HDI Tuning Ltd

How to clean and service the VNT mechanism of a GT1544V turbo charger.

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How does a VNT turbo operate?

Before you start taking your turbo charger apart, it's worth learning how it works and how it is set up so that you don't make any mistakes when putting it back together.

There are three variants of the 1.6 HDI up until 2010. The 75 and 90 BHP models come fitted with a waste gated turbo charger (MHI TD025), and the 110 BHP models come fitted with a variable geometry turbo charger, also known as VNT (Variable Nozzle Turbine). This is the Garrett GT1544V.

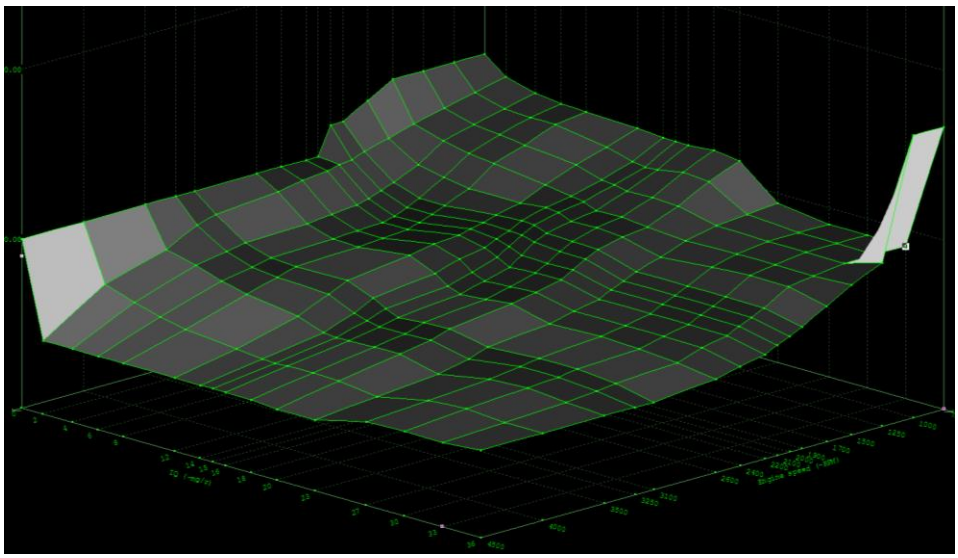
The VNT turbo is better in many ways when compared to a conventional waste gated turbo as the drive to the turbine wheel can be adjusted by altering the pitch angle of the vanes. This affectively alters the throat area through the turbine nozzle which in turn alters the pressure ratio across the turbine.

When the vanes are fully open the area is greater and thus the pressure ratio across the turbine is lower, when the vanes are fully closed the area is reduced and the pressure ratio is increased, this gives the turbine more drive. Boost pressure is regulated by precise control of the VNT mechanism.

Here's a video guide showing how the VNT nozzle operates (ignore the actuator as this is different): https://www.youtube.com/watch?v=puJy99Iz3po

The position of the turbo vanes is adjusted by altering the duty cycle of the turbo electro valve (N75 solenoid) which allows a controlled level of vacuum through. This then pulls the actuator arm on the turbo charger. In the relaxed position the vanes are left fully open (low boost) which acts as a safety measure if the vacuum system fails. As the duty cycle to the electro valve is increased, more vacuum can pass through and the vanes are closed more.

The ECU fitted to the 1.6 HDI engine has 2 basic modes of controlling the boost pressure from the turbo charger. The first method is known as 'open loop control', here there are pre-set maps in the ECU with the axes of engine speed and injected fuel quantity. During transient conditions the vanes will quickly adjust to the pre set values from this map. Due to this it is important that the VNT actuator is calibrated correctly.



Once the ECU has had time to take a reading of the boost pressure through the MAP sensor (Manifold Absolute Pressure), PID control kicks in. PID control is an advanced control method which adjusts and adapts the control signal to the turbo electro valve based on the difference between the boost pressure set point and the actual boost pressure measured.

For these reasons it is VERY IMPORTANT that the length of the VNT actuator is never adjusted. Furthermore, it is important that a new turbo charger comes with this set properly from the Garrett factory. Any cheap sub £300 turbo charger will not be set up properly and will cause terrible boost performance. This also applies when fitting a new turbo cartridge (CHRA), the arm which joins to the VNT mechanism is always going to be attached slightly different and hence the VNT will need recalibrating on a flow bench.

Is it best to service my current turbo or buy a new one?

If your engine is fitted with a known good, original Garrett turbo (that has not been replaced with a cheap after market unit), then it is worth servicing if the vanes have become clogged. Before you start your overhaul, check the compressor wheel for damage and also check the bearings for shaft play. If all is good then it's worth going ahead and fixing your turbo charger.

VNT cleaning or replacement guide

1. Remove the turbo charger from the vehicle

2. Mark the position of the turbine housing against the turbo core by putting a hard scratch in to both pieces. Also mark the actuator against the core. This will come in handy when refitting so that you can get an exact line-up, the actuator and turbine housing can move by approx 1 to 2mm relative to the core once the bolts are loosened.

3. Remove the e-clip from the VNT actuator. If the actuator arm does not move freely up and down then the vanes are clogged. If it is stiff, do not force it as you risk bending the vanes as they are very thin. (If the actuator moves freely then you can refit the turbo without disassembling).

4. Remove all five 10mm bolts from the turbine housing. These will be very tight, so fix the turbo in to a vice or on to your bench and give the spanner a light tap with a hammer.

5. Carefully lift the core out of the turbine housing. Be careful to remain concentric to avoid damaging the turbine blades.

You will now be able to see if the VNT mechanism is clogged with soot. Here is a good example of a very clogged turbo, this one would not move at all.

6. Lift the rollers out with a screw driver and then the VNT ring will lift off. Once off, you can also remove the roller pins using pliers.

7. Remove the three TorX screws and lift the VNT assembly out of the turbo.


8. Inspect the vanes for damage. If any are bent or melted they need to be replaced. If they are damaged, carefully inspect the turbine wheel to ensure there have been no collisions.

Ideally it's best to clean and re-fit your existing vanes as you don't want to alter the geometry, however it was decided that the VNT ring 'should be' manufactured to the exact same specifications so a new system was chosen. An up rated system was used with solid vanes which should prevent the risk of melting or bending.

9. If you're cleaning your vane assembly, leave it to soak in a strong solvent such as brake cleaner or thinners and carefully remove all dirt. It is not advised that you oil any of the parts as this will attract dirt, and also the oil will be burnt off quickly due to the temperature at which the turbine operates.

If you have a new vane assembly, don't assume it is put together in the right orientation, this one was not. Also, it cannot be dropped in and then the cable ties removed, there is not enough space.

10. Fit the base plate and line up the three spacers.


11. Carefully lower the vanes down on to the spacers making sure they don't move. It will only fit in one orientation as the holes are off centred. Drop the screws in and tighten.

12. Move each vane so that they are pointing towards the centre. Lower the control ring down, making sure the offset for the vane lever lines up with the very small pin hole which aligns the core.

13. Once the control ring is seated flat, lift it just a little and then push the rollers in to place. Push the pins in to fix them in.

14. Align the arm from the turbo core with the alignment pin on both parts. Carefully lower the core in to the turbine housing. Refit all bolts and the actuator making sure you align it the same as it was previously. Test that the actuator moves freely and refit to your engine.