

Knock Control

Tasks of the knock control system

Operation of an engine with knocking combustion over a prolonged period can lead to serious damage. Knocking tendency is increased by:

- Increased compression ratio
- High cylinder charge
- Poor fuel quality (RON/MON)
- High intake air and engine temperatures

The compression ratio can also reach excessively high values due to deposits or production-related scatter.

On engines without knock control, these unfavourable influences must be taken into consideration in the ignition design by providing a safety distance to the knock limit. However, this results in unavoidable losses in efficiency in the upper load range.

The knock control can prevent knocking engine operation. It retards the ignition timing of the affected cylinder (s) (cylinder-selective) only as far as necessary and only if there is an actual risk of knocking. In this way, the ignition characteristic map can be adapted to the optimum consumption values. A safety distance is no longer necessary. The knock control handles all the knock-related corrections at the ignition point.

The knock control provides:

- Protection against knocking damage also under unfavourable conditions
- High efficiency due to optimum utilization of the fuel quality and consideration of the relevant engine status
- Logistics advantages with regard to fuel availability
- Lower consumption and higher torque over the entire upper load range depending on the fuel quality used.

Design of knock control system

This engine is equipped with a cylinder-selective, adaptive knock control system. Central components of this system are the knock sensors. These piezoelectric sensors record the structure-borne sound of the individual cylinders and convert them into voltage signals. The sensor signals are evaluated in the DME control units on a cylinder-selective basis. A special evaluation circuit (knock module) is used in the control unit to achieve this.

One sensor monitors two cylinders. Two sensors are in turn grouped into one component (double knock sensors).

Function of the knock control system

When knocking combustion occurs, the affected cylinder emits a characteristic structure-borne sound profile that is picked up by the knock sensors. Based on this signal, the ignition is retarded for a certain number of cycles. As soon as combustion knock is no longer detected, the ignition point gradually approaches the original value. Retarding the ignition timing can be controlled individually for each cylinder (cylinder-selective). The DME control unit evaluates the knock signal for each cylinder only in the operating range relevant to knocking.

Installation location and conditions

The double knock sensors are secured by means of a screw to the water jacket of the engine block between every two cylinders of a cylinder bank.

Only screw locking compound may be used to lock the screws. Washers, spring washers or toothed lock washers must not be used as they would falsify the knock signal.

Self-diagnosis and emergency operation of the knock control system

Self-diagnosis of the knock control system includes the following:

- Check for sensor signal interference/line break, plug connector defective etc.
- Self-test of evaluation circuit
- Check of the basic engine noise level recorded by the knock sensors

If a fault is detected during the test or during engine operation, the knock control is deactivated. An emergency program then adopts the task of controlling the ignition timing. At the same time, a fault code is entered in the fault code memory of the DME control unit. The emergency program ensures damage-free engine operation, depending on the engine load, speed and temperature.