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## Throttle Position Tech & Adjustment Procedure

The Toyota 22RE and 3VZ engines are electronically fuel injected. As such they lack a mechanical carburetor and instead split the function of the carburetor into three parts: the air flow meter in the air cleaner box, the throttle body and the fuel injector. The air flow meter uses a flapper vane and temperature sensor to detect the temperature and velocity/flow of the incoming air charge. The throttle body controls the airflow into the engine and the fuel injectors supply the proper amount of fuel to the engine depending upon operating conditions.

The throttle body contains the throttle valve that it operated by the accelerator pedal in the driver's compartment. The valve serves to regulate the amount of air that gets introduced into the engine. The fuel injectors spray atomized fuel into the intake of each cylinder in response to an electrical signal from the engine computer (ECU). One determining factor (among many) for the amount of fuel to inject is based upon the position of the throttle valve, which is determined by the throttle position sensor (TPS). Periodically, the throttle body should be cleaned or checked for a buildup of sludge that may clog the air bypasses, vacuum ports, or prevent the throttle plate from closing to its proper position. This should be checked prior to any adjustment of the TPS. Crankcase vapors are commonly vented into the throttle body for re-introduction into the combustion process (by the Exhaust Gas Recirculation, or EGR, valve). These vapors can leave an oily residue on the back of the throttle plate and allow sludge and dirt to accumulate. The throttle body can easily be cleaned while on the vehicle with a little carburetor cleaner and a cloth or throttle body cleaners. However, for heavy sludge buildup, it should be completely removed, washed in solvent, and dried thoroughly. When doing this, it is important that the TPS should be removed to prevent contamination (a primary cause for failure) and the throttle body-to-plenum gasket replaced. We strongly recommend cleaning your throttle body thoroughly before attempting any adjustment.

The Toyota 22RE engines use a "Linear" throttle position sensor. The sensor basically looks at idle or closed throttle (IDL) and throttle angle opening (VTA). The TPS itself is simply a linear variable resistor that when driven by the ECU produces a linear voltage in a 0-5 volt range, 0 volts being idle and up to 5 volts representing throttle opening angle. Internally, there is also a switch that detects the idle position. Proper adjustment of the TPS is critical for engine performance, fuel economy, and emissions. An improperly adjusted TPS affects many other inputs and outputs from the ECU, many of which would not even logically point to the TPS. Some common symptoms of a bad TPS are; erratic shifting (automatic transmission), inability to adjust timing correctly, poor throttle response, poor fuel economy etc... Many of these running issues can be solved by a simple adjustment! Aside from being out of adjustment, the TPS can just plain wear out or break internally.



After you have properly adjusted the stop screw and the TPS you will need to look at the dash pot. The dash pot is designed to slow down the closing of the throttle to prevent backfiring. It consists of a round air bellow, a spring loaded plunger, and the air vent line that attaches to the fitting at the base of the bellows. The vent line has a check valve in-line and an air filter to keep dirt out. The check valve lets air into the bellows when the throttle opens and extends the plunger. When the throttle closes, the stop screw contacts the plunger and pushes it in. The check valve slows down the air flow which slows down the throttle linkage. To troubleshoot the dash pot make sure the check valve air filter is clean and make sure the check valve is not clogged or stuck open. You should be able to blow air into the bottom freely (throttle opening) but it should be harder to suck air back out of the check valve (throttle closing). You can clean the air filter and check valve with some soapy water, do not use any harsh cleaner like carburetor cleaner. The plunger will also stick sometimes; you can spray a small shot of **DRY** silicone spray to help keep it moving freely. Lube it then push it in and out fully a few times to work the lubricant down into the plunger. The adjustment procedure for the dash pot is listed below with the TPS adjustment (step 8). **Make sure you DO NOT contaminate the inside of the sensor.**

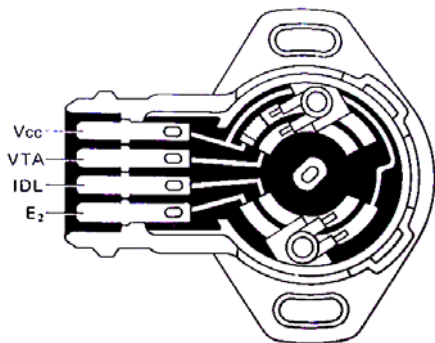
### **TPS Adjustment / Testing Procedure:**

This procedure can be done with the throttle body installed but is much easier to do out of the vehicle. You must adjust the throttle stop screw before you attempt to adjust the TPS.

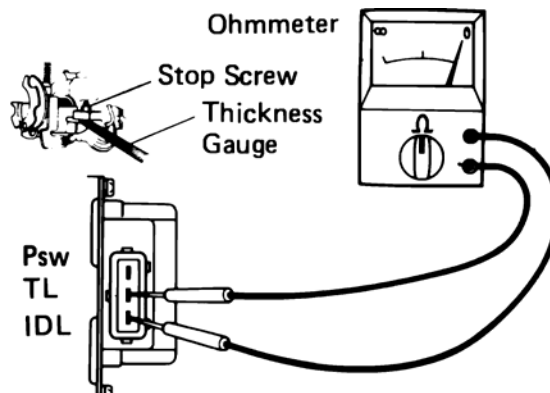
1. Loosen the jam nut and unscrew the throttle stop screw all the way so that the throttle blade closes fully against the throttle body itself.
2. Turn the stop screw back in until it just touches the linkage, then turn in  $\frac{1}{4}$  turn more. This extra  $\frac{1}{4}$  turn keeps the throttle blade from sticking against the inner bore of the throttle body.
3. Tighten the jam nut while holding the stop screw in place to prevent it from moving.
4. Unplug TPS
5. Loosen the TPS mounting screws just enough that you can barely move the TPS. You want to keep the TPS from moving too freely (it is easier to keep the TPS snug enough that you tap it very lightly to move it into adjustment).
6. Use an ohmmeter and a feeler gauge to test the TPS (test the TPS itself and not the connector side). See pictures and charts below for connector pin outs and test values.
  - a. If in doubt about the layout of the terminals an easy way to identify the proper orientation is to identify the VTA-E2 terminal pairs. E2 is at one end of the TPS or the other. VTA is one pin in from the opposite end. The VTA-E2 signal varies from a few hundred to a few thousand ohms as the TPS moves through its range of travel. So try one end of the TPS connector for E2 and see if the resistance varies properly, if not, try the other end. Once the E2 end of the connector is identified, the rest of the pins should be laid out as indicated in Figure 3.
7. The TPS adjustment is very touchy so make sure that you make small adjustments. If the TPS fails to read the proper resistance in any tests then it should be replaced.
8. Adjust the dash pot by setting the plunger so that it first makes contact with the throttle linkage about halfway back from wide open throttle. If set too deep you will have more spring force to overcome and that can cause the throttle to not fully close. Too shallow and the dash pot will not slow the linkage down properly.



**85-95 TPS (22RE & 3VZ)**



**83-84 TPS**



1983 & 1984 Only			
Clearance Between Linkage & Stop Screw	Resistance		
	IDL - TL	Psw - TL	IDL - Psw
0.50mm (0.0197")	Continuity	No Continuity	No Continuity
0.70mm (0.0276")	No Continuity	No Continuity	No Continuity
Wide Open Throttle	No Continuity	Continuity	No Continuity

1985-1995 22RE & 3VZ				
Test	Clearance Between Linkage & Stop Screw	Between Terminals	Resistance (85-88)	Resistance (89-95)
1	22RE - 0.00mm (0.0000")	VTA - E2	.20K - .80K	0.47K - 6.1K
	3VZ - 0.50mm (0.0197")			
2	22RE - 0.57mm (0.0224")	IDL - E2	Less Than 2.3K	Less Than 2.3K
	3VZ - 0.77mm (0.0303")			
3	0.85mm (0.0335")	IDL - E2	Open / Infinite	Open / Infinite
4	Wide Open Throttle	VTA - E2	3.3K-10K	3.1K - 12.1K
5	Any Position	Vcc - E2	3.0K - 7.0K	3.9K - 9.0K

In the above tests, you are actually simulating various throttle positions and rotating the TPS on its base to achieve all the above conditions. Below is an explanation of these tests.

- Test #1 simulates the closed throttle position, with the throttle valve fully closed and the throttle stop lever in contact with the throttle stop screw
- Test #2 and #3 test the transition from idle to normal operation
  - If you are unable to get the exact feeler gauge size then use the closest gauge you have to the value, or stack two thinner gauges to make one the right thickness



- Also note that there are a range of values for these tests.
  - Setting the TPS idle transition too close to 0 opening may result in a rough idling engine if the throttle were to stick open a tiny bit.
  - Setting the transition too far out, would result in a sluggish throttle response, since the ECU would see a longer idle section on the TPS.
- If your TPS makes the idle transition (below 2300 to infinite) but it will do it at 0.90mm instead of at 0.85mm does this mean the TPS is bad? Probably not, if everything else checks out, you may just be seeing the effect of the manufacturing tolerances of the TPS and the throttle body stacking up and pushing the setting outside the "normal" range. But if the TPS never makes the idle transition (i.e. it reads infinite at all throttle openings) then it is bad.
- Test #4 tests the wide open throttle (WOT) setting.
- Test #5 just measures the entire resistance of the outer-most current.
- One final test, not listed would be to run the TPS shaft from idle to wide open throttle and watch the VTA-E2 resistance and make sure it increases steadily, no drop outs or dead spots. If you observe abrupt resistance changes, the TPS could be faulty.

### **Allen Head Bolt Upgrade:**

One challenge to adjusting the TPS is that the screws are nearly impossible to access when the unit is in the vehicle. To make the adjustment easier LC Engineering offers a TPS bolt upgrade kit (part #1093082) to replace the stock TPS Phillips head screws with allen head bolts and then use a ball-end allen wrench to loosen and tighten them. The ball headed allen wrench allows you to access the bolts at an angle instead of having to get to them straight on like the stock screws. This kit will also help if you have damaged the stock screw heads trying to loosen them up. This kit contains two M4-0.7 x 16mm socket head bolts, four M4 flat washers and one 3mm ball head allen wrench. The screw length changed around on the stock applications so we supply you with bolts to match the longest stock application and then you can use the supplied washers to shim them as needed for proper length.