

Issue no. 2/2014: Trivial Pursuit—the search for the turbo culprit

The causes of turbocharger damage generally do not lie in the turbocharger itself, but rather in the engine peripherals. If only the turbocharger is replaced and the actual cause of failure is not remedied, then it will inevitably be damaged again. The new turbocharger will automatically be the first suspect. Whether it really was “Mr Boost” is frequently only investigated after the supposedly defective turbocharger was replaced. In order to save time, nerves, and money, it is advisable to identify the actual cause of damage for every failure. For this purpose, we would like to provide you with some useful hints...

SUSPICIOUS NOISES: WHISTLING AND CLANGING

When **whistling noises** occur immediately after installation, it is often hastily concluded that a crack in the turbocharger or a manufacturing defect is the cause. However, an examination of the returned turbocharger usually reveals something else:

- A gasket inserted the wrong way around. This reduces the diameter and therefore also the flow rate, which can lead to whistling noises and/or a decrease in performance.
- Incorrect fit of the hoses/components of the charge air line. This can cause air to escape and as a result, the whistling.
- Incorrect mounting of the housing. For certain types of turbochargers, the compressor housing is adjusted by loosening and tightening the mounting screws. If the screws are not tightened correctly, they can become loose during engine operation. The resulting angle of the housing causes the impeller to strike the housing, thus audible as “scratching” or whistling.

Metallic or rattling **clanging** can indicate a detached piece of metal in the exhaust manifold. Important: the error must be eliminated immediately to avoid major turbocharger and consequential damages.

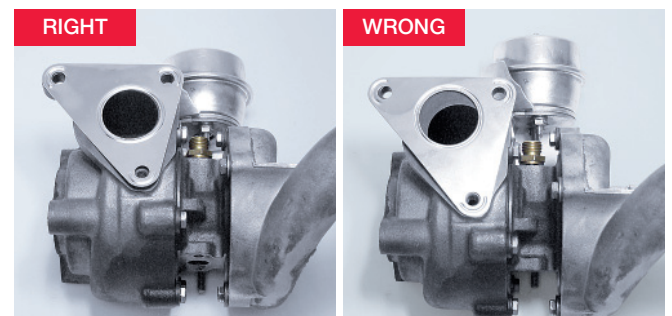


Figure 1: Incorrectly fitted gasket—a common cause of whistling noises and/or lack of performance

INDICATIONS OF BLOCKAGES: SMOKE FORMATION AND OIL LOSS

Smoke emissions and loss of oil are among the most common reasons for an unnecessary turbocharger replacement. Here a little background knowledge is necessary: almost all series turbochargers have hydrodynamic bearings. In this case, oil acts to “separate” the moving parts. An adequate supply and removal of oil is therefore essential for the durability and operation of the turbocharger.

If the **oil supply** is hindered or the oil pressure is too low, an adequate lubricating film cannot form; mixed friction occurs between the shaft and the bushing (Fig. 2) resulting in major turbocharger damage. Clear indications for inadequate lubrication include a loose nut on the impeller, a broken shaft (Fig. 3), or discolouration due to high temperatures. If the defect is not remedied prior to the installation of a new turbocharger, then this one will also become damaged immediately after installation.

A blocked return line or excessive crankcase pressure can clog the **oil return** (Fig. 4). Because the oil can no longer flow out into the oil sump after lubricating the bearings of the turbocharger, it accumulates in the bearing housing. At the same time, the oil pump supplies fresh oil to the bearing points for lubrication and cooling. The oil must now somehow flow out of the bearing. However, since the return flow is blocked due to the clogged line, it searches for another path: despite the sealing piston rings, it is forced into the compressor and turbine side, where it enters, is carbonised, or is burnt in the combustion chambers via the intake air and the exhaust system via the turbine.

FURTHER INDICATION: POOR PERFORMANCE

In the event of poor performance, the turbocharger is also suspected much too often. The possible actual culprits are:

- **The exhaust gas system:** The various exhaust gas after-treatment and recirculation systems used in modern vehicles create many contact points where throughput can be reduced. If the exhaust gases cannot flow freely, similar symptoms to a turbocharger fault occur. Only close examination of the exhaust gas tract unveils the real culprit.
- **The recirculation air valve:** The boost pressure control valve enables fast responsiveness, prevents

abrupt braking of the rotor when the throttle valve is closed, and protects petrol engines from overspeeding. When these properties are no longer given and if a pronounced turbo lag is noticeable, often the complete turbocharger is replaced. But in many cases, the valve can be replaced separately (ideally promptly, in order to prevent damages to the turbocharger).

- **The air mass flow meter:** It determines the air volume flowing into the engine. The engine control unit thus calculates the optimal quantity of fuel and additional values for the air-fuel ratio. An incorrect measurement can lead to poor performance and even to dry running – symptoms, which could also indicate a defective turbocharger. A glance at the measurement values of the air flow meter helps to find the actual cause.
- **Cracks in the air-guiding area:** These can lead to unfiltered air entering into the system within specific speed ranges. The result is an inadequate air-fuel ratio, along with a noticeable lack of performance and gradual wear of all mechanical parts. A leak detection spray is recommended for quick identification of the leak points.

Additional useful tips and interesting facts relating to the turbocharger can also be found in the **MAHLE After-market damage brochure**.



Figure 2: Clear signs of wear on the shaft at the bearing point



Figure 3: Broken shaft shank



Figure 4: Carbonised oil return line