

Toyota

Twin-Cam

Valve Adjustment

I worked in a shop where some of the technicians thought shim-style valve adjustments were a type of legalized gambling. The way they figured it, selecting the right adjustment shim involved about three parts luck and one part skill.

After the guys had crapped out under the hood a few too many times, they surrendered their shim-style valve adjustments to a foreign-speaking gentleman who had mastered the mathematical equations needed to beat the dealer (no pun intended). The equations had been passed down to him before he left the old country. He guarded his adjustment tools and private stock of adjustment shims jealously, and shared his knowledge with no one.

Adjustable valves on imports are in danger of going the same route as ignition points before them. Several multi-valve engines produced by Toyota are holding out against the tide of hydraulic lifters, however. We're going to cover the valve adjustment procedure for the 4A-GE engine found in the Toyota MR2, Corolla GTS, and FX-16 models.

If you've done valve adjustments on OHC Fiat or Volkswagen engines, the Toyota setup should look very familiar. The twin-cam Toyota has one cam for the intake valves, and one for the exhausts. There are two intake valves and two exhaust valves in each cylinder. Bucket-type shim holders sit directly above the valve stem and right beneath the cam lobes. This eliminates rocker arms and push rods. Selective shims in the bucket holders allow you to correct valve lash.

The valve adjustment procedure we will describe for the 4A-GE is the same for other Toyota multi-valve engines. Please use the underhood sticker to check the recommended clearances for each engine.

Intake side: $N = T + [A - 0.20 \text{ mm (0.008 inch)}]$
Exhaust side: $N = T + [A - 0.25 \text{ mm (0.010 inch)}]$
T = Thickness of the used, original shim
A = Your original valve clearance measurement
N = Thickness of the new shim

There are charts that let you compare your original valve lash measurement with the thickness of the original shim. These charts are supposed to send you to the correct replacement shim. They also take up two pages!

Unless your last name is Einstein, or you happen to enjoy mental gymnastics, you may prefer to try a more simplified approach. Let's check two valves. One of them is right on the money. The other is too tight. All we need is our chart, a set of feeler gauges, and a little common sense. The chart shows all 17 selective shims available, their actual thicknesses, and their number designations.

1) We'll start with an intake valve. Turn the engine until an intake cam lobe points away from the adjusting shim (straight up in the air). Then measure the gap between the heel of the cam and the adjusting shim below it with a 0.20 mm feeler gauge.

2) If the 0.20 mm feeler gauge fits, and fits snugly, the valve clearance is probably correct. We know we have at least enough clearance. Just to be sure we don't have too much clearance, let's double check our adjustment by trying to fit a 0.25 mm no-go gauge between the cam and shim.

It won't fit?

You're done with that valve. It's okay. You have enough valve clearance, but not too much.

3) When we get to the next valve to be checked, we find that the 0.20 mm gauge won't fit between the heel

of the cam and the shim. This valve doesn't have enough clearance. The shim that's in there is too thick.

Since the shims are sized in 0.05 mm steps, take a 0.15 mm feeler gauge and try again. If the 0.15 mm feeler gauge fits you know you need a shim one step, or 0.05 mm thinner than the one that's in there. Remember, if you need a thinner feeler gauge, you'll need a thinner replacement shim. The thinner the shim, the greater the valve lash.

4) Remove the shim from the tight valve and measure it at several places with a micrometer. This shim measured 2.650 mm. This is shim number 08 on the chart. But we need a shim that's 0.05 mm thinner. Our chart tells us that shim number 06 is 2.600 thick. Just what the doctor ordered. Install the 06 shim and recheck lash using your 0.20 mm gauge and your no-go gauge.

Sometimes, that no-go gauge will fit. In that case, we know that we have too much clearance, and will need a thicker shim to take up the slack.

5) Once in a great while, you'll run into a valve that's more than one shim size (more than 0.05 mm) out of adjustment, but most of the time, you'll only need to go up or down one size shim to correct the adjustment. Our test engine had gone 40,000 miles since its last adjustment, and none of the valves were off by more than 0.05 mm.

Even if the lash is off by more than one size, you can still check clearances with your feeler gauges. For example, if we had to go all the way down to a 0.10 mm before our feeler gauge would fit in that intake valve, we would need a shim 0.10 mm thinner than the original shim. In this case, we would replace the 08 shim (2.650 mm thick) with an 04 shim (2.550 mm thick), or two sizes thinner.

Now you can repeat this sequence for the remaining valves.

You'll need two special tools to remove and replace the adjustment shims. The pliers shown in our photos fit between the camshaft and the followers. These pliers compress the buckets holding the adjustment shims. The wedge tool then keeps the buckets compressed so you can remove and replace the shims with the pliers removed. These tools can be used on other Toyota multi-valve OHC engines as well.

—By Karl Seyfert

Toyota Valve Adjusting Tools available from:

Schley Products, Inc.

Circle No. 200

Snap-on Tools

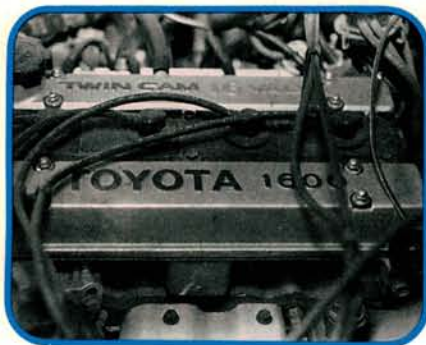
Circle No. 201

Toyota Motor Sales, Inc.

Circle No. 202

Shim thickness mm (in.)

Shim No.	Thickness	Shim No.	Thickness
02	2.500 (0.0984)	20	2.950 (0.1161)
04	2.550 (0.1004)	22	3.000 (0.1181)
06	2.600 (0.1024)	24	3.050 (0.1201)
08	2.650 (0.1043)	26	3.100 (0.1220)
10	2.700 (0.1063)	28	3.150 (0.1240)
12	2.750 (0.1083)	30	3.200 (0.1260)
14	2.800 (0.1102)	32	3.250 (0.1280)
16	2.850 (0.1122)	34	3.300 (0.1299)
18	2.900 (0.1142)		



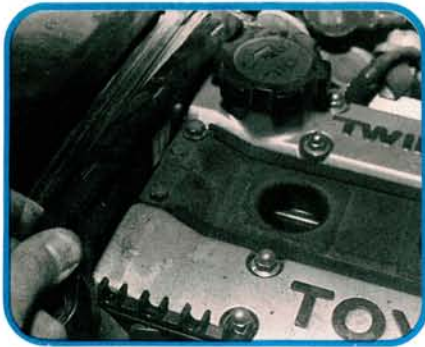
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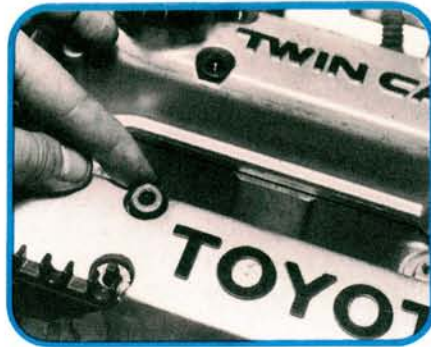
We used a 1987 Toyota Corolla GTS for our photos. Toyota recommends a cold valve adjustment and lists clearances accordingly. A stone-cold engine can be hard to come by in the real world, however. Either allow enough time for the engine to cool, or use the hot specifications (0.25 mm intake, 0.30 mm exhaust).

There's not much in your way on the 4A-GE engine. Remove the four plug wires and move them safely out of the way. Ground the coil wire if you plan to crank the engine with the ignition key, or you may end up with a face full of exploding battery case. Remove the throttle bracket from the back of the head.



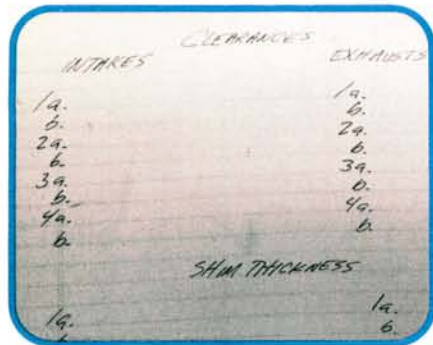
3

The cover plate in the center of the head may give you some trouble coming off. Its two front bolts are stuck under a wiring harness that crosses the engine behind the timing cover. Move the harness off its locating tabs, then slide it out of the way so you can unscrew those cover bolts.



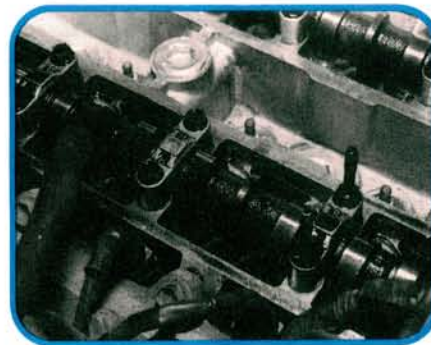
4

Remove the four nuts from each valve cover. If the covers still won't budge, don't reach for a pry bar. These rubber seals and washers under the nuts can get dry and hard, forming a perfect impression around the stud's threads. A few taps with a small chisel should get them turning so you can unscrew them.



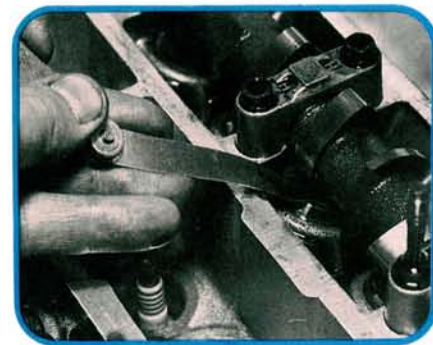
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If you don't have a complete set of shims on hand, make a chart like this one so you'll know what to order. Then run through all the valves and jot down the initial settings. It's pretty hard to keep track of all those numbers on a 16 valve engine.



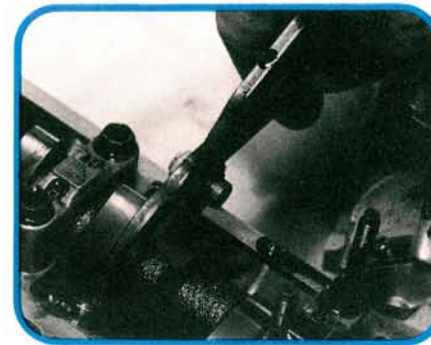
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Most manuals will tell you to check half the valves at TDC and the other half after turning the engine over once. For greater accuracy, we suggest that measurements be taken with each pair of lobes pointing straight up. The cam must be in this position for shim replacement anyhow.



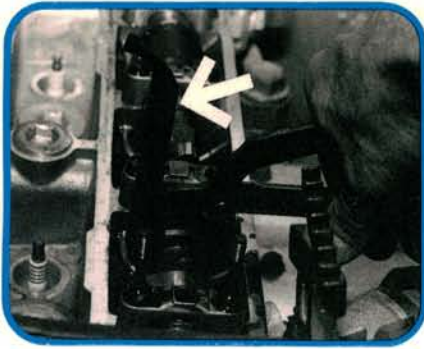
7

Each pair of valves is separated by a bearing cap, labeled A and B on my chart. We used a remote starter switch and checked all the intakes, and then all the exhausts. If you do a lot of these jobs, a separate set of go/no-go gauges can save you time and eliminate errors.



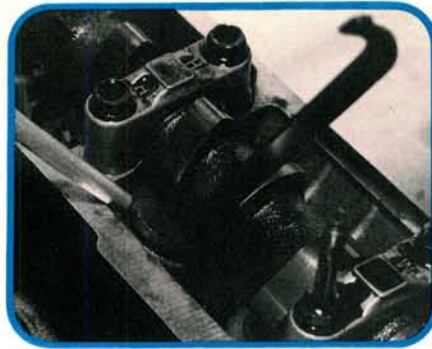
8

To remove a shim, you must first rotate the shim carrier until one of the notches faces toward a spark plug. Depress the carrier with the pliers as shown. Keep the pliers to one side of the cam lobe to avoid damaging the lobe. Squeeze the pliers completely closed.



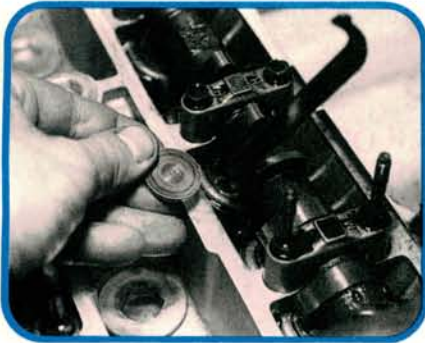
9

The wedge tool has different curves at each end to fit different engine designs. Choose the end that best fits under the camshaft. Place the foot of the wedge on the edge of the shim carrier, next to the shim. Slowly release the pliers while holding the wedge in place to keep the carrier depressed.



10

The oil film between the shim and carrier can create a strong suction. A nut pick can be used to pop the shim loose. Hold the shim up with the pick and remove it with a small magnet. The shim will slide out either side of the shim holder.



11

This engine had gone a long way between valve adjustments (probably oil changes too). Replace badly scored or worn shims even if the clearances are still correct. Make sure the shims are installed with the numbered side facing away from the camshaft lobes.



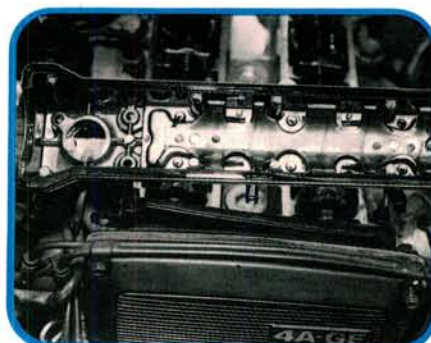
12

Measure each shim you remove with a micrometer. Jot down the thickness on the chart. Below that, put the number of the replacement shim needed, so you won't lose track. That way, you can order all your shims at once, and know exactly where they go.



13

It makes sense to keep a supply of replacement shims on hand if you do many of these valve adjustments. Otherwise, you have to do the job twice, in addition to the hassle of making a special trip to the Toyota parts department each time you do a valve adjustment.



14

The 4A-GE uses formed rubber gaskets on its valve covers. A little grease will hold the gaskets in place during reinstallation. Toyota had applied a dab of RTV to the gasket corners closest to the cam sprockets. Don't go crazy when you tighten the valve cover nuts or you'll warp the aluminum covers.