KZ650 Engine Overhaul - 2

The Examination

Now it's time to take a more detailed look at the pile of bits and work out what we'll have to spend on it to make it serviceable. Some of the major bits which usually suffer after high mileages look in surprisingly good nick, but there are signs of some parts being simply worn out.

Unbolting the big ends from the crank reveals the old bearing shells. I always replace shell bearings as a matter of course, but the condition of the old shells can give a good indication of the state of the crank itself. These shells are showing typical signs of wear but no undue scuffing, and the big end journals look smooth and polished. The micrometer confirms they're still within factory tolerances.

Moving up the engine it's time to take a good look at the cylinder bores. There is some sign of surface corrosion, particularly on No.2 (shown) but as this isn't deep it may not be too much of a problem. I'll be honing out the bores before rebuilding the engine, and as long as the bores are within tolerance afterwards it will be fine. Deep pitting would mean a re-bore.

To check piston ring and bore wear I remove the top ring from each piston and gently insert it a few millimetres down its respective bore. The gap can now be checked with a feeler gauge. The factory service limit for this engine is 0.7mm, this one measures 0.6mm. Fitting the ring at the bottom of the bore and measuring again gives me a reading of 0.5mm, indicating the bore is worn by 0.1mm, hardly enough to warrant the expense of a re-bore. As the rings are still within service limits I could re-use them, but I'd rather fit new if the budget permits.

A few minutes with steel wool and aluminium cleaner cleans up the pistons nicely, and scraping with an old piston ring cleans out the ring grooves. Unless there's obvious damage to the pistons its rarely necessary to replace them unless re-boring the engine. These pistons are still the standard size, which means the barrels could be bored at least twice in future should it ever prove necessary.

Moving higher up the engine the first sign of a potential problem is found. On this Z650 the cam bearings are machined straight into the head, which means the cams run direct in alloy. The integrity of the cam bearings therefore depends on a constant supply of clean oil and if oil changes are missed or foreign bodies allowed to enter the engine these bearings will suffer first. Some of the cam bearing journals are showing signs of scoring.

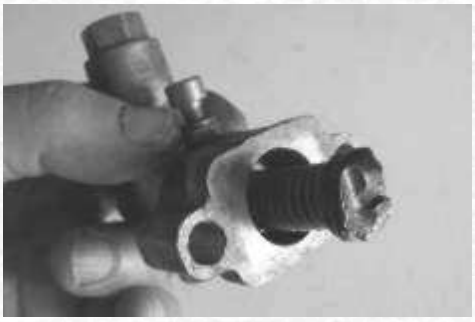
The matching bearings in the head also show some signs of wear, and I'm reserving judgement on these until I've had the head down to a specialist engineering company for a second opinion. If these bearings get too sloppy oil pressure across the whole engine will drop, which leads to a vicious circle of rapid engine wear. The recommended cure is to fit a new head and cams, which would be outrageously expensive, so if necessary we may be hunting for some second hand bits.

Next, the valves have to come out of the head. On this DOHC design with shim and bucket tappets the easiest way to remove the buckets is to pull them out with a "sucker and stick" valve grinding tool. The Z650 had it's shims fitted under the buckets rather than on top. This was to stop any possibility of an engine spitting out a shim under hard racing conditions, but it did make the shims harder to get at. Here you can see the shim clipped into the top of the valve spring collar, but watch for shims stuck into the inside of the bucket.

With the buckets lifted out the valves all release with a conventional valve spring compressor, though the limited space around the valve top collar means some compressors sold for car engines will not fit. There is some carbon build up on both the combustion chambers and valves, but both clean off fairly easily. The valve seats themselves look in surprisingly good condition, with only very light pitting on the sealing faces.

Many engines have pitted valve seats, and it has become almost a matter of routine to send the head out for re-cutting. Engines designed for use with unleaded fuel, like this one, have very hard valve seats which are difficult to lap in by hand. However the pitting is so light on this engine I can use the old fashioned "sucker and stick" method to clean them up nicely. With a little engine oil on the valve stem, I can smear a little grinding paste onto the valve seat, lower the valve into place with the tool and rotate it back and forth on the seat, lifting occasionally to re-distribute the paste. Once the valve seat shows an unbroken matt grey ring I can switch to fine paste to finish off, then clean off all the old paste with petrol. I've removed the old valve stem seals first.

Turning now to the other main engine components, the cam chain is next in line for scrutiny. This cam chain shows obvious signs of wear without having to measure it, and I will be fitting a new one as a matter of course. This cam chain has also had a soft link fitted at some point (shown), probably an indication that it has been replaced without stripping the engine. Factory cam chains are endless, and the engine has to be stripped to fit them. There's nothing inherently wrong with soft linking a cam chain if its done properly, but I like to have endless chains in my engines and this is a good opportunity to swap it.



The cam chain tensioner is rather suspect. I noticed that the original 6mm mounting bolts had been replaced with 8mm studs, a sign the tensioner had been removed several times in the past. I suspect this tensioner may be from a later engine as early Z650s used a single plunger type, and this twin plunger tensioner is usually found on later Z650s and Z750s. Certainly the rubber pad on the end of the main plunger looks badly chewed up, perhaps not a major problem in itself but something I'd want to replace.

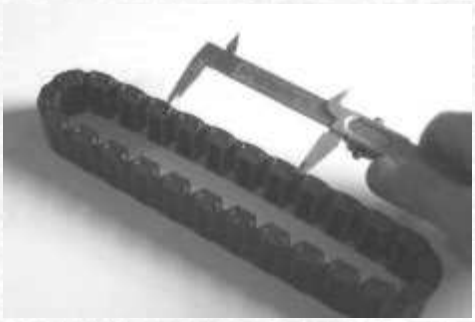
Components of the cam chain tensioner. Kawasaki revised this design at least three times to try and make it work properly. In theory the main plunger can advance inwards to take up slack as the chain wears. The secondary plunger then moves across at ninety degrees to lock the main plunger in place, and stop it moving backwards. Wedge ends on the plungers supposedly lock the two together. In reality the two plungers frequently chattered against each other, burred up the wedges and left the cam chain to its own devices. Kawasaki added progressively longer springs and end caps to fix it, but many owners converted the tensioner to manual operation by simply adding a pinch bolt and locknut to hold the main plunger in the tensioner body. This one has been so converted, but the bolt is the wrong size to engage with the slot in the plunger and has made matters worse.

This is the type of burring you usually find on the plunger ends. You can theoretically clean these up with a whetstone and re-use them, but once they've got this bad both plungers will have to be replaced. It may be a bit "belt and braces" but I'd also prefer to convert the tensioner to manual operation too. This does mean it will have to adjusted by hand at each service; not a major job but easily overlooked if the owner assumes the tensioner is still automatic.

Early Z650s used a combination of sprockets and rubber idler wheels to guide the cam chain run, later replaced in favour of simpler slipper blades. This is the main guide roller assembly which fits at the rear of the barrel and is pivoted by the cam chain tensioner. The rubber roller has hardened with age and worn dimples around its working face, and I'll be fitting a new one. However this may not be a cheap option.

This rubber guide wheel, also from the cam chain, is showing signs of breaking up around the working edge. It's also become quite hardened and brittle compared to a new one, so it goes on the list for replacement too.

And this is one of the cam chain guide sprockets. These are supported in tiny needle roller bearings and it's as well to check to make sure the rollers are intact, as they are here. Note the flats on the end of the bearing pin - these are sandwiched against tiny rubber blocks between the head and barrel which also harden with age. Nothing wrong with the sprocket, but I'll be replacing all the tiny rubber blocks.



The primary chain is an enormous Hy-Vo device, massively strong but also massively expensive to replace. Kawasaki advise measuring wear by looking for sideways play which should not exceed 27mm, which you can do with the sump removed and the engine in the bike. Here I'm checking for length between the pins. There's no tensioner provided for the primary chain. I'm not surprised, to find this one is well within its service limit.

The jackshaft assembly is supported by this roller bearing in the crankcase, which should be checked for wear. The bearings are rarely a problem but should be replaced every third or fourth engine rebuild, as driving out the jackshaft subjects it to sideways load. At the left end of the shaft is the primary chain sprocket, with the starter motor clutch amidships. The primary sprocket has a built in shock absorber which rarely gives trouble. The starter clutch is a different matter, and should be checked for wear every time the jackshaft is out.

The starter clutch follows conventional Japanese design. These three rollers are fitted in wedge-shaped slots, and held outwards by small springs and plungers. When the starter is engaged the three rollers are wedged against the drive gear to transmit the drive. After high mileages the three rollers can begin to develop flats and may not lock against the drive gear correctly, making the starter spin without turning the engine over. Now is the time to fit new rollers and springs.

This is the boss on the drive gear which should wedge against the rollers in the starter clutch. Any sign of flatting, or "three-penny bitting" on the boss means the starter clutch can slip under load. This one has the first signs of wear and is approaching the end of its service life. Replacing it now may not be the cheap option but it may save another engine strip to change it in a few thousand miles.

Next in the pile is the gearbox shafts and gears. The Z650 has a strong transmission design and rarely gives problems here, but its always worth checking while its apart. This bearing on the output shaft fits behind the engine sprocket. If the rear chain has been run too tightly it will have put too much load on this bearing. If any signs of wear replace it now, and use a genuine bearing rather than one from a supply shop.

Check the individual gears for chipped or broken teeth, or worn or damaged dogs here. The selector forks which engage in the sliding gears should also be checked for any damage or wear and particularly bent ends if any selection problems have been encountered. Bent or damaged selector forks should be replaced with new ones - don't try to straighten them.

I've stripped the oil pump right down and cleaned it up for examination. I always follow the recommended checks for clearance between the rotors, but I've found the common problem with these pumps is frequently scoring on the endplate (shown). Any foreign bodies in the sump can be drawn into the pump (which is before the oil filter in the system) and go around inside it. Even light scoring here can dramatically affect oil pressure and is worth watching out for. This one has only light polishing, and should be fine.

The clutch plates look a little on the thin side. Sure enough when measured they're under the service limit of 3.5mm, and I'll be fitting a new set for the rebuild. Only the friction plates need replacing, the plain plates will have only suffered if they've buckled due to very hard use or racing. Check the plain plates on a flat surface to make sure of course, but under normal use they should last more or less indefinitely.

Clutch springs are cheap, and a new set would usually be on the list when fitting new plates.

And that's about it. This engine isn't in bad condition at all with most major components showing only light wear, though I'll be seeking a second opinion before pronouncing the camshafts healthy. I also found lots of play in the shock absorber on the back of the clutch basket, which could prove expensive to replace. But with a new cam chain and the tensioner sorted out properly the engine is basically sound and should be capable of providing many more thousands of miles of faithful service, once it's rebuilt !

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