KOLBENSCHMIDT

POSTER INSIDE

PRODUCT KNOWLEDGE

PISTON RINGS –
SEALING UNDER EXTREME CONDITIONS

OUR **HEART** BEATS FOR YOUR ENGINE.

MOTORSERVICE
RHEINMETALL AUTOMOTIVE

KOLBENSCHMIDT PISTON RINGS. CONTROLLED APPLICATION OF FORCE.

Inertia and gas loads, as well as high temperatures, place high technical demands on piston rings. An optimum service life and adherence to emissions regulations are only achieved by tailoring piston rings precisely to the particular engine.

Design, dimensions, material selection and a precise production process are essential for ensuring controlled contact pressure, which determines how well the rings function.

Casting process for piston ring castings (die casting)

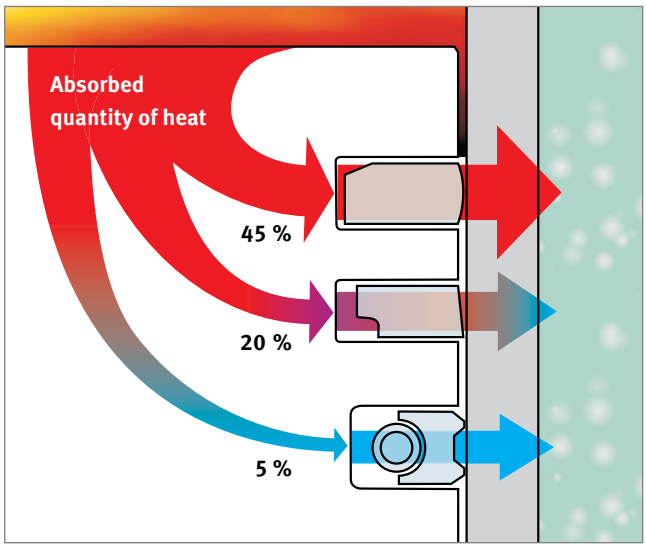
Grinding the piston ring sliding surface

Internal lathe – manufacturing the inner contours

Phosphate coating plant

Molybdenum coatings

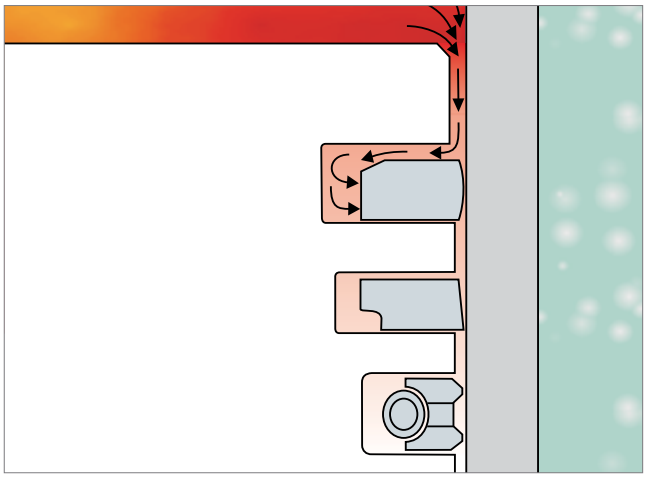
To protect the rings against burn marks, the sliding surface of the rings can be filled or coated on one surface with molybdenum. Flame spraying or plasma spraying procedures can be used for this. Thanks to its high melting point (2,620 °C), its porous structure and its lubricating effect, molybdenum provides more durable piston ring sliding surfaces.



Continuous heat dissipation

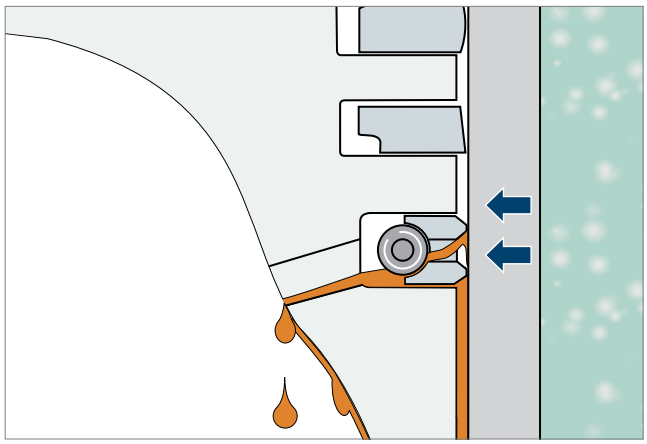
Temperature management is a vital task of the piston rings. Most of the heat that is absorbed by the piston during the combustion process is dissipated by the piston rings to the cylinder. Without this continuous heat dissipation, the aluminium piston would melt within minutes.

Compression rings dissipate up to 70 % of the piston temperature to the engine block.



Pressure is essential

Only the proper amount of combustion pressure will enable compression rings to fully perform their sealing function. The internal stress of the rings only performs the basic function, which is to create contact with the cylinder wall. The far higher pressure force – up to 90 % of the total pressure force – is generated by the combustion pressure during the combustion cycle. The pressure is applied behind the piston ring (see illustration) and increases the pressure force on the cylinder wall.



Two are better than one

Two scraping lands on oil control rings ensure that the oil film thickness of 1 – 2 µm required for lubrication is always achieved, but never exceeded. Low oil consumption and mixture flow rate, as well as a long service life of the associated parts, are implemented in a virtually ideal manner.

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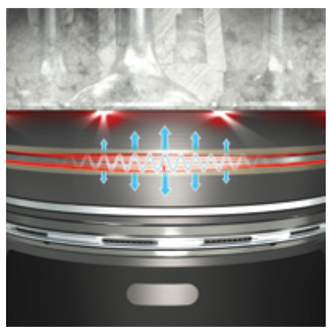
KOLBENSCHMIDT

DAMAGE DIAGNOSIS

PISTON RINGS

INCORRECT RECONDITIONING

Piston impact on the cylinder head

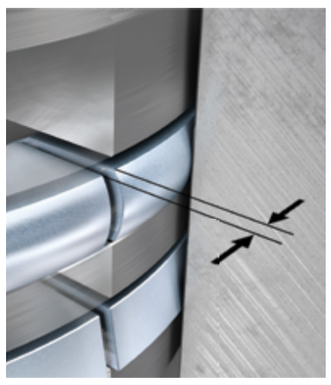


If the sealing area of an engine block is reconditioned and a piston with standard compression height fitted, this may cause mechanical impact by the piston on the cylinder head in the case of diesel engines. The same occurs if cylinder head gaskets with the wrong thickness are fitted. Due to these hard impacts, the piston rings start to flutter and no longer seal properly.

Consequence: High oil consumption and high cylinder wear (see also „Fuel flooding“)

Remedy: Compliance with the correct piston protrusion, use of the correct cylinder head gaskets

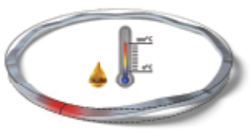
Piston ring joint clearance too small



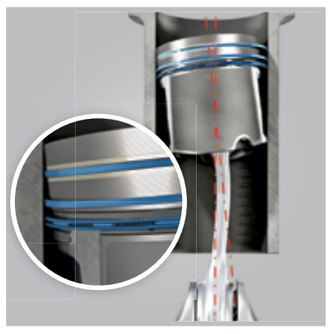
The piston ring joint clearance is comparable to the valve clearance. Warming up the parts causes thermal expansion of the components and a change in length. The joint clearance when the machine is cold ensures that the piston rings in the cylinder will not get stuck when the machine is hot. If the joint clearance is too small when the machine is cold, there will be high piston ring wear, sealing problems and engine damage when the engine is hot.

Consequence: Premature piston ring wear, piston seizure and high oil consumption

Remedy: It is essential that the minimum joint clearances are complied with – a reduction of the joint clearance by the repair shop is not permitted



Asymmetric piston wear pattern



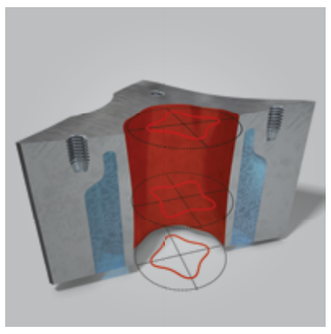
Bent connecting rods, which often occur as a result of engine damage, cause the piston to run at an angle in the cylinder. The piston rings consequently take on an elliptical form and no longer rotate in the piston. This results in uneven wear and ring flutter.

Consequence: High level of wear, ring fractures and excessive oil consumption

Remedy: Check the connecting rod for distortion and twisting before installing it

INSTALLING WORN PARTS

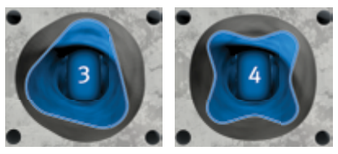
Out-of-round cylinders



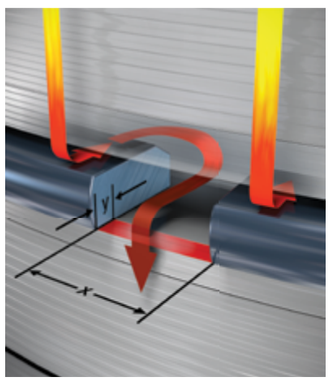
When machining the cylinder bores, it is essential to make sure that the geometry is perfect. Piston rings can still seal slightly oval cylinders.
However, sealing becomes difficult for 3rd and 4th order out-of-roundness. These often occur due to tensile stresses from the cylinder head bolts. The crescent-shaped gaps caused by out-of-roundness between the piston ring and cylinder will result in leaks.

Consequence: Poor performance, excessive oil consumption and engine damage

Remedy: Observe cylinder head tightening specifications or eliminate out-of-roundness during cylinder machining

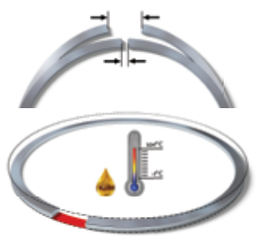


Piston ring joint clearance too great

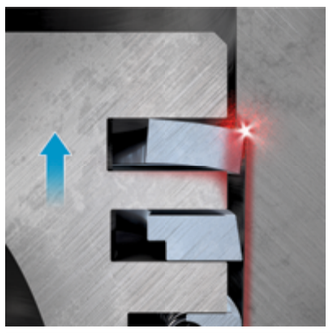


An excessive joint clearance on the piston rings appears after a long service life and high wear on the cylinders and piston rings. The joint clearance is too great if it has doubled its size compared to its new condition. Increases in clearance of up to 0.3 mm are negligible. They contribute neither to a notable loss of engine power nor to high oil consumption. The significance of a slightly enlarged piston ring joint clearance is often over-estimated. See also "Piston ring joint clearance too small".

Remedy: Replace worn pistons and cylinders



Worn cylinders

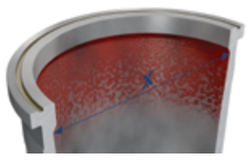


If new pistons and piston rings are installed in a worn cylinder, the piston rings often hit the upper wear edge of the cylinder. As a result, the piston rings start to flutter and no longer seal properly.

See also "Piston impact on the cylinder head" and "Dirt in the intake air"

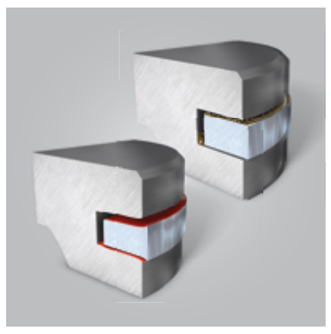
Consequence: High oil consumption and premature wear

Remedy: Replace worn cylinders or rebore cylinders



MAINTENANCE FAULTS

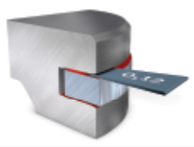
Dirt in the intake air



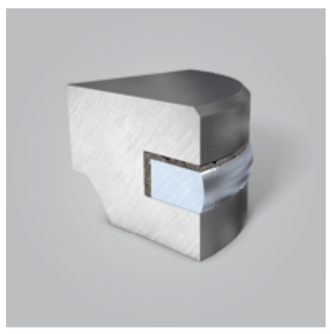
Dirt that reaches the combustion chamber settles in the ring grooves where it causes abrasive wear in the ring grooves and at the piston ring flanks. This results in excessive ring height clearance and consequently to a deterioration of the guidance of the piston rings in the ring grooves. The rings will become bent during use and start to flutter. If the rings are severely worn at the sides, they can break.

Consequence: High oil consumption and poor performance

Remedy: Regular air filter maintenance, particularly in dusty areas



Blocked piston rings



Piston rings must be able to rotate freely in their ring grooves during operation (exception: two-stroke engines). If the piston rings are blocked by carbon deposits or dirt in the ring grooves, they are no longer able to seal properly and will not wear uniformly. It the rings get stuck in the grooves, the sealing effect is no longer guaranteed. This causes a blow-by of combustion gases on compression rings, and results in the passage of oil into the combustion chamber on oil rings.

Consequence: Piston seizure, high wear and high oil consumption

Remedy: Regular air filter maintenance and use of engine oil with the right oil specification for the engine

COMBUSTION DEFAULTS

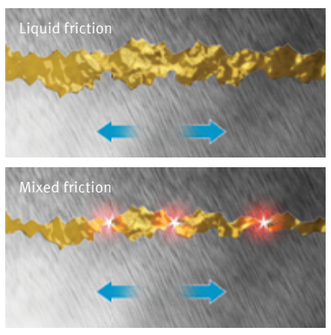
Knocking combustion and glow ignition

Knocking combustion and glow ignition causes excessive pressure peaks in the cylinder and high mechanical stress on the parts. The piston rings start to flutter and can break. With molybdenum-coated rings, the molybdenum layer can break away.

Consequence: Piston seizure, loss of engine power and/or high oil consumption

Remedy: Use of high-grade fuels

Fuel flooding



The oil film is washed off due to incomplete combustion of the injected fuel or too much injected fuel. This causes mixed or dry friction of the piston in the cylinder. The metal parts rub against one another.

Consequence: High ring and cylinder wear, high oil consumption

Remedy: Correct function and adjustment of the fuel system

You can receive more professional knowledge, direct from the experts, from your local Motorservice partner and on: www.ms-motorservice.com/tech

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