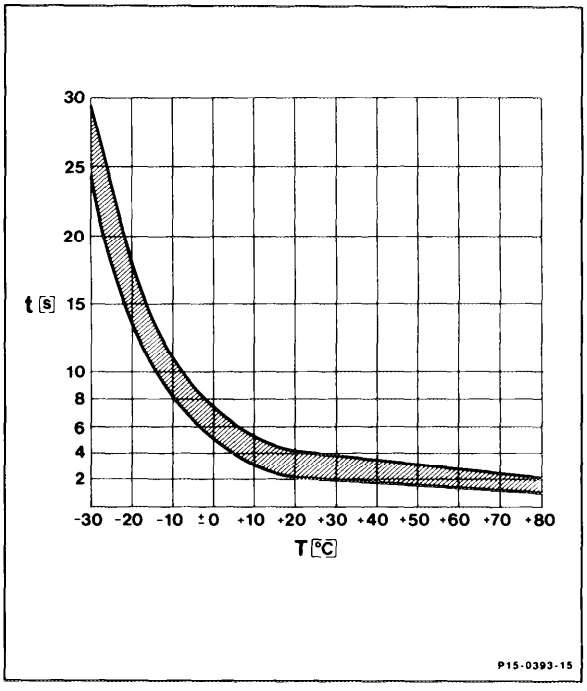
The preglow time relay has the following functions:

- Activating the glow current
- Indicating readiness to start
- Safety cutout
- Identifying faults

Preglow without afterglow Model 124 engine 603.96

T Ambient temperature of preglow time relay in °C

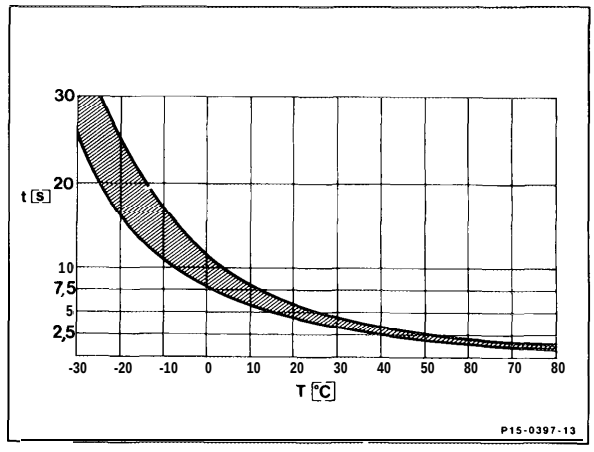
t Preglow time in seconds



Preglow with afterglow

Preglow Time

T Coolant temperature in °C
t Preglow time in seconds

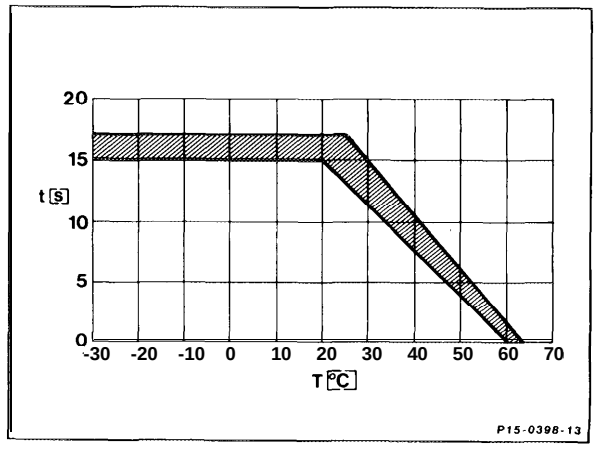


Afterglow Time

To improve warm-up properties, the glow plugs continue to glow when the engine is running dependent on the coolant temperature.

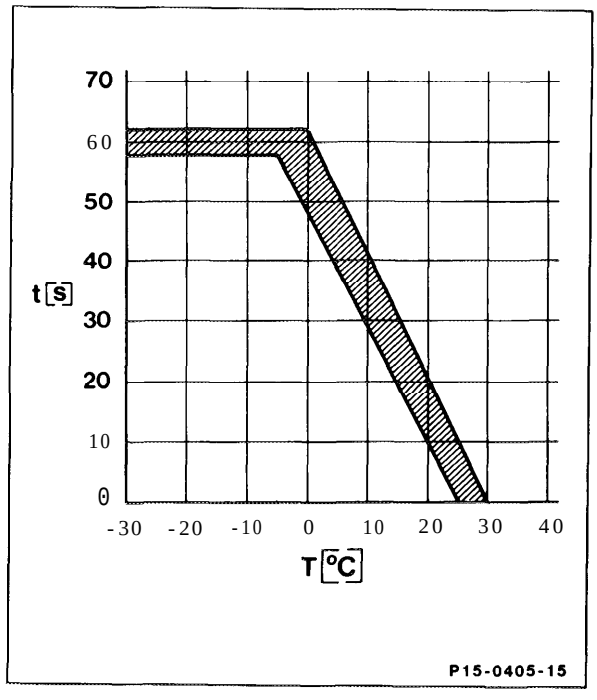
a) Version:
Model 201 Engine 602.961 Model Year 1988

T Coolant temperature in °C
t Afterglow time in seconds
Afterglow time up to max. 175 s (refer to diagram)



b) Version:
Models 124, 201 Engine 602.9611962,
Model 124 Engine 603.96 from Model Year 1989

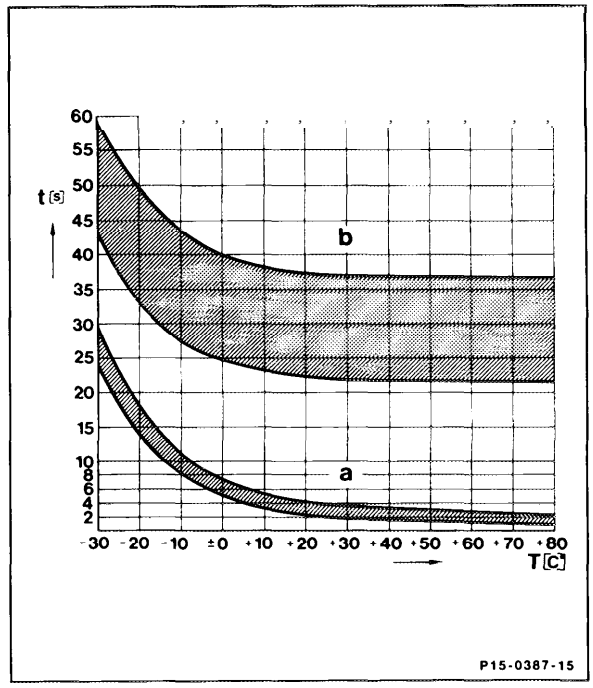
T Coolant temperature in °C
t Afterglow time in seconds
Afterglow time up to max. 60 s (refer to diagram)



Safety cutout

If the engine is not started within 20-25 seconds after the readiness to start indication being given, the glow current is interrupted by the safety cutout. If the engine is then started, the glow system is switched on again for the duration of the starting operation.

The duration of safety cutout is not fixed. It is the combination of time up to readiness to start (preglow indicator lamp going out) plus 20-25 seconds.



b Safety cutout

Switching the glow current

When the key is moved into position "2" (preglow, drive), the preglow time relay is switched on (voltage to terminal 15). The preglow time relay closes the circuit from terminal 30 (positive) to the glow plugs (R9).

If the key is turned into position "3" (start), the preglow time relay remains activated and remains retracted through terminal 50. The glow process is continued until the key is turned back to position "2".

Readiness to start indication

a) Model 124 Engine 603.96

When the glow system is switched on, the preglow indicator lamp in the instrument cluster lights up. The glow duration is determined by a temperature sensor installed in the preglow time relay. Once the required glow time has been reached, depending on the ambient temperature of the preglow time relay, the preglow indicator lamp goes out, thus indicating that the engine is ready to start.

Model 201 Engine 602.961,
Model 124 Engine 602.962, Engine 603.96 effective 1989

When the glow system is switched on, the preglow indicator lamp in the instrument cluster lights up. The glow duration is determined by the temperature sensor in the coolant. Once the required glow time has been reached, the preglow time relay switches off the preglow indicator lamp, indicating that the engine is ready to start.

Fault Indication

Model 124 Engine 603.96

A fault in the preglow system is indicated by the preglow indicator lamp failing to light up when the key is moved into position "2".

The following faults are detected:

- Interrupt in the cable to connection terminal 30.
- 80 ampere fuse faulty.
- Fault in power relay of preglow time relay.
- Interrupt in one or more cables to the glow plugs.
- Open circuit in one or more glow plugs.

Fault Indication

Models 124, 201 Engine 602.961, 602.962, 603.96 **Effective 1989**

A fault in the preglow system is indicated by the preglow indicator lamp failing to light up when the key is turned into position "2". In addition, the preglow indicator lights up for approx. 1 minute when the engine is running.

The following faults are detected:

- Interrupt in the cable to connection terminal 30.
- Preglow time relay faulty.
- Open circuit in one or more cables to the glow plugs.
- Open circuit in one or more glow plugs.
- Short-circuit at one or more glow plugs or in the cables.

15-710 Checking preglow system without afterglow function

Commercially available tool

Engines 602/603	
Multimeter	e.g. Sun, DMM 5

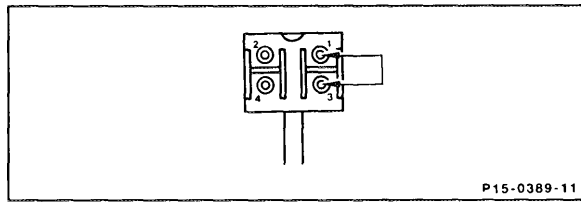
Checking

Electrical wiring diagrams (see 15-705).

1 **Checking glow bulb and wiring**

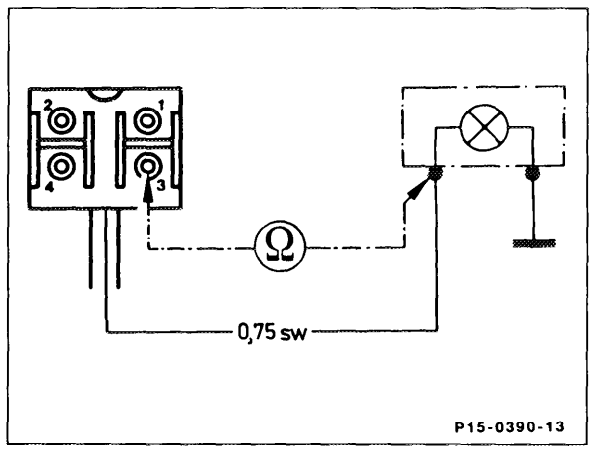
If preglow indicator lamp fails to light up when switching on the preglow system despite opportunity to start.

Pull 4 or 5-pin coupling off preglow time relay, turn key to position "2", bridge jacks 1 and 3 of the coupling.



If the preglow indicator lamp fails to light up, check or replace glow bulb.

If the glow bulb is OK, check the black cable from the coupling jack 3 of the preglow time relay up to the preglow indicator lamp for open circuit. Eliminate open circuit.

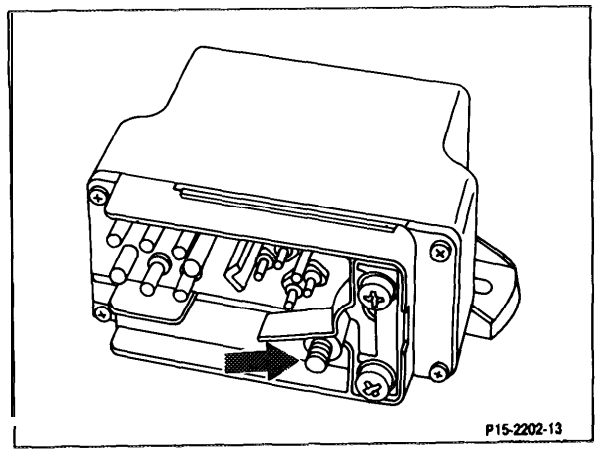


If the preglow indicator lamp lights up, the preglow time relay is defective. Replace preglow time relay.

2 Checking the main power circuit of the preglow system for open circuit

Problem:
Preglow Indicator lamp fails to light up, engine cannot be started.

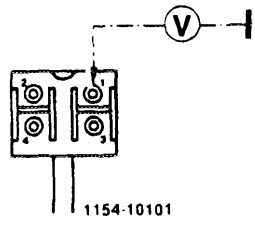
With the multimeter in the volt measuring range, check voltage on terminal 30 of the preglow time relay against ground.



If no voltage is present. check red 4 mm wire from the terminal block X35 terminal 30 to the preglow time relay terminal 30 for open circuit and eliminate open circuit if necessary.

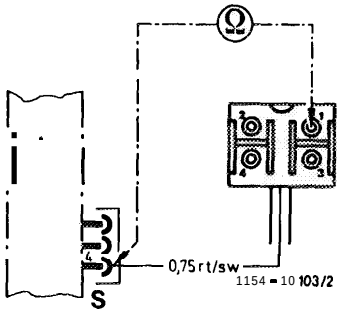
If voltage is present (approx. 12 V), check 80-A fuse for tight seat or an open circuit, replace if required.

If no fault was found so far, check voltage on jack 1 of the 4-pin coupling of the preglow time relay against ground.



If no voltage is present with preglow system switched on (model 201), check red/black wire from the central electrical coupling S jack 4 to the coupling jack 1 of the preglow time relay for an open circuit and eliminate open circuit.

On model 124, check pink/red wire from fuse 7 **(unprotected side)** via connector engine/interior 12-pole X 26 to coupling jack 1 of the preglow time relay for open circuit and eliminate open circuit.

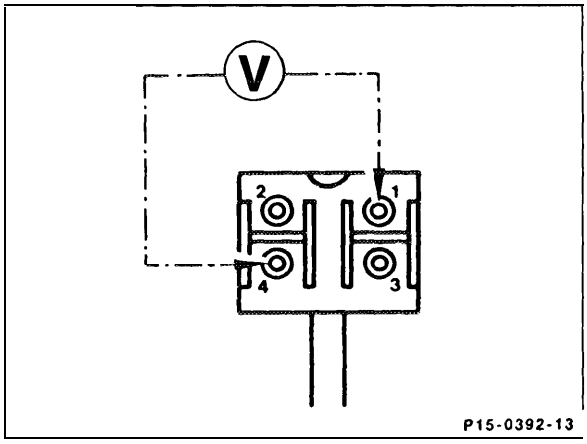


Model 201.1

If voltage is present (approx. 12 V), connect multimeter in volt measuring range to jack 1 (terminal 15) and jack 4 (terminal 31) and measure voltage (set value approx. 12 V).

If no voltage is indicated, check brown wire from jack 4 to ground for open circuit and eliminate open circuit.

If no fault was established to this point, the preglow time relay is defective, replace preglow time relay.



3 Checking pencil-type glow plugs and their lines

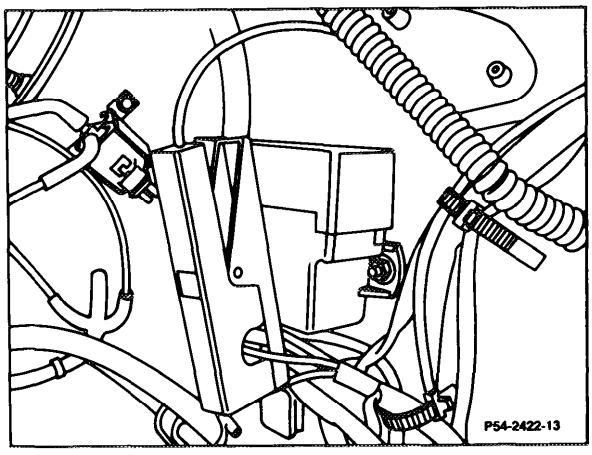
Problem:

Preglow indicator lamp fails to light up, engine is hard to start; an open circuit in one or more pencil-type glow plugs or in the lines leading to the pencil-type glow plugs is possible.

Problem:

Preglow indicator lamp lights up, engine is hard to start after reaching start readiness; an open circuit of a pencil-type glow plug or a line to the pencil-type glow plugs of cylinders no. 2 to 5 is possible or incorrect power may be consumed by the pencil-type glow plugs in cylinders 1 through 6.

Measuring power consumption of the pencil-type glow plugs with the DC current probe.



For this purpose place the current probe over the individual lines on the preglow time relay.

Cylinder 1 = 2.5 black/blue
Cylinder 2 = 2.5 black/purple
Cylinder 3 = 2.5 black/red
Cylinder 4 = 2.5 black/yellow
Cylinder 5 = 2.5 black/green
Cylinder 6 = 2.5 black/white

Turn key in steering lock to position "2", the power consumption of each glow plug should be 8-15 A after 10-20 seconds.

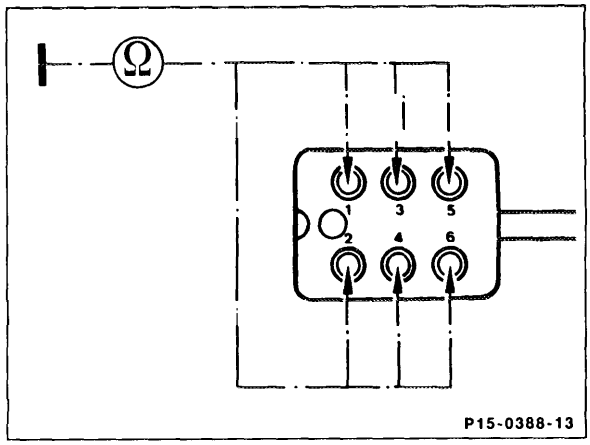
If the value is above 15 A, replace glow plug.

At a value below 8 A, check electric lines or glow plug with multimeter ohm measuring range for open circuit.

In order to test for an open circuit pull 6-pin coupling off preglow time relay.

Using the multimeter ohm measuring range measure the resistance to ground (engine block) of one after the other as follows:

Jack 1 of couplmg	= Pencil-type glow plug cylmder 1
Jack 2 of coupling	= Pencil-type glow plug cylinder 2
Jack 3 of couplmg	= Pencil-type glow plug cylmder 3
Jack 4 of couplmg	= Pencil-type glow plug cylmder 4
Jack 5 of coupling	= Pencil-type glow plug cylinder 5
Jack 6 of couplmg	= Pencil-type glow plug cylmder 6



If infinite resistance is measured, an open circuit in the respective pencil-type glow plug or the feed line or the connection is the problem.

Eliminate open circuit in the feed line or replace glow plug.

Note
It may be possible that the indicator lamp (due to unfavorable tolerances) indicates a fault only upon failure of 2 pencil-type glow plugs in the cylinders 2-5.

In order to ensure that the fault indication in the preglow time relay is accurate, 2 pencil-type glow plugs of the cylinders 2 to 5 have to be disconnected in this case and the preglow process repeated.

15-711 Checking preglow system with afterglow function

Commercially available tool

Engines 602/603	
Multimeter	e.g. Sun, DMM 5

Checking

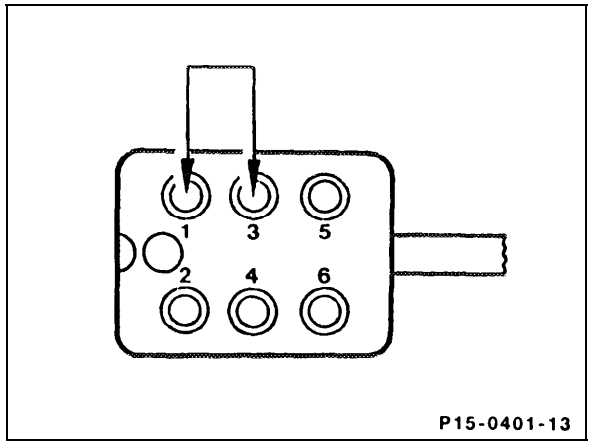
Electrical wiring diagrams (see 15-705).

Checking glow bulb and its wiring

Problem:
Preglow indicator lamp fails to light up when turning on the preglow system despite start readiness.

Pull 6-pin coupling off preglow time relay, turn key to position "2", bridge jacks 1 and 3 of the coupling.

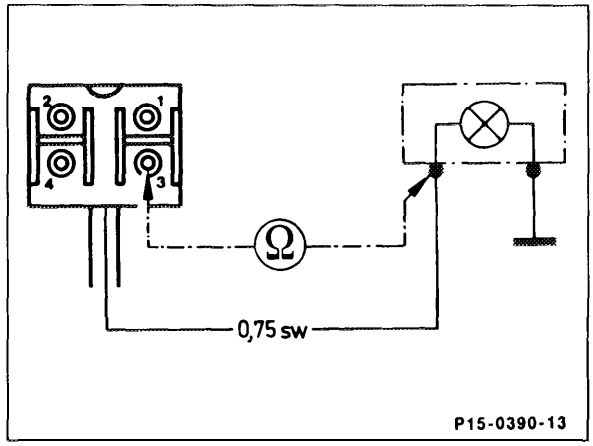
If the preglow indicator lamp fails to light up, check or replace glow bulb.



If the glow bulb is OK, check black wire from coupling jack 3 of the preglow time relay to the preglow indicator lamp for an open circuit. Eliminate open circuit.

If the preglow indicator lamp lights up, the preglow time relay is defective, replace preglow time relay.

Lamp lights up permanently.
Fault: Preglow time relay defective (relay sticking).

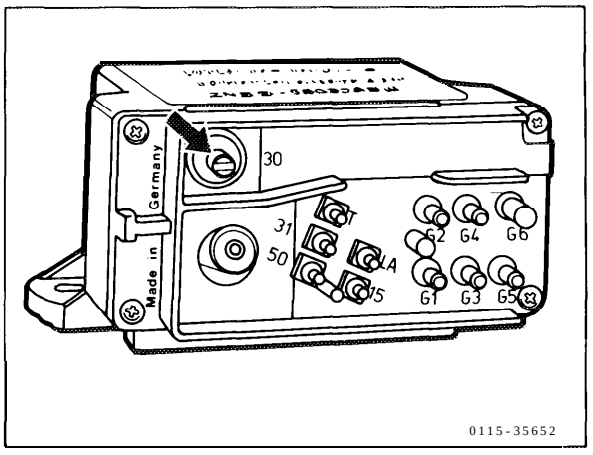


Checking main power circuit of preglow system for open circuit

Problem:

Preglow indicator lamp fails to light up, engine cannot be started.

Using the multimeter volt measuring range, check the voltage on terminal 30 of the preglow time relay against ground (arrow).



If no voltage is present, check 4 mm red wire from the terminal block X35 terminal 30 to the preglow time relay terminal 30 for open circuit and eliminate open circuit.

If no fault was established to this point, measure voltage on jack 1 of the 6-pin coupling of the preglow time relay against ground.

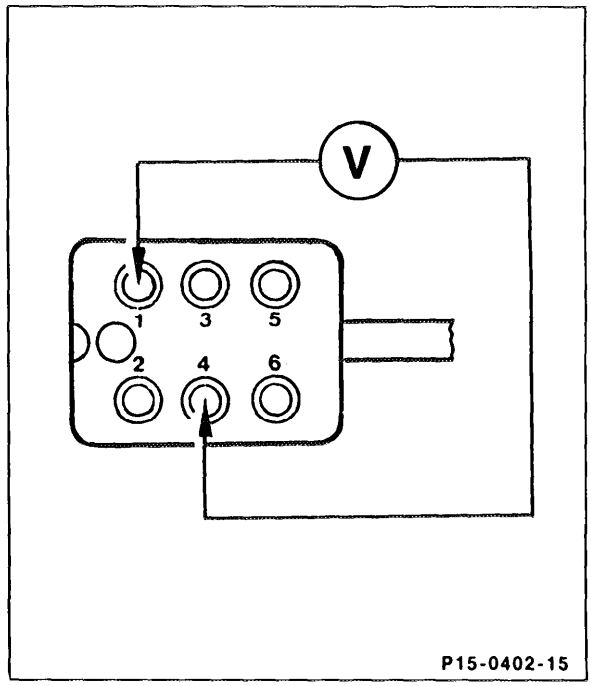
Model 201

If no voltage is present with the preglow system switched on, check red black wire from the central electrical coupling S jack 4 to the coupling jack 1 of the preglow time relay for open circuit and eliminate open circuit.

If voltage is present, connect multimeter volt measuring range to jack 1 (terminal 15) and jack 4 (terminal 31) and measure voltage.

If no voltage is indicated, check brown wire from jack 4 to ground for open circuit and eliminate open circuit.

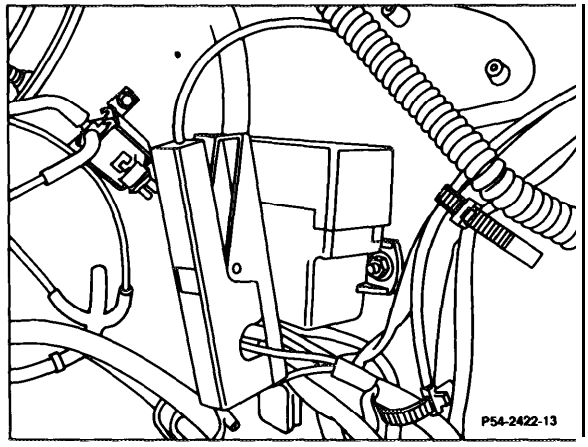
If no fault was established to this point, the preglow time relay is defective, replace preglow time relay.



Checking pencil-type glow plugs and their lines

Problem:
Preglow indicator lamp fails to light up when switching on.
Lights up for approx. 1 minute while driving.
Engine is hard to start.
An open circuit of one or more pencil-type glow plugs or their lines to the pencil-type glow plugs is possible.

Measure power consumption of the pencil-type glow plugs using the multimeter ampere measuring range and DC current probe.
For this purpose place current probe over the individual wires on the preglow time relay.



Cylinder 1 = 2.5 black/blue
Cylinder 2 = 2.5 black/purple
Cylinder 3 = 2.5 black/red
Cylinder 4 = 2.5 black/yellow
Cylinder 5 = 2.5 black/green
Cylinder 6 = 2.5 black/white

Turn key in steering lock to position "2", the power consumption for each glow plug should be 14-l 6 A after approx. 8 seconds.

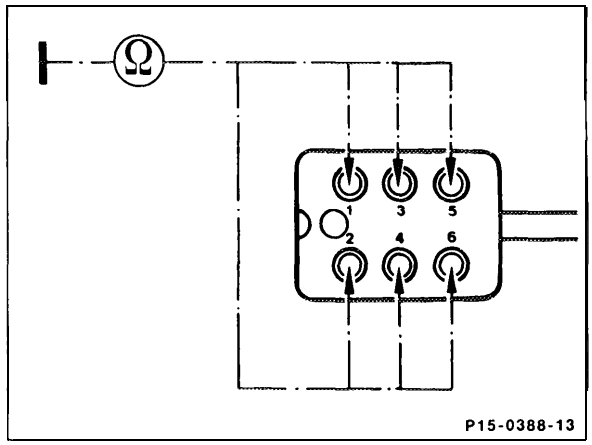
If the value is higher than 16 A, replace glow plug.

With a value below 14 A, check wire and glow plug for open circuit.

In order to check for an open circuit, pull 6-pin coupling off preglow time relay.

With the multimeter ohm measuring range measure the resistance against ground (engine block) one after the other as follows:

Jack 1 of couplmg	= Pencil-type glow plug cylinder 1
Jack 2 of couplmg	= Pencil-type glow plug cylinder 2
Jack 3 of couplmg	= Pencil-type glow plug cylmder 3
Jack 4 of couplmg	= Pencil-type glow plug cylinder 4
Jack 5 of couplmg	= Pencil-type glow plug cylmder 5
Jack 6 of couplmg	= Pencil-type glow plug cylmder 6



If infinite resistance is measured, an open circuit of the respective pencil-type glow plug or the feed line or the connection is the problem.

Eliminate open circuit in the feed line or replace glow plug.

Preglow power circuit protection
An electronic cut-out is installed in the preglow time relay. If a short circuit occurs in the glow plugs or in the electrical lines the power circuit is interrupted.

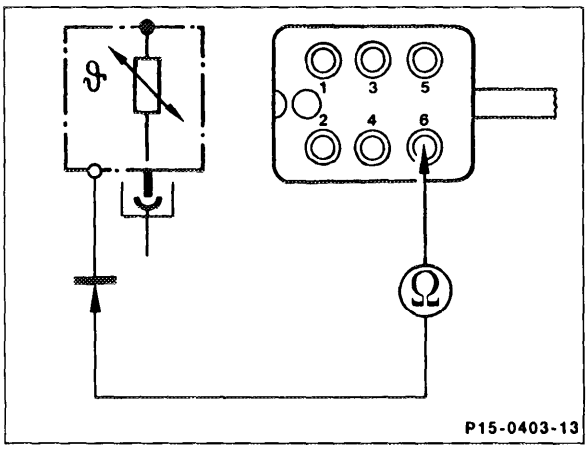
Note
After a short circuit is repaired, the relay is operational again when the key in the steering lock is turned back to position "0".

Checking temperature sensor with line

Preglow time until preglow indicator lamp goes out is excessive or too short. (see table).

Pull plug off preglow time relay and measure resistance against ground using multimeter ohm measuring range.

Set value at + 25 °C 2442 Ω ± 170 Ω
+ 80 °C 291 Ω ± 16 Ω



If set value is not attained:
Replace temperature sensor.

If infinite resistance is indicated:
Eliminate open circuit in electrical wire.

If resistance < 1Ω is indicated:
Eliminate short circuit in electrical line.

15–711 Testing preglow system with afterglow function - Turbodiesel

Models 124, 201 with Engines 602.961, effective Model Year 1989, 602.962, 603.96, effective Model Year 1989

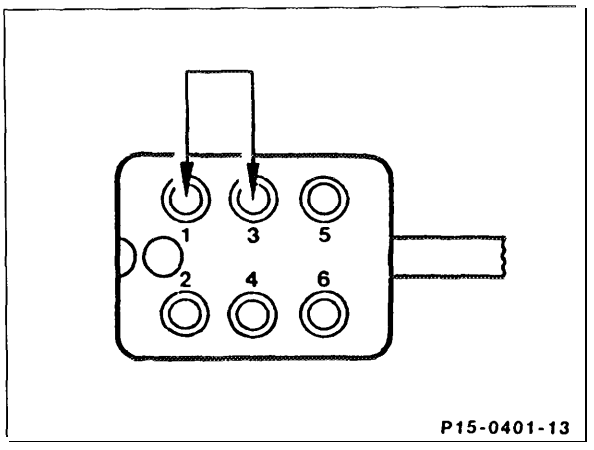
Commercial Tool

Multimeter	e.g.	Sun, DMM-5

Testing Bulb and Its Wiring

If the following problem occurs:
Preglow indicator lamp does not light up when the preglow system is switched on, despite being able to start engine.

Detach 6-pin connector from preglow time relay, turn key into position "2", bridge contacts 1 and 3 of the connector. If the preglow indicator lamp does not light up, test bulb or replace if necessary.



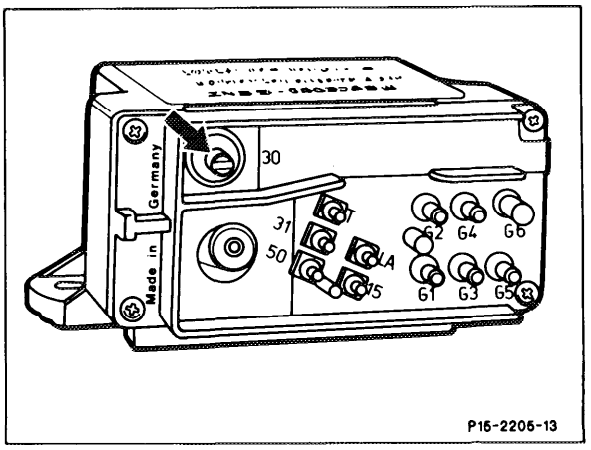
If the bulb is in order, test black cable from connector contact 3 of the preglow time relay to the preglow indicator lamp for open circuit.
Rectify open circuit.
If the preglow indicator lamp lights up, the preglow time relay is defective. Replace preglow time relay.
Lamp shows a steady light.
Fault: preglow time relay defective (relay sticking).

Testing Main Circuit of Preglow System for Interruption

If the following problem occurs:

Preglow indicator lamp does not light up, engine cannot be started.

With the multimeter set to the Volts range, test the voltage at terminal 30 of the preglow time relay to ground (arrow).



If no voltage is indicated, test 4 mm² red cable from terminal block (X35) terminal 30 to the preglow time relay terminal 30 for open circuit. Rectify open circuit.

If no fault has been detected to this point, test voltage at contact 1 of the 6-pin connector of the preglow time relay to ground.

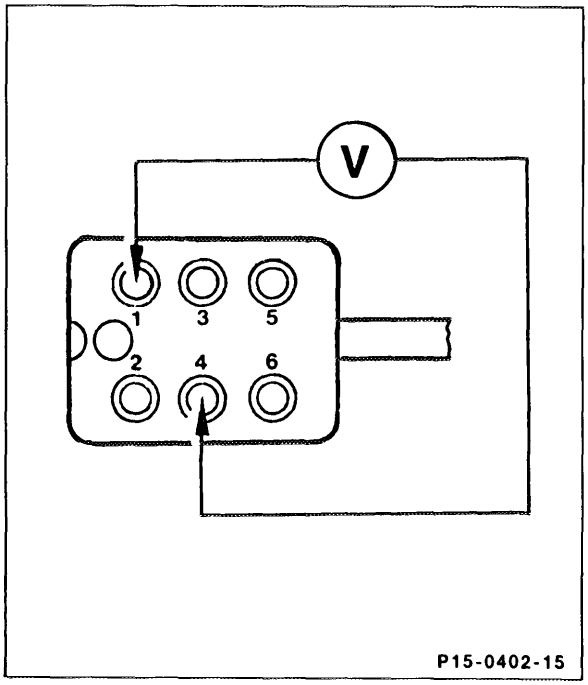
Model 201

If no voltage is indicated when the preglow system is switched on, test red/black cable from the electrical centre connector **S** contact 4 to the connector contact 1 of the preglow time relay for open circuit or rectify open circuit.

Model 124

Test pink/red cable from fuse 7 (unprotected side) through plug connection of engine wiring harness to the connector contact 1 of the preglow time relay for open circuit. Rectify open circuit.

If voltage is indicated, connect multimeter Volts range to contact 1 (terminal 15) and contact 4 (terminal 31) and test voltage. If no voltage is indicated, test brown cable from contact 4 to ground for open circuit. Rectify open circuit. If no fault has been detected to this point, the preglow time relay is defective. Replace preglow time relay.



Testing Glow Plugs and Their Wiring

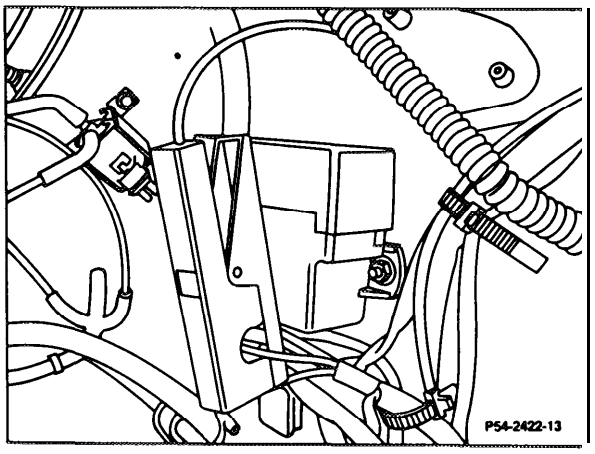
If the following problems occur:

- Preglow indicator lamp does not light up when switching on
- Lights up for approx. 1 min. when driving
- Engine is difficult to start

there may be an open circuit in one or more glow plugs or in the cables to the glow plugs.

Test current consumption of the glow plugs with multimeter set to Amperes range and with D.C. clamp. The clamp is placed over the individual cables at the preglow time relay for the step.

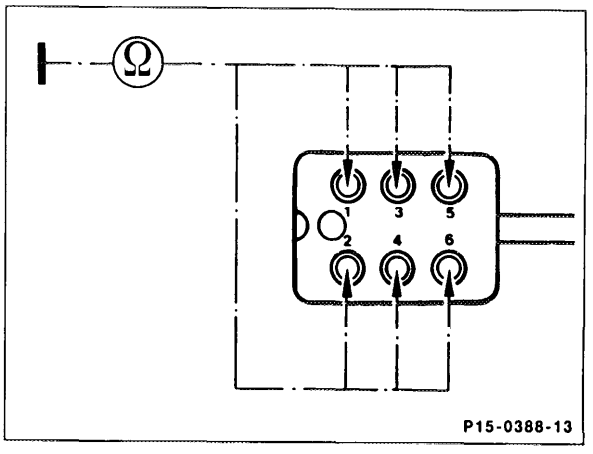
Cylinder 1 = 2.5 black/blue
Cylinder 2 = 2.5 black/violet
Cylinder 3 = 2.5 black/red
Cylinder 4 = 2.5 black/yellow
Cylinder 5 = 2.5 black/green
Cylinder 6 = 2.5 black/white



Turn key in the steering lock to position "2", the current consumption of each glow plug must be 14-16 A after 1 O-12 seconds.
If the reading is higher than 16 A, replace glow plug. If the reading is less than 14 A, test glow plug cable for open circuit.

Detach 6-pin connector from preglow time relay for testing for open circuit. With the multimeter set to Ohms range, measure in turn the resistance to ground (engine block) at

- 1 Connector = glow plug cylinder 1
- 2 Connector = glow plug cylinder 2
- 3 Connector = glow plug cylinder 3
- 4 Connector = glow plug cylinder 4
- 5 Connector = glow plug cylinder 5
- 6 Connector = glow plug cylinder 6



If infinite resistance is measured, there is an open circuit in the respective glow plug or in the lead or the connection. Rectify open circuit in the lead or replace glow plug.

Safeguarding Preglow Circuit

An electronic short-circuit safeguard is installed in the preglow time relay. The circuit is interrupted if a short-circuit develops in the glow plugs or in the cables.

The relay is again operational

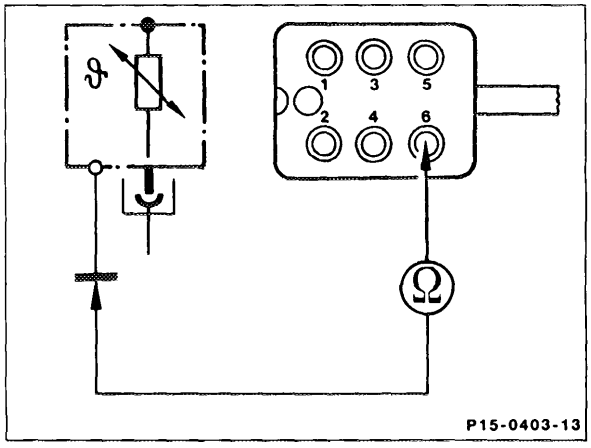
- once the short-circuit has been rectified and
- the key turned back to position "0".

Testing temperature sensor with wiring

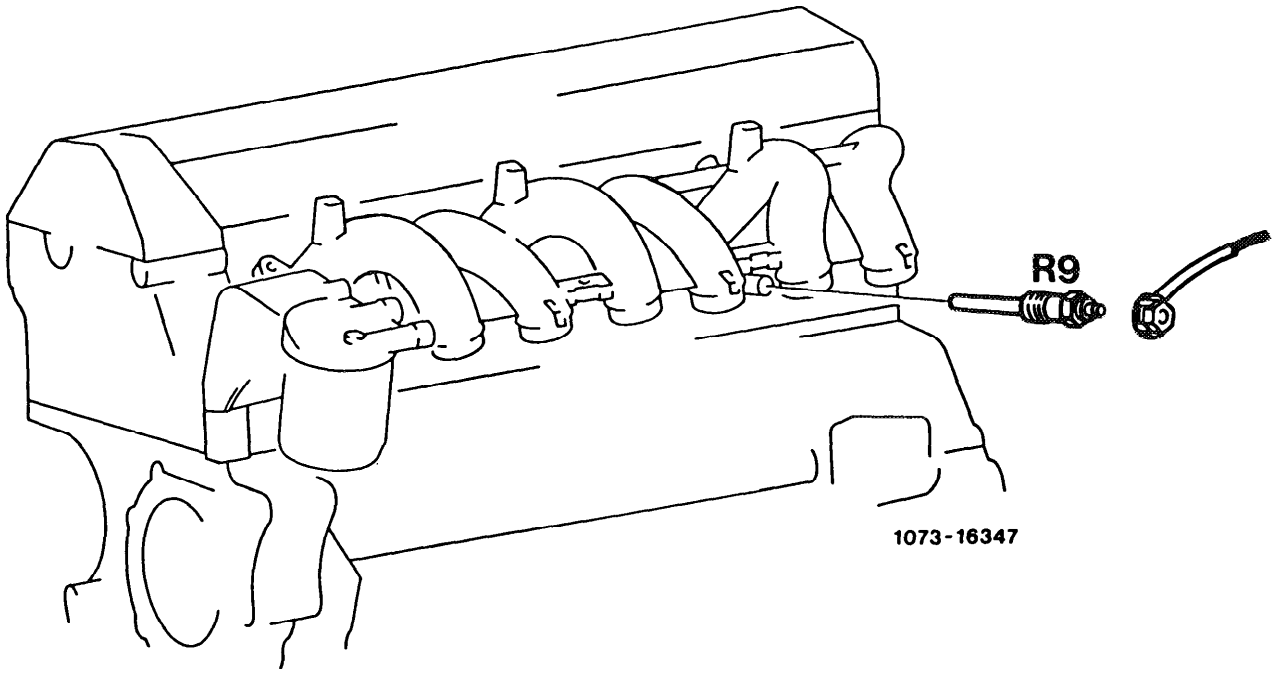
Preglow time until preglow indicator lamp goes out is too short or too long (refer to table). Detach plug on preglow time relay and test F resistance to ground F with multimeter set to Ohms range.

Specification at+25 °C 2442 Ω ± 170 Ω
at+180 °C 291 Ω ± 16 Ω

If specified value is achieved:
Replace temperature sensor. If resistance ∞ Ω is indicated: rectify open circuit in cable. If resistance <1Ω is indicated: rectify short-circuit in cable.



15-715 Removal and installation of glow plugs



Complete air cleaner	remove, reinstall (09-400).
Electrical line on glow plugs	connect, disconnect, tightening torque 4 Nm.
Glow plugs (R9) 4, 5 or 6 off	remove, reinstall, tightening torque 20 + 2 Nm Observe distinguishing features pencil-type glow plugs.

Tightening torques	Nm
Quick-start pencil-type glow plugs	20 + 2
Electrical line on glow plugs	4

Distinguishing features pencil-type glow plugs

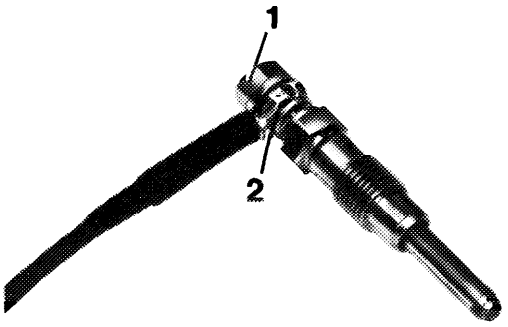
Engine	602	602	602.961	602.911
Injection/preglow system	Vertical injection without afterglow function	Inclined injection precham ber 5°/180° 60 s afterglow function	Inclined injection prechamber 5° 16 s afterglow function	Inclined injection 5° without afterglow function
Beru no.	0100221107	0100221162	0100221153	0100221138
Bosch no.	0250201001	0250201026	–	
Length of glow tube	25	23	27	27
Glowing current after approx. 8 s in ampere	8 - 1 5	14 – 16	14 – 16	14 – 16
Identification	yellow	transparent with circular groove around the hexagon	black	transparent

Removal

1 Remove, reinstall complete air cleaner housing (09-400).

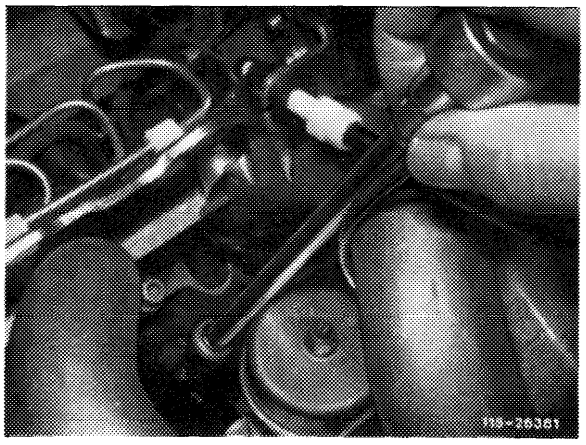
2 Unscrew nuts from glow plugs.

The nuts (1) cannot be lost as they have been inserted in the terminals (2) of the wiring harness.



115-26300

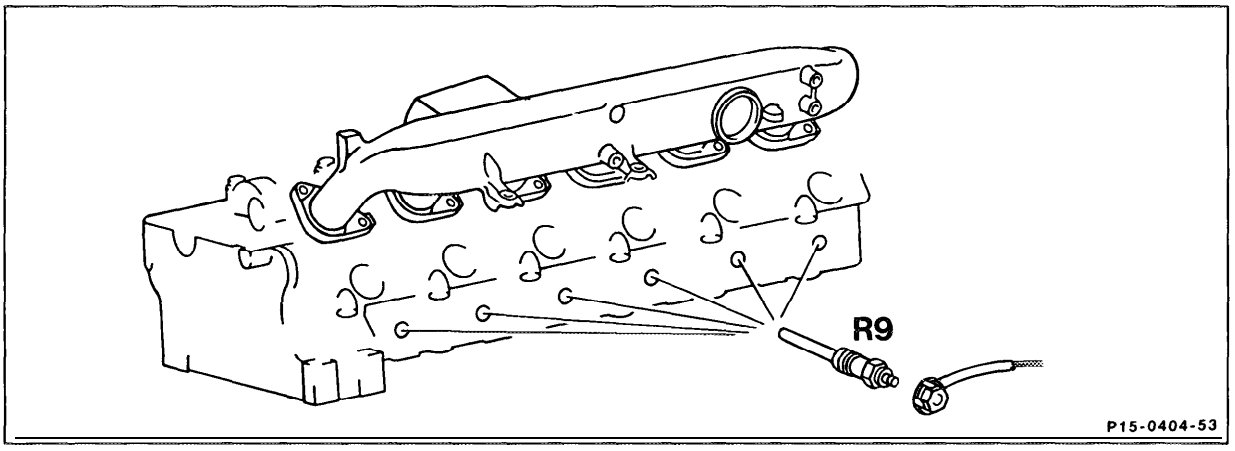
3 Unscrew glow plugs.



Installation

4 Installation occurs in reverse order.

15–715 Removal and Installation of glow plugs - Turbodiesel



Cable to glow plugs	disconnect, connect.
Pencil-type glow plugs (R9)	remove, install.

Tightening torques	Nm
Quick-start pencil-type glow plugs	20 + 2
Cable to glow plugs	4

Commercial tool

3/8" ratchet with universal joint

Distinguishing Features of Pencil-type Glow Plugs

Engine	603.96	602.96 603.96	602.961 Standard 1987
Injection preglow system	Vertical injection without afterglow	Oblique injection prechamber 5°/180° 60 s afterglow	Oblique injection prechamber 5° 15 s afterglow
Beru No.	010 022 11 07	010 022 11 62	010 022 11 53
Bosch No.	025 020 10 01	025 020 10 26	–
Length of glow tube	25	23	27
Glow current after approx. 8 s in amperes	8–15	14–16	14–16
Identification	yellow	Transparent with annular groove around hexagon	black