# Solving GSL-SE Idle Problems

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The GSL-SE is supposed to idle steadily at 800 rpm, and it will do so as long as everything is working perfectly. As soon as something wears, starts to leak, or gets dirty, it will affect idle speed. Figuring out what is wrong and how to fix it can be a challenge. The first place most people turn is to the official Mazda shop manual, or the Haynes manual. There they discover that the description for setting idle speed only shows a procedure that will work if everything else is operating perfectly. After that, things get messy. For instance, in the section on trouble-shooting a "rough idle," the shop manual shows seventeen possible causes, each described in a separate section. There are fifteen possible causes for "...high idling speed in normal operating temperature," and at least seven of them are common to both lists (although not in the same order).

Making matters worse, to find the location of the item in question you must look at a diagram at the beginning of the chapter. One-line descriptions of their functions are on another page. Actual instructions for checking the items are spread all over the "Fuel And Emissions Control System" section of the manual. The locations of these instructions vary, depending on whether the parts are considered to belong to the Air Induction System, Bypass Air Control System, Deceleration Control System, or Ignition Control System. The troubleshooting section tells you which gizmos to check, and how to do it, but nowhere are you given a general explanation of how the various elements come together to give you that nice, steady 800 rpm idle.

It is very confusing.

The purpose of this article is to take a general look at how the idle works on a GSL-SE, and then to apply that knowledge to fixing specific problems. From the outset, I must be clear about a few things:

First, I am neither a mechanic nor a professional technical writer. I have no affiliation with Mazda or with any other automotive entity. This information should be considered as one hobbyist speaking to another. Use it at your own risk.

Second, I am limiting this discussion to idle problems which show themselves at normal operating temperature. I don't know enough about the engine's warm-up cycle to add much to what is already available in the shop manual.

Third, most of the information I will present has been gleaned from discussions on the RX-7 net. I am indebted to those who have contributed over the years.

Finally, there is often a conflict between terms used in the shop manual and the generic names for things. Where possible, I will stick with Mazda's terminology, but will also put (in parentheses) the more generic names for reference.

I hope this guide proves to be useful on those frustrating days when the idle is wandering around, and nothing seems to make sense.

## Outline

The first part of this discussion will be an overview of how idle control operates on the GSL-SE, including descriptions of all the elements involved. Please read this before attempting to troubleshoot. The second part includes descriptions of various problems and suggestions for solving them. The third section contains instructions for adjusting the Throttle Sensor, and for doing a Standard Idle Adjustment as described in the shop manual. These procedures are common to several problem-solving strategies.

# General Function

The idle on a GSL-SE is under constant monitoring by the EGI (Electronic Gas Injection) system. This is Mazda's term for Fuel Injection. For simplicity, I will use the term "EGI" to cover any of the car's engine management computing systems. If working perfectly, the system will seek out an idle speed of about 800 rpm. It does this by varying the amount of air coming into the engine. When something (air conditioner, power steering, head-lights, etc.) causes an additional drag on the engine, the EGI calls for more air, and matches it with an appropriate amount of additional fuel. Thus, most idle problems have to do with the various air intake paths and the systems used to control them. It is not as difficult as it sounds. To get the general layout of things, and to become familiar with the parts involved, let's start at the air filter and work our way into the engine. We can identify components as we go along. It will help if you are looking at a shop manual or, better yet, the car itself as we go through it.

## Air Filter And Air Flow Meter

Air flow through the engine is not very great at idle, so the air filter is not usually involved with idle problems. Below the air filter is the Air Flow Meter. This tells the EGI system how much air is entering the engine. It is rarely troublesome. However, with the 1984 cars, the opening for the air intake was located in front of the radiator, and if a sufficiently heavy puddle was hit, it was thought possible for the car to suck a little water into the system. Over time, this could gum up the air flow meter. In 1985 Mazda lengthened the air intake tube, extending it to pick up air from the vicinity of the battery. In any case, you can check the Air Flow meter by (engine off) removing the air filter and sticking your finger down the air intake toward the rear and center of the car. You will feel a trap door in there. If it moves easily and shuts with a soft "clunk" it should be mechanically okay. If it is not easy to move, or if it is not smooth, the EGI system will not be getting valid information, and you will have general driveability problems. You can also check the electical characteristics as outlined in the shop manual.

## Variable Resistor

Just aft of the air filter is a black fitting with "R--L" (Rich--Lean) printed on it. This is an idle mixture adjustment, but is not intended to be used for setting idle speed. It really doesn't do much in that regard, but it will significantly alter the air/fuel ratio entering your exhaust at idle. It is considered to be a part of the emissions control system, and for that reason, Mazda doesn't want you messing with it. The adjustment screw is buried beneath a quarter inch of sealer, and is not supposed to ever need adjusting. If you want to mess with it, the procedure is simple, and will be covered later.

## Throttle Chamber (Throttle Body) and Dynamic Chamber (Intake Plenum)

Start at the Air Flow Meter and follow the black ducting (Mazda calls it the "air funnel") to where it connects with the engine. It fastens via two bolts to the Throttle Chamber (where the throttle plates and shafts are located), and then to the Dynamic Chamber (the part that says RE-EGI on it). Most people refer to these parts as the Throttle Body and the Intake Plenum, respectively. Mazda likes the term "Dynamic Chamber" because it serves a "dynamic tuning" function to reinforce the flow of air into whichever rotor is currently opening its intake port. If the throttle plates do not come to rest in the correct position, it will effect idle.

## Air Adjust Screw

The Air Adjust Screw is the closest thing we have to a classic idle adjustment screw. It is located prominently at the top of the Throttle Chamber. It is a simple air bleed screw, which is used to "fine adjust" the amount of air flow through the Throttle Chamber and into the Dynamic Chamber. If your idle is steady, but tends to be a little bit high or low, you can correct it with the Air Adjust Screw. Turning it clockwise should slow the idle down and visa versa.

## Throttle Stop Screw

The throttle stop screw is not even shown (at least I can't find it) in the shop manual, but it is the mechanical point on which the throttles rest. You will find it about 3 1/2 inches to the passenger's side of the "G" in RE-EGI. The screw faces upward and is locked in place with a shallow nut. It is directly underneath the top left stud for the Throttle Chamber.

### Throttle Sensor (Throttle Position Sensor, or TPS)

If you are standing on the passenger's side of the car, you will find the Throttle Position Sensor (TPS) forward and to the right of the Throttle Chamber. It is black, and has a plunger that moves in and out within it as the throttle is depressed. Mazda refers to this as the "Throttle Sensor," but the other term (TPS) is more widely used, so I will use it here. This is the device that tells the EGI system how far you have your foot down on the gas. It also tells the EGI system when the car is idling, so adjusting the TPS is often involved with idle problems.

### Bypass Air Supply

As I said in the beginning, the EGI system varies the amount of air entering the engine to control idle. To do so, it needs a supply of filtered air to work with, and a way to bypass the air around the throttle plates since they would otherwise get in the way. This is what the Bypass Air System is all about.

Following the air funnel (black duct) from the Air Flow Meter back to the engine, you come to a small (about 3/4 inch) tube that connects to a short hose which in turn connects to the Dynamic Chamber. What you can't see is that the tube entering the Dynamic Chamber goes all the way through and exits from the other side into another hose. This hose makes a 90 degree turn and connects to the Bypass Air Control (BAC) valve, so called because the air it controls has bypassed the Throttle Chamber. This is the main device for varying the air supply to the engine during idle. What most think of as the BAC valve is really only the forward half of the mechanical assembly. The rearward half is called the Air Supply Valve, and it only comes into play to compensate for the load placed on the engine when the air conditioner compressor clicks in.

### Vent Solenoid Valve And Vacuum Solenoid Valve

Just below the BAC valve and in back of the oil cap you will see four small items--each with electrical connections and vacuum lines. The last two are the Vent and Vacuum Solenoid Valves, but we will go through all four devices just because I am so happy to have finally figured out what they are for. The one most forward is green in color. This is the Vacuum "Control" Solenoid Valve (Not to be confused with the Vacuum Solenoid Valve--the last device in the line). It's job is to return the spark timing to its most retarded setting during deceleration and idle. The second is colored orange. It is the Pressure Regulator Control Solenoid Valve. Its job is to help the car start when hot.

The third and fourth devices are barrel shaped. They are the Vent Solenoid Valve and the Vacuum Solenoid Valve. These two valves are controlled by the EGI system. Their job is to vary the setting of the BAC valve. This regulates how much "bypass air" gets into the engine.

Trace the electrical wires coming from the Vent and the Vacuum Solenoid Valves. A proper idle adjustment requires you to disable the BAC system, so you will need to disconnect the signal to these two items. Both get their signal from the same plug.

## Troubleshooting

Troubleshooting idle problems on a GSL-SE is rarely a simple procedure. The effect can be a combination of small problems in several systems. For instance, the Throttle Chamber and the BAC valve are both exposed to carbon build-up from the small amount of combustion material present in the Dynamic Chamber. Cleaning one will often solve part of the problem, but will expose that the other is also not working well. Secondly, most idle problems are not the result of a sudden failure. Rather, things get worn, or gummed up over time. You may face not only the original source of the problem, but complications arrising from several people trying to correct it without getting to

the root cause. For this reason, after an attempt to fix any idle-related problem, it is always a good idea to go through the Standard Idle Adjustment Procedure as described in Section 3.

## Problem #1

Idle speed is a little off, but nothing else is really wrong.

You can probably tweak this by simply turning the Air Adjust Screw. Turning it clockwise slows the idle down. Keep in mind that the Air Adjust Screw is a very simple device, and if your idle is wandering, something else is probably starting to become unstable. In other words, you can expect this to be a stop-gap measure until the situation gets worse.

## Problem #2

Idle speed drops over a period of days and becomes irregular (give or take a hundred rpm or so). Hooking a timing light to the wire that comes from the coil to the leading plugs shows an occasional miss, accompanied by a little stumble of the engine at idle.

This is usually a symptom of spark plug trouble. It is a good idea before doing any troubleshooting to verify that the plugs are in good shape. Unless they are very new, I suggest replacing them as a general precaution. If it doesn't solve the problem, you can put the originals back in later. These symptoms can occur if the plugs are partially fouled, burned, badly gapped, or possibly chipped. If installing new plugs fixes the problem, you shouldn't have to do any further adjusting. However, if attempts were made by other means to adjust the idle, everything will have to be put back to where it was before the trouble started. If this is the case, go through the Standard Idle Adjustment Procedure (Section #3).

## Problem #3

Idle speed cycles up and down. Otherwise the car drives normally.

This condition is caused by unexpected air getting into the system. The more air, the worse the cycling. The EGI system senses the additional air, but the Throttle Position Sensor is telling it to idle. This confuses the EGI system which, in turn, causes idle speed to cycle. Obviously there can be many causes for the unwanted air, but here are the most typical:

1. Lower Intake Manifold Gasket: If the engine has recently had the lower intake manifold off for work, you may have a leak there. These gaskets were prone to leak if not torqued down exactly right. Recent gaskets from Mazda are improved, but no one knows how many of the older types are still hanging on pins in shops around the world.
2. Broken or Cracked Vacuum Hoses: These are not usually a problem with GSL-SEs, but occasionally one will come off (or be left off) when someone works on the car. Sometimes you can hear the hissing.
3. Dirt and/or carbon building up in the Throttle Chamber: This keeps the throttles from closing all the way, which lets more air into the system than it is supposed to have. The EGI system becomes confused and the idle cycles. The fix for this is to remove the Air Funnel (the black duct) from the Throttle Chamber and spritz everything out with a suitable cleaner. Carb cleaner or WD-40 will do. End with a light lubricant in either case. If the problem is severe , you might want to remove the whole Dynamic Chamber so you can get to the throttle plates and shafts from the back. Perform the Standard Idle Adjustment Procedure (Section #3) to straighten out any previous attempts to solve the problem.
4. Dirt and/or carbon building up in theBAC Valve: If the BAC Valve can't close all the way, it allows too much air to enter the Dynamic Chamber. Clean the BAC valve as described in Problem #5.

## Problem #4

Idle Cycling in Conjunction with Surging (the car speeds up and slows down on the highway even though you are holding steady throttle).

This is associated with a miss-adjusted Throttle Sensor (TPS). Another symptom of a badly adjusted TPS is lurching transitions when trying to gently accelerate and back off--as you might do in a rolling traffic jamb. Since the car is surging with the throttle open part way, you know the problem is not confined to the idle, so adjusting the TPS is a good first step. However, the basic problem can still be dirt in the throttle body or a BAC valve that is not closing.

Here is what happens: Your idle starts to cycle, so you take it to a mechanic or friend who immediately adjusts the TPS. The TPS adjustment is designed to match the TPS to the position of the throttles at idle. If the throttles are not closing all the way, the match will be made with the throttle in the wrong position. That, plus compensating with other controls, may tame the idle, but the TPS will be out of position for the rest of its range, which causes the surging and lurching. If you find your car in this condition, clean the Throttle Chamber, re-adjust the TPS and then go through the rest of the Standard Idle Adjustment. That should straighten everything out. If a problem persists, look for the BAC valve to be hanging up and not closing all the way. Clean as in Problem #5.

## Problem #5

- Idle speed too low
- Car Stalls
- Idle speed drops when Air Conditioner Compressor engages
- Idle speed drops with additional electrical load on engine

These are symptoms of a malfunctioning Bypass Air Control (BAC) Valve or Air Supply Valve. Since these are both on the same assembly, we will deal with them together. The fix is the same.

The BAC valve is the EGI system's tool for maintaining 800 rpm. With the engine off, the BAC valve is closed. The EGI system opens it when additional air/fuel is needed to compensate for drag on the engine caused when the alternator must work harder to provide electricity for heater fans, headlights, and other devices. If the BAC valve is stuck shut, additional air will not be available, and any of these activities will cause the idle to drop. A properly working BAC valve varies its opening depending on demand.

The aft end of the BAC valve is the Air Supply Valve (ASV), which only responds to the mechanical load when the Air Conditioning compressor engages. It is an on/off device, powered by a small electromagnet, and is less prone to failure. However, if the idle is just fine until you put the air conditioner on, look there for your problem. For simplicity, I will refer to the BAC/ACV valve combination as the BAC Valve assembly.

If you suspect a problem with the BAC valve, the first step is to remove it and see if the valve itself is moving. Disconnect the black hose on top, and the two electrical connectors on the wires that come from each end of the assembly. Remove the small vacuum hose coming off of the front the BAC valve, on the same side as the Dynamic Chamber (it is not easy to see). Remove the two bolts holding the BAC Valve assembly to the Dynamic Chamber. Remove it carefully, noting the condition of the gasket where it attaches to the Dynamic Chamber (they usually come off cleanly, so you probably won't need a new gasket). Note that this is the opening through which "bypass air" enters the Dynamic Chamber to supplement the air coming past the throttle plates.

There are two bolts connecting the BAC valve and the Air Supply Valve together. Remove them and separate the two parts. Look at the BAC valve first. When at rest, the valve itself is closed, and the shaft will be extended outward. You should be able to put your finger on the end and push it in. You should feel some resistance. When released, the valve should smoothly return to it's closed position. If you have it handy, take a piece of vacuum tubing, attach it to the hose barb on the diaphragm and suck on it. This should also open the valve (pull it inward). If it does not move smoothly, or if it is stuck shut, clean it with a suitable cleaner and lube it with WD-40. It does not have to be a high-tech operation, just get it working smoothly. Have a rag handy for the sludgy liquid which will come out as the cleaner drains.

Now work with the Air Supply Valve. To test it, you will have to apply 12 volt power from the battery to the electrical leads. The plunger should snap in and out sharply. You might as well clean it out while you have the part off. Put the BAC/ASV assembly back together and remount it to the Dynamic Chamber. Reconnect the vacuum hose in the front, the two electrical connections, and the larger hose on top. If, in your quest to solve the problem, you have been messing with the TPS or other adjustments, do the Standard Idle Adjustment to bring everything else back in line.

If everything else seems okay, but the idle still falls below 800 rpm when the air conditioner compressor is engaged, you can adjust the Air Supply Valve by removing the black cap that covers the access hole to the adjusting screw (if the cap is still there). Turn the screw counter-clockwise to increase engine speed when the air conditioner compressor is engaged.

Note: There is a fancier method to adjust the Air Supply Valve shown in the shop manual. I have included it with the instructions for the Standard Idle Adjustment.

## Problem #6

Idle speed too high (above, say, 1000 rpm).

If you have a steady idle that is too high, you are getting just a little too much air into the system, but not enough to cause cycling. You can try and compensate with the Air Adjust Screw, but the base cause could either be a BAC valve which is not closing all the way or the throttle plates not closing all the way. Eventually, the problem is likely to get worse. Start with the BAC valve as in Problem #4 simply because it is easier. If you don't find a problem, clean the throttles as described under Problem #5.

## Problem #7

Idle speed "hangs up" at around 1100 rpm, but suddenly drops back to normal (as if the ignition was momentarily turned off) when the clutch pedal is released

Another way to drop the idle back to normal is to place an electrical load on the engine (like holding the power window switches down when the windows can't go any further). Felix Miata (mrmazda@gate.net) posted a solution to this one, and I will paraphrase it here.

Adjusting the engine's spark advance can alter the idle speed. Within limits, the more advanced the spark, the faster the idle. Spark advance on the GSL-SE engine is controlled in part by the EGI system, which supplies vacuum to the distributor when the spark needs to be advanced. This occurs when the engine speed increases beyond the range of 1,000 to 1,200 rpm. When the Throttle Position Sensor senses that your foot is off the gas, the EGI system cuts the vacuum supply, and the spark timing suddenly drops to its retarded setting. (This, by the way, is a function of the green valve below and to the left of the BAC valve. That's why they call it the Vacuum Control Solenoid Valve.) As the engine ages, the throttle shafts get a little loose, and even though you have adjusted the TPS by the book, the throttle shafts may be shifting position a little, not allowing the TPS to get to the point where it signals the EGI that the car is supposed to be idling. The EGI system fails to retard the spark, and the idle hangs up until something else (releasing the clutch, or putting an electrical or mechanical load on the engine) persuades the EGI system to cut vacuum to the distributor. You can watch this happening with a timing light.

One fix for this is to get a new Throttle Body, but that would be costly. Better to tweak the TPS so that it compensates for the wear in the throttle shafts. When adjusted according to the manual, the TPS will show proper adjustment over a range of a half-turn of the screw or so. Favor the adjustment toward the screw being turned clockwise. If this doesn't work, Felix suggests readjusting the TPS, but not by the manual.

He says to cause the idle to hang up by raising engine speed above 2,000 rpm. Do this with the gas pedal to duplicate the actual driving condition. Don't touch the throttle shaft. Hold your engine speed above 2000 rpm for several

seconds and release. This should hang the idle up. Go to the TPS and delicately--without any downward pressure--turn the adjusting screw slowly clockwise until the idle speed falls.

You can now shut the engine down and (using the standard procedure) check the TPS. You should get the proper reading. Refer to the section on adjusting the TPS for details on the adjustment.

### Problem #8

When coming to a stop, the idle drops significantly below 800 rpm and then comes back up. Sometimes, the car stalls near the very end of the warm-up cycle if the air conditioning compressor is engaged.

This one is relatively rare, but a devil to find if you don't know what to look for. Due to wear or misadjustment, the throttle plates are closing too far. The EGI system compensates by fiddling with the BAC valve. This works pretty well most of the time, but every once in awhile the BAC system is not quick enough to catch it and the idle drops like a rock. Then it comes back up. To verify that you have this condition, try turning the Air Adjust Screw. If the throttles are not letting much air pass, turning the Air Adjust Screw (which comes before the throttle plates) won't have much of an effect on idle speed. Also, if you disable the BAC system (by disconnecting the electrical connection for the Vent Solenoid Valve and the Vacuum Solenoid Valve) the car will hardly idle at all. The Standard Procedure for Adjusting Idle will also not have much of an effect.

To adjust the throttle stop screw, first take note of it's current position. The object is to turn the throttle stop screw inward an eight of a turn each time--propping the throttle plates open more and more. When you get a linear response from the Air Adjust Screw, you are probably in the right place. The Standard Procedure for Adjusting Idle will also work properly. You will need to use it since changing the resting point for the throttles will put your TPS out of adjustment.

## Standard Adjustment Procedures

### Adjusting The Throttle Sensor (Throttle Position Sensor, or TPS)

Locate the test connector near the strut tower and the air filter. It is a green, three pronged connector. Position it so the two parallel connectors are on top, looking like two eyes and a mouth. You will be measuring current flow between the mouth and each eye. There are three ways to do this:

1. You can get from Mazda (or build) a rig with two 12 volt, 3.4 watt light bulbs. Mazdatrix sells it as part # 49-F018-0010. To build your own, pigtail one lead from each bulb together, and connect them to the "mouth." Connect the remaining lead from each bulb to one of the eyes.
2. You can use two voltmeters. Set the range for 20 volts DC. Meter #1 will have it's positive lead to the "mouth" and the negative lead to the left "eye." Meter #2 will have it's negative lead to the "mouth," and its positive lead to the right "eye."
3. If you only have one volt meter, you can buy another one (cheap) or you can make do with the single meter and by alternating the position of the leads. The problem is you have to reverse leads as you alternate to keep the meters wired as in the "two meter" description above.

Locate the TPS adjusting screw. This is a slotted screw located 2 inches to the intake side of the "R" in "RE-EGI." This screw came with a cap over it, but don't be surprised if it is missing.

For the following procedure, reference is made to voltage registering on one, both, or neither meter. This is the same as one both or neither lights glowing if you are using that method.

1. Warm up the engine and stop it.
2. Connect the meters or lights to the green test connector
3. Turn the ignition switch on (light the dash warning lights)
4. Look for one meter to register voltage.

5. If voltage registers on both meters turn the adjusting screw counter-clockwise.
6. If voltage registers on neither meter turn the adjusting screw clockwise.

The TPS is properly adjusted when only one meter registers voltage.

Note: This procedure will not work unless the key has been turned off, and then back on. In other words, you cannot adjust the TPS if the key remains on after the engine has stalled. You must turn the key off, and then back on again.

### Testing For A Bad TPS

If you suspect the TPS is malfunctioning (as opposed to being out of adjustment) you can check it with an ohmmeter. This is done with the engine off. Disconnect the connector from the Throttle Sensor itself and orient it like an upside-down face, with the "mouth" on top, and the two parallel "eyes" on the bottom. Connect your ohmmeter to the "eye" on the right and the "mouth" above. Look for a reading of about 1 k-ohm with the throttle closed (idle) and 5 k-ohm with the throttle fully open.

## Standard Idle Adjustment Procedure

The object here is to get the engine to idle at 800 rpm WITHOUT help from the EGI system working through the Bypass Air Control system. Since you are going to disconnect them, you must be sure you are not putting any load on the engine from accessories.

1. Switch everything off (heater fan, lights, radio, etc.)
2. Remove the fuel filler cap.
3. Warm up the engine to normal operating temperature
4. Check the TPS for proper adjustment. Adjust if necessary.
5. Disconnect the electrical lead for the Vent Solenoid Valve and the Vacuum Solenoid Valve (This is a single plug connecting to the two barrel-shaped solenoids located under the BAC/ASV assembly).
6. Adjust idle for 800 rpm using the Air Adjust Screw.
7. Reconnect the electrical lead for the Vent Solenoid Valve and the Vacuum Solenoid Valve, OR proceed to the options below.

### Option 1: Adjusting the Air Supply Valve

This is not necessary unless you have just cleaned the BAC and Air Supply Valve, and you still have a problem with idle dropping below 800 rpm but only when the air conditioner compressor is engaged.

Before reconnecting the Vent and the Vacuum Solenoid Valves, disconnect the electrical connector to the Air Supply Valve. Hook up the two leads to the battery. This will open the valve and let more air into the Dynamic Chamber. Look for idle speed to increase to the range of 1,000 to 1,070 rpm. If outside of that range, the adjustment screw is under a black plastic cap (if the cap is still there) on the side of the Air Supply Valve.

Reconnect the electrical lead for the Vent Solenoid Valve and the Vacuum Solenoid Valve, OR proceed to the option below.

### Option 2: Adjusting the Idle Mixture

This is not necessary unless you have reason to suspect it has been tampered with, or you have just replaced it. If you want to check the Idle Mixture (the black thing that says R--L on it, located just aft of the air filter) this is a good time. Remove the goop if it is still in there, exposing the screw. Adjust the screw counter clockwise until the idle drops very slightly, (from 800 rpm to 780 rpm). Then turn the screw clockwise until you are back to 800. Keep

in mind that this is not ever supposed to need adjustment, so I wouldn't mess with it unless you have reason to suspect that someone else has been in there.

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