

Last week, I jumped into our 2000 Toyota Tundra pickup truck to go to an appointment, and instead of the usual surefire start, all I heard was a single “chunk” from under the hood. After some troubleshooting steps, I realized that the starter solenoid had gone out, so I thought, “sure...a starter is really easy. Crawl under the truck, a couple of bolts, attach the wire and that’s it.”

Wrong.

The Toyota Tundra, with the 4.7 liter engine, demurely wears its starter buried deep beneath the intake manifold, like some sort of Victorian corset. In other words, the starter is basically *inside* the engine. Normally, I would not write about something as mundane as engine repair on an otherwise light-hearted travel blog, but I realized that there may be others out there with the same problem who could benefit from a how-to from a non-mechanic’s viewpoint. I know enough about engines to know the general theory of how they work, where to pour the oil, etc. Fortunately, I’m also pretty fearless when it comes to general mechanical and structural work. Given the proper instructions and tools, I believe I can tackle almost anything.

Initially, Miss Fish and I decided to save the hassle and have a pro do the work. The dealer wanted almost \$1000 to replace the starter, and the local independent shop quoted \$1500. That shock sealed the deal for us; we opted to do it ourselves. Keep in mind that the last time I went into an engine, it was to adjust the carburetor, replace the points, change a manifold gasket, clean spark plugs, and adjust the timing. In other words, it was a long time ago in a bygone era, back when fuel injectors were some sort of esoteric thing seen only in fancy cars with unpronounceable, Italian names.

Let’s get started.

This how-to is written for the 4.7 liter Toyota engine, also known as the 2UZ-FE engine. If this isn’t the engine in your Toyota, then I assume you’re only reading this for pleasure—in which case, you’re a strange duck and we like the cut of your jib.

Assumptions:

1. You’re not a professional mechanic or someone skilled with auto repair. If you are, then this how-to will only insult your intelligence.
2. However, you need to have some level of familiarity with what’s under the hood. If you don’t even know how to change your oil, then this isn’t the job for you to be doing.
3. You’ve definitively diagnosed (or have had diagnosed) the problem as the starter and/or starter solenoid and **not** a starter relay or a dying battery, or any of the other myriad reasons why a vehicle won’t start.
4. You have a rudimentary knowledge of tool usage. If I say “Torque Wrench,” you should not feel nervous or sweaty.
5. You have no problems saying “I’m stuck” and asking a more-knowledgeable person for help if necessary. If you’re lucky, you have a mechanically-inclined friend who’d be willing to help you out for an afternoon.
6. You’re not a concert soloist or a surgeon. You will get scraped knuckles from this.

7. You understand that this is a record of *my experience only*, and is **not** an official guide. You already know that we're imbeciles under the hood. If you're using my notes as a definitive guide, then you've been warned.
8. By undertaking this project yourself, you run the risk of rendering your vehicle unusable. You run the risk of setting your vehicle on fire. You run the risk of over/under-tightening bolts and breaking very expensive parts. You run the risk of bodily injury to yourself. And, there's a whole universe of other things that can go wrong.
9. At some point, you will be climbing into your engine compartment. *Be careful where you sit, and watch where you set your hands/feet/butt*. It's easy to break something, snap off a connector or sensor, or bend a tube. Get some padding to rest your knees/butt on. The edges get uncomfortable.
10. The same model of engine can have small differences from year to year, so your own situation may vary.
11. Keep in mind that Miss Fish did about 50% of the work on her own, and she has zero mechanical aptitude. It *is* possible to do this job.

### **Before-the-job steps:**

**1. Know what you're getting into** and understand that you'll be spending several hours being intimate with the guts of your truck. Visit the various bulletin board sites for helpful information from people who know what they're doing. The problem is that if you *don't* know what you're doing, like Miss Fish and me, then you'll waste a good deal of time wondering what a "throttle body" is. I found the most helpful information in a long thread on [tundrasolutions.com](http://tundrasolutions.com) and some pictures in another thread at [YotaTech](http://YotaTech). Read through and get a feel for what's involved. The folks at the parts desk at your local dealer also may be a good resource. At least the guys at our local dealer were.

**2. Sign up for a two-day membership (\$15) at [techinfo.toyota.com](http://techinfo.toyota.com)**, also known as "TIS". This will give you access to lots of diagrams, and general steps to disassembly and assembly. Search the library tree for the information on the 2UZ-FE engine. Ignore the other engine model(s). You're looking for information on "Engine" and "Starter." Download, save, and print out the PDF files. I found the component schematics and torque specifications most helpful.

**3. Order your parts.** You'll need to spend a little money to fix your truck. Order your parts from a dealer or a reputable source, and use "Denso"-brand parts. Those are the parts already in your truck.

**Starter:** There are **two** different starters available for your engine, and either one will fit. The "normal" starter is the 1.4 kilowatt model. That's what I had in my truck. There's also a 2.0 kilowatt starter, which is more powerful and beneficial if you live in a cold area. You can either replace the entire starter (\$260) or just attempt a replacement of the solenoid contacts inside the starter (\$20).

I opted to upgrade my whole 1.4 kilowatt starter with the 2.0 kilowatt model. If you decide to only replace the contacts, you'll need to research further information on contact replacement elsewhere, such as [tundrasolutions.com](http://tundrasolutions.com). Keep in mind that replacing the solenoid contacts may

not solve your starter problem if the problem is not the contacts. It would be a major pain in the neck to reassemble your engine only to find that your truck still doesn't start.

**Gaskets:** You have an option here just to reuse the gaskets you already have in the engine or get new ones. I opted for new gaskets. Now that I've been into the engine, I realize that reusing the existing gaskets is a reasonable decision.

**Final shopping list:**

- 2.0 kilowatt Starter (\$260, plus \$30 deposit)
- Intake manifold gaskets x 2 (one for each side) (\$30 each)
- Throttle body gasket (\$27)

If you order parts from your local dealer, have your VIN number ready. They'll know exactly what specific part numbers you'll need based on the VIN. You can locate the VIN number on the inside of the driver's side door pillar.

When you pick up the parts, save your receipt so you can get the \$30 deposit refunded when you return the old starter. Return the old starter inside the same box in which you got the new one.

**4. Tools you'll need** This is a list of every single tool we used. Everything is metric on the Tundra.

- Box wrenches: 8mm, 10mm, 12mm, 14mm, 22mm
- Adjustable wrench
- 3/8" ratchet handle
- Standard-depth sockets: 10mm, 12mm, 14mm
- Deep sockets: 12mm, 14mm
- 3/8" socket extensions: 3", 6", and 12"
- Torque wrench, capable of between 13 ft/lbs and 29 ft/lbs. The folks at the local auto parts store should be able to help you learn how to use one if you don't know how.
- Needle-nosed pliers. Squeezing hose clamps and general holding-on-to-things.
- Large and small flat-blade screwdrivers. We gently—that's *gently*—used these for the connector catches that refused to budge with finger pressure alone.
- #2 Philips-head screwdriver. Used to remove the hose clamps on the air intake.
- A Shop-Vac. You'll use this to suck up crud from around the openings in the cylinder head.
- A bag of rags. You'll need at least 10 or more clean rags to sop up gas from disconnected fuel lines and plugging up the openings in the cylinder head to keep piston-destroying trash out of your engine.
- Very important: a telescoping, magnetic retrieval tool. You will need this. Trust me.
- Flexible, lighted grabber tool. We used this in combo with the magnetic tool to retrieve fallen nuts, bolts, and sockets.
- Small stepladder or a concrete cinderblock on its side. The little extra height makes a world of difference.
- A pair of gloves.
- A couple of small buckets for nuts and bolts.

- Masking tape and a pen. We used this to label hoses and wires.
- A camera to document each step so you can retrace your route if anything goes wrong.

We're ready to begin. For the photos below, you can click on the picture to get a full-sized image. Good mechanical hygiene is important: keep dirt out of hoses and openings, keep the tools organized, keep track of nuts and bolts, and don't gouge up the polished mating surfaces between parts. Take pictures so you can use them as reference if something isn't going back together correctly.

## Steps to replacing the Starter

1. Roll the truck into a place easily reached from all sides, set the parking brake, and put chocks under the wheels.
2. Remove the negative battery terminal and tuck it down and away from the battery. From this point on, electricity is NOT your friend.



3. Remove Throttle Body cover. There are two nuts holding the cover.



4. Remove and label vacuum lines, cable bundle support, and hose bracket from air intake hose. There are four rubber hoses and a cable bundle connected to the rectangular box on the air intake hose, and a hose mount bracket on the front of the air intake hose. For sanity's sake, we placed

the bolts back into the holes once the brackets were removed.



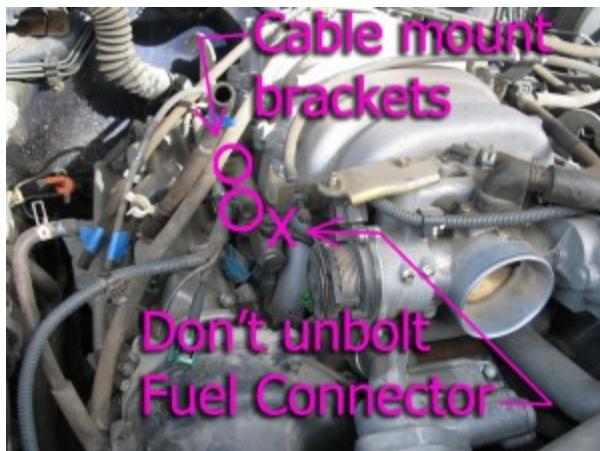
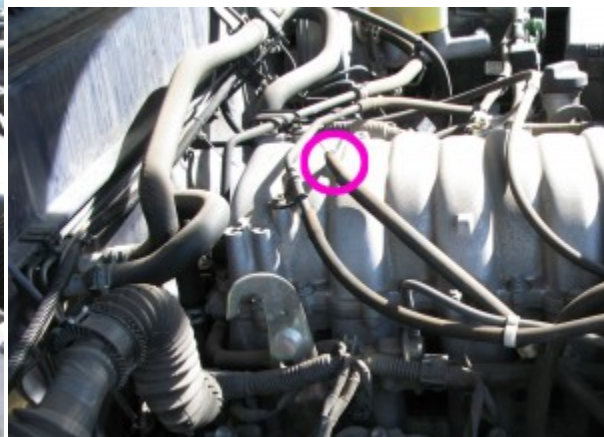
5. Remove air intake hose by loosening the hose clamps at the air intake and the throttle body and wiggling the hose free.

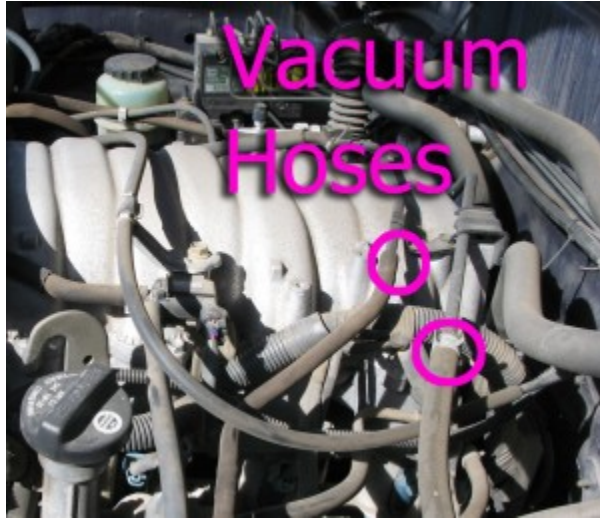


6. Unplug the large connector from the air intake box.



7. Intake Manifold Assembly: Remove and label vacuum lines. Unbolt throttle cable bracket and assorted cable mount brackets. Unplug cable connector from the small black box on the driver's side of the intake manifold. Make sure that you don't mistakenly unbolt the fuel rail connectors.





8. Unplug all fuel injectors. There are four, blue fuel injectors with connectors nestled below the fuel rails on either side of the intake manifold assembly. The fuel rails are pipes with a fine, waffle-print pattern on them. The upper part of the blue fuel injectors plug into the fuel rails, and the lower part of the injectors plug into the intake manifold.

There's a small tab on the underside of the connector. Pinch the tab and the connector between the thumb and fingers and wiggle gently. For us, this was the most difficult part of the entire job, as the connectors were firmly stuck, and some are almost inaccessible beneath the cables and hoses. *Note:* Be gentle when wiggling the connector free—you may wind up breaking an injector o-ring. Injector o-rings are easy enough to replace once you get the intake manifold out, but it means another trip to the parts desk for a new set of o-rings and another twenty bucks. If you see fuel suddenly pooling around the injector, then you will need to replace all the o-rings on that side. I speak from experience.



9. Unbolt the throttle cable from the front bracket. There are two nuts sandwiching the fingers of the bracket. Just loosen the front nut.



10. Unbolt the Throttle Body. Pull it away from the intake manifold and move it to the side. You don't have to drain coolant or remove any hoses. Pull the gasket away from the intake manifold. If you're planning on reusing it, set it aside where you won't damage it.



11. Disconnect fuel return line (if equipped) from the intake manifold assembly. The fuel return line is located at the back of the intake manifold assembly, on the driver's side, below the level of the fuel rail. Wrap a rag around the fuel line joint to absorb any spilled fuel as you disconnect



it.



12. Disconnect fuel line. The connection is located at the back end of the fuel rail on the driver's side. To disconnect the fuel line, use your 22mm wrench to unscrew the "fuel pulsator." It's a top-hat-shaped widget, about 1" diameter, located at the rear of the driver's side fuel rail. It's on there pretty snugly. You don't need to touch the screw on top. Place a rag under it, as it will drip fuel. When you pull out the pulsator, the fuel line and its donut-shaped connector will be free. There are two washers, one above and one below the fuel line connector. **Don't lose these fuel line washers and make sure they go back on in the proper order when you reassemble them.** When reassembling, the washer *without* teeth goes on the bottom, between the fuel rail and the donut-shaped fuel line connector, and the washer *with* teeth goes on top, between the donut-shaped connector and the pulsator.



13. Remove six 12mm bolts and 4 nuts from intake manifold to cylinder head. The nuts are at the corners of the intake manifold, and the bolts are nestled between the fuel injectors. If you find yourself unbolting something above the level of the fuel rail, you're in the wrong place. Have the magnetic grabber handy to fish out the bolts and the nuts as you remove them. A 12mm socket on your long extension fits beautifully between the fuel rail and the intake manifold assembly,

and there's even little notches on the fuel rail to make room.



14. Before removing the intake manifold assembly, check to see if there are any stray cable mounting brackets, vacuum hoses, or support brackets still attached to the intake manifold. Trace the hoses/cables to make sure that they really do interfere with removal. Remove and label as necessary.

15. Carefully lift out intake manifold/injector assembly. This is best done with two people. Guide it around the corners, brackets, etc. Set it down in a clean location. You don't want to get crud in the injector ports on the bottom, and you don't want to scratch or gouge the polished mating surfaces.

16. You are now looking at the starter nestled in the valley of the engine. In our case, a family of mice had made a nest in the head block. Before removing the gaskets, use a shop-vac to clean up any loose dirt/rust/etc. from around the head openings. Remove the gaskets from the head. Stuff rags into the openings to keep foreign bodies out of the cylinders. If you plan on reusing the gaskets, carefully set them aside.

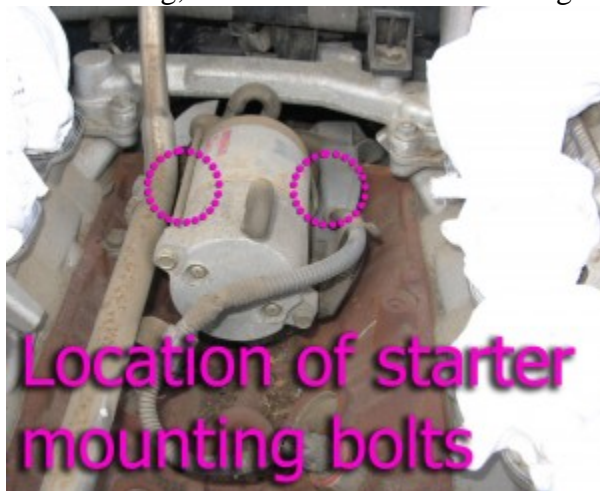


17. Remove 12mm bolt connecting the wire harness to the starter. This bolt is reached from behind the engine. The bolt is hard to get to, as you have to reach your socket wrench between the firewall and the head block. You need to do this by touch, and there is hardly any room to operate the wrench. Again, your magnetic grabber is helpful here to retrieve the bolt as you

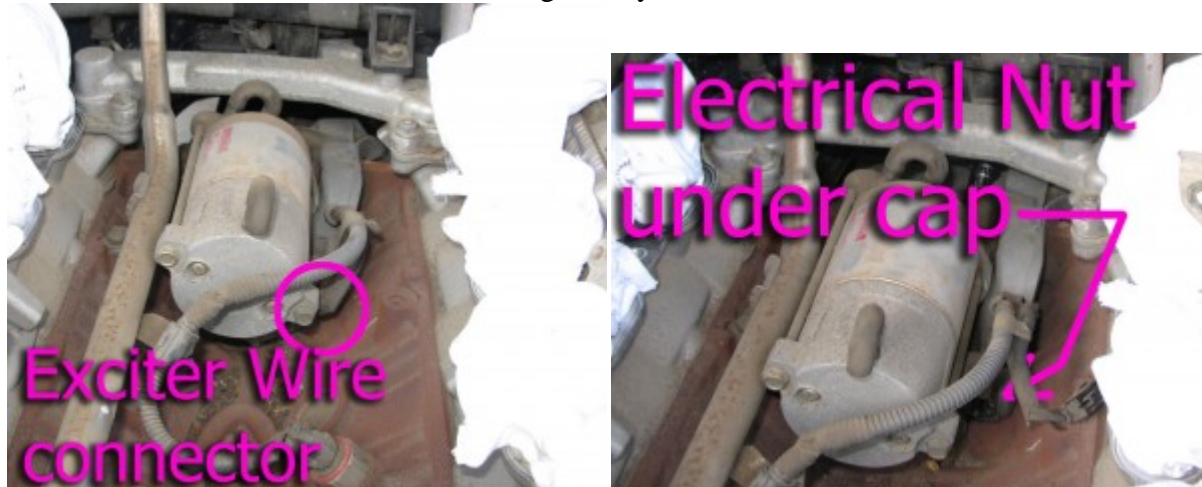
remove it.



18. Remove the two 14mm bolts holding the starter to the block. Again, you reach these bolts from the back. These are even harder to get to than the bolt in step 17. If you need guidance, take a look at the bolt holes on your new starter to guide you. You'll need to experiment with extensions and deep vs. regular sockets to get the best results. At least the heads on these bolts are extra long, which makes them easier to get to.



19. Once you've unbolted the starter, rotate starter counterclockwise a little bit and unplug the exciter wire and remove 12mm nut holding battery wire to starter. The nut is located under a cap.



20. Here's a photo of the new starter in place, showing the electrical connector nut and the socket for the exciter wire.



22. Clean the polished mating surfaces on the head block, the intake manifold assembly, and the throttle body. Don't scratch or gouge. A little gas on a rag should do the trick.

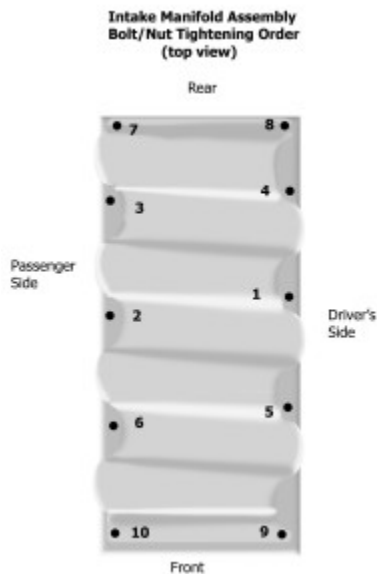
23. It's time to reassemble everything by following the steps in reverse order to install new starter. If you're just replacing the solenoid contacts in your old starter, complete that project and then follow the steps in reverse. Don't break off the little rubber snorkels on the starter; don't worry if they're folded over on the new starter. They'll slowly unfold on their own.

24. When replacing the bolts in the new starter, they should be tightened to a torque setting of **29 foot-pounds**. My torque wrench wouldn't even fit in the tiny space, so I clamped a practice bolt in a shop vise and got the feel of how 29 ft/lbs feels before using the ratchet wrench to tighten the starter bolts.

25. Before replacing the intake manifold assembly, triple-check the head block openings to make sure absolutely nothing fell in there, then install your intake manifold gaskets. Guide the intake

manifold into place and lower it onto the bolts at the corners. Again, another person makes this much easier.

26. When tightening the bolts and nuts on the intake manifold assembly, tighten them to **13 foot-pounds** using the torque wrench. Tighten the bolts and nuts in the following pattern, starting with 1, then 2, etc. Start on the driver's side middle bolt and work in a clockwise circular pattern back and forth across the manifold.



27. After you've bolted the intake manifold assembly into place, finish reassembly by reversing the steps. When bolting the Throttle Body back onto the intake manifold, use your torque wrench to tighten the four nuts and bolts to **13 foot-pounds**.

## Final steps

When you've finished, carefully go through the engine and check for any hoses or connectors you may have missed. Check for stray tools or rags. Look for fuel leaks around the fuel injectors and the fuel line connectors. Remedy any problems that you see before starting the vehicle.

Try starting your truck. If everything went as planned, it should start right up and sound normal. Look under the hood and see if any fuel is leaking from around the fuel connectors or fuel injectors.

## Troubleshooting

**Fuel Injector o-ring replacement:** If you managed to tear a fuel injector o-ring, you'll see fuel leaking from around that location. In most cases, it's the o-ring that seals the bottom of the injector in the intake manifold. You'll need to replace all the bottom o-rings on that side of the intake manifold assembly (or top o-rings, if that's what you broke). To replace the bottom o-rings, order a set of four for each side from the parts desk. While the intake manifold assembly is

still out of the vehicle, unbolt the fuel rail and fuel connectors and carefully lift the rail and injectors away from the intake manifold. The tops of the injectors should still be in the fuel rail. Pull out the old o-rings from the holes in the intake manifold and use a Q-Tip to clean out the holes. Apply a very thin amount of plain vaseline to the new o-rings and place them into the holes in the intake manifold. Carefully lower the fuel rail with its dangling fuel injectors back onto the intake manifold, lining up the bottoms of the injectors so that they slip into the o-rings. Reattach the fuel rail. Use the torque wrench to tighten the fuel connector bolt to **29 foot-pounds**.

**Check Engine Light:** If you notice that the “Check Engine” light comes on, then turn off the motor and get back under the hood. Once again, look for any fuel leaks around injectors, and triple-check all the electrical connectors and all the vacuum hoses.

Reset the “Check Engine” light by holding down the odometer button for about 10 seconds while turning the key to “on,” but don’t start the engine. Or, better yet, follow the steps described in your owner’s manual.

Try starting the truck again. The check engine light should remain off. If it comes back on, and you’re absolutely positive you’ve reconnected everything correctly, then something else is going wrong. Misfire, bad sensor...maybe you stepped on a connector while deep in the engine. You may need to have a mechanic hook up a computer to the diagnostic port and discover what’s causing the light to come on.

If you turn the key and the engine doesn’t start, then you’ll need to go online and research the problem further, as it probably wasn’t the starter at fault to begin with.

**You’re done!**

I hope this has been helpful. If it has, please leave a comment.