MOTORSERVICE
RHEINMETALL AUTOMOTIVE

Practical know-how

Our knowledge for your work

SERVICE
TIPS & INFO

POSTER
INSIDE

KOLBENSCHMIDT

Piston damage – recognising and rectifying!

It is unfortunately no rarity to find that damage and failure reoccur after an engine has been repaired, because the damaged components have been replaced but the cause of damage has not been eliminated. A precise root cause analysis is therefore an essential part of professional reconditioning to help identify the fault. If an expert is only presented with a faulty part with no further information on the service life or the extent of the damage, specific diagnostics is often difficult.

3.4 | Damage due to abnormal combustion

Ring land fractures

Description of the damage
- Ring land fracture on one side of the piston between the first and second compression ring (Fig. 1).
- Fracture, starting at the groove base at the top and running at a diagonal angle into the piston material, emerging at the groove base underneath (Fig. 2).
- Fracture is extended downwards.
- No piston seizure marks or signs of overheating.

Fig. 1

Fig. 2 Cross section of fracture

Damage assessment
Land fractures are not caused by material faults, but by material overload. A distinction can be made between 3 different causes:

1. Knocking combustion:
The octane rating of the fuel was not capable of covering the engine's needs under all operating and load conditions (refer to the chapter entitled "General information about piston damage due to abnormal combustion in petrol engines").

Ring land fractures caused by knocking combustion usually occur on the pressure side. On a diesel engine, knocking combustion is caused by an ignition delay.

36 | Piston damage – recognising and rectifying

MOTORSERVICE
RHEINMETALL AUTOMOTIVE

Damage d

2. Hydraulic locks:
Liquid (water, coolant, oil or fuel) accidentally enters the combustion chamber when the engine is stopped or running. As the liquid is incompressible, the piston and crankshaft drive are subjected to enormous stresses during the compression cycle. This results in ring land fractures, boss fractures or connecting rod/crankshaft damage.

Fig. 3 shows the course of a
occurs with knocking comb
hydraulic locks: the force
fracture and acting from a
land causes the fracture
extend downwards.

3. Installation faults:
If the piston rings are incorrectly compressed, more force is required when installing the piston. Forcibly pressing in or knocking in the piston causes pre-damage to the ring lands in the form of fine hairline cracks.

The ring lands fracture i
direction as the pressur
below in this case (Fig.

Possible causes for the damage

Knocking combustion on petrol engines:
- Fuel without suitable anti-knock properties. The fuel quality must correspond to the compression ratio of the engine, i.e. the octane rating of the fuel must cover the octane requirements of the engine under all operating conditions.
- Petrol contaminated by diesel, which lowers the octane rating of the fuel.
- Excessively high compression ratio caused by excessive machining of the engine block surface and cylinder head mating surface, e.g. for engine reconditioning or tuning purposes.
- Ignition timing too advanced.
- Mixture too lean, resulting in higher combustion temperatures.
- Intake air temperatures too high, caused for example by inadequate ventilation of the engine compartment or incorrect switching of the intake air flap to summer operation (particularly on older carburettor engines).

Knocking combustio
- Injection nozzles w
or leaks.
- Injection pressure
too low.
- Compression pres
correct cylinder h
piston protrusion
or damaged/wo
- Defective cylind
- Damage to the p
- Improper or exc
(e.g. starting sp
- Defective turbo

KOLBENSCHMIDT

Extract from the brochure

This brochure gives interested readers an insight into the various potential forms of damage deep inside a combustion engine and helps the expert with diagnostics and cause analysis. Like in the specialist field of medicine, a holistic approach is required when assessing engine damage to enable the cause(s), which may not always be obvious, to be identified.

Further details on the topic can be found in our brochure "Piston damage – recognising and rectifying", Reference number 50 003 973-02 (English) or at www.ms-motorservice.com

MOTORSERVICE
RHEINMETALL AUTOMOTIVE

Motorservice Partner:

Headquarters:
MS Motorservice International GmbH
Wilhelm-Maybach-Straße 14–18
74196 Neuenstadt, Germany
www.ms-motorservice.com

4 028977 611797
50 003 801-02 – EN – 11/14 (072017)

MOTORSERVICE
RHEINMETALL AUTOMOTIVE

Piston damage and causes

Piston crown damage

Seizure due to overheating (mainly piston crown)

- Overheating due to combustion defaults
- Bent/blocked oil injection jet
- Installation of incorrect pistons
- Malfunctions in the cooling system
- Clearance restriction in the upper sliding surface area

Impact marks

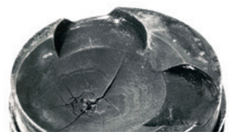
- Piston protrusion too great
- Excessive remachining of the cylinder head sealing surface
- Incorrect valve recess
- Incorrect cylinder head gasket
- Carbon deposits on the piston crown
- Insufficient valve clearance
- Incorrect valve timing caused by incorrect adjustment or a slipped toothed belt

Fused/melted off material

- Faulty injection nozzles
- Incorrect quantity of injected fuel
- Incorrect injection point
- Insufficient compression
- Ignition delay
- Oscillating injection lines

Cracks in the crown and crown bowl

- Faulty or incorrect injection nozzle
- Incorrect injection point
- Incorrect quantity of injected fuel
- Insufficient compression
- Lack of piston cooling
- Installation of pistons with incorrect bowl shape
- Improvement in performance (e.g. chip tuning)



Piston ring damage

Material washout in the ring area

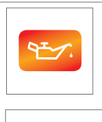
- Incorrectly installed pistons
- Fuel flooding
- Severe axial wear of the ring groove and piston rings
- Ring flutter

Radial wear due to fuel flooding

- Fault during mixture formation
- Combustion defaults
- Insufficient compression pressure
- Incorrect piston protrusion dimension

Axial wear due to ingress of dirt

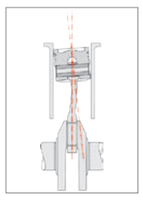
- Abrasive dirt particles due to inadequate filtration
- Dirt particles that are not completely removed during reconditioning of the engine (chips, blasting agent)
- Abraded particles caused when the engine is being run in



Piston skirt damage

Asymmetrical piston wear pattern

- Bent/twisted connecting rod
- Connecting rod eyes bored at an angle
- Cylinder bore not straight
- Individual cylinders not installed straight
- Excessive connecting rod bearing clearance



45° seizure

- Excessively narrow fit of the piston pin
- Seizure in connecting rod eye (inadequate lubrication at initial start-up)
- Incorrectly installed shrink-fit connecting rod

Dry running/Fuel damage

- Over-rich engine running
- Combustion defaults (misfiring)
- Insufficient compression
- Defective cold-start device
- Oil dilution with fuel

Cylinder liner damage

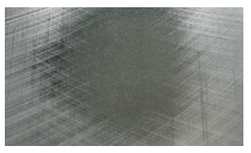
Cavitation

- Poor/inaccurate seating of the cylinder liner
- Use of incorrect O-ring seals
- Use of unsuitable coolant agent
- Insufficient prepressure in the cooling system
- Operating temperature too low/too high
- Restricted coolant flow

Bright spots in the upper cylinder area

Carbon deposits on the piston top land due to:

- Excessive ingress of oil into the combustion chamber due to defective components
- Increased emissions of blow-by gases with oil entering the intake air system
- Insufficient separation of oil vapour from the blow-by gases
- Frequent idling or short-distance drives



Further details on this subject can be found in our brochure "Piston damage – recognising and rectifying".
Or ask your local Motorservice partner.
We have also provided a lot more information for you at www.ms-motorservice.com and on our Technipedia at www.technipedia.info.

The Motorservice Group is the sales organisation for the worldwide aftermarket activities of Rheinmetall Automotive. It is a leading supplier of engine components for the independent aftermarket. With the premium brands Kolbenschmidt, Pierburg, TRW Engine Components and the BF brand, Motorservice offers its customers a wide and comprehensive range of top quality products from a single source.

www.ms-motorservice.com

4 028977 520242

KOLBENSCHMIDT