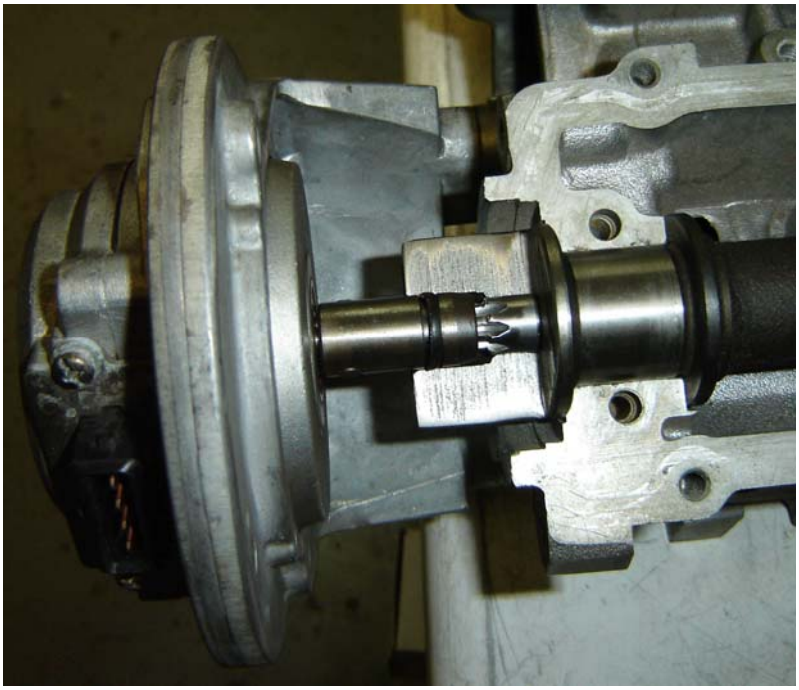
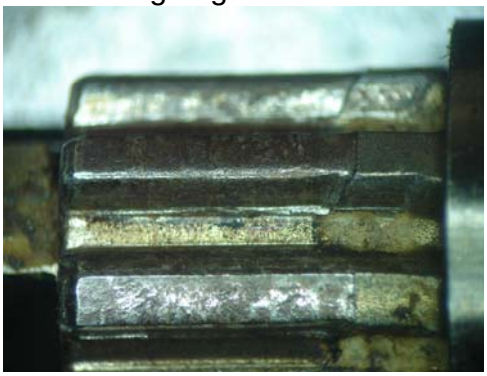
NISSAN VG30DE(TT) CAM ANGLE SENSOR COUPLING MISALIGNMENT CAN CAUSE UNEXPLAINED DETONATION IN HIGH PERFORMANCE ENGINES

Nissan's VG30DE(TT) for the most part is a well-designed engine compared to others designed in the eighties. Like all engines, it to has a few warts, one of which is the topic of discussion here, but first a little back ground. Nissan had chose to use a self-enclosed dual channel optic sensor to track the rotational position of the engine on the VG30DE. The Camshaft Angle Sensor (CAS) is coupled to the front of the left exhaust camshaft via a splined coupling pin pressed into the front of the camshaft. As it is necessary to have a sensor that can accurately report the engine's rotational position throughout a full 720 crank degrees, attaching it to the first camshaft being pulled by the timing belt was the most accurate choice. In theory this was a good layout, but in production, caused Nissan a bit of grief. Almost as soon as the Z32 was released in 1989, the CAS coupling pins started wearing at an alarming rate. A technical service bulletin was issued when it was discovered that the cause was a slight eccentricity in the alignment of the CAS to the camshaft, caused by a machining error of the CAS mounting bracket to cylinder head aligning dowel holes. This would cause the coupling splines to wear, causing a large amount of backlash at the CAS, which in turn sent an erratic position signal to the ECU. The backlash can wear to as much as 3 or 4 cam degrees, causing the ignition timing to wander as much as 6 to 8 crankshaft degrees! This condition can cause unexplained detonation in various RPM ranges, as the CAS resonated from the backlash. Nissan's bulletin also stated that the cylinder head must be replaced if the CAS mount was not concentric to the cam-bearing bore. While this Service Bulletin was specific to early production of the 1990 model, it is not uncommon to find unacceptable misalignment in later engines for various reasons.





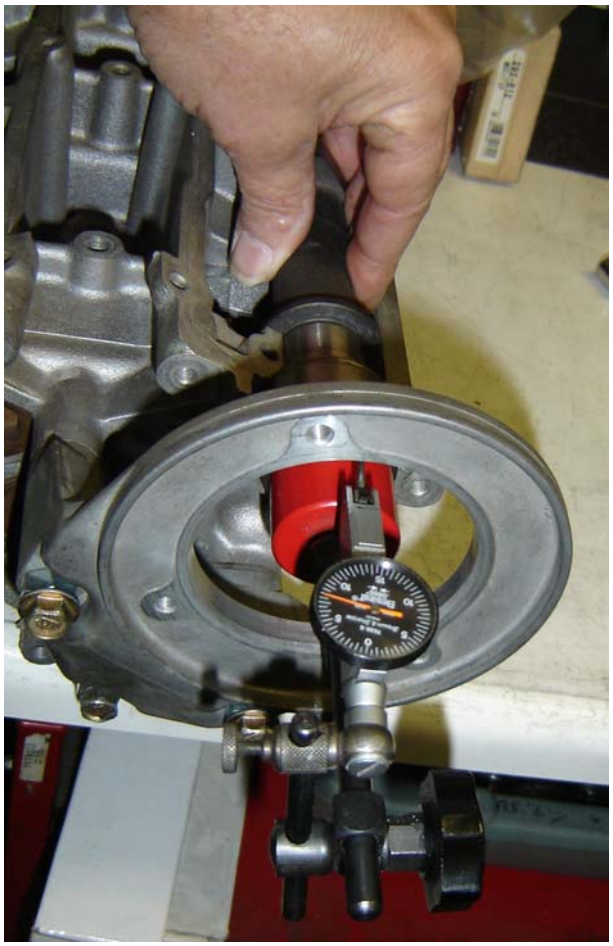
There are a couple of symptoms that may indicate a concentricity issue. The first is, if there is any reddish rust residue in the coupling splines, which is an indication that the splines are wearing from misalignment. The second is seen when logging the Position and Reference signals with a Consult or other tool that can log from the OBD port. A graph of these signals should look like clean lines plotting the RPM, however, if the plotted lines show any divergent scatter (buckshot pattern) from the lines at any RPM, this is a classic sign of CAS backlash. As the coupling backlash vibrates, the CAS is advancing and retarding relative to the engine's actual position, causing the spark timing to be presented to the engine as excessively retarded and more serious, excessively advanced which can cause detonation.

CAS drive pins have never been available separately from Nissan, however JWT makes a Chromoly CAS drive pin that is available.

Measuring for CAS concentricity can be done in the car, however, the CAS unit and the CAS drive pin will probably need replacement, if wear and or misalignment are found. Replacing the CAS drive pin will require the camshaft be removed from the engine. Changing out the CAS drive pin is explained at the end of the instruction below.

If any of the above symptoms are apparent or if you are building a high performance VG30DE(TT) engine, the following CAS drive alignment inspection and correction should be done:

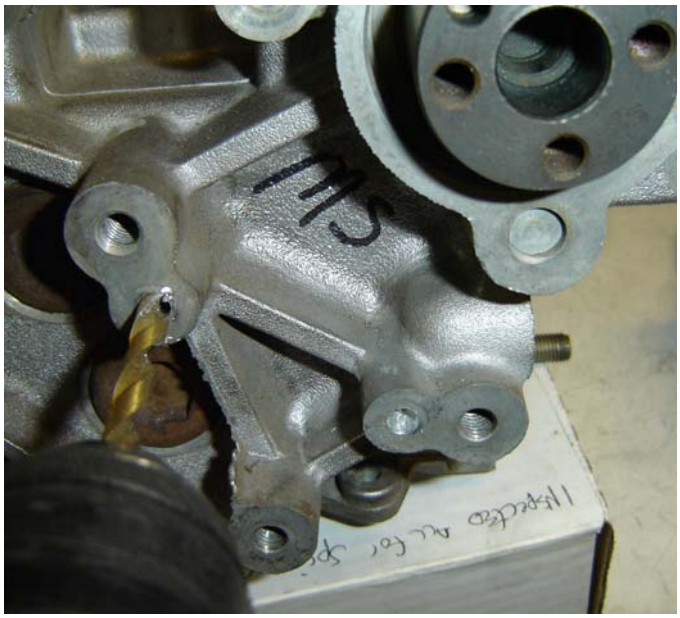
1. Indicate the CAS register using a last-word indicator as shown. If the engine is still in the car, remove the left side timing belt cover, the CAS, and one of the cam sprocket bolts to allow a magnetic (or threaded stud) base indicator stand to be attached to the cam/sprocket. Remove the spark plugs for easy engine rotation. Set up the indicator so the contact ball is touching the inside surface of the CAS register circle. It is not important that the indicator stand be centered on the cam, as the cam will rotate and the contact ball will stay concentric relative to the center of rotation. Rotate the engine and mark the 2 points of highest eccentricity and the amount at each point. If the total indicated run-out (TIR) is more than .002", you will need to correct it.



Note: If you have a new CAS mount, test fit it to determine if any eccentricity is in your mount or the head. If your original error is repeated with the new mount, the error is with the head, if it is concentric with the new mount, you are done, use the new mount! If not, continue.

2. Remove the aluminum CAS mount and the 2 alignment dowels from the cylinder head. Note: Timing belt cover backing plate is not shown in any steps for clarity.

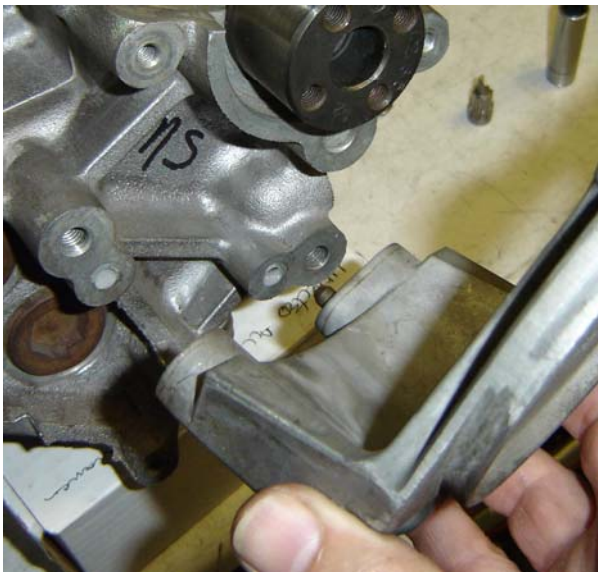
3. Drill out the dowel holes in the head with a ¼" drill if the eccentricity is less than .012" TIR, else use a drill that is large enough that the aluminum mount can be aligned.



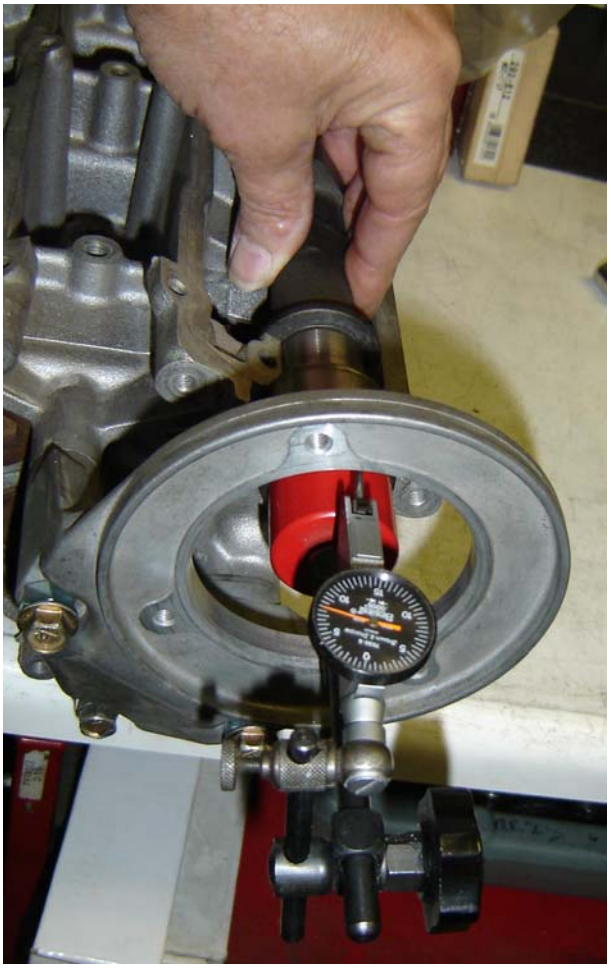
4. The dowel pins should be a slip fit into the CAS mount holes (they should go in and out of the holes by hand). Clean the dowel pins and remove any burrs from the holes until the dowels can be slipped in and out of the holes by hand. This will allow the dowels to stay with the head during any future disassembly.

5. Mix a small amount of JB Weld (not the Quick Dry version) and apply it in the 2 enlarged dowel holes in the head. Be careful to only apply enough to fill the holes after the dowels are in place.

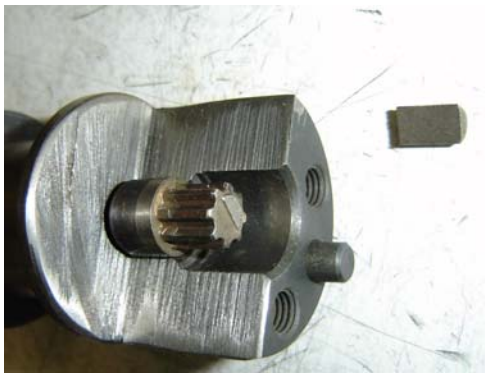
6. Install the CAS mount with the dowels in it, tighten all 3 bolts completely (12 to 15 ft-lb) and then loosen them just enough to final align the mount.



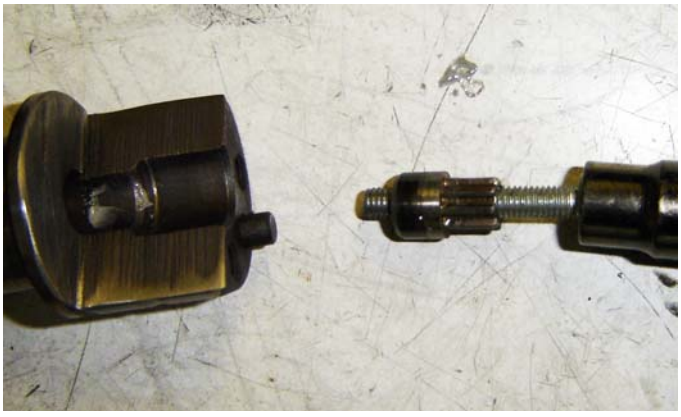
7. Reinstall the indicator setup and tap on the mount with a plastic hammer until concentricity of .002” TIR or less is achieved. Carefully tighten the mount bolts, rechecking the indicator measurement until all 3 bolts are final torqued to 12 to 15 ft-lb and concentricity is .002” TIR or less. Let the parts setup for at least 15 hours before disassemble.



8. To remove the CAS drive pin from the camshaft, break off the locating stub from the old CAS pin and drilling a 5mm hole completely threw the pin and tap it with a M6x1 tap.



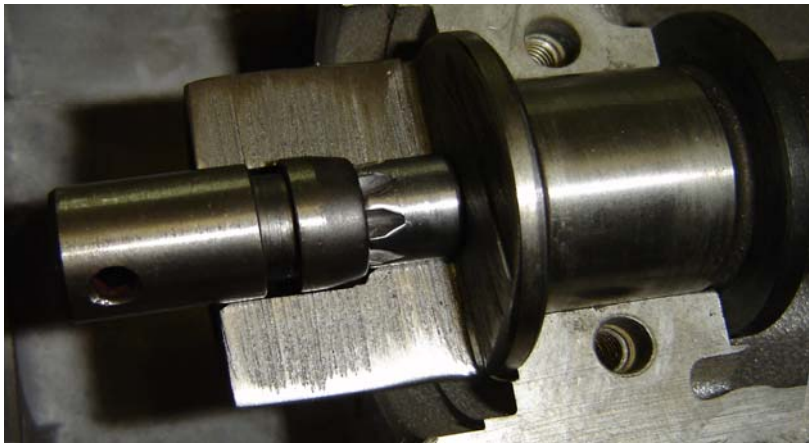
9. Thread an M6 bolt into the hole until it contacts the cam behind the CAS pin; continue tightening the bolt until the CAS pin is pulled out of the hole.



10. If you are installing a new CAS unit, remove the female coupling from the end of your old CAS unit by using a drift punch to remove the retaining pin. This will make the perfect tool for pressing the new CAS drive pin into the camshaft. If not you will need to make a sleeve suitable for pressing the CAS drive pin into place; it must sit snug on the shoulder below the spline section.

11. To install the new CAS drive pin, support the cam so that damage to lobes and bearing journals is not possible. When installing the CAS drive pin into the camshaft, insure that it is exactly aligned as shown, with the half round extension positioned on the left (9:00 o'clock if the cam dowel is at 12 o'clock) and the straight edge aligning with the middle of the cam dowel pin.

12. Using the female coupling you removed from the old CAS and a hammer, tap the CAS drive pin slightly into the cam and check that it's rotational position is correct before seating the CAS pin. If the alignment is good, continue to seat the CAS pin until the female coupling bottoms in the shoulder hole, as shown (the hammer feedback will feel distinctly more solid).



Final inspect the assembly. Remove the O-ring dampener from the female coupling on the new CAS unit, and assemble the CAS unit, CAS mount, and camshaft with new CAS drive pin into the cylinder head. Check that the CAS unit moves freely in the register and that there is no binding. Reinstall the O-ring dampener on the CAS unit and final assemble the engine.