

PISTON FAILURE ANALYSIS GUIDE

Piston Failure Analysis Guide

Analysis and reasons for piston failure.....	3
Lean seizure.....	4
Small to medium scoring.....	4
Medium to deep scoring.....	5
Carbon seizure.....	6
Damage by excessive engine speed.....	6
Piston ring breakage.....	6
Piston ring locating pin loose.....	7
Damage caused by loose gudgeon pin circlips.....	7
Bearing failure.....	7
Damage caused by foreign objects.....	8
Fine dust particles.....	8
Larger dust and dirt particles.....	9
Large hard particles.....	9

Piston Failure Analysis Guide

Analysis and reasons for piston failure

The piston is often said to be the heart of the engine. By analysing the piston after an engine failure one can in most cases pinpoint the factors that caused the failure. The following pictures of piston failures should be used as a basis when forming a judgement of the cause of cylinder and piston failure. Due to tight quality control process's defects or errors in today's modern manufacturing are a very rare occurrence.

Use this guide to help explain the cause to the customer and avoid repeated failures.

In the majority of cases there are other factors which result in failures, such as:

1. Insufficient or no 2T oil mixed with the fuel.
2. Incorrect grade or type of oil.
3. Insufficient maintenance.
 - Clogged silencer and screen.
 - Clogged, broken or incorrect type of air filter.
 - Dirty or clogged air intake on the starter cover.
 - Dirty cooling fins on the cylinder.
 - Dirty fins on the flywheel.
4. Incorrectly adjusted carburettor.
5. Insufficient fuel feed depending on:
 - Clogged fuel filter.
 - Clogged tank ventilation.
 - Cracked or deformed fuel hose.
 - Worn, aged or dirty carburettor components.
 - Clogged or leaking impulse channel.
 - Loose or damaged mounting.

The first two pictures show what new pistons look like, one from the inlet side and the other from the exhaust side. Note the clearly visible machining marks from manufacturing.

The second two pictures show two pistons with normal wear and normal discolouring based on using a high quality 2-stroke oil.



New piston from the inlet side



New piston from the exhaust side



Piston from the inlet side with normal wear and normal discolouring



Piston from the exhaust side with normal wear and normal discolouring

Piston Failure Analysis Guide



Small to medium scoring within the exhaust port area

Lean seizure

A damaged piston due to insufficient lubrication is commonly referred to as lean seizure. Lean seizures are usually caused by some type of lubrication breakdown. Lubrication breakdown occurs when the engine overheats, this can occur when the carburettor is set too lean, or when there is insufficient lubrication from the wrong fuel-oil mixing ratio, wrong type of oil or simply no oil at all.

Small to medium scoring within the exhaust port area

The piston in the picture has small to medium size score marks, usually shown around the exhaust port area or on the opposite side to the flywheel. In extreme cases, heat development can be so great that material from the piston smears along the piston skirt and in the cylinder bore. Scuffmarks may appear on the intake side opposite of the heaviest exhaust scoring due to the rapid heat expansion of the exhaust side of the piston. Generally the piston ring is undamaged and moves freely in the ring groove.

Reason:

- Incorrect carburettor setting.
- Recommended max. speed has been exceeded.
- Incorrect oil mixture in the fuel.
- Fuel is stale or too old.

Action:

- Check and change the carburettor setting.
- Change to fresh fuel.

Piston Failure Analysis Guide

Medium to deep scoring

Medium to deep scoring along the entire piston skirt is caused when the piston ring has begun to stick or is completely stuck in its groove and has therefore not been able to seal against the cylinder wall, this results in further, intensive temperature increases on the piston and cylinder wall.

Vertical seizure scores are visible across the entire piston skirt on both the exhaust and inlet sides.

Reason:

- Incorrect oil mixture in the fuel.
- Fuel is stale or too old.
- Air leaks.

Cracked fuel hose.

Leaking inlet gaskets.

Cracked manifold or inlet manifold.

- Air leakage in engine body.

Leaking crankshaft seals.

Leaking cylinder and crankcase gaskets.

- Bad maintenance.

Dirty cooling fins on the cylinder.

Blocked air intake on the starter.

Blocked spark arrest screen on the silencer.

Action:

- Change to a fuel with the correct oil mixture.
- Change to fresh fuel.
- Replace damaged parts.
- Replace leaking gaskets and shaft seals.
- Clean the cooling fins and air intake.
- Clean or replace the spark arrest screen.



Medium to deep scoring



Deep scoring

Piston Failure Analysis Guide

Carbon seizure

Piston damage from excessive carbon build up can at first appear to be a lean seizure. The piston will be scored on the exhaust side and the piston ring will most likely be stuck in the ring groove. However, unlike a lean seizure, carbon deposits will be present on top of the piston and in the combustion chamber of the cylinder. Heavy carbon deposits are usually present in the exhaust port. These deposits can break loose and become lodged between the piston and the cylinder wall. However, the piston skirt has a darker colour caused by the hot combustion gases that are blown past the piston ring. The top two pictures illustrate typical carbon seizures and the main causes.

Reason:

- Wrong type of two-stroke oil or petrol.
- Incorrect oil mixture in the fuel.
- Incorrect carburettor setting.

Action:

- Change the fuel.
- Change to a fuel with the correct oil mixture.
- Correct the carburettor setting.

Damage by excessive engine speed

Typical damage associated with a too high an engine speed is, broken piston rings, broken circlips on the gudgeon pin or the guide pin for the piston ring coming loose. The following pictures illustrate typical over speed damages and the main causes.

Piston ring breakage

When the carburettor setting is too lean this results in too high an engine speed and a high piston temperature. The engine may not be running lean enough to cause a lean seizure but the abnormal operating temperature causes the ring to stick in the ring groove. The edges of the piston ring can then hit the top edge of the exhaust port and will be broken and can also cause piston damage. Excessive engine rpm can also cause rapid ring wear and contribute to ring breakage.



The piston ring (seen from the inlet side) is stuck in the groove and the dark discoloration under the piston ring is due to compression blow-by



Medium to deep scores on the exhaust side. The piston ring is stuck in the groove. Dark discoloration under the piston ring due to compression blow-by

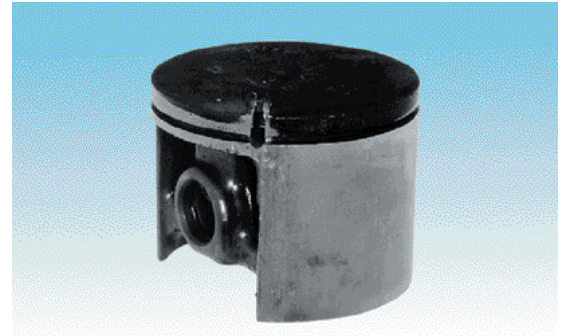


Exhaust side damaged by a broken piston ring. The piston ring parts damage the top section and cause score marks

Piston Failure Analysis Guide

Piston ring locating pin loose

A too high engine speed can also cause the ends of the piston ring to hammer against the guide pin when the piston ring moves in its groove. The intensive hammering can loosen the pin which will then exit through the top of the piston causing serious damage to the cylinder and piston.



The locating pin for the piston ring has been pushed up through the top of piston

Damage caused by loose gudgeon pin circlips

A too high engine speed can cause the gudgeon pin circlips to vibrate. The circlips are drawn out of their groove due to the vibrations, which in turn reduces the circlips' tensioning power. The rings can then become loose and damage the piston.



Deep, irregular grooves caused by a loose circlips is here shown here on the piston's inlet side

Bearing failure

A failure on the crankshaft bearing or on the connecting rod bearing is usually caused by a too high an engine speed, resulting in the bearing being overloaded or over heating. This in turn can cause the bearing rollers or balls to glide instead of rotate, which can mean that the roller or ball retainer breaks. The broken debris can be trapped between the piston and cylinder wall, damaging the piston skirt. Debris can also pass up through the cylinder's transfer ports and cause damage to the top and sides of the piston as well as the cylinder's combustion chamber. To avoid excessive engine rpm always use a tachometer when adjusting the carburettor. The maximum speed recommended must not be exceeded.



Irregular grooves on the piston's inlet side caused by a broken roller retainer

Piston Failure Analysis Guide

Damage caused by foreign objects

Anything other than clean air and fuel entering the engine through the intake port will cause some type of abnormal wear and damage to the piston. Abnormal wear and damage of this type is always evident on the intake side of the piston starting at the lower section of the piston skirt where it passes the intake port. Abnormal piston wear is the result of improperly filtered air passing through the carburettor into the engine. Larger foreign objects entering the engine can cause severe lower intake skirt damage to the piston. Of course, if the engine is operated with a damaged air filter or without an air filter, rapid piston wear or damage is a certainty. The following three pictures demonstrate various types of foreign object damage. The examples are easily prevented with routine air filter maintenance and replacement as instructed in the Operator's Manual.

Fine dust particles

Intake side shown, exhibiting small scratches and a dull grey appearance.

Cause:

- Incorrect air filter for application.
 - Faulty air filter. Small dust particles pass through the filter.
 - The filter is worn out due to too much cleaning, whereby small holes have appeared in the material.
 - Unsuitable filter maintenance, e.g. wrong method or wrong cleaning agent.
- Flock material comes loose and holes appear.
- Air filter incorrectly fitted.
 - Air filter damaged or missing.

Action:

- Fit a finer grade filter. Check the filter carefully for holes and damage after cleaning. Replace the filter if necessary.
- Clean more carefully and use the right cleaning agent (e.g. warm soapy water or Husqvarna Active Cleaning).
- Change the filter. Fit the filter correctly. Fit a new air filter.



Small score marks and a matt, grey surface on the piston's inlet side caused by fine dust particles



Particles of dust and dirt from carbon-like deposits on the top of the piston and in the piston ring groove



The piston scored and worn from the piston ring down on the inlet side

Piston Failure Analysis Guide

Larger dust and dirt particles

Large, softer particles that penetrate into the engine cause damage to the piston skirt under the piston ring as the photograph shows.

Cause:

- Air filter incorrectly fitted.
- Air filter damaged or missing.

Action:

- Fit the air filter correctly.
- Fit a new air filter.

Large hard particles

Larger, harder particles that enter the engine cause serious damage to the underside of the piston skirt.

Cause:

- Air filter damaged or missing.
- Parts from the carburettor or intake system have become loose and entered the engine.

Action:

- Fit a new air filter.
- Regular service and inspection.



Extensive damage to the lower part of the piston's inlet side



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