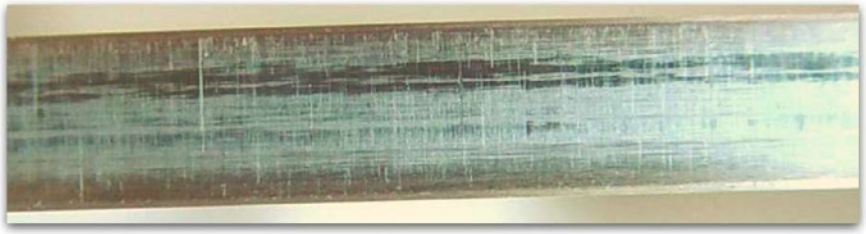
KMP BRAND TECHNICAL BULLETIN

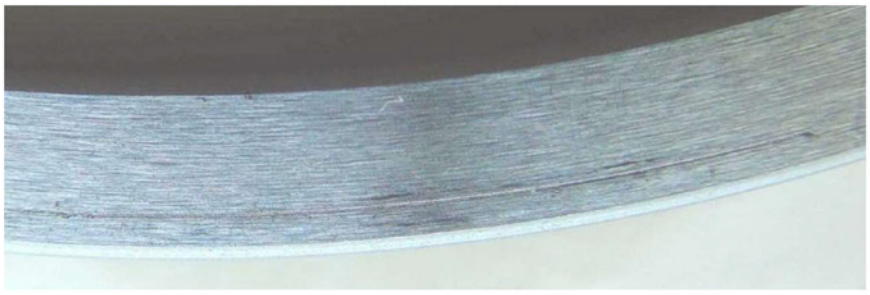
Piston Failures - Part 2

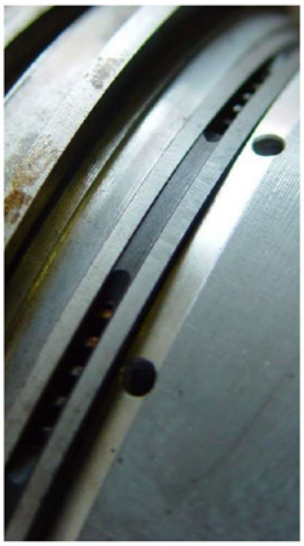
KB-15003-2

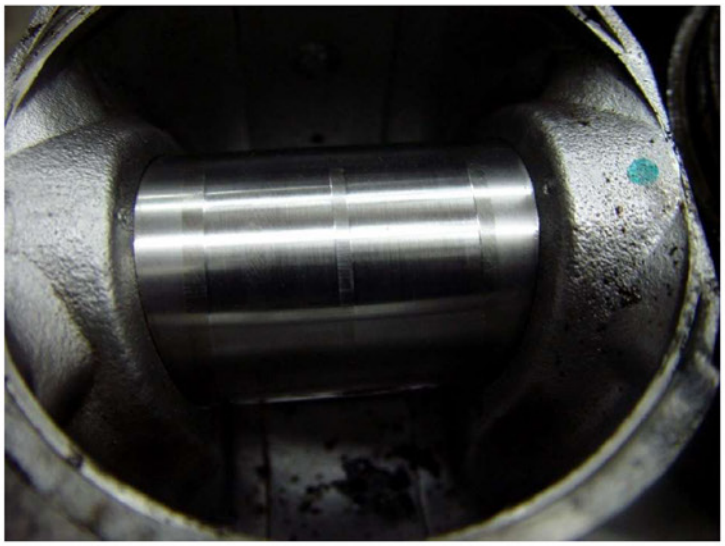
PISTON FAILURES

As mentioned previously the piston rings and also the gudgeon pins will also exhibit wear patterns indicating that there was abrasive contamination present whilst the engine was operating.









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PISTON FAILURES

So where did the contamination originate from ??

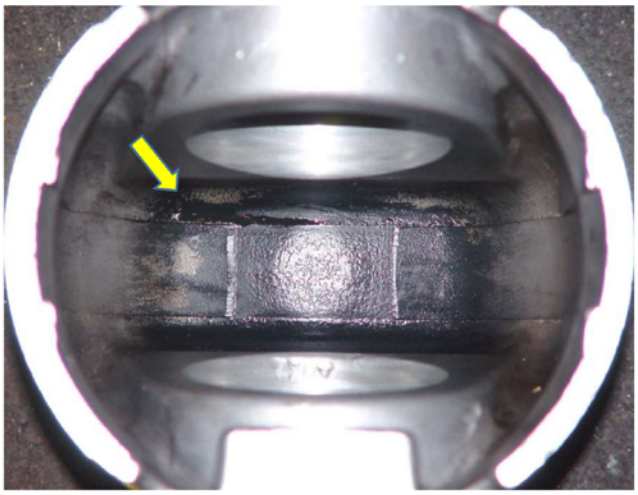
If failure occurs shortly after an engine overhaul/repair there is a very strong possibility that the contamination was "built-in". The majority of engine parts are lubricated prior to installation, but if the work bench is not clean, there is a possibility that dirt could adhere to a component prior to installation.
If there has been a grinding or honing procedure it is important to make sure all galleries and surfaces are thoroughly cleaned prior to assembly.
Contamination can also originate from the air intake system so it is important to adhere to regular servicing of the filters, and also to check that all connections between the air filter and engine intake are not damaged or loose.
Oil servicing is another possible source of contamination but it is difficult to differentiate between the built-in dirt and dirt introduced with oil; however, if the contamination was introduced via the oil, this tends to cause damage to the crankcase components and the piston skirt below the ring belt and the upper portion of the piston remains relatively undamaged.

If abrasive contamination could be eliminated this would be a major contribution to the prevention of premature engine failures.

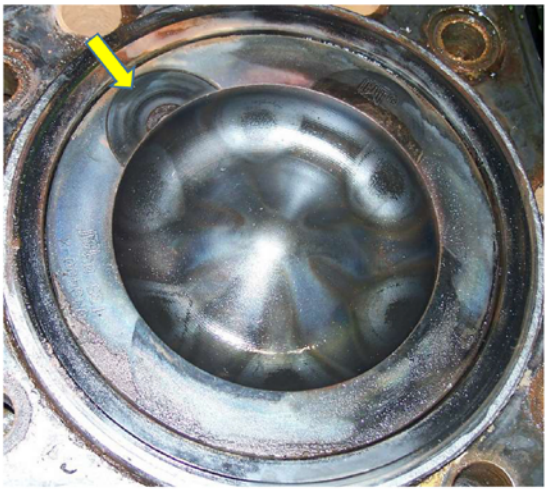
ENGINE OPERATION

Lugging - is when the engine is operated at low engine revolutions with high loading and as a consequence there is a decrease in the volume of fresh air intake which results in piston crown overheating.

Over-speeding - is when the engine is run at more than the manufacturer's recommended rated speed; the higher engine revolutions can stretch the component tolerance "stack-up" which causes the piston crown to contact the valves. The resultant material displacement on the piston crown can then result in the elimination of running clearance between the piston and the liner wall – an adhesion condition would then lead to seizure of the piston.



An indication of high combustion temperatures



Valve head and piston crown contact

Other possible causes of valve and piston crown contact are - valve timing incorrectly set, excessive connecting rod bearing clearances due to wear or failure, loose connecting rod bolts, or machining of the engine block/cylinder head but the material removal is not compensated for.

ASSEMBLY ERRORS

If the type of damage shown in the following photograph is evidenced shortly after an engine overhaul, then there is a very strong possibility that the piston ring was broken when the piston was fitted into the

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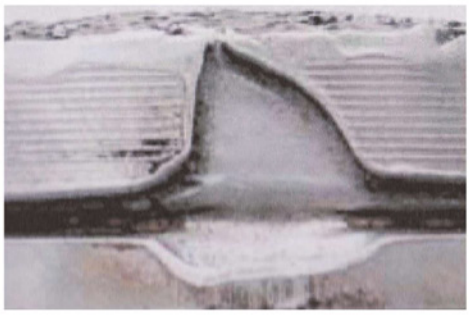
PISTON FAILURES

cylinder. The broken ring erodes away the piston ring land and the area of erosion can soon reach the crown of the piston resulting in a far more catastrophic failure to other engine components.

Initial damage from a broken ring



Progression of damage from a broken ring

Another area where assembly errors can create avoidable failures is in the installation of the gudgeon pin retainers/circlips. These should never be reused and the new ones should be correctly located in the grooves and should not be distorted during installation. The photographs below show the resultant damage when one of these becomes dislodged.

Besides careless installation there are other possible reasons for this type of failure:

- A bent or twisted connecting rod can cause the gudgeon pin to thrust against one of the circlips and eventually dislodge it.
  The wear pattern on the skirt will confirm that the piston travel was not straight.

- A crankshaft journal may have been ground with a conical shape, this will also cause the connecting rod to thrust to one side.
- Excessive axial movement of the crankshaft.
- Too much clearance between the end of the gudgeon pin and the circlip.

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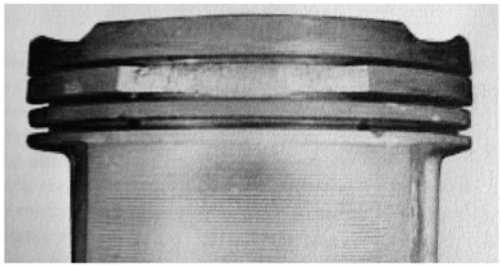
Ring land fractures

It is often suspected that material faults are the cause of this type of failure, however they occur because of the material being subjected to abnormal loading for which there are three possible causes; abnormal combustion, hydraulic lock or installation error.



The combustion irregularity can result from :

- Delayed ignition of the injected fuel because of insufficient compression.
- Injector nozzles leaking or insufficient injection pressure.
- Too much fuel injected into the cylinder.
- The incorrect use of a starting aid (ether).

Hydraulic lock can occur when the engine is either stationary or running because any fluid which enters the cylinder cannot be compressed. In a stationary engine coolant could enter the cylinder either as the result of a cracked cylinder head, blown head gasket or liner cavitation which has resulted in the perforation of the liner. Illustration A shows the formation of a fracture as a result of a combustion irregularity or a hydraulic lock. The fracture surfaces extend downwards as a result of the force which has come from above the ring land.

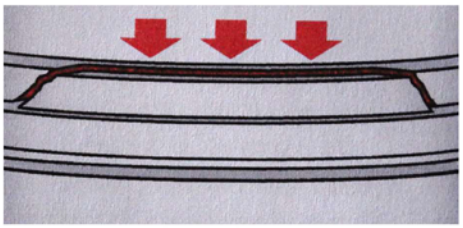


Illustration A

An installation error occurs when the incorrect tooling is used for the installation of the piston into the cylinder. If the rings are not correctly compressed into their respective grooves the protruding ring will hit against the cylinder causing an upward force and therefore creating a fracture of the ring land as shown in illustration B.

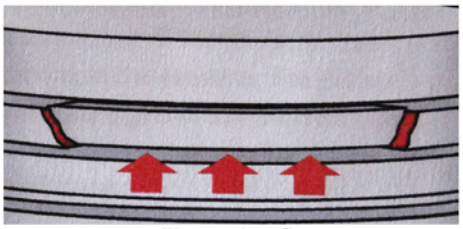


Illustration B

When a piston failure has occurred then it is extremely important to inspect all the engine components during the stripping process. By conducting a thorough inspection of the various components, this will indicate the possible cause/causes of the failure; this should ensure that the same failure does not occur again once the engine is repaired and put back into service.

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