

Step

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Disassembly

Reassembly

- Jack and jackstands
- 4-way lug wrench
- 7-17mm sockets (long and short, and in varying drive sizes)
- Short and long extensions in varying drive sizes
- Drive adapters for various drive sizes (ie 1/4" to 3/8", 3/8" to 1/2")
- 1/4" drive torque wrench that will read in in/lb
- 3/8" drive torque wrench that will read in ft/lb
- 1/2" drive torque wrench that will read up to 133 ft/lb
- Combination hand wrenches from 7-17mm
- 3mm and 8mm Allen wrenches (hex keys)
- 30mm axle nut socket (1/2" drive)
- 1/2" drive breaker bar (mine was 18" long)
- Flat head screwdrivers (regular size and a small one)
- Phillips head screwdriver
- Crescent wrench
- T25, T30, T40, and T45 sockets
- Needle-nose pliers
- Channel-lock pliers
- C-clamps or strong ratchet bar clamps (4)
- Spanner tool for holding cam pulleys (or fabricate an equivalent tool)
- Small drill bit (or steel pin) about 2mm in diameter
- A torque angle gauge (looks like a 1/2" drive extension with a dial face around it)
- Harmonic balancer puller (Loan-a-tool at AutoZone) if doing oil seals, water pump, etc.
- An extendable magnet tool (PRICELESS when you drop something somewhere hard-to-reach!)
- Short length of steel stock (welding section of Lowe's, 1/8" thick x 1.25" wide)



You will notice that every (new) gasket you see in this tutorial is copper-colored. I used this product, "Permatex Copper Spray-A-Gasket High Temp Sealant," on both sides of every gasket that I replaced while doing this job (except for the black, rubbery side of the exhaust manifold gaskets, the head side). I have read excellent reviews on car forums about this product and a similar one (K&W "Copper Coat"). It is supposed to seal dry gaskets and make them impervious to water, oil, etc so they will last longer. I was told it was a good idea to spray a good coat of it on my head gasket too (both sides).

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1



Disconnect the negative terminal of the battery (10mm) and position it so that it cannot accidentally make contact.

Reconnect the negative terminal of the battery and make sure the connection is clean and tight.

2



Remove the coolant reservoir cap, open the radiator drain valve, and open the engine block drain (next picture) to drain the coolant from the engine and radiator (13mm). The radiator drain valve is located on the left side of the radiator. In this picture, the front clip that goes underneath the radiator/fan area has been removed for clarity. **Also go ahead and drain the engine oil at this point.**

Refill the engine with oil. Close the radiator drain valve and fill the reservoir with distilled water (to flush with). Wait a few minutes until you can add more to the reservoir, then repeat. Keep doing this until you don't see the level in the reservoir drop after 5 minutes. After running the car for a few minutes to circulate it, shut it off, let it cool a while, then refill with 1 gallon of pure coolant (to get the ratio right) and top it off with distilled water using the same fill procedure. Check the level (while cool, before starting) every time you use the car until the reservoir stays at the full mark (when you're sure you have it all the way refilled). Always buy a gallon of the full strength coolant and mix it with a \$1 gallon of distilled water to have two gallons of 50/50 mix for much less than what two gallons of the "premixed" coolant costs. It held close to 2 gallons.

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Here is the engine block drain (13mm). It is located on the timing belt end of the engine, back side, down low on the block, protruding toward the rear of the car. If finding or reaching it is difficult, it can be opened later on in the repair without affecting anything. Just make sure to open this and drain the block at some point in this repair (to get out ALL of the old coolant that may have oil in it).

Make sure the engine block drain is closed.

4



Break loose (but don't remove yet) all five lug bolts (maybe 1/4 turn) with a breaker bar or 4-way lug wrench (19mm).

Torque all five lug bolts to 81 ft/lb, tightening every other one until all five are properly torqued.

5



Jack the car up (with the jack on a substantial portion of the underbody) and place heavy-duty jackstands under heavy portions of the frame that will support the weight of the car, then let the car slowly down onto the jackstands. I always try to rock the car after I have the jackstands in place to make sure it is stable.

Jack the car up (with the jack on a substantial portion of the underbody) and carefully remove the jackstands, then let the car slowly down onto the ground/driveway.

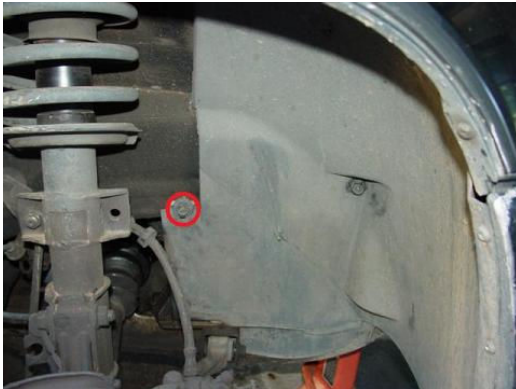
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Finish removing the five lug bolts, then remove the tire/wheel. Now remove the wheelwell apron nut circled in red, fold the apron up along the crease, and secure it out of the way (I secured it with a small spring clamp). The whole apron looked like a big job to try and remove, so this seemed the best option.

Replace the wheelwell apron in the position it goes and secure it with the nut circled in red. Replace the tire/wheel (noting there is a pin and hole that have to be positioned right for it to fit) and hand-tighten the five lug bolts.

7



Disconnect the coolant reservoir hose from the thermostat housing (T25).

Reconnect the coolant reservoir hose to the thermostat housing.

8



Lift the coolant reservoir out of the fenderwell bracket. Press the locking wire in and disconnect the coolant reservoir electrical connection.

Press the locking wire in and reconnect the coolant reservoir electrical connection. Place the coolant reservoir back into the fenderwell bracket.

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Disconnect the hose on the bottom of the reservoir at the point where it connects to the water pipe at the back of the engine (Flat-head screwdriver). This is down behind the passenger side of the timing belt cover. The coolant reservoir should now be completely free from everything.

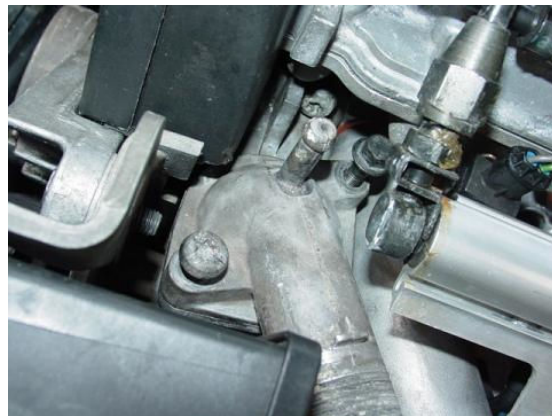
Reconnect the hose that comes out of the bottom of the reservoir where it connects to the water pipe at the back of the engine.

10



Disconnect the plastic tube leading from the radiator shroud to the computer box (the one with an accordion segment in it). It just snaps into place at both ends. Remove the top radiator hose from the radiator and the thermostat housing (Flat-head screwdriver). Remove the top of the thermostat housing (T40 - and a 10mm bolt on mine). Also remove the thermostat and gasket.

Replace the thermostat and gasket (FCP Groton Part [#271664](#) for both). Replace the thermostat housing. Replace the top radiator hose (FCP Groton Part [#1335433](#)) at the radiator and the thermostat housing. Reconnect the plastic tube leading from the radiator shroud to the computer box.



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Remove the six bolts (T30), then remove the cover from the top of the engine.

Replace the cover on top of the engine and re-attach it with the six bolts.

12



Disconnect the top PCV hose from the top of the engine and leave it to the side. Mine came off with just a little rotation and pulling. This will stay where it is for now.

Reconnect the top PCV hose to the top of the engine. Mine went back on with just a little rotation and pushing, with the original clamp still in place.

13



With the bottom channel as the pivot point (red arrow), tilt the fuel injector cover back toward the front of the car and remove from the channel.

Insert the fuel injector cover back into its channel (red arrow), and tilt toward the rear of the car to secure it in place.

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Press the locking wires in, disconnect the wiring from all 5 fuel injectors (yellow in picture), and pull it back out of the way.

Press the locking wires in and reconnect the wiring to all 5 fuel injectors (yellow in picture).

15



Remove the fuel lines from beneath the fuel line bracket (10mm). This is located at the back side of the engine near the firewall and can be found by tracing the fuel lines leading from the fuel rail. I saw some instructions about removing a second fuel line bracket somewhere on top of the engine near the top of the timing belt cover, but mine only had the one in back. I kept up with the bracket and bolt by reinstalling them after removing the fuel lines from underneath.

Reinstall the fuel lines under the fuel line bracket.

16



Disconnect the fuel line from the fuel rail (17mm). There are remnants of some type of sealer "skin" at the bottom threads of this connection that I missed removing before taking this picture.

Reconnect the fuel line to the fuel rail.

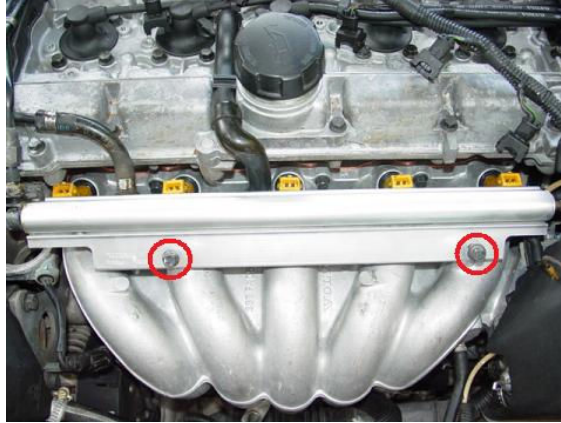
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Remove the two bolts (circled in red) that secure the fuel rail onto the intake manifold (10mm). Using even pressure all along all 5 injectors, remove the fuel rail and injectors from the intake manifold. When I removed mine, all five injectors remained in the rail and came out of the holes they were in on the intake manifold. The injectors are held in the rail and the manifold by snug O-rings, with no fasteners to remove.

Using even pressure all along all 5 injectors, reinstall the fuel rail and injectors to the intake manifold. Make sure that each injector nestles into the corresponding hole for it on the intake manifold, push in until it seats, and take care not to damage the ends of the injectors. Reinstall the two bolts (circled in red) that secure the fuel rail onto the intake manifold and torque them to 88 in/lb.

18



Disconnect the vacuum line from the fuel pressure regulator (red arrow). Then remove the regulator from the fuel rail (T25 - red circles). The fuel rail should now be completely free. Secure the fuel lines out of the way.

Reattach the fuel pressure regulator to the fuel rail and reconnect the vacuum line to the fuel pressure regulator (red arrow). Make sure and reattach these in such a way that they will be positioned right when you twist the rail back over for installation into the intake manifold.

19



Carefully remove all 5 injectors from the rail, taking care not to damage them.

Remove old fuel injector O-rings/spacers (taking care not to damage the injectors) and install both new O-rings (top and bottom - same size - 2 come in set, FCP Groton Part [#30731375](#) need 5) and the spacer (bottom - larger than O-rings, FCP Groton Part [#6842408](#) need 5). I also bought 5 of what was called an "upper spacer" (FCPGroton part #3528216) but could not find any place it would fit or any old part for it to replace, so it is in my "parts I might need later" collection. Insert fuel injectors into the fuel rail with a twist and a push until they bottom out in the fuel rail. You want the electrical connections facing the same side of the fuel rail as the fuel inlet nipple is. I applied a very light film of moly grease to the O-rings to aid in putting them on the injector and to lubricate them for insertion into the fuel rail and the intake manifold. I also applied a very light film to the ports of the fuel rail before inserting the injectors.

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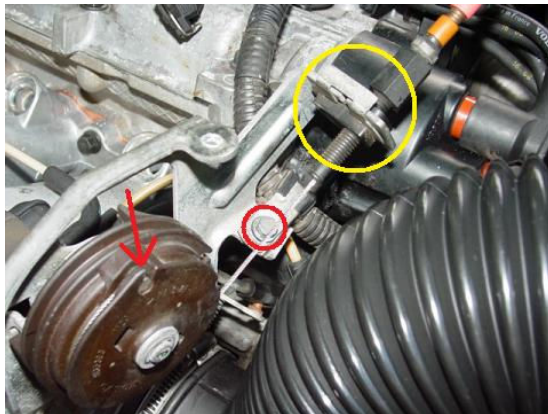
20



Remove the throttle cover (T25).

Replace the throttle cover.

21



Remove the clip (yellow circle) and cable from the throttle control bracket, thread the throttle cable out from around the pulley, slide the peg on the end of the cable (red arrow) out of the pulley and secure the throttle cable out of the way. Remove the injector wiring holder (red circle) from the throttle control bracket (10mm).

Slide the peg on the end of the cable (red arrow) into the pulley, thread the cable around the throttle control pulley in the outer groove, and replace the throttle cable into the throttle control bracket and secure with the clip (yellow circle). Reattach the injector wiring holder (red circle) on the throttle control bracket.

22



Press the locking wire in and disconnect the wiring to the mass air flow sensor.

Press the locking wire in and reconnect the wiring to the mass air flow sensor.

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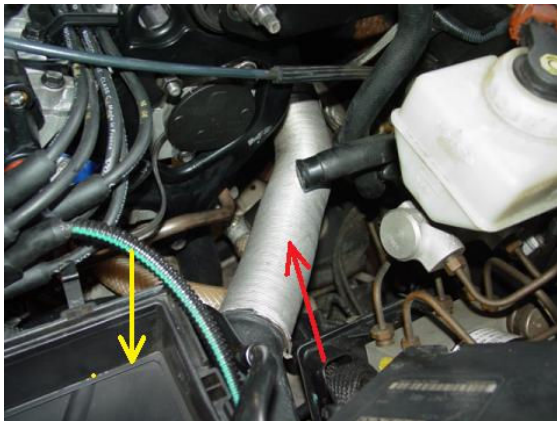
23



Remove the air intake hose from the air filter housing (red circle), remove the air filter cover (unsnap at yellow circles all around housing), remove the air filter, and remove the fresh air intake duct (blue arrow).

Replace the fresh air intake duct (blue arrow), the air filter (FCP Groton Part [#C35148](#)), the air filter cover (snap at yellow circles all around housing), and the air intake hose to the air filter housing (red circle).

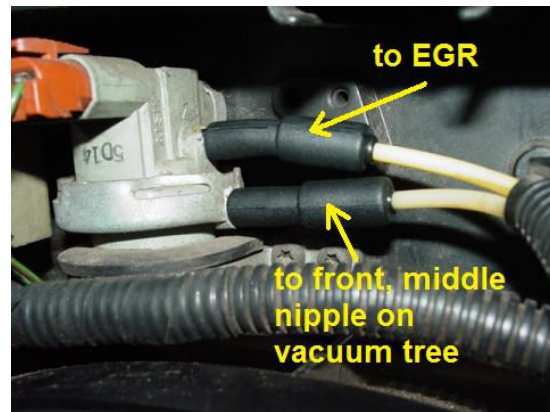
24



Remove the preheater hose from the air filter housing and the exhaust manifold (red arrow). Remove the air filter housing (yellow arrow - lifts out once everything has been disconnected from it).

Replace the air filter housing (yellow arrow) and the preheater hose (red arrow).

25



Disconnect the vacuum lines coming from the vacuum tree in front above the radiator fan. The top nipple connects to the nipple on the EGR valve. The bottom nipple connects to the front middle nipple of the vacuum tree on the intake (both in next picture). I know, the vacuum connectors are on backwards; here's why. The original vacuum connectors were degraded pretty bad, so I bought new connectors. I accidentally bought ones that had too large of an opening on the big end to fit the vacuum tree nipples. So I wrapped electrical tape around the vacuum lines until they were fat enough to tightly fit into the big end and then connected the smaller end to the vacuum tree nipples where they fit snugly.

Reconnect the vacuum lines to the vacuum tree in front above the radiator fan. The top nipple connects to the nipple on the EGR valve. The bottom nipple connects to the front middle nipple of the vacuum tree on the intake.

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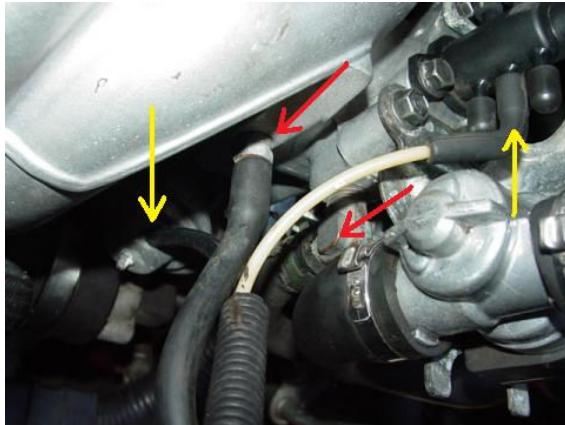
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Now it's time to start disconnecting a bunch of stuff (hoses, wires, etc) in order to remove the fan and then the intake manifold. If there is **any** doubt as to whether or not I am going to remember where something was disconnected from, I put a piece of masking tape on it and label it somehow ("A" goes to "A", "top front nipple," etc) to let me know where it goes during reassembly. I hope the pictures here will help to remove confusion, but you may still want to label something here and there if at all in doubt.

26



Here you see where the vacuum lines from the previous picture lead to (yellow arrows). Disconnect them (mine were bundled together inside a sleeve). Also remove the two vacuum hoses marked with red arrows. The one with a clamp on it is the brake servo vacuum hose (the hose running from underneath air filter housing area). The other one with a red arrow runs toward the fan and must also be detached from where it is secured in clips along the fan housing. After disconnecting both of these, secure them out of the way.

Reconnect the vacuum lines. The ones with yellow arrows are bundled together and will connect to the vacuum tree above the radiator fan. The one with a red arrow and a clamp on it is the brake servo vacuum hose (the hose running from underneath air filter housing area). The other one with a red arrow runs toward the fan and must also be secured in the clips for it along the fan housing.

27



Disconnect the cooling fan wire that is on the fan housing.

Reconnect the cooling fan wire that is on the fan housing.

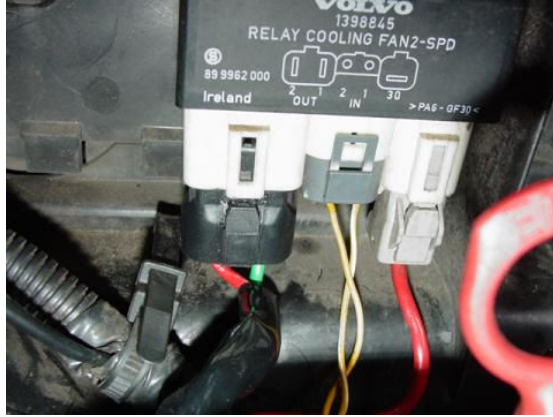
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Disconnect the cooling fan wires at the relay (connector with red/green wires).

Reconnect the cooling fan wires at the relay (connector with red/green wires).

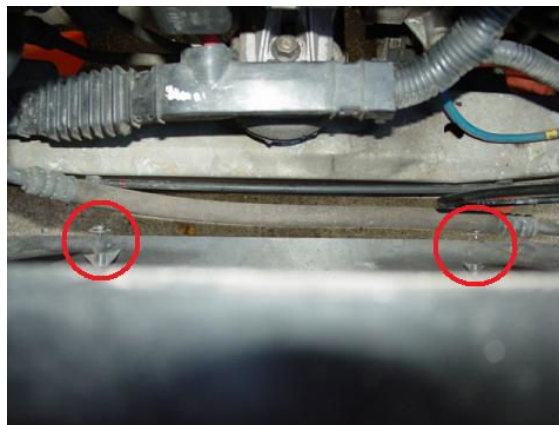
29



Remove the two top screws that secure the fan housing to the shroud (T25).

Replace the two top screws that secure the fan housing to the shroud.

30



The two bottom screws fit into "slots" on the fan housing, rather than holes. So you can just pull upward on the fan and it should slide off of the two bottom screws (they may need to be backed out a quarter-turn if pulling it out seems too difficult). Remove the fan carefully (it required a little manipulation to get it out).

The two bottom screws fit into "slots" on the fan housing, rather than holes. So you should be able to thread the fan into where it goes, then slide the slots of the fan housing behind the two bottom screws.

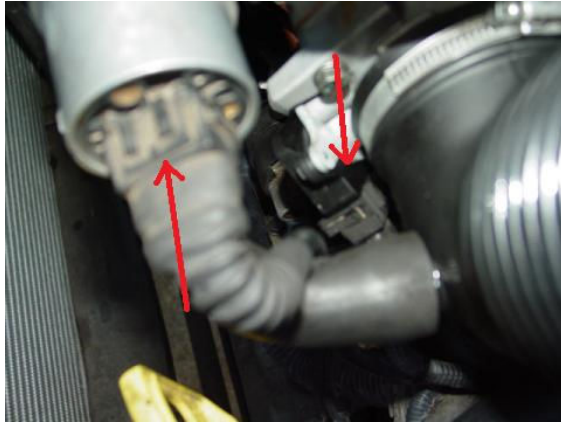
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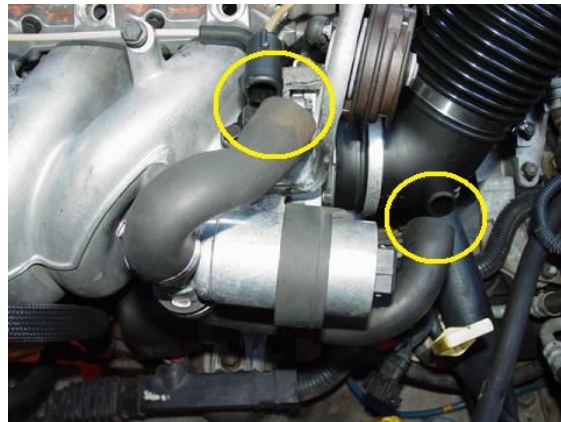
31



Press the locking wires in and disconnect the wiring to the throttle position sensor (TPS - down bottom) and the idle air control (IAC) valve. This picture is taken from the position where the transmission dipstick is the yellow thing in the bottom of the pic and the air intake duct is on the right side of the picture.

Press the locking wires in and reconnect the wiring to the throttle position sensor (TPS - down bottom) and the idle air control (IAC) valve.

32



Disconnect the IAC valve hoses, one from the large front port of the vacuum tree and one from the front port of the elbow on the air intake hose. The black bracket that surrounds the IAC valve fits into a notch and can be slid back and forth on the IAC valve.

Reconnect the IAC valve hoses, one to the large front port of the vacuum tree and one to the front port of the elbow on the air intake hose. The black bracket that surrounds the IAC valve fits into a notch and can be slid back and forth on the IAC valve.

33



Disconnect the flame trap vacuum line from the bottom, back nipple of the vacuum tree (yellow arrow). The top, back nipple is the one that was connected to the fuel pressure regulator on the fuel rail (red arrow) and should be disconnected also.

Reconnect the flame trap vacuum line to the bottom, back nipple of the vacuum tree (yellow arrow). The top, back nipple is the one that was connected to the fuel pressure regulator on the fuel rail (red arrow) and should be reconnected also.

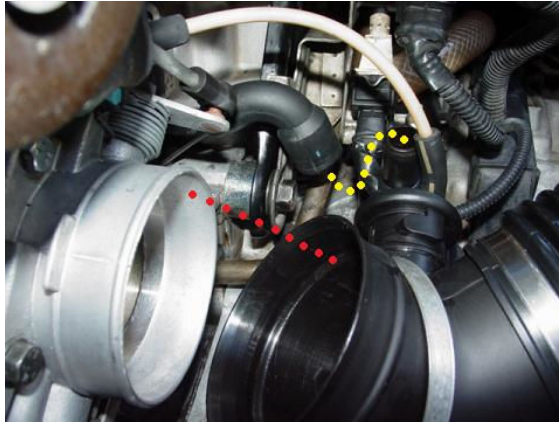
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Disconnect the air intake hose from the throttle body (red dotted path, Flat-head screwdriver) - and remove the hose running from the PCV oil trap from the large port on the flame trap (yellow dotted path).

REASSEMBLY - Reconnect the air intake hose (FCP Groton Part [#9141228A](#)) to the throttle body and reconnect the hose running from the PCV oil trap onto the large port on the flame trap.

35



Remove the flame trap from the elbow of the air intake hose (twist-locks off, note tabs and grooves).

Replace the flame trap (FCP Groton Part [#1389657](#)) onto the elbow of the air intake hose (twist-locks on, note tabs and grooves).

36



Remove the vacuum tree from the intake after removing the bolt securing it (10mm). It is a snug fit and may need to be wiggled slightly to remove it.

Replace the vacuum tree on the intake and replace the bolt securing it. It is a snug fit and may need to be wiggled slightly to install it.

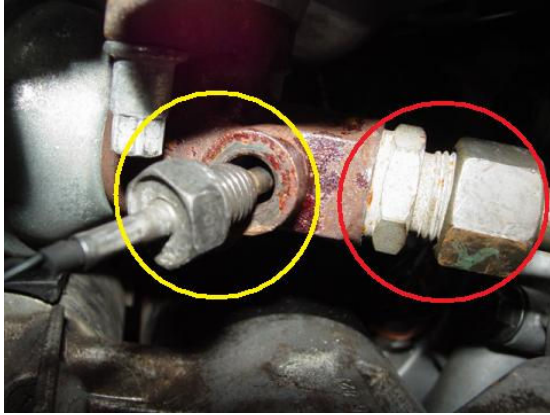
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Underneath the throttle body, remove the EGR temperature sensor (yellow circle) that connects to the side of the EGR valve (the wires will have to twist counter-clockwise 6 or 7 turns as you remove it)(14mm). Disconnect the hard line (red circle) that runs from back the of the EGR valve to the exhaust manifold (Crescent wrench on both ends, as it was bigger than 20mm - the largest combination wrench I have).

Underneath the throttle body, reconnect the hard line (red circle) that runs from back of the EGR valve to the exhaust manifold. Reattach the EGR temperature sensor (yellow circle) that connects to the side of the EGR valve (twist the wires counter-clockwise 6 or 7 turns to account for the turns in the wires once tightened).

38



Also disconnect the hard line at the exhaust manifold on the rear of the engine (Crescent wrench on both ends, as it was bigger than 20mm - the largest combination wrench I have).

Reconnect the hard line at the exhaust manifold on the rear of the engine.

39



Remove the bolt (12mm) securing the oil dipstick bracket from underneath, pull the dipstick assembly firmly out. The other end is secured in the oil pan with a wide, thick O-ring (FCP Groton Part [#30637865](#)).

Replace the oil dipstick, inserting the lower end into the oil pan and pushing firmly to seat it, then replace the bolt securing the oil dipstick bracket from underneath.

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Behind the leg where the oil dipstick bracket was bolted onto the intake manifold, there is another leg where the intake manifold is secured to its bracket from underneath. Remove this bolt (12mm).

Replace the bolt that secures the intake manifold to its bracket from underneath.

41



There are 7 bolts securing the intake manifold to the head, 3 on top and 4 on bottom. The 3 on top can be removed (red circles), while the 4 on the bottom (yellow circles and dots) only need to be loosened a turn or so (10mm), since the manifold has slots (rather than holes) down bottom.

Replace the 3 top manifold bolts (red) and tighten all 7 of them to 14 ft/lb in an alternating pattern.

42



Remove the intake manifold, rocking it gently to break the seal of the old gasket, and allow the top PCV hose to feed out as you remove the manifold.

After cleaning all the remnants of old gasket off and cleaning the mating surfaces well, and threading the top PCV hose through between manifold channels, position the new intake manifold gasket (FCP Groton Part [#9146266](#)) on the head and secure it with the 4 bottom manifold bolts. These 4 bolts should be pre-installed and tightened until there is just enough of them protruding to ensure the bottom slots on the manifold will slide onto them easily. Carefully replace the intake manifold, keeping the gasket (undamaged) between the manifold and the head, and sliding the manifold (bottom slots) onto the 4 bottom bolts.

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Remove the ground leads from the top section of the cylinder head at rear near firewall (10mm). Mine had 2 of these.

Replace the ground leads on the top section of the cylinder head at rear near firewall.

44



Remove the exhaust heat shield from the exhaust manifold on the firewall side of the cylinder head (12 or 13mm). There are five bolts total (yellow dot indicating one not shown in picture), 2 on the lower side and 3 on the upper side nearest the engine. This requires a little manipulation to remove it (removes from top side).

Replace the exhaust heat shield on the exhaust manifold on the firewall side of the cylinder head and torque to 11 ft/lb. There are five bolts total (yellow dot indicating one not shown in picture), 2 on the lower side and 3 on the upper side nearest the engine.

45



Remove the exhaust manifold nuts (12 or 13mm); the threaded studs should stay in the head. There are ten of these, two for each exhaust port, located diagonally at opposite corners of each exhaust port. Mine came off easily, but many times exhaust components can be heavily corroded. If they look corroded at all, spray them down with a good penetrant like PB Blaster - let sit - and repeat (sometimes for a few days) before attempting to remove them.

Flex the exhaust manifold back as much as possible, tilt it, and position it onto the threaded studs on the head (that should already have the gaskets on them). Torque the nuts to 18 ft/lb.

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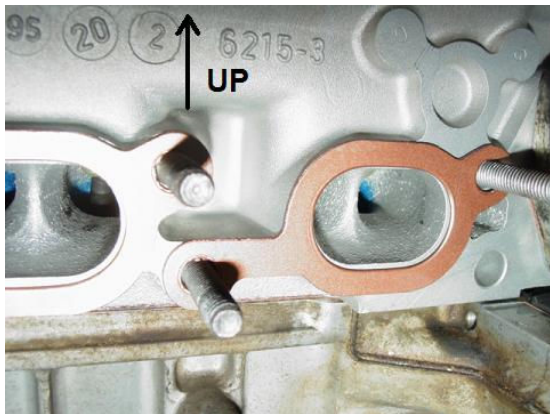
46



Remove the 4 nuts (13mm) where the exhaust manifold meets the exhaust pipe at the flange (best done from underneath the car). Mine came off easily, but many times exhaust components can be heavily corroded. If they look corroded at all, spray them down with a good penetrant like PB Blaster - let sit - and repeat (sometimes for a few days) before attempting to remove them. Remove the exhaust manifold from the engine well. This requires a little manipulation to remove it (removes from the top side).

Apply the new flange joint gasket (FCP Groton Part [#9135122](#)) to the exhaust manifold at the flange end, using the four threaded studs to hold it in place. Install it back onto the front exhaust pipe and torque the nuts to 18 ft/lb (best done from underneath the car). Torqueing these can be more easily done after performing the next step (while it is held still).

47



Note the positioning of the exhaust manifold gaskets, then remove them from the threaded studs and discard them.

Put all five of the exhaust manifold gaskets (FCP Groton Part [#1366786](#) need 5) on the threaded studs. They will only fit on one way (and still line up with the port holes). The other side of the gaskets is black and kind of rubbery.

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Remove the wiring bracket (10mm at yellow circle) that is connected to the transmission dipstick tube (to gain access to the bottom bolt for starter removal). Then remove the two starter bolts (14mm at red circles) that secure the starter to the bell housing.

Replace the two starter bolts that secure the starter to the bell housing and torque to *25 ft/lb. Then replace the wiring bracket that is connected to the transmission dipstick tube.

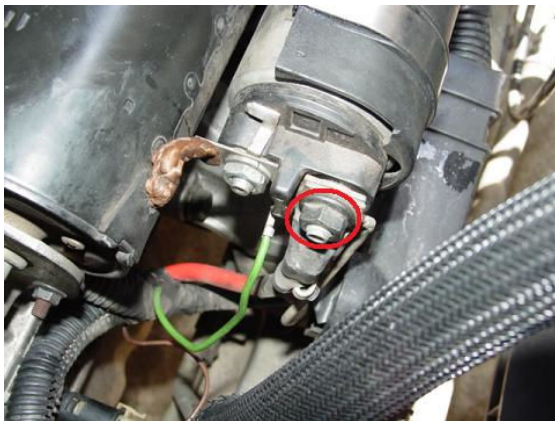
49



Remove the starter bolt where the bracket is secured to the side of the engine (12mm).

Replace the starter bolt where the bracket is secured to the side of the engine and torque to *25 ft/lb.

50



Disconnect the starter wiring. This consists of one green wire that connects via a spaded connection and one (13mm) nut that secures two red wires and one light gray (whitish) wire.

Reconnect the starter wires as described above.

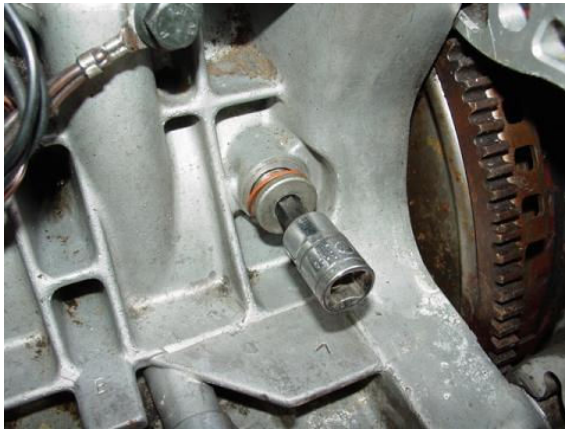
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Remove the starter from the bell housing (pulling it straight backwards just a little) and lift it out of the engine well. Remove the plug (8mm Allen) from the access hole behind the starter. This is in the center of the picture and has a socket in it. Also note that you can now see the teeth of the flywheel in the right side of the picture. Having access to this hole and the flywheel is **THE KEY** to holding the crankshaft still while keeping everything in time. This access hole very much impressed me in terms of the engineering behind it (you'll see why later).

Replace the plug in the access hole behind the starter (making sure it is snug enough as oil can leak from this if it's not) and replace the starter in the bell housing.

52



This line runs along the fender next to the timing belt. It felt and looked like it was basically styrofoam. I found that by twisting it I could unlock the front end going into the computer box, then twisting it again I got it free of the sleeve it attached to near the firewall. While this is optional, I found that it gave me a little extra room.

If you decided to remove this styrofoam line, twist it back onto the sleeve near the firewall and then twist and attach the front end to the computer box.

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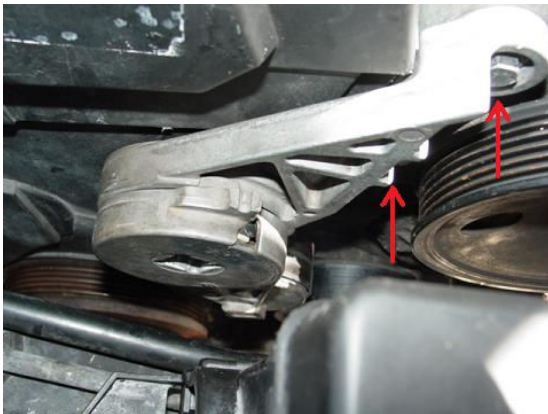
53



Release the tension on the serpentine belt and remove it (which is easier said than done). The tensioner on my 850 has a hole in the pulley arm that is 3/4" square. But the problem is I didn't have a 3/4" drive ratchet or breaker bar adapter, my serpentine belt tool set did not have a 3/4" adapter, and the 3/4" drive ratchet I DID go and get was too big to fit into the very limited clearance between the fender and the tensioner. I bought the shortest length I could of 3/4" by 3/4" steel tubing from the metal stock (welding) section in our local hardware store. I cut the length that I determined would work, which was 1.5" long, and tapered all four edges down just a bit with a grinder, since the hole in the tensioner actually reduces in size a little as it gets deeper. I finally got it just right and could get it to fit about 1/2" deep into the tensioner. Then I just positioned it in the tensioner, adjusted a large crescent wrench to fit snugly on the tubing/tool, and rotated the handle toward the front of the car - releasing the tension so I could get the serpentine belt off. Whew! I actually distorted the steel tubing a little, so I think I am going to get a piece of solid steel stock and make the same tool next time.

My belt (FCP Groton Part [#9186352](#)) was too long to route the traditional way shown in the Haynes manual. The belt routing I had to use was for the longer belt and it was very tight. The belt routing was as follows: Crank - AC compressor - Alternator - Idler - PS pump - Tensioner. The shorter belt routing is the same, except you have to switch the order of the Alternator and Idler in the routing. I noticed that there is a protrusion on the pulley arm that has a hole in it. This lines up (when the tensioner is "compressed") with a hole in the base of the tensioner so you can sort of lock it open while you route the belt around it. My tensioner did not have this (it was broken off), so I just had to route everything and hold it in place while making slack with the tensioner. I was at the END of the slack of the tensioner and still had to fight to get the belt around everything. I ended up getting it around everything but the PS pump, stretching the tensioner open, and then stretching to get the belt to barely start on the pulley for the PS pump (which I then rotated the pulley off to "thread" the belt the rest of the way on). A wooden yardstick is helpful in getting the belt to feed around stuff down low where it is hard to reach (I used my serpentine belt tool).

54



Remove both of the bolts (12mm) and remove the belt tensioner.

Reinstall the belt tensioner and torque to 15 ft/lb.

Step

Picture

Disassembly

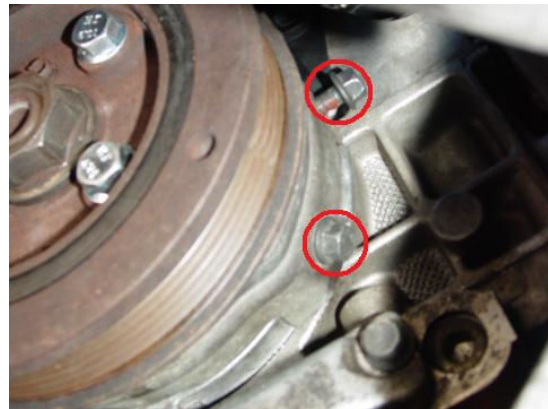
Reassembly

55



Remove the one bolt (12mm - indicated by the red arrow) and remove the upper timing belt cover. It requires a little manipulation, but it will come off.

56



Remove the two bolts (10mm - red circles) that hold the bottom timing belt cover on (right behind crank pulley) and remove the cover. This is a snug fit to do with the crankshaft pulley on, but if the upper portion is pulled out first (and you "hold your mouth right") it will come out with patience and just a small amount of manipulation.

57



Using a 30mm axle nut socket, 1/2" extension (s), and a 1/2" drive breaker bar, rotate the crank in a clockwise direction until the timing marks all line up (depicted in the next few pictures). This is assuming your car was running fine and was in time when you began this job.

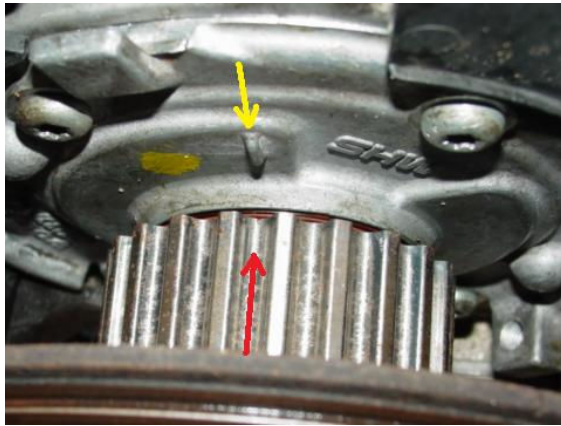
Step

Picture

Disassembly

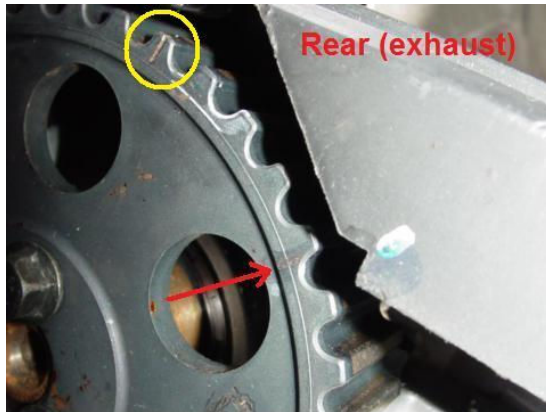
Reassembly

58



Note where the protrusion on the oil pump housing is (yellow arrow). While rotating the crank in a clockwise direction, watch for a very small notch on the crank pulley (red arrow). This notch is between teeth and is so small that you could fill it up with the end of a sewing needle. If you look closely, you can barely see it in this picture (where there is a little bit of the orange seal showing through the depression at the edge of the pulley). You want this lined up precisely with the protrusion on the oil pump housing. In the correct position, you can insert a 3/8" extension (at least 2" long) into the hole that was behind the starter (3 or 4 pictures below) and it will lock the crank from being turned backwards (counter-clockwise).

59



Rear (exhaust)

Once the crank marks are lined up, check to see if the cam marks are lined up. If they are, you are ready for the next step. If not, rotate the crank 1 more revolution and recheck. The cam marks are **VERY** faint. The red arrows point to the faint scratches on the edges of the cam pulleys, which should line up with the "points" of the notches in the top timing belt cover. These are very, very hard to see. I ended up making me some new marks (with an engraving pen) on the top side of the timing belt cover and on the side of the corresponding tooth on the cam pulleys (one of them in yellow circle). **When they are correct and in time, you should have the following patterns of bolt heads on the cam pulleys - on the front pulley (intake) there will be 2 bolts at the top and 1 at the bottom, and at the rear pulley (exhaust) there will be 1 bolt at the top and 2 at the bottom.**

60



Front (intake)

Step

Picture

Disassembly

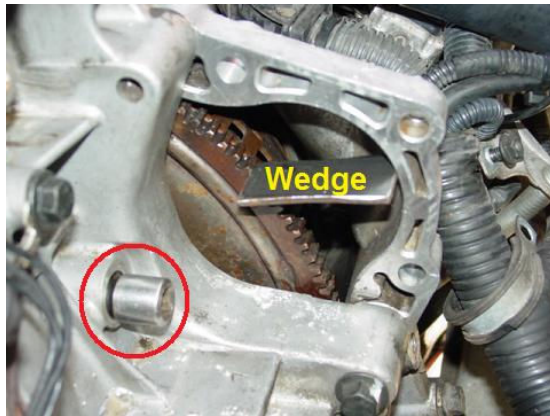
Reassembly

61



If all of the marks match up and you are in time, remove the timing belt tensioner top bolt (12mm - red circle), the bottom bolt (10mm - yellow circle), the white plastic bushing on the top of it, and the top timing belt cover (10mm - blue circle and socket). **Take care not to rotate the cams or the crank now that the tension is released from the timing belt, as they are only supposed to rotate together (in time).**

62



The crankshaft must be locked before breaking the crank nut loose (pretty tight). Remember that hole behind the starter? Now is the time to use it. There are tools (that sell for around \$500/set) made specifically for doing a head gasket job. I'm going to show you things that work just as well in place of each of those tools, and that won't cost you more than a few dollars! The first is a tool that goes into this hole. In place of this tool, just insert a 3/8" extension (at least 2" long and male end in - red circle). The crank is now locked and will not turn more than a flywheel tooth or so (counter-clockwise) when removing the crank nut. It only locks it from turning counter-clockwise though, so this picture also shows a lock (wedge) I made from a flat piece of steel stock (1/8" x 1.25" x about 2.25") to use when it came time to tighten the crank nut back on. When properly placed, it locked between two flywheel teeth and the bell housing, preventing the crankshaft from rotating clockwise. Use whichever of these you need for the direction in which you need to turn the crank. You can substitute a prybar held in place on the flywheel for either of these, but you run the risk of it slipping off and you have to have a second set of hands. **Only use the "wedge" when you need it and have it wedged firmly in place though, as it could fall down into the bell housing (and need retrieving) if you rotated backwards.**

Step

Picture

Disassembly

Reassembly

63



Remove the four bolts that mount the harmonic balancer to the crank pulley (10mm - already removed in this picture). Then, using a 30mm axle nut socket (6 point socket with 1/2" drive), 1/2" extensions, and a 1/2" drive breaker bar, break the axle nut loose (center nut - 30mm). The four bolts I had here were so tight that I marred the heads of them, so I replaced them with new ones.

64



Attach a harmonic balancer puller to the harmonic balancer as shown. My kit did not have the right size bolts in the right length, so I had to go buy a couple. Using this kit, you secure the yoke (the part that looks like a "peace symbol") to the balancer with the two bolts, insert the big bolt into the center of the yoke and tighten it, which pulls the balancer off. It is normal to have to adjust this a time or two during the process (loosen the center bolt, tighten down the two other bolts and start back). The clearance is minimal here, and I barely had room enough.

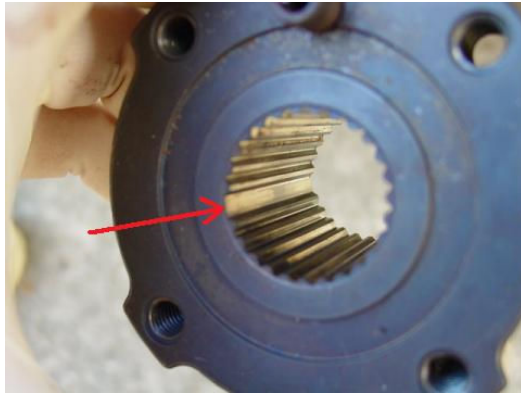
Step

Picture

Disassembly

Reassembly

65



Once the harmonic balancer is removed, remove the timing belt completely. You should now be able to just wiggle the crank pulley a little as you slide it off. Note the larger-than-the-rest groove on the inner splines and the corresponding portion of the splines on the crankshaft in the other picture. Now that you have it off, you can more plainly see the notch that was earlier used to line up the crank with the protrusion on the oil pump housing (when getting it "in time"). There is also an easy-to-see protrusion on the outer face of the crank pulley that is exactly lined up with the very small notch, but you could not see it earlier with the harmonic balancer on.

66



The cam pulleys can now be removed. While I have heard of folks using other means to keep the camshafts from spinning while taking off the bolts that secure them, I have found that a sprocket holding tool (that is made for this) works very well. I got mine on eBay years ago and it looks like this one.

Step

Picture

Disassembly

Reassembly

67



Using the sprocket holding tool to hold the cam pulleys still (as shown), break loose the bolts (10mm). Make sure and mark which is the intake (front) and the exhaust (rear). In this picture (at about the 3 o'clock position), you can see a faint "R" (for "rear") that I engraved on my pulley. The bolts and cam pulleys can now be removed.

68



Disconnect the coil wire from the coil (left fenderwell) by grasping the entire upper portion of the boot and pulling firmly.

Reconnect the coil wire to the coil, pushing firmly down until it seats.

69



Remove the spark plug wire leads from the plugs by grasping the entire upper portion of the boots and pulling firmly. Pull them out of the way, but keep these bundled together and leave them connected to the distributor cap for now.

Replace the spark plug wire leads to the spark plugs, pushing firmly down until they seat on the plugs.

Step

Picture

Disassembly

Reassembly

70



Remove the three screws and remove the distributor cap (leaving the wires still attached).

Replace the distributor cap (FCP Groton Part [#3501944](#)), making sure it is in the correct position (that it was when removed). Also be sure to wiggle/manipulate it right in order to center the dust cap underneath into the proper position (as the distributor cap is all that holds it in place) and allow the distributor cap to engage the housing at all three anchor points.

71



If you want to install a new distributor cap, the first thing you should do is label the plug wires in some way before removing them. I numbered mine with dots of white-out before removing them. If your cap is like mine, you will have a black sleeve covering your cap that has numbering on it reflecting the cylinder numbers (a "3" can be seen near the "Bosch" on the top side of the cap in the picture above this one). It has all five numbers on it for all five cylinders (1 being the cylinder farthest from the cap and 5 the cylinder closest.) After making sure the wires are labeled for reassembly, disconnect them by grasping and pulling firmly.

Inspect your plug wires for any damage, cracks, or burnt spots. Resistance (if you want to check it) "should be between 1.5 and 4.5 ohms, depending on the length of the lead" (taken from the factory manual). Replace the plug wires on the cap in the positions they were originally in (using the info above if needed).

Step

Picture

Disassembly

Reassembly

72



Remove the distributor dust cover. It should almost fall off, as it is held in position by the distributor cap that was just removed.

Replace the distributor dust cover and hold it in place until the distributor cap is replaced over it.

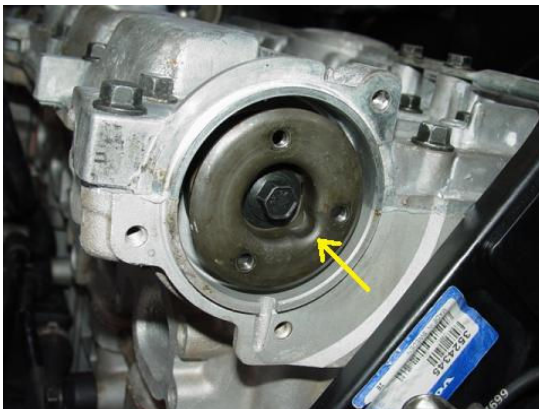
73



Remove the distributor arm (rotor) by removing the three small bolts (3mm Allen) that secure it to the companion flange.

Replace the distributor arm (FCP Groton Part [#1367783](#)) on the companion flange.

74



Remove the companion flange (10mm), noting how the depression around the bolt hole (yellow arrow) is positioned around 4 o'clock, and how the protrusions on the back of the flange line up in the slot on the camshaft.

Replace the companion flange in the position described above.

Step

Picture

Disassembly

Reassembly

75



Remove the two bolts (T40) that secure the cam position sensor and remove the sensor. It is a very snug fit and will require even pressure to remove (or replace) it. Be careful not to damage it.

Replace the cam position sensor.

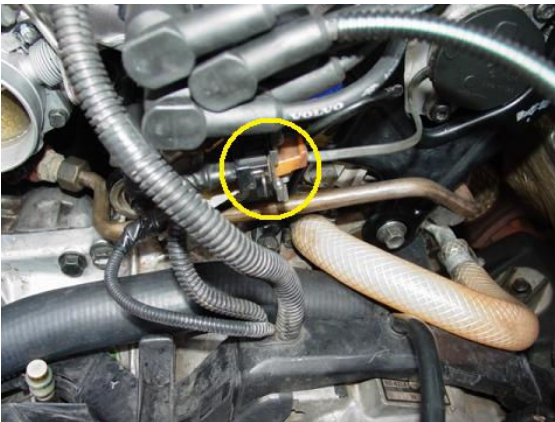
76



Remove the cam position sensor wiring anchor from the engine bracket by squeezing the tabs together and pulling it out of the hole its anchored in.

Replace the cam position sensor wiring anchor to the engine bracket.

77



Press the locking wire in and disconnect the cam position sensor wiring. Put the sensor somewhere it will not get damaged.

Press the locking wire in and reconnect the cam position sensor wiring.

Step

Picture

Disassembly

Reassembly

78



Remove the bolt (10mm) that secures the aperture in the cam position sensor housing, noting how the cutaway portion of the wall of the aperture runs from 8 o'clock to 2 o'clock, and how the protrusions on the back of the flange line up in the slot on the camshaft.

Replace the aperture in the position described above.

79



Remove the upper engine steady bar from the engine bracket (15mm nut in red circle - 13mm bolt on other end), swing the bracket out of the way, and secure it (I used cable ties).

Reattach the upper engine steady bar to the engine bracket and torque to 26 ft/lb.

80



Remove the supporting rod from the engine bracket (13mm) and the head (10mm).

Reattach the supporting rod to the engine bracket (torque to 18 ft/lb) and the head (torque to 88 in/lb).

Step

Picture

Disassembly

Reassembly

81



Remove the engine bracket lower bolts (red circles - 14mm). Disconnect the crank position sensor wiring connector (yellow circle) and the cam position sensor wiring (above the yellow circle) and remove the wiring from the wiring bracket so it can be removed with the engine bracket.

Replace the engine bracket lower bolts and the wiring bracket and torque to 33 ft/lb. Reconnect the crank position sensor wiring connector (yellow circle) and cam position sensor wiring (above the yellow circle).



82



Disconnect the water pipe from the rear of the head (near the water pump - 10mm).

This was (or should have) been done after replacing the head (when it was easier to get to).

Step

Picture

Disassembly

Reassembly

83



Disconnect the wiring connector for the engine coolant temperature sensor (this is underneath the power steering fluid reservoir), so that the thermostat housing can be removed with the head (the easiest way).

After reinstalling the head (with the thermostat housing attached), reconnect the wiring connector for the engine coolant temperature sensor.

84



Remove the spark plugs (5/8" deep well spark plug socket). The engine should be cold when you do this and you should remove them with gentle pressure, not a quick snap.

Gap the spark plugs to 0.028" (with a wire gauge, not a "ramp" gauge). Mine were not pre-gapped out of the box (FCP Groton Part [#4228](#)). Apply an adequate coating of anti-seize to the threads of the spark plugs. Replace the spark plugs and torque to 18 ft/lb.



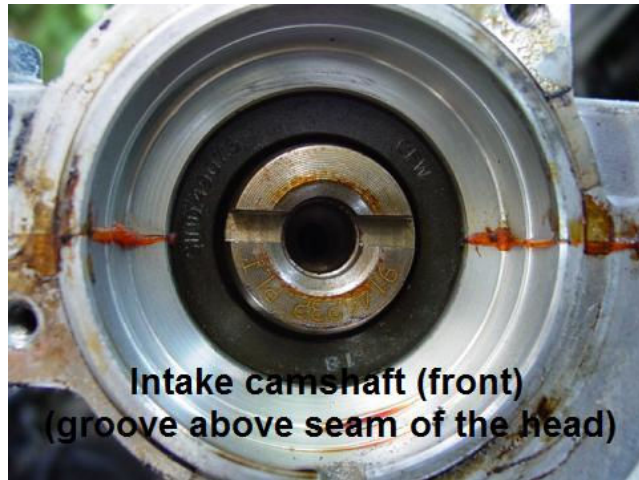
Step

Picture

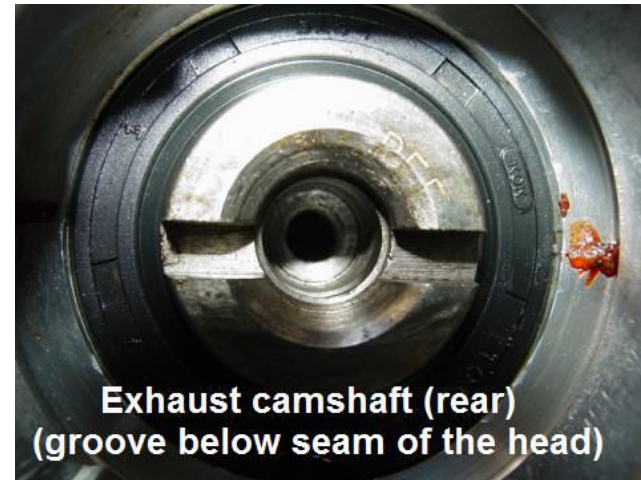
Disassembly

Reassembly

It is now time to remove the top portion of the head. Before doing this, you want to secure the camshafts so that they stay in their correct positions and come off with the top of the head. I have read where one person said that this was not necessary, that you can just take it apart and pay attention to the camshaft positions when you reassemble. I played it safe and secured them though, as I definitely didn't want to have to buy a new camshaft (or two) if they broke loose, hit the concrete, scraped up a lobe or two, and were ruined. But before we remove them, let's note the position the camshafts should be in:

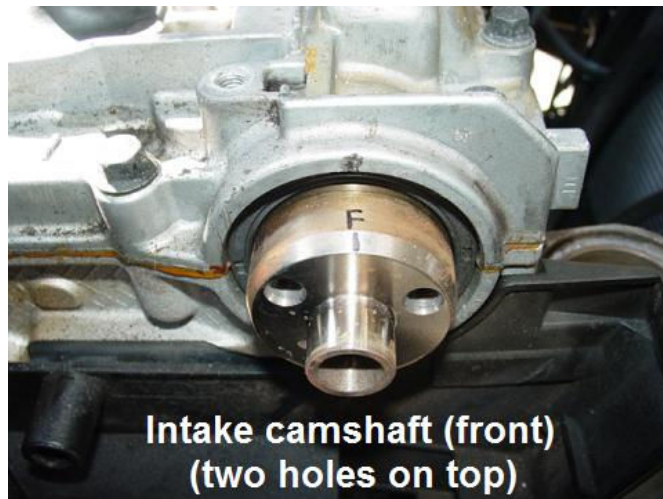


Intake camshaft (front)
(groove above seam of the head)

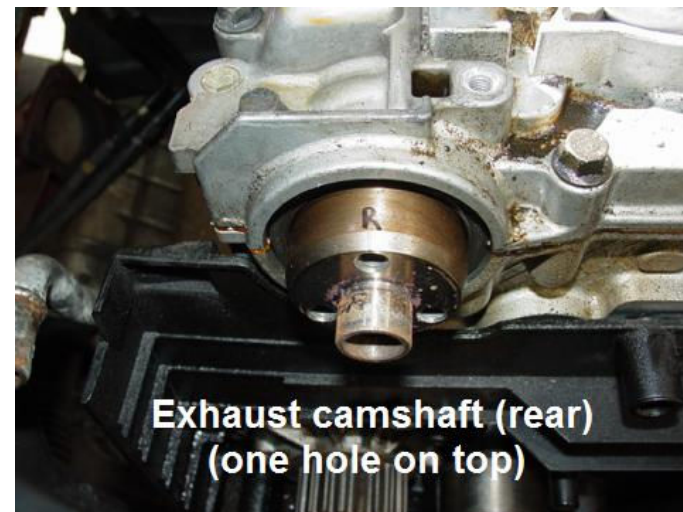


Exhaust camshaft (rear)
(groove below seam of the head)

Note that on the back of the engine (the distributor end), the groove on the intake camshaft is ABOVE the seam of the head, while the groove on the exhaust camshaft is BELOW the seam of the head. This picture was taken before removal with the old sealant showing. If you look closely on the intake camshaft, you can see an "I" as the last letter of the part number stamped there (about 8:30 just below the groove). There is an "E" (at about 2:30 in this picture) in a similar location. Also note that on the front of the engine (the timing belt end), the intake camshaft has two holes on top, while the exhaust camshaft has one hole on top.



Intake camshaft (front)
(two holes on top)



Exhaust camshaft (rear)
(one hole on top)

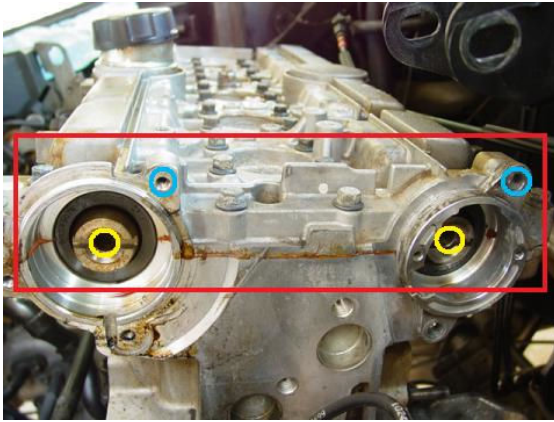
Step

Picture

Disassembly

Reassembly

85



To make a tool for securing the grooved ends of the camshafts, I decided to use just a simple piece of wood (1" x 4") as a bracket and two pieces of the steel stock (1/8" x 1.25") to fit into the camshaft grooves. I cut a piece of 1x4 to about as long as the width of the head (red outline). I then put the bolts back in the end of each camshaft (yellow circle) and left them protruding to the edge of the head so they would touch the wooden 1x4 in the next step. I then dabbed just enough engine grime on the heads of each of the bolts so that when I held the 1x4 parallel with the head (red outline) and pressed it against the bolt heads, I was left with an impression of the outline of each bolt head on my piece of wood. The blue circles show where the bolts to secure this will go.



I then took a circular saw and made cuts in the 1x4 that were centered on the bolt head marks and parallel with the long edge of the 1x4; the cut for the intake was made just above the center of the bolt head and the cut for the exhaust was made just below the center of the bolt head. I then saw how far into the cuts a piece of steel stock would fit and added to that the depth it would take to reach from the 1x4 all the way into the grooves of the camshafts. These two pieces of steel were wedged into their cuts on the 1x4, using some folded paper around the end of the steel for added thickness so that they were very snug and tight when I drove them into the cuts on the 1x4. These two pictures were taken when the top of the head was already off so that I could better show what I am talking about.



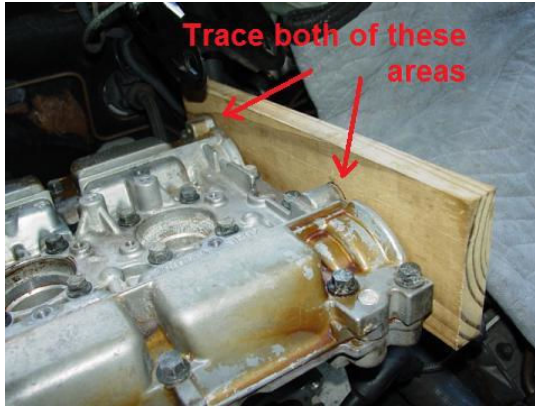
Step

Picture

Disassembly

Reassembly

86



I then held the 1x4 in place, with the steel stock inserted into the camshaft grooves on either side, and traced onto the 1x4 the outline of the cam position sensor housing and the outline of the distributor housing. Then I made another tracing of both of them on paper, punched the bolt holes into the paper with the tip of the pen, applied it to the tracing on the 1x4, and determined exactly where I needed to drill two holes so that the piece of wood could be secured with a distributor housing bolt and a cam position sensor bolt (T40).

87



Next, I the inserted the bolts and secured the 1x4 bracket onto the engine with them and with the steel stock firmly inserted into the camshaft grooves. I did have to drill a hole large enough for the head of the T40 bolt to be countersunk, due to the short length of it.

Step

Picture

Disassembly

Reassembly

88



The timing belt ends of the camshafts are much easier to anchor. Reattach (on the timing belt end) two of the T30 bolts that secured the black cover to the top of the engine. Wrap one end of a wire coat hanger around one of the bolts, pull and tightly wrap it around both ends of the camshafts, then pull it tightly around the other bolt and secure it as shown. **You are now ready to start removal of the head.**

Remove the 40 bolts securing the top cylinder head to the bottom cylinder head (10mm). There are 24 of these along the center of the engine surrounding the cylinders, and 8 along the front and back of the engine. These should be removed starting with the outer edges and working inward in a criss-cross pattern.

89



There are parting lugs (yellow circle) at every location where there is a dowel (red circle). There are 5 of these, 2 in front and 3 in back. I took two regular screwdrivers, laid the blade of one flat on the bottom lug, placed the other screwdriver blade on top of the first and pryed upward against the bottom one. This touches none of the "sealing surfaces." Once the gap between got bigger, I could fit the male end of a 3/8" extension on top of the screwdriver blade and do the same. Using this method, you can break the top cylinder head free from the bottom one without having to hammer anything or mar any of the "sealing surfaces."

90



Once the top cylinder head is completely broken free from the bottom one, carefully lift it off (making sure the camshafts stay secured to the top portion) and sit it upside down somewhere so as not to scratch or damage the camshaft lobes. The anchoring tools on each end can now be removed, the camshafts can be removed (keep them from being damaged), the oil seals can be removed (and discarded), and all of these disassembled components can be cleaned. Take care not to scratch the smooth sealing surfaces, keeping in mind that aluminum can be damaged by anything made of a harder metal (such as razor blades, putty knives, scrapers). I used degreaser, gasket remover spray (very strong stuff), and pieces of old credit cards that I cut to fit whatever location I was scraping off. The plastic would abrade and wear down before any damage to the aluminum head could occur, since the aluminum is harder.

Step

Picture

Disassembly

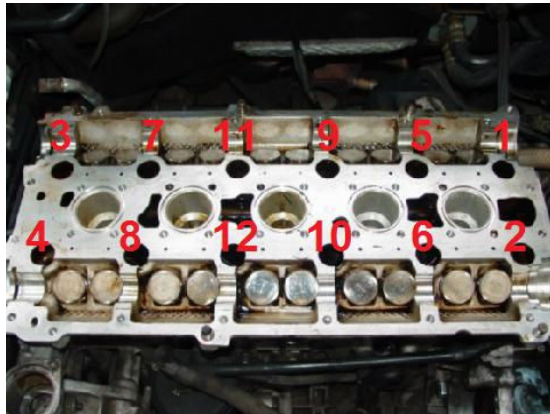
Reassembly

91



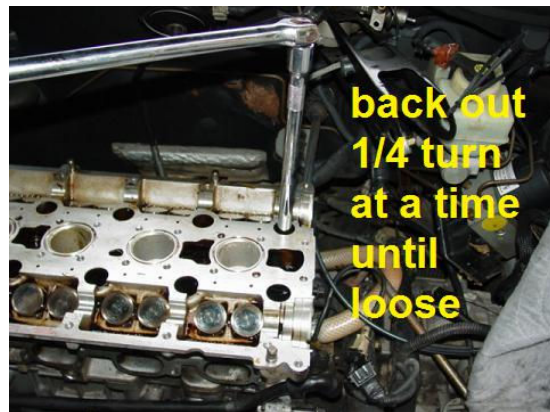
Your remaining lower cylinder head should look something like this. I sopped up all of the motor oil I could with the blue paper (shop) towels that I like to use. I did this in order to try and prevent having a big mess when I removed the head bolts and the lower head portion.

92



This is the sequence that the head bolts are to be removed in, starting with the outer edges and criss-crossing as you work your way inward. Using a 1/2" drive breaker bar, extension, and 6-point 14mm socket, back each bolt out 1/4 turn in the sequence shown and repeat until they are loosened enough to remove by hand. After I had backed each of mine out just 1/2 a turn, they were loose enough that there was no resistance at all on the breaker bar, but keep to that sequence until you're sure they're all loose. Completely remove all of the head bolts. You have to use new head bolts when you install the new head gasket, as these are torque-to-yield bolts (that actually get "stretched" a little), but keep at least one of your best-looking old bolts to chase your threads with later.

93



back out
1/4 turn
at a time
until
loose

Step

Picture

Disassembly

Reassembly

94



Once all of the head bolts are removed, lift the lower portion of the head off of the block. There are no dowels between the lower head and the block like there were between the upper and lower head sections, but there are two of the bolt holes (circled in red) that have short little protrusions for alignment and securing of the head gasket and head. I broke the head loose from the block without any immense effort, gently tugging a little all around, pulling on exhaust side studs and intake port holes all around. The lower head is a little heavy (maybe 50lbs?), so when it does break loose, you may not want to lift it by yourself. Just make sure you don't allow any trauma to occur (drops, etc) that would mar the surface of the block or either surface of the lower head. You should have somewhere padded to place the lower head - or stand it on it's end. After the head is off is the easiest time to remove the lower thermostat housing (T40).



95



The old head gasket has been removed in this picture. Notice how it is a little clean around the edges of the piston on cylinder 5. This indicates there was definitely a head gasket leak that was allowing coolant into the combustion chamber, which then turned into steam which cleaned some of the carbon off.

You can now take your head to a machine shop and have them check it for warp, vacuum test the valves to see if you need a valve job (mine did), put new valve stem seals in, and plane it or resurface it if needed. The lower portion of the head is all they should need (or needed of mine). There was a 2 day turnaround at the shop I took mine to, so that gave me some time to do other things like cleaning the upper head portion, the PCV system, the engine block, the intake manifold, the camshafts, the cam pulleys, prepping the intake components with new gaskets, replacing all the O-rings and seats on the fuel injectors, replacing the water pump, and just about anything else I could think of to clean and pre-

Step

Picture

Disassembly

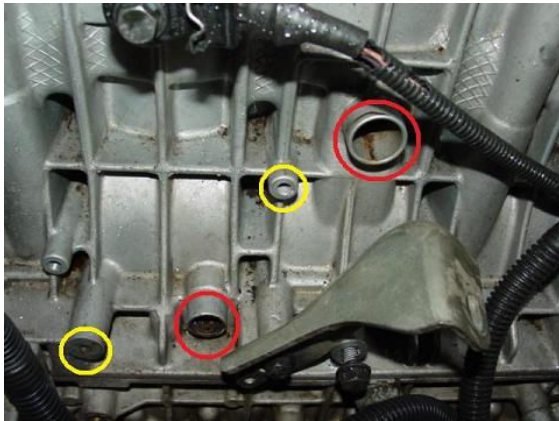
Reassembly

96



I cleaned the upper head using degreaser, gasket remover, and sharp pieces of plastic that I cut from old credit cards. You want to pay close attention that the oil holes for the journals (like the one the red arrow is pointing to) are cleaned out and do not get anything introduced into them (like fragments of the dried sealer you will be removing). Make sure all of the little channels are cleaned out ... everything. Do not do anything to scratch the surface of the head either.

97



Remove the PCV oil trap hoses from the locations circled in red (top one pulls off and bottom one is secured with a clamp with two T25 screws). The two hoses that lead from the top of the oil trap have already been disconnected previously. Remove the 10mm bolts that hold the oil trap onto the block (yellow circles). Remove the oil trap and clean it out thoroughly with degreaser and hot water. I cleaned mine several times over a period of a few days. I felt ok re-using mine since it looked to be in good shape - all the plastic was ok, hoses were supple, and nothing was cracked or broken.

Replace the PCV components and torque the bolts to 14 ft/lb.



Step

Picture

Disassembly

Reassembly

98



If you want to remove them for a thorough cleaning, label where they go and remove the knock sensors (larger red circles - 13mm). Label where they go and remove the grounds (smaller red circles - 12mm).

Replace the knock sensors and grounds and torque to 15 ft/

99



DISASSEMBLY - If you want to remove it for a thorough cleaning, remove the crank position sensor (or RPM sensor). This is right next to the lower radiator hose and disconnects with one bolt (10mm).

REASSEMBLY - Replace the crank position sensor and torque to *12 ft/lb.

Step

Picture

Disassembly

Reassembly

100



Remove the bottom radiator hose from the engine and the radiator. NOTE - Where the two ends of my homemade heater core bypass (white/clear braided hose) connect, you will have your regular heater hoses (black and can be seen in a few pics of that area).

Replace the bottom radiator hose (FCP Groton Part [#6842428](#)) at the engine and the radiator.



Remove the timing belt idler pulley (12mm).

Replace the timing belt idler pulley (FCP Groton Part [#9146376](#)) and torque to 18 ft/lb.

101



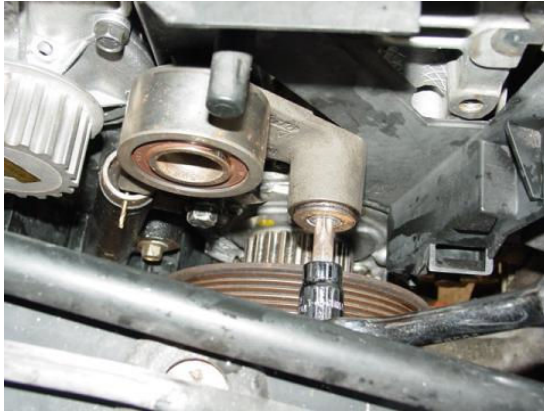
Step

Picture

Disassembly

Reassembly

102



Remove the timing belt tensioner pulley (T45). This is a very restricted space. My low profile ratchet and T45 bit would BARELY fit in there. I found it helpful when removing this to have penetrant sprayed onto the bolt, the T45 and ratchet wedged in, and with a prybar forcing them into the fastener tightly. To fit the T45 and ratchet in there, I actually had to start the T45 into the head of the bolt while it was still at an angle, wedge it in, break the bolt loose, remove the T45 and ratchet, and then remove the bolt with just the T45 and my fingers. (Your timing belt tensioner should already have been removed by this point, but this picture shows

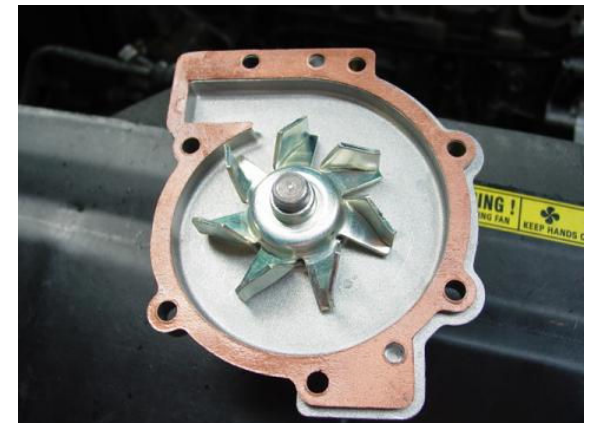
Replace the timing belt tensioner pulley (FCP Groton Part [#9135036](#)) and torque to 22 ft/lb (I guessed at this as my torque wrench would not fit in there).

103



Remove the 7 water pump bolts (red circles, red dots for hidden ones, yellow dots where dowels fit into holes on water pump) and remove the water pump. After the water pump has been removed, you can remove the bolt (12mm - blue circle) securing the back timing belt cover and remove the cover for cleaning. It will only come out once the water pump and both belt pulleys are off.

Replace the back timing belt cover (before installing the new water pump). After cleaning all the remnants of old gasket off and cleaning the mating surfaces well, apply the new gasket (emphasis on applying RTV or something like this Copper Spray on each side of the gasket), install the water pump (FCP Groton Part [#272476](#) includes gasket and new bolts), and torque to 15 ft/lb.



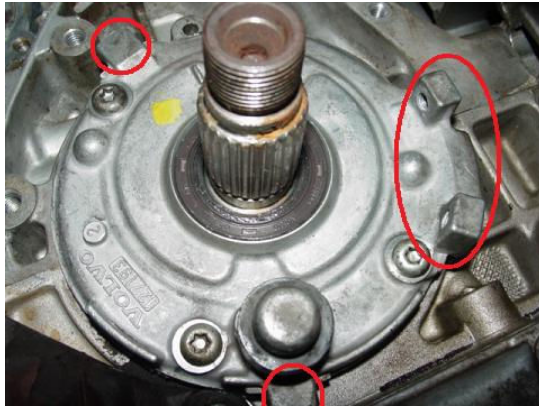
Step

Picture

Disassembly

Reassembly

104



Remove the 4 oil pump bolts (T30). Using a screwdriver or small prybar, carefully pry behind both parting lugs (top and bottom red circles) and behind the area where the small, bottom timing belt cover was bolted on (larger red oval). Try to pry evenly around the oil pump housing to remove it without binding it.

After disassembling, inspecting, lubricating, and reassembling the oil pump (steps below), clean all the remnants of old gasket off the mating surfaces well, apply the new gasket and replace the oil pump on the crankshaft. Start the 4 oil pump bolts and use them as guides (don't try to force the oil pump in using the bolts). The crank nut should do the pressing (using makeshift washers). I used pieces of plywood that I cut into wooden washers so they would fit around the crankshaft and press against the oil pump housing. I would tighten the crank nut on against the wooden washers until it reached the end of the threads, then back it off and put another wooden washer on and start over. Once the oil pump is pressed all the way in, torque the 4 bolts to 88 in/lb. Install a new oil seal on the crankshaft and press it into the oil pump housing as far as it will go.

105



Here I am removing the oil seal from the oil pump. Since the oil pump mounts on the crank, this seal serves as both the oil pump seal and the crank seal. To show the metal band inside, I pulled some of the sealing material off of the seal in the area where I am prying. Used cautiously to avoid scoring the metal walls of the housing, a small screwdriver with a little electrical tape on the end can easily remove an oil seal like this, especially when there is no shaft in the way. Once under this lip, some upward pressure is all that is needed to pop this seal out. The next picture is of the oil pump once it has been disassembled into two halves. I cleaned mine good, inside and out, and inspected the internal components for signs of excessive wear or scoring (especially the crescent portion between the inner and outer gears). To separate the halves of the oil pump, remove the two bolts (4mm Allen). Use caution as there is a spring that will push the halves violently apart if it is not held together during removal. After cleaning and inspecting the inner parts of the oil pump, lubricate the gears by packing some moly grease in there, compress the spring while holding the halves together, and reassemble it.



Step #

Picture

Disassembly

Reassembly



Step

Picture

Disassembly

Reassembly

106



Here the new oil pump O-ring (black and surrounding the oil pump) has been installed on the oil pump body with a little moly grease applied. The next picture is of the installed oil pump with a new oil pump (or crank) seal that is orange. It is best to install it after installing the oil pump back on the crankshaft. The first one I installed was installed on the oil pump, then the oil pump installed onto the crankshaft. But as I pressed the oil pump onto the crankshaft, the friction on the crankshaft turned the sleeve of the oil seal outward and displaced the spring around the inner lip of the seal (this can be seen in the picture above where the red circles outline the oil pump removal lugs). That would not have functioned properly at all, so I removed it and installed a new one (I had luckily and accidentally ordered an extra one because I thought they would be two different seals). **When I install an oil seal** - I liberally coat it with moly grease on every edge but the flat outer face (that will be the only thing showing once it is installed). Then I center it where it is to be installed (over whatever shaft it goes around) and slide it gently into place before pressing it in. Some people use a large socket, an oil seal "installer," or even the old seal turned around backwards to install an oil seal. I have always installed oil seals by just distributing my fingers evenly all around and pushing evenly all around until it was seated, making sure not to push more on one area than another so that it didn't get unevenly wedged in. A nice coat of grease is key to installing an oil seal, and you can easily wipe away any extra or residual grease left behind once the seal is installed. (FCP Groton Part [#271439](#) is the oil pump gasket kit that includes the gasket below, the large O-ring, and the oil pump seal from the pictures above, colors may vary).

Step

Picture

Disassembly

Reassembly

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Cleaning the block - Plug or tape the hole the crank position sensor was in and the flywheel access where the starter came off with something to keep trash and rinse water out while you are cleaning the engine (but something you can get to come back out/off and that won't drop inside and get lost). Also try not to spray water directly into these openings as you clean the engine. I cleaned my engine very aggressively. I had buildup in the whole PCV system and just wanted everything thoroughly clean when I was through. I took some degreaser (Purple Power) and sprayed it full strength onto the whole engine on all sides and all over the top - even the pistons, cylinders, and oil channel areas (red circles). In this picture there are blue paper (shop) towel pieces in all the head bolt holes. The channel that surrounds all five cylinders is where coolant flows through. I brushed everything I could reach on all sides and the top of the block with an old toothbrush, then rinsed everything well with hot water. After getting the pistons clean with degreaser and an old toothbrush, I rinsed them thoroughly (I actually had each cylinder full of hot water for a minute during this cleaning), suctioned out the water, wiped them completely dry, then coated them with penetrating spray to prevent corrosion (the cylinder inserts are not aluminum, but steel) and lubricate the rings underneath where the penetrant may have seeped (I left a little penetrant on each piston head for a few minutes to allow some to seep in there before wiping the excess off). The coolant channels were naturally too tight to scrub (and didn't need scrubbing) and were just rinsed clean of degreaser with hot water (all ports and openings were open anyway). I used plastic wedges cut from old credit cards to scrape any old gasket material I felt on the block surface, and actually used a little bit of gasket remover wiped specifically where I needed it with a blue paper (shop) towel to dissolve some of it (that gasket remover spray BURNS if you get it on your skin). The water pump area also had a lot of old, hardened gasket on it, so I used the gasket remover and plastic scraper to get all of it clean too. After scraping out all the gunk I could, I also sprayed a lot of degreaser into the PCV ports that the oil trap connected to and rinsed them well with hot water (leads to the oil pan). After everything was cleaned and rinsed well, I opened the oil pan plug and drained all of the degreaser rinse water out, leaving the plug out and letting it all drain / dry as much as it would while I found something else to do. When I came back, I replaced the oil pan plug and (using a long transmission fluid funnel) poured a gallon of diesel fuel into the pan through the six oil channels (red circles) and the PCV ports. I did this to rinse, soak, clean, and lubricate. I left this diesel fuel in for a few days until I was completely through with this repair, with no adverse effect. It did seem to break loose a lot of stuff in the engine, as I had little greasy spots in the first 3 oil changes (which were at very low intervals for this very reason) before starting it on synthetic oil (since there were only about 111,000 miles on it with every oil seal on the engine new but the rear main).

Step

Picture

Disassembly

Reassembly

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109



One very important aspect of cleaning the block in preparation for installing the new head gasket is to clean out the head bolt holes **completely**. I don't have an air compressor at present, so I suctioned the water and degreaser residue out of the head bolt holes, then ran blue paper (shop) towels down into them until they would come out dry (poking them gently in and to the bottom with a rod). I also ran pipe cleaners into them, looping the end and twisting them to make a cleaning loop at the bottom end, until they came out with no moisture or anything on them. I took one of my old head bolts (making sure it had good threads), cleaned it really well, then used it to gently chase the threads of each hole. Each time I would run it all the way into a head bolt hole, making sure there was no resistance or binding, then run it back out. I would then wipe down the threads on the bolt (with something dry) to make sure they were dry before using the bolt again (and to make sure the threads it just came out of were dry). I was very particular and deliberate in this, so I ended up chasing each head bolt hole at least twice (some three times if there was any doubt about moisture in the threads). After completely drying out each head bolt hole and chasing the threads, I would plug the hole with a big piece of a blue paper (shop) towel to prevent any accumulation of moisture or any debris from falling into the bolt hole. **If the head bolt holes are not completely clean and free of any fluid, damage could occur to the block when you torque them down, or you may have an incorrect torque that could lead to another head gasket failure.** The bolt hole depicted here is one of the two that have a small protrusion around them to align the new head gasket and upper head portion. You also want to take some sort of very reliable straight edge and check the block surface for flatness along all edges and at all angles. However, the machine shop that did my cylinder head told me that it is rare for the block to have warped, saying it is usually always the cylinder head that will warp. They actually told me that if I had a large, flat file I could lightly run it all along the block surface and if there were any low areas they would be revealed (they would be the areas that were not shiny bare metal if they were lower). But I felt better about just cleaning the block off really well and not "buggering up" the factory surface of the block. Mine checked out when I checked for flatness with a metal edge and did not appear to have any warpage.

I cleaned the intake manifold (after removing the components from it as shown below) with degreaser and an old toothbrush, but throttle body cleaner may have worked even better (or faster) had I used it. I also soaked the intake manifold in diesel fuel for about 2 or 3 days to loosen it up even more, then repeated the degreaser. I removed the old oil seals from the camshafts and cleaned them (camshafts) the same way, degreaser, diesel soak, degreaser. The cam pulleys and crank pulley were also cleaned in the same way. I had engraved a small "F" on the front camshaft (intake) and an "R" on the rear camshaft (exhaust) in an area that wouldn't affect them. But I noticed in looking back through my pictures that on the grooved end there is a part number engraved on them from the factory. The exhaust one ends in "E" and the intake one ends in "I." Yours may be the same. The large things I soaked in diesel were done by filling a 5 gallon bucket and soaking one end, then removing the part and soaking the other end.

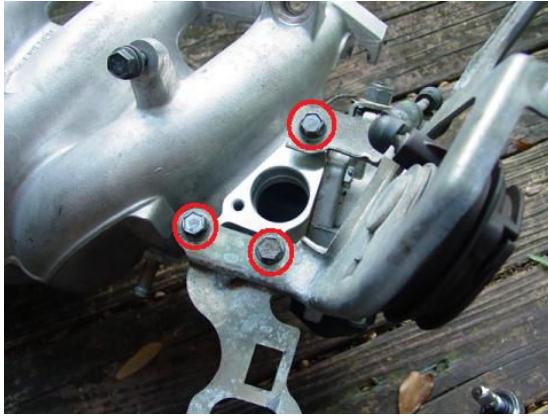
Step

Picture

Disassembly

Reassembly

110



Remove the throttle control and bracket (10mm).

REASSEMBLY - Reattach the throttle control and bracket and torque to *88 in/lb.

111



Disconnect the control arm from the throttle body (unsnap ball joint circled).

Reconnect the control arm to the throttle body (snap-on ball joint circled).

112



Remove the throttle body from the intake manifold (10mm).

After cleaning all the remnants of old gasket off and cleaning the mating surfaces well, apply the new gasket (FCP Groton Part [#9135990](#)) and reattach the throttle body to the intake manifold and torque to *88 in/lb (10mm).

Step

Picture

Disassembly

Reassembly

113



Remove the throttle position sensor from the throttle body (7mm).

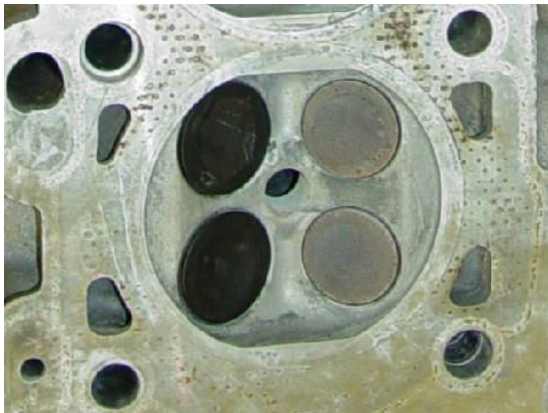
Reattach the throttle position sensor to the throttle body.

114



Remove the EGR from the throttle body (8mm).

After cleaning all the remnants of old gasket off and cleaning the mating surfaces well, apply the new gasket (FCP Groton Part [#3531078](#)) and reattach the EGR to the intake manifold and torque to *88 in/lb (8mm).



This is what the head surface and valves looked like before and after the machine shop worked on it. They machined the head, did a valve job, and put my new valve stem seals (FCP Groton Part [#3517893](#) need 20) in for me. The head was really immaculate when I got it back, as you can see. I was expecting a smooth-as-glass finish (like when a brake rotor is turned), but I've learned there needs to be just a little texture to "grip" the head gasket.

Step

Picture

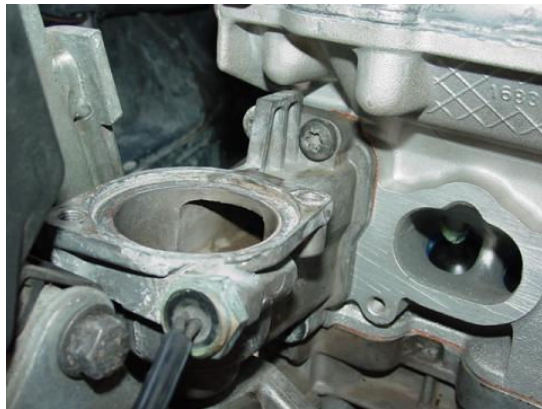
Disassembly

Reassembly

115



After having done a thorough job of cleaning the surfaces of any gasket material, it is time to put the new head gasket on. First, make sure to clean any oil or residue from the surfaces of the block and the lower portion of the head that will contact the head gasket. This is best done with something like acetone and a lint-free cloth. The acetone will dissolve and clean away any oils, residues, etc. and it evaporates very quickly, leaving no residue behind. Also, go ahead and reinstall the lower thermostat housing (T40) with a new gasket (FCP Groton Part [#9463274](#)) to the lower portion of the head before mounting the head on the block.



116



Here is the new head gasket (FCP Groton Part [#3531017](#)), coated with the Permatex Copper Spray, and positioned properly on the head. Note the projected sleeves around the bolt holes in two locations, at the 4:30 corner of cylinders 1 and 5, and make sure to align the head onto them when you place it. Before you place it, you might want to familiarize yourself with the weight of it and the positioning you are going to have to do. You may want someone to help you lift it and place it to make sure you don't slip and damage something (or yourself). I did it by myself, but I am a pretty big guy.

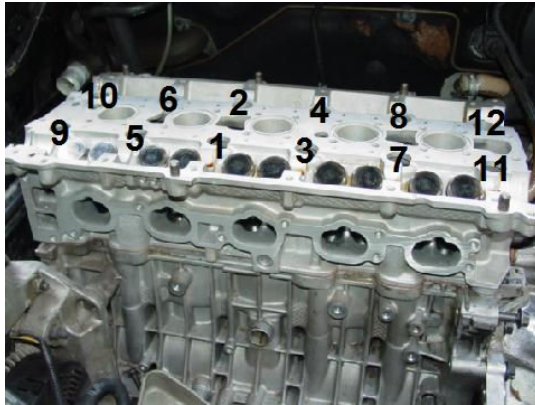
Step

Picture

Disassembly

Reassembly

117



This is the sequence for installing and tightening the new head bolts (FCP Groton Part [#6842347](#) need 12). Once the head is properly positioned on the block and the gasket is noted to have stayed in the correct position, undamaged, the head bolts can be installed. This sequence is backwards from when we were removing the old head bolts. This time you start tightening in the middle, working your way out diagonally as indicated in the numbering in this picture. You want to make sure you are using **new head bolts** and not any of your old ones that might accidentally get mixed in. Here is a picture of one of my old head bolts and a new head bolt side by side. You can see that the old one actually stretched a little from being used before. If you try to use old head bolts, you very well may break one off, or have an inadequate seal from the new head gasket somewhere down the road.



I know this may seem like a very simple thing, but labeling the correct torque sequence next to the bolt holes helped me easily keep track of which I had tightened and which I had not. Here you can see the 1, 2, and 6 of my numbering I wrote on the head with a Sharpie.

Step

Picture

Disassembly

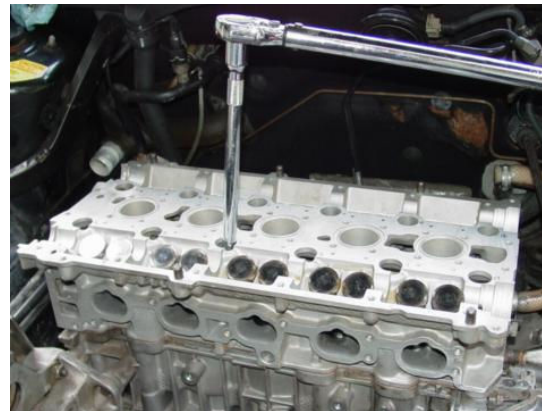
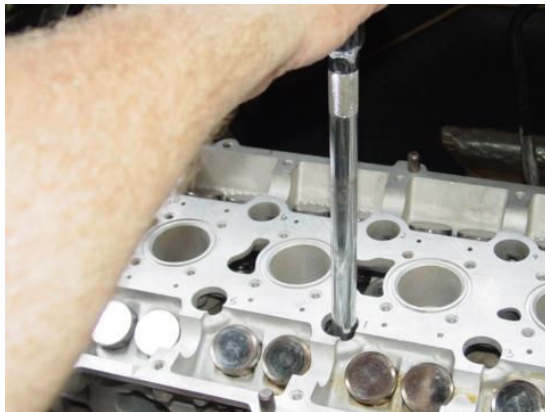
Reassembly

118



Before inserting each head bolt, apply a thin coat of clean engine oil to the threads, the shaft, and the underside of the bolt head. I found the easiest way to do this was with a blue paper (shop) towel that was saturated with clean engine oil. I wrapped the oily part around the bolt and turned it a few times in my hand, making sure the whole bolt was just barely shiny from the underside of the bolt head to the tip of the threaded end. This helps assure a smooth application with accurate torques. I then installed the bolts (using the correct sequence above) one at a time and just tightened them finger-tight with the extension and a 6 point 14mm socket.

119



Using the sequence above (that starts in the middle of the head), torque all the head bolts to 15 ft/lb. Once you have finished, repeat the sequence and torque them to 44 ft/lb this time. **NOTE - if you have a US Haynes manual that states the second torque should be 37 ft/lb (as mine does), it is INCORRECT.** I also had a British Haynes manual and a Volvo factory manual to refer to, and both of them gave a Nm value that converted to 44 ft/lb. I further researched and found from another source online ([AERA](#) page 116, second line, last column on the right) that the second torque should be 44 ft/lb. I have communicated with Haynes and notified them of the error, and they agreed. So, torque to 15 ft/lb the first time through the sequence, and 44 ft/lb the second time through it. The third and final torque is the one that is a nail-biter, and it is done with a torque angle gauge (above). This is basically a short 1/2" drive extension with a dial around it showing degree measurements (0-360). It has an arm that protrudes from a bracket on the dial so it doesn't move, while the clear cover on top of it has an indicator line that shows exactly how much you have tightened (in degrees). I got mine on ebay, as I couldn't find one locally.

Step

Picture

Disassembly

Reassembly



Here you see the setup I had to use to have the correct height for reaching the head bolt and to be in the correct position to use the torque angle gauge (that has to have something to anchor to). I had to use a 1/2" to 3/8" drive adapter - plugged into a 3/8" deep-well 6 point 14mm socket. This setup worked fine, as you can see in the other picture. In the second picture, you can see how this gauge works. The dial is held from spinning by the anchoring arm that is kept from rotating by the hole it is hooked into. But the drive portion and the clear screen with an indicator mark can rotate together. So it is secured as shown, the clear screen is rotated until the indicator is on "0," and the appropriate angle measurement desired is tightening to with a 1/2" drive breaker bar. Once this is secure, go back through the tightening sequence a final time and tighten the head bolts an additional 130 degrees. This is only a little more than a third of a turn. But after tightening them to 15 ft/lb, then 44 ft/lb, this final torque was a nail-biter to me. All of my life, I have always stopped tightening a fastener when I would hear ANY kind of squeaking or creaking (to avoid breaking the fastener). But pretty much the whole 130 degrees of this final torque, there were some wicked creaking and groaning sounds going on. This is normal and is what stretches the head bolts so that they work the best (torque-to-yield bolts), but my read-end was still drawn up so tight that you couldn't have driven a nail in it. But none of them broke (the gnawing fear I was having) and everything worked just as it should have.

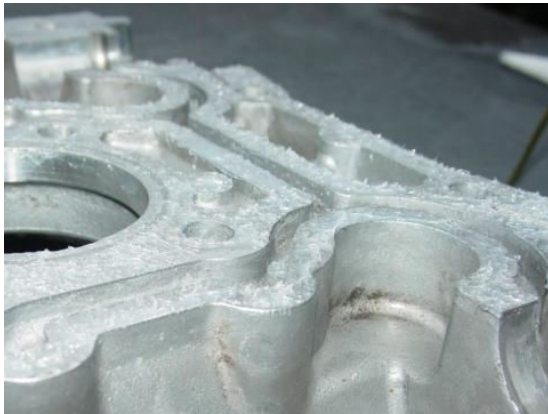
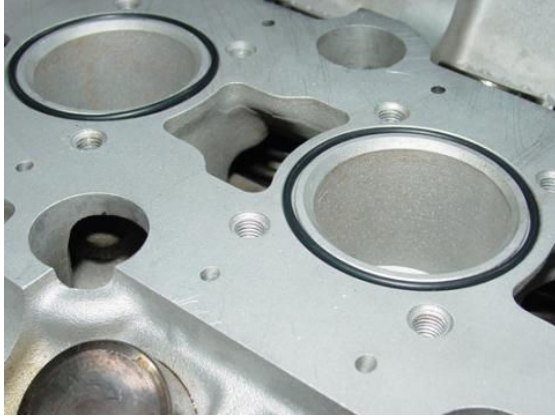
Step

Picture

Disassembly

Reassembly

120



Now it is time to put the top portion of the head back on. First, put the five spark plug O-rings (FCP Groton Part [#1397525](#) need 5) around the spark plug ports in the little depressions they go in on the lower portion of the head. If you have a couple that won't lay completely flat, just leave them on the head in the sun for a few minutes and they will limber up. Although I am showing and describing the step of applying the sealant in the next picture, I would encourage you to look through the next couple steps before applying the sealant. Familiarize yourself with how you are going to secure the camshafts, what you are securing them with and where it's at, where your lube is (moly grease), etc. It takes long enough to just apply the sealant (which is done before securing the camshafts in the upper head) and you don't want to drag your feet on the rest of the steps before installing the upper head and end up with sealant too dried out to work. I think it took me about 15 minutes to apply the sealant completely, then another 5 to get the camshafts ready and lubed. Mine sealed up fine, and has not leaked in the 700 miles or so since I did this, but we were having a lot of humidity around here and that may have helped to keep the sealant from "skinning" a lot. I used the sealant from FCPGroton (FCP Groton Part [#1161059](#)) and it worked fine. But it did not appear to be applied the same way as the factory sealant, which appears to be more of a liquidy sealant that you can roll on. The way I applied it was to run a small bead everywhere I could in a given area and then go along patting it with my fingertip quickly and lightly like tapping out a telegraph or something. This spread it out and left a nice, tacky finish (picture). As I squirted a bead of sealant out, I would leave more on bigger areas than on smaller ones, and would leave none on tiny areas - but would transfer the extra from another area to it via my fingertip. This stuff is thick and a little effort is required to squeeze it out fast. It has one of those sardine can clips that slides on the end and keeps it rolled up and coming out (like you may roll your toothpaste tube up).

Step

Picture

Disassembly

Reassembly

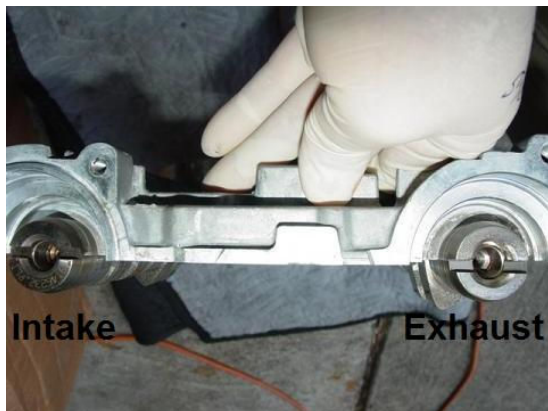
121



Keeping any of it from getting into or onto your sealant, put a little dab of moly grease (like multi-application axle grease in a cardboard tub) on each of the journals where the camshafts will contact the upper head. After installing the camshafts onto the upper portion of the head and securing them (as in the steps below), put a dab on each of the cam lobes (oblong areas) and on the camshafts where they will contact with the journals in the lower head. This is to have some type of lubrication (after these have been degreased and cleaned) in those areas when they start rotating later (during timing belt installation, initial startup, etc.)



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Place the camshafts in their correct positions, with the exhaust camshaft on the back closer to the exhaust manifold studs, and the intake manifold on the front. Remember, the groove on the intake camshaft is ABOVE the seam of the head, while the groove on the exhaust camshaft is BELOW the seam of the head. This picture was turned around 180 degrees since I was holding it upside down when it was taken

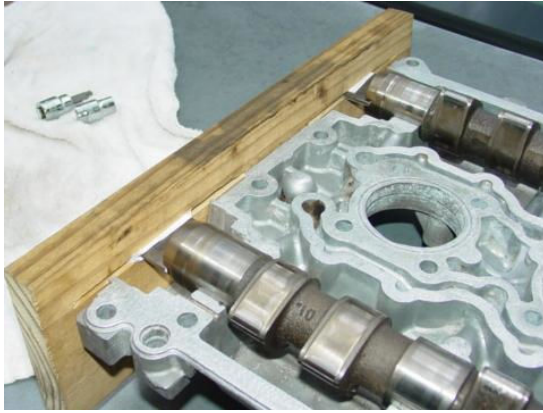
Step

Picture

Disassembly

Reassembly

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Here you see the bracket used earlier to hold the camshafts in place with the steel stock pieces in the grooves and a distributor and cam position sensor bolt holding the bracket on. The other end of the camshafts is secured with the wire coat hanger used earlier.



Step

Picture

Disassembly

Reassembly

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Mount the upper head section in place on top of the lower section, with all dowels lining up as shown. Apply clamps to hold down the top head section while the 40 bolts (10mm) are installed. I installed my bolts barely finger-tight, then used a sequence like the one for tightening head bolts to go back over them (working from the center outward). I also made sure the clamps were clamped down tight each time so that the bolts weren't having to do the work. Each time I went back over the 40 bolts, I would spin the bolt with just the extension and my fingers (barely finger-tight). Each time I went back over these, I would find that a lot of slack had accumulated that I could take up with finger-tightening. It is important to let the clamps do the majority of the tightening here, so that the bolts don't get strained, stripped, or broken. Even though I was just finger-tightening, I had one bolt in the middle on the back side that sort of stripped, but is not leaking. If I do anything with this again I will probably drill out the threads and tap that hole for a bigger bolt.



125



After cleaning all the remnants of old gasket off and cleaning the mating surfaces well, apply the new gasket (FCP Groton Part [#1236119](#)) and replace the water pipe (10mm) on the rear of the head and torque to *15 ft/lb. NOTE - Since these mating surfaces are very close together once the head is replaced, I flexed the water pipe back just a bit, threaded the top bolt through (sticking the top part of the gasket in over the bolt as it went through), then let the gasket swivel on the top bolt into correct

Step

Picture

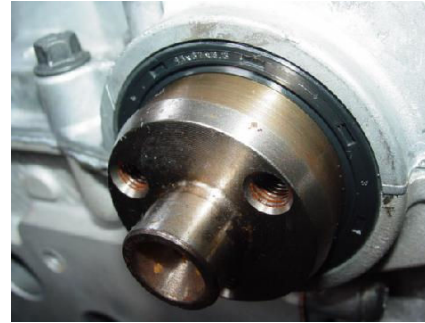
Disassembly

Reassembly

126



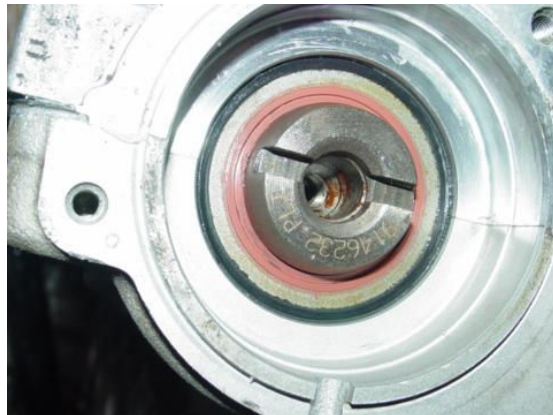
Install both of the front cam seals (FCP Groton Part [#6842272](#) need 2). Here is one greased for installation, then installed (I did end up pushing it farther inward just a little after this picture was taken). Use the same method you used for installing the oil pump (crank) seal.



127



Install both of the rear cam seals (FCP Groton Part [#9443310](#) need 2).



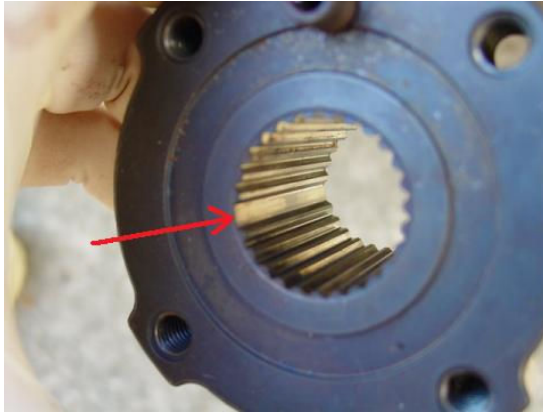
Step

Picture

Disassembly

Reassembly

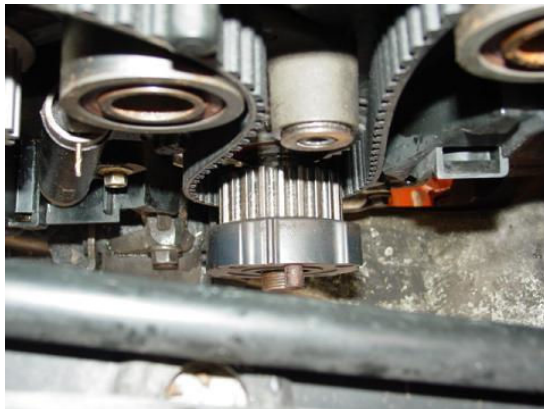
128



Make sure the crank seal (came with oil pump gasket kit) has already been installed, then install the crank pulley. Align the large groove on the inner splines with the corresponding portion of the splines on the crankshaft and press on evenly, wiggling a little if necessary. The timing belt can be threaded around the crank pulley now too.



129



All timing belt components (except for the tensioner and cam pulleys we are about to do below) should have been replaced by now. If not, replace whatever might be missing now. Remember the back timing belt cover goes on before the water pump or timing belt pulleys. The water pump, oil pump, both timing belt pulleys, and the crank pulley should be installed at this point (refer back to instructions on previous pages if needed). **The timing belt should be routed around the crank pulley BEFORE mounting the harmonic balancer back onto the crank pulley** as in this picture. You may find directions to the contrary, but I saw no way to get the belt on around an already-installed harmonic balancer without contorting (and thus damaging) the belt. To be honest, I really saw no way to do it even if I was willing to bend the belt a lot.

Step

Picture

Disassembly

Reassembly

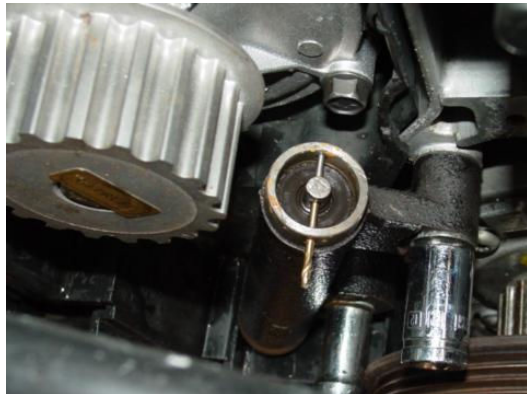
130



If you are re-using your timing belt tensioner (FCP Groton Part [#9146693](#)), which you can do if it meets criteria, you first have to compress the piston back into the tensioner. Wipe the tensioner down and get it free of any oil first, because one criteria of it still being usable is that it doesn't leak any oil when you compress it. The other criteria is that it maintains resistance, and does not fail to push strongly outward when compressed or when released. To compress it, you can use a bench vise or a big C-clamp (which is what I did). It takes a little coordination, especially if your C-clamp has a slick surface that enables either end to "walk" or move while doing this. But if you get it positioned right (and keep it right) and slowly compress it, taking at least 5 minutes (I took 10) to slowly press the piston back into the tensioner, it works like a charm. I then secured it by inserting a small (2mm) drill bit that I had broken previously anyway.



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Reinstall the timing belt tensioner (locked with pin) with 2 bolts (12mm top and 10mm bottom) and torque to 18 ft/lb. Ignore the fact that in this picture I already had the harmonic balancer installed with-

Step

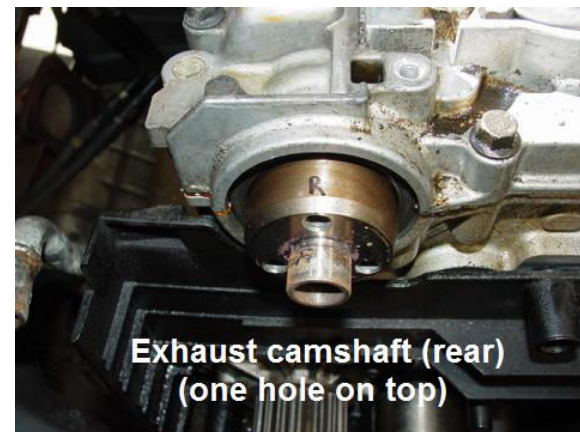
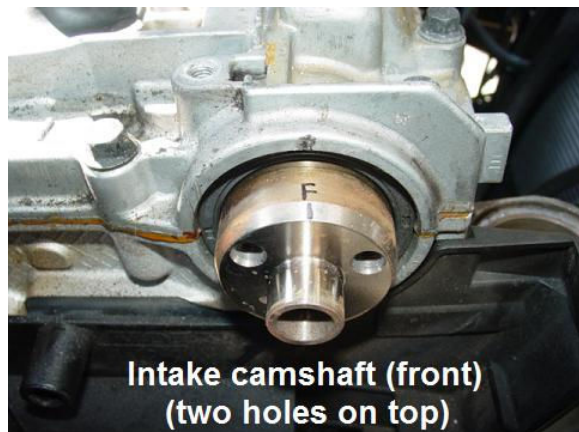
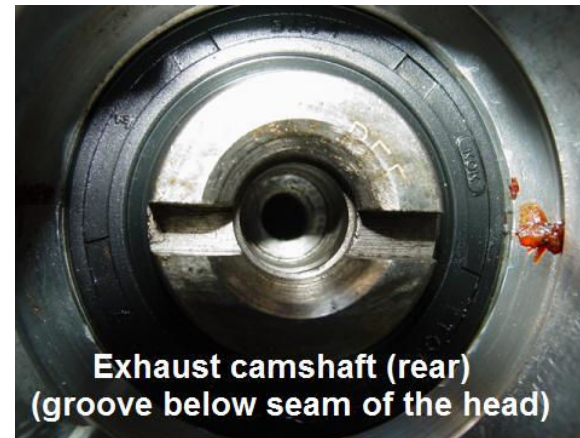
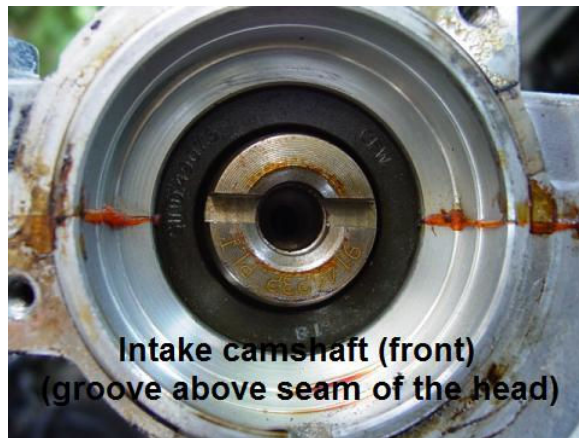
Picture

Disassembly

Reassembly

Make sure the camshafts are lined up (since they have been moved and reassembled). **Use the grooves on the back end of the camshafts to make sure they are in time at this point, as they have been moved, the cam pulleys have been moved, and the cam pulleys have slots (that allow travel) for them to bolt on with.** The grooves should line up exactly with the seam between the top and bottom sections of the head - with the intake groove above the seam and the exhaust groove below the seam - which will make the other end have one bolt hole be on top on the exhaust camshaft and two holes be on top on the intake camshaft. Also, go ahead and install both of the cam pulleys (with the oil seals already in) back onto the camshafts, being sure to leave the bolts (10mm) just loose enough for the cam pulleys to be able to travel in their slotted bolt holes. The top timing belt cover (10mm - that fits over the top of the cam pulleys and has the timing marks on it) can be temporarily put back in place and removed as needed to see alignment with timing marks on the cam pulleys if needed.

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Step

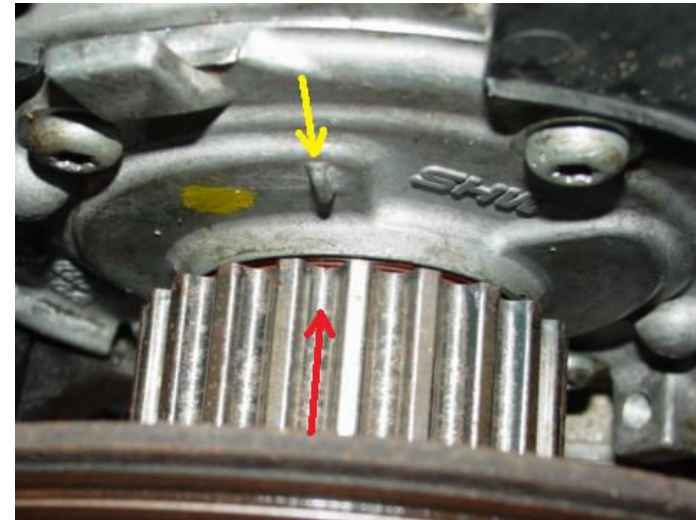
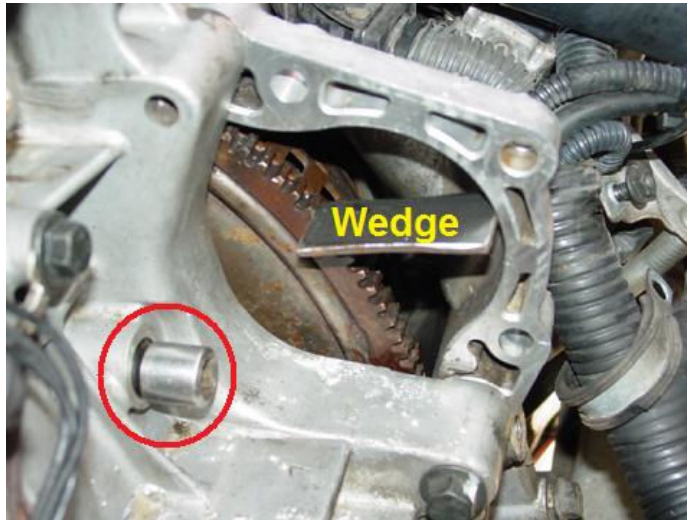
Picture

Disassembly

Reassembly

Make sure the crank is lined up. It should not have been moved the entire time (if the anchoring techniques shown were used), but check anyway. Note where the protrusion on the oil pump housing is (yellow arrow) and where the very small notch on the crank pulley is (red arrow). Remember to have the "wedge" in the flywheel teeth (and the timing belt threaded around the crank pulley) before you install the harmonic balancer and tighten up the crank nut.

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Align the harmonic balancer so that the pilot hole goes over the peg in the crank pulley and push evenly and firmly onto the crankshaft. Don't worry about pushing it all the way on by hand, as the crank nut will force it on when it is tightened on. Make sure the flywheel is locked with the little wedge (or something) so it will not rotate clockwise. Tighten the crank nut (30mm) and torque it to 133 ft/lb. Also install the four bolts (10mm) that mount the harmonic balancer to the crank pulley and torque them to

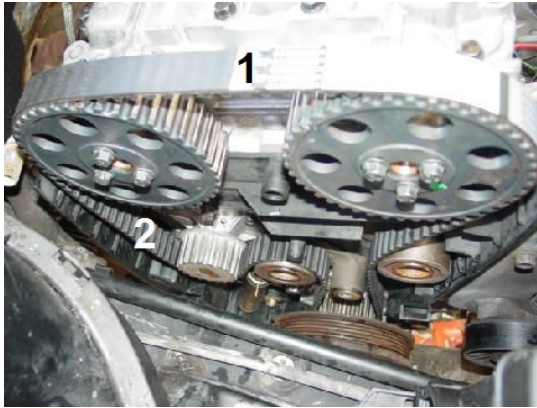
Step

Picture

Disassembly

Reassembly

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With everything in time, mesh the teeth of the timing belt (FCP Groton Part [#272327](#)) onto the crank pulley teeth, pulling the belt tightly upward and over the idler pulley, then over the front cam pulley, then over the rear cam pulley. This should be kept as tight as possible from the crank, past the idler pulley, and onto the cam pulleys. The cam pulleys may have to rotate a small amount one way or the other for their teeth to mesh exactly with the positioning of the timing belt and this is why the bolts securing them were not tightened down yet. Mine actually ended up being right in the middle of the slotted bolt holes to also line up with my marks on the cam pulleys (not as important as grooves lining up on other end). All the way forward hit on one tooth and all the way backward hit on another. Once I let mine settle right in the middle, everything lined up fine. But the important thing is to have the camshafts lined with their grooves on the other end (which can be fine tuned before putting the timing belt back on), the crank in time and with a tight belt between it and the cam pulleys, then the cam pulleys adjusted to mesh right. **Read and prepare for the next step before doing this next part.** Now, with everything meshed right and tight from crank to back cam pulley, and the bolts still not tightened all the way, push down HARD and TWICE on the belt where the "1" is (between the cam pulleys), then push inward HARD and TWICE on the belt where the "2" is (between the rear cam pulley and the water pump). Then release the tensioner by rapidly pulling the pin out. Once the tensioner has been released, replace the white plastic bushing on the top of it. The curved "bowl" of it goes around the "knob" on the tensioner pulley.

Step

Picture

Disassembly

Reassembly

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Here you can see the timing belt tensioner in place with the belt ready to be tensioned. I have needle-nosed pliers in place to quickly pull it out and have made sure that there is enough travel room to do so. Also notice how the timing belt has a slack appearance in this picture. Then notice in the next picture, where the tensioner pin has been pulled and tension applied, how the timing belt has a tightened appearance.

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138



Using the sprocket holding tool to hold the cam pulleys still (as shown), tighten the bolts (10mm) securing the cam pulleys to the camshafts and torque them to 15 ft/lb. Replace the top timing belt cover

Step

Picture

Disassembly

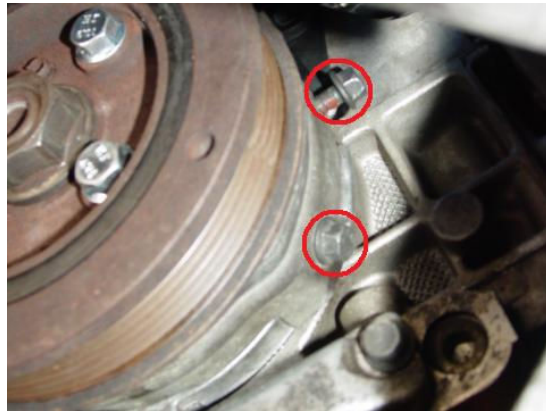
Reassembly

139



Using the sprocket holding tool to hold the cam pulleys still (as shown), tighten the bolts (10mm) securing the cam pulleys to the camshafts and torque them to 15 ft/lb. Replace the top timing belt cover

140



Replace the bottom timing belt cover behind the crank and secure it with the two bolts (10mm - red circles) that hold it on. This is tight to do with the harmonic balancer on, but if the bottom portion is fed into where it goes first, the upper portion will fit with patience and just a small amount of manipulation.

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Replace the upper timing belt cover (12mm - indicated by the red arrow). Make sure both "ears" at the bottom part of this cover go into their corresponding slots on the back timing belt cover.

Step

Picture

Disassembly

Reassembly

Parts List & Finishing Up

Starting at the bottom of each page and working toward the top of each page, go back through and perform all of the "Reassembly" instructions. **Make sure the drain plug is on the oil pan and that there is adequate oil in the engine (since an oil change should have been done if the PCV system was changed out or cleaned out).** When doing mine, I waited until I was "about to start the engine" to refill with new oil, since the whole valve train had been removed, cleaned, etc. and did not really have any lubrication in there aside from the grease I applied. I poured fresh oil in and fired it right up within a minute of putting the oil cap back on. Stand back and admire a job well done!

FCP Groton Part	Part Description	FCP Groton Part	Part Description
3531017	Head gasket	6842347	Head bolts (x12)
1366786	Exhaust manifold gasket (x5)	9146266	Intake gasket
9135990	Throttle body gasket	3531078	EGR gasket
3517893	Valve stem seals (x20)	271439	Oil pump gasket kit
6842272	Front cam seals (x2)	9443310	Rear cam seals (x2)
1397525	Spark plug O-rings (x5)	1236119	Water pipe gasket
1161059	Gasket liquid	272327	Timing belt
9186352	Serpentine belt	6842428	Lower radiator hose
1335433	Upper radiator hose	272476	Water pump & gasket
271664	Thermostat & gasket	4228	Spark plug (x5)
1367783	Distributor rotor	3501944	Distributor cap
9135122	Exhaust flange gasket	C35148	Air filter
9141228A	Air intake hose	6842408	Fuel injector lower seal (x5)
9463274	Thermostat housing gasket	30637865	Dipstick tube O-ring
30731375	Fuel injector O-ring set (x5)	9146693	Timing belt tensioner
9146376	Idler pulley	9135036	Tensioner pulley