

## INSTALLER CONNECT TURBO EXPERT TRAINING COURSE

### LEVEL 4, ANIMATION 6

The take-aways below relate to the sequence of each instructional video and will help you gather the knowledge you need to complete the Garrett Motion Installer Connect training modules. You can return to the video as often as you wish.

#### **Turbo damage, oil leakage and external influences**

This is the module for the Level 4 training course. As seen in previous animations, the correct operation of the lubrication and sealing systems relies not only on the components inside the turbo, but also on many systems on the engine or vehicle.

Please use these notes in conjunction with the course video. Using both resources will help you succeed in gaining Level 4 certification on the road to becoming a turbo expert!

#### **Turbo damage and oil leakage**

##### **About the risks associated with oil leakage and contamination:**

##### Knowledge booster

- Oil leakage can be the result of internal damage to the turbocharger or may be caused by the incorrect functioning of external systems.
- The turbo has simple requirements: clean, filtered oil of the correct type specified for the engine, clean, filtered air and clean exhaust gas. None of these are exclusive, they rely on each other.
- The job of the oil is primarily to lubricate all the internal moving parts of both the engine and the turbo, but it also carries any debris or wear particles from the engine, which should be removed by the filter.

##### **Contaminated oil**

- If oil and filter change intervals have not been respected on the engine, then the concentration of contaminants being carried around by the oil can reach excessive levels and under these conditions, it can be expected that damage will occur to the bearing system of the high-speed turbocharger.
- An excessive concentration of fine particles, which may be typically minute carbon particles from the combustion process, turns the lubricant into a very effective polishing or lapping medium, which will polish and erode the material of the bearings, increasing critical clearances until the oil can no longer effectively control the complex motion of the shaft and wheels.
- This leads to excessive shaft motion which is often accompanied by a sharp increase in noise level and a reduction in performance. The excessive shaft motion can cause metal to metal contact within the bearings, rubbing of the shaft on the piston rings, causing rapid wear. and followed by oil leaking from the turbo. This is often followed by oil leaking from the turbine or compressor end or both and then total failure.
- If the oil filter has become blocked and is bypassing, then unfiltered oil can pass directly to the turbo and larger particles may then score the journal and thrust bearings, shaft, thrust collar and bearing bore, which will no longer function as they should.

- If oil contamination has been severe, then even changing the oil and filter may not remove the threat to a new turbo. Often sludge can build up in the oil sump, engine oilways and in severe cases may coat many engine parts. Then when new oil is added to the engine, the residual contaminants may cause a repeat of the same type of damage.
- In really severe cases, the only solution may be to dismantle and clean all contaminated components inside the engine and associated systems, or damage may occur to subsequent new turbos. Often, the oil inlet pipe to the turbo may be contaminated and sometimes carbon can build up due to heat soak from the exhaust manifold, severely restricting oil flow.
- Blowing through the pipe with compressed air proves nothing and Garrett Motion advise renewing the oil inlet pipe whenever a new turbo is installed. Some engines use an in-line filter on the oil inlet and in cases of severe contamination, just like any filter, these can block and prevent oil from entering the turbo. In this case, the turbo may appear to have been damaged by a lack of lubrication, but the root cause is oil contamination. The oil inlet pipe and any in-line filter must be renewed before a replacement turbo is installed.
- Another example of oil contamination is where unburned fuel enters the lubrication system, which may be due to poor combustion, worn engine components or malfunctioning fuel injectors. A high concentration of fuel in the oil reduces the capability of the oil to control the high-speed shaft and wheels and the lubricating properties of the oil becomes marginal, allowing metal to metal contact with the same results - a destroyed turbo.
- *Note: The Garrett Warranty does not cover damage due to oil contamination.*

## Dry Start-up

- One of the most common causes of early life damage to a turbo – which can happen within minutes or even seconds after starting the engine - is known as dry start-up. This is where the turbocharger is started with insufficient oil. It is mostly completely avoidable. Running at such high speeds, a delay of just a few seconds in receiving oil can destroy the bearing system. It is critically important to ensure that the turbo receives the correct oil supply, particularly after overhauling or servicing the engine or even after just changing the turbo.

## Oil & Filter Change

- It is also important to understand what may happen during even a simple oil and filter change when the oil sump and oil pick-up tube from the pump will empty completely. In addition to that, the oil pressure system may also be completely drained of oil. This is particularly true of an older engine, where there may be wear and tear of the oil pump with enlarged clearances allowing oil to leak back. Also, any non-return valve in the pressure system may be blocked open by contaminants, damaged or non-functional.
- Under these conditions, the high-pressure side of the oil system may totally empty. This means that when the engine is refilled with oil, the whole of the oil system up to the turbo may be empty of oil, but full of air. Then during the first engine start-up, the oil pump contains both oil and air, so it cavitates; that is where the pump is pushing both air and oil and it takes time for the air to clear and the pump to start pushing through pure oil. In those vital seconds, the turbocharger will already be spinning at very high speeds – without any oil. The turbo will be quickly destroyed, often within minutes or even just seconds.

## Gasket

- Another reason for lack of lubrication, dry start-up and oil leakage can be the use of an incorrect gasket. Only use the correct gaskets, which do not block either the oil inlet or outlet. Do not use silicon sealant or a liquid gasket, if they enter a turbo's oilways, they can destroy it in seconds and should be avoided in all cases.

## Oil Seals

- Vehicles and engines use a variety of oil seals. The most common of these is the lip type contact seal, which are highly effective, working with rotating shafts like the crankshaft. If one of these starts to leak, it is relatively easy to diagnose and rectify the problem by replacing the seal.

- A turbo does not use this type of seal, due to the high speed, extremely high temperatures and the large shaft clearances necessary for correct operation. If oil is found to be leaking from a turbo, firstly it is more complex to diagnose correctly and secondly there is no possibility to just change a seal, like on a crankshaft.
- *Important note: changing the turbo may not cure the problem, as the oil leak is very often just a symptom of some other problem on the vehicle.*

## External influences and oil leakage

### About oil drainage system restrictions and pressure balance:

#### Knowledge booster

- If the crankcase pressure is too high, this can prevent the oil and gas draining from the turbo and can air-lock the pipe.
- The oil will then follow the only other possible route, by leaking past the piston rings in the turbine and compressor. *Check the manufacturer's service limits of crankcase pressure for the specific engine.*
- Similarly, if the oil level in the engine sump is too high, it may cover the oil drain and prevent oil from draining from the turbo. Again, oil will leak past the piston rings.
- Anything which causes the pressure difference across the piston rings to change may lead to oil leakage. For example, a blocked air filter reduces the mass flow of air into the compressor, which can lead to a drop in pressure behind the compressor wheel. If it drops below the pressure in the centre housing, oil will start to leak past the piston ring – even if it is in perfect condition.
- Leaks from the air pressure system, including hoses and charge air cooler can have the same effect.
- Any leaks in the exhaust or the EGR system may also lead to oil leakage from the turbo.
- The importance of checking all these external systems cannot be overstated because any of them can be the root cause of oil leakage from a perfectly healthy turbocharger. These systems must be checked and any faults corrected prior to installing a replacement turbo.

## Knowledge Check

After watching the animation, your new understanding should enable you to answer the following questions.

- What will be the effect of a blocked oil filter on the turbo?
- In cases of severe oil contamination, what can happen to turbo bearings?
- What is the most likely cause of fine particle contamination?
- What is the effect on the turbo of a dry start-up?
- What impact does a blocked air filter have on the turbo?
- What risks are presented to the turbo if engine oil levels are too high?
- What sort of gaskets must not be used on a turbo and why?
- What type of damage will not be covered by the Garrett Motion turbo warranty?

*Remember to use these notes in conjunction with the Installer Connect videos as you take the tests that support your journey to becoming a certified Garrett Motion turbo expert.*