Ver 7, Nov 2004

SPICA FUEL SUPPLY SYSTEM DIAGNOSTIC GUIDE

This guide is intended to aid the owner-mechanic in understanding and diagnosing Alfa Romeo SPICA fuel supply system malfunctions. It is not a substitute for the official factory repair publications. No claim to absolute accuracy or utility is expressed or implied. The reader uses this guide at his own risk.

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System Description

As an early caveat, keep in mind that Alfa Romeo did not necessarily change the specifications and equipment design in strict accordance with model years. It is possible to have cars of the same model year with components from different manufacturers or systems that are slightly different from one another. In the following descriptions, references are made to model years, but you must look at your particular car to determine the exact system design and component installed. In addition, previous owners (PO's) may have substituted components from other model years.

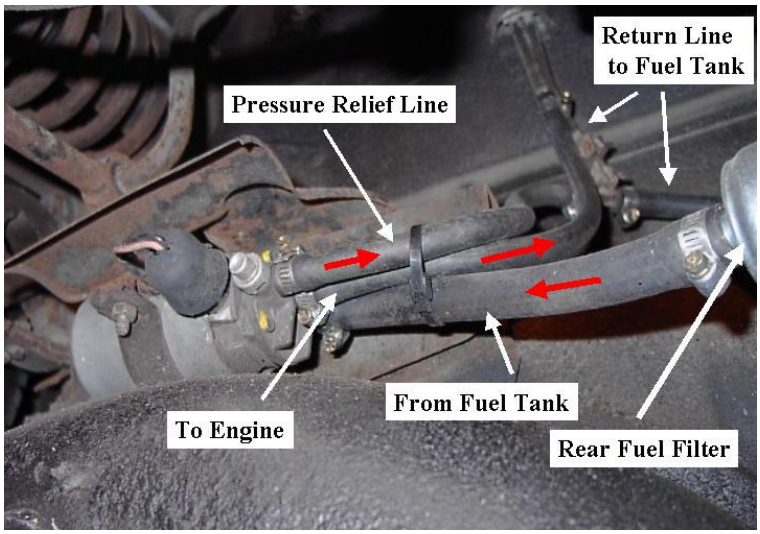
Something else to consider is your own ability and knowledge. This guide assumes the reader has a basic knowledge of automotive systems, experience in mechanical repairs, and safety practices.

The fuel supply of the SPICA Fuel Injection System has traditionally proven to be the most troublesome part of the system. Specifically, the most common failures are: 1) Clogging of the rear in-line fuel filter. 2) Weak or failed fuel supply pumps. 3) Rusted, leaky, and dirty fuel tanks (that clog rear fuel filters).

The fuel supply system for the SPICA (say "speek-a") injection system is a medium pressure (10-20 psi) closed loop recirculating system. See Appendix 8 for schematics of the fuel system. On '69 thru '74 models, fuel gravity exits the fuel tank, goes through a in-line filter, then to the fuel supply pump where it is put under 10-20 (ideally 15-18) psi and pumped forward to the canister type main fuel filter on the right side of the engine compartment. The canister has several functions. It filters the fuel again, has an inline pressure-sending unit that detects pressure below 7 psi, and may have a pressure relief valve ('69-'74). The pressure regulator is inside the big cap screw that secures the brass fitting that the fuel return line passes through. If the pressure is above 17 psi, the relief valve opens and vents fuel back into the fuel return line to the tank. If below 7 psi, the top left red light on the center instrument panel illuminates. After the front fuel filter canister, the fuel enters the SPICA Injection Pump through the rear fuel inlet fitting where it is used for engine and cooling/lubrication purposes. Unused fuel exits the pump through the front fuel outlet fitting. This fitting has a restrictor orifice (3/32") that allows the supply pump to maintain adequate pressure in the injection pump fuel galleries. If, for some reason, you remove both fuel fittings and inadvertently reverse them (putting the restrictor in the rear), you will have "apparent" good pressure (fuel low pressure warning light OUT), but have very little pressure in the injection pump fuel galleries and the engine will probably not run well, if at all. After passing through the restrictor, the fuel passes though the segregated top section of the main fuel filter (containing the PRV) and then back to the fuel tank.

'69-'74 2-port Pump Installation (right axle area).
Fig 1

A healthy pump will emit a medium frequency audible "hum" into the passenger compartment and produce about 10 psi under battery-only power, and about 15 psi with the alternator running and a charging voltage of 13-14V. As you can see, the fuel supply pump is very sensitive to voltage and current. Lower than 12V seriously degrades the pump speed and pressure. Wiring with high resistance, a weak battery, or a failing alternator will have a direct affect on the efficiency of the supply pump.



'75-'78 3-Port Pump Installation (right axle area)
Fig 2

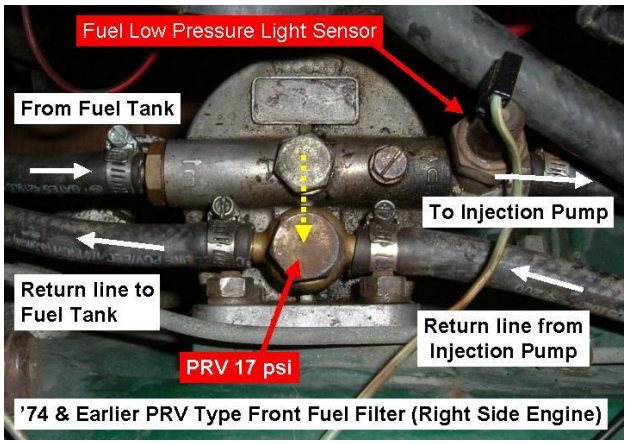
In 1975, the fuel supply pump was replaced by a 3-port model incorporating an integral pressure relief valve in place of the one that was in top of the front
(main) fuel filter. However, some post '75 cars did retain the PRV in the front fuel filter. Also, due to emissions regulations, the fuel vent system in the trunk was connected to the Oil Separator (right front of the engine compartment). See Appendix 8.

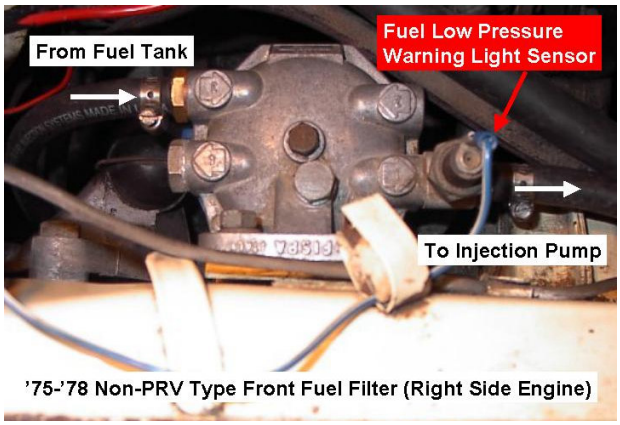
In later models, Alfa fitted a small in-tank boost pump attached to the bottom of the fuel gauge sending unit assembly. Cars with boost pumps will

have connections for two components on the top of the tank (one for the fuel level and one of the boost pump). Within the tank, the pump is connected to the top flange fittings by a rubber hose. It supplies fuel under positive pressure (3.5 psi) to the main supply pump. Alfa's thinking was to reduce the chances for vapor lock cavitation and to prevent loss of supply to the main supply pump during hard cornering with low fuel levels.

As noted above, the system has two fuel filters. The rear fuel filter is a simple high-flow in-line replaceable unit. The front filter can be one of several different types depending upon the year. Up until 74, the front filters were canister type. Starting in 75, it turned into a screw on type. The tops of the fuel filters look similar but are very different. '74 and earlier had a pressure relief valve (set at 17 psi) incorporated. These filters will have four hose connections. Later filter assemblies did not have PRVs, but rather, had a PRV built into the pump (3-port model) and have only two connections (fuel feed input & output).

The SPICA injection pump must have very clean fuel to operate properly and prolong the life of the injection pump. The injection pump plungers are manufactured with VERY close tolerances (50 millionths of an inch) and therefore need clean, non-abrasive fuel to prevent wear. The injectors operate at approximately 350-400 psi, so are not usually subject to clogging as are some electronic injectors that operate at 30-50 psi. Unless left to sit derelict and rust, SPICA fuel injectors almost never go bad.





Front Fuel Filters
Fig 3

The main supply pumps were primarily manufactured by Bosch, but also SPICA and AEG (very rare). The old AEG pumps were dry motors with a separate geared pump section. Bosch and SPICA pumps operate "wet," meaning that the entire interior including the electric motor section of the pump is bathed in fuel. Since there is no air in the pump, there is no danger of igniting the fuel. Although you can sometimes find rebuilt original supply pumps, the later Bosch supply pumps from the L-Jetronic systems work fine and are a good and readily available substitute. They are also new, as opposed to the rebuilt replacements. If you are replacing a 3-port pump, you will have to make minor modifications, by capping off the supply pump return line or removing it altogether (leave the main return line alone). The older pumps originally equipping SPICA injected Alfas look different from the L-Jetronic models. See figure 5.

If your car has an original supply pump installed, it's likely that it will fail soon. Some of these pump are reaching 30 years old and are well beyond their designed service life. As a matter of improving the reliability of your car, it's recommended that you either change the pump to a newer model as a matter of preventative maintenance, or carry a spare in the trunk.

Another important thing to mention is that on '69 through '75 those system supply pumps were not fitted with inertial switches that would cut off fuel in the even of a collision. As you can imagine, having a collision and breaching a fuel line could result in a large quantities of gasoline being pumped onto the ground until the ignition switch was turned off or the battery disconnected. It is highly advised that you retrofit an inertia switch on cars without them

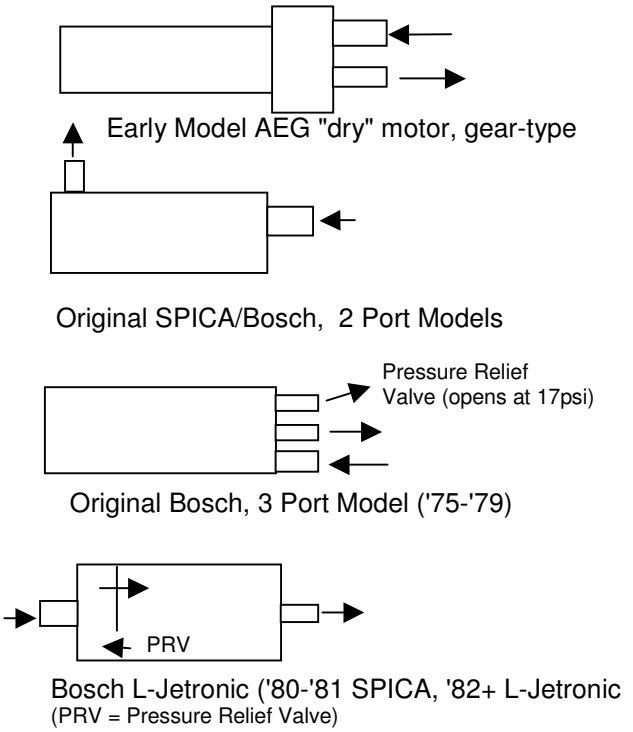
As a matter of good maintenance practice, replace all rubber fuel lines when replacing a fuel pump. Rubber fuel lines can deteriorate internally and slough-off bits of rubber that can clog filters. Standard fuel line is fine, as the system's working pressures is 10-20 psi. Fuel line from the tank to the pump is standard ½" internal diameter and rest is 8mm (5/16") internal diameter, although you should check your particular car to be sure. There is no need to use the special high-pressure fuel line commonly used by newer electronic fuel injection systems (EFI) that have working pressures of 30-50 psi. Another item of concern is corrosion of the steel fuel line running from the rear axle area to the engine compartment. Since is it covered in foam, it can trap moisture and corrode.

WARNING

DO NOT replace steel fuel line with copper or other soft metal tubing. Steel fuel line will likely maintain its integrity in the event of a collision. Soft metal lines break easily and could feed a fire with raw gasoline.

Spider Center Instrument Panel.
Note Fuel Low Pressure Warning Light Illuminated.
Fig 4

Fuel pressure is monitored by the driver via the upper left red warning light on the center instrument panel. See Fig 4. The light illuminates when the pressure in the fuel feed line is below 7 psi. In normal day-to-day operation you should never see that light illuminate except just prior to starting the engine. When first turning the key switch to ignition, it takes a few seconds for the fuel supply pump to build pressure in the line. If the light takes more than a few seconds to extinguish, there is likely a problem developing in the system, such as a clogged filter, discharged battery, or a failing supply pump. In Fig 4 also note that the fuel level in the tank is very low with an additional low fuel level red indicator illuminated. Do not run very low fuel levels in the fuel tank. Fuel is used to cool the injection pump. On a hot day, low fuel tank levels in the tank can soak up considerable heat from the pavement and engine and in extreme circumstances hot fuel could cause fuel supply pump cavitation.



Caution: Do not pressure test these pumps via "deadhead" method. They can put out extreme pressures when deadheaded and could cause rubber fuel line rupture and possible fire.

Fuel Supply Pump Models
Figure 5

Good Shop Practices when Working on Fuel Systems

1. Be very clean. If you open the fuel system, make sure the area around it is free of grit and grime. Small pieces of grit, if introduced into the system downstream of the front filter could make its way into the injection pump or injectors.
2. Don't work alone.
3. Disconnect the battery and remove all sources of ignition in case you spill some fuel.
4. Double-check all fitting's security before you pressurize the system.
5. Do not work on a fuel system in an enclosed area where fumes could build up.
6. Have a fire extinguisher handy.

Typical Failure Modes of the SPICA Fuel Supply System

1. Low pressure. (Fuel low-pressure light ON, or intermittently ON)
2. Low output. (May be accompanied by an intermittent fuel low-pressure light.)
3. Fuel supply pump stops working altogether.
4. Blows it's fuse on the fuel supply pump fuse block (beside main fuse block under left side of dash).
5. Leaking. A leaking fuel supply pump is a fire hazard.
6. Tank internal feed line broken/leaking. ('77-'81 models only)

Since various failures can result in similar symptoms, it is usually necessary to ensure the function of all the components of the fuel supply system when diagnosing malfunctions.

Diagnostic Guide

A. SYMPTOM: **Fuel low-pressure light ON, steady or intermittent.**

POSSIBLE CAUSES:	ACTIONS:
1. Inertia switch tripped. (post Aug '75 models) Fuel pump is silent. LP warning light on steady	Reset inertia switch in engine compartment by pushing down on inertial switch top reset button.
2. Supply pump fuse blown. With ignition "on" fuel pump will not make any noise. LP warning light on steady.	a. Replace fuse (8A). Supply pump fuse is located on a small separate fuse block right beside the main fuse block. Disconnect positive wire from fuel supply pump and replace fuse. If it blows again, there is a short in the supply wire, not a pump problem. Do not use a higher amperage fuse of short the fuse block in attempts to get the pump to run. Fuse is 8 amps.
3. Fuel filter clogged.	Change filters. Change rear in-line filter first and retest. Rear filter almost always clogs first. Pump may sound, "labored" with clogged filter. Rear fuel filter is commonly available in auto parts stores. WIX #33299 Do not use generic filters. They may be too restrictive and choke the supply pump.
4. Fuel Tank vent plugged. Evident by "oil canning" of fuel tank and/or sound of vacuum hiss when removing tank cap	Clean out vent system. Check for ice in the small vent PRV if temperature is below freezing and humidity is high.
5. Fuel Tank out of gas. Perhaps fuel quantity gauge is giving false indication of fuel in tank when it is indeed empty.	Listen for fuel slosh through the filler cap while shaking the car.
6. ('75-'81 models) a. Failed in-tank boost pump b. Leaking internal-tank rubber fuel line from boost pump to exit line on fuel level sending unit flange. Rubber hose is approx 1.25" long with 12mm to 10mm connections. See Fig. 10.	a. Disconnect power to main supply pump and listen/feel for in-tank pump operation. Disconnect inlet to main supply pump and confirm positive pressure provided by in-tank boost pump. If you have a fuel pressure gauge, you may check the boost pump's output pressure via a deadhead setup. Pressure should be 3.5 psi. If pump is running but pressure is less than that, check (b).

	b. Remove sending unit from top of tank and check integrity of internal rubber fuel hose.
7. a. Weak main fuel supply pump. Engine will probably falter under acceleration or climbing a hill. Low-pressure light may come on at the same time. Pump may emit an unsteady whine or sound erratic. b. Failed pump. Light ON steady. Engine will not run.	a. Replace fuel supply pump. b. As an emergency measure, sometimes giving the pump a good whack can cause it to run again. Even if successful, pump failure is imminent..
8. (Pumps with 3 fittings) Pressure relief valve in pump stuck open preventing pump from building up line pressure.	Pinch off rubber fuel line from pressure relief port and observe fuel low-pressure warning light. If successful in extinguishing the fuel low pressure warning light, this line may be blocked off, or pinched (as a temp fix). Pump pressure relief port is redundant to the pressure relief valve in front fuel filter (if equip w/PRV). Standard 2 port SPICA or L-Jetronic pumps may be substituted if unused line is capped or removed. (See Appendix 1 for caveats)
9. False low-pressure light. Engine seems to run normally. a. Wire between sending unit and gauge shorted. b. Failed fuel low-pressure sending unit stays grounded despite line pressure greater than 7 psi. (Unlikely, if not cracked or obviously damaged)	a. Check for shorted wire. With ignition ON (and presumably the fuel low pressure light ON), disconnect the wire from the low-pressure sensor-sending unit on the top of front fuel filter. If low-pressure light stays on, then there is a short somewhere between the dash light and the sending unit connection. b. A failed sending unit is impossible to diagnose without knowing the exact line pressure. Either remove and replace the sending unit with a known good unit, or take a line pressure reading with a gauge and a "T" fitting between the front fuel filter and FI pump.
10. Failed low-pressure sending unit. (Unlikely, if not cracked or obviously damaged)	Replace sending unit on front fuel filter canister.
11. 69-74 models only. Leaking/failed pressure relief valve (PRV) on front fuel filter canister top (if installed) (Unlikely except for fuel systems that have sat unused and could be badly varnished). If your front fuel filter has 4 hose fittings, you have a PRV integral to the filter, If your filter has only 2, then you have a 3 port supply pump with PRV integrated into the supply pump itself.	a. Pinch fuel line exiting injection pump. If fuel low-pressure light stays ON, the problem is probably a clogged filter or weak pump. b. Pinch *fuel return line* exiting front fuel filter canister. If light goes out, it *may* indicate a leaking/failed pressure relief valve. Remove front filter canister top from car and clean/inspect pressure relief valve. c. See Appendix 4 for detailed test of PRV
12. Leak in Fuel Line. In order to be of such magnitude to cause a loss of pressure, leak would have to be quite large.	Stop engine. Turn off ignition switch to stop fuel supply pump. Disconnect battery ground cable to prevent any possibility of sparking. Repair leak.
13. Wiring problem to fuel supply pump. a. Shorted wire could cause blown fuse. b. Bad ground wire will cause pump to be inoperative also. c. Wire to pump not supplying full voltage.	a. Check connector under trunk mat and wire integrity. b. Check fuse block connections clean and tight. c. Check pump positive wire and ground wire connections clean and tight. Check full 12 volts at the + terminal on the pump.
14. Rubber fuel line from tank to supply pump kinked or collapsing.	Turn key on and check for collapsed fuel line. Pump may sound, "labored." Replace rubber fuel line if found deteriorated.
14. Fuel return line partially restricted or obstructed. A fuel tank that has sat unused for a long time with fuel in it can corrode/varnish and internally block the return line inlet pipe. Problem may be manifested by labored pump sound, failure to start, and/or stalling at idle with a low pressure light. Above idle the engine may run. Plugged fuel return line can cause overheating of fuel supply pump, vapor lock and cavitations resulting in temporary failure. After cool down, system may appear to work normally until the cycle repeats itself.	Listen for a good flow of fuel into the tank from the fuel return inlet fitting. Remove the gas filler cap and listen through the filler neck. Also, you may be able to feel the inlet fitting and feel the vibration caused by good flow. Removing the rubber fuel line from the inlet fitting and blowing air through the inlet pipe may reveal blockage. A plugged line requires removal of the fuel tank and a thorough cleaning.

B. SYMPTOM: **Fuel low-pressure light stays ON for prolonged time when first switching on the ignition, but then extinguishes.**

After sitting overnight, it is normal for the light up to 3 seconds or so to extinguish. If it takes longer than that, a weak or failing pump could be the reason.

POSSIBLE CAUSES:	ACTIONS:
1. Fuel filter dirty	Change fuel filters. Change rear in-line filter first and recheck operation.
2. Weak supply pump	Replace weak supply pump.
3. Wiring to pump not supplying full voltage	Check 12 volts (minimum) at pump wiring
4. Vacuum in fuel tank.	Open filler cap. Listen for hiss. Fix vent system.

C. SYMPTOM: **Fuel low-pressure light comes ON while operating the starter motor for more than a few seconds.**

POSSIBLE CAUSES: Starter motor is drawing current away from fuel supply pump (also a high current item) causing an under speed and low pressure in the fuel line. Even with an adequate battery, prolonged cranking of the starter motor can rob electrical current from the supply pump and result in the fuel low-pressure warning light coming on. When the starter motor is stopped and normal current is restored to the supply pump, the fuel low-pressure warning light should extinguish.

ACTIONS: A check of battery connections and battery capacity would be prudent.

D. SYMPTOM: **With the car stopped and idling, such as at a stop light, the fuel low pressure warning light illuminates and the engine stalls. Increasing RPMs may help keep the engine running. The fuel low pressure warning light does not illuminate (and engine runs well) while underway and normal running speeds.**

POSSIBLE CAUSE: Kink in fuel return line or blockage (probably in the return line pipe in the fuel tank). Blockage in the fuel tank return pipe is possible if the car sat derelict for considerable time with fuel in the tank. Varnish may have formed at the sitting fuel level and completely blocked the return pipe. The result is that the fuel is no longer re-circulating as it should and the supply pump is being almost completely "deadheaded" and putting out excessive pressure. This could be in excess of 60 psi! With the engine fuel demands high at running speeds, it may be allowing enough fuel to pass in order to keep the fuel in the supply pump from going heat critical. However, with very low demand at idle, the pump is almost totally deadheaded. The fuel in the supply pump doesn' t move, the supply pump overheats, goes into vapor lock, and no longer provides pressure. This illuminates the fuel low-pressure warning light and the engine stalls. After a cool down period the pump is no longer vapor locked and will again appear to function normally.

ACTIONS: Open the fuel tank filler valve and listen closely for fuel flowing back into the tank from the fuel return line. If you don' t hear any circulation, you must determine the source of the blockage. Start with the return inlet in the fuel tank and work your way backwards through in the system.

E. SYMPTOM: **Leaking fuel pump.**

POSSIBLE CAUSES: Internal seals failed or rubber fuel line deteriorated at attachment points. There is no field repair kit for fuel supply pumps.

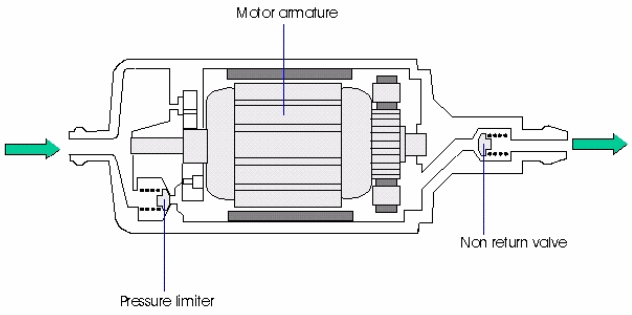
ACTION: Replace the supply pump. DO NOT keep a leaking fuel supply pump in service.

APPENDIX 1
Replacement of Supply Pumps and Substituting Alternate Pumps

It is not recommended that a failed or leaking fuel supply pump be replaced by used a pump of unknown age, condition and quality. It is much better to replace a fuel supply pump with a new Bosch L-Jetronic pump. Some people have used a less expensive (about $80) alternative, the Master (model # E2000) pump from a Ford Truck V-8 with good success. Regardless, the pump must provide sufficient pressure and quantity.

If you have an original SPICA or Bosch pump installed in the car, I recommend a new Bosch L-Jetronic pump be carried as a spare or, preferably, changed outright as a preventative measure to increase the car' s reliability. Every original equipment SPICA/Bosch supply pump I' ve ever owned has failed. The age of any original supply pump makes it way overdue for failure. With an old supply pump, it' s not a question of "if"; it' s a question of "when."

Bosch L-Jetronic pumps are easily retrofitted to the SPICA supply pump bracket and wiring. See Fig. 9. The L-Jetronic pump is slightly less in circumference so it requires a thin piece of rubber floor mat or some other material to make the pump snug in the bracket. Rubber fuel lines should hook up with no problem or modification. Also, the L-Jetronic supply pump has screw posts for electrical connections, versus the male spade terminals on the SPICA supply pump. If you have an older supply pump and wish to carry a L-Jetronic pump as an in-car spare, it would be a good idea to fit male spade terminals to the Bosch electrical posts. That way, the only tools you would need to change the pump temporarily would be a screwdriver for the fuel line clamps, and some mechanics wire to temporarily suspend the pump from the existing bracket. While not elegant, it will get you home (without the indignity of a tow truck) where you can make a permanent repair.

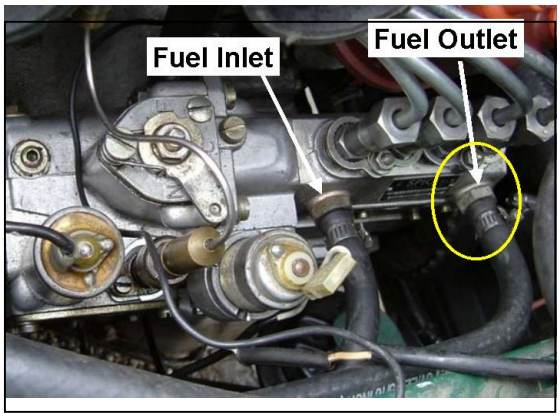


Bosch L-Jetronic Substitute Supply Pump for SPICA Injected Alfas. Caution: Do not deadhead. These pumps can create pressures well in excess of 50psi before pressure relief valve opens.

Fig 6

Substituting a Bosch L-Jetronic or other supply pump for an original 3-port pump (incorporating an integral pressure relief valve) could theoretically create a problem with overpressure. The original PRV is discarded with the old pump, and there' s not one in the front fuel filter assembly, as in earlier years, ' 69 74. The restrictor in the FI pump outlet fitting is usually big enough to lower the line pressure to nominal levels. However, after retrofitting a new L-Jetronic pump, the line pressure should be checked with a gauge to be sure it' s operating at no more than about 20 psi. Even the L-Jetronic supply pumps have an internal pressure relief valve, but its relief pressure is much higher than the SPICA value of 17 psi.

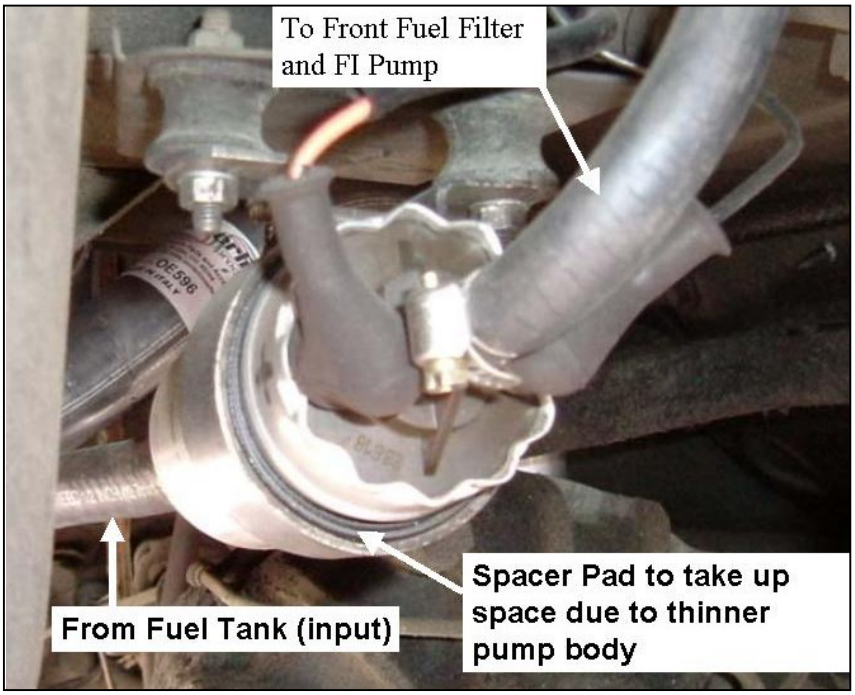
The restrictor in the FI pump outlet fitting was normally 3/32" in diameter, although depending on the year, it may be different. This size restrictor was meant to work with the SPICA or old-style Bosch supply pumps, which put out a large volume. When substituting the slightly lower volume L-Jetronic supply pump, the restrictor should be made smaller to maintain 15-18psi in the system. If the restrictor is left at 3/32," it' s likely that the low-pressure warning light will be on (< 7psi) with just battery power, and only maintains 10psi or so with the alternator running. Optimum is 15-18 psi. See Fig. 7. To modify the restrictor, remove the fitting from the pump and fill it with electrical solder and re-drill with a 1/16" drill bit. A simple propane torch works well to melt the solder into the existing hole. See Fig. 8.



Fuel fitting to be modified.
Fig 7

Outlet Restrictors. Left one is stock (3/32”). Right one has been soldered-in and redrilled with a 1/16” drill.

Fig 8



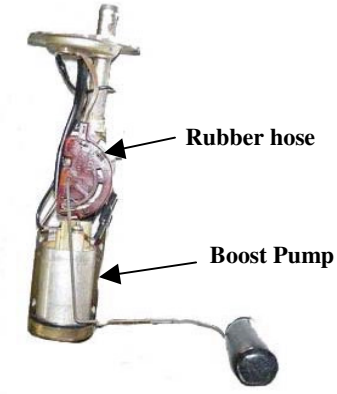
L-Jetronic Fuel Supply Pump retrofitted into a SPICA system. Electrical connectors will need to be changed to ring connectors.
Fig 9

APPENDIX 2 Fuel Tank

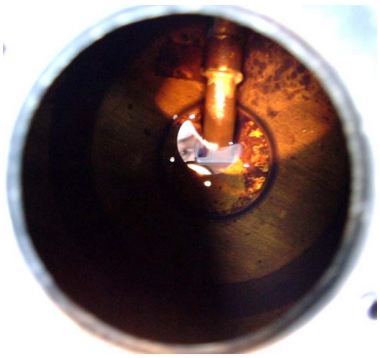
Alfa fuel tanks are subject to corrosion. This is especially true of cars that have sat derelict for long periods of time, those that were fueled infrequently, or left to sit with low tank levels. These conditions favor water condensation inside the tank and subsequent rusting. Cars that have sat derelict will usually have rust and varnish. In extreme conditions, the tank can literally rust through and leak. Given the ready ignition sources close to the fuel tank, ANY leak is serious and must be fixed immediately.

On SPICA cars without in-tank boost pump modificaton (pre '77), fuel is drawn from a sump in the bottom of the tank, through a metal pipe that exits at the right front lower corner of the tank, then to the rear fuel filter. The supply pump has to "pull" this fuel. One of the problems this system experienced was occasional fuel starvation with low fuel levels during hard turns. In addition, if the fuel got hot from hot ambient conditions, reflected heat from the pavement, and engine/FI pump heat, it was possible that the supply pump could cavitate and lose pressure. Although these things happened very rarely, Alfa decided to fix the problem. That said, owners with the old system should not feel compelled to retrofit the newer style tanks and boost pumps. Keeping the fuel filters clean, fuel tank clean, and not running routinely with very low fuel tank levels will prevent any potential problems.

Alfa's solution was to fit a small 3.5 psi boost pump attached to the fuel level sending unit inside the fuel tank to provide a positive head of pressure to the main supply pump. This boost pump was not powerful enough to supply engine needs, just a positive feed to the main supply pump. In this configuration, fuel is sucked up by the boost pump in the tank and routed out a pipe in the sending unit flange on top of the tank. From there it goes to the rear fuel filter and onto the main supply pump. Although boost pump failures are rare, one problem that is known to occur is a failure of a short piece of rubber hose connector between the boost pump and the top flange. If this rubber hose leaks pressure can be lost to the fuel feed and a little geyser forms inside the fuel tank. Replacement of this rubber hose is easy and is available in any auto parts store, but it does require breaching the fuel tank and removing the fuel gauge sending unit/boost pump assembly.



Fuel Tank Sending Unit w/Boost Pump ('75 on, but check you car for actual installation). This pump MAY be deadhead checked. Looking for 3.5 psi.
Fig 10



Non-Boost Pump Tank. Looking into the fuel tank through the sending unit flange opening. Note the fuel pipe from the bottom sump to the front lower right corner of the tank. Note slight corrosion in the tank
Fig 11

APPENDIX 3
Testing a Fuel Supply Pump

In reality, the low-pressure light tells you everything you need to know about the main supply pump. If you want to take a pressure reading, a "T" fitting MUST be used. A standard auto vacuum/fuel pressure tester is adequate to test a SPICA fuel supply system. Normally these test gauges are only marked to 10 psi, but will often times indicate higher, although you'll have to interpolate. A 30 psi gauge is better but not absolutely necessary. DO NOT take a deadhead reading. The pressure should be 10-20 psi and flow rate output between .5 -.6 gallons per minute, measured on the outlet side of the injection pump. Nominal pump pressures are about 10 psi with pump on, battery only, (engine not running) and about 15 psi with the engine running the alternator. As you can see, the fuel supply pump is very sensitive to voltage and current. When taking a reading with the engine running, you will likely see large fluctuations on your gauge, unless you have a dampened gauge unit. These fluctuations are due to the pressure surges caused by the working FI pump. Simply interpolate a median reading.

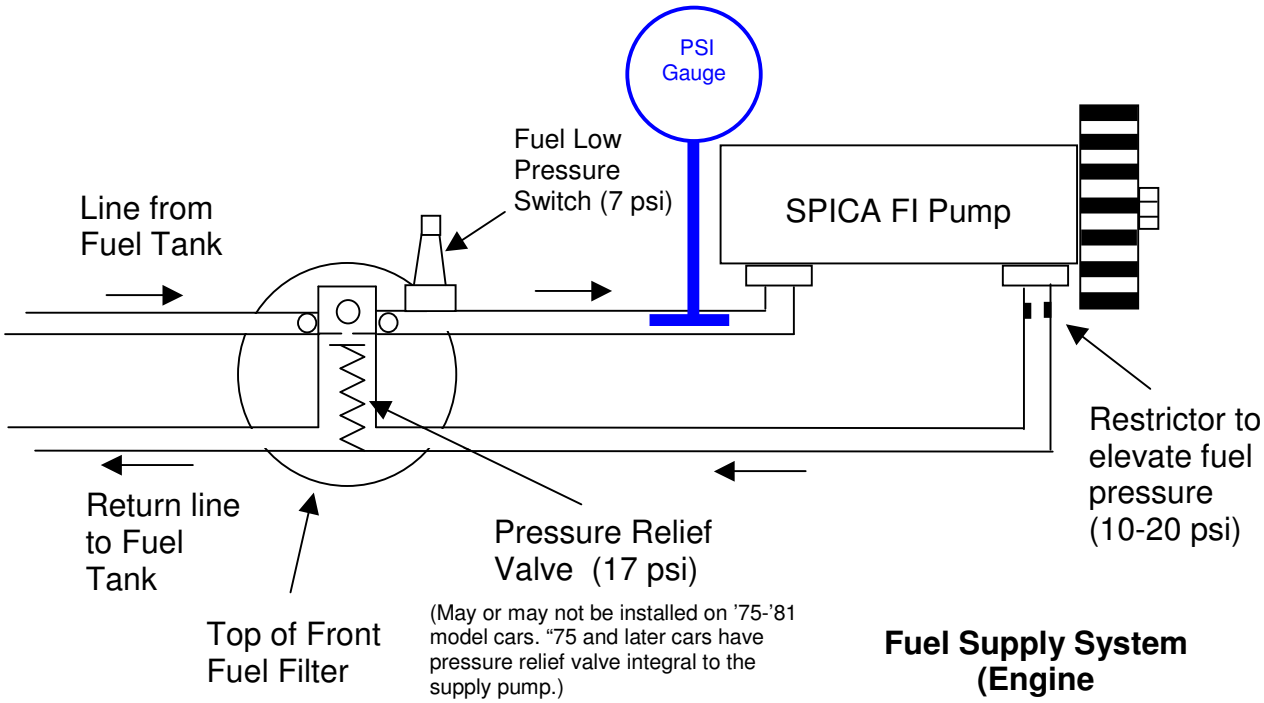
Using an ohmmeter you can measure the pump's internal resistance, which should be 2-50 ohms. A reading of infinity would indicate a completely open connection and a reading of zero ohms (no resistance at all) would show a shorted pump. In either case, the pump would be inoperative.

Another good check is that of the wiring leading to the pump. This voltage should be within ½ volt of battery voltage. If it's low, then all connections should be checked, cleaned shiny, and tightened. Don't overlook the fuel pump fuse block when checking and cleaning all connections. Each connection should have less than one-tenth volt drop across it. As a matter of course, I replace and solder all questionable connectors I find anywhere in the car. Also, old and/or cheap quality spade connectors tend to lose their gripping power as they age, so if you do replace spade connectors, but sure they're good quality ones.

Low pressure readings could be due to many causes, such as leaking PRV (Pre '75 models), clogged filters, very low fuel level in the fuel tank, an incorrectly sized restrictor in the FI pump outlet fitting, collapsed hose, or just a weak/failing supply pump. See diagnosis section for detailed troubleshooting.

Caution

DO NOT conduct deadhead pressure readings on the main fuel supply pump.
The supply pump is capable of high pressures (perhaps greater than 100 psi) and may burst fuel lines if deadheaded. Also, these pumps are intended to function in a re-circulating system and deadhead operation may overheat them.
DO NOT run supply pumps "dry." Running dry can cause rapid wear and failure. The internal electric motor in the supply pump relies on being immersed in fuel to for safe operation, cooling, and lubrication.



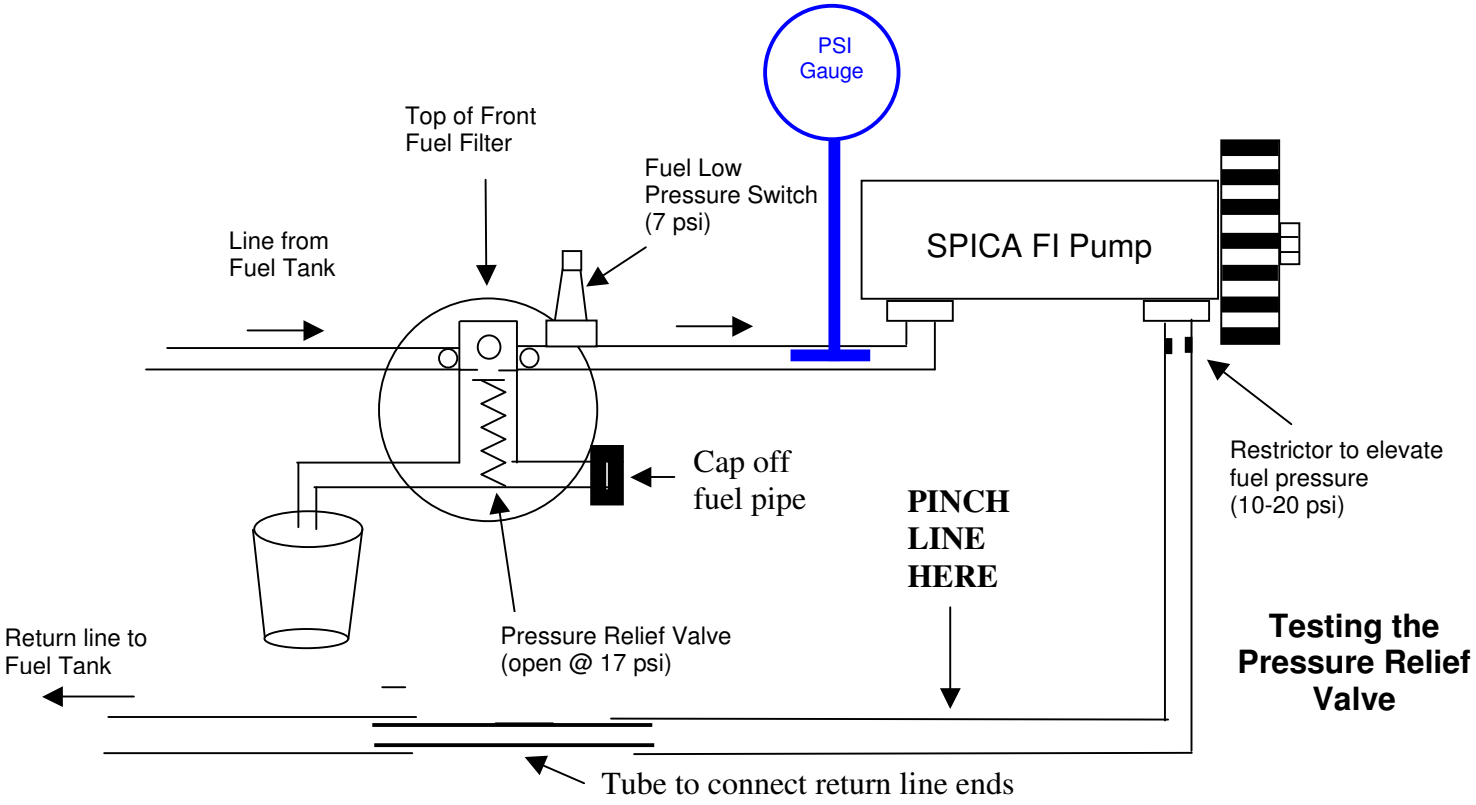
(May or may not be installed on '75-'81 model cars. "75 and later cars have pressure relief valve integral to the supply pump.)

Fuel Supply System (Engine Compartment)

APPENDIX 4
Testing the front Fuel Filter Pressure Relief Valve (PRV) ('69 '75 models).

If you suspect a leaking pressure relief valve in the front fuel filter it is possible to test it in-situ. You need to install your pressure gauge using the "T" fitting. Next the return lines must be disconnected from the filter, which is then bypassed using a piece of straight tubing. One of the now open fittings must be capped and the other fitted with a piece of hose that goes into a bottle. An empty plastic milk bottle works well and prevents splashing. What we have now done is to provide a visual indication of fuel going through the pressure relief valve.

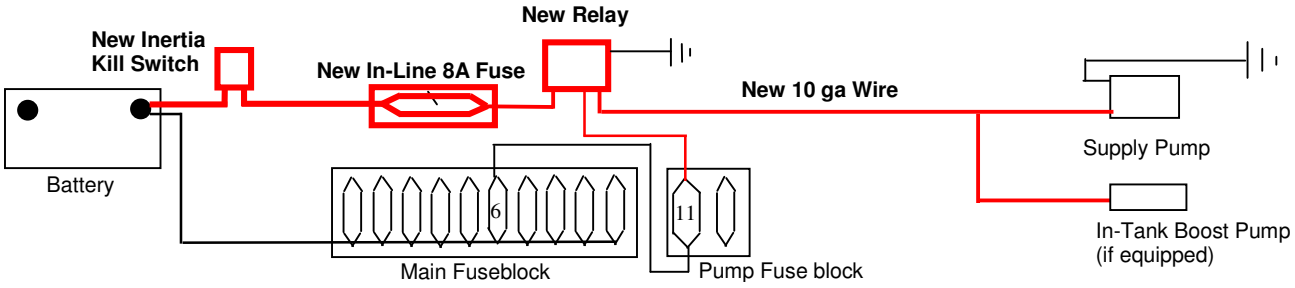
Turn the key on to start the fuel supply pump. Observe the pressure reading on the gauge. If the pressure is below 17psi, there should be no fuel going through the PRV and venting into the bottle. To check the pressure at which the PRV opens, carefully pinch the return line and observe the pressure gauge. As you pinch harder, the pressure should rise. At 17 psi, the PRV should open and fuel should flow into the bottle.



Testing the Pressure Relief Valve

APPENDIX 5
Installing an inertia kill switch and electrical relay for the fuel supply pump.

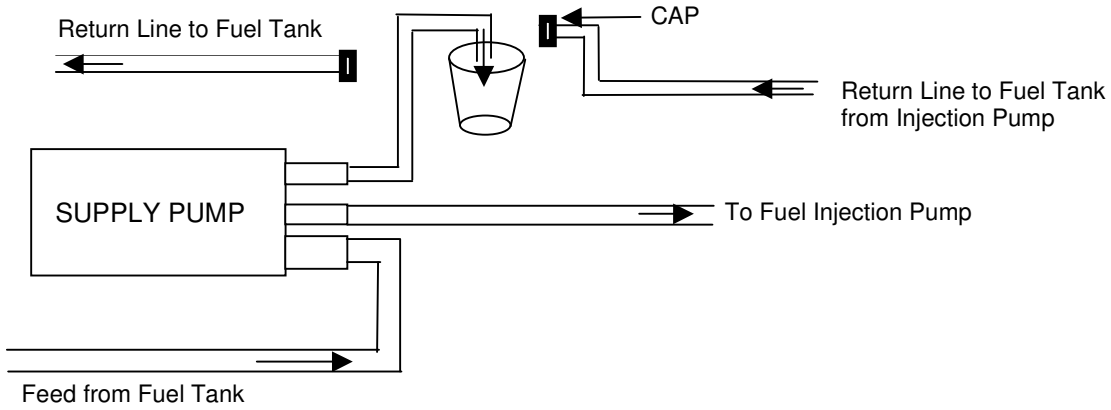
The originally installed wiring for the fuel pump is barely adequate in terms of size and capacity to operate a high electrical draw item like the fuel supply pump. Some owners have installed a relay with a 10ga main feed wire. This will prevent a voltage drop to the supply pump. Also, fitting an inertial kill switch is a good safety measure to prevent the possibility of an uncontrolled fuel spill in the event of a breached fuel line, such as in an accident.



Note: Fuses 8A

APPENDIX 6
Testing the Fuel Supply Pump PRV (' 75 on, if equipped with 3 port pump)

If you suspect a loss of pressure due to a leaking PRV in a Bosch 3 port pump, you simply have to disconnect the pressure relief (return) line from the pump and cap it off. Run a long piece of fuel line from the pump port to a jar and turn on the pump. Use special care not to have gasoline in the vicinity of an ignition source. If the fuel pressure light illuminates and you have fuel coming out of the PRV port hose, then you probably have a leaking PRV on the pump that is causing a pressure loss.



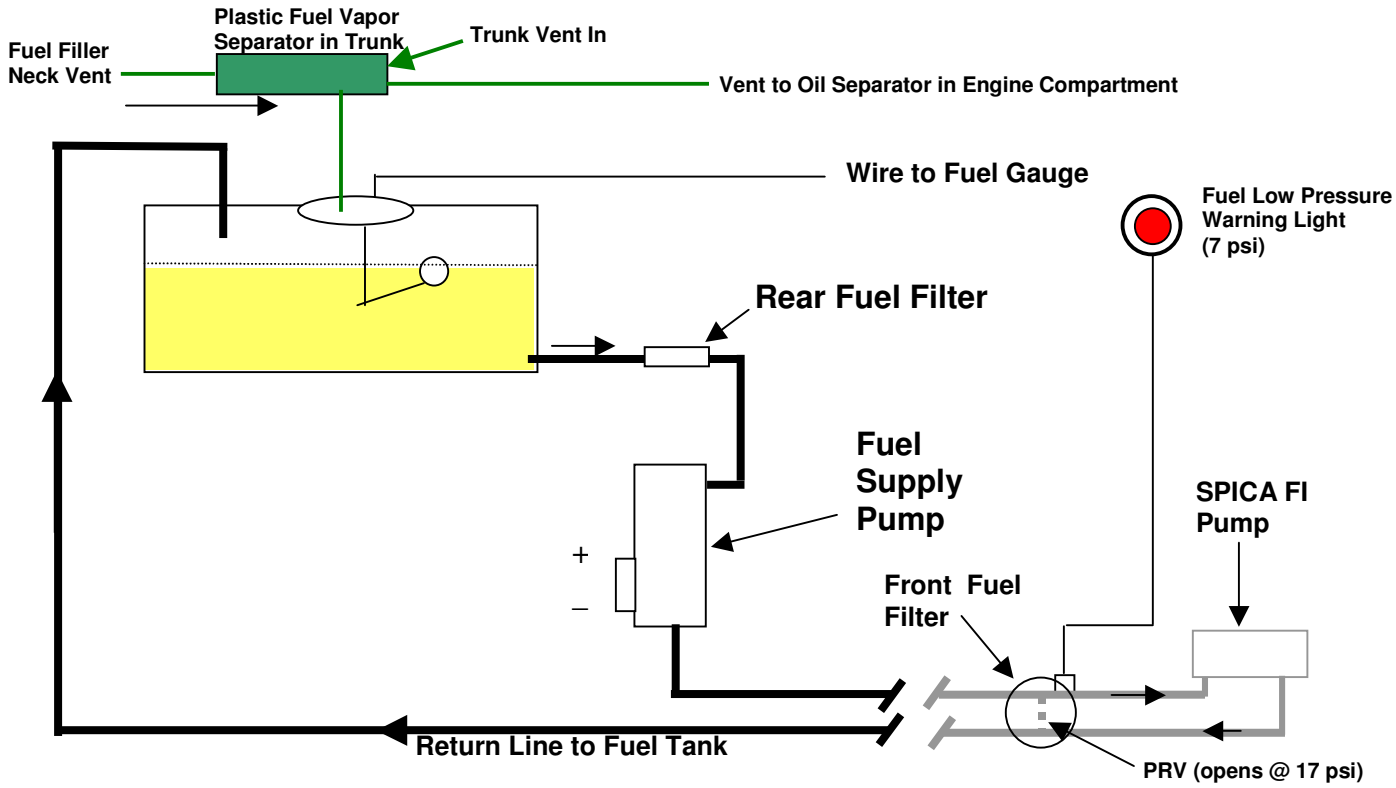
APPENDIX 7
Testing a In-Tank Boost Pump (' 80-' 81 models only, and ' 77-' 79 models if retrofitted)

Disconnect the fuel tank outlet hose from the top flange and fit a manifold/fuel pressure tester to the line. It is permissible to check this pump via deadhead reading. Reading should be 3.5 psi. If the pump is running, but you are getting low or no pressure, it' s possible that the rubber fuel line from the pump to the top flange is leaking. In this case you will have to remove the top flange with the fuel level and pump assembly and replace the hose. See Fig. 10.

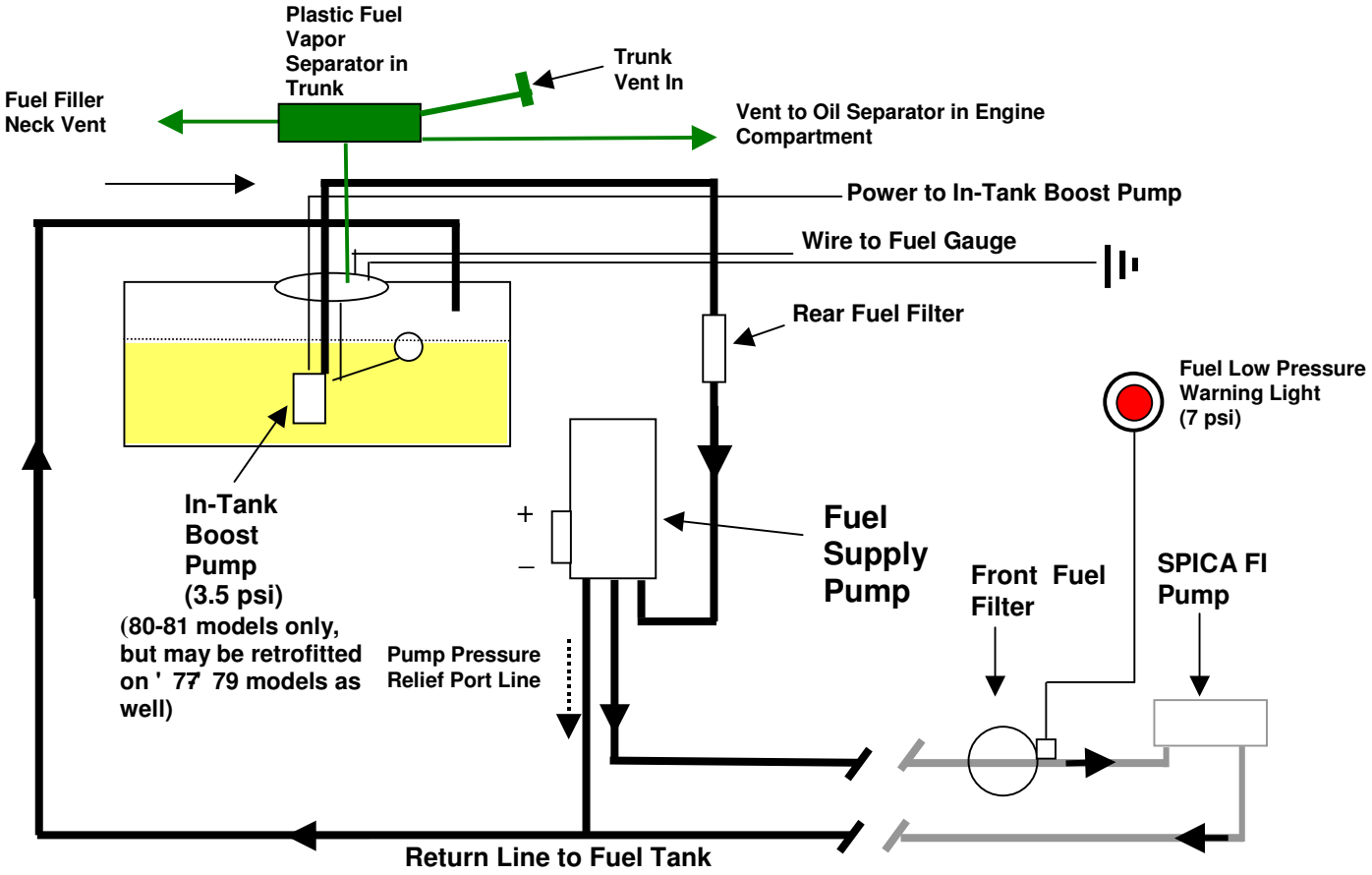
CAUTION

Be sure to use all safety precautions associated with servicing an open fuel tank.

APPENDIX 8
Schematics



Fuel System Schematic ('69 - '74)



Fuel System Schematic ('75-'79)

Notes

1. '80-'81 models similar except they have 2-port L-Jetronic type pumps and the Pressure Relief Valve line from the supply pump to the return line is omitted.

2. '77-'81 models' front fuel filter did not have a PRV.

Version 7 changes:

1. Picture of AEG supply pump included. Additional verbiage related to AEG pumps added to text.
2. Verbiage added concerning inadvertently installing fuel restrictor to the wrong port.
3. Tripped inertia switch added to fault diagnostics.
4. Various typographical corrects.
5. In-Tank Boost Pump added to Appendix 5 electrical schematic.
6. Corrections and clarifications to Fuel System Schematics.