

Oilhead Valve Adjustment for Dummies

Where Our Ham fisted Hero Pursues Advanced Valve Adjustment Procedures in 99 Easy to Follow Steps (Some Of Which Are Repeated Over And Over And Over Again)

- Or -

Smidges, Snerks, Torques, Tweaks, and a Peculiar Quantum Tunneling Problem at the Mechanical Level...

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Who Should Read This

Nobody. Really. We're not kidding. We can tell and show you the steps, but, if you really want to learn this, you need to get the 'feel'. The best way to cop a feel is to serve an apprenticeship.

However, if you insist on reading this you might find some of it entertaining, you'll get a good idea of the procedure, discover that there is no real mystery to this type of wrenching, and you might pick up a nifty tip or two.

What's This All About

Ultimately, valve adjustment is about the ride. But we're getting ahead of ourselves.

Contrary to what you might think, valve adjustment is a straightforward procedure. It's easy to do. You're not going to end up with oil all over. You don't need to buy thirty or forty specialty gaskets and an Iraq-pack of oil. Nor will you have an explosion of tiny little parts to track, reassemble or lose.

You really only need a handful of tools, two different sized feeler gauges, an old bucket, and enough oil on hand to replace the half a coffee cup of oil you'll lose.

You don't need a fancy shop. You can do this in your garage, or, on a calm day, out in the driveway, with any kind of stool or chair that's going to let you work at cylinder head level for a couple hours. (On your third try, you'll probably only need 30 to 45 minutes, depending upon how persnickety you are, and how adept you become (practice makes perfect!).

Finally, you'll need some patience. Well, maybe, *a lot* of patience the first time through. No biggie, really. Hey, if Javarilla can do it...

I Do This Already – What's Special about This Procedure?

Not only are you going to adjust your valves, you are going to refine your valve gaps so they MATCH. Each pair of intake valves will be matched, as will each pair of exhaust valves.

We're going to be picky about this, but the results will be divine.

Promise.

Why Bother?

"Why," you might be asking, "Should I put down this beer and adjust my valves? The bike runs - they must be set right, RIGHT?"

"And why," you might be asking after you noticed how long this procedure is, "the HELL would I care THIS MUCH about adjusting my valves? Doesn't my mechanic do this for me?"

Well, your bike might run, but YOU can make it run MUCH better. Smoother. Sharper acceleration. Little or no surging. And yes, your mechanic does adjust your valves for you, but he doesn't (won't, can't) do it as well as you can.

“Why,” you might be asking...

LISTEN! Display some mechanical curiosity or go buy a goddamn Honda!

Joking aside - we're serious about the difference you can make in the quality of your ride. You truly CAN and WILL give yourself a better valve job than your professional mechanic can offer you.

Stop snickering. I said VALVE job.

The pro-wrenchers can do decent work. They will almost always get your valves within spec. But that's not the same as getting the job done right. Remember, they have a clock to race, a profit to turn, and a line of customers to please.

You, on the other hand, have only your own sorry ass to please. And, we're betting that unless your ass is hanging off the back of JLo or Rabia, you're probably the only one who cares enough about it to focus on superior tuning.

Valves – What's the Big Deal?

Oilhead engines are extremely sensitive to EXACT valve adjustment. Does this mean the engine won't run if they aren't set exactly?

No, the engine will run, just not as well – not as briskly, or smoothly, or consistently.

There's a lot more to this than meets the eye. (Actually, since the valves are hidden, we insist there's more to this than 'numbs the buns' or 'makes your hands go buzz.')

In fact, many of the common solutions to 'Driveability Issues' such as surging, and the like, begin with this magic phrase,

“ADJUST THE VALVES.”

EXACT valve adjustment (when maintained) reduces these problems. And, when other adjustments are maintained, your engine really springs to life.

We're not talking shit here - here's a snippet from the May 2003 issue of Motorcycle Consumer News:

“Surging? BMW's officials still say that 'surging' is an aberration blamed on 'techs taking shortcuts' when doing tune-ups.”

You still don't believe us, do you?

Well, the best way to learn is to experience this first hand. In other words, get used to the bike as your mechanic tunes it, then tune it yourself – and then, well, try not to get pissed at your mechanic... BMW designed the valve train, the bastards.

Trust us. Once you've done this – you too will become a valve tweeko evangelist.

What's the Hardest Part?

The hardest part is just deciding to do this. If you make it to the end of the next sentence you'll be over the hump.

Awesome!

Let's get down to business.

Some Stuff You'll Need

Here is a list of stuff you should have on hand...

1. If you've still got the stock engine timing cover plug – go to BMW and get yourself a **REAL MAN'S** plug from a R650-750-800-900-1000. They cost a buck. Go on. We'll wait right here. Where's the fridge?



2. Some Anti-Seize. There's a copper based anti-Seize available from Wurth that is the primo Columbian weed of anti-seize products – but anything that'll protect the weather exposed bolts from gunkin' up will do fine. Your auto parts store has got stuff that will do.

3. A decent metric toolkit –Just about everything you need is in the stock kit, except for the 16mm wrench you'll use to fumble around for Top Dead Center (TDC). I've got a spiffy little aftermarket kit from Proxxon that has just about everything I need. I've also got a cool little T-handle ratchet from MotionPro which combines accessibility, speed and, most critically, snerkability. (Snerk will be defined shortly).
4. Four (4) feeler gauges. Two .15mm's and two .30mm's. Yes, 2 of each. Remember, we're going to match valve settings, and you'll soon find out why you need two of each.
5. A working flashlight - you're gonna be looking in a hole for TDC. Yes, we know that 'working flashlight' is redundant - if it's not working, it's not a flashlight, it's a stick – but we're trying to be clear. We've been around people like you before. (Uh, truthfully? We ARE people like you.)
6. A couple rags – one for the dirty stuff, one for the final clean up.
7. An oil catch pan or cheap throwaway bucket – to catch the couple of teaspoons of oil that you lose when you pop the cylinder head covers off.
8. An uncluttered surface so you can layout parts-n-stuff without loosing them, and so you know what order to put them back, and so you have a quick indicator that YOU FORGOT SOMETHING!
9. A magnet stick for the parts you drop. Maybe some needle nosed pliers for the non-magnetic stuff you drop.
10. What else. Oh yeah, right! Where's the card for that motorcycle towing place?
11. That's it. You are ready to wrench!

The Tools Of the Trade



Wait – Can't I Buy SPECIAL Tools?

Ok, for those of you that fix motorcycles just because it's an excuse to stock a toolbox, we'll throw you a bone AND a rationalization to help you past spousal objections. (Remember – now you owe us, and don't think we'll forget about it.)

There is a type of wrench that can make the job a touch easier and a touch more exact. You don't absolutely NEED it, (but we won't tell your spouse that.)

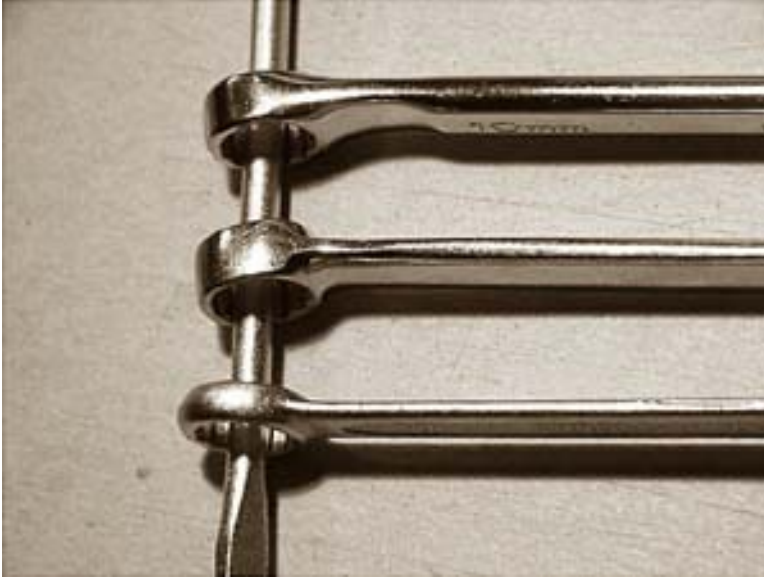
So here it is – we suggest you get a 'special' wrench...

Bonus Tool Acquisition Break...

We suggest you find the smallest, lightest, thinnest 10mm box end wrench that you can find. You want this wrench to be:

- Short – like 4.75" or 120mm, or less
- Flat – like zero offset
- Thin – like half the width of your average 10mm box end

To give you an idea of what you're looking for, here's a quick 10mm wrench comparo...



That bottom wrench is what you want. See how it's about ½ the thickness of the normal wrench? See how it's flat? That's a Heyco wrench.

The light, thin nature of the Heyco will make the job easier. Ignition wrenches, and some wrenches by Hazet and Stahlwille have these qualities as well. Wrenches by Mac and Snap-on will work, too.

And here is your rationalization –

Spouse: “Why do you need another wrench? What's all this fuss over a little wrench?”

You: “Because it will tend to limit applied torque and let me apply the proper amount of torque consistently for all 4 lock nuts. It's important. Besides, these wrenches can cost as little as \$10, cheap at twice the price compared to the cost of just one threaded insert, or having to replace the threaded valve adjuster bolt and lock nut. And that little wrench is a LOT cheaper than a trip to the shop!”

Let's see, anything else?

Do you have a complete set of ¼” drive, bits, extensions, and ratchet?

Well, you SHOULD. In fact, you should use a ¼” drive for everything while doing these adjustments. The only exception is the 16mm ratchet for turning the engine over.

Again with the why? Because it will limit your max applied torque and lessen the chances of over torquing anything and everything.

AND, using lighter tools yields better feel and control, which can help to prevent stripping out threads due to muscling the bolt home. These engines are mostly aluminum and as such are quite easy to strip the threads out of. Yes, there are threaded inserts in lots of places but they are still imbedded in aluminum, and there are places that don't have inserts... yet... (Such as the bolts that hold head guards on etc.).

The tools in the picture of the ‘recommended tools’ are ALL ¼”drive (except as noted) for just that reason.

Ok. Got the tool monkey off your back? Good. Let’s get rolling. We did make it clear that we’re done the moment you’re out of beer?

Getting Started.

1. Make sure the machine is cold (as defined by the manual as less than 95°F or 35°C). Ask yourself – would you dare touch the exhaust with your tongue? By god, if you burn yourself doing this on a hot engine you are a bigger idiot than me and you’d probably just better stop, put your stuff away, go back upstairs, grab some Cheetos and a Bud, toss the underwear off the couch and turn on the TV. Mr. McMann is probably up to something nasty on the WWF!
2. Clean the machine. Especially where the cylinder head cover meets the cylinder head. You don’t want any grit gitt’n in the engine.
3. If you skipped step 2, go back to step 2, you skank. One half-assed swipe of the bike with a wet rag every 3000 miles isn’t going to hurt you or it one little bit, and you might spot that loose bolt or melted hose that you heard or smelt but never bothered to check out.
4. Put the dog outta the garage and seal the remains of the cat in a ziplock bag.
5. Put the kids in a closet.
6. Send the wife to the male strip joint.
7. Put your favorite wrenchin’ music on the boombox.
8. Pull up a stool.

Go...

1. If you have crash bars and they interfere with removing the stock head guards, they will most likely also interfere with removing your cylinder head covers as well... so git-ta wrenchin’. Hey, don’t look at us. We didn’t put those damn things on there.
2. Remove the stock cylinder head guards. Remember where the bolts went – there are 2 different lengths. It’s hard to mess ‘em up when you bolt things back together, but you’ll find yourself wasting time on a stupid little game of musical bolts if you get them mixed up.

3. Remove the plug cover from the cylinder head cover. It pops off. Grab it at the back of the cylinder, (where the plug wire exits) and pull it back slightly and out. Should come off pretty easily.



4. Find that strange plastic gadget in your stocker toolkit that looks like this...



5. Remove the plug wire using that strange looking plastic gadget in your stocker toolkit. **You don't have to remove the plugs.** Lucky bike! God knows how badly you'd foul that up...
6. Now would be a good time to clean everything, if you skipped step #2. Blow air in the plughole if you got it. No, no, no – in the bike's plug hole! No more beer for you!
7. Remove the black alternator cover at the front of the engine block. Why? It's our preferred way of finding Top Dead Center (TDC).



Mechanical Gauntlet Throwing Break...

We are members of the cult of convenience and mechanical advantage. We're doing this so we have a relatively easy way of spotting and repeating TDC. Just loosen up and do as we say this time. You can pursue your own dumbass ideas next time.

There is an ongoing religious debate (of near armegeddonic proportions) amongst the grease gurus. There are those who work the rear tire to find TDC. There are those who remove plugs and watch the piston run to TDC. There are those who do it by feel. There are those who can just shut off the engine at the right time. There are those who advocate telekinesis. There are those who swear a good \$20 whore can suck the piston to TDC. We lesser, lazier beings just take off the front cover and turn the crank with a wrench. We can think of better use for the whore.

8. Take note of the stuff that was hidden by the alternator cover. We're going to wrench on that big bottom bolt when we go looking for TDC.



9. You'll find the engine timing on the 'Throttle grip' side of the engine. It's that little round slightly concave rubber plug behind the cylinder head, right up above the throttle body, just below the telelever hinge. Oh, for chrissakes, it's right HERE...



10. Slip a flat screwdriver up behind the throttle body and pop it off.

11. Now, hunt for it. It's probably stuck in the throttle body cabling somewhere.
12. No, look, it's in the oil catch pan. Good thing we took it out before we had oil in that bucket, eh?
13. Now, position your drip bucket under the cylinder head cover. Align it so that it will catch the oil that will drip out from the leading edge of the cylinder head cover when you pop it off. You'll figure this out. Remember the gravity thing? Pretend you're oil – where would you go?
14. You did clean everything, right? Things will get gritty in a minute if you didn't.

Mechanical Philosophy Break...

Just a bit of insider knowledge here – letting grit get INSIDE the engine is usually considered BAD FORM. The gitter of grit inside the engine is commonly known as a “dumbass.” If you stand around your local shop for a while, you'll find the term is rather broadly applied.

15. Unbolt the cylinder head cover. Just unscrew the four bolts until they play free. Don't try to pull them all the way out. They have a stopper on them. That's good, leave them alone - you'd probably just lose them, anyway.



16. Wiggle the cylinder head cover loose - just a wee bit. Some oil will drip out into your strategically placed bucket. Congratulate yourself. Now kick the bucket and get oil on your pant leg or shoe.

17. Let it drip. Don't freak. There's only a teaspoon or two. There, it's done. See?



18. Pull the gasket off. It's a pretty beefy piece of gasketry. You don't have to be a wimp, but don't Schwarzenegger it off, either. You will reuse this.

19. Set the cylinder head cover on the bucket so the oil can drain out. If you let it drain you'll find it much less messy when you remount it. We'll make fun of you later because you forgot this step.

20. Clean the gasket with the designated 'dirty rag'.



21. Clean the cylinder head surface where it meets the gasket. Don't try to clean the inside bits. Pretend you're having sex and just do as little as necessary. If you try too hard, you'll just break something, or get lint everywhere. Just clean the joining surfaces.



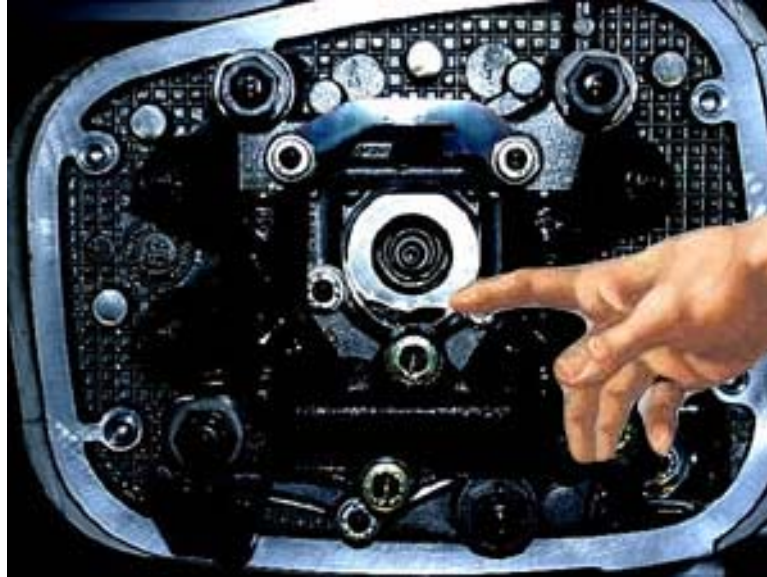
22. Clean the matching surfaces on the cylinder head cover.



23. Now – some odd business. There's a rubber plug gasket that surrounds the spark plug. It's typically stuck to the inside of the cylinder head cover, but it might still be buried in the head in the spark plug tunnel.
- Find it, remove it, clean it.
 - Now, look at it for a minute. Do you see some arcs in the surface that was facing the engine?



- c. Look in the spark plug tunnel of the cylinder head. Do you see what made the arcs?



- d. Good. First clean the mating area on the cylinder head cover then put the gasket back into place on the cover and rotate the rubber plug gasket about 90 degrees so those it will press virgin flesh against the plug tunnel wall. Ahhhh.

Find Top Dead Center (TDC)

24. Now, scoot back around to the front of the engine block, and put a 16mm socket on the **BOTTOM** bolt at the front of the engine block. (Remember where we removed the alternator cover?)



25. Get yourself a ratchet handle at least 12 inches long so you get some nice mechanical advantage. Excuse me. I forget we have an international audience, and that was rather Ameri-centric wasn't it. Ok, in translation for all you foreigners, find a ratchet roughly 3 times the length of your dick.
26. Pick up your flashlight. Turn it on. Bang it on your palm. Again. Now, go to the store and buy batteries.
27. Position yourself so you can look in the engine timing hole.
28. Shine your light in the engine timing hole. See the fly wheel/starter ring with all the teeth on it? There will be a metal tab on the rear side that will indicate top dead center with the letters OT. You'll see it when you rotate the engine.

29. Ok – grab the ratchet and rotate the engine clockwise. (Pull toward yourself across the bottom arc of the ratchet.)
30. Go slow.
31. You'll get some resistance as you pull compression, but you'll get through it.
32. Go slow.
33. Watch for the metal tab that reads S. Just a little bit past the S is OT – that's what we want, that's TDC.
34. Just a little further is OT.
35. See the line under OT? You want that line in the middle of the hole.



36. If you got it - great! If you went past it, go around again. **DO NOT** turn the engine backwards (As you're looking in the timing hole, you should always pull your ratchet up from the bottom, never down from the top.)
37. Wiggle the valve assembly (where the valve adjusters and lock nuts are). If it's loose then it's time to get to work. If not, crank the engine around to OT again to free the valves on your side.

It's Valve Adjustin' Time...

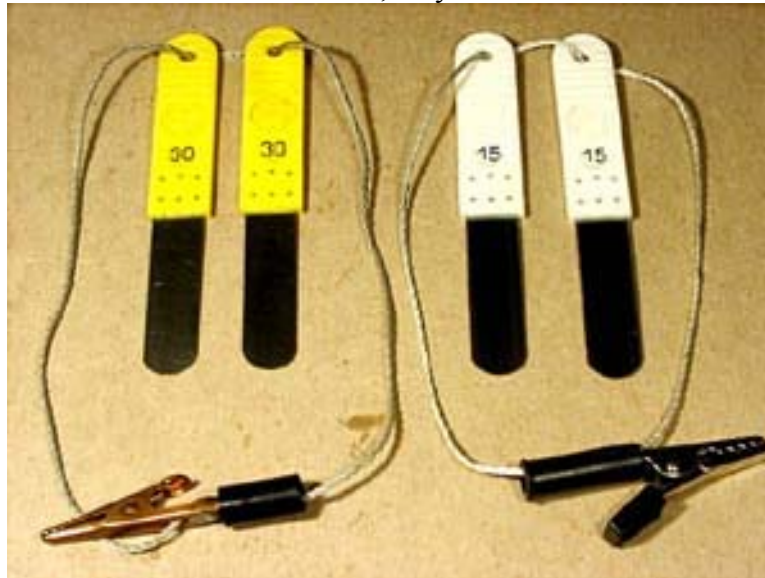
38. Grab your 4 feeler gauges, but don't do anything just yet.
39. Notice the bucket of oil right under valve assembly.

40. Think for a minute about what will happen if you drop one of the feelers.

Mechanical Tip Break...

Here's a handy tip to help keep your feelers outta the oil...

- a. Get yourself:
 - i. 2 strings about 12-16 inches long, and
 - ii. 2 alligator clips. Roach clips will do. Look in your teenager's bedroom.
- b. Loop one string through both 15's and a clip, and tie the string off.
- c. Do the same for both 30's and their clip, and tie the string off.
- d. Now, you can clip the string to the cooling fins while you're working. If the feelers come free and fall, they won't fall into the oil.



41. Clean all your feeler gauges – they're about to go to work.

42. Clip your intake feelers to a cooling fin. Then insert the intake feelers into the intake valve assembly. We're talking about the 15's. They go in the valve assembly at the 'rear' of the cylinder head.



43. Clip your exhaust feelers to a cooling fin and insert the exhaust feelers (the 30's) into the exhaust valve assembly. Note: The exhaust valve assembly is at the 'front' the cylinder head near the exhaust headers.



44. Make sure all four feelers are in place at the same time. In this picture, the front of the bike is on the left, meaning the exhaust valve assembly is on the left and the intake valve assembly is on the right.



Mechanical Philosophy Break...

Why all four at once? Well, You're going to see some **weird** stuff happen when you start wrenching on the valves – changes at an intake valve will affect an exhaust valve, and changes at one intake valve will affect the other. Can't explain it. Sort of a quantum-tunneling problem at the mechanical level.

Remember, you're going for **matched adjustment** – you want both intakes to be as close to one another as humanly possible. Same with the exhausts. The closer they're matched the sweeter the ride. So you need two of each feeler gauge, and you know weird stuff is gonna happen when you wrench, so go buy all four feelers, you cheap shit. Geez, drop \$15 thou on a motorcycle then try to save \$5.00 on gauges.

45. With all the feeler gauges in place, assuming you could get them all in, let's check your valves. We're going to test both intake valves to see if they feel the same, and both exhaust valves to see if they feel the same. If one or more feeler gauge(s) just doesn't want to slip in the gap you will need to open the gap up a bit during steps 57 & 58. Then you'll be able to proceed. Ready?

46. Brace your hand on the cylinder head just above the top intake valve. Bracing your hand is important – you’re doing this by feel and you want the feel conditions as similar as possible.



47. Grasp the feeler gauge between thumb and forefinger, and make long strokes in and out lengthwise on the feeler gauge... Oh yea, baby! Long strokes are important... Here’s why...

Mechanical/Marital Aid Break...

While you’ve heard this before, albeit under different circumstance and from people marginally prettier than us, that quick in-n-out poking isn’t going to get you maximum results. Here’s why...

You’re gonna feel 2 different types of drag on the feeler gauge.

- a. **Stiction** (AKA Static Friction) This is the initial resistance felt as drag when you start to move the feeler gauge and also when you reverse directions. This will mask the more important feel of:
- b. **Friction** (AKA, uh, Friction) This is what you want to pay attention to. This is the more-or-less constant friction felt once the gauge is moving. This is why long strokes are best. It allows you to feel the moving friction for a longer period of time.

You want to maximize your feel for friction and minimize the stiction with long strokes. Which pretty much sums up life in general, dudnit?

48. Make sure not to bind the gauge by twisting or bending it...
49. Feel that? Move your fingers back and forth so that you find the least drag when pushing and pulling lengthwise on the gauge. That spot with the least drag is what you want to feel, that's just the friction.
50. Do it some more. Oh. Oh. Yea baby. Long strokes. Got the feel?
51. Good, now use the **same** hand and the **same** type of brace and **feel** the other intake valve.
52. I'm betting they're different! **AND THIS**, my friend (for as long as the beer holds out) is where you'll make your adjustments and change your life!
53. Grab your 10mm box wrench and your 3mm hex wrench. It's time to adjust.
54. Select the valve that needs the most adjustment.
55. Put the box wrench on the lock nut, **but don't do anything just yet**.
56. Put the hex wrench into the valve adjuster, **but don't do anything just yet**.

The Agony and the Ecstasy

57. **Brace your HEX wrench hand on a sturdy engine bit** – don't try to move the wrench. Just brace it so that it **doesn't** move when you loosen the bolt with the box wrench. It's hard to see, but we're pushing the hex wrench into the cylinder head. The hex wrench actually bows under the pressure.



Here's another view of a different type of bracing... Note how two fingers are used to pull the thumb and hex wrench into the cylinder head, 'locking' the hex wrench in place.



58. Loosen the lock nut with the box wrench.

Mechanical Philosophy Break...

On your first session, or, on any session following a trip to your professional mechanic, odds are that ALL of the lock nuts are waaay too tight.

But, even more importantly, they are **not tightened equally**. This small detail figures prominently in how long your valve setting will last (at least it's one of the most important parameter you have direct control over).

What this means is (at least for your first adjustment), ALL of the lock nuts should be loosened and then tightened so that they all match. Usually during the first adjustment you'll have to do this anyway, just because, as you'll see later...

59. Loosen or tighten the hex wrench just a smidge as determined by your earlier feeler, uh, feels.

Mechanical Vocabulary Break...

A smidge is not the woman you caught your dad with in the closet at the Christmas party your parents threw back in '72. That was Mrs. Olsen.

A smidge is the technical term for "about the width of the hex wrench as measured at the outer most end of the wrench." You're going to find it doesn't take much movement of the hex wrench to make a substantial difference in the feel of the valve adjustment. Work in smidges.

Pre-Smidge...



Post-Smidge...



Compare the two photos, looking closely at the pink (you pervert). See how very slightly the hex wrench moved? That is a smidge!

60. **Brace your HEX wrench hand on a sturdy engine bit** so the next step doesn't move the setting (too much). We suggest you **PUSH** the outer end of the hex wrench into the cylinder head, thus 'locking' it in place.

61. Tighten the lock nut with the box wrench **just a little bit**.
62. Check the feeler gauge. Long strokes. Braced hand.
63. Better? Worse? Go back and repeat **The Agony and the Ecstasy** until you're happy.

Mechanical Head Thump Break...

It's tempting to try to feel the gap when things are loose. This doesn't work. When you tighten the lock nut, the gap will change.

It's tempting to try and move all pieces at once. This doesn't work. You'll just end up warping threads, making your valve adjustment suck forever after. When you buy that Honda because "it's so much smoother", we'll all know that you warped your threads, Dumbass.

It's tempting to not brace your HEX hand securely. You'll learn that the brace is the key to speed during this procedure..

It's tempting to give up. But keep going. It's worth it. Really, it is!

64. Great! One valve is done. (Or is it?)
65. Now do the other intake valve.
66. Done? Great!
67. Now go back and forth between the intake valves until they're matched to each other. **This is the trick**. This is where you make the difference. Do NOT skimp here. Get those valves to match.

Mechanical Technique Break...

Remember; use the **same** hand to test.

Brace that **same** hand in the **same** way.

Use long feeler strokes, lengthwise on the feeler.

Your First Valve Adjustment Sympathy Break...

Yes, the gap changed. Changing one changes the other. Keep at it.

Yes, isn't that odd. Changing the other, changes the first. Keep at it.

Yes, it's frustrating. Put down the hammer. Calm down. Keep at it.

****Keep THIS firmly in mind**** – what you are doing right now is what the pros can't afford the time to do. Every refinement you make right here pays off big time in rideability. Keep at it!

ALSO KEEP IN MIND IT WILL GET EASIER, MUCH EASIER, THE MORE TIMES YOU DO THIS! ! !

68. Now adjust the exhaust valves. This is the exact same drill. Except you're using the thicker feeler gauges, and you're working at the front of the cylinder head. Refreshing change of view, ain't it?

69. Match the exhaust valves.

70. Done? Excellent!

The Agony and the Ecstasy, the Sequel.

71. Now check your intake valve gaps. They changed didn't they? HA-HA-HA-HA. Ow! Ok. We won't laugh again. We promise.

Your Last Valve Adjustment Sympathy Break – (get over it)...

Remember how you always hear about quantum mechanics and tunneling and such. Well, as near as we can tell, you've just taken a crash course in the former, because you've just experience the latter. YOU'VE JUST ENTERED THE TWILIGHT ZONE.

BMW mechanics swear this "is not supposed to happen."

Well, it does.

You now know what it takes to get the valves set, then matched in their pairs, then refined across all settings. It's going to take you the better part of an hour the first time through. Don't sweat; you will get faster each time.

72. Re-adjust your intake valves.

73. Re-check your exhaust valves.

74. HA-HA-HA-HA. Sorry. I know we promised not to laugh...

75. Got it? Here, let me check. Nope, this one's a little tighter than that one. This feels pretty loose. You might be happy, but if it was MY bike.... (We find guilt to be a superior motivator.)

76. Repeat.

77. Good? Fantastic! OK, now we go for the final torque on the lock nuts... Spec calls for 8Nm (about 5.9ft-lbs). ALSO during this final set of adjustments, remove the 3mm allen wrench AND the 10mm box wrench after EVERY adjustment. This means the only tools touching your valve assembly are the feeler gauges. This removes ALL external influences while you are going for that last bit of Tweek.

Kinesthetic Awareness Break...

How do you know when you have applied 5.9ft lbs of torque? Well, here's where an experienced hand (or experience, period) comes into play.

Your hand (without ANY extra mechanical leverage) can generate about 7ft-lbs of torque. The grip shown below would generate more power than you need right now.



Not only is that too much, you can't use a ratchet because you need to keep the hex wrench locked while torqueing the locknut.

So what do you do?

What is needed is a smooth $\frac{1}{2}$ sneerk shortly after real resistance is felt.

Here's a way to think of $\frac{1}{2}$ sneerk with the box wrench – think 'Pinky'.



Now, don't be thinking this is a delicate maneuver. You're putting power to the wrench, but, because you've choked up, and you're holding the pinky off the wrench, you're preventing yourself from putting a fistful of twist on that locknut.

If you put that pinky down, you're going to apply more force than you need. Experiment with the two grips by clamping a bolt in a vice and wrenching a nut with pinky up and pinky down. There's a surprising difference.

Ok – so it is REALLY hard to communicate the feel of $\frac{1}{2}$ sneerk on paper. The best we can do is show you the illustration above, and give you a couple of polar extremes to avoid...

Do NOT just make the locknut finger-tight. You'll be paying the big bucks for someone to dig it out of your engine block 50 miles from now, and...

...you most definitely do NOT want to be doing this...



This tender little expression of leverage would rip the shit outta threads.

IT IS **NOT** A GOOD THING to over torque the locknuts. Go for that smooth ½ sneerk shortly after real resistance is felt. Use a slightly disabling grip, and the smallest, thinnest, flattest 10mm box wrench you can find, and you'll be fine.

But more importantly, develop the feel for consistently repeating this amount of torque so that all 4 lock nuts are the same.

Also, be aware that other techniques will work. It is important that you find a means to apply the desired ½ sneerk consistently, if this means using a couple of fingers at the end of the wrench instead of choking up on the wrench with your whole hand that will work as well...It's the ½ sneerk **every time** that is important.

78. SOOOO continue refining your valve adjustments until you're seriously considering a lifetime membership in the hair club for men – or – until we can no longer guilt trip you into further refinement.

79. Got it? Ok, let's button it up.

Thank God That's Over...

80. Clean the cylinder head to gasket joining surfaces. I know you did it. Do it again. Trust me. See. It was oily again, wasn't it! Use the final clean up rag for these last steps.
81. Clean the cylinder head cover gasket. Again.
82. Clean the cylinder head cover mating surfaces. Again? Yes, again. Is there still oil in it? You forgot to drain it didn't you?!?!
83. Clean the rubber plug gasket. Yes, again.
84. Remount the cylinder head gasket – it's shaped so you can't really mess it up. Be sure it fits flush.



85. Put the rubber spark plug gasket back into/onto the cylinder head cover. You remembered to rotate this gasket so the plug arcs get virgin gasket, right? Ahhhh.



86. Pop the cylinder head cover back on the bike. Remember there's oil in it. Get all your surfaces together with hand pressure, then start tightening bolts. Don't dawdle. **Faster**, damnit!
87. Ah geez, my grandmother is faster than you and she's dead! Pull it out, let's clean it all up and try it again. NOTE, if any oil is left on either of the gasket to metal surfaces and then the valve cover is tightened down, THAT is where oil will weep from.
88. On? Ok! Tighten that sucker up by rotating bolts for even pressure in a cross pattern. NOTE. DO NOT OVER TORQUE the 4 cylinder cover bolts. The spec calls for 8Nm (just like the lock nuts on the valve adjuster). Once you feel the cylinder cover bolts seat, just a tiny sneerk is more than enough.
89. Push the spark plug wire into the plug tunnel and onto the plug until you hear it 'Pop'. If you don't hear the pop, do it again. Maybe make sure there's nothing else in there. You did clean the bike didn't you? (Dumbass, we **told** you to clean the bike.)
90. Replace the spark plug cover on the cylinder head cover.

Plastic Magic Break...

Here's a nifty trick of mounting the spark plug cover. Seat it from the back (wire exit side) to front using your thumb.

Near the back of the spark plug cover, on the inside surface, is a rubber insert. Seat it into it's mating holes at the rear of spark plug cover, then push the sparkplug cover from the back of the cover toward the front of the bike.



Once the rubber insert is seated into the back of the cylinder head cover, you can just apply a little pressure laterally along the side of the cylinder head and the cover will just snap into place. Und voila, amigos! Ich neyt parlez pas Spanglais!



You should hear the front of the plug cover snap into place.

Don't try to snap the covers on from the side. It'll fall off two miles from home on your first ride where it'll be pulverized by a '78 Crown Vic.

Don't try to mount front to back. It'll fall off two miles from home on your first ride, where it'll be pulverized by a '80 Crown Vic. (they do travel in packs).

Appease the Crown Vic by snapping it on, back to front.

91. Put a little anti-seize on the cylinder head guard bolts, and start all 3 by hand. (Hint the 1 short bolt goes on the front of the engine, that leaves 2 long bolts for elsewhere. AND put the front bolt in 1st, and leave it loose... The other 2 bolts will align easier...) After they are all started and seated by hand THEN tighten with a ratchet. DO NOT OVER TORQUE.
92. By God. You're **HALF** way done!

Halftime!

Good time to score some lunch and take a break so you don't rush.

93. Rotate the engine to top dead center again. Use your flashlight, and your 16mm socket on a ratchet that's 3 times the length of your dick, and rotate the engine CLOCKwise through S to OT.
94. Go repeat **The Agony and the Ecstasy** and **Thank God That's Over** on the other side of the engine.
95. Done? Wow. You're getting fast!

Fourth Quarter

96. Remount the alternator cover at the front of the engine block. Use a little anti-seize, please.

Alternator Cover Alternatives...

Hey kid wanna know a secret? After you move the cover into place put the bolts on the right side (as you face the cover) in first, USING YOUR HAND AND NOT A RATCHET.

Why you ask? If you look closely you'll see a metal tube with 2 tangs that reach in and will be bolted down between the cover and the engine.

Here's the upper tang, of the alternator cover...



And, here's the lower tang...



These tangs may not line up perfectly with the holes in the engine (did you notice that these 2 bolts came out with more effort?). If this is what you have found then you have 2 choices. 1st choice is to fight putting these 2 right side bolts in every time, or 2nd go Schwarzenegger on the tube and adjust it's resting position so that the tabs line up properly.

Note: The tube is an oil return line from the oil cooler under the headlights. Then put the bolts in on the left side, then you can tighten them all up using a ratchet.

97. REMEMBER TO REPLACE THAT NIFTY LITTLE NEW (OLD) TIMING COVER PLUG...Believe it or not it does make a difference on how the engine runs if you forget it...

Sudden Death

98. Place key in ignition, turn and start.

99. Suhweeit! You are done and we are out of beer.

Now, go tune your throttle bodies...**They WILL need it...**

Post Script

AND NOW FOR MORE AGONY (which ultimately leads to more ecstasy as the rest of the engine gets used to and then wants to stay running properly).

This is just the first adjustment and it won't last very long. Why? Because once you become sensitized to how well the engine CAN run you'll notice that after a while it will turn once again to the dark side...

Which means, Luke, you will get more practice at doing this. After a few more sessions the amount of time needed to complete this procedure will plummet to under an hour. At the same time the number of valves that need to be adjusted and their amount of adjustment (how much you have to turn the 3mm hex wrench) will also diminish. The engine will get used to staying in the sweet spot and you will become more expert at the feel required and thus get better results.

And now that you've completed this exercise in engine tweaking you can rest on your laurels knowing you've reached the pinnacle of tweakdom, RIGHT?

Well... Just think of this as PHASE I. Yes, Virginia there is more, there's always more...
BUUHAHAHAHAHA

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