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GEN3 1.6 Missed Shift Over-Revs

Over the last couple of months we have inspected and diagnosed a few GEN3 engines that have been over- revved to 8200 RPM and even up to 9100 RPM, based on recorded ECU data.

The only way this can happen is by mechanically over-revving the engine when a lower gear is selected by mistake during an intended up shift. The most common missed shift is selecting 3rd gear when up shifting from 4th to 5th gear. The less common missed shift is selecting 2nd gear when up shifting from 3rd to 4th. Either one of these missed shifts near the rev limit would bend the valves of the 1.9L engine.

People have asked, if the GEN3 has an electronic Rev-Limiter, how can this happen? It's easy to understand when you look at the RPM gaps between gears. At the electronically limited speed of 6750 RPM the gap between 2nd and 3rd is 2013 RPM and between 3rd and 4th is 1671 RPM.

So if you push the clutch to make your up-shift at 6735 RPM from 3rd to 4th and select 2nd by mistake and release the clutch, 6735 + 2013 = 8752 RPM or 4th to 5th and select 3rd by mistake and release the clutch, 6735 + 1671 = 8406 RPM. So how do you get to the 8900 to 9100 range?

The simple answer is that everything inside the engine and gear box has mass and energy, even if you hear that you selected the wrong gear and push the clutch back in really quickly all of the energy stored in the moving parts can accelerate the parts just a bit past the target of RPM plus gear gap RPM…

Valve Float occurs around 7400 RPM and is not good for engine reliability. 1.6L Valve train is very stable; we have not seen any valve train damage as of this date.

The damaging part of the over rev are the "Reciprocating Parts" The formulae involved is long and not needed for this over simplified example. It is exponential …when the engine is running, as the #1 cylinder fires, the #4 piston and rod assembly is sort of like dead weight. The rod cap and bolts control that mass on the downward stroke (remember way over simplified here, this just to make point). The force of that mass at X RPM is equal to:

1050 RPM = 30 lbf
3000 RPM = 245 lbf
6750 RPM = 1244 lbf

At 9000 RPM it jumps to 2226 lbf Easy to see why a 1000 / 1500 / 2000 RPM over-rev is really bad for bearing reliability.

We have inspected an engine that was damaged at Daytona this past August. The engine had one broken rod bolt, as well as a couple rod bolts below factory torque spec due to stretching on the remaining intact rods.

We also inspected a couple of other engines that have been over-revved to the 8000 to 8200 RPM range and found a couple of rod bolts below the factory torque spec and no other damage.

It's not easy to determine what failed first; the stretched/broken rod bolt or if the rod bearing spun due to the damage of the mating surfaces between the rod cap and body. The good news is that if the engine seems to be running fine and has good oil pressure with no knocking sounds after a big over-rev, we can catch the problem before further damage occurs.

After a big over rev we have also seen loosened flywheel bolts.

In order to save an engine from further or catastrophic damage, we offer a new service. If you incur an 8100 RPM plus over rev and want the bottom end of your engine checked, we will inspect it, change bearings, reseal and dyno to verify output. The cost of this inspection and repair is $1250. Far better than the $5400 cost of an engine exchange after Block, Crank and rod damage.

This is also good for a rental car program, if your rental car engine has seen a big over rev…now there is a procedure for damage inspection.