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VOLUME 4, ISSUE 4



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The Story Behind LS7 Valve Guide Wear

By Jason Harding

Getting to the root of & correcting a high-performance problem.

The C6 Chevrolet Corvette Z06 is a renowned performer on and off the race track. Its 7.0-liter (427-ci) LS7 engine was rooted in the Corvette Racing program, with high-flow cylinder heads, lightweight features such as titanium intake valves and more, to produce 505 hp.

It's been more than a decade since the C6 Z06 and its LS7 engine were introduced, becoming a dependable and fiercely competitive weapon for road racers. But the LS7 has been dogged for years by stories of dropped valves that have led to catastrophic engine failures.

At Katech, where we've developed, built and tested racing engines for nearly 40 years, we have worked with the LS7 engine since it was introduced. When the *valves problem* rumors began, we monitored the situation and when it became clear that—true or not—the issue had to be confronted, we did our own independent evaluation.

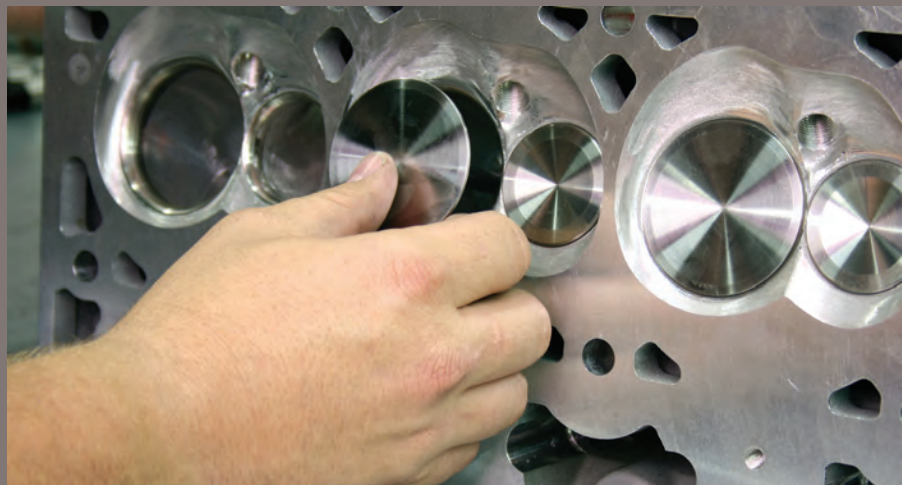
INSIDE THE LS7

Here's what we found: Starting in about 2011, we began seeing high valve guide wear in some LS7 engines. On the internet,

owners were reporting failed exhaust valves, but we had never seen one that caused exhaust valve failure.

That may have been due to the fact we had seen mostly low-mileage engines through our specialty race shop; but as time went on, we noticed the guide wear issue more and more—and on lower-mileage engines.

We documented every LS7-powered vehicle that came into our shop for the repair and even discussed it with representatives from General Motors. We determined, with information provided by GM, that the root cause of the issue was a machining error at the cylinder head supplier, which caused the valve guides to be machined non-concentric to the valve seat. That



Katech's solution for the valve guide issue is installing manganese-bronze (simply referred to as *bronze*) valve guides and performing a valve job.



Some LS7 engines started seeing high valve guide wear as early as 2011.

caused side pressure of the valve against the guide, which in turn caused an hourglass-shaped wear pattern on the valve guide.

As a result, valve guide clearance at the top and bottom became much larger very rapidly. And the condition was not limited to the exhaust side. Katech doc-

umented the issue on intake valve guides. The condition also afflicted the supercharged LS9 engine used in the Corvette ZR1.

Additionally, Katech found it was not just a concentricity issue, but also one of clearance.

MORE THAN EXPECTED

Katech's independent research has not limited the issue to 2008-'11 models; but rather all LS7s and LS9s 2006-present. We measured a 2012 engine and new LS7 cylinder heads in 2014 purchased through the dealer parts network that had the issue.

Katech's solution for the valve guide issue is installing manganese-bronze (simply referred to as *bronze*) valve guides and performing a valve job, which comes from our experience building engines for 24-hour endurance racing.

The valve seat cutter pilots in the valve guide, so the two are brought back into concentricity. We've been asked whether the new bronze guides are better than the original powdered metal guides, containing mostly iron, which is a harder metal.

It's true that bronze is softer, but it has much better lubricity than powdered metal and, when the cylinder head is machined correctly and combined with molybdenum-coated valve stems, it will last much longer.

In fact, Katech ran bronze guides with titanium/molybdenum valves in Corvette C5-R racing engines that won the 24 Hours of Le Mans and showed virtually no wear.



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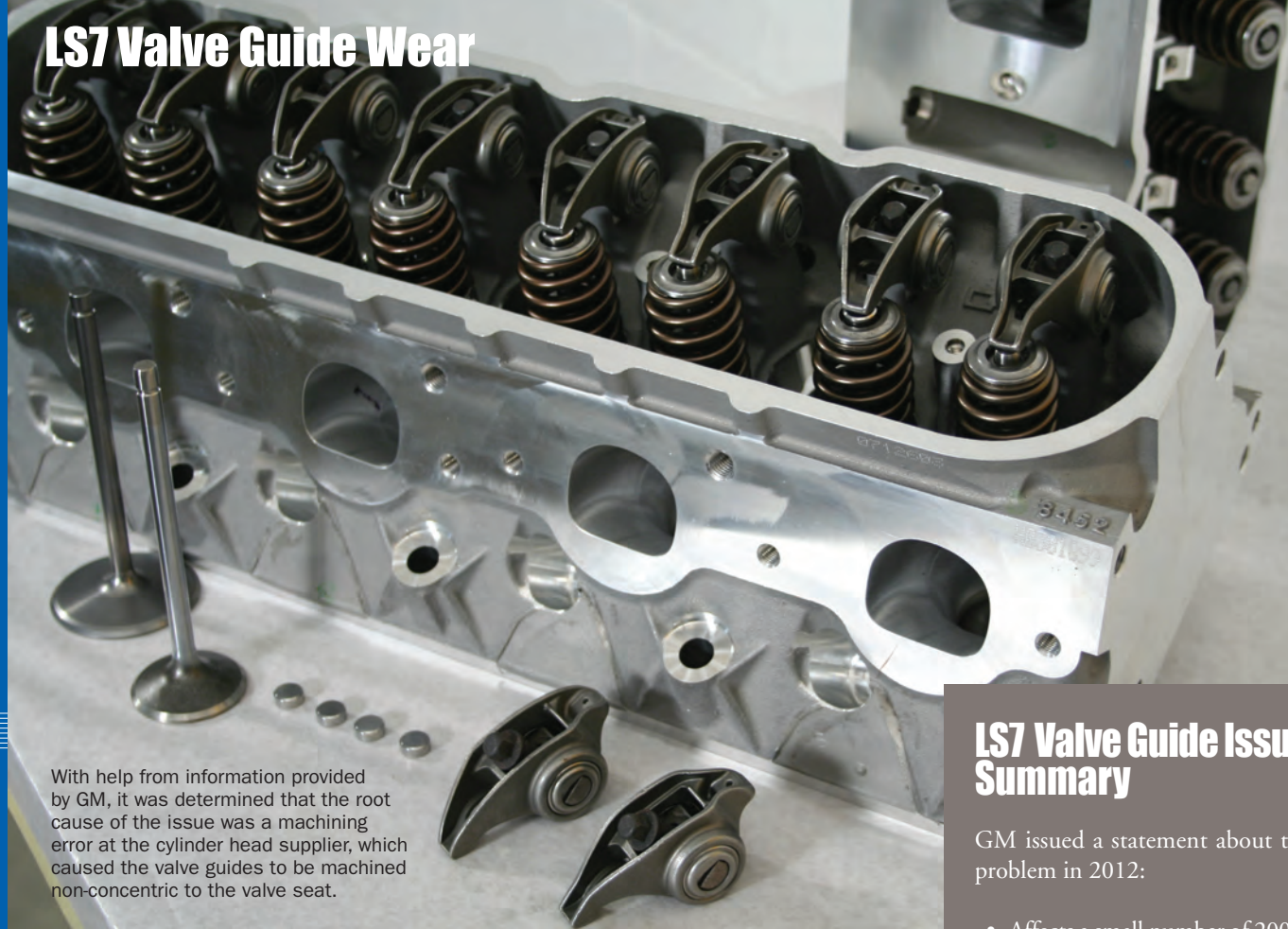
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LS7 Valve Guide Wear



With help from information provided by GM, it was determined that the root cause of the issue was a machining error at the cylinder head supplier, which caused the valve guides to be machined non-concentric to the valve seat.

About those titanium/molybdenum valves:

Another issue with guide wear is on the intake side. The LS7's original titanium valves have a chrome-nitride coating to prevent valve seat wear. Racing engines with titanium valves typically have copper-beryllium valve seats, but that's incompatible with a production-vehicle engine.

We have found the chrome nitride coating on the original valves to have a very rough surface finish, which is another critical component of the valve guide wear. That can create an abrasive slurry of the chrome nitride coating, powdered metal and oil, accelerating wear even further.

The chrome nitride coating is also too rough for the softer bronze used for the exhaust valve guides.

AFTERMATH

Some have tried tumble-polishing the intake valves to make them smoother and more compatible with bronze guides. Katech attempted this, but halted when we were unable to achieve the surface finish we felt was necessary for bronze compatibility.

So, Katech manufactures its own intake valve that still has a chrome nitride coating that's compatible with the valve seat, but

the stem is cut down ever so slightly and a molybdenum coating is applied.

The valve also features a steel tip insert, so the lash cap is eliminated. That's not an issue on the exhaust side, because the factory exhaust valve is stainless steel and does not require a coating. Katech also offers a titanium/molybdenum exhaust valve for customers who want the best possible combination.

There are countless opinions floating around suggesting the factory hollow-stem, sodium-filled exhaust valves are the root of the LS7 valvetrain issues, but Katech has found that not to be the case. If it were, we would not have seen valve guide wear also on the intake side.

The root of the problem was the valve guide machining and when that is addressed with the solutions outlined above, Katech is confident the engine does not need its exhaust valves replaced for a street application. We do, however, recommend the titanium/molybdenum exhaust valve for extreme-duty road race applications.

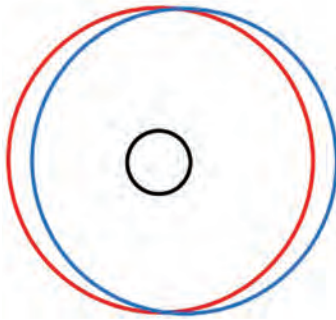
The only way to properly determine when an LS7 engine has excessive valve guide wear is disassembly of the cylinder head and measurement of the stem-to-guide clearance. GM did issue a service

LS7 Valve Guide Issue Summary

GM issued a statement about the problem in 2012:

- Affects a small number of 2009-'11 Corvette Z06 models
- GM discovered the condition through cylinder head warranty data involving a very small number of vehicles
- Through inspection of returned heads, it was determined that a machining error in the valve guide had occurred at the head supplier
- The quality issue has been contained as of February 2011, with 100-percent inspection of the heads
- The most common customer complaint has been excessive valvetrain noise
- However, if the condition is not addressed, it could result in engine failure. To date, where this condition has been observed, it has occurred very early in the vehicle life

What customers need to know: They should drive and enjoy their vehicles without fear. If their car demonstrates this condition, they are likely to hear unusual valvetrain noise first.



VALVE GUIDE
 VALVE SEAT - CONCENTRIC
 VALVE SEAT - ACTUAL
 Exaggerated for illustrative purposes

bulletin for a *wiggle test* that involved moving the top of the valve in an assembled cylinder head on the car to determine how much side clearance there was in the valve guide.

Katech didn't feel it was an accurate test, because it was hard to define a good/bad threshold and was only truly effective on engines that had very worn guides. GM later concluded the same and dropped the test.

Some have reported symptoms of excessive valvetrain noise or high oil consumption, but we have seen some engines that have had extreme valve guide wear and exhibited no symptoms.

Katech's recommendation is that all engines should be inspected to prevent a much more expensive failure in the future. **TS**



JASON HARDING is the director of aftermarket operations for Katech Inc., a professional driving instructor, and a car dealer/collector.

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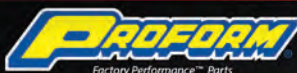


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