

### A. General

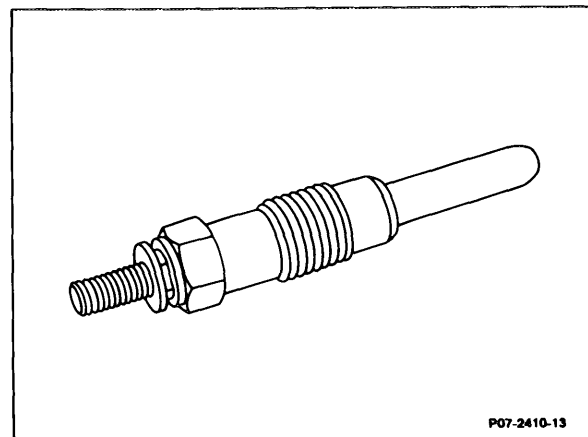
Combustion in the diesel engine occurs through the injection of self-igniting diesel fuel into highly compressed and therefore, hot combustion air.

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.

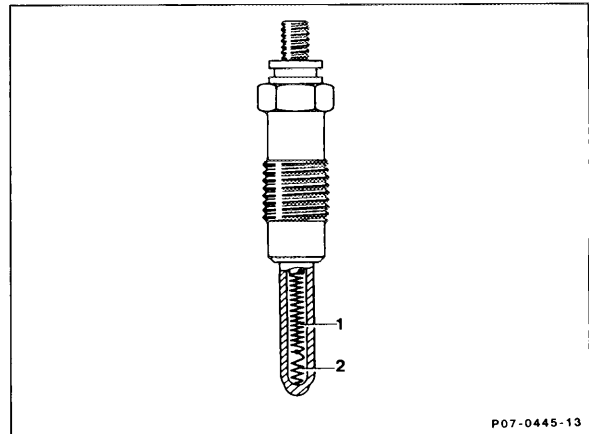


The single-pole connection pin is secured to the housing by means of a permanent connection consisting of a brass round nut.

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.

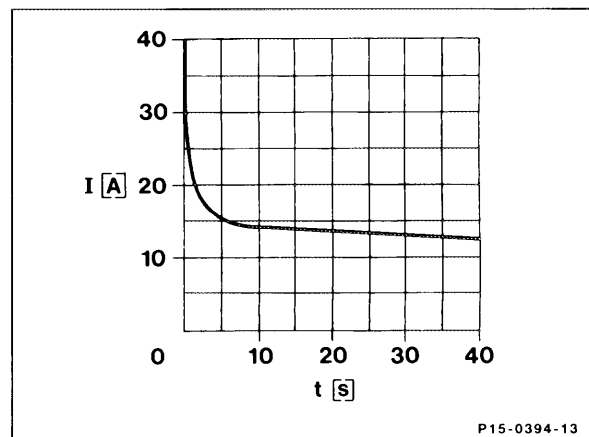
- 1 Control coil
- 2 Heater coil



P07-0445-13

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.

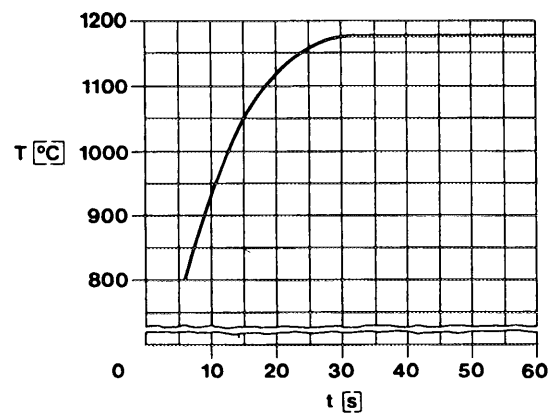
Current curve of the quick-start pencil-type glow plug



P15-0394-13

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

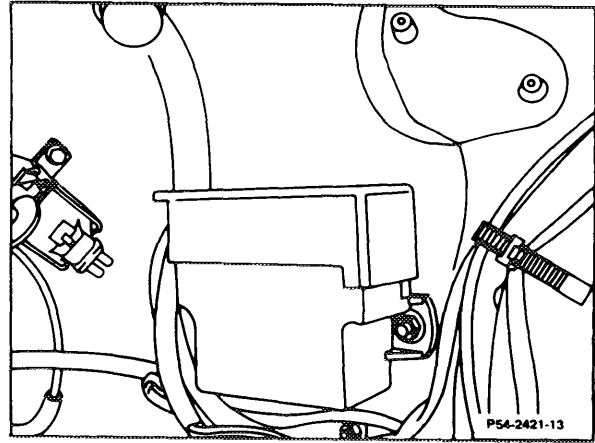


### **Preglow time relay**

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:

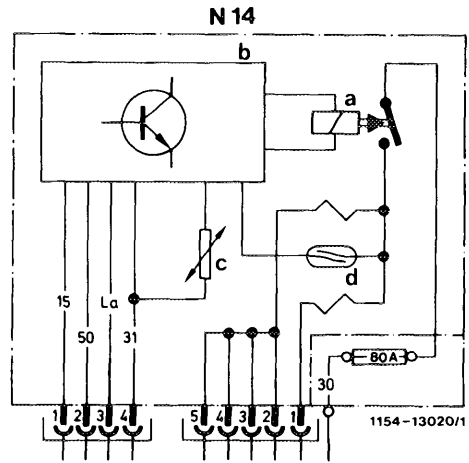
- Activating the glow current
- Indicating readiness to start
- Safety cutout
- Identifying faults

### **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.

Engines 602



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".

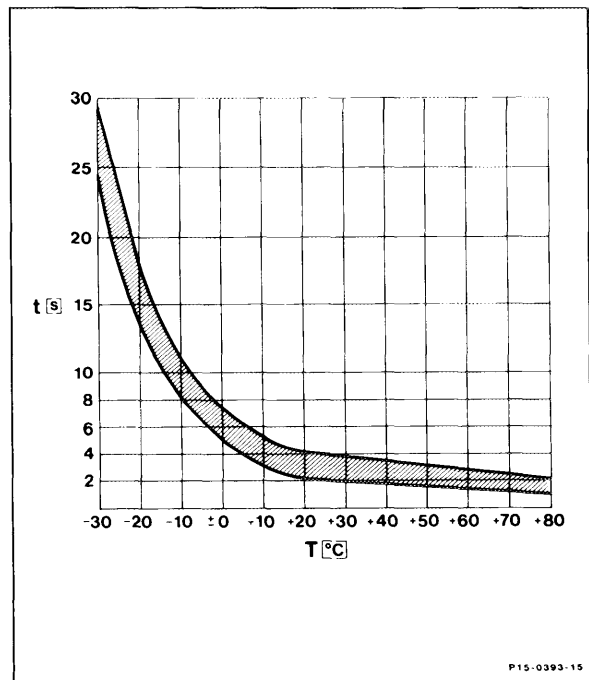
### Ready-for-starting indication

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

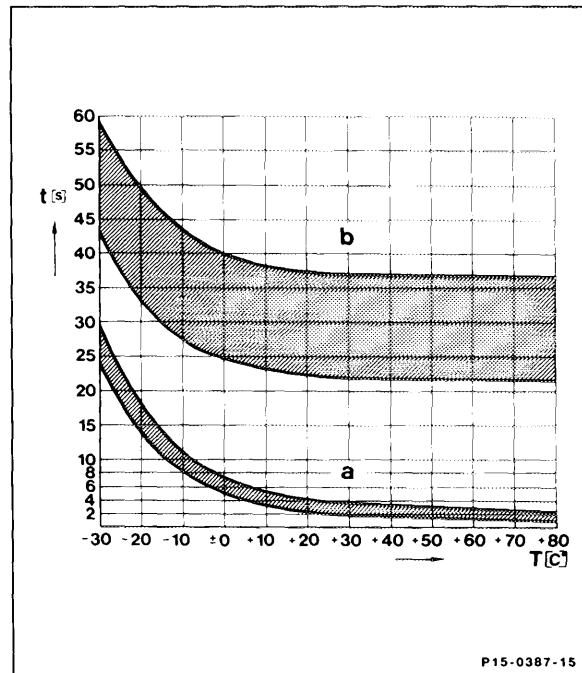


### Safety cut-out

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:

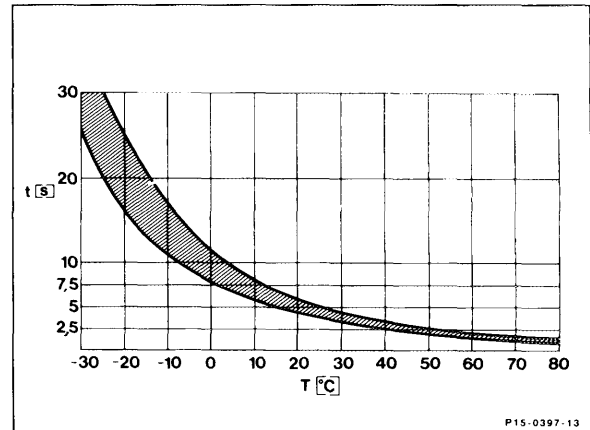
- Preglow time-delay relay
- Coolant temperature sensor
- Pencil-type glow plugs

### Preglow time-delay relay

#### Preglow time

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

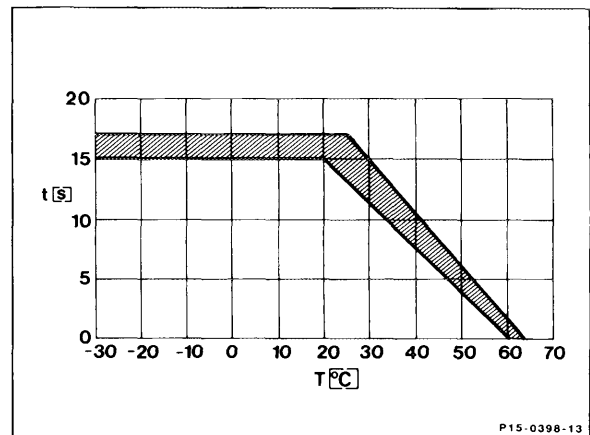
Preglow time  $t$  in seconds  
Coolant temperature  $T$  in  $^{\circ}\text{C}$



### 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.

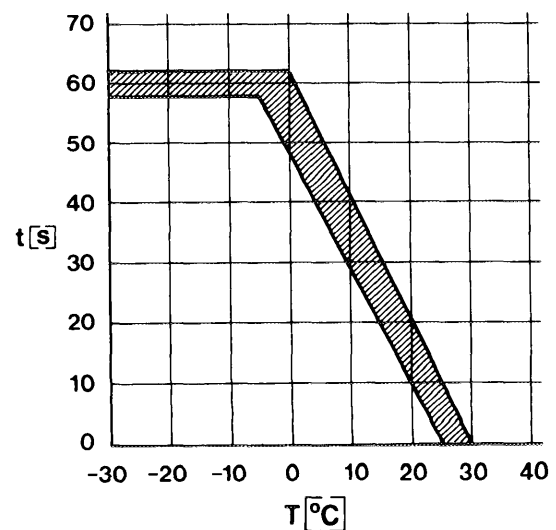
Afterglowing time  $t$  in seconds  
Coolant temperature  $T$  in  $^{\circ}\text{C}$



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  $^{\circ}\text{C}$





**Production breakpoint:** January 1989 (preglow system with afterglowing)

| Model              | Engine  | Engine end no.<br>Manual transmission | Engine end no.<br>Automatic transmission |
|--------------------|---------|---------------------------------------|--|
| 124.133<br>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.

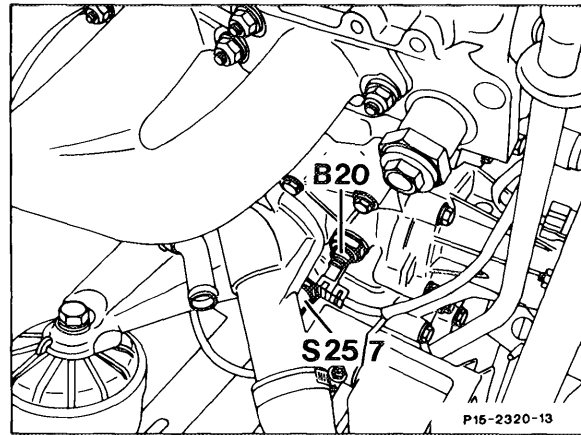
### **Protection of preglow current circuit**

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.

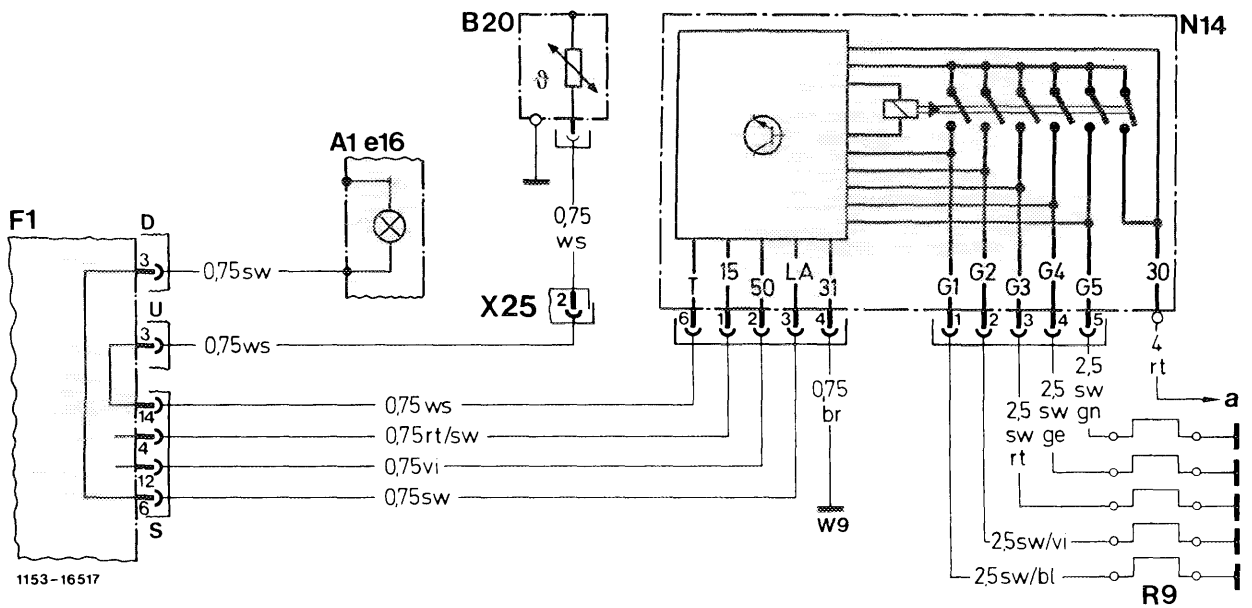
Arrangement engine 602



### 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



- A1e16 Instrument cluster preglow indicator
- B20 Temperature sensor (preglow)
- F1 Central electrics
- N14 Preglow time-delay relay

- R9 Glow plugs
- W9 Ground, front left (near headlamp unit)
- X25 Connector preglow cable harness
- a X35 Terminal block terminal 30, terminal 61 (battery)