Voodoo Engineering's guide to:

# Converting Your Carbureted EA-Series Subaru to Single Point Fuel Injection

Compiled by Kelly Huff

Contents:



Also Provided:

1. Section on SPFI system including detailed troubleshooting procedures from 1989 FSM.
2. Helpful schematics from FSM, Chilton's, and Haynes covering both the SPFI electrical system and those of the cars likely to receive this conversion.

## Why SPFI?

There is a huge variety of options available to provide fuel and ignition control, each with its unique advantages and disadvantages. Most of our older Subarus utilize a Hitachi, or in some cases a Carter/Weber carburetor in conjunction with an electronic distributor with vacuum and mechanical advance. Many people have retrofitted the popular Weber 32/36 DGEV carburetor, which can offer some performance gains, but requires a substantial amount of tuning and adjustment to function properly. As the years went by and more and more electronic controls were added, these relatively simple systems became increasingly complex in order to provide improved emissions, fuel economy, and drivability characteristics. These later systems did provide some improvements, but there is only so much that can be done with electronic control of carburetors. The end result was a system that was extemely complex, both mechanically and electronically, and still was lacking in performance, economy, and drivability in comparison to fully electronic fuel injection systems.

Clearly, there are some improvements that can be made to the engine control systems that our Subarus came  from the factory with, but which avenue do you take? You could go so far as to swapping in a later-model EJ-series engine, complete with multi-point EFI and advanced spark control. Another option is to keep the EA-series engine that's currently in the car but convert to either Subaru multi-point fuel injection or retrofit the Bosch CIS system. And there is always the option of a stand-alone fuel and spark management system. All of these options provide substantial gains in power, drivability. and economy, but require copious amounts of cash and time to implement correctly. So what's a Soob-head to do? Look no farther that the local junkyard, which is most likely filled with 85-94 EA82 cars with single point fuel injection.

The single-point EFI system that was offered with the EA82 cars is truly a beautiful thing. It was light years beyond the carburetors and vacuum-advanced timing that came before it without becoming excessively complex like the MPFI systems that were offered. Furthermore, this system was offered for nine years in the United States, so junkyards are full of SPFI cars that parts can be taken from. The entire conversion can be done for just a few hundred dollars (compared to the Weber carburetor, that amount will be made up in fuel savings in a few short years).

## What cars can this system be installed in?

-Any carbureted EA82 car can be retrofitted to SPFI with no fabrication. All the components will bolt up and the wiring is a cakewalk if the proper manuals are available.
- The system can be installed in EA81 cars with very little modification. The distributor must be modified slightly, and the wiring may be slightly different which could present some minor difficulties but nothing that can't be overcome. (This conversion has been done, just not by me.)
-Installation in EA71 cars has been theorized but not accomplished as of yet. The biggest hurdle for this install is that a custom intake manifold would have to be made, as the EA82 manifold will not bolt up like it does on the EA81.

## SPFI System Layout

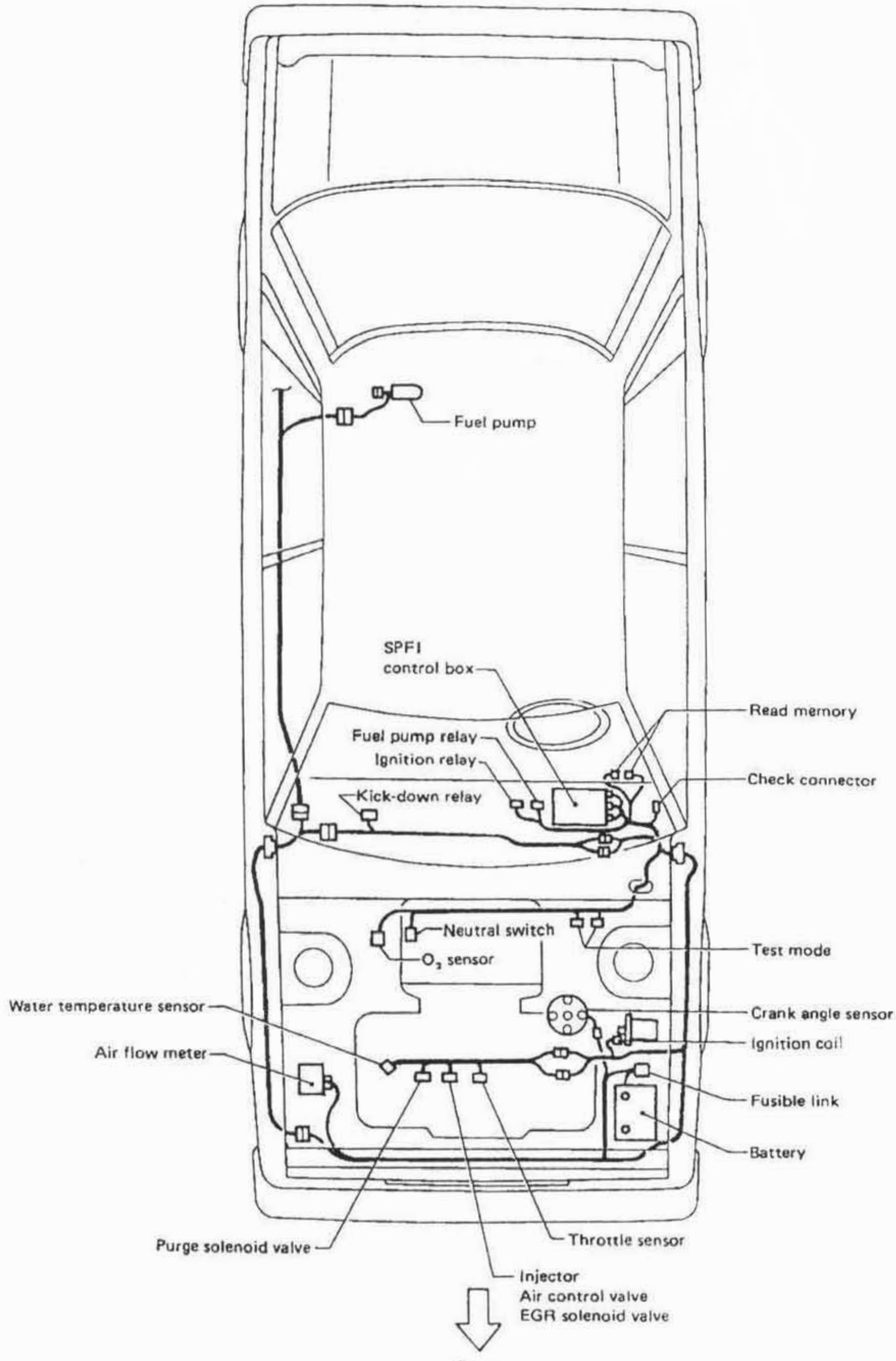


*Fig. 35*

L2-850

# SCHEMATIC DRAWING OF SPFI SYSTEM

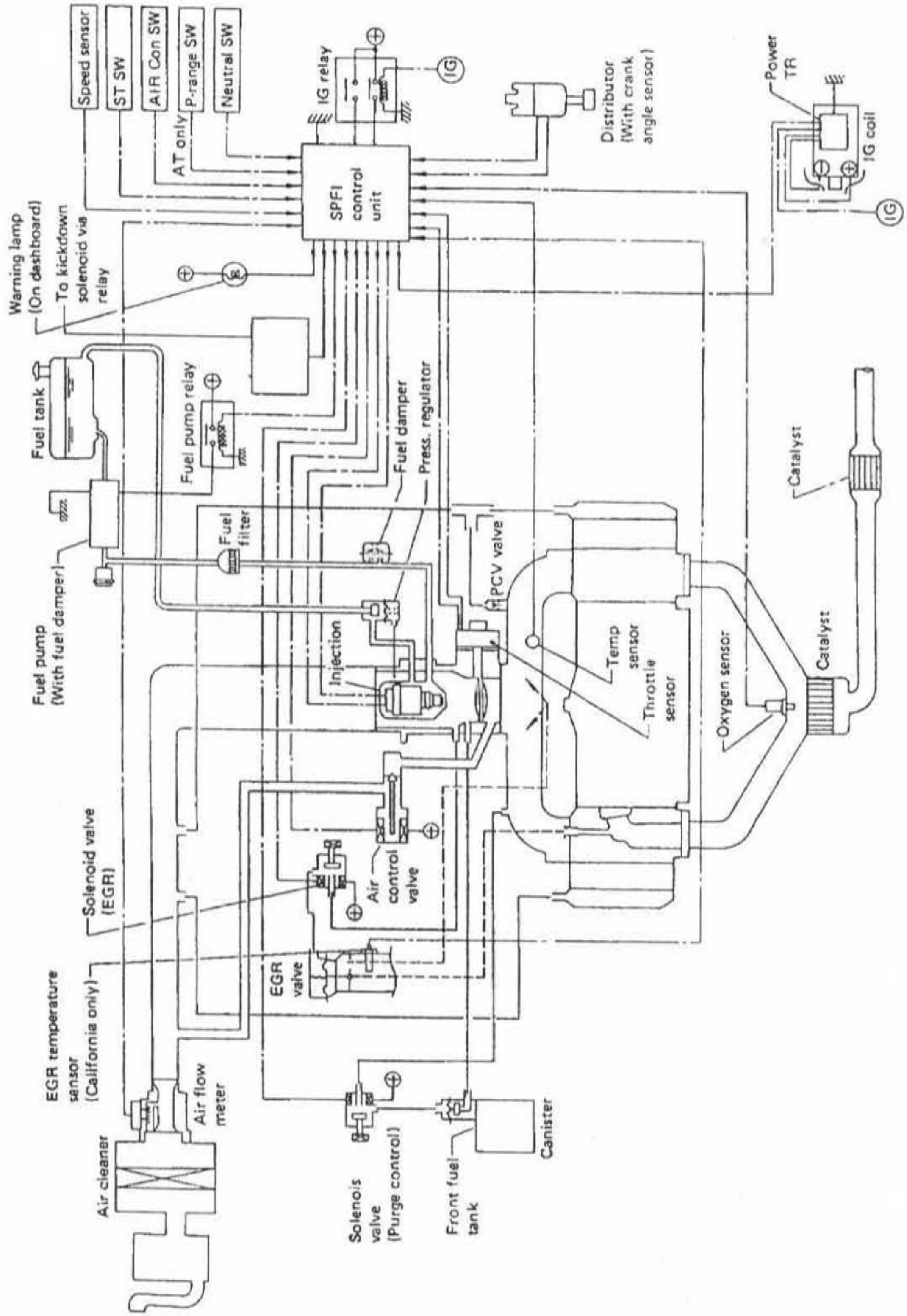


*Fig. 10*

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# Single Point Fuel Injection System

## MECHANISM AND FUNCTION

### General

For conventional carburetors, the SPFI system substitutes a throttle chamber containing one fuel injector. It electronically controls the amount of fuel injection from the fuel injector and supplies the optimum mixture to suit all operating conditions of the engine.

The features of this SPFI system are as follows:

1) The reduction in the number of components results in easy servicing.

2) More precise control of the air-fuel mixture can be achieved by using an increased number of input signals transmitting engine operating conditions to the control unit.

3) The adoption of a hot wire type air flowmeter not only eliminates the need for high-altitude compensation, but also improves driving performance at high altitudes.

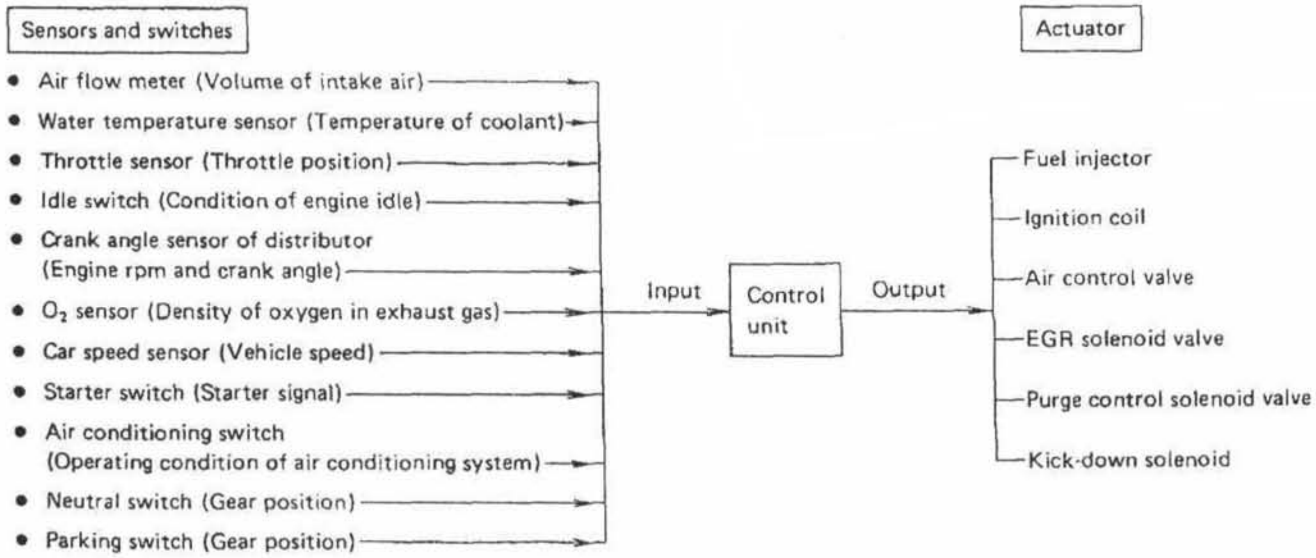
4) The air control valve automatically regulates the idle speed to the set value under various conditions.

5) The ignition timing is electrically controlled, thereby allowing the use of complicated spark advances characteristics.

6) The aging of the air flow meter and fuel injector is automatically corrected so that they maintain their original performance.

7) Trouble diagnosis can easily be accomplished by the built-in self-diagnosis function.

FLOW OF INPUT AND OUTPUT SIGNALS



**What donor car should I use?**

The SPFI system was offered in EA82 cars from 1985-1994. I would not recommend using the 85-86 system for two reasons. First, since this system was only offered for those years, it is likely to be less common in junkyards so parts are going to be more difficult to come by. Some parts may interchange between the earlier and Iater systems, but many do not and I advise against any mixing af parts as that may have negative results on performance and economy. Also, this earlier system utilized a "flapper-door" style airflow sensor, which was quickly eliminated in place of the superior "hot-wire" airflow sensor, which is the szyle that remains today.

There are a couple of other differences between the SPFI systems that were offered. The transmission used in the vehicle necessitated a few changes to the fuel system. Find a donor vehicle with the same type of transmission as the car that the system will be installed in (it is possible to "convert" the ECM by switching some wires around, but why not just find one that's already set up for your car?). California models also are different, in that they utilize an EGR gas temperature sensor to help control emissions better. My recommendation is to avoid this model. If this additional input to the ECM resulted in increased performance and fuel economy, Subaru would have included it in the 49-state models as well. It is also another thing that can go wrong. Finally, models with automatic shoulder belts had an additional ECM connection. This shouldn't be a big deal to sort out, but like the other variations, if youl can locate a donor car that doesn't have this option, the conversion will be that much simpler.

If you are looking for a donor car in a junkyard, try to locate one with obvious severe body damage. Since the car ran well enough to get into a collision, all the of the parts that you need should be in good condition.

**What parts do I need?**

From the donor car:
-ECM.
-Complete wiring harness from dash forward (Trust me, it's worth the time to just get the whole thing.).
-Ignition and fuel pump relays. These are attached to the steering colurnn and connect to the wiring harness with large connectors which are brown and blue respectively.
-Intake manifold with all attached pieces (EGR pipe that connects to the passenger side cylinder head included).
-Air filter housing, mass airflow sensor, and all intake ducting including the PCV system.
-Coil bracket assembly (bracket, coil, and all attached bits).
-Distributor.
-Y-pipe with oxygen sensor mounting hole (if your existing Y-pipe doesn't have one). This piece doesn't have to come from the SPFI donor car. Anything that bolts up will work fine.
-Fuel pump and mounting bracket.

**New parts:**
-Oxygen sensor (The one in the donor car is likely quite old and it response time, which is critical to its effectiveness, is slowing down.)
-Intake manifold gaskets
-Exhaust gaskets (If you are removing the Y-pipe)
-Distributor cap and rotor (Like the oxygen sensor, these are most likely old and worn out.)
-Fuel filter
-Several feet of fuel line of the same size as that used on the donor car
-Clamps for that fuel line
-You may need some brass adapters to go from the existing fuel lines to the larger line on the inlet side of the fuel pump, and to step the size down from the fuel pressure regulator to the fuel return line. The sizes may vary from vehicle to vehicle, so you'll have to check.
-Get a roll or two of 14ga wire, a couple packs of butt connectors, and three fuse holders with 20 amp fuses. Some other miscellaneous electrical connectors may be required, so it's a good idea to pick up one of those "electrical kits" that have a few of everything.

**Important note:** It is highly recommended that you purchase the new parts from Subaru of America whenever possible (of course you can get the fuel line, clamps, wires, etc from your local supplier). This is especially imperative for the gaskets and oxygen sensor. Aftermarket parts are NOT the same in some cases, and this is one example. I have had particularly bad luck with aftermarket exhaust gaskets and I have heard similar stories about the intake manifold gaskets.

**Do I need any special tools?**

Basic hand tools are all that is REQUIRED for the conversion. A good set of electrical pliers that can cut, strip, and crimp are a necessity. Although you can get by without it, you really should use a torque wrench on the intake manifold bolts as this is a critical mating point on the engine (do you really want to risk dealing with coolant getting sucked into the cylinders?). Also, as with any electrical project, a good-quality digital volt/ohm meter (DVOM) can be a lifesaver. You probably won't need it if everything goes perfectly, but when was the last time that happened? Besides, if you don't have one and aren't familiar with their use, a DVOM is a really cool thing to have that is extremely helpful with a wide variety of things and is relatively easy to learn to use.

Before we get to work, I've included some relevant sections from Larry Owens' Book, How to Keep Your Subaru Alive, which deal with some basic concepts that one should understand before tackling any electrical project. If you have much electrical experience at all, you can skip over this.

## WHAT ARE THE NECESSARY ELEMENTS IN AN ELECTRICAL CIRCUIT?

Four elements are necessary for an **electrical circuit** to work: (1) a source of juice like a **charged battery**; (2) a **"hot" wire** to carry juice from the **positive battery post** to the component; (3) a **component**—such as a light bulb or horn—in the circle that resists (slows) the flow of juice; and (4) a **"ground" wire** to carry juice from the component back to the **negative battery post** to complete the circuit. Why do you need the resisting component? Without the resistance to the flow of juice, it would flow too fast and overheat the battery and wires in the circuit.

Now let's add a **switch** to break the flow of juice in the circuit when we want to turn the component off (in other words, break the circle). And let's add a **fuse** to protect the wires, components, and battery in case of a problem (such as a **"short,"** which happens when the resistance is bypassed, or an **overloaded circuit**). Now we have a complete circuit, just like all the ones in your Soob.

What follows is an explanation of the two most common electrical problems—"shorts" and overloaded circuits.

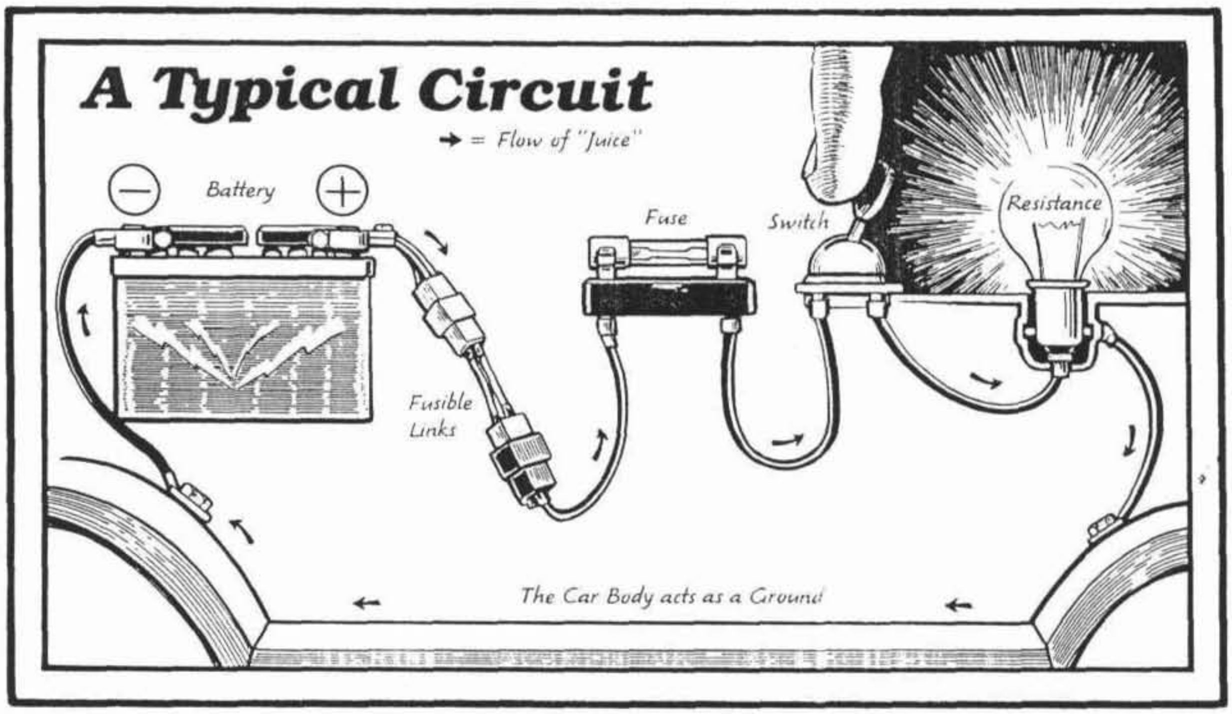
## SHORTS (SHORTCUTS) AND OVERLOADED CIRCUITS

If the juice takes a shortcut from the positive battery post back to the negative post without going through a component to slow it, it's called a "short." Shorts cause the battery and wires to overheat, melt, and maybe start a fire. The battery might even explode. Nasty.

Circuits can occasionally be overloaded by turning on too many components at the same time. The wires are designed to handle the load, but once in a while there's just too much going on. Again, the wires may overheat or damage may be done to the battery.

## FUSES AND FUSIBLE LINKS

To protect the wires, components, and battery when a short or overload condition occurs, **fuses** and **fusible**



**links** on '78 and newer models are installed in each circuit, with one exception—the cranking circuit. Fuses and fusible links are made of lighter, more fragile material than the wires and components in the circle. They're designed to melt and break if more juice is flowing through the circuit than the wires or components can handle.

## A TYPICAL CIRCUIT (CIRCLE)

Let's follow the juice all the way around a circuit (circle) to see how it works. We'll take a taillight for example and start and end the circle at the battery. (Turn the **headlight switch** ON to complete the circle and start the juice flowing.) Starting at the positive (+) battery post, juice flows through a wire to the **fuse box** (on '75-'77 models) or to **fusible links** and then to the fuse box (on '78 and newer models). From the fuse box, the juice goes through a wire to the light switch. For convenience, the taillight switch, parking light switch, and headlight switch are all incorporated into the **headlight switch** so they all go on by pulling or turning just one knob instead of three. Switches simply cause an open place in the circle when you want to turn the component off.

From the light switch, the juice goes through a wire to a **bulb** on the rear of the car. The wire passes the juice to the bulb through a **contact** (metal point) on the bottom of the bulb. Inside the bulb, the juice flows through a tiny wire called a **filament**, which you can see inside the glass globe of the bulb. Since the filament is a smaller wire, it resists the flow of juice. This *resistance* makes the filament get so hot it glows brightly, creating light. After squeezing through the filament, the juice moves on to the large metal part of the **bulb base**, which passes the juice to the metal **bulb socket**.

Now, here's a nifty part. The juice still has to get back to the battery to complete the circle, but instead of using another wire to carry the juice back to the battery, the car body is used to do it. This is called a **"ground,"** and all circuits work this way on their return run to the battery. In the case of our light circuit, here's how: the bulb socket either touches the body itself or is connected to it with a wire. The juice flows through the metal body, finally meeting the point where the negative battery cable is attached to the body (and/or engine). It flows through the cable to the negative battery post and thereby completes the circuit (circle).

With all that electricity in the body, how come you don't get zapped when you touch the car? Because the voltage is so low (12 volts) and it's in the form of **direct current (DC)**, you can touch both posts of the battery at the same time and not even feel the full 12 volts of DC current coursing through your body. The coil and spark plug wires however should be left alone when the engine is running because the ignition coil hops the 12 volts up to about 30,000 volts!

## ELECTRICAL SYSTEMS IN YOUR SOOB

Your Soob has four separate electrical systems with four distinct jobs: the **charging system**, the **ignition system**, the **cranking system**, and the **accessory** (everything else) **system**. The four systems have one important common component: the *battery*. They also share the battery cables and the "ground" (body), so they are interrelated. Let's take it from the top and go through them one by one.

## CHARGING SYSTEM

Main parts of the charging system are the **battery**, the **alternator**, the **voltage regulator**, and the wires that connect them.

You know the battery, the big box with two posts sticking out of the top and plastic **filler caps** on top so you can add water (except on maintenance-free batteries). The battery *stores* electricity so you can start the engine, play the radio or tape deck while parked in Lover's Lane, and operate any of the other electrical gizmos even if the engine isn't running.

**PROCEDURE 5: HOW TO DIAGNOSE NON-ENGINE ELECTRICAL PROBLEMS**

This deals with electrical failures or gremlins not related to the way the engine starts or runs. If the engine has cranking or charging problems, go to Procedure 6 or Procedure 9 later in this chapter.

**Condition:** An electrical component isn't working; OR the battery loses its charge; OR a fuse keeps blowing (breaking); OR anything amiss that seems like it may have an electrical source.

**Tools and Materials:** A 12-volt test light or Volt/Ohm meter (VOM), maybe new fuses, light bulbs, or whatever component you're checking, maybe a 10mm or 12mm wrench to disconnect the negative battery terminal. Also: sandpaper or knife for cleaning contacts, a piece of wire about 12" long for testing "ground," some extra fuses to help locate shorts, electrical tape for patching shorts.

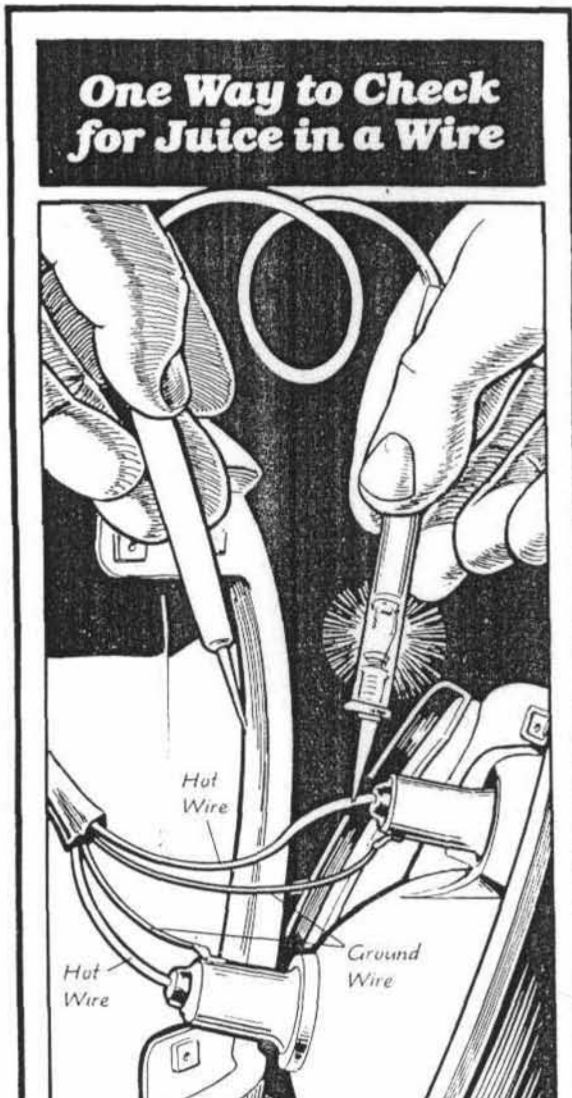
**Remarks:** Most problems with the electrical system are due to a blown fuse, a poor wire connection, or a worn-out component (bulbs, etc.). Very seldom is a broken wire the problem.

If you've never used a Volt/Ohm meter (VOM), or need a refresher course, see Procedure 11.

**Step 1. Check Fuses.**

Start by locating the fuse box and the fuse for the component that isn't working (see Procedure 2). Replace the fuse for that component with a new fuse, then try the component to see if it works. Don't forget to turn the ignition key to ON if the component is switched by the ignition system. If the fuse blows within a few seconds after installation, see Step 3.

Is yours a headlight problems? Some models have three fuses that affect the headlights: One fuse for the high beams or right headlights, a separate fuse for the low beams or left headlights, and a master fuse that controls all the headlights and a few other lights. Check all three fuses if you have them (Step 3).




**Step 2. Check for Juice and Ground at Component.**

All electrical components receive their supply of electrical energy from the *positive* (+) terminal of the battery. The electrical energy (juice) arrives at the component through an insulated wire, passes through the component to make it light, beep, pump, or whatever it was designed to do, then returns to the negative terminal of the battery through the car body and frame (the "ground"). This circuit must be completed for electrical things to work. Here's how to see if there's juice getting to the component through a wire, and if there's a good ground connection so the juice can get back to the battery.

**Light bulbs:** Remove the lens and bulb (Procedure 4), then come back here to check for juice and ground connection.

The juice for light bulbs gets to the filament inside the bulb through small brass or aluminum contact(s) inside the bulb socket that touch a metal contact (or contacts) on the bottom of the bulb. The contacts inside the socket and on the bottom of the bulb have to be clean and free of crud and corrosion for the bulb to work properly. Be sure the ignition key and light switch are OFF, then use sandpaper, a knife, or a small screwdriver to clean the contact points in the bulb socket and on the end of the bulb then try the bulb again. On small round bulb setups, also clean up the metal walls of the socket and sides of the bulb holder. If the light still doesn't work, see if there's juice to the contact(s) in the socket and if the socket is grounded. (See Check for Juice and Check for Ground, just ahead.)

On some lights, the bulb socket and/or its mounting screw(s) touch the car body and act as the ground to return the juice to the battery. Other light sockets have a wire (usually black) that runs from the socket to a part of the body to provide the ground. Check to see that the wire is firmly attached at both ends.

**Other components:** There's usually a wire connection on or near the electrical component (windshield washer motor, windshield wiper motor, fuel pump, etc.) that supplies the current to make the thing work. To complete the circuit there's either a wire connecting the component to the body, or the component itself is mounted to the body, which provides the ground directly. Get out your test light or VOM.

**Check for juice:** Turn the ignition switch and the component's switch ON. If you have a VOM, set it to 15 DC volts. Disconnect the wire that supplies current to the component. Touch one probe of the test light or the red (+) probe of the VOM to the wire and touch the other probe to bare metal. Test both contacts if there are two. If none of the wires to the component lights the test light, or moves the VOM needle, there's no juice getting to the component. If the fuses are good, the problem is probably in the switch. The switches are usually complicated and difficult to get to, so I suggest you take the car to Subaru or a garage and have them check the switch.

If more than one wire goes to the component and one of the wires has juice but the other one is black and doesn't have juice, check the black wire to see if it's a ground wire. Its other end will attach to bare body metal somewhere. Here's more about grounding.

**Check for ground:** If there's juice to the component but it still won't work, maybe the component isn't grounded properly. Again, first turn the ignition and the component switch ON. You'll need a VOM or a piece of wire to test the ground. Set the VOM to RX 10, then touch one probe to the component's metal body or to the black ground wire that didn't have juice in it. Touch the other probe to bare metal. The needle should swing over to 0 ohms if the component is properly grounded. No VOM? Install the bulb if it's a light you're checking. Check again that the component is switched on. Touch one end of a piece of wire to the metal part of the bulb socket, or to the metal body of whatever thing you're checking. Touch the other end of the wire to bare metal. If the bulb lights up or the component works, the thing itself is good but it isn't properly grounded.

If that's the case, turn off the switch and remove the mounting nuts, bolts, or screws that attach it to the car body, or follow the black wire from the component to where it attaches to the body and detach it. Use sandpaper or a wire brush to clean the place where the screw, nut, bolt, wire, and/or socket touches the body. Make it shiny. Now attach the light socket or component to the body, turn on the switch, and see if the problem is solved.

If the component is getting juice and is grounded properly but still doesn't work, the component is probably bad. Replace it with a new one.

If the component isn't getting juice or you can't get it grounded, you'll have to seek professional help.

**Step 3. Checking for Shorts.**

A short means the juice is taking a short cut back to the battery before going through the component. How? A break in the insulation (the wire's plastic sheath) allows the wire to contact the body or frame of the car and this completes the circuit. Without the resistance in the component to slow the flow of juice, the juice flows so fast it overheats the wires and blows the fuse for the circuit. If new fuses blow within a few seconds after you install them, you have a major short for sure. A minor short can slowly drain the battery over a period of a few days without blowing the fuse.

**Check for a minor short:** Put your safety glasses on, then disconnect the negative (-) terminal of the battery (Procedure 1, Step 3). Turn the ignition switch and all electrical components OFF, then gently touch the negative battery clamp to the negative battery post while watching for a small spark. If you see a spark, you have a short in some circuit somewhere. Now to find the short. Go to the fuse box (see Procedure 2, Step 1, to locate it) and pull out one of the fuses, then try the ground-clamp-to-negative-post-test again. Still sparks? Put the fuse back in and try another fuse. Try each fuse like that until you find the circuit that *doesn't* cause a spark when the fuse is removed. The short is in that circuit. Put the fuse back in, then read the next section.

**Identify faulty component:** If you have a major short, the fuse will blow immediately or very soon after the faulty component is turned on. It might take several ones to locate the problem so be sure you have several new fuses handy. Disconnect the components on the problem circuit one at a time. Then do the spark check (for minor short) or install a new fuse (for major short). Keep disconnecting components, then testing one at a time. When you find the component that doesn't cause a spark or blow a fuse when it's disconnected, you'll know the short is in that component or the wiring to that component. Note the color of the wire(s) to the component, then follow that wire until it disappears into a large bundle of wires taped or wrapped together (the **wire harness**). If you find a bare place in the wire, tape it with plastic tape. Look for a wire running from the fuse box

**PROCEDURE 11: HOW TO USE A VOLT/OHM METER (VOM)**

Small Volt/Ohm meters are readily available, and relatively inexpensive, at your local electronics store. (Is there a town in the world that doesn't have a dear old Radio Shack?) You don't need a big fancy one to check out your Soob. Just be sure it will measure at least 15 volts DC and has an OHM scale.

**Condition:** You need to check the voltage of the battery; OR you're checking the charging system; OR you're checking for juice at the fuse box or one of the electrical components; OR you're checking a fuse or wire to see if juice can go from one end to the other (continuity check).

**Tools and Materials:** A Volt/Ohm meter (also called a VOM).

**Remark:** The VOM you have may look different from the one illustrated, and use slightly different names or symbols for the various scales, but they all measure the same electrical phenomena: AC and/or DC *volts*, and resistance in *ohms*.

A good VOM will test a number of things, but I'm going to limit the explanation to things that are applicable to your Soob: *Volts, Continuity*, and *Resistance*. **Caution:** The VOM is a very sensitive instrument and you should just touch the probes lightly to whatever you're testing, so you can quickly see if you have the dial set at the wrong scale (the needle will jump all the way across). Setting the VOM to the wrong scale can burn it out. Never test for continuity or resistance on anything that's plugged in to a battery or wall outlet. If you're testing voltage and have the VOM set to DC volts and the needle takes a dive to below zero, you have the *wrong polarity* so switch the probes around . . . that is, put one where the other was. Don't try to check the voltage of the large spark plug or coil wires with a VOM: you might fry the meter.

### Step 1. Set Up Volt/Ohm Meter

Most Volt/Ohm meters require one or two small flashlight batteries. Be sure yours has good batteries before using it to do tests on your Soob.

Untangle the two wires for the VOM. You'll notice that the plastic insulator on one end of each wire is longer than the one on the other end. The longer insulator end is called a **probe** and the shorter insulator end is called a **jack**. Plug the jack for the red wire into the positive (+) **V-Ω-A hole** on the meter. Now plug the jack for the black wire into the negative (-) **COM hole** on the meter.

### Step 2. How to Measure Voltage

Set up your VOM according to Step 1. Since your Soob has a 12-volt DC electrical system, set the selector knob on the VOM to the next higher DC volt setting above 12 volts (probably 15 volts DC). (Your VOM might say DC V, Volts DC, etc.) Now to find the proper scale on the meter for your setting. Look at the column of numbers under the DC on the right side of the meter. Find the number that corresponds to your selector knob setting (probably 15). The numbers to the left of that number on the same row are the ones you use to read the voltage of the component being checked. Look at the illustration of my VOM on page 171 (if you don't have one handy) so you'll know what I'm talking about. In the illustration, the selector knob is set at 15 DC V (volts) and the needle is showing 12 volts (two lines to the right of the 10).

To check the voltage in the battery, touch the *black* probe to the *negative* (-) battery terminal and the *red* probe to the *positive* (+) battery terminal. If the battery has any juice in it, the needle on the meter will move to the right telling you how many volts the battery is putting out. If it's less than 12 volts, the battery needs a charge. Doing this test with the engine running should give you a higher reading, like about 13.5 to 14.5 volts, if the alternator and voltage regulator are working properly. If your readings are different, see Procedure 6.

To see if there's juice in any wire on your car (except spark plug and coil wires), turn the ignition switch and the switch for the component being tested ON. Touch the red probe to the metal on the end of the wire and the black probe to bare metal on the car body or engine. The VOM should show 12 volts. If it doesn't, the wire or component isn't getting any juice or is shorted out, or there may be a loose connection.

### Step 3. How to Check for Continuity.

**CAUTION:** This is not a test to see if the battery or a component is getting juice. Turn the switch to whatever you're testing OFF or disconnect the negative (-) battery cable clamp to be sure it's not getting juice. Use this test to see if juice is *capable* of flowing through a wire, fuse or ground connection.

Set up your VOM as described in Step 1. Turn the selector knob to the RX10, RX100, or RX1K position in the OHMS section. To adjust the VOM, touch the metal ends of the two probes together. The needle should swing toward the zero (0) on the right side of the OHMS scale on the meter. If the needle doesn't point to the 0, turn the *Ohms adjust knob* until the needle points to the 0.

Now you can test wires, fuses, paper clips, your body, etc., to see if electricity can flow from one probe, through whatever you're testing, to the other probe. To check continuity in a fuse, you must remove it from its receptacle. Touch a probe to each end of the fuse. If the needle swings to zero, the fuse is OK; if it stays at *infinity*

(∞), the fuse is blown. Use the VOM in the same way to test for continuity through any wire or component, touching the probes to the opposite ends of the electrical connector (juice path) you want to test.

Let's play with the VOM for a while. With the selector knob set at the RX1K position, touch the two probes together. The needle goes to 0 so there's no resistance to the flow of electricity and you have continuity. Check a paper clip, belt buckle, or anything metal that isn't connected to a source of electricity. If the needle goes to the 0 on the OHMS scale, you have continuity. If the needle doesn't move, there is no continuity or you're testing something that's nonconductive (incapable of carrying electricity). If the needle moves part way toward the 0 and stops, electricity is capable of flowing through the object, but there's a resistance to the flow (see Step 4).

**Step 4. Test for Resistance**

Some wires and electrical gizmos on your Soob are designed to have a certain amount of resistance to the flow of electricity. For instance, the coil and spark plug wires on most Soobs have a built in resistance factor to help eliminate electrical static on the radio. The wires work fine as long as the resistance is within a prescribed range, but when the resistance becomes greater than it's supposed to be, the current flowing through the wires to the coil or spark plug(s) will be insufficient to "fire" the plug efficiently.

If you're handy with a VOM and have the Subaru workshop manual for your model, you can check the resistance of almost every wire and electrical component on the car, then compare your meter readings to the specifications in the manual. Space just doesn't allow me to include all the specifications for all the years and models. Anyway, here's how you use a VOM to check wires for resistance: Set up the VOM as described in Step 1. Now set the selector knob at RX1K. The R stands for resistance (to the flow of electricity), the X means times (as in multiplication), and the 1K stands for 1000. Touch the probes to the palm of your hand about 1" apart. Don't worry, you won't get zapped. If you have a sweaty palm, the needle will move just a little. A dry palm probably won't move the needle. Now lift off the probes, lick your palm and try again. The needle will probably move to about 200 on the OHMS scale. Multiple 200 times 1000(1K) and you get 200,000 ohms resistance in 1" of wet palm skin. If the probes are clean and you haven't used them on a battery, touch the probes to your tongue and see what the resistance is. There's probably less resistance on your tongue than your sweaty palm because more moisture is present (water is a good conductor).

I'm trying to figure out a way to use a VOM to measure the resistance of my kid to taking out the trash and making his bed. If anyone knows how to do this, please write me.

**Retrofitting mechanical parts**

The preferred method for going about this conversion is to swap all of the mechanical pieces of the SPFI system onto the vehicle, then take care of all the wiring. At least for me, it's easier to keep track of everything this way.

**1**. Intake Manifold:

In order to swap out the intake manifold, the coolant should first be drained from the engine and radiator, so that it doesn't run into the cylinders when the manifold is removed. Remove the block drain plugs from each cylinder head and allow the coolant to drain into a suitable container. This is also a good time to replace the radiator hoses if they are getting old. While you're waiting for the coolant to escape from the engine, spray all six intake manifold bolts liberally with a good quality penetrating oil. These are notorious for getting corroded and rusted and generally nasty, which often results in them seizing and breaking off during removal. If these bolts are dealt with carefully, there shouldn't be any trouble, and even if they do break off think of it as an excuse to use your tap-and-die set.

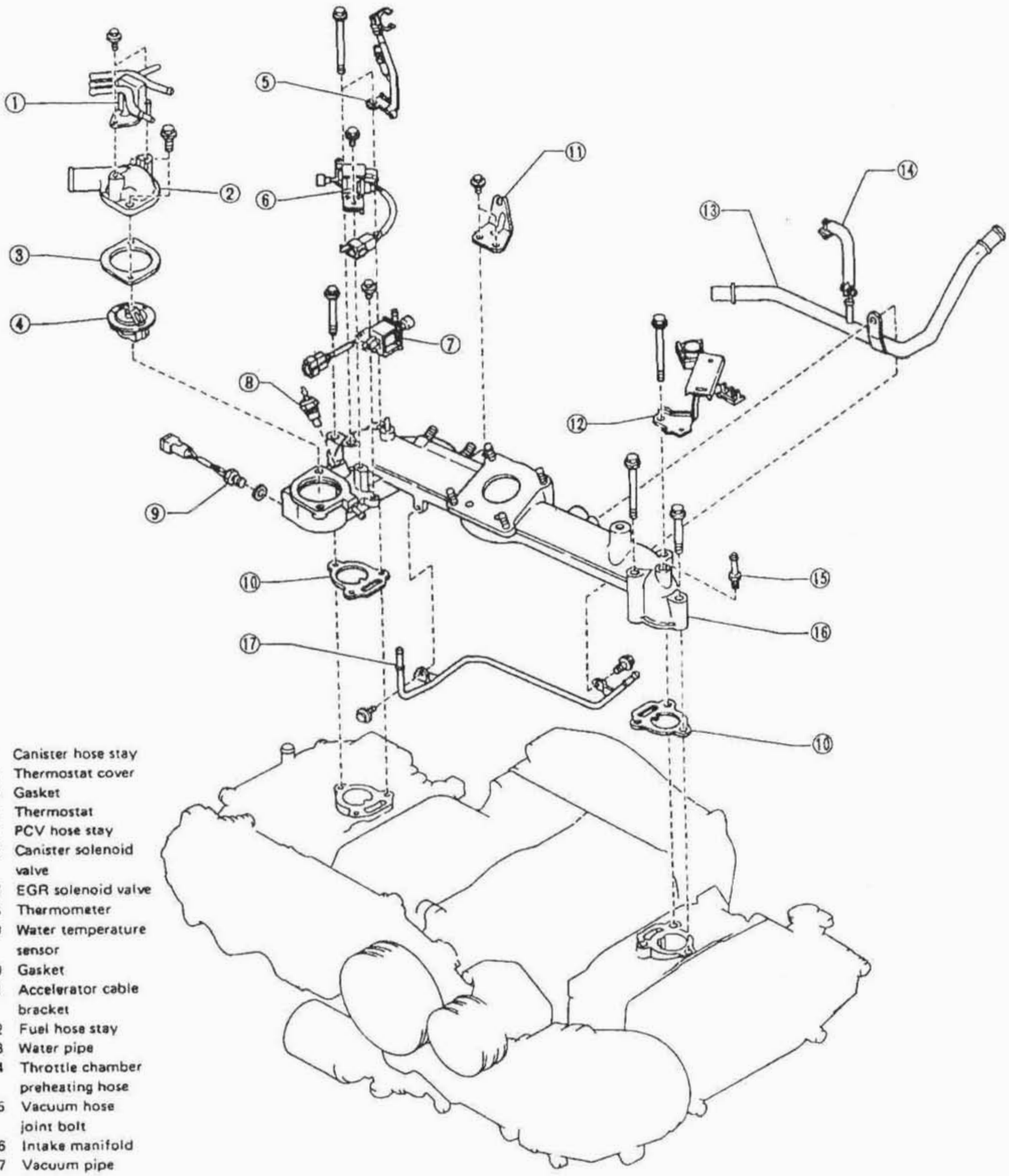
Now go ahead and disconnect any electrical and vacuum connections that must be removed. Keep track of what you do with the brake booster vacuum source (the big hose going to the manifold on the driver side) and the vacuum source for the heater controls (the smaller hose that runs from the firewall to the manifold on the passenger's side. Also remove the upper radiator hose and the small coolant hose that goes from the manifold to the top of the engine. The rubber fuel supply and return hoses should be replaced with new hose, as the old ones may have deteriorated enough to have problems with the greatly increased fuel pressure they will soon be subject to. If your car is equipped with an anti-backfire valve you can remove it. This is a piece mounted to the passenger's side fender with a large hose running to the EGR valve as well as a small vacuum hose running to the intake manifold. The air suction system MUST be either removed or disabled, as extra air in the exhaust will give the oxygen sensor false readings. I plugged mine with two large bolts but wiIl probabIy remove everything sometime soon to reduce clutter.

Carefully break loose the intake manifold bolts and remove them. After disconnecting the EGR pipe that runs from the manifold to the passenger's side head, you may now take the intake manifold and carburetor off of the engine.

After removing the old manifold and sacrificing it to the Internal Combustion Gods, thoroughly clean the head to manifold mating surfaces on both the heads and the SPFI intake manifold. I generally use a gasket scraper followed by a yellow Roloc disc chucked into a high-speed electric drill (you can get these at most parts stores). Small brushes with plastic or brass bristles are also good to remove the old gasket residue. Now set the new genuine Subam of America intake manifold gaskets onto the mating surfaces. Absolutely no sealant or gasket maker should be used as they are meant to be installed dry. PIace the new intake manifold onto the engine and bolt it down. The bolts should be torqued to 12-15 Ib-ft.

You can now reconnect the coolant hoses and vacuum lines, as well as the EGR pipe. The vacuum hoses that connect to the charcoal canister can be connected as usual, but the hose that used to vent the carburetor's float bowl is no longer needed. This can be plugged as you see fit (I used a bolt).

# Intake Manifold



1 Canister hose stay
2 Thermostat cover
3 Gasket
4 Thermostat
5 PCV hose stay
6 Canister solenoid valve
7 EGR solenoid valve
8 Thermometer
9 Water temperature sensor
10 Gasket
11 Accelerator cable bracket
12 Fuel hose stay
13 Water pipe
14 Throttle chamber preheating hose
15 Vacuum hose joint bolt
16 Intake manifold
17 Vacuum pipe

*Fig. 12*

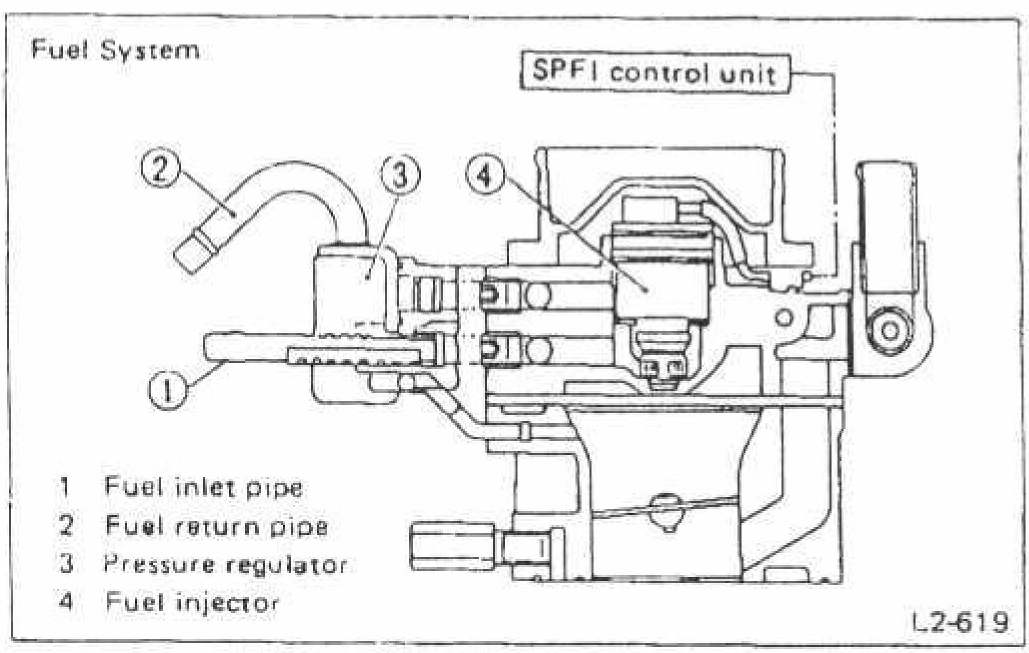
L2-623

**2. Fuel Suppy:**

The factory fuel pump on carbureted models produces around 3 psi. This fuel injection system requires more than 10 times that amount, so the fuel pump must be swapped out as well. This is pretty simple. Dive under the back of the car and pinch off the hose running from the fuel tank to the pump using a set of vice grips so that fuel does not run out. You may now unplug the pumps electrical connector, disconnect the fuel hoses, and remove the fuel pump and its mounting plate. Remove the rubber fuel hoses located downstream of the pump, as these should be replaced at this time. Also thoroughly inspect the steel hard lines. as they have a tendency to rust out on these cars. If these are in poor condition, new lines must be fabricated (copper tube is a suitable replacement).

If you grabbed a mounting plate with the SPFI fuel pump, it wiII bolt right up in place of the original one. The electrical connector must be changed though. On the car side of the connector, cut the power wire (it should be red, and if if isn't then use the red power wire on the pump side of the connector as a reference), and splice in a new 14ga. wire. Run this new wire from the fuel pump up to the dash so you can connect it to the fuel pump relay later on. The fuel hose that comes from the tank will likely be a different size than the fitting on the fuel pump. This necessitates procuring a piece of hose that fits onto the fuel pump as well as a suitable adapter that can step down the size to that of the hose on the car. Just go to the hardware store and get some brass fittings the right size. Make sure you use liquid pipe thread sealant that specifically states that it is impervious to fuel. The pump output should be the same size as the hard line on the car, so no adaptation is needed on that side. If your car has a little metal piece in the fuel hose from the pump to the hard line, keep it there. If not take one from the SPFI donor car and install it there.This is a darnper that eases the pressure pulses from the fuel pump.

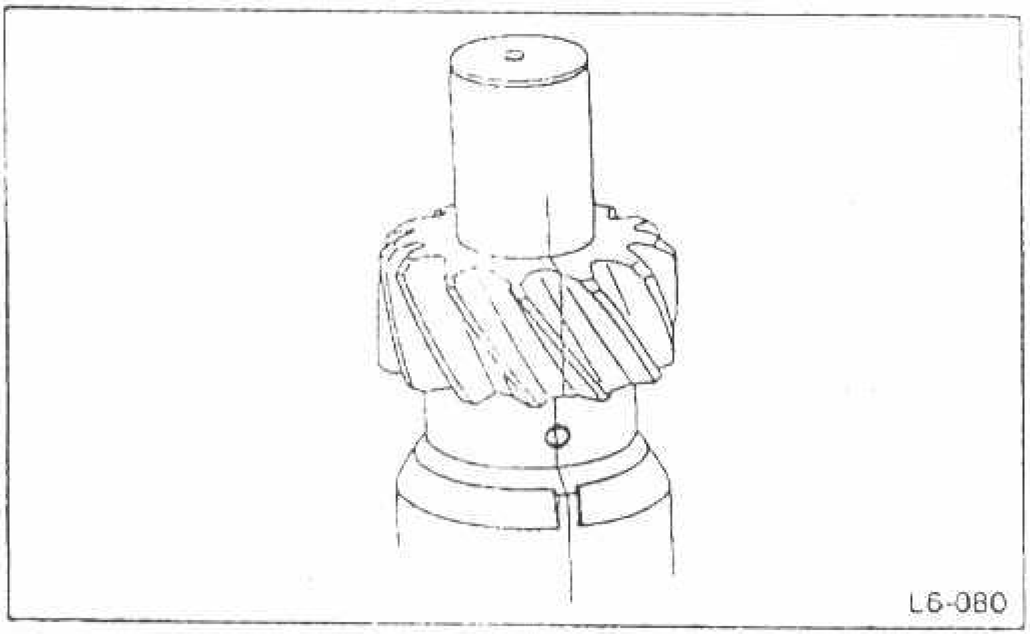
Meanwhile, back in the engine compartment, run your new fuel hose from the supply hard line to a fuel filter and from the filter to the input on the throttle body. After doing that, again using new fuel hose, run a line from the return part on the throttle body to the return hard line on the car. The return line is the smaller of the two fuel lines that used to connect to the carburetor. The original return line is smaller than the new return line. So you will also need to go buy an adapter to step down the size here as well. In both places the smaller lines can still flow plenty of fuel, so don't worry about that. The picture below illustrates which fuel line is which on the throttle body.



**3**. Distributor:

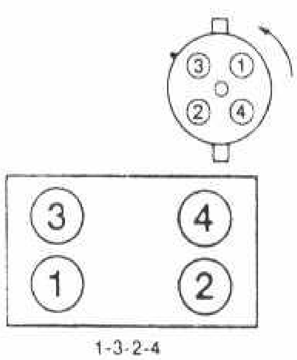
Replacing the distributor and getting it lined up properly is best done by following the Following procedure. First, turn the engine by hand (the crank bolt is 7/8 if you don't have metric sockets that big) until it reaches top dead center. This can be verified by removing the distributor cap and checking that the rotor is pointing at the terminal in the cap for the #1 cylinder. If it points 180 degrees in the opposite direction, just turn the engine one complete revolution. After disconnecting the two wires that run to the old distlributor and unbolting the distributor hold downs, carefully remove it.

Before installing the new distributor, apply several drops of oil to the shaft where it goes into the distributor body and rotate the shaft, allowing the oil to lubricate the bushings inside. Repeat this a few times to "prime" the bushings so they are not dry upon the initial startup. Align the marks on the distributor as illustrated by the diagram below and install the distributor, making sure that the shaft does not turn before its gear meshes with the camshaft gear.



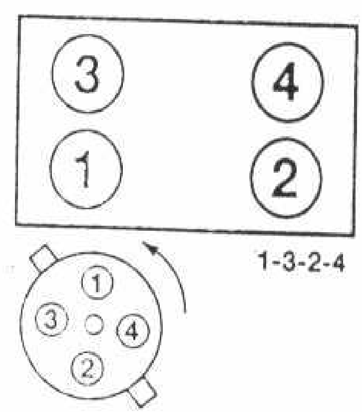

Reinstall the hold down bolts, put on the new cap and rotor, and connect the spark plug wires.

EA82




Cylinder location and distributor rotation

EA-71 and EA-81




Cylinder location and distributor rotation

**4**. Coil Assembly:

The coil mounting bracket is held onto the driver's side strut tower with two 10mm bolts. After disconnecting the wires that attach to the coil, simply remove the old assembly and bolt on the new one. Keep track of both the yellow the black wires as they will be used later on.

**5**. MAF and Air Intake:

On EA82 cars, the air filter and MAF housing will bolt up right where it did on the donor car. One of the bolt holes is not there on the car, but that one is not desperately needed to hold the assembly in place. On other models, you will have to sort something out as far as mounting the air filter housing. I have not performed the conversion on an EA8 l to date so I won't try to theorize how this can be done.

After mounting the air filter and MAF assembly, install the rest of the intake ducting. Make sure that you either clean the PCV valve or just replace it with a new one. Also clean out the PCV hoses as they are probably dirty and nasty. They may need replacement if hardened from long-term heat exposure.

**6**. Oxygen Sensor:

If your car is already equipped with an oxygen sensor for a feedback carburetor, you can simply replace it with the new one. If not, you will have to either fabricate a sensor boss and weld it into the exhaust pipe somewhere before the catalytic converter or just go find a Y-pipe that has this already. I find that it's much easier to remove the Y-pipe when installing an oxygen sensor. With the pipe still on the car, it's a pain if you have the special socket and impossible if you don't. This is also a great excuse to replace your exhaust gaskets, which, if it's an old Subaru, probably leak.

> Cautionary note: The exhaust mounting studs that go into the heads on the EA-series Subarus are really horrible about stripping out, getting rusted, and all sorts of bad things. Soak these with penetrating oil for as long as possible before attempting to remove them. If the old studs are not reusable, DO NOT replace them with bolts. Bolts have empirically proven to work very poorly in this situation and will try to pull out. If you can't find replacement studs, cut the head off of a bolt that's a little longer than the stud and screw that in there.

**Hooking Everything Up**

(No, you don't have to be a member of the IBEW. It's not that complicated.)

The first step in conquering anything is to understand it. In order to see where all the wires go, you must take the wiring harness and strip off all the plastic sheathing and electrical tape. This also allows the removal of the wires for the headlights and such which you will not be utilizing. You can leave the sub-harness on the engine just as it is, as no modification is needed there. Also, leave the gray sheathing over the sensor and control wires, as they do not need to come off and they keep everything organized. Spend a good long time going through all of the connectors and using the diagrams on the following pages figure out which ones connect to what pieces and making sure that nothing is damaged. This will make everything MUCH easier when sorting through the whole mess with it in the car.

After examining the wiring harness, the underdash panels as well as the plastic around the steering column must be removed in order to gain access to the vehicle's wiring as well as the ECM mounting location. The ECM bolts to the steering column underneath the dash. If your car has a computer for a feedback carburetor, it can be removed at this time. In order to run all the wires into the engine compartment, the large rubber grommet that allows the original harness to pass through the firewall must be removed and in most cases the hole must be enlarged for the connectors to fit through. I found it relatively easy to carefully cut the rubber away from the wiring and expand the hole in the firewall by bending the lip back with a pair of Channel-Lock pliers. I made a new grommet afterward by stuffing the hole with bits of foam and globbing a large amount of clear silicone over the whole mess. It's not the prettiest thing in the world, but quite functional. I'm sure there are other ways that are more aesthetically pleasing. How you want to go about this is up to you.

Now that everything is prepared for the install, go ahead and connect the ECM as well as the ignition relay and fuel pump relay to the wiring harness. Set that end of the harness on the floor directly under where it will be mounted, with all of the individual wires spilling out of the car onto the floor or driveway as the case may be. This way, you can take each wire or group of wires and put it where it needs to go, and when you are done connecting everything, all that is left outside of the car can be thrown into the garbage. Start by running the main engine control harness up through the firewall hole, and follow with all of the other wires that need to run to the engine compartment. This simplifies the though process further by placing everything in the general area where it needs to end up.

## Connector Terminal

### CONTROL UNIT CONNECTOR

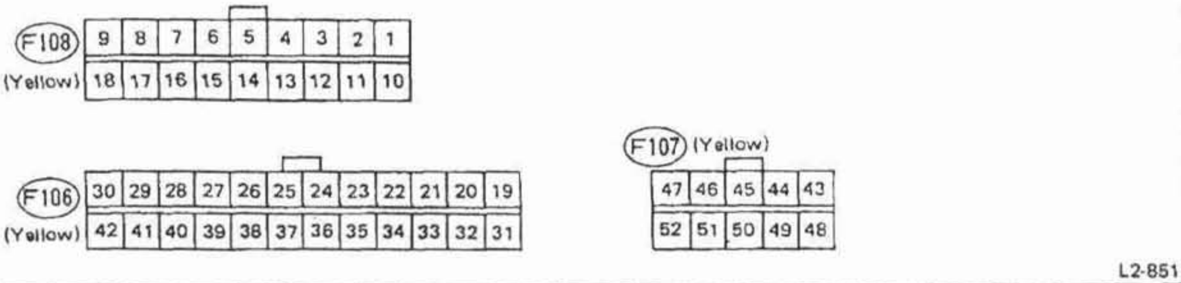



*Fig. 36*

| | | | | | |
|---|---|---|---|---|---|
| 1 | LG | Kick-down control | 27 | BW | Power (input) |
| 2 | RL | CHECK ENGINE light | 28 | GW | Self-shutoff signal |
| 3 | R | Test 4 | 29 | W | Power (input) |
| 4 | LR | EGR solenoid (control) | 30 | BR | GND |
| 5 | GL | Purge control solenoid | 31 | Br | Test mode connector (used at line end only) |
| 6 | LY | Air conditioner signal | 32 | BR | Test mode connector (used at line end only) |
| 7 | – | ——— | 33 | Lg | 49-state/Cal identification |
| 8 | W | Air flow meter (signal) | 34 | SA | $O_2$ sensor |
| 9 | B | Air flow meter (GND) | 35 | B | GND |
| 10 | Y | Line end cord output | 36 | WR | EGR monitor |
| 11 | L | Line end cord output | 37 | LgR | Test mode connector (used at line end only) |
| 12 | RL | Line end cord output | 38 | RL | Ignition switch |
| 13 | YR | Inhibitor switch (AT models only) | 39 | LgW | Clear memory |
| 14 | YG | Neutral switch | 40 | – | ——— |
| 15 | YL | Parking switch (AT models only) | 41 | W | Power (input) |
| 16 | LgR | Kick-down monitor | 42 | BR | GND |
| 17 | R | Air flow meter power (output) | 43 | RW | Injector ⊕ |
| 18 | LgY | Starter switch | 44 | BR | GND |
| 19 | GB | Crank angle sensor power (output) | 45 | GR | Air control valve |
| 20 | GY | Crank angle sensor signal (reference) | 46 | GY | A/C control |
| 21 | BW | Crank angle sensor signal (position) | 47 | LB | Fuel pump |
| 22 | YG | Car-speed sensor | 48 | RB | Injector ⊖ |
| 23 | WB | Water temperature sensor | 49 | RL | Power (input) |
| 24 | LG | Idle switch | 50 | BY | GND |
| 25 | W | Throttle sensor (signal) | 51 | B | GND |
| 26 | R | Throttle sensor power (output) | 52 | WY | Ignition control |

**Intermediate connector I (body side) . . . (F41)**

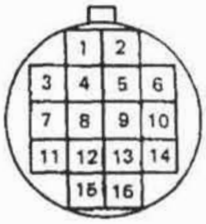



*Fig. 37*

| | | |
|---|---|---|
| 1 | BR | Ground |
| 2 | YB | Oil pressure (to combination meter) |
| 3 | — | ——— |
| 4 | YG | Thermometer (to combination meter) |
| 5 | B | Injector ⊖ |
| 6 | B | Shield |
| 7 | LG | Idle switch |
| 8 | — | ——— |
| 9 | R | Throttle sensor (power) |
| 10 | W | Injector ⊕ |
| 11 | BY | Ground |
| 12 | W | Throttle sensor (signal) |
| 13 | B | Ground |
| 14 | B | Ground |
| 15 | RL | Power supply |
| 16 | BR | Ground |

**Intermediate connector II (body side) . . . (F42) (Black)**

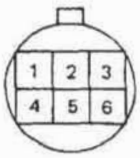



*Fig. 38*

| | | |
|---|---|---|
| 1 | GR | Air control valve (control) |
| 2 | Lg | Identification of specifications |
| 3 | GL | Purge solenoid (control) |
| 4 | WR | EGR gas temperature sensor |
| 5 | LR | EGR solenoid (control) |
| 6 | WB | Water temperature signal |

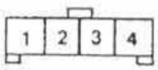
**Air control valve connector . . . (E10) (Black)**


L2-854

*Fig. 39*

| | | |
|---|---|---|
| 1 | W | Air control valve control |
| 2 | BW | IG power supply |

**Air flow meter connector . . . (F20) (Black)**

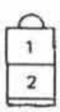



L2-855

*Fig. 40*

| | | |
|---|---|---|
| 1 | – | ——— |
| 2 | R | Air flow meter power supply |
| 3 | B | Ground |
| 4 | W | Air flow meter signal |

**Purge solenoid valve connector . . . (E13) (Black)**




L2-856

*Fig. 41*

| | | |
|---|---|---|
| 1 | GL | Canistor solenoid valve control |
| 2 | BW | IG power supply |

**Crank angle sensor connector . . . (F93)**

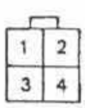
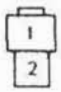



*Fig. 42*

L2-1511

| | | |
|---|---|---|
| 1 | GB | Power supply |
| 2 | GY | Ref. sign |
| 3 | BW | Pos. sign |
| 4 | B | Ground |

**EGR solenoid valve connector . . . (E11)**




L2-858

*Fig. 43*

| | | |
|---|---|---|
| 1 | LR | EGR solenoid valve control |
| 2 | BW | IG power supply |

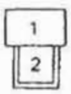
**Fuel pump relay connector . . . (F78) (Blue)**


L2-859

*Fig. 44*

| | | |
|---|---|---|
| 1 | BW | IG power supply |
| 2 | BW | IG power supply |
| 3 | LB | Fuel pump control |
| 4 | LW | Fuel pump |

**Ignition coil connector . . . (F43) (Black)**

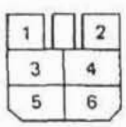



L2-1571

*Fig. 45*

| | | |
|---|---|---|
| 1 | BW | IG power supply |
| 2 | WY | Ignition coil control |

**Ignition relay connector . . . (F79) (Brown)**




L2-861

*Fig. 46*

| | | |
|---|---|---|
| 1 | GW | Self shutoff control |
| 2 | B | Ground |
| 3 | R | Battery ⊕ |
| 4 | BW | Battery ⊕ |
| 5 | RL | (Injector) power supply |
| 6 | W | SPFI control unit power supply |

**Injector connector . . . (E9) (Black)**


*Fig. 47*

L2-862

| | | |
|---|---|---|
| 1 | RB | Injector ⊖ |
| 2 | RW | Injector ⊕ |

**KD relay connector . . . (i48)**

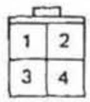



*Fig. 48* L2-859

| | | |
|---|---|---|
| 1 | BW | IG power supply |
| 2 | BW | IG power supply |
| 3 | LG | SPFI C/U (for KD control) |
| 4 | L | KD solenoid |

**Neutral switch connector (MT) . . . (F56)**


*Fig. 49* L2-854

| | | |
|---|---|---|
| 1 | BR | Ground |
| 2 | YG | Neutral signal |

**Throttle sensor connector . . . (E8) (Black)**

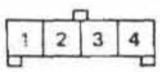



*Fig. 50* L2-865

| | | |
|---|---|---|
| 1 | R | Battery ⊕ |
| 2 | G | Throttle position signal |
| 3 | B | Ground |
| 4 | LG | Idle switch signal |

**Water temperature sensor . . . (E12) (Black)**

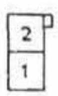



*Fig. 51* L2-1572

| | | |
|---|---|---|
| 1 | BR | Ground |
| 2 | WB | Water temperature signal |

**EGR gas temperature sensor . . . (F34)**

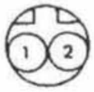



*Fig. 52* L2-862

| | | |
|---|---|---|
| 1 | WR | EGR gas temperature signal |
| 2 | B | Ground |

**How to Connect Each Individual Component**

1. Engine Control Sub-Harness:

Simply plug in the two intermediate connectors. This sub-harness requires no modification. Take a minute to inspect all of the connections to the sensors and actuators to make sure they are functioning properly.

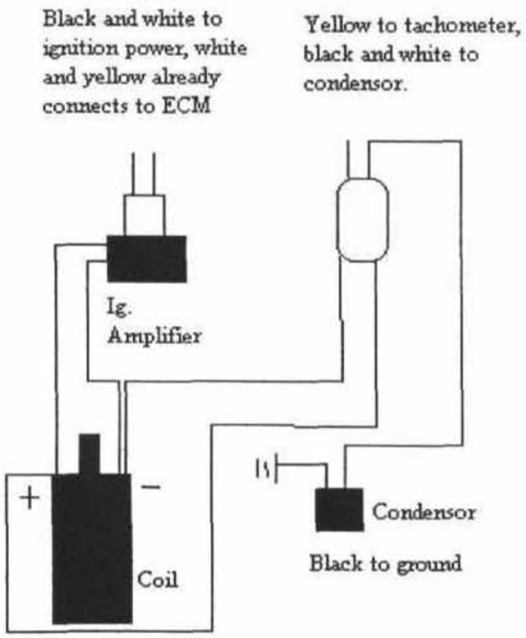
2. Distributor:

This also just plugs in.

3. Coil And Ignition Amplifier:

There are two connectors that go to the coil assembly, each containing two wires. The rectangular one that connects to the ignition amplifier (the electronic piece mounted below the coil itself) has a white and yellow wire which already runs back to the ECM. This allows the computer to control the ignition timing by providing the coil ground when it chooses. This connector also contains a black and white wire, which is the coil power. This must be hot whenever the ignition is turned on, so run this wire to the underdash area and keep track of it, as you will connecting it to the ignition positive later on.

The other, round, connector contains a yellow wire which runs to the coil. On the body side of this connector, the yellow wire must be spliced to the yellow wire that you removed from the old coil. This runs to the tachometer to indicate the engine's speed. The other wire in this connector, which is black and white, runs to the condensor (also known as the noise reducer or absorber). The condensor is a small black piece attached to the black and white wire a few inches away. Another, entirely black wire runs out from this piece. This wire must go to chassis ground. Remember the other black (or possibly black and white) wire you took off of the coil before? You can just splice those two together.



4. Other Sensors in the Engine Compartment:

The mass airflow sensor and the oxygen sensor must also be connected. These are a simple plug-and-play deal.

5. Ignition Relay:

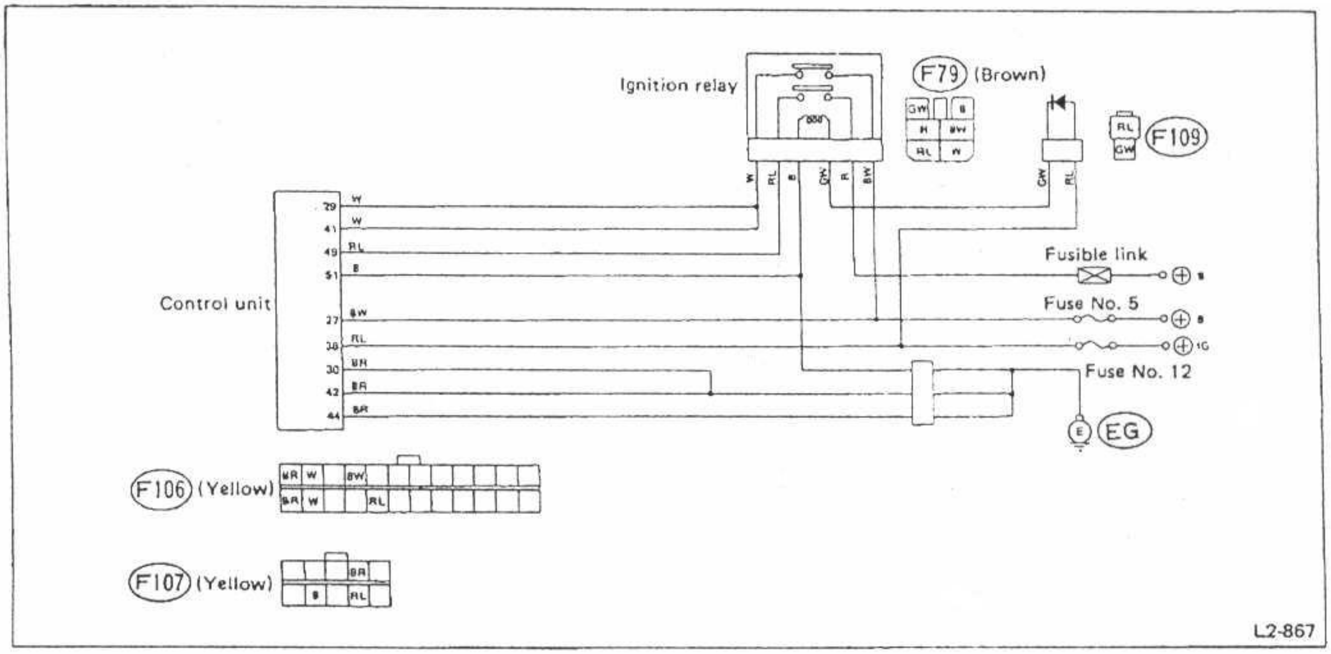
This is the large relay that you grabbed from the steering column on the donor car. The ignition power supply has a one-way diode in the wire right before the relay. This is a small gray piece about the size of the condensor that was connected to the coil. The red and blue wire that comes out of the diode should connect to a modicum of other red and blue wires. One connects to terminal 38 on the ECM, while the others run to the engine sub-harness to provide ignition power to the actuators up there. Also connected to these is a red and blue wire which runs to a broad, flat, rectangular connector that used to connect to the underdash portion of the wiring harness. Cut this wire just before that connector and put it aside with the black and white wire that you ran under the dash from the ignition coil. These will both later connect to the ignition power supply.

The large red wire coming from the ignition relay must go to battery positive (hot all the time) with a fusible link. These instructions are based on my experience with EA82 cars. The fusible link box, if there is one, EA81 cars may be set up differently, so take care when installing on older cars. If you grabbed the fusible link box with the wiring harness, and the car you are installing the system in has a fusible link box, this will be easy. In carbureted vehicles the forwardmost fusible link bay is not used. This may not be the case in some cars with feedback carburetors. If your has a feedback carburetor, simply splice into the output side (the side closer to the engine) of that forwardmost fusible link with a 14ga wire and run that back to the red wire coming from the ignition relay. If your car does not already have a fusible link there, it does already has the input or positive terminal for the fusible link. Use a small screwdriver or similar implement to remove the output terminal from the fusible link box from the donor car. Push the terminal into the slot in your car's fusible link box, connect the fusible link after making sure that it passes current, and run the wire back to the large red one in the ignition relay.

If your car does not have a fusible link box, some customization will be necessary. Whatever you do, don't run the wire to the relay without a fusible link. If something goes wrong, this can result in undesirable things like your car catching on fire.

Finally, there is another battery power connection that needs to be made. There is a black and white wire running from the ignition relay that joins with at least one other but possibly several other black and white wires, the most important of which being the one that connects to terminal27 on the ECM. These wires must be provided with fused battery power.

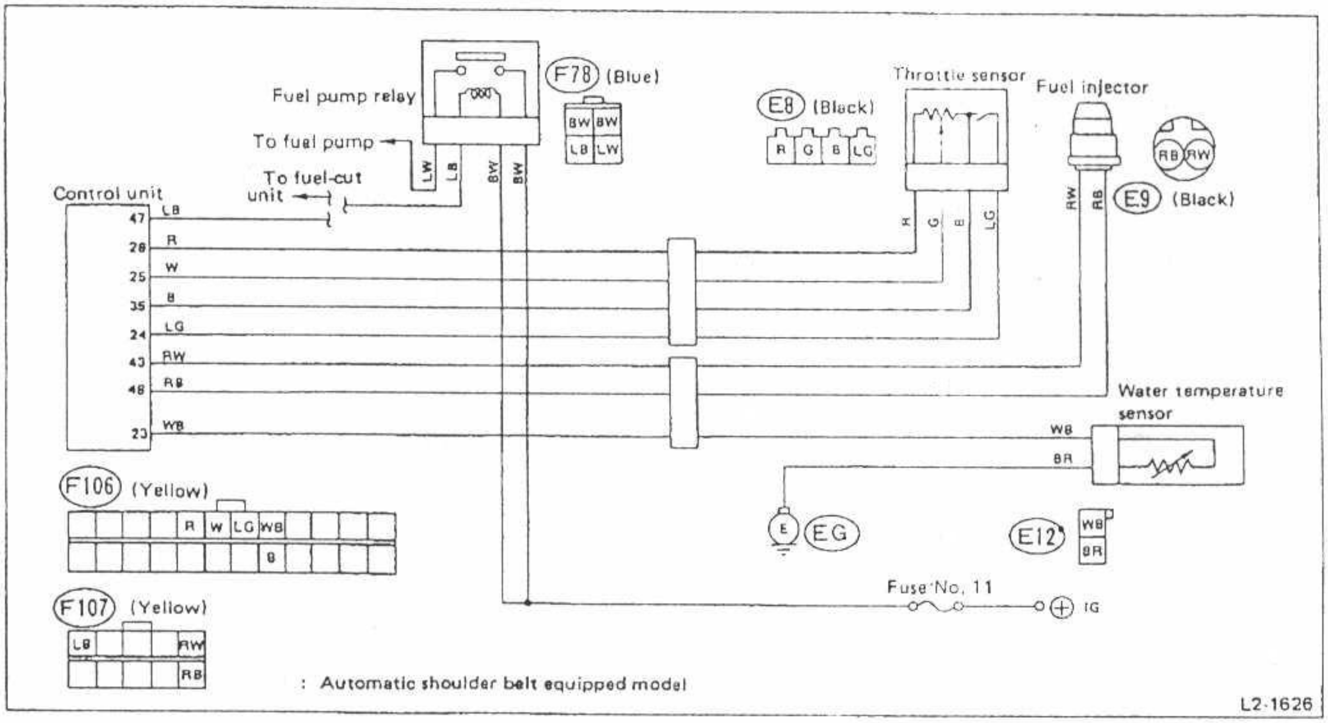
The grounds for the ignition relay, the fuel pump relay, and the ECM are provided for already by the engine sub-harness.




6. Fuel Pump Relay:

This is the smaller relay that came from the steering column on the donor car, which hooks up to the wiring harness via a blue connector. The blue and white wire coming from this relay connects to the wire which you ran to the dash from the fuel pump. This is the fuel pump power supply. The two black and white wires coming from the relay may already be connected to the black and white ignition power supply for the ignition relay. If this is the case, no modification is required. If this is not the case, a separate fused ignition power supply must be provided. Now, although everything will work if the wires are connected to the same power supply as the ignition relay, my personal preference is to provide a separate power supply. This adds redundancy and makes troubleshooting easier if something goes awry.

There is also a blue and white wire connected to the fuel pump relay. This wire is already connected to terminal 47 on the ECM and controls the fuel pump operation by providing the ground for the relay. Nothing needs to be done to this wire.



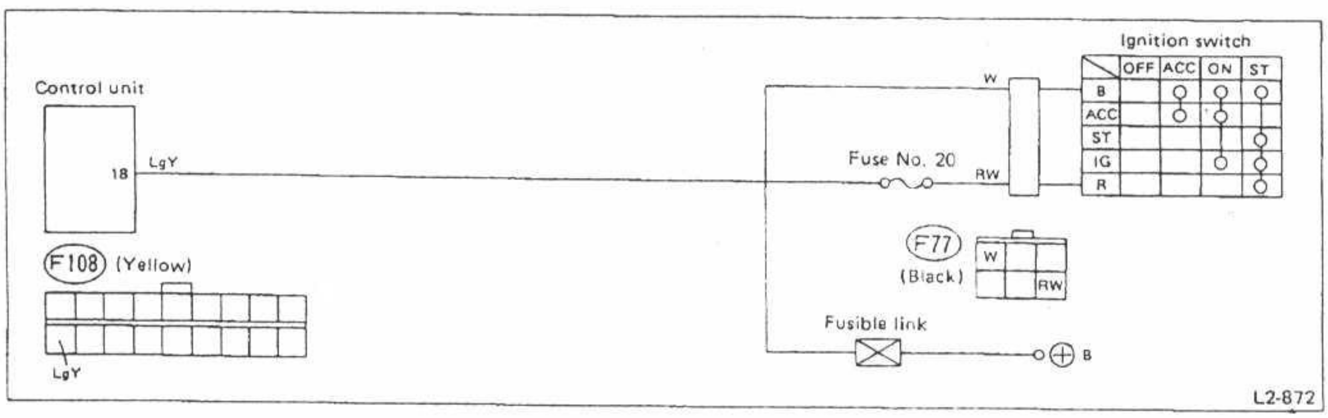
Fuel pump relay
F78 (Blue)
BW BW
LB LW
E8 (Black)
R G B LG
Throttle sensor
Fuel injector
RB RW
To fuel pump
To fuel-cut unit
LW LB BW BW
Control unit
47 LB
28 R
25 W
35 B
24 LG
43 RW
48 RB
23 WB
R G B LG
RW RB
E9 (Black)
Water temperature sensor
WB
BR
F106 (Yellow)
R W LG WB
B
E EG
E12
WB
BR
Fuse No. 11
IG
F107 (Yellow)
LB RW
RB
: Automatic shoulder belt equipped model
L2-1626

7. Starter Signal to ECM:

Connected to terminal 18 on the ECM is a light green and yellow wire. This must be fed with power only when the ignition switch is in the start position, which can be accomplished in two ways, the ease of which may depend on what type of car the system is being installed in. In addition, although it is not required for operation, it is advisable to install a fuse in this wire. It's not likely that anything bad could happen, but I would rather spend a couple bucks on a fuse holder than a few hundred for an ECM.

The first method of providing start power to this wire is the way it was intended to happen from the factory. On EA82 cars and potentially on older models, there is a connector going to the ignition switch with six terminal slots, five of which are used on the ignition switch side and four of which are used on the body side, at least on non-feedback carburetor models. The four that are used on the older cars are all clustered together, using two-thirds of the connector. The fifth pin is over by itself. I cannot assure you of this wire's color, as the FSM diagram differed from what I found on my 1986 wagon. You can verify that you have the correct wire by using your DVOM to check for continuity. This wire should be one of two that have continuity with the white supply wire ONLY in the start position. Once you are positive that this is the correct wire, you can connect it with the light green and yellow wire. If you can find an unused connector pin somewhere on the donor wiring harness, it is quite easy to remove that pin and insert it into the body side connector. That will result in a cleaner install and less hassle if you have to take things apart later. Otherwise, just splice it in and remember to use a fuse.

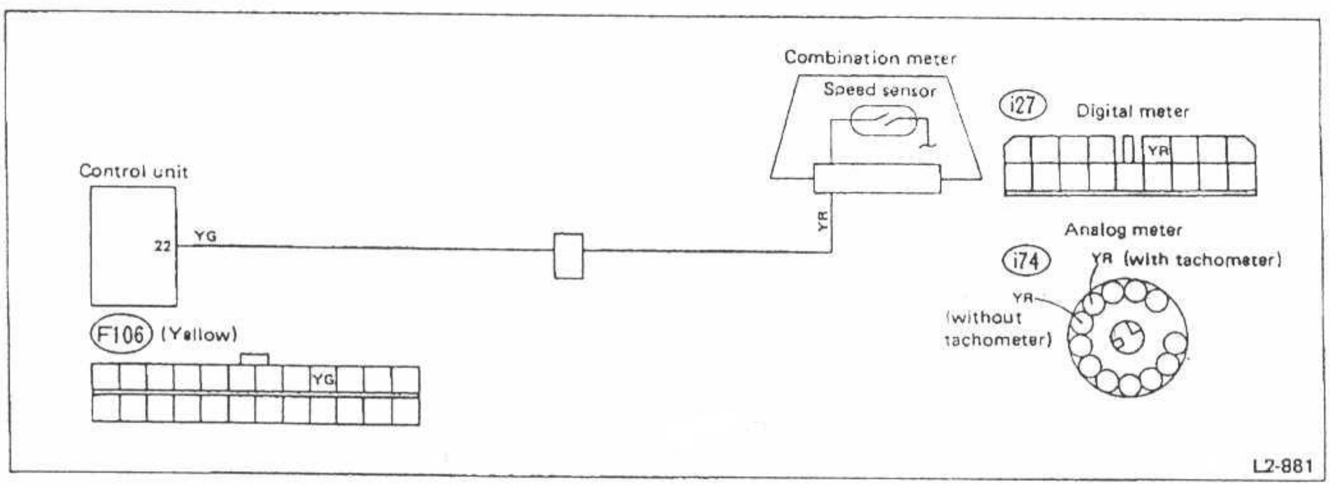
The second method is to splice this wire in with the small wire which supplies start power to the starter solenoid. I prefer the previous method, as there is likely less possibility for a catastrophic failure if something goes horribly wrong. Don't forget the fuse.



8. <u>Speed Sensor</u>:

In my discussion with other people who have installed newer engines and fuel systems into their 1980's and 1970's Subarus, it is generally the consensus that the vehicle speed sensor is not a requirement for the fuel system to operate properly. That said, it is still my belief that this sensor should be connected whenever possible, as it likely provides valuable information that alters the fuel and ignition timing maps. At minimum, it appears that when the vehicle is moving, the ECM deems it a good idea to kick the idle up a few hundred RPM, which generally results in less clutch stress, especially with inexperienced drivers.

All EA82 cars have the output in the instrument cluster for the speed sensor connection to the ECM. I am unable to ascertain if this is the case on older models, at least based on the manuals that I have in my possession. To access this wire, which is yellow and red, you must unscrew the instrument cluster so it can slide forward, then remove the trim piece directly behind it. The wire you need attaches to the round white connector that goes into the cluster right behind the speedometer. Simply splice into that wire and run your new wire down to the yellow and green wire connected to terminal 22 on the ECM. I recommend leaving the portion of that yellow and red wire that runs into the dash intact and still connected, as it may be used for something unbeknownst to me. It's better not to mess with things since the dash is a pain to take apart if you have to fix it later.



9. Check Engine Light:

Although not a necessity for operation, a functional check engine light can come in quite handy. A red and blue wire connected to terminal 2 on the ECM provides the check engine light ground. If the check engine light already exists on your dash, you can simply connect this wire to its ground side, and power should be provided by the existing harness, though this may not be the case. It may be much easier though, to just connect a small LED bulb to this red and blue wire and provide it with fused ignition power from the same source as the ignition relay.

10. A Sensor Not to Worry About:

There is no need whatsoever to connect the neutral switch. This functions to prevent starting of the vehicle in gear. If your car is an automatic, you may want this, but for manual transmissioned vehicles, this function is actually a detriment. Let's say the clutch cable breaks and you need to drive home. There is no way to get going if you can only start the car in neutral. Although I probably can't legally say this, it is my recommendation to not connect this switch to the ECM.

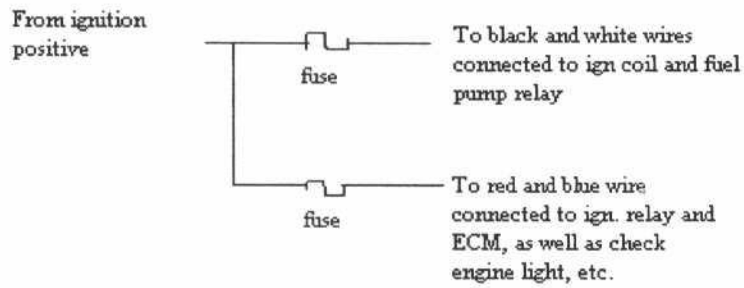
(Finally, the Power Supplies)

11. Fused Battery Power:

Remember those wires from step #5 that needed fused battery power? You can finally hook them up now. Locate a suitable battery positive (root around near the battery so that this wire isn't stealing power from another source and possibly overloading the existing electrical system). Connect to this power source and install a 20 amp fuse in the new 14ga wire in an intuitive and easily accessed location. Now run the wire under the dash and connect to the wires that need battery positive.

12. Ignition Power:

Locate the ignition power wire leading from the ignition switch. The color of this wire may vary depending on the model of your car. The schematic I printed off of Mitchell tells us that the wire should be black, but you should verify this with either a DVOM or a test light. Splice into this wire with some sort of heavy duty connector. Remember, this wire provides power to most of the vehicle's high-draw electrical components, so you don't want to add resistance with a dinky little connector or wires that are twisted together and covered with tape. Divide this power supply into two wires, running each through a separate 20 amp fuse. Connect so that there is a fuse powering the ignition coil as well as the fuel pump, and another fuse powering the ECM and its associated components.




**Final Things and Initial Startup**

You should now be ready to bolt the ECM up under the dash and secure the big mess of wires. Depending on the model of the donor car, there may be a few wires left connected to the unused portion of the wiring harness. It is not within the scope of this manual to sort out what they are and where they go, so you must sort that out on your own. Be sure to properly secure everything so that it does not get chafed or rubbed through, leading to tremendous problems. This is particularly important where the wires go through the firewall. As I mentioned before, you can make a new grommet there by sealing the hole with silicone. The next few pages are photocopies from various manuals detailing the procedures for setting ignition timing and adjusting the idle air screw.

**If not, replace the air flow meter.**

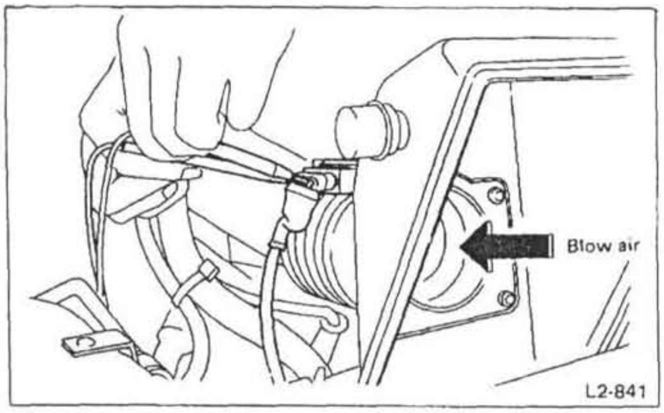



*Fig. 19*

# Throttle Chamber ASSY

## INSPECTION AND ADJUSTMENT

### IGNITION TIMING

1) Warm up the engine.
2) Turn the ignition switch OFF.
3) Disconnect the connector of the throttle sensor.
4) Ensure that the resistance between the throttle sensor terminals Ⓐ and Ⓑ is 0Ω when the accelerator pedal is released.

**If it is ∞Ω, adjust idle contact by referring to the following subsection, "THROTTLE SENSOR".**

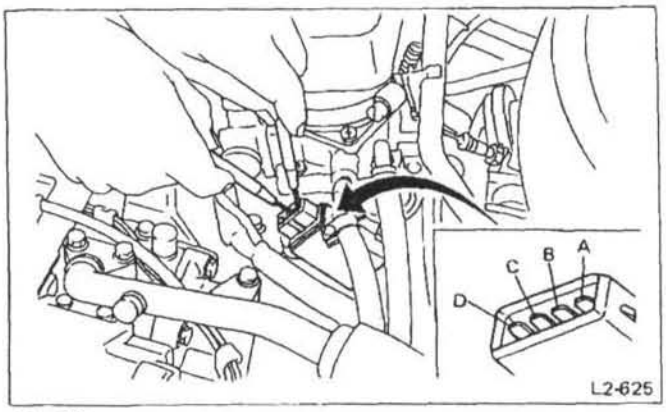



*Fig. 20*

5) Connect the connector of the throttle sensor.
6) Connect the test mode connector.
7) Start the engine and run it at idle speed. Do not depress the accelerator pedal.
8) Check and adjust ignition timing.

---

Specified ignition timing:
20° BTDC

---

**The specified ignition timing can be obtained regardless of engine speed when the engine is idling without depressing the accelerator pedal.**

9) Stop the engine.
10) Disconnect the test mode connector.

### IDLE SPEED

1) Disconnect air control valve harness at throttle chamber ASSY.
2) Adjust idling speed to 550±50 rpm by turning in or out IAS.

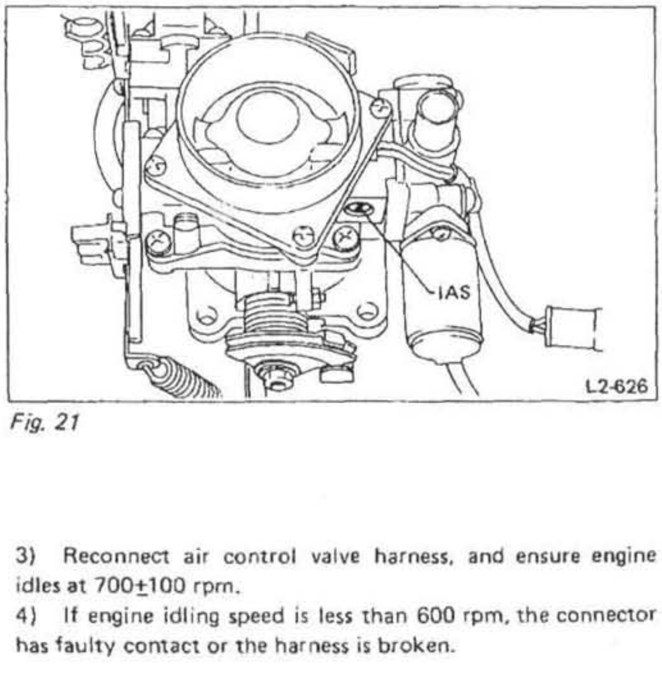



*Fig. 21*

3) Reconnect air control valve harness, and ensure engine idles at 700±100 rpm.
4) If engine idling speed is less than 600 rpm, the connector has faulty contact or the harness is broken.

### THROTTLE SENSOR

#### Idle contact

Insert a thickness gauge between the stopper screw of the throttle chamber and stopper, and check for continuity between Ⓐ and Ⓑ.

This chapter describes major inspection and service procedures for the engine mounted on the body. For procedures not found in this chapter, refer to the service procedure section in the applicable chapter.

# Ignition Timing

## INSPECTION AND ADJUSTMENT

### BEFORE CHECKING AND ADJUSTING IGNITION TIMING

1) Warm up the engine.
2) (1) Confirm that the idle switch is ON. (Refer to "Chapter 2-7".)
   (2) Connect the test mode connector.

**a. The CHECK ENGINE light will come on. This does not indicate a problem.**
**b. Ignition timing must not be adjusted and cannot be checked while the idle switch is off or the test mode connector is disconnected.**

### CHECKING IGNITION TIMING

To check the ignition timing, connect a timing light to #1 cylinder spark plug cord, adjust the engine idle speed to the specification and illuminate the timing mark with the timing light.
If the timing is not correct, proceed to the next paragraph for adjustment.

[BTDC/rpm]

| | | |
|---|---|---|
| SPFI | MT<br>AT | 20°/700*<br>20°/700* |
| MPFI<br>TURBO | MT<br>AT | 20°/700*<br>20°/800* |

* **Ignition timing can be set when the test mode connector is connected and the idle switch is turned ON, regardless of engine rpm. Do not check ignition timing while the connector is disconnected and the switch is OFF.**

### ADJUSTING IGNITION TIMING

1) Loosen the 6-mm bolts on the mounting plate of the distributor.
2) Turn the distributor housing. The timing is advanced when the distributor housing is turned clockwise and is retarded when turned counterclockwise.
3) Tighten the bolt and make sure that the timing is correct.

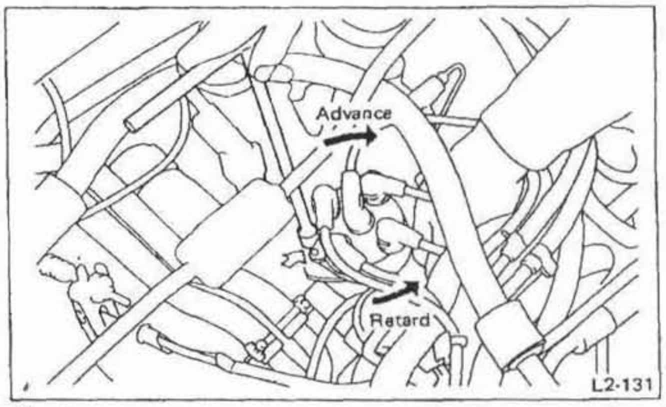



*Fig. 1*

### AFTER CHECKING AND ADJUSTING

Be sure to disconnect the test mode connector.

# Engine Compression

## MEASUREMENT

1) After warming up the engine, turn off the ignition-starter switch.
2) Make sure that the battery is fully charged.
3) Remove all the spark plugs.

**On MPFI model, disconnect the harness connectors for injectors.**
**On SPFI model, disconnect the harness connector for injector.**

4) Fully open the throttle valve.
5) Check the starter motor for satisfactory performance and operation.
6) Crank the engine by means of the starter motor, and read the maximum value on the gauge when the pointer is steady.

**Hold the compression gauge tight against the spark plug hole.**

7) Perform at least two measurements per cylinder, and make sure that the values are correct.

## 30 Ignition timing check and adjustment (every 15,000 miles or 12 months)

*Refer to illustrations 30.3, 30.6a, 30.6b and 30.6c*

**Note:** *It is imperative that the procedures included on the tune-up or Vehicle Emissions Control Information (VECI) label be followed when adjusting the ignition timing. The label will include all information concerning preliminary steps to be performed before adjusting the timing, as well as the timing specifications. If no VECI label is found refer to the specifications chart at the beginning of this Chapter.*

1 At the specified intervals, the ignition timing should be checked and adjusted.

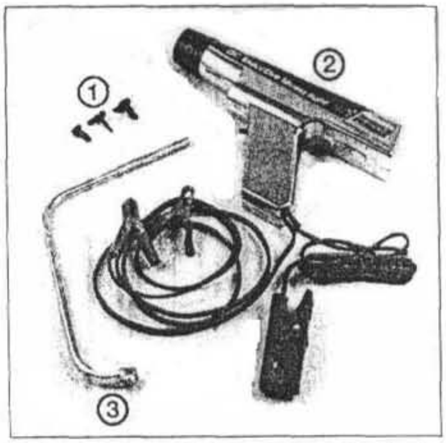
2 Various procedures (depending on the model of the vehicle) must be performed to disable the distributor or computer advance mechanism before attempting to check the timing. Locate the Tune-up or VECI label under the hood and read through and perform all preliminary instructions concerning ignition timing. If no VECI label is found refer to the Specifications Section at the beginning of this Chapter.

3 Before attempting to check the timing some special tools will be needed for this procedure **(see illustration)**.

4 Check that the idle speed is as specified (see Section 29).

5 Connect a timing light in accordance with the manufacturer's instructions. Generally, the light will be connected to power and ground sources and to the number one spark plug wire (refer to the cylinder location diagram in this Chapter's Specifications).

6 Locate the timing marks on the engine **(see illustrations)**. Clean them off with sol-

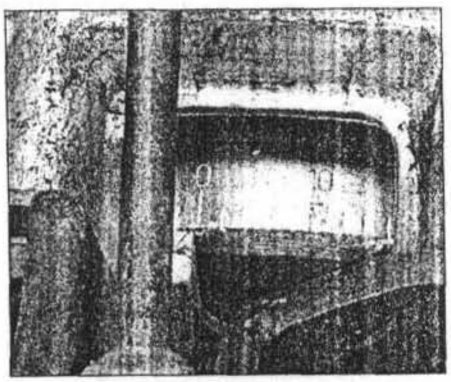



**30.3 Tools needed to check and adjust the ignition timing**

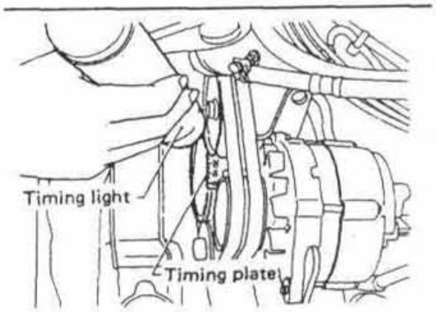
1 ***Vacuum plugs*** - *Vacuum hoses will, in most cases, have to be disconnected and plugged. Molded plugs in various shapes and sizes are available for this*

2 ***Inductive pick -up timing light*** - *Flashes a bright, concentrated beam of light when the number one spark plug fires. Connect the leads according to the instructions supplied with the light*

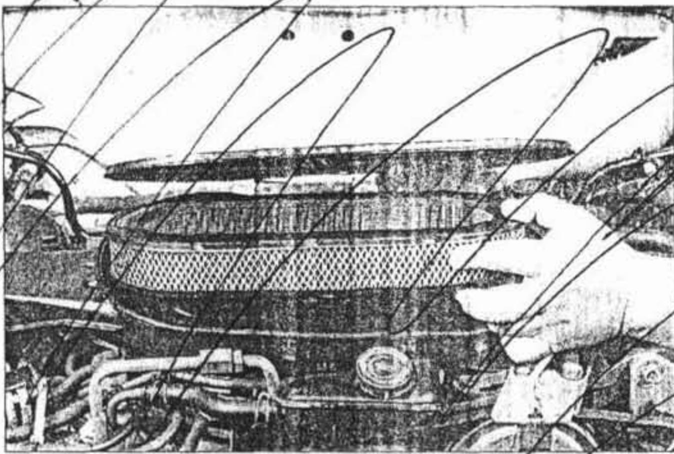
3 ***Distributor wrench*** - *On some models, the hold-down bolt for the distributor is difficult to reach and turn with conventional wrenches or sockets. A special wrench like this must be used*



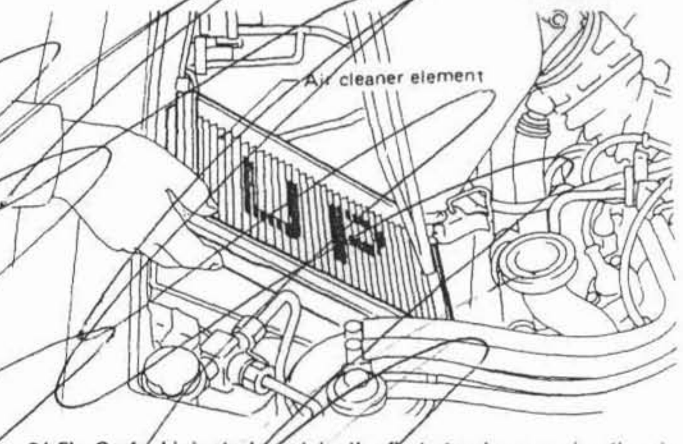
**30.6b Each mark on the flywheel represents 2 degrees of ignition timing**




**30.6c On models equipped with a turbocharger, the ignition timing indicator is located at the front of the engine by the crankshaft pulley**



31.5a After setting the top cover aside, the filter element can be lifted out of the housing




31.5b On fuel injected models, the first step in removing the air filter is detaching the clips on the housing - always position the new filter as indicated above

vent if necessary so you can see the numbers or marks and small grooves.

7 Use chalk or paint to mark the groove in the crankshaft pulley.

8 Mark the timing tab in accordance with the number of degrees called for on the VECI label or the tune-up label in the engine compartment.

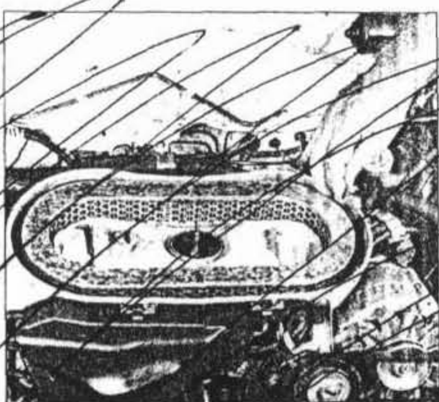
9 Make sure timing light is clear of all moving engine components, then start the engine and warm it up to normal operating temperature.

10 Aim the flashing timing light at the timing mark by the crankshaft pulley, again being careful not to come in contact with moving parts. The marks should appear to be stationary. If the marks are in alignment, the timing is correct.

11 If the notch on the flywheel or crankshaft pulley (turbo models) is not aligned with the correct mark on the timing tab, loosen the distributor hold-down bolt and rotate the distributor until the notch is aligned with the correct timing mark.

12 Retighten the hold-down bolt and recheck the timing.

13 Turn off the engine and disconnect the timing light. Reconnect the vacuum advance hose, if removed, and any other components which were disconnected.



31.8 On carbureted models the PCV filter must also be replaced

## 31 Air filter and PCV filter check and replacement (every 30,000 miles or 24 months)

*Refer to illustrations 31.5a, 31.5b and 31.8*

1 At the specified intervals, the air filter should be replaced with a new one. A thorough preventive maintenance schedule would also require the filter to be inspected between filter changes.

2 On carbureted models, the air filter housing is mounted on top of the carburetor in the engine compartment.

3 On fuel injected models, the air filter housing is located on the right side of the engine compartment.

4 Remove the wing nut(s) and the cover retaining clips. Then detach all hoses that would interfere with the removal of the air cleaner cover from the air cleaner housing. While the top cover is off, be careful not to drop anything down into the carburetor or air cleaner assembly.

5 Lift the air filter element out of the housing **(see illustrations)** and wipe out the inside of the air cleaner housing with a clean rag.

6 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.

**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.*

7 Place the new filter in the air cleaner housing, making sure it seals properly.

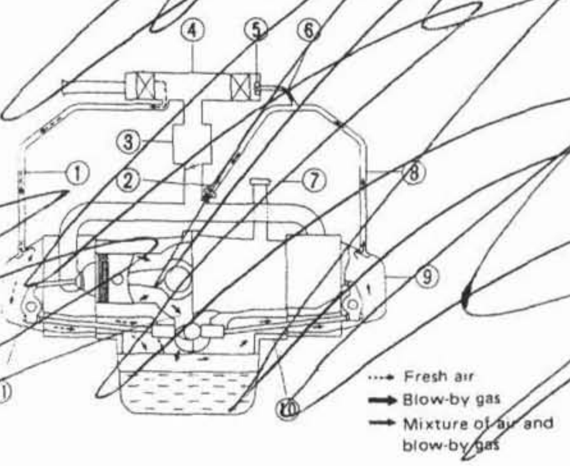
8 On carbureted models it will also be necessary to replace the PCV filter at the specified intervals **(see illustration)**.

9 Installation of the cover is the reverse of removal.

## 32 Positive Crankcase Ventilation (PCV) valve check and replacement (every 30,000 miles or 24 months)

*Refer to illustration 32.1*

1 The PCV valve is located in the intake manifold **(see illustration)**.




32.1 PCV valve mounting details (OHV engine shown, all other engines similar)

1 *Connecting hose*
2 *PCV hose*
3 *Carburetor*
4 *Air cleaner*
5 *Air filter*
6 *Connecting hose*
7 *Oil filler cap (sealed)*
8 *Connecting hose*
9 *Rocker cover on #2 - #4 side*
10 *Crankcase*
9 *Rocker cover on #1 - #3 side*

**In Conclusion**

I think you will be extremely happy with the improved performance, drivability, and fuel economy that your Subaru should now be blessed with. Repairs will also likely be less frequent and no more difficult than when the car was carbureted.

Any comments, questions, or reports of errors in this manual can be directed to Kelly, either by Private Message on the USMR to username Snowman, or by email to ksnow43@hotmail.com.

Thank you and good luck.

The Ultimate Subaru Message Board

http://www.ultimatesubaru.net/forum/index.php?

More information about SPFI Subarus can be found at:

http://www.main.experiencetherave.com:8080/subaru_manual_scans/1980_Subaru_Manuals/

in the form of pdf files.

courtesy of Moderator on the USMB named Legacy777