

DrVanos.com Stage II Installation Instructions

Special Tools Needed:

Camshaft locking tool
TDC Crank pin
Sprocket turning tool

112300 

113240 

115490 

**Tool rental is available with the purchase of a vanos kit
*See website for more info***

In addition to your basic metric tools, you will also need:

E-10 Torx socket
22mm combination wrench (for crank bolt)
32mm thin wrench (for fan and solenoid removal)
19mm combination wrench (for banjo bolt)
8, 10, 13mm standard sockets
A deep well 10mm socket
Standard & Phillips screwdrivers
Small mirror and flashlight
RTV Sealant

A container is handy for keeping all the small parts in as they are removed

It is recommended to replace the valve cover gaskets if they have not been recently replaced.

The upper timing chain tensioner and chain are also good items to replace 'while you're in there', especially on engines with 100k + miles, but they do require that the cam gears be removed for installation. The Stage II installation document covers this procedure in more detail.

The tool rental and other replacement parts can be purchased from the website when ordering a vanos kit...

<http://www.drvanos.com/vanos>

To gain sufficient clearance, it's best to remove a few items first.

1. Remove plastic intake cover from the top of the radiator. Remove the top part of the alternator cooling duct. This will allow access to remove fan and to rotate the crank.



2. Carefully release pressure in the cooling system by *slowly* opening the coolant tank cap until all air has escaped, then re-tighten cap. On the driver's side of the radiator, loosen the hose clamp holding the small coolant return hose and pull hose off of the fitting. Remove the hose clamp and set it aside. Do NOT remove hose from coolant tank side.



3. Now carefully remove the clip next to the radiator cap that sits around the bleed valve. It has two tabs that just need to be pushed towards each other and then lifted straight up. Leave the bleed screw tight.



4. Move the expansion tank to the side by tilting it to the left. The top of the tank will slide under the fan shroud, pulling the detached return hose with it. Just move it far enough to gain clear access to the front of the vanos. Do not disconnect any other hoses!



5. Remove the clutch fan using a thin 32mm wrench, turning the fan nut *clockwise*. If necessary, use a long screwdriver between two bolts on the water pump pulley to hold pulley while loosening the fan nut. Carefully work the fan up out of the fan shroud toward the right side of the radiator. Work one blade at a time around upper radiator hose.



6. Remove the strut brace if you have one.
7. Remove spark plug/injector covers from the main valve cover.
8. Detach the coil pack wiring from each coil pack. Release the connectors by pulling up on connector locks. The wire connectors should slide away from the coil packs.



9. Carefully pull each coil wire from the hold down clips on the valve cover.
10. Remove each coil pack by removing the two 10mm nuts from each pack. Note the placement and position of the two grounding straps typically located at the #2 and #6 coil pack.

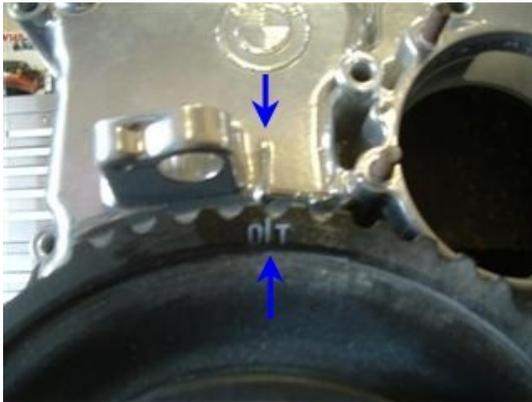
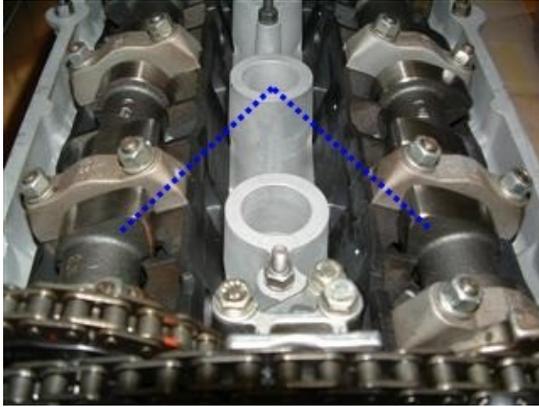


11. Now you can remove the bolts holding the valve cover down. There are 11 bolts around the perimeter and 4 in the middle. Two of the middle bolts will need the grounding straps removed first, (8mm nut) then the bolt itself can be removed. Note that these two have a stud on top for the grounding straps. Be sure to remove each washer and rubber gasket beneath each valve cover bolt before removing the valve cover so they don't get lost.
12. Remove the vent hose from the front of the valve cover.
13. Once all the bolts are out, carefully lift the valve cover off.
14. Remove the plastic oil splash cover over the intake cam by gently pulling up.



15. Set the crank to Top Dead Center...

Now that you can see the cams, you need to rotate the engine until it reaches TDC. Make sure the car is not in gear. Using a 22mm wrench, turn the nut at the front of the crank shaft clockwise until you see the front pair of cam lobes point toward each other at a 45deg angle. Using a small mirror and flash light, align the timing mark on the front timing cover with the mark on the crank pulley. Some pulleys may not have the timing mark on them, but you can remove the #1 spark plug and use a wooden dowel or a dial gauge tool to find TDC of the #1 piston.



16. Lock the crank at TDC

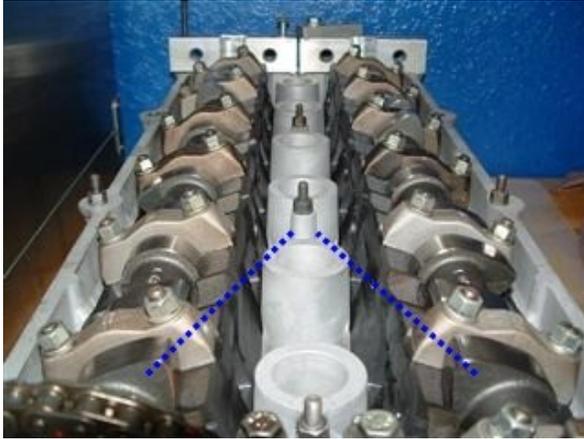
Using a pair of pliers or a small hooked tool, remove the plastic plug from the engine block (under the starter) to access the hole for the TDC pin. Slide the TDC pin into the hole until it seats in the notch on the flywheel. Confirm that the pin is seated by gently attempting to rotate the crank with the 22mm wrench. It should not move.



Note: Some aftermarket lightweight flywheels do not have the notch for the TDC pin. If you don't seem to have that notch, or are unable to get the pin into the block, do not fear. You will just have to use the small mirror and carefully align the timing marks the best that you can. As mentioned previously, removing the #1 spark plug and using a dial gauge can provide the most accurate results.

Once the crank is at TDC, remove the three valve cover mounting bolts (10mm) located at the back of the head. This will allow you to set the cam locking tools flat against the cylinder head. Do not connect the two cam locks together at this time. Set each one independently on a cam until they are both sitting flat on the cylinder head.

Note: You may find that the cams are not perfectly square to each other and one or both of the cam blocks will not sit flat against the cylinder head. At this point of the process, it's not necessary to worry about the cams being perfectly aligned since the vanos needs to come off anyway. The cams will be aligned once the vanos is replaced, below.



17. Removing the Vanos

Unplug the solenoid connector from the engine wiring harness.

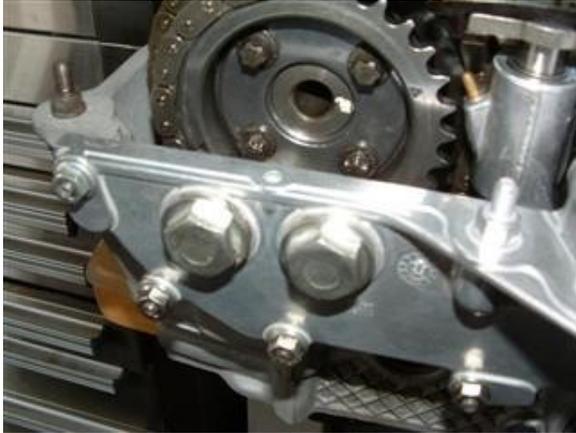
Use a 19mm closed end wrench to remove the banjo bolt where the oil line attaches to the vanos. Use a few shop rags to catch any oil from the vanos so it does not drip on the belt. Discard the two crush washers on each side of the banjo bolt. Two new washers are included in the kit.



On OBD-I cars, remove the plastic cable cover that is attached at the bottom of the vanos. It is held on by two small e-clips. Be careful not to lose the e-clips!

On OBD-II cars, disconnect the small vacuum tube that crosses in front of the vanos.

Remove the two large access bolts from the front of the vanos with a 19mm wrench



Remove the six 10mm nuts along the bottom of the vanos, and the two 13mm bolts that attach the engine hanger bracket to the front of the head/vanos. Remove the bracket.

Lock the chain tensioner down with a small drill bit through the hole on the back of the tensioner. This will release the tension on the chain and make it much easier to remove the vanos.



With the cam blocks still in place on the cams, loosen the 4 torx bolts on the exhaust cam gear about 1 full turn. DO NOT remove them! They just need to be loose enough to rotate the exhaust gear. You will use the two access holes in the vanos to reach the two lower torx bolts.

Use a short socket extension to reach the two lower torx bolts.



Now, use the sprocket turning tool on the exhaust cam gear and while rotating the tool clockwise, gently wiggle the vanos loose from the mounting studs and slide it out. This is easier with a second set of hands to wiggle the vanos loose while rotating the tool.
Be careful because some oil will drain out of the vanos where you removed the banjo bolt!



Remove any old RTV sealant from the head where the vanos was seated.

Replace the metal vanos gasket with a new one (supplied in the kit)

Remove your old solenoid using a 32mm wrench or adjustable wrench, and install it on the new vanos.

Remove cam gears

Remove the 4 torx bolts and large washer from the exhaust cam gear.

On the intake cam side, loosen the three 10mm nuts equally until the spring plate is no longer applying pressure to the thrust washer. If you do not have the spring plate (early 325's only), simply remove the three 10mm nuts.

Remove the three 10mm nuts, 4mm thrust washer, and spring.



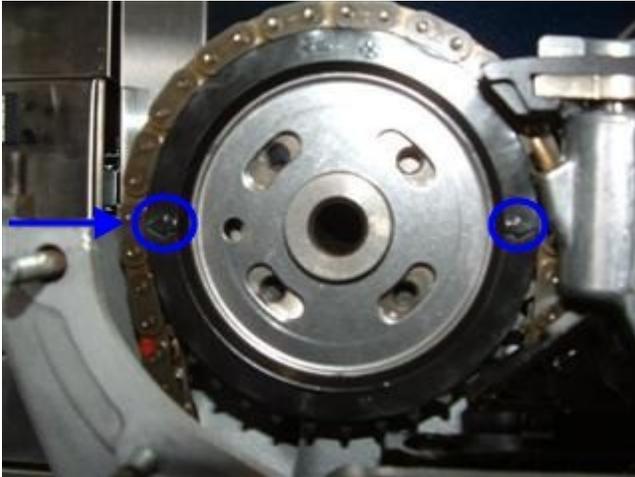
Now you should be able to slide the two cam gears and the timing chain off together. Replace chain if necessary.

Remove the upper chain tensioner. There are 3 10mm bolts on top, and one on the front. Remove the lower chain tensioner from the exhaust side of the cylinder head using a 32mm wrench. Replace chain tensioners if necessary.

Once the two cam gears, upper timing chain and both chain tensioners have been removed, then larger primary exhaust cam gear can now be removed.

Remove the 2nd (larger) exhaust cam gear from the cam by sliding it off of the exhaust cam, then working the primary chain around the gear until it is free. (Be careful not to drop the timing chain down into the engine)

Note that the arrows were probably pointing up and down originally. This does NOT indicate that they were improperly installed before. The factory installed them in this direction on most cars, but the orientation of the arrows does not affect the timing in any way. They are simply a reference. By turning the cam gear 90 degrees and installing them with the arrows pointing left and right, it provides a better reference point by using the top edge of the cylinder head to line up the arrows with.



Installing the new cam gear

Place the larger cam gear under the chain with the arrows pointing to the left and right, and slide cam gear onto exhaust cam until it's sitting flat against the mating surface.

Note that the left arrow should line up perfectly with the top edge of the cylinder head when the primary chain has the proper tensioner on it. To check this, you can use your finger (in the hole where the primary tensioner was removed) to push against the chain guide until the chain is pulled tight.

If you find that the arrows are above or below the reference point, then move the cam gear one tooth in the appropriate direction until they are aligned with the edge of the head. Check by pushing the chain guide tight with your finger again. The 4 slots in the cam gear should approximately be centered over each threaded hole in the exhaust cam now.

Once you have the primary cam gear correctly installed, reinstall the primary chain tensioner (the one on the side of the cylinder head).

Installing the new thrust washers

Carefully study the photo below! The Stage II kit comes with 2 thrust washers, one thin 2mm washer and one thicker washer with a much larger center hole. These are numbered #1 and #2 in the diagram below.

DO NOT confuse the #2 washer included in the Stage II kit with the 4mm thrust washer in the diagram! They are not interchangeable, but at first glance they can look similar and it may seem as if the wrong washer was sent in the kit.

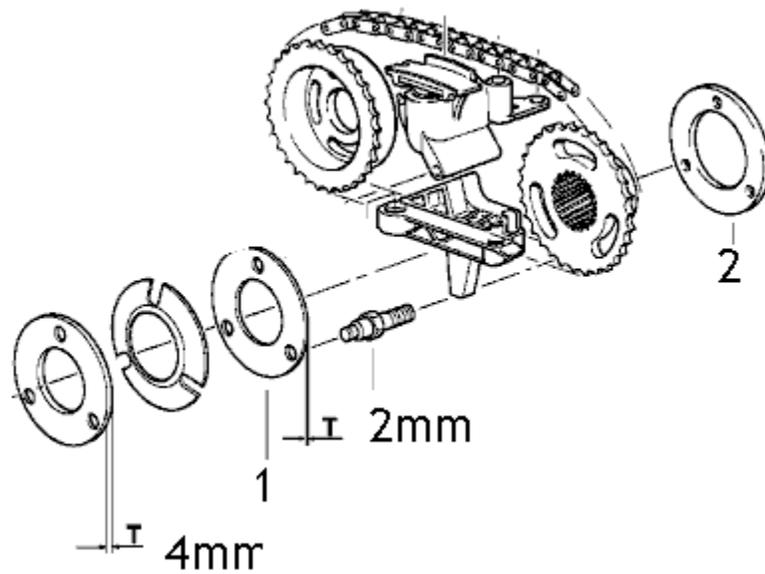
With the stage II kit, the thicker polished thrust washer goes on FIRST, and mounts directly to the intake cam using the 3 mounting studs.

The intake cam gear is next.

Then the 2mm polished washer (included in the kit)

Then your original spring plate (note orientation)

Finally your original 4mm thrust washer and the three 10mm nuts.



Remove the 3 mounting studs from the intake cam with a 10mm wrench. The cam block should hold the cam in place while loosening the studs.

Remove the thrust plate (#2 in the diagram), and replace it with the new thrust plate then reinstall the 3 mounting studs. Apply a light film of oil on the thrust plate. BE CERTAIN that you do not mix the 3 cam studs with the 3 valve cover mounting studs removed earlier!



Reinstall the upper chain tensioner with the locking pin still in place.

Next, install the smaller exhaust cam gear, chain, and intake cam gear on the cams as shown. The exhaust cam gear also has arrows, which should be pointing to the top edge of the head, while the intake cam gear needs to have the left side of the slots against the mounting studs. This may take some trial and error, but it will ensure correct alignment of the gears to the mounting studs.



Install the washer on the exhaust cam gear, and then the 4 torx bolts. DO NOT fully tighten the torx bolts yet. Simply tighten them until they are snug then back them off a half turn.

You should now be able to rotate the two cam gears left and right nearly the full length of the slots. If they do not both fully rotate the length of the slot without hitting a mounting bolt or stud, then they are not in sync.

Lightly oil the polished 2mm thrust plate and install it over the intake cam gear.

Install the spring plate with the small end of the cone facing away from the 2mm thrust plate.

Install your original 4mm thrust plate, making sure all the holes line up with the studs correctly.

Apply Loc-tite to the threads of the 3 studs.

Install the three 10mm nuts and hand tighten them down evenly, making sure the 4mm thrust washer is squarely seated on the studs.

Tighten the three 10mm nuts evenly until they bottom out on the shoulder of the studs. Apply a final torque of 10nm (7ft/lb or 85in/lb). Do not over tighten!

Installing the new vanos

Push the splined cup fully into the vanos.

Before installing the vanos, rotate the exhaust gear fully clockwise with the tool until it stops.

Position the new vanos on the mounting studs and use your fingers to rotate the splined cup until it engages with the intake cam. You should only see about 1-2mm of the splines on the cup sticking out of the intake gear. (See photo)



Now, while gently pushing against the vanos, slowly rotate the exhaust gear **counter-clockwise** until the intake gear catches the first available tooth on the cup. You shouldn't have to rotate the exhaust gear very far for the intake gear to catch. Once it catches, continue rotating the tool until the vanos is fully seated against the head.

Be sure not to continue rotating the tool once the vanos is fully seated, as it will pull the splined cup back out of the housing. If this happens, gently rotate the tool back (clockwise) until the cup moves fully back into the housing.

Once the vanos is installed the arrows on the cam gears will not line up as before. This is normal.



Once the vanos is fully seated, replace the six 10mm nuts, and the two 13mm bolts along with mounting bracket. Be sure the longer of the two 13mm bolts goes in the top hole, along with the ground wire (on OBD-I).

Tighten the 10mm nuts to 11nm (8ft/lb or 97in/lb), being very careful not to over tighten, as you can easily pull the studs out of the head.

Tighten the 13mm bolts to 15nm (11ft/lb or 133in/lb). Again, DO NOT over tighten as you can strip the soft aluminum threads in the head.

Remove the drill bit or pin tool from the upper tensioner to re-apply tension on the chain.

Attach the oil feed line with the banjo bolt and two new crush washers, one on each side of the banjo bolt (supplied in the kit).

Plug the connector from the solenoid back into the wiring harness.

Do not remove the cam blocks yet.

19. Set the cam timing -

Now, if you did not use the TDC pin, double check the TDC timing marks on the front of the engine and/or the #1 piston. Adjust the crank until the marks are perfectly aligned, using the small mirror. You will want to angle the mirror to the left to follow the centerline of the engine, and not point it straight up and down as it will change your perspective of the timing marks.

Inspect the cam blocks and make sure they are fully seated against the cylinder head by gently applying pressure on them, if needed. This may rotate one or both cams slightly, until everything is square. Once they are square, lock the two cam blocks together (two 13mm bolts on top of each block) to hold the cams in place during the next step.

Once you are positive that the crank and both cams are perfectly aligned, it's time to tighten the 4 torx bolts on the exhaust cam gear...

Slightly tighten the 4 torx bolts on the front of the exhaust cam, then go back and tighten each one to 15nm (11ft/lb or 133in/lb). This procedure locks the exhaust cam to the crank, and the intake cam to the exhaust cam, so that the timing is set. Be very careful not to rotate the cam when tightening the bolts! The cam block may tilt if too much force is applied to the torx bolts while tightening. It may help to have someone hold the cam blocks down by hand while tightening the bolts.

Remove the cam blocks, and TDC pin.

Rotate the engine two full revolutions clockwise using the 22mm wrench, coming back exactly to TDC using the timing marks. Double check the timing again with the cam blocks. The cams should still be square with the cam tool. If they are not square, loosen the 4 torx bolts on the exhaust cam and square the cams with the cam blocks again while the crank is at TDC, and then tighten the torx bolts again as described above.

If everything looks good you are done with the timing!

20. Reassembly and post check list

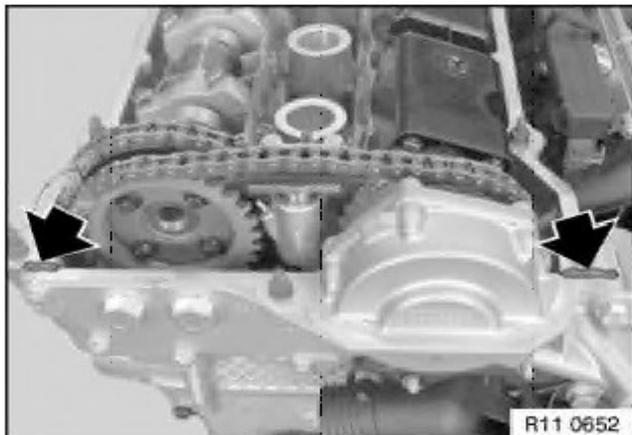
Replace the two 19mm access bolts in the front of the vanos.

Replace the TDC dust cap in the block if necessary.

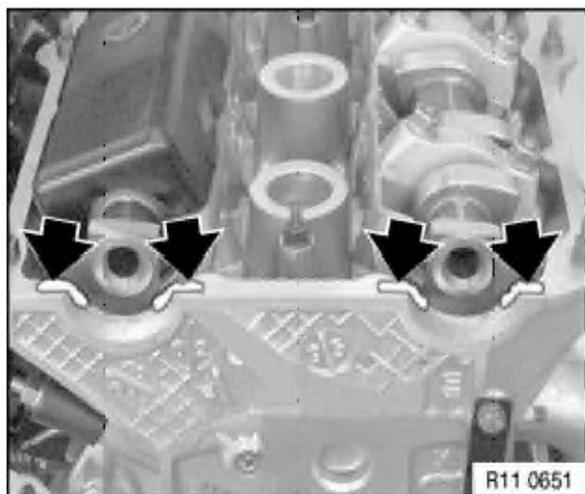
Replace the three valve cover studs at the back of the head.

Replace the plastic oil splash cover over the intake cam.

Apply a thin coat of RTV sealant at the mating lines between the vanos and cylinder head.



Apply a thin coat of RTV sealant at the corners of the half-moon transitions at the back of the cylinder head.



Check the valve cover gaskets. If they are brittle replace them.
On OBD-1 cars, the gaskets sit on the head. On OBD-II cars, the gaskets sit in the valve cover.

Replace the valve cover, and 15 bolts/washers/rubber seals.

Be sure **all the rubber seals are installed** or you will have a serious oil leak!
Double check all 15 valve cover bolts to make sure they are tight. There are a couple that are hidden under the wiring harness.

Install coil packs, and the two grounding straps.
Replace the vent tube on the valve cover.
Replace the coil pack and injector covers.

Use a screwdriver to fish the coolant hose back through the hole in the fan shroud while positioning the coolant tank back into place.
Install the small coolant hose on the radiator and tighten the hose clamp.
Install the retaining clip over the coolant tank bleed valve.
Install the fan, turning the fan nut counter-clockwise until it is snug. No need to overtighten.



Make sure that...

- The TDC Pin has been removed
- The banjo bolt is tight
- The two 19mm access plugs are tight
- The solenoid is securely connected
- All the valve cover bolts are tight
- The hose clamp for the small radiator hose is tight
- Any loose vacuum hoses are connected (OBD-II)
- The plastic wire cover is installed under the vanos (OBD-1 Crank Position Sensor wire)
- Oil level is topped off
- Coolant is topped off

<http://www.drvanos.com>