KMP BRAND TECHNICAL BULLETIN

Diagnosing Common Complaints on Cylinder Liners

KB - 15001 PART 2

DIAGNOSING COMMON COMPLAINTS ON CYLINDER LINERS

Continuing from KB-15001

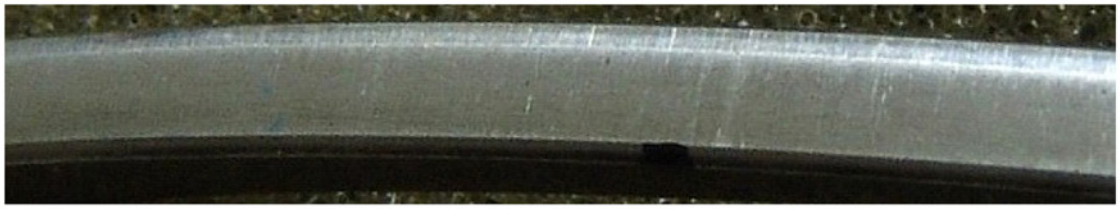
- PREMATURE WEAR
- GLAZING/POLISHING
- CAVITATION EROSION

In addressing "**premature wear**" it is assumed that the engine has been recently overhauled and has developed abnormal oil usage and blow-by.

In the majority of the cases abrasive contamination was the cause of the customer's complaint.

Examples of wear patterns from abrasive contamination are shown below.

THE RAILS OF THE OIL RINGS HAVE BEEN WORN AWAY, COMPARE THE APPEARANCE WITH A NEW OIL RING SHOWN BELOW



THE FACES OF THESE COMPRESSION RINGS EXHIBIT FINE VERTICAL SCRATCHES

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DIAGNOSING COMMON COMPLAINTS ON CYLINDER LINERS

THE SIDE OF THIS COMPRESSION RING HAS BEEN DAMAGED BY CONTAMINATION AS THE RING ROTATED IN THE RING GROOVE IN THE PISTON

VERTICAL SCORING IN THE BORE OF THE LINER AS THE RESULT OF ABRASIVE CONTAMINATION

Besides damaging piston rings, pistons and cylinder liner bores the contamination will damage any component where movement takes place, so connecting rod and main bearings as well as the crankshaft journals would also sustain some degree of wear.

So where did the contamination originate from ??

- Air intake system

  Damaged or incorrectly assembled air filter elements, loose or damaged hoses or tubes, missing or damaged gaskets or seals.

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❖ Contaminated oil

Bulk storage of oil can sometimes result in the contamination if the container used for the transfer of the oil is not perfectly clean.

❖ Built in dirt

Whilst every precaution is taken when overhauling an engine, mistakes can occur.
An engine has many areas were dirt can become lodged, oil galleries in the block and crankshaft are a prime example. If bores have been honed or a crankshaft has been ground then any residual debris should be properly removed prior to assembly. During the assembly process many components are lubricated prior to fitment, and if the bench area is not clean it is possible for debris to adhere to the "oiled" component and be assembled into the engine – with catastrophic results.

If the source is identified then the education of the persons concerned would go a long way in preventing a reoccurrence of the problem.

GLAZING AND POLISHING

The bores of cylinder liners are plateau honed to produce a surface finish made up of peaks and valleys; these are essential because when the engine is operating the valleys contain the oil which lubricates the piston rings as they travel up and down the liner.
Glazing and polishing are often thought to be one and the same; this is not true, even though their appearances are similar.

➢ Glazing - after an engine overhaul it used to be common practice to leave the engine idling for a while, for it to "bed in" – and this is what causes glazing because the combustion bi-products which are created, tend to form a skin over the honing pattern in the bore of the liner. When this occurs the piston rings can no longer form the required "seal" for oil control and good compression.

In bore glazing the valleys become filled with lacquer, displacing oil and thus preventing correct ring lubrication

General recommendations are to run the engine for a maximum of five minutes whilst checking for oil/water leaks and that the correct oil pressure is being achieved. *An overhauled engine should never be allowed to idle for longer than this period of time.* Load should then be applied to the engine and recommendations vary from 60% to 80% for a minimum of two hours; however, if a manufacturer's specifications are available they should be strictly adhered to. Of course the ideal situation would be to run the engine on a dynamometer where load factors, temperatures, oil pressures and horsepower output can all be monitored and controlled.

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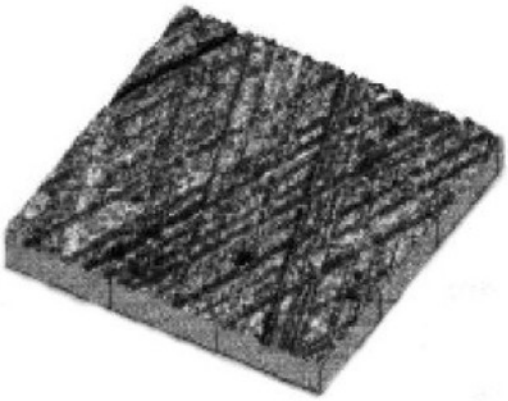
➢ Polishing - this normally occurs at higher hours after an engine overhaul and can also result in high oil consumption and in extreme cases, scuffing and seizure; this is because of the deterioration of the oil film.

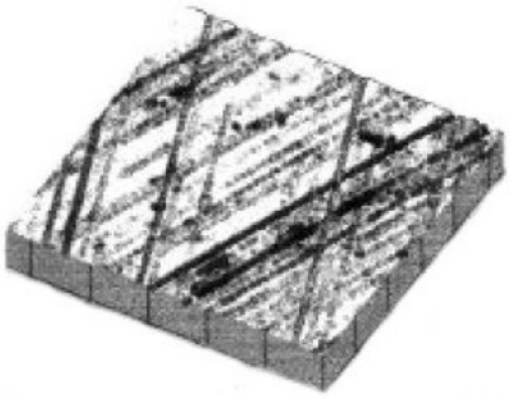
A combination of high temperatures and carbon build-up gradually wear away the critical honing pattern in the bore of the liner. Without the critical oil retention in the "valleys" of the honing pattern, the rings will no longer be adequately lubricated and there will be an increase in oil consumption.

When the bore surface becomes polished all peaks and most valleys become worn away, also preventing correct ring lubrication

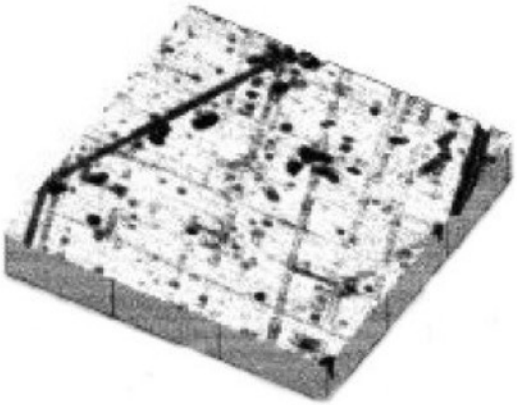
Below are magnified examples of varying degrees of polishing.



NO POLISHING



LOW POLISHING



MEDIUM POLISHING

HEAVY POLISHING

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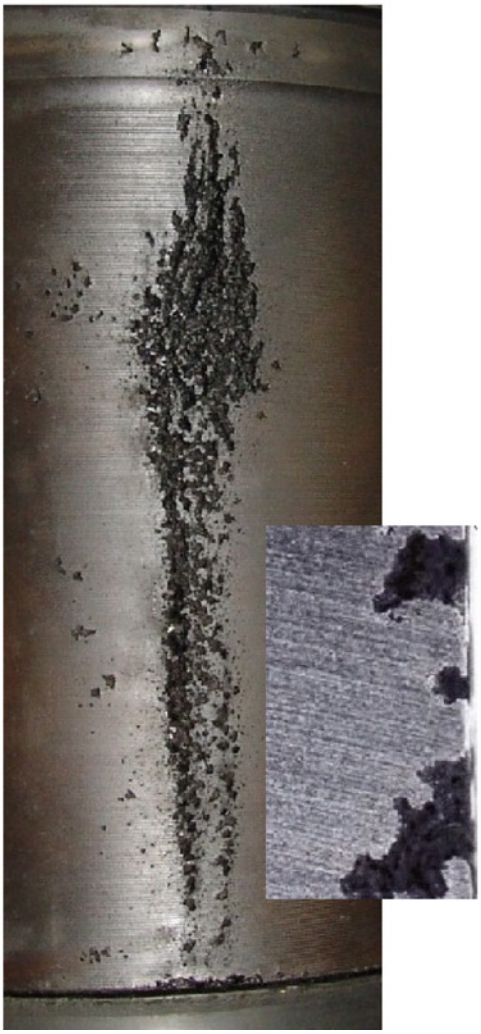
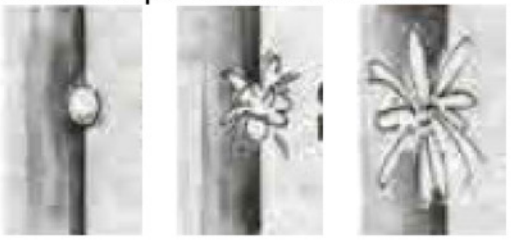
CAVITATION EROSION

This damage did not occur because the liners were made from an inferior material, it is a phenomenon which has been researched and commented on for decades.



Imagine the disastrous effect if the cavitation perforated through the liner and coolant entered the combustion area – it can happen.

Cavitation erosion is caused by the harmonic engine vibrations which result in the formation of small air pockets between the coolant and the liner (air bubbles) and when they collapse they remove minute particles of the liner.



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So how can the effect of cavitation erosion be reduced ?
The first step is to maintain a good coolant condition by adding a suitable coolant conditioner, this is offered by KMP against part number 3P2044.
Certain operating conditions will also require antifreeze to be added to the cooling system, however the coolant conditioner will also be required. Whilst the antifreeze may contain a coolant conditioner this will be depleted during normal operation and therefore needs to be replenished.
The correct cooling system pressure is also important; it can assist in reducing the amount of air bubbles that will be present in the system – so another important point would be to eliminate any leaks or replace a loose or leaking radiator cap.
As previously mentioned, cavitation erosion is ultimately the result of vibration, so as a consequence, anything that could cause unnecessary vibrations should be eliminated.

An extract from an independent report carried out on three different liners

Comparing samples A, B & C all the cylinder liners are supposed to be of alloyed grey cast iron in a heat treated condition, it is not possible to classify any one as substandard or otherwise. Performance wise cylinder liner A has the least cavitation, even after 189,000 miles. At the same time liner B which has similar characteristics has appreciable cavitation. In the other group C has additional molybdenum and nickel, would enhance strength with lesser residual stresses. However the principal elements that would promote corrosion resistance are chromium, silicon and copper. All the three elements are comparatively lesser in C than the other group. Even if excessive cavitation in C is excused for that, there is no plausible material reason why B would perform inferior to A. It is therefore logical to conclude that the main reason for excessive cavitation is aggressive environment rather than the material or its heat treatment condition. The quality of coolant and its circulation could be play a major role in observed cavitation.

Acknowledgements to the originators of the original report.

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