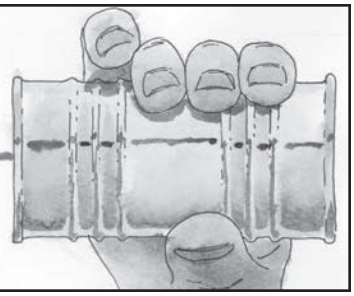
MEMBER 2 MEMBER



Member Solutions to Member Problems

6.7-LITER VARIABLE GEOMETRY TURBOCHARGER REVIEW

by Jason Clifton of City Diesel, Decatur, Alabama

I grew up in my dad's diesel shop. Hanging out with the guys in the shop was cheaper and way more fun than going to daycare or a babysitter. As I grew older he started giving me odd jobs around the shop to keep me busy. One of the easiest things for me to do was to clean up old turbochargers for rebuilding. That was 18 years ago.

I've learned a little bit since then. At the same time turbochargers have certainly evolved. From your fixed turbine wheel, to wastegates and now variable geometry turbochargers (VGT) much has changed, much has been learned. Let me share with you some of the latest updates on the Cummins/Holset VGTs (6.7-liter engine '07.5-newer) that we see here at our shop.

First, let's do a primer on how your 6.7-liter VGT works. Here is a reprint of an article and pictures right out of your good 'ole TDR magazine, Issue 70, page 46-50 by technical writer Jacques Gordon:

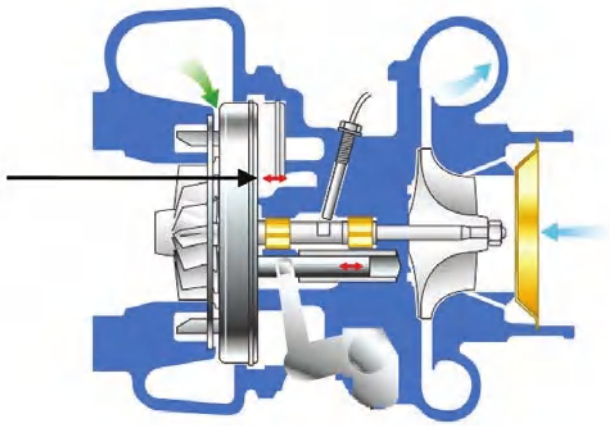
From Issue 70: The VGT Turbocharger, Simple and Direct

Compared to a wastegate, or even an electronically controlled wastegate, the VGT is a complex piece of machinery. The restriction device is in the collector ring of the exhaust turbine housing. That means there are moving parts in the hottest, dirtiest part of the turbocharger. Early models suffered soot-related seizure, proving that keeping things moving properly requires advanced materials, extremely precise engineering and sophisticated controls.

Precision is easier when the machine is simple: to that end the Holset VGT has only one moving part in the turbine's hot section. It is a high-temperature alloy sleeve with vanes at one end, and it moves axially, parallel to the turbine shaft. When the sleeve is fully retracted, exhaust gas flows freely from the exhaust collector through the turbine wheel. When fully extended, the vanes block off more than half the flow area between the collector and the turbine blades, increasing flow rate and directing it towards the turbine blades.

The sleeve is operated by an electronically-controlled brushless motor, so the sleeve position is infinitely variable. This provides the critical feature of the VGT turbocharger: infinite and continuous control at any engine speed/load. The motor and electronic controls are in a housing mounted on the center section of the turbocharger housing. To help deal with the heat, coolant is circulated through part of the motor/control housing, but truly advanced electronics are required to withstand that kind of heat and vibration.

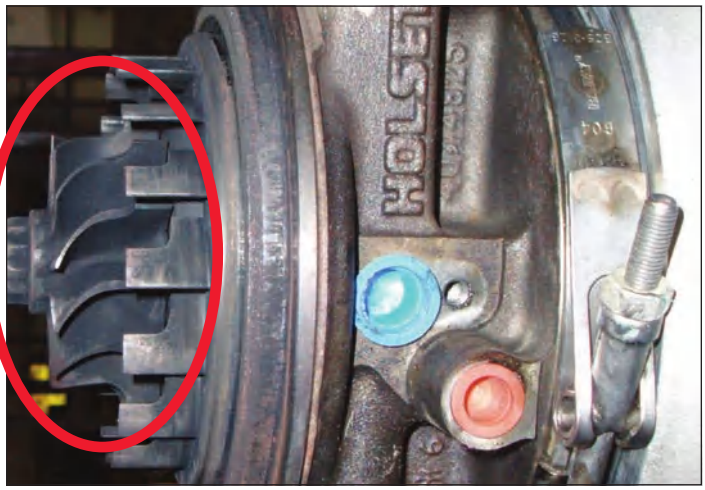
The Holset Variable Geometry Turbocharger



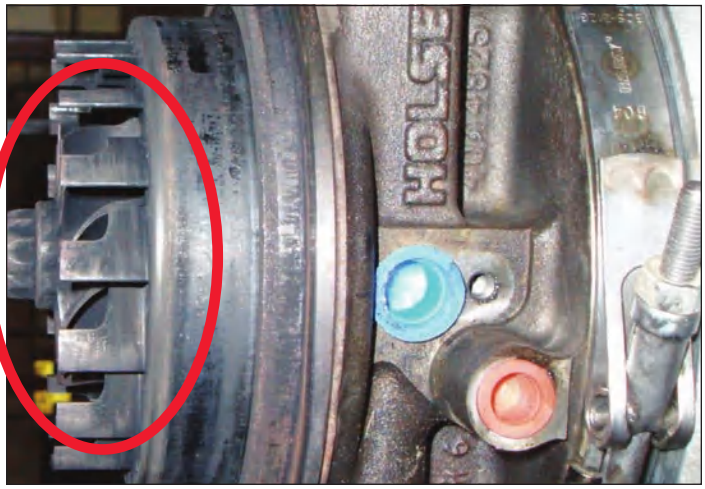
In this picture the vane is closed. Exhaust gas flow is restricted and, thus, the turbocharger is acting like an exhaust brake. Allow the vane to move to the right (see black arrow) 0and the exhaust gas flow is "full-on" allowing the turbine (exhaust) blades of the turbocharger to spin faster and ceate more boost. (See page 23 for actual photographsof the sliding vane.)

The motor is below this circuit board inside the motor housing. The visible gear engages a position sensor that sends information to the engine control computer. The electronics remain accurate over a 300-degree temperature range, but additional cooling is needed for this application.

The gear rack on the left connects to the linkage that moves the vane sleeve. The two holes to the right of the gear are coolant passages.



With the sleeve totally fully retracted, the vanes are open to exhaust flow. Exhaust flows freely and the pressure on the turbine blades builds intake air boost/pressure.



With the sleeve fully extended, the vanes are closed to exhaust flow. This creates exhaust gas back pressure (the exhaust cannot escape) and the turbo acts like an exhaust brake.

More From City Diesel

With the VGT everything changed. To work on it you need training and expensive tools. As an authorized Holset/Cummins rebuilder, we would have a customer bring us the turbocharger off of a 6.7 and ask if it was good or needed rebuilding. We couldn't give them a straight answer. How could we test the electronic actuator on the turbo? Early on this led to many customers and even turbo rebuilders developing the attitude, "If you have turbo codes just replace the entire unit, actuator and all."

We immediately started working to fix this. Step one was to develop an actuator tester that anyone could use. Shortly after we released it, more affordable rebuilt turbochargers started showing up. However, there was still a problem because the actuator has to be calibrated to the turbocharger and customers were not able to simply replace an actuator. This means they either have to pay a fee to get their actuator calibrated at a dealership (average price $200) or buy the entire turbocharger even if the actuator was the only problem.

The cost-effective solution: our creation of a new actuator. It is what we call a half-shell: you replace all the electronics, including the circuit board and motor, and reusing the half of your actuator that only contains gears (the "gearbox"). Our actuator is even in a nice and shiny billet aluminum housing. There is no calibration required and no complicated installation. Again, what this means to you is that you have a viable, cost-effective option for replacing your actuator when you have a problem.

The City Diesel actuator for the '07.5-'12 6.7-liter engines.

The replacement is simple:

- Drain the coolant
- Remove the four 5mm Allen-head bolts holding the actuator to the turbo
- Check to make sure the gear that the actuator moves on the turbo is free
- Separate the actuator shell by removing the 4 torxbit screws holding it together
- Join our actuator to your gearbox with the included screws
- Bolt the assembly back on to your turbo with the included new 5mm Allen-head bolts
- Replace the coolant

Some benefits of our actuator half-shell:

- It wipes the vanes/self-testing on every key cycle, preventing soot and carbon buildup.
- The motor has almost twice the torque: This makes it more difficult for the vanes to freeze up and gives you faster throttle response.
- The actuator was designed from the beginning to work well with EFI-live aftermarket tuners: Due to the way the EFI-live tuning works, it can sometimes lead to the stock actuator going into limp mode and throwing actuator or turbo codes even when nothing is wrong with the actuator. This actuator has been specifically designed to avoid this issue.

Pricing: List price is $795. Bonus: It looks awesome!

At City Diesel we have always believed in helping our customers to help themselves. Some customers want a “turnkey” experience where we handle everything from start to finish, but many more believe in doing things themselves. I have watched and listened to my dad walk someone through a problem, teaching them along the way how to fix it themselves. When you do this you make a friend and customer for life.

Jason Clifton
City Diesel; Decatur, Alabama

The actuator installed.

Contact information:

City Diesel
2215 Gordon Terry
Decatur, Al 35601
800-950-2489