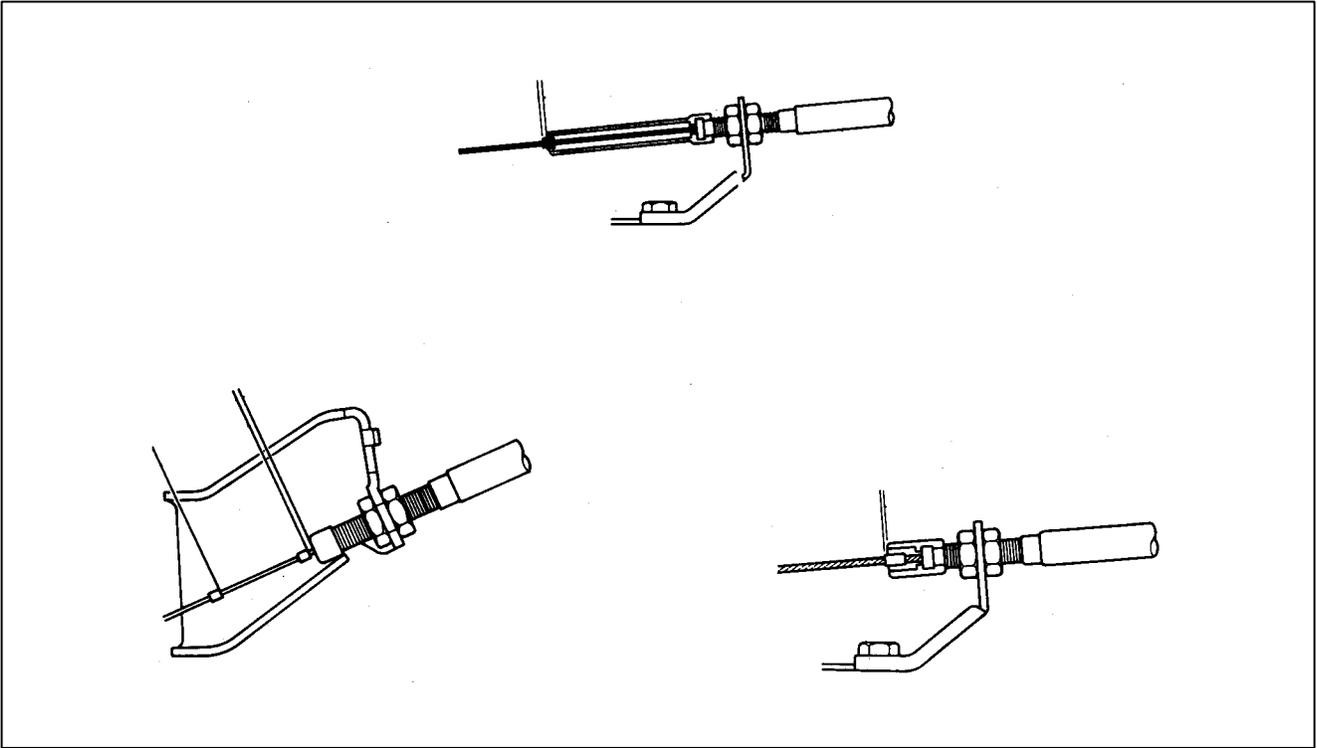


Section 11

TRANSMISSION CHECK, ADJUSTMENTS AND DIAGNOSIS



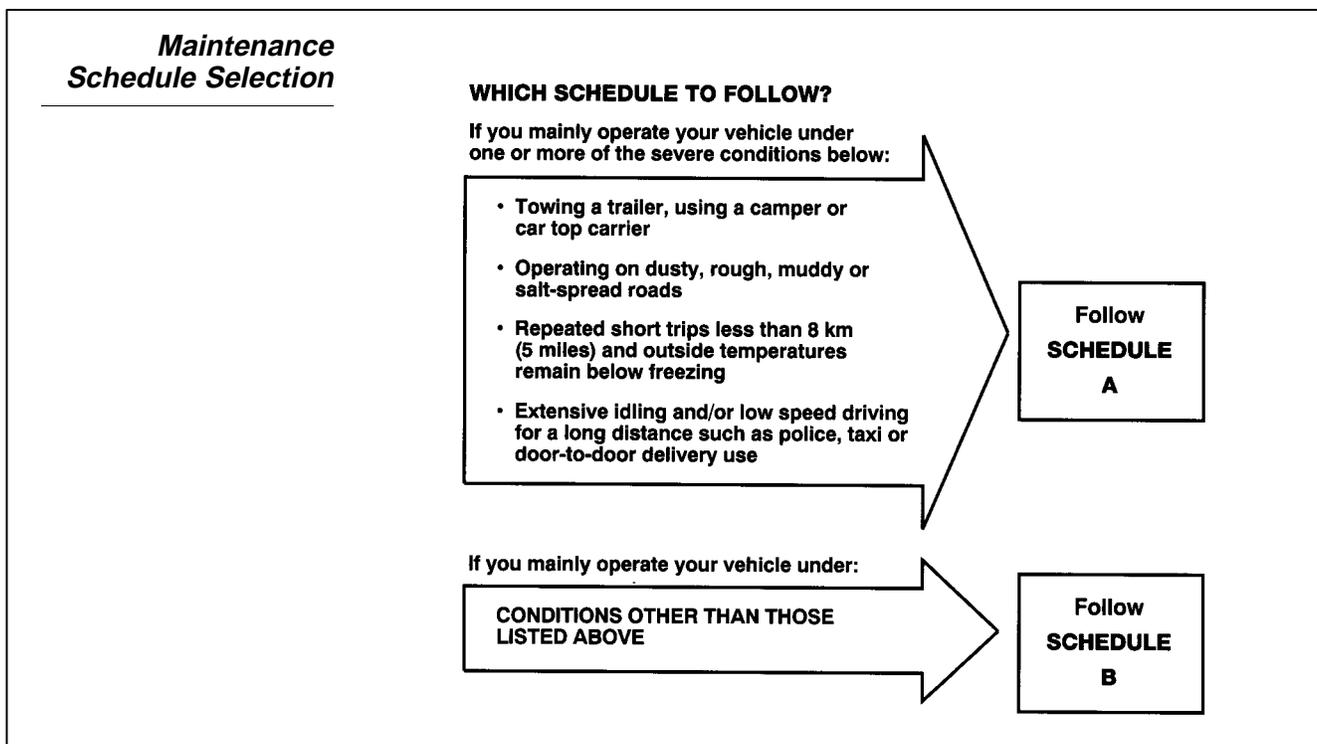
- Lesson Objectives:**
1. -Perform pressure test of the automatic transmission using appropriate pressure gauge set.
 2. Perform stall test of automatic transmission vehicle using procedure described in appropriate repair manual.
 3. Using an ECT Analyzer, distinguish between mechanical and electrical failures in electronic control transmissions.
 4. Using a voltmeter at the diagnostic connector, determine if the ECT ECU is processing input and directing output signals correctly.
 5. Using a voltmeter at the diagnostic connector, determine if the throttle position switch and brake switch inputs to the ECT computer are correct.

Checks and Adjustments

The transmission requires regular maintenance intervals if it is to continue to operate without failure. As we discussed in previous sections, transmission fluid loses certain properties over time and especially due to heat.

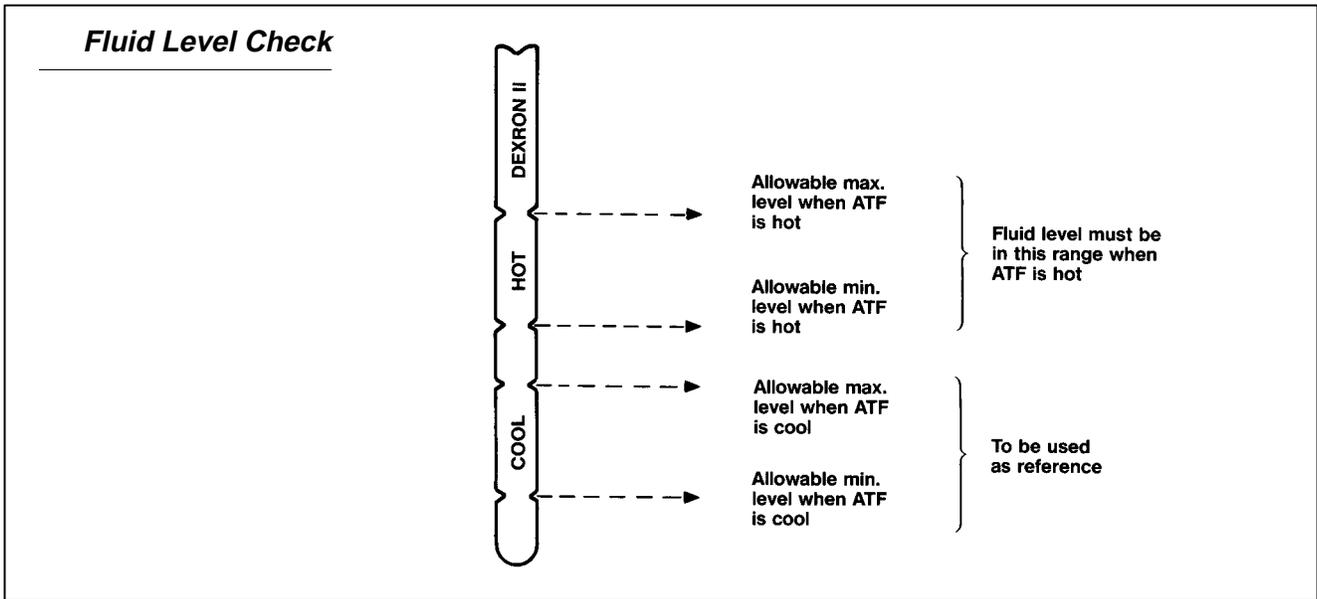
The Maintenance Schedules found in the repair manual or the Owners Manual indicate the appropriate replacement schedules based on how the vehicle is used. Schedule A for example, recommends replacement of the fluid every 20,000 miles or 24 months. Whereas Schedule B recommends just an inspection of the fluid every 15,000 miles or 24 months and no replacement interval.

The chart below indicates which maintenance schedule to follow based on the use of the vehicle.



Fluid Level The fluid level in the automatic transmission should be inspected by means of the dipstick after the transmission has been warmed up to ordinary operating temperature, approximately 158°F to 176°F. As a rule of thumb, if the graduated end is too hot to hold, the fluid is at operating temperature. The fluid level is proper if it is in the hot range between hot maximum and hot minimum.

NOTE The cool level found on the dip stick should be used as a reference only when the transmission is cold. The correct fluid level can only be found when the fluid is hot.



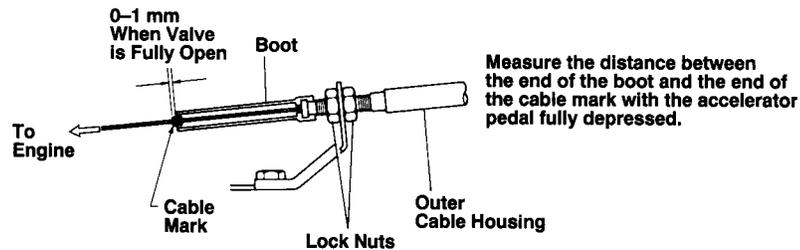
It is important to keep the fluid at the correct level at all times to ensure proper operation of the automatic transmission. If the fluid level is too low, the oil pump will draw in air, causing air to mix with the fluid. Aerated fluid lowers the hydraulic pressure in the hydraulic control system, causing slippage and resulting in damage to clutches and bands. If the fluid level is excessive, planetary gears and other rotating components agitate the fluid, aerating it and causing similar symptoms as too little fluid. In addition, aerated fluid will rise in the case and may leak from the breather plug at the top of the transmission or through the dipstick tube.

In addition, be sure to check the differential fluid level in a transaxle. This fluid is sealed off and separate from the transmission cavity in some applications.

Throttle Cable The throttle cable is adjustable on all automatic transmissions. And in each case it controls throttle pressure. Throttle pressure is an indication of load. When the throttle is depressed, the cable transfers this motion to the base of the throttle valve and moves it upward to increase throttle pressure. Throttle pressure causes the primary regulator valve to increase line pressure. As the throttle is depressed, greater torque is produced by the engine and the transmission may also downshift to a lower gear. If line pressure did not increase, slippage could occur which would result in wear of the clutch plate surface material.

Throttle pressure's affect on transmission operation differs between a hydraulically controlled transmission (non-ECT) and an electronically controlled transmission (ECT). In a non-ECT transmission, throttle pressure affects shift points and line pressure; whereas in an ECT transmission it only affects line pressure. Control of line pressure will affect the quality of the shift, not the shift points, in an ECT transmission.

Throttle Cable Adjustment

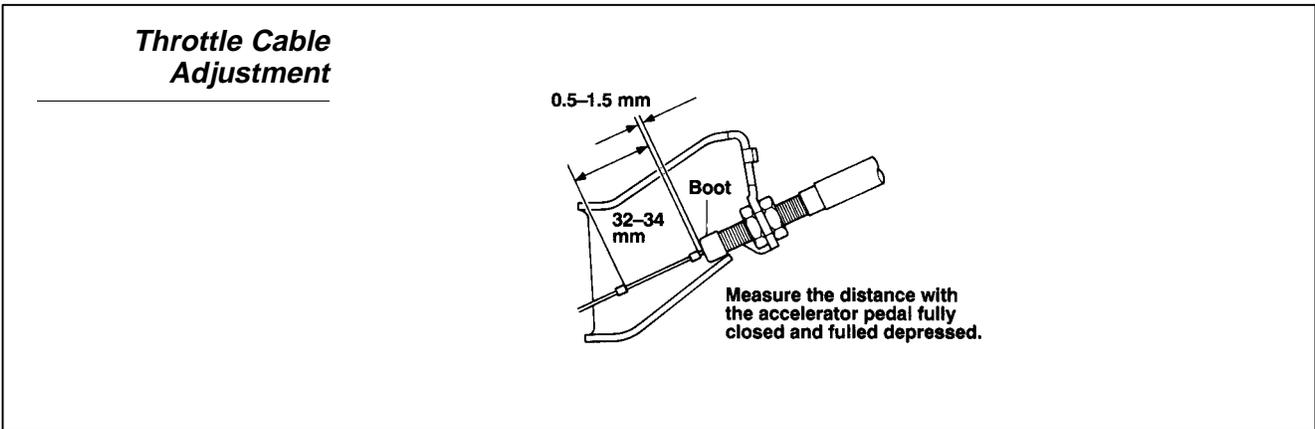


Inspect and Adjust the Throttle Cable

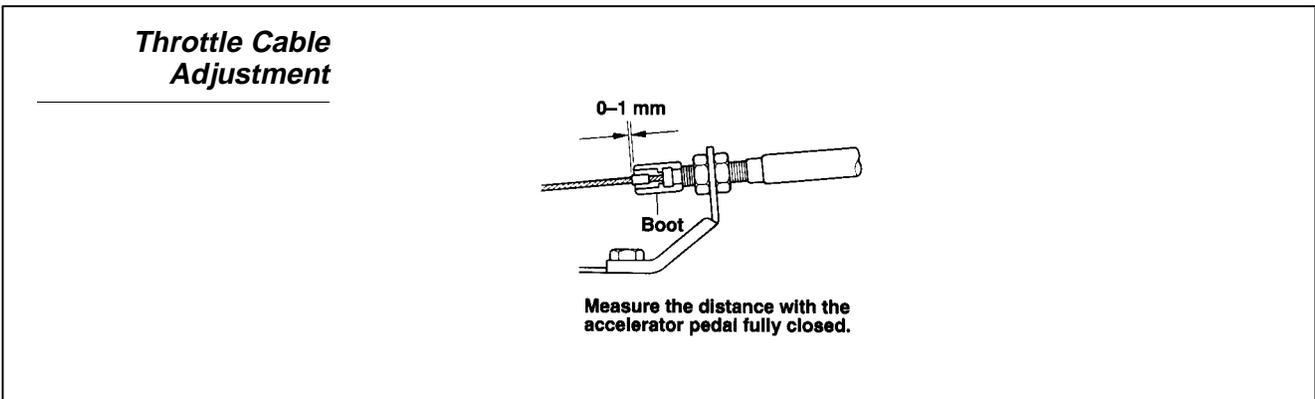
To inspect the throttle cable adjustment, the engine should be off. Depress the accelerator pedal completely, and make sure that the throttle valve is at the maximum open position. If the throttle valve is not fully open, adjust as needed.

With the throttle fully open, check the throttle cable stopper at the boot end and ensure that there is no more than one millimeter between the end of the stopper and the end of the boot. If adjustment is required, make the adjustment with the throttle depressed. Loosen the locking nuts on the cable housing and reposition the cable housing and boot as needed until the specification is reached.

The Land Cruiser A440 automatic transmission throttle cable is adjusted differently, as seen below. It is measured in two positions. The first measurement is made with the throttle fully closed. The distance varies in that the measurement is made from the end of the boot to the front of the stopper. Measure the same distance with the throttle in the fully open position.

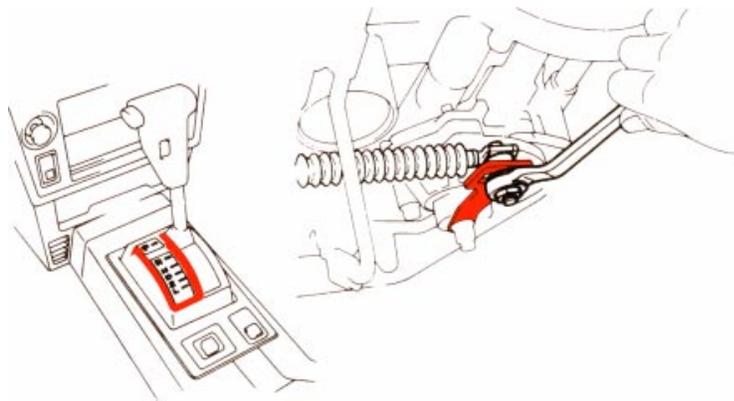


The illustration below represents yet another adjustment type. The rubber boot has a shallow extension when compared to the first one discussed earlier. The procedure differs in that the throttle is left in the fully closed position when the distance is measured from the front of the boot to the front of the stopper.



Inspect and Adjust the Shift Cable

To inspect the shift cable, move the gear selector from neutral to each position. The gear selector should move smoothly and accurately to each gear position. Adjust the shift cable if the indicator does not line-up with the position indicator while in the proper detent. To adjust, loosen the swivel nut on the shift linkage. Push the manual lever at the transmission fully toward the torque converter end of the transmission. Then pull the lever back two notches from Park through Reverse to the Neutral position. Set the selector lever to the Neutral position and tighten the swivel nut while holding the lever lightly toward the reverse position.

Shift Cable Adjustment**Check Idle Speed and Adjust if Applicable**

Idle speed is an important aspect for transmission engagement. If set too high, when shifting from neutral to drive or reverse, the engagement will be too abrupt, causing not only driver discomfort, but also affecting the components of the transmission as well. And, of course, if the idle is too low, it may cause the engine to stall or idle roughly.

To adjust the idle speed:

- The engine should be at operating temperature.
- All accessories should be off.
- Set the parking brake.
- Place the transmission in park or neutral position.
- Engine cooling fan should be off.

Diagnosis During diagnosis, always verify the customer complaint. If the verification includes a test drive, be sure to check the level of ATF first. This will ensure that a low level is not contributing to the problem and give you an idea as to the condition and service that the vehicle has seen. Although preliminary checks suggest making adjustments, drive the vehicle before any adjustments in order to experience the same condition as the customer. If you are unable to verify the problem, ask the customer to accompany you on the test drive and point-out when the condition occurs.

When test driving a vehicle, have a plan and record your findings. The chart that follows is quite thorough and provides room for comments. Rather than trying to remember the results of a specific test, simply refer to the diagnostic form. Not only do you want to find out what has failed, but also what is functioning properly. Armed with this information, you will save time in your diagnosis and be more thorough.

**Road Test —
Automatic
Transmission**

Vehicle _____

Driver _____

Tach Reader _____

Recorder _____

Speedometer Reader _____

1. D Range Upshifts:

	NORMAL	POWER
Quarter Throttle	1-2 _____ mph	1-2 _____ mph
	2-3 _____ mph	2-3 _____ mph
	3-4 _____ mph	3-4 _____ mph
Half Throttle	1-2 _____ mph	1-2 _____ mph
	2-3 _____ mph	2-3 _____ mph
	3-4 _____ mph	3-4 _____ mph

Shift Quality: Normal Excess Shock Slippage

2. 2-Range Upshifts:

Quarter Throttle	1-2 _____ mph
Half Throttle	1-2 _____ mph

Shift Quality: Normal Excess Shock Slippage

3. 2-Range Engine Braking: OK NG

4. L Range Engine Braking: OK NG

5. D Range Kick-Down:

	OK	NG
OD to 3	_____	_____
OD to 2	_____	_____
3 to 2	_____	_____
2 to 1	_____	_____

6. Manual Down-Shifts:

ECT Transmission—At 35 mph in OD, press OD OFF button; record engine rpm change. _____ rpm

At 35 mph, shift from D to 2; engine speed increases. _____ rpm

At 25 mph, shift from 2 to 1; engine speed increases. _____ rpm

Comments: _____

For example, if the transmission does not slip while accelerating from a stop with wide open throttle, line pressure is sufficient. If shift points occur at the proper speeds, throttle pressure and governor pressure are sufficient. Or for ECT transmissions, throttle sensor and speed sensor inputs are being received by the ECU and the circuit and solenoids are working properly.

Upshift quality is important to consider during the road test because it is an indicator of proper line pressure and accumulator operation. If all upshifts are harsh, it indicates a common problem such as line pressure and should be verified with a pressure test. If a harsh upshift is evident in a specific gear, check the accumulator which is associated with the holding device for that specific gear.

Following the road test, compare your findings with the troubleshooting matrix chart in the repair manual. (An example can be found on page 223 of the appendix to this book.) The matrix chart will assist you in identifying components or circuits which can be repaired while the transmission is mounted in the vehicle. Or identify the components which should be inspected with the transmission on the bench.

Based on your diagnosis, if the transmission can be repaired with an on-vehicle repair, the off-vehicle repair should be attempted first. Should the transmission require removal from the vehicle, a remanufactured transmission should be evaluated against the cost of an in-house overhaul.

Electrical Diagnostic Testing

Onboard Diagnostics

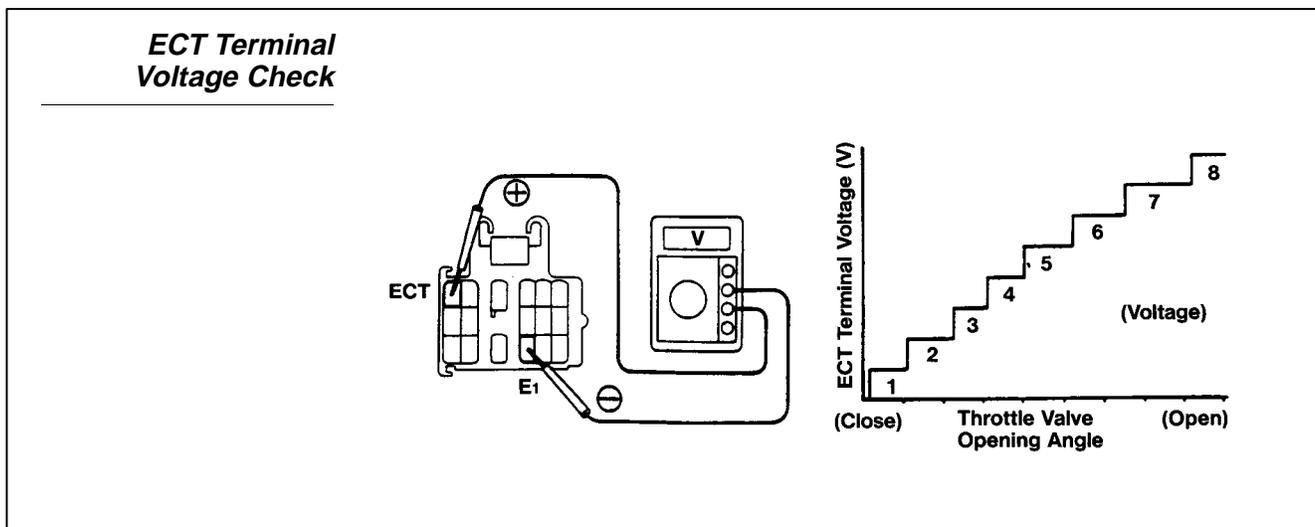
The ECU is equipped with a built-in self diagnostic system, which monitors the speed sensors, solenoid valves and their electrical circuitry. If the ECU senses a malfunction:

1. It blinks the OD OFF light to warn the driver.
2. It stores the malfunction code in its memory.
3. (When properly accessed) it will output a diagnostic code indicating the faulty component or circuit.

Once a malfunction is stored in the memory system, it will be retained until canceled (erased). The vehicle battery constantly supplies 12 volts to the ECU B terminal to maintain memory even if the ignition switch is turned off. If the malfunction is repaired or returns to normal operation, the warning light will go off but the malfunction code will remain in memory. In order to erase a diagnostic code from the memory, a specified fuse must be removed for approximately 30 seconds while the ignition switch is off. The fuse is identified in the repair manual or on the ECT Diagnostic Information technician reference card. A copy of this card can be found in the appendix of this book.

Throttle Position Sensor Signal

In order to determine if the throttle position sensor signal and brake switch signal are being received by the ECU, place the ignition switch to the ON position with the engine off, connect a digital voltmeter to the diagnostic check connector and slowly depress the throttle. On models prior to 1987, if the vehicle does not have a diagnostic check connector in the engine compartment, connect the voltmeter to the DG Terminal. Its location can be found in the appropriate repair manual.



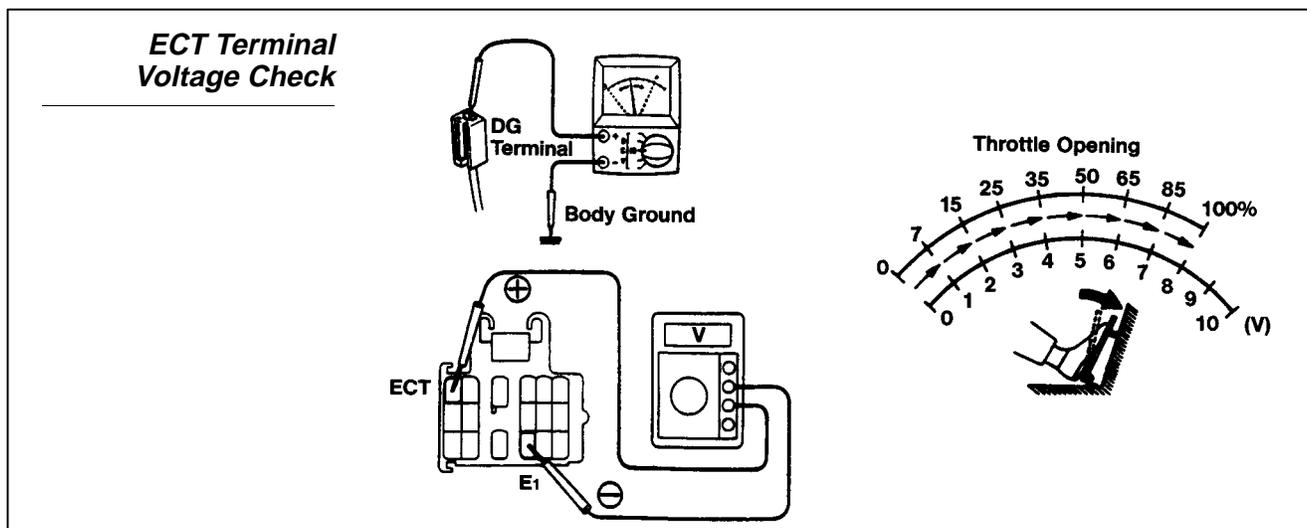
The ECT terminal can be designated as TT or T1 depending on the vehicle model. The position in the diagnostic check connector remains the same. The voltage will increase in one volt increments from 1 to 8 volts as the throttle is slowly opened. To verify the brake signal, apply the brake pedal while the throttle is wide open. The voltage displayed on the voltmeter screen will go to zero.

If the voltage readings progress in a step-like fashion, it indicates proper operation of the following:

- Throttle sensor
- Circuit integrity from the sensor to the ECU
- Circuit integrity from the ECU to the diagnostic check connector.

If the voltage remains at 0 volts as the accelerator is depressed, possible causes are:

- Brake signal remains on.
- IDL signal remains on.
- ECU power supply circuit.
- Faulty ECU.

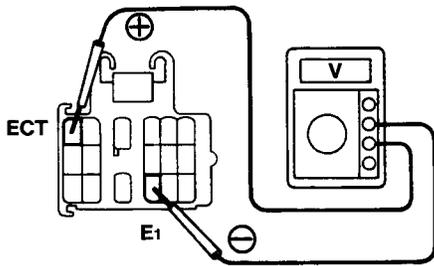


The voltage chart above provides a voltage value for the corresponding throttle opening. This can be used to establish accelerator position for a given throttle opening.

Terminal voltage and Gear Position

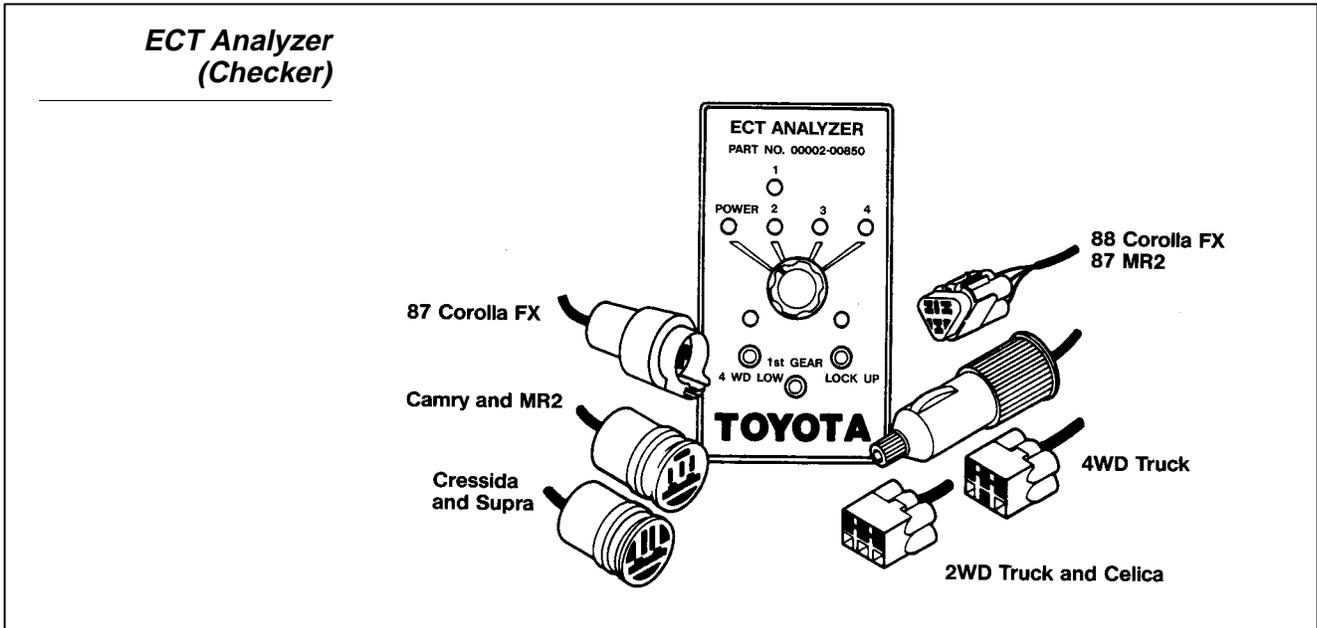
To check for shift timing while the vehicle is driven, connect a voltmeter and drive the vehicle. Voltage will increase in one volt increments from 0 to 7 volts. These voltage signals are output from the ECU to indicate a response to system sensors. The lock-up voltages in second and third gear may not be consistently output with throttle opening under 50%. In order to output each voltage signal, the throttle will need to be open greater than 50%. If the gears fail to shift in response to the changes in voltage readings, the solenoids may be sticking or the electrical circuit to the solenoid may have an open.

Terminal Voltage and Gear Position



ECT Terminal (V)	Gear Position
0	1st
2	2nd
3	2nd Lock-Up
4	3rd
5	3rd Lock-Up
6	O/D
7	O/D Lock-Up

ECT Analyzer The ECT Analyzer is designed to determine if a transmission malfunction is ECU/electrical circuit related or in the transmission. The analyzer is connected at the solenoid electrical connector using appropriate adapter harnesses. The vehicle is driven using the analyzer to shift the transmission.



If the transmission operates properly with the ECT Analyzer, the fault lies between the solenoid connectors up to and including the ECU. On the other hand, if the transmission does not operate properly with the analyzer, the fault is likely to be in the transmission. This would include a failure of the solenoid or a mechanical failure of the transmission. A solenoid may test out electrically and fail mechanically because the valve sticks. Apply air pressure to the solenoid; air should escape when the solenoid is energized and should not escape when the solenoid is not energized.

Operating Instructions

Two technicians are required when testing with the ECT Analyzer. One technician must actually drive the vehicle, and the second technician will change gears.

CAUTION

The analyzer leads should be routed away from hot or moving engine components to avoid damage to the tester.

Choose a safe test area where there are no pedestrians, traffic and obstructions.

Testing for proper gear shifting:

1. The driver and passengers should wear seat belts.
2. Depress the service brake pedal.
3. Start the engine and move the vehicle gear selector to Drive.
4. Rotate the gear selector knob on the ECT Analyzer to the "1-2" position. The transmission will shift to second gear.
5. Press and hold the first gear button. The transmission will shift to first gear.
6. Release the parking brake.
7. Accelerate to 10 mph.
8. Release the first gear button. The transmission should shift to second gear.
9. Accelerate to 20 mph.
10. Rotate the selector knob to the number "3" position. The transmission should shift into third gear.
11. Accelerate to 25 mph.
12. Rotate the selector knob to the number "4" position. The transmission should shift to fourth gear.
13. Release the accelerator and coast.
14. Rotate the selector knob to the number "3" position. The transmission should downshift into third gear.
15. Apply the brakes, and stop the vehicle. Testing is complete.

Testing for lockup operation:

1. Operate the vehicle and ECT Analyzer up to fourth gear.
2. Accelerate to 40 mph.
3. Press and hold the "Lockup" button to engage the lockup clutch. Observe the tachometer and note a slight reduction in the engine rpm. (Is more noticeable when the vehicle is going up a slight hill due to converter slippage.)
4. Release the "Lockup" button to disengage the lockup clutch.
5. Apply vehicle brakes, and bring the vehicle to a halt. Test is complete.

NOTE

Testing for lockup can also be performed with the vehicle stopped, but with the engine running. With the gearshift selector in "D," press the "Lockup" button to engage the lockup clutch. With the converter in lockup, the engine idle rpm will drop significantly or stall. If there is no change in the engine idle rpm, the lockup function is not operational.



Notes

A large grid area for taking notes, consisting of a fine grid of squares.



PROCEDURE
Preliminary Checks and Adjustments

Vehicle	Year/Prod. Date	Engine	Transmission
---------	-----------------	--------	--------------

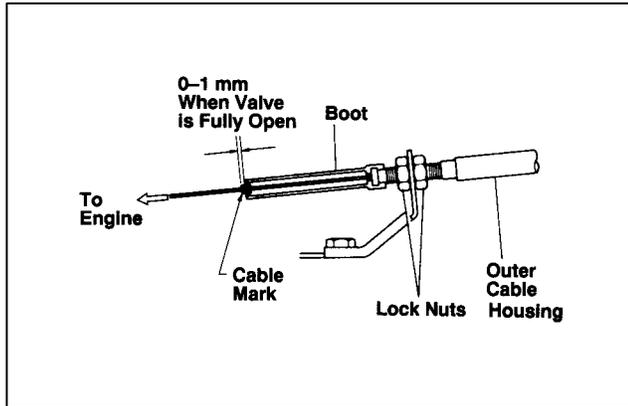


Fig.

1. Inspect and Adjust Throttle Cable (Long Boot Type)

- a. Depress the accelerator pedal all the way and check that the throttle valve opens fully.

HINT:
If the valve does not open fully, adjust the accelerator link.

- b. Fully depress the accelerator pedal and measure the distance:

OK/NG

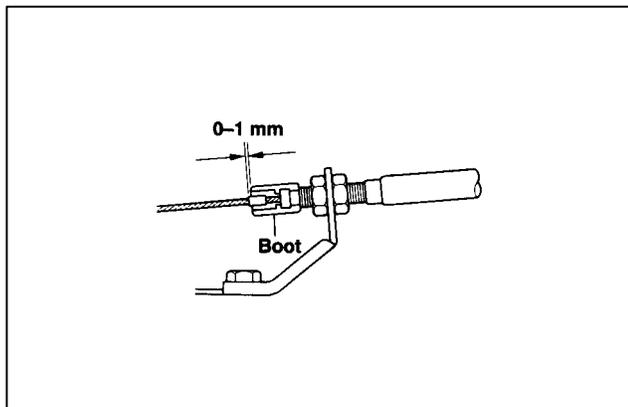
Measured Distance

mm

- c. Loosen the adjustment nuts.
- d. Adjust the outer cable so that the distance between the end of the boot and stopper on the cable is the standard.

Standard Distance: 0 -1 mm (0 - 0.04 in.)

- e. Tighten the adjusting nuts.
- f. Recheck the adjustments.



2. Inspect and Adjust Throttle Cable (Short Boot Type)

- a. Check that the accelerator pedal is fully released.
- b. Check that the inner cable has no slack.
- c. Measure the distance between the outer cable end and the stopper on the cable.

Standard Distance: 0 • 1 mm (0 - 0.04 in.)

Measured Distance

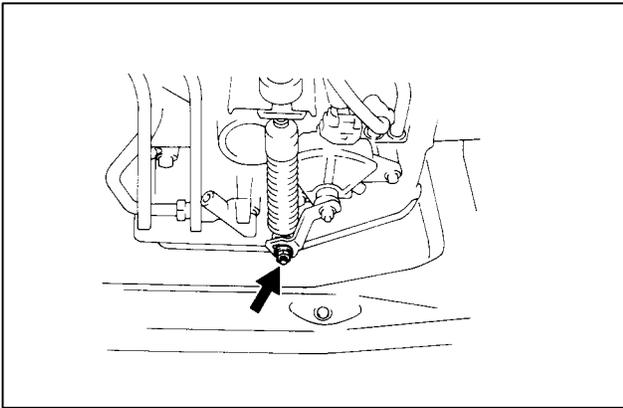
mm

If the distance is not standard, adjust the cable by the adjusting nuts.



PROCEDURE

Preliminary Checks and Adjustments (Continued)



3. Inspect and Adjust Shift Cable

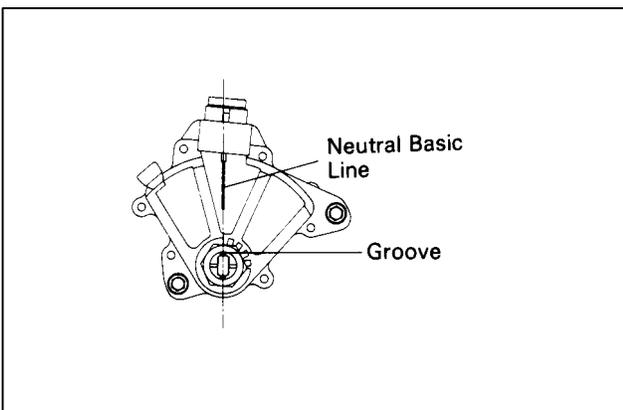
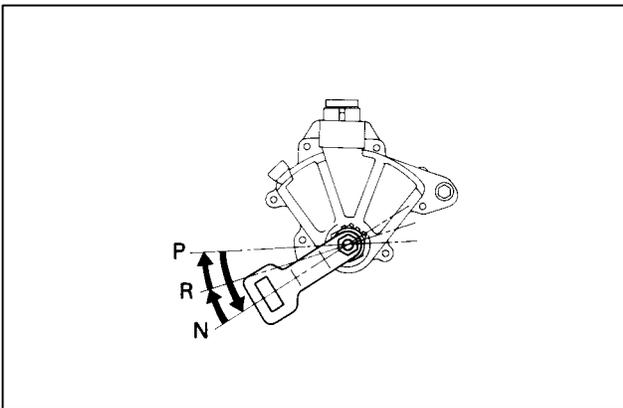
When shifting the shift lever from the N position to other positions, check that the lever can be shifted smoothly and accurately to each position and that the position indicator correctly indicates the position.

OK/NG

Shift Cable Adjustment

If the indicator is not aligned with the correct position, carry out the following adjustment procedures.

- a. Loosen the swivel nut on the manual shift lever.
- b. Push the manual lever fully toward the right of the vehicle.
- c. Return the lever two notches to NEUTRAL position.
- d. Set the shift lever to N.
- e. While holding the lever lightly toward the R range side, tighten the swivel nut.



4. Inspect Neutral Start Switch

Check that the engine can be started with the shift lever only in the N or P position, but not in other positions.

If not as stated above, carry out the following adjustment procedures.

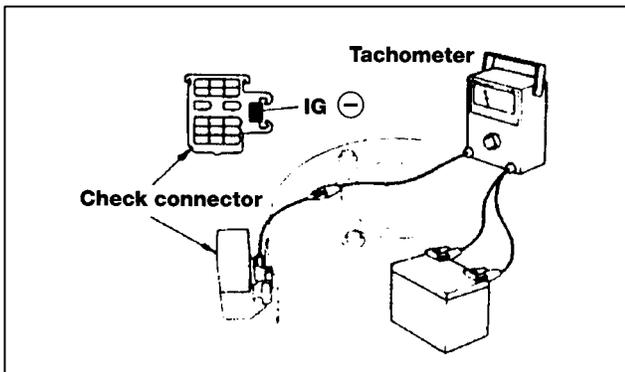
- a. Loosen the neutral start switch bolt and set the shift lever to the N position.
- b. Align the groove and neutral base line.
- c. Hold in position and tighten the bolt.
Torque: 48 in. lb.

Torque: 48 in. lb.



PROCEDURE

Preliminary Checks and Adjustments (Continued)



5. Inspect Idle Speed (Models W/TWC)

a. Initial Conditions

- (1) Air cleaner installed.
- (2) All pipes and hoses of the air induction system connected.
- (3) All vacuum lines connected.

HINT:

All vacuum hoses for the EGR system should be properly connected.

- (4) All accessories switched off.
- (5) EFI system wiring connectors securely connected.
- (6) Ignition timing correctly set.
- (7) Transmission in N range.

b. Warm Up Engine

Allow the engine to reach its normal operating temperature.

c. Connect Tachometer

Connect the test probe of the tachometer to the IG-terminal of the check connector.

NOTICE:

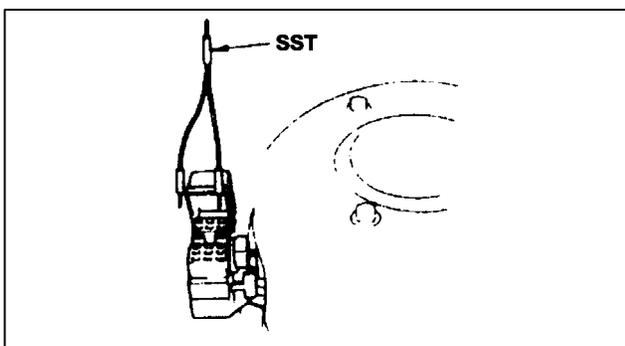
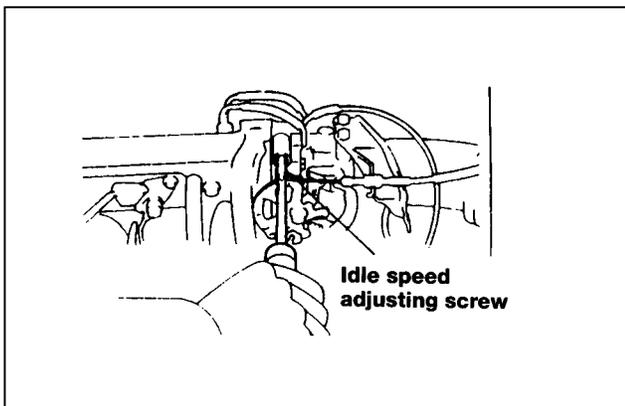
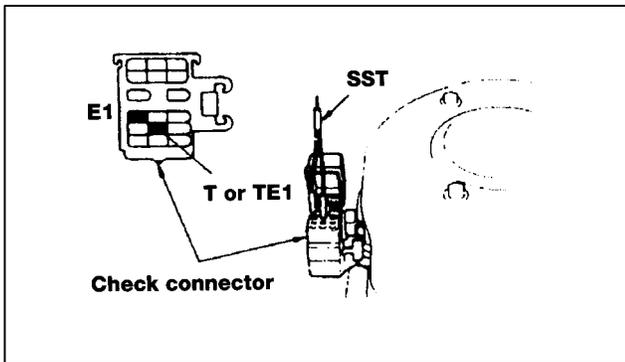
- **NEVER** allow the tachometer terminal to touch ground as it could result in damage to the igniter and/or ignition coil.
- As some tachometers are not compatible with this ignition system, we recommend that you confirm the compatibility of your unit before use.

d. Check Air Valve Operation

e. Check and Adjust Idle Speed

- (1) Race the engine at 2,500 rpm for about 90 seconds.
- (2) Using the SST, connect terminal T or TE1 with terminal E1 of the check connector.

SST 09843-18020





PROCEDURE

Preliminary Checks and Adjustments (Continued)

(3) Check the idle speed.

Idle speed (cooling fan off):

Specification

RPM

Measured

RPM

If not as specified, adjust the idle speed by turning the idle speed adjusting screw.

f. Remove the Tachometer and SST.