Jaguar Valve Adjustment

In a continuing effort to bring you unique and unusual valve adjustment procedures, we offer the dual overhead cam six cylinder Jaguar engine. Jaguar has used this classic engine design to power almost every Jaguar model since the engine was introduced a few years after World War Two.

This basic engine design remained largely unchanged until it was replaced by an all aluminum six cylinder in the new XJ6. Jaguar got almost as much use out of their original six cylinder design as Chevy has gotten out of the small block. The new aluminum Jaguar engine is similar to the old engine, and that includes parts of the valve adjustment procedure we will describe here.

Unlike many overhead cam engines, the Jaguar's valve clearance adjusting shims ride on top of the valve stem, beneath the bucket tappets. Just like the Saab valve adjustment procedure we covered in the April 1990 *Import Service*, the camshaft(s) must be removed to replace the adjusting shims. The Jaguar engine doubles the fun with intake and exhaust camshafts.

Staying Power

Hiding the adjusting shims under the bucket tap-

pets makes for some extra work at valve adjustment time. There is one big advantage to this arrangement, however. Since the camshafts never touch the adjusting shims, the only friction and wear the shims are exposed to is at their contact point with the valve stems. As a result, a properly adjusted Jaguar engine should hold its adjustment for a good many miles.

There's even hope if you're stuck ten miles from Timbuktu and can't find the right adjusting shim. Because most of the shim wear is in the middle of one side of the shim, flipping over the original shim will often bring the valve clearance back into specification.

If Jaguar valve adjustments come few and far between at your shop, you can still follow the valve adjustment procedure each time the cylinder head is removed for other reasons (head gasket replacement, valve grind, etc.).

Jaguar technicians often make a basic valve adjustment while the cylinder head is off the engine. They recheck their work after the engine is assembled and usually find that no further adjustment is necessary.

Slap Shot

The Jaguar engine uses upper and lower timing chains to spin its twin overhead cams. The lower chain has a hydraulic chain tensioner and requires no periodic adjustment. The upper chain has a mechanical chain tensioner, reached by removing the crankcase breather assembly.

Always check the upper timing chain tension during a valve adjustment. The upper chain stretches as it wears and the mechanical tensioner has no way to take up the slack without some outside help. The upper chain should be re-tensioned at 20 to 30,000 mile intervals, even if the valves don't require an adjustment at that point.

If the upper timing chain tensioner adjustment is neglected long enough, the upper chain can get very loose. A loose upper chain will make disturbing noises as it slaps inside the head casting. The noise is especially noticeable at idle, and is loud enough to get the driver's attention, even inside the well-insulated passenger compartment.

Let's Dance

A loose upper timing chain is bad enough, but how about a broken chain? Unlike many other overhead cam engines, there's no way that the Jaguar's pistons can hit the valves. The engine will freewheel and the valves will escape damage if the lower timing chain breaks.

But the valves can hit each other! Clearances are tight inside the Jaguar's hemispherical combustion chambers. The upper timing chain's job is to make sure that only one intake or one exhaust valve per cylinder is fully open at a time. If the chain breaks, the intake and exhaust valves will do a deadly fox trot in the dark.

All this is very important to remember during a valve adjustment. Proper valve timing must be maintained while the camshafts are removed and reinstalled during valve adjustment shim replacement. The procedure isn't that difficult, but there are plenty of pitfalls for a careless or unwary technician.

Roll Up Your Sleeves

The bucket tappets on many overhead cam engines ride directly inside machined bores in their aluminum cylinder heads. The Jaguar engine surrounds the tappets with pressed-in-place steel sleeves. Time, mileage, and hundreds of heating and cooling cycles can cause a sleeve to gradually back out of its bore in the cylinder head.

A loose sleeve can get a little too friendly with the camshaft if the sleeve backs out far enough. The engine will make a random, loose valve clearance-type noise as the cam hits the sleeve, knocking it back into the head. Shattered sleeves often result from this kind of unchaperoned togetherness.

Several fixes (both authorized and unauthorized) have been tried over the years to remedy loose sleeve problems. Drilling a hole, then installing a sleeve retaining pin or bolt in the side of the cylinder head was an early solution. We'll demonstrate a relatively easy and long lasting repair technique in our photo sequence.

If you arrive at the scene too late (Shatter City), you'll need to install a new tappet sleeve. Installation of a new sleeve usually requires cylinder head reaming because new sleeves are machined to slightly oversize dimensions. The cylinder head and valve components must be removed to do the reaming job.

Our host shop has had success installing good used sleeves to replace shattered or damaged originals. After installing a used sleeve, sleeve retaining plates are installed, all with the cylinder head in place. Unless you're a Jag specialist, you probably don't have a personal stash of used sleeves, however.

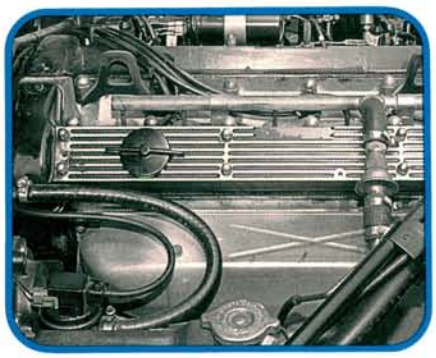
Merry Old England

England has a long history of going its own way in many things, why should automobiles be any different? You all remember Whitworth wrenches, don't you?

With most of the rest of the world using the metric system, England chose to give up their measuring system and try ours for a while. In the end they went Metric too. As a result, it's anybody's guess what kind of fasteners you're going to find if you look under the hood of a Jaguar.

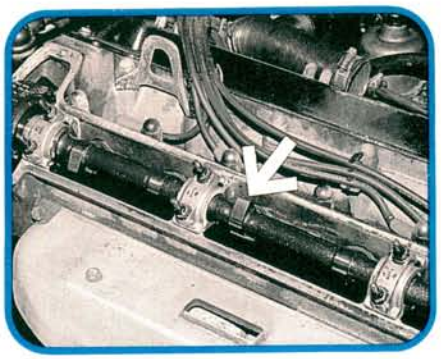
The valve clearance specifications and shim dimensions are listed by Jaguar in decimal fractions of an inch. Shims are available in 0.001 inch (0.0254 mm) increments. We'll list everything that way in the text, followed by metric equivalents.

—By Karl Seyfert



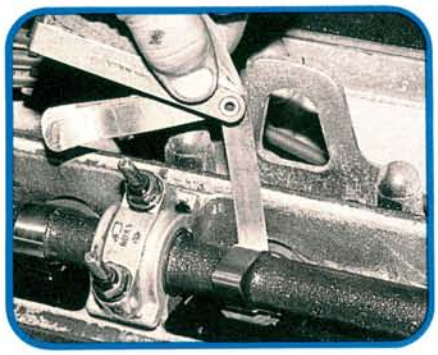
1

The engine should be cold before starting your adjustment. Clearances on 1970 and later engines are the same for the intake and exhaust valves (0.012-0.014 in/0.30-0.36 mm). We chose the exhaust valves for our photos. Remove the air injection plumbing and cowl brace, then remove the valve cover.



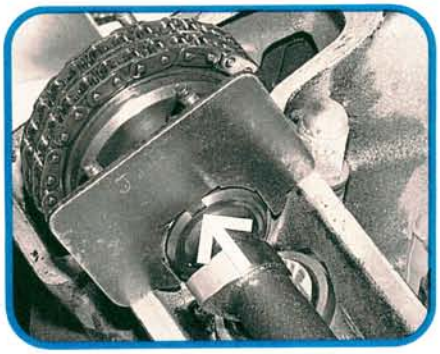
2

Use a remote starter switch to rotate the engine until one of the cam lobes is facing away from its tappet. It's very important to get the lobe in this position because the cam profile will affect your results if you take measurements with the side of the lobe facing the tappet.



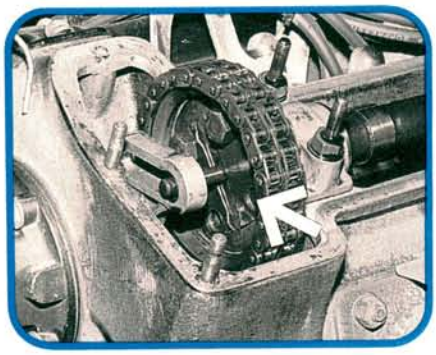
3

Keep sliding larger feeler gauges under the lobe until you find your clearance. Actual clearances on a properly maintained engine will rarely be more than one or two shim thicknesses away from the recommended clearance range. Write down your measurement, then rotate the engine to check the rest of the valves.



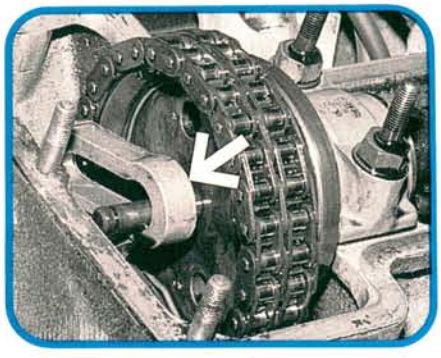
4

This is where it gets interesting. The camshaft must be removed with the index notch next to the front bearing cap facing up. A special gauge plate (arrow) is available to measure camshaft position. The four sprocket-to-cam bolts and lock tabs must be removed in the proper order so the cam ends up in this position.



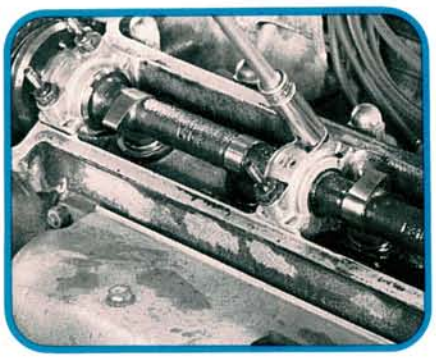
5

To remove the cam-to-sprocket bolts, rotate the engine until the cam notch is 180 degrees away from the gauge plate position. Bend back the lock plates, then remove the bolts one at a time. Turn the engine over slightly to reach the next bolt. A dropped bolt or lock plate here means a fishing expedition or engine teardown.



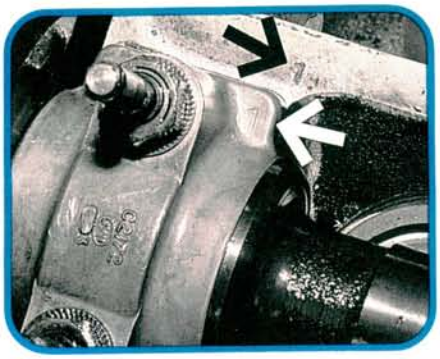
6

Line up the cam notch, then remove the last sprocket-to-cam bolt. Slide the sprocket and chain off the front of the cam. The aluminum sprocket support (arrow) catches the pin on the front of the camshaft sprocket to support the upper chain. This keeps everything properly timed while the camshaft is removed.



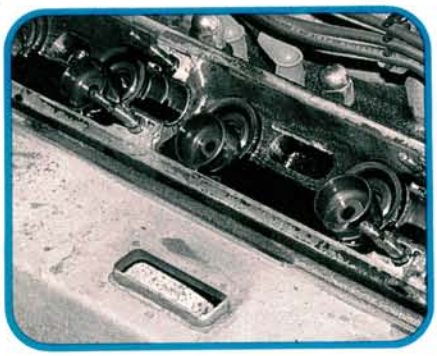
7

Slowly and evenly remove the camshaft bearing caps. Some of the valves will be partly or completely open in this position, putting some strain on the cam. The cam is pretty brittle and can break if the caps are loosened unevenly. Put the cam in a safe place after it's removed.



8

The bearing caps are numbered for location in their upper right hand corners. There's a corresponding number stamped in the aluminum head (arrows). The front bearing on each cam also serves as the thrust bearing. The bearing cap studs should be torqued to 19.5 Nm (15 ft-lb) during reassembly.

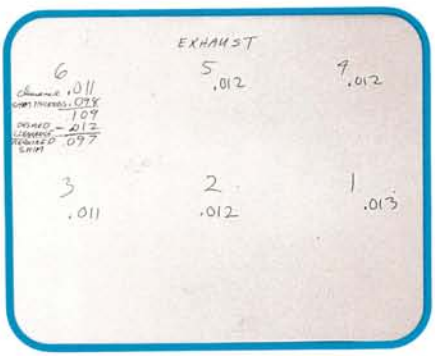


9

Check your chart, then use a strong magnet to remove the valve tappets and shims needing replacement. Flip the tappets over, then place them next to their original locations in the head to avoid confusion. A film of oil sticks the adjusting shims to the underside of the tappets.

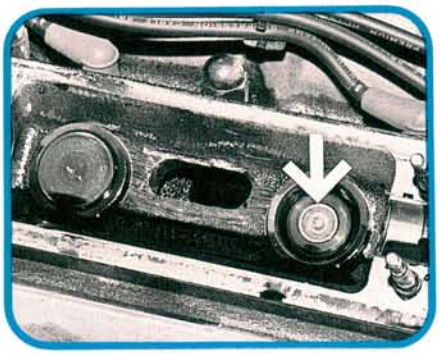
10

Use a micrometer to measure the center of the adjusting shim. Valve stem wear at the center of the shim often makes the shim thinner here. Measuring closer to the edge won't give you a true measurement. The factory shim identification (letters A to Z) usually wears off and shouldn't be trusted anyway.



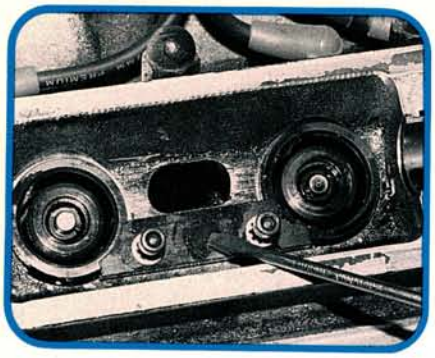
11

Add the original clearance dimension to the thickness of the shim that you just removed. Subtracting the desired clearance from this amount gives you the required thickness of the new shim. Shims are available in 0.001 inch (0.0254 mm) steps so you can put the adjustment right on the money.



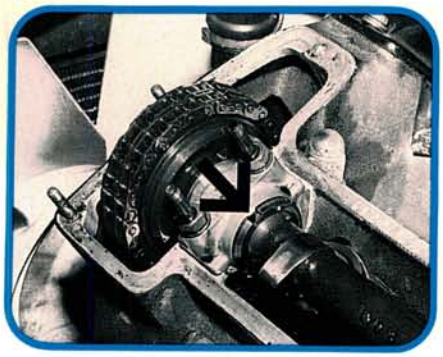
12

Install the replacement shim in the valve spring retainer. Never resurface valve stem tips during cylinder head work, unless you want to risk dropping a valve. Shortening the valve stem lets the inside surface of the tappet ride on the spring retainer instead of the adjustment shim. This can pop the valve spring keepers.



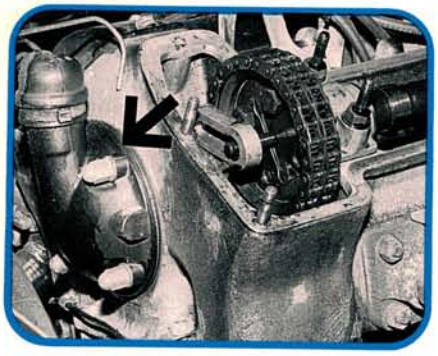
13

Each valve tappet rides inside a steel sleeve that's pressed into the aluminum cylinder head. The sleeves can work loose, hit the camshaft, and cause serious engine damage. After drilling and tapping the head, these retaining plates can be installed to hold pairs of tappet sleeves.



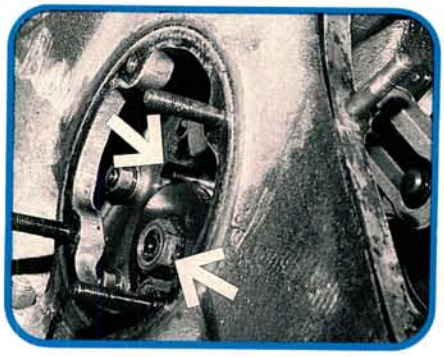
14

Reinstall all shims and tappets, then reinstall the camshaft. Remember, the cam must be reinstalled with its notch facing upward to prevent valve damage. Reinstall the timing chain sprocket, then recheck your valve adjustment. Clearances don't always end up as planned, even with careful measurements.



15

You'll need to adjust the upper timing chain if the sprocket won't fit back on the camshaft, or if the chain seems very loose. To reach the chain adjuster, remove the crankcase breather housing and screen. A clogged breather screen can cause excess crankcase pressure and oil leaks at engine seals and gaskets.

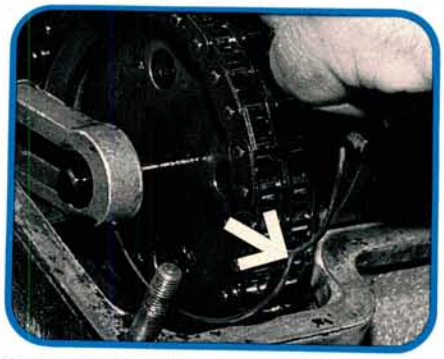


16

Loosen the upper chain adjuster's lock nut until it's finger tight (lower arrow). Now depress the adjuster's locking pawl (upper arrow) to release the adjusting mechanism. Turn the adjuster wheel clockwise to loosen the chain. This will give you enough slack to reinstall the camshaft sprocket.

17

This homemade tool engages two holes in the adjuster wheel to tension the upper chain. Jaguar says the chain should be "less than bar tight." So don't tighten the chain any more than you can manage with your bare hands on the tool arm. Release the locking pawl, then tighten the lock nut to hold the adjustment.



18

Valve timing is adjustable at the sprockets, although it shouldn't be necessary during a normal valve adjustment. The sprocket center can be removed after removing the inner sprocket retaining ring (arrow). Interlocking gears on the inner and outer sprocket parts allow half degree valve timing changes.