

WARRANTY INSPECTION REPORT

Before reading the Warranty Inspection Report, it is essential to consider following carefully, to understand and appreciate the comments to and results of the report.

SMOKING

Smoking may be due to air intake restriction, often caused by dirty/partially blocked air filter or a collapsed intake hose. These problems affect the air/fuel ratio and give black smoke. Also if the engine cannot breathe as designed, it will pull air from other sources. Excessive closed crankcase ventilation (CCV) will give smoke.

LOW POWER / BOOST

Air inlet restriction prevents the engine from breathing as designed, this increases the engine operating temperature. As an air leak in the compressor outlet, or a partially or blocked intercooler would restrict the engine breathing.

NOISY / WHISTLING

Often the noise comes from air/gas leakage, due to pre-turbine exhaust gas or an air/boost leak. Check all joints, if noise continues check turbocharger clearances and wheels for housing contact.

SEIZED / SLUGGISH

If the turbocharger rotor has seized or is hard to rotate, this is often due to lubricating oil degeneration which can cause a high build up of carbon in the bearing housing interior, restricting rotation. Insufficient or an intermittent drop in oil pressure can cause the rotor to seize, as can introducing dirt into the lubricating oil.

WORN / EXCESSIVE CLEARANCE

A turbocharger has specific axial and radial rotor clearances. These are sometimes mis-diagnosed as 'worn bearings'. If the clearances are out of specifications, the cause could be attributed to a lubricating oil problem, insufficient oil, dirt ingress, oil contamination with coolant or fuel.

OIL LEAKAGES

Oil leakages at the turbo, provided bearing clearances are normal, are in most cases a result of an engine problem. Check crankcase pressure, carter ventilation, air filter.

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TURBOCHARGER TROUBLESHOOTING PROCEDURES

General recommendations and remarks regarding life and service of turbochargers

Identify the cause of the problem first! Is it a turbo problem and must the turbo be replaced? Or is it an engine problem, showing up at the turbocharger?

If your engine is not operating properly, you should not automatically assume, that the turbocharger is causing the problem.

*In many cases a turbocharger is replaced, although the fault is **engine related and not caused by malfunctioning of the turbo.***

Very often fully functioning turbochargers are replaced, because the problem shows up at the turbo, although the turbocharger is in good condition.

Therefore always carefully check all point from the Holset Turbocharger Diagnostic Chart to identify the problem, before removing the turbo from the engine.

Only after all these points have been checked, one should check the turbocharger for faults. Since the turbocharger components are manufactured on high-precision machines to close tolerances and the wheels rotate up to 140,000 rpm in commercial diesel engines, turbochargers should be inspected by qualified specialists only.

Turbocharger service and lifetime

The turbocharger is designed such, that it will usually last as long as the engine. It does not require any special maintenance and inspection is limited to a few periodic checks.

To ensure that the turbocharger's lifetime lines up with that of the engine, the following engine manufacturer's service instructions must be strictly observed and followed up:

- > Oil change intervals*
- > Oil filter system maintenance and replacement*
- > Oil pressure control*
- > Air filter system maintenance and replacement*

What are the main factors causing turbocharger failure?

90 % of all turbocharger failures are due to the following causes:

- * Penetration of foreign parts into the turbine or the compressor of the turbocharger*
- * Dirt/contamination in the lubrication oil of the engine, also lubricating the turbo bearings*
- * Insufficient/inadequate oil supply (oil pressure/filter system/engine start up-shut down)*
- * High exhaust gas temperatures (incorrect fuel injection system)*

These failures can be avoided by regular maintenance. When servicing the air filter system for example, care should be taken that no tramp material gets into the turbocharger.

IMPACT DAMAGE

Picture 1 – Compressor wheel damage



Picture 2 – Turbine wheel damage



Impact damage caused by foreign material, entering the compressor housing or turbine housing is clearly visible on the blades of compressor/turbine wheel

Never continue to operate a turbocharger with damaged blades.

The rotor balance will be affected and this could impact the life of the turbo and total damage of the turbocharger, even resulting in engine damage

INSUFFICIENT OIL SUPPLY

Picture 3 – Use of silicone sealants



The use of sealants can block the oil passages to the turbocharger bearings and result in restricted oil flow, causing bearing failure

Picture 4 – Insufficient lubrication oil



Insufficient oil supply can be caused by:

4a Installation of a turbocharger without proper priming

4b Long periods of non-use

4c Broken or restricted oil feed pipe

4d Low engine oil pressure due to incorrect functioning lubrication system

4e Low level or no oil in sump of engine

4f The use of sealants can cause restriction of oil flow to the turbo bearings

DIRT IN OIL

Picture 5 – Scored shaft on bearing journal by dirt



Picture 6 – Scored bearing by dirt



Dirty oil damages the turbocharger components by causing heavy scoring of critical bearing surfaces

The avoid damage, pol and filter should be of a quality recommended by the Engine Manufacturer. Filters must always be changed when a new turbocharger is fitted. Also filters must be changed at regular intervals according to the Engine Manufacturers specification

Damages by dirty oil can result from:

6a Blocked, damaged or poor quality oil filter

6b Dirt introduced during servicing

6c Engine wear or engine remanufacturing remainders

6d Malfunctioning of the oil filter by-pass valve

6e Low quality of degraded lubrication oil

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INSUFFICIENT LUBRICATION

Picture 7 – Burnished and polished mating surfaces of bearings



Short durations (4-5 seconds) of interrupted oil supply can burnish and polish bearing surfaces.

Usually this is a result of incorrect pre-lubrication during engine start-up or after installation of a new turbo:

7a Lack of priming before installation

7b After oil changes and replacement of the oil filter

7c After long periods of non-use

7d Incorrect start-up procedure, in particular under extreme cold conditions

7e Low oil pressure - malfunction of the lubrication system – oil pump failure

7f Mix-up of lubrication oil with cooling liquid or engine fuel

7g Extensive use during long periods at high load

7h Low oil level in engine sump

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NO OIL – OIL STARVATION

Picture 8 – Burnished mating surface of thrust bearing



Picture 9 – Shaft burnished and discoloration - Burned journal bearing



Longer periods (8-10 seconds) of interrupted oil supply can result in serious bearing damages.

Caused by excessive heat due to lack of oil, the mating surfaces of thrust bearing and journal bearings will show heavy signs of burnishing. Heat discoloration will often show on the shaft. The bearings will be discolored and scored.

The most common causes are:

8a Broken or restricted oil feed pipes

8b Oil pump failure

8c Low oil level or no oil in engine sump

8d Blocked oil filter

8e Air leaks in lubrication system

OVERHEATING

Picture 10 – Excessive build up of carbon on Shaft/Wheel



Picture 11 – Bearing damage due to hot shutdown



Failure from excessive exhaust temperatures or shutting the engine down without allowing time for the turbocharger to cool down results in carbon build-up.

It is recommended to run the engine at idle speed for 2 to 3 minutes to cool down the bearing system, before shutting down the engine.

Turbine end heat soak into the bearing housing results in oil carbonization and corrosion of the bearing system.

The main damage occurs in the shaft seal ring and groove area, turbine-end bearing and bearing housing oil drain cavity blockage.

Causes:

10-11a Blocked air cleaner/excessive air intake restriction

10-11b Hot shutdown of engine

10-11c Degraded oil quality carbonizing in service

10-11d Infrequent oil change intervals causing oil breakdown in service

10-11e Air and gas leaks

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