# **Stillen V2 Supercharger Installation-Aid – "SuperCharger Install For Dummies" ("SCIFD")**

Written by Josh Frohman, a.k.a. ptatohed

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***Preface:***

I have written the following to aid anyone who wants to take on the job of installing their Stillen supercharger himself or herself. My intention is to provide you with supplementary material to the instructions provided by Stillen. I want you to have what I wish I had during my installation! I hope that my time spent writing this installation-aid will benefit anyone whom decides to use it. First of all a big thanks goes out to my best friend Jim. He was there with me every step of the way. All 45 hours of it, all 5 days of it and until 4 am four out of five of those days. I bugged him to become a maxima.org member even though he doesn't have a Maxima. His handle is 'The Wizard'. If you see him around, say hello. Now I just need to talk him into getting a Maxima!! ...lol. As I said above, it took us 45 hours to install the supercharger. And that's two guys. Adam at Stillen told me it takes one guy 10 hours there. So yes we took much longer than they would but hey, we don't install these every day, we have never done anything like this before, and in fact, neither one of us had ever changed our own oil before this. And we also didn't have the best instructions to follow!!! :oD (… thus the reason I am writing this in the first place). My point being, if we can do it, you can do it. And I hope that it will be easier/less time-consuming than it was for us. So, with these instructions, figure your time will be 50-75% our time. I'm just guessing and I guess I won't really know until some of you actually start using these instructions and start giving me feedback. Before I get into the actual installation process, let me explain to you Stillen's instructions and why I am even writing this. In a very, very general point of view, they work. They get the job done. (Ex. look at us, we got it done from the Stillen instructions alone). However, are they flawless? Are they user-friendly? The answer to that is ABSOLUTELY NOT! If you try to install the charger with Stillen's instructions alone, you will be cussing them out just as much as we did. So, with that said, this is the format of my installation instructions: I am not going to rewrite them entirely. Rather, I am going to provide 'supplementary' information to the Stillen instructions. The instructions I am talking about are the 14-page 'Installation Instructions' provided by Stillen that come with the V2 supercharger. If you would like a copy of these before you actually purchase your supercharger, contact Adam Hume at Stillen or feel free to e-mail me: ptatohed@netzero.net. I can e-mail you the .pdf file or fax it to you. They can also be found in Appendix A of this write-up. So, like I just said, you will be using the Stillen instructions for your installation but I will be adding, deleting, correcting, giving tips, etc. to the Stillen instructions. Don't worry, you can install this thing yourself. I was hesitant at first but now I am so glad I did. You get a great learning experience, you get to save $600 - $800, you don't let any grease monkeys touch your car, you get a wonderful feeling of accomplishment, you get future bragging-rights and you get to stick your tongue out at those who told you couldn't do it yourself. O.k., enough preface, let's get started...

***Before you order/purchase:***

There are several things to consider before you purchase.

- For one, what **pulley size** do you want to use? The stock pulley, 3.6", produces ~ 7 pounds per square inch of boost. This is more than safe for the VQ engine. They say the VQ can handle up to about 12 p.s.i. before any major internal engine re-working would need to be done to handle high boost. Following is a list if pulley sizes and their respective boost:

| | | |
|---|---|---|
| Stock 3.6": | ~7 psi | Part # 2A036-360 (although mine reads '361') |
| 3.48": | ~8 psi | Part # 2A036-348 |
| 3.33": | ~9 psi | Part # 2A036-333 |
| 3.25": | ~10 psi | Part # 2A036-325 |
| 3.125": | ~11 psi | Part # 2A036-312 |
| 2.87": | ~13 psi | Part # 2A036-287 |

I believe each downsize in pulley is equal to ~10 horsepower. Figure a Stillen supercharger with the stock 3.6" pulley will take approximately a second off your quarter mile time and each decrease in pulley size will further reduce your time by ~0.2 seconds.

The reason I bring this up as something to consider ahead of time is that it is VERY time-consuming to change the pulley once the supercharger has been installed. However, keep in mind that the supercharger comes with a one-year warranty that will be void if you change the pulley. Although, I'm still not sure if I did the right thing or not, I opted to keep the stock pulley - for now. I did so for several reasons: To keep the warranty, to transition slowly into driving a boosted car, so I can dyno/compare the different pulleys and to have something to look forward to! :o) A smaller pulley is definitely in my future (Although I am not looking forward to giving up a weekend to change it – :oI ). I can't help you decide, you do what's best for you. If you do decide to buy a smaller pulley, I believe the only way to do so is through Vortech themselves: www.vortechsuperchargers.com. Also note you will need a different size serpentine belt for the various pulley sizes. These are made by Gates and can be purchased at any automotive store. I have listed them below:

| | |
|---|---|
| Stock 3.6": | Gates K060710 |
| 3.48": | Gates K060710 |
| 3.33": | Gates K060710 |
| 3.25": | Gates K060705 |
| 3.125": | Gates K060705 |
| 2.87": | Gates K060703 |

- Another thing you might consider getting before you purchase the supercharger is an **aluminum belt tensioner pulley** (the 2" diameter pulley with sidewalls). The stock pulley has been known to melt. I am sorry, but I don't have much information on where to get one. I will add more here when I learn myself. In the meantime, try searching at maxima.org. Try this: http://www.aspracing.com/intro.htm

So far I see no signs of physical damage on my pulley. Once again, it will be a lot easier to install this while you are doing the initial installation so if you think you want to use an aluminum pulley, buy one ahead of time.

- You also might want to consider a **blow-off valve**. I honestly know very little about blow-off valves and have not, as of yet, purchased one myself. The Stillen kit comes with a Bosch unit but what I hear from most .org members is that it is inferior to the Blitz unit that most SC owners buy. I believe the Blitz is around $200. I still don't know what the benefits are 100%. Performance? Wear and tear on the blower? I'm not sure but I believe a little of both. Even Stillen's own catalogue states that purchasing one will "increase drivability". From what I understand, what they do is release some of the boost that has already been made by the charger and sent to the throttle body, which is now closed when you take your foot off the gas. The boost has nowhere to go otherwise and could go back and ruin the super charger blades. What I have gathered so far is that they are more important for turbos than superchargers, more important for high boost than low boost, and more important for stick shifts than for automatics. So, since I have an SC, low boost, and auto, I'll probably keep the stock Bosch unit for now until I go with a smaller pulley. The Blitz blow off valve is a simple bolt-on so don't worry about getting one before the install.

- Also, if you have an automatic transmission, there are a few things to consider before you purchase your Supercharger. The unanimous consensus around the .org is that you will need a **'VB mod' upgrade**. This modifies the valvebody in your transmission for harder/quicker/faster shifts. It claims to increase performance while decreasing wear and tear on your transmission. See mobiletek.net, levelten.com. Once again, I have to admit, I have not done this upgrade yet. My reason is because I don't want a rough shifting transmission. I could be doing harm to my transmission. I guess time will tell… :oI Along with the vb mod upgrade, it is advised that you get a **transmission cooler**. The one that seems to be the most common is the Hayden model 1404 (often incorrectly called 404). It is not a bad investment for ~$40 for anyone with an automatic transmission. I did this and I am glad I did. I used the installation instructions provided in the how-to section at maximadriver.com and maxima.org (the same instructions). However, contact me first if you plan on doing this as I feel I improved on those instructions by doing a few things differently. It should take you 2-4 hours. Lastly, is a changeover to **synthetic transmission fluid**. A normal drain and refill at your local shop should be around $50 but if you are changing over for the first time, they need to do a full flush and then fill it up with more expensive synthetic fluid. Figure on $150. I went with Mobile One but I hear Amsoil is the best. The above-mentioned items need not be done before the SC install but consider doing them shortly after.

- Another item many supercharger owners like to purchase are **gauges**. I myself have not purchased any gauges yet so I don't know too much about them. Do a search at Maxima.org for more information. I believe the two main gauges are an EGT (Exhaust Gas Temperature) and Boost gauges. You won't necessarily need these ahead of time, just something to think about. Most people place these on their 'A' pillar. See picture below:


- You might want to think about **Cold Air Intake** for your supercharger. Cheston has a great how-to on his maximadriver.com. The concept is to draw in cooler, outside air rather than the hot air in the engine bay. A car will always perform better with cooler, denser air. This also is not something that has to be done at the time of install so you have time to think about. I think I'm going to go this road but I have not as of yet.

- The last thing I will mention as an item you might possibly consider ahead of time is an **intercooler**. I can't speak on this topic at all so you will have to research this yourself. But this can be added later anyway so don't worry too much about it at this point. Try spearcointercoolers.com. There are no intercoolers specifically made for the supercharged Nissan Maxima so one will have to be custom fabricated. Several Maxima owners have done this that I know of.

***Before the installation:***

O.k., your supercharger just showed up! If you're like me, you only get one out of two boxes and then a few days later, the second box. Luckily, the main box came first for me, the one with

the actual Vortech blower and most of the installation parts. :o) I know you're excited! You have probably been tracking the boxes at fedex.com or ups.com for days now. It's finally here! O.k., after you hold the blower in your hands enough hours and you can finally wipe that goofy grin off your face, and you have taken a picture or two of you holding the Vortech, you're going to want to do inventory. I did not have all the correct parts and most everyone I speak to did not as well so take this seriously. Don't assume Stillen packed everything you need. The last thing you want is to get started and then find out at 1am Friday night that you are missing some crucial parts that prohibit you from moving on and now you have to wait until Monday morning to call Stillen. Take the first page of the Stillen Installation Instructions, the 'Materials supplied' page (See Appendix A). It looks very scary at first. If you count up all the parts, it must add up to over 150 parts! That's o.k. They are listing every nut, bolt, washer and even the break-down of things that already come assembled for you, so it isn't quite as bad as it looks (and that scary list actually starts to make more and more sense as you get into the installation). Before taking inventory, look everything over for any damage. During the shipping of my charger, something must have pierced the side of the box. It penetrated the side of the shipping box, the K&N box and crushed in the filter. I had a brand new one on my doorstep the next day. :o) Now, the fun part of taking inventory. Luckily, Stillen did a pretty darn good job at separating out all the various groups and labeling all the packages very nicely. This is a lifesaver during installation as well. Thanks Stillen. (I feel bad for anyone who buys his or her SC used).

Now, this is the part that is kind of hard to put in words. It's even hard to do in person as well. I struggled with it. There are so many parts and so many names I did not recognize. What the heck is an ADEL clamp, a cam sensor retainer plate, a standoff bolt? This stuff meant nothing to me. All I can say is start at the top and take it category by category. With some prior knowledge, some common sense and some deductive reasoning/ elimination, you'll get through it. I'll walk you through a few but I can't describe every part nor can I show a picture of every single part with its name.

<u>VORTECH SUPERCHARGER & MOUNTING PLATE ASSY.</u> You'll see 5 items listed. Well, it really is only one since the whole thing came assembled for you!

<u>AIR FILTER ASSY.</u> Everything you need will be in the K&N box. Some of the things listed as separate items were confusing because they were already attached to the air filter (ex. Plastic nipple, rubber grommet). I even had an extra hose clamp in my box.

<u>CRANKCASE BREATHER ASSY.</u> The '45° plastic vent adapter' was missing on mine. That's o.k., it ends up already being attached to another part.

<u>POWER STEERING.</u> I never got my power steering hose! Make sure you get yours. (Although you'll see later you may not even need it if you so choose – step #14).

<u>BYPASS VALVE.</u> There was a 'bypass valve adapter' in my kit that is not listed on the instructions. It IS needed so make sure you have it. It is fairly small, black, metal and shaped like () with a little cylindrical extension out the middle like (o).

PRESSURE PIPE ASSY. (Although mine was labeled 'Hardware Intake Tube Assy') This is box 2 of 2. This is, by far, the hardest category to go through. There were so many parts that had strange names or didn't make sense to me. Just go slow and do your best. Nail the easy ones and use process of elimination. My bag slit during shipping so where it reads "6ea. M6-…" I was missing several of those small washers and nuts and bolts. Hopefully this won't happen to you. Check everything VERY thoroughly. I had two #44 hose clamps instead of a #40 and a #44, so read the sides carefully. Even use a ruler to measure the length of bolts that are supposed to be xx mm long. Trust me, I had a 20 mm bolt that should have been 25 mm.

VACUUM FITTINGS. (Although mine was labeled 'Vacuum Line Assy') See where it reads "72" – 5/32 Vacuum hose"? Well, I had 48". You know what Bill at Stillen told me when I called? "48 inches is all you need, just get started.". Well, I'll tell you right now, 48" won't cut it. But at the time I trusted him and it bit me in the @$$ later when I got to that part and couldn't finish it. So make sure you have AT LEAST 72". (You'll find out why I say 'at least' later – step #38).

ASSOCIATED HARDWARE. This one isn't that fun but not all that bad. A lot of misc. parts but the description of each one is pretty accurate. I had a foam tube in my bag that seemed to play no role. Ignore it if you have one. See where it reads "1ea. M8-1.25 x 25mm FHCS - …"? Well, this is the one I was telling you about that was 20 mm long. I was sent a 25 mm bolt by Stillen after I called. My point is, do a detailed inventory check, it will save you a lot of time and trouble later.

O.k., now what do you do if you have missing/wrong parts? Or even questions for that matter? Let me give a little plug to Adam Hume at Stillen. He is the Maxima contact there at Stillen and he is a very cool guy. He went out of his way for me whenever I had a question or problem. Even if it was a technical question, he hunted down the right person who would have the answer. So, forget anyone else at Stillen, your contact is Adam:

Adam Hume:
1-800-576-2131 ext. #138
(714) 540-5566 ext. #138

(714) 540-1826 fax

adam@stillen.com

O.k., now that you have done a complete and total inventory, contacted Adam and your replacement parts are on the way, let's make sure you have everything, as far as parts and tools, you'll need before starting. Turn to page 2 of the Stillen Installation Instructions and look under "Equipment needed". Everything listed there is correct with the following exceptions:

*Item 1. Metric & SAE ...* This is absolutely correct, you will need all that but I really, really, really want to emphasize opened-ended wrenches, *especially 10mm*.

*Items 4, 5, 6 and 11*. I was confused here. Except for a few times, Stillen never tells you what to use and where. The products I purchased were:

4. Permatex Threadlocker Blue. Item# 24200
5. Permatex 2 Form A Gasket Sealant. Item# 80016 2BR
6. Permatex Anti-seize lubricant. Item# 81343 133AR
11. Permatex Thread Sealant. Item# 59214

but only ended up using two out of four. I never used items 6 nor 11. Perhaps this might be a question for Stillen?

*Item 7. Wire Crimps*. I am not exactly sure what wire crimps are. Are they the same as wire strippers? Either way, I don't see that you will need them.

*Item 9. Oil, filter, drain plug washer.* When purchasing my motor oil, I was wondering if I should be putting in more than the stock 4.25 quarts now that I have an SC. I asked this question at Maxima.org and somebody said that you should still go with 4.25 quarts. That's what I did and my oil level seems to be fine. I guess getting a new copper sealing washer couldn't be a bad idea but I didn't get a chance to during this installation. It isn't mandatory by any means.

*Item 10. Coolant.* This is optional. See step #12. If you do buy some, you will only need enough to fill the coolant reservoir with 30% - 50% antifreeze. No more than ½ of a quart.

*Item 12. .25" drill bit and drill.* Here they claim for '95-'99 models. Well, in step #28, they say only early '95 models. Either way, I didn't drill any holes on my '96. We will discuss this later (in step #28).

*Item 13. Jack Stands.* I am going to add to Stillen's "recommended" a VERY recommended. Almost mandatory, in fact. It's either jacks or ramps. I guess you could use ramps but it actually helps a lot to have a large wheel well gap for step #39. We just used two - 2-ton jacks and left the front end of the car up in the air for a week and a half.

Now, let me add my own items to Stillen's list of equipment needed:

- 6 one-step colder **sparkplugs** (NGK part number PFR6G-11). My local dealer wanted $16 each and Courtesy Nissan only wanted $8.88 each so make sure you buy them from courtesy-nissan.com. Tell them you are an .org member.

- As you will see in step #14, you may or may not choose to buy **power steering fluid** (Why Stillen doesn't list power steering fluid is beyond me).

- A **test lamp** if you are following Stillen's instructions "by the book" (see step #39).

However I didn't use one and I don't feel it is necessary.

- Many, many **rags**.

- Spare **towels/blankets** to place over your fenders/headlights/grill while working.

- A **degreaser** such as 409 or Fantastik to clean engine parts that you remove or are working on. (optional but nice).

- **Hand cleaner** (Ex. Lava or Zep-O-Kreme, etc.).

- Don't forget to wear **junk clothes**, you WILL get filthy.

- A **junk blanket or cardboard** to lie on when you are under the car.

- **A blow dryer** (to loosen stuck hoses).

- Extra **hose clamps** of various sizes might not be a bad idea.

- Latex **Gloves.** Optional but nice. Your hands and fingernails will be filthy!

- Another 36" – 48" of 5/32" diameter **vacuum hose** IF you want to completely hide your vacuum lines (more in step #38). Found at any auto parts store for under 10 cents per inch.

- A **hammer**.

- A portable **fluorescent light** (or two).

- A **metal coat hanger**.

- A **Torque Wrench**.

- A rough **file or sandpaper** with a sanding block.

- **Vice grips**.

- **Tape** (masking, electrical, duct, scotch).

- **A Camera** (if you want).

- **Throttle Body cleaner** if you so desire. This is a great time to clean your throttle body, as it will be completely exposed. Valvoline is pretty good.

- **Fuel Filter** if you are due or even near due. You will have easier access to it during this install than ever before and ever again. Great opportunity. I recommend genuine Nissan.

- Last but not least, **a friend!** (see picture below). I guess one could do this task alone but it wouldn't be just two times as hard, it would be four times.


O.k., one last thing I want to talk about. I may sound a little firm and/or rude here but it's because I feel very strongly about this. This is in regards to repair manuals made for our cars. Ex. The Haynes, the Chilton's and the Factory Service Manual. GET THEM!!! Period. I can't stress this enough. It was one of the first things I did after buying my car. I wouldn't recommend changing your spark plugs without them so you better not be trying to install a supercharger without them. The Haynes and the Chilton's are around $15-$20 so there is NO excuse for not having both (yes both). The Factory Service Manual (or FSM) is pretty pricey ($100+) so I have a harder time telling you that you have to get it. If you can, get it, if not, definitely buy the other two at least. I could not have completed the supercharger installation without them. However, even though my goal of this installation-aid is for you to be able to install your supercharger with these (and Stillen's) instructions alone, I still strongly recommend you getting the repair manuals.

Well, I guess that covers it for all the pre-install talk. If you have completed all of the above, you are now ready for the actual installation procedure! Woo-hoo, here goes…

***Installation:***

As a reminder, the format of the following installation-aid is to add to and/or correct Stillen's instructions. I am assuming you have a set of Stillen's instructions in front of you (also found in Appendix A of this write-up). As you go along, please first read the step in the Stillen instructions and then look at my comments for that step.

***Disclaimer:***

*I strongly recommend that you read this instruction-aid and Stillen's instructions over completely before you start the installation process. This will help familiarize you with the terms and parts and steps needed, to help save time later. I didn't write these as I installed the SC, I started writing them a few weeks after. The install is fairly fresh in my mind but there may be a few things I might have forgotten to add here. If anyone who has installed a supercharger before wants to make a correction/addition to my write-up, please feel free to e-mail me. On the same token, if you are installing your supercharger using these instructions and you find a mistake or want to add something, please tell me. I didn't take nearly as many pictures along the way as I wish I had. Please note I had to take many of the following pictures for this write-up after I completed the installation. Therefore, some of the pictures may not reflect the exact stage you will currently be at (ex. When you see a picture of my auxiliary fuel pump (step #28), you will see my coolant bottle in the picture (not installed until step #32)). Also, keep in mind, I have a California emissions, automatic, 1996 GLE. Some things may or may not be different on your particular car. On this token, realize when I quote a Factory Service Manual (FSM) page number, it is from the 1996 FSM (however, you can view scanned images of the FSM pages I call out in this write-up in Appendix E). And please understand this is for the V2 supercharger. The V1 is considerably different so I can't recommend using these instructions for a V1 install (however, I have included scanned images of Stillen's V1 installation instructions in Appendix B). Lastly, (this has to be said after all this is a disclaimer, right?), I am not to be held responsible for any damage that might result in the use of this instruction-aid. But with that said, I will do my absolute 'darndest' to walk you through this and make it as easy and trouble–free as possible for you. :o)*

0. Drive the car around for at least 10-15 minutes. In step #4, you will be draining your oil and therefore, you want your oil warm. When you get back, position the car where you will be working. The car will be immobile for days so make sure you choose your spot wisely. Make sure you have plenty of room at the front of the car, make sure you have plenty of light, make sure you can close your garage door if you are working in a garage, make sure you are within reach of power outlets, close to your tools, etc., etc. Your car will be up on jacks for the entire install process.

1. *Disconnect battery.* Simple enough, right? Well, what do they mean by 'disconnect'? Remove the battery from the car completely? Just disconnect the negative battery terminal? In looking at the repair manuals, they say disconnect the negative battery terminal/cable. However, I felt I should remove the whole battery. This way, you have more room to work, you have a chance to clean the battery and the battery tray and any other areas/parts that you can now get to and also, since there won't be any oil in your engine you want to make 1000% sure that your engine is not started over while you are doing the install for the next x days. Remove the battery and set it aside somewhere safe.

2. *Raise the front of your vehicle.* Like I said before, you could use ramps but I feel jacks are best. I'm not really sure why Stillen lists jack stands as 'recommended' because you can

NOT complete the super charger installation without raising the front end of the vehicle. As I said, I used two 2-ton jacks. I had never jacked up my car prior to this with anything except the stock jack. The stock jack fits perfectly in the groove underneath the car. Well, where do I put my 2-ton jack? All I did was put them exactly where you would put the stock jack but on the inside of the wall:

(Please excuse the glue from the removed side skirts (getting re-painted) and please excuse the black front bumper (I was test fitting my new ’97 bumper on my ’96)).

(Please excuse the mud 'splotchy' from the recent rains)

3. *Remove stock intake*. I recommend you skip to step #4 and come back.

Step #3 is pretty self-explanatory. However, go ahead and take out everything from intake to throttle body. Here is a picture of what you will be taking out:

See Haynes page = 4-7

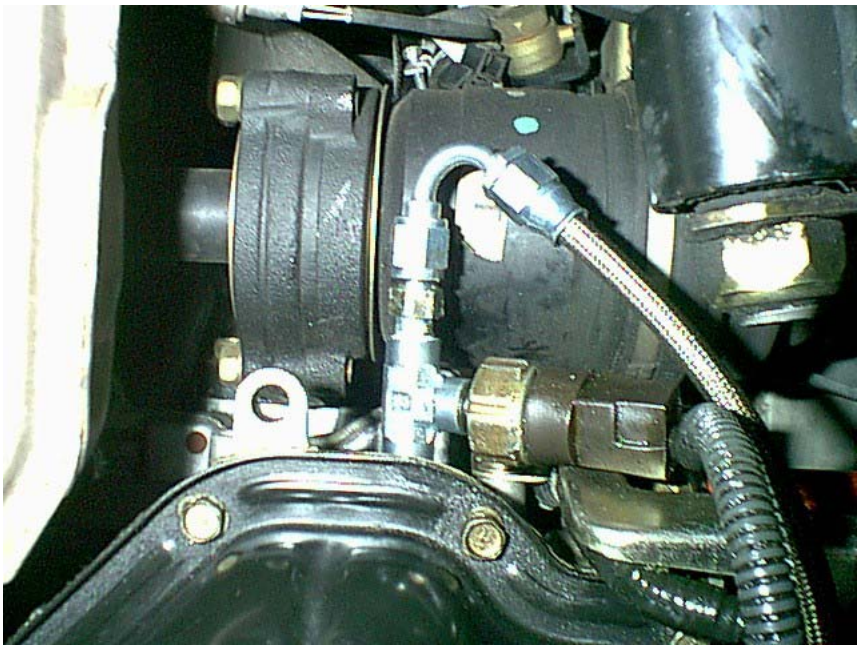
You don't have to but if you want to, feel free to take out the stock air intake at this point:

Some of the hoses are a pain to take off. Just keep at it, you'll get them eventually. If you'd like, use a blowdryer to heat the hose in order to slip it off easier. Detach all hoses at the airbox so the hoses stay in the car from the other end. These will be connected back later.

This should go without saying but make sure you save EVERYTHING off to the side. Also try your best to memorize where things came from. It can't hurt to do what I did and label EVERYTHING that came off the car. I placed tags on every removed part and taped the little parts to a sheet of paper. See picture:

4. *Drain engine oil and replace filter.* I recommend doing step #4 before step #3. You want to drain out your old oil while it is still hot. It also gives you a chance to let your oil drain while you do step #3.
   I will not go into detail and give a step-by-step in changing oil. I will assume you know how or you can visit a site that clearly shows how (www.motorvate.ca is awesome!). And the Chilton's and Haynes do a great job at showing how (and I know you already purchased these manuals!). Chilton's page = 1-38, Haynes page = 1-11, FSM page = MA-14. The only thing I'd like to add is I recommend not torqueing your drain plug at this time. What the heck, let it drain for days, get as much of the old oil out that you can. You know Wal-Mart or Jiffy Lube doesn't do this! Let it drain as long as you can and then hand tighten the plug back in for now. When you get towards the end (ex. Step #43) unscrew the plug again and get another ~ 8+ ounces! :o) Lastly, if you got a new sealing washer, then great, use it but if you didn't, just reuse your old one.

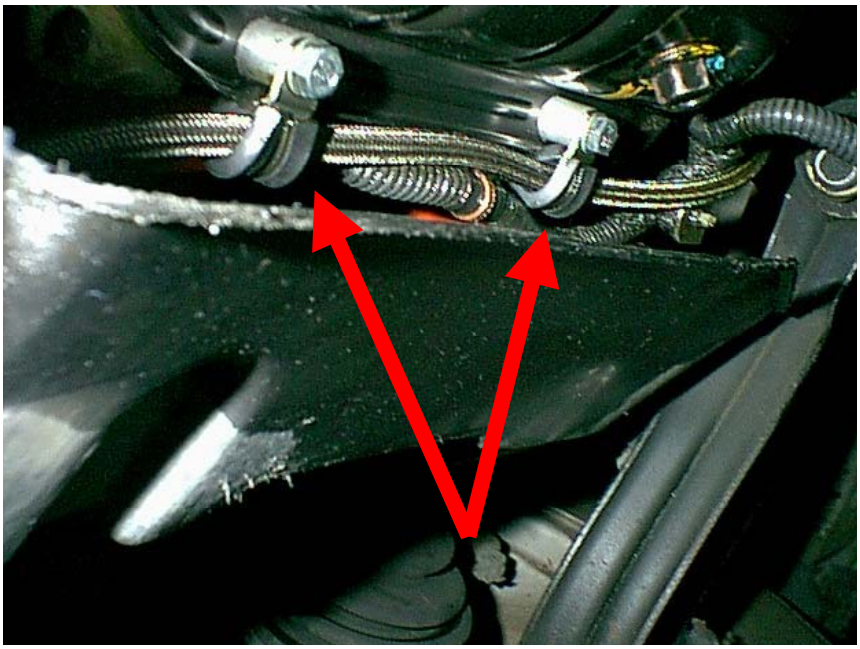
5. *Install "T" adapter.* Pretty self-explanatory. Stillen's picture (photo 1, page 2) is decent but here is an additional picture that might help a little more:



When it reads “apply liquid sealant on threads”, did they mean ‘liquid sealer’ or ‘pipe thread sealant’? I believe you are to use the liquid sealer/Form-A-Gasket (See ‘Before the Installation’ Section). However, if you read the fluorescent pink warning card that comes attached to the Vortech, it reads “Do not use any sealant or sealing tape on oil feed lines.”. So make sure you put the sealant only on the thread of the “T” that screws into the engine block. Lastly, when they say to rotate the “T” until it faces the front, right tire, it won’t face it completely perpendicularly. It will be pointed down somewhat. See picture above.

6. *Install oil feed line*. Self-ex. Just note my comment above about not using any sealant on these threads. See picture above.

7. *Route feed line along oil pan.* Pretty self-ex. and Stillen even provides a decent picture (photo 2 , page three). Chilton’s page = 2-8/9, Haynes page = 2C-6, FSM page = LC-4. See below for an additional picture:



8. *Relocate stock anti-theft horn.* On step #8, Stillen starts of by saying "On some 1999 models remove anti-theft horn from…". Well, let me tell you, I have a 1996 and I have a horn there! If you have one, you will know it. It is located between the coolant overflow bottle (removed in step #12) and the engine crankcase (the part of the engine that reads "V6 3000") and under the metal/rubber refrigeration line that runs above (it has a little blue cap with an "L" on it). Haynes page = 12-15, 19.3; FSM page = EL-245. Stillen's instructions are pretty good for this step so you should be fine. They even include a decent picture. I, however, didn't relocate my horn where they said to. My logic being, and this maybe silly but oh well, was perhaps a thief might pop your hood while the alarm is going off and simply cut the horn wire. And I also thought it would look a hair better hidden as opposed to right there in the open. I installed mine in the open space under the right (passenger) headlight leading down to the bottom of the car. You access this from under the car working up. Here is a picture of my horn looking up:

The picture might seem a little hard to envision at first but if you get under your car, peel back the plastic liner on the front, right most corner of your car and look up, you'll see this. As you can see I used the top most bolt of that 3-bolt triangular, black piece (used for towing I guess?). You can do what I did or you can do what Stillen suggests, the choice is yours. Either way, just make sure that the horn does not touch any walls around it. Otherwise it will sound awful when it goes off! Trust me. ;o)

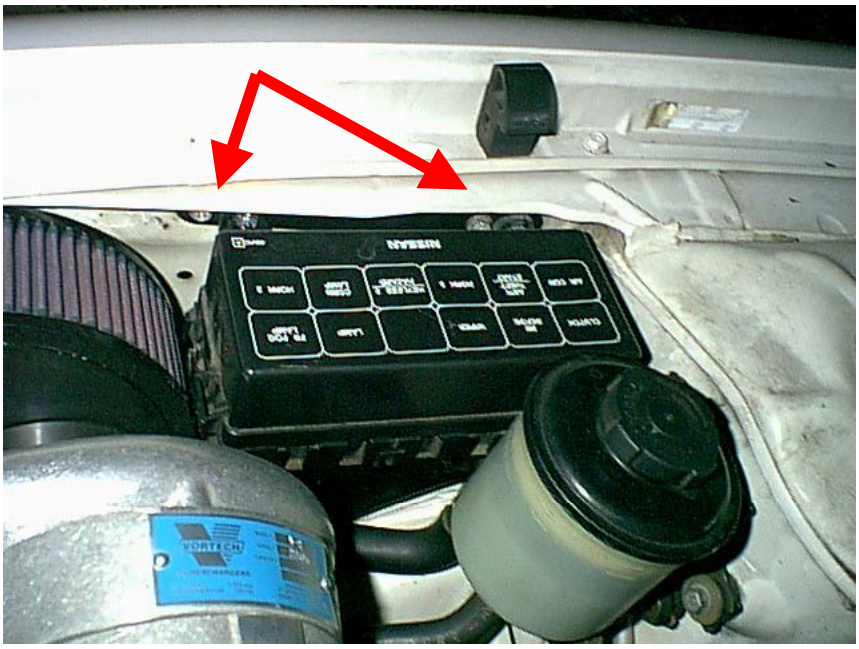
9. *Remove serpentine drive belt.* Unfortunately I didn't take any pictures of the stock belt, adjuster pulley, tension adjuster or lock nut. So I will try my hardest to walk you through this in words. Chilton's page = 1-21, Haynes page = 1-15/16, FSM page = MA-10. The factory service manual does the best job here. Luckily, there is a downsized copy of the FSM page in the Chilton's so that will work fine too. Look at the picture of the pulleys labeled "With air conditioner", then follow the arrow from the idler pulley to the top, right. That is a great diagram. Just as Stillen says, first loosen the nut on the idler pulley, and then loosen the adjusting nut. The pulley nut is accessed from below, the adjusting nut is accessed from above. Before you loosen the idler pulley nut, take the time to remove enough of the plastic fender lining so that you can access the pulleys more easily. You will be spending a lot of time here and it's going to be hard enough without the lining in the way, trust me. We only removed a screw/pressure clip or two, just enough to push it out of our way, not remove it completely. Save your clip/screw(s). Loosen the pulley nut, loosen the adjuster nut, and now remove the stock drive/serpentine belt.

10. *Remove factory idler pulley assembly.* Pretty self-ex. Just be sure to save all the parts (you will need some later – ex. step #16) and keep them together and try to keep them in the order they were on the car. You will access this from under the car. It is the idler pulley that you just loosened in step #9. Remove the nut holding the pulley wheel, remove the pulley wheel, then the three bolts holding the assembly in place.

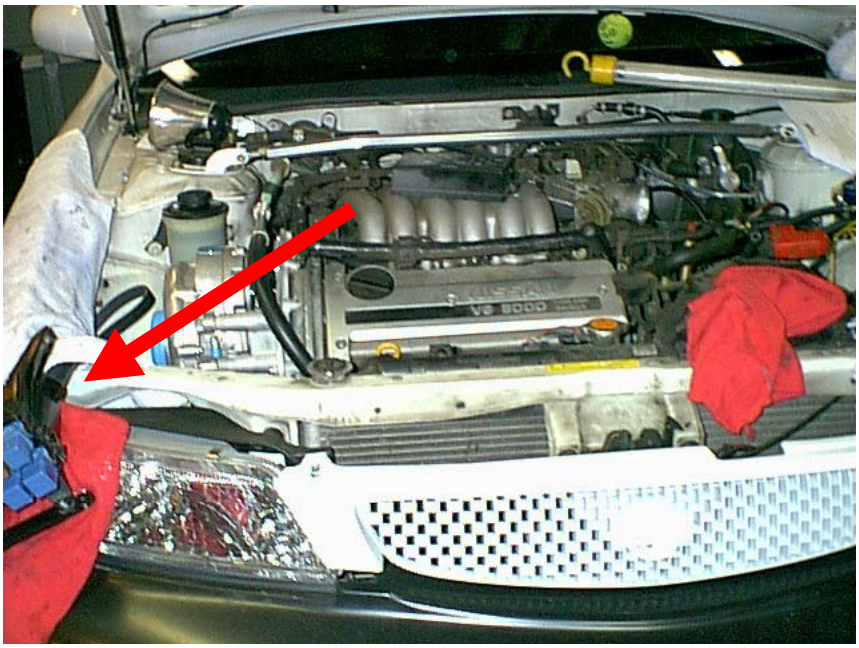
11. *Install drain back plate.* Stillen did a pretty good job explaining this but I'll elaborate just a little. The plate you want to remove is held on by 4 bolts. The plate you are removing is black and you are replacing it with an exact-shaped one that is brass/silver in color and has a tube protruding from it (found in your 'Oil Drain Back Assy '). The location of this plate is right above the crankshaft pulley and idler pulley and just to the left of the adjuster nut you used in step #9. If you look at the diagram discussed in step #9 above, you will see it. You can see more pictures of it in FSM page = LC-9 (where they call it a 'water pump cover'). Once again, Chilton's reproduces this diagram on their page = 3-27. Lastly, look on Stillen's own page 7 of their installation instructions, photo 9. You can see it connected to the Vortech. Also, look at the V1 instructions, page 3, step #12. There is a picture of the drain back plate installed and called out (there are some cases where the V1 instructions are more complete/better than the V2 instructions. Go figure…). Don't confuse this water pump cover with the Chain Tensionor Cover. They look very similar. The Chain Tensionor Cover can be seen in the photo/diagrams mentioned above, located just above the Power Steering Oil Pump. When you get the water pump cover off, you will see dried up junk all over the perimeter. Do your best and spend the time to scrape it all off. Get in the crack too! It can be a little tight in there. I took a nail, bent it 90° and put it in my vise grips. Use the liquid sealer and put the new cover on. If you can get a torque wrench in there, then torque the bolts to ~10 lb. I didn't use one though.

12. *Remove engine coolant overflow bottle.* This is another easy step. Start by removing the hose attached at the radiator cap. Chilton's page = 3-23, Fig. 59; Haynes page = 3-4, 4.12, arrow 'C'. Slide the easily squeezable hose clamp up the hose a few inches (I say easily squeezable because just wait until you see the clamps provided by Stillen! - ex. step #32). Then pull the hose off. Now have your friend hold that end of the hose up in the air to prevent spilling and pull the reservoir straight up off its mounting bracket. Haynes page = 3-5, 5.2. Set the whole thing aside, careful not to spill. If you want, you can very well leave the coolant in there the whole time and never need to refill it. However, it might not be a bad idea to drain it and clean out the bottom. Mine was pretty bad. I used a long, skinny metal rod, with a sock wrapped over it to get in there and wipe up the bottom. It was filthy! I didn't get a price but you could replace the whole thing if your reservoir is really bad. Finally, remove the coolant reservoir mounting bracket. There are two bolts that use either a 10mm hex or a #3 phillips. Save everything together. I taped my two screws to the bracket and taped a label 'coolant reservoir mounting bracket' to it. Just in case. ;o)

13. *Relocate fuse box.* You're basically doing all this just to gain about 1" of clearance (by moving the fuse box 1" towards the firewall). Stillen did a decent job in describing what to do in this step so there isn't much for me to elaborate on. I would like to add the following however. I have this thing where I hate doing permanent damage. For the most part, everything done in the supercharger installation process can be reversed and brought back to stock, if need be – for whatever reason. Here is one of the few instances where you can't go back to stock since they ask you to trim off the peg under the foot of the fuse box. I did not trim it off and it still works just fine. I just let it get squished off to the side a little. I'll let you decide what you want to do. Here's a picture at angle so you can see it installed with the adapter:



The other thing is we ended up taking the fuse box back out again when trying to get the Vortech in place. I recommend putting it back in but not tightening the bolts all the way or just leaving it out for now. Note you will need to remove the two end relays closest to the fender (the theft warning relay and the AC relay) to take the fuse box on/off. Store them somewhere safe and remember to place them back in the correct location when placing back. Here is a picture of how we left the fuse box out while we worked (with the adapter attached). Just drape it over the headlight/fender with towels underneath it. Sorry for the poor picture. You can see it in the bottom, left corner of the picture, slightly chopped off:



14. *Reroute power steering lines.* O.k., here's the deal. I did not receive my power steering lines with my supercharger (and unfortunately didn't notice while doing my inventory!). So, I'll be honest with you, I never rerouted mine. :oI I simply unhooked them where they were attached to the car to give me more slack and just 'squished' them out of the way the best I could. It works and to this day, everything seems fine. They go directly under the Vortech and I believe they even touch. However, when I touch them with my hand after driving, they do not seem to be hot. I can't recommend not rerouting yours. All I can tell you is I didn't reroute my power steering lines and mine seem to be fine. You have to decide for yourself. And since I didn't do this myself, you're on your own here if you decide to reroute yours. Hopefully the Stillen instructions are adequate. I'm not even sure how you disconnect the power steering hoses without the brake fluid spilling everywhere. ? I will point out though that the repair manuals recommend 'bleeding' the system whenever any of the power steering lines have been disconnected. It doesn't seem to be much more than turning the steering wheel side to side with the front end in the air. I think this is what Stillen means by 'cycle steering rack'. Chilton's page = 8-28, Haynes page = 10-16, FSM page = ST-5. Haynes seems to do the best write-up on bleeding. Also, I obviously didn't add the power steering cooler that comes with the 1999 supercharger. Good luck. If someone wants to add a write-up for this step, please send it to me. Here is a picture donated by my friend Jaime:

Also see the V1 instructions, step #18. Note that if you look at the color version of Stillen's picture in the V2 instructions on page 4, photo 4, you will see the power steering lines are blue. Mine are black and Jaime's are black. I believe the blue ones were provided with the V1 only.

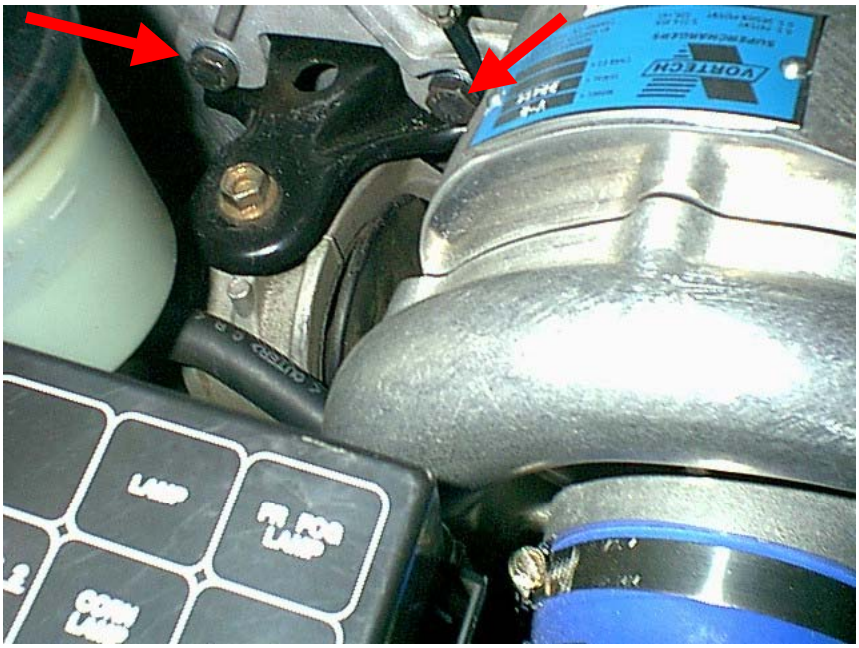
15. *Install Cam Timing Sensor Retainer.* This step took us forever. We had no idea what the heck a 'cam timing sensor was', where it was and what the heck 'rotate the sensor so that the retainer indexes on the sensor' meant! ??? Luckily, we had the help of the repair manuals. Luckily, you have this installation aid. :o). O.k., how do I explain this? The cam timing sensor (or the camshaft position sensor as it is called by all three repair manuals) is an electrical connection plugged in to the side of the engine, directly above the oil drain back plate you installed in step #11, above the tension adjuster you adjusted in step #9 and just to the right of the engine mount. Haynes page = 6-13, FSM page = EC-199. There is a very good picture in the Haynes (picture 10.6) with an arrow pointing to it. However, the best picture is probably in Stillen's own instructions on page 5 (and 7, although not as good). On page 5, look directly below the words 'Hole #3'. That is the camshaft position sensor. And it also shows the retainer installed. Lastly, if you look at the V1 installation instructions, step #19, you'll see that they do a 20x better job at explaining what to do and they even show a great picture (why would Stillen omit that from the V2 instructions?). Unplug the connector and place it safely away on top of the engine, where it will stay for a while. Next remove the one screw holding the sensor in place. When that screw is out, the sensor will now rotate freely. What you want to do is rotate the sensor about 45° counter clockwise (as shown in the photo) and install the retainer with the original bolt to hold it there. Stillen says to not

tighten it completely at this time but I disagree. You won't need to access it anymore after this and why give yourself one more thing to remember? Go ahead and tighten it all the way.

16. *Install the new belt adjuster bracket.* O.k., here's where it starts getting fun. Stillen does a pretty decent write-up for this step and they even include a picture. However, I can guarantee you that if you put the belt adjuster in right now, you will have to remove it again and again for future steps. I must have at least three times. What I might suggest is doing a quick, 'dry run' to get a feel but then leaving it out for now. While working under the car, install the new belt adjuster bracket found in your 'Belt Adjuster/Pulley' bag. It goes exactly where you removed the stock one from in step #10. The order from back to front is the adjuster bolt, the adjuster plate, the stock washer, the adjuster rod (and then later the pulley wheel and nut). You can see this pretty clearly in Stillen's picture, page 5, photo 6. Now put the plate in place and put in the bottom two bolts. Don't even bother putting them all the way in until you are ready (I'll tell you when :o).

17. *Install rubber drain back hose onto drain back plate.* You can skip this step altogether. Unless you are Plastic Man or Inspector Gadget, forget doing this in the order Stillen suggests. They say to install the drainback hose to the drain back plate with leaving the other end loose. They later want you to lower the supercharger on to the hose and then somehow tighten the clamp. No way. We'll be doing this the opposite way.

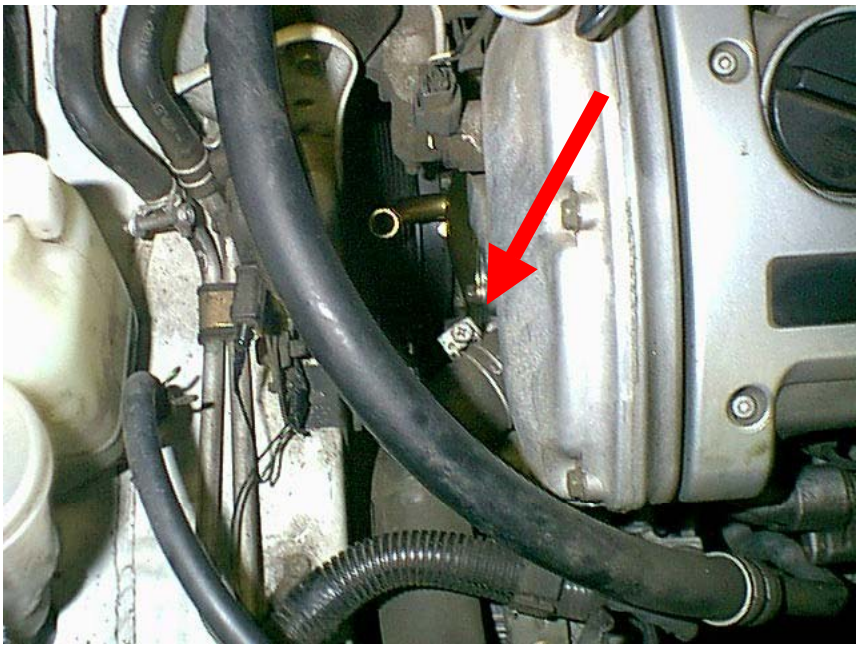
18. *Remove two M10 bolts from front engine mount.* Stillen kills me! They will have a step like step #20 or step #30 that have a million hard, separate steps in one and then they will make a step by itself of 'remove two bolts'. :oD Needless to say, this is a piece of cake. There is a very good photo in Haynes page = 2B-21, 18.14, arrow A. Just follow the two, short arrows and not the single long arrow. I have also included a picture below:



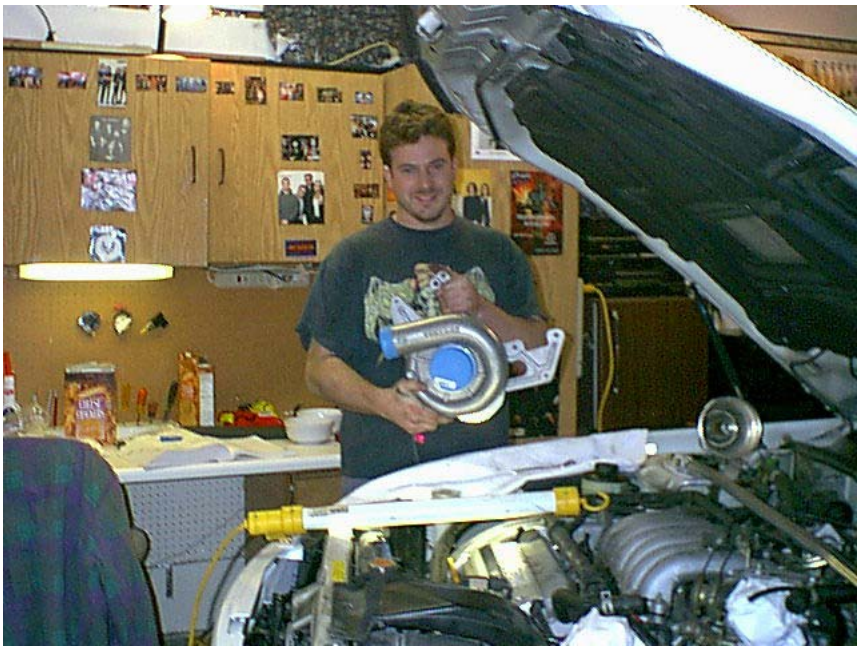

They are the two matching bolts at the top of the picture directly above the black part of the engine mount. Remove them and save them, as you will need them later.

19. *Remove the cranked bracket, remove upper alternator bolt, loosen lower bolt, turn hose clamp on thermostat joint.* The best pictures I could find are Haynes page = 5-12, 13.10 and 13.13. But even those aren't the best. The alternator is located just to the right of the idler adjuster pulley you dealt with in step #s 10 and 16. Haynes page = 5-2, arrow 5. Also see the Stillen instructions page 5, photo 7, under the words "Hole #16". First remove the upper alternator bolt and the cranked bracket. What is a 'cranked bracket'? This is hard to explain. It is attached at the top off the alternator. Here is a picture of it already removed:

Now regarding the loosening of the lower bolt. If you notice, you can't do this from the front (Haynes is incorrect in their picture 13.13). Look at the FSM page = EL-34. You will see it is accessed from behind. That's all I can tell you. You have to just struggle through this. It is a b. to get to and a total pain in the a. And even when you do get to it, good luck turning it. In other words, this part sucks! Luckily you only need a fraction of a turn on the lower bolt to be able to swivel the alternator into position (using a hammer that is). Just get under the car, find an access point from somewhere behind the alternator and try to contort and bend your arm in funny positions to locate the bolt. Then come in with the tool once you have found it. Use an extension on your socket for this one. Now for the rotating of the thermostat hose clamp. The thermostat is located just to the right and above the drain back plate installed in step #11. See picture below and Haynes page 3-2, 1.1, arrow 5 and page 3-3, 3.14b. 1.1 shows the hose still connected which is how yours will be, obviously. 3.14b shows the hose removed. Another picture of the thermostat (with the hose removed) can be seen on Stillen's page 5, photo 7, just below the words "Hole #18". You are to loosen the hose clamp, rotate it and re-tighten it. Stillen says to rotate it so that it can still be accessed once the super charger is installed. Well, I highly doubt that you will be able to access it anyway, no matter where you rotate it! And if you could, I don't think you would be getting to the actual thermostat very easily. Anyway, I do recommend still rotating the hose clamp because the "knuckle" of the hose clamp will get in the way of the supercharger if left in the upper half (9 o'clock to 3 o'clock position) of the hose. With that said, place it anywhere in the 4 o'clock to 8 o'clock position. I'd guess 6 o'clock would be as good a place as any - in the theory that it can be accessed later from below, although doubtful but at least it's out of the way. Here is a photo of mine before rotation. Mine was in the 9 o'clock position stock.



20. *Install the Vortech!!!!* (Sorry in advance for the long write-up for this step.) All right, this is the step you have been waiting for. First, have your friend take some mandatory pictures of you holding the blower with a big, goofy grin on your face. This will be your last chance. See below:



(Just remember to shave and comb your hair, unlike myself :o)

Next, follow the Stillen instructions. They are half-decent in this step. Remove the bolt above the thermostat housing, "Hole #18" as seen in the Stillen instructions, page 5, photo 7. Replace with the stand-off bolt (brass bolt with threads and also a threaded hole in its hexagon-shaped top). Then remove the stock bolt from "Hole #16" and install the second stand-off bolt. However, please note that Stillen is calling out the wrong bolt in their picture (page 5, photo 7)!!! The correct bolt is directly above and to the right of the one they have called out as "Hole #16". Now remove the 4 stock bolts from holes #2, #5, #7 and #9. Here we go, the fun part. It is now time to mount the supercharger to the engine! Or should I say "offer up" (whatever the heck that means??) as Stillen puts it?! :oD First, I want to mention a few things Stillen doesn't address. One, if you did purchase a smaller pulley for your supercharger, I hope you have installed it already. If not, last chance. Secondly, there are going to be some things in your way. Already talked about is the fuse box. You can try to squeeze the SC in with the fuse box in place but I had mine out (see photo in step #13 above). There is also a metal/rubber refrigeration line that runs above the engine mount. Haynes page = 3-13, 12.21. It needs to be bent and pushed out of the way. Pushed towards the driver side of the car. It runs through a support that is attached to the passenger side strut tower. You can bend that support forward by hand. Lastly, the metal, "L"-shaped/tear drop-shaped bracket used to mount the cam timing sensor's wires (see step #15) to the top of the engine needs to go. It is a metal "L" that has a little hole for the cam timing sensor's little, plastic plug and it has a black loop zip-tie ring to wrap around the neighboring black wire tube that runs parallel to the refrigeration line just discussed. It is located on top of the engine, near the engine mount. See Haynes page = 2B-21, just to the right of the bubbled "A" (although the black tube is missing in this picture). Here is a picture of it off the car:

That should be it for any obstacles. However, do a quick 'dry run'. Place the supercharger into position on the side of the engine and double check everything as far as clearance goes.

If everything looks good, you are ready to install the super charger. Well, not quite yet. Remember when we skipped step #17? You need to do this now. Take the rubber drain back hose discussed in step #17, and place it over the brass nipple on the bottom of the super charger. With the supplied hose clamp #10, tighten it down as much as you can. I say as much as you can because even when mine was fully tightened, my hose still rotated around the SC nipple. I was worried but it hasn't leaked yet so it should be o.k.. I want to discuss a few things here, real quick. One, I had some kind of a pipe cleaner-looking piece in my drainback hose. See picture below:

I had no idea what it was. I didn't know whether to leave it or remove it. Was it meant to be there? Was it an accident? Is it some kind of functional filter? I trusted Stillen knew what they were doing and I ended up just leaving it. When I later talked to Adam at Stillen, he told me it was there so if the hose were to get bent, it can't fold in on itself. However, he told me what I have is the old style and the new style doesn't have anything inside. Great! He sent me a 'new style' drainback hose but it's too late now. However, everything seems to be fine. So if you have one too, don't freak out (like I did!). Next I'd like to point out that Stillen talks about cutting this hose to fit. Well, I never cut mine. It seemed to go on just fine. Lastly, the drainback hose has a unique shape to it. Which way does it go? Which side goes on the supercharger and which goes on the drain back plate? I couldn't really see an advantage one way or the other. Just look it over and give it your best guess. I had two colored dots on mine, a blue and a white, I believe. If it helps any, I placed my blue dot on the engine-side and the white dot on the SC-side. O.k., so you have attached the drain back hose to the supercharger, you have installed the #10 hose clamp and tightened it down. Now take the other #10 hose clamp and place it on the other end of the drainback hose. Just tighten it enough so that it won't slip off. Now it is time to install the charger! Start aligning it up to the side of the engine while slipping the drainback hose over the tube on the drainback plate (installed in step #11). It's hard to get the hose all the way on the tube but

you'll have another chance from underneath in a little while. Take Stillen VERY seriously when they say to install the bolts for hole #s 5 and 7 first. These holes line up with the two bolts "held captive", as Stillen puts it, in the super charger. You will need an open-ended 10mm wrench for this job. Start screwing them in. Switch among the two frequently so as to drive them in at the same rate. It is easy to scrape up the pulley here (the stock one anyway – if you have a smaller pulley, it might clear) so be careful. You might even consider putting some tape or paper over the pulley where the heads of the captive bolts hit it. When you are about half way feed the cam timing sensor wire (from step #15) through the oval hole on the supercharger plate. See step #25 of this write-up. Be careful not to pinch it as you continue tightening. Tighten the two bolts pretty far down but don't do the final tightening. By now the supercharger should have 'sucked' itself up to the engine and all the holes should be lined up. Follow the instructions by Stillen on page 6. Start with holes 1 and 3 (use photo 8 on page 6) and continue from there. They aren't kidding when they talk about hole #18. You will need to access this from below. And if you think this is bad, the worse is yet to come!!! As I said back in step #16, if the idler pulley is attached, it will make hole #18 very difficult, if not impossible. Remove the idler adjuster pulley now, if you haven't already. Also, while you are under there, go ahead and slip the drain back hose down the drain back plate tube as much as you can and tighten the hose clamp. It won't be easy but it's doable. Don't forget hole #s 14 and 15 while you are under there. Now tighten all the bolts completely. Time to take a break. Kick back, look at your, shiny new Vortech in your engine bay and have a few Cokes. :o)

21. *Align alternator with hole.* This will take some patience. Actually, I'm not really sure how to put this in words. The only way to actually move the alternator is with a hammer. Start by using say a nail or a small screwdriver. To test if the holes are lined up, stick it in the hole from behind the alternator to see if it goes all the way through. You can kind of get a feel for

the direction the alternator will need to be rotated by doing this. Then tap the alternator with the hammer in that direction. Just keep repeating this process until you get it. It will take some time but you'll get it. Now for the second part of this step "Fit the oil drain back hose to the nipple…" Yeah right! Now do you see why we did this step out of order?

22. *Install 2" pulley with side rails.*

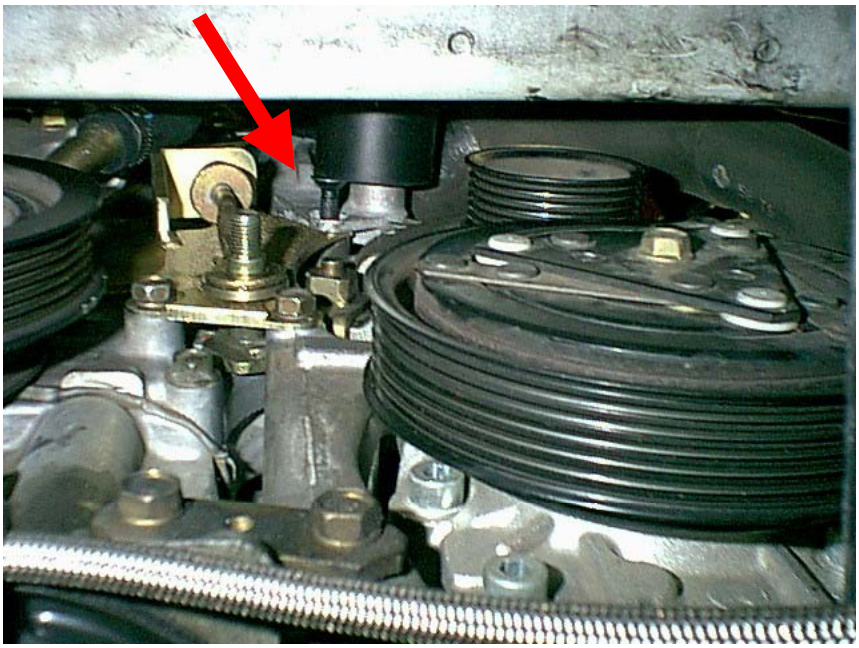
23. *Install 2" pulley without side rails.*

I am going to combine my write-up of steps #22 and #23. You'll see why in a second. Refer to the picture in the Stillen instructions, page 7, photo 9. Anyone you speak to who has installed a supercharger before will tell you how big a pain in the a. these two steps are. Here's the deal. If you put in the upper pulley first, you block access to the 3rd hole on the belt adjuster/lower pulley (hole #14, Stillen page 6, photo 8). However, if you do what Stillen says and perform step #22 before step #23, there is no way in h. you will be able to reach up in there to perform step #23. You have two choices.

1.) Install the belt adjuster pulley bracket/plate (the one from step #16 that I told you to leave off the car for now) with all three bolts but leave the 2" pulley off (unlike what Stillen tells you to do) and try to then get the upper 2" pulley without side rails installed before going back and installing the lower 2" pulley with side rails. Note you need to hammer the sleeve into the 2" pulley without side rails (nice of Stillen to mention this, huh?) It will be tight and might even seem like it won't fit. But keep hammering, it will go.

- or -

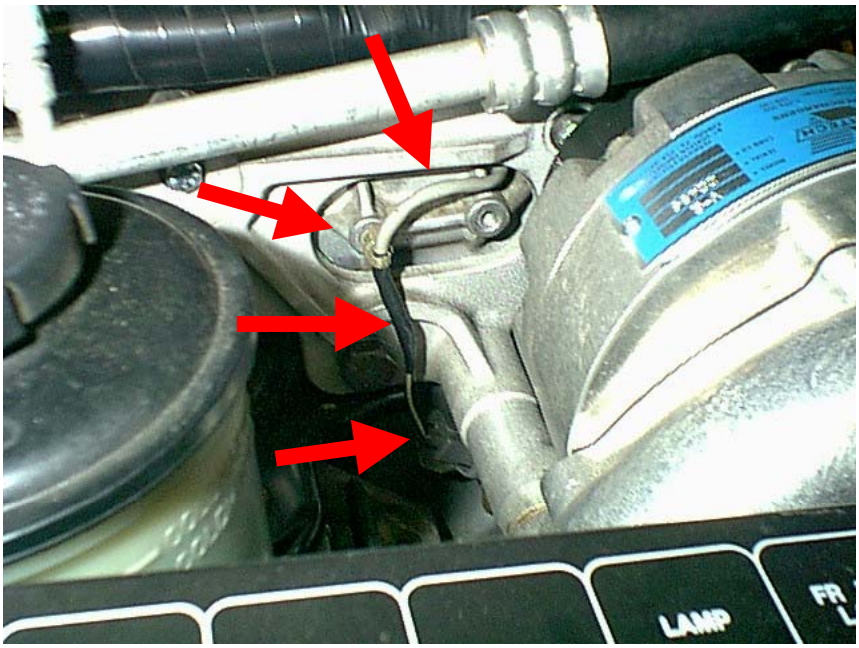
2.) Do what I did and continue to leave the belt adjuster bracket/plate off the car. I tried to do what I mentioned above in part 1.) but I still found it too hard to work up that high, in such a tight spot, with the belt adjuster in place (even with the pulley off the bracket). So here's my trick. First, don't forget to hammer the sleeve into the 2" pulley without side rails. I installed the upper 2" pulley without rails (located to the 11 o'clock position of the alternator, 6 o'clock position of the thermostat housing) and screwed in the bolt ever so slightly. Literally like 4 turns in (as loose as possible but with NO chance of falling out). Now you can finally install the belt adjuster bracket (from step #16). Slip the top, right corner under the upper pulley you just installed. Place in the lower two bolts but keep the pulley off for now. Now, here is the tricky part. If you take your time, you can get the third, upper allen screw in the adjuster bracket, even with the upper 2" idler pulley in place. See the picture below:



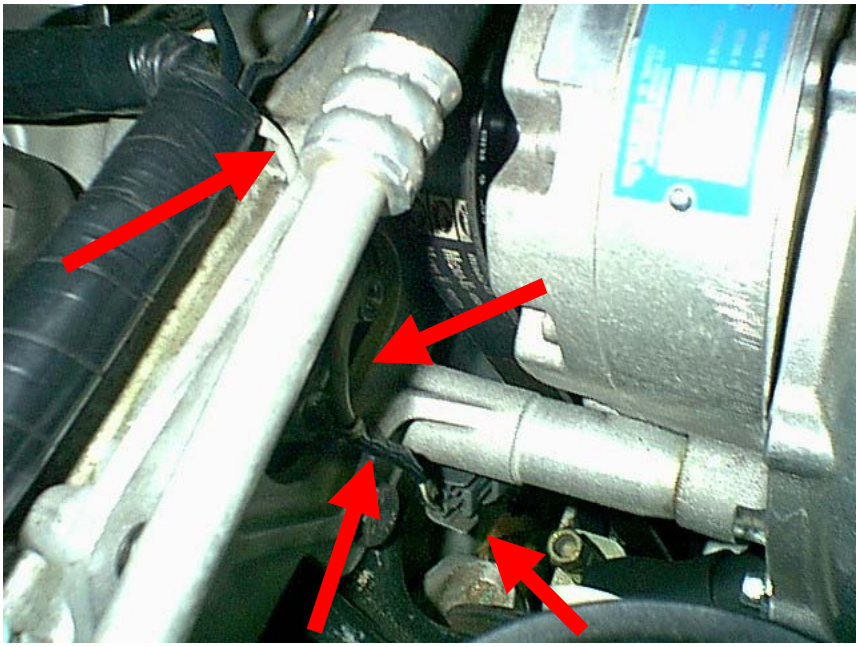
With the tips of your fingers, slowly and patiently screw this allen bolt in. As you get it in further and further, you can now start screwing in the bolt for the 2" idler pulley without rails. When everything is in by hand, you can now tighten them with tools. Now you are ready to install the lower 2" pulley with rails per Stillen's instructions in step #22. Tighten all three bracket bolts but still leave the adjuster nut loose. Now tighten the lower alternator bolt loosened in step #19. Wipe your brow, congratulate yourself and take a breather.

24. *Route drive belt.* The picture provided should be more than enough. It is difficult to get this belt in place but keep at it, you'll get it eventually. The way I did it was I routed the belt around every pulley except the air conditioner compressor pulley. Chilton's page = 1-21, FSM page = MA-10. And I just muscled it on from there. Next tighten the tension adjuster nut (from above) until you get the tension you want in the belt. You can use Stillen's method of checking for tension which is to rotate the belt (from the AC to the crankshaft) in a "corkscrew" direction util you can't rotate it past 90°. The other way is by measuring deflection. A perfect write-up for this is Haynes pages = 1-15/16. Now tighten the adjuster pulley nut (from below).

25. *Plug in the cam timing sensor.* Stillen says to route the sensor (see step #15) over the supercharger mounting plate, but I ran mine through, as discussed in step #20. See picture:

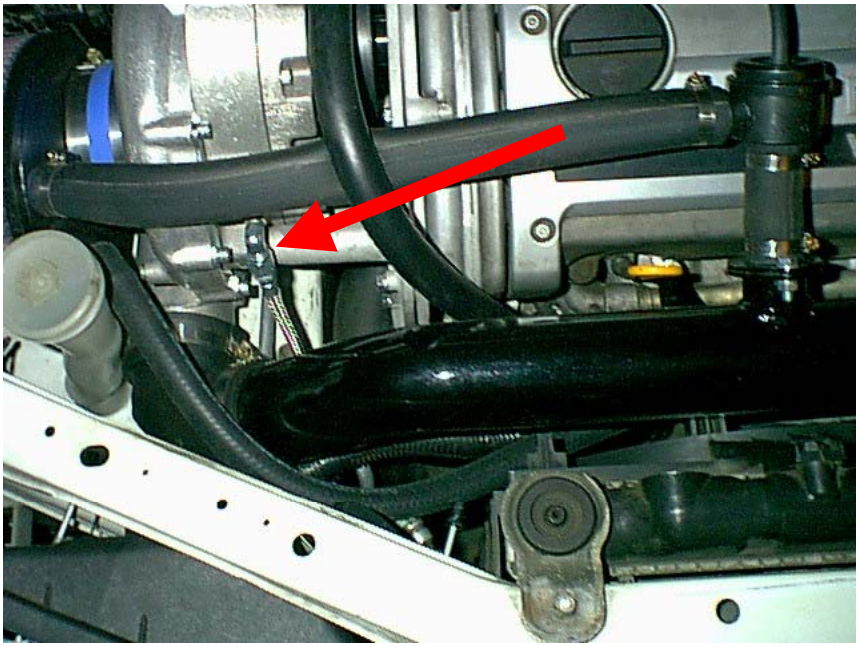



Note the cam timing sensor wire going through the supercharger mounting plate. Also note that the plastic knob fits nicely into one of the two holes on the engine. Here's a different angle:



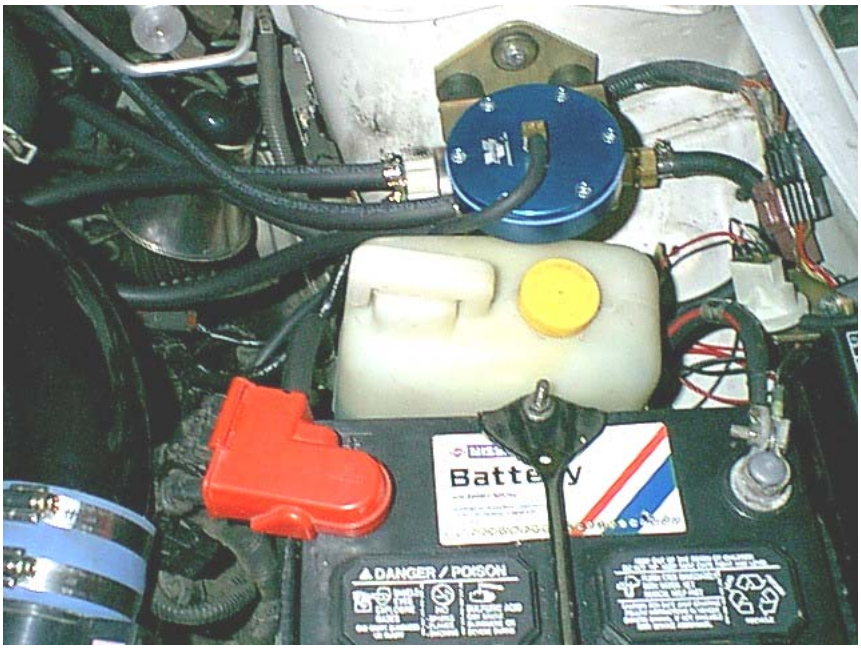
What's funny, and I noticed this after I installed my wire through the SC, if you look at the V1 instructions, step #23, they instruct to run the wire through the SC as opposed to over it. :o) As for Stillen saying to tighten the retaining bolt, you should have already done that in step #15 (now do you see why I said to tighten it before the Vortech was in?).

26. *Route oil line to supercharger*. There isn't much I can add to this one. Simply route the oil feed line that has been dangling under the car since step #7 up to the supercharger. Try your best to do a neat, efficient run but avoid unnecessary contact with things around it. You will screw it into the supercharger as seen in the picture below:



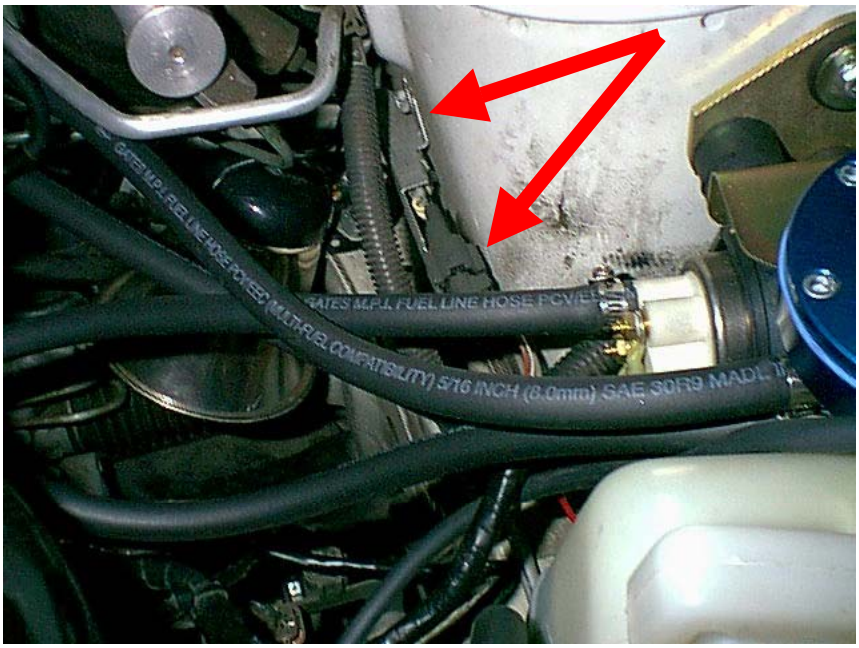
You can ignore the underlined warning by Stillen. Since it is a 90° connection, it can't go anywhere. You'll be fine. If you look at the final picture of their Maxima on page 14 of the Stillen instructions, they have a straight-on connection. Perhaps that's why they have that disclaimer.

27. and 28. *Install auxiliary fuel pump and pressure regulator.* The wording by Stillen on this one is a little off. They tell you what to do if you have a '99 automatic, a manual transmission or an early '95, but everyone else is not addressed. ?? Well, if you just look at their photo on the top of page 9, it should make sense to you. Also take a look at the pictures in the V1 instructions pages 5 and 6. The auxiliary fuel pump mounts to the driver side strut tower. See picture below:




(Note how the vacuum line – attached later in step #38 – on top of the aux fuel pump points straight to the front of the car. In Stillen's pictures, it faces towards the right side/passenger side of the car. This would actually be preferable for a cleaner run but the vacuum line connection 'brass square' felt firmly fixed. You might be more daring and try to rotate it 90º but I just left it as-is.)

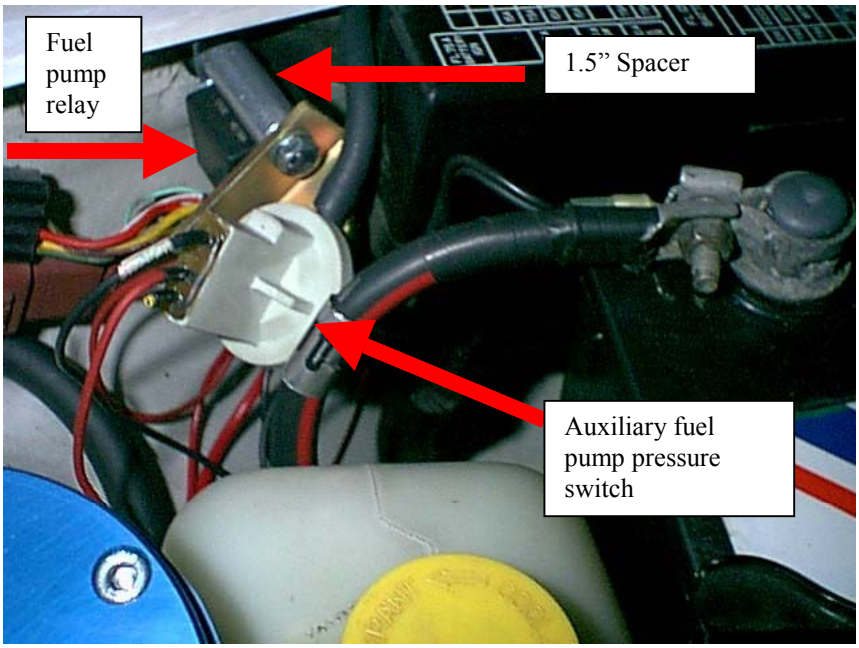
Even though I do not have a 1999, I still had to follow step #27. However, I found my own place to relocate the ballast resistor instead of what Stillen shows on page 8, photo 10. I placed mine on the inner side of the driver side strut tower. See picture below for my location:



(please ignore that illegal P.A. speaker down there. ;o)

Do this relocation if you need to on your vehicle as well. You can choose the location I chose or the one Stillen recommends. I did not need to drill any holes so if you have an early '95 that requires drilling, I cannot comment on it. You are now ready to install the aux. fuel pump. Just make sure that you disassemble the FMU and reassemble per the Stillen instruction before installing. Before installing, you might want to test fit it and check for hood clearance. Mine was angled too high and would have hit the hood/hood liner. I had to bend it while it was off the car, otherwise the rubber just stretches instead of the metal "L" bending. There is one more thing I'd like to mention. In step #30 you will be fitting the fuel hoses to the aux. fuel pump installed in this step. We had to take ours back off to get the hoses on. I recommend cutting and installing the hoses now while the aux. fuel pump is off the car. Take a look at photo 12, page 9 of Stillen's instructions. While this illustration is a tad overly complicated, it is helpful. We'll talk about this diagram again in step #30 but for now just take note of the four hoses and their lengths, 21.5", 21.5", 23" and 30". Cut these lengths from the 8' of 5/16" I.D. hose found in your "Fuel Pump & Management Assy." Now attach these per photo 12, page 9 noted by the 'bubbled' 15 and 16. (If you look over at the table in photo 12, '15' and '16' are not listed but my guess is Stillen meant for them to stand for the 5/16" I.D. hose and #4 hose clamps. After attaching the hoses, you can now install the Aux. fuel pump.

29. *Install auxiliary fuel pump pressure switch.* This step is pretty straightforward. Stillen's picture, page 8, photo 11, is o.k. However, here is an additional picture:



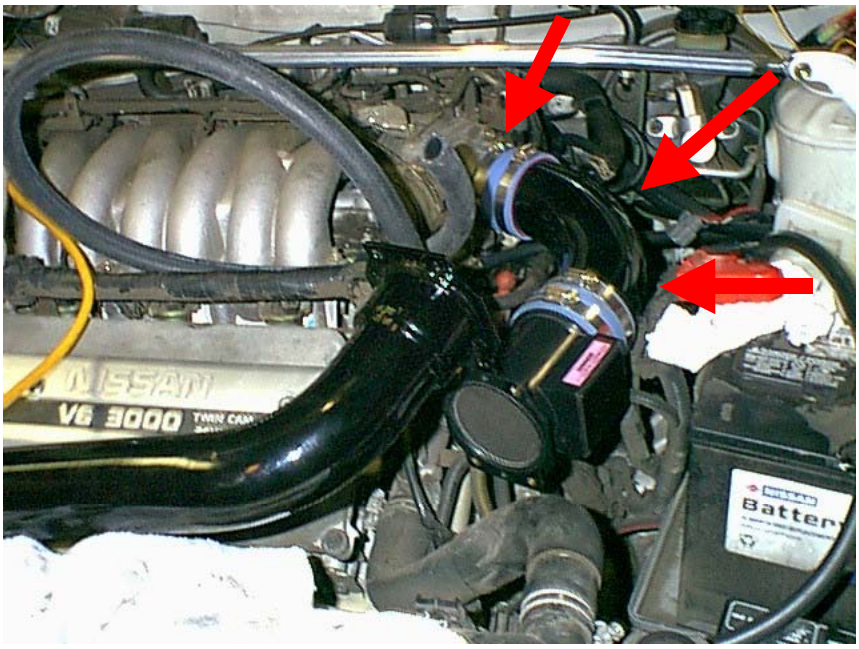

The only thing I’d like to comment on, is that they never mention the Auxiliary Fuel Pump Relay!! They only talk about the Pressure Switch. Well, what we did was install it before the spacer, up against the fender. (see photo above). Note that V1 instruction step #31 does mention both the switch and relay.

30. *Attach fuel lines.* This step picks up where step #28 left off. This is a fairly simple step, you just have to pay extra special attention to which hose goes where. Photo #12, page 9 of the Stillen instructions is very helpful. Stillen does a decent job at explaining how to disconnect the existing fuel lines and connect the new fuel lines (keep a blow dryer handy, some of the hoses are very difficult to remove!!). However, it is a little difficult to understand the exact location of some of the connection points Stillen mentions. We’ll go down the list, one item at a time. Note that the upper (blue – not black as incorrectly stated by Stillen) puck-shaped part is the F.M.U. (Fuel Management Unit) and the lower, (white) cylindrical part is the F.P.A. (Fuel Pump Assembly). First, follow the existing fuel path like Stillen mentions. This will help you get familiar with the OEM fuel route. Follow the path coming from the top of the fuel filter. See Chilton’s page = 1-16 and Haynes page = 1-20 for the location of the fuel filter (at the firewall on driver side). The path gets a little tricky and is easy to lose in that hose/tube ‘jungle’ but try your best. You will see that it comes out the top of the fuel filter (let’s call this point ‘A’) and then goes into a brass tube to the right of the throttle body (point ‘B’). It comes out on the left side of the throttle body right next to the fuel pressure regulator (point ‘C’). See Chilton’s page = 5-6, Haynes page = 4-10, FSM page = EC-13 for the fuel pressure regulator. Also see a good picture of the fuel pressure regulator in step #38 of these instructions. From there it goes into the fuel rail located to the right of the crankcase breather hose (see step #33) (point ‘D’). Next note that the return line brass tube is located just above the first brass tube mentioned as point ‘B’ above. You will see that it comes out

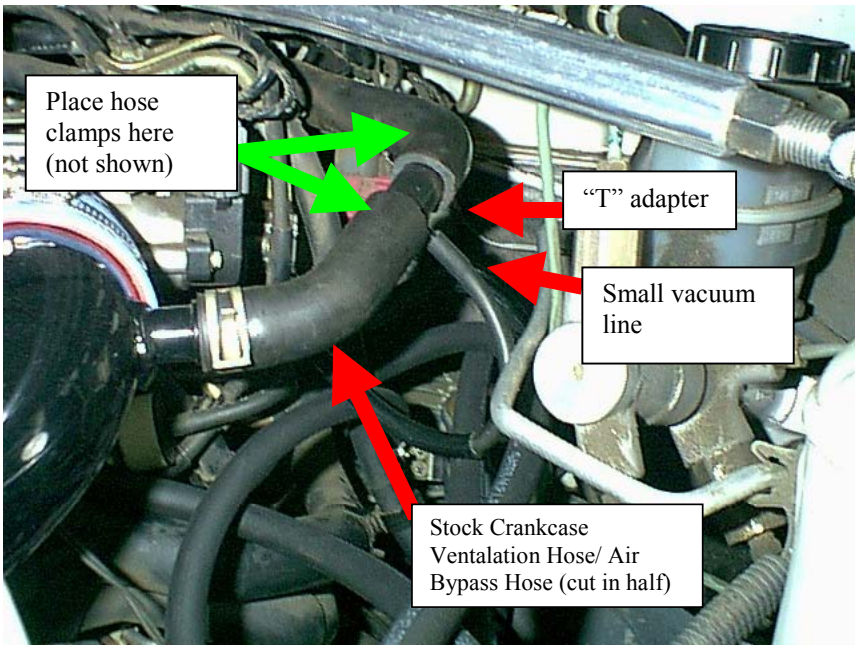
of this brass tube (point 'E') and runs back to the gas tank, running just along the side of the fuel filter. Let's call the hose running back to the gas tank point 'F'. Now that you are familiar with the stock route, let's hook up the four hoses we need to hook up. I'm going to try to do most of this with words as it would be hard to show all this 'spaghetti' in pictures. First disconnect the OEM hose at the fuel rail inlet (point 'D') and connect the 21.5" hose coming from the F.P.A. 'Out' side which you already cut and installed to the F.P.A. in step #28. You can remove the stock hose at the other end, point 'C', and remove it from the car. Next run a line from the top side of the fuel filter (point 'A') to the 'In' side on the Fuel Pump 'Assembly using the 30" hose you already cut and installed to the F.P.A. in step #28. Note now is the time to install a new fuel filter if you planned on doing so. Next disconnect the OEM hose at the pressure regulator outlet/fuel rail return line (point 'E') and connect the 21.5" hose from the F.M.U. to point 'E'. Finally, hook up the 23" hose you already installed to the 90° brass fitting on the F.M.U. to the hose going to the gas tank (we called this point 'F'). This is the stock hose that was connected to point 'E'. Use the 5/16" barbed joiner (coupler) and the #4 hose clamps to connect hose to hose. You can now remove the hose that ran from point 'A' to 'B'. Also note that the brass tube from points 'B' and 'C' (running underneath throttle body) will be left abandoned. That's it! I hope you were able to follow me with all that 'A', 'B', etc. stuff, I just didn't know how else to explain it. :o)

31. *Install pressure tubes*. If you want to clean your throttle body and haven't already, now is your last chance. First retrieve your Ambient Air Sensor from the stock air box you set aside in step #3. The correct term, used by all three manuals is Intake Air Temperature Sensor, or IAT Sensor. Chilton's page = 4-16, Haynes page = 6-11, FSM page = EC-120. See picture below:

However, keep in mind there are two different types of IAT sensors and I have the 2-bolt flange style. If you have the push-on type, you will probably need the adapter and O-ring Stillen talks about. Since, I didn't need the adapter nor O-ring, I can not comment on their installation. I believe the Chilton's shows a diagram of the push-in style (page 4-16, Figures 41 and 42). According to Stillen, mine should have just pushed right in. Wrong! If you have the 2-bolt style, like mine, you might have to remove the two cylinders protruding from the IAT sensor. They look as though they don't remove easily but a simple tug with some needle-nose pliers will prove otherwise. Use a little liquid sealer and install the IAT sensor to the 90°x3" black tube. Now install the 90° tube to the throttle body. See picture below:

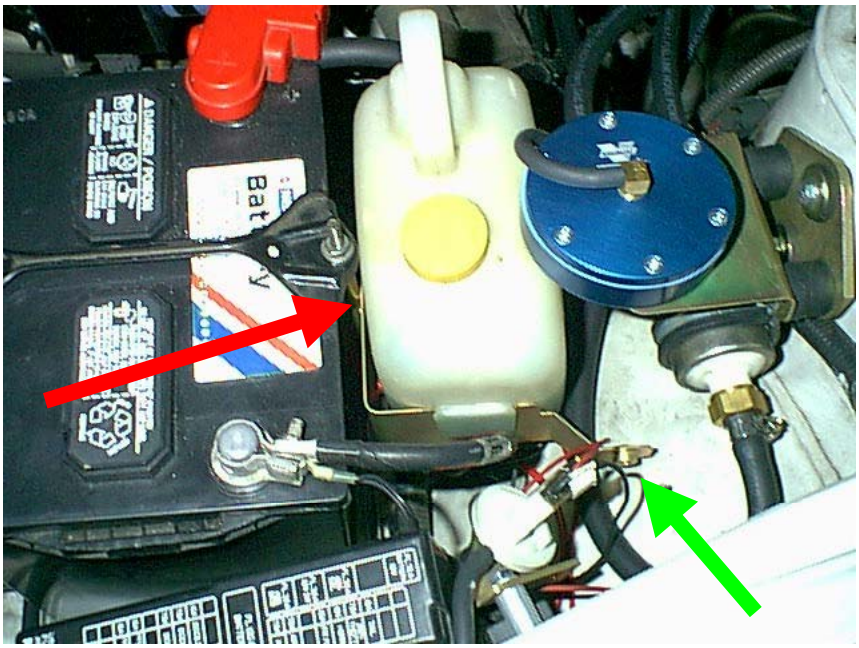



Please note that you will not have your M.A.S. nor long pressure pipe installed at this point (I regret not taking more pictures as I went along – sorry). Next is the air bypass hose and small vacuum line (disconnected from stock air box in step #3). I believe the correct term for air bypass hose is Crankcase Ventilation Hose. For a picture of the hose in the stock location, see Haynes page = 4-7, 9.2b, arrow 1. You can also see the little vacuum line just below the hose clamp on the Crankcase Ventilation Hose in that picture. Stillen says some models will need an adapter ('T' adapter) for the ventilation hose and vacuum line. I did and I'm not even sure why you wouldn't. Here's the part that had us scratching our heads for half an hour. Stillen simply says "Install the "T" shape air bypass adapter provided in kit between the nipple … and the air bypass hose…". Well, it doesn't take Einstein to realize a metal tube will not hook directly up to another metal tube of equal diameter! With a little brainstorming and looking at Stillen's finished product on page 14, we realized the "T" should fit in the middle of the stock crankcase ventilation hose. Just cut it in half and insert the "T". See picture below:

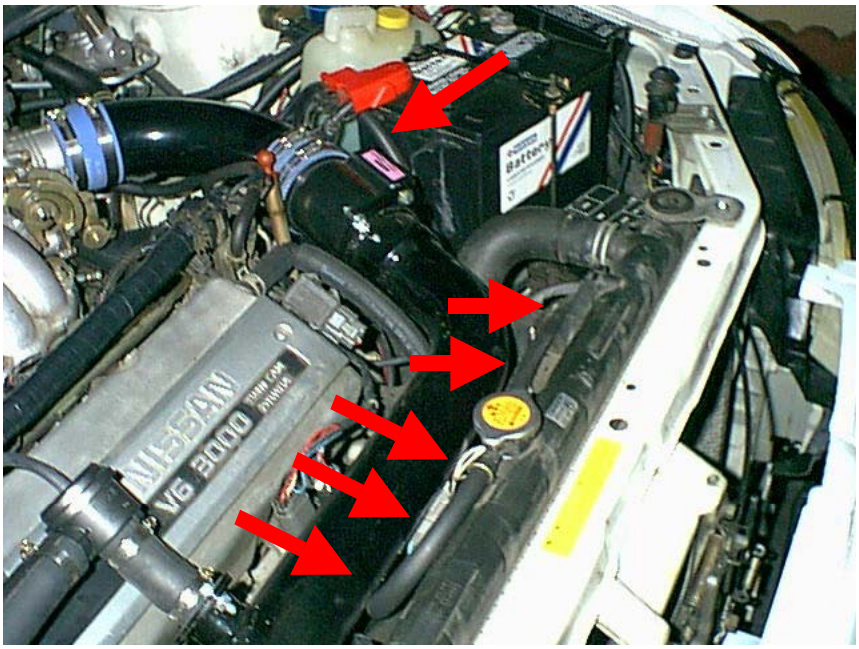



The one thing I reeeeeeealy want to point out is, although I do not have them shown in the picture above, MAKE SURE YOU INSTALL HOSE CLAMPS on either side of the "T" adapter on the cut hose. See green arrows above. This is very important. I did not and one day my car started running like cr@p. I had no clue why and I was so bummed. Turns out the hose slipped off at the "T" adapter. (Thanks Jim for discovering that!) Next fit the small vacuum line to the "T", see picture above, and install the M.A.S., see Stillen's finished product page 14 or my finished product.

32. *Install coolant overflow bottle*. If you left the battery out of the car (step #1), you can opt to place it back in the car at this point. I, however, continued to leave mine out just so I had a little extra working room. I put off this step (#32) for a little longer. You will need to have the battery in for step #39 so you can decide if you want to skip this step and leave it out for a little while longer or do it now. Install the battery mounting rod through the coolant bottle tube, like Stillen says. Be careful not to spill the coolant if you never drained it out (step #12). See my finished product picture at the end of this write-up, the finished product picture on Stillen's page 14, the two photos for step #44 in the V1 instructions, and see picture below:

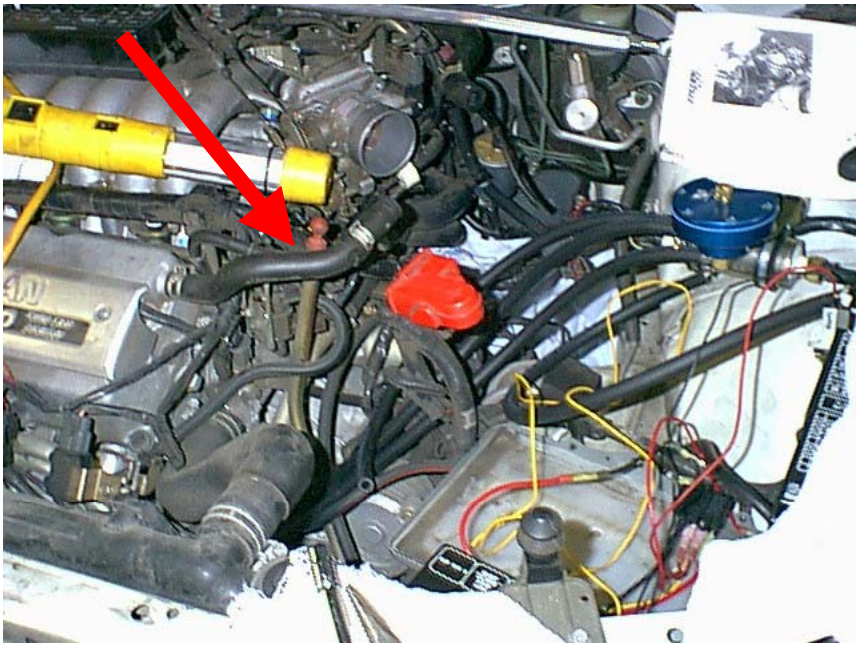


There is one thing I'd like to point out. You'll notice that the coolant bottle bracket has an extension with a threaded hole in it. Please see green arrow above (the bottom, right arrow if you printed this out in black and white). What is this for? I have absolutely NO idea!! If you figure it out, let me know. :o) I just left mine as-is. The second part of this step is to run the provided hose from the radiator (near the radiator cap) to the coolant bottle you just installed. See picture below:

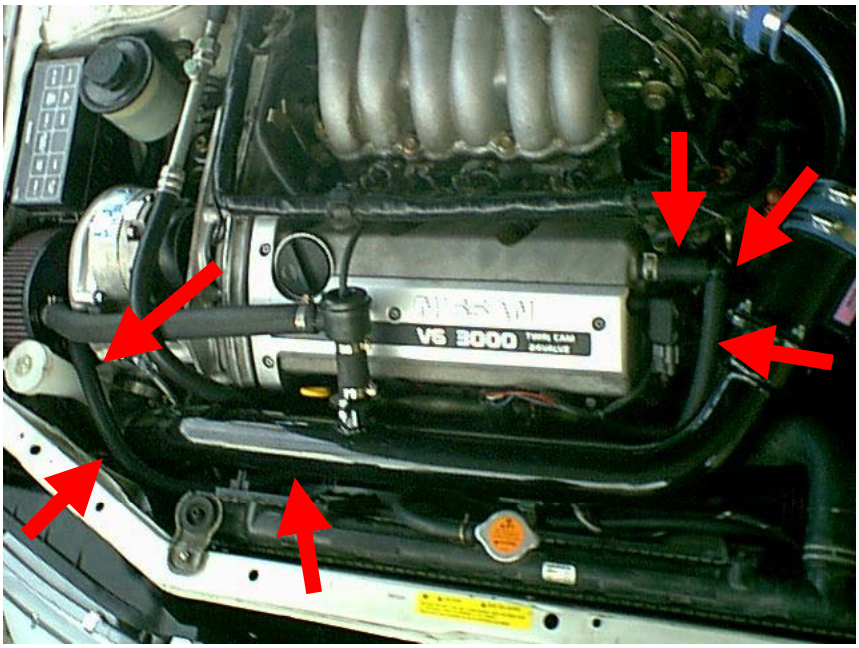


Once, again, there is something I'd like to add to this. You'll find out that the hose clamps provided by Stillen are extremely difficult to work with. In my personal opinion, very unsafe as well. They are very, very stiff and hard to open and, when placed in pliers to spread them open, feel like they could slip and shoot out fast at any second. This is why I mentioned possibly just re-using the OEM clamps which, by comparison, can be simply opened by hand! You decide what you are going to use but if you use the Stillen clamps, be careful.

33. *Remove and replace OEM crankcase vent hose.* See Haynes page = 4-7, 9.2b, arrow 8 for location of OEM hose or see the picture below:



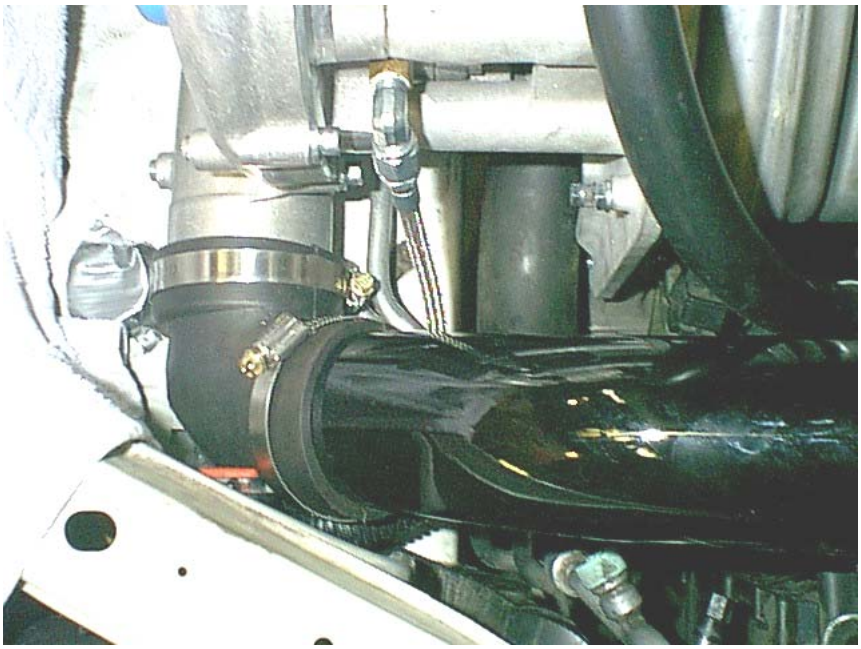
See picture below for finished product:



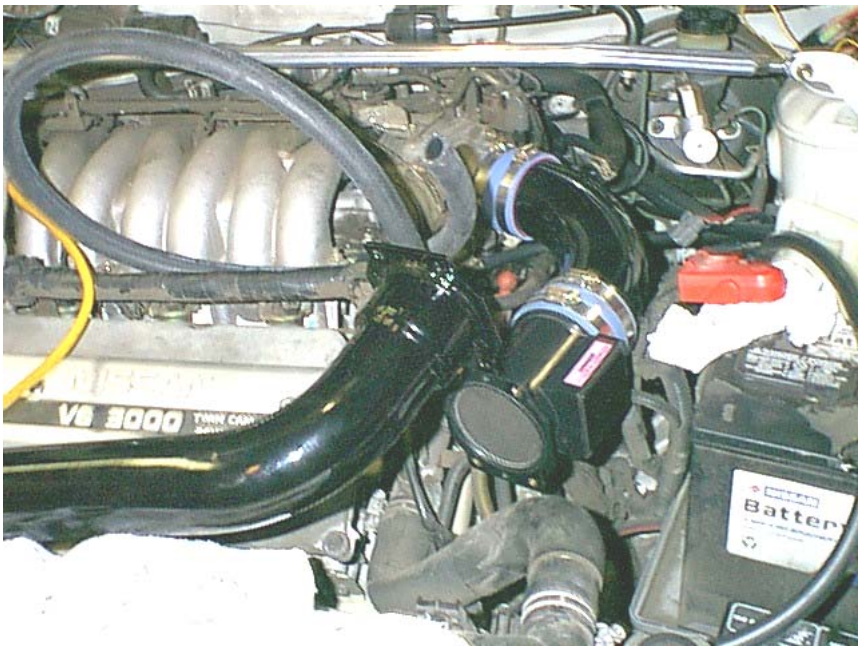

You won't have your air filter installed at this point so just leave the hose loose for now.

34. *Remove plastic panel and bracket from behind passenger headlight.* This is an easy step and self-ex.

35. *Install long pressure pipe.* You're getting there! This is another exciting step. :o) Regarding shaving the cooling fan, as you know I hate doing permanent damage. Well, trust me, I tried to not do this, but realized it is necessary. Use a rough file and sand down the 90° end to a 45° chamfer. Stillen's picture page 11, photo 11 is fine. Now mount the pressure pipe to the Vortech using the 90° molded hose and clamps. See picture below:

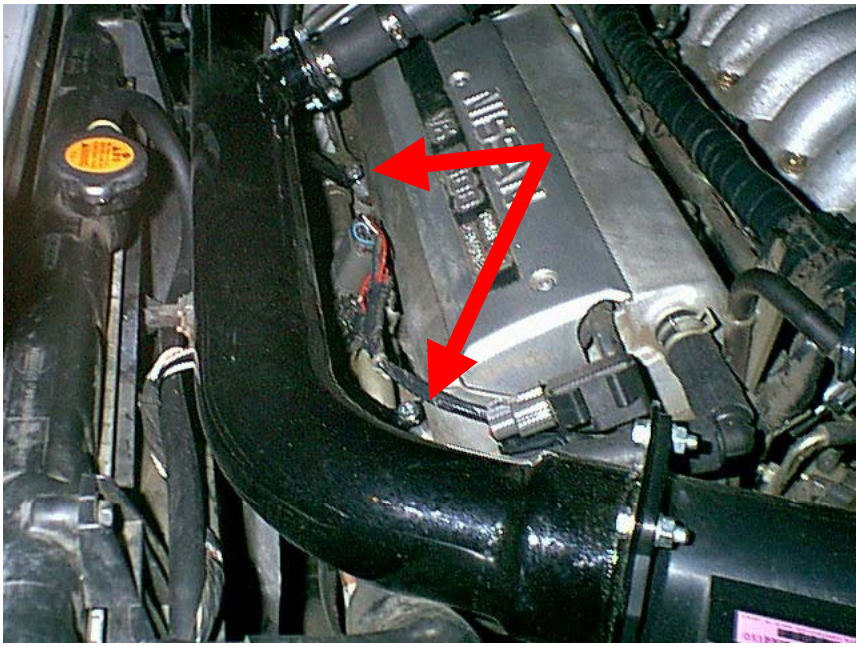


What I found to be best was, while the pipe was off the car, go ahead and install the 90° elbow on the charger and tighten the hose clamp (#44) all the way. Then place the pressure pipe into the other end of the 90° elbow without tightening the clamp (#40) yet. Now attach the other end to the M.A.S. installed in step #31. See picture below repeated from step #31:




Fitting the spacers in is not fun. It takes a lot of patience and some creative thinking. We used one of those long, bendable, little claw tools to hold the spacer in place while we lowered in the bolts. It's not difficult to drop the spacer into the engine several times while

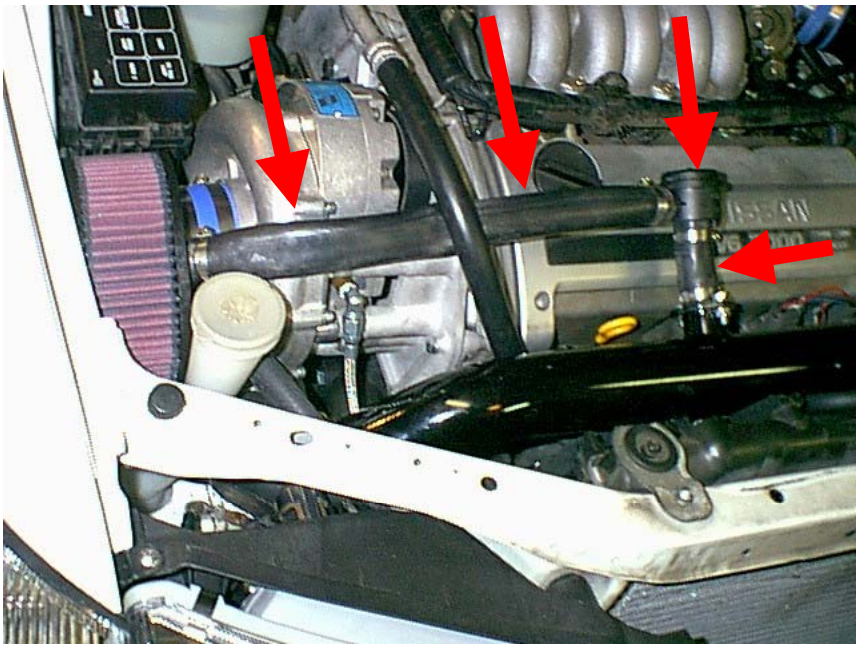
doing this. :oD But you'll get it eventually. Here is a picture of the spacers, bolts and split washers installed:



Now go ahead and tighten all bolts from this step and step #31.

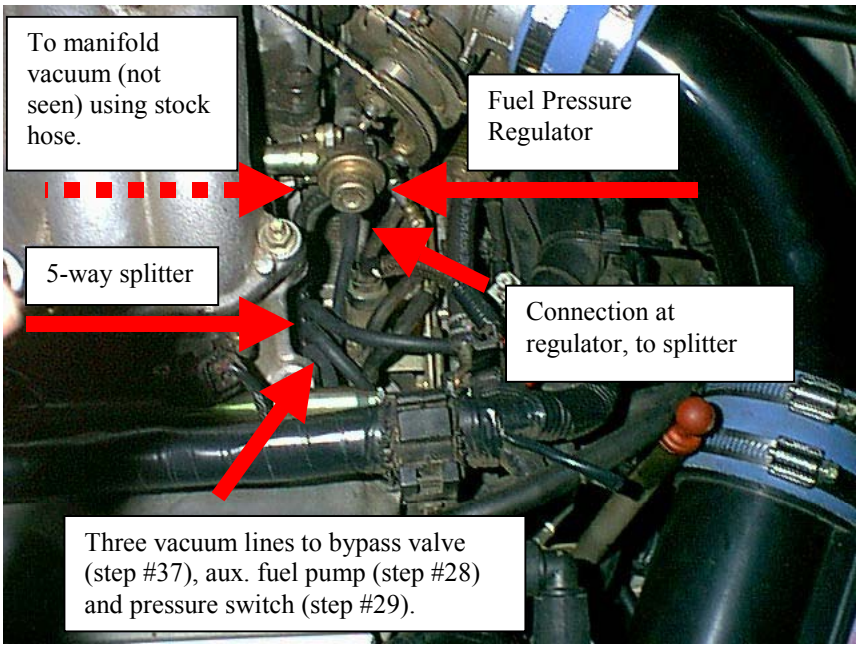
36. *Remove SCV control vacuum check valve.* I do not have a 1999 model so I did not have to do this step.

37. *Install Bosch bypass valve.* This step is self-ex. Here is a picture of the finished product:



Once again, you won't have your air filter on at this point. Also, note that I ran my bypass hose under the Air Conditioning refrigeration line. If you look at Stillen's finished product picture on page 14, you will see that they ran theirs over. I felt it kinked less by going under, you can choose for yourself.

38. *Route vacuum lines*. Stillen does a very good job here with their diagram on page 12, photo 16. I just want to add that I do not agree with the lengths that they tell you to cut. For example, 1.5" is way too short in my opinion for the line from the o.e.m. pressure regulator to the 5-way vacuum splitter. I used around 6-8 inches. The other lengths may be adequate to reach and get the job done but I feel they should be longer so that you have more slack to run them neatly and out of site. This is why I mentioned earlier that you might want to purchase additional 5/32 vacuum hose. I did not write down all the lengths I used, unfortunately, and it would be difficult to explain in words the paths I took for each line or to show pictures of each run. So I will leave it up to you for your best judgement. Here is a picture, however, of the vacuum line coming out of the regulator, to the splitter, and to the manifold:

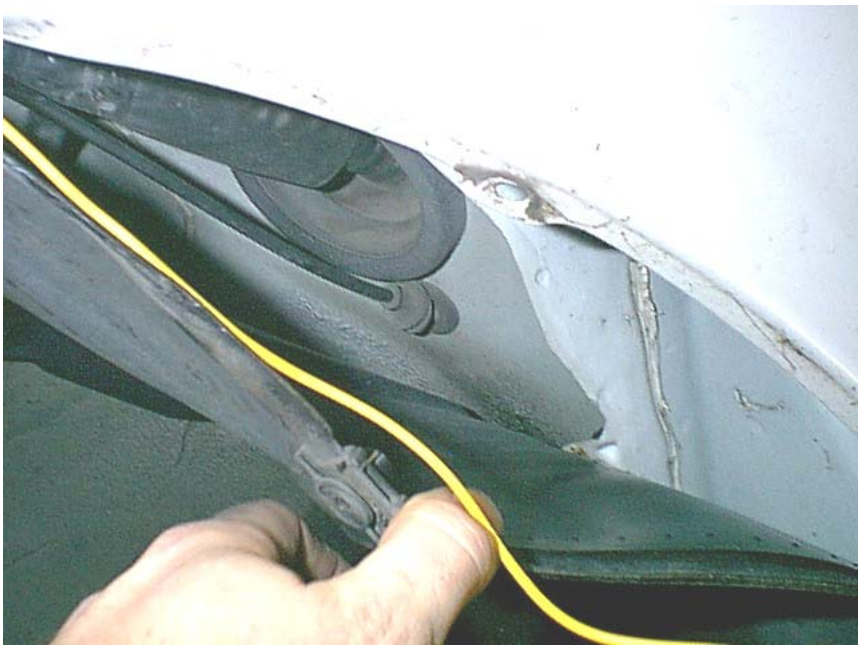



Start by disconnecting the o.e.m. hose connected to the o.e.m. fuel pressure regulator. Chilton's page = 5-6, Haynes page = 4-10, FSM page = EC-13. It will be stubborn, but you'll get it eventually. Now take the free end of the hose you just removed and place it on one of the two end tubes on the 5-way splitter. Then take a piece of vacuum hose that you cut (mine was 6-8" as mentioned above but yours may vary depending on where you want your splitter to reside) and run it from the other end of the splitter to the connection on the fuel pressure regulator that you just removed. Now run the vacuum lines for the remaining three tubes on the splitter to the bypass valve (see step #37), the auxiliary fuel pump (see steps #27/28) and to the auxiliary fuel pump pressure switch (see step #29).

39. *Auxiliary fuel pump electrical connection.* If you haven't placed the battery in your car, do so now. Also, perform step #32 now, if you skipped it. I didn't care too much for Stillen's instructions in this step, so I hope I can make this clearer for you. Aside from their diagram one page 13, photo 17, they never talk about any of the wires other than the yellow wire! You will notice two wires coming out of the auxiliary fuel pump pressure switch and four attached to the auxiliary fuel pump relay (both installed in step #29). If yours is like mine, there will also be a 'chopped' yellow wire coming out of the pressure switch. It's o.k., just ignore it, it's not used. Let's start with the two wires coming out of the pressure switch. There is a black one and a red one. The red one simply goes to the fuel pump relay (comes already connected). The black one, which has a loop connector attached to it, first runs to the battery, where the loop is connected to the negative battery terminal connection, and the other end of the black wire is connected to the negative (-) connection on the Auxiliary Fuel Pump (steps #27/28). If you look very closely, you will see a little (-) and (+) on the fuel pump. Now for the aux. fuel pump relay. Aside from the red wire we just discussed, there is another red wire (a hair thicker and a little brighter in color), a very thick red wire and a

yellow wire. The slightly thicker and brighter red wire goes to the positive (+) connection on the Auxiliary Fuel Pump. The thick red wire with the in-line fuse goes to the positive terminal connection on the battery. Now it's time for the yellow wire! You were probably wondering why I listed a coat hanger in the tools needed section. Well, now you will know. :o) You want the yellow wire to run through the fender, through the firewall and into the cabin. Start by pulling down the inside lining on the driver side wheel well. You don't need to pull down that much, just enough to see the hood release cable's grommet. Pull down the plastic liner approximately from the ~1 o'clock to the ~3 o'clock position on the front, left wheel. See photo below:

Then tape the end of the yellow wire to the coat hanger and feed it through a hole located directly behind the fuse box attached to the driver side fender. Have one person feed it in, while the other person receives it at the fender opening. Remove the wire from the hanger, pull the hanger back out and leave the wire there. See picture below:



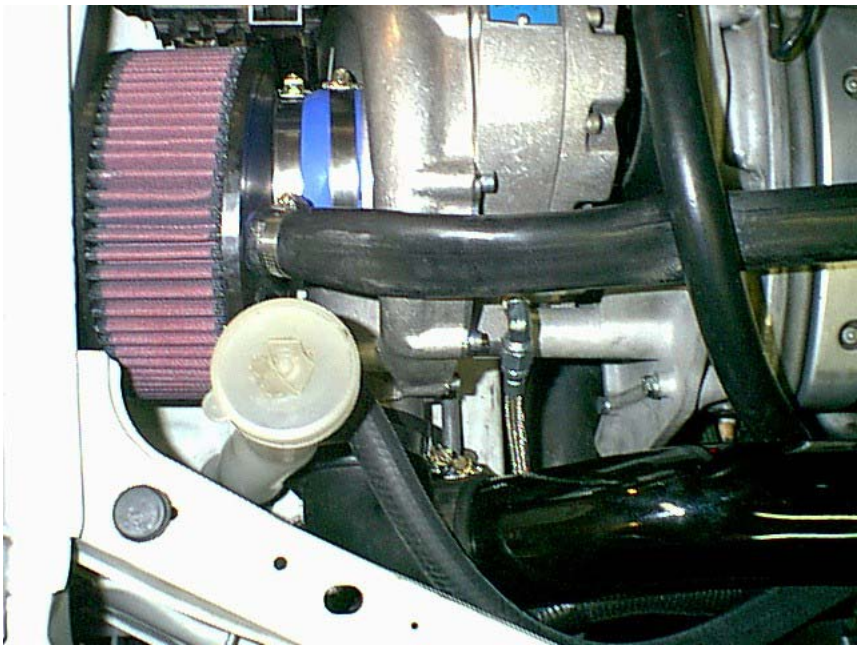
The next part isn't as easy as Stillen seems to make it. I could not figure out a way to feed the wire through either the hood release cable's grommet nor the larger grommet above it without actually puncturing the grommets themselves. Next we taped the yellow wire to the coat hanger again, and pushed it through the bottom of the large grommet. We were then able to get it from inside the cabin. See picture below:

Next remove the kick panel like Stillen says. Haynes page = 11-16. There is one screw that can be done by hand and then the panels just pull out. It takes a good wiggle, but you'll get

it. Now, when Stillen says to remove the bolts retaining the computer, I have NO idea what they are talking about. What computer?!?! When I removed my kick panel, all I saw was the two bolts retaining the zinc plate over the relays just as they mention next, but no computer (my guess is that ABS cars might have a computer control unit there. ?). Anyway, peel back the silver, sticky foil insulator (similar to car audio Dynomat) and remove the two bolts holding in the relays to access them. See picture below:

Now this next part makes no sense to me. Stillen tells you to connect the battery, listen for clicking, use a test lamp, use a probe, etc. and then they go and tell you to tap in to the yellow and black wire. LOL. I have no idea what a test lamp and a probe is, but I do know a black and yellow wire when I see one. LOL. So, if you want, you can do everything they said but all I did was find the black wire with the yellow stripe on it and tap in using supplied 3M tap. I did connect the battery and listen for clicking just to make sure, but it wasn't necessary (because only one relay has a black/yellow wire. Remove some of the tightly bound tape around the relay wires so you can tap in up high. I believe the relay I needed to tap into was the relay closest to the firewall.

40. *Slice groove in neck of windshield bottle reservoir.* As you know, I do not like doing permanent damage and I didn't even see the need to do this. I just rotated mine to clear the filter. See picture below:



41. *Install air filter.* See picture above (step #40). Stillen fails to mention the use of the steel insert. Place steel insert inside the hole in the air filter. Then use the blue hose and hose clamps. Note they do a better job in the V1 instructions, step #52 than in the V2 instructions.

42. *Connect the crankcase vent hose and bypass valve hose to air filter.* Connect the crankcase vent hose (step #33) to the black, 90° extension coming off the filter. Then connect the bypass valve hose (step #37) to the clear extension on the filter. Ignore the instruction to insert a ¾" diameter grommet and 45° adapter, this does not apply. Stillen?? (Perhaps it was different for the V1). The last thing I'd like to point out is the filter gets kind of tweaked, the bypass valve hose gets kinked, and the connection of the crankcase vent hose at the air filter seems to really tweak the 90° extension in the filter. I suppose all this is normal and there is nothing we can do about it. :o(

43. *Double check connections and top off fluids.* You are getting there, final stretch!!! :oD Remember to unscrew the oil drain plug one last time and get the last bit of oil out. Then torque it to 22-29 ft-lb. Take the time to run through the list one more time and double check EVERYTHING!!! Don't be in a hurry or overly anxious just because you are this close. This is too important. Top off oil (4.25 quarts), coolant reservoir if you emptied it (it holds 7/8 qt. Use 30% anti-freeze if your temperature never goes below 5 °F where you live and 50% antifreeze if your temperature does go below 5 °F. Use distilled water.) and power steering fluid if you changed your power steering lines.

44. *Reconnect battery/check fuel lines*. This step is self-ex.

45. *Start engine and inspect*. This step is self-ex.

46. *Short drive and double-check*. This step is self-ex.

***Engine start up and fuel considerations.***

I strongly agree with Stillen here and I recommend the same things. Even before the supercharger install I always let my car warm up. I feel it is very important. You will hear people argue this all the time but, what the heck, it can't hurt. Be patient. I start my engine and I will not put it into 'R' or 'D' until I see my "H/C" needle *at least* leaving the "C" position, if not already to the 9 o'clock position (half way between "H" and "C"). And if I do leave before the H/C needle is at the 9 o'clock position, I will drive very conservatively until the needle is at 9 o'clock. Regarding using premium, name brand gasoline, I cannot agree more. Once again, even before the supercharger, I always did so. Unfortunately, here in California, the highest octane rating we have available is 91. :o(

FINISHED PRODUCT!:

You are done! Congratulations! Now don't you feel good you did it yourself? Now enjoy yourself (but be safe/responsible)!!! :o)

*The preceding Stillen/Vortech Supercharger installation-aid was written by Josh Frohman, Maxima.org member ptatohed, in March of 2002. Please feel free to contact me with any feedback you might have. Ptatohed@netzero.net. Thank-yous, complaints, compliments,*

*suggestions, feedback, corrections, additions, experiences, etc., etc. are all welcomed. You may use/reproduce these instructions for any purpose (other than to make money!!!!) but I ask that you give me credit. I spent many, many hours on this write up. And with that said, I am not asking that a statue be erected in my name or anything but I would really appreciate some thank-yous. I had nothing to gain by writing this, I did it for you guys. So just a quick thanks and seeing people use this, will make it all worth it to me. Thanks everyone. :o)*

-Josh

## ***Appendix:***

*Appendix A* – Stillen V2 Installation instructions:

# INSTALLATION INSTRUCTIONS

Stillen Super Charger
1995-1998, & 1999 Nissan Maxima
P/N 407000

**Materials supplied:**

1- VORTECH SUPERCHARGER & MOUNTING PLATE ASSY.
- 1ea. Supercharger assy. with pulley
- 1ea. Aluminum mounting plate
- 2ea. M6-1.0 x 55mm bolts in plate assy.
- 1ea. 6-Rib drive belt

1- AIR FILTER ASSY.
- 1ea. Air filter
- 1ea. Steel insert in filter spout
- 2ea. Hose clamp #56
- 1ea. 1" plastic nipple - bypass hose to air filter
- 1ea. 3.50"∅ blue Silicone hose - filter to supercharger
- 1ea. ¾"∅ Rubber grommet

1- CRANKCASE BREATHER ASSY.
- 1ea. 38"- 5/8 I.D. Hose
- 1ea. 90° - 5/8" O.D. Plastic vent adapter
- 1ea. 45° - 5/8" O.D. Plastic vent adapter

1- OIL FEED LINE / SUPERCHARGER
- 1ea. –4 Braided line w/ fittings
- 3ea. –6 ADEL clamps
- 3ea. Aluminum spacer ½" long
- 3ea. M6-1.0 x 25mm HHCS
- 3ea. M6 Flat washer
- 1ea. Oil feed "T" adapter

1- FUEL PUMP & MANAGEMENT ASSY.
- 1ea. Fuel management assy w/bracket
- 1ea. Fuel pump assy w/ ADEL clamps
- 1ea. Mounting plate w/ Insulators
- 2ea. ¼" Flat washers
- 2ea. ¼" –20 Nylock nuts
- 2ea. Rubber bonded isolators ¼" M/F
- 1ea. Package- fuel pump terminal nuts & washers
- 2ea. M6-1.0 x 25mm HHCS
- 2ea. M6 Split washer
- 9ea. Hose clamp #4 – fuel hose
- 1ea. 8' - 5/16"I.D. High pressure fuel hose
- 4ea. Cable ties 11"
- 1ea. 5/16" Barbed joiner – fuel hose

1- AUXILIARY FUEL PUMP ELECTRICAL ASSY.
- 1ea. Fuel pump relay w/ wring harness
- 1ea. Fuel pump pressure switch w/ bracket
- 1ea. Blue 3M splice connector
- 1ea. M6-1.0 X 65mm HHCS
- 1ea. M6 Flat washer
- 1ea. ½"OD X 1-1/2" aluminum spacer

1- POWER STEERING –
2- *ON 99 MODEL ADD P/S COOLER KIT 4071000*
- 1ea. 8' – 3/8" I.D. hose

1- COOLANT OVERFLOW RELOCATION
- 1ea. Mounting bracket – bottle relocation
- 1ea. 40" – 5/16" I.D. Rubber coolant hose
- 2ea. 5/16" Hose clamp

1- BYPASS VALVE
- 1ea. BOSCH bypass valve
- 1ea. 24" –1.0" I.D. Rubber hose
- 4ea. Hose clamp #12 narrow

1- OIL DRAIN BACK
- 1ea. Modified oil drain back plate
- 1ea. Molded hose – supercharger drain back
- 2ea. Hose clamp #10 narrow

1- FUSE BOX RELOCATION
- 1ea. Teardrop shape retainer
- 1ea. Fuse box mounting plate
- 2ea. 10-32 x ¾" FHCS
- 2ea. 10-32 Nylock hex nut
- 1ea. M6-1.0 x 20mm HHCS
- 1ea. M6-1.0 Nylock hex nut
- 1ea. M6 Flat washer

1- PRESSURE PIPE ASSY.
- 1ea. Long pressure pipe w/ bypass mount
- 1ea. Bypass valve adapter
- 6ea. M6-1.0 x 20mm HHCS – adapter to pipe/ MAS mounting
- 6ea. M6-1.0 hex nut – adapter to pipe/ MAS mounting
- 6ea. M6 Flat washer– adapter to pipe/ MAS mounting
- 6ea. M6 Split lock washer– adapter to pipe/ MAS mounting
- 2ea. 2.0" – 3.0" I.D. Silicone blue hose
- 1ea. 90° Molded hose – pressure pipe to supercharger
- 4ea. Hose clamp #48 – pressure pipe to blue hose
- 1ea. 90° - 3.0" O.D. Tube – M.A.S. to throttle body
- 1ea. Adapter – air temp sensor to 90° tube
- 1ea. Viton O-ring – air temp sensor mounting
- 2ea. M4-0.7 x 12mm SHCS – Air temp. sensor adapter mounting
- 1ea. Hose clamp #40
- 1ea. Hose clamp #44
- 2ea. Aluminum spacer ½" x ½" - pressure pipe to valve cover
- 2ea. M6-1.0 x 25mm HHCS - pressure pipe to valve cover
- 2ea. M6 Split lock washer - pressure pipe to valve cover
- 1ea. "T" air bypass adapter

1- BELT ADJUSTER / PULLEY
- 1ea. Base bracket
- 1ea. 2"∅ Pulley w/ side rails
- 1ea. Spacer - pulley

1- IDLER PULLEY
- 1ea. 2"∅ Pulley, No side rails w/ brg. sleeve
- 1ea. ½-13 x 1-1/2" HHCS
- 1ea. M12 Flat washer

1- VACUUM FITTINGS
- 1ea. 5-Way Plastic connector
- 1ea. 72" – 5/32"∅ Vacuum hose

1- ASSOCIATED HARDWARE
- 1ea. M6-1.0 X 65mm HHCS – S/C plate to engine
- 2ea. M6 Stand-off bolts – S/C plate to engine
- 1ea. M6-1.0 X 55mm HHCS – S/C plate to engine
- 1ea. M6-1.0 X 30mm HHCS – S/C plate to stand-off, outer
- 1ea. M6-1.0 X 20mm FHCS – S/C plate to stand-off, inner
- 2ea. M6 Flat washer
- 2ea. M6 Split lock washer
- 1ea. M6 Serrated spring washer
- 1ea. M8-1.25 x 25mm FHCS – S/C plate/ belt adjuster mtg. to engine
- 1ea. M8-1.25 x 30mm Flange HHCS – S/C plate to alternator
- 2ea. M10-1.5 x 60mm HHCS – S/C plate to upper engine mtg.
- 2ea. M10 Flat washer – S/C plate to upper engine mtg.
- 1ea. Cam sensor retainer plate

**INSTALLATION INSTRUCTIONS**
Stillen Super Charger
1995-1998 & 1999 Nissan Maxima
P/N 407000

***WARNING!!! IF YOU ARE NOT EXPERIENCED IN THE AREA OF AUTOMOTIVE MECHANICS WE STRONGLY URGE THAT YOU REFER THIS INSTALLATION TO YOUR MECHANIC***

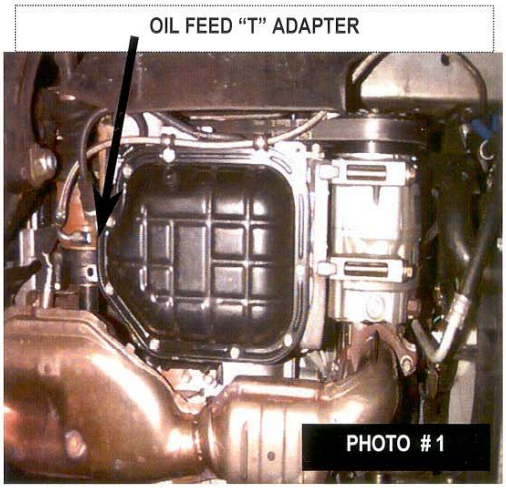
**Equipment needed:**

1. Metric & SAE sockets, ratchets and wrenches
2. +,-- Screw drivers
3. Long hex key drive & universal joint 3/8 drive (Mac tool #XDLS)
4. Loctite® Threadlocker #242 (Blue)
5. Liquid sealer (i.e. Permatex Form-a-Gasket#2®, Loctite®518)
6. Anti-seize paste
7. Wire crimps (Electrical connector type)
8. Pliers
9. Engine oil & filter, oil drain plug copper sealing washer
10. Engine Coolant
11. Pipe thread sealant paste (Not Teflon tape)
12. ∅.250 Drill bit & drill motor on 1995-1998 models
13. Jack stands (Recommended)

***Installation:***

**Please read instructions a few times and visually look over your vehicle while reading before starting the assembly process. We recommend to torque all fasteners and Loctite be used on all threaded fasteners during installation. Keep covers on supercharger inlet & outlet to prevent foreign objects from entering.**

1. Disconnect the battery (Note, save radio stations and any other electronic memory as needed).
2. Support the front of the vehicle on jack stands.
3. Remove air filter box assembly from backside of battery and unbolt MAS (Mass Air Sensor) from air filter lid, as OEM filter box assembly will not be used in the kit. **Remember to save O-ring gasket from MAS, it will be re-used later.**
4. Drain all engine oil and replace oil filter with a new quality oil filter. Also replace the copper o-ring sealing gasket on drain plug. Torque drain plug to 22-29 ft-lb. Dispose of engine oil properly.
5. On backside of engine closest to the oil filter remove the oil pressure-sending unit and install the oil feed "T" adapter assembly. Apply liquid sealant, on threads, and screw male thread into engine block, rotate till "T" points out toward right front tire. Screw oil pressure sending unit into side of "T". (SEE PHOTO # 1)



6. Attach -4 steel braided oil pressure feed line to -4 male fitting at end of "T" adapter that was just attached into engine block. The 120° fitting goes on backside of "T" adapter assembly. The other end of the line with the straight fitting will attach to supercharger later on the installation process.

7. Route the -4 stainless steel braided oil feed line along edge of oil pan closest to right front tire, by removing 2 of the M6- 1.0 x 10mm HHCS that hold the oil pan to engine block, they are located next to the oil filter. Replace with the ½" long aluminum spacer, M6- 1.0 x 25mm HHCS and M6 Flat washer and two –6 ADEL clamps provided in kit, This oil line will have to be routed in such a way that it will not be in contact with ANYTHING AT ALL!!!! At this point the feed line is still not attached to the supercharger and is hanging loose from below crank pulley. (SEE PHOTO # 2)

PHOTO # 2

8. On some 1999 models remove anti-theft horn from body of vehicle chassis next to windshield washer bottle. Unbolt "L" shape bracket from horn leaving only the straight tab bracket already bolted to horn. Remount horn in any one of two holes already in the upper radiator support brace. Mount the horn in front of the A/C condenser. Extend horn wire harness by cutting taped plastic harness holder. This will extend the harness so it can be rerouted underneath the radiator support brace to horn.(SEE PHOTO # 3)

9. Remove the OEM serpentine drive belt from engine by loosening the lock nut on the adjuster pulley, then by loosening the nut on the tension adjuster in a counterclockwise rotation. A longer belt will be used for the Stillen supercharger assembly.

10. Remove factory serpentine idler pulley assembly from the engine block, by removing its 3-bolts.

11. Install Stillen supercharger oil drain back plate (identical plate with welded "J" tube) by first removing the black water pump cover plate from front of engine located above and to the right of crank pulley and just below and left of thermostat housing. Then clean all sealing surfaces and apply a modest amount of sealer. Fit the Stillen supercharger oil drain back plate and tighten to the engine block with the same 4- bolts.

12. Remove engine coolant overflow bottle and hose from radiator neck. This will be relocated to backside of battery later on in the installation process.

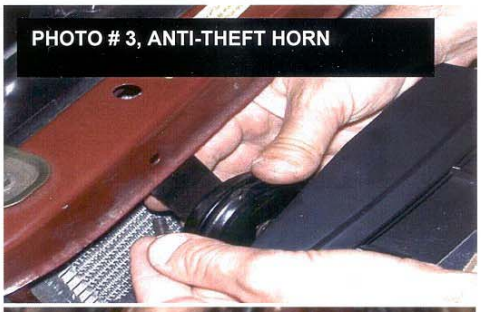


PHOTO # 3, ANTI-THEFT HORN

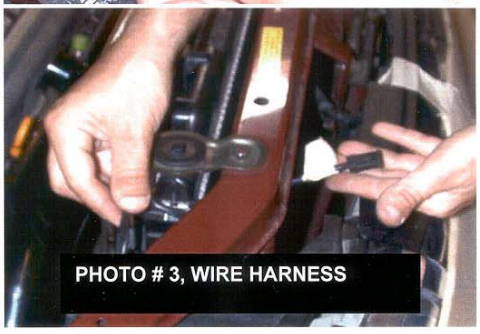


PHOTO # 3, WIRE HARNESS

13. To provide adequate clearance for the Stillen supercharger fitment it is necessary to relocate the fuse box rearward on the right fender apron.
   - First remove and re-assemble the fuse box to the new mounting plate supplied by kit, by using 2 of the 10-32x ¾" FHCS and Nyloc hex nuts also supplied from kit.
   - Trim off the original location peg under the foot of the fuse box.
   - Mount the fuse box w/-mounting bracket to the original fuse box mounting holes, using the previously removed hardware.
   - Partially removed the right inner wheel arch cover, to gain access. Fit the teardrop shape retainer (supplied in kit) over the foot of the fuse box, using an M6-1.0x20mm HHCS, flat washer and Nyloc hex nut supplied by kit. (SEE PHOTO # 4)

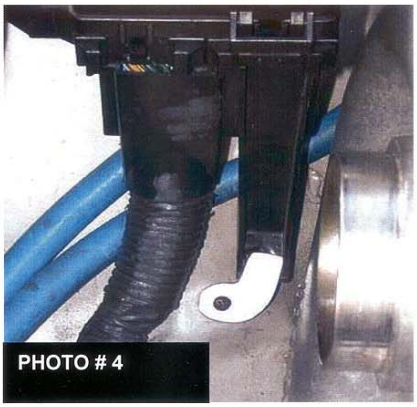


PHOTO # 4

14. Replace the original rubber and aluminum tube power-steering lines from the plastic reservoir to the aluminum cooler in front of the radiator with the power-steering hoses provided in kit. Route new hoses under fuse box (SEE PHOTO # 4) and away from any pulleys or sharp edges. After completing supercharger installation, replenish power-steering reservoir with new P/S fluid and cycle steering rack. **NOTE:** On 1999 and later models attach aluminum Power Steering cooler KIT # 407100 ("U" shaped aluminum tube) to center radiator support and lower chassis rail. (SEE PHOTO # 5)
15. Unplug connector from the Cam Timing Sensor, and remove the M6 bolt that attaches the sensor to the timing case. Install the new cam sensor retainer assembly provided in kit. Rotate the sensor so that the retainer indexes on the sensor, refit the original M6 bolt and do not tighten at this time, as sensor must be aligned once the supercharger is fitted.

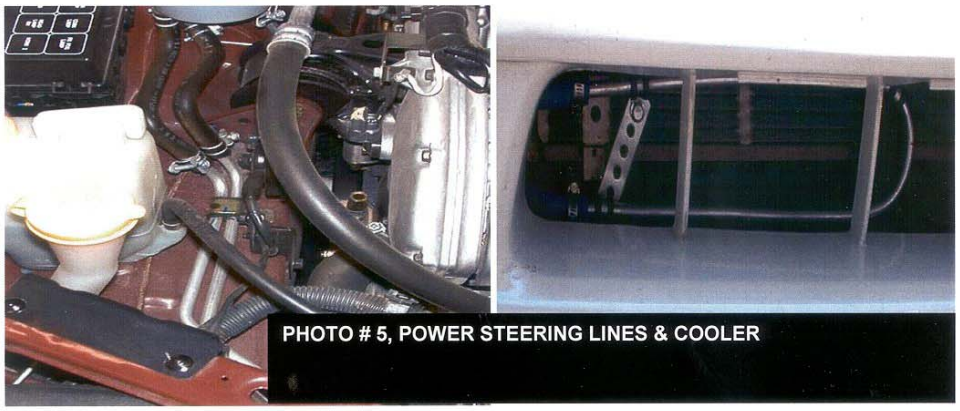
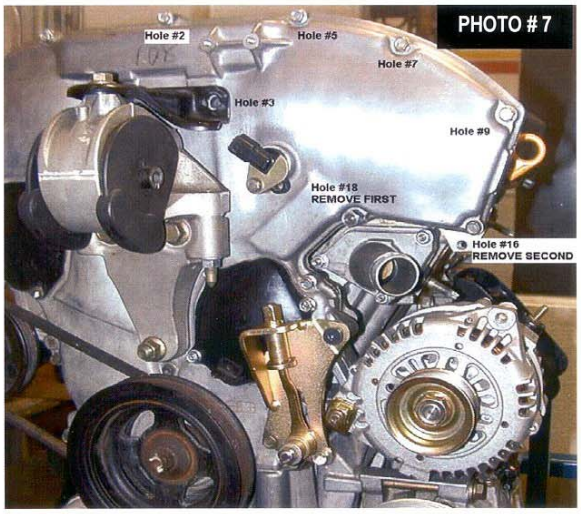


PHOTO # 5, POWER STEERING LINES & COOLER

16. Partially assemble the new belt adjuster bracket from kit, using the original tension adjuster rod and nut, and 1/8" thick OEM washer between rod and mounting plate. Refit this partial assembly back onto the engine with the original mounting bolts in the lower 2-holes only. Do not fully tighten at this time. (SEE PHOTO # 6)
17. Slip on rubber drain back hose with a #10 hose clamp supplied in kit, to the drain back plate "J" pipe. Place the other #10 hose clamp on the opposite end, it will be attached to bottom of supercharger brass drain back fitting later on. Some trimming will be needed to fine tune hose for clearance. Make sure hose is not pinched, so it will not block flow of drain back oil from supercharger.
18. Remove two M10 bolts from front engine mount located on Right side of engine bay (Passenger side) near Power Steering Reservoir.
19. Remove the cranked bracket, which secures the upper alternator ear to the engine. Loosen the lower alternator bolt to allow the alternator to move freely. Loosen and turn the hose clamp on the hose to thermostat joint so it will be accessible once supercharger is fitted.

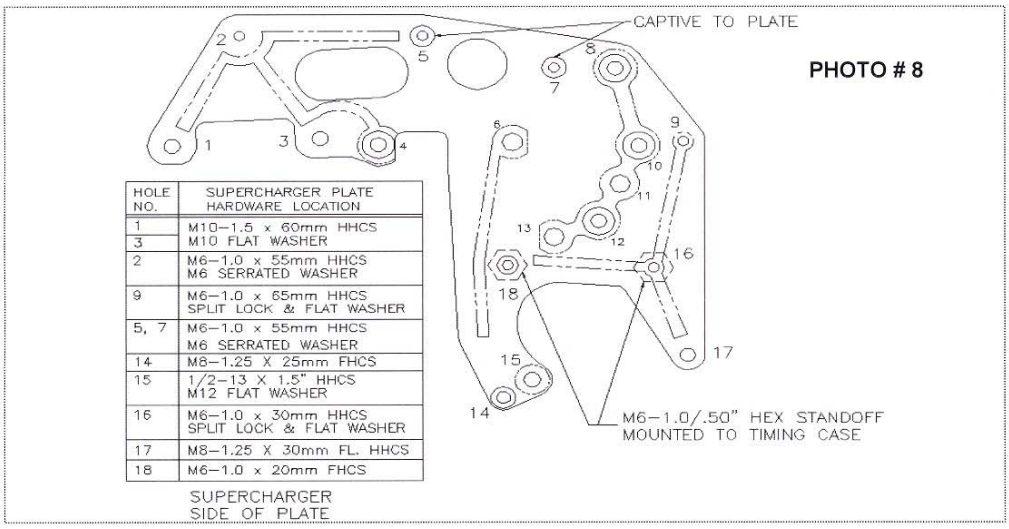

20. Looking at the supercharger & mounting plate assembly, you will note that there is two M6-1.0x55mm HHCS captive in the plate behind the pulley, the other fittings are in the kit and are identified in photo # 8. In order to fit the supercharger & mounting plate assembly it will be necessary to remove the six M6 bolt from the forward section of the timing case DO NOT REMOVE THESE BOLTS AT THIS TIME , AS OIL LEAKS CAN OCCUR YOU MUST FIRST:

- Remove M6 bolt directly above main body of the thermostat housing (SEE PHOTO # 7), and replace with an M6-1.0 Stand –off bolt supplied in kit. Note use Loctite Theadlocker #242 (blue) on threads. Torque to 8.7 to 10 ft.lbs (DO NOT OVER TIGHTEN).
- Repeat this procedure to the M6 bolt adjacent to the previous M6 bolt, above the neck of the thermostat housing.
- With this area secured, you can now remove the four M6 bolts located counter clockwise to the 2-Stand-off bolts around the upper section of the timing case, nearest the front of the car.
- Offer up the supercharger & mounting plate assembly to the engine timing case. The two M6 bolts captive to the mounting plate MUST BE INSERTED FIRST into the timing case, (NOTE: use loctite #242 on all threaded hardware) and progressively tighten until the plate is flush onto the engine timing case and the 2-Stand-offs. NOTE: * FAILURE TO DO SO WILL RESULT IN POSSIBLE PULLEY DAMAGE DURING ASSEMBLY. ***Do not full tighten*** these two M6-1.0X 55mm HHCS at this time, as the mounting plate must be aligned to allow fitment of the other hardware.



- Using the two M10-1.5x60mm HHCS & Flat washers supplied in kit, secure the mounting plate at the upper engine mount. Do not tighten at this time. Using PHOTO # 8 as a guide locate and fit all the hardware shown progressively around the plate.
- The M6-1.0x20mm FSHS (HOLE 18) requires patience and a 6" long 4mm hex ball end Allen wrench (MAC tool # XDLS), a 3/8" socket U/ joint with a 3" extension and ratchet.
- Once all hardware is located and fitted, torque all M6 bolts to 8.7 to 10 ft.lbs max. Torque both M10 engine mount bolts to 32 to 41 ft.lbs.

21. Align the alternator with the hole in the mounting plate and fit a M8-1.25x30mm Flange HHCS supplied in kit. Fit the oil drain back hose to the nipple under the supercharger, align to clear, and tighten both hose clamps using a small socket & extension bar.




| HOLE NO. | SUPERCHARGER PLATE HARDWARE LOCATION |
|---|---|
| 1 | M10-1.5 x 60mm HHCS |
| 3 | M10 FLAT WASHER |
| 2 | M6-1.0 x 55mm HHCS<br>M6 SERRATED WASHER |
| 9 | M6-1.0 x 65mm HHCS<br>SPLIT LOCK & FLAT WASHER |
| 5, 7 | M6-1.0 x 55mm HHCS<br>M6 SERRATED WASHER |
| 14 | M8-1.25 X 25mm FHCS |
| 15 | 1/2-13 X 1.5" HHCS<br>M12 FLAT WASHER |
| 16 | M6-1.0 x 30mm HHCS<br>SPLIT LOCK & FLAT WASHER |
| 17 | M8-1.25 X 30mm FL. HHCS |
| 18 | M6-1.0 x 20mm FHCS |

22. Working from under the vehicle, now tighten the 2 lower bolts securing the belt adjuster plate to the engine. Fit the pulley step spacer onto the though bolt then slip on the 2" dia. pulley with the 2-side rails (supplied in kit), then the original washer and nut LEAVE LOOSE AT THIS TIME.
23. Fit the 2" dia. Idler pulley w/o side rails (supplied in kit) to the ½-13UNC hole in the mounting plate, just below the thermostat housing, using the ½-13UNCx1.5" HHCS and M12 flat washer supplied in kit. Tighten this bolt and the lower bolt on the alternator at this time.
24. Route the drive belt as shown in PHOTO # 9, ensure it is in all the pulleys correctly, then tighten the tension adjuster nut until the longest section of the belt can be rotated 90° using the thumb and forefinger. Then tighten the nut on the adjuster pulley to 19 to 24 ft.lbs.
25. Route the cam angle sensor wiring over the upper mounting plate and connect to the sensor, plug the plastic cable locator into the threaded hole on the timing case, and tighten the retaining bolt.
26. Route the –4 braided oil line for the supercharger up to the 90° fitting on the supercharger, secure the oil line to the threaded hole in the chassis rail using the –6ADEL clamp, 1/2"long spacer, M6-1.0x25mm HHCS and M6Flat washer supplied. When tightening the oil line fitting to the supercharger, HOLD THE FITTING ON THE SUPERCHARGER WITH A WRENCH WHILE DOING SO.

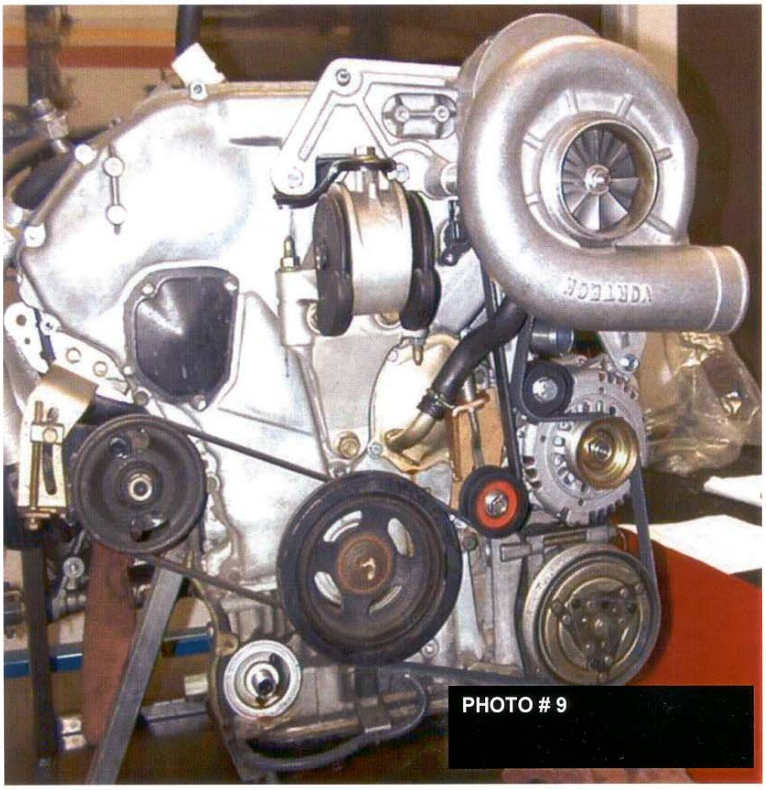


PHOTO # 9

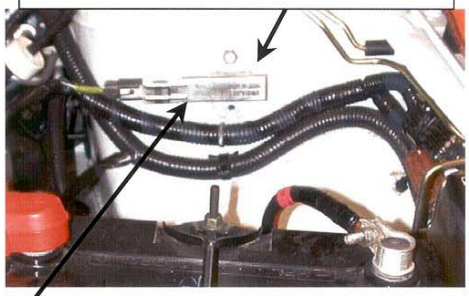
27. On 1999 Automatic transmission models – Remove ballast resistor from (Drivers side) left front strut tower and relocate to tab on bottom of battery tray. Unclip harness from left inner fender and ABS unit. Install fuel pump & management assembly, utilizing the ballast resistor mounting holes (SEE PHOTO # 10)

28. On Manual transmission models install and mount auxiliary fuel pump and pressure regulator assembly on left strut tower in engine bay just below brass clutch bleed union. On early '95 models, drilling (2) ∅. 250 holes to mount fuel pump assembly to strut tower may be required. NOTE: It will be necessary to partially dismantle the FMU / fuel pump assembly from its mounting plate before installing, for both the Automatic / Manual transmission models. (SEE PHOTO # 12)

- First remove the two ¼-20 nuts on top of the rubber isolator mounts, so that the M6 hardware and the fuel pump mounting plate can be accessed.
- Fit the fuel pump mounting plate to the strut tower with the two M6-1.0x25mm HHCS, split lock washer and1/4 M/F rubber bonded isolators.
- Reassemble the FMU / Fuel pump assembly with the ¼-20 nuts. Make sure all hardware is tight and secure.

29. Remove rear bolt from fuse box mounted on left fender apron and install auxiliary fuel pump pressure switch w/ bracket, using the ½ OD x 1-1/2" alum. Spacer, M6-1.0X65mm HHCS and washer. (SEE PHOTO # 11)

MOUNTING LOCATION FOR AUX. FUEL PUMP ASSY.



REMOVE FROM HERE ... AND INSTALL HERE

PHOTO # 10

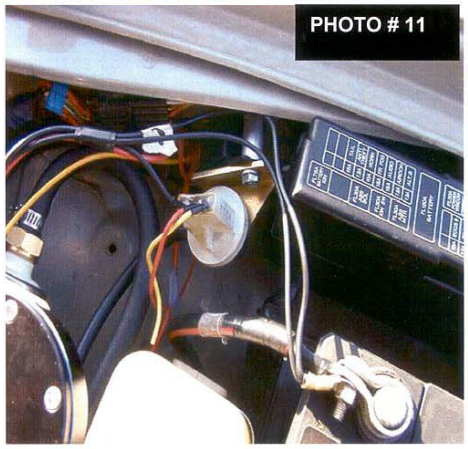
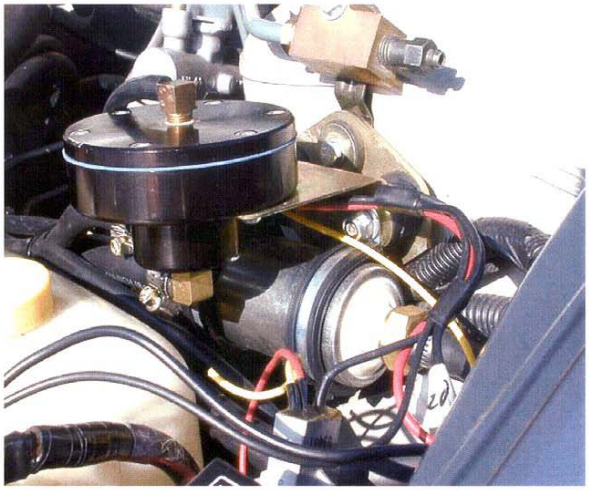


PHOTO # 11

30. Attach fuel lines. NOTE: Use 5/16" ID HIGH PRESSURE FUEL LINES with the 9- #4 hose clamps, cut to 4 different length as shown in PHOTO # 12.



- Follow fuel flow direction from outlet of fuel filter to hose connection at beginning of fuel rail located behind crankcase breather hose on number 6 cylinder.
- Disconnect hose connection at beginning inlet of fuel rail and connect the auxiliary fuel pump outlet line to fuel rail inlet with a 21.5" hose.
- Attach auxiliary fuel pump inlet to outlet of fuel filter with a 30" hose.
- Disconnect hose connection of OEM pressure regulator outlet / return line from steel tube assembly just underneath throttle body.
- Attach inlet hose from straight brass fitting of black FMU (Fuel Management Unit) to OEM pressure regulator outlet / return (fuel rail return) with a 21.5"hose.
- Attach outlet / return hose from 90° brass fitting on FMU to OEM hose return line back to tank with a 23" hose using the 5/16 barbed joiner and three #4 hose clamps.

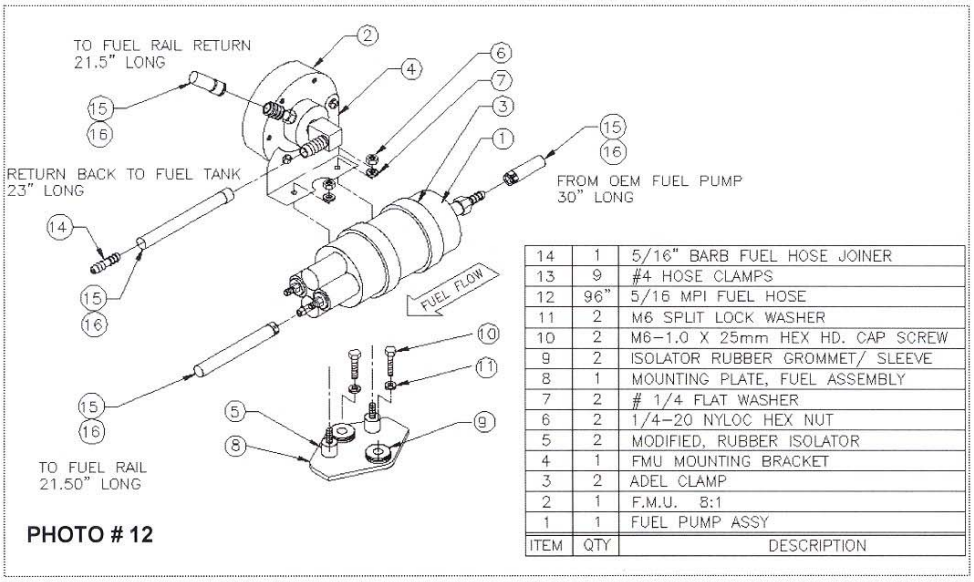



**PHOTO # 12**

| ITEM | QTY | DESCRIPTION |
|---|---|---|
| 14 | 1 | 5/16" BARB FUEL HOSE JOINER |
| 13 | 9 | #4 HOSE CLAMPS |
| 12 | 96" | 5/16 MPI FUEL HOSE |
| 11 | 2 | M6 SPLIT LOCK WASHER |
| 10 | 2 | M6-1.0 X 25mm HEX HD. CAP SCREW |
| 9 | 2 | ISOLATOR RUBBER GROMMET/ SLEEVE |
| 8 | 1 | MOUNTING PLATE, FUEL ASSEMBLY |
| 7 | 2 | # 1/4 FLAT WASHER |
| 6 | 2 | 1/4-20 NYLOC HEX NUT |
| 5 | 2 | MODIFIED, RUBBER ISOLATOR |
| 4 | 1 | FMU MOUNTING BRACKET |
| 3 | 2 | ADEL CLAMP |
| 2 | 1 | F.M.U. 8:1 |
| 1 | 1 | FUEL PUMP ASSY |

31. INSTALLATION OF PRESSURE TUBES

- Prior to fitting, check which type of Ambient Air Sensor the vehicle has. Some models will have a 2-bolt flange type, some will have a "push in" type (later models).
- Once determined, locate the 90° X3"OD –M.A.S. TO Throttle body tube, and the A.A. Sensor Adapter supplied in kit.
- For early type A.A. Sensor no adapter is required to fit to the 90°X3"OD tube, as the sensor fits straight on with 2-screws and a little silicone sealer to prevent leaks.
- For the later models the "Push in" type A.A. Sensor will require an adapter with a O-ring to be fitted to the 90°X3"OD tube using the two M4 – 0.7x12mm SHCS. Lubricate the sensor and push through the O-ring seal to locate.
- Fit the 90°X3"OD tube to the Throttle body using the 2"x3"ID blue silicone hose with two #48 hose clamps supplied in kit. Do not fully tighten at this time.

NOTE: Some vehicles will require an adapter for the air bypass hose and small vacuum line to the intake.

- Install the "T" shape air bypass adapter provided in kit between the nipple on the 90°X3"OD tube and the air bypass hose on the throttle body. Ensure that all clamps, hoses and etc. do not interfere with throttle cable operation.
- Fit the small vacuum intake to the small nipple on the "T" air bypass adapter.
- Insert the Master Air Sensor (M.A.S.) into the 90°X3"OD tube using the 2"x3"ID blue silicone hose with a #48 hose clamps supplied in kit. Do not fully tighten at this time.

32. Remove rear battery mounting rod and insert through tube in coolant bottle mounting bracket and reinstall battery holding rod and tighten. Route over-flow 5/16"OD rubber hose and secure with two 5/16 hose clamps (provided in kit) from neck of radiator to new location of coolant bottle, ensure there is no kinks in hose.

33. Remove OEM crankcase vent hose from top right forward valve cover and replace with 1-1/2" of the 5/8"ID hose supplied in kit, and the 90°x 5/8 OD plastic vent adapter from kit, attach the remaining length of hose the other end of 90° vent adapter. Set aside it will be attach to air filter later.

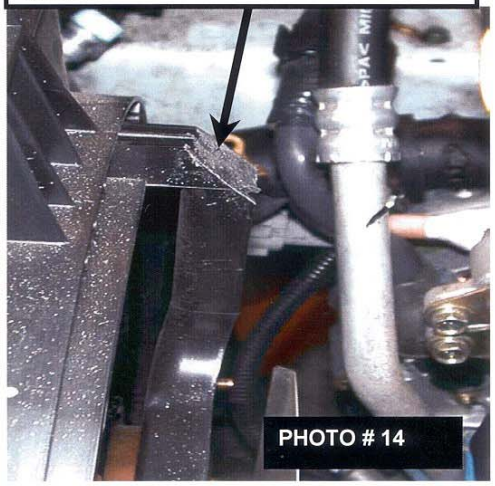
34. Remove black plastic cover from behind right (passenger) headlight. Remove the wiring support bracket from the wiring harness at the point immediately behind the right headlamp and discard. The wiring support bracket at the alternator can be re-bent and located onto the original mounting where the original alternator bracket was located with the bolt previously remove. (SEE PHOTO # 13)

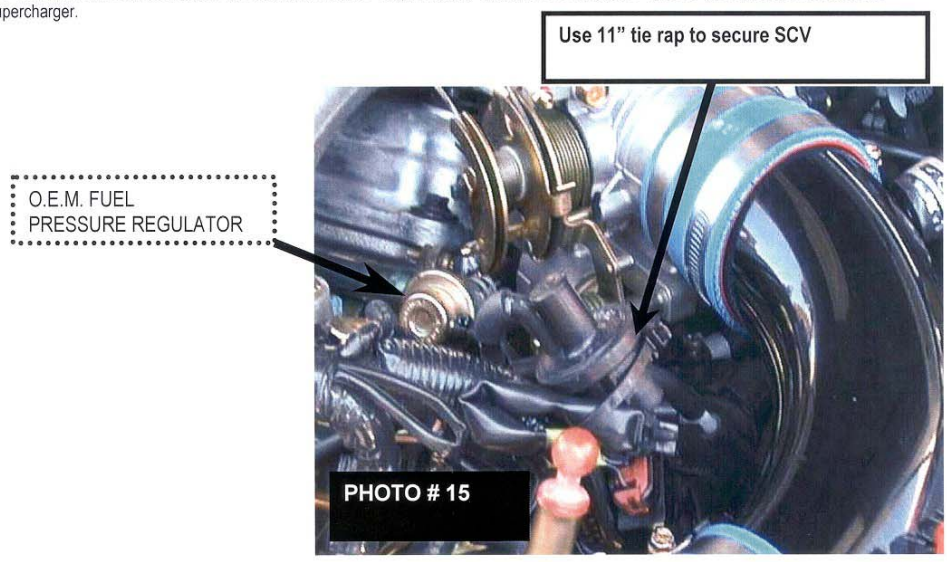
35. Prior to mounting the main Long Pressure Pipe with Bypass Mount, it will be necessary to modify the right hand cooling fan mount to gain clearance. (SEE PHOTO # 14)

- Fit the Long Pressure Pipe with Bypass Mount to the supercharger using the 90° molded hose, hose clamp #44 and hose clamp #40, Do not fully tighten at this time.
- Assemble the Long Pressure Pipe with Bypass Mount to the M.A.S. (remember to re-fit the O-ring) using the four M6-1.0 20mm HHCS, flat washers, Split washers and M6-1.0 Hex nuts supplied in kit. Do not over tighten (M.A.S. is made of a plastic material and may crack).
- Fit the two ½"x 1/2" OD aluminum spacers between the support bracket of the Pressure Pipe and the valve cover and secure it using the M6-1.0X25MM HHCS and Split washers supplied in kit.
- Rotate and align the Long Pressure Pipe with Bypass Mount, then tighten all bolts and hose clamps to supercharger, M.A.S., and throttle body.

36. On 1999 and later models remove SCV control vacuum check valve from gold bracket that was attached to air filter assembly. Remove gold bracket and zip tie assembly to wire loom on transmission side of engine. (SEE PHOTO # 15)

37. Assemble the BOSCH bypass valve to the Bypass valve adapter using 2" of the 1"ID Rubber hose and two #12 narrow hose clamps. Mount this assembly to the Long Pressure Pipe with Bypass Mount flange using a thin smear of silicone sealant on the face of flange. Use the M6-1.0x20mm HHCS, Flat washers and Split lock washers supplied in kit. Turn the BOSCH bypass valve so the outlet faces towards the supercharger.

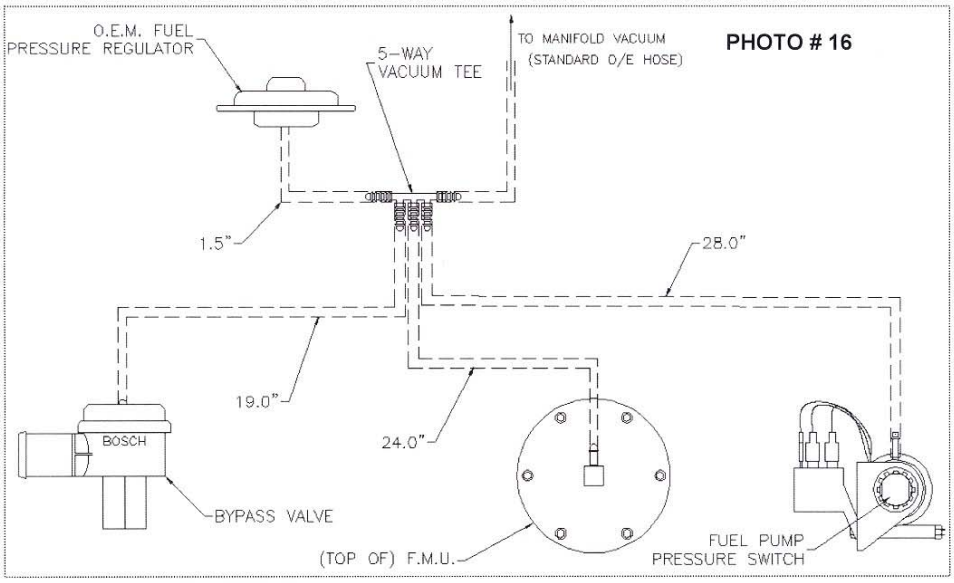


38. Attach and route the new vacuum lines. (SEE PHOTO # 16)

- Disconnect the vacuum line at the OEM fuel pressure regulator visible directly below the throttle cable cam. (SEE PHOTO # 15)
- Using a 1.5" of the 5/32∅ vacuum hose connect the 5-way connector to the original OEM fuel pressure regulator.
- Using a 19" of the 5/32∅ vacuum hose connect the 5-way connector to the BOSCH bypass valve.
- Using a 24" of the 5/32∅ vacuum hose connect the 5-way connector to the Auxiliary fuel pump FMU.
- Using a 28" of the 5/32∅ vacuum hose connect the 5-way connector to the Auxiliary fuel pump pressure switch.
- The vacuum lines for fuel pump pressure switch, F.M.U. and the new fuel lines may be bunched and routed together using the 11"black tie rap in 2-places.

NOTE: do not over tighten tie raps they may cut off vacuum or fuel. Important to ensure that the vacuum line splice is into the MANIFOLD vacuum and not the ported vacuum.



39. Auxiliary fuel pump electrical connection. The wiring harness attached to the Auxiliary fuel pump pressure switch and relay mounted on the inner fender can now be connected. (SEE PHOTO # 17)

- The long yellow wire must be routed through to the left-hand (driver side) inner trim kick panel. Run through the fender well along side the hood release cable and through the rubber grommet on firewall.
- Remove the left-hand kick panel and the bolts retaining the computer and lay off to one side out of the way.
- Remove 2 M6 bolts retaining the blue zinc plated bracket to access the fuel pump relays.

NOTE: IT IS IMPORTANT THAT ALL THE FUEL LINES HAVE BEEN CONNECTED AND SECURED.

- Temporarily connect the battery, and turn on the ignition. With the ignition on a distinct "clicking" will be heard from one of the relays as it turned on, then the relay will "click" off again in 2 to 3 seconds. This will help identify the correct relay.
- Using a test lamp and probe, locate the black and yellow wire of this relay, and splice in the yellow wire from the Auxiliary fuel pump relay using the 3M blue connector from kit.
- Re-assemble the relays and computer, refit the kick trim panel and any other parts that were removed.

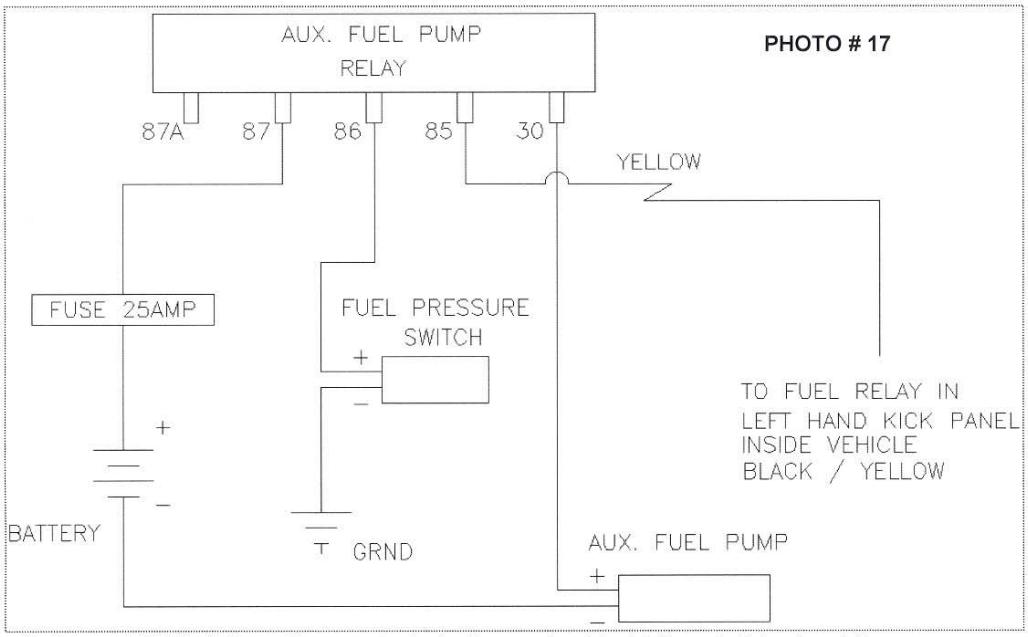


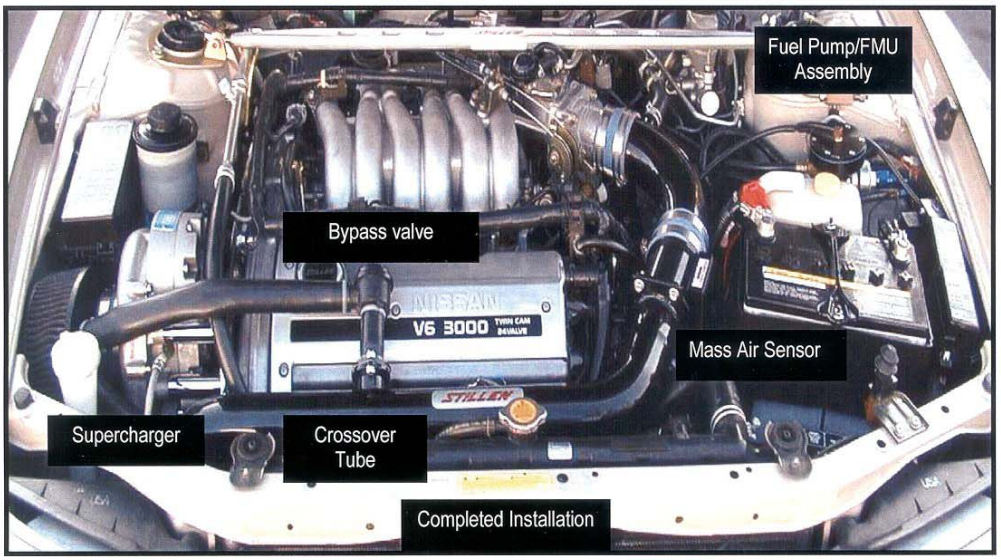

**PHOTO # 17**

40. Remove windshield bottle filler neck from reservoir and cut or slice groove in neck to rotate filler neck out of way from air filter area.
41. Install air filter to supercharger by using the 3.5"∅ blue silicone hose and two #56 hose clamps.
42. Connect the crankcase vent hose from 90° nipple on front valve cover to the hole in air filter by inserting the ¾"∅ rubber grommet and the 45°x 5/8 OD plastic vent adapter into air filter, then attach the vent hose to the 45° vent adapter. Attach 22" x 1" ∅ hose from bypass valve to 1" ∅ plastic nipple on air filter with a #12 narrow hose clamp. Tighten all hose clamps for bypass valve and air filter.

43. Recheck all fasteners, hoses / clamps, oil, vacuum, and fuel lines to make sure they are properly tightened. Replenish and top off all fluids. I.E. engine oil and coolant.
44. Reconnect battery. Turn key to "ON" position and check fuel lines for any leaks. Auxiliary fuel pump will turn on. As soon as engine is started auxiliary pump will turn off. This is normal.
45. Start engine and inspect for any fuel, oil, vacuum, or water leaks. Make sure supercharger drive belt is tracking properly and has proper tension. (Refer back to step #24.) Due to the nature of gears in the supercharger gear housing some gear noise will be apparent
46. After a short drive, double-check all connections and fasteners for tightness.

## Engine start up and fuel considerations.

Never operate your engine at full throttle when engine is cold. When starting the engine each day, always allow plenty of time for the oil to reach full operating temperature before running above 2500RPM. Full supercharger operating temperature is achieved only after the engine water temperature has been at the normal indicated operating temperature for about 5minutes. Always use highest-octane **SUPER UNLEADED 92 Octane** fuel. Always use national brand fuel. If filling from another source than the one you use regularly, always listen for audible detonation. If detonation is audible, cease using heavy throttle and drive with greater care until fuel is consumed or replaced.



*Appendix B* – Stillen V1 Installation instructions:

# INSTALLATION INSTRUCTIONS

Stillen Super Charger
1995-1998, 1999 Nissan Maxima
P/N 407000

## Materials supplied:

(1) Air Filter Assembly
- (1) Silicone Hose, Blue - ∅3 ½" air filter to supercharger
- (1) Steel Insert-air filter to supercharger
- (2) Hose clamp, #56
- (1) Blow-off hose nipple
- (1) Air filter

(1)Vortech Supercharger assembly.
- (1) Supercharger adapter plate assembly
- (1) Supercharger
- (1) Idler pulley
- (1) Supercharger drive belt

(1) Intake tube w/blow off mount, ∅2 ½" with STILLEN decal

(1) Modified thermostat housing w/gasket

(1) Crankcase breather hose assembly
- (1) 36" ∅5/8" ID Crank case breather hose
- (1) 90° ∅5/8" OD Plastic vent line adapter
- (1) 45° ∅5/8" OD Plastic vent to air filter
- (1) 2" ∅5/8" ID Crankcase breather hose

(1)Oil feed line, -4 S.S braided line
- (2) Adel clamps, ∅5/16", oil feed line
- (1) Oil Tee adapter assembly
- (2) M6x1.0x30MM HHCS
- (2) Aluminum spacers, ∅½" OD x ∅ ¼" ID x ½" Long

(1) Blow off hose to air filter
- (1) ∅1" ID x 20" Long

(1) Fuel pump assembly
- (1) FMU (Fuel Management Unit)
- (1) Bracket, Auxiliary fuel pump
- (2) Rubber Insulators – Fuel pump bracket
- (2) Adel clamps fuel pump holder
- (2) ¼-20 Male stud/Female rubber isolator
- (2) ¼-20x1/2 Flathead cap screw
- (2) ¼ Flat washer
- (2) ¼-20 Nylon locking nut
- (8) Mini Hose clamps
- (4) 5/16" F/I fuel line
- (2) Isolator to assembly bracket
- (1) Electrical nuts to fuel pump (package)
- (2) M6x1.0 HHCS w/washers

1) Auxiliary Fuel Pump electrical assembly
- (1) Fuel pump relay electrical assembly
- (1) Fuel pump pressure switch
- (1) Blue 3M splice

(2) 48" Blue silicone hose
(1) Power Steering oil cooler-Stillen (1999 models)
(3) Adel clamps SG-6 (1999 models)
(3) M6 x 1.0 x 10mm Flange bolt (1999 models)
(1) M6x1.0 Nylon locking nut (1999 models)
(1) Back strap 18" long (1999 models)

(1) Coolant overflow bottle relocation bracket (1999 model different)
(1) 40" 5/16" hose, radiator overflow to coolant bottle
(2) Spring clamps, overflow radiator hose

(1) Fuse box mounting brackets (teardrop)
(1) Fuse box relocation mounting bracket
(2) Flat head 10-32 x 5/8
(2) 10-32 Nyloc nuts

(2) 90° 3" OD tube w/Air temp sensor hose & crankcase vent (push in type and bolt in type air sensor)

(1) Modified oil drain back plate
(1) Blower oil drain back hose-preformed
(2) Hose clamps, # 10

Hardware – Intake tubes
(1) Silicone hose, Black - 90°, supercharger to cross over tube
(1) Silicone Hose, Blue - MAS to 90° ¬ 3.00 tube
(1) Silicone hose, Blue - 90°tube to Throttle body
(4) Hose clamp #48 Hard pipe/Mas/Throttle body
(1) Blow Off Valve Assy.
(4) Cable Ties, 11" Black
(2) Aluminum spacers – Stand off to valve cover
(1) M8x1.25x40mm Flange Head CS
(1) M8x1.25 Prevailing Lock Nut
(5) M6x1.0x55mm Hex bolt
(5) M6 lock washer
(2) M10x1.5x55mm Hex bolt
(2) M10 flat washer
(6) M6x1.0 Nyloc nuts
(12) M6 Flat washers
(6) M6x1.0x25mm Hex bolt
(2) M6x1.0x40mm Hex bolt

Vacuum line assembly
(3) Vacuum Tees, 3/16"
(5) Cable Ties, 6" black
(5) Vacuum lines, 3/16" ID
(1) Air-bypass adapter

(1)Cam sensor retainer



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**INSTALLATION INSTRUCTIONS**
Stillen Super Charger
1995-1998, 1999 Nissan Maxima
P/N 407000

***WARNING!!! IF YOU ARE NOT EXPERIENCED IN THE AREA OF AUTOMOTIVE MECHANICS WE STRONGLY URGE THAT YOU REFER THIS INSTALLATION TO YOUR MECHANIC***

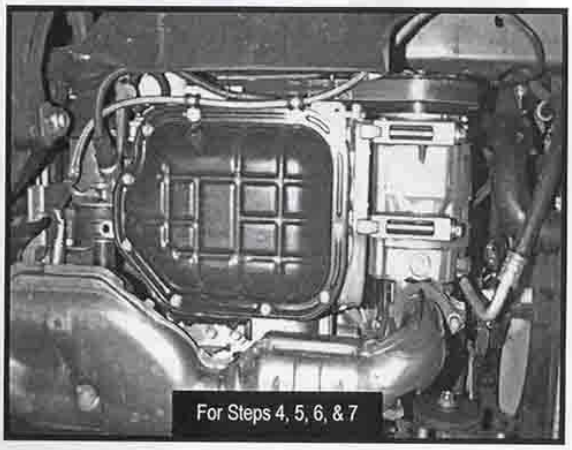
**Equipment needed:**

1. Metric & SAE sockets, ratchets and wrenches
2. +,-- Screw drivers
3. Loctite® Blue
4. Liquid sealer (i.e. Permatex Form-a-Gasket#2®, Loctite®518)
5. Anti-seize paste
6. Wire crimps (Electrical connector type)
7. Pliers
8. Engine oil & filter, oil drain plug copper sealing washer
9. Engine Coolant
10. Pipe thread sealant paste (Not Teflon tape)
11. ∅.250 Drill bit & drill motor on 1995-1998 models
12. Jack stands (Recommended)

***Installation:***

**Please read instructions a few times and visually look over your vehicle while reading before starting the assembly process. We recommend to torque all fasteners and Loctite be used on all threaded fasteners during installation.**

1. Disconnect the battery (Note, save radio stations and any other electronic memory as needed).
2. Support the front of the vehicle on jack stands.
3. Remove air filter box assembly from backside of battery and unbolt MAS(Mass Air Sensor) from airfilter lid as OEM filter box assembly will not be used in the kit. **Save O-ring gasket from MAS. Save grommet for push-in air temp sensor (if vehicle has push-in sensor) for they will be needed during installation.**
4. Drain all engine oil and replace oil filter with a new quality oil filter. Also replace the copper o-ring sealing gasket on drain plug. Torque drain plug to 22-29 ft-lb. Dispose of engine oil properly.
5. On backside of engine closest to the oil filter remove the oil pressure sending unit and install the "T" fitting assembly. Screw male thread into engine block and rotate till "T" points out toward right front tire. Screw oil pressure sending unit into side of "T".
6. Attach -4 steel braided oil pressure feed line to -4 male fitting at end of "T" that was just attached into engine block. The 120° fitting goes on backside of "T" assembly. The other end of the line with the straight fitting will attach to supercharger later on the installation process.


For Steps 4, 5, 6, & 7



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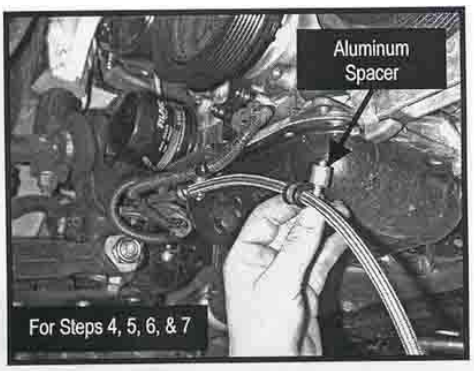
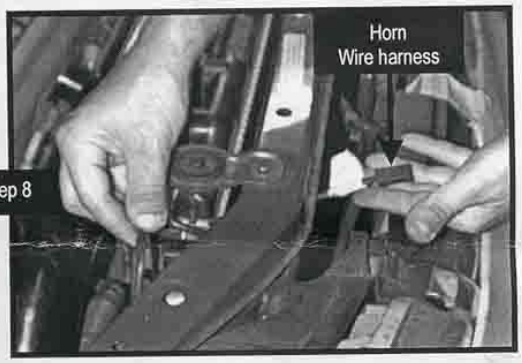
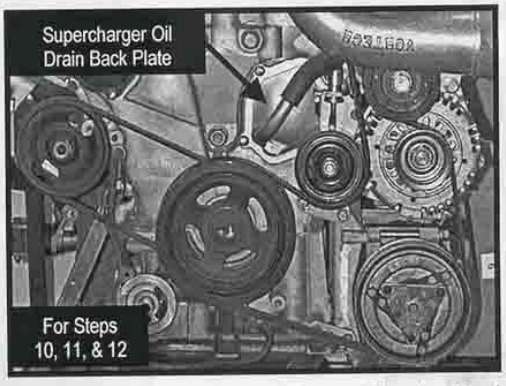
7. Route the -4 stainless steel braided oil feed line along edge of oil pan closest to right front tire by unscrewing 2 of the 10mm hex head screws (M6 x 1.0 thread) that hold oil pan to engine block that are located next to the oil filter. Insert the longer M6 bolts provided in kit with the aluminum spacer and insert them through the Adel clamp and tighten. This oil line will have to routed in such a way that it will not be in contact with ANYTHING AT ALL!!!! At this point the feed line is still not attached to the supercharger and is hanging loose from below crank pulley. **(See oil pan picture)**
8. On some 1999 models remove anti-theft horn from body of vehicle chassis next to windshield washer bottle. Unbolt "L" shape bracket from horn leaving only the straight tab bracket already bolted to horn. Remount horn in any one of two holes already in the upper radiator support brace. Mount the horn in front of the A/C condenser. Extend horn wire harness by cutting taped plastic harness holder. This will extend the harness so as to be rerouted underneath the radiator support brace to horn.








9. Drain all engine coolant from cooling system once engine has cooled and dispose of coolant properly.
10. Remove OEM serpentine drive belt from engine by loosening the locknut on pulley and then loosening the adjusting nut in a counterclockwise rotation. A longer belt will be used for the supercharger.
11. Remove factory serpentine idler pulley from engine block.
12. Remove black water pump cover plate from front of engine located above and to the right of crank pulley and just below and left of thermostat housing. Install supercharger oil drain back plate (identical plate with welded "J" tube) . Clean sealing surfaces and apply a modest amount of sealer. Refit the plate and tighten bolts.
13. Remove OEM thermostat housing from engine.
14. Shave Alternator top mounting ear by approximately .062 - .125" as needed to give clearance to thermostat housing. Install Stillen modified housing from kit. (Thermostat in modified housing is a new OEM thermostat. Due to tolerance between vehicles some minor grinding for clearance will be needed to install thermostat housing. Check for clearance on ear of timing case just above alternator. Relieve/grind as needed. (See picture)
15. Modify radiator hose by cutting just enough off top of hose that attaches to modified thermostat housing. **NOTE: AFTER COMPLETION OF THIS STEP, IT IS HIGHLY RECOMMENDED THAT THE COOLING SYSTEM BE PRESSURE TESTED. SUPERCHARGER ASSEMBLY WILL HAVE TO BE REMOVED COMPLETELY TO FIX LEAK IF LEFT UNTIL LATER!!!!!!**
16. Remove engine coolant overflow bottle. This will be relocated to backside of battery later on the installation process.



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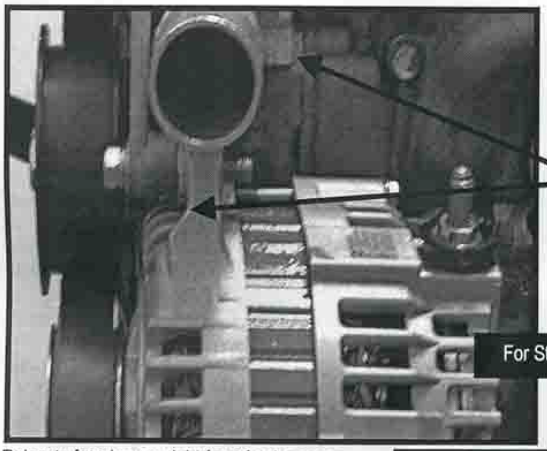
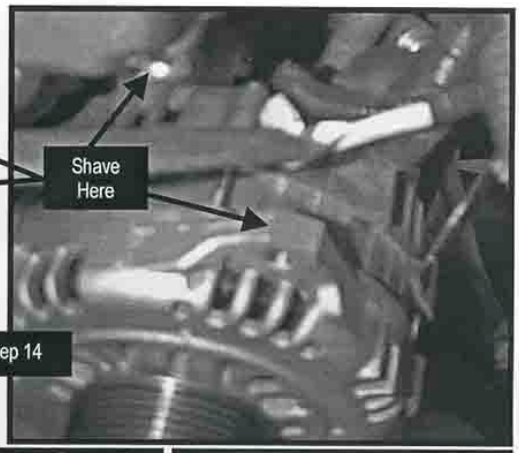
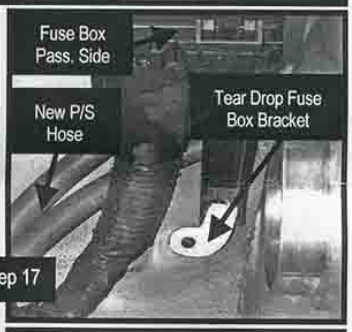
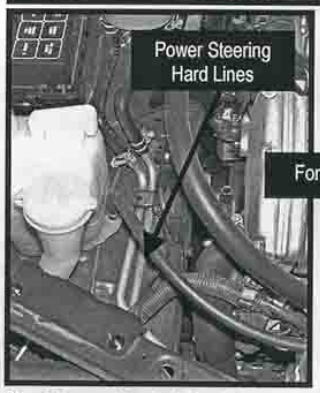



17. Relocate fuse box on right front fender apron and install rectangular aluminum bracket and teardrop shaped bracket to plastic foot of fuse box. **(See P/S reservoir / fuse box picture)**
18. Replace power-steering hard lines from plastic resiervor to lines in front of radiator with blue power-steering hoses provided in kit. Route new hoses away from any pulleys or sharp edges. Replenish power-steering reservoir with new P/S fluid and cycle steering rack after complete supercharger installation. On 1999 and later models attach aluminum Power Steering cooler (U shaped aluminum tube) to center radiator support and lower chassis rail (see picture)
19. Unplug connector from Cam Timing Sensor located just above water pump cover plate and to the right of front engine mount. Remove the M6 bolt that attaches the sensor to the timing case and install the new cam sensor retainer assembly provided in kit. Rotate the sensor CCW to clear supercharger plate. Reinstall OEM idler pulley and leave in Loosened position. Make sure there is enough clearance between drain back tube and tensioner assembly.





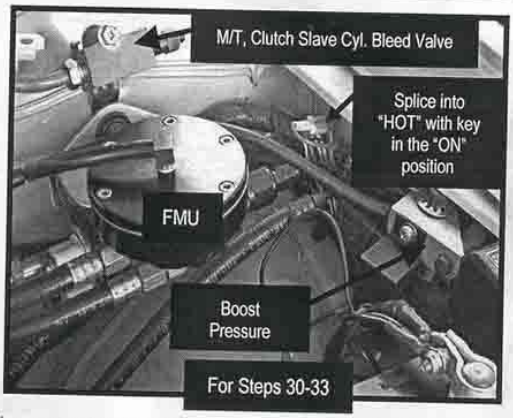





20. Slip on rubber drain back hose and hose clamps supplied in kit to drain back plate with "J" pipe. The other end will be attached to bottom of supercharger brass drain back fitting later on. Some trimming will be needed to fine tune hose for clearance. Make sure hose is not pinched to block flow of drain back oil from supercharger.
21. Remove two bolts from front engine mount located on Right side of engine bay (Passenger side) near Power Steering Reservoir.

22. Mock up or hold supercharger assembly to engine timing chain cover and remove the 7 (M6x1.0 thread) bolts (10MM hex head) starting at the M6 bolt just above the thermostat housing and going counter-clockwise remove the 6 other M6 bolts.
23. Route cam sensor harness through oval hole on top of super charger mounting plate on backside of spud. Carefully plug sensor harness connector back onto OEM cam timing sensor and slowly tighten engine mount and timing case bolts while checking to make sure nothing is pinched or tangled up in assembly.
24. Mount supercharger assembly to engine. Reinstall with longer M6 x 1.0 thread bolts provided in kit. Start bolts only. Do not tighten fully yet. Carefully plug sensor harness connector back onto OEM cam timing sensor and slowly tighten engine mount and timing case bolts while checking to make sure nothing is pinched or tangled up in assembly.
25. Install front engine mount bolts through supercharger plate.
26. Slowly finish tightening the 7 M6 bolts to timing cover and 2 bolts to front engine mount, make sure belt is routed correctly through the pulleys and not bound or pinched. **(Use Blue Loctite® and torque all bolts so as not over tighten and strip threads in aluminum timing case cover) Torque M6 bolts 8.7 to 10.1ft-lb. M10 bolts 32 to 41 ft-lb.**
27. Finish routing oil pressure feed line from back of engine block, down side of oil pan, up to front of supercharger and attach to -4 male fitting on supercharger. Make sure oil feed line is clear of any pulleys, belts or sharp edges.
28. Install belt around crank pulley. Belt is tight but will fit, be patient. Tighten serpentine belt by tightening OEM tensioner making sure belt is tracking on center of all pulleys. Tighten tensioner-adjusting nut in a clockwise rotation till you can twist the belt at the longest section with thumb and forefinger and rotate 90°. Tighten lock not on OEM tensioner pulley to 19-24 ft-lb.
29. On 1999 Automatic transmission models – Remove ballast resistor from left (Drivers side) front strut shock tower and relocate to tab on bottom of battery tray. Unclip harness from left inner fender and ABS unit. Install fuel pump assembly utilizing the resistor mounting holes (see picture)
30. On Manual transmission models install and mount auxiliary fuel pump and pressure regulator assembly on left strut tower in engine bay just below brass clutch bleed union. On early '95 models, drilling (2) ∅. 250 holes to mount fuel pump assembly to strut tower may be required.
31. Remove rear bolt from fuse box mounted on left fender apron and install manifold pressure switch and auxiliary fuel pump relay with alum spacer and new longer M6 bolt.
32. Splice Yellow wire from wire into OEM harness connector located on left fender apron just back of fuse box assembly. Using supplied blue colored splice, splice into large diameter RED wire in plastic connector. You want a circuit that is "HOT" or have "Power" only with ignition key in the "ON' position. **(See wiring schematic or factory service manual)**
33. Connect Black lead from relay to - Negative side of battery and Red lead to + Positive side of battery. **(See wiring schematic.)**
34. Attach fuel lines. Follow fuel flow direction from outlet of fuel filter to hose connection at beginning of fuel rail located behind crankcase breather hose on number 6 cylinder.
35. Disconnect hose connection at beginning/inlet of fuel rail and connect auxiliary fuel pump outlet line to fuel rail inlet.
36. Attach auxiliary fuel pump inlet to outlet of fuel filter.





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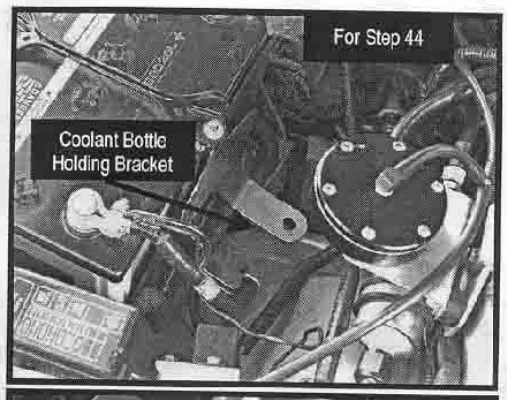
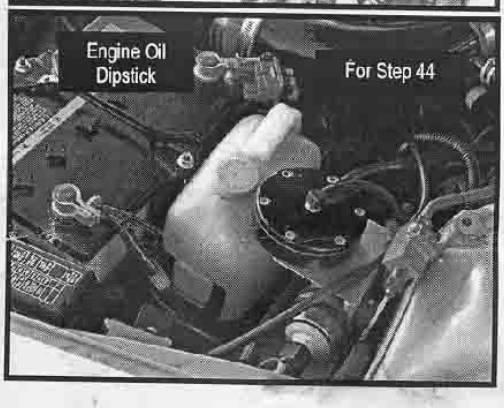
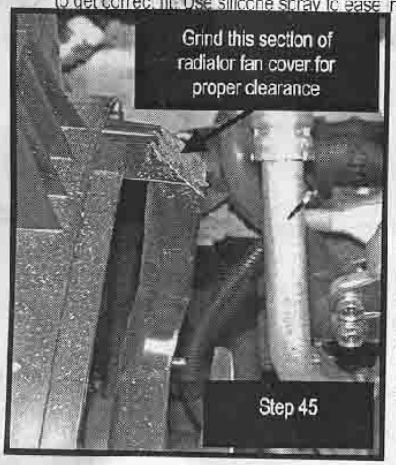
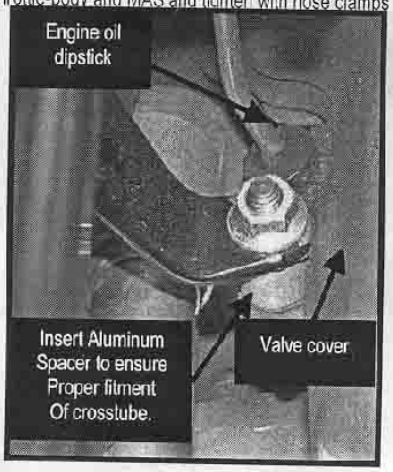
37. Disconnect hose connection of OEM pressure regulator outlet/return line from steel tube assembly just underneath throttle body.
38. Attach inlet hose from straight brass fitting of black FMU (Fue Management Unit) to OEM pressure regulator outlet/return.
39. Attach outlet/return hose from 90° brass fitting on FMU to OEM steel return line back to tank.
40. Slip on large silicone hose to throttlebody and then slip 90° tube with nipple. Use silicone spray if needed (There is two- (2) 90° intakes tube provided to allow for different air temperature sensors. Your vehicle will either have a push in type sensor or a bolt in sensor with 2 screws. Use the appropriate tube for your vehicle application.)
41. Install air bypass adapter provided in kit in between nipple welded to the 90° tube that attaches to throttle-body and air by-pass hose on throttle-body. Make sure all hose clamps clear throttle-body operation.
42. Insert air temp sensor grommet into hole provided in tube and insert air temp sensor or bolt air sensor to tube depencing on sensor type. Use a very small amount of silicone sealer on bolt in sensors to prevent a small vacuum leak. Harness to air temp sensor wires may need to be trimmed or cut away from harness to allow sensor to reach on some models.
43. Attach MAS (Mass Air Sensor) to large bend tube. **(See picture on last page) Note: Some vehicles will require an adapter for the Air-Bypass hose. Included in kit is the adapter tee fitting to attach Air-bypass hose and small vacuum line to intake system.**
44. Remove rear battery mounting rod and insert through tube in coolant bottle holding bracket and reinstall battery holding rod and tighten. Route over-flow hose provided in kit from neck of radiator to new location of coolant bottle and assure there is no kinks in hose.
45. Remove OEM crankcase vent hose from top right of forward valve cover and install vent hose assembly from kit. Route vent hose towards front of engine and along front cover towards supercharger.
46. Remove black plastic cover from behind R+ or passenger headlight. Remove vertical wire loom support bracket
47. Mount supercharger crossover tube between engine and radiator, Slight clearancing of the right hand cooling fan mount might be needed. (See photo) Attach supercharger tube with blow-off valve flange to supercharger with 90° rubber hose and MAS to supercharger cross over tube. Install aluminum spacers underneath mounting tabs to valve cover and screw in M6 bolts. Rotate supercharger tube and adjust rubber hoses to get correct fit. Use silicone spray to ease installation of rubber hose connections to tube, throttle-body and MAS and tighten with hose clamps provided in kit.
48. On 1999 and later models remove SCV control vacuum check valve from gold bracket that was attached to air filter assembly. Remove gold bracket and zip tie assembly to wire loom on transmission side of engine (see picture)
49. Mount blow-off valve assembly to blow-off flange on crossover pipe. Apply a bead of sealer at flange mating surfaces and bolt together
50. Attach and route vacuum lines and plastic tees. 'Tee off' of OEM fuel pressure regulator as vacuum source, run one vacuum line from 'Tee' to blow off valve. From other side of 'Tee' run another line to FMU and



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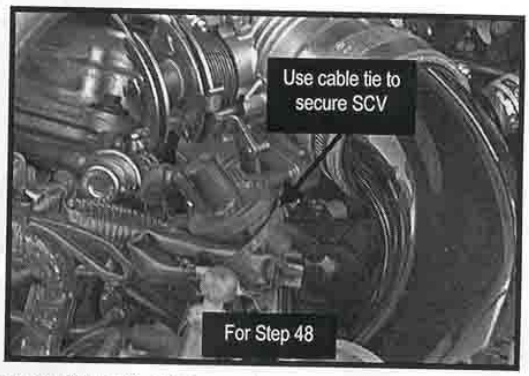
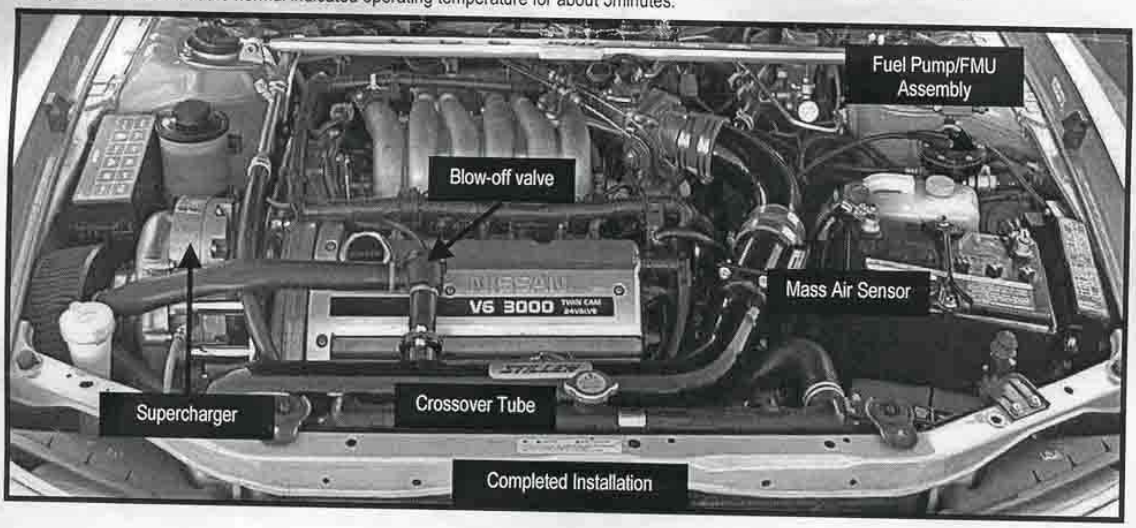
'Tee' off to manifold pressure boost switch/Hobb switch. Double check that you "Tee" into manifold vacuum ***not ported!***

51. Remove windshield bottle filler neck from reservoir and cut or slice groove in neck to rotate filler neck out of way from air filter area.
52. Install air filter to supercharger by slipping filter-mounting flange inside blue silicone hose clamped to supercharger. Route crankcase vent tube from nipple of front valve cover to small hole in air filter. Insert black plastic hose adapter from crankcase vent into air filter. Attach large 1" diameter hose from blow-off valve to plastic nipple on air filter.
53. Recheck all fasteners and hoses and oil lines to make sure they are properly tightened.
54. Replenish and top off all fluids. I.E. Engine oil and coolant.
55. Reconnect battery.
56. Turn key to "ON" position and check fuel lines for any leaks. Auxiliary fuel pump will turn on. As soon as engine is started auxiliary pump will turn off. This is normal.
57. Start engine and inspect for any fuel, oil, vacuum, or water leaks. Make sure supercharger drive belt is tracking properly and has proper tension. (Refer back to step #28.) Due to the nature of straight cut gears in the supercharger gear housing some gear noise will be apparent
58. After a short drive, double-check all connections and fasteners for tightness.



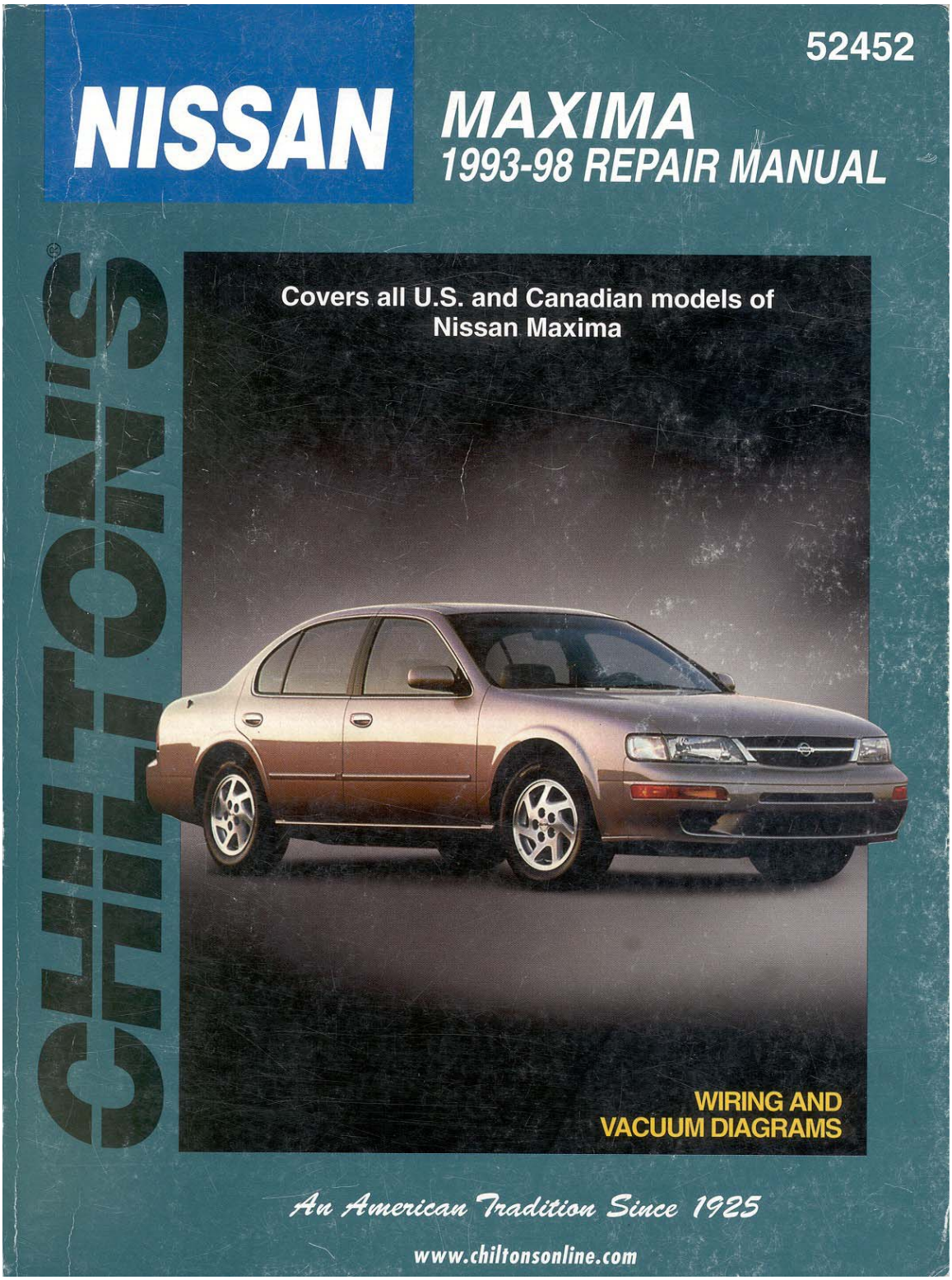

## Engine start up and fuel considerations.

Never operate your engine at full throttle when engine is cold. When starting the engine each day, always allow plenty of time for the oil to reach full operating temperature before running above 2500RPM. Full supercharger operating temperature is achieved only after the engine water temperature has been at the normal indicated operating temperature for about 5minutes.




Always use highest-octane **SUPER UNLEADED 92 Octane** fuel. Always use national brand fuel. If filling from another source than the one you use regularly, always listen for audible detonation. If detonation is audible, cease using heavy throttle and drive with greater care until fuel is consumed or replaced.

*Appendix C* – Sited Chilton's repair manual pages:



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## Air Cleaner

An air cleaner is used to keep airborne dirt and dust out of the air flowing through the engine. Proper maintenance is vital, as a clogged element will restrict air flow and power, and allow excessive contamination of the oil with abrasives.

Maximas are equipped with a disposable, paper cartridge air filter element. The element should be checked at every tune-up or sooner if the vehicle is operated in a dusty area. Nissan does not recommend attempting to clean and reuse the element. The filter element should be replaced every 30,000 miles (48,000km).

### REMOVAL & INSTALLATION

**See Figures 44, 45 and 46**

1. Disengage the four clips on the sides of the air cleaner housing.
2. Lift up on the housing cover and remove the filter element.
3. Before installing the original or the replacement filter, wipe out the inside of the housing with a clean rag or paper towel.

**To install:**

4. Install the paper air cleaner filter, seat the top cover on the bottom housing and tighten the wing nut(s), if equipped.

**Make sure the word UP is facing up when you install the filter element.**

## Fuel Filter

The fuel filter is a disposable unit located in the engine compartment, next to the power brake booster. The filter should be replaced at least every 30,000 miles (48,000km). A dirty filter will starve the engine of fuel and cause driveability problems.

### REMOVAL & INSTALLATION

**See Figures 47, 48 and 49**

1. Remove the fuel pump fuse from the fuse panel.
2. Start the engine.
3. After the engine stalls, try to restart the engine. If the engine will not start, the fuel pressure has been released.
4. Turn the ignition switch **OFF**.
5. Using a shop rag to absorb the excess fuel, loosen the fuel filter's hose clamps, remove the hoses and the filter. Check the hoses for cracks and flexibility. Replace any hardened and/or cracked hoses.
6. Install a new fuel filter in the proper direction. Usually an arrow indicates the direction of fuel flow.

**Be sure to install a new high pressure fuel filter, not a carburetor type. Also, be sure to use new hose clamps.**

7. Install the fuel pump fuse.
8. Start the engine and check for leaks. It may be necessary to crank the engine for a time to build fuel pressure, so don't be alarmed if it doesn't start immediately.

## Positive Crankcase Ventilation (PCV) Valve

**See Figure 50**

This valve feeds crankcase blow-by gases into the intake manifold to be burned with the normal air/fuel mixture. The PCV valve has no strict interval for maintenance. However, it is wise to check the system occasionally in case of clogging, especially if you know that you have a vehicle that has been neglected. Make sure all PCV connections are tight. Check that the connecting hoses are clear and not clogged. Replace any brittle or broken hoses.

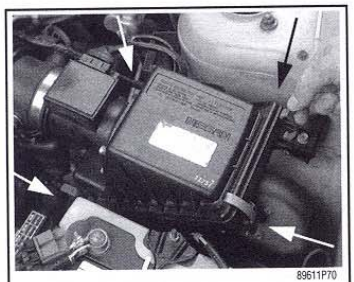

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**Fig. 44 The four spring clips on the edges of the air cleaner are disengaged by pulling back on the tabs**

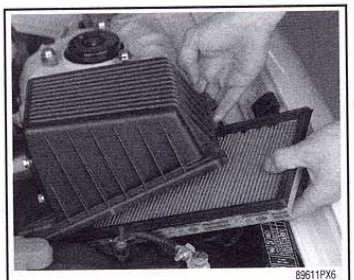

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**Fig. 45 Lift up on the upper filter housing, and slide out the filter element from the housing**

89611P68

**Fig. 46 An example of a severely clogged filter element. A filter this dirty can hamper engine performance**

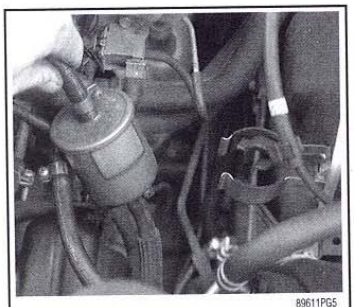

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**Fig. 47 The fuel filter unclips from the bracket, allowing for easier replacement**

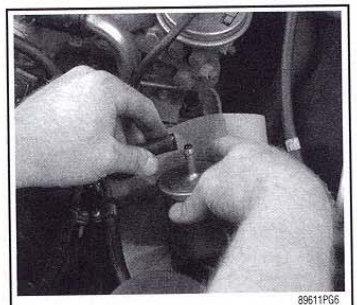

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**Fig. 48 Be sure the filter is in the proper direction when attaching the hoses**

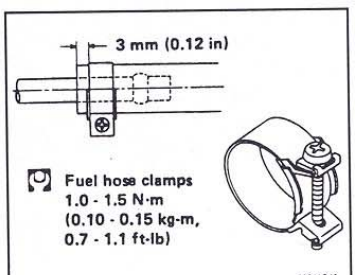


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**Fig. 49 When installing fuel hose clamps, be sure to position the clamp so it is 3mm from the end of the hose**


**Fig. 71 Loosen the mounting bolt just enough to allow the adjustment bolt to properly tension the belt**


**Fig. 72 After the tension is set with the adjustment bolt, tighten the mounting bolt and check the that the tension hasn't changed**

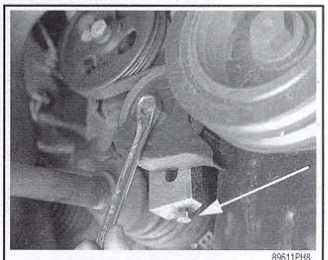


**Fig. 73 Loosen the pulley mounting bolt just enough to allow the adjustment bolt (arrow) to set the belt tension**

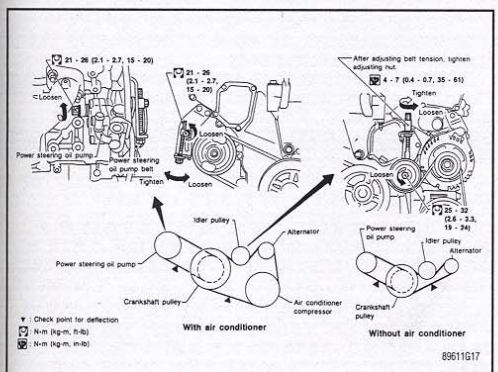


**Fig. 74 Accessory belt routing and adjusting diagram for 1995–98 models**

3. Turn the adjustment bolt to change the belt tension.
4. After adjustment is satisfactory, tighten the adjustment bolt locknut and the pump pivot bolt.
5. Check that the tension has not changed.

### REMOVAL & INSTALLATION

**See Figures 76 and 77**

The replacement of the inner belt on multi-belted engines may require the removal of the outer belts.

To replace a drive belt, loosen the adjusting and mounting bolts of the component which the belt is driving. Move the component inward to relieve the tension on the drive belt.

Slip the belt off the component pulley and match the new belt with the old belt for length and width. The old belt will be slightly longer. After a new belt is installed correctly, adjust the tension.

**When replacing more than 1 belt, it is a good idea to make note or mark what belt goes around what pulley; this will make installation easier if you mix up the belts.**

## Timing Belts

### SERVICING

Timing belts are typically only used on overhead camshaft engines. Timing belts are used to synchronize the crankshaft with the camshaft, similar to a timing chain on a overhead valve (pushrod) engine. Unlike a timing belt, a timing chain will normally last the life of the engine without needing service or replacement. Timing belts use raised teeth to mesh with sprockets to operate the valve train of an overhead camshaft engine.

Engines, chain or belt driven, can be classified as either free-running or interference. Depending on what would happen if the piston-to-valve timing is disrupted. A free-running engine has enough clearance between the piston and the valve to allow the crankshaft to turn (pistons still moving) while the camshaft stays in one position (several valves fully open). If this condition occurs normally, no internal engine damage will result. In an interference engine, there is not enough clearance between the pistons and valves to allow the crankshaft to turn without the camshaft being in time. Maximas from 1993–94 with the VG30E engine use a belt to drive the camshafts. The VG30E is also an interference type engine, which can suffer extensive internal damage if a timing belt fails. The piston design does not allow clearance for the valve to be fully open and the piston to be at the top of its stroke. If the belt fails, the piston will collide with the valve and will bend or break the valve, damage the


**Fig. 75 Alternator and A/C compressor belt tensioner adjustment bolt**

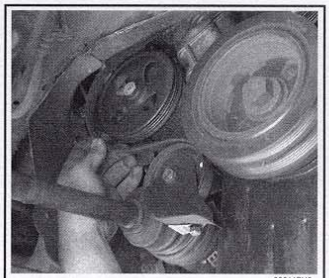


**Fig. 76 After the tension on the belt is relieved, slip the belt from the pulley**

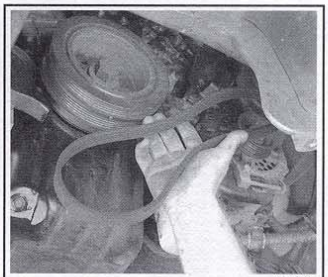


**Fig. 77 The replacement of some belts may require the removal of other belts**

**➡Your engine's fuel requirement can change with time, mainly due to carbon buildup, which will in turn increase the temperatures in the combustion chamber and change the compression ratio. If your engine pings, knocks or runs on, switch to a higher grade of fuel. Sometimes just changing brands will cure the problem. Using a higher grade of fuel is always recommended.**

## Engine

### OIL LEVEL CHECK

**See Figures 149, 150, 151 and 152**

The best time to check the engine oil is before operating the engine or after it has been sitting for at least 10 minutes in order to obtain an accurate reading. This will allow the oil to drain back in the crankcase. To check the engine oil level, make sure the vehicle is resting on a level surface, remove the oil dipstick, wipe it clean and reinsert the stick firmly for an accurate reading. The oil dipstick has two marks to indicate high and low oil level. If the oil is at or below the "low level" mark on the dipstick, oil should be added as necessary. The oil level should be maintained in the safety margin, neither going above the "high level" mark or below the "low level" mark.

### OIL & FILTER CHANGE

**See Figures 153 thru 160**

The Nissan factory maintenance intervals (every 7500 miles or 6 months) specify changing the oil filter at every second oil change after the initial service. We recommend replacing the oil filter with every oil change. For the small price of an oil filter, it's cheap insurance to replace the filter at every oil change. One of the larger filter manufacturers points out in its advertisements that not chang-

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**Fig. 149 Be sure to push the dipstick all the way down to obtain an accurate reading**

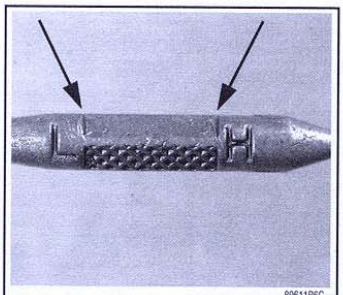

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**Fig. 150 The engine oil level should ALWAYS be maintained between the marks**

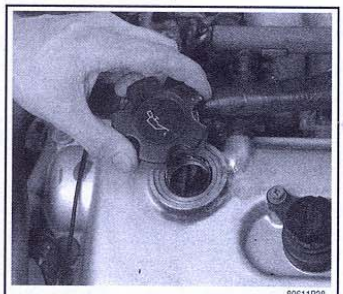
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**Fig. 151 Unscrew the cap on the front valve cover to add oil to the engine**

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**Fig. 152 Add oil in small increments; overfilling the engine with oil can damage internal components**


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**Fig. 153 Always use the proper size wrench when loosening or tightening the drain plug**

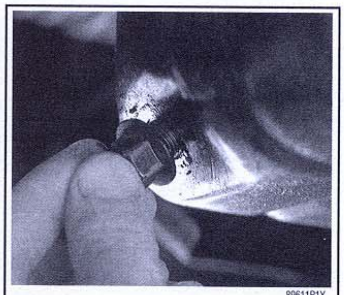
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**Fig. 154 After the drain plug is loosened, unscrew it by hand while pushing in . . .**

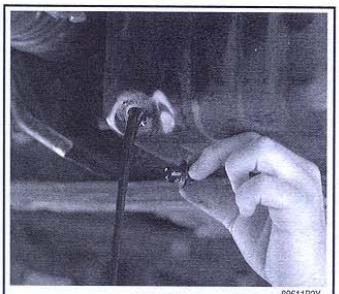
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**Fig. 155 . . . then quickly pull it away, and let the oil drain**


89611P3Y

**Fig. 156 The copper washer should be replaced to ensure a leak-free seal**


89611P7Y

**Fig. 157 Carefully clean any dirt around the drain hole that would interfere with the copper washer**


**Fig. 158 Use an oil filter wrench to loosen the filter**

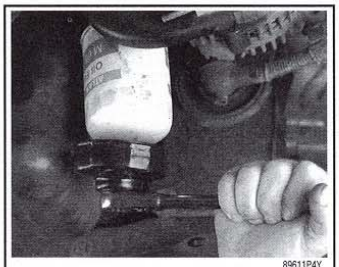


**Fig. 159 This is another example of an oil filter wrench. Select the type which best suits your application**

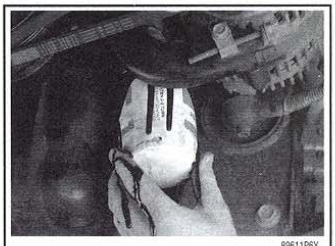


**Fig. 160 After the oil filter is loosened with a wrench, spin it off the housing. Keeping the filter upright will minimize spillage**

ing the filter leaves 1 quart (0.9L) of dirty oil in the engine. This claim is true and should be kept in mind when changing your oil.

1. Run the engine until it reaches normal operating temperature.
2. Raise and safely support the vehicle and support it on safety stands if necessary to gain access to the filter.
3. Slide a drain pan of at least 6 quarts (6L) capacity under the oil pan.

### ⁂ CAUTION

**The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.**

4. Loosen the drain plug. Turn the plug out by hand. By keeping an inward pressure on the plug as you unscrew it, oil won't escape past the threads and you can remove it without being burned by hot oil.
5. Allow the oil to drain completely and then install the drain plug. Don't overtighten the plug or you'll be buying a new pan or a trick replacement plug for damaged threads.
6. Using an oil filter wrench, remove the oil filter. Keep in mind that it's holding about 1 quart (0.9L) of dirty, hot oil.
7. Empty the old filter into the drain pan and dispose of the filter and old oil.

➡**One ecologically desirable solution to the used oil disposal problem is to find a cooperative gas station owner who will allow you to dump your used oil into his tank or take the oil to a reclamation center (often at garages and gas stations).**

8. Using a clean rag, wipe off the filter adapter on the engine block. Be sure the rag doesn't leave any lint which could clog an oil passage.
9. Coat the rubber gasket on the filter with fresh oil. Spin it onto the engine by hand; when the gasket touches the adapter surface give it another ½–¾ turn. No more or you'll squash the gasket and it will leak.
10. Refill the engine with the correct amount of fresh oil.
11. Crank the engine over several times and then start it. If the oil pressure indicator light doesn't go out or the pressure gauge shows zero, shut the engine down and find out what's wrong.
12. If the oil pressure is OK and there are no leaks, shut the engine off and lower the vehicle.

## Manual Transaxle

### FLUID RECOMMENDATION

**◗ See Figure 161**

For manual transaxles be sure to use fluid with an API GL4 rating.

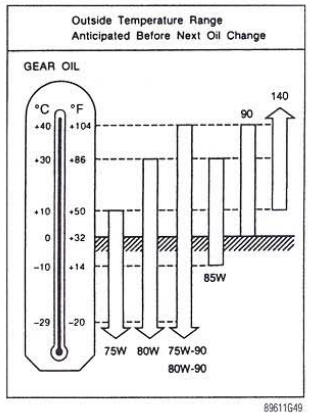


**Fig. 161 Select the appropriate gear oil for the ambient temperature**

### LEVEL CHECK

**◗ See Figure 162**

You should inspect the manual transaxle gear oil at 12 months or 15,000 miles, at this point you should correct the level or replace the oil as necessary. The lubricant level should be even with the bottom of the filler hole. Push in on the filler plug when unscrewing it. When you are sure all of the threads of the plug are free of the transaxle case, move the plug away from the case slightly. If lubricant begins to flow out of the transaxle, then you know it is full. If not, add the correct gear oil as necessary

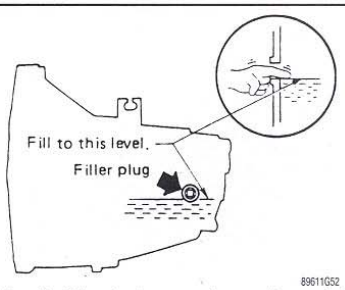


**Fig. 162 When the filler plug is removed, a small amount of oil should run out; this indicates a correct fluid level**

Heavy cables, connectors and switches are utilized by the starting system because of the large amount of amperage this system is required to handle while cranking the engine. For premium starter motor function, the resistance in the starting system must be kept to an absolute minimum.

A discharged or faulty battery, loose or corroded connections, or partially broken cables will result in slower-than-normal cranking speeds. The amount of damage evident may even prevent the starter motor from rotating the engine at all.

## Starter

Maximas use a gear reduction starter has a set of ratio reduction gears; the brushes on the gear reduction starter are located on a plate behind the starter drive housing. The extra gears make the starter pinion gear turn at about ½ the speed of the starter, giving the starter twice the turning power of a conventional starter.

The starting system is comprised of the following components:

- Permanent magnet gear-reduction starter motor with a solenoid-actuated drive
- Battery
- Remote control starter switch (part of the ignition switch)
- Park/Neutral Position switch (Automatic models)
- Clutch Pedal Position switch (on manual transmission models)
- Starter relay
- Heavy circuit wiring

### TESTING

The easiest way to test the performance of the starter is to perform a voltage drop test.

**➦The battery must be in good condition and fully charged prior to performing this test.**

1. Connect a voltmeter between the positive and negative terminals of the battery.
2. Turn the ignition key to the **START** position and note the voltage drop on the meter.
3. If voltage drops below 11.5 volts, there is high resistance in the starting system.
4. Check for proper connections at the battery and starter.
5. Check the resistance of the battery cables and replace as necessary.
6. If all other components in the system are functional, the starter may be faulty.

**➦Many automotive parts stores have starter bench testers available for use by customers. A starter bench test is the most definitive way to determine the condition of your starter.**

### REMOVAL & INSTALLATION

**◗ See Figures 23 and 24**

1. Disconnect the negative battery cable from the battery.
2. On the VE30DE and VQ30DE engines, remove the air duct.

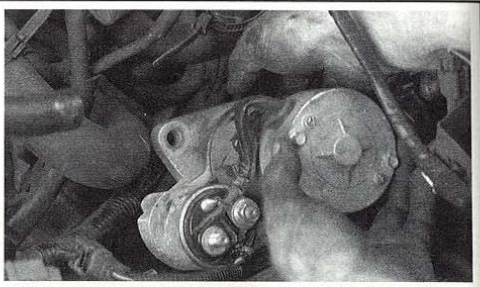

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**Fig. 23 Removing the starter (automatic transaxle)**

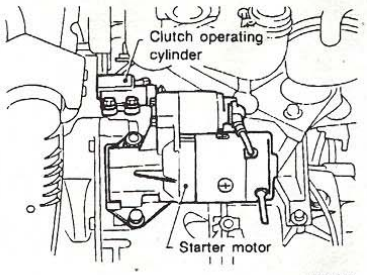


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**Fig. 24 Starter location and mounting detail—manual transaxle**

3. Disconnect the starter wiring at the starter, taking note of the positions for correct installation.
4. On the VE30DE engine, remove the connector brackets.
5. Remove the starter-to-engine bolts ,and remove the starter from the vehicle.

**To install:**

6. Holding the starter in position, insert and tighten the attaching bolts. Be careful not overtorque the mounting bolts as this will crack the nose of the starter case.
7. Install the starter wiring in the correct location.
8. On the VE30DE engine, install the air duct and the connector brackets.
9. Connect the negative battery cable.
10. Start the engine a few times to make sure of proper operation.

## SENDING UNITS AND SENSORS

**➦This section describes the operating principles of sending units, warning lights and gauges. Sensors that provide information to the Electronic Control Module (ECM) are covered in Section 4 of this manual.**

Several types of sending units exist, however most can be characterized as being either a pressure type or a resistance type. Pressure type sending units convert liquid pressure into an electrical signal that is sent to the gauge. Resistance type sending units are most often used to measure temperature and use variable resistance to control the current flow back to the indicating device. Both types of sending units are connected in series by a wire to the battery (through the ignition switch). When the ignition is turned **ON**, current flows from the battery through the indicating device and on to the sending unit.

## Oil Pressure Switch

The oil pressure switch is located underneath the front of the engine, next the to oil filter. This switch sends a signal to the oil light on the instrument cluster, warning of low oil pressure.

### TESTING

**◗ See Figures 25 and 26**

**⁂ CAUTION**

**During this procedure, the engine will running; use extreme caution. Keep clear of moving parts.**

**➦The engine should be at normal operating temperature before performing this procedure.**

1. Turn off the engine.
2. Unplug the oil pressure switch connector.
3. Using an ohmmeter, check the continuity between the terminal and ground; there should be continuity.
4. Start the engine and let it idle. Check the continuity between the terminal

6. Install the exhaust manifold to the engine. Torque the exhaust manifold-to-engine bolts, in sequence, to 13–16 ft. lbs. (16–22 Nm).
7. Install the exhaust pipes to the manifolds.
8. Connect the negative battery cable. Start the engine and check for exhaust leaks.

**VQ30DE Engine**

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.

**➡To make removing the exhaust manifolds easier, soaking the exhaust pipe retaining bolts with penetrating oil is recommended.**

3. Remove the exhaust manifold heat shields.
4. Disconnect the exhaust pipes from the exhaust manifolds.
5. Remove the exhaust manifold-to-engine bolts, in the opposite order of the tightening sequence. Discard the gaskets.

**To install:**

6. Clean all gasket mounting surfaces. Install new gaskets.
7. Install the exhaust manifold to the engine. Torque the exhaust manifold-to-engine bolts to 13–16 ft. lbs. (16–22 Nm).
8. Install the exhaust pipes to the manifolds.
9. Install the exhaust manifold heat shields.
10. Connect the negative battery cable. Start the engine and check for exhaust leaks.

## Radiator

REMOVAL & INSTALLATION

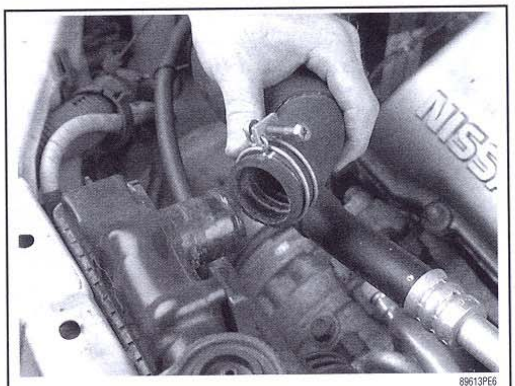
**◗ See Figures 58 thru 64**

1. Remove the splash shield underneath the vehicle. This makes access to the lower hose easier.
2. Disconnect the upper and lower radiator hoses.
3. Disconnect the radiator overflow hose.

**⁂ CAUTION**

**Never open, service or drain the radiator or cooling system when hot; serious burns can occur from the steam and hot coolant. Also, when draining engine coolant, keep in mind that cats and dogs are attracted to ethylene glycol antifreeze and could drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantities. Always drain coolant into a sealable container. Coolant should be reused unless it is contaminated or is several years old.**

4. Disconnect the automatic transaxle cooler lines from the radiator (automatic models).



89613PE6

**Fig. 58 Twist the hose while pulling away to disconnect it from the radiator**


89613PF1

**Fig. 59 Pinch the clamp with pliers to loosen it; then pull it back to remove the hose**


89613PE2

**Fig. 60 After the automatic transaxle cooler lines are removed, use plugs to keep any ATF from spilling**

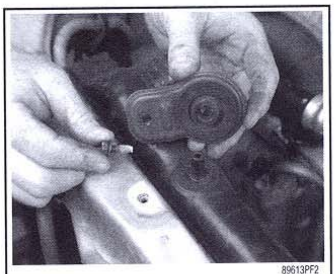

89613PF2

**Fig. 61 Remove the bolt and pull the upper bracket from the pin on the radiator**

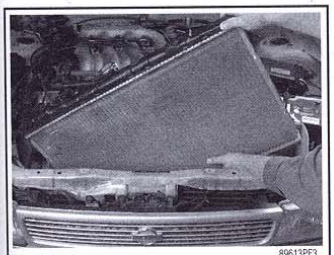

89613PF3

**Fig. 62 When lifting the radiator out of the engine compartment, be careful not to damage the cooling fins**

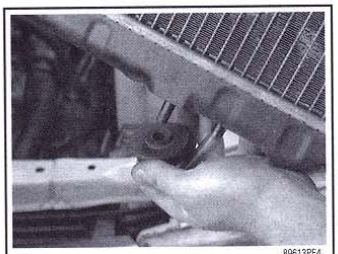

89613PF4

**Fig. 63 Make sure the rubber spacers are installed properly on the bottom radiator pins . . .**

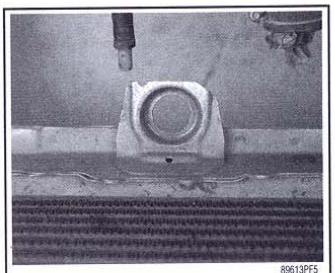

89613PF5

**Fig. 64 . . . and the spacers are seated properly in the radiator mounts**

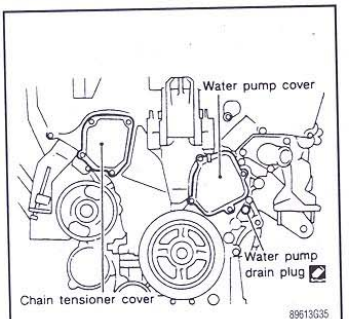



Fig. 80 Water pump and chain tensioner cover locations—VQ30DE engine

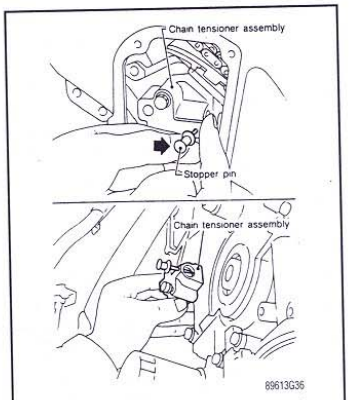



Fig. 81 Push in the chain tensioner and hold in place with a small pin

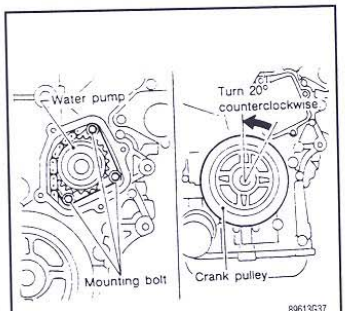



Fig. 82 After the three water pump bolts are removed, turn the crankshaft to loosen the timing chain slightly

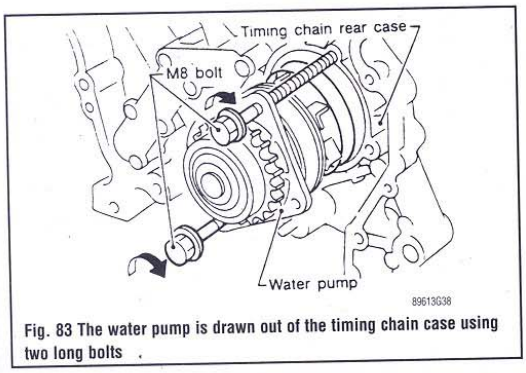



Fig. 83 The water pump is drawn out of the timing chain case using two long bolts .

**attracted to ethylene glycol antifreeze and could drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantities. Always drain coolant into a sealable container. Coolant should be reused unless it is contaminated or is several years old.**

3. Remove the right side motor mount and bracket assembly. Use a jack or an engine support to hold the engine in place while the mount is removed.
4. Remove the drive belts and the idler pulley bracket.
5. Remove the water pump drain plug.
6. Remove the chain tensioner cover and the water pump cover.
7. Using a suitable tool, push in the timing chain tensioner sleeve. Use a small pin to stop the tensioner from returning.
8. Remove the three water pump bolts. To relax the tension on the timing chain, turn the crankshaft damper approximately 20° counterclockwise.
9. Using two longer bolts, carefully draw the pump out of the housing. Turn each bolt no more than one half turn each time, or the pump and housing may be damaged.
10. Remove the water pump assembly from the engine. Discard the O-rings.
11. Inspect the assembly for excessive corrosion, rough operation or end play. Replace as necessary.

**To install:**

12. Place a small amount of coolant on the O-rings to lubricate them.
13. Carefully push the water pump assembly into the housing.

**⁂ WARNING**

**Be sure not to cut the O-rings on the pump housing when installing the pump assembly. Be sure to lubricate the O-rings before assembly.**

14. Tighten the water pump assembly bolts to 5.1–7.2 ft. lb. (7–10 Nm.).
15. Return the crankshaft to its original position by turning it 20° forward.
16. Install the timing chain tensioner. Tighten the two bolts to 6.2–8.0 ft. lb. (8.4–10.8 Nm.). Remove the retainer pin from the tensioner.
17. Clean the mating surfaces of the chain tensioner cover and water pump cover. Apply a fresh bead of appropriate liquid gasket to each cover.
18. Install the covers, and torque the bolts to 7–9 ft. lb. (10–13 Nm.).
19. Install the water pump drain plug.
20. Install the drive belts and the idler pulley bracket Be sure to set belt tension properly.
21. Install the right side motor mount and bracket assembly.
22. Refill the coolant system.

## Cylinder Head

### REMOVAL & INSTALLATION

**➦To prevent distortion or warping of the cylinder head, allow the engine to cool completely before removing the head bolts.**

**VG30E Engine**

**◗ See Figures 84 thru 91**

**➦To remove or install the cylinder head, you'll need a cylinder head bolt tool, No. ST10120000 (J2423901). This tool may be available through aftermarket manufacturers, available at most auto supply stores.**

**➦The collector assembly and intake manifold have special bolt sequence for removal and installation.**

1. Disconnect the negative battery cable for safety purposes.
2. The distributor assembly is located in the left cylinder head. Mark and remove it, if necessary.
3. Release the fuel system pressure.

**⁂ CAUTION**

**Observe all applicable safety precautions when working around fuel. Whenever servicing the fuel system, always work in a well ventilated area. Do not allow fuel spray or vapors to come in contact with a spark or open flame. Keep a dry chemical fire extinguisher near the work area. Always keep fuel in a container specifically designed for fuel storage; also, always properly seal fuel containers to avoid the possibility of fire or explosion.**

4. Rotate the crankshaft to position the No. 1 piston on TDC of it's compression stroke.

8. Measure and note the ECT sensor resistance with the engine hot.
9. Compare the cold and hot ECT sensor resistance measurements with the accompanying chart.
10. If readings do not approximate those in the chart, the sensor may be faulty.

### REMOVAL & INSTALLATION

**See Figure 40**

1. Partially drain the engine cooling system until the coolant level is below the ECT sensor mounting hole.
2. Disconnect the electrical harness from the ECT sensor.
3. Remove the coolant temperature sensor from the cylinder head.

**To install:**

4. Coat the sensor threads with Teflon® sealant.
5. Thread the sensor into the intake manifold and tighten securely.
6. Refill the engine cooling system.
7. Start the engine and check for coolant leaks.
8. Top off the cooling system as necessary.

## Intake Air Temperature Sensor

### OPERATION

**See Figure 41**

The Intake Air Temperature (IAT) sensor resistance changes in response to ambient air temperature. Sensor resistance decreases as the air temperature increases, and resistance increases as the temperature decreases. This provides a signal to the ECM, indicating the temperature of the incoming air charge.

### TESTING

**See Figures 42 and 43**

1. Disconnect the electrical harness from the IAT sensor.
2. Measure the resistance between the sensor terminals.
3. Compare the resistance reading with the accompanying chart.
4. If the resistance is not within specification, the IAT sensor may be faulty.
5. Connect the electrical harness to the sensor.

### REMOVAL & INSTALLATION

1. Disconnect the electrical harness from the IAT sensor.
2. Remove the sensor mounting screws.
3. Remove the sensor from the air cleaner housing.

**To install:**

4. Install the sensor in the air cleaner housing and tighten the screws securely.
5. Connect the electrical harness to the IAT sensor.

## Mass Air Flow Sensor

### OPERATION

The Mass Air Flow (MAF) sensor directly measures the amount of air flowing into the engine. The sensor is mounted between the air cleaner assembly and the air cleaner outlet tube.

The sensor utilizes a hot wire sensing element to measure the amount of air entering the engine. The sensor does this by sending a signal, generated by the sensor when the incoming air cools the hot wire, to the ECM. The signal is used by the ECM to calculate the injector pulse width, which controls the air/fuel ratio in the engine.

### TESTING

**See Figures 44, 45, 46 and 47**

1. Using a multimeter, check for voltage by backprobing the MAF sensor connector, as illustrated.
2. With the ignition switch **ON** and the engine stopped, voltage should be less than 1.0 volt.
3. With the engine idling at operating temperature, voltage should be 1.0–1.7 volts.
4. With the engine running at approximately 2,500 rpm, voltage should be 1.5–2.1volts.

**➡It is important to watch for a linear voltage rise in response to increases in engine rpm, up to about 4000 rpm.**

5. If voltage is not within specifications, check the power and ground circuits.
6. If the power and ground circuits test okay, the MAF sensor may be faulty.

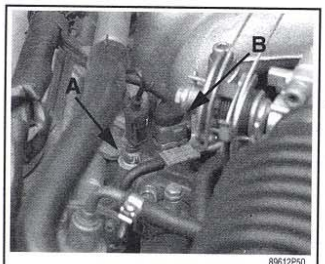


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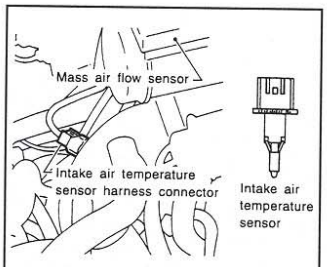
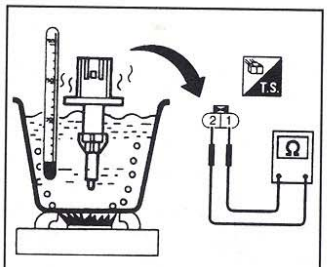
**Fig. 40 Location of the thermal sending unit (A) next to the coolant temperature sensor (B)**



89614G18

**Fig. 41 The intake air temperature sensor is located in the air intake duct**



89614G19

**Fig. 42 Using hot water to check intake air temperature sensor function**

**INTAKE AIR TEMPERATURE SENSOR**

| Temperature °C (°F) | Resistance |
|---|---|
| 20 (68) | 2.1 - 2.9 kΩ |
| 80 (176) | 0.27 - 0.38 kΩ |

89704C03

**Fig. 43 Compare the sensor readings with these values**

### REMOVAL & INSTALLATION

**See Figure 48**

1. Loosen the hose clamps securing the air tube.
2. Disconnect the air tube from the MAF sensor and throttle body.
3. Disconnect the MAF sensor electrical harness.
4. Remove the MAF sensor attaching bolts.
5. Carefully remove the MAF sensor from the air box.

c. Install the fuel rail-to-cylinder head bolts and torque the bolts to 6.9-8.0 ft. lbs. (9.3-10.8 Nm). Then tighten them again to 15-20 ft.lbs. (21-26 Nm).
d. Connect the fuel rail assembly to the fuel lines.
e. Connect the vacuum hose to the fuel pressure regulator.
f. Connect the electrical connectors to the fuel injectors.
10. Install the intake manifold collector.
11. Connect the negative battery cable.
12. Start the engine and check for leaks.

**➦Keep in mind that the engine may take longer to start, since the fuel system has to pressurize. Be sure the battery is in good condition.**

## Fuel Pressure Regulator

REMOVAL & INSTALLATION

**VG30E Engine**

**◗ See Figures 26, 27 and 28**

The pressure regulator is always located on the fuel return side of the fuel injection rail and is attached to the right rear of the fuel rail assembly, at the right rear corner of the intake manifold.

**⁂ CAUTION**

**Observe all applicable safety precautions when working around fuel. Whenever servicing the fuel system, always work in a well ventilated area. Do not allow fuel spray or vapors to come in contact with a spark or open flame. Keep a dry chemical fire extinguisher near the work area. Always keep fuel in a container specifically designed for fuel storage; also, always properly seal fuel containers to avoid the possibility of fire or explosion.**

1. Disconnect the negative battery cable and relieve the fuel pressure.
2. Disconnect the air intake duct from the dual duct housing.
3. Unplug the electrical connectors from the throttle body, the step motor AAC valve and the exhaust gas temperature sensor.
4. Disconnect and label the hoses from the rocker arm cover, the throttle body, the step motor AAC valve, the EGR control valve and the air cut valve.
5. If the spark plug wires are in the way, disconnect them and move them aside. Disconnect the accelerator cable from the throttle body.
6. Remove the upper intake manifold collector-to-intake manifold bolts, in sequence, and lift the assembly from the intake manifold. Discard the gasket.
7. Remove the lower intake manifold collector-to-intake manifold bolts, in sequence, and lift the assembly from the intake manifold. Discard the gasket.
8. Remove the fuel injector assembly by performing the following procedure:
   a. Disconnect the electrical connectors from the fuel injectors.
   b. Disconnect the fuel injector assembly from the fuel lines.
   c. Remove the fuel rail-to-cylinder head bolts.
   d. Remove the fuel rail assembly from the engine.
9. Remove the fuel pressure regulator from the fuel rail assembly.

**To install:**

10. Clean the gasket mounting surfaces.
11. Install the fuel injector assembly by performing the following procedure:
    a. Install the fuel rail assembly to the engine.
    b. Install the fuel rail-to-cylinder head bolts and torque the bolts to 1.8-2.4 ft. lbs. (2.5-3.2 Nm).
    c. Connect the fuel injector assembly to the fuel lines.
    d. Connect the electrical connectors to the fuel injectors.
12. Use a new gasket and install the lower intake manifold collector; torque the lower intake manifold collector-to-intake manifold bolts, in 2-3 steps, in sequence, to 13-16 ft. lbs. (18-22 Nm).
13. Use a new gasket and install the upper intake manifold collector-to-intake manifold; torque the bolts to 5.1-5.8 ft. lbs. (7-8 Nm).
14. Connect the spark plug wires, if disconnected. Connect the accelerator cable to the throttle body.
15. Connect the hoses to the rocker arm cover, the throttle body, the step motor AAC valve, the EGR control valve and the air cut valve.
16. Connect the electrical connectors to the throttle body, the step motor AAC valve and the exhaust gas temperature sensor.
17. Connect the negative battery cable.
18. Start the engine and check for leaks.

**➦Keep in mind that the engine may take longer to start, since the fuel system has to pressurize. Be sure the battery is in good condition.**

**VE30DE and VQ30DE Engines**

**◗ See Figure 29**

The fuel pressure regulator is attached to the fuel rail, near the throttle body, below the upper intake manifold collector.

**⁂ CAUTION**

**Observe all applicable safety precautions when working around fuel. Whenever servicing the fuel system, always work in a well ventilated area. Do not allow fuel spray or vapors to come in contact with a spark or open flame. Keep a dry chemical fire extinguisher near the work area. Always keep fuel in a container specifically designed for fuel storage; also, always properly seal fuel containers to avoid the possibility of fire or explosion.**

1. Relieve the fuel system pressure.
2. For safety purposes, disconnect the negative battery cable.
3. Disconnect the vacuum hose attached to the regulator.
4. Disconnect the fuel hose from the regulator. Use a rag to catch any excess fuel.
5. Remove the retainer screws that hold the regulator to the fuel rail.
6. Place a rag under the regulator to contain any excess fuel, then pull it away from the fuel rail.

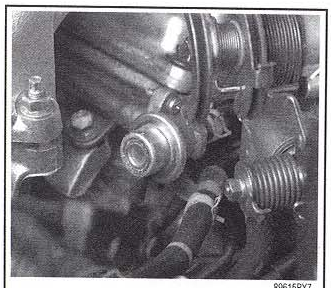

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**Fig. 26 The pressure regulator can be found attached to the fuel rail**

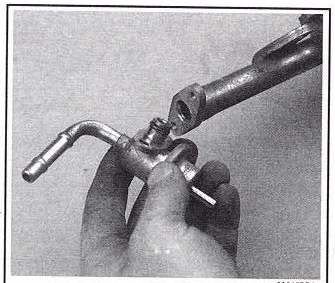
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**Fig. 27 After the two bolts are removed, pull the regulator from the fuel rail**

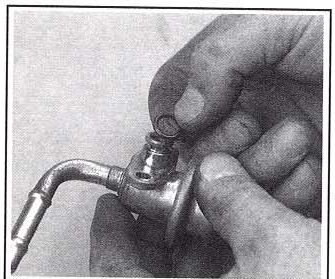

89615PP5

**Fig. 28 Always install a new O-ring when removing the fuel pressure regulator**

5. Loosen the locknut and remove the tie rod end from the tie rod, counting the number of complete turns it takes to completely free it.

**To install:**

6. Install the new tie rod end, turning it in exactly as far as you screwed out the old one. Make sure it is correctly positioned in relationship to the steering linkage.
7. Fit the ball joint and nut, tighten them and install a new cotter pin. Torque the ball joint stud nut to specifications. Check front end alignment.
8. The outer tie rod end-to-steering knuckle torque specification is 22–29 ft. lbs. (29–39 Nm.).

➦ **Always replace the cotter pins and if necessary replace the retaining nut.**

9. Check and adjust the front end alignment as necessary.

## Power Steering Gear

### REMOVAL & INSTALLATION

◗ **See Figures 92 and 98**

**⁂ CAUTION**

**The air bag system must be disarmed before removing the steering wheel. Failure to do so may cause accidental deployment, property damage or personal injury.**

1. Point the front tires straight ahead and lock the steering in this position.

**⁂ WARNING**

**Do not turn the steering wheel or column with the lower joint removed from the steering column or the spiral cable may be damaged.**

2. Remove the steering wheel.

➦ **The steering wheel must be removed before disconnecting the steering column lower joint to avoid damaging the SRS spiral cable.**

3. Raise and support the vehicle safely and remove the front wheels.
4. Disconnect the tie rod ends from the steering knuckles.
5. Remove the carbon canister from the vehicle.
6. Support the engine then remove the bolts attaching the engine mounts to the engine mounting center member. Remove the engine mounting center member.
7. Remove the front stabilizer bar from the vehicle.
8. Remove the nuts attaching the hole cover to the bulkhead.
9. Move the hole cover aside and disconnect the lower joint from the rack and pinion. Matchmark the pinion shaft and the pinion housing to record the steering neutral position.
10. Disconnect the power steering fluid pipes from the rack and pinion.
11. Remove the bolts attaching the mounting brackets and remove the rack and pinion from the vehicle.

**To install:**

12. Position the rack and pinion in the vehicle and install the mounting brackets. Tighten the mounting nuts and bolts in the proper sequence.
13. Install new O-rings to the power steering fluid pipes and connect them to the rack and pinion. Tighten the low pressure line 20–29 ft. lbs. (27–39 Nm). Tighten the high pressure line to 11–18 ft. lbs. (15–25 Nm).
14. Align the lower steering joint to the pinion shaft and install the joint onto the pinion shaft. Install the bolt and tighten to 17–22 ft. lbs. (24–29 Nm).
15. Properly position the hole cover and install the attaching nuts, tighten the nuts to 2.9–3.6 ft. lbs. (4–5 Nm).
16. Install the front stabilizer.
17. Install the engine mounting center member and tighten the attaching bolts. Attach the engine mounts to the center member and tighten the bolts. Remove the support from the engine.
18. Install the remaining components in the reverse order of removal.
19. Tighten the tie rod end nuts, then install a new cotter pin.
20. Fill the power steering reservoir with fluid and bleed the air from the power steering system.
21. Check the vehicle front end alignment and adjust as necessary.

## Power Steering Pump

### REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. If necessary, remove the air cleaner duct and the air cleaner.
3. Remove the drive belt from the air conditioning compressor, if equipped.
4. Loosen power steering pump belt adjustment as follows:
   a. Loosen the pivot and mounting bolts.
   b. Loosen the idler pulley locknut and turn the adjusting nut counterclockwise to remove the power steering belt.
5. Loosen the power steering hoses at the pump and remove the bolts holding the power steering pump to the bracket.
6. Disconnect and plug the power steering hoses and remove the pump from the vehicle.

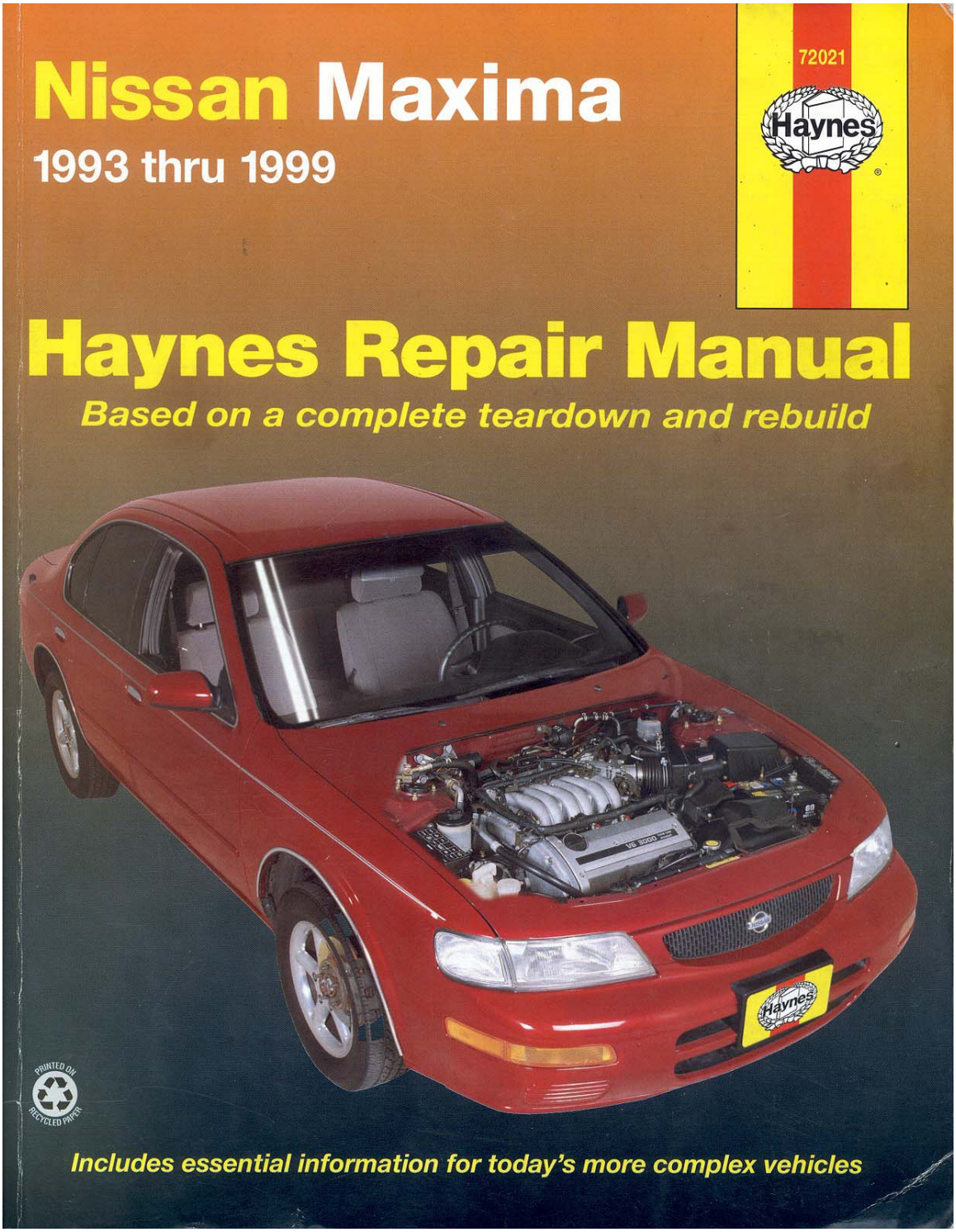
**To install:**

7. Using new O-rings, connect the power steering hoses to the steering pump.
8. Install the power steering pump and secure it with its mounting bolts. Tighten the front and rear mounting bolts to specifications.
9. Install the remaining components in the reverse order from which they were removed.
10. Connect the negative battery cable.
11. Fill the power steering system, start the engine and turn the steering wheel from side-to-side to bleed air from system.

### BLEEDING

1. Fill the pump reservoir and allow to remain undisturbed for a few minutes.
2. Raise the vehicle until the front wheels are clear of the ground.
3. With the engine off, quickly turn the wheels right and left several times, lightly contacting the stops.
4. Add fluid if necessary.
5. Start the engine and let it idle.
6. Repeat Steps 3 and 4 with the engine idling.
7. Stop the engine, lower the vehicle until the wheels just touch the ground. Start the engine, allow it to idle, and turn the wheels back and forth several times. Check the fluid level and refill, if necessary.

*Appendix D* – Sited Haynes repair manual pages:






Josh Frohman
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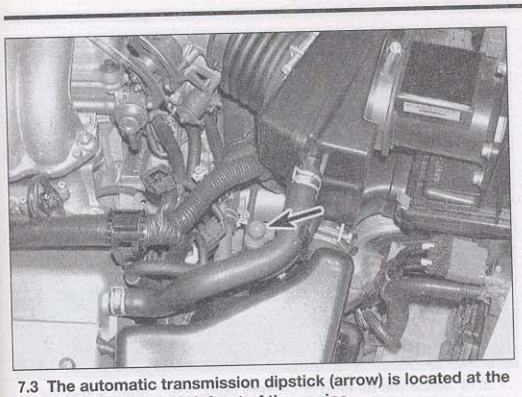
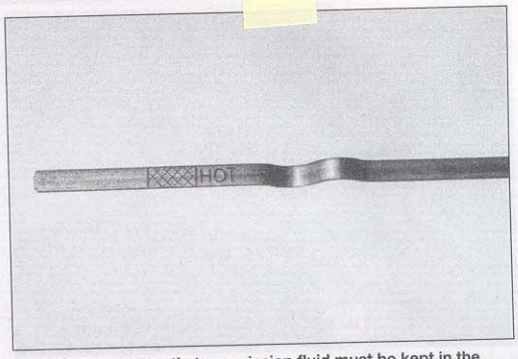


7.3 The automatic transmission dipstick (arrow) is located at the left front of the engine




7.6 The automatic transmission fluid must be kept in the crosshatched area on the dipstick at normal operating temperature



the fluid level. The fluid should be at the proper level, depending on whether it was checked hot or cold **(see illustration 6.2)**. Never allow the fluid level to drop below the lower mark on the dipstick.

7 If additional fluid is required, pour the specified type directly into the reservoir, using a funnel to prevent spills.

8 If the reservoir requires frequent fluid additions, all power steering hoses, hose connections, steering gear and the power steering pump should be carefully checked for leaks.

## 7 Automatic transmission fluid level check (every 3000 miles or 3 months)

*Refer to illustrations 7.3 and 7.6*

1 The automatic transmission fluid level should be carefully maintained. Low fluid level can lead to slipping or loss of drive, while overfilling can cause foaming and loss of fluid.

2 With the parking brake set, start the engine, then move the shift lever through all the gear ranges, ending in Park. The fluid level must be checked with the vehicle level and the engine running at idle. **Note:** *Incorrect fluid level readings will result if the vehicle has just been driven at high speeds for an extended period, in hot weather in city traffic, or if it has been pulling a trailer. If any of these conditions apply, wait until the fluid has cooled (about 30 minutes).*

3 With the transmission at normal operating temperature, remove the dipstick from the filler tube. The dipstick is located at the front of the engine compartment on the driver's side **(see illustration)**.

4 Wipe the fluid from the dipstick with a clean rag and push it back into the filler tube until the cap seats.

5 Pull the dipstick out again and note the fluid level.

6 If the fluid is warm, the level should be between the two dimples **(see illustration)**. If it's hot, the level should be in the crosshatched area, near the MAX line. If additional fluid is required, add it directly into the tube using a funnel. It takes about one pint to raise the level from the bottom of the crosshatched area to the MAX line with a hot transmission, so add the fluid a little at a time and keep checking the level until it's correct.

7 The condition of the fluid should also be checked along with the level. If the fluid at the end of the dipstick is a dark reddish-brown color, or if it smells burned, it should be changed. If you are in doubt about the condition of the fluid, purchase some new fluid and compare the two for color and smell.

## 8 Engine oil and filter change (every 3000 miles or 3 months)

*Refer to illustrations 8.3, 8.9, 8.14 and 8.18*

1 Frequent oil changes are the most important preventive maintenance procedures that can be done by the home mechanic. As engine oil ages, it becomes diluted and contaminated, which leads to premature engine wear.

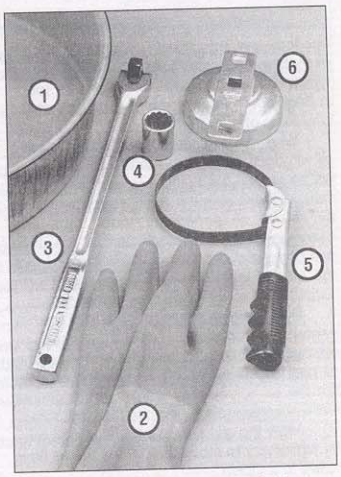
2 Although some sources recommend oil filter changes every other oil change, we feel that the minimal cost of an oil filter and the relative ease with which it is installed dictate that a new filter be installed every time the oil is changed.

3 Gather together all necessary tools and materials before beginning this procedure **(see illustration)**.

4 You should have plenty of clean rags and newspapers handy to mop up any spills. Access to the under side of the vehicle may be improved if the vehicle can be lifted on a hoist, driven onto ramps or supported by jackstands. **Warning:** *Do not work under a vehicle which is supported only by a bumper, hydraulic or scissors-type jack.*

5 If this is your first oil change, familiarize yourself with the locations of the oil drain plug and the oil filter.

6 Warm the engine to normal operating

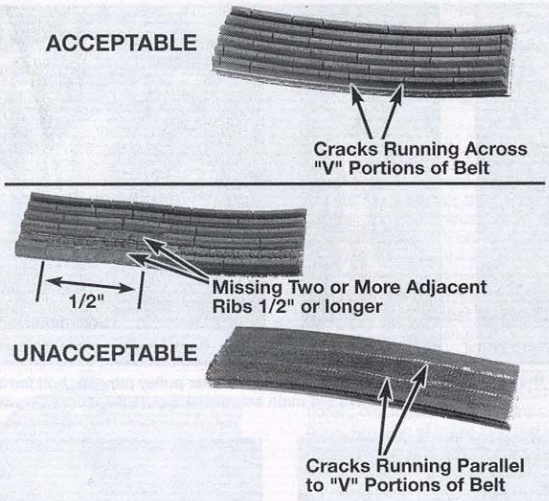



8.3 These tools are required when changing the engine oil and filter

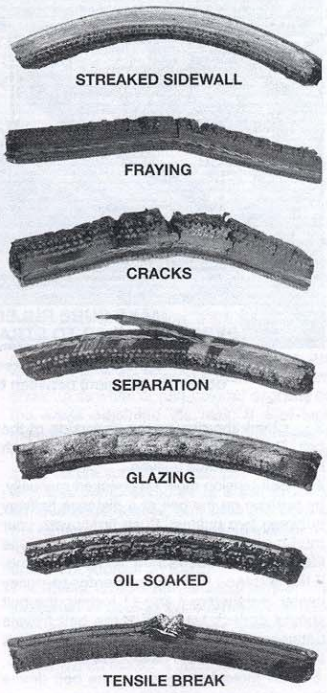
1 ***Drain pan*** *- It should be fairly shallow in depth, but wide to prevent spills*
2 ***Rubber gloves*** *- When removing the drain plug and filter, you will get oil on your hands (the gloves will prevent burns)*
3 ***Breaker bar*** *- Sometimes the oil drain plug is tight, and a long breaker bar is needed to loosen it*
4 ***Socket*** *– To be used with the breaker bar or a ratchet (must be the correct size to fit the drain plug - six-point preferred)*
5 ***Filter wrench*** *- This is a metal band-type wrench, which requires clearance around the filter to be effective*
6 ***Filter wrench*** *- This type fits on the bottom of the filter and can be turned with a ratchet or breaker bar (different-size wrenches are available for different types of filters)*



Josh Frohman
Ptatohed




12.2a Check ribbed (serpentine) belts for signs of wear like these - if they look worn, replace them as a set




12.2b Look for these signs of wear or damage on V-belt drivebelts

**Note:** *The manufacturer recommends the battery be removed from the vehicle for charging because the gas that escapes during this procedure can damage the paint. Fast charging with the battery cables connected can result in damage to the electrical system.*

11 Slow-rate charging is the best way to restore a battery that's discharged to the point where it will not start the engine. It's also a good way to maintain the battery charge in a vehicle that's only driven a few miles between starts. Maintaining the battery charge is particularly important in the winter when the battery must work harder to start the engine and electrical accessories that drain the battery are in greater use.

12 It's best to use a one or two-amp battery charger (sometimes called a "trickle" charger). They are the safest and put the least strain on the battery. They are also the least expensive. For a faster charge, you can use a higher amperage charger, but don't use one rated more than 1/10th the amp/hour rating of the battery. Rapid boost charges that claim to restore the power of the battery in one to two hours are hardest on the battery and can damage batteries not in good condition. This type of charging should only be used in emergency situations.

13 The average time necessary to charge a battery should be listed in the instructions that come with the charger. As a general rule, a trickle charger will charge a battery in 12 to 16 hours.

14 Remove all the cell caps (if equipped) and cover the holes with a clean cloth to prevent spattering electrolyte. Disconnect the negative battery cable and hook the battery charger cable clamps up to the battery posts (positive to positive, negative to negative), then plug in the charger. Make sure it is set at 12-volts if it has a selector switch.

15 If you're using a charger with a rate higher than two amps, check the battery regularly during charging to make sure it doesn't overheat. If you're using a trickle charger, you can safely let the battery charge overnight after you've checked it regularly for the first couple of hours.

16 If the battery has removable cell caps, measure the specific gravity with a hydrometer every hour during the last few hours of the charging cycle. Hydrometers are available inexpensively from auto parts stores - follow the instructions that come with the hydrometer. Consider the battery charged when there's no change in the specific gravity reading for two hours and the electrolyte in the cells is gassing (bubbling) freely. The specific gravity reading from each cell should be very close to the others. If not, the battery probably has a bad cell(s).

17 Some batteries with sealed tops have built-in hydrometers on the top that indicate the state of charge by the color displayed in the hydrometer window. Normally, a bright-colored hydrometer indicates a full charge and a dark hydrometer indicates the battery still needs charging.

18 If the battery has a sealed top and no built-in hydrometer, you can hook up a digital voltmeter across the battery terminals to check the charge. A fully charged battery should read 12.6 volts or higher.

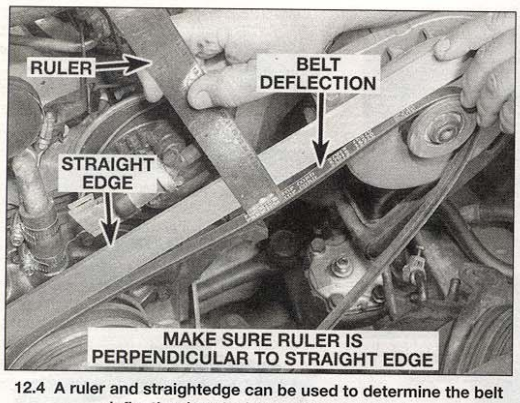
19 Further information on the battery and jump-starting can be found in Chapter 5 and at the front of this manual.

## 12 Drivebelt check, adjustment and replacement (every 6000 miles or 6 months)

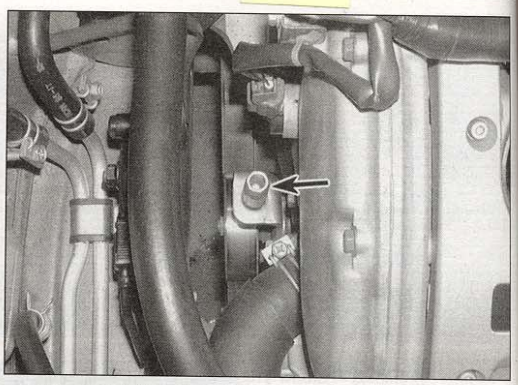
*Refer to illustrations 12.2a, 12.2b, 12.4, 12.5a, 12.5b and 12.5c*

1 Drivebelts are located at the front of the engine and play an important role in the overall operation of the engine and its components. Due to their function and material make up, the belts are prone to wear and should be periodically inspected. Early models have three belts, including serpentine and V-belt types, while 1995 and later models have two belts, both of the serpentine type. The drivebelts drive the alternator, power steering pump, water pump and air conditioning compressor (if equipped).

2 With the engine off, open the hood and use your fingers (and a flashlight, if necessary), to move along the belt checking for cracks and separation of the belt plies. Also check for fraying and glazing, which gives the belt a shiny appearance **(see illustrations)**. Both sides of the belt should be inspected, which means you will have to twist the belt to check the underside.




**12.4 A ruler and straightedge can be used to determine the belt deflection (tension) between two pulleys**



**12.5a Loosen/tighten the idler pulley adjuster bolt (arrow) to adjust the main serpentine belt (1995 model shown)**

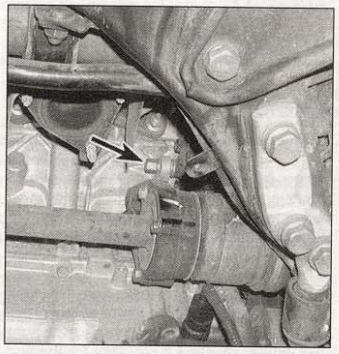
3 Check the ribs on the underside of the belt. They should all be the same depth, with none of the surface uneven.

4 Belt tension must be checked manually, by pushing on the belt at a distance halfway between two pulleys. Push firmly with your thumb and see how much the belt moves (deflects) **(see illustration)**. As rule of thumb, if the distance from pulley center-to-pulley center is between 7 and 11 inches, the belt should deflect 1/4-inch. If the belt travels between pulleys spaced 12 to 16 inches apart, the belt should deflect 1/4 to 1/2-inch.

5 On three-belt models, one belt drives the water pump and power steering pump, and is adjusted by a idler accessed from below the engine. Another short belt drives the alternator, and is adjusted by moving the alternator adjuster. A longer belt drives the air-conditioning compressor and is adjusted by a top-mounted idler. Later models have one serpentine belt adjusted at the power steering pump, and a larger serpentine belt adjusted at the upper idler **(see illustrations)**.

6 To replace the belts, loosen the adjuster or component until the belt can be removed from the various pulleys. On multiple-belt applications, outer belts will have to be removed to access inner belts, but as a general rule, all belts should be replaced at the same time anyway.

7 Route the new belt over the various pulleys, then adjust the tension. **Note:** *Refer to your owner's manual for the belt routing diagram for your specific model.*



**12.5b From below, loosen the bolt (arrow) at the back of the power steering pump . . .**

**12.5c . . . then adjust the belt tension at the adjuster bolt (arrow) - when proper tension is achieved, retighten the bolt on the back of the pump**

## 13 Underhood hose check and replacement (every 6000 miles or 6 months)

### General

**Caution:** *Replacement of air conditioning hoses must be left to a dealer service department or air conditioning shop that has the equipment to depressurize the system safely and recover the refrigerant. Never remove air conditioning components or hoses until the system has been depressurized.*

1 High temperatures in the engine compartment can cause the deterioration of the rubber and plastic hoses used for engine, accessory and emission systems operation. Periodic inspection should be made for cracks, loose clamps, material hardening and leaks. Information specific to the cooling system hoses can be found in Section 14.

2 Some, but not all, hoses are secured to their fittings with clamps. Where clamps are used, check to be sure they haven't lost their tension, allowing the hose to leak. If clamps aren't used, make sure the hose has not expanded and/or hardened where it slips over the fitting, allowing it to leak.

### Vacuum hoses

3 It's quite common for vacuum hoses, especially those in the emissions system, to be color-coded or identified by colored stripes molded into them. Various systems require hoses with different wall thickness, collapse resistance and temperature resistance. When replacing hoses, be sure the new ones are made of the same material.

4 Often the only effective way to check a hose is to remove it completely from the vehicle. If more than one hose is removed, be sure to label the hoses and fittings to ensure correct installation.

5 When checking vacuum hoses, be sure to include any plastic T-fittings in the check. Inspect the fittings for cracks and the hose where it fits over the fitting for distortion, which could cause leakage.

6 A small piece of vacuum hose (1/4-inch inside diameter) can be used as a stethoscope to detect vacuum leaks. Hold one end of the hose to your ear and probe around vacuum hoses and fittings, listening for the "hissing" sound characteristic of a vacuum leak. **Warning:** *When probing with the vacuum hose stethoscope, be very careful not to come into contact with moving engine components such as the drivebelt, cooling fan, etc.*

19.2 Remove the filler plug from the side of the manual transaxle - place your finger in the hole to check the lubricant level

20.1a Release the four spring clips (arrows) securing the air filter cover

3 At the same time, inspect the underside of the body for holes, corrosion, open seams, etc. which may allow exhaust gases to enter the passenger compartment. Seal all body openings with silicone or body putty.

4 Rattles and other noises can often be traced to the exhaust system, especially the mounts and hangers. Try to move the pipes, muffler and catalytic converter. If the components can come in contact with the body or suspension parts, secure the exhaust system with new mounts.

5 Check the running condition of the engine by inspecting inside the end of the tailpipe. The exhaust deposits here are an indication of engine state-of-tune. If the pipe is black and sooty or coated with white deposits, the engine is in need of a tune-up, including a thorough fuel system inspection.

## 19 Manual transaxle lubricant level check (every 15,000 miles or 12 months)

*Refer to illustration 19.2*

1 The manual transaxle does not have a dipstick. To check the fluid level, raise the vehicle and support it securely on jackstands.

2 Remove the oil filler plug from the side of the transaxle. Measure with your finger to feel that the oil level is at the plug opening **(see illustration)**.

3 If the transaxle needs more lubricant (if the level is not up to the opening, use a gear oil pump to add more and bring it up to the proper level. Stop filling the transaxle when the lubricant begins to run out the hole.

4 Clean and install the plug and tighten it securely. Drive the vehicle a short distance, then check for leaks.

## 20 Air filter replacement (every 30,000 miles or 24 months)

*Refer to illustrations 20.1a and 20.1b*

1 The air filter is located inside a housing at the left side of the engine compartment. To remove the air filter, release the four spring clips that keep the two halves of the air cleaner housing together, then lift the cover up and remove the air filter element **(see illustrations)**.

2 Inspect the outer surface of the filter element. If it is dirty, replace it. If it is only moderately dusty, it can be reused by blowing it clean from the back to the front surface with compressed air. Because it is a pleated paper type filter, it cannot be washed or oiled. If it cannot be cleaned satisfactorily with compressed air, discard and replace it. While the cover is off, be careful not to drop anything down into the housing. **Caution:** *Never drive the vehicle with the air cleaner removed. Excessive engine wear could result and backfiring could even cause a fire under the hood.*

3 Wipe out the inside of the air cleaner housing.

4 Place the new filter into the air cleaner housing, making sure it seats properly.

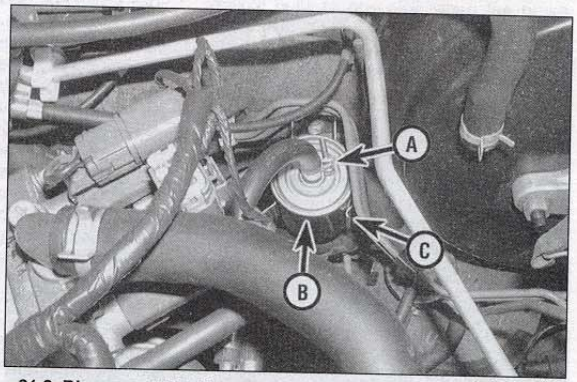
5 Installation of the cover is the reverse of removal.

## 21 Fuel filter replacement (every 30,000 miles or 24 months)

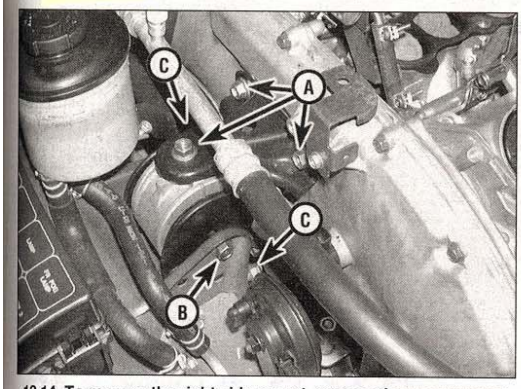
*Refer to illustration 21.3*

1 The canister filter is mounted in a clip on the firewall near the brake master cylinder.

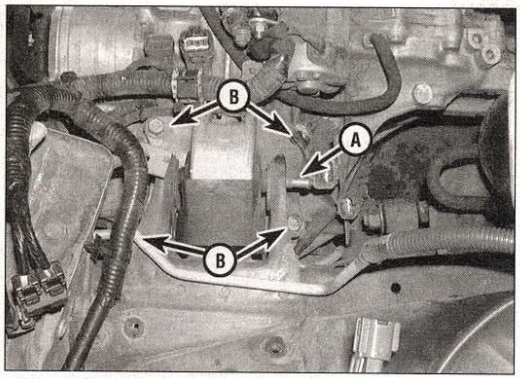
20.1b Lift the cover enough to pull the air filter out - when reinstalling, make sure the housing is clean and the lip of the filter fits the housing all the way around




21.3 Disconnect the inlet and outlet fuel hoses (A indicates the outlet hose clamp) from the fuel filter (B), then pull it out of the spring-clip bracket (C)




18.14 To remove the right side mount, remove the upper mount bracket bolts (A), the engine mount through bolt (B) and the engine mount-to-lower bracket retaining nuts (C) (not visible in this photo)




18.18 With the air cleaner housing and air intake duct removed, there is access to the left side mount through-bolt (A) and the engine mount-to-transaxle bolts (B)

through-bolts and remove the mounts **(see illustration 18.9)**.

12 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the engine weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening* (Step 21).

### Right side engine mount

13 Support the engine from above using a hoist or an engine support fixture.

14 Remove the upper engine mount bracket and the engine mount through-bolt **(see illustration)**.

15 Raise the engine slightly higher, remove the nuts securing the mount to the lower engine mount bracket and remove the mount from the vehicle.

16 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening* (Step 21).

### Left side transaxle mount

17 Position a floor jack under the transaxle housing (not the fluid pan on automatic transaxle models). Place a wood block between the jack head and the transaxle and raise the jack just enough to support the weight of the transaxle.

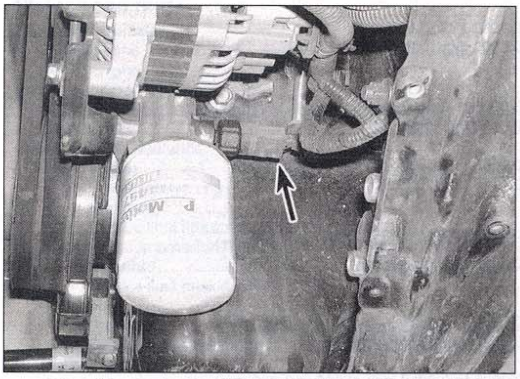
18 Working from above, remove the air cleaner housing and the air intake duct (see Chapter 5). Remove the engine mount through-bolt at the chassis bracket **(see illustration)**.

19 Lower the transaxle slightly, remove the transaxle-to-mount bolts and remove the mount.

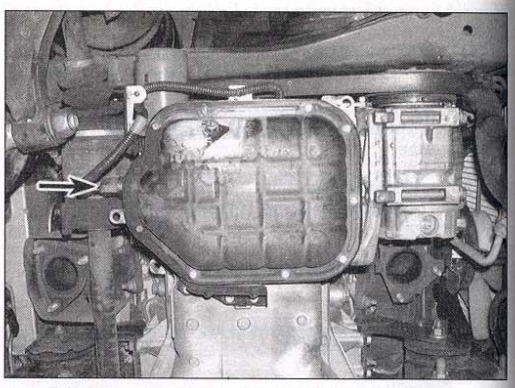
20 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

### Final tightening

21 To ensure maximum bushing life and prevent excessive noise and vibration, the vehicle should be level and the powertrain weight should be on the mounts during the final tightening stage. **Note:** *Use thread-locking compound on the nuts/bolts.* Ensure that the bushings are not twisted or offset. If you have replaced more than one mount, or when you are installing the engine, tighten the mounts in the following order: crossmember bolts, rear engine mount, front engine mount, left-side transaxle mount and right side engine mount.



2.2a Oil pressure sending unit location – SOHC engine



2.2b Oil pressure sending unit location – DOHC engine

## 1 General information - engine overhaul

Included in this portion of Chapter 2 are the general overhaul procedures for the cylinder head and internal engine components.

The information ranges from advice concerning preparation for an overhaul and the purchase of replacement parts to detailed, step-by-step procedures covering removal and installation of internal engine components and the inspection of parts.

The following Sections have been written based on the assumption that the engine has been removed from the vehicle. For information concerning in-vehicle engine repair, as well as removal and installation of the external components necessary for the overhaul, see Chapter 2A or 2B.

The Specifications included in this Part are only those necessary for the inspection and overhaul procedures which follow. Refer to Chapter 2, Part A or Part B for additional Specifications.

It's not always easy to determine when, or if, an engine should be completely overhauled, as a number of factors must be considered.

High mileage is not necessarily an indication that an overhaul is needed, while low mileage doesn't preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine that's had regular and frequent oil and filter changes, as well as other required maintenance, will most likely give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

Excessive oil consumption is an indication that piston rings, valve seals and/or valve guides are in need of attention. Make sure that oil leaks aren't responsible before deciding that the rings and/or guides are bad. Perform a cylinder compression check to determine the extent of the work required (see Section 3). Also check the vacuum readings under various conditions (see Section 4).

Loss of power, rough running, knocking or metallic engine noises, excessive valve train noise and high fuel consumption rates may also point to the need for an overhaul, especially if they're all present at the same time. If a complete tune-up doesn't remedy the situation, major mechanical work is the only solution.

An engine overhaul involves restoring the internal parts to the specifications of a new engine. During an overhaul, the piston rings are replaced and the cylinder walls are reconditioned (re-bored and/or honed). If a re-bore is done by an automotive machine shop, new oversize pistons will also be installed. The main bearings, connecting rod bearings and camshaft bearings are generally replaced with new ones and, if necessary, the crankshaft may be reground to restore the journals. Generally, the valves are serviced as well, since they're usually in less-than-perfect condition at this point. While the engine is being overhauled, other components, such as the distributor (if equipped), the starter and alternator, can be rebuilt as well. The end result should be a like new engine that will give many trouble free miles. **Note:** *Critical cooling system components such as the hoses, drivebelts, thermostat and water pump should be replaced with new parts when an engine is overhauled. The radiator should be checked carefully to ensure that it isn't clogged or leaking* (see Chapter 3). *If you purchase a rebuilt engine or short block, some rebuilders will not warranty their engines unless the radiator has been professionally flushed. Also, we don't recommend overhauling the oil pump - always install a new one when an engine is rebuilt.*

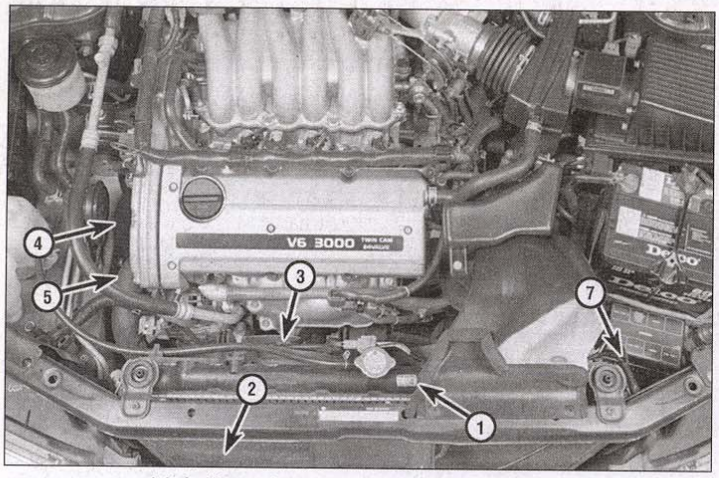
Before beginning the engine overhaul, read through the entire procedure to familiarize yourself with the scope and requirements of the job. Overhauling an engine isn't difficult, but it is time-consuming. Plan on the vehicle being tied up for a minimum of two weeks, especially if parts must be taken to an automotive machine shop for repair or reconditioning. Check on availability of parts and make sure that any necessary special tools and equipment are obtained in advance. Most work can be done with typical hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be replaced. Often an automotive machine shop will handle the inspection of parts and offer advice concerning reconditioning and replacement. **Note:** *Always wait until the engine has been completely disassembled and all components, especially the engine block, have been inspected before deciding what service and repair operations must be performed by an automotive machine shop*. Since the block's condition will be the major factor to consider when determining whether to overhaul the original engine or buy a rebuilt one, never purchase parts or have machine work done on other components until the block has been thoroughly inspected. As a general rule, time is the primary cost of an overhaul, so it doesn't pay to install worn or substandard parts.

As a final note, to ensure maximum life and minimum trouble from a rebuilt engine, everything must be assembled with care in a spotlessly clean environment.

## 2 Oil pressure check

*Refer to illustrations 2.2a and 2.2b*

1 Low engine oil pressure can be a sign of an engine in need of rebuilding. A "low oil pressure" indicator (often called an "idiot light") is not a test of the oiling system. Such indicators only come on when the oil pressure is dangerously low. Even a factory oil pressure gauge in the instrument panel is only a relative indication, although much better for driver information than a warning light. A better test is with a mechanical (not electrical) oil pressure gauge. When used in conjunction with an accurate tachometer, an engine's oil pressure performance can be compared to factory Specifications for that




**1.1 Cooling and air conditioning system components**

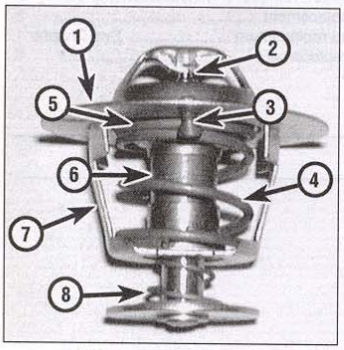
1 *Radiator*
2 *Condenser*
3 *Engine cooling fan*
4 *Water pump*
5 *Thermostat*
6 *Coolant reservoir*
7 *Accumulator/drier*

## 1 General information

*Refer to illustrations 1.1 and 1.2*

### Engine cooling system

All vehicles covered by this manual employ a pressurized engine cooling system with thermostatically controlled coolant circulation **(see illustration)**. An impeller-type water pump mounted on the engine block pumps coolant through the engine. The coolant flows around each cylinder and toward the rear of the engine. Cast-in coolant passages direct coolant around the intake and exhaust ports, near the spark plug areas and in close proximity to the exhaust valve guides.




**1.2 Typical thermostat**

1 *Flange*
2 *Piston*
3 *Jiggle valve*
4 *Main coil spring*
5 *Valve seat*
6 *Valve*
7 *Frame*
8 *Secondary coil spring*

A wax-pellet type thermostat controls engine coolant temperature. During warm up, the closed thermostat prevents coolant from circulating through the radiator. As the engine nears normal operating temperature, the thermostat opens and allows hot coolant to travel through the radiator, where it's cooled before returning to the engine **(see illustration)**.

The cooling system is sealed by a pressure-type radiator cap, which raises the boiling point of the coolant and increases the cooling efficiency of the radiator. If the system pressure exceeds the cap pressure relief value, the excess pressure in the system forces the spring-loaded valve inside the cap off its seat and allows the coolant to escape through the overflow tube into a coolant reservoir. When the system cools the excess coolant is automatically drawn from the reservoir back into the radiator.

The coolant reservoir serves as both the point at which fresh coolant is added to the cooling system to maintain the proper fluid level and as a retaining tank for overheated coolant. This type of cooling system is known as a closed design because coolant that escapes past the pressure cap is saved and reused.

### Heating system

The heating system consists of a blower fan and heater core located in the heater unit, the hoses connecting the heater core to the engine cooling system and the heater/air conditioning control panel on the dashboard. Hot engine coolant is circulated through the heater core. When the heater mode is activated, a flap door opens to expose the heater unit to the passenger compartment. A fan switch on the control head activates the blower motor, which forces air through the core, heating the air.

### Air conditioning system

The air conditioning system consists of a condenser mounted in front of the radiator, an evaporator mounted adjacent to the heater core, a compressor mounted on the engine, a receiver-drier which contains a high pressure relief valve and the plumbing connecting all of the above components.

A blower fan forces the warmer air of the passenger compartment through the evaporator core (sort of a radiator-in-reverse), transferring the heat from the air to the refrigerant. The liquid refrigerant boils off into low pressure vapor, taking the heat with it when it leaves the evaporator. **Warning:** *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system components to avoid the possibility of accidental deployment of the airbag(s), which could cause personal injury (see Chapter 12).*

## 2 Antifreeze - general information

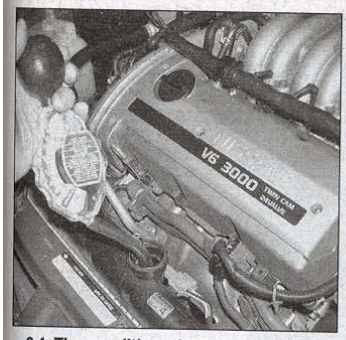
*Refer to illustration 2.4*

**Warning:** *Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container or in puddles on the floor; children and pets are attracted by its sweet smell and may drink it. Check with local authorities about disposing of used antifreeze. Many communities have collection centers, which will see that antifreeze is disposed of safely. Never dump used anti-freeze on the ground or into drains.*

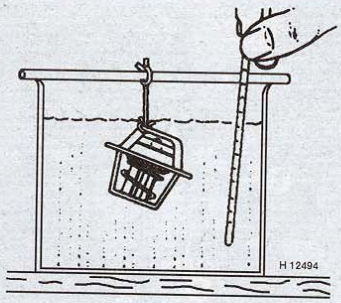
The cooling system should be filled with a water/ethylene glycol based antifreeze solution, which will prevent freezing down to at least -20-degrees F, or lower if local climate requires it. It also provides protection against corrosion and increases the coolant boiling point.

The cooling system should be drained, flushed and refilled at the specified intervals (see Chapter 1). Old or contaminated antifreeze solutions are likely to cause damage and encourage the formation of rust and scale in the system. Use distilled water with the antifreeze.

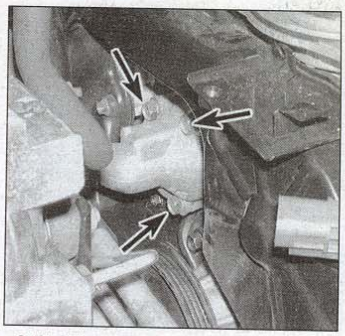
Before adding antifreeze, check all hose connections, because antifreeze tends to leak through very minute openings. Engines don't normally consume coolant, so if the level goes down, find the cause and correct it.




2.4 The condition of your coolant can easily be checked with this type of hydrometer, available at auto parts stores




3.7 A thermostat can be accurately checked by heating it in a container of water with a thermometer and observing the opening and fully open temperature



3.14a Thermostat cover retaining bolts (SOHC engine) (arrows indicate three of the four bolts)

The exact mixture of antifreeze-to-water that you should use depends on the relative weather conditions. The mixture should contain at least 50-percent antifreeze, but should never contain more than 70-percent antifreeze. Consult the mixture ratio chart on the antifreeze container before adding coolant. Hydrometers are available at most auto parts stores to test the ratio of antifreeze to water **(see illustration)** or antifreeze test strips are available instead of the hydrometer gauge. Use antifreeze that meets the vehicle manufacturer's specifications.

## 3 Thermostat - check and replacement

**Warning:** *Do not attempt to remove the radiator cap, coolant or thermostat until the engine has cooled completely.*

### Check

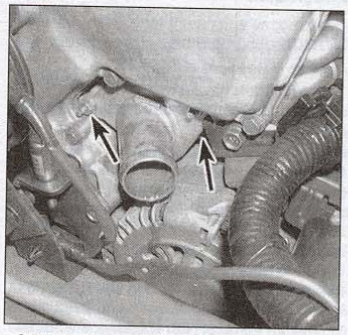
*Refer to illustration 3.7*

1 Before assuming the thermostat is responsible for a cooling system problem, check the coolant level (see Chapter 1), drivebelt tension (see Chapter 1) and temperature gauge (or light) operation.

2 If the engine takes a long time to warm up (as indicated by the temperature gauge or heater operation), the thermostat is probably stuck open. Replace the thermostat with a new one.

3 If the engine runs hot, use your hand to check the temperature of the upper radiator hose. If the hose is not hot, but the engine is, the thermostat is probably stuck in the closed position, preventing the coolant inside the engine from traveling through the radiator. Replace the thermostat. **Caution:** *Do not drive the vehicle without a thermostat. The computer may stay in open loop and emissions and fuel economy will suffer.*

4 If the lower radiator hose is hot, it means that the coolant is flowing and the thermostat is open. Consult the *Troubleshooting* Section at the front of this manual for further diagnosis.



3.14b Thermostat cover retaining bolts (DOHC engine) (arrows indicate two of the three bolts)

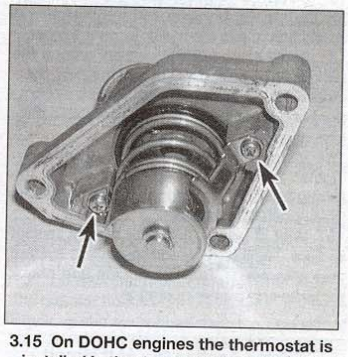
5 A more thorough test of the thermostat can only be made when it is removed from the vehicle (see *Replacement*). If the thermostat remains in the open position at room temperature, it is faulty and must be replaced.

6 To test it fully, suspend the (closed) thermostat on a length of string or wire in a container of cold water, with a thermometer (cooking type that reads beyond 212 degrees F).

7 Heat the water on a stove while observing the temperature and the thermostat. Neither should contact the sides of the container **(see illustration)**.

8 Note the temperature when the thermostat begins to open and when it is fully open. Compare the temperatures to the Specifications in this Chapter. The number stamped into the thermostat is generally the fully open temperature. Some manufacturers provide Specifications for the beginning-to-open temperature, the fully open temperature, and sometimes the amount the valve should open.

9 If the thermostat doesn't open and close as specified, or sticks in any position, replace it.



3.15 On DOHC engines the thermostat is installed in the thermostat cover and is retained by two screws (arrows) - on SOHC engines the thermostat is installed in the thermostat housing on the engine block

### Replacement

*Refer to illustrations 3.14a, 3.14b, 3.15 and 3.17*

10 Disconnect the negative cable from the battery.

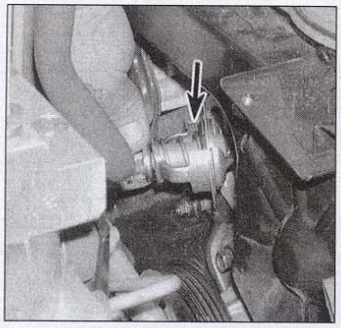
11 Drain the coolant from the radiator and the engine block (see Chapter 1).

12 On SOHC engines detach the upper radiator hose from the coolant outlet at the intake manifold and the radiator, then unbolt the hose clamp at the timing belt cover and remove the radiator hose. Detach the bypass hose from the thermostat cover.

13 On DOHC engines remove the drivebelts and the idler pulley bracket. Also remove the lower radiator hose and the water pump drain plug from the side of the block which faces the front of the vehicle.

14 Remove the thermostat cover from the engine **(see illustrations)**. Be prepared for some coolant to spill as the gasket seal is broken.

15 Remove the thermostat, noting the direction in which it was installed **(see illustration)**.

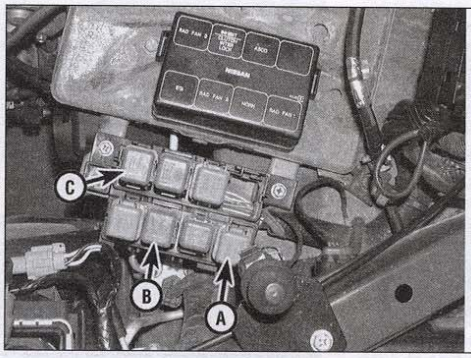


**3.17 On either engine, install the thermostat with the jiggle valve (arrow) UP (SOHC engine shown)**

16 Scrape off any old gasket or sealant on the thermostat housing and the thermostat cover, then clean them with lacquer thinner.
17 Apply a bead of RTV sealant around the perimeter of the cover, install the new thermostat with the jiggle valve UP **(see illustration)** and bolt the cover in place within 5 minutes of applying the sealant.
18 Installation is the reverse of removal. Tighten the thermostat cover fasteners to the torque listed in this Chapter's Specifications, then reinstall the hoses.
19 Wait at least a half-hour for the sealant to cure. Refill and bleed the cooling system (see Chapter 1). Run the engine and check for leaks and proper operation.

## 4 Engine cooling fan and circuit - check and component replacement

**Warning:** *Do not work with your hands near the fans at any time that the engine is running or the key is ON. With the key ON, (even with the engine not running) the fan can start at any time, since it is controlled by coolant temperature.*



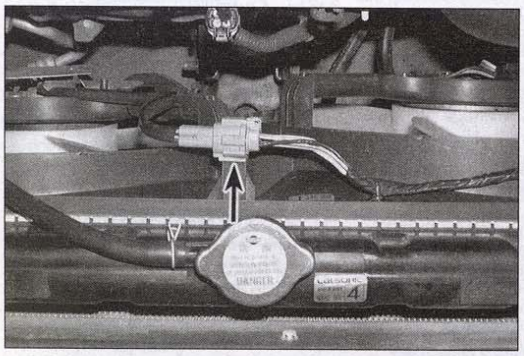

**4.2 Typical engine cooling fan relay locations**

*A Low Speed*
*B High speed no. 1*
*C High speed no. 2*

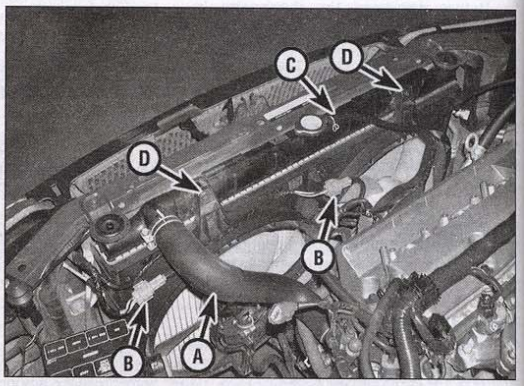
### Check

*Refer to illustrations 4.2 and 4.5*

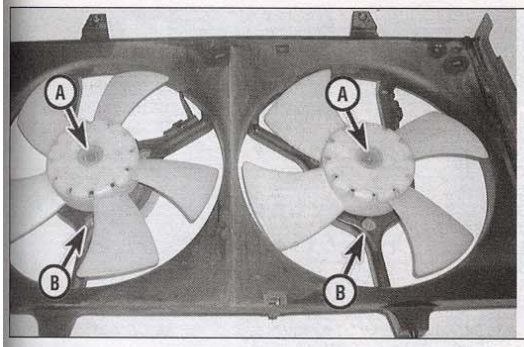
1 All models have a two-speed electric fan mounted in a plastic shroud attached to the back of the radiator.
2 Fan operation is controlled both by the PCM and the high and low-speed fan relays **(see illustration)**. The coolant temperature sensor signals the PCM of engine temperature, and the PCM turns on the appropriate relay(s). At warm idle, the low-speed relay turns the fan on at low speed. When coolant temperature reaches 221 degrees F, the PCM turns the high-speed relays 1 and 2 on, causing the fan to run at high speed. There are two high-speed relays to ensure proper cooling even if one relay fails, and they will also operate if the coolant temperature sensor fails.
3 If the fan operates continuously, the fault could be the coolant temperature sensor or the relays. Refer to Chapter 6 for diagnosis of the sensor, and Chapter 12 for diagnosis of the relays.
4 Warm the engine up until the gauge on the instrument panel indicates the high side of NORMAL. The fan should come on. If not, check the cooling system fan control fuses in the engine compartment fuse panel and in the interior fuse panel (see Chapter 12 for fuse locations).
5 If the fuses checked OK, disconnect the electrical connector from the electric fan motor **(see illustration)**. Attach a fused jumper wire with battery voltage to either of the two power terminals on the fan, and a chassis-ground jumper to the black wire terminal on the fan (see the wiring diagrams in Chapter 12). If the fan doesn't operate, it should be replaced.
6 If it does operate with jumper wires, but doesn't under normal driving conditions, connect a voltmeter to a chassis ground and probe the power terminals of the fan connector on the harness side. If the engine is hot and the temperature gauge shows above NORMAL, there should be battery voltage at one of these terminals.
7 Check the ground of the circuit by switching your meter to the ohms scale. Ground one side of the meter and probe the other side at the black wire terminal of the fan



**4.5 To test either fan motor, disconnect the electrical connector (arrow) and use jumper wires to connect the black wire terminal directly to ground; apply battery voltage to each of the other terminals in turn - if the fan still doesn't work, or it works at one speed but not both, replace the motor**




**4.12 Remove the upper radiator hose (A), the fan electrical connectors (B), the overflow hose (C) and the fan shroud mounting bolts (D)**




**4.14 Remove the nuts (A) retaining the fan to the motor and the screws (B) retaining the motor to the shroud - four out of six motor-to-shroud screws are not visible in this photo**

connector. Resistance should be no more than 5 ohms. If resistance is high, trace the ground wire circuit to the chassis.

8 If there was no power at the terminals in Step 6, check that power is being supplied to the low-speed fan relay. One of its sockets on the relay panel should exhibit battery voltage at all times, and one only when the key is in the On or Start position.

9 If these sockets check OK, refer to Chapter 12 for checking continuity within the relays themselves.

### Replacement

*Refer to illustrations 4.12 and 4.14*

10 Disconnect the electrical connector from the fan motor.

11 Disconnect the upper radiator hose and overflow hose at the radiator.

12 Remove the two fan shroud bolts and remove the fan/shroud assembly **(see illustration)**. **Note:** *The bottom of the fan shroud fits into tabs on the radiator.*

13 Remove the nut retaining the fan to the motor shaft.

14 Remove the screws retaining the motor to the shroud **(see illustration)**.

15 With an assistant retaining the fan, hit the shaft of the motor with a hammer and blunt punch to separate the fan from the motor.

16 Installation is the reverse of removal.

## 5 Radiator and coolant reservoir - removal and installation

**Warning:** *Wait until the engine is completely cool before beginning this procedure.*

### Coolant reservoir

*Refer to illustration 5.2*

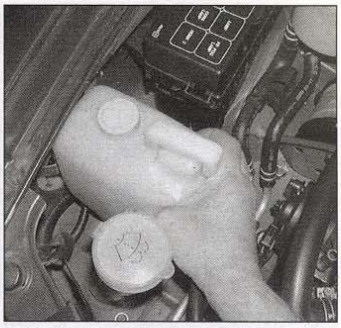
1 The coolant reservoir is mounted adjacent to the battery in the left corner of the engine compartment 1993 and 1994 models. On 1995 and later models the coolant reservoir is mounted on the opposite side of the engine compartment in the front right corner.

2 Detach the hose from the top of the radiator and pinch it off. On 1993 and 1994 models remove the reservoir retaining bolt and remove the reservoir from the vehicle. On 1995 and later models lift the reservoir straight up out of the bracket **(see illustration)**.

3 Pour the coolant into a container.

4 After washing the reservoir inside and out (use a household "bottle" brush to clean inside), inspect the reservoir for cracks and chafing. If it's damaged or so obscured by age as to make reading the water level difficult, replace it. **Warning:** *If you use a brush to clean the coolant reservoir, never again use it for cleaning drinking glasses or bottles.*

5 Installation is the reverse of removal.



**5.2 Lift the coolant reservoir straight up out of its bracket**

### Radiator

*Refer to illustrations 5.9 and 5.12*

6 Disconnect the cable from the negative terminal of the battery.

7 Set the parking brake and block the rear wheels. Raise the front of the vehicle and support it securely on jackstands.

8 Drain the cooling system (see Chapter 1). If the coolant is relatively new or in good condition, save it and reuse it. Read the **Warning** in Section 2.

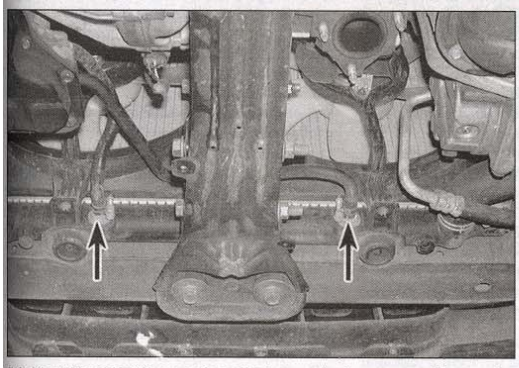
9 Disconnect the automatic transmission cooler lines from the radiator if equipped **(see illustration)**. Use a drip pan to catch spilled fluid and plug the lines and fittings.

10 Loosen the hose clamps, then detach the radiator hoses from the radiator. If they're stuck, grasp each hose near the end with a pair of slip joint pliers and twist it to break the seal, then pull it off - be careful not to damage the radiator fittings! If the hoses are old or deteriorated, cut them off and install new ones. Also disconnect the small hose to the coolant reservoir.

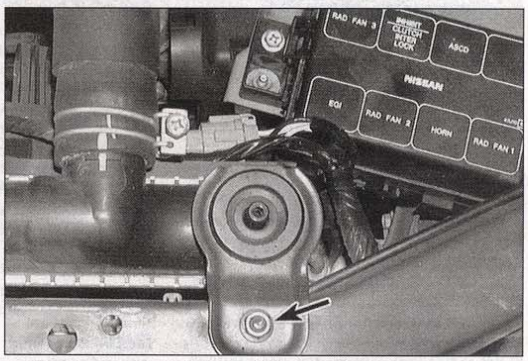
11 Refer to Section 4 and remove the engine cooling fan assembly.

12 Unbolt the small brackets that attach the top of the radiator to the radiator support **(see illustration)**.





**5.9 If equipped with an automatic transmission remove the cooler lines (arrows)**




**5.12 Remove the bolts (arrow) that attach the upper radiator mounts to the radiator support**


12.18 A basic charging kit for 134a systems is available at most auto parts stores - it must say 134a (not R-12) and so should the can of refrigerant

12.21 Attach the refrigerant kit to the low-side charging port - it's near the right shock tower - the cap should be marked with an "L"

other properly equipped repair facility.

17 Further inspection or testing of the system is beyond the scope of the home mechanic and should be left to a professional.

### Adding refrigerant

*Refer to illustrations 12.18, 12.21 and 12.22*

**Caution:** *Make sure any refrigerant, refrigerant oil or replacement component your purchase is designated as compatible with environmentally friendly R-134a systems.*

18 Purchase an R-134a automotive charging kit at an auto parts store **(see illustration)**. A charging kit includes a 12-ounce can of refrigerant, a tap valve and a short section of hose that can be attached between the tap valve and the system low side service valve. Because one can of refrigerant may not be sufficient to bring the system charge up to the proper level, it's a good idea to buy an additional can. **Warning:** *Never add more than two cans of refrigerant to the system.*

19 Hook up the charging kit by following the manufacturer's instructions. **Warning:** *DO NOT hook the charging kit hose to the system high side!* The fittings on the charging kit are designed to fit **only** on the low side of the system.

20 Back off the valve handle on the charging kit and screw the kit onto the refrigerant can, making sure first that the O-ring or rubber seal inside the threaded portion of the kit is in place. **Warning:** *Wear protective eyewear when dealing with pressurized refrigerant cans.*

21 Remove the dust cap from the low-side charging and attach the quick-connect fitting on the kit hose **(see illustration)**.

22 Warm up the engine and turn On the air conditioning. Keep the charging kit hose away from the fan and other moving parts. **Note:** *The charging process requires the compressor to be running. If the clutch cycles off, you can put the air conditioning switch on High and leave the car doors open to keep the clutch on and compressor working.* **Note:** *The compressor can be kept on during the charging by removing the connector from the low-pressure switch (combination high-limit and low-limit switch on some models) and bridging it with a paper clip or jumper wire during the procedure* **(see illustration)**.

23 Turn the valve handle on the kit until the stem pierces the can, then back the handle out to release the refrigerant. You should be able to hear the rush of gas. Add refrigerant to the low side of the system, keeping the can upright at all times, but shaking it occasionally. Allow stabilization time between each addition. **Note:** *The charging process will go faster if you wrap the can with a hot-water-soaked shop rag to keep the can from freezing up.*

24 If you have an accurate thermometer, you can place it in the center air conditioning duct inside the vehicle and keep track of the output air temperature **(see illustration 12.9)**. A charged system that is working properly should cool down to approximately 40-degrees F. If the ambient (outside) air temperature is very high, say 110 degrees F, the duct air temperature may be as high as 60 degrees F, but generally the air conditioning is 30-40 degrees F cooler than the ambient air.

25 When the can is empty, turn the valve handle to the closed position and release the connection from the low-side port. Replace the dust cap.

26 Remove the charging kit from the can and store the kit for future use with the piercing valve in the UP position, to prevent inadvertently piercing the can on the next use.

## Heating systems

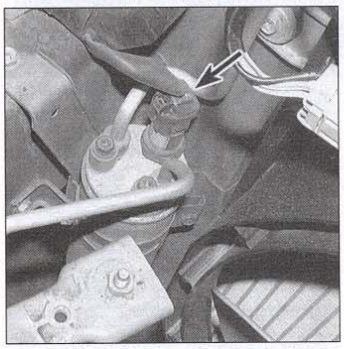
27 If the carpet under the heater core is damp, or if antifreeze vapor or steam is coming through the vents, the heater core is leaking. Remove it (see Section 12) and install a new unit (most radiator shops will not repair a leaking heater core).

28 If the air coming out of the heater vents isn't hot, the problem could stem from any of the following causes:

a) *The thermostat is stuck open, preventing the engine coolant from warming up enough to carry heat to the heater core. Replace the thermostat* (see Section 3).

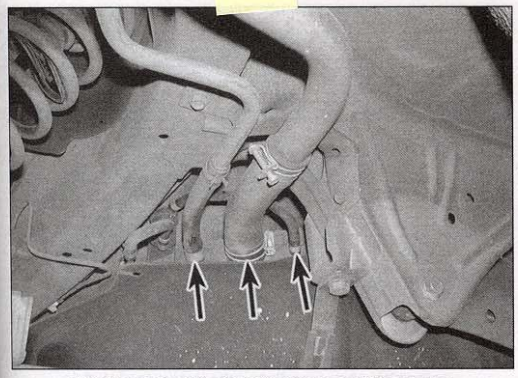
b) *There is a blockage in the system, preventing the flow of coolant through the heater core. Feel both heater hoses at the firewall. They should be hot. If one of them is cold, there is an obstruction in one of the hoses or in the heater core, or the heater control valve is shut. Detach the hoses and back flush the heater core with a water hose. If the heater core is clear but circulation is impeded, remove the two hoses and flush them out with a water hose.*

c) *If flushing fails to remove the blockage from the heater core, the core must be replaced* (see Section 11).

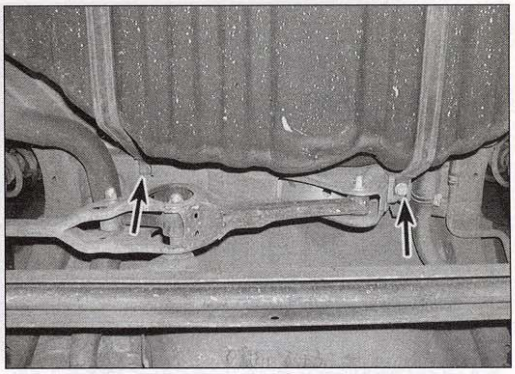


12.22 The air conditioning pressure switch (arrow) is located on top of the receiver/drier - if the compressor will not stay engaged, disconnect the connector and bridge it with a jumper wire during the charging procedure

3



7.7 Disconnect the fuel filler hose, vent hose and EVAP hose (arrows) from the fuel tank



7.9 Remove the fuel tank strap bolts (arrows) and swing the straps out of the way

11 If you're replacing the tank, or having it cleaned or repaired, refer to Section 8.
12 Refer to Section 5 to remove and install the fuel pump/sending unit assembly, if necessary.
13 Installation is the reverse of removal. Clean engine oil can be used as an assembly aid when pushing the fuel filler hose back onto the fuel tank.

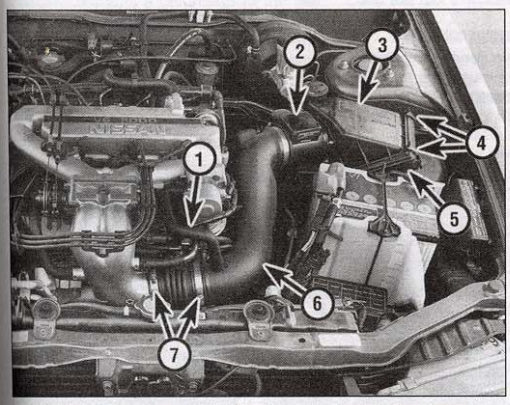
## 8 Fuel tank - cleaning and repair

1 The fuel tank installed in the vehicles covered by this manual is not repairable. If the tank is damaged in any way it must be replaced. If cleaning is required, due to fuel contamination, the process should be carried out by a professional who has experience in this critical and potentially dangerous operation. Even after cleaning and flushing, explosive fumes can remain and ignite.
2 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside a garage where a natural gas-type appliance is located, because the pilot light could cause an explosion.

## 9 Air filter assembly - removal and installation

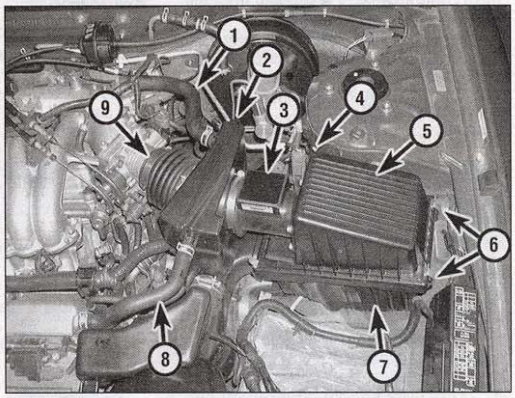
*Refer to illustrations 9.2a, 9.2b and 9.5*
1 Disconnect the cable from the negative terminal of the battery.
2 Disconnect the electrical connector from the mass airflow sensor and intake air temperature sensor **(see illustrations)**.
3 Loosen the retaining clamp securing the mass airflow sensor to the air intake duct or resonator.
4 Detach the spring clips and remove the air filter upper housing and mass airflow sensor as an assembly.

4




9.2a Air intake duct and air filter housing installation details - 1993 and 1994 models

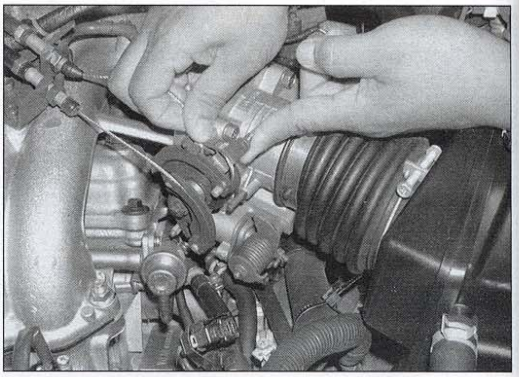
1 *IAC valve air bypass hose*
2 *Mass airflow sensor*
3 *Air filter housing (upper)*
4 *Air filter housing retaining clips*
5 *Air filter housing (lower)*
6 *Air Intake duct*
7 *Hose clamps*




9.2b Air intake duct and air filter housing installation details - 1995 and later models

1 *Crankcase ventilation hose*
2 *Air intake resonator*
3 *Mass airflow sensor*
4 *Intake air temperature sensor*
5 *Air cleaner housing (upper)*
6 *Air cleaner housing retaining clips*
7 *Air cleaner housing (lower)*
8 *Crankcase ventilation tube*
9 *Hose clamp*

9.5 Remove the bolts (arrows) and the lower air filter housing



10.1 Rotate the throttle lever until the slot in the throttle lever aligns with the cable, then pass the cable through the slot

5 Remove the lower air filter housing mounting bolts and remove it from the engine compartment **(see illustration)**.
6 Installation is the reverse of removal.

## 10 Accelerator cable - removal, installation and adjustment

**Note:** *The adjustment procedure for the accelerator cable and the cruise control cable is similar except where noted below.*

### Removal

*Refer to illustrations 10.1, 10.2 and 10.3*

1 Detach the accelerator cable and the cruise control cable (if equipped) from the throttle lever **(see illustration)**.
2 Loosen the cable locknut and adjusting nut, then separate the accelerator cable from the cable bracket **(see illustration)**.
3 From inside the passenger compartment, pull the cable end out from the accelerator pedal arm, then pass the cable through the slot in the arm. Remove the bolts securing the accelerator cable to the firewall **(see illustration)**.
4 Disconnect any remaining cable clips.
5 Remove the cable through the firewall from the engine compartment side.

### Installation

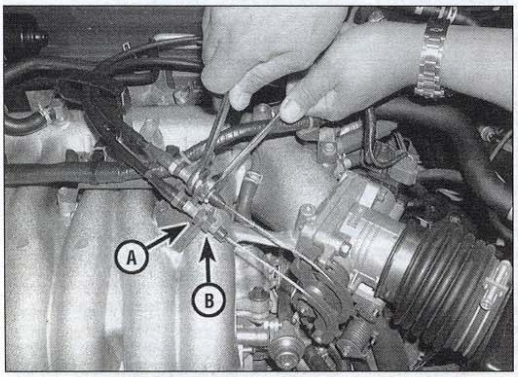
6 Installation is the reverse of removal. Be sure the cable is routed correctly and to fasten all the cable retaining clips.
7 If necessary, at the engine compartment side of the firewall, apply sealant to the accelerator cable bracket where it mates to the firewall to prevent water from entering the passenger compartment.

### Adjustment

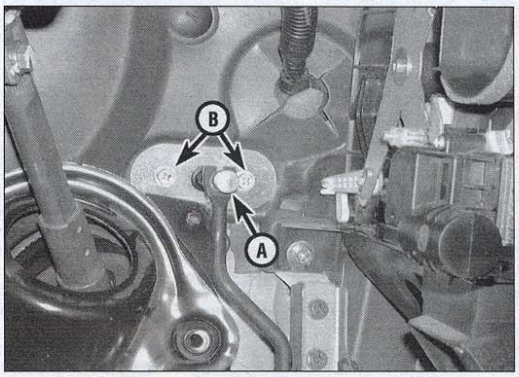
8 To adjust the accelerator cable:
*a) Lift up on the cable to remove any slack.*
*b) Turn the adjusting nut until the throttle lever just starts to move.*
*c) Back off the adjusting nut 1-1/2 to 2 turns.*
*d) Tighten the locknut.*
*e) Verify that the throttle valve opens all the way when you depress the accelerator pedal to the floor and that it returns to the idle position when you release the accelerator. Verify the cable operates smoothly. It must not bind or stick.*
9 To adjust the cruise control cable:
*a) Check the accelerator cable for proper adjustment.*
b) *Turn the adjusting nut until the throttle lever just starts to move.*
*c) Back off the adjusting nut 1/2 to 1 turn.*
*d) Tighten the locknut and check for proper operation of the cruise control system.*

## 11 Fuel injection system - general information

All models are equipped with a multi-port fuel injection system. Fuel is delivered into each intake port in sequence with the engine firing order in accordance with engine



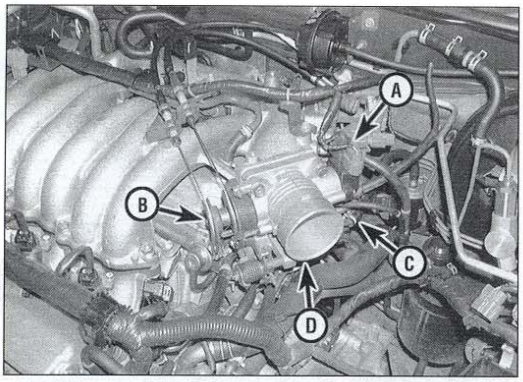

10.2 Loosen the accelerator cable locknut (B) and adjusting nut (A)



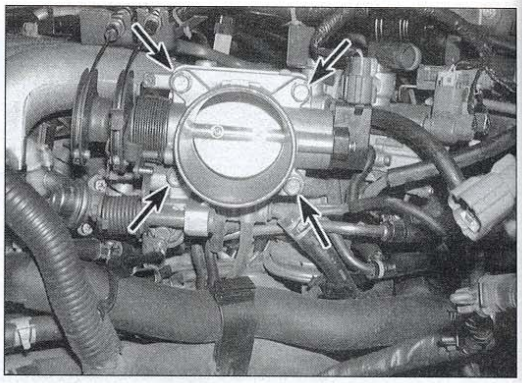

10.3 Working under the dash, pull the cable end (A) from the accelerator pedal recess and lift it through the slot, then remove the cable mounting bracket bolts (B)



Josh Frohman
Ptatohed




13.5 Disconnect the TPS connectors (A), the accelerator and cruise control cables (B), the coolant hoses (C) and the vacuum hoses (D)



13.6 Remove the throttle body mounting bolts (arrows) (1995 and later model shown)

## 13 Throttle body - removal and installation

*Refer to illustrations 13.5 and 13.6*

**Warning:** *Wait until the engine is completely cool before beginning this procedure.*

1 Disconnect the cable from the negative battery terminal.

2 Remove the air filter outlet tube from the intake duct or throttle body.

3 Disconnect the throttle position sensor connectors from the throttle body (see Chapter 6). Also label and detach all vacuum hoses from the throttle body.

4 Detach the accelerator cable (see Section 10) and if equipped, the cruise control cable.

5 Detach the coolant hoses from the throttle body **(see illustration)**. Plug the lines to prevent coolant loss.

6 Remove the throttle body mounting bolts **(see illustration)**. On 1993 and 1994 models, remove the intake duct. Remove the throttle body and gasket. Remove all traces of old gasket material from the throttle body and air intake plenum.

7 Installation is the reverse of removal. Be sure to use a new gasket. Adjust the accelerator cable and the cruise control cable (see Section 10). Check the coolant level and add, if necessary (see Chapter 1).

## 14 Fuel pressure regulator - removal and installation

*Refer to illustrations 14.3 and 14.4*

**Warning:** *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 2.*

1 Relieve the fuel pressure (see Section 2). Disconnect the cable from the negative terminal of the battery.

2 Remove the air intake duct and resonator from the throttle body and air filter assembly.

3 Clean any dirt from around the fuel pressure regulator. Detach the vacuum hose and the fuel return hose from the fuel pressure regulator **(see illustration)**.

4 Remove the two screws retaining the fuel pressure regulator **(see illustration)** and detach the regulator from the fuel rail.

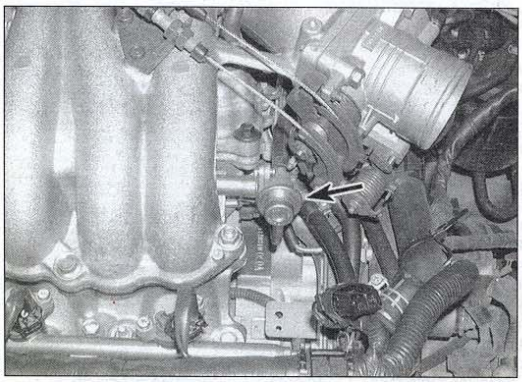
5 Install new O-rings on the pressure regulator and lubricate them with a light coat of oil.

6 Installation is the reverse of removal. Tighten the pressure regulator mounting screws securely.

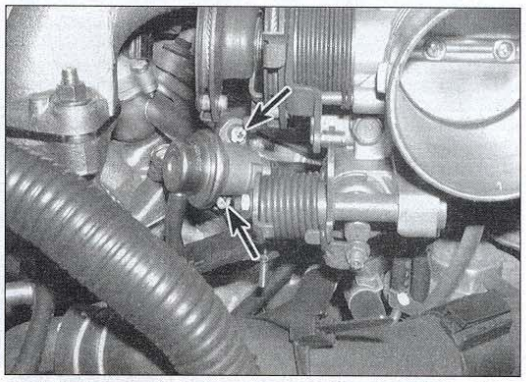
## 15 Fuel rail and injectors - removal and installation

*Refer to illustrations 15.4, 15.5a, 15.5b, 15.6 and 15.8*

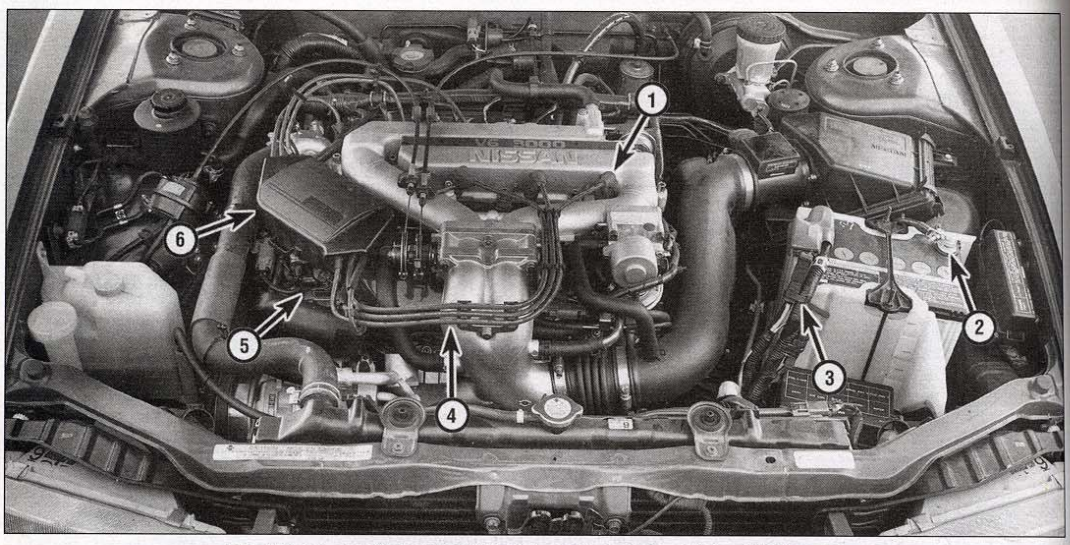
**Warning:** *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 2.*



14.3 Disconnect the vacuum hose, loosen the hose clamp and remove the fuel return line from the fuel pressure regulator (arrow)



14.4 Remove the fuel pressure regulator screws (arrows)




**1.1a Starting, charging and ignition system components - 1993 and 1994 models**

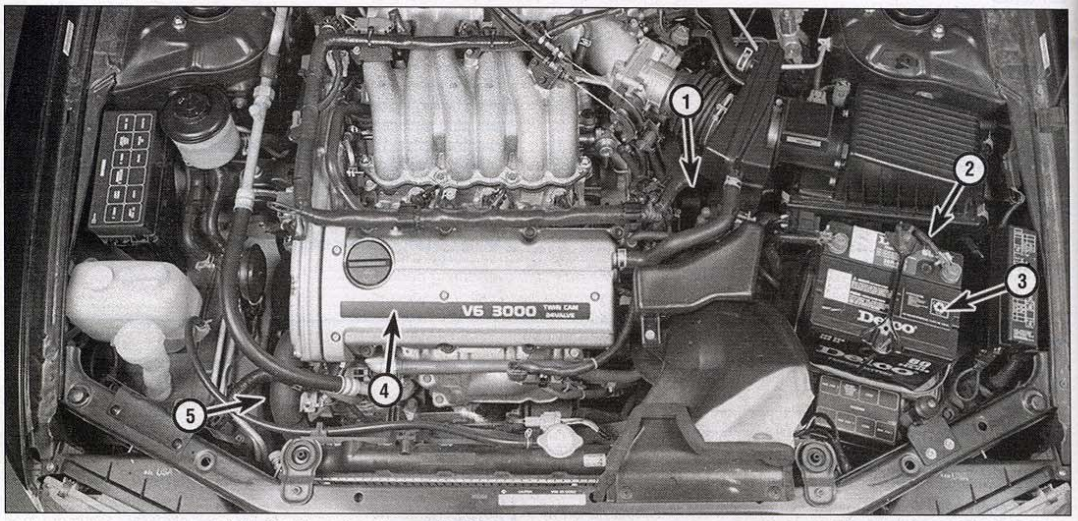
1 *Spark plug*
2 *Battery*
3 *Battery cable*
4 *Spark plug wires*
5 *Ignition coil and power transistor*
6 *Distributor*

## 1 General information

*Refer to illustrations 1.1a and 1.1b*

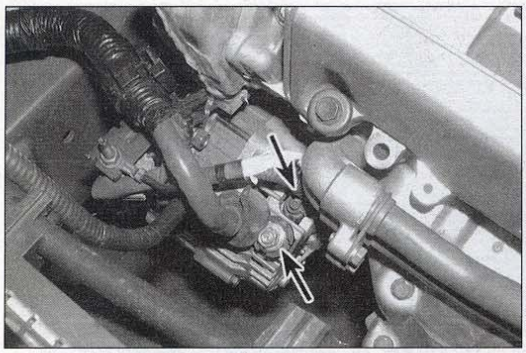
The engine electrical systems include all ignition, charging and starting components **(see illustrations)**. Because of their engine-related functions, these components are considered separately from chassis electrical devices like the lights, instruments, etc.

Be very careful when working on the engine electrical components. They are easily damaged if checked, connected or handled improperly. The alternator is driven by an engine drivebelt which could cause serious injury if your hands, hair or clothes become entangled in it with the engine running. Both the starter and alternator are connected directly to the battery and could arc or even cause a fire if mishandled, overloaded or shorted out.

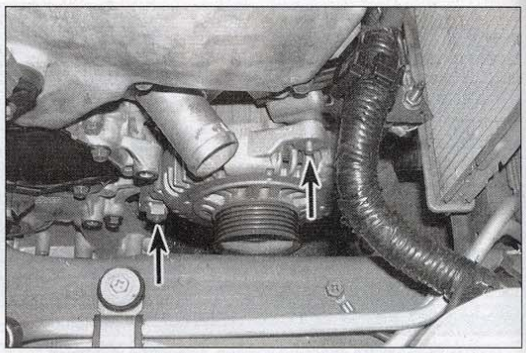



**1.1b Starting, charging and ignition system components - 1995 and later models**

1 *Starter motor (not visible)*
2 *Battery cable*
3 *Battery*
4 *Ignition coil (under cover)*
5 *Alternator (not visible)*



13.10 Disconnect the alternator electrical connector and output wire



13.13 Remove the mounting bolts and remove the alternator

### *1995 and later models*

*Refer to illustrations 13.10 and 13.13*

8 Disconnect the cable from the negative terminal of the battery.

Raise the vehicle and support it securely on jackstands. Remove the lower splash shield beneath the alternator and the right-side inner fender splash shield.

9 Remove the drivebelt (see Chapter 1).

10 Disconnect the electrical connector and the alternator output wire from the alternator **(see Illustration)**.

11 Remove the engine cooling fan and shroud (see Chapter 3).

12 Remove the air conditioning compressor mounting bolts (without disconnecting the refrigerant lines) and slide the compressor forward.

13 Remove the alternator mounting bolts and remove the alternator from the engine **(see Illustration)**.

14 Installation is the reverse of removal.

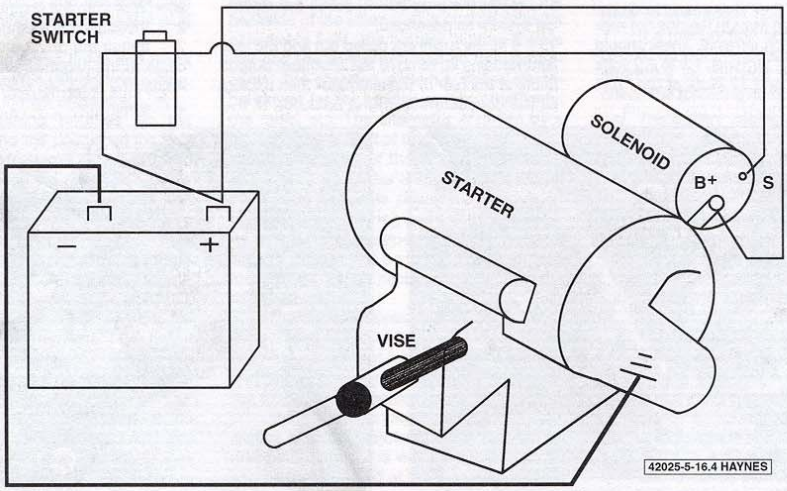
15 Install the drivebelt and reconnect the cable to the negative terminal of the battery. Adjust the drivebelt following the procedure in Chapter 1.

## 14 Starting system - general information and precautions

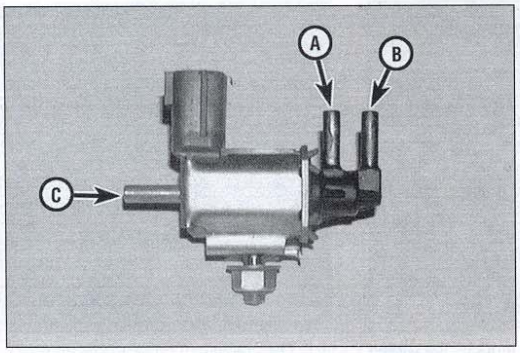
The sole purpose of the starting system is to crank the engine over fast enough to allow it to start. The starting system is composed of the starter motor, starter inhibitor or interlock relay, battery, ignition switch and connecting wiring.

The starter circuit is equipped with an inhibitor or interlock relay. Turning the ignition key to the Start position actuates the starter relay through the starter control circuit. The starter relay then connects battery power to the starter solenoid. The starter solenoid connects battery power to the starter motor and the starter motor turns. The relay is located in the engine compartment fuse/relay box (see Chapter 12). The starter/solenoid assembly is mounted to the transmission bellhousing.

Automatic transaxle models are equipped with a Park/Neutral position switch in the starter control circuit, which prevents operation of the starter unless the shift lever is in Neutral or Park. Manual transaxle models are equipped with a clutch interlock switch in the starter control circuit, which prevents starter operation unless the clutch pedal is depressed.

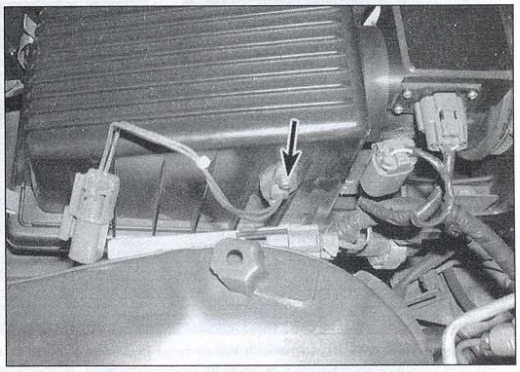



15.7 Starter motor bench testing details




**6.8 MAP sensor solenoid valve vacuum port identification**

*A To MAP sensor*
*B To intake air duct*
*C To intake manifold vacuum source*



**7.3a Disconnect the electrical connector from the intake air temperature sensor (arrow) and measure the resistance across the two terminals of the sensor connector**

### *Replacement*

9 Disconnect the cable from the negative terminal of the battery.
10 Disconnect the electrical connector from the MAP sensor and/or solenoid valve.
11 Remove the MAP sensor and/or solenoid valve mounting screws. Detach the vacuum hose(s) and remove the MAP sensor and/or solenoid valve.
12 Installation is the reverse of removal.

## 7 Intake air temperature sensor - check and replacement

1 The IAT sensor is a thermistor that changes resistance as temperature changes. The sensor is installed in the intake air duct to sense air temperature. As temperature increases, sensor resistance decreases and vice versa. The PCM uses this information to compute the intake temperature and fine tune fuel metering. A problem in the IAT sensor circuit will set a trouble code. The fault may be in the circuit wiring or connections or in the sensor itself.

### *Check*

*Refer to illustrations 7.3a and 7.3b*

**Note:** *Performing the following test will set a diagnostic trouble code and illuminate the Check Engine light. Clear the diagnostic trouble code after performing the tests and making the necessary repairs (see Section 2).*

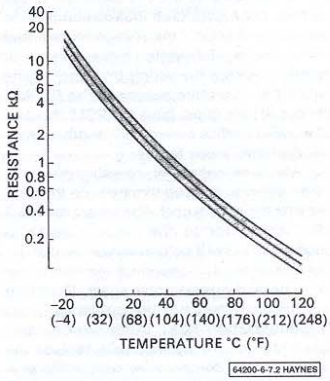
2 Before checking the intake air temperature sensor, check the voltage supply and ground circuits from the PCM. Disconnect the electrical connector from the intake air temperature sensor and connect a voltmeter to the two terminals of the harness connector. Turn the ignition key On - the voltage should read approximately 5.0 volts. If the voltage is incorrect, check the wiring from the intake air temperature sensor to the PCM. If the circuits are good, have the PCM checked at a dealer service department or other properly equipped repair facility.
3 With the ignition switch OFF, disconnect the electrical connector from the intake air temperature sensor. Using an ohmmeter, measure the resistance between the two terminals on the sensor with the engine cool. Reconnect the electrical connector to the sensor, start the engine and warm it up until it reaches operating temperature, disconnect the connector and check the resistance again. Compare your measurements to the resistance chart **(see Illustrations)**. If the sensor resistance test results are incorrect, replace the intake air temperature sensor.
**Note:** *A more accurate check may be performed by removing the sensor and suspending the tip of the sensor in a container of water. Heat the water on the stove while you monitor the resistance of the sensor.*

### *Replacement*

4 Disconnect the electrical connector, then carefully remove the IAT sensor from the air intake duct. Be careful not to damage any of the plastic parts.
5 Install and connect the new sensor.

## 8 Engine coolant temperature sensor - check and replacement

1 Like the intake air temperature sensor, the engine coolant temperature sensor is a thermistor, which is a variable resistor that changes its resistance as temperature changes. On 1993 and 1994 models, the engine coolant temperature sensor is located in the coolant inlet pipe behind the distributor. On 1995 and later models, the sensor is located in the coolant outlet pipe behind the left (front) cylinder head. The engine coolant temperature sensor senses coolant temperature. As coolant temperature increases, sensor resistance decreases and vice versa. The




**7.3b Intake air temperature sensor and engine coolant temperature sensor approximate temperature vs. resistance values**

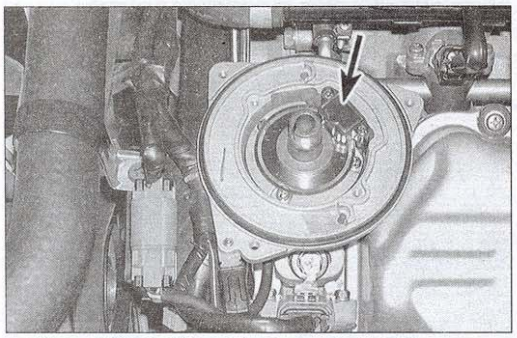
PCM uses this information to compute the engine operating temperature. A problem in the engine coolant temperature sensor circuit will set a trouble code. The fault may be in the circuit wiring or connections or in the sensor itself.

### *Check*

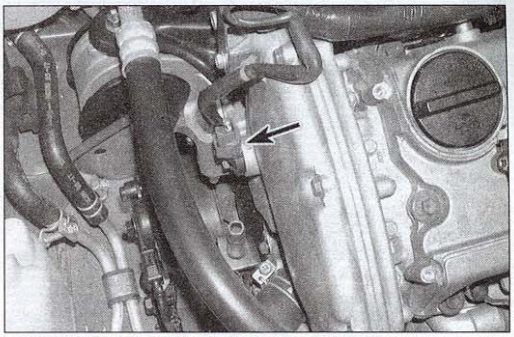
*Refer to illustration 8.2a and 8.2b*

**Note:** *Performing the following test will set a diagnostic trouble code and illuminate the Check Engine light. Be prepared to clear the diagnostic trouble code after performing the tests and making the necessary repairs (see Section 2).*

2 Before checking the engine coolant temperature sensor, check the voltage supply and ground circuits from the PCM. Disconnect the electrical connector from the



10.1 On 1993 and 1994 models, the camshaft position sensor (arrow) is an integral part of the distributor



10.6 On 1995 and later models, the camshaft position sensor (arrow) is located on the timing chain cover

to the sensor. Using a suitable probe, backprobe the white wire terminal of the sensor connector (see Chapter 12 for additional information on how to backprobe a connector). Connect the positive lead of a voltmeter to the probe and connect the negative lead to a good engine ground point. Turn the ignition key On. Touch the tip of the sensor with a metal object (such as a screwdriver) and quickly pull it away. The voltmeter should indicate 5.0 volts when contacted and quickly drop to zero volts when the metal object is pulled away. If the sensor does not react as described, replace the sensor. **Note:** *If in the rare case that the wiring, PCM and sensor are all good and the system continues to set a diagnostic trouble code, check the flywheel/driveplate for broken or stripped gear teeth.*

### Replacement

5 Disconnect the electrical connector from the sensor.

6 Remove the crankshaft sensor retaining bolt and remove the sensor.

7 Installation is the reverse of removal.

## 10 Camshaft position sensor - check and replacement

**Note:** *Performing the following test will set a diagnostic trouble code and illuminate the Check Engine light. Be prepared to clear the diagnostic trouble code after performing the tests and making the necessary repairs (see Section 2).*

### 1993 and 1994 models

*Refer to illustration 10.1*

1 The camshaft position sensor monitors engine speed and piston position and relays this data to the computer which in turn controls the fuel injection duration (fuel injector on/off time) and ignition timing. The camshaft position sensor consists of a rotor plate and a wave forming circuit. The rotor plate has 360 slits for each degree, or one percent signal (engine speed signal) and six slits for the 120-degree camshaft position signal. Light Emitting Diodes (LED) and photo diodes are built into the wave forming circuit. When the rotor plate passes the space between the LED and the photo diode, the slits on the rotor plate continually cut the beam of light sent to the photo diode from the LED. They are then converted into on-off pulses by the wave forming circuit and then sent to the ECM. The camshaft position sensor is an integral part of the distributor **(see Illustration)**.

2 Disconnect the electrical connector from the wiring harness leading to the distributor. Turn the ignition key On. Using a voltmeter, check for battery voltage at the white/black wire terminal of the harness connector. If voltage is not present, check the circuit from the battery to the ECCS relay (don't forget to check the fuses), check the ECCS relay and the circuit from the relay to the distributor connector (see Chapter 12 and the wiring diagrams). Using an ohmmeter, check for continuity to ground at the black wire terminal.

3 Turn the ignition OFF and remove the distributor from the engine (see Chapter 5). Reconnect the distributor connector. Using a suitable probe, backprobe the green/black wire terminal of the distributor connector (see Chapter 12 for additional information on how to backprobe a connector). Connect the positive lead of a voltmeter to the probe and connect the negative lead to a good engine ground point. With the ignition ON, slowly rotate the distributor shaft and check the voltage, the meter should fluctuate between zero volts and 5.0 volts six times per revolution of the distributor shaft . This tests camshaft position sensor 120-degree signal.

4 Turn the ignition OFF and backprobe the green/yellow wire terminals with the voltmeter. With the ignition ON, slowly rotate the distributor shaft, the meter should fluctuate between zero volts and 5.0 volts 360 times per revolution of the distributor shaft. This tests camshaft position sensor 1-degree signal.

5 If the camshaft position sensor doesn't operate as described, the distributor must be replaced (see Chapter 5). The camshaft position sensor is an integral part of the distributor and not serviced separately.

### 1995 and later models

*Refer to illustration 10.6*

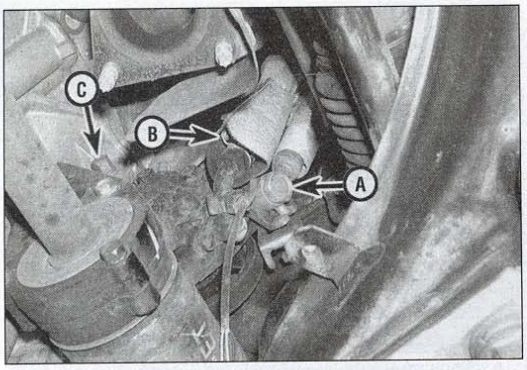
6 The camshaft position sensor is located on the timing chain cover at the front of the engine **(see Illustration)**. The sensor uses a permanent magnet, core and coil to detect a gap in the camshaft sprocket. The changing gap causes the magnetic field near the sensor to change, this in turn varies the voltage signal to the PCM. The camshaft position sensor provides information on cylinder TDC position to the PCM.

7 Disconnect the electrical connector from the sensor. Using an ohmmeter, measure the resistance across the two camshaft sensor terminals. Resistance should be 1,440 to 1,760 ohms at 68-degrees F (20-degrees C) for a Hitachi made sensor or 2,090 to 2,550 ohms at 68-degrees F (20-degrees C) for a Mitsubishi made sensor. If the resistance values are incorrect, replace the sensor.

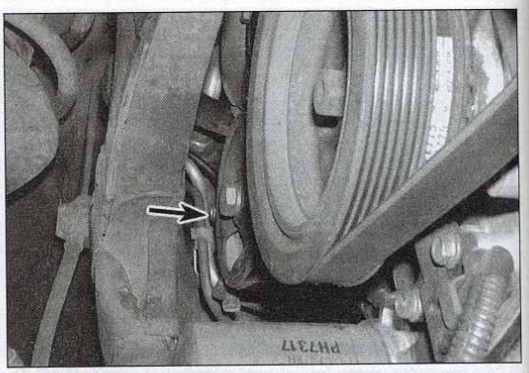
8 If the resistance values are correct, refer to the wiring diagrams and check the wiring harness for an open circuit to the PCM or a damaged harness. Check for continuity to ground on the black wire of the harness connector. If the sensor and the wiring harness are both good, have the PCM diagnosed by a dealer service department or other qualified repair shop.

## 11 Power steering pressure switch - check and replacement

1 The power steering pressure switch is a normally open switch, mounted in the pressure line between the steering gear and the power steering pump. When steering system pressure reaches a high-pressure setpoint, the power steering pressure switch closes and sends a signal to the PCM that the PCM uses to maintain engine idle speed during parking maneuvers. The PCM can detect switch problems and set trouble codes to




18.5 Unscrew the banjo fitting bolt from the power steering fluid pressure line (A), loosen the clamp on the return hose fitting (B) and disconnect the hose, then remove the pivot bolt (C)



18.8a Remove this bolt (arrow) that attaches the adjuster bracket to the power steering pump

20 Install the charcoal canister and the air filter housing and duct.
21 Bleed the steering system (see Section 19).

## 18 Power steering pump - removal and installation

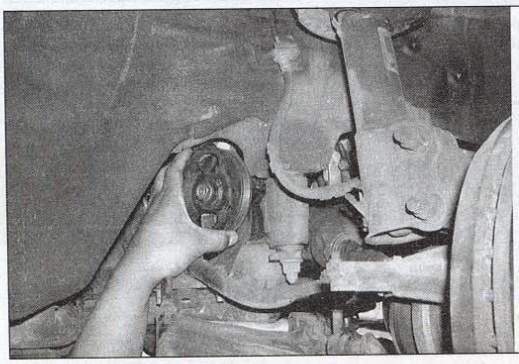
### Removal

*Refer to illustrations 18.5, 18.8a and 18.8b*

1 Disconnect the cable from the negative battery terminal.
2 Loosen the tensioner and remove the drivebelt (see Chapter 1).
3 Using a large syringe or suction gun, suck as much fluid out of the power steering fluid reservoir as possible. Place a drain pan under the vehicle to catch any fluid that spills out when the hoses are disconnected.
4 Loosen the right front wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheel.
5 Working under the vehicle, remove the pressure line-to-pump banjo bolt **(see illustration)**, then detach the line from the pump. Remove and discard the copper sealing washers. They must be replaced when installing the pump. Wrap a plastic bag around the end of the hose to prevent fluid spillage.
6 Loosen the clamp and disconnect the fluid return hose from the pump **(see illustration 18.5)**. Plug the hose.
7 Detach the right tie-rod end from the steering knuckle arm (see Section 15) and swing the tie-rod to the rear, out of the way.
8 Remove the pump mounting bolts **(see accompanying illustration and illustration 18.5)**, then guide the pump out through the fenderwell **(see illustration)**.

### Installation

9 Installation is the reverse of removal. Be sure to tighten the pressure line banjo bolt to the torque listed in this Chapter's Specifications (be sure to use new sealing washers). Adjust the drivebelt tension following the procedure described in Chapter 1.
10 Connect the tie-rod end to the steering knuckle (see Section 15).
11 Install the wheel and lug nuts. Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.
12 Top up the fluid level in the reservoir (see Chapter 1) and bleed the system (see Section 19).



18.8b Guide the power steering pump out through this opening in the inner fender panel

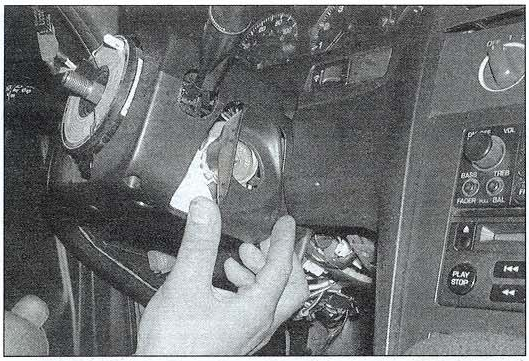
## 19 Power steering system - bleeding

1 Following any operation in which the power steering fluid lines have been disconnected, the power steering system must be bled to remove all air and obtain proper steering performance.
2 With the front wheels in the straight ahead position, check the power steering fluid level and, if low, add fluid until it is between the Cold marks on the reservoir.
3 Raise the front of the vehicle and support it securely on jackstands.
4 Turn the steering wheel back-and-forth repeatedly, lightly hitting the stops.
5 Start the engine and allow it to run at fast idle. Recheck the fluid level and add more if necessary to reach the Cold marks.
6 Bleed the system by turning the wheels from side to side, just barely contacting the stops. This will work the air out of the system. Keep the reservoir full of fluid as this is done.
7 When the air is worked out of the system and the fluid level stabilizes, return the wheels to the straight ahead position and leave the vehicle running for several more minutes before shutting it off. Lower the vehicle.
8 Road test the vehicle to be sure the steering system is functioning normally and noise-free.
9 Recheck the fluid level to be sure it is between the Hot marks on the reservoir while the engine is at normal operating temperature. Add fluid if necessary (see Chapter 1).

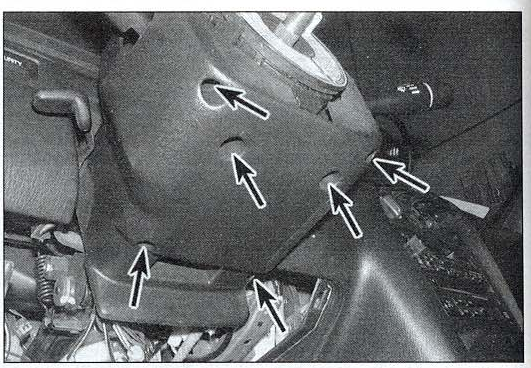
## 20 Wheel studs - replacement

*Refer to illustrations 20.3 and 20.4*

1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.
2 Remove the brake disc or drum (see Chapter 9).
3 Install a lug nut part way onto the stud



26.2 Pull the cover from around the ignition switch



26.3 Remove the two lower and four upper screws (arrows) from the lower column cover and separate the upper and lower covers

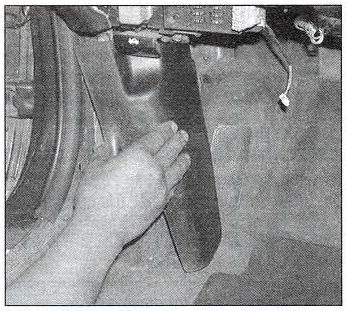
3 Remove the steering column cover screws from the lower cover **(see illustration)**.
4 Separate the cover halves and detach them from the steering column.
5 Installation is the reverse of the removal procedure.

## 27 Instrument panel - removal and installation

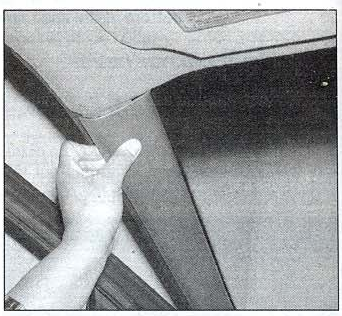
*Refer to illustrations 27.8, 27.9, 27.10, 27.11, 27.12, 27.13, 27.14a, 27.14b, 27.16a and 27.16b*

**Warning:** *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system components to avoid the possibility of accidental deployment of the airbags, which could cause personal injury (see Chapter 12).*

**Note:** *This is a difficult procedure for the home mechanic, involving tedious disassembly and the disconnection/reconnection of numerous electrical connectors. If you do attempt this procedure, make sure you take good notes and mark all matching connectors (and their mounting points) to aid reassembly.*

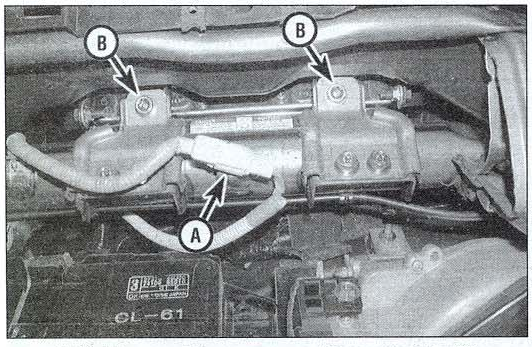


27.8 Pull out the kick panels at each side

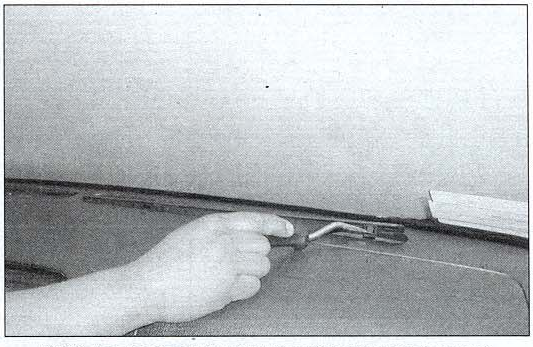


27.9 Pull back the rubber weatherstripping, then remove the windshield post trim strips (retained by clips)

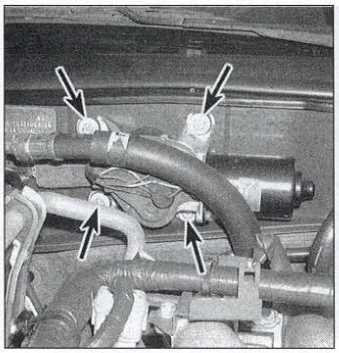
1 Disconnect the cable from the negative terminal of the battery.
2 Remove the center console (see Section 24).
3 Remove the steering column covers (see Section 26).
4 Remove the instrument cluster bezel (see Section 25).
5 Remove the instrument cluster (see Chapter 12).
6 Remove the dashboard trim panels (see Section 25).
7 Remove the radio and heater/air conditioner controls (see Chapter 3 and Chapter 12).
8 Remove the kick panels at each side **(see illustration)**. The panels simply pull out.
9 Remove the left and right trim strips along the interior of each windshield post **(see illustration)**.
10 The passenger airbag is attached to the



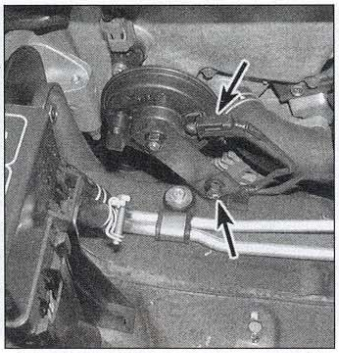

27.10 Disconnect the passenger airbag connector (A), then remove the two bolts (B)



27.11 Access the upper instrument panel bolts by prying up the defroster vent grilles



18.11 Unplug the electrical connector, remove the mounting bolts (arrows) and remove the wiper motor



19.3 Unplug the electrical connector (A) and remove the bolt (B), then detach the horn

## 19 Horn - check and replacement

*Refer to illustration 19.3*

**Note:** *Check the fuses before beginning electrical diagnosis.*

1 Unplug the electrical connector from the horn.

2 To test the horn, refer to the wiring diagrams and connect battery voltage and ground to the two terminals with a pair of jumper wires. If the horn doesn't sound, replace it. If it does sound, the problem lies in the switch, relay or the wiring between the components.

3 To replace the horn, unplug the electrical connector and remove the bracket bolt **(see illustration)**.

4 Installation is the reverse of removal.

## 20 Daytime Running Lights (DRL) - general information

The Daytime Running Lights (DRL) system used on Canadian models turns the headlights on whenever the engine is started. The only exception is when the engine is turned on when the parking brake is engaged. Once the parking brake is released, the lights will remain on as long as the ignition switch is on, even if the parking brake is later applied.

The DRL system supplies reduced power to the headlights so they won't be too bright for daytime use while prolonging headlight life.

## 21 Rear window defogger - check and repair

1 The rear window defogger consists of a number of horizontal heating elements baked onto the inside surface of the glass. Power is supplied through a large fuse from the power distribution box in the engine compartment. The heater is controlled by the instrument panel switch. Test the switch for continuity (see Section 9).

2 Small breaks in the element can be repaired without removing the rear window.

### Check

*Refer to illustrations 21.5 and 21.6*

3 Turn the ignition switch and defogger switches to the ON position.

4 Using a voltmeter, place the positive probe against the defogger grid positive terminal and the negative probe against the ground terminal. If battery voltage is not indicated, check the fuse, defogger switch and related wiring. If voltage is indicated, but all or part of the defogger doesn't heat, proceed with the following tests.

5 When measuring voltage during the next two tests, wrap a piece of aluminum foil around the tip of the voltmeter positive probe and press the foil against the heating element with your finger **(see illustration)**. Place the negative probe on the defogger grid ground terminal.

6 Check the voltage at the center of each heating element **(see illustration)**. If the voltage is 5 to 6 volts, the element is okay (there is no break). If the voltage is 0 volts, the element is broken between the center of the element and the positive end. If the voltage is 10 to 12 volts the element is broken between the center of the element and the ground side. Check each heating element.

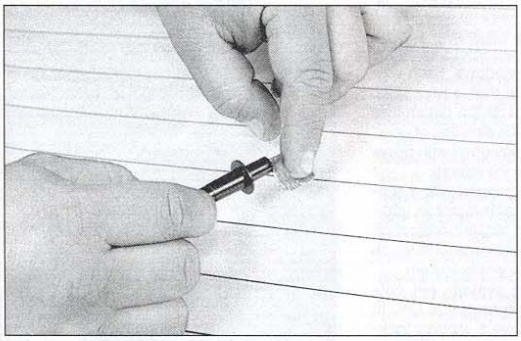
7 If none of the elements are broken, connect the negative probe to a good chassis ground. The voltage reading should stay the same, if it doesn't the ground connection is bad.

8 To find the break, place the voltmeter negative probe against the defogger ground terminal. Place the voltmeter positive probe with the foil strip against the heating element at the positive side and slide it toward the negative side. The point at which the voltmeter deflects from several volts to zero is the point where the heating element is broken.

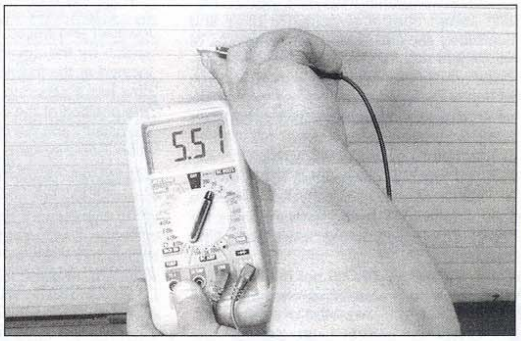
### Repair

*Refer to illustration 21.14*

9 Repair the break in the element using a repair kit specifically for this purpose, such as Dupont paste No. 4817 (or equivalent). The kit includes conductive plastic epoxy.

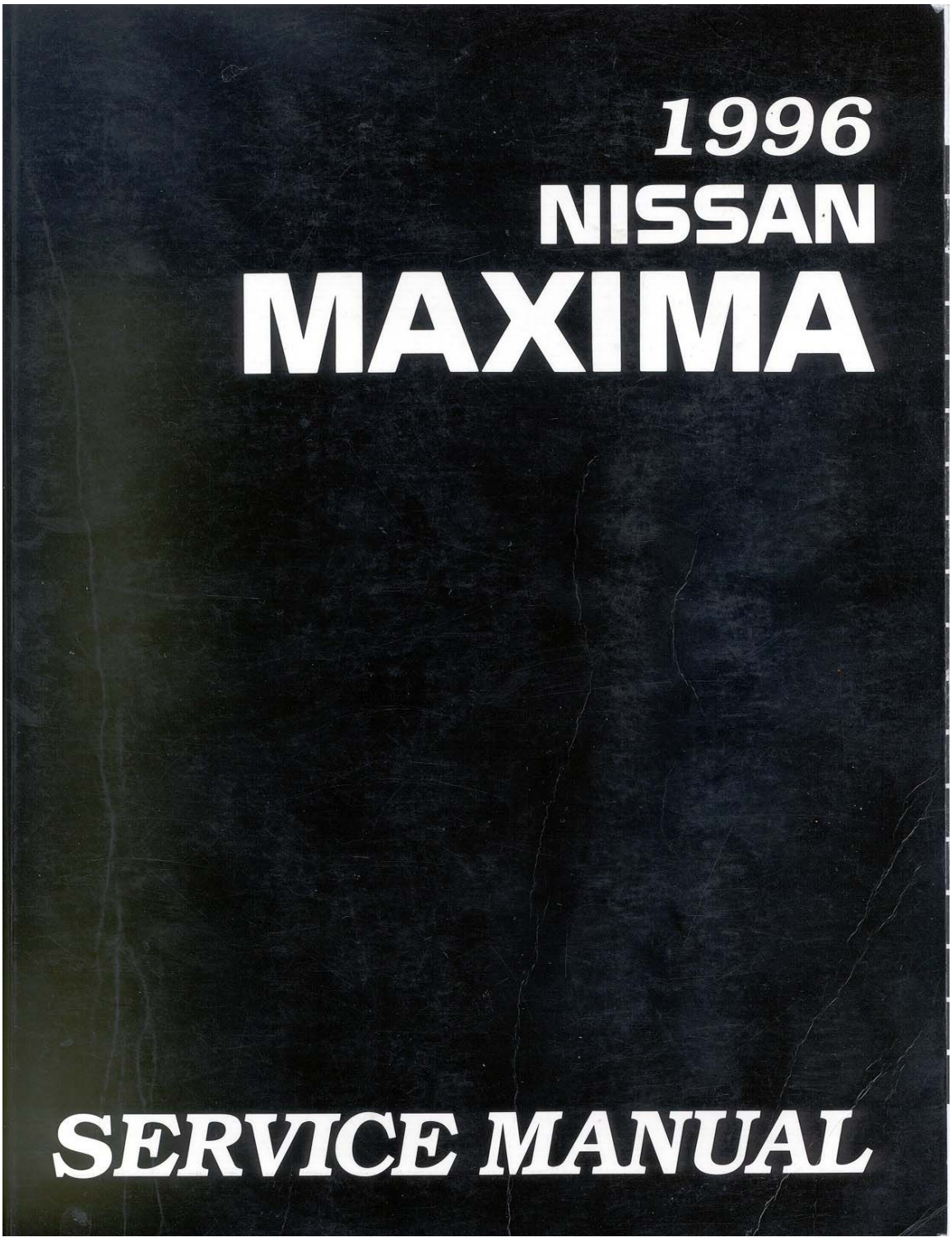


21.5 When measuring the voltage at the rear window defogger grid, wrap a piece of aluminum foil around the negative probe of the voltmeter and press the foil against the wire with your finger

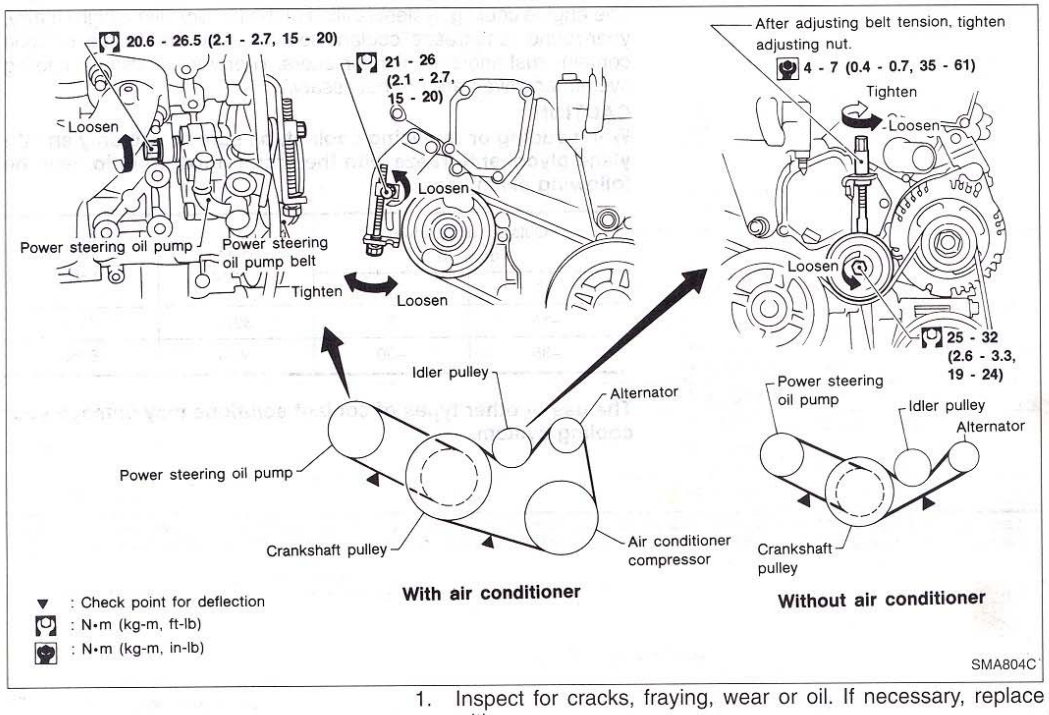



21.6 To determine if a heating element has broken, check the voltage at the center of each element - if the voltage is 6-volts, the element is unbroken

*Appendix E* – Sited 1996 Factory Service Manual pages:



## Checking Drive Belts




1. Inspect for cracks, fraying, wear or oil. If necessary, replace with a new one.
2. Inspect drive belt deflections by pushing midway between pulleys.

**Inspect drive belt deflections when engine is cold.**

**Adjust if belt deflections exceed the limit.**

**Belt deflection:**

Unit: mm (in)

| Drive belts | Used belt deflection | | Deflection of new belt |
|---|---|---|---|
| | Limit | Deflection after adjustment | |
| Alternator | | | |
| With air conditioner compressor | 7 (0.28) | 4.2 - 4.6 (0.165 - 0.181) | 3.8 - 4.1 (0.150 - 0.161) |
| Without air conditioner compressor | 10 (0.39) | 6.3 - 6.9 (0.248 - 0.272) | 5.8 - 6.2 (0.228 - 0.244) |
| Power steering oil pump | 11 (0.43) | 7.3 - 8 (0.287 - 0.315) | 6.5 - 7 (0.256 - 0.276) |
| Applied pushing force | 98 N (10 kg, 22 lb) | | |





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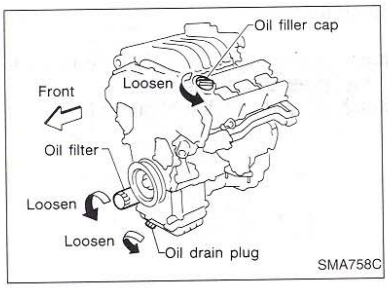



## Changing Engine Oil

**WARNING:**

- **Be careful not to burn yourself, as the engine oil is hot.**
- **Prolonged and repeated contact with used engine oil may cause skin cancer; try to avoid direct skin contact with used oil. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.**

1. Warm up engine, and check for oil leakage from engine components.
2. Remove drain plug and oil filler cap.
3. Drain oil and refill with new engine oil.

**Oil grade: API SG or SH**
**Viscosity: Refer to MA-8.**

**Refill oil capacity (Approximate):**

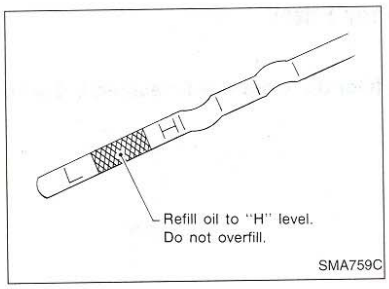
Unit: liter (US qt, Imp qt)

| | |
|---|---|
| With oil filter change | 4.0 (4-1/4, 3-1/2) |
| Without oil filter change | 3.7 (3-7/8, 3-1/4) |

**CAUTION:**

- **Be sure to clean drain plug and install with new washer.**
  **Drain plug:**
  **: 29 - 39 N·m (3.0 - 4.0 kg-m, 22 - 29 ft-lb)**
- **The refill capacity depends on the oil temperature and drain time; use the "Refill oil capacity" values as a reference and be certain to check with the dipstick when changing the oil.**

4. Check oil level.
5. Start engine and check area around drain plug and oil filter for oil leakage.
6. Run engine for a few minutes, then turn it off. After several minutes, check oil level.



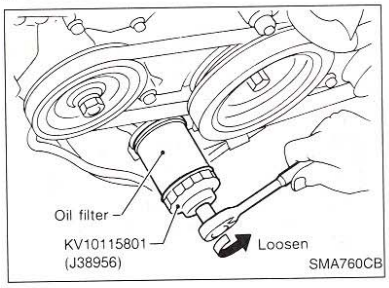

## Changing Oil Filter

1. The oil filter is a small full-floating cartridge type and is provided with a relief valve.

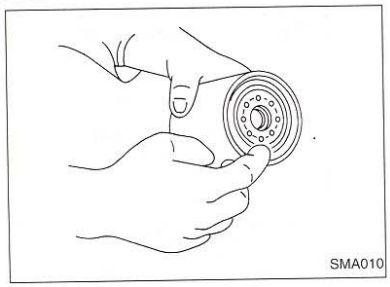
**Refer to LC section ("OIL FILTER").**

2. Remove oil filter with Tool or suitable tool.

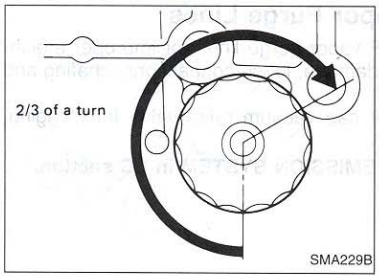
**WARNING:**
**Be careful not to burn yourself, as the engine and the engine oil are hot.**




3. Clean oil filter mounting surface on cylinder block. Coat rubber seal of new oil filter with engine oil.



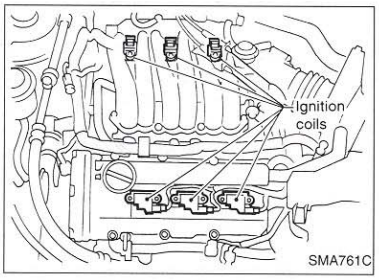
## Changing Oil Filter (Cont'd)



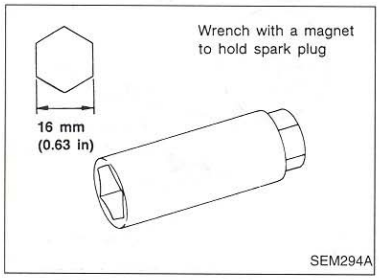

4. Screw in the oil filter until a slight resistance is felt, then tighten additionally 2/3 turn.
5. Add engine oil.

**Refer to "Changing Engine Oil", MA-14 .**

## Changing Spark Plugs




1. Remove left side rocker cover ornament.
2. Disconnect ignition coil harness connectors.
3. Loosen ignition coil fixing bolts and pull out coil from intake manifold connector.

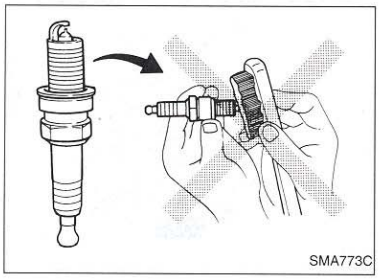



4. Remove spark plugs with suitable spark plug wrench.

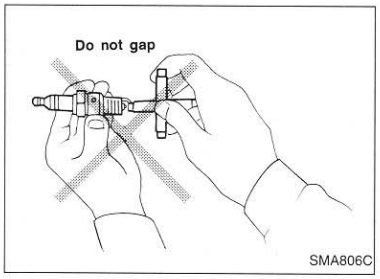
**Spark plug (Platinum-tipped type):**

| Make | NGK |
|---|---|
| Standard type | PFR5G-11 |
| Hot type | PFR4G-11 |
| Cold type | PFR6G-11 |

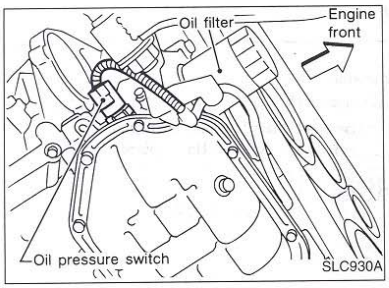
**: 20 - 29 N·m (2.0 - 3.0 kg-m, 14 - 22 ft-lb)**

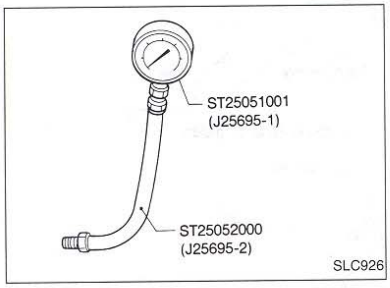



- **Do not use a wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used.**
  - **Cleaner air pressure:**
    **Less than 588 kPa (6 kg/cm$^2$, 85 psi)**
  - **Cleaning time:**
    **Less than 20 seconds**




- **Checking and adjusting plug gap is not required between change intervals.**




## Oil Pressure Check

**WARNING:**

- **Be careful not to burn yourself, as the engine and oil may be hot.**
- **Oil pressure check should be done in "Neutral position" (M/T) or "Parking position" (A/T).**

1. Check oil level.
2. Remove oil pressure switch.
3. Install pressure gauge.
4. Start engine and warm it up to normal operating temperature.
5. Check oil pressure with engine running under no-load.

| Engine speed rpm | Approximate discharge pressure kPa (kg/cm$^2$, psi) |
|---|---|
| Idle speed | More than 69 (0.70, 10.0) |
| 3,000 | 435 - 551 (4.44 - 5.62, 63.1 - 79.9) |

**If difference is extreme, check oil passage and oil pump for oil leaks.**

6. Install oil pressure switch with sealant.

## Oil Pump

### REMOVAL AND INSTALLATION

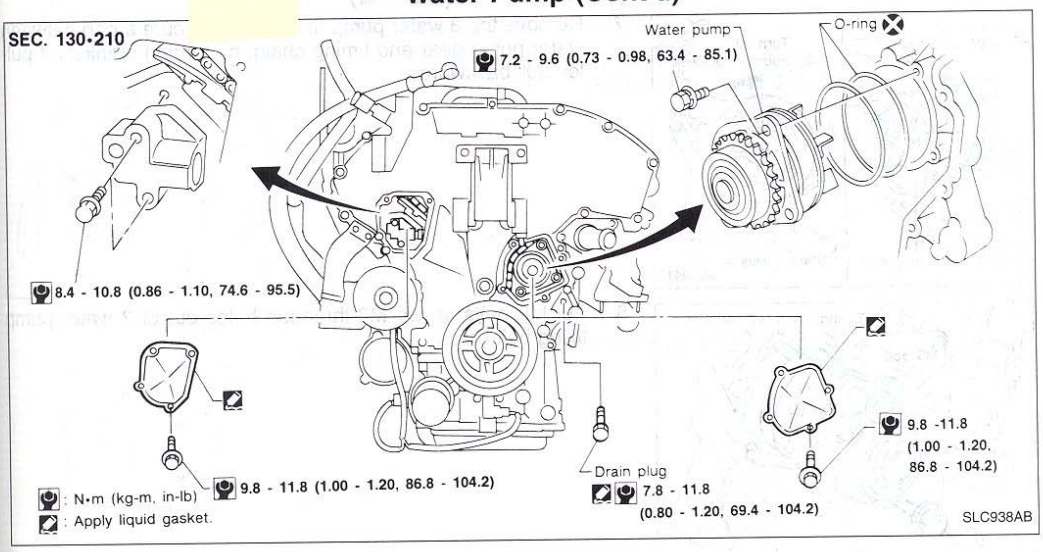
**CAUTION:**

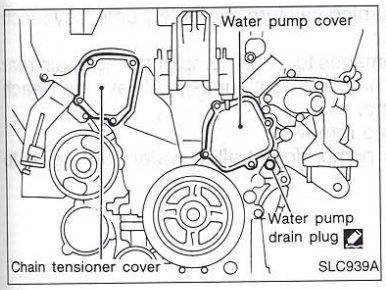
**When removing the oil pans, oil pump assembly and timing chain from engine, first remove the camshaft position sensor (PHASE) and the crankshaft position sensor (REF)/(POS) from the assembly.**

**Be careful not to damage sensor edge.**

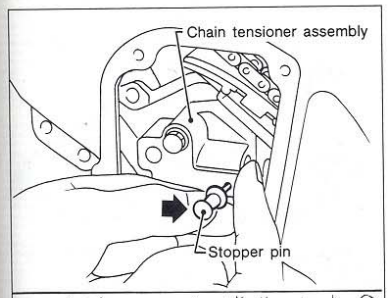
1. Drain engine oil.
2. Remove drive belts.
3. Remove camshaft position sensor (PHASE), and crankshaft position sensor (REF)/(POS).
4. Remove crank pulley.
5. Remove engine lower covers.
6. Remove front exhaust tube and its support.
7. Support engine at right and left side engine slingers with a suitable hoist.
8. Remove engine right side mounting insulator and bracket bolts and nuts.
9. Remove center member assembly.
10. Remove air compressor assembly and bracket.
11. Remove oil pans. (Refer to "Removal" of "OIL PAN" in EM section.)
12. Remove water pump cover.
13. Remove front cover assembly.
14. Remove timing chain. (Refer to "Removal" of "TIMING CHAIN" in EM section.)
15. Remove oil pump assembly.
16. Reinstall any parts removed in reverse order of removal.

## Water Pump (Cont'd)

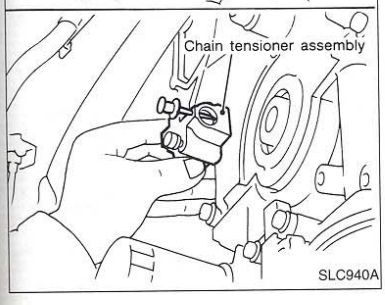


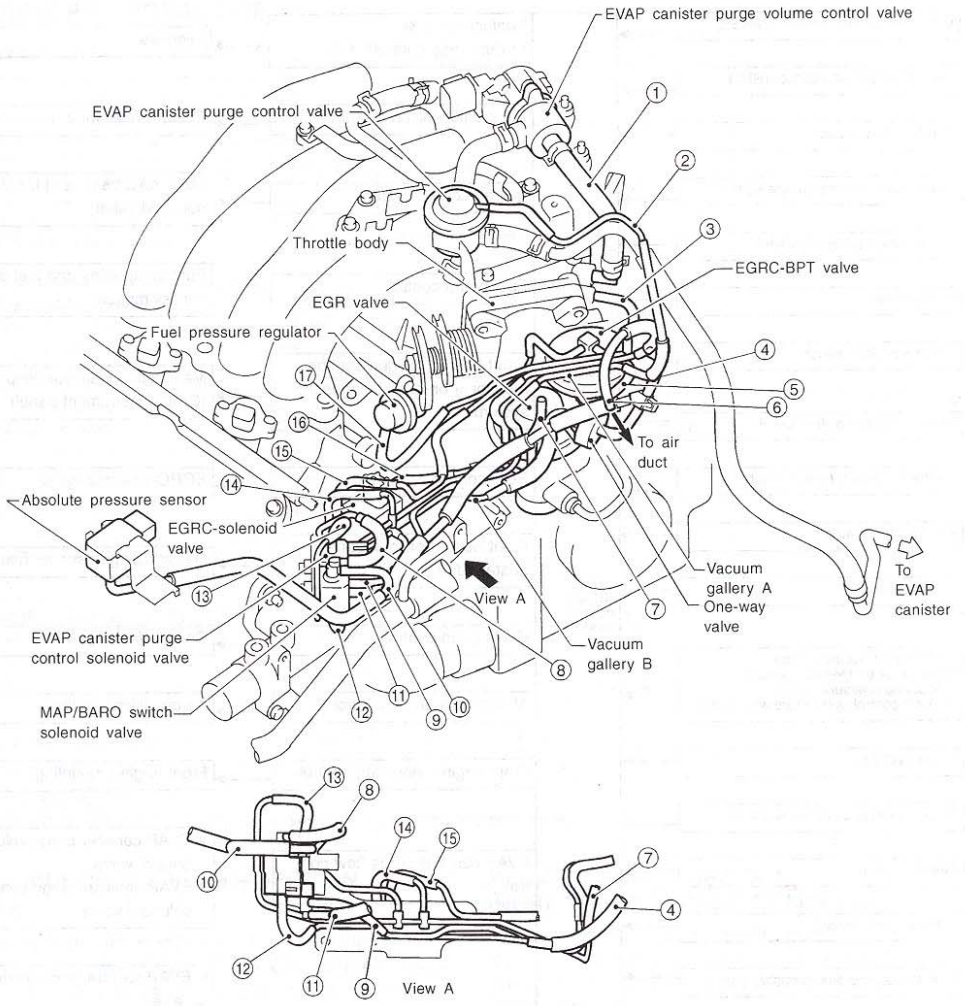

1. Drain coolant from drain plugs on radiator and both sides of cylinder block.
   Refer to "Changing Engine Coolant" in MA section.
2. Remove water pump drain plug.
3. Remove right side engine mounting, mounting bracket and nuts.
4. Remove drive belts and idler pulley bracket.
5. Remove chain tensioner cover and water pump cover.




6. Pushing timing chain tensioner sleeve, apply a stopper pin so it does not return. Then remove the chain tensioner assembly.



## Vacuum Hose Drawing




SEF807Q

① EVAP canister purge volume control valve to Throttle body
② EVAP canister purge control valve to Vacuum gallery A
③ Throttle body to Vacuum gallery A
④ Vacuum gallery A to Vacuum gallery B
⑤ EGR valve to EGRC-BPT valve
⑥ Air duct to Vacuum gallery A
⑦ Throttle body to Vacuum gallery B
⑧ MAP/BARO switch solenoid valve to Vacuum gallery B
⑨ EVAP canister purge control solenoid valve to Vacuum gallery B
⑩ MAP/BARO switch solenoid valve to Absolute pressure sensor
⑪ EVAP canister purge control solenoid valve to Vacuum gallery B
⑫ MAP/BARO switch solenoid valve to Vacuum gallery B
⑬ EVAP canister purge control solenoid valve to Vacuum gallery B
⑭ EGRC-solenoid valve to Vacuum gallery B
⑮ EGRC-solenoid valve to Vacuum gallery B
⑯ EGRC-solenoid valve to Vacuum gallery B
⑰ Fuel pressure regulator to Vacuum gallery A

**Refer to "System Diagram" in ENGINE AND EMISSION CONTROL SYSTEM for vacuum control system.**







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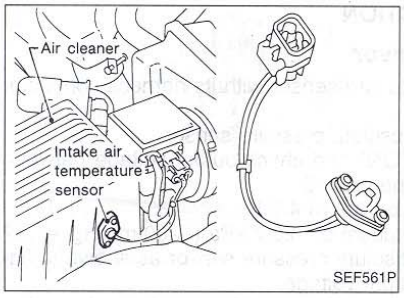
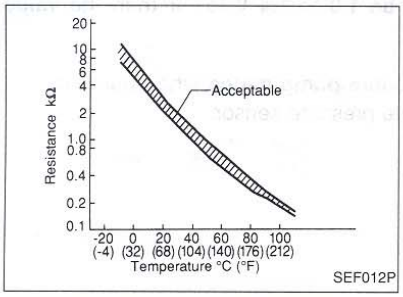



## Intake Air Temperature Sensor (DTC: 0401)

The intake air temperature sensor is mounted to the air cleaner housing, detects intake air temperature and transmits a signal to the ECM.

The temperature sensing unit uses a thermistor, which is sensitive to the change in temperature. Electrical resistance of the thermistor decreases in response to the temperature rise.

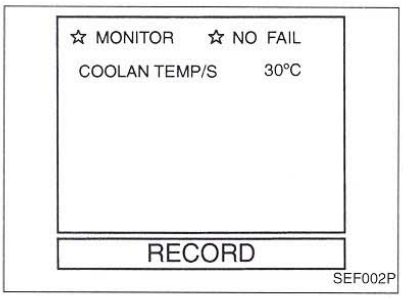
This sensor is not directly used to control the engine system. It is used only for the on-board diagnosis.

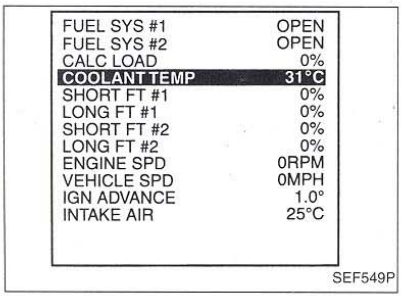



〈Reference data〉

| Intake air temperature °C (°F) | Voltage (V) | Resistance (kΩ) |
|---|---|---|
| 20 (68) | 3.5 | 2.1 - 2.9 |
| 80 (176) | 1.23 | 0.27 - 0.38 |

| Diagnostic Trouble Code No. | Malfunction is detected when ... | Check Items (Possible Cause) |
|---|---|---|
| P0110<br>0401 | A) An excessively low or high voltage from the sensor is sent to ECM.<br>B) Rationally incorrect voltage from the sensor is sent to ECM, compared with the voltage signal from engine coolant temperature sensor. | • Harness or connectors (The sensor circuit is open or shorted.)<br>• Intake air temperature sensor |




### DIAGNOSTIC TROUBLE CODE CONFIRMATION PROCEDURE

#### Procedure for malfunctions A and B

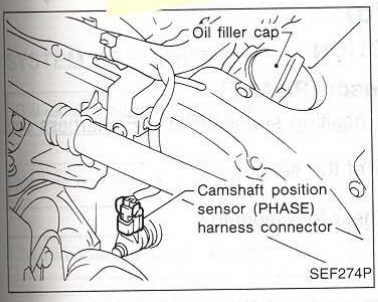
1) Wait until engine coolant temperature is less than 90°C (194°F).
   (1) Turn ignition switch "ON".
   (2) Select "DATA MONITOR" mode with CONSULT.
   (3) Check the engine coolant temperature.
   (4) If the engine coolant temperature is not less than 90°C (194°F), turn ignition switch "OFF" and cool down engine.
2) Turn ignition switch "ON".
3) Select "DATA MONITOR" mode with CONSULT.
4) Wait at least 5 seconds.

OR

1) Wait until engine coolant temperature is less than 90°C (194°F).
   (1) Turn ignition switch "ON".
   (2) Select MODE 1 with GST.
   (3) Check the engine coolant temperature.

## Camshaft Position Sensor (CMPS) (PHASE) (DTC: 0101) (Cont'd)

### DIAGNOSTIC PROCEDURE



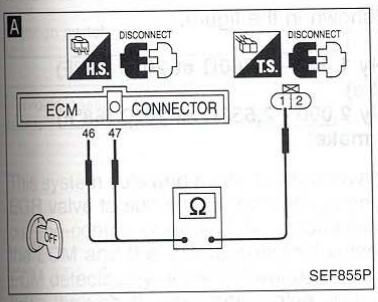

INSPECTION START

CHECK STARTING SYSTEM.
Does the engine turn over?
(Does the starter motor operate?)

No → Check starting system. (Refer to EL section.)

Yes

A

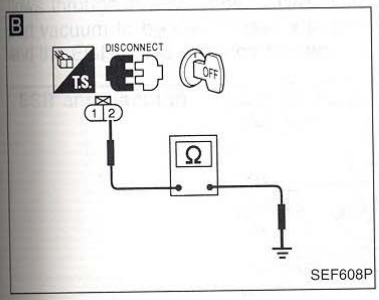



**CHECK INPUT SIGNAL CIRCUIT.**
1. Turn ignition switch "OFF".
2. Disconnect camshaft position sensor (PHASE) harness connector and ECM harness connector.
3. Check harness continuity between terminal ① and ECM terminals ㊻, ㊼.
   **Continuity should exist.**
   If OK, check harness for short.

NG → Repair harness or connectors.

OK

B




**CHECK GROUND CIRCUIT.**
1. Turn ignition switch "OFF".
2. Loosen and retighten engine ground screws.
3. Check harness continuity between terminal ② and engine ground.
   **Continuity should exist.**
   If OK, check harness for short.

NG → Repair harness or connectors.

OK

CHECK COMPONENT
[Camshaft position sensor (PHASE)].
Refer to "COMPONENT INSPECTION" on next page.

NG → Replace camshaft position sensor (PHASE).

OK

Disconnect and reconnect harness connectors in the circuit. Then retest.

Trouble is not fixed.

Check ECM pin terminals for damage and check the connection of ECM harness connector. Reconnect ECM harness connector and retest.

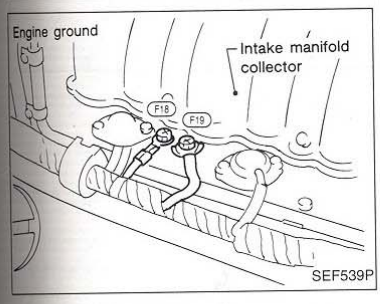
Trouble is not fixed.

Visually check the surface of camshaft sprocket for chipping.

NG → Replace camshaft sprocket.

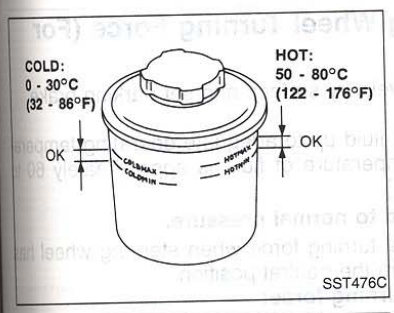
OK

INSPECTION END



## Checking and Adjusting Drive Belts (For power steering)

Refer to "Checking Drive Belts" for "ENGINE MAINTENANCE" in MA section.

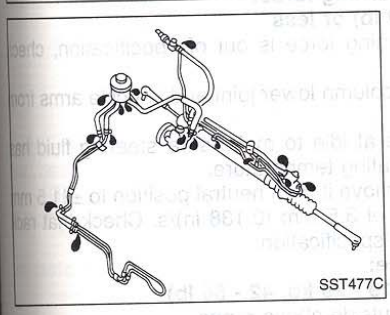



## Checking Fluid Level

Check fluid level.
Use the correct range of the tank depending on the fluid temperature. Use the "HOT" range at 50 to 80°C (122 to 176°F), or the "COLD" range at 0 to 30°C (32 to 86°F).

**CAUTION:**

- **Do not overfill.**
- **Recommended fluid is Automatic Transmission Fluid "DEXRON™II" type or equivalent.**




## Checking Fluid Leakage

Check the lines for improper attachment and for leaks, cracks, damage, loose connections, chafing or deterioration.

1. Run engine between idle speed and 1,000 rpm.

**Make sure temperature of fluid in oil tank rises to 60 to 80°C (140 to 176°F).**

2. Turn steering wheel right-to-left several times.
3. Hold steering wheel at each "lock" position for five seconds and carefully check for fluid leakage.

**CAUTION:**
**Do not hold the steering wheel in a locked position for more than 15 seconds.**

4. If fluid leakage at connectors is noticed, loosen flare nut and then retighten.

**Do not overtighten connector as this can damage O-ring, washer and connector.**

5. Check rack boots for accumulation of power steering fluid.

## Bleeding Hydraulic System

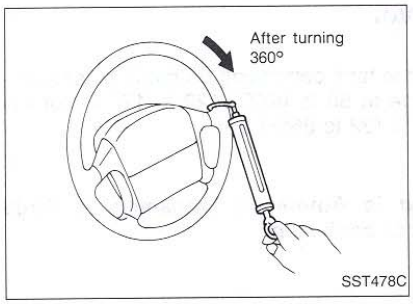
1. Raise front end of vehicle until wheels are clear of the ground.
2. Add fluid into oil tank to specified level. Then quickly turn steering wheel fully to right and left and lightly touch steering stoppers.
   Repeat steering wheel operation until fluid level no longer decreases.
3. Start engine.
   Repeat step 2 above.

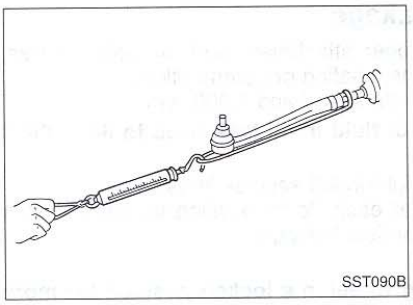
## Bleeding Hydraulic System (Cont'd)

- Incomplete air bleeding will cause the following to occur. When this happens, bleed air again.

a. Air bubbles in reservoir tank
b. Clicking noise in oil pump
c. Excessive buzzing in oil pump

Fluid noise may occur in the valve or oil pump. This is common when the vehicle is stationary or while turning steering wheel slowly. This does not affect performance or durability of the system.




## Checking Steering Wheel Turning Force (For power steering)

1. Park vehicle on a level, dry surface and set parking brake.
2. Start engine.
3. Bring power steering fluid up to adequate operating temperature. [Make sure temperature of fluid is approximately 60 to 80°C (140 to 176°F).]

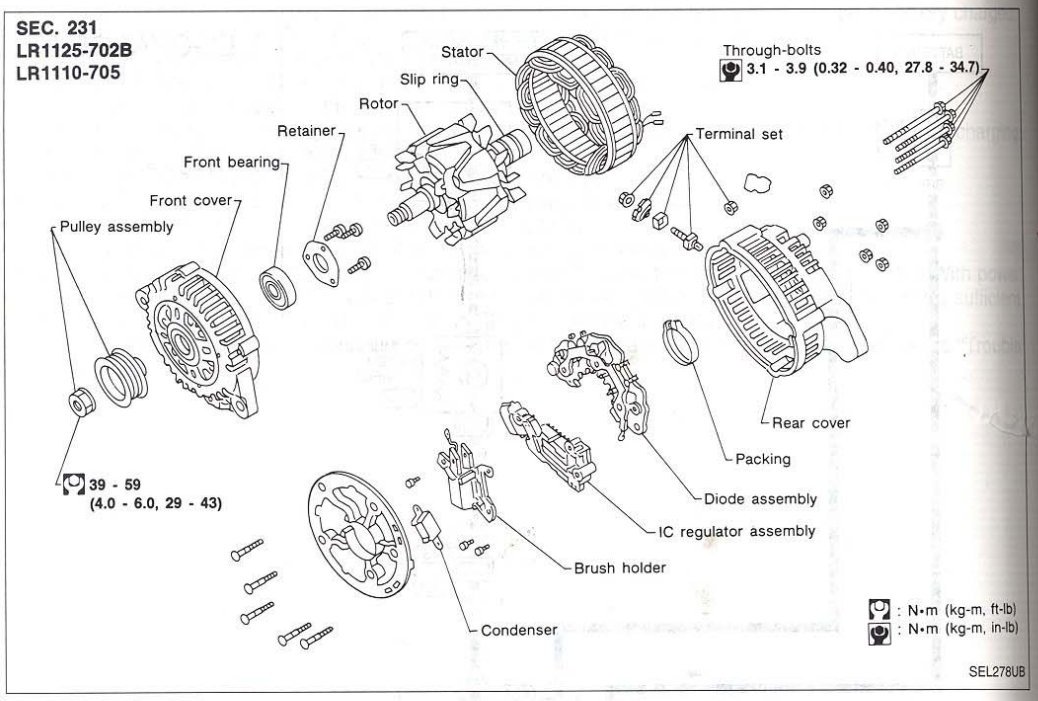
**Tires need to be inflated to normal pressure.**

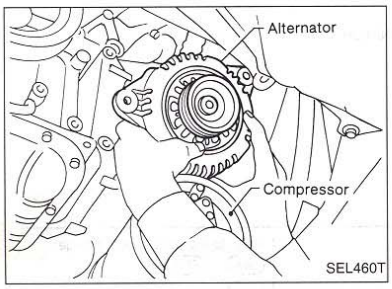
4. Check steering wheel turning force when steering wheel has been turned 360° from the neutral position.
   **Steering wheel turning force:**
   **39 N (4 kg, 9 lb) or less**
5. If steering wheel turning force is out of specification, check rack sliding force.

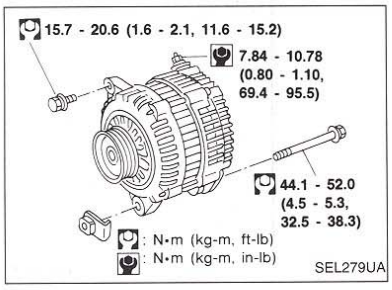
a. Disconnect steering column lower joint and knuckle arms from the gear.
b. Start and run engine at idle to make sure steering fluid has reached normal operating temperature.
c. Pull tie-rod slowly to move it from neutral position to ±11.5 mm (±0.453 in) at speed of 3.5 mm (0.138 in)/s. Check that rack sliding force is within specification.
   **Rack sliding force:**
   **186 - 284 N (19 - 29 kg, 42 - 64 lb)**
d. Check sliding force outside above range.
   **Rack sliding force:**
   **Not more than 294 N (30 kg, 66 lb)**

6. If rack sliding force is not within specification, overhaul steering gear assembly.
7. If rack sliding force is OK, inspect steering column. Refer to ST-11.

## Construction




## Removal and Installation

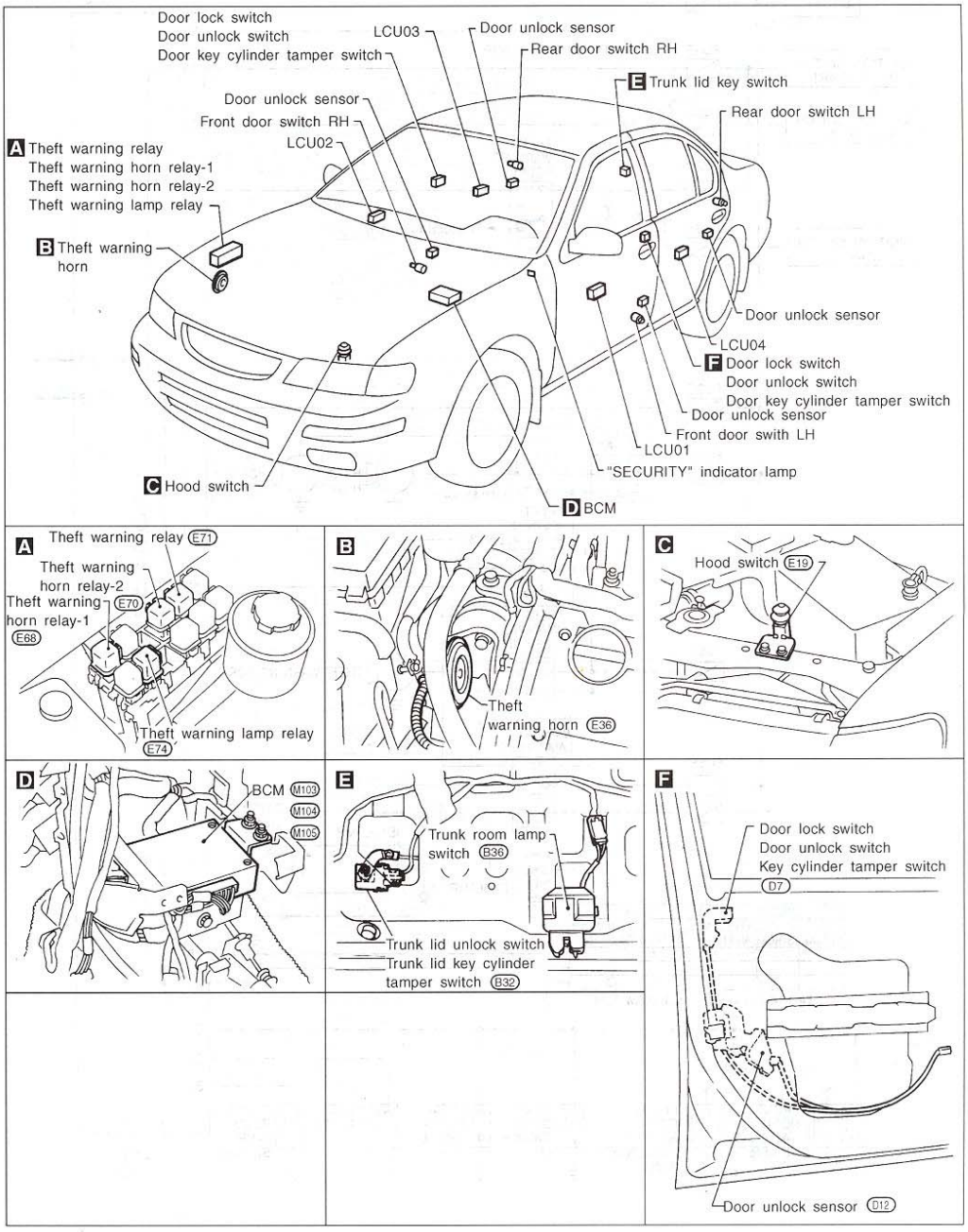
### REMOVAL

1. Remove engine undercover RH.
2. Remove side inspection cover RH.
3. Loosen belt idler pulley.
4. Remove drive belt.
5. Remove A/C compressor mounting bolts (four).
6. Remove cooling fan and fan shroud.
7. Slide A/C compressor forward.
8. Disconnect alternator harness connector.
9. Remove alternator upper bolt and lower bolt.

### INSTALLATION

To install, reverse the removal procedure.

## Component Parts and Harness Connector Location

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Josh Frohman
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