

6-cylinder Single Vanos Procedure (E36, E34, E39)

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Introduction

“Vanos” is BMW’s name for its variable valve timing units. Vanos units take on various shapes and design according to car year and model (engine model). The vanos discussed here is BMW part # 11-36-1-748-036 (M50TU, US S50) and 11-36-1-748-819 (M52, S52). It’s a single vanos, meaning only the intake valve timing is varied. This vanos unit is part of BMW 6-cylinder engines M50TU, M52, US S50, S52. These engines were incorporated into a wide range of car models during years 1993-1999. They are found in the 3-series E36 93-97, 5-series E34 93-95 / E39 96-98, 7-series E38 95-98, Z3 Roadster 2.8 E36 96-98, EU Z3 Coupe 2.8 E36 96-98, US M3 E36 94-99, US Z3 M E36 98-99.

This vanos has been experiencing a failure. It has been diagnosed that the failure is due to deterioration of the vanos piston seal O-ring. It has been determined that the O-ring is made from Buna (Buna-N, NBR, Nitrile). Buna is a very common O-ring material, but is limited in its temperature and chemical resistance characteristics. Unfortunately it is fairing quite badly in the vanos/engine environment. The O-ring has been found to harden, shrink, and have flat surfaces. This deterioration is causing the O-ring to lose its functional characteristics and thus cause the vanos to fail. BMW has been engaged regarding this matter, but has elected to not address the issue, “No further development will be done”. New (rebuilt) vanos units are being sold with the same Buna O-ring. BMW does not provide the vanos piston seal/O-ring as a separate part.

Here is a link to the Roadfly BMW E39 forum where much of this information was first made public regarding the double vanos: <http://bimmer.roadfly.com/bmw/forums/e39/7494631-2.html>.

The double vanos shares the same seals design and O-ring failure as the single vanos.

The piston O-ring lies under and provides support to a piston Teflon seal ring. Replacing the O-ring requires removing the Teflon seal to access the O-ring. The Teflon seal can not be practically removed from the piston seal groove without damaging it. Thus replacing the O-ring necessarily requires replacing the Teflon seal.

The Buna O-ring can be replaced with an O-ring made from Viton. Viton (FKM, Fluorocarbon) has similar functional characteristics to Buna, but has much higher temperature and chemical resistance characteristics. It's also recommended for the automobile engine environment. The vanos Teflon (PTFE filled) seal is not a standard part and needs to be semi-custom manufactured.

The single vanos has one piston with one seal/O-ring.

A vanos seal/O-ring repair kit can be acquired through Beisan Systems (bee-saan), www.beisansystems.com/products. It includes a vanos replacement OEM Teflon seal and enhanced (Viton) O-ring. Here is a link to the Roadfly BMW E39 forum where the double vanos seals product was first introduced: <http://bimmer.roadfly.com/bmw/forums/e39/8705552-2.html>. The double vanos utilizes the same Teflon and O-ring material and design as the single vanos.

Symptoms

Cars experience:

Overall loss of torque and power, particularly in the lower RPM range, < 3k. Bogging then surging at 3k RPM. Uneven power distribution and RPM transition. Engine hesitations in the lower RPM range, < 3k. Louder idle and intermittent idle RPM hiccups. Difficult takeoffs. Loss of power and bogging when AC on. Increased fuel consumption.

Repairing the vanos seals provides:

Overall increase in torque and power, particularly in the lower RPM range, < 3k. Resolution of bogging then surging at 3k RPM. Smooth even distribution of power and RPM transition. Resolution of engine hesitations in the lower RPM range, < 3k. Quiet stable idle. Smooth easy takeoffs. Improved performance when AC on. Reduced fuel consumption, by ~10%.

In some cases the engine computer will generate the following fault code: P1519 (BMW 212, 0xD4): Vanos mechanically stuck (jamming).

Diagnosis

A vanos fault code, as described above, without previous tampering with the engine timing, is most likely a vanos seals failure indication.

Otherwise the vanos needs to be removed from the engine for inspection. Once the vanos cylinder cover is removed, an inspection of the piston seals fit in the cylinders will show a loose fit and thus a seals failure. Removal of

the seals from the piston will show the inner O-ring has flat spots and a loss of elasticity.

In general, a diagnosis is not necessary. The vanos Buna O-ring is deteriorating in 20k miles (32k kilometers). Thus essentially all the cars with this vanos have a deteriorated seal O-ring and a failing vanos.

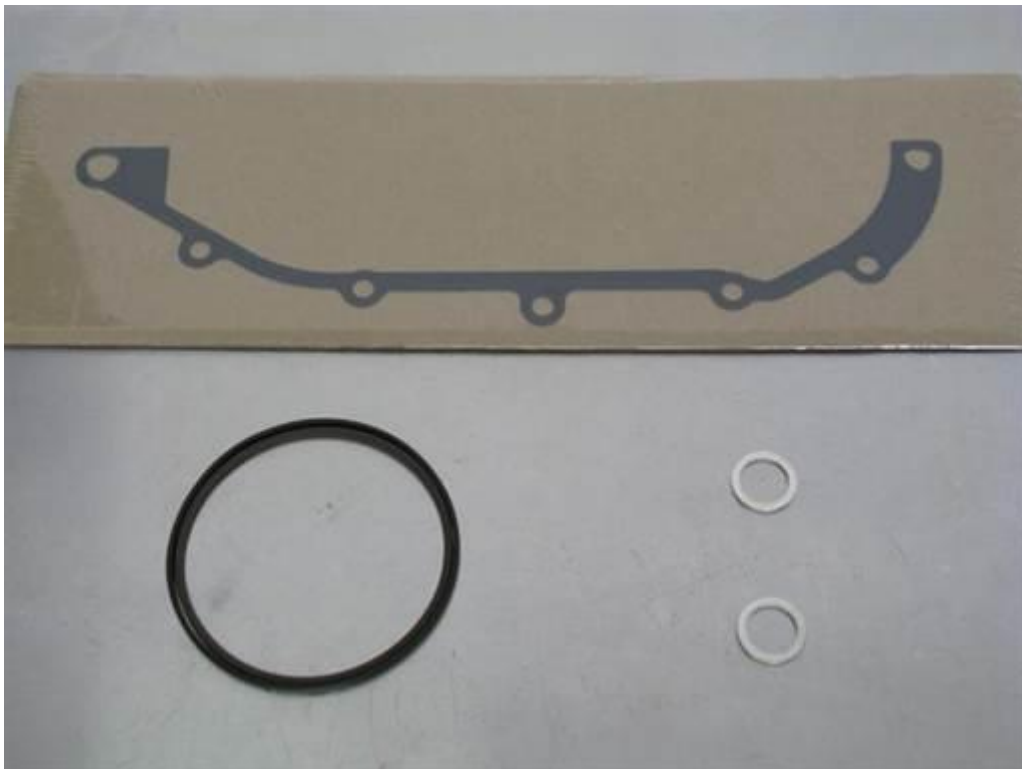
Repair Procedure

The following is an E36, E34 & E39 single vanos piston seals R&R (remove and replace) procedure.

If the valve cover gaskets are over 40k miles (64k kilometers) old, then it's prudent to replace them during this repair. If they are over 80k miles (128k kilometers) old, then it is a requirement to replace them during this repair, otherwise they might leak due to being dismantled and reused. These gaskets have an estimate lifespan of ~60k miles (96k kilometers) and replacing them during this repair requires no extra effort. The needed parts and replacement procedure are included as optional.

Repair time: 4 hours mechanic, 6+ hours DIY.

Parts, Tools, and Shop Supplies



Single vanos seals kit (6-cyl) (BS011) \$30/each (www.beisansystems.com), vanos gasket (11-36-1-740-840) 7.48/each, 2 x vanos oil hose/pipe washer (32-41-1-093-596) \$.25/each



Optional Parts

Valve cover gasket replacement parts:

Valve cover gasket set: M50TU, US S50 engines 93-95 (silver metal cover) (11-12-0-034-107) \$32.89/each, M52, S52 engines 96-99 (black plastic cover) (11-12-0-034-108) \$35.70/each

15 x valve cover bolt grommet (11-12-1-437-395) \$1.37/each, oil fill neck gasket (11-12-7-526-447) 2.29/each

Easily breakable parts: 4 x cover bolt/nut cap (11-12-1-726-089) 3.05/each, 2 x fan shroud rivet (17-11-1-712-963) \$.35/each, E36: 2 x air duct rivet (51-48-1-915-964) \$.49/each, E39: radiator overflow neck (17-11-0-419-132) \$1.67/each

Easily lost parts: 4 x engine cover pad (11-12-1-730-352) \$2.35/each

E36 & E39: Small adjustable hose clamp. Needed if radiator overflow hose OEM clamp not previously replaced with adjustable clamp.



Gasket scraper, putty-knife

Strait pick tool, razor knife, medium nose pliers (small)

24mm combo wrench, 19mm combo wrench, Philips screwdriver (medium), torx driver (any small size), 3 flathead screwdrivers (2 medium, 1 small), tack lifter, needle file, mirror (small), magnet pickup

22mm socket 1/2", 19mm socket 1/2", 3/8" to 1/2" socket adapter

13mm socket 3/8", 10mm deep socket 3/8", 10mm socket 3/8", E-10 torx socket 3/8"

8 mm socket 1/4"

1/2" ratchet, 3/8" ratchet, 1/4" ratchet, 3/8" long-arm ratchet, 1/2" long-arm ratchet

3/8" socket extension (short), 1/4" socket extension (short)

Torque wrench (8 Nm [6 ft-lb], 50 Nm [37 ft-lb])



BMW timing tools:

Camshafts lock blocks (11-3-240), sprocket turner (11-5-490), crankshaft lock pin (11-2-300), camshaft tensioner lock pin (11-3-292) (or small set nail (3d))

The above timing tool kit can be rented in the US from Bimmer Tool Rental, www.bimmertoolrental.com.

Rental is \$25 for 30 days, \$5 USPS Priority small flat rate shipping, and refundable deposit of \$90.

Return shipping is responsibility or renter (\$5 USPS Priority small flat rate).

Late returns will receive an automatic rental renewal for an extra 30 days with \$25 deduction from deposit.



E36 & E39 mechanical fan removal tools
32mm combo wrench, BMW water pump pulley holder (11-5-030) \$20/each
Handheld sledge hammer (3lb)



E36 fan/shroud removal tools
~6" x 5/16" (8mm) vacuum hose, 2 small clamps



Paper towels, water based cleaner (simple green 1:10), spray lubricant, brake cleaner, engine oil (synthetic 5W30)
Parts plate, RTV sealant, large cup

Not shown: large pad (quilt), oil pan, 3 small cloth towels

Repair

Car engine must be cold to perform repair procedure.

M50TU and M52 engine specifics will be labeled "M50TU:" and "M52:". For easy identification, the M50TU engine (93-95) has a silver metal valve cover, and the M52 engine (96-99) has a black plastic valve cover.

Right and Left denotations are from car front at hood orientation.

Removal of fan & shroud

[E36 fan & shroud removal](#)

[E34 fan & shroud removal](#)

[E39 fan & shroud removal](#)

Removal of cabin filter housing

[E39 cabin filter housing removal](#)

Removal of valve cover



Remove engine top covers.

Pry off 2 center caps at each engine cover (flathead).

Unscrew 2 bolts at right cover, and 2 nuts at left cover (10mm socket 3/8" / 3/8" ratchet & extension, magnet pickup).

Remove right engine cover.
Unscrew oil fill cap, remove left engine cover, reinstall oil fill cap.



M50TU:
Remove valve cover vent hose at cover right front corner.
Pry up retaining clip and pull off connector (flathead).



M52:

Remove valve cover vent hose at cover right front corner.
Press in hose connector ring clip at sides and wiggle off connector.
Warning: Do not pull connector off. This can cause sudden release and break hose. Wiggle connector off.



Disconnect ignition coils electrical harness.
For each coil, pull up on coil connector metal lock and pull off cable

electrical connector.

M50TU:

Remove connector cables from valve cover cable bracket at cover left side.

M52:

Remove coil harness ground wire from valve cover bolt/stud located between coils 2 & 3 (8mm socket 1/4" / 1/4" ratchet & extension, magnet pickup).



M52:

Disconnect coil harness rail from valve cover clips.

Pry on each valve cover coil harness rail right side clip and pull out coil harness rail (flathead).

Pull off complete coil harness and set on left side components.



Remove coils.

M50TU: Coils mount with nuts.

M52: Coils mount with bolts.

Remove 2 mounts at each coil (10mm socket 3/8" / 3/8" ratchet & extension).

M50TU: Maintain coil harness cables in brackets mounted with coils 3,4,5.

Pull up and out all coils.

Note: Maintain coil/cylinder association for reinstallation. This is not necessary, but is good practice.



Remove coil ground strap(s) (8mm socket 1/4" / 1/4" ratchet & extension).
M50TU: Ground strap at cylinder 6.
M52: Ground straps at cylinders 1 & 6.



Remove 11 valve cover mounting bolts w/ washers & grommets at perimeter of valve cover (10mm socket 3/8" / 3/8" ratchet & extension, flathead).

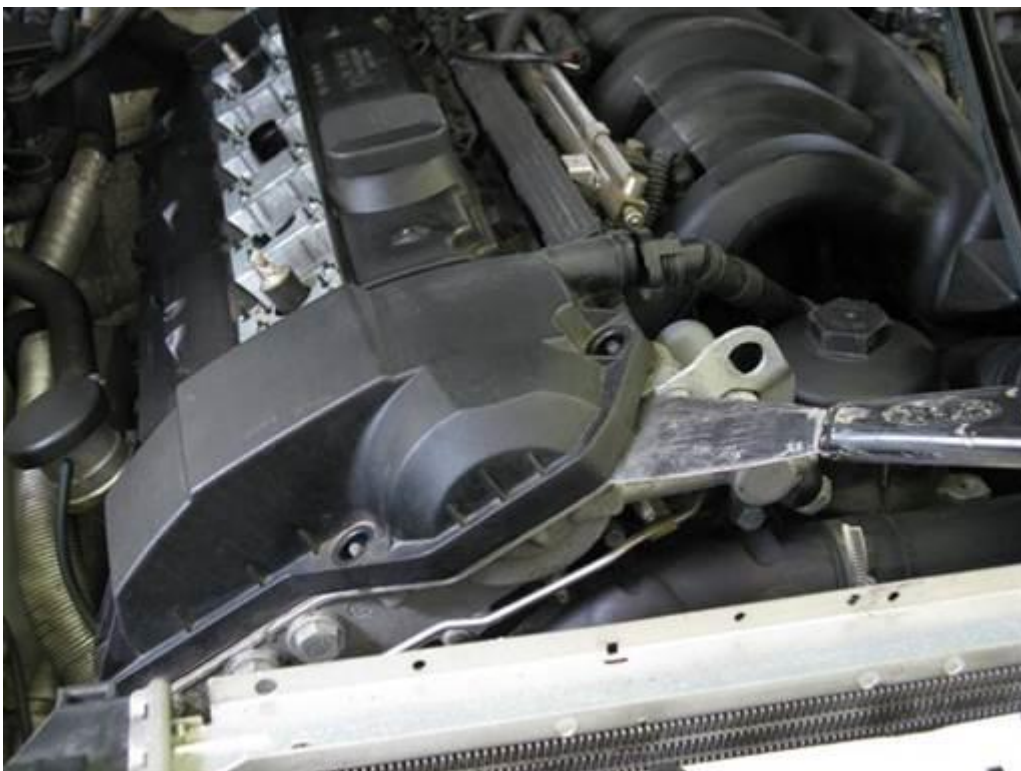
Note: Be sure to not miss the left rear corner bolt.



Remove 4 valve cover mounting bolts/studs w/ washers & grommets at center of valve cover (10mm socket 3/8" / 3/8" ratchet & extension, flathead).

M50TU: Second bolt/stud from front is same as perimeter bolts.

M52: Third bolt/stud from front is same as perimeter bolts.



Remove valve cover from engine head.
Insert blade (putty-knife) between valve cover gasket and engine head at all front end accessible locations to break gasket bond.
Pull up and remove valve cover. If resistant, insert blade (putty-knife) between valve cover gasket and engine head at sticking locations.
Note: If valve cover can not be removed, double check valve cover 11 perimeter bolts and 4 center bolts/studs have been removed. If valve cover

is stuck, pull up on free front end of cover to break gasket bond on remainder of valve cover.

M50TU: Pull up coil harness cables to allow access for cover removal.

M52: Remove cables from valve cover rear bracket/slot. Lift up on rear cables to allow access for cover removal.

Maintain cover perimeter gasket with cover.

Valve cover perimeter gasket will stick at rear half moon dips due to RTV sealant. Pull up on gasket to release.

Remove valve cover sparkplug well gaskets.

Note: If gasket is stuck to engine head, attempt inserting blade between gasket and head from an edge (putty-knife). This facilitates gasket removal without breaking plasticized brittle gaskets into pieces.





Remove intake camshaft cover.
Pull up to release clips. Remove from engine bay.

Locking engine timing





If manual transmission, place transmission in neutral. This allows turning of crankshaft.

Turn crankshaft pulley clockwise until cylinder 1 intake and exhaust cams point to each other at ~45 degree angle (22mm socket 1/2" / 1/2" long-arm ratchet).

Note: Turning crankshaft counter clockwise is acceptable.



Adjust crankshaft pulley to adjust exhaust camshaft for rear camshaft

square to be flush with head surface (22mm socket 1/2" / 1/2" long-arm ratchet).





Inspect TDC (top dead center) timing marks on engine timing cover and crankshaft harmonic balancer at ~11 o'clock position (mirror). Adjust crankshaft pulley to align TDC timing marks (22mm socket 1/2" / 1/2" long-arm ratchet).

Note: Angle of view changes alignment position. A tilted view to ~11 o'clock position provides correct alignment view.

Raise front of car and place on jack stands (follow appropriate procedure; chock both sides of both rear wheels).



Locate crankshaft lock hole plug at engine right rear (front orientation).
Pry out plug by inserting narrow driver into plug eyelet and prying against engine frame (torx bit driver).



Insert narrow driver into crankshaft lock hole and roughly measure hole depth.
Measurement will provide reference for crankshaft lock pin insertion in next step.



Insert crankshaft lock pin into crankshaft lock hole.
Pin should insert as far as narrow driver in previous step.

When lock pin is fully inserted crankshaft pulley will be locked in place and can not be rotated. Check crankshaft pulley is locked (22mm socket 1/2" / 1/2" long-arm ratchet).

Note: Crankshaft pulley will have very slight play (movement) when locked.

If lock pin does not fully insert or crankshaft pulley is not locked, adjust crankshaft pulley in slight increments and attempt pin insertion (22mm socket 1/2" / 1/2" long-arm ratchet).

If lock pin still does not fully insert, clean lock hole surfaces (needle file).

If lock pin persists in not inserting, there might be rust and grime at engine case hole and/or drive plate / flywheel hole.

Insert wide diameter driver into crankshaft lock hole instead of lock pin (Philips).

Precisely align timing marks on engine timing cover and crankshaft harmonic balancer.

Lower car from jack stands (follow appropriate procedure).



Remove 3 valve cover studs at rear of engine head (10mm socket 3/8" / 3/8" long-arm ratchet & extension).
E36: No room for socket extension.

Remove excess RTV sealant at top of engine head at half-moon corners.



Place exhaust camshaft lock block (bolt hole on block right) on exhaust camshaft rear square and engine head.

Note: Lock block might not fit well until camshaft position adjustment in next step.



Place open wrench (24mm combo wrench) on exhaust camshaft hex at middle of camshaft.

Adjust camshaft to allow flush seating of camshaft lock block on engine head (24mm combo wrench).

For final fine tuning, rock wrench back and forth while feeling block by hand.



Place intake camshaft lock block (bolt hole on block left) on intake camshaft rear square and engine head.

Note: Lock block might not fit well until camshaft position adjustment in next step.



Place open wrench (24mm combo wrench) on intake camshaft hex at middle of camshaft.

Adjust camshaft to allow flush seating of camshaft lock block on engine

head (24mm combo wrench).

For final fine tuning, rock wrench back and forth while feeling block by hand.



Install lock blocks bracket and bolts (13mm socket 3/8" / 3/8" ratchet).
Note: Bracket helps maintain lock blocks position and counters block movements.

Removal of vanos



Remove vanos oil hose and bolt (19mm combo wrench).
Note: There are 2 washers, one at each side of hose end contact surfaces.
Discard washers.



Remove engine lift bracket at vanos intake solenoid.
Remove top and bottom bolts (13mm socket 3/8" / 3/8" ratchet & extension).
Remove bracket.



Disconnect vanos intake solenoid electrical cable connector.
Move valve cover vent hose and vanos oil hose to right side of oil filter canister to facilitate space for access.
Pull up on solenoid cable to follow to electrical connector.
Press in connector spring clip and pull off cable connector.



M50TU:
Remove cable bracket E-clips under vanos.
Pull off E-clips to left side (medium nose pliers).



M50TU:
Remove cable bracket from mounting studs.
Pry off electrical cable from back of cable bracket and remove bracket.



M52:
Remove vacuum pipe 2 bracket mounting nuts (10mm standard & deep socket 3/8" / 3/8" ratchet).



M52:

Pull off vacuum pipe from mounting studs.

Pull vacuum pipe further out and lay down on thermostat and radiator lower hose.

Note: Side vacuum hoses provide slack needed to pull forward on vacuum pipe.



Remove 2 vanos exhaust sprocket access bolts (19mm socket 1/2" / 1/2" long-arm ratchet).



Insert cloth towel below exhaust sprocket. This will prevent any falling bolt from dropping into oil sump.

Remove 4 exhaust sprocket mounting bolts (E-10 torx socket 3/8" / 3/8" ratchet & extension).

Remove any dropped bolt with magnet pickup and not by hand.

Remove cloth towel.



Install camshaft chain tensioner lock pin.

Press down on tensioner and insert pin up to chain.

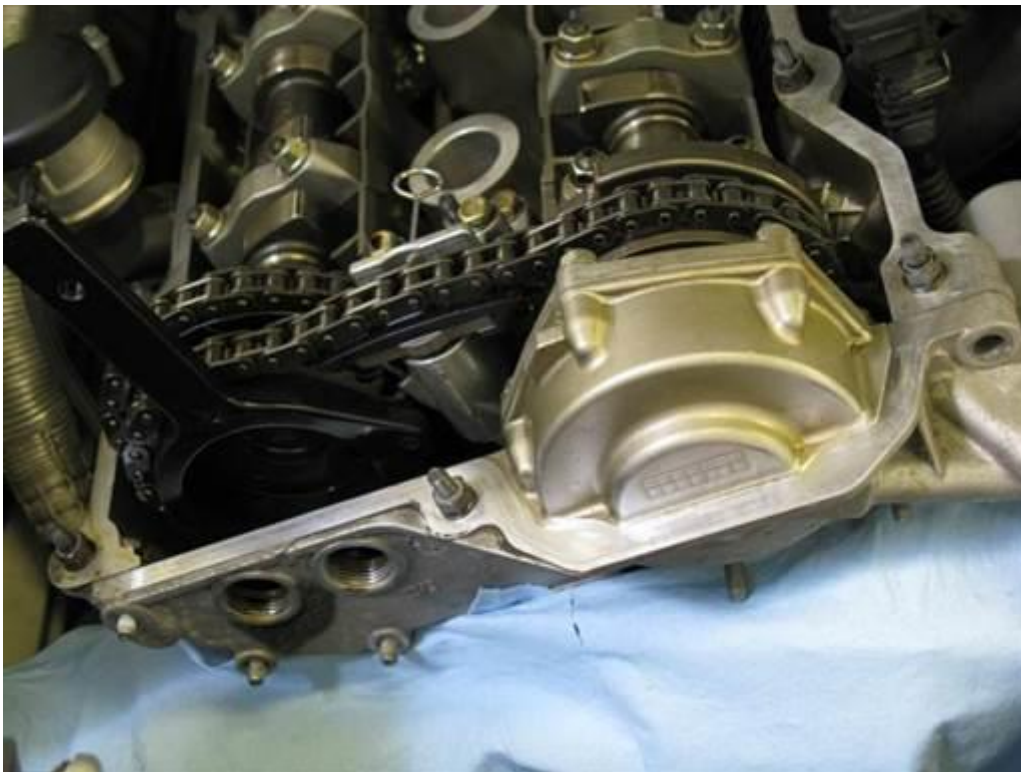
Note: Lock pin should not be inserted under chain as it can inadvertently tension chain.



Remove vanos 6 mounting nuts at front lower half of vanos (10mm standard & deep socket 3/8" / 3/8" ratchet & extension).
M52: 2nd nut from left and 1st nut from right were removed previously when removing vacuum pipe.



Cover AC belt and lower radiator hose to protect from oil leakage (towels). Install small bag over vanos oil feed hole to catch leaking oil (vanos seals product bag).





Remove vanos from engine head.

Mount sprocket turning tool on exhaust sprocket.

Wiggle vanos forward off engine head while simultaneously turning exhaust sprocket clockwise.

Note: Turning exhaust sprocket clockwise facilitates chain slop allowing intake sprocket clockwise rotation which in turn allows vanos splined shaft to be retracted.

Note: Significant oil will drain from vanos oil feed hole.

Take vanos to oil receptacle and attempt to drain oil from vanos (oil pan).

Tilt vanos to facilitate drainage of oil from vanos inner oil relieve spout and outer oil feed hole.

Lay vanos down on table with inner side facing up.

Remove and discard vanos gasket at engine head.

Replacement of vanos piston seals

During following seals installation procedure, great care should be taken to not drop and damage vanos components. Perform work over table, so if part is dropped it will fall to table top.



Remove vanos cylinder cover mounting bolts (10mm socket 3/8" / 3/8" ratchet).



Remove cylinder cover with splined shaft and piston from vanos body.
Drain oil from cylinder and cover into oil receptacle (oil pan).
Wipe off oil from vanos components (towels).

For failure diagnosis verification, insert piston in/out of vanos cylinder and

note loose fit.

Inspect vanos cylinder by feel for any marring. Wall should be exceedingly smooth with no felt irregularities.

Note: Seal sliding wear patterns will be present. Also cylinder wall will not be as polished at ends of cylinder.

Piston seals removal and installation



Cut cross section of piston Teflon seal in piston groove (razor knife).
Note: Rocking of blade while pressing helps create cutting motion.

Remove cut Teflon seal from piston groove.



Cut cross section of piston O-ring in piston groove (razor knife).
Note: Rocking of blade while pressing helps create cutting motion.

Remove cut O-ring from piston groove.

Note: Deteriorated O-ring will be flattened at top and bottom surfaces, shrunk in size, and plasticized thus having a loss of elasticity. This is the common vanos failure mode.



After both piston seal rings are removed, piston groove will be metal. Wipe clean piston groove (towel).



Install new O-ring (circular brown) in piston groove. Insert O-ring in piston groove at one end, and stretch other end over piston and drop into groove (hands/fingers).
Note: O-ring should not be twisted during installation process.

Verify O-ring is not twisted in piston groove. Adjust and center as necessary (pick tool).



If Teflon seal in cold environment, <65F (18C), soak seal in warm water for 2+ minutes.
Remove and dry Teflon seal just before installation.



Note: Perform following step on ground over large pad while kneeling with

knees on pad. This minimizes risk of dropping piston and damaging its surfaces.

Install new Teflon seal (rectangular black) in piston groove. Insert Teflon seal in piston groove at one end, and stretch other end over piston and drop into groove (hands/fingers). Do not over stretch.

Note: Attempt to stretch Teflon seal evenly and take care to not scuff/damage. Some sliding of seal on piston rim is normal.

Note: Moderate force is needed to stretch Teflon seal.

[pic]

Once stretched and installed, Teflon seal will fit loosely in piston groove.

Piston Teflon seal resizing

Apply coat of assembly lubricant (engine oil) to vanos cylinder wall. Be sure to include chamfer (rim bevel).

Apply coat of assembly lubricant (engine oil) to vanos piston Teflon seal and adjacent piston surfaces.



Press in on helical gear shaft to fully separate piston from cylinder cover. Insert piston into cylinder at ~30 degree angle, then rotate piston to insert into cylinder.

Rotate piston to be flush with cylinder. As piston is rotated, excess seal protruding from piston groove will be collected and pressed into piston

groove.

If seal is binding, reposition piston and attempt again. With each attempt seal will partially resized. Eventually piston can be fully rotated without binding seal.



Press in on splined shaft to fully insert and properly position piston in cylinder.

Verify cylinder cover is fully seated on vanos body.



Allow piston to sit in cylinder for 2 minutes then remove. Teflon seal will be compressed close to original size.



Reinstall piston in cylinder.
Press in on splined shaft to fully insert and properly position piston in cylinder.
Rotate cylinder cover to achieve proper mounting holes orientation.
Mount cover 5 bolts (10mm socket 3/8" / 3/8" ratchet).

Fully tighten, 10 Nm (7 ft-lb) (10mm socket 3/8" / 3/8" torque wrench).

Note: Tighten bolts evenly in crisscross pattern.

Double check piston movement in vanos cylinder by inserting and retracting helical gear shaft. This will take force due to new seal tight fit.

Comparison of new seal piston resistance to movement in cylinder to old seal piston movement in cylinder verifies old seal failure.

Fully insert vanos splined shaft in vanos.

Cleaning of parts

Note: When cleaning parts, spray cleaning compound on towel then wipe component with towel. Components can also be placed in a small container and sprayed with cleaning compound then individually wiped with towel.

Clean all mounting bolts/studs, nuts, washers, rubber grommets, ground strap ends (brake cleaner & towels)

Clean vanos matting surfaces; head, valve cover, oil feed (brake cleaner & towels).

Remove sealant compound on engine head (gasket scraper, finger nail).
Clean engine head matting surfaces; vanos, vanos studs, valve cover gaskets (brake cleaner & towels).

Clean coils mounting contact surfaces (at coils) (brake cleaner & towels).

Remove sealant on valve cover gasket (pick tool, finger nail).

Clean valve cover gaskets (water based cleaner & towels).

Clean valve cover mating surfaces; gaskets and mounting bolt access holes (water based cleaner & towels), coils (brake cleaner & towels).

Optional: Replacement of valve cover gaskets

Replace valve cover gaskets.

Remove 15 valve cover bolt grommets from bolts and install new grommets on bolts.

Remove valve cover oil fill cap. Remove oil fill neck gasket and install new gasket. Mount valve cover oil fill cap.

Note: If old gasket is stuck to valve cover, attempt inserting blade between gasket and cover starting from an edge (putty-knife). This facilitates gasket removal without breaking plasticized brittle gaskets into pieces.

Installation of vanos



Note: Verify old vanos gasket is removed from engine head and surface clean.

Mount new vanos gasket onto engine head front. Mount top corners onto dowels and place gasket flush with head surface.

Note: Gasket is asymmetric.



Mount sprocket turning tool onto exhaust sprocket.
Rotate exhaust sprocket clockwise as far as possible. This will rotate intake sprocket clockwise as far as possible.
Note: This step is critical for proper installation of vanos in next step.





Fully insert vanos splined shaft in vanos. Note: This step is critical for proper installation of vanos.

Mount vanos onto engine head front.

Insert vanos onto engine head studs. Insert helical gear shaft into intake sprocket.

Rotate helical gear shaft and slightly insert into sprocket. Helical gear shaft will slightly insert into sprocket and stop rotating.

Note: This step is critical for proper installation of vanos.



Mount sprocket turning tool onto exhaust sprocket.
Rotate exhaust sprocket counter clockwise while pushing in on vanos to insert helical spline shaft into intake sprocket. Wiggle vanos and sprocket tool to help insertion.
Note: It is critical to insert into first possible gear spline alignment. Push vanos in while turning sprocket.

Insert vanos onto engine head studs, then vanos top corners onto head matting dowels.



M52: Do not install 2nd nut from left and 1st nut from right in this step. Thus only 4 nuts will be installed.

M50TU: Install all 6 nuts.

Install vanos mounting nuts and tighten evenly working back and forth (10mm standard & deep socket 3/8" / 3/8" ratchet & extension).

Fully tighten, 8 Nm (6 ft-lb) (10mm standard & deep socket 3/8" / 3/8" torque wrench & extension).



Remove camshaft chain tensioner lock pin.
Press down on chain tensioner and remove lock pin.



Insert cloth towel below exhaust sprocket. This will prevent any falling bolt from dropping into oil sump.

Install 4 exhaust sprocket mounting bolts and tighten evenly in crisscross pattern (E-10 torx socket 3/8" / 3/8" ratchet & extension).

Remove any dropped bolt with magnet pickup and not by hand.
Fully tighten, 20 Nm (15 ft-lb) (E-10 torx socket 3/8" / 3/8" torque wrench & extension).

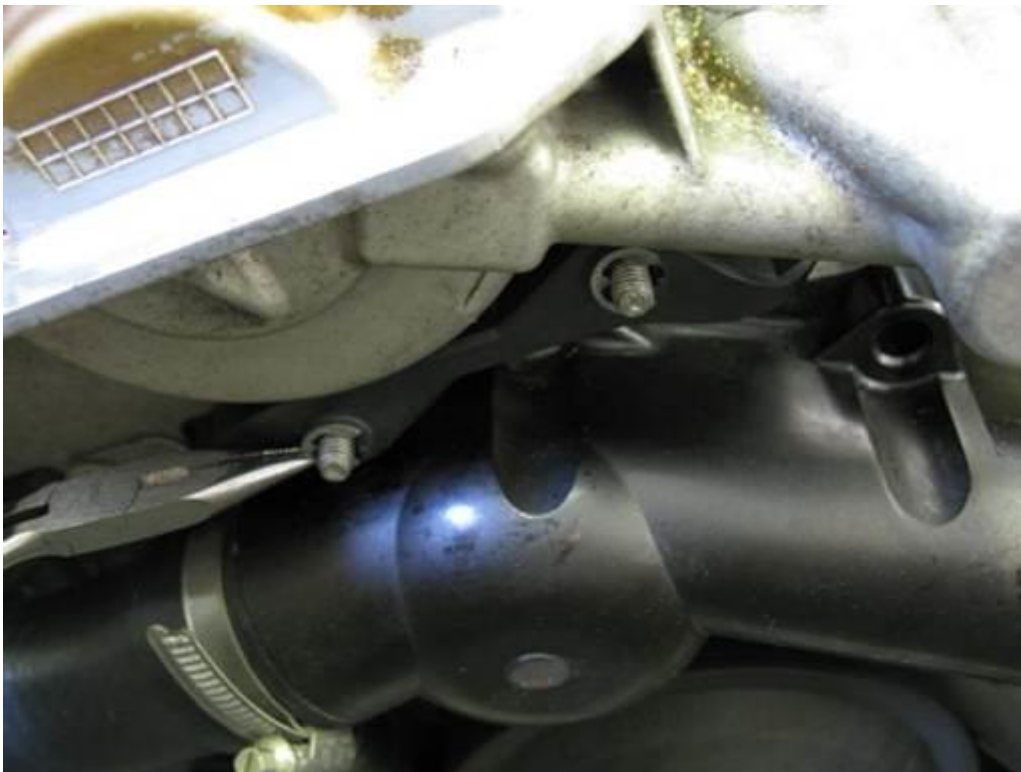
Remove cloth towel.



Install 2 vanos exhaust sprocket access bolts (19mm socket 1/2" / 1/2" ratchet).
Fully tighten, 50 Nm (37 ft-lb) (19mm socket 1/2" / 3/8" torque wrench & 3/8" to 1/2" socket adapter).



M50TU:
Install cable bracket under vanos onto electrical cable.
Press cable into bracket rear cable slot.



M50TU:
Install cable bracket onto mounting studs.
Install cable bracket E-clips onto mounting studs (medium nose pliers).



M52:

Install vacuum pipe onto mounting studs.

Install 2 bracket mounting nuts (10mm standard & deep socket 3/8" / 3/8" ratchet).

Fully tighten, 8 Nm (6 ft-lb) (10mm standard & deep socket 3/8" / 3/8" torque wrench).

Verify 6 vanos mounting nuts fully tightened, 8 Nm (6 ft-lb) (10mm standard & deep socket 3/8" / 3/8" torque wrench).



Install vanos intake solenoid electrical cable connector.
Press in connectors until clip snaps in place.



Install engine lift bracket at vanos intake solenoid.
Install long bolt at top and short bolt at bottom (13mm socket 3/8" / 3/8"
ratchet & extension).
M50TU: Install ground wire with top bolt.
Fully tighten, 8 Nm (6 Ft-lb) (13mm socket 3/8" / 3/8" torque wrench &
extension).



Install vanos oil hose with bolt and 2 new washers (19mm combo wrench). Mount first washer on bolt. Insert bolt through hose. Mount second washer on bolt. Screw bolt onto vanos.

Fully tighten, 32 Nm (24 ft-lb) (19mm combo wrench / by feel).

Note: Insert rod (flathead) between hose pipe and vanos intake solenoid to keep hose from turning.

Unlocking engine timing



Remove camshaft locking blocks.

Remove sealant compound on engine head half moon corners (gasket scraper, finger nail).

Clean engine head mating surface (brake cleaner & towels).

Install 3 valve cover studs at rear of engine head (10mm socket 3/8" / 3/8" ratchet & extension).

Fully tighten, 8 Nm (6 Ft-lb) (10mm socket 3/8" / 3/8" torque wrench & extension).

E36: No room for socket extension.



Raise front of car and place on jack stands (follow appropriate procedure; chock both sides of both rear wheels).

Remove crankshaft lock pin from crankshaft lock hole.
Note: Wiggle pin while pulling to help release.

Insert plug into crankshaft lock hole.
Note: If plug difficult to insert, insert narrow driver into plug eyelet and press in plug (torx bit driver).

Lower car from jack stands (follow appropriate procedure).

Installation of valve cover



Install intake camshaft cover.

Orient cover with arched end at rear and open end at front.

M50TU: Lift coil electrical harness wires to facilitate access.

Press down on cover to lock tabs on valvetrain.

When fully installed, cover will have no vertical movement and slight axial (fore/aft) play.



M52:
Install valve cover perimeter gasket and sparkplug well gaskets on valve cover.



M50TU:
Install valve cover sparkplug well gaskets on engine head.
Orient gaskets to fit valve cover studs. Gasket cup side orients down.



Place thin coat of RTV sealant at 2 engine vanos/head contact points and head rear half moon corners.
Allow sealant to solidify for 2 minutes before mounting valve cover.



M50TU:

Install valve cover perimeter gasket onto engine head/valves. Take care to align properly before placement.

Lift coil electrical harness wires to facilitate access.



Install valve cover onto engine head/valves. Take care to align properly before placement.

M50TU: Lift up coil electrical harness wires to facilitate access.

M52: Lift up rear cables for access. Install rear cables in cover rear bracket/slot.



Install 11 bolts w/ washers & grommets at cover perimeter, and 4 bolts/studs w/ washers & grommets at cover center (10mm socket 3/8" / 3/8" ratchet & extension).

M50TU: Center second bolt/stud from front is same as perimeter bolts.

M52: Center third bolt/stud from front is same as perimeter bolts.

Tighten bolts/studs evenly working back and forth, assuring even pressure distribution on cover. Tighten until bolts/studs bottom out on head. Fully tighten, 10Nm (7 ft-lb) (10mm socket 3/8" / 3/8" torque wrench & extension).





Install coil ground strap(s) with mounting nut(s) (8mm socket 1/4" / 1/4" ratchet & extension).

M50TU: Ground strap at cylinder 6.

M52: Ground straps at cylinders 1 & 6.

Note: Ground strap highly bent end mounts on valve cover stud. Cylinder 1 strap connector orients to top corner, and cylinder 6 strap connector orients to bottom corner. This facilitates alignment of strap loose ends to coil mounts.



Install coils.

M50TU: Coils mount with nuts.

M52: Coils mount with bolts.

Install each coil into original sparkplug well with 2 mounts (10mm socket 3/8" / 3/8" ratchet & extension).

Note: Coil boot will not fully insert onto sparkplug during initial mount. This is normal.

M50TU: Mount coil harness cable brackets with coils 3, 4, 5. Mount ground strap with coil 6.

M52: Mount ground straps with coils 1 & 6.

Rotate between coil mounts to mount coil evenly.

M50TU: Mount coils 3, 4, 5 evenly together to assure even mounting of coil harness cable brackets.

Fully tighten, 10Nm (7 ft-lb) (10mm socket 3/8" / 3/8" torque wrench & extension).





Install ignition coil electrical harness.

M52: Install coil harness rail on valve cover and clip into place.

For each coil, lift up on connector metal lock, press in cable electrical connector, and push down on connector metal lock.

M50TU: Install coil harness cables in valve cover left side cable bracket.

M52: Install coil harness ground wire on valve cover bolt/stud located between coils 2 & 3 (8mm socket 1/4" / 1/4" ratchet & extension).





Install valve cover vent hose at cover front right corner. Push hose connector onto cover neck until it snaps on.





Install engine covers.

Install right side engine cover. Orient cover arches with intake manifold air tubes at right.

Install cover 2 mount bolts (10mm socket 3/8" / 3/8" ratchet & extension, magnet pickup).

Unscrew oil fill cap, install left side engine cover, reinstall oil fill cap.

Install cover 2 mount nuts (10mm socket 3/8" / 3/8" ratchet & extension, magnet pickup).

Clip on 2 bolt/nut cover caps at center of each engine cover.

Align silver lines on cap with cover. Insert clip at an angle and gently press down on other end (picture).

Note: Caps are dry, brittle, and will break easily.

Installation of cabin filter housing

[E39 cabin filter housing installation](#)

Installation of fan & shroud

[E36 fan & shroud installation](#)

[E34 fan & shroud installation](#)

[E39 fan & shroud installation](#)

Post repair procedures

Allow RTV sealant to dry a minimum of one hour before driving car.

On first engine start after repair engine will experience a couple engine hiccups at idle. This might be related to trapped air in the vanos.

Check and replenish engine oil.

Drive car, then park car and let engine oil settle.

Remove oil dipstick; wipe dipstick end; fully reinsert dipstick; remove dipstick again; read oil marking. If oil is low add needed (small) amount of new oil at oil fill cap at valve cover.

E36 & E39:

Check and replenish coolant fluid.

When car is fully cold (morning), inspect coolant level at side of expansion tank (reservoir). Coolant should be at mid level. Fill coolant as needed.

Drive car until warm. Slightly open bleed screw at expansion and allow air to escape (Philips). Close bleed screw when only fluid is escaping.

Repeat fill and bleed procedure as needed to achieve proper coolant level.

~100 miles (160 kilometers) of city driving is needed to break-in new seals to achieve smoother RPM transition.

Please provide feedback on vanos forum after seals break-in period. www.beisansystems.com/forum.html

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