

# Self-regulating pencil type glow plugs

## *Design and function*

The BERU glow plug basically comprises the plug body, heating rod with heating and regulating coil, as well as the connecting bolt. The corrosion resistant glow rod is pressed in the housing so that as to be gas-tight. The plug is additionally sealed by a sealing ring or a plastic component at the connector. A battery supplies the electrical energy for the glow plug. It is controlled by an electronic glow time control unit.

### HEATING AND REGULATING COIL

The basic principle of a modern glow plug is the combination of a heating and a regulating coil into a single common resistor element. The heating coil is made of high-temperature resistant material the electrical resistance of which is largely temperature-independent. Together with the front part of the glow rod, it forms the heating zone. The regulating coil is attached to the live connecting bolt; its resistance has a large temperature coefficient.

The entire coil is firmly packed in a compressed, electrically insulating but highly heat-conductive ceramic powder. During mechanical compaction, the powder is compressed so much that the coil is fitted as if it was cast in cement. This makes it so stable that the thin wires of the heating and regulating coil can permanently resist all vibrations. Even though the individual windings are arranged only a few tenths of a millimeter apart, no winding short circuits can be produced – and certainly no short circuit to the glow tube, which would destroy the plug.

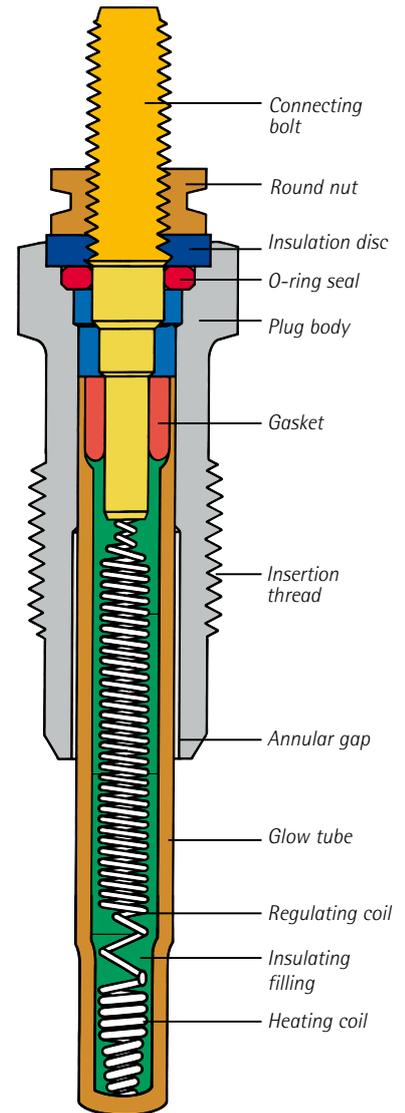
With the different materials, lengths and diameters, and different wire thicknesses for the heating and regulating coil, it is possible to change the heat-up times and glow temperatures of the plug in accordance with the respective requirements of the engine.

### FUNCTION

During pre-heating, a high current initially flows via the connecting bolt and the regulating coil to the heating coil. The latter heats up quickly, causing the heating zone to glow. Glowing quickly expands – after 2-5 seconds, the heating rod glows up to near the plug body. This additionally increases the temperature of the regulating coil that has already been heated up by the current. Then, the electrical resistance increases and the current is reduced to a point where it cannot cause any damage to the glow rod. Overheating of the glow plug is thus not possible.

If the engine is not started, the glow plug will be switched off by the glow time control unit after a certain stand-by time.

The resistance of the alloy used on BERU glow plugs increases with the temperature. It is thus possible to design the regulating coil in such manner that it will initially let through a higher current to the heating coil than when it reaches the target temperature. The target temperature is thus reached quicker and is maintained within the permissible range by an increased regulating effect.



Design of a self-regulating, fast-heating pencil type glow plug.

# Self-regulating pencil type glow plugs

## *Post-heating pencil type glow plugs (GN)*

Older vehicle models are normally equipped with glow plugs that only glow before and during the start phase. They can be recognized from the abbreviation GV. Modern Diesel passenger cars normally leave the assembly line with fitted GN glow plugs. They are equipped with the innovative 3-phase glow system. This means that they glow

- before the start,
- during the start phase,
- after the start, and
- during engine operation (in coasting mode).

### FUNCTION

The electronically controlled pre-heating starts when the ignition lock starter switch is operated and lasts for approx. 2-5 seconds at normal outside temperatures until the engine is ready to start. The post-heating time is up to 3 minutes after starting the engine to reduce pollutant and noise emissions to a minimum.

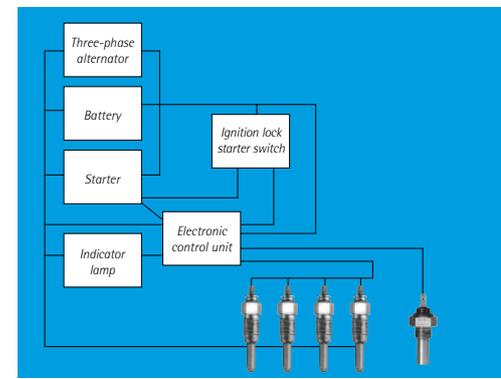
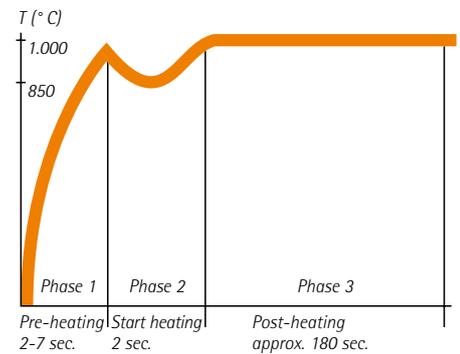
The engine operating state is registered e.g. by measurement of the coolant temperature. The post-heating process is continued until the coolant has reached a temperature of 70 °C, or it will be switched off after a certain time which is set in the performance map. No post-heating will normally take place if the coolant temperature was already higher than that before starting.

### PROTECTION AGAINST OVERHEATING

Self-regulating glow plugs restrict the current flowing from the battery to the plug with increasing temperature to prevent overheating. However, when the engine is running, the voltage will increase to a point where glow plugs that do not comply with the newest technology will blow. Besides, the plugs that are supplied with current are exposed to high combustion temperatures after the start, and are thus heated up from the inside and the outside. The post-heating BERU glow plugs are functional at full generator voltage. Their temperature increases very quickly, but will then be limited by the new regulating coil to a saturation temperature that is lower than that of non post-heating plugs.

Important: Only GN glow plugs may be installed in a glow system designed for GN glow plugs – GV glow plugs could be damaged very quickly.

The 3-phase glow technology.



Circuit design principle for a post-heating glow system with four fast-heating glow plugs connected in parallel and a temperature sensor.