

E. Pre-heating System

The pre-heating system serves to increase the temperature of the compressed air and to ignite fuel particles at the surface of the hot wire of the glow plugs, thus allowing the starting of a cold engine.

In the diesel engine the combustion is accomplished by the self-ignition of the fuel injected into the highly compressed and therefore highly heated combustion air. The compression temperatures of a diesel engine under hot running conditions are approx. 700 to 900° C. During the starting of a cold engine without pre-heating, however, the compression temperatures are only approx. 300° C. This temperature is not sufficient for the self-ignition of the fuel.

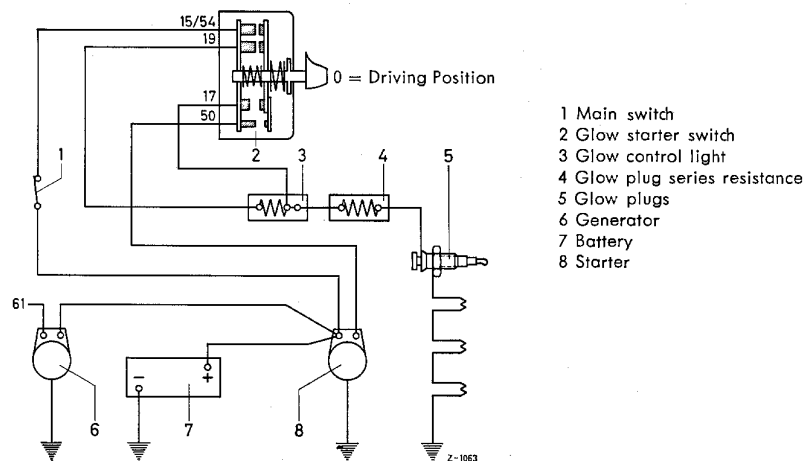


Figure 15-00/5

Electric wiring diagram of a pre-heating system with glow starter and stop switch

The glow plugs receive their power from the 12-volt battery via the glow starter switch. The glow plugs are connected in series with the glow control light (3) and the additional glow plug series resistance (4) (see Fig. 15-00/5) in accordance with the rated voltage of the glow plugs, so that the sum of all individual rated voltages, including loss of voltage in the lines, corresponds to the rated voltage of the battery.

During the starting the glow control light is shorted, so that the heat output of the glow plugs does not drop too much during the decreasing battery voltage (see Figure 15-00/5 and also Job No. 15-33, Description of the four Switch Positions, item d).

The duration of the pre-heating depends on the temperature of the engine and the outside temperature.

Average pre-heating periods with cold engine:

Outside temperature + 20° C approx. 20 seconds
 Outside temperature 0° C approx. 40 seconds
 Outside temperature - 5° C approx. 1 minute
 At lower temperatures no more than 2 minutes.

On Model **OM 636** there are two different versions of pre-heating systems:

1st version: Glow plugs Bosch KE/GA 2/2 and Beru 202/GE with spiral filament and a rated voltage of 1.4 Volt each, glow control light with a rated voltage of 1.4 Volt, and glow plug series resistance with a rated voltage of 5.0 Volt.

2nd version: Glow plugs Bosch KE/GA 1/8 and Beru 214 GK with eye-shaped filament and a rated voltage of 0.9 Volt each, glow control light with a rated voltage of 0.9 Volt, and glow plug series resistance with a rated voltage of 6.6 Volt.

To prevent damages in the pre-heating system following the replacement of a glow plug, a glow control light, or a glow plug series resistance, watch out for correct rated voltage which is visibly marked on each of these parts.

On Model **OM 621** there are two different versions of glow plugs:

1. Glow plug Bosch KE/GA 1/8 and Beru 214 GK (2-pole, 0.9 Volt, approx. 40 Amp.) installed in engines of type 621.910, models 190 D or 190 Db and 180 Dc. Filament loop length approx. 15 mm, filament loop width 8 to 9 mm, filament thickness for the Bosch and Beru glow plug 1.7 mm dia.

2. Glow plug Bosch KE/GA 1/21 and Beru 381 GK (2-pole, 0.9 Volt, approx. 40 Amp.) installed in engines of type 621.912 for model 190 Dc and 621.913 for models L and O 319 D.

thicker and the loop was shortened to prevent burning out and breaking of the filament. Filament loop length approx. 10 mm, filament loop width 8 to 9 mm, filament thickness for the Bosch glow plug 1.8 mm dia., for the Beru glow plug 1.9 mm dia. **For this reason install only Bosch glow plugs KE/GA 1/21, or Beru 381 GK, respectively, into engine models 190 Dc, L and O 319 D, provided with OM 621.**

Attention! The OM 621 engine used in models 190 Dc and L and O 319 D for heavier service the glow plug filament must be

Note: The stem of the Beru glow plug which comes out of the filament, is not conductive and thus is not susceptible to short circuits.

Glow Plug

Job No.
15-30

Figure 15-30/1 shows the design of a glow plug. The current flows through the power lead (1) or a connecting cable, depending on the location of the plug, to the center electrode (13) or the ring shoulder (3) of the outer electrode (11). The center electrode (13) and the outer electrode (11) are connected through the filament (6). The insulation between the two electrodes is handled by the insulating compound (12) and against the plug body (5) by the insulating compound (4). An additional plastics insulator (2) has been installed between the outer and the center electrode at the upper end of the glow plug. The connector insulator (10) separates the two power connections. The spring washer (8) installed in the insulator serves to secure the knurled nut (7) (see Figure 15-30/1).

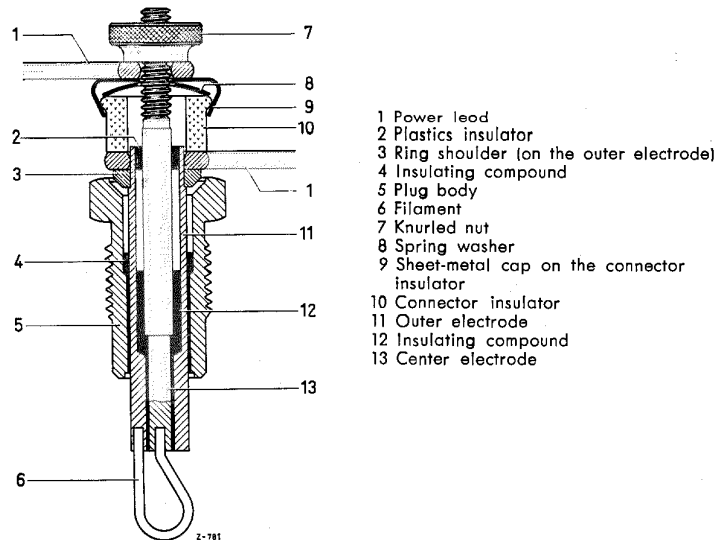


Figure 15-30/1

The operating life of the glow plug depends to a wide extent on the condition of the injection nozzles and the process of combustion. Too low injection pressures, sticking nozzle needles, coked and dribbling nozzles, and a too early beginning of injection can cause the premature breaking of the filament. Furthermore, the filament can burn out due to a short-circuit to ground caused by oil-carbon bridging.

During the pre-heating the temperature of the filament is approx. 900 to 1000° C, and in an engine under hot running conditions 600 to 800° C due to the combustion temperature. Temperatures above 800° C are harmful during continuous operation.

Type designation of the different glow plug versions:

Version with spiral-shaped filament and a rated voltage of 1.4 volt:

Bosch KE/GA 2/2
 Beru 202/GE

636 Engine
 0.9V - 12V
 0-250-001-001

Version with loop-shaped filament and a rated voltage of 0.9 volt:

Bosch KE/GA 1/8
 Beru 214/GE and/or lately Beru 214/GK

Removal and Installation of Glow Plug

Job No.

15-31

Removal:

1. Loosen the connection cable (10) from the 1st or 4th glow plug by unscrewing the knurled nut (11) (see Figure 15-31/1).
2. Also unscrew the other knurled nuts, remove the connection insulators (9) and the bus rails (8) (see Figure 15-31/1).
3. Use a socket wrench size 21 mm to unscrew the glow plug.

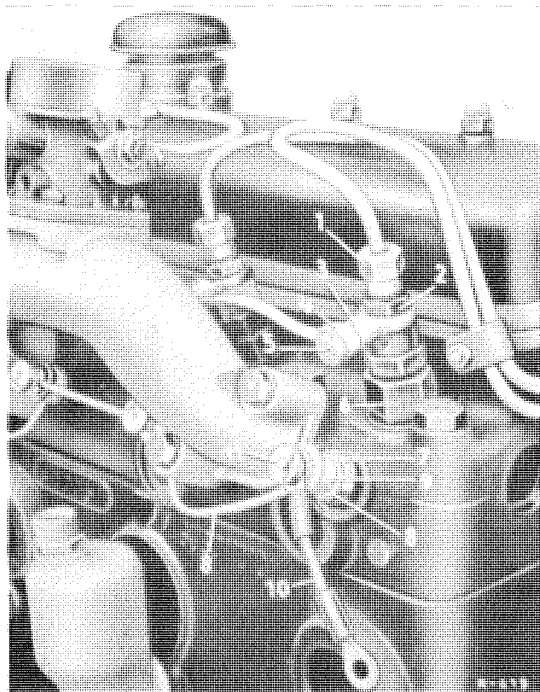


Figure 15-31/1

- | | |
|---|---|
| 1 Union nut for mounting the injection line | 7 Glow plug |
| 2 Hex. nut for mounting the fitting | 8 Bus rail |
| 3 Fitting | 9 Connection insulator |
| 4 Connection head of leak oil line | 10 Connection cable or ground cable resp. (on both, outer glow plugs) |
| 5 Hollow screw | 11 Knurled nut |
| 6 Nozzle holder | |

4. Before installing the glow plugs, clean the ducts and the bores in the pre-chambers using the reamer part No. 636 509 03 53. To do this, fill the grooves of the reamer

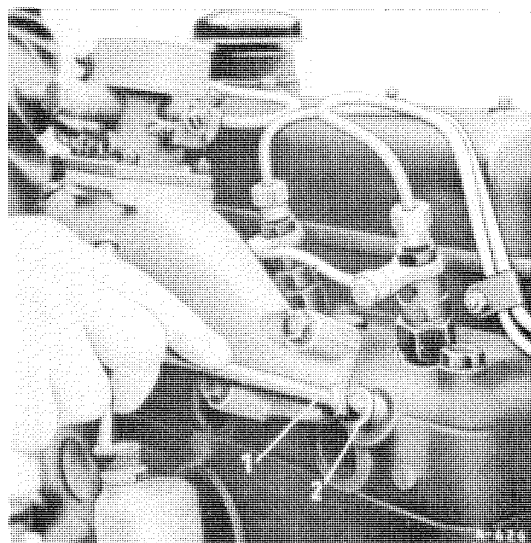


Figure 15-31/2

- 1 Reamer part. No. 636 589 03 53
- 2 Limiting collar on the reamer

with grease and ream the glow plug ducts (Figure 15-31/2).

Also a commercial reamer with 11 mm dia. can be used for cleaning the glow plug ducts. To do this, observe the following:

The reamer should only be inserted up to approx. 55 mm to avoid damaging of the ball pin in the pre-chamber (see Figure 15-31/3). Therefore, it is imperative to fit a stop on the reamer (tightly seated rubber ring or similar objects).

Note: After some time, oil carbon will deposit in the glow plug ducts. This may eventually cause shorting to ground of the glow plugs and starting troubles; therefore, the glow plug ducts should be cleaned on the occasion of larger repairs on the cylinder head and when exchanging the glow plugs i. e., also outside the normal service routine.

5. If the glow plugs had been cleaned with the cylinder head mounted, then crank the engine several times to blow the residues out of the combustion chamber.

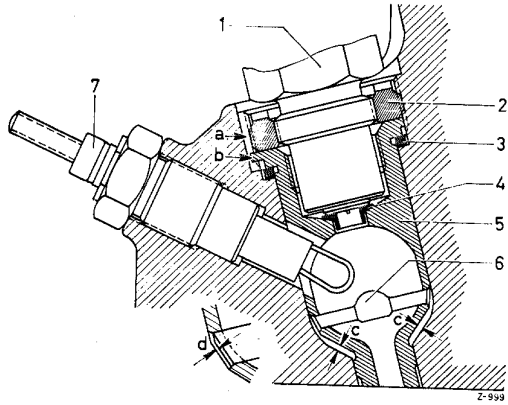


Figure 15-31/3

- a Groove in the cylinder head
- b Lug securing pre-chamber against turning
- c Distance between pre-chamber (5) and cylinder head
- d 0.5 mm; max. permissible measure of a retreated ball pin with respect to the outer dia. of the pre-chamber
- 1 Nozzle holder
- 2 Threaded ring
- 3 Seal ring between pre-chamber and cylinder head
- 4 Seal ring between pre-chamber and nozzle holder (nozzle plate)
- 5 Pre-chamber (ball pin version)
- 6 Ball pin in the pre-chamber
- 7 Glow plug

6. Apply some graphited oil to the thread of the glow plug. Screw the glow plug into the cylinder head and tighten with 5 mkg.

7. Connect the glow plugs with the bus rails (8). First place the two outer rails with the larger connection eyes, which connect the 1st and 2nd as well as the 3rd and 4th glow plug. Place the connection insulators (9) and the bus rail connecting the 2nd and 3rd plug and tighten with the knurled nuts (11). Depending on the type, connect the cable (10) to the 1st or 4th glow plug with the knurled nut (11). Also mount the ground cable (10) on the opposite side with the knurled nut (see Figure 15-31/1).

8. Check glow plugs for proper function (see also Job No. 15-32).

Testing of Glow Plugs

Job No.

15-32

A glow control light has been installed in the dashboard and/or the instrument panel in order to control the pre-heating system; the glow control light has the same rated voltage as each of the respectively used glow plugs (see Job No. 15-00 Section E).

During the pre-heating period the glow control light glows in the same way (light red) as the glow plugs, thus indicating the condition of the glow plugs.

If the glow control light does not glow, the filament of a glow plug is usually broken or burned out due to a ground short. In order to determine the faulty glow plug, subsequently bridge the two power leads of each individual plug with a screwdriver (Figure 15-32/1).

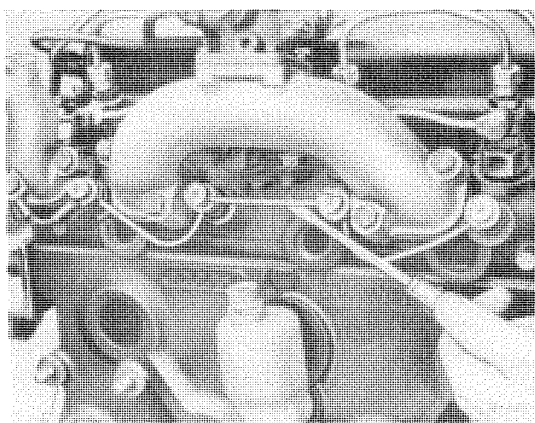


Figure 15-32/1

For this purpose put the glow starter switch to position 1 (pre-heating). The glow control light will glow during the bridging of the connections of the defective glow plug.

The glow control light will glow considerably faster and brighter if there is a ground short in the pre-heating system. If the glow control light continues to glow after disconnecting the ground lead of the pre-heating system, there is a ground short in the pre-heating system.

In this case check the power leads for a possible ground short with the cylinder head. If the power leads are in order, the ground short can be at one of the glow plugs. In order to determine the faulty glow plug consecutively disconnect the power leads, starting at the ground end, while the pre-heating system is switched on. The power will be cut off with the disconnecting of the power lead on the plug with a ground short-circuit. The glow control light will no longer glow.

Note: Make sure of the correct rated voltage during the installation of new glow plugs.

cable. In this position of the adjusting lever the control rod is in the stop position, the plungers of the pump elements are set to no delivery, the engine no longer receives fuel and stops. The terminals 19, 50 and 17 are dead in this position.

The key of the main switch can be removed.

b) 0 = Driving Position

In the driving position the slotted eye of the bowden cable at the adjusting lever is set in such a way that the pin of the adjusting lever is located approximately in the center of the eye, the adjusting lever will therefore not be actuated. In this position the terminals 19, 50 and 17 are dead.

The key of the main switch **cannot** be removed.

c) 1 = Pre-heating Position

Turn the handle of the rotary switch from the driving position clockwise until a noticeable resistance can be felt at position 1. The switch must be held in this position until the pre-heating is completed (depends on the outer temperature and the operating temperature of the engine). In this position the terminal 19 is supplied with power which causes the glowing of the glow plugs (5) by way of the glow control light (3) and the series resistance (4) (Figure 15-33/1). The terminals 50 and 17 are dead in this position.

In the pre-heating position the slotted eye of the bowden cable is set in such a way that the eye does not touch the adjusting lever, i.e., the adjusting lever is not actuated.

d) 2 = Starting Position

After the completion of the pre-heating operation the handle of the glow starter switch is turned fully clockwise past the resistance indicating position 1 and is pressed against the stop until the engine starts.

In the starting position the pin of the adjusting lever rests against the other end of the eye (compared to stop position) and presses the adjusting lever fully towards the front. By this the control rod is moved fully in direction "full" beyond the full load stop and the injection pump injects the starting fuel quantity.

In addition to the terminal 19, the terminals 50 and 17 are supplied with power. The starter (8) functions via the terminal 50. The glow plugs (5) are still supplied with power by way of the terminal 17 during the starting position, the glow control light (3), however, is bridged via the lead (17) and therefore out of operation (see Figure 15-33/1). The switching-off of the glow control light prevents that the heat output of the glow plugs is reduced too much during the starting operation.

If the handle of the rotary switch is released after the engine has started, the handle will go back to the driving position, position 0.