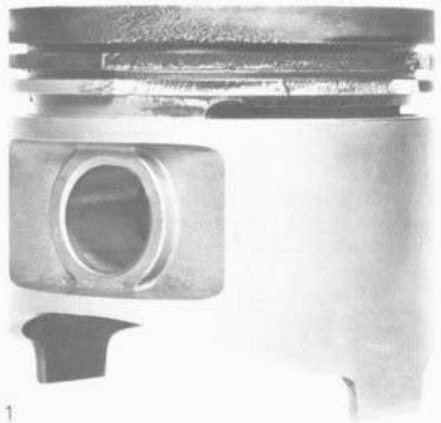
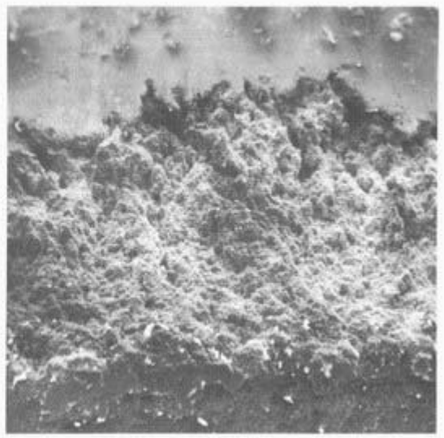
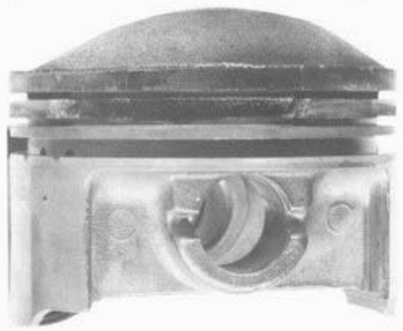
2.2.2



1

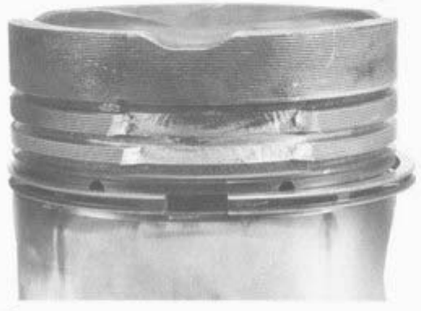


4 Edge of piston crown
(SEM magnification 500:1)



2

5 Groove side
(SEM magnification 500:1)



3

2 Ring lands

2.2.2 Breakage of the ring lands caused by faulty combustion

Symptoms

The compression rings have seizure marks around their entire periphery -they are "scuffed". The cylinder bore which is also affected exhibits longitudinal marks. As a result, piston seizures may occur in the lower ring belt or upper skirt area.

Cause and Effect

In the interest of clarity, the factors affecting Otto engines (Figure 1 and 2) and Diesel engines (Figure 3) are dealt with separately.

Otto engine

Knocking combustion - pinging - leads to a high pressure rise of up to 300 bar per degree crank angle (normal value approximately 3-5 bar/degree crank angle) and to a vibration similar to ultrasonics as well as simultaneously to overheating as the result of an irregular progression of the combustion.The temperature and the compressional vibrations lead to cracking of thering land - which is designed for normal operating conditions - and subsequent breakage progressing from top to bottom.

In the case of the particularly dangerous high-speed pinging, the result is severe heating of the piston crown. Causes of the faulty combustion areover-advanced ignition, an over-lean fuel/air mixture for full load, or fuel with an octane rating which is too low, or an increase in compression caused by deposits in the com bustion chamber (city driving). Excessive temperature of the intake air (faulty preheating of the air) can also lead to knocking,since a higher octane rating is required in this case. Basically, traces of erosion especially on the top land and the edge to the top groove are clear indications to faulty combustion, i.e. knocking and pinging.

Diesel engine

Knocking combustion, caused, however, in this case, in contrast to the Otto engine, by an excessive ignition delay, also leads to high pressure peaks. These cause the ring lands to be mechanically overloaded. The causes of this ignition delay are wrong injection timing (over-advanced or overretarded), an excessive injection quantity (poor swirl action), excessive delivery of fuel from starting devices or inadequate ignition characteristics of the Diesel fuel (cetane rating too low).

Remedy

On Otto engines, use an anti-knock fuel with the recommended octane rating. If heavy deposits have built up in the combustion chamber after lengthy short-haul driving, first allow the engine to "loosen up" (restrained driving for the first 100 kilometres) before subjecting the engine to full load, in order to avoid dangerous high-speed pinging.

Do not alter the basic setting of the carburetor (nozzles) to try to save fuel with a lean mixture. Do not over-advance the ignition timing.

In the case of Diesel engines, set the injection quantity and injection timing in accordance with the engine data. Check the injection nozzles.