



TURBO DIESEL

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TDR REVIEW

A Product, Event, or Article Review

For this magazine, let's revisit the Cummins/Holset variable geometry turbocharger that has been in use since the first 6.7-liter engine that was introduced in 2007.5.

THE HOLSET "VGT" REVISITED

To say that it is beneficial to have the Geno's Garage staff close-by to the TDR is correct. Every day there is a reminder that not everyone has read the TDR and/or read the many "Technical Information" links at the location of a specific Geno's part.

The most recent example involved questions about the Cummins/Holset variable geometry turbocharger (VGT): The history of a turbocharger; the development of the VGT; the principle of operation; problems that an owner may encounter; and repair options.

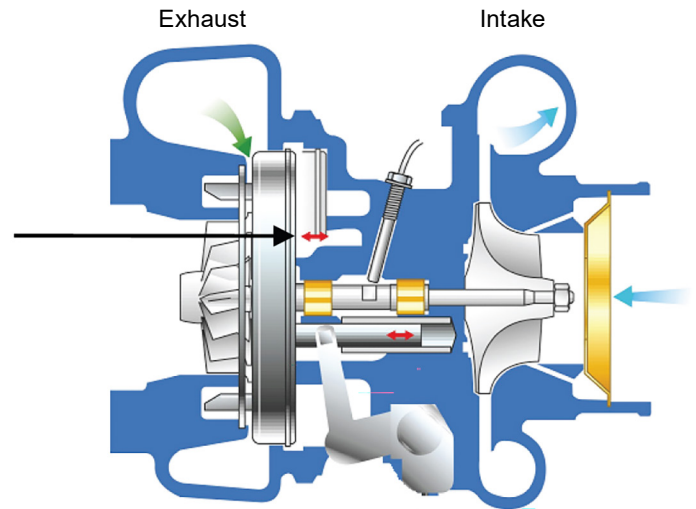
From Issue 70: The VGT Turbocharger, Simple and Direct

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 sleeve and its 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 high temperature, alloy sleeve is closed. Exhaust gas flow is restricted and, thus, the turbocharger is acting like an exhaust brake. Allow the sleeve to move to the right (see black arrow) and the exhaust gas flow is "full-on" allowing the turbine (exhaust) blades of the turbocharger to spin faster and create more boost

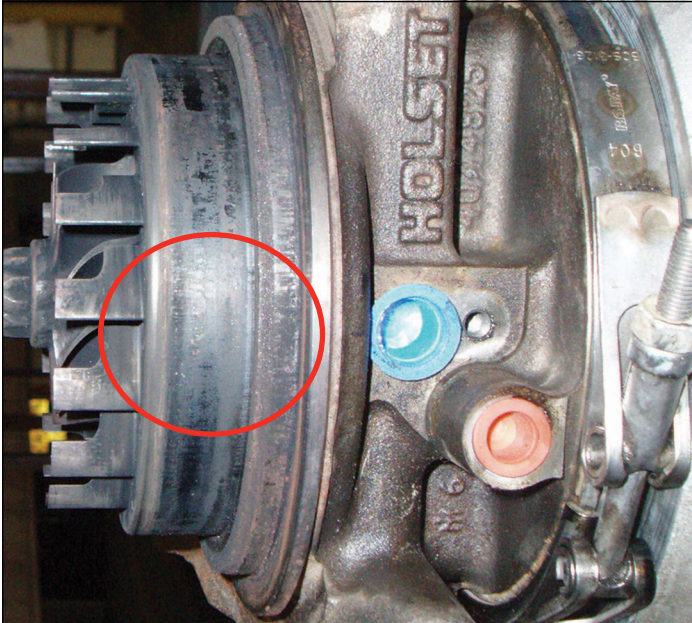
Now, 20 Years of Operation

It's hard to believe the Cummins/Holset VGT has been used on the trucks almost 20 years! Given this time span, I find it amazing that there aren't more repair problems. With the help of Jason Clifton at City Diesel, let's take a look at some of the diagnostic trouble codes that will illuminate the check engine light if your Holset VGT starts to "act up." (Jason and City Diesel are the manufacturers of a simple/cost effective turbocharger actuator as well as a Holset repair location that offers fully rebuilt turbochargers.)

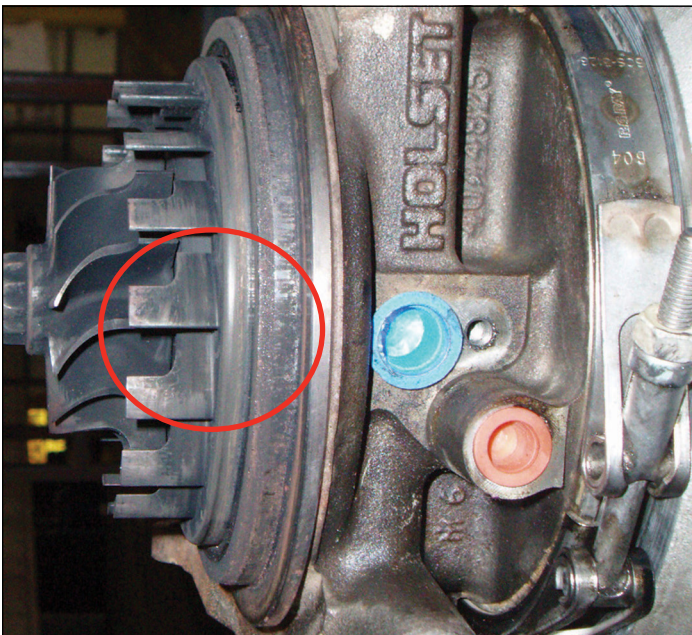
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Let's Get Educated: City Diesel, A Quick Introduction

The actuator's job is simple, move the turbocharger's variable geometry sleeve and its vanes. When the sleeve sticks, the actuator works harder than designed, which leads to overheated circuit boards, stripped gears, and premature failure. Many customers replace just the actuator, only to see it fail again within a year. Let's take a look at how the turbocharger's variable geometry sleeve moves inside the Holset turbocharger.

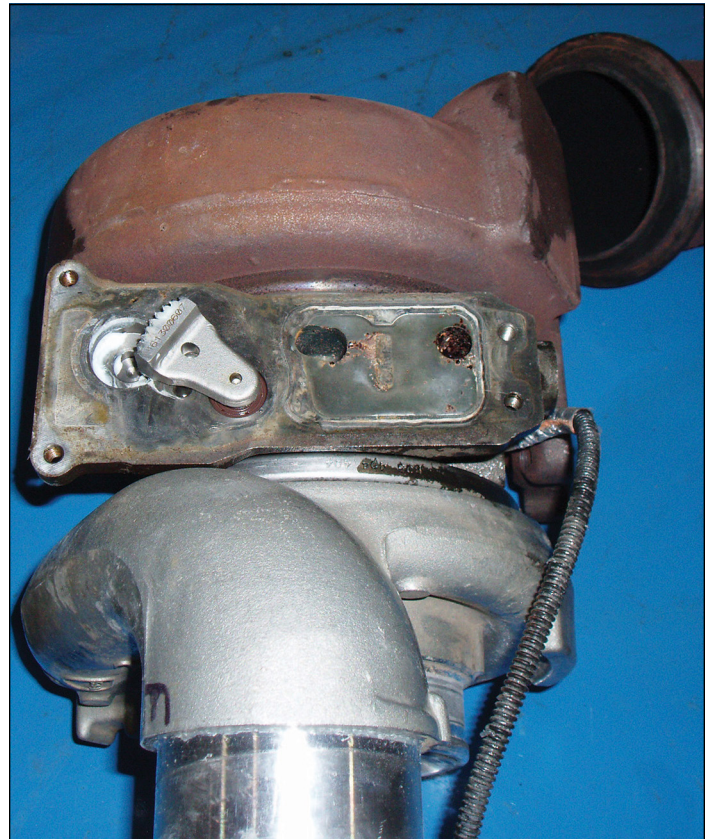


With the sleeve fully extended, the vanes are closed to exhaust flow. This creates exhaust gas back pressure (the exhaust cannot escape) and the turbo acts like an exhaust brake.

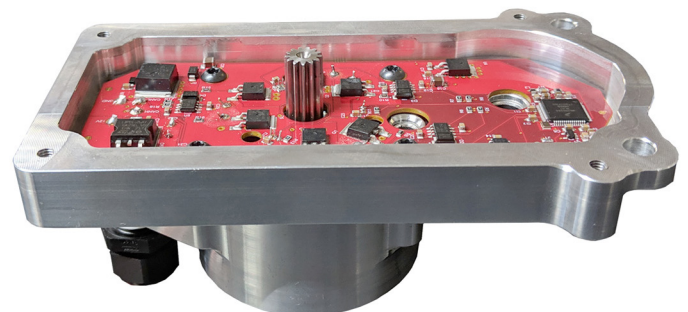


With the sleeve totally fully retracted, the vanes are open to exhaust flow. Exhaust flows freely and the pressure on the turbine blades builds intake air boost/pressure.

*The actuator's job is simple,
move the turbocharger's variable
geometry sleeve and its vanes.*



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.



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

MORE FROM CITY DIESEL: MANUFACTURER'S NOTES

With a look at the basic components behind us (the moveable sleeve and the electronic actuator) let's discuss some of the different trouble codes.

You start your truck and "bing" the check engine light comes on. You read one of the following codes:

- U010C – Lost communication with turbocharger/supercharger control module
- P0046 – Turbocharger boost control circuit performance
- P003A – Turbocharger boost control module position exceeded learning limit
- P00AF – Turbocharger boost control module performance
- P2266 – Turbocharger boost slow response

You realize that the turbocharger's actuator or the turbocharger itself is going to be problematic and an expensive repair may be on the horizon.

What to do?

Refresher Course

Here is some discussion (from TDR 114) on those five most often codes associated with actuator problems.

U010C and P0046: These codes normally point to either a turbocharger actuator or the power, ground or communication wires that go to the actuator. A bad turbocharger cannot cause these codes, but bad wiring can.

To troubleshoot these codes, you'll want to do the easy and no-cost diagnostics first. So, let's check to make sure your connector terminals look good and are not corroded. Make sure that you have good power and ground to the actuator.

With the key "Off" (giving it plenty of time for the ECM to shutdown ~10 minutes), unplug the actuator and check ohms between the appropriate pins of the connector on the harness side. It should read 115-125 ohms.

On the late models (2013-current) the wire order goes 'Ground, CAN Low, CAN High, and Power,' but on the early models (2007.5-2012) it goes 'Power, Ground, CAN High, CAN Low.' The resistance check should be between 'CAN High and CAN Low.' If you don't see the correct resistance reading (115-125 ohms) or there is not 12-volt power at the correct pin location.

P003A and P00AF: The code P003 says the "end stops" could not be found by the actuator. This is normally an actuator issue but could be caused by removing the actuator without re-calibrating it. The code P00AF can only be set by either a bad actuator or wiring fault, like was found when checking for Code P0046.

Finally, P226C: This is normally a fault in the turbocharger. The code is saying that the desired vane position does not match the actual position. This is normally caused by a stuck sleeve or intermittently stuck sleeve.

We normally recommend people with this code get the turbocharger replaced or rebuilt regardless of what the sleeve feel like. It can be caused by a bad actuator, but it is rare and, if it is, they will have a P00AF or P003A code set as well.

There is an excellent YouTube video on replacing the turbo actuator on 2007.5-2012 and 2013-up Turbo Diesels by The MotorCity Mechanic (David Pike): "Cummins 6.7L Turbo Actuator Replacement." In the video he discusses the diagnostic trouble codes that I just mentioned. In the video he goes on to replace the actuator with detailed instructions.

Typical Correspondence

This correspondence was captured from my discussions with some of the TDR members at www.tdr1.com.

I have a 2013 Turbo Diesel with around 130,000 miles. The check engine light came on. It was very unresponsive at first, but then the light cleared, and it started running again. The light has come on and off a couple times, but it is still running well. The code reader said: U010C.

BMeyers

This is the exact same thing that mine was doing (same DTC as well) before the turbo actuator failed completely. I was able to run it for about six weeks or so that way before it wouldn't work at all. Given my experience, he should start thinking about replacing his turbo actuator soon.

TimothyLong

These notes are typical of an impending actuator failure. It is time to start saving your money!

Jason @ City Diesel

Summary

Bottom line, if you observe one of the codes we have discussed, you are on "borrowed time." Save your paycheck and let's hope the problem is the actuator and not the entire turbocharger.

Final Comments

Okay, borrowed time, save my paycheck... any additional ideas?

Yes, please, please, take the time to watch the MotorCity Mechanic/ David Pike video (click "Videos") on YouTube. Please, please take the time to download and read the additional articles (on the Geno's Garage product page, click "Install and Tech Information") that I've written for the TDR and those written by other TDR writers. Yes, there are some subtle differences in '07.5-'12 versus '13-current product. And yes, there are some great installation tips given by the TDR's writing staff. With all of the data available, you can face this repair with confidence and save some money along the way.

Jason Clifton
City Diesel